CONTENTS

ELECTRICITY: BASIC PRINCIPLES

STRUCTURE OF MATTER

Matter – anything that occupies space and has weight

Element – a substance that cannot be decomposed any further by chemical action

Compound – a combination of two or more elements

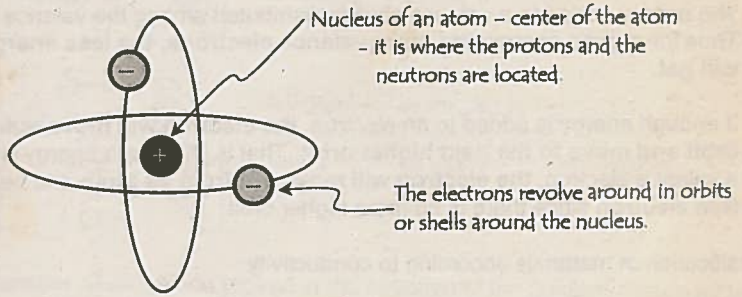
Molecule – smallest particle that a compound can be reduced to before it breaks down into its elements.

Atom - smallest part that an element can be reduced to and still keeping the properties of the element.

Parts of an atom:

Name	Charge	Mass (kg.)
Proton	Positive charge	1.672×10^{-27}
Electron	Negative charge	9.107×10^{-31}
Neutron	No charge	1.672×10^{-27}

The atomic structure of an atom:



Orbital shells of an atom:

K-shell - first orbit
L-shell – second orbit
M-shell – third orbit
N-shell – fourth orbit
O-shell – fifth orbit

$$N = 2n^2$$

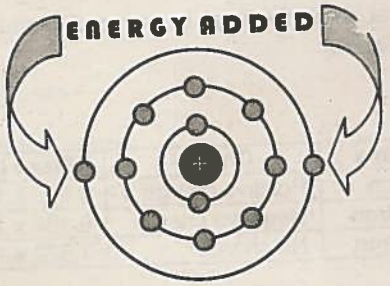
where: N = total number of electrons on a given shell
n = n^{th} shell of the atom

Valence electrons – electrons found in the outermost shell or orbit of an atom.

Atomic Number – represents the number of electrons or protons of an atom.
Atomic Mass – represents the sum of protons and neutrons of an atom.

The electron energy level:

Rule: Although all electrons have the same negative charges, not all electrons share the same energy level. The further an electron orbits from the nucleus, the greater its energy.



1. The energy added to a valence shell is distributed among the valence electrons. Thus for a given energy, **the more valence electrons, the less energy each will get.**

2. If enough energy is added to an electron, **the electron will move out from its orbit and move to the next higher orbit.** That is, if enough energy is added to a valence electron, **the electron will move out from its atom** and becomes a **free electron** since there is no more higher orbit.

Classification of materials according to conductivity:

Conductor – has 3 or less valence electrons

Semi-conductor – has exactly 4 valence electrons

Insulator – has 5 or more valence electrons

Element Name	No. of electrons	No. of protons	No. of neutrons	Valence electron(s)
Copper	29	29	34	1
Aluminum	13	13	14	3
Germanium	32	32	41	4
Phosphorus	15	15	16	5

ELECTRIC CHARGE

A body is said to be charge, if it has either an **excess or deficit of electrons** fr normal values due to sharing.

Coulomb (C) – unit of electric charge which is equivalent to **6.25 x 10^{18}** electro protons.

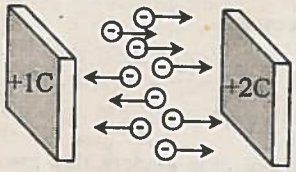
- named after the French physicist, **Charles A. Coulomb** (1736 – 1806).

POTENTIAL DIFFERENCE

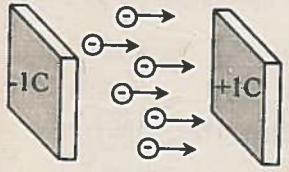
Potential – the capability of doing work

Any charge has the capability of **doing work of moving another charge** either attraction or repulsion.

Example: Assume 1 C of charge can moved 3 electrons.

a. 

6 electrons will be attracted by the +2 C plate and 3 electrons will be attracted by the +1 C plate, making a resultant motion of 3 electrons going towards the +2 C plate

b. 

3 electrons will be attracted by the +1 C plate and 3 electrons will be repelled by the –1 C plate, making a resultant motion of 6 electrons going towards the +1 C plate

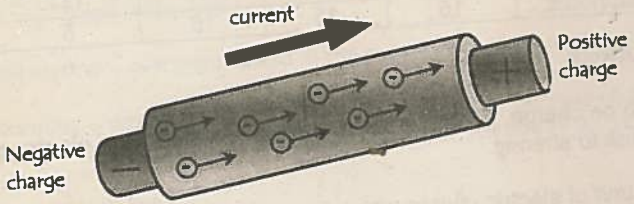
The **net number of electrons** moved in the direction of the positive charge plate depends upon the **potential difference** between the two charges.

Volt (V)– unit of potential difference which is equal to **one joule of work done p one coulomb of charge.**

- named after the Italian physicist, **Alessandro C. Volta** (1754 – 1827) who invented the first electric battery.

ELECTRIC CURRENT (CHARGE IN MOTION)

When a potential difference between two charges forces a third charge to move, the charge in motion is called an **electric current.**



Ampere (A) – unit of charge flow equal to **one coulomb of charge past a given point in one second.**

- named after the French physicist and mathematician **Andre M. Ampere** (1775-1836).

Example: A cloud of 2.5×10^{19} electrons move past a given point every 2 seconds. How much is the intensity of the charge flow?

Solution: Charge = 2.5×10^{19} electrons (1 Coulomb / 6.25×10^{18} electrons)
= 4 Coulombs
Intensity of charge flow = Charge per second
= 4 Coulombs / 2 Seconds
= 2 Amperes

RESISTANCE (OPPOSITION TO CHARGE FLOW)

The fact that a wire carrying a current can become hot, it is evident that the work done by the applied force in producing the current must be accomplished against some opposition.

Ohm (Ω) – practical unit of resistance

- named after the German physicist, **Georg S. Ohm** (1787 – 1854).

Factors affecting resistance:

1. **Kind of material**
2. **Length**
3. **Cross-sectional area**
4. **Temperature**

$$R = \frac{\rho L}{A} \qquad R = \frac{\rho V}{A^2} \qquad R = \frac{\rho L^2}{V}$$

where: R = resistance
A = cross-sectional area
ρ = resistivity
L = length
V = volume
= cross-sectional area x length

Specific resistance or resistivity – resistance offered by a unit cube of the ma

Circular mil (CM) – area of a circle having a diameter (d) of **one mil.**

$$CM = d^2$$

1,000 mil = 1 inch
1 MCM = 1,000 CM

Effect of temperature in resistance:
- experiments have shown that the **resistance of all wires** generally used practice in electrical systems, **increases as the temperature increases.**

$$\frac{R_1}{R_2} = \frac{T + t_1}{T + t_2} \qquad \frac{R_2}{R_1} = 1 + \alpha \Delta_t \qquad \alpha = \frac{1}{T + t_1}$$

where: R_1 = initial resistance
R_2 = final resistance
T = inferred absolute temperature
= temperature when resistance of a given material is zero.
t_1 = initial temperature
t_2 = final temperature
Δ_t = change in temperature
$= t_2 - t_1$
α = temperature coefficient of resistance
= ohmic change per degree per ohm at some specified temperature

Material	ρ (Ω-CM / ft)	T (°C)	α at 20 °C
Silver	9.9	243	0.0038
Copper	10.37	234.5	0.00393
Aluminum	17	236	0.0039
Tungsten	33	202	0.0045
Zinc	36	250	0.0037
Nickel	47	147	0.00598

CONDUCTANCE (RECIPROCAL OF RESISTANCE)

Conductance (G) is a measure of the material's ability to conduct electric curre

$$G = \frac{1}{R}$$

Siemens (formerly **mho**) – unit of conductance

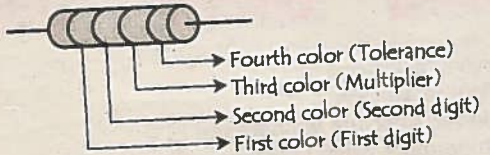
- named after the German engineer, **Ernst Werner von Siemens** (1816-1892)

Resistor – a **linear circuit element** specifically designed to have a specific value of resistance.

Common types of resistors:

1. **Wire wound resistor** – a special type of wire called **resistance wire** (tungsten or manganin) is wrapped around an **insulating core** (commonly porcelain, cement or pressed paper). They are generally used for **high current applications** where accurate resistance value is necessary. Its wattage ratings are available from **5 watts or more**

2. **Carbon composition resistor** – this resistor is made from **finely divided carbon or graphite** mixed with a powdered insulating material as a binder and joined to the two ends are two metal caps with tinned lead for soldering to connections to the circuit. Its wattage ratings are available **are 1/8, 1/4, 1/2, 1 or 2 watts.**



Resistor Color Coding:

Color	Digit	Multiplier	Tolerance
Black	0	$10^0 = 1$	
Brown	1	$10^1 = 10$	
Red	2	$10^2 = 100$	
Orange	3	$10^3 = 1000$	
Yellow	4	$10^4 = 10000$	
Green	5	$10^5 = 100000$	
Blue	6	$10^6 = 1000000$	
Violet	7	$10^7 = 10000000$	
Gray	8	$10^8 = 100000000$	
White	9	$10^9 = 1000000000$	
Gold		$10^{-1} = 0.1$	± 5%
Silver		$10^{-2} = 0.01$	± 10%
No color			± 20%

Tolerance – the amount in percent by which the actual resistance can be different from the color coded value.

Power rating of resistors

- a physical property that depends on the **resistor construction** (physical size). The larger the size, the higher is the power rating of the resistor.

Example: What is the ohmic resistance of a resistor with the color bands: brown, bla orange and gold?

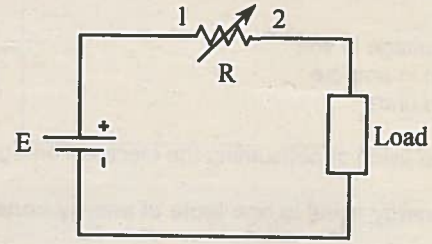
Solution:
Brown = 1 (first digit)
Black = 0 (second digit)
Orange = 10^3 = 1,000 (multiplier)
Gold = ± 5% (tolerance)

Thus, the value is $10 \times 10^3 = 10{,}000$ ohms with a tolerance of ± 5%

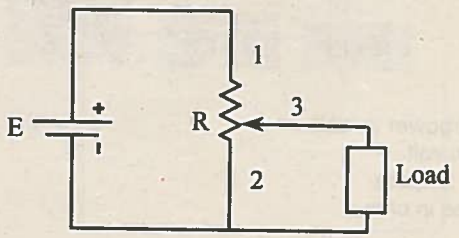
Variable resistance resistor – it can either be wire wound or carbon composi

Common types:

1. **Rheostat** – a variable resistance with **2 terminals** connected in serie the load (the purpose of which is **to vary the current**).



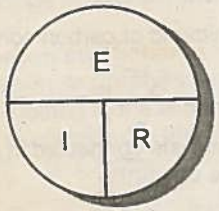
2. **Potentiometer** – a variable resistance with 3 terminals (the purpose is **vary the voltage** between the center terminals and the ends).



OHM'S LAW & THE ELECTRIC CIRCUITS

Electric circuit – a closed path for electric current to flow.

Ohm's Law – states that the current flowing in an electric circuit is **directly proportional** to the **impressed emf** applied to the circuit and **inversely** to the **equivalent resistance** of the said circuit.



$$I = \frac{E}{R} \qquad R = \frac{E}{I} \qquad E = IR$$

where: E = impressed voltage in volt
I = current drawn in ampere
R = resistance in ohm

Electrical power – rate of using or consuming the electrical energy

Watt – unit of electrical energy equal to **one joule of energy consumed in one second.**

- named after the British engineer and inventor **James Watt** (1736 – 1819).

$$P = EI \qquad P = I^2R \qquad P = \frac{E^2}{R}$$

where: P = electrical power in watt
E = voltage in volt
I = current in ampere
R = resistance in ohm

Other practical units of power:

1 horsepower (Hp) = 746 watts
1 kilowatt (kW) = 1,000 watts
1 megawatt (MW) = 1,000,000 watts

Kilowatt-hour (kW-hr) – unit in which electrical energy is sold to a customer.

$$kW - hr = \text{kilowatts} \times \text{hours}$$

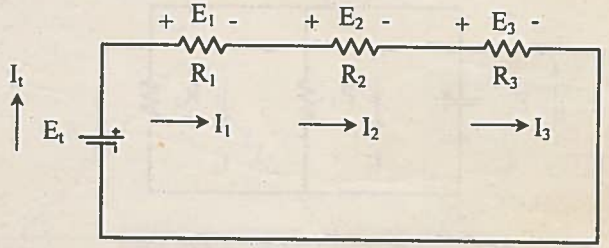
Note: 1 day = 24 hours
1 month = 30 days
1 year = 365 days
= 8760 hours

$$C = (kW - hr) \times (\text{cost per } kW - hr)$$

where: C= total cost of using or consuming electrical energy

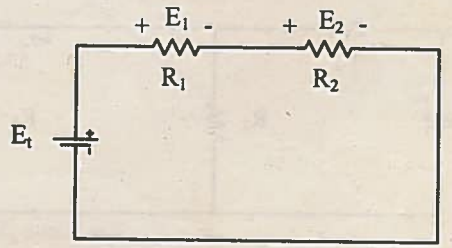
Types of electric circuits according to connections:

a. **Series circuit** – the resistances are connected end to end.



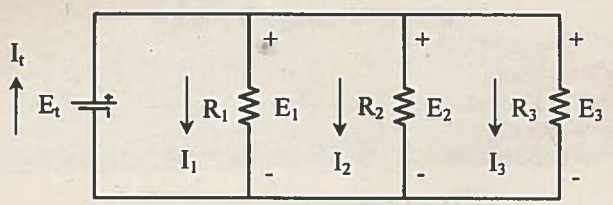
$$R_t = R_1 + R_2 + R_3 \qquad E_t = E_1 + E_2 + E_3 \qquad I_t = I_1 = I_2 = I_3$$

Voltage Division Theorem (VDT) in two resistors connected in series:



$$E_1 = \frac{E_t R_1}{R_1 + R_2} \qquad E_2 = \frac{E_t R_2}{R_1 + R_2}$$

b. **Parallel circuit** – the resistances are connected across each other.

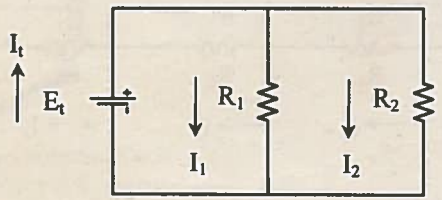


$$R_t = \frac{1}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}}$$

$$E_t = E_1 = E_2 = E_3$$

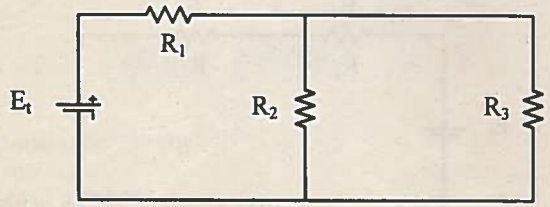
$$I_t = I_1 + I_2 + I_3$$

Current Division Theorem (CDT) in two resistors connected in parallel:



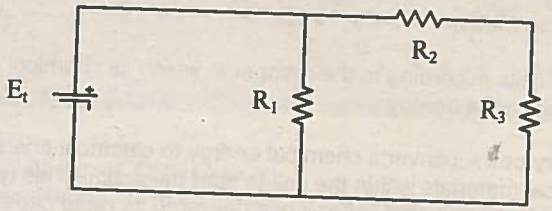
$$I_1 = \frac{I_t R_2}{R_1 + R_2} \qquad I_2 = \frac{I_t R_1}{R_1 + R_2}$$

c. **Series-parallel circuit** – a combinational circuit which when simplified will result into a series circuit.



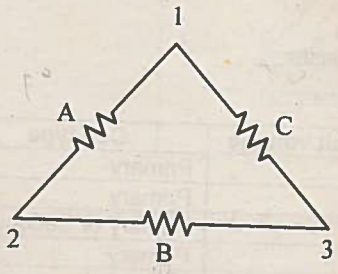
$$R_t = R_1 + \frac{R_2 R_3}{R_2 + R_3}$$

d. **Parallel-series circuit** – a combinational circuit which when simplified will result into a parallel circuit.



$$R_t = \frac{R_1(R_2 + R_3)}{R_1 + (R_2 + R_3)}$$

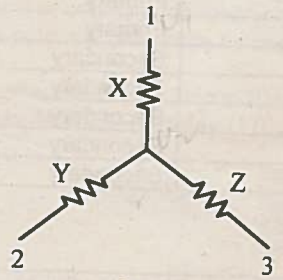
e. **Delta and wye connected resistances**



$$A = \frac{XY + YZ + ZX}{Z}$$

$$B = \frac{XY + YZ + ZX}{X}$$

$$C = \frac{XY + YZ + ZX}{Y}$$



$$X = \frac{AC}{A + B + C}$$

$$Y = \frac{AB}{A + B + C}$$

$$Z = \frac{BC}{A + B + C}$$

If A = B = C = R_Δ and X = Y = Z = R_Y

$$R_\Delta = 3R_Y \qquad R_Y = \frac{R_\Delta}{3}$$

CELL - a single unit for electrolysis (process of converting chemical energy to electrical energy).

BATTERY – a combination of cells

Classification of cells according to the manner in which its chemical energy is converted into electrical energy:

a. **Primary cell** – converts chemical energy to electrical energy, using the chemical materials within the cell to start the action. This type of cell **cannot be recharged**. After it has delivered its rated capacity, the cell must be discarded.

b. **Secondary cell** – must be charged with electrical energy before it can convert chemical energy to electrical energy. This type of cell **can be recharged** due to its chemical action can be reversed.

Classification of cells according to type of chemicals used:

a. **Wet cell** – uses liquid chemicals
b. **Dry cell** – contains a chemical paste

Cell name	Open circuit voltage	Cell type
Carbon-zinc	1.5 V	Primary
Zinc-chloride	1.5 V	Primary
Manganese-zinc	1.5 V	Primary or Secondary
Mercury-oxide	1.35 V	Primary
Silver-oxide	1.5 V	Primary
Lithium	3.0 V	Primary
Lead-acid	2.1 V	Secondary
Nickel cadmium	1.25 V	Secondary
Nickel-iron	1.2 V	Secondary
Silver-zinc	1.5 V	Secondary
Silver-cadmium	1.1 V	Secondary

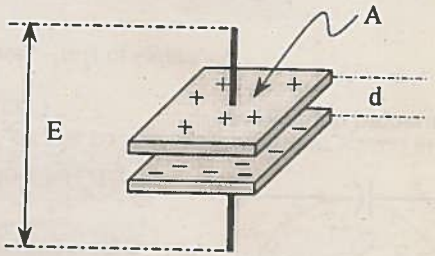
Sizes for popular types of dry cells:

Size	Height (inch)	Diameter (inch)
D	2 1/4	1 1/4
C	1 3/4	1
AA	1 7/8	9/16
AAA	1 3/4	3/8

CAPACITANCE & INDUCTANCE

CAPACITOR (old name is **CONDENSER**)
- any device on which electric charges can be stored so as to posses electrical potential.

- it consist of **two conducting plates** separated by a layer of an insulating medium called **dielectric**.



Capacitance (C) – is a measure of how well a capacitor can store electrical charges.

Farad (F) - unit of capacitance when one coulomb of charge given to its plates raises its potential difference by one volt.

- named after the British physicist and chemist who discovered electromagnetic induction, **Michael Faraday** (1791 –1867).

$$Q = CE \qquad C = \frac{\Sigma_o \Sigma_r A}{d}$$

where: Q = charge accumulated in coulomb
C = capacitance in farad
E = potential difference (voltage across) in volt
A = area (size) of the plate in square meter
d = distance between plates in meter
Σ_o = permittivity of free space
= **8.854×10^{-12} farad per meter**
Σ_r = relative permittivity
= ratio of permittivity of the material to that of free space
= also called **dielectric constant**

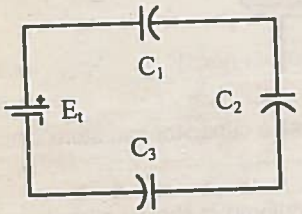
Material	Σ_o
Air or vacuum	1
Glass	4.2
Mica	5 to 9
Dry paper	3.5
Porcelain	5.5
Oil	2 to 5
Hard rubber	2.8

Capacitors are generally classified **according to the dielectric used.**

a. air
b. ceramic
c. mica
d. paper
e. electrolytic
f. oil-filled

Circuit connections:

a. Series connected capacitors

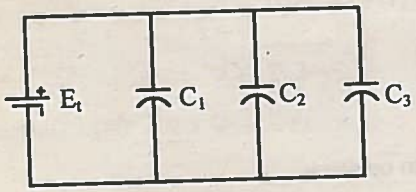


$$E_t = E_1 + E_2 + E_3$$

$$Q_t = Q_1 = Q_2 = Q_3$$

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

b. Parallel connected capacitors



$$E_t = E_1 = E_2 = E_3$$

$$Q_t = Q_1 + Q_2 + Q_3$$

$$C_t = C_1 + C_2 + C_3$$

where: Q_t = total charge accumulated in coulomb
C_t = total capacitance in farad
E_t = supply voltage in volt

Note: For series-parallel and parallel-series connections, use the basic principles in series and parallel connections to simplify the circuit.

Energy stored in a charge capacitor:

$$W = \frac{1}{2}CE^2 \qquad W = \frac{1}{2}QE \qquad W = \frac{1}{2}\left(\frac{Q^2}{C}\right)$$

where: W = energy stored in joule
C = capacitance in farad
E = voltage across in volt
Q = charge accumulated in coulomb

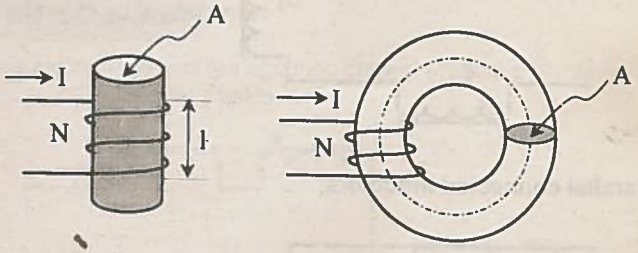
Elastance (S) – reciprocal of capacitance

$$S = \frac{1}{C}$$

Reciprocal farad or daraf – unit of elastance

INDUCTOR (CHOKE COIL)

- a two terminal device that consist of a coiled wire wound in common core or in free air.



Inductance (L) – is a measure of how much counter emf is generated in a circuit or component for a change in current through that circuit or component.

Henry (H) -- unit of inductance.

- named after the American physicist, **Joseph Henry** (1791 – 1878)

$$E_L = L\frac{di}{dt} \qquad L = \frac{\mu_o \mu_r A N^2}{l}$$

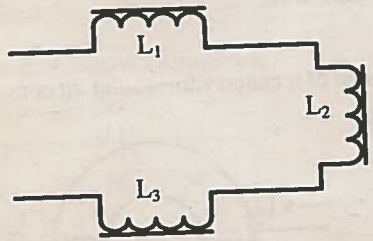
where: E_L = voltage induced in volts
L = inductance in henry
$\frac{di}{dt}$ = change in current in amperes per second
μ_o = permeability of free space
$= 4\pi \times 10^{-7}$ **henry per meter**

μ_r = relative permeability of the core used
A = cross sectional area per turn
N = number of turns
l = mean length of magnetic path

Material	μ_o
Air	1
Magnetic iron	200
Nickel	100
Permalloy	8,000
Mumetal	20,000
Copper-zinc ferrite	1,500

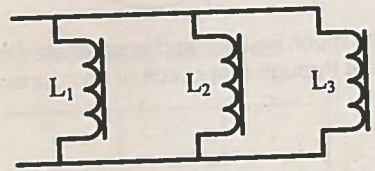
Circuit connections:

a. **Series connected inductors**



$$L_t = L_1 + L_2 + L_3$$

b. **Parallel connected inductors**



$$\frac{1}{L_t} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$$

Note: For series-parallel and parallel-series connections, use the basic principles in series and parallel connections to simplify the circuit.

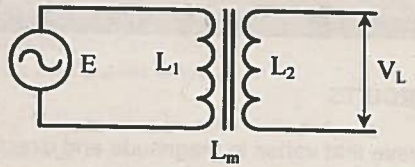
Energy stored in an inductor with a current:

$$W = \frac{1}{2} L I^2$$

where: W = energy in joule
L = inductance in henry
I = current in ampere

Mutual induction – the condition of inducing an emf in a coil or conductor by magnetic flux lines generated in another coil or conductors.

Mutual inductance – the amount or degree of mutual induction that exists between two coils or windings.

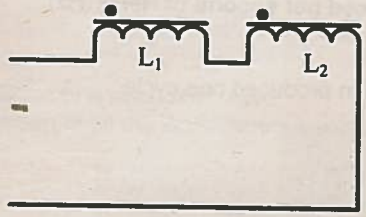


$$L_m = k\sqrt{L_1 L_2}$$

where: L_m = mutual inductance in henry
L_1 = self inductance of coil 1 in henry
L_2 = self inductance of coil 2 in henry
k = coefficient of coupling

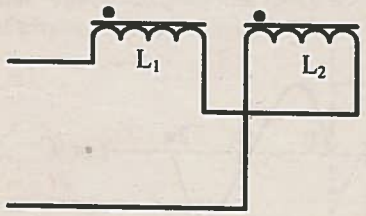
Series coils with mutual inductance:

a. **Series aiding** – means the common current produces the same direction of magnetic fields.



$$L_t = L_1 + L_2 + 2L_m$$

b. **Series opposing** – connections result in opposite fields.

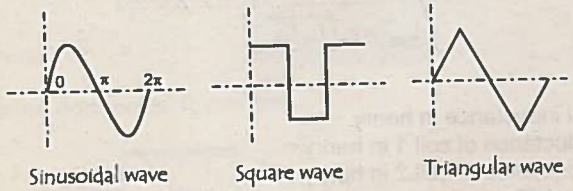


$$L_t = L_1 + L_2 - 2L_m$$

AC CIRCUITS: BASIC PRINCIPLES

SINGLE PHASE AC CIRCUITS

Alternating wave – a wave that varies in magnitude and direction periodically.



Sinusoidal wave Square wave Triangular wave

The **sinusoidal wave** is the most popular and most commonly used AC waves.

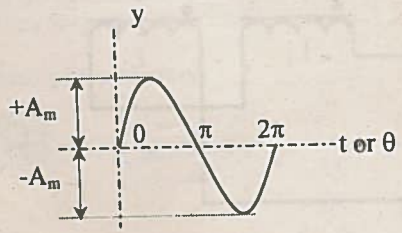
Terms related to a sinusoidal wave:

a. **Frequency** of the wave (f)
   - number of **cycles produced per second** or **Hertz** (Hz).

b. **Period** of the wave (T)
   - **time** needed in **seconds** to produced one cycle

$$T = \frac{1}{f}$$

c. **Instantaneous value** of a sinusoidal wave
   - magnitude of the wave **at any instant** of time or angle of rotation.



d. **Alternation** – equal to one-half of a cycle.

e. **Wavelength** (λ) - length of one complete cycle

$$\lambda = \frac{V_c}{f}$$

where: V_c = velocity of propagation in m/sec.
$= 3 \times 10^8$ **m/sec** (for radio waves)
= 344 m/sec (for sound waves)
f = frequency

General sinusoidal equations:

$$y(\theta) = A_m \sin\theta \qquad y(t) = A_m \sin wt \qquad w = 2\pi ft$$

where: A_m = maximum value
w = angular velocity in radians per second
t = time in seconds
θ = angle of rotation in degrees

f. **RMS value (root-mean square) or effective value** of a sinusoidal wave
   - The r.m.s. value of a sinusoidal wave is that which when applied to a given circuit for a given time, produces the same expenditure of energy when DC is applied to the same circuit for the same interval of time.

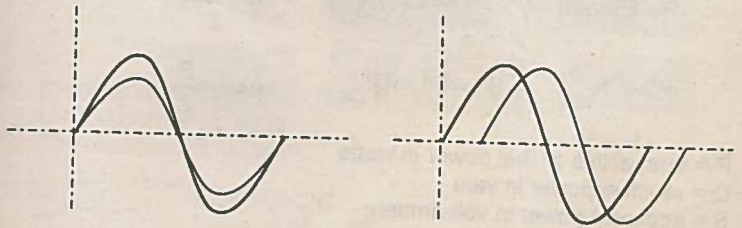
$$\text{RMS value} = 0.707\, A_m$$

g. **Average value** of a sinusoidal wave
   - the **mean** of all the instantaneous values of **one-half cycle**.

$$\text{Average value} = 0.636\, A_m$$

Phase relation among waves:

1. **In-phase waves** – waves that occur at the same time
2. **Out-of phase waves** - waves that do not occur at the same time



Behaviors of R, L and C in AC circuits:

a. **Resistor** – it takes a current that is **in phase** with the voltage across it.

b. **Ideal Inductor** – it takes a current that **lags** the voltage across it by 90 electrical degrees.

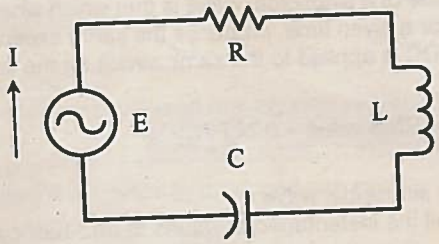
c. **Ideal Capacitor** – it takes a current which **leads** the voltage across it by 90 electrical degrees.

Reactance – property of an inductor or a capacitor to **oppose** current flow in a given circuit

$$X_L = 2\pi fL \qquad X_C = \frac{1}{2\pi fC}$$

where: X_L = inductive reactance in ohm
X_C = capacitive reactance in ohm
C = capacitance in farad
L = inductance in henry

Impedance (Z) – the joint effect of combining resistance and reactance in an AC circuit.



$$I = \frac{E}{Z} \qquad Z = \sqrt{R^2 + (X_L - X_C)^2}$$

Active, Reactive and Apparent powers:

$$P = EI\cos\theta \qquad Q = EI\sin\theta \qquad S = EI$$

$$P = I^2 R \qquad S^2 = P^2 + Q^2 \qquad \cos\theta = \frac{R}{Z}$$

where: P = true, active or real power in watts
Q = reactive power in vars
S = apparent power in volt-ampere

cos θ = power factor
θ = power factor angle or phase angle

Power factor (pf) – defined as the ratio of true power to the apparent power.

Types of power factor:

a. **Unity pf** – the voltage and current are **in phase**.

Examples of unity pf loads: resistive loads such as incandescent lamps, electric flat irons, water heaters, etc

b. **Lagging pf** - the current **lags** the voltage by an acute angle θ.

Examples of lagging pf loads: inductive loads such as electric motors, fluorescent lamps, door bells, electric fans, television set, air-conditioning unit, etc (loads with a winding or a coil on it).

Note: Majority of the electric loads are inductive type.

c. **Leading pf** - the current **leads** the voltage by an acute angle θ.

Examples of leading pf loads: capacitve lods such as synchronous motors

Admittance (Y) – reciprocal of impedance

$$Y = \frac{1}{Z}$$

Siemen –(formerly **mho**) unit of admittance

Resonance – a circuit phenomenon wherein the inductive and capacitive reactances are both equal.

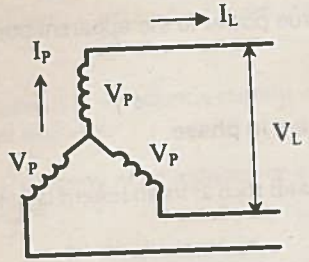
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

where: f_r = resonant frequency in hertz
L = inductance in henry
C = capacitance in farad

$Q = \sqrt{P^2 + S^2} = P + S$

THREE PHASE CIRCUITS (voltage and current relationships)

a. **Wye-connected system**

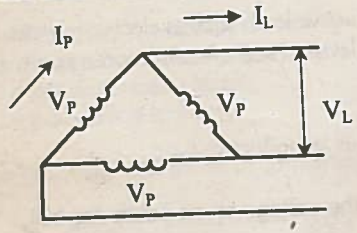


$V_L = \sqrt{3}V_P$

$I_L = I_P$

$V_P = \frac{V_L}{\sqrt{3}}$

b. **Delta connected system**



$V_L = V_P$

$I_L = \sqrt{3}\, I_P$

where: V_L = line to line voltage
V_P = line to ground voltage or phase voltage
I_L = line current
I_P = phase current

Three-phase power formulas:

$P = 3V_P I_P \cos\theta$ $\quad P = \sqrt{3}V_L I_L \cos\theta$

$S = 3V_P I_P$ $\quad S = \sqrt{3}V_L I_L$

where: P = active power in watts
S = apparent power in volt-ampere
cos θ = power factor

Neutral current (I_N) - current in the ground wire

$$I_N = \sqrt{(I_1)^2 + (I_2)^2 + (I_3)^2 - (I_1 I_2) - (I_2 I_3) - (I_3 I_1)}$$

where: I_1, I_2 and I_3 = line currents in each of the three conductors

ELECTRICAL TOOLS & MEASURING INSTRUMENTS

ELECTRICAL TOOLS

Classifications:

a. **Hand tool** – tools operated by our hands without the need of electricity to operate it.

Examples: Screw drivers, Electrician's pliers, Hacksaw, etc.

b. **Machine tool** – tools operated by our hands with electricity to operate it.

Examples: Electric drill, Soldering gun, Electric pipe cutter, etc.

Basic types of electrical tools:

1. **C-clamp** – used in holding objects together while they are being assembled
2. **Center punch** – used for marking metal parts
3. **Electrician's knife** – used by electricians to removed insulation of large wires or big cables.
4. **File** – used to remove rough edges
5. **Gimlet** – used to make an initial hole for wood screws
6. **Hacksaw** – used for cutting metals
7. **Hammer** – used for striking hard objects like nails, etc.
   a. **Claw hammer** – used for pulling out nails
   b. **Ball pen hammer** – used to flatten metal surfaces
   c. **Soft-faced hammer** – used in rewinding jobs
8. **Handrill and bit** – used for boring holes
9. **Hickey** – used in bending small size pipes
10. **Micrometer** – used to measure the diameter of small wires in mils.

11. **Pipe-cutter** – use cut small size of pipes

12. **Pipe-threader** –used in threading pipes

13. **Pipe-vise** – used to hold down the pipe while it is being cut

14. **Pliers** – used for cutting, twisting or gripping electrical components.

    a. **Lineman's pliers** (Side-cutting pliers)
    b. **Long nose pliers**
    c. **Diagonal pliers** (simply called "cutter" in the practice)
    d. **Mechanical pliers**

15. **Puller** – used for pulling out gears, bearings or bushings

16. **Push-pull tape rule** – a length measuring tool

17. **Reamer** – used to cut away the rough edges inside the pipe after being cut

18. **Screw drivers** –used to turn or drive screws with slotted heads.

    a. **Standard screw driver**
    b. **Phillips screw driver**
    c. **Stubb screw driver** (short in length)

19. **Wire stripper** – used in removing the insulation of small size wires.

20. **Wrenches** – used to tightened or loosened objects

    a. **Adjustable wrench** –size is adjustable
    b. **Open-end wrench** – used to grip the nut only in two sides
    c. **Box wrench** – used to grip the nut in all sides
    d. **Allen wrench** – used for hexagonally shaped nuts
    e. **Vise-grip wrench** – used to locked on the objects and grip it
    f. **Pipe wrench** – used for gripping pipes only

ELECTRICAL MEASURING INSTRUMENTS

- these devices are used to measure important electrical quantities like voltage, resistance, current, frequency, etc.

Types of instruments:

a. **Indicating instruments** – devices that indicate directly the value of the quantity being measured on the scale.

Examples: Voltmeters, ammeters, ohmmeters, etc.

b. **Integrating instruments** – device that combines two or more electrical quantities and registers it as a single equivalent unit.

Examples: kW-hr meters, power factor meters, etc.

c. **Recording instruments** – devices that give a record of the variations of the electrical quantity being measured over a period of time.

Examples: Load-graph, seismograph, chronograph, etc.

Instrument name	Quantity being measured / observed
Ammeter	Current
Calorimeter	Heat generated
Clamp-ammeter	Current
Dynamometer	Mechanical output of a motor
Frequency meter	Frequency
Galvanometer	Small voltage or current
Hydrometer	Specific gravity of the liquid in a battery
Inductometer	Inductance
Kilowatt-hour meter	Electrical energy consumption
Megger	Insulation resistance
Ohmmeter	Resistance
Oscilloscope	Waveform characteristics
Photometer	Luminous intensity of light
Power factor meter	Power factor
Pyrometer	High temperatures
Synchroscope	Alternator's synchronization
Tachometer	Speed of shaft
Thermometer	Temperature
Voltmeter	Voltage
Wattmeter	Active power

TYPES OF INDICATING INSTRUMENTS ACCORDING TO CONSTRUCTION

a. **Permanent magnet moving coil meter** (also called **d'Arsonval meter**)
   - a coil wound on soft-iron core is placed between the poles of a pemanent magnet. The needle of the meter is attached to the core and it will deflect in proportion to the current in the coil.

   - invented by a Frenchman **Arsen d'Arsonval** in 1882 and named in honor of the Italian scientist **Galvani**.

Advantages:
1. very accurate, reliable and rugged
2. requires small operating current
3. energy consumption is low
4. scale is linear

Disadvantages:
1. can only be used in DC measurements

2. cost is high
3. errors are due to aging of springs and magnets

b. Moving iron meter (also called **iron vane meter**)
- two pieces of rectangular pieces of soft iron, called vanes are placed inside a coil of wire. One iron vane is free to move while the other is fixed. The pointer of the meter is connected to the moving vane. Once current flows through the coil, the moving vane will repel with the fixed bar and move causing the pointer to deflect in proportion to the current flowing through the coil.

Advantages:
1. it is the cheapest
2. can be used in both AC and DC measurements
3. can stand for momentary overloads
4. applicable for low frequency and high power circuits

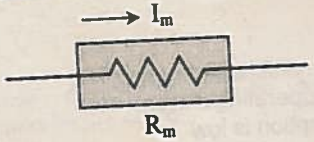
Disadvantages:
1. at low voltage range, its consumes more energy
2. errors are obtained with a change in frequency
3. external magnetic fields affect the reading of the meter
4. scale is non-linear

c. Dynamometer
- the meter basically consist of a fixed coil (current coil) and a moving coil (potential coil). Its operation is based on the principle that a mechanical force exist between two current carrying conductors. The moving coil is attached to the moving parts so that under the action of deflecting torque, the pointer moves over the scale.

Advantages:
1. it can be used in both AC and DC measurements
2. not affected by external magnetic fields

Disadvantages:
1. not uniform scale
2. more expensive than the other two meters
3. sensitivity of the meter is low

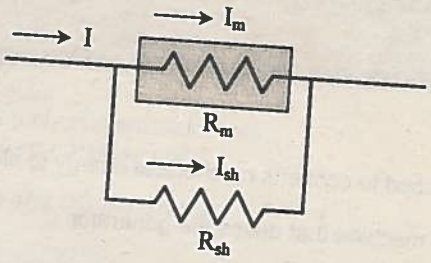
GALVANOMETER'S EQUIVALENT CIRCUIT



where: R_m = coil resistance of the meter
I_m = full scale current of the meter (current capacity of the coil)

AMMETER SHUNTS

The ammeter range can be extended by connecting a **low resistance** (called **ammeter shunt**) across the meter's coil.



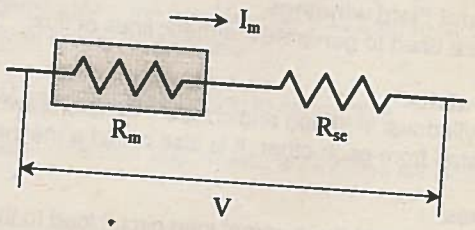
$$I = I_m + I_{sh} \qquad I_m R_m = I_{sh} R_{sh}$$

where: R_{sh} = shunt resistance
I_{sh} = current in the shunt resistance
I = current to be measured

Note: a. An ammeter is connected in **series with the load.**
b. Ideal ammeter has **zero equivalent resistance.**

POTENTIAL DIVIDER

The voltmeter range can be extended by connecting a **high resistance** (called **potential divider**) in series the meter's coil.



$$V = I_m (R_m + R_{se})$$

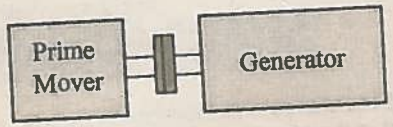
where: V = voltage to be measured
R_{se} = resistance of the potential divider

Note: a. A voltmeter is connected **across the load.**
b. Ideal voltmeter has **infinite equivalent resistance.**

DIRECT CURRENT MACHINERIES

GENERATOR
– a machine used to converts mechanical energy to electrical energy.

Prime mover - a machine that drives the generator



Main parts of a DC generator:

a. **Yoke or Frame**
– it is cylindrical in form to which an even number of poles are bolted. It is either made from cast iron or cast steel.

b. **Armature core and winding**
- the core is cylindrical in form made from sheet steel laminations with slots that carry the armature windings.

c. **Poles and Field windings**
- they are used to generate magnetic lines of flux.

d. **Commutator**
- it is cylindrical in shape and consists of hard drawn copper conductors insulated from each other. It is also called a mechanical rectifier.

e. **Brushes**
- used to connect the external load circuit load to the armature. They are made from carbon particles and are held in position by spring pressures.

Types of armature windings:

a. **Lap winding** – a winding that forms a loop as it expands around the armature core. It is suitable for **high current** DC generators.

b. **Wave winding** – a winding that forms a wave as it expands around the armature core. It is suitable for **high voltage** DC generators.

Number of armature current paths:

for Lap winding $a = mP$

for Wave winding $a = 2m$

where: a = number of armature current paths
P = number of poles
m = multiplicity factor
= 1, if simplex (only one armature coil)
= 2, if duplex (two armature coils)

Generated emf equation of a DC generator

$$E = \frac{PNZ\phi}{60a}$$

$1 \text{ weber} = 1 \times 10^8 \text{ max wells}$

where: E = generated emf in volt
P = number of poles
N = speed of prime mover in rpm
Z = number of armature conductors
ϕ = flux per pole in weber
a = number of armature current paths

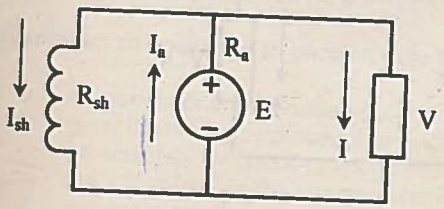
Exciter – an external equipment used to supply voltage to the field windings of a generator.

Self - excited generator – the field winding is excited from its own generated in the armature.

Separately - excited generator – the field winding is excited from a separate source such as a battery or another DC generator.

Types of self-excited DC generators according to connection:

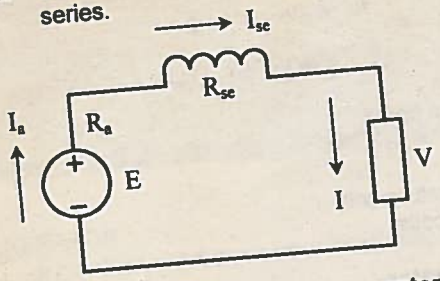
a. **Shunt generator** – the field and armature windings are connected across each other.



$E = V + I_a R_a$ $I_a = I + I_{sh}$

$I_{sh} = \frac{V}{R_{sh}}$ $I = \frac{P}{V}$

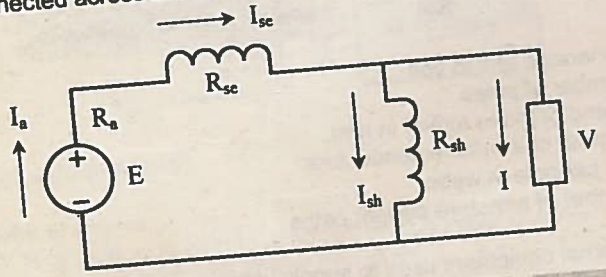
b. **Series generator** – the field and the armature windings are connected in series.



$$I_a = I_{se} = I$$

$$E = V + I_a(R_a + R_{se})$$

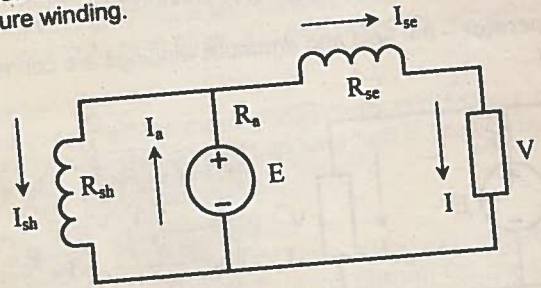
c. **Long shunt compound generator** – the series field winding is connected in series with the armature winding while the shunt field winding is connected across the series combination.



$$I_a = I_{se} \qquad I_a = I + I_{sh} \qquad I_{sh} = \frac{V}{R_{sh}} \qquad I = \frac{P}{V}$$

$$E = V + I_a(R_a + R_{se})$$

d. **Short shunt compound generator** – the series field winding is connected in series with the load while the shunt field winding is connected across the armature winding.



$$I_a = I + I_{sh} \qquad E = V + I_a R_a + I_{se} R_{se})$$

$$I = I_{se} \qquad I_{sh} = \frac{V + I_{se} R_{se}}{R_{sh}} \qquad I = \frac{P}{V}$$

where: E = generated emf
V = terminal or load voltage
R_a = armature winding resistance
R_{sh} = shunt field winding resistance
R_{se} = series field winding resistance
I_a = armature current
I_{sh} = shunt field current
I_{se} = series field current
I = load current
P = power drawn by load

Power generated (P_g) in the armature of a DC generator:

$$P_g = E\, I_a$$

Voltage regulation (VR) – percentage rise in voltage at the terminals of a generato when the load is removed.

$$\%VR = \frac{V_{NL} - V_{FL}}{V_{FL}} x100\%$$

where: V_{NL} = no-load terminal voltage
V_{FL} = full-load terminal voltage

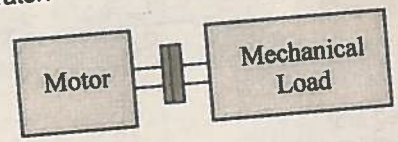
Requirements for the parallel operation of DC generators:

a. the same external characteristics or behaviors when loaded
b. terminal voltage of each machine must be numerically equal
c. terminal polarity must be the same

Advantages of operating in parallel over single operation:

a. no generator is overloaded (load is properly shared).
b. good maintenance procedures since machine can be shut down immediately for check-up purposes while the rest of the generators are still delivering the energy demanded by the load.
c. service is continuous with slight power interruptions.

MOTOR
– a machine that converts electrical energy to mechanical energy. It is the opposite of a generator.



Note: The basic parts of a DC generator are the same basic parts of a DC motor.

Counter or back emf – voltage induced into the armature conductors of a DC motor when the armature rotates.

Speed-torque characteristics of a DC motor:

a. The **speed (N)** of a DC motor is directly proportional to the **back emf (E_b)** and inversely as the **flux (ϕ)** generated per pole.

$$N = k_n \frac{E_b}{\phi}$$

b. The **torque (T)** exerted by the DC motor is directly proportional to both the **armature current (I_a)** drawn and the **flux (ϕ)** generated per pole.

$$T = k_t I_a \phi$$

where: k_n and k_t = proportionality constant

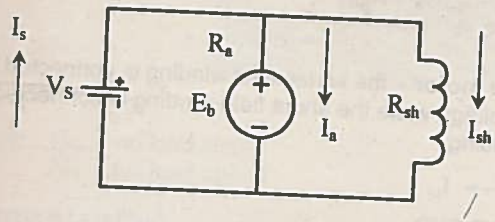
Horsepower rating of a DC motor –the maximum safest mechanical power it can deliver to the load.

$$HP = \frac{2\pi NT}{k}$$

where: HP = mechanical power in horsepower
N = speed of the motor in rpm
T = torque exerted by the motor
k = proportionality constant
= **44,760** if T is in **newton-meter**
= **33,000** if T is in **pound-foot**

Types of DC motors according to connections:

a. **Shunt motor** – the armature and the field windings are connected in parallel.



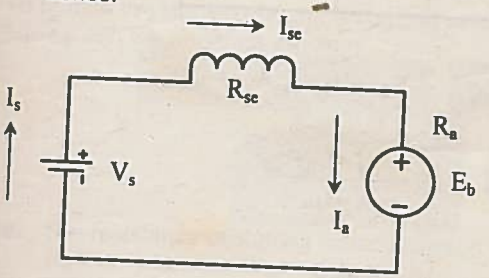
$$E_b = V_s - I_a R_a$$

$$I_s = I_a + I_{sh}$$

$$I_{sh} = \frac{V_s}{R_{sh}}$$

This machine is used where **almost a constant speed** is required. Examples, in lathe machines, wood working machines and other machine tools.

b. **Series motor** – the armature and the field windings are connected in series.

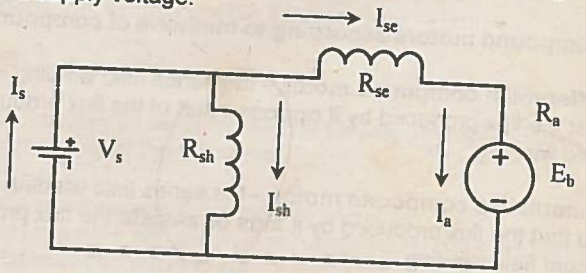


$$I_s = I_{se} = I_a$$

$$E_b = V_s - I_a(R_a + R_{se})$$

This machine is used where (a) **the load suddenly comes and goes after some time** (b) **where constant speed is not essential**. Examples, in punching machine presses, power hammers, lifting machines, etc.

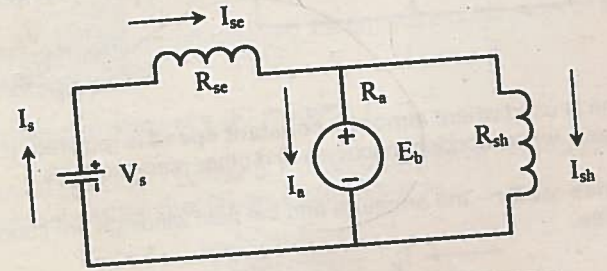
c. **Long shunt compound motor** – the series field winding is connected in series with the armature winding while the shunt field winding is connected across the supply voltage.



$$I_a = I_{se} \qquad I_s = I_a + I_{sh} \qquad I_{sh} = \frac{V_s}{R_{sh}}$$

$$E_b = V_s - I_a(R_a + R_{se})$$

e. **Short shunt compound motor** – the series field winding is connected in series with the supply voltage while the shunt field winding is connected across the armature winding.



$$I_s = I_a + I_{sh} \qquad E_b = V_s - I_{se}R_{se} - I_aR_a$$

$$I_s = I_{se} \qquad I_{sh} = \frac{V_s - I_{se}R_{se}}{R_{sh}}$$

where: R_a = resistance of the armature winding
R_{sh} = resistance of shunt field winding
R_{se} = resistance of the series field winding
I_a = armature current
I_{sh} = shunt field current
I_s = current drawn by the motor from the supply
E_b = back emf or counter emf
V_s = supply voltage

Types of compound motors according to methods of compounding used:

a. **Differential compound motor** – the series field winding is so connected so that the flux produced by it **opposes** that of the flux produced by the shunt field winding

b. **Cumulative compound motor** – the series field winding is so connected so that the flux produced by it **aids or assists** the flux produced by the shunt field winding.

To change cumulative to differential and vice-versa, **interchange only the term connections of the series field windings.**

Speed regulation (NR) – percentage rise in speed when load is removed

$$\%NR = \frac{N_{NL} - N_{FL}}{N_{FL}} x100\%$$

where: N_{NL} = no load speed
N_{FL} = full load speed

MOTOR STARTING

At starting, the motor draws a **high armature current**. The reason of this hig starting current is the **back emf**, since **at starting its value is zero.** This cur is only normal to the motor but it affects the operation of the other loads connected in the same feeder as the motor.

To reduce the starting current, a **starting resistor** (rheostat) is **connected in series** with the armature windings.

$$R = \frac{V_s}{I_{as}} - R_a$$

where: R = resistance of starting resistor needed
R_a = armature winding resistance
I_{as} = armature current at starting (limitations)
V_s = supply voltage

REVERSION OF ROTATION

The direction of rotation of a DC motor is reversed by any of the following methods:

a. interchange the terminals of the armature windings
b. interchange the terminals of the field windings

SPEED CONTROLS

The speed of a DC motor can be controlled by varying the resistance of a rheostat connected in series to any of the following:

a. a rheostat in series with the armature windings
b. a rheostat in series with the field windings (most common method)
c. a rheostat in series with the supply terminals

ALTERNATING CURRENT MACHINERIES

ALTERNATOR (SYNCHRONOUS GENERATOR)

– an alternating current generator.

The working principle is exactly the same as that of a DC generator. However in alternators it is the **field which is made to rotate** while the **armature is kept stationary**.

Basic parts of an alternator:

a. **Stator** (armature)
b. **Rotor** (field poles and winding)

$$n = \frac{120\,f}{P}$$

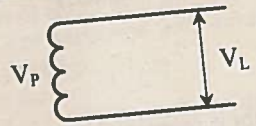
Relation between speed, poles and frequency of the generated emf:

$$f = \frac{PN}{120}$$

where: N = speed in rpm
P = number of poles
F = frequency in hetz

Types of alternator as to number of phases:

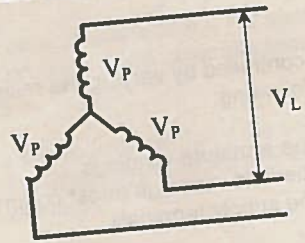
a. **Single-phase alternator** – there is only one winding used.



$$V_L = V_P$$

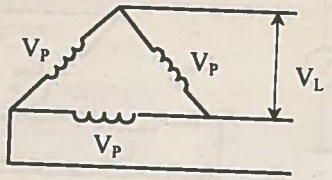
b. **Three phase alternator** – there are three separate windings used.

Wye-connected windings



$$V_L = \sqrt{3}V_P$$

Delta-connected windings



$$V_L = V_P$$

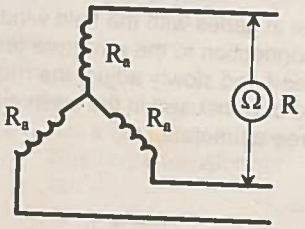
where: V_P = generated voltage per winding or per phase voltage
V_L = line to line voltage or voltage measured between any two line conductors of the alternator

Tests on alternators:

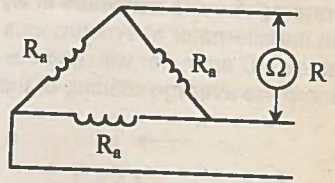
a. **Resistance test** – use to evaluate the resistance of the windings per phase

Test procedures:

1. Stop the machine from running and disconnect all loads
2. Using an ohmmeter, measure the resistance between any two lines.



$$R_a = \frac{R}{2}$$



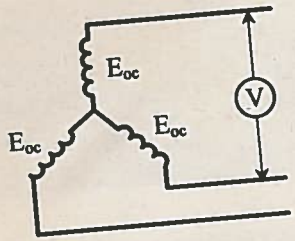
$$R_a = \frac{3R}{2}$$

where: R_a = DC armature resistance per phase
R = measured resistance in any two terminals of the alternator

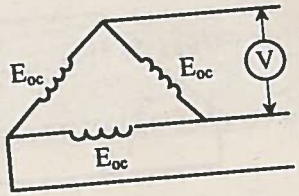
b. **No load test or Open circuit test**

Test procedures:

1. Connect a rheostat and a DC ammeter in series with the field winding.
2. Run the machine at synchronous speed.
3. Measure the voltage across any two lines of the generator using an AC voltmeter.
4. Adjust the rheostat resistance so that the AC voltmeter will read approximately equal to the rated line to line voltage of the alternator.



$$E_{oc} = \sqrt{3}\,V$$



$$E_{oc} = V$$

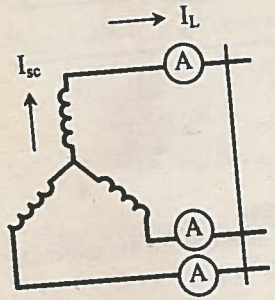
where: E_{oc} = voltage generated per phase
V = line to line voltage as measured by the voltmeter

c. **Short circuit test**

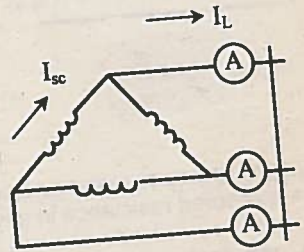
Warning: Perform this test with great care!

Test procedures:

1. Connect a rheostat and a DC ammeter in series with the field winding.
2. Connect three AC ammeters in wye connection to the armature terminals.
3. Run the alternator at synchronous speed and slowly adjust the rheostat so that the DC ammeter will read the field current used in the open circuit test.
4. Record the average reading of the three ammeters.



$$I_{sc} = I_L$$



$$I_{sc} = \frac{I_L}{\sqrt{3}}$$

where: I_{sc} = short circuit current carried by each winding
I_L = average line current as measured by the three ammeters

Purpose of the open and short circuit tests:

To evaluate the synchronous impedance and synchronous reactance of the alternator per phase.

$$Z_s = \frac{E_{oc}}{I_{sc}} \qquad X_s = \sqrt{(Z_s)^2 - (R_a)^2}$$

where: Z_s = synchronous impedance per phase
X_s = reactance per phase

Requirements for parallel operation of alternators:

1. operating frequency must be equal
2. line to line voltage must be equal
3. phase sequence must be the same

TRANSFORMER

- a static device used to transform electrical energy from one voltage to another without a change in waveshape and frequency.

Classifications:

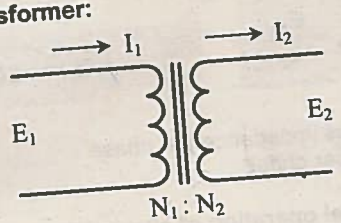
a. **According to the core used**
   1. Core type transformer
   2. Shell type transformer
   .....etc

b. **According to method of cooling the windings**
   1. Self-cooled transformer
   2. Oil-self cooled transformer
   3. Force-oil cooled transformer
   4. Force-air cooled transformer
   .....etc

c. **According to purpose or applications**
   1. Distribution type transformer
   2. Instrument type transformer
   3. Power transformer
   4. Welding transformer
   5. Rectifier transformer
   6. Regulating transformer
   7. Lighting transformer
   .....etc

d. **According to voltage transformation**
   1. Step-up transformer (low to high)
   2. Step-down transformer (high to low)

Voltage, current, ohmic relationships between primary and secondary quantities of an ideal transformer:



$$\frac{E_1}{E_2}=\frac{N_1}{N_2} \qquad \frac{I_1}{I_2}=\frac{N_2}{N_1} \qquad \frac{R_1}{R_2}=\left(\frac{N_1}{N_2}\right)^2 \qquad \frac{X_1}{X_2}=\left(\frac{N_1}{N_2}\right)^2$$

where: N_1 = number of turns in the primary windings
N_2 = number of turns in the secondary windings
E_1 = primary voltage
E_2 = secondary voltage
I_1 = primary current
I_2 = secondary current
R_1 = resistance of primary windings
R_2 = resistance of secondary windings
X_1 = reactance of the primary windings
X_2 = reactance of the secondary windings

Tests on transformers:

a. **No load test or Open circuit test** – use to determine the iron loss or core loss of the transformer.

Test procedures:

1. Connect a voltmeter and a wattmeter at the low voltage side of the transformer.
2. Supply the low voltage side with its rated voltage. Use the reading of the voltmeter to check the magnitude of this voltage
3. Record the reading of the wattmeter.

$$P_{core} = \text{Wattmeterter reading}$$

where: P_{core} = core loss

b. **Short circuit test** – use to determine the copper loss, equivalent resistar and impedance of the transformer.

Test procedures:

1. Connect an ammeter, a voltmeter and a wattmeter in the high voltage sid of the transformer.
2. Supply the high voltage side with a variable AC source while the low voltage side is short-circuited.
3. The variable AC source is varied until the ammeter will read approximatel the rated high side current.
4. Record the readings of the ammeter, voltmeter and the wattmeter.

$$P_{copper} = \text{Wattmeter reading}$$

let: P_{sc} = wattmeter reading
E_{sc} = voltmeter reading
I_{sc} = ammeter reading

$$R_{oh}=\frac{P_{sc}}{(I_{sc})^2} \qquad Z_{oh}=\frac{E_{sc}}{I_{sc}} \qquad X_{oh}=\sqrt{(Z_{oh})^2-(R_{oh})^2}$$

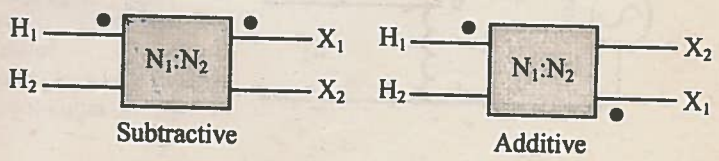
where: P_{sc} = wattmeter reading during the test
E_{sc} = voltmeter reading during the test
I_{sc} = ammeter reading during the test
R_{oh} = equivalent resistance referred to the high side
Z_{oh} = equivalent impedance referred to the high side
X_{oh} = equivalent reactance referred to the high side

c. **Polarity test**

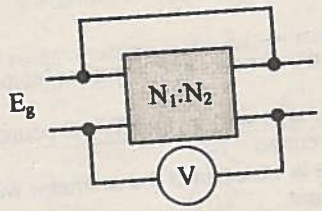
Note: The correct polarity of the terminals of a transformer is needed during parallel operation of transformers and when several transformers are to be banked for three phase applications.

The polarity can be determined using any of the following ways:

1. Noting the manner in which the terminals are marked.



2. Perform a simple voltmeter test by impressing the high voltage side with a voltage smaller than its rating.

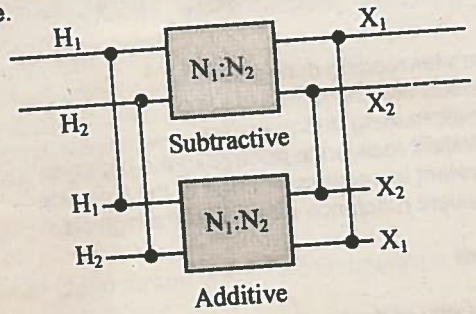


Indications: If the voltmeter reading (V) is **greater than** the supply voltage (E_g), polarity is **additive** while if its reading is **smaller than** the supply voltage, the polarity is **subtractive**.

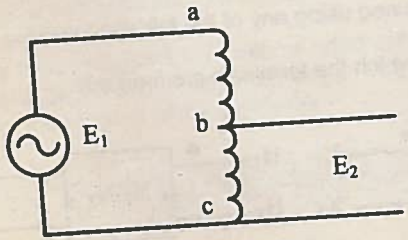
Parallel operation of transformers

Requirements:

1. voltage ratio must be the same
2. transformers must be properly connected as to polarity
3. the ratio of the equivalent resistance to reactance of all transformers should be the same.



Autotransformer – a transformer with only one winding common to both primary and secondary windings.



$$\frac{E_1}{E_2} = \frac{N_{ac}}{N_{bc}}$$

Instrument transformers – used in conjunction with an ammeter or a voltmeter to measure **relatively large values** of current or voltage.

a. **Current transformer (CT)** – the primary terminals is connected in series to the line in which the **current flowing through it** is to be measured while an **ammeter** of suitable range is connected across the secondary terminals.

b. **Potential transformer (PT)** – the primary terminals is connected across the high voltage line in which the **voltage across it** is to be measured while a **voltmeter** of suitable range is connected across the secondary terminals.

Standard kVA ratings of SINGLE PHASE TRANSFORMERS

1, 1 ½, 2, 3, 5, 7 ½,
15, 20, 25, 30, 37 ½,
50, 75, 100, 150, 167,
200, 250, 333 and 500

Standard kVA ratings of THREE PHASE TRANSFORMERS

3, 6, 9,
15, 20, 25, 30, 37 ½,
45, 50, 60, 75, 100,
112 ½, 150, 200, 225, 300
400, 500, 750, 1000,
1500 and 2000

AC MOTORS

Types of rotor as to construction:

a. **Squirrel cage type** – the rotor consist of aluminum bars located in slots in the iron core and connected to one another by means of heavy cast aluminum rings located on both ends of the core.

b. **Wound rotor type** – the rotor has windings that are connected to a commutator.

Capacitor motors – a single-phase induction motor that uses a **squirrel cage rotor** and a stator that has two windings called the **main or run windings** and the **start or auxiliary windings.** The direction of rotation is reversed by **interchanging the connection to the start or to the run windings.**

Basic parts:
1. rotor
2. stator
3. end plays or brackets
4. centrifugal device

5. stationary switch
6. one or more capacitors

a. **Capacitor-start motor** – an **electrolytic capacitor** is inserted in the start windings. The motor is equipped with a centrifugal switch that disconnects the start winding after the rotor has accelerated to about 75% of its rated speed.

b. **Permanent-split capacitor motor** – a capacitor motor having no centrifugal switch. It uses an **oiled filled type capacitor** instead of an electrolytic type.

c. **Two-value capacitor motor** – a capacitor motor using different values of capacitance for the start and run windings.

Repulsion-start induction motor – one of the oldest forms of single-phase induction motor and were widely used from 1930's through 1950's. The rotor has a standard **DC armature winding, a commutator of special design** and a **centrifugal mechanism** for short circuiting all the commutator bars when the motor approaches its rated speed.

Features:
a. high starting torque
b. low strating current
c. it is capable of doing well on low voltage
d. most expensive of all single phase motors

Universal motor – it is basically a **series DC motor** which is specially designed to operate on single-phase AC as well as DC supplies. The direction of rotation is reversed **by interchanging the connection to the armature or to the field.** This motor is commonly used in **portable tools** such as electric drills, saws, etc and in **home appliances** such as blenders, mixers, vacuum cleaners, etc.

Features:
a. high speed
b. small in size

Three-phase squirrel cage induction motor – supply voltage is a three-phase voltage. The direction of rotation is reversed **by interchanging any two line terminals to the motor windings.**

Features:
a. more powerful compared to a single-phase
b. no starting windings
c. not noisy, unlike single-phase motors which vibrate at a rate of twice the frequency of the AC voltage supplied
d. rotor speed is slower than its synchronous speed

Wound rotor induction motor – it consists of a rotor core with three windings in place at the conducting bars of the squirrel cage rotor. The advantage of having windings in the rotor is that the wires can brought out through the slip rings so that **resistance can be added** and therefore current through the windings can be controlled.

Features:
a. variable speed capability
b. high starting torque
c. efficiency is lower compared to a three-phase induction motor

Synchronous motor – the basic parts are similar to a three-phase synchronous generator. The motor is needs a **DC voltage** to excite the rotor windings.

Features:
a. under normal condition, it runs at a constant speed
b. it can be used to improved system power factor

FUSES, CBs, SWITCHES & DISCONNECTS

Overcurrent – any current in excess of the rated capacity of the equipment or the rated ampacity of the conductor.

Causes of overcurrent:

a. **overload of the equipment or conductors**
b. **short circuit or ground fault**

Types of overcurrent devices:

a. **fuse**
b. **circuit breaker (CB)**

FUSE – an overcurrent protective device with a circuit opening **fusible element** which opens (break) when there is an overcurrent in the circuit.

Circuit symbols:

General classification:

a. **Cartridge fuse** – it is enclosed in insulating tube.

b. **Plug fuse** – it is enclosed in porcelain or rubber commonly used in various electrical appliances.

c. **Fuse wire** – opened wire of low melting point commonly used in the safety power switch.

Rule of thumb: Fuses will hold **five (5) times their rating** for different periods of time based on the type of fuse used.

a. **Non-time delay fuse** will hold five times its rating for 1/4 to 2 seconds (not ideal to loads which requires more than 2 seconds to accelerate).

b. **Dual-element time delay fuse** will hold five times its rating for 10 seconds.

Important ratings when choosing replacement fuses:

a. **Voltage rating** – the rating must match or exceed the voltage rating of th circuit

b. **Amperage rating** – the rating should match the full load current rating c the equipment or ampacity of conductor as closely as possible.

c. **Interrupt capacity** – the total current in which the fuse can interrupt withou being damage.

CIRCUIT BREAKER – a mechanical switching device capable of making, carrying and breaking currents under normal or abnormal circuit conditions.

Circuit symbols:

The name of the circuit breaker is taken from **the medium or the manner of extinguishing the arc produced** when the circuit breaker's contacts opened.

a. **Air blast type CB** – uses dry and compressed air to extinguish the arc

b. **Air CB** – interruption occurs in free air

c. **Oil type CB** – uses a special oil to extinguish the arc

d. **Gas type CB** – uses SF_6 (sulphur hexaflouride) gas to extinguish the arc

e. **Vacuum type CB** – uses a vacuum container
.....etc

Important ratings when choosing replacement CB's:

a. **Rated voltage, Rated normal current** – values used to designate it and which is related to the operating conditions of the CB

b. **Rated breaking capacity** – expressed in MVA as the product of the rated breaking current in kilo-amperes and the corresponding rated voltage in kV.

c. **Rated frequency** – frequency of the electrical system in which the CB is to be connected.

d. **Rated short time current** – effective value of current in which the CB must carry for a stated time. This requirement is needed since the fault current which has to be cleared by another CB, may have to flow through it.

Advantages of a FUSE over a CB:

1. it is reliable (it can stay in position for a long period and can act when needed)
2. first cost is cheaper
3. it does not require periodic maintenance

Advantages of a CB over a FUSE:

1. it can be used again after the fault has been corrected
2. its position (open or close) can easily be detected or viewed
3. it can act as a switch

Standard ratings of fuses and circuit breakers in Amperes:

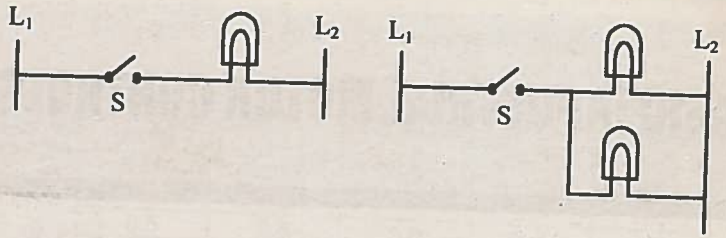
15, 20, 25, 30, 35, 40, 45,
50, 60, 70, 80, 90 100,
110, 125, 150, 175, 200,
225, 250, 300, 350, 400, 450, 500,
600, 800, 1000,
1200, 1600, 2000, 2500,
3000, 4000, 5000 and 6000

SWITCH – used to control (switch-on or switch-off) the current path in a circuit.

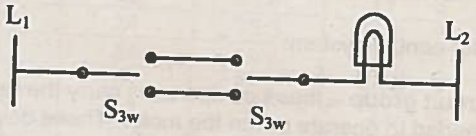
SWITCHES	SYMBOL
Single pole	S
Duplex (2 single pole switch on one switch plate)	S_2
Triplex (3 single pole switch on one switch plate)	S_3
Double pole	S_{2P}
Three pole	S_{3P}
Four-Way	S_{3W}
Automatic Door	S_{AD}
Key Operated	S_K
Master Selector	S_M
Remote Control	S_{RM}

Switches for lamp controls:

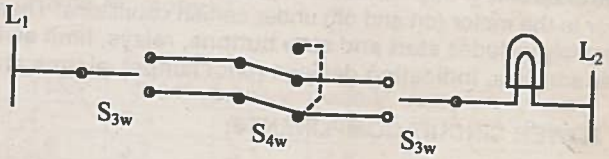
a. **SPST (single pole single throw) switch** – used to control a single or group of lamps from one location. This switch has only **two terminals**.



b. **SPDT (single pole double throw) or Three-way switch** – used to cor the lamp from two different locations. This switch has **three terminals**.



c. **Four-way switch** – a special type of switch used in conjunction with thr way switches to control a lamp from **three or more** different locations. T switch has **four terminals**.



For lamp's control from three or more locations, there should always be tv **3-way switches needed** and the rest, are **4-way switches**.

Example: Four locations, needs two 3-way switches and two 4-way switches
Five locations, needs two 3-way switches and three 4-way switches
Six locations, needs two 3-way switches and four 4-way switches

DISCONNECT (safety power switch) – a mechanical switching device use to isolate a circuit or an equipment from the supply side. It could either be **fused or non-fused type**.

Symbol:

Standard ratings of disconnects in AMPERES

30, 60, 100,
200, 400, 600, 800,
1200, 1400, 1600 and 1800

BASIC INDUSTRIAL MOTOR CONTROLS

Motor control system – controls the electrical energy used to run a motor and majority of the devices used to control that energy are in the motor controller.

Devices under motor control system:

a. **Power circuit group** – these components carry the rated voltage and current needed to operate or run the motor. These devices commonly includes **disconnects, power conductors or wires, fuses, circuit breakers, magnetic contactors, rigid metal conduits, and overload heaters, and others**

b. **Control circuit group** – these components are necessary in switching power to the motor (on and off) under certain conditions. These devices commonly includes **start and stop buttons, relays, limit switches and other sensors, indicating devices (pilot lamps), alarms and others.**

SIZING THE POWER CIRCUIT COMPONENTS:

1. **Disconnect switch** – used to isolate the motor from the power source.

Size = 115% of FLA

where: FLA = means Full Load Amperes of the motor

Example: What size of disconnect shall be used in 1 ½ HP, 230 V single-phase motor?

Refer to the table for standard motor's FLA:
For 1 ½ HP, 230 V, the FLA is 10 A.

Size = 115% of FLA
= 1.15 x 10
= 11.5 A

Refer to the table for standard sizes of disconnect, use 30 A (minimum standard size of disconnect available)

Standard full load amperes (FLA) of single phase AC motors

HP	115 V	200 V	208 V	230 V
0.166	4.4	2.5	2.4	2.2
0.25	5.8	3.3	3.2	2.9
0.33	7.2	4.1	4.0	3.6
0.5	9.8	5.6	5.4	4.9
0.75	13.8	7.9	7.6	6.9
1	16	9.2	8.8	8
1.5	20	11.5	11	10
2	24	13.8	13.2	12
3	34	19.6	18.7	17
5	56	32.2	30.8	28
7.5	80	46	44	40
10	100	57.5	55	50

Source: Philippine Electrical Code, Part 1, 1992 edition

Standard full load amperes (FLA) a of three-phase induction type squirrel-cag and wound-rotor type AC motors

HP	115 V	200 V	208 V	230 V	460 V	575 V	2300 V
0.50	4	2.3	2.2	2	1	0.8	
0.75	5.6	3.2	3.1	2.8	1.4	1.1	
1	7.2	4.1	4.0	3.6	1.8	1.4	
1.5	10.4	6.0	5.7	5.2	2.6	2.1	
2	13.6	7.8	7.5	6.8	3.4	2.7	
3		11.0	10.6	9.6	4.8	3.9	
5		17.5	16.7	15.2	7.6	6.1	
7.5		25.3	24.2	22	11	9	
10		32.2	30.8	28	14	11	
15		48.3	46.2	42	21	17	
20		62.1	59.4	54	27	22	
25		78.2	74.8	68	34	27	
30		92	88	80	40	32	
40		119.6	114.4	104	52	41	
50		149.5	143	130	65	52	
60		177.1	169.4	154	77	62	16
75		220.8	211.2	192	96	77	20
100		285.2	272.8	248	124	99	26
125		358.8	343.2	312	156	125	31
150		414	396	360	180	144	37
200		552	528	480	240	192	49

Source: Philippine Electrical Code, Part 1, 1992 edition

Standard full load amperes (FLA) of a three-phase synchronous type AC motors

HP	230 V	460 V	575 V	2300 V
25	53	26	21	
30	63	32	26	
40	83	41	33	
50	104	52	42	
60	123	61	49	12
75	155	78	62	15
100	202	101	81	20
125	253	126	101	25
150	302	151	121	30
200	400	201	161	40

Source: Philippine Electrical Code, Part 1, 1992 edition.

Standard full load amperes (FLA) of DC motors

HP	Armature voltage rating					
	90 V	120 V	180 V	240 V	500 V	550 V
0.25	4.0	3.1	2.0	1.6		
0.33	5.2	4.1	2.6	2.0		
0.50	6.8	5.4	3.4	2.7		
0.75	9.6	7.6	4.8	3.8		
1	12.2	9.5	6.1	4.7		
1.50		13.2	8.3	6.6		
2		17	10.8	8.5		
3		25	16	12.2		
5		40	27	20		
7.5		58		29	13.6	12.2
10		76		38	18	16
15				55	27	24
20				72	34	31
25				89	43	38
30				106	51	46
40				140	67	61
50				173	83	75
60				206	99	90
75				255	123	111
100				341	164	148
125				425	205	185
150				506	246	222
200				675	330	294

Source: Philippine Electrical Code, Part 1, 1992 edition.

2. **Power circuit conductors** – these conductors carry the full load current to the motor terminals.

Size = 125% of FLA

Example: Refer to previous example, what size of type THW copper conductors shall be used?

Size = 125% of FLA
= 1.25 x 10 = 12.5 A

Refer to the table for standard ampacity of conductors, use size 2.0 mm^2 THW copper whose ampacity is 15 A.

Allowable ampacities of insulated copper conductors rated 0 – 2000 V, 60°C to 90°C (Not more than three conductors in raceway or cable)

Size	Temperature rating of conductors			
	60°C	75°C	85°C	90°C
mm^2	Types TW UF	Types FEPW,RH, RHW, THHW THW, THWN, XHHW, USE, ZW	Type V	Types TBS, SIS, FEP, FEPB, RHH, THHN, THHW, XHHW
2.0	15	15	25	25
3.5	20	20	30	30
5.5	30	30	40	40
8.0	40	45	50	50
14	55	65	70	70
22	70	85	90	90
30	90	110	115	115
38	100	125	130	130
50	120	145	150	150
60	135	160	170	170
80	160	195	205	205
100	185	220	225	225
125	210	225	265	265
150	240	280	295	295
200	280	330	355	355
250	315	375	400	400
325	370	435	470	470
400	405	485	515	515
500	445	540	580	580

Source: Philippine Electrical Code, Part 1, 1992 edition.

3. **Fuse or CB** – used to protect the motor for overcurrent due to faults.

Size = Percentage factor of FLA

Maximum rating or setting of motor branch circuit short-circuit and ground fault protective devices

Type of MOTOR	Percentage factor of full load current			
	Non-time delay fuse	Time delay fuse	Instantaneous trip CB	Inverse time CB
All AC single phase squirrel cage and synchronous motors with full voltage, resistor or reactor starting:				
No code letter.....	300	175	700	250
Code letter F to V...	300	175	700	250
Code letter B to E...	250	175	700	200
Code letter A.....	150	150	700	150
All AC squirrel cage and synchronous motors with autotrans-former strating				
Not more than 30 A				
No code letter.....	250	175	700	200
More than 30 A				
No code letter.....	200	175	700	200
Code letter F to V...	250	175	700	200
Code letter B to E...	200	175	700	200
Code letter A.....	150	150	700	150
High reactance squirrel cage				
Not more than 30 A				
No code letter.....	250	175	700	250
More than 30 A				
No code letter.....	200	175	700	200
Wound rotor	150	150	700	150
Direct current				
Not more than 50 hp				
No code letter.....	150	150	250	150
More than 50 hp				
No code letter.....	150	150	175	150

Source: Philippine Electrical Code, Part 1, 1992 edition.

Note: **The size should be selected to the closest lower standard size. However as a rule, if there is no available standard size, the next higher standard size shall be used.**

Example: Refer to previous example, what size of a time delay fuse shall be used to protect the motor from overcurrent?

Referring to the table for the percentage factor to be used for a time delay fuse, use 175%.

Size = 1.75 x 10 = 17.5 A

Therefore use 15 A (the closest lower standard size available)

4. **Magnetic contactor** – it is basically a large switching relay designed to open or closed the path of current to the motor terminals.

Contactors are manufactured and sized using some standards:
- **NEMA** - National Electrical Manufacturers Association
- **IEC** - International Electrotechnical Commission
- **EEMAC** - Electrical Electronics Manufacturers Association of Canada
- ....etc

Factors to consider in selecting sizes of contactors:
a. **voltage rating**
b. **current rating**
c. **horsepower rating**
d. **duty cycle**

5. **Thermal relay or Overload relay** – used to protect the motor during critical overloading periods.

Service factor (SF) – a nameplate data used to determine whether the motor is allowed to carry overloads for a certain period of time.

Setting = 125% of FLA if SF = 1.15

Setting = 115% of FLA if SF = 1.0 or not written

Example: If the motor of the previous example has a service factor of 1.15, what will be the trip setting of the overload relay to be used?

Setting = 125% of FLA
= 1.25 x 10
= 12.5 A

Note: The **number of overload heaters** to be used is dependent on **types of motor and type of supply system available**. Refer to the table below.

Kind of motor	Type of supply system	Number & location of overload units
1-phase AC or DC	2-wire, 1-phase AC or DC, ungrounded	1 in either conductor
1-phase AC or DC	2-wire, 1-phase AC or DC, one conductor grounded	1 in ungrounded conductor
1-phase AC or DC	3-wire, 1-phase AC or DC, grounded neutral	1 in either ungrounded conductor
2-phase AC	3-wire, 2-phase AC, ungrounded	2, one in each phase
2-phase AC	3-wire, 2-phase AC, one conductor grounded	2, in the ungrounded conductors
2-phase AC	4-wire, 2-phase AC, grounded or ungrounded	2, one per phase in ungrounded conductors
3-phase	any 3-phase	3, one in each phase

Source: Philippine Electrical Code, Part 1, 1992 edition.

SIZING THE FEEDER CONDUCTORS & THE PORTECTIVE DEVICE SUPPLYING MORE THAN ONE MOTORS:

Conductor size = sum of the motors FLA + 25% of the largest motor FLA

Feeder protection = largest motor protective device + sum of FLA of the remaining motors

Example: Given the FLA of the three motors as shown below, what is the size of the feeder conductors and the size of the feeder protection to be used?

Motor A = 10 A
Motor B = 12 A
Motor C = 8 A

Conductor size = 10 + 12 + 8 + 0.25(12)
= 33 A

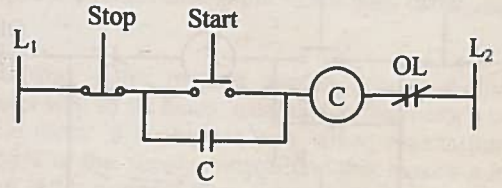
Refer to the table for standard conductor ampacity, use 8.0 mm^2 THW copper conductor whose ampacity is 40 A.

For the largest motor protection (motor B):
= 250% of FLA
= 2.5 x 12
= 30 A
Therefore, use a 30 A CB

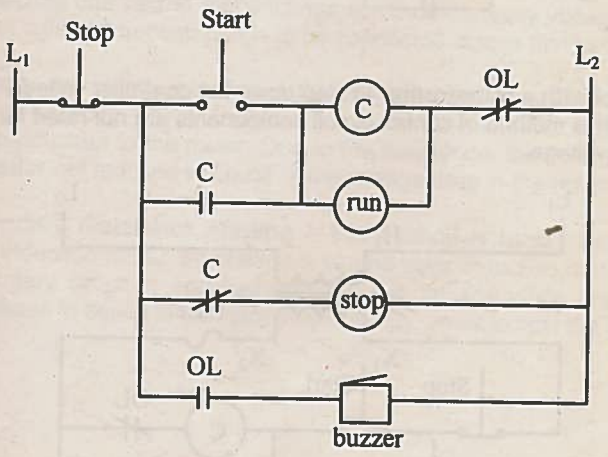
Feeder protection = largest protective device + summation of the other motor currents
= 30 + 10 + 8
= 48 A
Therefore, use a 50 A CB

BASIC MOTOR CONTROL CIRCUIT DIAGRAMS:

a. Single **Start-Stop** pushbutton control



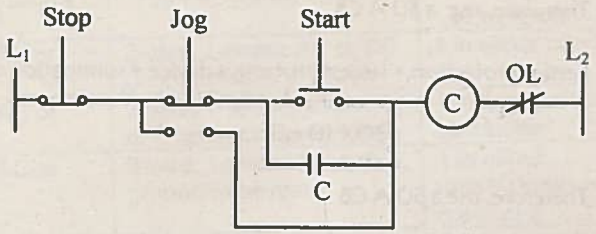
b. Control with **pilot lights for signaling purposes**



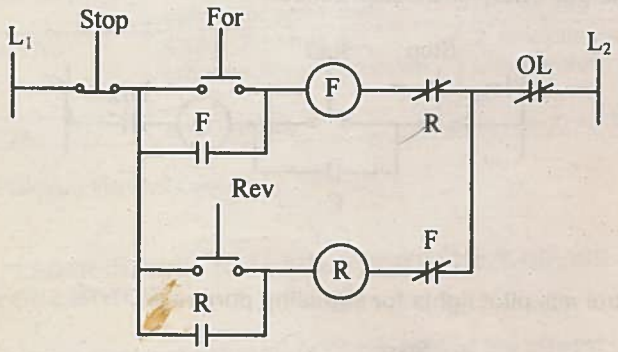
Note: The buzzer is used to give an alarm in cases where the motor is experiencing an overload.

c. **Jog-Start-Stop** pushbutton control

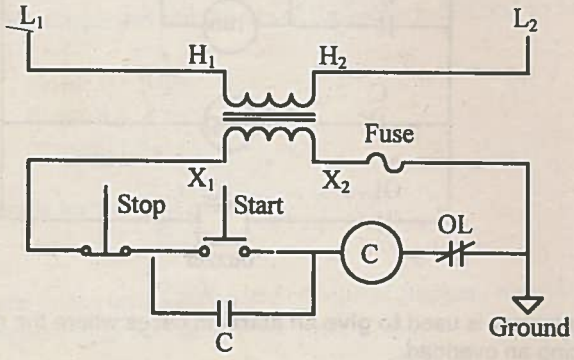
Jogging – is an operation in which the motor will run when a pushbutton is pressed and will stop when the said pushbutton is released.



d. **Forward-Reverse-Stop** control with electrical interlock



e. Control **with a transformer** to step down the controller voltage - this method of control circuit components are not rated for line voltage.



Note: The ground terminal **shall be connected correctly on its position as shown** to prevent the motor for accidental starting when the secondary terminals of the control transformer, is grounded.

The fuse on the circuit is **used to protect the control circuit and the transformer** during abnormal current conditions due to ground faults

Reduced voltage or reduced current starting - these methods are used in starti a large horsepower, large voltage and a large current rating three phase AC motors.

Common methods:

a. **Autotransformer starting** – this method provides reduced voltage to tl stator windings at start and thus the starting current will be lower than would have been started on rated line voltage. After a preset time, th autotransformers are removed and the motor then continues to run at rate line voltage.

b. **Star-delta starting** – this method applies only to a three-phase delt connected motor with all six leads, extended to the motor's terminal box. At starting, the motor is connected wye, which means that each windin carries only 58% of the supply voltage and this makes a lower current a starting instant. After a preset time, the motor is reconnected in delta anc continuous to run.

c. **Part winding starting** – this method provides lower starting current by first connecting one part of the windings across the supply voltage and after a preset time, the second part is to be connected across the first part.

d. **Primary resistance starting** – this method uses a resistance of suitable current capacity. These resistors are to be connected in series with each line conductors to the motor. Due to the resistance, the voltage supplied to the stator will reduced because of the voltage drop in the resistances.

e. **Secondary resistance starting** – this method is used to start a wound rotor induction motor. At starting a wound rotor induction motor, the stator or primary circuit is supplied with the line voltage while resistances are connected in series to the rotor or secondary circuit to limit the current.

ILLUMINATION & LIGHTING MATERIALS

ILLUMINATION (E) – the intensity of light per unit area

Terms, quantities, units and conversion factors:

a. **Light** – the energy radiated in the form of luminous flux that produces a sensation to the eyes.

b. **Lumen** (lm) – unit of luminous flux

c. **Brightness** – the intensity of sensation resulting from viewing light sources and backgrounds.

d. **Color** – defined as the quality of visual sensation which is associated with the spectral distribution of light.

e. **Glare** – a strong steady dazzling light

f. **Candlepower** (I)– the light radiating capability of a light source

$$I = \frac{\Phi}{4\pi}$$

Φ = total lumens produced by the lamp

g. **Candle or candela** – unit of candle power

h. **Coefficient of utilization** (Cu) — ratio of the lumens actually received by a particular surface to the total lumens emitted by the luminous source. This is dependent on type of lamp, type of lighting system and color of the room.

$$Cu = \frac{\text{lumens received}}{\text{lumens emitted}}$$

i. **Depreciation factor** (Df)– it is the factor related cleanliness of the lamp including the room, replacement of lamp after recommended life, etc.

$$Df = \frac{\text{illumination when everything is new}}{\text{illumination under actual condition}}$$

j. **Efficacy** – ratio of luminous output to the input power in watts.

$$\text{Efficacy} = \frac{\text{lumen output}}{\text{wattage consumed}}$$

k. **Footcandle** (Fc) – unit of illumination when foot is taken as the unit of length.

$$\text{footcandle} = \frac{\text{lumens}}{ft^2}$$

l. **Lux** (Lx) – unit of illumination when meter is taken as the unit of length.

$$\text{lux} = \frac{\text{lumens}}{m^2}$$

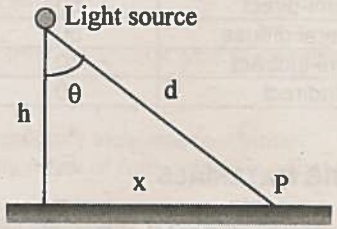
1 footcandle = 10.76 lux

LAWS ON ILLUMINATION:

1. The illumination on a surface is **directly proportional to the luminous intensity** of the illuminating source.

2. The illumination on a surface is **inversely proportional to the square of the distance** between the illuminating source and the surface.

3. The illumination on a surface is **directly proportional to the cosine of the angle** made by the normal to the illuminated surface with the direction of the incident flux.



$$E = \frac{I}{d^2}\cos\theta \qquad d = \sqrt{x^2 + h^2} \qquad \cos\theta = \frac{h}{d}$$

where: E = illumination at point P
I = luminous intensity of the light source
d = distance of the light source to point P
h = mounting height or distance of the light source from the surface

x = horizontal distance of the light source to point P
θ = angle of incidence

Example: A lamp having a candlepower of 100 candelas is hang 10 feet directly above the working table. What is the intensity of illumination of a point on the table?

Since the point of interest is directly below the lamp, θ = zero degree.

$$E = \frac{I}{d^2}\cos\theta = \frac{100}{(10)^2}\cos 0°$$

E = 1.0 foot-candle

Average efficacy of various types of lamps:

Lamp name	Lumen per watt
Fluorescent	50 - 80
Incandescent	14 - 20
Mercury	40 – 70
Metal halide	60 – 80
Sodium lamp	90 – 100
Tungsten halogen	16 - 20

Lighting systems are classified in terms of the **percentage of light that falls downward towards the work plane** and the **percentage of light towards the walls and ceilings**.

Lighting system name	% downward	% upward
Direct	90	10
Semi-direct	60	40
General diffuse	50	50
Semi-indirect	40	60
Indirect	10	90

ELECTRICAL LIGHTING MATERIALS

1. **Incandescent lamp** – the most commonly used lamp

   Characteristics:
   a. cost is cheaper
   b. fast starting and small in size
   c. only about 10% of the input power is converted to light
   d. sensitive to voltage fluctuations
   e. life span is short

2. **Fluorescent lamp** – one of the most commonly used lamp, second only t the incandescent lamp.

   Characteristics:
   a. for the same light output, it consumes lesser energy than an incandescent lamp
   b. pleasant light output (high efficacy)
   c. life span is longer
   d. not sensitive to voltage fluctuations
   e. limited to indoor usage
   f. noisy due to ballast hum

3. **Mercury lamp** – a combination of the arc discharge characteristics of the fluorescent lamp and the shape of an incandescent lamp.

   Characteristics:
   a. higher lighting efficiency compared to incandescent lamp
   b. available in many different sizes and shapes
   c. requires a ballast and a certain warm-up period before discharging full intensity
   d. like the fluorescent lamp, it is also noisy

4. **Sodium lamp** – high intensity discharge lamp

   Characteristics:
   a. small in size
   b. life span is longer
   c. high lumen output
   d. does not start instantly but warm-up period is shorter than that of the mercury lamp

5. **Tungsten halogen lamp** – a special type of incandescent lamp also known as quartz lamp.

   Advantages over an ordinary incandescent lamp:
   a. lighting ability (level of light output) is constant
   b. longer life
   c. efficacy is higher

6. **Metal halide lamp** – it is basically a mercury lamp with a certain innovation of its arc tube.

   Characteristics:
   a. better coloring effect compared to a mercury lamp
   b. efficacy is higher compared to a mercury lamp
   c. life span is shorter compared to a mercury lamp

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IMPORTANT NOTES ABOUT RA 7920

TITLE

This act shall be known as the **"New Electrical Engineering Law."**

COMPOSITON OF THE BOARD

The Board of Electrical Engineering shall be created as a collegial body under the general supervision and administrative control of the **Professional Regulation Commission**, hereinafter called as the Commission, composed of **a chairman and two (2) members** to be **appointed by the President of the Philippines** from among the **recommendees of the Commissioner** of the Professional Regulation Commission, hereinafter referred to as the Commissioner, who were chosen from the nominees of the integrated and accredited association of electrical engineers and of other registered associations of electrical engineers and allied fields

POWER AND DUTIES OF THE BOARD

The Board shall be vested with the following specific powers, functions, duties and responsibilities:

a. Supervise and regulate the practice of electrical engineering in the Philippines

b. Determine and evaluate the qualifications of the applicants for registration with or without licensure examination and for special permit.

c. Prepare the examination questions and prescribe the syllabi of the subjects and their relative weights for the licensure examinations.

d. Prescribe, amend or revise the requirements for PEE and subjects in the licensure examination for REE and RME and their relative weight subject to the approval of the Commission.

e. Register successful applicants for PEE and applicants who have passed the licensure examination s for REE and RME and issue corresponding certificates of registration and professional licenses.

f. Look into the conditions affecting the practice of the electrical engineering profession and conduct ocular inspection to places where registrants practice their profession.

g. Promulgate rules and regulations including a code of ethics, administrative policies, orders and issuances to carry out the provisions in this act.

h. Investigate violations of the Act and the rules and regulations, code of ethics, administrative policies, orders and issuances promulgated by the Board.

i. Issue subpoena to secure the attendance of respondents or witnesses or the production of documents relative to the investigation conducted.

j. Delegate the investigation of the case to the chairman, a member of the Board or a PRC attorney.

k. Render decision, order or resolution on preliminary investigation or inquiry and shall become final and executory unless appealed with the Commission within 15 days from receipt of the copy.

l. After due notice and hearing, cancel examination results and or bar an examinee from future examination, refuse or defer his registration; reprimand the applicant with stern warning; suspend him from the practice of his profession, revoke his certificate of registration or de-list his name from the roll of PEEs, REEs or RMEs

m. Administer oath in connection with the administration, implementation, or enforcement of the Act.

n. Submit annual report on the proceedings and accomplishments during the year and recommendations of the Board to the Commission after the close of each year.

o. Prosecute or institute criminal action against any violator of the Act and or the rules and regulations of the Board.

p. Adopt an official seal.

q. Coordinate with the DECS in prescribing, amending and or revising the courses.

r. Prescribe guidelines and criteria on the CPE (Continuing Professional Education) program for PEEs, REEs and RMEs and renew their professional licenses after compliance with the CPE requirements.

s. Perform such other functions and duties as may be necessary to implement effectively the Act.

QUALIFICATIONS OF BOARD MEMBERS

a. Be **a natural-born Filipino citizen** and a resident in the Philippines for **at least five (5) consecutive years**.

b. Be **at least thirty-five (35) years of age**, of proven integrity with high moral values in his personal as well as his professional conduct.

c. Be **a person with no final conviction by the court** of an offense involving moral turpitude.

d. Be **a holder of the degree of Bachelor of Science in Electrical Engineering** (BSEE) from a university, school, college, academy or institute duly constituted, recognized and accredited by the Philippine government.

e. Be **a professional electrical engineer (PEE)** with a valid certificate of registration and a valid professional license duly qualified to practice electrical engineering in the Philippines.

f. Have **practice electrical engineering for a period of not less than ten (10) years** prior to his appointment, with a sworn statement as such.

g. **Not be an official member of the faculty** nor have a pecuniary interest in any university, college, school or institution conferring a bachelor's degree in electrical engineering for **at least three (3) years prior to his appointment** and is not connected with the review center or with any group or association where review classes or lectures in preparation for the licensure examinations are offered

TERM OF OFFICE

The members of the Board shall hold office for **a term of three (3) years** from the date of appointment or until their successors shall have been appointed and qualified. **Vacancies in the Board shall be filled up by the President** from the list of recommendees selected by the Commissioner who were chosen from the list of nominees submitted by the integrated and accredited association for the **unexpired term** only.

REMOVAL OF BOARD MEMBERS

Any member of the Board maybe removed by the President of the Philippines upon the recommendation of the Commissioner for **neglect of duty, incompetence, malpractice, commission or tolerance of irregularities in the examination or for unprofessional, unethical, or dishonorable conduct,** after having been given the opportunity to depend himself in a proper administrative investigation

EXECUTIVE OFFICER OF THE BOARD

The **Commissioner of the PRC** shall be the executive officer of the Board and shall conduct the examination given by the Board.

HOLDING OF EXAMINATIONS

Examinations for the practice of electrical engineering in the Philippines should be given **twice a year** in the **City of Manila and other places** on dates the Board may recommend for determination of scheduling. The qualified applicants for examination, **notice of admission shall be issued** not later than **ten (10) days** prior to the first day of examination.

QUALIFICATIONS OF APPLICANTS FOR REGISTERED MASTER ELECTRICIAN EXAMINATION

Any persons applying for admission to the registered master electrician's examination, as herein provided **shall established to the satisfaction of the Board** that, on or before the date of the examination, he possesses the following qualifications:

a. He is a **citizen of the Philippines**

b. He is at least **eighteen (18) years** of age

c. He is of **good reputation** with high moral values

d. He **has not been convicted by the court** of an offense involving moral turpitude

e. He has any of the following technical backgrounds:

   1. Has completed **at least three (3) years of a five-year Bachelor of Science in Electrical Engineering (BSEE)** program or **a three year course in electrical engineering technology** from an engineering school recognized by the Philippine government and in addition, has a subsequent specific record of **one (1) year practice** in electrical wiring and installation, operation and maintenance of utilization devices and equipment, or

   2. Has graduated from **a two-year electrician's course of instruction** from a vocational or trade school recognized by the Philippine government and in addition, has **at least two (2) years of apprenticeship** after completion of the course of instruction on electrical wiring and installation, operation and maintenance of utilization devices and equipment, or

3. Has completed from **a one-year electrician's course of instruction** from a vocational or trade school recognized by the Philippine government and in addition, has **at least three (3) years of apprenticeship** after completion of the course of instruction on electrical wiring and installation, operation and maintenance of utilization devices and equipment, or

4. Has completed **a four year high school education** or its equivalent and in addition, has a subsequent specific record of **at least five (5) years of apprenticeship** in electrical wiring and installation, operation and maintenance of utilization devices and equipment

REPORT OF RATINGS

The Board of Electrical Engineering shall, within **one hundred fifty (150) days** after the date of completion of the examinations, report the ratings obtained by each candidate to the Commission.

RE-EXAMINATION OF FAILED SUBJECTS

An applicant **shall be allowed to re-take, any number of times, only on the subject/s in which he has obtained a grade below fifty percent (50%)**. When he shall obtained an average grade of seventy percent (70%) in the subject/s repeated, he shall be considered to have passed his licensure examination.

OATH

All **successful candidates** in the examination **shall be required to take a professional oath** before the Board or any government official authorized to administer oaths prior to entering upon the practice of PEEs, REEs and RMEs.

ISSUANCE OF CERTIFICATES OF REGISTRATION AND PROFESSIONAL LICENSES

The registration of PEEs, REEs and RMEs commences from the date his name is entered in the roll of registrants or licenses for his profession. **Every registrants who has satisfactorily met all the requirements specified in this Act, upon payment of the registration fee, shall be issued a certificate of registration as a PEE, a REE or a RME** that shows the full name of the registrant and with serial number, signed by the Commissioner and official seal, as evidence that the person named therein is entitled to practice the profession with all the rights and privileges appurtenant thereto

A professional license signed by the Commissioner and bearing the **registration number** and **date of issuance** thereof and the **month of expiry** or renewability shall likewise be issued to every registrant who has paid the annual registration fees for **three (3) consecutive years** and has complied with the requirements of the **Continuing Professional Education (CPE)** unless exempted therefrom

INDICATION OF REGISTRATION / PROFESSIONAL LICENSE NUMBER

The PEEs, REEs or RMEs shall be required to indicate his **registration / professional license number, the date registered, and the date of its expiry** in **the documents he signs, uses or issues** in connection with the practice of his profession

REFUSAL TO ISSUE CERTIFICATES

The Board shall not issue a certificate of registration to **any person convicted by the court of any criminal offense involving moral turpitude** or to **any person guilty of immoral or dishonorable conduct** or to **any person of unsound mind.**

After no less than **one year** from the finality of the Board's decision, the Board, out of equity and justice, may recommend to the Commission the issuance of the certificate of registration to the applicant.

REVOCATION OF CERTIFICATES AND SUSPENSION FROM THE PRACTICE OF THE PROFESSION

The Board shall have the power, upon proper notice and hearing to revoke any certificate of registration or suspend him for any of the following causes; **use of fraud in obtaining the certificate of registration**, or **for gross negligence**, or **for incompetence**, or **for unprofessional or dishonorable conduct**, or **for violations of this Act, the rules and regulations and other policies of the Board and the Code of Professional Ethics**

RE-ISSUANCE OF REVOKE CERTIFICATES AND REPLACEMENT OF LOST CERTIFICATES

Subject to the approval of the Commission, the Board may, after the expiration of **one (1) year from date of revocation** of a certificate, for reasons it may deem sufficient entertain an application for an original one. **It may exempt the applicant from the necessity of undergoing an examination.**

FIELD OF PRACTICE OF A REGISTERED MASTER ELECTRICIAN

A registered master electrician's field of practice includes the **installation, wiring, operation, maintenance** and **repair** of electrical machinery, equipment and devices, in residential, commercial, institutional, commercial and industrial buildings, in power plants, substations, watercrafts, electric locomotives, and the like, provided that if the installation or the machinery is rated not in excess of **five hundred kilovolt-amperes (500 kVA)** or in excess of **six hundred volts (600 V)** the work shall be under the supervision of a professional electrical engineer or a registered electrical engineer.

TEST 1

TECHNICAL SUBJECT

RME Board April 1994

1. A 6-volt lead-acid battery has an internal resistance of 0.01 ohm. How much current will flow if the battery has a short circuit?

   A. 60 A
   B. 600 A
   C. infinity
   D. zero

2. An AC series circuit has a resistance of 6 ohms, an inductive reactance of 10 ohms and a capacitive reactance of 18 ohms. What is the circuit power factor?

   A. 0.6 leading
   B. 0.8 lagging
   C. 0.6 lagging
   D. 0.8 leading

   $PF = \frac{R}{Z}$

   $Z = \sqrt{R^2 + (X_L - X_C)^2}$

3. A binary alloy of copper and zinc.

   A. Bronze
   B. Brass
   C. Alnico
   D. Steel

RME Board April 1994, RME Board April 1995

4. The resistance of a conductor when its temperature is increased,

   A. increases
   B. remains constant
   C. varies
   D. decreases

5. A meter whose needle is initially at the center.

   A. Dynamometer
   B. Iron vane meter
   C. Galvanometer
   D. Voltmeter

RME Board October 1995, RME Board October 1996

6. Automatic device that operates at preset values is known as

   A. relay
   B. mercury switch
   C. contactor
   D. fuse

7. Modern contact surfaces are made from _____ alloys.

   A. copper
   B. silver
   C. aluminum
   D. manganin

8. A voltage source of 20 V is applied across the terminals of a 2.5-ohm rheostat. Calculate the power dissipated in the rheostat?

   A. 160 W
   B. 100 W
   C. 150 W
   D. 180 W

   $P = \frac{E^2}{R} = \frac{20^2}{2.5} = 160$ watts

RME Board October 1995

9. A generator may lost residual magnetism because of

   A. vibration
   B. over-excitation
   C. heating
   D. varying loads

10. Unit of electrical pressure is

    A. watt
    B. ampere
    C. ohm
    D. volt

11. A diagram showing the physical location of the components: coils, contacts, motors and the like in their actual positions that would be found on an installation.

    A. Ladder diagram
    B. Schematic diagram
    C. Wiring diagram
    D. Power flow diagram

12. At starting the motor current is high due to

    A. counter emf is high

B. counter emf is zero
C. supply voltage is high
D. armature circuit resistance is open

RME Board April 1996

13. Two resistors of resistances 5 ohms and 7 ohms are connected in series across a 60-volt source. What is the power absorbed in the 5-ohm resistor?

A. 50 watts
B. 25 watts
C. 125 watts
D. 100 watts

$I_T = \frac{E}{R_T}$ $P = I_T^2 R$
$= \frac{60}{12}$ $= 5^2(5)$
$= 5$ amper $= 125$

14. Shunt generators are most suitable for parallel operation due to their ___.

A. constant voltage characteristics
B. drooping voltage characteristics
C. increasing voltage characteristics
D. variable voltage characteristics

RME Board April 1996

15. A multimeter consist of a:

A. voltmeter, current meter and ohmmeter
B. voltmeter and ammeter
C. current meter and ohmmeter
D. voltmeter and current meter

16. When using ohms law E divided by I would solve for

A. watts
B. amperage
C. voltage
D. resistance

RME Board October 1996

17. On a simple ohmmeter, the zero ohm mark is _____ of the scale.

A. in the right
B. far left
C. none of these
D. far right

18. An instrument used to measure the state of electrical charge in a storage battery

A. Amprobe
B. Tachometer
C. Hydrometer
D. Calorie meter

RME Board October 1996

19. In resistance color coding, red color is assigned to a value

A. 3
B. 0
C. 2
D. 1

20. The members of the Board shall hold office for a term of ___ years from date of appointment.

A. 1
B. 2
C. 3
D. None of these

21. During the short circuit test on transformer, which side is shorted?

A. High side
B. Low side
C. Either sides
D. Both sides

RME Board October 1995

22. An electric iron takes 3 ½ amps. If the heating element has a resistance of 40 ohms, what is its power consumption?

A. 0.45 kW
B. 0.49 kW
C. 0.35 kW
D. 0.51 kW

$P = I^2 R$
$= (3.5)^2 40$
$= 490 \text{ watts} \times \frac{1 \text{ kw}}{1000 \text{ watts}} = 0.49 \text{ kw}$

23. Another name for a secondary cell.

A. Wet cell
B. Storage cell
C. Dry cell
D. Disposable cell

24. Two resistances of 8 and 10 ohms respectively are connected in parallel and take a total current of 9 A. What is the current flowing in the 8-ohm resistance?

A. 5 A
B. 4 A
C. 6 A
D. 3 A

CDT
① $I_1 = \frac{I_T R_2}{R_1 + R_2} = \frac{9(10)}{8+10} = 5$ A
② $I_2 = \frac{I_T R_1}{R_1 + R_2}$

25. A 50 μF capacitor has a reactance of 53.05 ohms at a frequency of

A. 80 Hz

B. 50 Hz
C. 70 Hz
D. 60 Hz

26. What resistance must be connected across a 4-ohm resistor in order to give an equivalent resistance of 3 ohms?

A. 10 ohms
B. 8 ohms
C. 12 ohms
D. None of these

RME Board October 1995

27. A high resistance connected in parallel with a potential relay across a 120-V battery will

A. increase the current through the relay
B. increase the voltage across the relay
C. have no effect on the relay
D. make the relay inoperative

28. Three capacitors of 5, 10 and 15 μF respectively are connected end to end. Find the equivalent capacity of the combination.

A. 2.73 μF
B. 30 μF
C. 5.23 μF
D. None of these

$C_T = \frac{1}{15} + \frac{1}{10} + \frac{1}{5}$

RME Board April 1995

29. How is a voltmeter connected in a circuit?

A. Connect in short circuit across the load
B. Connect in shunt across the load
C. Connect in series across the load
D. Connect in open circuit with the load

30. Component of an atom that doesn't have any electrical charge.

A. Electron
B. Proton
C. Neutron
D. None of these

31. A lead-acid cell is constructed in multiplate for the purpose of _____.

A. increasing the emf of the cell
B. increasing the capacity of the cell
C. increasing the internal resistance of the cell
D. all of these

32. An ohmmeter consists of a meter movement in series with _____.

A. an inductor
B. a spring
C. a capacitor
D. a battery

33. The resistance reading of a shorted capacitor is

A. high
B. zero
C. infinity
D. low

34. In a large alternator, which of the following is negligible?

A. Reactance of winding
B. Resistance of winding
C. Impedance of winding
D. None of these

35. A phenomenon on a series AC circuit wherein maximum current will flow.

A. Avalanche
B. Resonance
C. Break-even
D. Breakdown

36. A measuring instrument used to measure the diameter of circular wires in mils.

A. Micrometer
B. Millimeter
C. Wire gauge
D. Milliammeter

RME Board October 1994, RME October 1995

37. The rotating part of a DC motor is known as

A. pole
B. stator
C. carbon brush
D. armature

38. The resistance of a coil of wire is 1 kΩ at 20 °C. If the coil is immersed into an oil, the resistance falls to 880 Ω. If the wire has a temperature coefficient of 0.006 at 20 °C, how much is the temperature of the liquid?

A. 0 °C
B. –20°C
C. 17.6 °C

D. None of these

39. Power factor is defined as the ratio of

A. watts to volt-amps
B. volt-amps to reactive volt-amps
C. watts to reactive volt-amps
D. volt-amps to watts

40. The electrons in the last orbit of an atom are called

A. bound electrons
B. free electrons
C. valence electrons
D. charged electrons

41. A 400 MCM cable has 37 strands. What is the diameter of each strand in mils?

A. 10.81
B. 1081
C. 104
D. 108

RME Board October 1996

42. If the two leads of a DC series motor are reversed, which of the following events will happen?

A. It becomes a generator
B. It runs in the same direction as before
C. It will not run
D. It will run in the reversed direction

43. The copper field coils of a motor was measured at 21°C and found to have a resistance of 68 ohms. After the motor has run for a given time, the resistance is found to be 90 ohms. What is the hot temperature of the winding?

A. 106.36 °C
B. 166.30 °C
C. 103.66 °C
D. None of these

44. The continuity of a coil of winding maybe determined by measuring the resistance of the coil. If the resistance measured is infinite, the coil winding is

A. open
B. in perfect condition
C. partially shorted
D. totally shorted

45. A secondary cell is charged with a constant current of 10 A for 10 hours. How much charge is accumulated?

A. 100 coulombs
B. 360,000 coulombs
C. 100,000 coulombs
D. 60,000 coulombs

46. In an automatic "forward-reverse-stop star-delta controller", how many electrical timer(s) are needed?

A. At least one
B. Only one
C. Exactly two
D. No timer is needed

47. A cell whose emf is 1.45 V has an internal resistance of 4 ohms. What current will flow if this cell is connected across a 1-ohm resistor?

A. 0.4 A
B. 0.2 A
C. 0.5 A
D. 0.3 A

48. Another name for full voltage starting?

A. Reduce voltage starting
B. Full load starting
C. Direct on line
D. Starting without a contactor

49. What is the neutral current of a 4-wire, 3-phase circuit if line A carries 50 A, line B carries 50 A and line C carries also 50 A?

A. 50 A
B. 86.6 A
C. 0 A
D. 16.67 A

50. What is the amperage of a 120 V, 1-phase circuit that supplies a load of 3,120 volt-amperes?

A. 26 A
B. 30 A
C. 22 A
D. 15 A

TEST 2

PHILIPPINE ELECTRICAL CODE

1. The maximum electrical trade size of intermediate conduit is

   A. 150 mm
   B. 125 mm
   C. 200 mm
   D. 100 mm

2. Before starting any installation work, alteration, repair or extension on any electrical system, what type of permit is needed?

   A. Building permit
   B. Working permit
   C. Electrical permit
   D. Mayor's permit

3. The Philippine Electrical Code (PEC) is intended for ____ applications by government bodies exercising legal jurisdiction over electrical installation.

   A. advisory
   B. optional
   C. mandatory
   D. all of these

RME Board October 1995

4. Equipment for installation in hazardous locations must be tested and approved for use according to the classification of the hazards involved. These are divided into ____ groups.

   A. 4
   B. 3
   C. 7
   D. 6

5. Individual branch circuits using type FCC (flat conductor cable) shall have ratings not exceeding _____.

   A. 20 A
   B. 30 A
   C. 15 A
   D. 40 A

6. Which of the following conductors is applicable for underground ser entrance conductors?

   A. type THWN
   B. type UF
   C. type MI
   D. type USE

RME Board October 1995

7. If there are three wires of 150 mm^2 connected to one terminal entering a cabi or a switchboard, the bending space at each terminal shall NOT be less th ____, provided the conductors do not enter or leave the enclosure through wall opposite its terminals.

   A. 200 mm
   B. 300 mm
   C. 400 mm
   D. 250 mm

8. A clearance of not less than ____ shall be secured between bare curre carrying metal parts and any metal surface of an auxiliary gutter.

   A. 26 mm
   B. 24 mm
   C. 13 mm
   D. 12 mm

9. No box shall have an internal depth of less than _____.

   A. 15 mm
   B. 10 mm
   C. 12 mm
   D. 14 mm

10. Which of the following electrical conductor has the highest resistance?

    A. 3.5 mm^2
    B. 8.0 mm^2
    C. 2.0 mm^2
    D. 5.5 mm^2

11. A device or equipment which is suspended from overhead either by means of a flexible cord carrying the current, or otherwise.

    A. Rosette
    B. Pendant
    C. Fixture
    D. Air terminal

12. In the schedule of loads for motor circuits, which of the following is NOT included?

A. Type of motor
B. Motor's manufacturer
C. Motor as numbered or identified in the power layout
D. Number of phase

RME Board April 1996

13. What is the allowable ampacity of THW insulated copper conductor with an area of 8.0 mm^2 and exposed to an ambient temperature of 30 °C?

A. 45 A
B. 20 A
C. 30 A
D. 60 A

14. For two conductors inside the conduit, the ampacity of the conductors shall be derated to what percent?

A. 90 %
B. 80 %
C. 70 %
D. None of these

RME Board April 1996

15. Electrical equipment may best be mounted on a concrete wall by using one of the following. Which one is this?

A. Wooden plug
B. Expansion bolt
C. Load plug
D. Plastic plug

16. What is the neutral load of a range that has a demand load of 10.4 kW?

A. 7.28 kW
B. 13 kW
C. 8.32 kW
D. 10.4 kW

17. If the project is extensive and requires more time for checking and for computations of fees, the issuance of the electrical permit need not be issued immediately. However, the delay shall not be longer than how many working days?

A. 7
B. 6
C. 5
D. 8

18. Splices in ground conductors shall be as few as practicable and shal attached so as to withstand a pull test of _____.

A. 900 Newtons
B. 880 Newtons
C. 800 Newtons
D. 890 Newtons

19. Locations which are hazardous because of the presence of combustible dust

A. Class I
B. Class II
C. Class III
D. Class IV

RME Board October 1996

20. For an ambient temperature of 30 °C, a THW insulated copper conductor wit cross sectiona`1c I area of 3.5 mm^2 and buried underground has the follow ampacity. Which one is correct?

A. 20 A
B. 40 A
C. 15 A
D. 30 A

21. All extended parts located within _____ of the lighting protection system shall bonded thereto.

A. 1,500 mm
B. 1,600 mm
C. 1,800 mm
D. 2,000 mm

22. Operation at substantially constant load for an indefinitely long time.

A. Periodic duty
B. Intermittent duty
C. Continuous duty
D. Short time duty

23. Transformer exceeding 112.5 kVA, shall not be located within ____ fro combustible materials of the building.

A. 400 mm
B. 300 mm
C. 200 mm
D. 500 mm

24. Electrodes of iron or steel plates shall be at least ____ in thickness.

A. 6.2 mm
B. 5.8 mm
C. 6.0 mm
D. 6.4 mm

25. The frame of the vehicle-mounted generator shall be permitted to serve as the grounding electrode for a system supplied by a generator located on the vehicle under which of the following conditions?

A. The vehicle of the generator is bonded to the vehicle frame
B. The generator supplies only equipment located on the vehicle
C. The non-current carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame
D. All of these

26. The minimum insulation level for the neutral conductors of a solidly grounded system shall be _____.

A. 600 V
B. 300 V
C. 500 V
D. 1,000 V

RME Board October 1996

27. The following copper conductors have the same cross sectional area but are made up of different number of strands. Which one has the least resistance to AC current?

A. 19-strand conductor
B. Single solid conductor
C. 7-strand conductor
D. 37-strand conductor

28. Advisory rules in the Code are characterized by the use of the word _____.

A. will
B. would
C. shall
D. should

29. A device capable to drawing lightning discharge to it in preference to vulnerable parts of the protected area.

A. Ground terminal
B. Lightning trap
C. Ground mat
D. Air terminal

30. Conductors normally used to carry current shall be of ___ unless otherv provided in the PEC.

A. aluminum
B. copper
C. copper clad aluminum
D. all of these

RME Board April 1996

31. Light fixtures suspended from the ceiling by chains should be wired so that th

A. chain is grounded
B. wires help support the fixture
C. wires will not touch the chains
D. wires do not support the fixture

32. An appliance, which is fastened or otherwise, secured at a specific location.

A. Permanent appliance
B. Stationary appliance
C. Portable appliance
D. Fixed appliance

33. Which one is a standard rating of an inverse time CB?

A. 140 A
B. 130 A
C. 120 A
D. 110 A

34. Aerial cable under non-metallic extensions shall have a clearance of not le than _____ from steel structure members or other conductive materials.

A. 60 mm
B. 30 mm
C. 50 mm
D. 40 mm

35. Above ground tanks containing liquids at atmospheric pressure are considere to be protected against lightning if the following requirements are meet. Whi one is NOT included?

A. The metal roof shall have a minimum thickness of 4.8 mm
B. The roof shall be welded, bolted or riveted to the shell
C. All pipes entering the tank shall be metallically connected to the tank at th point of entrance
D. None of these

RME Board April 1995

36. According to Republic Act No. 184, a licensed Master Electrician may operate and tend generator rated up to a certain voltage. What is this voltage?

A. 440 V
B. 750 V
C. 220 V
D. 460 V

37. A heavy duty lamp holder shall have a rating no less than _____

A. 450 W
B. 500 W
C. 600 W
D. 660 W

RME Board April 1995

38. In rigid metal conduit wiring, conduits shall be supported at least every

A. 2,500 mm
B. 3,500 mm
C. 3,000 mm
D. 2,000 mm

39. Conductors used in open wiring method within ____ from the floor shall be considered exposed to physical damage.

A. 3,000 mm
B. 2,500 mm
C. 2,000 mm
D. 1,800 mm

40. Heating elements of cables shall be separated at least ____ from the edge of outlet boxes and junction boxes.

A. 200 mm
B. 100 mm
C. 150 mm
D. 300 mm

RME Board April 1994

41. Auxiliary gutters shall not contain more than ____ current carrying conductors at any cross section.

A. 36
B. 32
C. 30
D. 24

42. Circuits rated from 201 to 400 A requires a minimum insulation resistance of

A. 25,000 ohms
B. 50, 000 ohms
C. 100,000 ohms
D. 12,500 ohms

43. No overcurrent device shall be connected in series with any conductor that is

A. stranded
B. current carrying
C. closed
D. intentionally grounded

44. Which of the following size of single-phase transformer is NOT standard?

A. 30 kVA
B. 37 ½ kVA
C. 75 kVA
D. 20 kVA

45. For the purpose of lightning protection, a high rise building is a building with a height over _____.

A. 23 m
B. 50 m
C. 20 m
D. 15 m

46. Branch circuits are classified according to the maximum _____.

A. voltage across it
B. load being served
C. power consumed
D. setting of the overcurrent device

47. Cable tray shall NOT be used in

A. hoistways
B. dry locations
C. industrial establishments
D. all of these

48. What type of electrical conductors has a trade name "moisture resistant thermoplastic"?

A. TW
B. THW
C. THWN
D. All of these

49. A device used for the purpose of minimizing irregularities in the flow of welding currents.

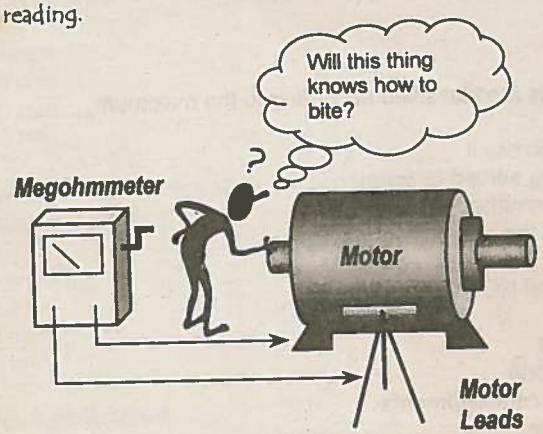
A. Rheostat box
B. Grounding transformer
C. Reactor
D. None of these

50. For all land-based electrical installation under the scope of the Philippine Electrical Code, where should an electrical permit be filed?

A. Department of Energy
B. Office of the City/Provincial Engineer
C. Office of the Mayor
D. Local Building Office

Master Electricians' work tip:

.....To test a motor for a ground, connect one lead of the megohmmeter to the motor frame and the other to one end of the motor terminals. A grounded motor will have a zero or near zero reading.



TEST 3

TECHNICAL SUBJECT

1. What is the diameter of a copper wire having s cross sectional area of 3, CM?

$d = \sqrt{cm}$

A. 1.6 mm
B. 7.9 mils
C. 0.16 inch
D. None of these

2. When n equal resistors are connected in series to a source of emf E volts, ea having a resistance of R ohms, which of the following statements is true?

A. The voltage drop across one of the resistor is equal to E/n
B. The equivalent resistance of the circuit is equal to nR
C. The current through each of the resistors is the same
D. All of these

RME Board April 1994

3. The unit of magnetic flux in SI is

A. Tesla
B. Volt-ampere
C. Maxwell
D. Weber

4. If the series field is connected in series with the armature, and the shunt field connected across the combination, what type of DC generator is this?

A. Shunt generator
B. Series generator
C. Long shunt compound generator
D. Short shunt compound generator

5. A small lamp used to indicate that a circuit is energized.

A. Pilot lamp
B. Electric sign lamp
C. Control lamp
D. Test lamp

6. An instrument that measures the voltage or electrical pressure in a circuit.

   A. Ammeter
   B. Megger
   C. Galvanometer
   D. Voltmeter

RME Board October 1994

7. A lubricant to make pulling of wires or cables through the conduit easier is

   A. grease
   B. resin
   C. talc
   D. iron filings

8. The start winding of a split-phase induction motor is switched out of the circuit by a device called

   A. magnetic contactor
   B. zero speed switch
   C. centrifugal switch
   D. proximity switch

RME Board April 1995

9. Give an example of an electrical conductor.

   A. Brass
   B. Asbestos
   C. Slate
   D. Latex

10. A small light bulb with a resistance of 1000 ohms is connected across a 120-V line. What is the current through the bulb?

    A. 1.2 A
    B. 0.12 A
    C. 0.012 A
    D. 12 A

11. A good capacitor has a _____ resistance.

    A. negligible
    B. negative
    C. very high
    D. none of these

12. Practically all batteries have a nominal rating based on the ___ hour rate of discharge.

    A. 8
    B. 24
    C. 16
    D. 12

13. Electrical symbol represented by a rectangle with a letter PB inside.

    A. Push button
    B. Pull box
    C. Battery panels
    D. None of these

14. The energy stored in an electrolytic cell is ____.

    A. an electrical
    B. a magnetic
    C. a mechanical
    D. a chemical

15. The most common usage of resistors in electronic circuits is to _____.

    A. limit current
    B. introduce a voltage drop
    C. generate heat
    D. all of these

RME Board April 1996

16. An applicant for the Registered Master Electricians' Examination must at least be a graduate of ____ year electrician course of instruction and has at least ___ years of apprenticeship after completion of the course.

    A. two, two
    B. one, one
    C. one, two
    D. two, three

17. A 200-V lamp has a hot resistance of 400 ohms. The power rating in watts of the lamp is

    A. 100 W
    B. 200 W
    C. 600 W
    D. 250 W

18. An inductance has a reactance of 10,000 ohms at 10 kHz. At 2 kHz, the inductive reactance will be equal to

    A. 20,000 ohms
    B. 500 ohms
    C. 2,000 ohms
    D. 32,000 ohms

RME Board October 1995

19. A battery is charged at 15 A for 10 hours. If the charging voltage is 120 V, what is the charging cost at 1.00 peso per kW-hr?

    A. 15 pesos
    B. 18 pesos
    C. 12 pesos
    D. 20 pesos

20. How much current is produced by a 60-V source connected across a 12-kΩ resistance?

    A. 5 A
    B. 7.2 A
    C. 20 mA
    D. 5 mA

21. When the speed of the prime mover of an alternator is increased, what parameter is affected?

    A. Frequency
    B. Voltage
    C. Both frequency and voltage
    D. None of these

22. When a circuit breaker is selected, which of the following is the most important factor to consider?

    A. Voltage rating
    B. Interrupting rating
    C. Momentary rating
    D. Continuous current rating

RME Board April 1996

23. If 18 resistances, each of a value of 36 ohms, are connected in parallel, then the total resistance is

    A. 36 ohms
    B. 2 ohms
    C. 648 ohms
    D. 54 ohms

24. How many 1.5 A lighting fixtures can be connected to a 15-A continuous duty branch circuit?

    A. 14
    B. 10
    C. 12
    D. 8

25. Which of the following is an integrating instruments?

    A. Ammeter
    B. Voltmeter
    C. Wattmeter
    D. All of these

26. A wire whose resistance is r ohms is being cut into four equal parts. If these parts are to be connected in parallel, how much is the equivalent resistance in ohms?

    A. r / 12
    B. r / 16
    C. r / 8
    D. r / 4

27. The resistance of a material in inversely proportional to its

    A. length
    B. temperature
    C. cross-sectional area
    D. all of these

28. An ammeter is connected _____.

    A. across the load
    B. in series with the load
    C. in series-parallel across the load
    D. none of these

29. If the number of valence electrons is exactly four, the material is

    A. a conductor
    B. a semi-conductor
    C. an insulator
    D. a superconductor

RME Board October 1996

30. In a circuit breaker, the current which exists at the instant of contact separation is known as

    A. recovery current
    B. surge current
    C. interrupting current
    D. restriking current

31. Which of the following is used to improve or correct the power factor?

    A. Capacitors
    B. Synchronous motors

C. Synchronous condensers
D. All of these

32. SI unit of potential difference.

A. Coulomb per volt
B. Statvolt
C. Volt per ohm
D. Volt

33. Commercial unit of electric energy.

A. Joule
B. Watt-hour
C. Megawatt
D. Kilowatt-hour

RME Board October 1996

34. What resistance must be connected in parallel with a 1.0-ohm resistance to give an equivalent resistance of 0.2 ohm?

A. 0.75 ohm
B. 0.25 ohm
C. 1.20 ohms
D. 0.50 ohm

35. Which of the following is a disadvantage of carbon composition resistors when compared to other resistance types?

A. They produce relatively high noise
B. They have a relatively high temperature coefficient
C. Both A and B
D. Neither A or B

36. When a battery is discharged in use, its voltage is _____ the theoretical voltage.

A. equal to
B. higher than
C. lower than
D. none of these

RME Board October 1995

37. For a ceiling fan, which of the single-phase motor is used?

A. split-phase type
B. capacitor start and run type
C. permanent capacitor type
D. capacitor start type

38. A water heater takes 2.5 A at 230 V. What is its hot resistance?

A. 82 ohms
B. 74 ohms
C. 92 ohms
D. None of these

39. An electric iron draws 15 A at 220 V. It is desired to reduced the current to 12 A by connecting a series rheostat. What is the resistance of the rheostat?

A. 3.66 ohms
B. 4.55 ohms
C. 5.12 ohms
D. 1.86 ohms

40. Watt-hour is equivalent to how many joules?

A. 4,186
B. 3,600
C. 44,760
D. None of these

41. The ability of a conductor to allow current flow.

A. Resistance
B. Coefficient of resistance
C. Conductance
D. Permeability

RME Board April 1995

42. The current carrying capacity of the fuse material depends on

A. cross-sectional area
B. length
C. material
D. all of these

43. A 0.4 μF capacitor has a charge of 20 μC. How much is the voltage across it?

A. 0.02 V
B. 8 V
C. 50 V
D. None of these

44. Blue is assigned to what digit value in the resistance color code?

A. 5
B. 6
C. 7
D. 4

45. The property that opposes any change in current.

A. Impedance
B. Resistance
C. Inductance
D. Capacitance

46. Three 120-ohm resistors are connected in series-parallel. The equivalent resistance of the combination is _____.

A. 360 ohms
B. 80 ohms
C. 180 ohms
D. 40 ohms

$R_T = R1 + \left(\frac{R_2 R_3}{R_2 + R_3}\right)$

SERIES PARALLEL

47. Expired licenses shall be renewed only after complying the required CPE units. What does CPE stands for?

A. Credit Professional Expenses
B. Certificate of Practice and Experience
C. Course of Professional Ethics
D. Continuing Professional Education

48. A half wave rectifier uses how many diodes?

A. At least two diodes
B. Only one diode
C. Only two diodes
D. One or more diodes depending on designer

RME Board October 1996

49. A 25-W incandescent bulb rated at 120 V and operated on a 120 V line has burnt out and has to be replaced as soon as possible. There are several lamps available but not of the same rating. Which of the bulbs below should be used to consumption of the busted bulb?

36.

A.
B.
C. low
D. none

th one of 2-ohm resistance. If the
m resistor, what is the equivalent
sistors?

RME Board Oct

37. For a ceiling fan,

A. split-phase type
B. capacitor start and
C. permanent capacitor
D. capacitor start type

rent.

38. A water heater takes 2.5 A at 230

TEST 4

PHILIPPINE ELECTRICAL CODE

1. For each 2-wire laundry branch circuit, a feeder load of NOT less than _ shall be included.

A. 1,800 VA
B. 1,500 VA
C. 2,000 VA
D. 1,200 VA

2. The computed load for the branch circuit installed to supply exterior signs a outline lighting shall be computed at a minimum of _____ volt-amperes.

A. 1,200
B. 1,500
C. 1,800
D. 1,000

3. Non-metallic boxes shall be permitted only with _____.

A. concealed knob and tube wiring
B. non-metallic sheathed cable
C. open wiring on insulators
D. all of these

RME Board April 1995

4. A building or other structure serve shall be supplied by only one service dr EXCEPT for

A. multiple occupancy building
B. fire pumps
C. emergency electrical system
D. all of these

5. Air terminals exceeding 600 mm in height shall be supported at a point NO less than ____ of its height.

A. three-fourth
B. two-fifth
C. one-half
D. one-third

A. Impedance
B. Resistance
C. Inductance
D. Capacitance

46. Three 120-ohm resistors are connected in series-parallel. The equivalent resistance of the combination is _____.

A. 360 ohms
B. 80 ohms
C. 180 ohms
D. 40 ohms

$R_T = R_1 + \left(\frac{R_2 R_3}{R_2 + R_3}\right)$

SERIES PARALLEL

47. Expired licenses shall be renewed only after complying the required CPE units. What does CPE stands for?

A. Credit Professional Expenses
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D. Continuing Professional Education

48. A half wave rectifier uses how many diodes?

A. At least two diodes
B. Only one diode
C. Only two diodes
D. One or more diodes depending on designer

RME Board October 1996

49. A 25-W incandescent bulb rated at 120 V and operated on a 120 V line has burnt out and has to be replaced as soon as possible. There are several lamps available but not of the same rating. Which of the bulbs below should be used to approximate the power consumption of the busted bulb?

A. 20 watts, 110 volts
B. 100 watts, 240 volts
C. 50 watts, 240 volts
D. 75 watts, 220 volts

$P = \frac{E^2}{P}$

50. A resistor of 3 ohms is connected in parallel with one of 2-ohm resistance. If the combination is connected in series with a 4-ohm resistor, what is the equivalent resistance of the whole combination of three resistors?

A. 6.4 ohms
B. 5.8 ohms
C. 4.5 ohms
D. 5.2 ohms

TEST 4

PHILIPPINE ELECTRICAL CODE

1. For each 2-wire laundry branch circuit, a feeder load of NOT less than ____ shall be included.

A. 1,800 VA
B. 1,500 VA
C. 2,000 VA
D. 1,200 VA

2. The computed load for the branch circuit installed to supply exterior signs and outline lighting shall be computed at a minimum of _____ volt-amperes.

A. 1,200
B. 1,500
C. 1,800
D. 1,000

3. Non-metallic boxes shall be permitted only with _____.

A. concealed knob and tube wiring
B. non-metallic sheathed cable
C. open wiring on insulators
D. all of these

RME Board April 1995

4. A building or other structure serve shall be supplied by only one service drop EXCEPT for

A. multiple occupancy building
B. fire pumps
C. emergency electrical system
D. all of these

5. Air terminals exceeding 600 mm in height shall be supported at a point NOT less than ____ of its height.

A. three-fourth
B. two-fifth
C. one-half
D. one-third

6. At least how many entrance(s) shall be provided to give access to the working space about electrical equipment?

   A. Two
   B. One
   C. Three
   D. Not specified in the Code

7. Sheet steel metal boxes over 1640 cm^3 in size shall be made from steel NOT less than ___thick uncoated.

   A. 1.25 mm
   B. 1.35 mm
   C. 1.6 mm
   D. 1.8 mm

8. For straight pulls, the length of the pull box shall NOT be less than ____times the outside diameter over sheath of the largest shielded or lead covered conductor or cable entering the box.

   A. 48
   B. 42
   C. 36
   D. 38

RME Board October 1994

9. This type of cable is a fabricated assembly of insulated conductors enclosed in a flexible metal sheath.

   A. Ground wire
   B. Integrated gas spacer cable
   C. Medium voltage cable
   D. Armored cable

10. Which of the following circuits shall NOT be grounded?

    A. 2-wire DC systems
    B. Vehicle mounted generators
    C. Heath care facilities
    D. All of these

11. An attachment plug and receptacle shall be permitted to serve as the disconnecting means for single phase room air conditioner rated 250 V or less if the manual controls of the room air conditioner is readily accessible and located within a certain distance from the floor. What is this distance?

    A. 2,000 mm
    B. 1,800 mm
    C. 1,900 mm
    D. 1,700 mm

RME Board April 1995

12. There are situations where deviations from the code requirements necessary. Before such deviations are made, there must be a written permi from one of the following entities. Which one is this?

    A. Board of Electrical Engineering
    B. Code Enforcing Authority
    C. IIEE Code Committee
    D. Philippine Regulation Board

13. Circuits with rigid non-metallic conduit approved for direct burial and pl under streets, hi-ways, roads, alleys, driveways and parking lots shall ha minimum cover distance of _____.

    A. 760 mm
    B. 900 mm
    C. 1,000 mm
    D. 600 mm

14. Energized parts of generators operated at more than _____ to ground shall be exposed to accidental contact where accessible to unqualified persons.

    A. 75 V
    B. 50 V
    C. 100 V
    D. 40 V

15. So constructed or protected that exposure to a beating rain will not result in entrance of water under specified test conditions.

    A. Raindrip
    B. Raintight
    C. Rainproof
    D. Rainsealed

16. The cross sectional area in square millimeters of a conductor shall be dural marked on the surface repeated at intervals NOT exceeding _____.

    A. 600 mm
    B. 900 mm
    C. 1,000 mm
    D. 760 mm

17. Motor circuit switches shall ____ permitted to be of the knife switch type.

    A. not be
    B. be
    C. be or not be
    D. none of these

RME Board October 1996

18. The following are common splicing rules EXCEPT one. Which one is this?

    A. A splice must provide a path for the current to pass through
    B. A joint must be mechanically as strong as the wire itself
    C. All splices must be mechanically and electrically secured by means of a solder
    D. Wires of the same size should be spliced together in line

19. For watercrafts, where should the said electrical permit be filed?

    A. Local Building Office
    B. Maritime Industry Authority
    C. Office of the Philippine Ports Authority
    D. Office of the Philippine Coast Guard

20. Reconnection by the supplier of electrical energy in cases where service has been cut-off due to non-payment of bills shall not require a new certificate of inspection provided the period of cut-off is NOT more than _____.

    A. one and one-half years
    B. two years
    C. half a year
    D. one year

21. Liquidtight flexible nonmetallic conduit shall NOT be used where the voltage of the contained conductors is in excess of _____.

    A. 600 V
    B. 300 V
    C. 250 V
    D. 1000 V

22. Roofs with a series of parallel ridges shall have air terminals along the end ridge at intervals NOT exceeding _____.

    A. 7,600 mm
    B. 8,000 mm
    C. 6,000 mm
    D. none of these

RME Board April 1996

23. Communication wires and cables shall be separated at LEAST a certain minimum distance from service drops of electric light and power conductors, which are not installed in a raceway or in cable. What is this minimum distance?

    A. 150 mm
    B. 175 mm
    C. 300 mm
    D. 200 mm

24. Service entrance using copper conductors shall have sufficient capacity and shall NOT be smaller than ____.

    A. 5.5 mm^2
    B. 3.5 mm^2
    C. 14.0 mm^2
    D. 8.0 mm^2

25. Hazardous locations in which easily ignitable fibers or material producing combustible flyings are handled, manufactured or used

    A. Class III, Division 1
    B. Class IIII, Division 2
    C. Class I, Division 1
    D. Class I, Division 2

RME Board April 1995

26. The rating of the overcurrent device shall not be less than the noncontinuous load plus a percentage of the continuous load.

    A. 125 %
    B. 80 %
    C. 100 %
    D. 140 %

27. A _____ branch circuit shall be permitted to supply cooking appliances that are fastened in place in any occupancy.

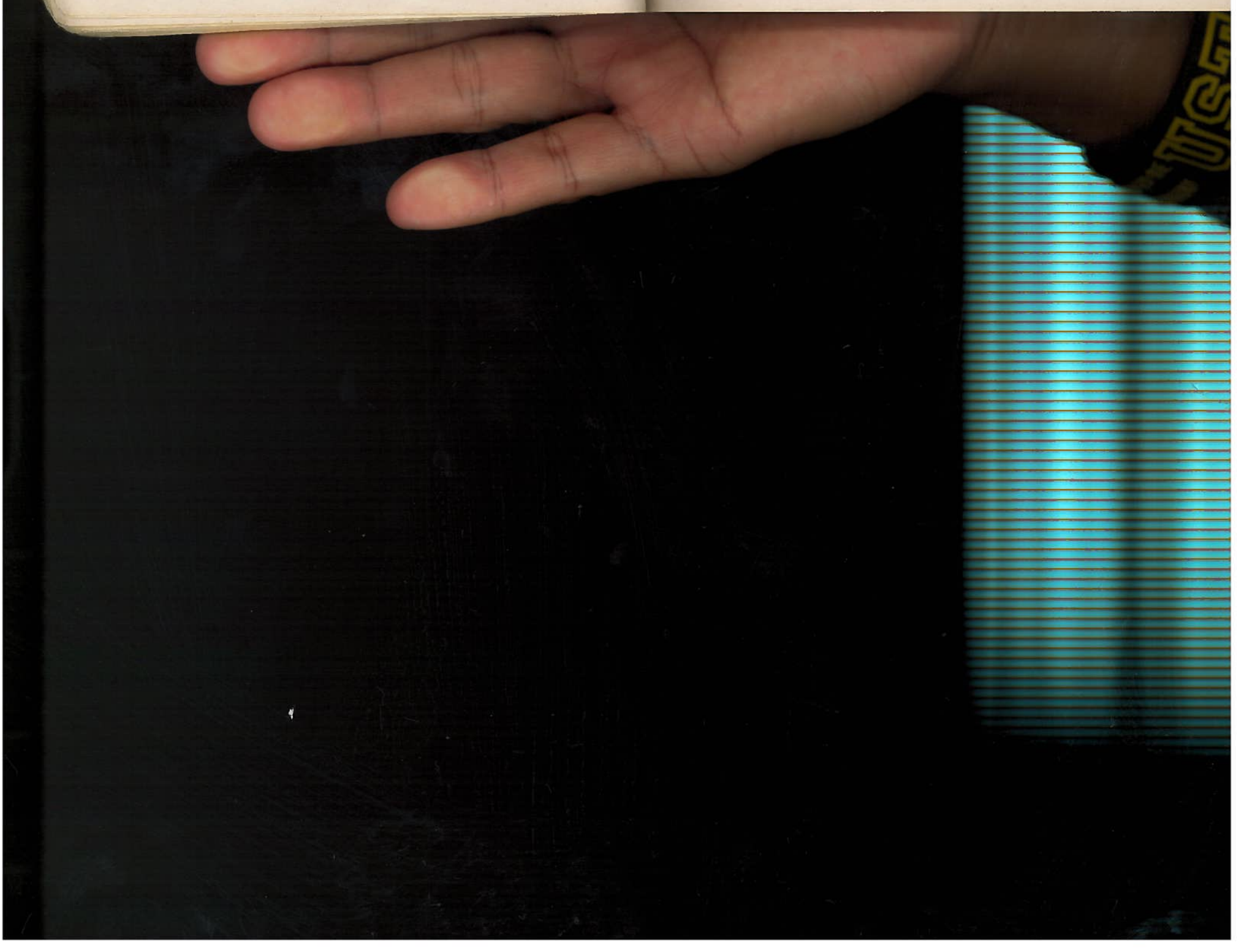
    A. 30 or 40 A
    B. 20 or 30 A
    C. 50 or 60 A
    D. 40 or 50 A

28. An overcurrent device shall be connected at the point where the conductors to be protected _____.

    A. receives its supply
    B. is being terminated
    C. receives its load
    D. none of these

29. Service entrance cables shall be supported by straps or other approved methods within____ of every service head

    A. 300 mm
    B. 500 mm
    C. 600 mm
    D. 400 mm



30. Type MC cable shall be supported and secured at intervals NOT exceeding

A. 2,000 mm
B. 1,800 mm
C. 1,500 mm
D. 2,500 mm

RME Board October 1994, RME Board April 1995

31. A point in a wiring system at which current is taken to be used in some equipment.

A. Grounded
B. Conductor
C. Service entrance
D. Outlet

32. Live vegetation or trees _____ used for support of overhead conductor spans.

A. shall be
B. should be
C. shall not be
D. should not be

33. A conductor having no covering or electrical insulation.

A. bare conductor
B. concealed conductor
C. encased conductor
D. exposed conductor

34. Type FC cable shall have the temperature rating durably marked on the surface at intervals NOT exceeding _____.

A. 600 mm
B. 550 mm
C. 800 mm
D. 760 mm

35. Hazardous locations where combustible dust is not normally in the air in quantities sufficient to provide explosive or ignitable mixtures, and dust accumulations are normally insufficient with the normal operation of electrical equipment.

A. Class II, Division 1
B. Class II, Division 2
C. Class III, Division 1
D. Class III, Division 2

RME Board October 1995

36. The clearance form the top of a switchboard to a ceiling which is combustib shall NOT be less than ____.

A. 1,000 mm
B. 800 mm
C. 900 mm
D. 1,250 mm

37. Overhead conductors used in festoon lighting shall NOT be less than _____.

A. 0.75 mm^2
B. 3.5 mm^2
C. 2.0 mm^2
D. 5.5 mm^2

38. Conductors used in lightning protection system maybe coursed through a without support for a distance of _____ or less.

A. 1,000 mm
B. 900 mm
C. 760 mm
D. 800 mm

RME Board April 1995

39. In concealed knob and tube wiring, the clearance to be maintained betwee conductors is

A. 55 mm
B. 45 mm
C. 76 mm
D. 50 mm

40. A run of type IGS cable between pull boxes or terminations shall NOT contai more than the equivalent of ____ quarter bends.

A. one
B. two
C. three
D. four

41. For optional calculation in dwelling units, the first 10 kW shall be computed a 100 % while the remainder is at _____.

A. 65 %
B. 60 %
C. 50 %
D. 40 %

42. Operation of equipment in excess of normal, full load rating or of a conductor in excess of rated ampacity.

A. Overload
B. Overvoltage
C. Overcurrent
D. Surge

43. Branch circuits larger than ___ shall supply only non-lighting outlet loads.

A. 30 A
B. 40 A
C. 50 A
D. 60 A

RME Board October 1995

44. When circuit breakers are installed in enclosed switchboards, they are usually derated to a certain percentage. What is this percentage?

A. 60 %
B. 80 %
C. 50 %
D. 70 %

45. Which of the following statement is NOT true?

A. Electrical equipment and wiring not mentioned in the code shall require a special permission prior to installation
B. Extended use of temporary installation shall not require a new approved electrical permit
C. An application of inspection shall be filed with the government agency concerned before a preliminary and or final inspection is done
D. A copy of the electrical permit shall be posted or kept at the job site at all times, until the approval of the work have been made.

46. Fixed electric space heating loads shall be computed at ____ of the total computed load.

A. 80 %
B. 90 %
C. 100 %
D. 125 %

47. The powers of the Board are vested in them by who's authority?

A. President of the Philippines
B. Commissioner of PRC
C. under RA 7920
D. National President of IIEE

48. The current carrying conductors in cablebus shall have insulation rating of ____or more.

A. 40 °C
B. 50 °C
C. 70 °C
D. 60 °C

RME Board April 1995

49. In hazardous location, the use of non-metallic conduit shall be permitted provided it is buried NOT less than ___ below the earth level.

A. 400 mm
B. 600 mm
C. 1,000 mm
D. 500 mm

50. Open conductors shall be separated from open conductors of other circuits by NOT less than a certain distance. What is this distance?

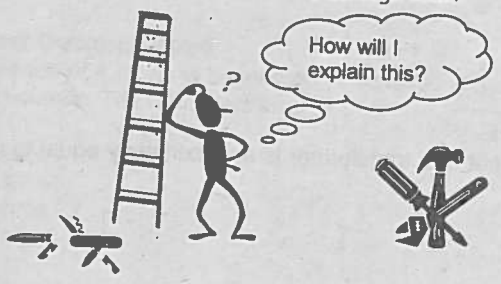
A. 200 mm
B. 100 mm
C. 150 mm
D. 120 mm

Master Electricians' work tip:

.....Never use any electrical tool as a hammer, unless it's a hammer.

..... Never use screwdrivers as wood chisels.

..... Never drop tools, it could damage them.



TEST 5

TECHNICAL SUBJECT

1. The term of office for any members of the BEE (Board of Electrical Engineering) is how many years?

   A. 3 years
   B. 2 years
   C. 1 year
   D. 4 years

RME Board April 1994

2. Relays which verify the condition of the power system or in protection systems.

   A. Auxiliary relay
   B. Regulating relay
   C. Programming relay
   D. Monitoring relay

3. A substance that cannot be decomposed any further by a chemical reaction.

   A. Ion
   B. Element
   C. Molecule
   D. None of these

RME Board October 1996

4. A 220-V, 10 hp, single-phase induction motor operates at an efficiency of 86% percent at a power factor of 90%. What is the current?

   A. 45.26 A
   B. 37.69 A
   C. 34.81 A
   D. 43.81 A

   $P_{in} = \frac{P_{out}}{\eta}$

   $P_{in} = EI\,pf$

   $I = \frac{P_{in}}{E\,pf}$

5. The no load power input of a transformer is approximately equal to what losses in a transformer?

   A. Iron losses
   B. Copper losses
   C. Ventilation losses
   D. All of these

6. Admittance in AC circuit is a parameter equivalent to the _____.

   A. impedance
   B. square of impedance
   C. square root of impedance
   D. reciprocal of impedance

7. In applying mouth to mouth rescue breathing to a person under electric shock, which of the following is the correct sequence out of the following scrambled steps?

   a. Pull his chain to keep his tongue out
   b. Clear his throat from any materials
   c. Place him on his back
   d. Blow air through his nose or mouth
   e. Tilt his head back as far as possible

   A. a, c, b, e, d
   B. c, e, a, d, b
   C. c, b, e, a, d
   D. a, e, c, d, b

RME Board October 1994, RME Board April 1996

8. What should you do to prevent a shock when working on a high voltage supply?

   A. Open the filter capacitor
   B. Discharged the filter capacitor
   C. Closed the filter capacitor
   D. Charge the filter capacitor

9. If the needle of the VOM will no longer align with the zero-ohm mark at the lowest range of resistance but will align on the other resistance ranges, which of the following is a probable cause?

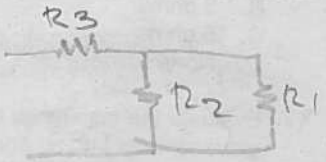
   A. The needle is bent
   B. The supply battery is weak
   C. The meter current is abnormal
   D. The terminals were interchanged

RME Board October 1996

10. A resistance of 4 ohms is connected in series to a parallel connection of two 8-ohm resistance. The total resistance is

    A. 6 ohms
    B. 20 ohms
    C. 8 ohms
    D. 12 ohms

    $R_T = R_3 + \frac{(R_1)(R_2)}{R_1 + R_2}$



11. When cleaning a commutator, which of the following shall NOT be used?

    A. Clean cloth

B. Sand paper
C. Emery
D. All of these

RME Board October 1995

12. A Merz-price protection is suitable for

A. alternators
B. transformers
C. transmission lines
D. feeders

13. Common tripping time for 60 Hz circuit breaker.

A. 6 cycles
B. 8 cycles
C. 7 cycles
D. 5 cycles

14. One horsepower is equivalent to how many watts?

A. 746
B. 764
C. 674
D. None of these

RME Board October 1995

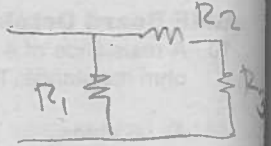
15. How would determine, from visual observation of the armature winding, whether the generator is a lap or a wave wound.

A. direction of the end connection
B. connection to the commutator
C. connection to the field winding
D. connection to brushes

16. A resistor of 4-ohm resistance is connected in parallel with a series combination two resistors, 3-ohm and 1-ohm respectively. What is the equivalent resistance of the whole combination?

A. 8 ohms
B. 3 ohms
C. 5 ohms
D. None of these

$R_T = \frac{R_1(R_2+R_3)}{R_1+(R_2+R_3)}$ Parallel-series



17. Evaluate the resistance of a shunt resistor required to convert a 1 mA, 300-ohm galvanometer into an ammeter with a maximum range of 5 A?

A. 60 mΩ
B. 600 mΩ

$I_{sh} = I - I_m$

$R_{sh} = \frac{I_m R_m}{I_{sh}} = (1000)$

C. 6 mΩ
D. None of these

18. What is the resistance of a component having no continuity?

A. Low resistance
B. No or zero resistance
C. Infinite resistance
D. All of these

RME Board April 1994

19. A battery is a group of cells connected in

A. parallel
B. series-parallel
C. series
D. all of these

20. Which of the following steps is used for isolating a circuit breaker f maintenance purposes?

A. turn off the main generator
B. open the disconnect switches
C. connect the circuit breaker contacts to ground
D. none of these

21. Lubrication commonly used by gearmotors.

A. Water
B. Oil
C. Grease
D. Talc

RME Board April 1995

22. For efficient operation, induction motors are always designed with a small

A. airgap
B. voltage drop
C. inductive reactance
D. impedance

23. A shunt motor draws a line current of 30 A from a 250 V source. If the total losses amount to 1,250 watts, how much is the efficiency of the motor at this load?

A. 87.45 %
B. 83.33 %
C. 89.21 %
D. None of these

$\eta = \frac{P_{in} - P_{losses}}{P_{in}} = \frac{V_s I_s - losses}{V_s I_s}$

24. An atom that acquires additional electrons.

A. Anion
B. Cathode
C. Anode
D. Cation

25. In order for a material to be called a conductor, what is the maximum number of valence electrons it can have?

A. Only one
B. Two
C. Three
D. None of these

RME Board April 1995

26. Three resistors R_1, R_2 and R_3 are connected in series across a 100-V source. If R_2 opens, the

A. voltage across R_2 is 100 V
B. voltage across R_1 is 100 V
C. total resistance decreases
D. voltage across R_2 is zero

27. The equivalent capacitance of two capacitors in series is 2.4 μF. If one of the capacitor has a capacitance of 4μF, what is the capacitance of the other?

$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$

$\frac{1}{2.4} = \frac{1}{4} + \frac{1}{C}$

A. 6 μF
B. 2 μF
C. 5 μF
D. None of these

28. An ideal step-up transformer with 100 turns in the primary and 2500 turns in the secondary carries a load of 2 A in the secondary windings. What is the current in the primary side?

$\frac{I_1}{I_2} = \frac{N_2}{N_1}$

A. 50 A
B. 0.08 A
C. 25 A
D. 1,250 A

29. This winding is connected in series with armature winding of a DC generator to compensate the field flux distortion due to armature reaction.

A. Series field windings
B. Interpole windings
C. Compensating windings
D. Shunt field windings

30. What is the load of 10 receptacle outlets supplying cord and plug-connect office equipment used at continuous duty?

LOAD = NO. OF OUTLETS X 180 VA/OUTLET

A. 1,800 VA
B. 1,440 VA
C. 2,250 VA
D. 3,000 VA

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31. Twenty resistors each having a resistance of 1000 ohms are connected parallel. The equivalent resistance is

$R_T = \frac{R}{N} = \frac{1000}{20} = 50$

A. 20,000 ohms
B. 50 ohms
C. 1,000 ohms
D. 5,000 ohms

32. An important feature of a thin film resistor is its ____ temperature coefficient resistance.

A. low
B. high
C. negative
D. zero

33. In parallel operation of DC generators which of the following parameters mu be the same?

A. speed
B. phase sequence
C. voltage
D. all of these

RME Board October 1996

34. Voltage across an electric circuit, acts as a

A. mass of electrons
B. negative ions
C. force
D. component of current

35. An oscilloscope is usually used to measure

A. rms voltage
B. average voltage
C. maximum voltage
D. all of these

36. One of the following parameters cannot be change by a transformer? Which on is it?

A. Impedance
B. Current
C. Voltage
D. Power

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37. A wattmeter measures

A. AC as well DC power
B. AC power only
C. DC reactive power only
D. None of these

38. What is the feeder load of a feeder serving three squirrel cage induction motors having FLAs of 34, 27 and 12 A respectively?

A. 73 A
B. 81.50 A
C. 91.25 A
D. 58.40 A

39. Two inductors of 6 and L henries are connected across its other. Neglecting the effect of mutual capacitance, what is the value of L if the total inductance of the combination is 2 H?

A. 4 H $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2}$
B. 8 H
C. 12 H
D. None of these $\frac{1}{2} = \frac{1}{6} + \frac{1}{L_2} = 3H$

RME Board April 1996

40. Which one is a semi-conductor?

A. Phosphorous
B. Arsenic
C. Gallium Arsenide
D. Diamond

41. If a person is accidentally in electric shock, which of the following is the first thing to do?

A. Call immediately the nearest doctor.
B. Attend instantly to the victim's breathing
C. Separate the victim immediately from the circuit
D. Give him water at once to help him breath

42. Capacitor commonly used in circuits that have a combination of DC and AC voltages.

A. Ceramic capacitor
B. Plastic capacitor
C. Oil-filled capacitor
D. Electrolytic capacitor

RME Board October 1994

43. Transforms heat energy to electric energy.

A. Transformer
B. Battery
C. Generator
D. Thermocouple

44. The torque exerted by a DC motor delivering power to a load is 742 N-m. If the motor is rotating at 480 rpm, how much is the mechanical power delivered by the shaft of the motor?

A. 60 hp $Hp = \frac{2\pi N_t}{K}$
B. 45 hp
C. 50 hp
D. 55 hp

45. A wire has a resistance of 30 ohms at 20 °C. What will its resistance at 60 °C. Assume the temperature coefficient of resistance to be 0.00385 at 20 °C.

A. 34.26 Ω $R_2 = R_1(1 + \alpha \Delta t)$
B. 36.42 Ω
C. 32.46 Ω
D. None of these =

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46. When examining a dead set, which item(s) should be checked?

A. Open filament
B. Power supply diodes
C. Fuse
D. All of these

47. Which of the following statements is NOT true?

A. A discharged lead-acid cell for a long time can easily be charged
B. Lead-acid cells can be charged and discharged at a very high rate without damaging the plates
C. A lead-acid cell has a lesser ampere hour capacity than a nickel iron cell of the same capacity
D. All of these

48. A DC load takes 6 A at 50 V. Find the value of a series resistance required in order to operate the same load successfully from a 110-V supply.

A. 10 ohms
B. 6 ohms
C. 12 ohms
D. 8 ohms

1. Motor used to start heavy loads.

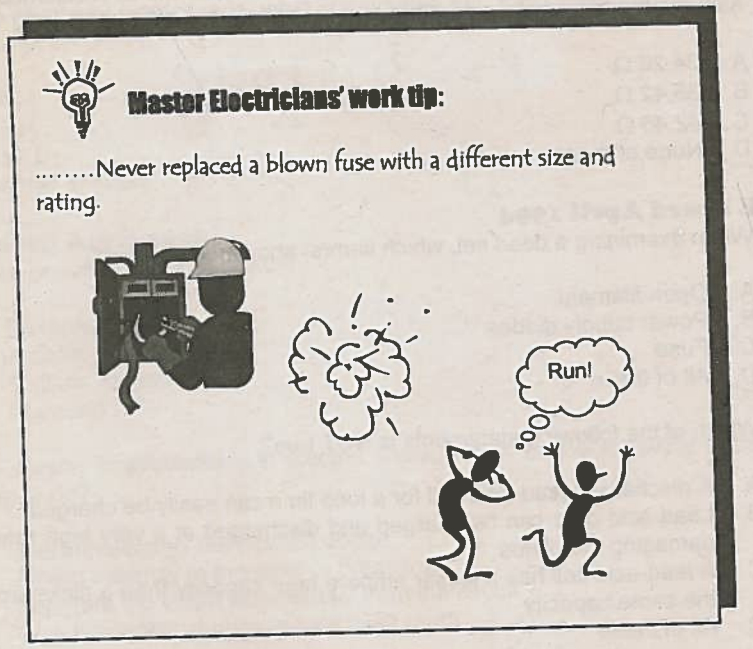
A. Synchronous motor.
B. Series motor
C. Wound rotor
D. Differential compound motor

RME Board October 1994

2. The resistances of four rheostats are 10, 5, 7 and 3 ohms, which are connected in series to a battery, which produces a potential difference of 75 V across its terminals. Find the current in each rheostat.

A. 10 A
B. 3 A
C. 5 A
D. 7 A

$I = \frac{E_T}{R}$



TEST 6

PHILIPPINE ELECTRICAL CODE

1. Where flexible tubing is used to encase the conductors, the tubing shall extend from the last insulating support to no less than ____ inside the nonmetallic boxes.

A. 8 mm
B. 10 mm
C. 5.5 mm
D. 6.4 mm

2. Metal raceways, enclosures, frames and other non-current carrying metal parts of electric equipment shall be kept at least a certain distance from lightning rod conductors. What is this distance?

A. 1,900 mm
B. 2,000 mm
C. 1,800 mm
D. 1,500 mm

RME Board October 1995

3. Where no standard electrical equipment of the exact size or rating is available and the next larger size is neither available the next smaller size or rating maybe used provided a special permission is obtained from one of the following. Which one is this?

A. Barrio Captain
B. Mayor
C. Electrical Inspector
D. Fire Chief

4. Instruments, pilot lights, potential transformers and other switchboard devices with potential coils shall be supplied by a circuit that is protected by a standard overcurrent device rated up to ____

A. 20 A
B. 30 A
C. 10 A
D. 15 A

5. A wire or other mechanical member having one end secured and the other end fastened to a pole maintained under tension.

   A. Lug
   B. Tie wire
   C. Cable rack
   D. Guy

RME Board April 1996

6. Below are the factors that affect the ampacity of an electrical conductor EXCEPT one. Which one is this?

   A. Insulation resistance
   B. Length of the conductor
   C. Conductor material
   D. Cross-sectional area of the conductor

7. For circuits over 600 V nominal, conductors shall NOT be bent to a radius less than ____ times the diameter for shielded or lead covered conductors.

   A. 6
   B. 8
   C. 10
   D. 12

8. Which of the following statements about overcurrent devices is NOT correct?

   A. It shall be located where they will not be exposed to physical damage
   B. It shall be readily accessible
   C. It can be located inside clothes closets
   D. In a multi-family dwelling, each occupant shall have ready access to all overcurrent device protecting his occupancy

9. Which of the following statements is NOT true?

   A. Conductors in raceways shall be continuous between outlets
   B. Metal raceways, boxes, cabinets and fittings shall be grounded
   C. Metal or non-metallic raceways shall be continuous between cabinets, boxes or other enclosures.
   D. Raceway shall be used as a means of support for other raceways

10. For receptacle outlets, each single or each multiple receptacle on one strap shall be considered not less than _____.

    A. 200 VA
    B. 180 VA
    C. 600 VA
    D. 150 VA

11. Corner joints on a gutter shall be made tight, where the assembly is he together by rivets or bolts. The spacing shall NOT be more than ____.

    A. 250 mm
    B. 100 mm
    C. 300 mm
    D. 200 mm

RME Board April 1995

12. What is the total number of mechanical degrees that a PVC conduit run mayb bent between pull points (pull boxes, junction boxes or utility boxes)?

    A. 360 degrees
    B. 180 degrees
    C. 120 degrees
    D. 270 degrees

13. The minimum size of wire used in electrical wiring is the former # 14 AWG Under the SI standard in the PEC, what is the diameter of this wire?

    A. 1.2 mm
    B. 2.0 mm
    C. 1.5 mm
    D. 1.6 mm

14. A box with a blank cover which is inserted in one or more runs of raceway to facilitate pulling of the conductors.

    A. Coupling box
    B. Junction box
    C. Terminal box
    D. Pull box

15. The neutral conductor from the neutral point of the transformer or generator to its connection point to the grounding impedance shall be _____.

    A. open
    B. grounded
    C. fully insulated
    D. none of these

RME Board October 1994

16. The sum of the cross sectional area of all conductors in a wireway must not exceed ___ percent of the cross-sectional area of the wireway.

    A. 15
    B. 20
    C. 10
    D. 25

17. Circuit containing electric discharge lighting transformer exclusively shall NOT be rated in excess of ___.

A. 30 A
B. 20 A
C. 15 A
D. 40 A

18. For ranges of 8.75 kW or more in rating, the minimum branch circuit required shall be

A. 20 A
B. 40 A
C. 30 A
D. 50 A

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19. Lighting fixtures shall be wired with a fixture flexible cord with a cross sectional area of NOT less than

A. 0.50 mm^2
B. 2.00 mm^2
C. 1.25 mm^2
D. 0.75 mm^2

20. If the setting of overcurrent device in a circuit ahead of equipment is 60 A, what is the minimum required grounding conductor using copper?

A. 5.5 mm^2
B. 8.0 mm^2
C. 14 mm^2
D. None of these

21. Mineral insulated metal sheathed cable shall be permitted in any of the following installations EXCEPT one. Which one is this?

A. For control circuits
B. Where exposed to oil and gasoline
C. For feeder circuits
D. Where exposed to corrosive atmosphere

22. Conductors which run above the top level of a window shall be permitted to be less than 1,000 mm but in no case shall be less than

A. 300 mm
B. 600 mm
C. 500 mm
D. 800 mm

23. For barber shops and beauty parlors, the general lighting load per square me of area shall be

A. 24 watts
B. 28 watts
C. 16 watts
D. 8 watts

24. Liquidtight flexible nonmetallic conduit shall be permitted to be used

A. for direct burial
B. where flexibility is required
C. in exposed or concealed locations
D. all of these

25. Outlet boxes _____ used as a sole support for ceiling fans.

A. shall be
B. shall not be
C. either (a) or (b)
D. none of these

RME Board April 1994

26. Flexible metal conduits must not be used in

A. wet locations
B. hoistways
C. storage battery rooms
D. all of these

27. For 25 to 50 A circuits, the minimum insulation resistance is

A. 100,000 ohms
B. 250,000 ohms
C. 50,000 ohms
D. 25,000 ohms

28. What is the maximum operating temperature of type THWN conductor?

A. 75 °C
B. 60 °C
C. 90 °C
D. 110 °C

29. A conductor encircling a building and interconnecting all ground terminals.

A. Bonding
B. Interlink
C. Air terminal
D. Counterpoise

42. Wireways shall be supported at intervals NOT to exceed

A. 1500 mm
B. 2000 mm
C. 1200 mm
D. 1800 mm

43. For a dwelling unit having a floor area not more than 50 square meters shall be permitted to have a single 20-A, 2-wire branch circuit provided the total load shall NOT exceed _____.

A. 3,680 volt-amperes
B. 3,860 volt-amperes
C. 3,080 volt-amperes
D. 3,068 volt-amperes

44. For show window lighting, a load of not less than _____ volt-amperes shall be included for each liners meter of show window.

A. 500
B. 400
C. 600
D. 300

45. The maximum setting of the ground fault protection of equipment shall be ____.

A. 1,500 A
B. 1,800 A
C. 1,400 A
D. 1,200 A

46. A grounded metal enclosure containing a factory mounted, bare or insulated conductors, which are usually copper, or aluminum bars, rods or tubes.

A. Cable tray
B. Busway
C. Wireway
D. Cablebus

RME Board April 1995

47. Flat conductor cable (FCC) system shall NOT be used in the locations enumerated below EXCEPT one. Which one is this?

A. Locations where subject to corrosive vapors
B. Damp locations
C. Residential buildings
D. Outdoors

48. Type MI cables shall be securely supported at intervals NOT exceeding ____.

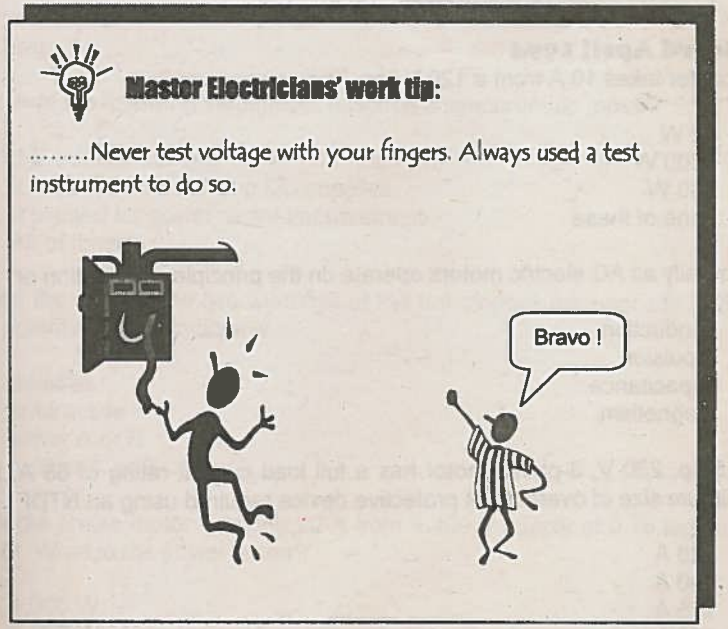
A. 1,800 mm
B. 2,000 mm
C. 1,500 mm
D. 2,500 mm

49. The grounding impedance for grounded neutral system shall be installe between the _____.

A. system neutral and the current carrying conductors
B. grounding electrode and system neutral
C. grounding electrode and metal frame of generator
D. all of these

50. In any watercraft, receptacle outlets operating at ___ volts or more shall have grounding pole.

A. 100 V
B. 120 V
C. 50 V
D. 60 V



TEST 7

TECHNICAL SUBJECT

1. Which of the following is the best advantage of a DC motor over an AC motor?

   A. It is easier to reverse its speed.
   B. It has a higher speed rating
   C. It has a better speed control
   D. All of these

2. A junction transistor has three terminals namely:

   A. anode, cathode and triode
   B. emitter, base and collector
   C. base, receiver and collector
   D. positive, negative and ground

RME Board April 1994

3. A toaster takes 10 A from a 120 V line. The power used is

   A. 12 W
   B. 1200 W
   C. 130 W
   D. none of these

4. Generally all AC electric motors operate on the principle of induction or

   A. conduction
   B. repulsion
   C. capacitance
   D. magnetism

5. A 25 hp, 230 V, 3-phase motor has a full load current rating of 68 A. Find the minimum size of overcurrent protective device required using an NTDF.

   A. 225 A
   B. 200 A
   C. 175 A
   D. 250 A

6. How much is the resistance of a 600 W, 120-V toaster?

   A. 0.2 ohm $R = \frac{E^2}{P}$
   B. 5 ohms
   C. 20 ohms
   D. None of these

7. In making a resistance test, remember that the resistance of a short circuit is

   A. infinite
   B. approximately zero
   C. midway between high and low range
   D. slightly above the midrange

8. Grease is a lubricant that is basically a combination of _____.

   A. oil and soap
   B. water and soap
   C. oil and water
   D. oil, water and soap

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9. The device used to attenuate specific signals is the

   A. splitter
   B. drop tap
   C. line tap off
   D. trap

10. Which of the following statements describe a synchronous motor?

    A. It is not self-starting
    B. It requires both AC and DC supplies
    C. It is used for power factor improvement
    D. All of these

11. When the emfs in the two windings of the transformer are opposite in direction, the polarity of the windings is

    A. additive
    B. subtractive
    C. either A or B
    D. neither A or B

12. A single-phase motor is taking 20 A from a 400 V supply at 0.75 lagging power factor. What is the power taken?

    A. 4,000 W
    B. 6,000 W $P = EI\,pF$
    C. 8,000 W
    D. None of these

13. How much is the load current for a 100-W incandescent bulb connected to a 120 V power line?

$I = \frac{P}{E}$

A. 1.2 A
B. 0.833 A
C. 8.33 A
D. None of these

RME Board April 1994

14. Electromotive force is measured by a

A. voltmeter
B. megger
C. clamp ammeter
D. galvanometer

15. What is the unbalanced neutral current in a 4-wire wye system with phase A carrying 68 A, phase B carrying 88 A and phase C carrying 96 A?

A. 20 A
B. 30 A
C. 25 A
D. None of these

RME Board October 1994

16. The full load rated current in amperes of a 5 hp, single-phase 230 V motor is

A. 56 A
B. 15 A
C. 28 A
D. 40 A

17. What important data can be gathered after the open circuit test on transformer?

A. Rated power output
B. Resistance and reactance of windings
C. Core or iron losses
D. Voltage and current ratios

RME Board October 1994

18. The power factor of a circuit is approximately 100 % if the circuit load consists only of

A. motors
B. incandescent lamps
C. fluorescent lamps
D. capacitors

19. All switches that have been turned off before doing repair work on any electrical equipment, shall be

A. left as it is
B. left with its cover open
C. left with a note stating that the work is being done
D. left with its cover closed and padlocked

RME Board October 1994

20. Which of the following electric machine is equipped with slip rings?

A. DC motor or DC generator
B. Split-phase motor
C. AC generator
D. Repulsion type motor

21. The internal resistance of a milliammeter should be very low in order to have

A. a negligible effect on the circuit current
B. maximum voltage drop across the meter
C. a current which will not damage the meter
D. all of these

RME Board October 1994

22. A device used to remove the sharp burrs or rough edges is called

A. reamer
B. threader
C. hickey
D. bender

23. The proper way of measuring an unknown voltage with a multi-tester is to

A. start measuring at the lowest range of the meter
B. start measuring at the mid range of the meter
C. start measuring at the highest range
D. de-energized the circuit first

24. An instrument used to measure the speed of a motor or a generator.

A. Hydrometer
B. Thermometer
C. Tachometer
D. Oscilloscope

RME Board April 1995

25. The condition of Ohm's law is that

A. the temperature should remain constant
B. the temperature should vary
C. ratio V / I should be constant
D. current should be proportional to voltage

26. What is the amperage of the neutral with a 600 A load?

A. 480 A
B. 500 A
C. 600 A
D. 420 A

1st 200 at 100% = 200
Ney 400 at 70% = 280
480

27. A dry cell has internal resistance of 0.02 ohm and a terminal voltage of 1.5 V on open circuit. What will be its terminal voltage if a 0.1-ohm resistance is connected across its terminals?

A. 1.25 V
B. 1.20 V
C. 1.42 V
D. 1.15 V

By VDT

$t_{load} = \frac{I_t R_{load}}{R_{load} + R_{internal}}$

28. A carbon composition resistor when connected across a 24-V battery draws a current of 1 mA. What is the minimum required resistance and wattage rating of the resistor?

A. 24,000 ohms, 1/4 W
B. 24,000 ohms, 1 W
C. 24 ohms, 1/8 W
D. None of these

$R = \frac{E}{I} = \frac{24}{0.001} = 24000$

$P = I^2R = (0.001)^2(24)$

29. Best suited motor to drive small electric fans.

A. Universal motor
B. Shunt motor
C. Capacitor run motor
D. Resistance split-phase motor

30. The pointer or needle of an indicating instrument is usually made from

A. soft iron
B. aluminum
C. silver
D. manganin

RME Board April 1995

31. The presence of current is only made known by the effect it produces. Three important effects are:

A. heating, electric shock and generation
B. heating, magnetic and electric shock
C. generation, chemical and electric shock
D. heating, magnetic and chemical

32. For prevent from an electric shock, electrical ladders should have

A. plastic footings
B. rubber footings
C. wood footings
D. metal footings

33. How many kilowatts is the power 200 joules per second equal to?

A. 0.2
B. 200
C. 0.02
D. None of these

200 joules/sec = 200 watts

$200\ W \times \frac{1\ kW}{1000\ W} = 0.2\ kW$

34. What is the total VA rating of 230 V, single-phase circuit supplied by a 20-A circuit breaker?

A. 4,400 VA
B. 3,500 VA
C. 3,680 VA
D. None of these

VA rating = VI = 230(20) = 4600

RME Board April 1995

35. Power factor is defined as the ratio of

A. watts to volt-amperes
B. volt-amperes to reactive
C. volt-amperes to watts
D. volts-amperes

36. A synchronous motor which is under-excited acts like _____

A. a resistor
B. an inductor
C. a capacitor
D. all of these

37. Each component in a motor controller must be approved for which of the following?

A. The voltage to which it will be connected.
B. The current it must carry.
C. The horsepower that it must control
D. All of these

38. A wire has a resistance of 5 ohms. What will be the resistance of another wire of the same material three times as long and half the cross sectional area?

A. 30 ohms
B. 25 ohms
C. 28 ohms
D. None of these

$\frac{R_1}{R_2} = \frac{L_1 A_2}{L_2 A_1}$

$R_2 = \frac{R_1 (L_2)(A_1)}{L_1 A_2}$

RME Board April 1994

39. Temperature coefficient of a conductor is defined as the

A. increase in resistance per degree absolute
B. increase in resistance per degree centigrade
C. increase in resistance per ohm per degree absolute
D. none of these

40. A small tool with a tapered drill point used to make a pilot hole for wood screw mounting.

A. Screw driver
B. Center punch
C. Puller
D. Gimlet

RME Board October 1995

41. The insulation resistance of the winding of an electric motor is measured by

A. ammeter
B. galvanometer
C. megohmmeter
D. voltmeter

42. Electrical symbol represented by a circle with a plus sign inside it.

A. Push button
B. Bell
C. Riser down
D. Pull box

43. A synchronous converter is used to change

A. speed
B. frequency
C. AC voltage to DC voltage and vice-versa
D. mechanical energy to electrical energy

RME Board October 1996

44. To control a lamp from five different places, an electrician would install the following:

A. three 4-way and two 2-way switches
B. two 3-way and three 4-way switches
C. four 3-way and one 4-way switches
D. three 3-way and two 4-way switches

45. The equivalent resistance of two resistors connected in parallel is 2 ohms. If one of them is 3 ohms, what is the ohmic value of the other?

A. 5 ohms
B. 3 ohms
C. 4 ohms
D. 6 ohms

46. A dry cell has an internal resistance of 0.02 ohm and open circuit voltage of 1.5 V. Calculate the power delivered to a resistor of 0.6-ohm resistance.

A. 3.5 watts
B. 2.4 watts
C. 2.0 watts
D. 3.8 watts

$I = \frac{E}{R} = \frac{1.5}{0.02 + 0.6} = \frac{1.5}{.62} = 2.419$

$P = I^2(R) = 2.419^2(0.6) = 3.5$

47. The direction of rotation a three phase motor can be reversed by

A. switching any two of the three leads
B. dismantling the motor and switching two leads
C. switching all three leads
D. none of these

RME Board October 1994

48. The least efficient lighting source is the

A. metal halide
B. fluorescent
C. mercury
D. incandescent

49. A 10-ohm resistor is connected across a battery whose internal resistance is 5 ohms. If the voltage across the 10-ohm resistance is 12 V, how much is the open circuit voltage of the battery?

A. 15 V VDT
B. 24 V
C. 18 V
D. 20 V

50. Calculate the resistance of a 100-W, 110 V incandescent lamp?

A. 121 ohms
B. 125 ohms
C. 115 ohms
D. None of these

TEST 8

PHILIPPINE ELECTRICAL CODE

1. Space heating cables shall be secured at intervals NOT exceeding

   A. 300 mm
   B. 200 mm
   C. 400 mm
   D. 500 mm

RME Board April 1994, RME Board October 1994

2. A run conduit between outlets, between fittings, between outlet and fitting shall not contain more than the equivalent of ____ quarterbends.

   A. 2
   B. 4
   C. 3
   D. 5

3. A general term covering an assembly or assemblies of devices for the interruption, control and metering of electric power.

   A. Control system
   B. Power system
   C. Switchgear
   D. Instrumentation

4. Thermoplastic insulated fixture wires shall be durably marked on the surface at intervals NOT exceeding

   A. 900 mm
   B. 500 mm
   C. 1,000 mm
   D. 600 mm

5. The average distance between down conductors in a lightning protection system shall NOT exceed

   A. 30 m
   B. 20 m
   C. 15 m
   D. 25 m

6. Type AC cable shall NOT be permitted to be used _____.

   A. in storage battery
   B. on cranes or hoists
   C. in motion pictures
   D. all of these

7. ____ shall NOT be used as the sole equipment grounding conductor.

   A. Earth
   B. Conduit
   C. Cable
   D. None of these

RME Board October 1994

8. This is a single conductor or multi-conductor assembly provided with or without an overall covering, primarily used for services.

   A. Tray cable
   B. Clad cable
   C. Service entrance cable
   D. Flat conductor cable

9. Fixture wires shall NOT be smaller than ____ .

   A. 0.5 mm^2
   B. 1.25 mm^2
   C. 2.0 mm^2
   D. 0.75 mm^2

10. Standard locknuts and _____ shall NOT be used as a bond for the service entrance raceway.

    A. connectors
    B. bushings
    C. within 50 feet of service equipment
    D. copper only

RME Board October 1995

11. Transformers that contain liquid that will burn shall be installed only in approved vaults and shall also comply with the following conditions EXCEPT one. Which one is this?

    A. Ample ventilation shall be provided for the continuous removal of flammable gases
    B. Vent openings shall lead to a safe locations outside the building
    C. All vent ducts and openings shall be of sufficient areas to reliable explosion pressures within the vault
    D. There shall be a robust door between the vault and any non-hazardous location

12. Flat cable assemblies shall have conductors of ____ special stranded copper wires.

    A. 2.0 mm^2
    B. 3.5 mm^2
    C. 5.5 mm^2
    D. 8.0 mm^2

13. A short length of a conductor used to make a connection between terminals or around a break in a circuit.

    A. Jumper
    B. Guy
    C. Bonding conductor
    D. Tie wire

RME Board April 1995

14. The surface nonmetallic raceway may NOT be used in the following locations EXCEPT one. Which one is this?

    A. In dry locations
    B. Where concealed
    C. Where subject to severe physical damage
    D. In hoistways

15. For bare metal parts, busbars, etc of opposite polarity held free in air shall maintain a minimum spacing of _____ for voltages rated not over 250 V.

    A. 10 mm
    B. 20 mm
    C. 16 mm
    D. 19 mm

16. Type IGS cable is using a dry kraft paper tape and an SF_6 gas. What do you mean by SF_6?

    A. Sulfur fluoride
    B. Sulfur hexafluoride
    C. Sulfur ferrite
    D. None of these

RME Board April 1995

17. What locations do NOT allow the installation of PVC rigid conduits?

    A. Hazardous locations
    B. Corrosive locations
    C. Wet locations
    D. In concealed locations

18. Flat cable assemblies shall NOT be installed _____.

    A. in hoistways
    B. in any hazardous locations
    C. outdoors
    D. all of these

19. Ground connections shall be made at approximately every other steel colu around the perimeter of the building and shall NOT be more than ____ apart.

    A. 18 m
    B. 20 m
    C. 16 m
    D. 24 m

20. For school buildings, the general lighting load is _____ VA per square meters

    A. 24
    B. 28
    C. 16
    D. 8

21. _____ is a fabricated assembly of insulated conductors in a flexible meta enclosure.

    A. Type MI
    B. Type USE
    C. Type UF
    D. Type AC

22. Splices and _____ in messenger wire shall be made by approved methods.

    A. devices
    B. taps
    C. both A and B
    D. neither A or B

RME Board October 1994

23. A storage battery supplying emergency lighting an d power shall maintain less than 87.5 % of full voltage at total load for a period of at least

    A. 1.5 hours
    B. 2.5 hours
    C. 2.0 hours
    D. 1.0 hour

24. An appliance which can easily be moved from one place to another in norm use.

    A. Fixed appliance

B. Accessible appliance
C. Stationary appliance
D. Portable appliance

25. The feeder demand factor for three kitchen equipment other than dwelling kitchen equipment shall be ____.

A. 100 %
B. 90 %
C. 70 %
D. 80 %

RME Board October 1994

26. To provide for small appliance load in a dwelling unit, the feeder should be computed at

A. 2,400 watts
B. 3,000 watts
C. 1,500 watts
D. 3,600 watts

27. Cables operated at over ____ shall be shielded.

A. 2,000 V
B. 1,000 V
C. 3,000 V
D. None of these

28. The nearest ground terminal shall be NOT less than ____ from the foundation wall.

A. 760 mm
B. 800 mm
C. 550 mm
D. 600 mm

RME Board April 1994

29. The circuit conductors between the service entrance equipment or isolated generating plant and the branch circuit overload device or devices.

A. overcurrent protector
B. feeder
C. motor controller
D. disconnecting switch

30. Conductors shall be securely attached to the buildings using fasteners. Fasteners shall be spaced NOT more than

A. 760 mm
B. 600 mm

C. 880 mm
D. 900 mm

31. The minimum diameter of air terminal used at the top of a heavy duty smoke or vent stacks shall be ____, exclusive of the corrosion protection.

A. 10 mm
B. 15 mm
C. 13 mm
D. 20 mm

32. _____ are used on conduits and are located inside and outside of the box.

A. Couplings
B. Bushings
C. Locknuts
D. Washers

33. No parts of cord connected fixtures, hanging fixtures or pendants shall be located within a zone measured _____ horizontally from a bathtub rim.

A. 900 mm
B. 1,000 mm
C. 800 mm
D. 700 mm

34. Busbars shall be copper having a minimum conductivity of ____ percent.

A. 100 %
B. 96 %
C. 98 %
D. 97 %

RME Board April 1995

35. What is the temperature rating of THW insulation?

A. 60 °C
B. 85 °C
C. 75 °C
D. 90 °C

36. Individual open conductors and cables other than service entrance cables shall NOT be installed within ___ of every grade level.

A. 3,100 mm
B. 2,500 mm
C. 3,700 mm
D. 3,000 mm

37. An insulated grounded conductor of 14 mm^2 or smaller shall be identified by a continuous ___ outer finish along its entire length.

A. green
B. black
C. green with yellow stripes
D. white or natural gray

38. Messenger supported wiring is permitted only in _____ establishments where maintenance personnel service the system.

A. industrial
B. commercial
C. both A and B
D. neither A or B

39. In damp or wet locations, boxes and fittings should be properly placed or insulated to prevent

A. dust from entering the box or fitting
B. water from entering the box or fitting
C. wiring exposure
D. grounding

40. Equipment having an open circuit voltage exceeding ____ shall NOT be installed in dwelling occupancies.

A. 500 V
B. 300 V
C. 250 V
D. 230 V

RME Board October 1995

41. Concealed knob and tube wiring conductors shall be rigidly supported on knobs not more than a certain minimum distance apart. What is this distance?

A. 2,000 mm
B. 1,500 mm
C. 1,300 mm
D. 2,500 mm

42. Which of the following materials is used to support the conductor in the open wiring method?

A. Insulated wire stoppers
B. Insulated nails
C. Rosettes
D. Split knobs

43. The minimum size of type IGS cable shall be

A. 100 mm^2
B. 125 mm^2
C. 150 mm^2
D. 200 mm^2

44. Watercraft's switchboards shall be provided with a clear working space of least ____ at the front.

A. 1,500 mm
B. 1,200 mm
C. 1,600 mm
D. 1,000 mm

RME Board October 1995

45. For grounding electrode to which portable or mobile equipment system neutr impedance is connected, shall be isolated from the ground by at least a certai distance from any other system or equipment grounding electrode. What is thi distance?

A. 4,000 mm
B. 6,000 mm
C. 5,000 mm
D. 3,000 mm

46. Which of the following metals is the best conductor of electricity?

A. Steel
B. Iron
C. Aluminum
D. Copper

47. Incandescent lamp fixtures shall be marked to indicate the allowable wattage of lamps. The markings shall be permanently installed in letters at least ___ high.

A. 6.0 mm
B. 6.4 mm
C. 6.3 mm
D. 6.5 mm

48. If the duty cycle of a motor-generator arc welder is 100 %, the supply conductors shall NOT be less than ____ of its rated primary nameplate current.

A. 115 %
B. 125 %
C. 100 %
D. 130 %

49. Most wires used in residential house wiring are usually insulated by

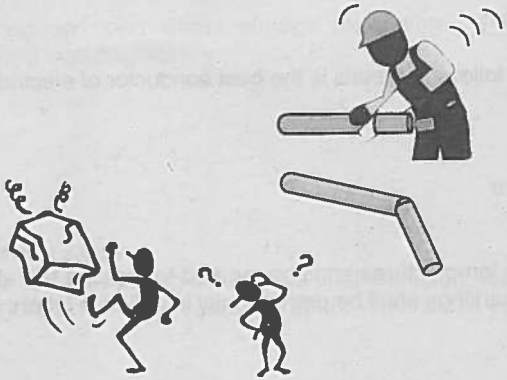
A. asbestos
B. cotton
C. thermoplastic
D. varnished cambric

50. Open wiring on insulators shall be permitted for wiring systems of ____ or less.

A. 150 V
B. 240 V
C. 300 V
D. 600 V

Master Electricians' work tip:

.....Never use dull tools, it will not only harm or endanger your work, but to yourself as well .



TEST 9

TECHNICAL SUBJECT

1. Inverse time characteristics of a fuse means

A. higher fault current, longer time needed to cut-off
B. lower fault current, shorter time needed to cut-off
C. higher fault current, shorter time needed to cut-off
D. none of these

RME Board October 1994

2. Current that continually reverse its direction

A. pulsating direct current
B. alternating current
C. direct current
D. pulsating alternating current

3. What level of electrical license is needed as one of the requirements to be appointed as members of the Board of Electrical Engineering?

A. RME
B. REE
C. PEE
D. All of these

4. Equalizer connections are necessary in paralleling two or more

A. shunt generators
B. series generators
C. compound generators
D. all of these

RME Board October 1995

5. An applicant for registered master electricians' examination must at least completed a___ year electrician course and has a specific record of ____years of apprenticeship after completion of the course.

A. two, three
B. one, one
C. two, two
D. one, two

6. In motor controls, a maintaining contact is a _____ contact.

   A. normally open
   B. normally close
   C. delay-on
   D. delay-off

RME Board April 1994

7. The power factor of an incandescent bulb is

   A. 0.707 lagging
   B. 0.707 leading
   C. 1.0
   D. zero

8. Which of the following generators are preferable for parallel operations due to their drooping voltage characteristics?

   A. Series generators
   B. Shunt generators
   C. Compound generators
   D. All of these

9. A relay used for protection of motors against overload.

   A. Thermal relay
   B. Magnetic contactor
   C. Buchholz's relay
   D. Differential relay

10. Device used to pull wire through the conduit is called

    A. Straps
    B. Fish tape
    C. Wire tongs
    D. Puller

RME Board October 1995

11. An oven takes 11 A at 220 V. It is desired to reduce the current to 10 A. What resistance must be connected in series?

    A. 2 ohms
    B. 22 ohms
    C. 20 ohms
    D. none of these

12. A cell of emf 1.45 V is connected to an external circuit of resistance 2.25 ohms and the current id found to be 0.2 A. What is the internal resistance of the cell?

    A. 4 ohms
    B. 3 ohms
    C. 6 ohms
    D. 5 ohms

RME Board April 1994, RME Board April 1996

13. What is the function of the zero adjust control in multimeter?

    A. The moving parts cab be tightened
    B. It serves to conduct the current
    C. With this control, the sensitivity of the instrument can be changed
    D. The zero point is corrected with the help of this control

14. What component of a DC generator is NOT found on a separately excited generator?

    A. Yoke
    B. Armature windings
    C. Commutator
    D. All of these

RME Board April 1995

15. The inducing emf within the circuit itself caused by any change of current wit that circuit.

    A. Mutual inductance
    B. Friction
    C. Self inductance
    D. Losses

16. If four 4-ohm resistors are connected in series, the total equivalent resistan will be

    A. 16 ohms
    B. 1 ohm
    C. 12 ohms
    D. None of these

RME Board April 1996

17. The compressed mixture of air and petrol is burnt by means of

    A. spark of spark plug
    B. distributor
    C. compression
    D. none of these

18. Which of the following statements is TRUE?

    A. The smaller the diameter of a conductor, the higher the resistance
    B. The larger the diameter of a conductor, the higher the resistance
    C. The smaller the diameter of a conductor, the lesser the resistance

D. The diameter of conductor does not affect the resistance

19. Two resistors of 5 and 10 ohms respectively are connected in parallel. If the total current to the branch is 24 A, find the current in the 5-ohm resistance?

A. 16 A
B. 15 A
C. 10 A
D. 8 A

$I_1 = I_T \left(\frac{R_2}{R_1 + R_2}\right)$

20. A 4-pole armature is wound with a duplex wave winding. How many armature current paths are there?

A. 2
B. 4
C. 6
D. 8

RME Board October 1995

21. If the individual resistances are 5, 10 and 15 ohms respectively. What potential must the battery supply to force a current of 0.50 A through the circuit?

A. 15 V
B. 30 V
C. 10 V
D. 60 V

22. The emf generated in the armature of a shunt generator is 625 V. The load draws a current of 400 A. If the field current is 6 A, find the terminal voltage. Assume an armature resistance of 0.06 ohm.

A. 603.2 V
B. 601.5 V
C. 600.6 V
D. 602.4 V

23. Overload protective devices are rated in

A. amperes
B. coulombs
C. watts
D. volts

24. The total opposition to current flow in AC circuits

A. resonance
B. impedance
C. admittance
D. conductance

RME Board April 1995

25. An open resistor reads _____ ohms in an ohmmeter.

A. infinite
B. zero
C. 1 megohm
D. none of these

26. An aggregate load of 250 A at 200 V is served by a two-wire feeder with a tota resistance of 0.08 ohm. What voltage must be maintained at the supply side o the feeder?

A. 230 V
B. 220 V
C. 210 V
D. 250 V

27. A step-down transformer,

A. lowers both the voltage and current
B. lowers the voltage and increases the current
C. lowers the current and increases the voltage
D. increases both the voltage and current

28. Commutator segments are made from _____

A. iron
B. hard drawn copper
C. brass
D. aluminum

29. Sparking occurs when a motor disconnect is switched off due to the high ___ o the motor.

A. Inductance
B. capacitance
C. resistance
D. all of these

RME Board April 1995

30. Megger in its operation is based upon

A. electrostatic meter
B. moving coil meter
C. dynamic meter
D. moving iron meter

31. A tool used for pulling gears, bearings, and bushings on the shaft of a motor or generator.

A. C-clamp
B. Hickey
C. Puller
D. Monkey wrench

32. In a given circuit, when the power factor is unity, the reactive volt-ampere is

A. maximum
B. zero
C. equal to real power
D. equal to apparent power

33. Which of the following is an advantage of a CB over a fuse?

A. It is more reliable
B. It is cheaper
C. It is easy to detect open, close or trip positions
D. It has a higher current rating

34. In an RL circuit, the current ____ the voltage.

A. leads
B. lags
C. both A and B
D. neither A or B

RME Board October 1994

35. The prefix pico means

A. 10^{-12} of a unit
B. 10^{-6} of a unit
C. 10^{-15} of a unit
D. 10^{-9} of a unit

36. RMS value of an alternating wave is the same as

A. average value
B. instantaneous value
C. effective value
D. absolute value

37. If a generator is excited from its own generated emf, the machine is classified as a _____ generator.

A. separately excited
B. self excited
C. both A and B
D. neither A or B

RME Board October 1994

38. The reciprocal of impedance

A. Conductance
B. Reluctance
C. Admittance
D. Susceptance

39. Which of the following instruments is the most sensitive?

A. Moving iron type
B. Induction type
C. Electrostatic type
D. Permanent magnet type

40. The resistance of a material is inversely proportional to its

A. length
B. diameter
C. cross-sectional area
D. volume

RME Board October 1995

41. Applicants for registered master electricians' examination must be at least ____ years of age.

A. 18
B. 19
C. 17
D. 21

42. Magnetism that remains in a magnet even after the magnetizing force has been withdrawn.

A. Natural
B. Saturation
C. Ideal
D. Residual

43. The speed of a DC motor is directly proportional to its

A. armature current
B. flux per pole
C. back emf
D. torque

44. The iron losses of a DC motor occur in the

A. Field
B. Armature

C. yoke
D. commutator

RME Board April 1994

45. It was experimentally found by James Prescott Joule that the heat produced in a current carrying conductor is proportional to

A. the square of the current
B. the current
C. square of resistance
D. none of these

46. One advantage of the moving coil instrument is that its scale is

A. non-linear
B. linear
C. both A and B
D. neither A or B

47. Which of the following cannot be used as a medium for extinguishing the arc of a CB?

A. vacuum
B. SF_6 gas
C. water
D. open air

RME Board April 1996, RME Board October 1996

48. Meter accuracy is determined by

A. full scale deflection
B. one fourth of full scale deflection
C. zero deflection
D. half scale deflection

49. In DC circuit, inductance and capacitance are irrelevant in circuit analysis due to

A. DC supply has no frequency
B. they do not exist in DC circuits
C. there effect is useless in DC circuits
D. all of these

50. A three-layer semi-conductor device.

A. Potentiometer
B. Diode
C. Transistor
D. Vacuum tube

TEST 10

PHILIPPINE ELECTRICAL CODE

1. Stage equipment like footlights, border lights and others shall be so arranged that no branch circuit supplying such equipment will carry a load exceeding ___.

A. 20 A
B. 15 A
C. 30 A
D. 10 A

2. Metal poles ____permitted to be used to support lighting fixture and enclosed supply conductors.

A. shall be
B. shall not be
C. both A and B
D. neither A or B

RME Board October 1995

3. Which of the raceway methods is NOT allowed to be used in a hazardous location?

A. Rigid metal conduit
B. Liquidtight flexible metal conduit
C. Rigid non-metallic conduit
D. None of these

4. How many side(s) of any pull box shall be removable?

A. Only one side
B. Two opposite sides
C. Two adjacent sides
D. One or more sides

5. Dimmers installed in ungrounded conductors shall be protected by OCPD not exceeding ____ percent of their rating.

A. 100
B. 115
C. 125
D. 150

6. Mobile home service equipment shall be rated NOT less than ___.

   A. 90 A
   B. 60 A
   C. 100 A
   D. 125 A

RME Board April 1996

7. The branch circuit conductors that supply one or more units of data processing systems shall have an ampacity NOT less than ____ percent of the total connected load.

   A. 150
   B. 100
   C. 125
   D. 200

8. Locations which are hazardous because of the presence of easily ignitable fibers of flyings.

   A. Class I
   B. Class II
   C. Class III
   D. Class IV

9. Where nails or screws are used to mount knobs, they shall be of a length sufficient to penetrate the wood to a depth equal to at least ____ the height of the knob.

   A. two-third
   B. three-fourth
   C. one-half
   D. one-third

RME Board April 1996

10. Explosion hazards exist due to the presence of the following material EXCEPT one. Which one is this?

    A. Combustible dust
    B. Flammable vapors
    C. Flammable liquids
    D. Carbon dioxide gas

11. Metal clad cables shall be supported and secured at intervals NOT exceeding

    A. 1500 mm
    B. 1800 mm
    C. 1600 mm
    D. 2000 mm

12. The ampacities of type UF (underground feeder) cable shall be that of the ___ conductors.

    A. 60 °C
    B. 75 °C
    C. 90 °C
    D. 40 °C

RME Board October 1995

13. Some of the principal factors that affect the operating temperature of a cable are the following EXCEPT one. Which one is this?

    A. Voltage
    B. Ambient temperature
    C. Ventilation
    D. Load current

14. Communication wires and cables shall have a voltage rating of NOT less than

    A. 300 V
    B. 250 V
    C. 500 V
    D. 600 V

15. Self-excited generators supplying power to organs shall have a potential of NOT more than ____.

    A. 15 V
    B. 24 V
    C. 30 V
    D. 60 V

RME Board April 1995

16. What is the temperature rating of THHN insulation?

    A. 60 °C
    B. 90 °C
    C. 85 °C
    D. 75 °C

17. All AC squirrel cage motors and synchronous motors with autotransformer starting shall have an overcurrent protective device using inverse time circuit breaker with a maximum setting of ____ of its full load current rating.

    A. 250 %
    B. 150 %
    C. 300 %
    D. 200 %

18. Rosettes for use with conduit boxes or raceway shall have bases high enough to keep wire and terminals at least _____ from the surface wired over.

A. 12 mm
B. 10 mm
C. 13 mm
D. 15 mm

19. No motor circuit in any watercraft shall have conductors less than

A. 5.5 mm^2
B. 3.5 mm^2
C. 2.0 mm^2
D. 1.25 mm^2

RME Board April 1995

20. Sizes of building wires manufactured in the Philippines are standardized in square millimeters. What is the area of copper conductor, which is next larger than 8 square millimeters?

A. 12 mm^2
B. 10 mm^2
C. 14 mm^2
D. 9 mm^2

21. Flexible cords or data processing cables used to connect computer units shall be ___ as part of the system.

A. isolated
B. approved
C. both A and B
D. neither A or B

22. Branch circuits to receptacles under raised floors in computer rooms shall be wired with

A. EMT
B. IMC
C. AC cable
D. all of these

23. As to the general rule, floating buildings shall be supplied by _____set(s) of feeder conductors from their service equipment.

A. one
B. two
C. three
D. all of these

RME Board October 1994

24. Which of the following electric wires has the highest ampacity?

A. 5.5 mm^2
B. 8.0 mm^2
C. 30 mm^2
D. 50 mm^2

25. Indoor antennas and indoor lead-in conductors shall NOT be run nearer than ___ to conductors of other wiring systems in the premises.

A. 40 mm
B. 30 mm
C. 60 mm
D. 50 mm

26. The ampacity of the neutral conductor of a dual voltage feeder shall be ___ of the ampacity of the ungrounded conductors.

A. 125 %
B. 150 %
C. 200 %
D. 100 %

RME Board October 1996

27. According to the PEC, the minimum insulation level for neutral conductors of residential installations, which have solidly grounded system, shall NOT be less than this voltage, which one is this?

A. 1,000 volts
B. 300 volts
C. 600 volts
D. 750 volts

28. Exit lights on watercrafts shall be provided at each point. The word "EXIT" shall be red letters not less than ___ high.

A. 50 mm
B. 60 mm
C. 64 mm
D. 40 mm

29. The nominal voltage used in elevator, dumbwaiter, escalator and moving walk driving machine motors, machine brakes and motor-generator sets shall NOT exceed

A. 1,000 V
B. 500 V
C. 600 V
D. 300 V

30. A cable made-up of electric conductors which provides electrical connection between an elevator or dumbwaiter car and fixed outlet in the hoistway.

A. Coaxial cable
B. Metal-clad cable
C. Flat-conductor cable
D. Traveling cable

31. What is the minimum weight of a fixture that requires a support that is independent of the outlet box?

A. 20 kg
B. 25 kg
C. 23 kg
D. 24 kg

32. For single phase AC or DC motors supplied by a two wire, single phase AC or DC with one conductor grounded how many overload units shall be required? s

A. One, in the grounded conductor
B. One, in the ungrounded conductor
C. Two, in both conductors
D. No overload units required

RME Board April 1996

33. What is the insulation resistance acceptable by the Philippine Electrical Code for 600-V circuits consisting of 2.0 mm^2 conductor?

A. 250,000 ohms
B. 750,000 ohms
C. 500,000 ohms
D. 1,000,000 ohms

34. Each patient bed location shall be provided with a minimum of how many receptacles?

A. 4
B. 2
C. 3
D. 5

35. Open conductors on insulators shall be separated at least ____ from metal raceways, piping or other conducting materials.

A. 50 mm
B. 60 mm
C. 70 mm
D. 40 mm

36. The nominal gas pressure used in type IGS cable shall be

A. 200 kPa
B. 150 kPa
C. 138 kPa
D. 140 kPa

37. Smallest size of EMT (electrical metallic tubing)

A. 20 mm
B. 15 mm
C. 10 mm
D. 12 mm

38. The use of non-metallic raceway shall be permitted in ____

A. wet locations only
B. dry locations only
C. both A and B
D. neither A or B

RME Board October 1995

39. Metal clad cables shall be permitted for installations in the following locations EXCEPT one. Which one is this?

A. Signal circuits
B. Branch circuits
C. Direct burial in the earth
D. Aerial cable

40. One set of service entrance conductors shall be permitted to supply more than ___ set(s) of service equipment.

A. one
B. two
C. three
D. none of these

41. It is known in the field as PVC.

A. Rigid metal conduit
B. Flexible non-metallic conduit
C. Rigid non-metallic conduit
D. Cable tray

42. Concealed knob and tube wiring shall be supported within ____ of each side of each tap or splice.

A. 150 mm
B. 125 mm

C. 100 mm
D. 200 mm

RME Board October 1996

43. A 15-A or a 20-A branch circuit shall be permitted to supply lighting units and other utilization devices. The rating of any one cord and plug connected appliance shall NOT exceed a certain percentage of the branch circuit rating. What is this percentage?

A. 80 %
B. 90 %
C. 70 %
D. 60 %

44. Receptacles located on stages in theaters shall NOT exceed ____ percent of their ratings for continuous duty loads.

A. 50
B. 60
C. 70
D. 80

45. Lighting fixtures exposed to cleansing water in agricultural buildings shall be __

A. drip proof
B. watertight
C. waterproof
D. any of these

46. A metal raceway of circular cross section with integral or associated couplings, connectors and fittings approved for the installation of electrical conductors.

A. Rigid metal conduit
B. Surface metal raceway
C. Electrical metallic tubing
D. Intermediate metal conduit

47. Rigid metal conduit and intermediate metal conduit when used underground shall have a minimum burial of _____

A. 100 mm
B. 200 mm
C. 250 mm
D. 150 mm

48. Storage batteries used, as source of power for emergency system shall maintain a voltage applied to the load without falling below a certain percentage of normal value. What is this percentage?

A. 95.3 %

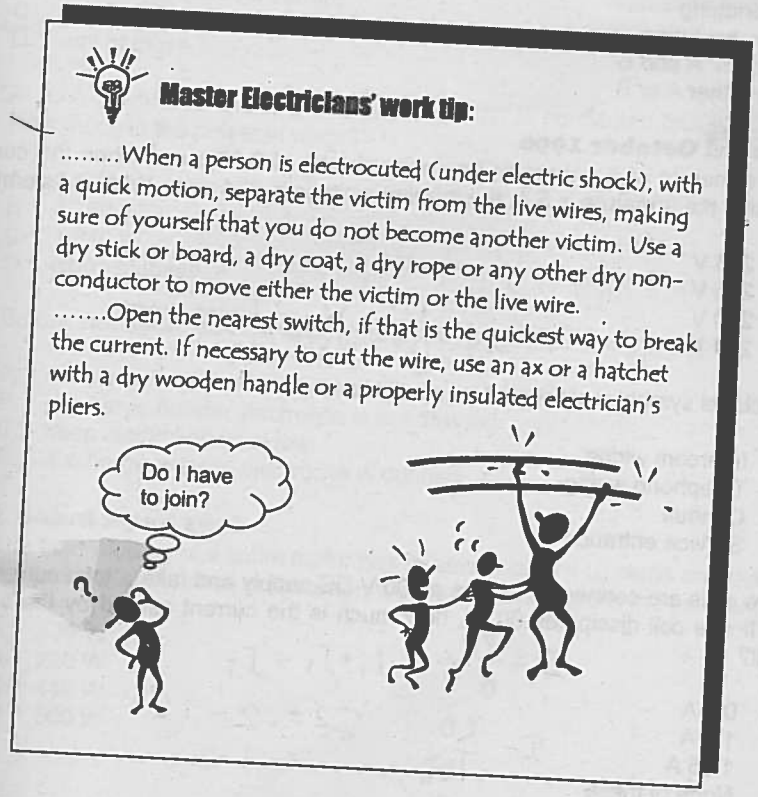
A. 87.5 %
B. 84.2 %
C. 93.7 %

49. Driven rods maybe used as a grounding electrodes provided the driven dept shall NOT be less than

A. 2,000 mm
B. 2,450 mm
C. 2,540 mm
D. 2,040 mm

50. An enclosed channel designed expressly for holding wires, cables or busbars with additional functions as permitted.

A. Cage
B. Cabinet
C. Junction box
D. Raceway



TEST 11

TECHNICAL SUBJECT

1. Copper when exposed to ordinary atmospheres becomes oxidized turning into a ____ color.

   A. brown
   B. light gray
   C. light orange
   D. black

2. A shorted capacitor can be checked by

   A. bridging
   B. substitution
   C. both A and B
   D. neither A or B

RME Board October 1996

3. The armature of a generator has a resistance of 0.20 ohm. When the current through the armature is 5 A, the terminal voltage is 224 volts. What is its emf?

   A. 226 V
   B. 225 V
   C. 230 V
   D. 224 V

4. Electrical symbol represented by a solid line.

   A. Intercom wiring
   B. Telephone wiring
   C. Conduit
   D. Service entrance

5. Two coils are connected across a 100 V DC supply and take a total current of 2 A. If one coil dissipates 80 W, how much is the current carried by the second coil?

   A. 0.8 A
   B. 1.0 A
   C. 1.25 A
   D. None of these

RME Board October 1994

6. If the number of turns in an inductor is increased, its inductance will

   A. vary
   B. decrease
   C. increase
   D. remain the same

7. Two capacitors connected in parallel across a 250 V mains have charge 3,000 and 5,000 μC, respectively. Find the total capacitance of the combinat

   A. 60 μF
   B. 32 μF
   C. 43 μF
   D. None of these

RME Board April 1996

8. How can the polarity of a DC generator be reversed?

   A. reversing the field current as well as rotation
   B. increasing the field current
   C. reversing the field current
   D. any of these

9. A 10-A electric fan with a power factor of 80% is connected to a 230-V sou How much is the power in watts?

   A. 2,300 W
   B. 1,760 W
   C. 1,840 W
   D. None of these

10. Before storing a lead-acid battery for a long time, the battery should be

    A. discharge and covered with canvas
    B. discharge but the electrolyte is not drained
    C. keep electrolyte level low
    D. discharge and the electrolyte is drained

RME Board April 1996

11. The field winding of a shunt motor has a resistance of 110 ohms and the volta applied is 220 V. What is the amount of power expended in the field excitatio

    A. 330 W
    B. 220 W
    C. 440 W
    D. 500 W

12. A 50-ohm relay is connected in series with a 30-ohm resistor. If the whole combination is connected across a 110-V DC supply. Determine the voltage across the relay.

    A. 68.75 V
    B. 76.58 V
    C. 41.25 V
    D. 33.42 V

13. Device used to increase or decrease in one step the value of field excitation of a generator.

    A. Field regulator
    B. Reclosing relay
    C. Field changing contactor
    D. Unit sequence starting relay

RME Board October 1995, RME Board April 1996

14. At absolute zero temperature a semi-conductor behave as a

    A. good conductor
    B. variable resistor
    C. good insulator
    D. super conductor

15. A substance that cannot be decomposed any further by chemical action.

    A. Molecule
    B. Compound
    C. Atom
    D. Element

16. Relay which functions on failure of the insulation of a machine to ground.

    A. Grounding reactor relay
    B. Ground protective relay
    C. Ground insulation relay
    D. None of these

17. Three parallel branches of 10, 20 and 30 ohms respectively are connected across a 60-V DC supply. How much is the total power consumed by these resistors?

    A. 600 W
    B. 606 W
    C. 660 W
    D. 560 W

18. Simplest form of a motor controller.

    A. Magnetic contactor
    B. Toggle switch
    C. Drum switch
    D. Relay

RME Board October 1996

19. A small swamping resistance is fit in series with the operating coil of a mov coil ammeter to compensate for the effects of

    A. external magnetic fields
    B. temperature variation
    C. hysteresis loss
    D. none of these

RME Board October 1994

20. A megohm is connected to the ends of a motor winding what will a low o reading indicate?

    A. Continuity
    B. Loose coil
    C. Open coil
    D. Dirty coil

21. Typical output of a solar cell.

    A. 0.10 V
    B. 0.25 V
    C. 0.50 V
    D. 0.35 V

RME Board October 1994

22. The process by which one conductor produces or induces a voltage in anoth conductor even though there is no mechanical coupling between the t conductors.

    A. Cutting of fluxes
    B. Short circuit
    C. Induction
    D. System

23. If an electronic device will hum, the most likely caused is a defective

    A. transistor
    B. filter
    C. diode
    D. amplifier

24. The purpose of the commutator in a DC motor is

    A. to rectify the armature current

B. to magnify the armature current
C. to invert the armature current
D. to control the armature current

25. A capacitor opposes any change in _____.

A. current
B. voltage
C. resistance
D. flux

26. This tool is used by lineman to remove insulation of large cables

A. Wire stripper
B. Lineman's pliers
C. Wire gauge
D. Electrician's knife

27. The rating of a storage battery is expressed in

A. ampere-hours
B. watts
C. kilowatt-hours
D. volt-amperes

28. Resistance offered by the active material of a cell.

A. Bulk resistance
B. Internal resistance
C. Absolute resistance
D. Specific resistance

RME Board April 1996

29. For excessive heat in the end play of a fractional horsepower motor the possible remedy is to

A. align pulleys correctly
B. add end play washers
C. replace end play bolts
D. adjust belt tension

30. If the heat in a motor increases, which of the following is a probable cause?

A. Repeated jogging or plugging the motor
B. Long periods of overload
C. Both A and B
D. Neither A or B

31. The power factor of a synchronous motor is

A. lagging
B. leading
C. unity
D. zero

RME Board April 1994

32. A 200-V lamp has a hot resistance of 400 ohms. The power rating in watts of lamp is

A. 100 W
B. 200 W
C. 600 W
D. None of these

33. Which of the following DC generator has a terminal voltage that varies wic with changes in load current?

A. Shunt generator
B. Series generator
C. Cumulative compound generator
D. Flat compounded generator

RME Board October 1996

34. Which of the following constitutes the major load for an automobile battery?

A. brake light
B. self-starter
C. parking lights
D. spark plug

35. Alternator synchronization means

A. connecting alternators in parallel
B. connecting alternators in series
C. adjustment in field excitations
D. load sharing between alternators

36. One foot-candle is equivalent to how many lux?

A. 107.6
B. 10.76
C. 1.076
D. None of these

37. Ampere per volt is the same as

A. erg
B. siemen
C. maxwell
D. none of these

38. Copper is a highly malleable and ductile metal with _____color?

A. amber
B. brown
C. bluish-white
D. reddish

39. Most common copper busbar form for carrying heavy current.

A. Round
B. Stranded
C. Channel
D. Flat

RME Board October 1995

40. If the allowable current in a copper bus bar is 1000 amperes per square inch of cross section, the width of a standard 1/4 bus bar designed to carry 1,500 A would be?

A. 4 inches
B. 6 inches
C. 8 inches
D. 2 inches

41. The capacitance of a capacitor is directly proportional to

A. area of its plate
B. thickness of dielectric
C. both A and B
D. neither A or B

42. Which of the following acts a depolarizer in a carbon-zinc cell?

A. Carbon-graphite
B. Silver-zinc
C. Nickel-iron
D. Manganese-dioxide

43. The frame of a DC generator or a motor is made of what metal?

A. Soft iron
B. Aluminum
C. Cast steel
D. Hard drawn copper

44. Refers to the generator's mechanical driver.

A. Exciter
B. Prime mover
C. Coupler

D. Transducer

45. Unit of conductance.

A. Gauss
B. Mho
C. Ohm
D. None of these

RME Board October 1995

46. Contamination of transformer oil is because of

A. moisture
B. heating
C. decomposition of oil
D. all of these

47. The armature core of DC machine is laminated to reduce the

A. copper windings needed
B. eddy current loss
C. hysteresis loss
D. weight of the armature

48. Circuit element used to resonate with capacitors.

A. Resistors
B. Transistors
C. Inductors
D. Diodes

RME Board October 1994

49. In a series circuit, the current is

A. proportional to the resistance
B. different in different resistors
C. constant
D. none of these

50. In star-delta starters, at starting the motor is connected in ____ configuration.

A. wye
B. delta
C. delta-wye
D. wye-delta

TEST 12

PHILIPPINE ELECTRICAL CODE

1. The bonding conductor used in agricultural buildings shall be copper, insulated, covered or bare, NOT smaller than _____.

   A. 8.0 mm^2
   B. 5.5 mm^2
   C. 14.0 mm^2
   D. 3.5 mm^2

2. In any watercraft, the motor circuit shall have an ampacity of NOT less than ___ of the motor's full load current rating.

   A. 125 %
   B. 100 %
   C. 115 %
   D. 130 %

RME Board October 1994

3. The largest size of electrical metallic tubing is

   A. 75 mm
   B. 125 mm
   C. 150 mm
   D. 100 mm

4. The overload relay used to protect each motor-compressor set shall be selected to trip at NOT more than ____ of the motor-compressor rated load current.

   A. 125 %
   B. 130 %
   C. 150 %
   D. 140 %

RME Board October 1994

5. Lamp protection shall be provided by elevation of at least ___meters from the normal working surface.

   A. 2
   B. 1
   C. 2.5
   D. 3

6. Type UF cables shall NOT be used ____.

   A. as branch circuits
   B. as service entrance
   C. as direct burial to earth
   D. all of these

7. Where "U" pulls are made on the pull box, the distance between each race entry inside the box and the opposite wall of the box shall NOT be less than times the trade diameter of the largest raceway in a row.

   A. 8
   B. 7
   C. 6
   D. 5

8. Reference ambient temperature for explosion proof electrical equipment shal ___ degree Celsius.

   A. 30
   B. 40
   C. 50
   D. 60

9. Welding process wherein coalescence is produced by heating with an elec arc with or without the application of pressure and with or without the use of f metal.

   A. Resistance welding
   B. Spot welding
   C. Arc welding
   D. All of these

RME Board April 1995

10. The use of underground feeder cables may NOT be used in the follow conditions EXCEPT one. Which one is this?

    A. Embedded in concrete
    B. Hazardous location
    C. Direct burial
    D. Theaters

11. Faceplates of insulating material shall be non-combustible and not less than _ in thickness.

    A. 2.5 mm
    B. 1.5 mm
    C. 2.0 mm
    D. 3.0 mm

12. Conductors supplying two or more motors shall have an ampacity equal to the sum of the FLA rating of all motors plus ____ of the highest motor FLA in the group.

    A. 30 %
    B. 15 %
    C. 20 %
    D. 25 %

RME Board April 1995

13. Which of the following colors identifies the grounded conductor of a branch circuit?

    A. Green
    B. Black
    C. White
    D. Blue

14. An enclosure of porcelain or other insulating material, fitting with terminals and intended for connecting the flexible cord carrying a pendant to the permanent wiring.

    A. Rosette
    B. Raceway
    C. Cable bus
    D. None of these

15. Receptacles installed for the attachment of portable cords shall be rated at NOT less than ____, 250 V.

    A. 20 A
    B. 30 A
    C. 10 A
    D. 15 A

16. Motors with a marked service factor of less than 1.15 shall have an overload protection equal to ____percent of the motor's FLA.

    A. 100
    B. 125
    C. 120
    D. 115

17. Cables and cords supplied through plugging boxes shall be of

    A. aluminum
    B. copper
    C. aluminum or copper
    D. copper-clad aluminum

RME Board October 1995

18. Which of the following statements is NOT correct?

    A. Overcurrent devices shall be located where they will not be exposed to physical damage
    B. Overcurrent devices shall be readily accessible
    C. Overcurrent devices may be located inside clothes closets
    D. In a multi-family dwelling, each occupant shall have ready access to all overcurrent devices protecting his occupancy

19. A conductor or group of conductors, in switchgear assemblies which serves as a common connection for two or more circuits.

    A. Bus
    B. Lug
    C. Cut-out
    D. Terminal block

20. The ampacity of capacitor circuit conductors shall NOT be less than ____ of the rated current of the capacitor.

    A. 125 %
    B. 115 %
    C. 135 %
    D. 150 %

21. The alternate or back-up source of power in a hospital shall have a capacity to sustain its connected loads for a minimum of ___ .

    A. 1.5 hours
    B. 2.0 hours
    C. 1.0 hour
    D. 2.5 hours

22. Cable trays shall NOT be used in _____.

    A. hoistways
    B. industrial establishments
    C. dry locations
    D. all of these

23. The load for the required branch circuit installed for the supply of exterior signs or outline lighting shall be computed at a minimum of ____ volt-amperes.

    A. 1,000
    B. 1,200
    C. 1,500
    D. 1,600

RME Board April 1996

24. The usual function of a disconnect switches in high voltage circuits is to

A. isolate from energized buses, equipment which are not in service
B. open or close the circuit under load
C. open the circuit in the event of an overload
D. maintain continuity of service

25. Pendant conductors where not cabled and longer than a certain length shall be twisted. What length is this?

A. 1,000 mm
B. 900 mm
C. 600 mm
D. 800 mm

26. The ampacity of the phase conductors from the generator terminals to the first overcurrent device shall NOT be less than ___ percent of the nameplate current rating of the generator.

A. 125
B. 110
C. 115
D. 120

RME Board October 1994

27. What is the maximum number of conductors permitted in a wireway at any cross-section, signal circuit or starter-control wires are not included?

A. 30 conductors
B. 50 conductors
C. 40 conductors
D. 25 conductors

28. Each motor shall be provided with how many disconnect(s)?

A. Two
B. Any number (optional requirement)
C. Only one
D. Not required by the PEC

29. Energized parts of a generator operated at more than ____ volts to ground shall NOT be exposed to accidental contact where accessible to unqualified persons.

A. 50
B. 30
C. 48
D. 60

30. A hoisting and lowering mechanism equipped with a car or platform w moves in guides in a substantially vertical direction and which serves tw more floors of a building or structure.

A. Dumbwaiter
B. Escalator
C. Elevator
D. All of these

31. An assembly of a flexible cord with an attachment plug on one end and a connector on the other.

A. Extension cord
B. Fixture cord
C. Appliance cord
D. None of these

32. Any box not over ____ cm^3 in size, intended for mounting in closed buil construction shall be affixed with anchors or clamps as to provide a rigid secure installation.

A. 1,540
B. 1,760
C. 1,800
D. 1,640

33. In battery rooms with alkaline batteries, the shelves shall be lined with s sheet NOT less than ____ thick.

A. 70 mm
B. 60 mm
C. 65 mm
D. 75 mm

34. A disruptive discharge around or over the surface of a solid or liquid insulator.

A. Sparkover
B. Corona
C. Flashover
D. Skin effect

35. Emergency lighting of ____ lux shall be provided in exit paths from all areas attended stations.

A. 10
B. 20
C. 30
D. 15

RME Board April 1994

36. An overheated cord often indicates

A. defective cord
B. corroded terminals
C. corroded terminals and defective cord
D. none of these

37. Individual arrester grounding conductors shall be no smaller than ____ copper.

A. 8.0 mm^2
B. 14 mm^2
C. 5.5 mm^2
D. none of these

38. A generic term for an artificial source of light.

A. Lumen
B. Lux
C. Candle
D. Lamp

39. Cable bus shall be securely supported at intervals NOT exceeding

A. 3,600 mm
B. 3,000 mm
C. 3,800 mm
D. 4,000 mm

40. Snap switches used with open wiring on insulators shall be mounted on insulating material that separates the conductors at least ____ from the surface wired over.

A. 12 mm
B. 10 mm
C. 11 mm
D. 13 mm

RME Board April 1996

41. The usual nameplate data on DC motors include the following EXCEPT one. Which one is this?

A. Manufacturer's name
B. Rated frequency
C. Rated voltage
D. Rated speed

42. Vertical runs of wireways shall be securely supported at intervals NOT exceeding _____.

A. 4,000 mm
B. 2,400 mm
C. 3,600 mm
D. 4,500 mm

43. Size 0.75 mm^2 fixture wire has an ampacity of

A. 6 A
B. 10 A
C. 4 A
D. 8 A

44. Type MI cable shall NOT be used ____.

A. in dry, wet or continuously moist locations
B. where exposed to destructive corrosive conditions
C. for services, and feeders
D. all of these

45. Each receptacle for DC plugging boxes shall be rated at NOT less than ____.

A. 20 A
B. 30 A
C. 15 A
D. 40 A

RME Board October 1995

46. Insulated ground conductor of 14 mm^2 or smaller shall be identified by a continuous white outer finish along its entire length or another color which is

A. green
B. natural gray
C. striped green
D. striped white

47. Metal covers for boxes shall be lined with firmly attached insulating material not less than ____ in thickness.

A. 0.80 mm
B. 0.50 mm
C. 0.75 mm
D. 0.64 mm

48. Electrical non-metallic tubing shall NOT be used where the voltage is over

A. 500 V
B. 230 V
C. 300 V
D. 600 V

49. Busways shall be marked with which of the following?

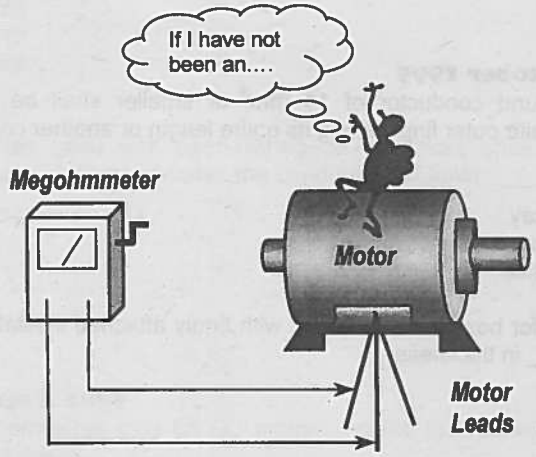
A. voltage rating
B. manufacturer's name
C. current rating
D. all of these

50. The system neutral conductor shall not be connected to ground EXCEPT

A. when the generator frame is not grounded
B. through the grounding impedance
C. through a grounding transformer
D. when a ground fault is very common

Master Electricians' work tip:

.....To test a motor for an open circuit, connect the terminals of the megohmmeter to each pair of phases of the motor. An open motor will show a high reading on the megohmmeter.



TEST 13

TECHINCAL SUBJECT

1. Most commonly used cell.

A. Silver-zinc
B. Lead-acid cell
C. Nickel-iron cell
D. Lithium cell

RME Board April 1996

2. _____ instruments are most sensitive.

A. Permanent magnet moving coil
B. Dynamometer
C. Moving iron
D. Hot wire

3. Two resistances of 5 and 10 ohms respectively, are connected in series with each other. If a 20-ohm resistance is connected across the series combination, how much is the total current drawn by the whole circuit if connected across a 120-V source?

A. 11.25 A
B. 10.5 A
C. 12 A
D. 14 A

$$\frac{R(R_2+R_3)}{R+(R_2+R_3)}$$

4. In a series circuit, the total resistance is _____.

A. the sum of the reciprocals of all resistances
B. the average of all resistances
C. the sum of all resistances
D. smaller than the smallest resistance

5. When using Ohm's law "IR" would solve for _____.

A. amperage
B. resistance
C. electrical power
D. voltage

6. In order to measure power in a 3-phase, 4-wire unbalanced load, the minimum number of wattmeter(s) needed shall be ____

   A. two
   B. three
   C. four
   D. one

7. The ratio of real power to apparent power is called _____.

   A. plant factor
   B. utilization factor
   C. factor of safety
   D. power factor

RME Board April 1994

8. A fluorescent lamp unit connected to a 110-V AC line takes 1.20 A and requires 110 W power. What is its power factor?

   A. 0.9
   B. 0.833
   C. 0.866
   D. 0.8

9. Electrons normally flow

   A. from the positive to the negative terminals of the battery
   B. from the negative to the positive terminals of the battery
   C. either A or B
   D. neither A or B

10. A coil of wire placed in the armature core used to fill up the vacant slots but which is not connected to the armature windings.

    A. Damping coil
    B. Auxiliary coil
    C. Dummy coil
    D. Compensating coil

RME Board October 1994

11. International ohm is defined in terms of resistance of

    A. a cube of carbon
    B. a column of mercury
    C. a cube of copper
    D. a unit length of metal wire

12. If the energy stored in a 0.125 μF capacitor id 50 J, solve for the charge accumulated.

    A. 3.35 mC
    B. 2.50 mC
    C. 1.25 mC
    D. None of these

13. An electric heater uses 20 kW-hr in 8 hours. If the voltage across the heater is 240 volts. What is the heater resistance?

    A. 2.5 Ω
    B. 83.3 Ω
    C. 23.04 Ω
    D. None of these

$P = \frac{W}{t} = \frac{20}{8} = 2.5\,kW = 2500\ W$

$R = E^2/P = \frac{240^2}{2500}$

14. A three phase load is balanced if all three phases have the same

    A. impedance
    B. power factor
    C. both A and B
    D. neither A or B

15. Unit of electrical current flow.

    A. Ampere
    B. Coulomb
    C. Weber
    D. Volt

RME Board April 1994

16. Ohm's law is applicable to

    A. electric arcs
    B. gas discharge lamps
    C. rectifying devices
    D. none of these

17. Capacitors are used to

    A. filter AC currents and pass DC currents
    B. filter AC and DC currents
    C. filter DC currents and pass AC currents
    D. pass DC and AC currents

18. The hot resistance of a 230-V incandescent lamp is 300 ohms. What current is required to operate the lamp?

    A. 0.85 A
    B. 0.77 A
    C. 1.30 A
    D. 0.74 A

$I = \frac{E}{R} = \frac{230}{300} = 0.76666$

19. Alternator voltage can be increased by _____.

A. decreasing the prime mover speed
B. increasing the field circuit rheostat
C. increasing the prime mover speed
D. increasing the armature resistance

20. One joule of electrical energy is equivalent to

A. one watt-second
B. one watt-minute
C. one kilowatt-hour
D. one watt per second

RME Board April 1995

21. What voltage would be required to produce a flow of 10 A through a resistance of 12 ohms?

A. 125 V
B. 122 V
C. 121 V
D. 120 V

22. The shunt of an ammeter is made from

A. copper
B. silver
C. manganese
D. manganin

23. The advantage of a wye-connected system is that _____.

A. the line currents and phase currents are equal
B. it is easy to troubleshoot due to it's a simple arrangement
C. two voltages can be used
D. none of these

RME Board April 1994, RME Board October 1995

24. The number of coils in a megger is

A. two
B. four
C. one
D. three

25. The resistance of coil of wire is 30 ohms. How much power is dissipated in the coil if connected across a 115-V source?

A. 441 W
B. 280 W

C. 580 W
D. 450 W

26. A wire in the American wire gauge has a conductor radius of 0.1823 inch. What is its area in circular mils?

A. 133 MCM
B. 13.3 MCM
C. 0.133 MCM
D. None of these

27. PVC is a widely used insulation or jacketing on communication wires control cable, bell wire, building wire, appliance cord, etc. What do you mean by PVC?

A. Propylene chloride
B. Polyethylene chloride
C. Polyester chloride
D. Polyvinyl chloride

RME Board April 1994

28. The number of cycles of an AC voltage is known as

A. frequency
B. wave form
C. phase angle
D. half mode

29. Type of overload that contains a solder pot.

A. Bimetallic
B. Metallic
C. Melting alloy
D. Magnetic

30. The direction of rotation of a capacitor-start induction motor can be reversed by reversing

A. the starting winding leads
B. the running winding leads
C. either A or B
D. neither A or B

31. Washing machines usually uses what type of motor?

A. Shaded-pole motor
B. Resistance split-phase motor
C. Hysteresis motor
D. Compound motor

RME Board April 1995

32. An AC circuit has a resistance of 4 ohms and a reactance of 3 ohms. What is the impedance?

    A. 7 ohms
    B. 5 ohms
    C. 12 ohms
    D. none of these

$Z = \sqrt{R^2 + X^2}$
$= \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25}$

33. A synchronous motor is excited with

    A. an AC current
    B. a DC current
    C. a combination of AC and DC currents
    D. none of these

34. Three resistors of 100, 120 and 150 ohms are connected in parallel. Determine the value of the current to the parallel system which will make the current in the 150-ohm resistance equal to 1.0 A.

    A. 4.00 A
    B. 5.25 A
    C. 3.15 A
    D. 3.75 A

35. Two loads with equal resistances are connected in parallel across a certain supply. If these loads are reconnected in series across the same supply, then __

    A. the power drawn by each will be decreased by 75 %
    B. the power drawn by each will be decreased by 25 %
    C. the power drawn by each will be decreased by 50 %
    D. none of these

36. A cell supplies a load current of 0.5 A for a period of 20 hours until its terminal voltage falls to an unacceptable level. How long it could be expected to supply a current of 100 mA?

    A. 50 hours
    B. 100 hours
    C. 60 hours
    D. 70 hours

37. If the resistance of the circuit is doubled while the applied voltage is held constant. The current will _____.

    A. increase by half as much
    B. remains the same
    C. decrease to half as much
    D. twice as much

RME Board April 1996

38. Lubrication is never used on

    A. a commutator
    B. a knife switch
    C. a cutting die when threading
    D. wire being pulled into a conduit

39. If an atom has less than 4 valence electrons, the material is _____.

    A. an insulator
    B. a semi-conductor
    C. a super conductor
    D. a conductor

40. Capacitance to ground is sometimes called _____capacitance.

    A. dielectric
    B. image
    C. skin
    D. stray

41. A rheostat is used to regulate the current in a circuit by

    A. varying the voltage of the circuit
    B. varying the power factor of the circuit
    C. varying the resistance of the circuit
    D. all of these

42. How can a short circuit be detected?

    A. By using an ohmmeter
    B. By using a megger
    C. By using an oscilloscope
    D. By using an ammeter

RME Board October 1994

43. Resistance commonly used in power circuits.

    A. Carbon composition
    B. Wire wound resistors
    C. Deposited film resistors
    D. Etched circuit resistors

44. An ideal current source has a _____ internal resistance.

    A. very low
    B. negative
    C. very high
    D. any of these

45. An AC circuit has impedance of 4.47 ohms. If the circuit resistance is 2 ohms, what is the reactance of the circuit?

$2 = \sqrt{R^2 + X^2}$

$X = \sqrt{Z^2 - R^2}$

$X = \sqrt{4.47^2 - 2^2}$

A. 4 ohms
B. 6 ohms
C. 5 ohms
D. 3 ohms

46. The physical of a resistor that determines its ability to dissipate heat is rated in

A. amperes
B. ohms
C. volts
D. watts

47. Solutions that are used in batteries are called _____.

A. pastes
B. catalyst
C. compounds
D. electrolytes

48. Insulators are commonly made from

A. mica
B. porcelain
C. ceramic
D. all of these

49. Which of the following is a basic requirement for inducing an emf in a coil of wire?

A. The flux should link the coil.
B. The coil should form a closed loop.
C. There should be a change in flux linking the coil
D. All of these

RME Board April 1995

50. A 3-ohm resistor and a 6-ohm resistor are connected in series across a DC supply. If the voltage drop across the 3-ohm resistor is 4 V, what is the voltage of the supply?

A. 6 volts
B. 8 volts
C. 18 volts
D. 12 volts

TEST 14

PHILIPPINE ELECTRICAL CODE

RME Board April 1996

1. When thermal overload relay are used for the protection of a three-phase induction motor, their primary purpose is to protect the motor in case of

A. short circuit between lines
B. reversal of phase sequence
C. high voltage
D. sustained overload

2. In type AC cable, all bends shall be made so that the cable will not be damage and the radius of the curve of the inner edge of any bend shall NOT be less than ____ times the diameter.

A. 4
B. 5
C. 6
D. 3

3. Non-metallic sheathed cable shall be supported within ____ from every cabinet, box or fitting.

A. 150 mm
B. 200 mm
C. 250 mm
D. 300 mm

RME Board April 1995

4. What is the nominal supply voltage specified by the Philippine Electrical Code for residential homes?

A. 225 volts AC
B. 230 volts AC
C. 240 volts AC
D. 220 volts AC

5. Messenger supported wiring shall NOT be used in ____.

A. hoistways
B. multi-conductor underground feeder
C. metal clad cable

D. all of these

6. Temporary electrical power and lighting installations shall be permitted for a period not to exceed _____ for Christmas decorative lighting, carnivals and similar purposes.

   A. 100 days
   B. 120 days
   C. 90 days
   D. 60 days

7. Which of the following conductors is NOT applicable on wet locations?

   A. Type THHN
   B. Type THW
   C. Type RHW
   D. Type THWN

8. A surge of unidirectional polarity.

   A. Skin effect
   B. Corona
   C. Flashover
   D. Impulse

9. For each small appliance branch circuit, the feeder load shall be ____ per 20 A circuit.

   A. 1,000 VA
   B. 1,200 VA
   C. 1,500 VA
   D. 1,800 VA

RME Board October 1995

10. The electrical plans for residential house include the following items EXCEPT one. Which one is this?

    A. Substation plan
    B. Location plan
    C. Floor plan showing location of service
    D. Layout of wiring plan for general lighting and receptacle outlets

11. Tools and portable handlamps likely to be used in wet and conductive locations shall not be required to be grounded where supplied through an isolating transformer with an ungrounded secondary of not more than ____.

    A. 100 V
    B. 150 V
    C. 50 V
    D. none of these

12. The minimum size of branch circuit capacity to supply laundry receptacle outlets shall be ___.

    A. 20 A
    B. 15 A
    C. 25 A
    D. 30 A

13. Conductors in open wiring on insulators shall be rigidly supported within ___ from a tap or splice.

    A. 200 mm
    B. 100 mm
    C. 250 mm
    D. 150 mm

14. Main and equipment bonding jumper shall of ____.

    A. copper
    B. aluminum
    C. both A and B
    D. neither A or B

15. The minimum insulation level for neutral conductors of solidly grounded system shall be _____

    A. 500 V
    B. 300 V
    C. 600 V
    D. 750 V

16. For class II lightning materials, the minimum diameter of a solid copper air terminal shall be _____.

    A. 15.9 mm
    B. 12.7 mm
    C. 10.5 mm
    D. 9.5 mm

RME Board April 1994

17. Connection between conductive or inductive metal object in an element of a lightning protection system to accomplish electrical continuity.

    A. Connectors
    B. Interlink
    C. Counterpoise
    D. Bonding

18. The grounding electrode conductor shall be ____.

A. copper
B. copper-clad-aluminum
C. aluminum
D. all of these

19. Mats of insulating rubber or other suitable floor insulation shall be provided for the operator where the voltage to ground exceeds _____

A. 150 V
B. 100 V
C. 250 V
D. none of these

20. How many 20 A branch circuit shall be provided for all receptacle outlets for the small appliance load?

A. One or more
B. At least two
C. Only one
D. None of these

21. For a one family dwelling unit having an initial load of 10 kVA or more, the minimum service entrance capacity shall be ___

A. 100 A
B. 90 A
C. 60 A
D. 30 A

RME Board October 1996

22. Flexible cords used in locations where there is a lot of flying flint or fibers shall comply with following EXCEPT one. Which one is this?

A. It shall be approved for use in locations which are vapor-filled
B. It shall contain in addition to the conductors, a grounding conductor
C. It shall be of type approved for extra hard usage
D. It shall be provided with suitable seal to prevent the entrance of dust

23. A point at which the load of a given area is assumed to be concentrated.

A. Switchboard
B. Outlet
C. Panelboard
D. Load center

24. The workspace about electrical equipment shall be adequate to permit at least ___ degree opening of doors or hinged panels.

A. 90
B. 45

C. 60
D. 75

RME Board October 1994

25. The multiplying factor for determining the size of branch circuit protection for non-time delay fuse is

A. 300 %
B. 175 %
C. 250 %
D. 150 %

26. For banks, the general lighting load shall be computed at ____ per square meters of the floor area.

A. 24
B. 20
C. 30
D. 28

27. In dwelling units, the computed lighting and small appliance load above 120,000 volt-amperes shall be computed at what demand?

A. 35 %
B. 25 %
C. 45 %
D. 20 %

28. Which of the following statements is NOT one of the primary objective of the Philippine Electrical Code?

A. To establish electrical work standards
B. To establish basic material qualities
C. To ensure safety in using electricity
D. None of these

29. The Code has been approved and adopted by the Board, PRC. What does the acronym PRC stands for?

A. Philippine Registration Commission
B. Professional Regulation Commission
C. Philippine Regulation Commission
D. Professional Registration Commission

30. Are sheet metal troughs with hinged or removable covers for housing and protecting electric wires and cables and which conductors are laid in place after this object has been installed as a complete system.

A. Wireways
B. Busways

C. Cable trays
D. Non-metallic extensions

31. Portable appliances equipped with proper cord and plug caps and NOT more than ____ maybe installed without an electrical permit.

A. 1,200 VA
B. 1,500 VA
C. 1,000 VA
D. 1,800 VA

32. Which of the following is not a standard content of an electrical plan?

A. Location plan
B. Legend and general notes
C. Schedule of maintenance
D. Specifications

RME Board October 1996

33. When installing cables or raceway type wiring method parallel to the framing members such as joists, rafters or studs, the cable or raceway shall be installed and supported so that the nearest outside surface of the cable or raceway is NOT less than a certain distance from the nearest edge of the framing member. What is this distance?

A. 20 mm
B. 30 mm
C. 10 mm
D. 50 mm

34. Which of the following is NOT a standard ampere rating of a fuse?

A. 60 A
B. 125 A
C. 45 A
D. 55 A

35. Cabinet and cutout boxes shall have an air space of at least ____ between any energized metal parts of enclosed fuses and the door.

A. 20 mm
B. 13 mm
C. 25 mm
D. 15 mm

36. Auxiliary gutter shall be supported throughout it entire length at intervals _____

A. 1,500 mm
B. 1,800 mm
C. 1,200 mm

D. 1,600 mm

37. A lighting and appliance branch circuit panelboard is one having more than ____ percent of its overcurrent device rated 30-A or less.

A. 10
B. 12
C. 15
D. 16

38. Open wiring on insulators shall be permitted on systems of up to ____.

A. 600 V
B. 500 V
C. 230 V
D. 300 V

39. Conductors in concealed knob and tube wiring shall maintain a clearance of NOT less than ____ between conductors.

A. 64 mm
B. 50 mm
C. 76 mm
D. 100 mm

RME Board October 1994

40. The minimum size of wire used in electrical wiring is the former number 14 AWG. Under the metric system shown in the PEC, the diameter is

A. 2.0 mm
B. 3.2 mm
C. 1.6 mm
D. 2.6 mm

41. Non-metallic sheathed cable shall be secured in place at intervals NOT exceeding _____.

A. 1,300 mm
B. 1,200 mm
C. 1,500 mm
D. 1,800 mm

RME Board April 1994

42. Motor A has a full load current of 8 A and motor B, 10 A. What is the ampacity of the feeder conductor supplying this two motors?

A. 9 A
B. 20.5 A
C. 18 A
D. 24.2 A

43. The bending radius of type SNM cable shall NOT be less than ____ times the diameter of the cable.

A. 3
B. 4
C. 5
D. 6

44. Flexible metallic tubing shall NOT be used in lengths longer than _____.

A. 2,000 mm
B. 1,800 mm
C. 1,900 mm
D. none of these

45. Size 1.25 mm^2 fixture wire has an ampacity of ____.

A. 10 A
B. 8 A
C. 12 A
D. 9 A

RME Board April 1995

46. Each transformer up to 600 V nominal shall be protected by an individual overcurrent device on the primary side at not more than a certain percentage of the rated primary current of the transformer. What is this maximum percentage?

A. 110 %
B. 125 %
C. 100 %
D. 140 %

47. Outdoor lighting fixtures and associated equipment ____ permitted to be supported by trees.

A. shall be
B. shall not be
C. either A or B
D. none of these (not specified in the PEC)

48. Rosettes shall be rated at 660 W, 250 V with a maximum current rating of ____.

A. 6 A
B. 10 A
C. 4 A
D. 12 A

49. Heating cables shall be furnished complete with factory assembled non-heating leads at least ____ in length.

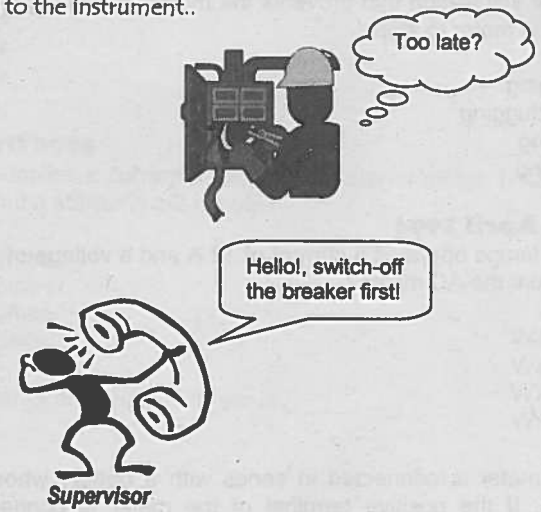
A. 2,000 mm
B. 2,200 mm
C. 2,300 mm
D. 2,100 mm

50. Conductors supplying one or more motor-compressors with or without additional loads shall have an ampacity not less than the sum of the rated load plus ___ percent of the highest motor-compressor rating in the group.

A. 30
B. 25
C. 20
D. 15

Master Electricians' work tip:

.....When testing for continuity using an ohmmeter, always remember to switch-off the circuit first, so as to prevent any damages to the instrument..



TEST 15

TECHINCAL SUBJECT

RME Board April 1994

1. A circuit has a capacitance of 35 microfarad and an inductance of 0.2 H. Calculate the resonant frequency of the circuit.

   A. 65 Hz
   B. 60 Hz
   C. 50 Hz
   D. 55 Hz

   $f = \frac{1}{2\pi\sqrt{LC}}$

2. The nominal open circuit voltage of a carbon-zinc cell is

   A. 1.35 V
   B. 2.1 V
   C. 3.0 V
   D. 1.5 V

3. A circuit or installation that prevents the motor from being reversed without first allowing the motor to stop.

   A. Plugging
   B. Anti-plugging
   C. Braking
   D. Jogging

RME Board April 1994

4. A bank of lamps operates a current of 12 A and a voltage of 120 V. What power is taken from the AC mains?

   A. 1.44 kW
   B. 1.20 kW
   C. 1.34 kW
   D. 1.22 kW

5. A DC ammeter is connected in series with a battery whose current is to be measured. If the positive terminal of the meter is connected with negative terminal of the battery, what will happen?

   A. The pointer of the meter will deflect downscale
   B. The pointer of the meter will deflect upscale
   C. The pointer of the meter will not move
   D. None of these

6. Mega is a prefix equivalent to

   A. 10^3
   B. 10^6
   C. 10^9
   D. 10^{12}

7. A series circuit has a resistance of 10 ohms and a reactance of 5 ohms. What is the circuit power factor?

   A. 0.50
   B. 0.866
   C. 0.75
   D. 0.89

8. At DC steady state, an inductor acts like _____.

   A. an open circuit
   B. a short circuit
   C. a capacitor
   D. an insulator

9. One coulomb of charge is equivalent to how many electrons or protons?

   A. 12.5×10^{18}
   B. 4.15×10^{18}
   C. 5.25×10^{18}
   D. 6.25×10^{18}

RME Board April 1995

10. A car battery supplies a current of 50 A to the starter motor. How much charge passes through the starter in 1/2 minute?

    A. 1500 coulombs
    B. 1800 coulombs
    C. 3000 coulombs
    D. 2000 coulombs

11. The power factor of an induction motor is _____.

    A. leading
    B. lagging
    C. unity
    D. zero

12. A 230-V, 3-phase motor takes 8 A at full load at 0.8 power factor lagging. How much power in kW does it take from the line?

    A. 1.84 kW
    B. 2.55 kW

C. 3.18 kW
D. 1.47 kW

13. Five carbon-zinc cells are in series. The open circuit voltage at the output is

A. 5.5 V
B. 10 V
C. 7.5 V
D. 6.5 V

14. If the three-phase load is unbalanced, two wattmeters are needed to measure the power. If one the wattmeters registers a zero reading, what is the approximate power factor of the unbalanced load?

A. 0.866
B. 0.707
C. 0.686
D. 0.50

RME Board October 1995, RME Board October 1996

15. Damping provides

A. counter torque
B. starting torque on pointer
C. good accuracy
D. braking action on the meter pointer

16. The shunt resistance of an ammeter is usually a _____

A. low resistance
B. high resistance
C. either A or B
D. neither A or B

17. Two cells each of emf 1.5 V and internal resistance of 0.2 ohm, are joined in parallel and connected to an external resistor of 0.2 ohm, what current will flow through the external resistor?

A. 5 A
B. 7.5 A
C. 15 A
D. None of these

RME Board April 1996

18. A battery having a total emf of 7.5 volts and a total internal resistance of 1.25 ohms. What external resistance will send a current of 2 A?

A. 2.0 ohms
B. 1.0 ohm
C. 1.75 ohms

D. 2.5 ohms

19. Electrical symbol represented by a rectangle with a circle inside.

A. Fluorescent lamp outlet
B. Incandescent lamp outlet
C. Lighting panelboard
D. Safety switch

20. Determine the ohmic value of a series resistance required converting a 1 mA, 300-ohm galvanometer into a 3-V voltmeter?

A. 2.7 kΩ
B. 2.9 kΩ
C. 2.85 kΩ
D. None of these

21. Which of the following motors is well adapted to start large heavy inertia loads?

A. Series wound motor
B. Repulsion induction motor
C. Shunt motor
D. Stepper motor

22. Ratio of output power to input power.

A. Demand
B. Regulation
C. Efficiency
D. Gain

23. Cells are connected in parallel to increase

A. the current capacity of the cells
B. the voltage capacity of the cells
C. the resistance capacity of the cells
D. all of these

24. Which of the following power plant has the longest expected life?

A. Diesel power plant
B. Nuclear power plant
C. Geothermal power plant
D. Hydroelectric power plant

25. If an atom losses some of its electron or accepts extra electrons from another atom, the atom will be called _____.

A. an element

B. a lattice
C. a neutron
D. an ion

26. The symbol S_{2P} shall mean _____.

A. a two-way switch
B. a two-position switch
C. a two-pole switch
D. duplex switch

RME Board April 1994

27. The first step in removing a generator from parallel operation,

A. remove the load from the off going generator
B. trip the generator off the bus bar
C. increase the cycle of the generator
D. turn off all electrical equipment

28. Most utility companies requires a minimum load power factor of

A. 0.50
B. 0.866
C. 0.75
D. 0.80

29. A 25 kVA 2,000/200 V single phase transformer has a rated primary current of

A. 10 A
B. 12.5 A
C. 7.22 A
D. 125 A

RME Board April 1995

30. A battery whose internal resistance is 5 ohms is connected to an external resistor of 10 ohms. The battery's terminal voltage is 15 V, what is the emf of the battery?

A. 17.5 V
B. 25 V
C. 22.5 V
D. none of these

31. A resistor of 10 ohms is connected in series with the combination of 12 ohms and 24 ohms in parallel. If the whole set-up is connected across a 144-V supply, how much is the voltage across the 10-ohm resistor?

A. 90 V
B. 80 V
C. 78 V

D. None of these

32. Device used to pull wires through the conduit.

A. Puller
B. Fish tape
C. Wire tongs
D. Dial indicator

RME Board October 1995

33. Charging a lead-acid cell causes the electrolyte to become

A. stronger
B. weaker
C. water
D. stable

34. If the 3-phase load is balanced, at least how many wattmeters are needed to measure the power?

A. One
B. Two
C. Three
D. Four

35. If a resistor is connected in series with the coil of a galvanometer designed to be used as a voltmeter, the resistor is used to _____.

A. increase the current rating of the voltmeter
B. increase the resistance rating of the voltmeter
C. increase the voltage rating of the voltmeter
D. all of these

RME Board October 1994

36. Hysteresis loss in a transformer depends upon the

A. reactance of windings
B. type of core material
C. applied voltage
D. number of laminations

37. A 6.6-kV, three-phase star connected alternator supplies 5,000 kW at 0.8 pf lagging. Calculate the line current.

A. 646.7 A
B. 946.9 A
C. 757.6 A
D. None of these

38. An instrument used to measure electrical current in a circuit?

A. Wattmeter
B. Megger
C. Ammeter
D. Galvanometer

39. The color band violet of a carbon composition resistor is equivalent to what digit?

A. 8
B. 7
C. 9
D. 5

40. The capacitor used in power factor correction is rated in

A. kW
B. kVA
C. kVAR
D. None of these

41. Another name for counter emf.

A. Back emf
B. Opposite emf
C. Mutual emf
D. Self induced emf

RME Board April 1995

42. The proper way to mix the electrolyte for a battery is to add

A. alkaline water to acid
B. acid to distilled water
C. distilled water to acid
D. acid to alkaline water

43. A load resistance of 10 ohms is connected to the terminals of a battery consisting of 10 cells each of emf 1.5 V and internal resistance of 0.25 ohm connected in series. Determine the current drawn.

A. 1.25 A
B. 1.30 A
C. 1.20 A
D. 1.10 A

44. The speed of a DC motor is dependent on _____.

A. flux
B. back emf
C. both A and B
D. neither A or B

45. A diode has a specified PIV rating. What do you mean by PIV?

A. Peak Instantaneous voltage
B. Peak insulation voltage
C. Peak inverse voltage
D. None of these

46. A 10:1 transformer is used to step down the voltage from 2,300 volts to 230 volts. If the load current on the low voltage side is 50 A, what is the transformer current on the high voltage side?

A. 0.5 A
B. 500 A
C. 0.05 A
D. None of these

47. The power factor of the circuit is zero, when the load of the circuit is a pure ____ only.

A. resistance
B. reactance
C. conductance
D. admittance

48. Which type of AC motors needs a DC excitation?

A. Capacitor-start and run motor
B. Shaded pole motor
C. Wound rotor induction motor
D. Synchronous motor

RME Board October 1995

49. Practical unit of electrical energy

A. watt
B. kilowatt
C. megawatt
D. kilowatt-hour

50. Which of the following DC motors is used in high-speed applications such as in compressors, blowers, fans, etc?

A. Series motor
B. Shunt motor
C. Cumulative compound motor
D. Differential compound motor

TEST 16

PHILIPPINE ELECTRICAL CODE

1. Capacitors containing more than ____ liters of flammable liquid shall be encased in vaults or outdoor fenced enclosures.

   A. 10
   B. 12
   C. 9
   D. 11

RME Board April 1996

2. Wiring methods / materials allowed by the Code for gasoline stations include all the following EXCEPT on. Which one is this?

   A. Type MI cable with approved terminal fitting
   B. Threaded steel intermediate conduit
   C. Rigid non-metallic conduit
   D. Threaded rigid metal conduit

3. A main bonding jumper shall be a ____.

   A. bus
   B. screw
   C. wire
   D. any of these

RME Board October 1995

4. What does the symbol consisting of rectangle with solid shading indicate?

   A. Fuse cut-out
   B. Telephone exchange
   C. Safety switch
   D. Lighting panelboard

5. The ampacity of conductors supplying therapeutic equipment shall NOT be less than ___ of the current rating of the equipment.

   A. 125 %
   B. 115 %
   C. 130 %
   D. 100 %

6. For 800 A circuits, the minimum insulation resistance shall be

   A. 12,000 ohms
   B. 6,000 ohms
   C. 5,000 ohms
   D. 8,000 ohms

7. Branch circuits shall be classified according to the maximum permitted ____.

   A. kW rating
   B. voltage rating
   C. ampere rating
   D. all of these

RME Board October 1996

8. Medium voltage cable shall be permitted for installation on the following EXCEPT one. Which one is this?

   A. Where installed in cable trays
   B. Where exposed to direct sunlight
   C. Power systems up to 35,000 volts in dry locations
   D. Power systems up to 35,000 volts in wet locations

9. Each autotransformer up to 600 V shall be protected by an individual overcurrent device rated not more than ____ percent of its rated full load current.

   A. 125
   B. 150
   C. 175
   D. 300

10. Each of the three 3.5 mm^2 TW copper conductors are in a conduit has an ampacity of 20 A. If there will be six of them in the conduit, what will be the ampacity of each conductor?

    A. 12 A
    B. 20 A
    C. 16 A
    D. 15 A

11. Branch circuit conductors supplying a single motor-compressor shall have an ampacity not less than ____ of either the motor-compressor rated load or the branch circuit selection current, whichever is larger.

    A. 100 %
    B. 125 %
    C. 115 %
    D. 130 %

12. What size of branch circuit is required to supply a fixed lighting load of 21.5 A used at continuous duty?

    A. 30 A
    B. 20 A
    C. 40 A
    D. 25 A

13. Potential transformers installed indoors or enclosed shall be protected with ___ fuses.

    A. primary
    B. secondary
    C. both A and B
    D. neither A or B

14. Which of the following is NOT a standard size of disconnect?

    A. 30 A
    B. 60 A
    C. 50 A
    D. 100 A

15. A disconnecting means shall be provided in each ungrounded conductor for each capacitor bank and shall NOT be less than ___ percent of the rated current of the capacitor.

    A. 125
    B. 115
    C. 150
    D. 135

RME Board April 1996

16. If a 460-V switchboard has exposed parts on one side and grounded parts or concrete on the opposite side, what working clearance between the two sides is permitted by the Code?

    A. 500 mm
    B. 1,900 mm
    C. 1,500 mm
    D. 1,100 mm

17. Cells in rubber or composition containers shall require no additional insulating supports where the total nominal voltage of all cells in series does NOT exceed a certain level of voltage. What is this level?

    A. 100 V
    B. 150 V
    C. 200 V
    D. 300 V

18. What is the maximum load of a 15 A circuit breaker protecting a branch circuit that supplies a continuous load?

    A. 15 A
    B. 20 A
    C. 12 A
    D. None of these

19. Aircraft energizers shall be so designed and mounted that all electric equipment and fixed wiring shall be at least ___ above floor level.

    A. 460 mm
    B. 500 mm
    C. 640 mm
    D. 400 mm

20. Each patient bed location where in patient care is provided shall be supplied by at least ___ branch circuit(s)?

    A. one
    B. two
    C. three
    D. four

21. Generator's compartments shall be lined with galvanized steel, not less than __ thick.

    A. 0.40 mm
    B. 0.50 mm
    C. 0.30 mm
    D. 0.60 mm

RME Board October 1995

22. For a rigid steel conduit of trade diameter 50-mm, the field bend shall be so made that the radius of the inner edge shall not be less than a certain radius for conductors without lead sheathed. What is this radius?

    A. 450 mm
    B. 250 mm
    C. 300 mm
    D. 375 mm

23. For all deck or floor plans, the standard scale to be used is

    A. 1:1000
    B. 1:10
    C. 1:100
    D. None of these

24. In locations where flammable anesthetics are employed, the entire area shall be considered hazardous location which shall extend upward to a level ___ above the floor.

A. 1,000 mm
B. 1,300 mm
C. 1,800 mm
D. 1,500 mm

25. As a rule branch circuits shall NOT be supplied by

A. an autotransformer
B. a generator
C. a transformer
D. a motor-generator set

RME Board April 1994

26. Is a multi-contact switch, which fixes the operation sequence of the major device during starting and stopping or during other sequential switching operations.

A. Motor operation sequence switch
B. Manual transfer switch
C. Position Switch
D. Field circuit sequence switch

27. Circuits from portable switchboards directly supplying equipment containing incandescent lamps of not over 300 W shall be protected by overcurrent device having a setting of _____.

A. 15 A
B. 20 A
C. 30 A
D. 40 A

RME Board October 1996

28. The Electrical Code requires that electrical plans and drawings shall be drawn on sheets of the following standard size. Which one is NOT considered standard?

A. 600 mm x 900 mm
B. 217 mm x 279 mm
C. 760 mm x 1000 mm
D. 500 mm x 760 mm

29. Disruptive discharges between electrodes of a measuring gap.

A. Lightning
B. Flashover
C. Surge
D. Sparkover

30. The chassis-grounding terminal of the battery shall be bonded to the vehicle chassis with a copper conductor of ____ size or its equivalent.

A. 5.5 mm^2
B. 3.5 mm^2
C. 8.0 mm^2
D. 2.0 mm^2

31. The length of the cord from the face of the attachment plug cap to the point where the cord enters the mobile home shall NOT be less than ___.

A. 5 m
B. 10 m
C. 8 m
D. 6 m

32. Non-metallic sheathed cables shall be supported within ____ of a non-metallic outlet box without cable clamps.

A. 200 mm
B. 150 mm
C. 180 mm
D. 220 mm

RME Board October 1996

33. A test lamp using an ordinary bulb is used to test one of the following. Which one is this?

A. Overload test
B. DC or AC check
C. Polarity check
D. Ground check

34. Air conditioning load has a demand load of ____.

A. 80 %
B. 100 %
C. 125 %
D. 150 %

35. How many sets of the complete electrical plans and specifications signed and sealed by a PEE shall be submitted, as one of the requirements in filing for an electrical permit?

A. 5
B. 4
C. 3
D. None of these

36. If there will be six or more 2-wire branch circuits for a one family dwelling unit, the minimum service entrance capacity shall be ____.

    A. 60 A
    B. 100 A
    C. 90 A
    D. 120 A

37. A unit of an electrical system which is intended to carry but not utilize electric energy.

    A. Wire
    B. Device
    C. Outlet
    D. Utilization equipment

38. Service entrance cables shall be supported at intervals NOT exceeding

    A. 900 mm
    B. 800 mm
    C. 760 mm
    D. 1,000 mm

39. An overcurrent device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it.

    A. Overload relay
    B. Fuse
    C. Thermocouple
    D. Magnetic contactor

40. What is the maximum size of lighting load that can be connected to a 20-A single phase branch circuit supplying a fixed appliance load of 7 A?

    A. 10 A
    B. 16 A
    C. 12 A
    D. 8 A

RME Board October 1996

41. If an electrician does not understand the instruction that were given by the supervisor, which of the following is the best for him to do?

    A. He asks that the instruction be repeated and clarified
    B. He does the job the way he thinks best
    C. He works out the solution to the problem himself
    D. He gets one of the other electricians to do the job

42. The branch circuit load for drying equipment is the larger of either the VA rating of the nameplate or ____.

    A. 5,000 VA
    B. 6,000 VA
    C. 4,000 VA
    D. 3,000 VA

43. For hallways of _____ or more in length, at least one receptacle outlet shall be installed.

    A. 2,000 mm
    B. 4,000 mm
    C. 5,000 mm
    D. 3,000 mm

44. The minimum headroom of working space about service equipment, switchboards, panelboards, etc shall be ____.

    A. 1,800 mm
    B. 2,000 mm
    C. 1,700 mm
    D. 1,900 mm

45. The equipment-grounding conductor of a branch circuit shall be identified by a continuous ____ color.

    A. white
    B. yellow
    C. green
    D. gray

46. The sum of the continuous ratings of the load consuming apparatus connected to the system or any part thereof.

    A. Peak load
    B. Connected load
    C. Average load
    D. Continuous load

RME Board April 1996

47. An outlet box should be fastened to a concrete wall by the use of

    A. Wood plug and nail
    B. Toggle bolts
    C. Porcelain insert and screw
    D. Expansion bolts

48. A ____ branch circuit shall be permitted to supply fixed lighting units with heavy-duty lampholders.

    A. 40 A
    B. 20 A

A. 50 A
B. 30 A

49. In every kitchen, family room, dining room, living room, parlor, library, bedroom or similar rooms or area of dwelling units, receptacle outlets shall be installed so that no point along the floor line in any wall space is more than ____ measured horizontally from an outlet in that space.

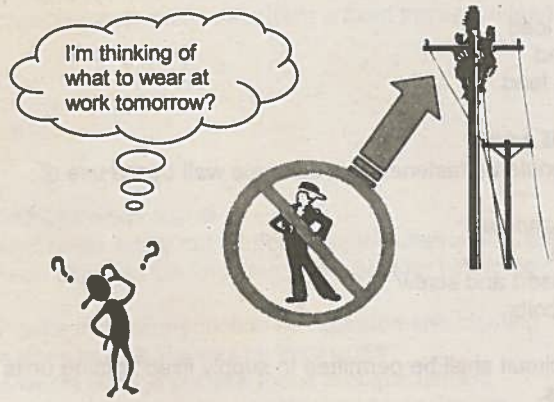
A. 2,000 mm
B. 1,800 mm
C. 1,900 mm
D. 2,100 mm

50. The path to ground from circuits' equipment and metal enclosures for conductors shall ____.

A. have capacity to conduct safely any fault current
B. have sufficiently low impedance
C. be permanent and continuous
D. all of these

Master Electricians' work tip:

.....Use proper attire. Wear rubber shoes and gloves while working with live electrical circuits. Avoid wearing loose clothing especially if the working space is only limited.



TEST 17

TECHINCAL SUBJECT

RME Board October 1996

1. If a split phase induction motor fails to start, one of the causes is

A. there is no voltage
B. faulty cut-out switch
C. open overload device
D. all of these

2. What is the secondary voltage of a transformer that has a primary voltage of 100 V, primary turns of 200 and secondary turns of 40?

A. 500 V
B. 25 V
C. 4 V
D. None of these

3. In a "START-STOP" motor controller using contactors, how many contactors are needed?

A. One
B. Two
C. Either A or B
D. Neither A or B

4. The output of a shunt generator is 500 A. Armature resistance is 0.02 ohm. Field resistance is 50 ohms. How much is the generated emf if the terminal voltage is 250 V?

A. 260.1 V
B. 263.4 V
C. 258.3 V
D. 252.8 V

5. The d' Arsonval meter is _____ meter movement meter.

A. moving iron
B. moving coil
C. both A and B
D. neither A or B

6. It is also called a quartz lamp.

   A. Sodium lamp
   B. Tungsten halogen lamp
   C. Metal halide lamp
   D. Incandescent lamp

7. The RMS value of a sinusoidal wave is equivalent to ___ times the peak value.

   A. 1.732
   B. 0.577
   C. 0.707
   D. 1.414

8. Which of the following motors has no commutator?

   A. Shunt motors
   B. Universal motors
   C. Induction motors
   D. Repulsion motors

RME Board April 1996

9. A DC motor can easily be identified by

   A. commutator
   B. size of conductor
   C. winding
   D. yoke

10. Reciprocal of resistance.

   A. Susceptance
   B. Reluctance
   C. Conductance
   D. Admittance

RME Board April 1996

11. Three 9-ohm resistors are connected in parallel across a 24-V source. The total power taken by the circuit is

   A. 120 W
   B. 240 W
   C. 192 W
   D. none of these

12. Three capacitors having capacitance of 4,6 and 8 μF respectively are connected in series. Find the equivalent capacitance of the combination.

   A. 1.85 μF
   B. 18 μF

   C. 18.5 μF
   D. None of these

13. A 4-pole, lap wound armature is driven at 600 rpm. If there are a total of 480 conductors in the armature, how much is the flux per pole in order for the machine to generate 120 volts?

   A. 20 mWb
   B. 30 mWb
   C. 25 mWb
   D. 15 mWb

14. A battery is rated 200 Ah. If it is use to supply a constant current of 8 A, how long can the battery last until it becomes unusable?

   A. 20 hour
   B. 25 hours
   C. 15 hour
   D. None of these

15. The resistance of a conductor varies ____ when the volume is fixed.

   A. directly as the cross sectional area
   B. directly as the square of the cross sectional area
   C. inversely as the cross sectional area
   D. inversely as the square of the cross sectional area

16. If the resistance of the circuit is 25 ohms, what voltage is necessary for a current flow of 4 A?

   A. 6.25 V
   B. 100 V
   C. 0.16 V
   D. 400 V

RME Board October 1995

17. The ampere-hour capacity of the battery depends on

   A. the area of the plates
   B. the distance between the plates
   C. the thickness of the plates
   D. the strength of the electrolytes

18. Thee resistors are to be connected in four possible type of circuit connections namely, series, parallel, series-parallel and parallel-series. Which type of connection will give the least amount of equivalent resistance?

   A. Series
   B. Parallel
   C. Series-parallel

D. Parallel-series

19. If a motor is to be controlled from two different locations, the START buttons are connected in _____ while the STOP buttons are connected in _____.

A. series, series
B. series, parallel
C. parallel, series
D. parallel, parallel

20. Electrical instrument use to measure electrical power.

A. Kilowatt-hour meter
B. Wattmeter
C. Clamp ammeter
D. Galvanometer

21. Which of the following unbalanced loads is the most difficult to handle?

A. delta connected loads
B. 4-wire star connected load
C. 3-wire star connected load
D. all of these

22. Rotating part of a large alternator.

A. Field
B. Armature
C. Yoke
D. Commutator

RME Board April 1996

23. Who shall be the executive officer of the Board of Electrical Engineering and shall also conduct the examination given by the Board, as provided in Art. II, Sec 9, of the New Electrical Engineering Law?

A. A member of the Board of Electrical Engineering
B. The President of the Philippines
C. The Commissioner of the Professional Regulations Commission
D. The Chairman of the Board of Electrical Engineering

24. The resistance of 500 meters of a certain wire is 125 ohms. What length of the same wire will have a resistance of 60 ohms?

A. 200 meters
B. 225 meters
C. 240 meters
D. 300 meters

25. Type of diode used to regulate DC voltage supply.

A. Shockley
B. Zener
C. Tunnel
D. SCR

26. The illumination on a surface varies inversely to the _____.

A. distance.from the light source
B. luminous intensity of the light source
C. square of the distance from the light source
D. cosine of the angle of incidence

27. If the line to line voltage of a 3-phase grounded system is 208 volts, what is the voltage between any of the three lines and the ground?

A. 208 V
B. 120 V
C. 147 V
D. 69.3 V

RME Board October 1995

28. To keep the terminals of a lead acid storage battery free from corrosion, it is advisable to

A. keep the electrolyte level low
B. apply petroleum jelly
C. charge the battery at frequent intervals
D. clean the terminals frequently

29. DC motor suitable for heavy-duty load applications such as in mills and crushers

A. Cumulative compound motor
B. Differential compound motor
C. Series motor
D. Shunt motor

30. A transformer will work on _____ supply.

A. DC
B. AC
C. either A and B
D. neither A or B

31. Synchronous motors are _____.

A. self-starting
B. not self-starting
C. either A or B
D. neither A or B

32. A bridge type rectifier uses how many diodes?

    A. One
    B. Two
    C. Three
    D. Four

RME Board October 1996

33. In automobiles, it prevents the arcing at the distributor points when they began to open.

    A. Condenser
    B. Ignition coil
    C. Contact points
    D. Spark plug

34. If three equal resistances are connected in parallel, the equivalent capacitance of the combination will be

    A. three times the value of one resistor
    B. half the value of one resistor
    C. one-third the value of one resistor
    D. none of these

35. PLC is one of the modern types of controller. What do you mean by PLC?

    A. Programmable Logic Counter
    B. Programmable Language Controller
    C. Programmable Laboratory Controller
    D. Programmable Logic Controller

36. A method of stopping a polyphase motor quickly by momentarily connecting the motor for reverse rotation.

    A. Plugging
    B. Jogging
    C. Inching
    D. Latching

RME Board April 1996

37. In a radio, gang condenser is a type of

    A. air capacitor
    B. electrolytic capacitor
    C. paper capacitor
    D. variable capacitor

38. Ratio of maximum load to the total connected load.

    A. Diversity factor
    B. Utilization factor
    C. Use factor
    D. Demand factor

39. How much charge is stored in a 2 μF capacitor connected across a 50-V supply?

    A. 100 μC
    B. 25 μC
    C. 200 μC
    D. None of these

40. A material with atoms in which the electrons tend to stay in their orbits.

    A. Inductor
    B. Conductor
    C. Intrinsic
    D. Insulator

41. Neutral current is the same as

    A. no-charge current
    B. ground current
    C. eddy current
    D. normal current

RME Board April 1996

42. The output of a shunt generator is 500 A at a terminal voltage of 250 V. If the shunt resistance is 50 ohms, what is the armature current?

    A. 500 A
    B. 495 A
    C. 505 A
    D. 510 A

43. Unit of luminous flux.

    A. Lumen
    B. Lux
    C. Foot-candle
    D. Candela

44. If a diode is forward biased, the cathode is connected to the _____ terminal of the supply.

    A. negative
    B. positive
    C. either A or B
    D. neither A or B

45. A capacitor consists of two _____

A. insulators separated by a conductor
B. conductors separated by an insulator
C. conductors
D. insulators

46. Nominal open circuit voltage of a lead-acid cell.

A. 2.1 V
B. 1.5 V
C. 3.0 V
D. 1.25 V

47. A 4-pole, lap wound armature has 120 slots, 4 conductors per slot. The flux per pole is 50 mWb and the speed is 600 rpm. Find the generated emf?

A. 250 V
B. 230 V
C. 240 V
D. 300 V

RME Board October 1996

48. A certain motor takes 350 A at 100 V and the hp output is 45. What is its efficiency?

A. 94.6 %
B. 95.9 %
C. 97.2 %
D. 93.5 %

49. In the vector diagram, if the voltage leads the current, the power factor of the circuit is _____.

A. unity
B. lagging
C. leading
D. zero

RME Board October 1996

50. A 100-W bulb is connected in series with a room heater of 750 W. What will happen if the bulb is replaced by a 60-W bulb?

A. Heater output will increase
B. Bulb will not glow
C. Heater output will decrease
D. Heater output remain unchanged

TEST 18
PHILIPPINE ELECTRICAL CODE

1. Where installed in raceways conductors of size ____ and larger shall be stranded.

A. 5.5 mm^2
B. 8.0 mm^2
C. 14 mm^2
D. 3.5 mm^2

2. What type letter for conductors has a trade name "moisture resistant thermoplastic"?

A. TW
B. THHW
C. THWN
D. THHN

RME Board October 1994

3. When the voltage between conductors does not exceed 300 V and the roof has a slope of not less than 100 mm in 300 mm, the clearance can be reduced to

A. 500 mm
B. 800 mm
C. 1000 mm
D. 900 mm

4. The down conductors shall be protected for a minimum distance of ____ above grade level.

A. 1,800 mm
B. 1,600 mm
C. 1,700 mm
D. 1,500 mm

5. Fuses shall be plainly marked with _____.

A. ampere rating
B. voltage rating
C. interrupting rating
D. all of these

6. Which of the following statements is NOT true about grounding electrode conductor?

   A. It shall be solid or stranded
   B. It must be continuous
   C. Splice or joints are allowed
   D. It shall be insulated, covered or bare

RME Board April 1995

7. The uses of non-metallic extensions are NOT allowed in all but one of the following. Which one is this?

   A. As an aerial cable
   B. Where exposed to corrosive vapors
   C. Where subject to corrosive vapors
   D. Through floors or partitions

8. Fixture wires shall NOT be used ____.

   A. for installation in lighting fixtures
   B. for connecting lighting fixtures to the branch circuit conductors
   C. as branch circuit conductors
   D. none of these

9. Exposed energized parts of motors and controllers shall be guarded against accidental contact by elevating it ____ or more above the floor.

   A. 2,500 mm
   B. 2,300 mm
   C. 2,600 mm
   D. 2,400 mm

10. Exposed energized parts of motor and controllers operating at ___ volts or more between terminals shall be guarded against accidental contact by enclosure.

    A. 50
    B. 30
    C. 40
    D. 60

RME Board October 1995

11. To improve the insulation resistance of a motor, it is first cleaned, washed, varnished then baked. Which is very economical and effective method of baking particularly the inside coils of a large motor?

    A. Putting incandescent lamps around the winding and cover
    B. Hanging resistor strips inside the core and cover
    C. Putting it inside the baking oven and control the oven temperature

    D. Connecting the terminals to a variable low voltage supply and increase the baking current gradually until the desired baking temperature is attained making sure that the rated current is not exceeded.

12. _____ includes any switch or device normally used to start and stop a motor by making and breaking the motor circuit current.

    A. Controller
    B. Rheostat
    C. Autotransformer
    D. Double pole double throw switch

13. Grounding electrodes shall be installed such that at least ___ of length is in contact with the soil.

    A. 2,000 mm
    B. 1,500 mm
    C. 2,500 mm
    D. 2,400 mm

14. Lamps installed in scene docks shall be so located and guarded and shall provide an air space of NOT less than ____ between such lamps and any combustible material.

    A. 75 mm
    B. 50 mm
    C. 40 mm
    D. 64 mm

15. Direct burial cables or conductors with a nominal voltage of 660 V or less and placed under a one or two family dwelling driveways and parking areas shall have a minimum cover distance of _____.

    A. 480 mm
    B. 500 mm
    C. 440 mm
    D. 460 mm

16. If the trade name of the conductor is "heat-resistant rubber", what type letter is it?

    A. type RH
    B. type RHW
    C. type THHW
    D. type MTW

17. The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

A. Welding
B. Molding
C. Bonding
D. Splicing

18. A metal underground gas piping system _____ used as a grounding system.

A. shall be
B. shall not be
C. both A and B
D. none of these (not specified in the PEC)

19. Cartridge fuses and fuse holders shall have a maximum operating voltage of ___.

A. 150 V
B. 500 V
C. 300 V
D. 250 V

RME Board April 1994

20. The Building Code (PD 1096) of the Philippines has several referral codes. The only no-referral code is

A. The Philippine Electrical Code
B. Fire Code
C. Structural Code
D. Chemical Engineering Code

21. What type of conductors is used for machine tool wiring in dry or wet locations?

A. type MTW
B. type RHW
C. type MI
D. type UF

22. Fuses, circuit breakers or combinations thereof shall NOT be connected in ___.

A. series
B. parallel
C. both A and B
D. neither A or B

23. At least ___ of free conductor shall be left at each outlet, junction and switch point for splices or the connection of fixtures or devices.

A. 200 mm
B. 100 mm
C. 150 mm
D. 300 mm

RME Board April 1995

24. Which of the following cables is NOT used as an electrical cable?

A. Flat cables
B. Optical fiber cables
C. Armored cables
D. Steel cables

25. Electrodes of pipe or conduit shall NOT be smaller than _____ trade size.

A. 20 mm
B. 15 mm
C. 25 mm
D. 32 mm

26. 8.0 mm^2 TW copper has an ampacity equal to _____.

A. 30 A
B. 50 A
C. 40 A
D. 60 A

27. The derating factors for the number of wires in a raceway shall not apply to conductors in nipples having a length NOT exceeding _____.

A. 500 mm
B. 600 mm
C. 760 mm
D. 300 mm

28. An enclosure either above or below ground, with fire resistant walls, ceiling and floor exclusively built for unattended transformer and their auxiliaries.

A. Transformer housing
B. Transformer yard
C. Transformer vault
D. None of these

RME Board October 1994, RME Board April 1995

29. A certain residential house has lighting load of 1.1 kVA and an appliance load of 10 A at 220 volts, single phase, two wires, 60 Hz. The branch circuit fuse protections for lighting and appliance loads are ___ and _____ respectively.

A. 30 A, 60 A
B. 20 A, 30 A
C. 15 A, 30 A
D. 15 A, 20 A

30. One of the approved grounding electrode system is using the metal underground water pipe in direct contact with the earth for _____ or more.

A. Welding
B. Molding
C. Bonding
D. Splicing

18. A metal underground gas piping system _____ used as a grounding system.

A. shall be
B. shall not be
C. both A and B
D. none of these (not specified in the PEC)

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B. parallel
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D. neither A or B

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B. 100 mm
C. 150 mm
D. 300 mm

RME Board April 1995

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C. Armored cables
D. Steel cables

25. Electrodes of pipe or conduit shall NOT be smaller than ____ trade size.

A. 20 mm
B. 15 mm
C. 25 mm
D. 32 mm

26. 8.0 mm^2 TW copper has an ampacity equal to ____.

A. 30 A
B. 50 A
C. 40 A
D. 60 A

27. The derating factors for the number of wires in a raceway shall not apply to conductors in nipples having a length NOT exceeding ____.

A. 500 mm
B. 600 mm
C. 760 mm
D. 300 mm

28. An enclosure either above or below ground, with fire resistant walls, ceiling and floor exclusively built for unattended transformer and their auxiliaries.

A. Transformer housing
B. Transformer yard
C. Transformer vault
D. None of these

RME Board October 1994, RME Board April 1995

29. A certain residential house has lighting load of 1.1 kVA and an appliance load of 10 A at 220 volts, single phase, two wires, 60 Hz. The branch circuit fuse protections for lighting and appliance loads are ___ and ____ respectively.

A. 30 A, 60 A
B. 20 A, 30 A
C. 15 A, 30 A
D. 15 A, 20 A

30. One of the approved grounding electrode system is using the metal underground water pipe in direct contact with the earth for ____ or more.

A. 3,000 mm
B. 4,000 mm
C. 2,500 mm
D. 1,500 mm

31. The minimum temperature at which a given liquid gives off vapor in sufficient concentration to form an ignitable mixture.

A. Kindling temperature
B. Flash point
C. Absolute temperature
D. Heat of fusion

32. One equipment shall in sight from another equipment not more than ____ from the other.

A. 10 m
B. 15 m
C. 20 m
D. 5 m

33. Lamp holders installed over highly combustible material shall be located at least ____ above the floor.

A. 2,000 mm
B. 2,500 mm
C. 2,400 mm
D. 2,600 mm

RME Board October 1995

34. How can the polarization index of transformer oil be improved?

A. Filtering
B. Vacuuming
C. Heating
D. All of these

35. Ground terminals shall be

A. solid plate
B. stranded cable
C. solid wire or rod
D. all of the these

36. Which of the following statements is NOT true regarding a rosette?

A. Fusible rosette shall not be installed
B. Rosettes installed in damp or wet locations shall be of weatherproof type
C. Separable rosettes that may change polarity shall not be used
D. None of these

37. Sheet metal of flush and recessed fixture housings shall be protected against corrosion and shall NOT be less than ___ thick.

A. 0.65 mm
B. 0.60 mm
C. 0.64 mm
D. 0.63 mm

RME Board October 1994

38. What is the size in square millimeters (mm^2) of the cable 250 MCM in size?

A. 150 mm^2
B. 135 mm^2
C. 125 mm^2
D. 145 mm^2

39. Metal fixtures, transformers and transformer enclosures on circuits operating at over ___ volts to ground shall be grounded.

A. 250
B. 100
C. 150
D. 300

40. Not less than ___ of free non-heating lead shall be within the junction box.

A. 100 mm
B. 150 mm
C. 175 mm
D. 200 mm

RME Board October 1995

41. A circle with the letter B stands for

A. Buzzer outlet
B. Pushbutton outlet
C. Outlet with blank cover
D. Bell outlet

42. The ampacity of branch circuit conductors and the rating or setting of overcurrent devices supplying fixed electric space heating equipment for pipelines and vessels shall be not less than ____ percent of the total load of the heaters.

A. 120 %
B. 110 %
C. 115 %
D. 125 %

43. Motors with a marked temperature rise not over 40 °C shall have an overload protection equal to ____ percent of the motor full load current.

A. 115
B. 125
C. 110
D. 100

44. For single-phase AC or DC motors supplied by a 3-wire, single-phase AC or DC with grounded neutral, the number of overload units required shall be ____.

A. one, in the grounded conductor
B. one, in either ungrounded conductor
C. two, in both ungrounded conductors
D. three, in all conductors

45. For wound rotors, to determine the maximum setting of its short circuit protective device, using a fuse or an inverse time circuit breaker, a multiplying factor of ___ of its current rating shall be used.

A. 125 %
B. 150 %
C. 250 %
D. 200 %

RME Board April 1996

46. The construction of metal cabinets and cutout boxes shall be such as to secure strength and rigidity. If constructed of uncoated sheet steel, the metal thickness should NOT be less than

A. 1.55 mm
B. 1.75 mm
C. 1.00 mm
D. 1.35 mm

47. The floors of transformer vaults in contact with the earth shall be of concrete NOT less than ___ thick.

A. 100 mm
B. 200 mm
C. 300 mm
D. 250 mm

48. The nominal battery voltage shall be computed on the basis of ____ per cell for the lead acid type.

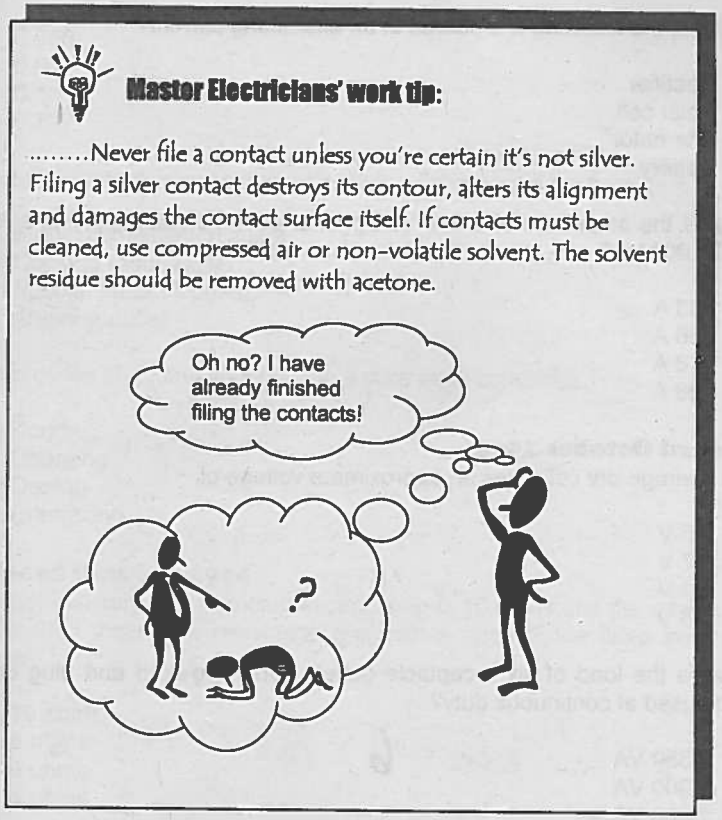
A. 1.5 V
B. 1.45 V
C. 3.0 V
D. 2. 0 V

49. Hazardous locations, in which volatile flammable liquids or flammable gases are handled, processed or used.

A. Class I, Division 2
B. Class II, Division 2
C. Class II, Division 1
D. Class I, Division 1

50. In mobile homes, if a range, clothes dryer or similar appliance is connected by metal covered cable or flexible metal conduit, a length of NOT less than ____ of free cable or conduit shall be provided to permit moving the appliance.

A. 800 mm
B. 700 mm
C. 600 mm
D. 900 mm



TEST 19

TECHINCAL SUBJECT

RME Board April 1994

1. Find the cost of running a 100-W, 220-V lamp for 20 hours at P 3.00 per kW-hr.

   A. P 6.00
   B. P 12.00
   C. P 10.00
   D. None of these

2. Which of the following is a source of an alternating current?

   A. Rectifier
   B. Solar cell
   C. Alternator
   D. Battery

3. What is the amperage of a 240-V, 3-phase feeder circuit supplying a total load of 128,000 VA?

   A. 533 A
   B. 256 A
   C. 178 A
   D. 308 A

RME Board October 1994

4. The average dry cell gives an approximate voltage of

   A. 1.5 V
   B. 1.7 V
   C. 1.1 V
   D. 1.3 V

5. What is the load of six receptacle outlets supplying cord and plug connected loads used at continuous duty?

   A. 1,350 VA
   B. 1,200 VA
   C. 1,080 VA
   D. 1,250 VA

6. Which type of single-phase motors develops more starting torque than any other types?

   A. Squirrel cage induction motor
   B. Split-phase capacitor start and run motor
   C. Repulsion start induction run motor
   D. Wound rotor induction motor

7. On a distribution transformer, the terminals labeled X_1 and X_2 are the ___ terminals.

   A. ground
   B. high voltage
   C. low voltage
   D. either A, B or C

8. If the active and reactive powers of the circuit are equal in magnitude, the power factor of the circuit is ____.

   A. 0.866
   B. 0.90
   C. 0.50
   D. 0.707

9. Electrical symbol represented by a circle with two solid lines inside it.

   A. Single convenience outlet
   B. Cooking range outlet
   C. Special purpose outlet
   D. Antenna outlet

10. The process of adding impurities to a pure semi-conductor.

    A. Bonding
    B. Charging
    C. Doping
    D. Energizing

RME Board October 1994

11. The hot resistance of an incandescent lamp is 10 ohms and the rated voltage is 50 V. Find the series resistance required to operate the lamp from an 80 V supply.

    A. 10 ohms
    B. 8 ohms
    C. 6 ohms
    D. 4 ohms

12. What is the purpose of reduced voltage starters?

A. To increase the motor torque at starting
B. To increase the motor current at starting
C. To reduce the losses at starting
D. To reduce the motor line current at starting

RME Board April 1995

13. An 8-ohm resistance and 10-ohm resistance are connected in parallel. If the total current is 9 A, what is the current in the 8-ohm resistor?

A. 6 A
B. 5 A
C. 4 A
D. 3 A

14. Relay which operates and resets with no intentional time delay.

A. Inverse-time relay
B. Instantaneous-trip relay
C. Electromechanical relay
D. Delay-off relay

RME Board April 1996

15. Which of the following is the best conductor of electricity?

A. Copper
B. Aluminum
C. Silver
D. Gold

16. In order to show that a resistor has a tolerance of ±10%,

A. the third band must be silver
B. no color in the fourth band
C. the fourth band is gold
D. the fourth band must be silver

17. Incorrect motor end play can be corrected by

A. adding / removing washers
B. replacing / lubricating bearings
C. tightening nuts or bolts
D. any of these

18. Which of the following causes an extreme vibration in a motor?

A. Overloads
B. Too much lubrications
C. Worn bearings
D. Shaft misalignment

19. The centrifugal switch used in split-phase motors will cut-off the starting winding after the motor developed approximately ____ of its rated speed.

A. 75 %
B. 80 %
C. 70 %
D. 85 %

20. What is the feeder demand load for the following appliances: 6.5 kW water heater, 1.6 kW dishwasher, 1.5 kW water pump and 3.6 kW blower motor?

A. 13.2 kW
B. 9.9 kW
C. 16.5 kW
D. 10.56 kW

RME Board April 1995

21. What should be done to prevent moisture damage to electrical apparatus during extended periods of idleness?

A. Fill the motor housing with CO_2 to inert the space
B. Place heat lamps in motor housings
C. Cover with canvas
D. Strap silica gel around the commutator

22. If a motor is to be controlled from five different locations, how many and what types of switches are to be used?

A. Three 4-way and two 3-way switches
B. Two 4-way and three 3-way switches
C. One 3-way and four 4-way switches
D. None of these

23. Motors most commonly used in home appliances such as blenders, mixers, vacuum cleaners, etc.

A. Shunt motors
B. Universal motors
C. Capacitor start & run motors
D. Squirrel cage induction motors

24. Meter used to test the armatures and stators of electric motor, generators, and other equipment for short circuit.

A. Test lamp
B. Megohmmeter
C. VOM
D. Growler

25. High-pressure sodium lamps are marketed under the trade name ____.

A. Lucalox
B. Ceramalux
C. Unalox
D. All of these

26. A machine used to transform mechanical energy into electrical energy.

A. Transformer
B. Electric motor
C. Generator
D. Condenser

RME Board October 1994

27. The field winding of a shunt motor has a resistance of 110 ohms and the emf applied to it is 220 V. What is the amount of power consumed in the field excitation?

$P = \frac{E^2}{R}$

A. 500 W
B. 440 W
C. 2 kW
D. 22 kW

28. What is the power factor of a RL circuit supplied with a DC source?

A. Unity
B. Lagging
C. Leading
D. Zero

29. A resistor that has an infinite resistance is a sign of ____ resistor

A. a shorted
B. an open
C. a grounded
D. all of these

RME Board October 1996

30. To cut rigid steel conduits, an electrician should

A. use a hack saw and ream the ends
B. use a three-wheel pipe cutter
C. use a cold chisel and ream the ends
D. order it to cut to size

31. When using Ohm's law, "E / R" would solve for _____.

A. Voltage
B. resistance
C. current
D. power

32. Who among the following electrical practitioner has the sole authority to seal electrical plans, etc and to practice electrical engineering in its full scope as defined in RA 7920?

A. Registered Electrical Engineer
B. Registered Master Electrician
C. Professional Electrical Engineer
D. All of these

33. During the open circuit test on transformers, which side is opened?

A. Low side
B. High side
C. Either A or B
D. Both A and B

34. In an RL series circuit, the current ____ the voltage.

A. is in phase with
B. leads
C. lags behind
D. none of these

RME Board October 1995, RME Board April 1996

35. In a transformer the purpose of the breather is to

A. to provide insulation to the winding
B. extract moisture in air
C. to take insulating oil from conservator
D. to provide cooling to the winding

36. A reverse-power relay is used to

A. reverse the rotation of the motor
B. change AC power to DC and vise-versa
C. protect the generator from power reversal
D. protect the motor from power surges

37. A 10-pole AC generator is running at 600 rpm, what is the frequency of the generated voltage?

$F = \frac{PN}{120}$

A. 60 Hz
B. 50 Hz
C. 70 Hz
D. 40 Hz

38. Core loss on electrical machines is the same term as _____.

A. copper loss
B. iron loss

C. windage loss
D. exciter loss

39. How much current does a 24-ohm resistance that dissipates 600 watts need?

A. 25 A
B. 5 A
C. 0.04 A
D. 1.04 A

RME Board April 1994

40. Which of the following lamps requires a cooling period prior to restarting?

A. Incandescent
B. Fluorescent
C. Mercury
D. None of these

41. A good fuse should have ___ resistance.

A. a very high
B. approximately no
C. either A or B
D. neither A or B

42. Contact metals maybe grouped in three general classifications namely

A. hard, highly conductive & non corroding metals
B. hard, soft and highly conductive metals
C. highly conductive, low conductive and non corroding metals
D. high resistance, low resistance and hard metals

RME Board October 1995

43. A standard transformer type motor starter has a several taps used for starting a large size motor. Which one is NOT standard?

A. 80 %
B. 63 %
C. 50 %
D. 100 %

44. A cell which cannot be recharged.

A. Primary
B. Secondary
C. Either A or B
D. Neither A or B

45. What is the neutral current of a 4-wire, 3-phase circuit if the three line currents are 50 A, 50 A and 30 A respectively?

A. 20 A
B. 75 A
C. 40 A
D. 130 A

46. DPDT stands for

A. Double pole duplex switch
B. Double pole double throw switch
C. Duplex switch
D. None of these

RME Board April 1994

47. A circuit has a resistance of 8 ohms. If a voltmeter connected across its terminals reads 10 V, how much current is flowing through the circuit?

A. 1.25 A
B. 1.50 A
C. 2.10 A
D. 0.80 A

48. A reduced current method of starting for squirrel cage motors that have two separate stator windings connected in parallel.

A. Primary resistance type
B. Secondary resistance type
C. Autotransformer type
D. Part winding type

RME Board October 1994

49. Heating elements can be repaired by a ____ tube, which crimps the two broken elements together.

A. aluminum/nickel
B. aluminum
C. wire
D. nickel/silver

50. An alternating voltage has an equation e = 311 sin 314t, volts. The frequency of the alternating wave is _____.

A. 60 Hz
B. 40 Hz
C. 50 Hz
D. 30 Hz

$F = \frac{\omega}{2\pi} = \frac{314}{2\pi}$

TEST 20

PHILIPPINE ELECTRICAL CODE

1. Conductors passing from windows, doors, porches, fire escapes or similar locations shall maintain a horizontal clearance of _____.

   A. 1,000 mm
   B. 1,800 mm
   C. 1,500 mm
   D. 1,200 mm

2. The horizontal distance between two adjacent supporting points of a conductor.

   A. Sag
   B. Clearance
   C. Space
   D. Span

RME Board April 1995

3. What is the temperature rating of a TW insulated conductor?

   A. 60 °C
   B. 90 °C
   C. 75 °C
   D. 100 °C

4. The supply conductors that extend from the street main or from transformers to the service equipment of the premises supplied.

   A. Service drop
   B. Service conductors
   C. Service
   D. Service laterals

5. Concealed knob and tube wiring shall be supported at intervals NOT exceeding

   A. 1,200 mm
   B. 1,300 mm
   C. 1,500 mm
   D. 1,400 mm

6. A dead end of a busway shall be ____.

   A. open
   B. closed
   C. either A or B
   D. screened

RME Board April 1996

7. What is the diameter of a solid wire, which is equivalent to 5.5 mm^2?

   A. d = 2.26 mm
   B. d = 1.62 mm
   C. d = 1.75 mm
   D. d = 2.65 mm

$$d = \sqrt{\frac{4(5.5)}{\pi}}$$

8. A factory assembly of one or more conductors insulated with a highly compressed refractory mineral insulation and enclosed in a liquidtight and gastight continuous copper or alloy steel sheath.

   A. type MI
   B. type NMC
   C. type NM
   D. type MV

9. The combined cross-sectional area of all conductors or cables shall NOT exceed ____ percent of the internal cross-sectional area of the raceway.

   A. 50
   B. 60
   C. 40
   D. 70

10. No conductors larger than ____ shall be installed in cellular metal floor raceways.

    A. 100 mm^2
    B. 38 mm^2
    C. 50 mm^2
    D. 14 mm^2

11. In mobile homes, receptacle outlets shall not be installed within ____ of a shower or bathtub space.

    A. 760 mm
    B. 600 mm
    C. 500 mm
    D. 1,000 mm

12. Rigid non-metallic conduit shall be supported within _____of each box, cabinet, or other conduit termination.

    A. 900 mm

B. 760 mm
C. 800 mm
D. 600 mm

13. Every recreational vehicle site with electrical supply shall be equipped with at least one ____, 250-V receptacle.

A. 15 A
B. 20 A
C. 30 A
D. 10 A

14. A main disconnecting means shall be provided where fuses are used or where more than ____ circuit breakers are employed.

A. one
B. two
C. three
D. four

15. For three recreational vehicle sites, the demand factor for feeder and service entrance conductors shall be ____.

A. 100 %
B. 125 %
C. 95 %
D. 90 %

16. Conductors in open wiring on insulators shall be rigidly supported within ___ of a dead end connection to a rosette, lamp holder or receptacle.

A. 150 mm
B. 200 mm
C. 300 mm
D. 100 mm

17. Electrical metallic tubing smaller than ____ electrical trade size shall NOT be used.

A. 12 mm
B. 16 mm
C. 10 mm
D. 15 mm

RME Board October 1995

18. What is the maximum distance between open service conductor supports for a voltage of up to 300 V?

A. 2,000 mm
B. 1,000 mm

C. 1,500 mm
D. 1,300 mm

19. Concealed knob and tube wiring shall be permitted to be used _____.

A. for extensions of existing installations
B. in unfinished attic and roof spaces
C. in the hollow spaces of walls and ceilings
D. all of these

20. Type AC cable shall be secured by approved staples, straps hangers or similar fittings at intervals NOT exceeding _____.

A. 1,300 mm
B. 1,200 mm
C. 1,000 mm
D. 1,500 mm

RME Board April 1996

21. Where coaxial cable are attached to building, they should have a separation of at least _____ from electric light or power cables.

A. 100 mm
B. 50 mm
C. 250 mm
D. 200 mm

22. Type MC cable shall be permitted for systems in excess of ___.

A. 500 V
B. 1,000 V
C. 300 V
D. 600 V

23. For smooth sheath cables (type MC) with an external diameter of more than 38 mm, shall have a bending radius of NOT less than ____ times the metallic sheath of the cable.

A. 12
B. 10
C. 15
D. 8

24. Cables that are flame retardant and have limited smoke characteristics shall be permitted to be identified with the suffix _____.

A. FS
B. PS
C. LS
D. UL

25. Flat cable assembly shall be installed for _____.

    A. concealed work only
    B. exposed work only
    C. both A and B
    D. neither A or B

RME Board April 1994

26. The minimum clearance of service drops over sidewalks.

    A. 8 ft
    B. 14 ft
    C. 10 ft
    D. 12 ft

27. The overall covering of type NM (non-metallic sheathed) cable shall be

    A. flame retardant and moisture resistant
    B. flame retardant and fungus resistant
    C. flame retardant and corrosion resistant
    D. none of these

28. An assembly of two pieces of insulating material provided with grooves for holding one or more conductors at a definite spacing from the surface wired over and from each other, and with holes for fastening in position.

    A. Cleat
    B. Split knob
    C. Spool insulator
    D. Gutter

29. Type TC (power and control tray) cable shall be permitted to be used in any of the following EXCEPT one. Which one is this?

    A. in raceway
    B. in cable trays in hazardous (classified) locations
    C. for power, lighting, control, signal and communication circuits
    D. where exposed to direct rays of the sun

RME Board April 1996

30. A phase converter is usually employed to convert single-phase to three-phase power supply so that three-phase motors maybe used. For this service, the PEC specifies that the single –phase conductors shall have an ampacity of NOT less than ____ of the full load current rating of motor or load being served where the input and the output voltages are identical.

    A. 173 %
    B. 240 %
    C. 216 %
    D. 350 %

31. The smallest electrical trade size for rigid non-metallic conduit is ____.

    A. 15 mm
    B. 12 mm
    C. 25 mm
    D. 20 mm

32. Where flexible metal conduit is installed as a fixed raceway, it shall be secured within ____ on each side of every outlet box.

    A. 300 mm
    B. 150 mm
    C. 200 mm
    D. 100 mm

33. Whose signatures are needed in the application form for an electrical permit?

    A. Owner or authorized representative
    B. PEE who signed and sealed the electrical plan
    C. Electrical practitioner in-charge of the installation
    D. All of these

RME Board October 1995

34. In the installation of power resistors, a thermal barrier shall be required if the space between the resistors and any combustible material is less than ____mm. What is this minimum clearance?

    A. 150 mm
    B. 300 mm
    C. 200 mm
    D. 250 mm

35. Splices and taps shall be made only in _____.

    A. pull boxes
    B. panelboards
    C. cut-out boxes
    D. junction boxes

36. The size of conductors in cablebus system shall be in no case smaller than

    A. 38 mm^2
    B. 50 mm^2
    C. 60 mm^2
    D. 100 mm^2

37. Electrical non-metallic tubing shall be firmly fastened within ____ of each outlet box, junction box, cabinet or fittings.

    A. 300 mm

B. 600 mm
C. 900 mm
D. 1,000 mm

RME Board October 1995

38. In estimating the loading of a branch circuit, what loading shall be used for each receptacle?

A. 160 volt-ampere
B. 120 volt-ampere
C. 180 volt-ampere
D. 150 volt-ampere

39. Nails where used as a fastening means, shall be permitted to pass through the interior of the enclosure if located within ____ of the back or ends of the enclosure.

A. 6.4 mm
B. 8.0 mm
C. 6.0 mm
D. 7.5 mm

40. The conductors including splices and taps shall NOT fill the auxiliary gutter to more than ___ of its area.

A. 70 %
B. 80 %
C. 75 %
D. 60 %

41. A space of ____ or more shall be provided between the top of any switchboard and any combustible ceiling.

A. 1,500 mm
B. 1,000 mm
C. 1,200 mm
D. 1,800 mm

RME Board April 1995

42. What is the minimum insulation resistance of a building's electrical wiring for circuits using 2.0 mm^2 or 3.5 mm^2 conductors?

A. 500,000 ohms
B. 250,000 ohms
C. 1,000,000 ohms
D. 750,000 ohms

43. Not more than ___ overcurrent devices of a lighting and appliance branch circuit panelboard shall be installed in any cabinet or cutout box.

A. 42
B. 50
C. 45
D. 48

44. For non-insulated busbars, the minimum spacing between it and the bottom of the enclosure shall be ____.

A. 255 mm
B. 250 mm
C. 240 mm
D. 205 mm

45. A form of air switch in which the moving element is a hinged blade wedge between stationary contact blades when closed.

A. Snap
B. Knife
C. Safety
D. Toggle

46. Open conductors passing over residential driveways and those commercial areas not subject to truck traffic where the voltage is limited to 300 V to ground shall maintain a vertical distance of ____.

A. 3,100 mm
B. 4,600 mm
C. 3,700 mm
D. 5,500 mm

RME Board April 1994

47. In wiring using rigid metal conduits, conduit smaller than ____ shall not be used.

A. 15 mm
B. 32 mm
C. 8 mm
D. 25 mm

48. Operation for alternate intervals.

A. Periodic duty
B. Short time duty
C. Varying duty
D. Intermittent duty

49. Festoon lighting is a string of outdoor lights suspended between two point more than ____ apart.

A. 4,000 mm
B. 3,800 mm

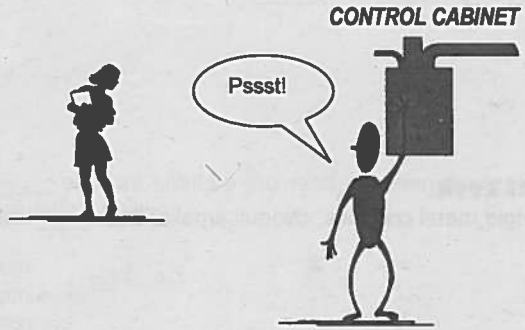
A. 4,500 mm
B. 5,000 mm

50. From signs, chimneys, radio and television antennas or similar, clearances through vertical, diagonal and horizontal shall be NOT less than _____.

A. 1,000 mm
B. 1,100 mm
C. 1,200 mm
D. 900 mm

Master Electricians' work tip:

.....Before opening an enclosure door or cover, wipe it off, especially the top. This helps keeps dirt and dust out of an enclosure and away from working parts.



TEST 21

TECHINCAL SUBJECT

1. A relay has a resistance of 30 ohms and an operating current of 0.8 A, how much power is required in order to operate the relay?

A. 24 W
B. 37.5 W
C. 19.2 W
D. None of these

2. Autotransformers used to start large induction motors are frequently called starting _____.

A. reactor
B. autotransformer
C. compensator
D. winding

RME Board October 1996

3. A starter resistor is necessary to start a DC motor because

A. it limits the speed
B. it limits the back emf
C. it starts the motor
D. it limits the starting current to a safe value

RME Board April 1996, RME Board October 1996

4. If a motor overheats, it must be due to

A. misaligned
B. low voltage
C. open circuited field
D. loose parts

5. The ____of an AC wave is the time in seconds required to complete exactly one cycle of the wave pattern.

A. wavelength
B. period
C. frequency
D. time constant

6. How is AC converted to DC?

   A. By means of a regulator
   B. By means of a clamping circuit
   C. By means of a rectifier
   D. All of these

7. Cells are connected in series to

   A. increase the current rating of the combination
   B. decrease the internal resistance of the combination
   C. increase the voltage rating of the combination
   D. increase the power rating of the combination

8. Two resistors of 10 and 15-ohm resistances are connected in series across a 60-V supply. What percent of the total power drawn is dissipated in the 10-ohm resistance?

   A. 40 %
   B. 48 &
   C. 64 %
   D. 36 %

RME Board October 1995, RME Board October 1996

9. An electric motor drives a mechanical load, taking 18.8 A from a 230 V source. Calculate the power input of the motor.

   A. 4,364 W
   B. 4,536 W
   C. 5,825 W
   D. 4,324 W

10. How many 1.5 outlets are permitted on a 20-A, 120-V, branch circuit used at continuous duty?

    A. 10
    B. 12
    C. 13
    D. None of these

11. An inductive circuit has a resistance of 100 ohms and an inductance of 2 henries. What is the impedance of the combination at w = 377 radians per second?

    A. 754 ohms
    B. 761 ohms
    C. 682 ohms
    D. None of these

12. Find the amperage of a 1,500 VA load on a 120-V, 1-phase branch circuit?

    A. 12.5 A
    B. 8.66 A
    C. 12 A
    D. None of these

RME Board October 1994

13. The magnetizing current for the field of an alternator is usually supplied by

    A. a battery
    B. a DC magnet
    C. a DC generator
    D. a pulse generator

14. In order to achieve maximum power transfer, load resistance should be ___ generator's internal resistance.

    A. greater than
    B. lower than
    C. equal to
    D. lower than or greater than but not equal to

RME Board October 1996

15. What is the most common type of motor that can be used for either AC or DC?

    A. Series motor
    B. Repulsion motor
    C. Shunt motor
    D. Shaded pole motor

16. The field winding of a self-excited generator is supplied from _____

    A. a battery
    B. an external rectifier
    C. its own generated emf
    D. a DC generator

17. Instrument use to measure specific gravity of the liquid in a storage battery.

    A. Micrometer
    B. Hydrometer
    C. Calorimeter
    D. Viscometer

18. A resistance wire wrapped around an insulating core.

    A. Film-type
    B. Fusible type
    C. Carbon composition
    D. Wire wound

19. If the length of the wire is doubled and the cross sectional area is reduced to one-half, the resistance of the wire will be _____.

    A. quadrupled
    B. halved
    C. doubled
    D. quartered

$$\frac{R_1}{R_2} = \frac{L_1 A_2}{L_2 A_1}$$

RME Board October 1996

20. The range of a moving iron AC ammeter is extended by

    A. a multiplier
    B. changing number of turns of operating coil
    C. a shunt
    D. none of these

21. In parallel circuit, the voltage across each branch is ____ the source voltage.

    A. lesser than
    B. greater than
    C. equal to
    D. all of these (dependent on size of load)

22. How many 1.5 outlets are permitted on a 20-A, 120-V, branch circuit used at noncontinuous duty?

    A. 13
    B. 12
    C. 10
    D. None of these

23. A 10-ohm resistor, a 2-H inductor and a 25-μF capacitor are connected in series. What current will be drawn if the circuit is connected across a 200-V, 60-cps supply?

    A. 0.50 A
    B. 0.30 A
    C. 0.25 A
    D. 0.15 A

24. A copper transmission line is to be replaced by one of aluminum having the same total resistance. If the cross sectional area of the copper wire is 500 MCM, what would be the cross sectional area of the new aluminum wire?

    A. 800 MCM
    B. 820 MCM
    C. 850 MCM
    D. None of these

$$\frac{R_1}{R_2} = \frac{\rho_1 A_2}{\rho_2 A_1}$$

25. If the potential across a circuit is 40 V and the current is 5,000 mA, what is the equivalent resistance of the circuit?

    A. 80 Ω
    B. 800 kΩ
    C. 8 Ω
    D. None of these

RME Board October 1995, RME Board October 1996

26. The frequency of an AC generator running at 600 rpm is 50 Hz. What is the number of poles?

    A. 6 poles
    B. 8 poles
    C. 10 poles
    D. 12 poles

27. An ideal coil of inductance 10 mH carries a constant current of 2 A. How much energy is stored in the coil?

    A. 0.02 J
    B. 0.01 J
    C. 0.04 J
    D. 0.08 J

28. In a single-phase power station the voltmeter and ammeter indicate 110 volts and 50 A respectively, while the wattmeter reads 3,310 watts. What is the power factor of the load being served?

    A. 70 %
    B. 80 %
    C. 50 %
    D. 60 %

$$pf = \frac{P}{EI}$$

RME Board October 1996

29. Which resistor is physically larger in size?

    A. 100 ohms, 10 W
    B. 1 kilohm, 1 W
    C. 10 ohms, 50 W
    D. 1 megohm, 1/2 W

30. Find the amperage of a 10,000 VA load on a 208 V, 3-phase branch circuit?

    A. 31.53 A
    B. 22.84 A
    C. 17.75 A
    D. None of these

31. A capacitive reactance of 48 ohms at 60 Hz shall mean a capacitance of ___.

A. 5.526 μF
B. 55.26 μF
C. 552.6 μF
D. none of these

32. The resistance of an electrical conductor is inversely proportional to _____.

A. its diameter
B. its cross sectional area
C. both A and B
D. neither A or B

33. Synchronous motors always run at speed ____ the synchronous speed.

A. less than
B. greater than
C. either A or B
D. neither A or B

34. An autotransformer is used in starting a large induction motor in order to

A. reduce the line voltage at starting
B. step-up the line voltage at starting
C. either A or B
D. neither A or B

RME Board April 1996, RME Board October 1996

35. A 25 kVA, 2400 /240 volt transformer has a primary current of 10 A. What is the secondary current?

A. 0.10 A
B. 100 A
C. 20 A
D. 50 A

36. Which of the following AC motors has a DC armature winding with a commutator and a centrifugal switch in its rotor?

A. Split-phase capacitor start motor
B. Shaded-pole induction motor
C. Wound rotor induction motor
D. Repulsion start induction run motor

37. Capacitors designed to be used in places where a high dielectric breakdown voltage is important.

A. Paper capacitors
B. Ceramic capacitors
C. Electrolytic capacitors
D. Mica capacitors

38. A device used to protect the motors for overcurrent due to excessive load.

A. fuse
B. disconnect
C. magnetic contactor
D. overload relay

39. Peak value of an AC wave is the same as

A. effective value
B. instantaneous value
C. maximum value
D. rms value

RME Board April 1995

40. Using a 5-hp motor plugged at 230-V line, find the current flowing in the circuit.

A. 17.33 A
B. 16.5 A
C. 17.314 A
D. 16.217 A

41. At no load the terminal voltage of an alternator is 530 V. At rated load, the voltage drops to 480 V. Calculate is the percentage voltage regulation of the machine.

A. 10.42 %
B. 9.43 %
C. 90.56 %
D. 12.52 %

42. This is a factor related to the cleanliness of the lamp including room, shade, reflector, etc.

A. Coefficient of utilization
B. Depreciation factor
C. Quality factor
D. Usage factor

RME Board April 1995

43. A tramway motor takes an average current of 32 A at 440 volts. What is the power absorbed in kW?

A. 8.14 kW
B. 14.08 kW
C. 4.18 kW
D. 6.25 kW

44. Askarel is a nonflammable, chemically stable, non-sludging synthetic liquid. Askarel is sold under which of the following trade names?

A. Inerteen
B. Pyranol
C. Chlorextol
D. All of these

45. In a parallel circuit, the total resistance is _____.

A. the sum of all the resistances
B. the reciprocal of all the resistances
C. larger than the largest resistance in the combination
D. smaller than the smallest resistance in the combination

46. The total voltage and amperage of four 0.5 A, 1.5 V cells connected in series

A. 1.5 V, 0.5 A
B. 6 V, 0.5 A
C. 1.5 V, 2 A
D. 6 V, 0.5 A

RME Board April 1994

47. The power factor rating of an inductive reactive circuit can be increased by adding

A. coils
B. fuses
C. inductors
D. capacitors

48. Reciprocal of reactance.

A. Susceptance
B. Conductance
C. Admittance
D. Elastance

49. The power rating of resistors are determined through their _____.

A. color bands
B. type
C. physical size
D. all of these

50. The negative plate of a nickel-iron storage battery is _____.

A. steel
B. nickel
C. iron
D. lead

TEST 22

PHILIPPINE ELECTRICAL CODE

1. Contact device installed at the outlet for the connection of a single attachment plug.

A. Junction box
B. Reactor
C. Rosette
D. Receptacle

RME Board April 1996

2. With respect to the safety value of the insulation on electrical maintenance tools, it can be said properly that

A. the insulation provides very little real protection
B. its value is mainly to the untrained electrician helper
C. the insulation should not be used as the only protective measure
D. it adequately insures the safety of the user

3. For ranges of 8.75 kW or more in rating, the minimum branch circuit rating shall be ___.

A. 30 A
B. 40 A
C. 50 A
D. 60 A

4. Service heads and goosenecks in service entrance cable shall be ___ point of attachment of the service drops to the building.

A. above the
B. below the
C. at the center of the
D. at the back of the

5. A disruptive discharge around or over the surface of a solid or liquid insulator.

A. Flashover
B. Sparkover
C. Corona
D. Surge

6. The minimum size of service lateral conductors using copper wires shall be __.

   A. 5.5 mm^2
   B. 3.5 mm^2
   C. 8.0 mm^2
   D. 2.0 mm^2

7. Plug fuses shall not be installed in circuits exceeding ____ between conductors.

   A. 125 V
   B. 250 V
   C. 300 V
   D. 150 V

RME Board April 1995

8. A continuous electrical load is one where the maximum current is expected to continue for a minimum duration of time. What is this minimum duration of time?

   A. 1 hour
   B. 4 hours
   C. 3 hours
   D. 2 hours

9. Direct buried conductors and cables emerging from the ground shall be protected by enclosures or raceways extending from the minimum cover distance required to a point ___ above finished grade.

   A. 2,000 mm
   B. 2,500 mm
   C. 2,400 mm
   D. 3,000 mm

10. For installations to supply only limited loads of a single branch circuit, service entrance conductors shall NOT be smaller than ____ hard drawn copper.

    A. 3.5 mm^2
    B. 8.0 mm^2
    C. 5.5 mm^2
    D. 14.0 mm^2

11. The upper most portion of a lightning protection system.

    A. Surge Arrester
    B. Lightning rod
    C. Ground terminal
    D. Air terminal

12. Where no standard electrical equipment of the exact size or rating required is available, _____ maybe used.

    A. the next lower standard size
    B. the next larger standard size
    C. any size available
    D. none of these

RME Board April 1995

13. The minimum size of service drop copper conductors allowed by the Philippine Electrical Code is one of the following. Which is this size?

    A. 3.5 mm^2
    B. 5.5 mm^2
    C. 2.0 mm^2
    D. 8.0 mm^2

14. Entrances to rooms and other guarded locations containing exposed energized parts shall be marked with a _____.

    A. welcome sign
    B. no entry sign
    C. warning sign
    D. all of these

15. Appliance outlets installed in a dwelling unit for specific appliances, such as laundry equipment, shall be installed within ___ of the intended location of the appliance.

    A. 1,800 mm
    B. 1,500 mm
    C. 2,000 mm
    D. 1,000 mm

16. What is the maximum permitted load of a 20-A branch circuit?

    A. 20 A
    B. 15 A
    C. 12 A
    D. 16 A

17. For warehouses or storage, a general lighting load of ____ shall be used.

    A. 2 VA/m^2
    B. 4 VA/m^2
    C. 8 VA/m^2
    D. 10 VA/m^2

18. Outlets for heavy-duty lamp holders shall be rated ____.

    A. 500 VA
    B. 600 VA
    C. 660 VA

D. 550 VA

RME Board October 1996

19. When fastening an outlet to a brick wall, the electrician should use one of the following. Which one is this?

A. Expansion bolts
B. Toggle bolts
C. Temporary nail
D. Wooden plug and nail

20. A portion of a lightning protection system extending into the earth.

A. Air terminal
B. Counterpoise
C. Surge arrester
D. Ground terminal

21. Open conductors passing over public streets, alleys, roads, parking areas subject to truck traffic shall maintain a vertical height ___ from finished grade.

A. 3,700 mm
B. 4,600 mm
C. 5,500 mm
D. 3,100 mm

22. Using copper, the minimum size of service entrance conductors shall be ___.

A. 14.0 mm^2
B. 8.0 mm^2
C. 5.5 mm^2
D. 3.5 mm^2

RME Board October 1996

23. When testing the insulation integrity of a new or old electrical wiring installation circuit of 5.5 mm^2 conductors, the Code specifies a minimum insulation resistance of what value?

A. 1,000,000 ohms
B. 250,000 ohms
C. 500,000 ohms
D. 100,000 ohms

24. What test is usually made on cables after installation?

A. Copper loss test
B. No-load test
C. Insulation resistance test
D. Ampacity test

25. For four to six conductors in a conduit, the derating factor for the conductor ampacity is ____.

A. 70 %
B. 90 %
C. 80 %
D. 60 %

RME Board October 1996

26. When soldering two copper surfaces together, they should be kept clean while heating by

A. applying the solder quickly
B. not admitting the open flame to touch the copper surfaces
C. frequently rubbing the tip with emery cloth
D. the use of flux

27. Circuits with a voltage of 600 V or less in a rigid metal conduit or in a rigid metal conduit or in a rigid non-metallic conduit approved for direct burial and placed under driveways and parking areas of a one or two family dwelling units, shall have a minimum cover distance of ____.

A. 300 mm
B. 150 mm
C. 460 mm
D. 600 mm

28. Plate electrodes of non-ferrous metal shall be at least ___ in thickness.

A. 1.2 mm
B. 1.0 mm
C. 1.5 mm
D. 1.8 mm

29. Conductors are selected at not less than ___ of the nameplate rating of the water heater.

A. 125 %
B. 100 %
C. 120 %
D. 130 %

30. The Philippine Electrical Code requires that no electrical installation, alteration or addition shall be connected or reconnected to any electrical power supply without _____.

A. payment of application fees
B. a certificate of inspection
C. an electrical permit
D. a certificate of completion

31. Neutral current up to ___ is computed at 100 %.

    A. 100 A
    B. 150 A
    C. 200 A
    D. 300 A

RME Board October 1996

32. In general, layout of motors and power outlets not exceeding a total of ___ maybe included in the lighting layout provided such inclusion will not make the reading, interpretation and or checking of the said plan difficult.

    A. 8
    B. 10
    C. 12
    D. 6

33. Direct grade level access is defined as being located not more than ____ above grade level and being readily accessible.

    A. 2,000 mm
    B. 1,500 mm
    C. 1,800 mm
    D. 2,500 mm

34. For armories and auditoriums, the general lighting load shall be ___ VA/m^2.

    A. 8
    B. 12
    C. 10
    D. 16

RME Board October 1996

35. Before an ammeter is disconnected from an energized current transformer circuit, one of the procedures should be followed. Which one is this?

    A. Primary winding should be shorted
    B. Secondary winding should be shorted
    C. Secondary winding should be opened
    D. Primary winding should be opened

36. Power conductors on poles, below communication conductors shall maintain a spacing distance of ____.

    A. 760 mm
    B. 600 mm
    C. 800 mm
    D. 540 mm

37. It is the intent of the PEC that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment EXCEPT

    A. to test for continuity
    B. to test for durability
    C. to detect alterations or damages
    D. all of these

38. The standard conductor sizes shall be expressed in

    A. mils
    B. circular mils
    C. square millimeters
    D. American wire gauge

39. Mandatory rules of the PEC are characterized by the use of the word ____.

    A. shall
    B. should
    C. both A and B
    D. neither A or B

RME Board April 1996

40. Give the minimum vertical clearance from finished grade of a service drop conductor installed between buildings on residential properties and driveways?

    A. 5,500 mm
    B. 4,600 mm
    C. 3,700 mm
    D. 3,100 mm

41. Where a neutral is NOT available, the grounding impedance shall be installed between the _____.

    A. grounding electrode and any of the current carrying conductor
    B. grounding electrode and the neutral derived from a grounding transformer
    C. grounding electrode and the system neutral of other station
    D. all of these

42. The voltage developed between the portable or mobile equipment frame and ground by the flow of maximum ground fault current shall NOT exceed ____.

    A. 100 V
    B. 50 V
    C. 150 V
    D. 30 V

43. A single electrode consisting of a rod, pipe or plate shall have a resistance to ground of ____ or less.

    A. 20 ohms
    B. 15 ohms
    C. 25 ohms
    D. 30 ohms

44. Where more than one electrode is used, each electrode of one grounding system shall NOT be less than ___ from any other electrodes of another grounding system.

    A. 1,800 mm
    B. 2,000 mm
    C. 2,400 mm
    D. 1,900 mm

RME Board April 1995

45. Who shall make the final decision in the interpretation of controversial provisions of the Philippine Electrical Code?

    A. IIEE Board of Governors
    B. Board of Electrical Engineering
    C. Building Official
    D. IIEE Code Committee

46. For equipment protected by a 20-A overcurrent device, the minimum size of equipment grounding conductor using copper shall be _____.

    A. 2.0 mm^2
    B. 3.5 mm^2
    C. 1.25 mm^2
    D. 5.5 mm^2

47. The height of air terminals shall be such as to bring the tip not less than ___ above the object to be protected for 6,000-mm maximum intervals.

    A. 250 mm
    B. 254 mm
    C. 300 mm
    D. 150 mm

48. The minimum clearance between the overhead ground wires and the highest protection on the protected structure shall be _____.

    A. 1,600 mm
    B. 1,500 mm
    C. 1,800 mm
    D. 1,700 mm

RME Board April 1994, RME Board April 1995

49. S_2 means

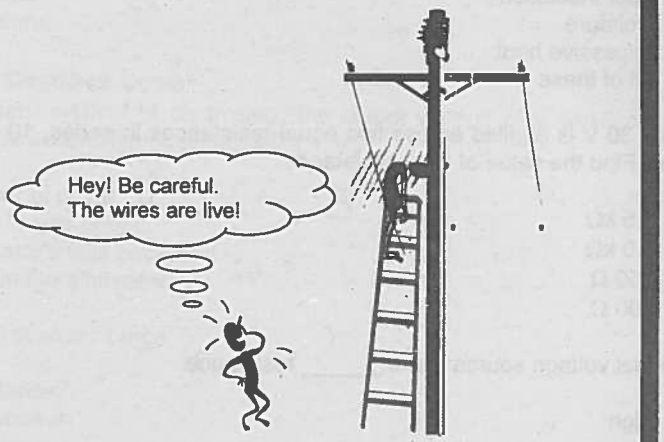
    A. duplex switch
    B. two-pole switch
    C. 2-way switch
    D. two-throw switch

50. Which of the following conductors is applicable only on dry locations?

    A. type THW
    B. type THWN
    C. type RH
    D. None of these

Master Electricians' work tip:

.....Do not work on live circuits with wet hands, body or clothing. This is very dangerous due to our body resistance will decrease when it is wet. or moist. And with low resistance, during accidental contact to live parts, large current (even fatal) may flow towards our body.



TEST 23

TECHINCAL SUBJECT

1. The resistance of a conductor varies ____ when the volume is fixed.

   A. directly as the length
   B. directly as the square of the length
   C. inversely as the length
   D. inversely as the square of the length

RME Board October 1995, RME Board April 1996

2. Sparking between contacts can be reduced by

   A. inserting a capacitor in series with the contacts
   B. inserting a capacitor in parallel with the contacts
   C. inserting a resistance in the line
   D. all of these

3. Which of the following is one of the common sources of machine breakdown?

   A. Poor insulation
   B. Moisture
   C. Excessive heat
   D. All of these

4. When 30 V is applied across two equal resistances in series, 10 mA of current flows. Find the value of each resistance.

   A. 1.5 kΩ
   B. 3.0 kΩ
   C. 150 Ω
   D. 300 Ω

5. An ideal voltage source has a _____ resistance.

   A. high
   B. low
   C. either A or B
   D. neither A or B

6. A 60 Hz frequency has an angular speed of _____.

   A. 314 radians per second

   B. 120 radians per second
   C. 377 radians per second
   D. 188 radians per second

RME Board October 1995

7. The following factors affect the required interrupting rating of a circuit breaker to be installed in a switchboard. Which one is NOT one of them?

   A. Size and length of the service drop conductors
   B. Size of the source transformer
   C. Voltage
   D. Frequency

8. Electrical diagram showing the control components rearranged to simplify the tracing of the circuit.

   A. Ladder diagram
   B. Schematic diagram
   C. Wiring diagram
   D. Pneumatic diagram

9. Three 100-ohm resistors are connected in wye configuration. What will be the ohmmeter reading if the terminals of the meter are connected between any two-line terminals of the wye connection?

   A. 67.7 ohms
   B. 300 ohms
   C. 50 ohms
   D. 200 ohms

RME Board October 1994

10. The standard method of controlling the output voltage of a 440-V, 60 Hz AC generator is accomplished by adjusting the

    A. number of poles
    B. prime mover speed
    C. alternator's field excitation
    D. load on the alternator

11. Reciprocal of capacitance.

    A. Inductance
    B. Elastance
    C. Reluctance
    D. Daraf

12. It is basically a mercury lamp with a certain innovation of its arc tube.

    A. Metal halide lamp
    B. Incandescent lamp

C. Neon lamp
D. Sodium lamp

13. A resistor with a color-coded value of 100 ohms and ±10% tolerance can have a expected measured resistance between _____.

A. 100 to 110 ohms
B. 99 to 101 ohms
C. 90 to 110 ohms
D. None of these

RME Board October 1996

14. The function of a protective relay in a circuit breaker is to

A. ground any stray voltages
B. to close the contacts when actuating quantity reaches a certain predetermined value
C. to provide additional safety in the operation of circuit breaker
D. to limit the arcing current during the operation of a circuit

15. Which of the following is NOT a factor that controls the generated emf of a generator?

A. Speed
B. Flux
C. Yoke
D. None of these

16. A non-polarized electrolytic capacitor actually contains two capacitors connected internally in _____ polarity.

A. series-aiding
B. series-opposing
C. parallel-aiding
D. parallel-opposing

RME Board October 1996

17. Select the poorest conductor of electricity

A. Carbon
B. Steel
C. Aluminum
D. Silver

18. Which of the following is a typical resistance and power rating of a carbon composition resistor?

A. 4,700 Ω, 1 W
B. 100 Ω, 5 W
C. 1,000 Ω, 10 W
D. 6,800 Ω, 100 W

19. A device which controls the gate or valve opening of the generator prime mover.

A. Contactor
B. Regulator
C. Governor
D. Converter

20. The capacitance of a capacitor is NOT affected by _____.

A. type of dielectric material
B. distance between plates
C. area of the plates
D. type of material used in the plates

21. The smallest size of a dry cell.

A. Size AAA
B. Size C
C. Size D
D. Size AA

RME Board October 1995

22. An applicant for registered master electricians' examination must as at least completed ____ of a five year Bachelor of Science in Electrical Engineering program and has a specific record of ___ practice in electrical wiring and installation.

A. 3 years, 2 years
B. 2 years, 1 year
C. 3 years, 1 year
D. 2 years, 2 years

23. Initial flux needed by a self-excited DC generator in order to build-up a voltage.

A. Residual flux
B. Saturation flux
C. Leakage flux
D. Effective flux

24. Five 1.5-V cells are connected in series. If the internal resistance of each cell is 0.25 ohm, what external load resistance will produce a current of 2 A through the cells?

A. 2.5 Ω
B. 3.0 Ω
C. 1.75 Ω
D. 2.25 Ω

25. A 6-ohm resistor is connected in parallel with another resistor R. If the equivalent resistance of the combination is 3 ohms, how much is R?

A. 6 ohms
B. 4 ohms
C. 5 ohms
D. 3 ohms

26. An active element on a circuit is the one that ____ to the circuit.

A. supplies energy
B. receives the energy supplied
C. both A and B
D. neither A or B

RME Board October 1994

27. If a magnetic field is cut across by a coil of conductor_____ is generated between the ends of the conductor.

A. electromotive force
B. resistance
C. stronger magnetic field
D. capacitance

28. A motor with short-circuited copper or aluminum bars pressed or embedded into the rotor slots.

A. Repulsion start induction run motor
B. Universal motor
C. Shunt wound motor
D. Squirrel cage induction motor

RME Board April 1994

29. Electric resistances of 7 and 11 ohms are connected in parallel. This combination is then placed in series with a single resistance of 15 ohms and the entire combination is placed across a 110 V DC mains, what current passes through the 15-ohm resistance?

A. 5.71 A
B. 3.17 A
C. 4.27 A
D. 6.77 A

RME Board October 1995

30. A 2-pole AC generator is running at 1,500 rpm. What is the frequency?

A. 25 Hz
B. 60 Hz
C. 50 Hz
D. None of these

31. When the mechanical load is removed, which of the following motors run at high speed?

A. Shunt motor
B. Differential Compound motor
C. Cumulative Compound motor
D. Series Motor

32. A transformer has a voltage ratio E_1 / E_2 equal to a. what is the current ratio I_1 / I_2 equal to?

A. a
B. $1 / a$
C. a^2
D. $1 / a^2$

33. Which of the following DC generators are suitable for running in parallel operation due its drooping voltage characteristics?

A. Series generators
B. Compound generators
C. Shunt generators
D. All of these

34. Preferred test used to check switchgear insulation?

A. DC high potential test
B. Megohmmeter test
C. AC high potential test
D. Varley loop test

35. The resistance of a kilometer of wire is 50 ohms. What is the resistance of this wire if the length is only 600 meters?

A. 30 ohms
B. 83.3 ohms
C. 12 ohms
D. None of these

36. Three resistances of 10, 4 and 6 ohms respectively are connected across each other. If the 6-ohm resistor is shorted, what is their equivalent resistance?

A. 1.9 ohms
B. zero
C. 2.85 ohms
D. None of these

37. Electrons in the last orbit of an atom.

A. Bound electrons

B. Free electrons
C. Valence electrons
D. None of these

RME Board April 1995

38. A single phase AC motor has a full load current of 30 A. The rating of the two fuses for line protection is

A. 60 A
B. 100 A
C. 30 A
D. 90 A

39. If the multiplier of the resistor is a silver color, the ohmic value of the resistor is expected to be _____.

A. greater than I ohm
B. less than 1 ohm
C. either A or B
D. neither A or B

40. Short circuit test on transformer is used to determine _____.

A. transformation ratio
B. equivalent parameters on the high side
C. polarity of transformer terminals
D. all of these

RME Board April 1994, RME Board April 1995

41. The resistance of a conductor, when its temperature is increased,

A. remains constant
B. varies
C. increases
D. decreases

42. Three capacitors of 5, 10 and 15 μF respectively are connected in series across a 100-V supply. Solve for the voltage across the 15-μF capacitor.

A. 54.5 V
B. 27.3 V
C. 18.2 V
D. 37.5 V

43. Magnetic lines of force.

A. Electromotive force
B. Magnetomotive force
C. Lumen
D. Flux

44. A new fully charged lead-acid cell will measure

A. exactly 12 V
B. more than 12 V
C. below 12 V
D. none of these

45. The symbol S_M means what type of switch?

A. main switch
B. manual switch
C. remote control switch
D. master selector switch

46. Motors commonly used in home appliances such as blenders, mixers, etc.

A. Universal motor
B. Capacitor start motor
C. *Capacitor start and run motor*
D. Compound motor

RME Board April 1994

47. If the current from a short-circuited 1.5 V dry cell is 25 A, what is the internal resistance of the cell?

A. 16.67 ohms
B. 6.67 ohms
C. 0.06 ohm
D. None of these

48. What is the purpose of the poles and winding in a generator?

A. To cut down the magnetic flux lines
B. To neutralized the effect of armature reaction
C. To produce magnetic flux lines
D. All of these

49. A variable resistance resistor with three terminals.

A. Resistance box
B. Potentiometer
C. Rheostat
D. Varistor

50. The condition of a liquid electrolyte in a battery is measured in terms of its

A. specific gravity
B. viscosity
C. acidity
D. water content

TEST 24

PHILIPPINE ELECTRICAL CODE

1. Enclosures for overcurrent devices shall be mounted in _____ position.

   A. horizontal
   B. vertical
   C. diagonal
   D. any

RME Board October 1995

2. What is the minimum depth of clear working space in front of a switchboard rated at 4,160 volts, where there are exposed energized parts on both sides of the workspace?

   A. 1,000 mm
   B. 1,900 mm
   C. 1,600 mm
   D. 2,000 mm

3. A 2.0 mm^2 TW copper conductor has an ampacity equal to ____.

   A. 20 A
   B. 10 A
   C. 15 A
   D. 25 A

4. Circuits with a voltage of 600 V or less in a rigid non-metallic conduit approved for direct burial without concrete encasement and placed in trench below a 50 mm thick concrete or equivalent shall have a minimum cover distance of ____.

   A. 300 mm
   B. 400 mm
   C. 460 mm
   D. 200 mm

5. A single enclosed raceway for conductors or cables.

   A. Box
   B. Duct
   C. Cabinet
   D. Gutter

RME Board April 1996

6. Which of the following statements is NOT correct?

   A. The use of an inductive ballast for fluorescent lamps is usually because it is the most efficient
   B. Lighting fixtures having exposed ballasts shall be so installed that they will not be in contact with combustible materials
   C. A ballast which incorporates an autotransformer to raise the voltage to more than 300 V shall be supplied only by a supply system which is grounded
   D. A receptacle outlet installed outdoors shall be located so that water accumulation is not likely to touch the outlet cover or plate

7. Conductor crossings of more than ___ type FCC cable runs shall NOT be permitted.

   A. two
   B. three
   C. four
   D. five

8. A generator set used for standby power systems shall have a time delay feature permitting a ___-minute setting to avoid retransfer in case of short time reestablishment of the normal source.

   A. 10
   B. 8
   C. 12
   D. 15

9. Rigid metal conduit shall be firmly fastened within ____ of each outlet box.

   A. 800 mm
   B. 900 mm
   C. 760 mm
   D. 600 mm

10. Type TW conductors have a maximum operating temperature of ___.

    A. 75 °C
    B. 50 °C
    C. 60 °C
    D. 90 °C

11. Type UF cable shall be permitted for use _____.

    A. underground including direct burial to earth
    B. underground but concealed with a rigid metal conduit
    C. underground but not direct burial to earth
    D. none of these

12. Enclosures of metal for electrodes of electric discharge tubings shall NOT be less than ____ thick sheet metal.

    A. 0.40 mm
    B. 0.35 mm
    C. 0.45 mm
    D. 0.50 mm

RME Board October 1996

13. A general-purpose single-phase motor rated 0.5 hp has a current rating of 5A. What should be the setting of the overload relay that is installed to protect the motor? Assume the service factor of the motor to be 1.0.

    A. 5.75 A
    B. 5.5 A
    C. 5.0 A
    D. 6.25 A

14. The grounded conductor of type FC (flat conductor) cable shall be identified by means of a distinctive and durable white or_____ marking.

    A. green
    B. natural gray
    C. brown
    D. yellow stripe

15. For multiple motors on a single crane or hoist, the minimum circuit ampacity of the power conductors shall be the nameplate full load ampere rating of the largest motor for any single crane motion, plus ___ percent of the nameplate full load ampere rating of the next largest motor.

    A. 25 %
    B. 30 %
    C. 40 %
    D. 50 %

16. Individually covered or insulated grounding conductors shall have a continuous outer finish that is either green, or green with one or more ____ stripes.

    A. white
    B. gray
    C. yellow
    D. violet

17. Intermediate metal conduit shall be shipped in standard lengths of _____.

    A. 5,000 mm
    B. 4,000 mm
    C. 2,000 mm
    D. 3,000 mm

18. The smallest copper conductor of type MC cable shall be _____.

    A. 2.0 mm^2
    B. 1.25 mm^2
    C. 0.75 mm^2
    D. 3.5 mm^2

RME Board April 1996

19. If a bare live conductor is touched accidentally, the severity of the electric shock is determined primarily by

    A. the size of the conductor
    B. the type of the power supply, whether AC or DC
    C. the contact resistance between the bare wire and the person at the point of contact
    D. the current flowing in the conductor

20. Smallest electrical trade size for flexible metal conduit.

    A. 15 mm
    B. 20 mm
    C. 25 mm
    D. 10 mm

21. As applied to circuit breaker, a term indicating there is purposely introduced a delay in the tripping action of the CB.

    A. Delay-on
    B. Adjustable trip
    C. Inverse time
    D. Delay-off

22. A factory assembly of one or more conductors each individually insulated and enclosed in a loose fit non-metallic flexible conduit as an integrated gas spacer.

    A. type MC
    B. type NMC
    C. type FCC
    D. type IGS

RME Board October 1995

23. Hazardous locations are classified by the Philippine Electrical Code in how many classes?

    A. Two classes
    B. Four classes
    C. Three classes
    D. One class

24. The branch circuit conductors supplying one or more units of a data processing system shall have an ampacity NOT less than ____ of the total connected load.

    A. 110 %
    B. 125 %
    C. 100 %
    D. 115 %

25. The main disconnecting means for all electric driven irrigation machines shall be visible and NOT more than ___ from the machine.

    A. 10 m
    B. 15 m
    C. 12 m
    D. 8 m

26. A factory assembly of two or more insulated conductors having an outer sheath of moisture resistant flame-retardant, non-metallic material.

    A. Non-metallic sheathed cable
    B. Mineral insulated cable
    C. Armored cable
    D. Medium voltage cable

27. The bottom of sign and outline lighting enclosures shall NOT be less than ___ above areas accessible to vehicles.

    A. 5,000 mm
    B. 4,800 mm
    C. 4,700 mm
    D. 4,900 mm

RME Board October 1996

28. Which is the most important thing to do when a person has been shocked by electricity?

    A. Separate the victim from the electric wire as soon as possible making sure that you do not become another victim
    B. Call for competent help
    C. Apply resuscitation
    D. Disconnect the switch

29. As applied to lightning protection, an attachment to secure the conductor to the structure or building.

    A. Bonder
    B. Stapler
    C. Support
    D. Fastener

30. In a watercraft, when the source of electric power is a generator, it shall be automatically started and connected to the emergency switchboard within ___ seconds of loss of the main source of electrical power.

    A. 40
    B. 50
    C. 25
    D. 45

31. Generator neutral maybe connected in common, provided that the third harmonic content of the waveform of each generator does NOT exceed ___.

    A. 3 %
    B. 4 %
    C. 5 %
    D. 6 %

RME Board October 1996

32. As a general rule, equipment rated 1,000 A or more and measuring more than 1,900 mm wide, containing overcurrent devices, shall have an entrance at both ends of the switchboard room. The width and height of each entrance shall be NOT less than the following dimensions. Which one is correct?

    A. 800 mm wide x 2,000 mm high
    B. 600 mm wide x 2,000 mm high
    C. 600 mm wide x 2,200 mm high
    D. 800 mm wide x 2,200 mm high

33. Type AC cable shall be secured by approved staples, straps hangers or similar fittings within ___ from every outlet box, junction box, cabinet or fitting.

    A. 200 mm
    B. 150 mm
    C. 400 mm
    D. 300 mm

34. Maximum electrical trade size of liquidtight flexible metal conduit.

    A. 125 mm
    B. 150 mm
    C. 100 mm
    D. 200 mm

35. Communication conductors shall be separated at least ___ from conductors of any electric light or power circuits.

    A. 50 mm
    B. 40 mm
    C. 60 mm
    D. 75 mm

36. Receptacles used in circuits operating at less than 50 V shall have an ampere rating of not less than ____.

A. 20 A
B. 10 A
C. 15 A
D. 5 A

37. Each resistance welder shall have an overcurrent device rated or set at not more than ___ percent of the conductor rating.

A. 300
B. 250
C. 175
D. 150

RME Board October 1996

38. To support conduit on a hollow block wall, use one of the following methods. Which one is this?

A. Machine screw
B. Lag screw
C. Toggle bolt
D. Through bolt

39. Circuits containing electric discharge lighting transformers exclusively shall NOT be rated in excess of ____.

A. 20 A
B. 30 A
C. 15 A
D. 40 A

40. The transformer's secondary open circuit voltage used in electric signs shall NOT exceed ___.

A. 15 kV
B. 20 kV
C. 12 kV
D. 10 kV

41. Conductors external to motors and controls in cranes and hoists shall NOT be smaller than _____.

A. 2.0 mm^2
B. 1.25 mm^2
C. 3.5 mm^2
D. 0.75 mm^2

42. For three cranes supplied by a common conductor system, a demand factor of ____percent shall be used.

A. 90 %
B. 91 %
C. 92 %
D. 88 %

43. Intermediate metal conduit shall be supported at least every _____.

A. 2,500 mm
B. 2,000 mm
C. 1,800 mm
D. 3,000 mm

44. An overcurrent device rated or set at NOT more than ___ percent of the conductor rating shall protect conductors that supply one or more motor-generator arc welders.

A. 300
B. 200
C. 150
D. 125

45. Type MI cables shall permitted for _____.

A. branch circuits
B. feeder circuits
C. services
D. all of these

46. Conductors in open wiring on insulators shall be rigidly supported at intervals NOT exceeding _____.

A. 1,200 mm
B. 1,500 mm
C. 1,300 mm
D. 1,400 mm

47. A hoisting and lowering mechanism equipped with a car which moves in guides in a substantially vertical direction, the floor area of which does not exceed 0.85 square meter and which is used exclusively for carrying materials.

A. Elevator
B. Stairway chair lifts
C. Dumbwaiter
D. None of these

RME Board October 1995

48. Which of the motor starters does not stress the motor winding severely?

A. Across the line starter
B. Wye-delta starter
C. Soft-start starter
D. Transformer-type starter

49. The demand factor for two elevators on a single feeder shall be _____.

A. 95 %
B. 96 %
C. 94 %
D. 97 %

50. Concealed knob and tube wiring shall NOT be used in

A. theaters
B. motion picture studios
C. commercial garage
D. all of these

Master Electricians' work tip:

.....Never be too dependent with pilot lights to determine whether the circuit is live or not. The lamp (pilot light) can be busted at any time and will no longer signify the actual condition of the circuit.

TEST 25

TECHINCAL SUBJECT

1. A battery can supply 10 joules of energy to move 5 coulombs of charge. What is the voltage of the battery?

$V = \frac{\text{joules}}{\text{coulomb}}$; thus $E = \frac{W}{C}$

A. 50 V
B. 2 V
C. 15 V
D. None of these

$\frac{10}{5} = 2\ V$

2. An operation in which the motor runs when the pushbutton is pressed and will stop when the pushbutton is released.

A. Clipping
B. Inching
C. Plugging
D. Reversing

3. Which of the following statements is NOT true regarding a cell?

A. The plates must be immersed in some electrolyte solution such as an acid, an alkali or a salt
B. Decreasing the distance between plates, decreases the internal resistance of the cell
C. The plates must be of different metals
D. Increasing the size of the electrodes, increases the emf of the cell

RME Board October 1995

4. It is not advisable to leave a lead acid storage battery in a discharged state for a long time mainly because

A. the plates will become sulphated
B. electrolyte will attack the condenser
C. electrolyte will become weak
D. acid will evaporate

5. A term universally employed to measure wire diameters.

A. Millimeter
B. Circular mil
C. Meter
D. Mil

6. A Leclanche cell is a _____.

   A. carbon-zinc dry cell
   B. cadmium-mercuric oxide cell
   C. zinc-silver oxide cell
   D. lead-acid cell

RME Board October 1995

7. In a radio, gang condenser is a type of

   A. electrolytic capacitor
   B. paper capacitor
   C. ceramic capacitor
   D. air capacitor

8. The simplest circuit representation of a dielectric.

   A. parallel combination of a resistor and a capacitor
   B. parallel combination of a resistor and an inductor
   C. parallel combination of a resistor, an inductor and a capacitor
   D. parallel combination of a capacitor and an inductor

9. An adjustable resistance R is connected in parallel with 8 and 12-ohm resistors. To what value must R be set so that the total current drawn from a 10-V source is 5 A?

   A. 5.22 Ω
   B. 3.27 Ω
   C. 3.43 Ω
   D. None of these

10. The advantage of star connection over mesh connection for the same phase voltage is that ____.

    A. it gives a higher line voltage
    B. its gives a higher line current
    C. it gives a higher apparent power
    D. all of these

RME Board April 1994

11. A device used to measure the mechanical output of a motor or a generator is called

    A. watt-hour meter
    B. sphygmomanometer
    C. engine indicator
    D. dynamometer

12. In an open delta connected system,

    A. phase voltage is greater than line voltage
    B. phase voltage is lesser than line voltage
    C. phase voltage is equal to line voltage
    D. phase voltage is zero

13. Two equal resistances are connected in series across a certain voltage source. If the current drawn by the combination is equal to the applied voltage, how much is the value of each resistance?

    A. 1 ohm
    B. 0.5 ohm
    C. 0.25 ohm
    D. None of these

14. The electrolyte used in carbon-zinc dry cell is a combination of ____ dissolved in water.

    A. sulphuric acid and manganese dioxide
    B. powdered carbon and zinc chloride
    C. ammonium chloride and zinc chloride
    D. none of these

RME Board April 1994

15. What is the angular velocity for a 25-cycle circuit?

    A. 3.1416 radians per second
    B. 157 radians per second
    C. 377 radians per second
    D. 314 radians per second

$\omega t = 2\pi f = 2\pi(25) = 157$

16. What is the minimum number of wattmeter(s) needed to measure balanced or unbalanced three-phase loads?

    A. One
    B. Two
    C. Three
    D. Four

RME Board April 1996

17. The inert gas present in an incandescent bulb is primarily intended to

    A. increase lumen output
    B. activate the surface of the filament
    C. decrease filament evaporation
    D. reduce the hazards when the glass bulb is shattered

18. The potential difference that exists across the space between two electrically connected materials is called contact potential difference or _____.

    A. Joulian effect

B. Seebeck effect
C. Flywheel effect
D. Volta effect

19. Which of the following metals has the highest electrical & thermal conductivity?

A. Gold
B. Platinum
C. Palladium
D. Silver

20. Electrical symbol represented by a broken line.

A. Open wiring
B. Circuit homerun
C. Underground wiring
D. Emergency wiring

RME Board October 1994

21. Among the multimeters, the ____ features compactness, simplicity and portability.

A. VOM
B. VOTM
C. VTVM
D. all of these

22. When a lead acid battery is in a nearly discharge condition, the electrolyte is in its ____ state.

A. stable
B. strongest
C. weakest
D. normal

RME Board October 1995

23. When the speed of the alternator increases, the frequency

A. varies exponentially
B. remains the same
C. increases
D. decreases

24. Lap windings in DC generators are used for _____ applications.

A. low voltage, low current
B. low voltage, high current
C. high voltage, high current
D. high voltage, low current

25. Most common semi-conductor in used today.

A. Germanium
B. Silicon
C. Arsenic
D. None of these

26. What is the VA rating of an 8000 VA machine used at continuous duty?

A. 8,000 VA
B. 10,000 VA
C. 9,000 VA
D. 6,400 VA

RME Board April 1996

27. The transformer oil used in a transformer provides

A. insulation and cooling
B. insulation, cooling and lubrication
C. insulation and lubrication
D. cooling and lubrication

28. If a three-phase load is unbalanced, the most suitable system connection is a

A. 3-wire star connection
B. 3-wire closed delta connection
C. 3-wire open delta connection
D. 4-wire star connection

29. Which of the following generator's regulation is preferred?

A. below 5 %
B. 50 %
C. 100 %
D. above 50% but less than 100 %

30. What is the rated primary current of a 250 kVA, 480/230-volt 3-ϕ transformer?

A. 521 A
B. 628 A
C. 301 A
D. None of these

31. If a transformer bank is using an open delta connection, how many single-phase transformers are interconnected?

A. Only one
B. Two
C. Three
D. All of these

32. What type of prime movers drives a high-speed alternator?

A. Diesel motor
B. Gas turbine
C. Steam turbine
D. Hydraulic turbine

RME Board April 1996

33. Which of the following metals has the highest melting point?

A. copper
B. gold
C. silver
D. tungsten

34. If the excitation on one alternator in parallel operation is adjusted, which of the following parameter of the alternator will change?

A. load
B. frequency
C. power factor
D. all of these

35. An over-excited alternator operates at _____ power factor.

A. leading
B. lagging
C. unity
D. zero

36. A parallel circuit has three branches of 12, 4 and 16 ohms respectively. If a 4 A current flows in the 12-ohm branch, how much is the total current supplied to the three branches?

A. 20 A
B. 16 A
C. 24 A
D. None of these

RME Board October 1996

37. The purpose of the ballast in a fluorescent lamp assembly is

A. to regulate the voltage across the lamp
B. to improve the overall power factor
C. to limit the current through the lamp
D. to regulate the lumens output

38. Coulomb is to charge as a joule is to _____.

A. Heat
B. emf
C. energy
D. power

39. One (1) gigawatt is how many megawatts?

A. 1,000
B. 100
C. 10,000
D. 10

40. Equalizer rings are needed when paralleling which type of generators?

A. Series
B. Shunt
C. Synchronous
D. Compound

RME Board October 1995

41. A 15-hp, 220 V shunt motor has an efficiency of 87% at full load. The resistance of the field is 440 ohms. What is the full load armature current?

A. 67.59 A
B. 57.96 A
C. 75.69 A
D. 49.58 A

42. Which of the following is a storage cell?

A. Lead-lead-acid type
B. Nickel-iron-alkali type
C. Nickel-cadmium-alkali type
D. All of these

43. A squirrel cage induction motor has a _____ starting torque.

A. very low
B. zero
C. very high
D. moderate

RME Board October 1995, RME Board April 1996

44. An arc lamp takes 10 A at 50 V. Find the value of the resistance to be placed in series so that the lamps may burn correctly from a 110-V supply.

A. 5 ohms
B. 11 ohms
C. 6 ohms
D. none of these

45. A 3-phase wye connected solidly grounded alternator is under test. Between one terminal and ground, the voltmeter registers 120 V, between any two terminals, the voltmeter is expected to register ____.

A. 360 V
B. 208 V
C. 170 V
D. 240 V

46. For a series RC circuit, the vector current ____ the vector voltage by an angle greater than zero but less than 90°.

A. lags
B. leads
C. is in phase with
D. any of these

47. An instrument used to measure temperature.

A. Thermometer
B. Tachometer
C. Synchroscope
D. Thermocouple

RME Board October 1996

48. A 2-pole AC generator is running at 1,500 rpm. What is the frequency?

A. 25 Hz
B. 50 Hz
C. 60 Hz
D. None of these

49. A cell with an emf of 1.45 V is connected to an external resistance of 2 ohms. If the current drawn by the external resistance is 0.5 A, what is the internal resistance of the cell?

A. 0.80 Ω
B. 0.90 Ω
C. 0.88 Ω
D. 0.75 Ω

50. To keep the terminals of a lead-acid storage battery free from corrosion, it is advisable to

A. keep electrolyte level low
B. apply petroleum jelly
C. charge the battery at frequent intervals
D. clean the terminals frequently

TEST 26
PHILIPPINE ELECTRICAL CODE

1. In banks and office buildings, a unit load of _____ VA per square meters shall be included for the general purpose receptacle outlets when the actual number of outlets is unknown.

A. 6
B. 8
C. 10
D. 12

2. Type AC cable shall be permitted in one of the following. Which one is it?

A. for branch circuits
B. for feeders
C. in cable trays where identified for such usage
D. all of these

3. Interlocked type armored cable or corrugated sheath cables shall have a bending radius of NOT less than ____ times the external diameter of the metallic sheath.

A. 7
B. 10
C. 12
D. 5

RME Board October 1995

4. The use of rigid metal conduits shall be permitted under all atmospheric conditions subject to the following conditions EXCEPT one. Which one is this?

A. Aluminum fittings and enclosures shall be permitted to be used with rigid steel conduits.
B. Ferrous metal conduits shall be permitted to be installed in concrete
C. Conduits shall be permitted to be used in sand fill which is subject to permanent moisture
D. Where the ferrous raceways are protected solely by enamel, the use is permitted only indoors

5. The radius of the inner edge of any bend for type MI cables shall NOT be less than ____ times the diameter of the cable.

A. 5
B. 6
C. 7
D. 8

6. The rating the branch circuit using flat cable assemblies shall NOT exceed ___.

A. 40 A
B. 30 A
C. 20 A
D. 15 A

RME Board April 1996

7. Where receptacles are connected to a 30-A branch circuit, the maximum allowable cord and plug connected load shall not be more than

load x 80%

A. 30 A
B. 24 A
C. 16 A
D. 20 A

8. At least how many receptacle outlet(s) shall be installed in the bathroom?

A. One
B. Two
C. Three
D. None of these (Not specified in the PEC)

9. Rigid metal conduit shall be supported at least every _____ .

A. 2,000 mm
B. 2,500 mm
C. 3,000 mm
D. 1,500 mm

RME Board October 1995

10. What is the maximum allowable voltage drop from the distribution panel to the farthest load?

A. 10 %
B. 5 %
C. 3 %
D. 2 %

11. An exposed wiring method using cleats, knobs, tubes and flexible tubing for the protection and support of single insulated conductor run in or on building and not concealed by the building structure.

A. Open wiring on insulators
B. Concealed knob and tube wiring
C. Armored cable wiring
D. Metal clad cable wiring

12. Conductors in concealed knob and tube wiring shall maintain a clearance of NOT less than _____ between the conductor and the surface over which it passes.

A. 30 mm
B. 25 mm
C. 28 mm
D. 26 mm

13. General purpose and appliance branch circuits using type FCC cable shall have ratings NOT exceeding _____.

A. 20 A
B. 15 A
C. 30 A
D. 40 A

14. A unit or assembly of units or sections and associated fittings, forming a rigid structural system used to support cables.

A. Cable tray
B. Cable bus
C. Wire way
D. Busway

RME Board October 1996

15. Overcurrent in transformers affect all of the following EXCEPT

A. breather effectiveness
B. mechanical stresses
C. life insulation
D. rise in temperature

16. The rating of the branch circuit serving a continuous load shall NOT exceed ___ percent of the continuous load.

A. 100
B. 130
C. 125
D. 115

17. One or more non-metallic surface extensions shall be permitted to be run in any direction from an existing outlet, but NOT on the floor or within ___ from the floor

A. 50 mm
B. 100 mm
C. 75 mm

D. 25 mm

18. Where a conduit enters a box, fitting or other enclosure, a _____ shall be provided to protect the wire from abrasions.

A. lock nut
B. fuse
C. fastener
D. bushing

RME Board October 1996

19. Bonding jumpers which connect communications cable grounding conductors and the grounding electrode of the building shall NOT be smaller than what copper size?

A. 5.5 mm^2
B. 8.0 mm^2
C. 14.0 mm^2
D. 3.5 mm^2

20. In hospitals, the general lighting load required shall be _____.

A. 24 VA/m^2
B. 12 VA/m^2
C. 16 VA/m^2
D. 28 VA/m^2

21. Each plate electrode shall expose NOT less than ____ of surface to exterior soil.

A. one-fifth square meter
B. one-fourth square meter
C. one-third square meter
D. one-half square meter

22. Non-metallic sheathed cable shall NOT have a bending radius less than ___ times the diameter of the cable.

A. 8
B. 7
C. 5
D. 6

23. Conductors after the final overcurrent device and before the load served.

A. Branch circuit conductors
B. Service conductors
C. Feeder conductors
D. None of these

RME Board October 1995

24. In every drawing, the title block shall be a standard strip, which shall contain th name of the project, owner, title of the sheet, scale used, name and signature the PEE. How wide is this strip?

A. 35 mm
B. 30 mm
C. 40 mm
D. 45 mm

25. Intermittent operation in which the load conditions is regularly recurrent.

A. Varying duty
B. Intermittent duty
C. Periodic duty
D. Short time duty

26. A factory assembly of two or more insulated conductors with or witho associated bare or covered grounding conductor under a non-metallic sheath approved for installation in cable trays or in raceways.

A. type NM
B. type FCC
C. type TC
D. type USE

27. Rod electrodes of steel or iron shall be at least ____ in diameter.

A. 10 mm
B. 12 mm
C. 14 mm
D. 16 mm

RME Board October 1996

28. The minimum size of conductors to be used for lighting purposes is

A. 1.5 mm^2
B. 1.25 mm^2
C. 1.75 mm^2
D. 2.0 mm^2

29. Conductors on poles shall have a separation of NOT less than ___ where not placed on racks or brackets.

A. 300 mm
B. 250 mm
C. 400 mm
D. 150 mm

30. Type FCC cable shall be permitted for the following applications EXCEPT one. Which one is this?

    A. for branch circuits
    B. for service entrance
    C. in damp locations
    D. in heated floors

31. Non-metallic surface extensions shall be secured in place by approved means at intervals NOT exceeding _____.

    A. 100 mm
    B. 500 mm
    C. 300 mm
    D. 200 mm

RME Board April 1996

32. Any unguarded metal sheathed service cable, service conduits, metal fixtures and similar non-current carrying parts, if located in urban districts and where liable to be charged to more than a certain voltage to ground shall be isolated or guarded so as not to be exposed to accidental contact by unauthorized persons. What is this voltage?

    A. 1,000 V
    B. 500 V
    C. 150 V
    D. 300 V

33. Auxiliary gutters may enclose conductors or busbars but shall NOT enclose which of the following?

    A. Switches
    B. Overcurrent devices
    C. Appliances
    D. All of these

34. Republic act which is known as the "New Electrical Engineering Law".

    A. RA 7902
    B. RA 7290
    C. RA 7920
    D. RA 7209

35. Where an intermediate metal conduit is used, there shall not be more than the equivalent of ___ quarter bends between pull points.

    A. 2
    B. 4
    C. 3
    D. 5

RME Board April 1996

36. Underground cable feeder and branch circuit cables shall be permitted for use in any of the following applications EXCEPT one. Which one is this?

    A. Where embedded in poured concrete
    B. For interior wiring
    C. For direct burial
    D. Where used in corrosive locations

37. Rigid metal conduits smaller than ____ electrical trade size shall NOT be used.

    A. 15 mm
    B. 20 mm
    C. 12 mm
    D. 16 mm

38. Flexible metal conduit shall be secured by an approved means at intervals NOT exceeding ____.

    A. 1,200 mm
    B. 1,300 mm
    C. 1,500 mm
    D. 1,400 mm

39. Which of the following premises wiring installations is NOT covered in the scope of the Philippine Electrical Code?

    A. Parking lots
    B. Dockyards
    C. Quarries and mines
    D. Motor vehicles

40. An auxiliary conductor used in connection with remote measuring devices or for operating apparatus at a distant point.

    A. Tie wire
    B. Jumper wire
    C. Pilot wire
    D. Dummy wire

RME Board April 1994

41. Service entrance conductors passing over roofs shall have a clearance over the roof which they pass of

    A. 1,000 mm
    B. 2,000 mm
    C. 1,500 mm
    D. 2,500 mm

42. The conductors including splices and taps shall NOT fill the wireway to more than ____ percent of its area at that point.

A. 65
B. 70
C. 75
D. 80

43. Liquidtight metal conduit smaller than _____ electrical trade size shall NOT be used.

A. 20 mm
B. 15 mm
C. 12 mm
D. none of these

44. Service drop conductors passing over residential property and driveways and those commercial areas not subject to truck traffic shall have a vertical clearance of _____.

A. 4,600 mm
B. 5,500 mm
C. 3,700 mm
D. 4,800 mm

45. The equipment bonding jumper shall be permitted to be installed inside or outside of a raceway or enclosures where installed on the outside, the length of the equipment bonding jumper shall NOT exceed _____.

A. 2,000 mm
B. 1,500 mm
C. 1,800 mm
D. 1,200 mm

RME Board April 1996

46. An electrician should consider all electrical equipment live unless he definitely knows that they are not. The main reason of this practice is to avoid

A. personal injury
B. energizing the wrong circuit
C. de-energizing the wrong circuit
D. unnecessary work

47. Electrical floor assemblies shall NOT be installed _____.

A. where subject to corroded vapors
B. outdoors
C. in wet or damp locations
D. all of these

48. In cases where there are energized parts normally exposed on the front of switchboards or motor control centers, the working space in front shall NOT be less than ____.

A. 1,000 mm
B. 1,500 mm
C. 2,000 mm
D. 1,800 mm

49. Cabinet and cutout boxes shall have an air space of at least ___ between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

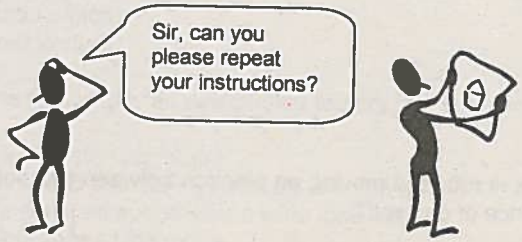
A. 1.5 mm
B. 1.8 mm
C. 2.0 mm
D. 2.4 mm

50. Service conductors in cable shall NOT be smaller than _____.

A. 5.5 mm^2
B. 8.0 mm^2
C. 3.5 mm^2
D. 14.0 mm^2

Master Electricians' work tip:

.....Never continue working if the instruction given to you is not clear. Do not even try using your own common sense and proceed to work. The proper way is to ask for the instruction to be repeated again. This is very dangerous, not only to your work but to yourself as well.



TEST 27

TECHINCAL SUBJECT

RME Board October 1994

1. Four resistances of 10, 4, 6 and 5 ohms are connected in series to a battery having a voltage across its terminals of 75 V. The current is ____.

   A. 6 A
   B. 3 A
   C. 4 A
   D. 5 A

   $I = \frac{E}{R_T}$

2. A 4-pole armature is wound with a duplex lap winding. How many armature current paths are there?

   A. 2
   B. 4
   C. 6
   D. 8

   $a = mp =$
   note: $m = 2$ since winding is duplex

3. The property of conductors to oppose the free flow of electric current is expressed in

   A. volts
   B. amperes
   C. ohms
   D. watts

RME Board April 1996

4. The filament of an incandescent electric bulb is usually made of

   A. iron
   B. tungsten
   C. nickel
   D. carbon

5. How much work is required moving an electron between two points that have a potential difference of one volt?

   A. One watt
   B. One joule
   C. One electron volt
   D. One volt-ampere

6. In resistor color code, yellow is equivalent to a digit value of ____.

   A. 3
   B. 6
   C. 5
   D. 4

7. If the resistance of a given copper wire is 32 ohms. If its length is 800 meters, what would be the resistance of the same wire which is only 250 meters in length?

   A. 10 ohms
   B. 15 ohms
   C. 48.4 ohms
   D. 102.4 ohms

   $\frac{R_1}{R_2} = \frac{L_1}{L_2}$

8. The energy supplied to a water heater in 10 minutes using a current of 5 A at 120 volts is _____.

   A. 600 J
   B. 360 kJ
   C. 6 kJ
   D. None of these

   $W = EIt$

RME Board April 1994

9. A semi-conductor which is made up of the semi-conductor material in its extremely pure form is

   A. N-type
   B. P-type
   C. extrinsic
   D. intrinsic

10. Contactor is another name for a

    A. manual switch
    B. magnetic starter
    C. automatic switch
    D. magnetic control

11. Which of the following is an outstanding feature of a shunt motor?

    A. It has a high starting torque
    B. It has a speed that varies inversely with the load
    C. It has a constant speed over a wide load range
    D. It is a low speed type motor

12. Armature cores are laminated to reduce

    A. armature copper losses

B. eddy current losses
C. weight of core
D. length of armature windings

13. Negative terminal of the diode.

A. Anode
B. Cathode
C. Triode
D. Pentode

14. A contact connected in a control circuit that will ensure that a particular sequence of operation is followed.

A. Sequential
B. Seal-in
C. Transition
D. Electrical interlock

15. Which of the following statements is true regarding series connection of resistances?

A. The current flowing through one resistor is equal to the current flowing through the other resistors in the combination
B. The voltage drop across one resistor is equal to the voltage drop across the other resistors in the combination
C. The power consumed in one resistor is equal to the power consumed in the other resistors in the combination
D. All of these

RME Board October 1995, RME Board April 1996

16. A circuit breaker normally operates

A. when the switch is put on
B. when the line is to be checked
C. when the power is to be supplied
D. whenever fault on the line occurs

RME Board April 1996

17. Compute the resistance of 180 meters of silver wire having a resistivity of 1.6 x 10^{-8} ohm-meter and having a cross section of 0.3 mm^2.

A. 4.9 ohms
B. 10.5 ohms
C. 9.6 ohms
D. 6.9 ohms

18. As a precaution against electric shock, the metal housings of electrically powered hand tools shall be

A. covered with plastic
B. connected to a switch
C. properly grounded
D. isolated

19. A 100-V, 60 Hz AC source is connected across a 100 μF capacitor. How much is the current through the capacitor?

A. 3.8 A
B. 1.0 A
C. 2.5 A
D. None of these

RME Board April 1995

20. What limits the size of an induction motor that can be started across the line?

A. Distribution system network
B. Horsepower rating
C. Branch circuit protection
D. Power supply

21. If two 100-W, 230 V incandescent lamps are connected in series across a 230-V source, what happens?

A. Both lamps will get burnt
B. Both lamps will consume more power
C. Each lamp will give more output lights
D. Each lamp will give lesser output lights

22. A grounding transformer may be connected zigzag or ____ connections.

A. delta-wye
B. wye-delta
C. wye-wye
D. delta-delta

23. Gearmotors are selected based on which of the following?

A. speed requirement
B. torque requirement
C. both A and B
D. neither A or B

RME Board October 1995

24. A 10-A electric fan with a power factor of 0.85 was connected to one 220-V convenience outlet. Calculate the power in the circuit.

A. 1,870 W
B. 2,200 W
C. 2,000 W

D. 2,588 W

25. Moving coil meters are used in

A. AC circuits only
B. DC circuits only
C. either AC or DC circuits
D. magnetic circuits only

26. A capacitor has been charged to a certain voltage If the plates of the said capacitor is moved further apart _____.

A. voltage across the capacitor is unaffected
B. voltage across the capacitor will decrease
C. voltage across the capacitor will increase
D. none of these

RME Board April 1996

27. A high school graduate can take the registered master electricians' examination if he has a subsequent specific record of at least ____ years of apprenticeship in electrical wiring, installations of electrical equipment.

A. 6
B. 3
C. 4
D. 5

28. In order for a material to be called a conductor, what is the maximum number of valence electrons it can have?

A. Only one
B. Two
C. Three
D. None of these

29. A series RL circuit has a resistance of 3 ohms and an inductive reactance of 4 ohms. If connected across a 100-V AC source, how much is the current drawn?

A. 12 A
B. 21.50 A
C. 14.28 A
D. 20 A

$I = \frac{E}{Z}$

$Z = \sqrt{R^2 + (X_L)^2}$

Note no X_C GIVEN

30. A 300-kW alternator has an efficiency of 90% at full load. Calculate the power losses.

A. 33 kW
B. 67 kW
C. 27 kW
D. 45 kW

$P_{losses} = P_{in} - P_{out}$

$P_{in} = \frac{P_{out}}{\eta}$

31. Which of the following is a property of a resonant circuit?

A. Total voltage and total current are in phase
B. Power factor is zero
C. Total reactance is zero
D. All of these

32. Product of total voltage and total current.

A. Total power
B. Reactive power
C. Real power
D. Apparent power

33. Basically electric motors operate on the principle of

A. induction
B. repulsion
C. either A or B
D. neither A or B

34. Order of rotation of the coil voltage in a balanced 3-phase system.

A. Phase sequence
B. Period
C. Alteration
D. Frequency

RME Board April 1994

35. In the SI unit, the unit of power is expressed in

A. kN-m
B. kW-hr
C. J-m
D. J/s

36. How many microfarad(s) is equivalent to one farad?

A. 1×10^{-9}
B. 1×10^{-6}
C. 1×10^{-12}
D. None of these

37. If a single-phase appliance connected to a source of 230 V and draws a current of 1.5 A at 0.8 pf, what is its power?

A. 276 W
B. 345 W
C. 288 W
D. 828 W

$P = EI\,pf$

38. A 110-V shunt motor draws an armature current of 50 A. If the armature resistance including brushes is 0.6 ohm, how much is the counter emf generated in the armature?

A. 140 V
B. 110 V
C. 95 V
D. 80 V

$E_b = V_t - I_a R_a$

RME Board October 1994, RME Board October 1996

39. In a circuit three resistors of 10, 15 and 20 ohms are connected in series. Find the potential at the source if the current flowing is 4 A.

A. 90 V
B. 180 V
C. 135 V
D. 45 V

$E = IR$

40. Ammeter which is preferable for high frequency current measurements?

A. Hot-wire type
B. Permanent-magnet type
C. Moving iron type
D. Thermocouple type

41. A current of 10 A divides between two branches in parallel, one having a resistance of 4 ohms and the other 6 ohms. How is the current in the 4-ohm resistance?

A. 6 A
B. 4 A
C. 7 A
D. 3 A

BY CDT

$I_1 = \frac{I_T(R_2)}{R_1 + R_2}$

RME Board April 1995

42. What is the purpose of having the contacts of a compensator starter immersed in oil?

A. Provide better contact cooling under heavy current
B. Minimize time delay under overload condition
C. Provide less contact friction
D. Minimize arcing effect between contacts

43. If a motor runs but fails to stop even if the stop button is pressed, the cause is probably one of the following. Which one is this?

A. The fuse has blown out.
B. The overload contact did not operate
C. The holding circuit interlock was welded
D. All of these

44. Find the amperage of an 8640 VA load on a 208 V, 3-phase branch circuit.

A. 20 A
B. 32 A
C. 42 A
D. 24 A

$I = \frac{S}{\sqrt{3}E} = \frac{8640}{\sqrt{3}(230}$

45. The switch symbol S_{RC} shall mean a _____ switch.

A. room control
B. roller type control
C. remote control
D. rocker type control

46. One of the biggest problem in split phase induction motor is

A. noise
B. high starting current
C. that it cannot be started at full voltage
D. all of these

RME Board April 1996

47. In DC generator the cause of rapid brush wear maybe

A. rough commutator segments
B. severe sparking
C. imperfect contact
D. any of these

48. A ground should have a _____ resistance.

A. high
B. low
C. negative
D. infinite

49. What is the cause of a magnetic contactor to chatter?

A. high current
B. low resistance
C. overload
D. low voltage

50. A test lamp is used to check for

A. low voltage
B. continuity
C. polarity of battery terminals
D. lamp condition

TEST 28

PHILIPPINE ELECTRICAL CODE

1. For non-dwelling receptacle loads, the demand factor for the first 10 kVA or less shall be

   A. 60 %
   B. 70 %
   C. 80 %
   D. 100 %

RME Board October 1996

2. In each conduit run entering an enclosure for switches, circuit breakers, relays and others that may produce high temperatures, seals on the conduit shall be installed within a certain length before entering the enclosure. What is this length?

   A. 900 mm
   B. 750 mm
   C. 250 mm
   D. 460 mm

3. The ampacity of the conductors can be derated at most, ____ time(s).

   A. two
   B. one
   C. three
   D. four

4. In the schedule of loads for lighting, which of the following contents is NOT necessary?

   A. Protective device rating
   B. Panel as numbered in the feeder diagram
   C. Number of lighting outlets per circuit
   D. Frequency rating

5. If potential exceeding ____ are employed, a permanent warning sign shall be displayed.

   A. 600 V
   B. 500 V
   C. 300 V

   D. 1,000 V

6. A load where maximum current is expected to continue for three hours or more.

   A. Continuous load
   B. Connected load
   C. Maximum load
   D. Average load

7. Communication conductors shall NOT be smaller than ____.

   A. 2.0 mm^2
   B. 1.25 mm^2
   C. 3.5 mm^2
   D. 5.5 mm^2

8. Receptacle and attachment plugs shall be permitted to be of lower ampere rating than the branch circuit but NOT less than ____ percent of the fixture full load current.

   A. 100
   B. 125
   C. 115
   D. 130

RME Board October 1996

9. A wye-delta starter for a single voltage three phase squirrel cage induction motor would require the connection of a certain number of wires from the motor. How many wires would be needed?

   A. 3 wires
   B. 9 wires
   C. 6 wires
   D. 12 wires

10. At least how many receptacle outlet(s) shall be installed outdoors for a one family dwelling unit?

    A. One
    B. Two
    C. Three
    D. None of these

11. What is the maximum permitted load of a 15 A branch circuit?

    A. 10 A
    B. 15 A
    C. 12 A
    D. 8 A

12. Where a feeder supplies continuos load or any combination of continuous and non-continuous load. The rating of the overcurrent device shall NOT be less than the non-continuous load plus ____ of the continuous load.

A. 125 %
B. 110 %
C. 150 %
D. 175 %

13. Faceplates of insulating material shall be non-combustible and NOT less than ___ in thickness.

A. 2.0 mm
B. 2.3 mm
C. 3.0 mm
D. 2.5 mm

RME Board April 1994

14. For raceway 20 mm trade size or larger containing conductors 22 mm^2 or larger, the minimum length of the box in straight pulls shall NOT be less than ___ times the trade diameter of the largest raceway.

A. 8
B. 10
C. 6
D. 12

15. Type MC cable shall NOT be used _____.

A. where exposed to corrosive materials
B. as direct burial to earth
C. where exposed to cinder fills
D. all of these

16. Using aluminum or copper clad aluminum conductors, the minimum size of service entrance conductors shall be ____.

A. 8.0 mm^2
B. 14. 0 mm^2
C. 5.5 mm^2
D. 3.5 mm^2

17. Ground counterpoise conductor shall be soft copper wire NOT smaller than

A. 5.5 mm^2
B. 2.0 mm^2
C. 3.5 mm^2
D. 8.0 mm^2

RME Board October 1995, RME Board April 1996

18. The disconnecting means for motor circuits rated up to 600 volts, shall have an ampere rating of at least ____ percent of the full load current of the motor.

A. 200
B. 115
C. 150
D. 125

19. How many amperes will a 100 A circuit breaker hold before tripping open the circuit? (Use rule of thumb).

A. 200 A
B. 500 A
C. 400 A
D. 300 A

20. A device for transferring one or more load conductor connections from one power source to another.

A. Disconnecting switch
B. Master switch
C. Isolating switch
D. Transfer switch

21. For an AC transformer and DC rectifier arc welder having a time rating of one hour, the supply conductors shall NOT be less than ____ percent of its rated primary nameplate current.

A. 90
B. 80
C. 75
D. 85

RME Board October 1996

22. Refers to the power plant mounted on wheels as used in the railroad transportation industry.

A. Electric locomotive
B. Electric train
C. LRT
D. None of these

23. If the terminal of the equipment grounding conductor is not visible, the conductor entrance hole shall be marked with the word _____.

A. green
B. white
C. gray
D. black

24. Type NMC (non-metallic sheathed cable) shall have an outer covering which has the following characteristics. Which one is NOT included?

A. flame retardant
B. moisture resistant
C. corrosion resistant
D. none of these

RME Board April 1996

25. Power and control tray cables (type TC) maybe used under one of the following condition. Which one is this?

A. Where exposed to physical damage
B. Where installed as open cable on brackets
C. Where installed in industrial establishment where a registered master electrician will service the installation
D. Where direct buried underground

26. Where rear access is required to work on de-energized parts on the back of enclosed equipment, a minimum working space of ____ horizontally shall be provided.

A. 1,000 mm
B. 900 mm
C. 800 mm
D. 600 mm

27. A one family dwelling unit shall have a disconnecting means of at least ____ where the initial computed load is 10 kVA or more.

A. 60 A
B. 90 A
C. 100 A
D. 30 A

28. Large batteries are those connected to a charging device with an output of more than _____.

A. 1.0 kW
B. 1.5 kW
C. 2.0 kW
D. 2.5 kW

RME Board April 1996

29. Which component of a DC motor is used to control the speed?

A. Carbon brush assembly
B. Armature winding
C. Commutator
D. Field winding

30. Switches used in watercrafts, shall be capable of breaking and making safely load current equal to ____ of their rated current at the rated voltage.

A. 100 %
B. 130 %
C. 125 %
D. 150 %

31. A wiring method using knobs, tubes, and flexible non-metallic tubing for th protection and support of single insulated conductors concealed in hollo spaces of walls and ceilings of buildings.

A. Open wiring on insulators
B. Open wiring with knobs, tubes, etc
C. Concealed knob and tube wiring
D. Knob and tube wiring

32. The ampacity of the branch circuit conductors and the rating or setting overcurrent protective devices supplying fixed electric space heating equipme consisting of resistance elements with or without a motor shall NOT be less tha ___ of the total load of the motors and the heaters.

A. 125 %
B. 130 %
C. 115 %
D. none of these

RME Board October 1996

33. A repulsion motor equipped with one of the following. Which one is this?

A. A set of slip rings
B. A commutator
C. Both commutator and slip ring
D. Neither a commutator nor a slip ring

34. Communication conductors shall have a vertical clearance of NOT less than ___ from all points of roofs above, which they pass.

A. 2,500 mm
B. 2,000 mm
C. 2,400 mm
D. 2,200 mm

35. A luminous discharge due to ionization of the air surrounding a conducto caused by a voltage gradient exceeding a certain critical value.

A. Corona
B. Skin effect
C. Johnson's effect
D. Surge

36. Branch circuit that supplies a number of outlets for lighting and appliance.

A. Multi-purpose branch circuit
B. Special branch circuit
C. Individual branch circuit
D. General purpose branch circuit

37. The minimum number of branch circuits shall be determined from the ____.

A. total computed load and the size of disconnect needed
B. total computed load and the rating of the circuits used
C. size or rating of the circuits used
D. minimum number required by the PEC

38. The insulated conductor of type TC (cable tray) cable shall be in sizes ____ through ____ copper.

A. 0.75 mm^2, 500 mm^2
B. 0.75 mm^2, 300 mm^2
C. 1.25 mm^2, 500 mm^2
D. 1.25 mm^2, 300 mm^2

39. A motor-generator arc welder has a 70 % duty cycle, the supply conductors shall NOT be less than ____ of its rated primary nameplate current.

A. 86 %
B. 80 %
C. 84 %
D. 88 %

RME Board October 1996

40. A frequency meter is connected as a potential device, which is connected across the line because of one of the following reasons. Which one is this?

A. A transformer maybe used for different voltages
B. The reading will be independent of the varying current
C. Only the voltage has frequency
D. It is safer than a series device

41. Rigid non-metallic conduit approved for direct burial without concrete encasement shall have a minimum burial of _____.

A. 500 mm
B. 400 mm
C. 460 mm
D. 440 mm

42. All metal parts associated with the hot tub shall be bonded using copper bonding jumper, insulated, covered, or bare, not smaller than _____.

A. 5.5 mm^2
B. 8.0 mm^2
C. 14.0 mm^2
D. 3.5 mm^2

43. All lighting fixtures, submersible pumps and other submersible equipment used in fountains shall operate at ___ or less between conductors.

A. 230 V
B. 300 V
C. 250 V
D. 500 V

44. The ground counterpoise when installed in earth shall be placed ___ above all cable in a trench.

A. 75 mm
B. 100 mm
C. 80 mm
D. 50 mm

45. Type FCC cable shall NOT be used in any of the following EXCEPT

A. outdoors
B. indoors
C. wet locations
D. hazardous locations

46. The ampacity of the conductors and the rating or setting of overcurrent devices in a circuit of a solar photovoltaic system shall NOT be less than ___ of the computed current.

A. 100 %
B. 115 %
C. 125 %
D. 130 %

47. For signaling circuits NOT exceeding ____ volts, the current required shall not exceed one ampere.

A. 24
B. 12
C. 30
D. 40

48. The grounding electrode shall be _____.

A. the nearest available effectively grounded structural metal member of the structure
B. the nearest available effectively grounded metal water pipe

A. the nearest concrete encased electrode
B. any of these

RME Board April 1994

49. Non-metallic boxes not over _____ cu. cm shall be permitted only on non-metallic wiring method.

A. 1,725
B. 1,520
C. 1,700
D. 1,640

50. The equipment bonding jumper (the connection between the equipment grounding conductor and the grounding impedance) shall be _____.

A. an unspliced conductor run
B. a spliced conductor run
C. either A or B
D. neither A or B

Master Electricians' work tip:

.....If a person is under electric shock, do NOT give him any liquid (whatever) by mouth, until the victim is fully conscious.

TEST 29

TECHINCAL SUBJECT

RME Board October 1995

1. At what speed must an 8-pole, AC generator runs so that its frequency shall b 40 Hz?

$RPM = \frac{120f}{P}$

A. 750 rpm
B. 600 rpm
C. 900 rpm
D. 500 rpm

2. A coil having a resistance of 8 ohms and an inductance of 0.2 H are connecte in series with a 50 μF capacitor. At what frequency does resonance occur?

$f_r = \frac{1}{2\pi\sqrt{LC}}$

A. 55 Hz
B. 50 Hz
C. 63 Hz
D. 58 Hz

3. A three-way switch is equivalent to a _____ switch.

A. SPDT
B. DPDT
C. SPST
D. DPST

RME Board October 1995

4. An applicant for re-examination shall be allowed to re-take ____ only in t subject in which he has obtain a grade below 50 percent.

A. two times
B. three times
C. any number of times
D. once

5. What is the ohmic value of a resistor having the color bands: brown, green, r and gold.

A. 150 Ω
B. 15 Ω
C. 1.5 kΩ
D. 15 kΩ

RME Board April 1996

6. It is a type of switch used in cars that must have a key inserted before it can be operated.

   A. twist switch
   B. battery switch
   C. ignition switch
   D. cut-out switch

7. Best suited motor to drive small air compressors.

   A. Universal motor
   B. Shaded pole motor
   C. Split-phase motor
   D. Capacitor start motor

8. Which of the following is NOT a part of an atom?

   A. electron
   B. proton
   C. neutron
   D. coulomb

RME Board April 1996

9. An oven takes 15 A at 220 V. It is desired to reduce the current to 12 A. Find the resistor that must be connected in series.

   A. 8.33 ohms
   B. 4.63 ohms
   C. 6.33 ohms
   D. 3.66 ohms

10. The torque of a series motor is directly proportional to

    A. the counter emf
    B. the armature current
    C. the square of the counter emf
    D. the square of the armature current

11. What is the mean reason why electrical appliances are connected in parallel rather in series?

    A. Parallel connection is simpler than a series connection.
    B. Each appliance will draw more current if connected in series
    C. It makes the operation of each appliance independent with each other
    D. Appliances connected in series are noisy.

12. Negatively charge component of an atom.

    A. Electron
    B. Proton
    C. Neutron
    D. Ion

RME Board October 1996

13. Fuse in motor circuits provides

    A. short circuit protection
    B. open circuit protection
    C. over current protection
    D. none of these

14. When selecting the size of wire to be used in a circuit, the most important item to consider is the _____.

    A. resistance of the circuit
    B. amperage of the circuit
    C. voltage of the circuit
    D. type of wire

15. Three 6-mH inductors are connected in series. What is their equivalent inductance?

    A. 2 mH
    B. 18 mH
    C. 9 mH
    D. None of these

16. Determine the length of a copper wire (ρ = 10.37 Ω-CM/ft) whose diameter is 0.30 inch and resistance of 0.5 ohm at 20 degrees Celcius.

    A. 4,339 ft
    B. 5,255 ft
    C. 6,125 ft
    D. None of these

17. When two 6-ohm resistor are connected in parallel, their total resistance is

    A. 12 ohms
    B. 3 ohms
    C. 9 ohms
    D. 6 ohms

18. Ampere is equivalent to

    A. coulomb-second
    B. coulomb per second
    C. volts per coulomb
    D. coulomb per volt

19. Electrical tool used to drive or pull out nails in the piece of wood.

A. Ball pen hammer
B. Soft faced hammer
C. Claw hammer
D. All of these

20. In a parallel circuit with unequal resistance on each branch, _____.

A. the current on each branch are equal
B. the voltage across each branch are equal
C. the power drawn on each branch are equal
D. none of these

21. Insulators have _____ temperature coefficient of resistance.

A. positive
B. negative
C. either A or B
D. neither A or B

22. The side of the transformer more turns is the _____ side.

A. primary
B. secondary
C. low voltage
D. high voltage

23. How can the phase sequence of a three-phase system be reverse?

A. By changing sizes of supply conductors
B. By improving system power factor
C. By increasing generators' excitation
D. By interchanging any two line conductors

RME Board October 1996

24. Megger is an instrument used to measure

A. insulation resistance
B. very high resistance
C. inductance of a coil
D. very low resistance

25. A lamp is to be controlled from two different locations. How many and what types of switches are to be used?

A. Two 4-way switches
B. One duplex switch
C. One 3-way and one 4-way switches
D. Two 3-way switches

26. A positively charged ion.

A. Anion
B. Cathode
C. Anode
D. Cation

27. Wave winding is used in

A. high voltage DC generators
B. low voltage DC generators
C. either A or B
D. neither A or B

28. A universal motor is a _____ wound motor.

A. parallel
B. series
C. series-parallel
D. parallel-series

29. What is the resistance of a DC load that takes 3 kW from a 110-V DC source?

A. 27.3 Ω
B. 36.7 Ω
C. 4.03 Ω
D. None of these

30. Capacitors used to filter DC components.

A. Electrolytic
B. Mica
C. Ceramic
D. Plastic

31. The equivalent resistance of four resistances of 6, 4, 3 and R ohms connected in parallel is 1.2 ohms. Find the value of R.

A. 8 ohms
B. 10 ohms
C. 6 ohms
D. 12 ohms

32. Lux is a unit of illumination equal to

A. lumen-meter
B. lumens per meter
C. lumens per square meter
D. lumens per cubic meter

RME Board October 1995, RME Board October 1996

33. A copper transmission line that is 1.5 miles in length is used to transmit 10 kilowatts from a 600-V generating station. Calculate the line current.

A. 16.67 A
B. 17.5 A
C. 18.0 A
D. 16.9 A

34. Which of the following is an advantage of a 3-phase system over a 1-phase system?

A. It can deliver more power
B. It is cheaper to transmit
C. Two voltage levels are available
D. All of these

35. Instrument use to measure electrical energy.

A. Wattmeter
B. Dynamometer
C. Kilowatt-hour meter
D. Power factor meter

36. A lamp having a candlepower of 100 candelas is hang 12 feet directly above a working table. What is the intensity of illumination of a point on the table directly below the lamp?

A. 8.33 Fc
B. 0.69 Fc
C. 1.44 Fc
D. None of these

37. The diameter of a wire is usually expressed in mils. How many mils are there in one (1) inch?

A. 1,000
B. 10,000
C. 100,000
D. 100

38. A 230-V DC electric motor is use to drive a mechanical load of 5 hp. How much current is drawn from the supply if the motor and the mechanical load has an overall efficiency of 78%?

A. 22.5
B. 20.8
C. 21.8
D. None of these

39. Secondary cells are frequently called _____.

A. storage cells
B. accumulators
C. either A or B
D. neither A or B

40. A synchronous motor will reverse its rotation when _____.

A. any two of the three stator lines are interchange
B. the field excitation is increased
C. the field excitation is decreased
D. none of these

RME Board October 1996

41. Interrupting medium in a contactor maybe

A. SF_6
B. oil
C. air
D. any of these

42. This term means that the motor will stop when there is a supply voltage failure and the motor will not restart automatically when the supply voltage is restored.

A. No voltage release
B. No voltage protection
C. No voltage control
D. None of these

43. Single-phase series motor can operate on

A. AC voltage only
B. DC voltage only
C. both A and B
D. neither A or B

44. A 10-mH inductor has a reactance of ___ at 60 Hz.

A. 0.377 ohm
B. 3.77 ohms
C. 37.7 ohms
D. 7.37 ohms

45. For wye-connected system, line to line voltage is _____ the phase voltage.

A. 1.732 times
B. 1.414 times
C. equal to
D. 70.7 % of

46. The following are reasons why 3-phase alternators are star-connected instead of a delta-connected. Which one is NOT included?

    A. For the same line voltage, star-connected alternators require lesser number of turns.
    B. For the same line voltage, star-connected alternators require lesser insulation.
    C. For the same power rating, star-connected alternators require smaller sizes of windings
    D. None of these

47. A 30-hp, 220-V series motor is taking a current of 40 A. Armature resistance is 0.5 ohm and series field resistance is 0.3 ohm. Evaluate the electrical power wasted in the armature.

    A. 700 W
    B. 800 W
    C. 560 W
    D. None of these

48. Volt is the same unit as

    A. joule per second
    B. joule per coulomb
    C. ampere per ohm
    D. watt per ohm

RME Board October 1996

49. The advantage of the iron-nickel battery over the lead acid battery is that

    A. it needs less maintenance
    B. it has much higher efficiency
    C. the cell voltage of the iron-nickel battery is higher
    D. it is much cheaper

50. Alternators are rated in

    A. kW
    B. kVA
    C. kVAR
    D. HP

TEST 30
PHILIPPINE ELECTRICAL CODE

RME Board April 1995

1. According to its make, conduits maybe classified as

    A. rigid metal
    B. rigid non-metal
    C. flexible metal
    D. all of these

2. In no case shall the grounding conductor be smaller than ____ copper.

    A. 5.5 mm^2
    B. 8.0 mm^2
    C. 3.5 mm^2
    D. 2.0 mm^2

3. Hazardous location in which flammable gases or vapors are present in the air in quantities sufficient to produce explosives or ignitable mixtures.

    A. Class IV
    B. Class III
    C. Class II
    D. Class I

4. The system neutral conductor shall NOT be connected to ground, EXCEPT through the neutral _____.

    A. grounding impedance
    B. grounding electrode
    C. grounding transformer
    D. derived from other system

5. In damp or wet locations, cabinets and cutout boxes of the surface type shall be mounted with at least ____ air space between the enclosure and the wall.

    A. 6.0 mm
    B. 6.4 mm
    C. 7.0 mm
    D. 7.5 mm

6. The minimum diameter of a solid air terminal under class I material requirements shall be ____ for copper and _____ for aluminum.

   A. 9.5 mm, 12.7 mm
   B. 12.7 mm. 9.5 mm
   C. 8.0 mm, 12.5 mm
   D. 12.5 mm, 8.0 mm

7. Circuits with a nominal voltage of 600 V or less in a rigid metal conduit or intermediate metal conduit and placed in a trench below a 50 mm thick concrete or equivalent shall maintain a minimum cover distance of _____.

   A. 150 mm
   B. 250 mm
   C. 460 mm
   D. 300 mm

RME Board October 1995

8. Vertical clearances of all service drop conductors above roofs shall NOT be less than one of the following values.

   A. 2,000 mm
   B. 2,750 mm
   C. 3,000 mm
   D. 2,500 mm

9. The lightning conductor or ground terminal shall extend vertically NOT less than ___ into the earth.

   A. 2,000 mm
   B. 3,000 mm
   C. 4,000 mm
   D. 2,500 mm

10. The circuit supplying an autotransformer type dimmer shall NOT exceed ___ between conductors.

    A. 240 V
    B. 250 V
    C. 230 V
    D. 200 V

11. A spark occurring between nearby metallic objects or from such objects to the lightning protection system or to ground.

    A. Flashover
    B. Sideflash
    C. Sparkover
    D. Discharge

12. Covers for boxes shall be permanently marked. The marking shall be on the outside of the box using the block type letters at least ____ in height.

    A. 10 mm
    B. 12 mm
    C. 15 mm
    D. 20 mm

RME Board October 1995

13. When wiring a raceway at least a certain length of free conductors shall be left at each outlet. What is this minimum length?

    A. 75 mm
    B. 100 mm
    C. 150 mm
    D. 200 mm

14. Where a rigid metal conduit is used, there shall NOT be more than the equivalent of ___ quarter bends between pull points.

    A. three
    B. four
    C. five
    D. two

15. There shall be at least ___ down conductor(s) on a heavy-duty smoke or vent stacks.

    A. one
    B. two
    C. three
    D. four

16. If the setting of the overcurrent device in a circuit ahead of the equipment is 60 A, the minimum equipment grounding conductor using copper shall be ____.

    A. 5.5 mm^2
    B. 3.5 mm^2
    C. 2.0 mm^2
    D. 8.0 mm^2

17. An exposed wiring support system using a messenger wire to support insulated conductors.

    A. Metal clad cable wiring
    B. Concealed knob and tube wiring
    C. Messenger cable wiring
    D. Messenger supported wiring

18. Air terminal shall be within _____ of outermost projection of roof edge.

A. 700 mm
B. 760 mm
C. 800 mm
D. 600 mm

19. In replacing a busted fuse which of the following is important?

A. same size and type
B. same size but different rating
C. same type but different rating
D. different size and type

RME Board April 1994

20. Which of the following wires has 75-ohm impedance?

A. Foam-filled twin lead
B. Coaxial
C. Flat twin lead
D. None of these

21. Rigid metal conduit shall be shipped in standard lengths of _____.

A. 3,000 mm
B. 6,000 mm
C. 4,000 mm
D. 5,000 mm

RME Board April 1995

22. The term given to an insulated stranded wire.

A. Durability
B. Cord
C. Length
D. Volume

23. Exposed non-current carrying metal parts of fixed equipment likely to become energized shall be grounded under the following conditions. Which one is NOT included?

A. where located in wet or damp locations
B. where in electrical contact with wooden floor
C. where in a classified hazardous locations
D. where supplied with a metal raceway or other wiring methods

24. Electrical equipment except x-ray tube inside anesthetizing room shall be located at least ____ above the floor.

A. 2,000 mm

B. 2,500 mm
C. 2,400 mm
D. 2,300 mm

25. Where the distance requirement in making holes cannot be maintained, the cable or raceway shall be protected from penetration by screws or nails by a steel plate or bushings at least ___ thick and of approved length and width to cover the area of the wiring.

A. 2.0 mm
B. 1.5 mm
C. 1.8 mm
D. 1.6 mm

26. The entire area of the aircraft hangar, including any adjacent communication areas not suitably cut-off from the hangar shall be classified as hazardous up to a level of ___ above the floor.

A. 400 mm
B. 460 mm
C. 500 mm
D. 480 mm

RME Board April 1996

27. In which method of starting a motor is the starting current a minimum?

A. star-delta
B. starter-rotor starter
C. direct on line
D. autotransformer

28. All switches and circuit breakers used as switches shall be so installed that the center of the grip of the operating handle when in its highest position shall NOT be more than ____ above the floor or working flatform.

A. 2,000 mm
B. 1,800 mm
C. 1,500 mm
D. 2,100 mm

29. For straight pulls, the length of the pull box shall NOT be less than ___ times the outside diameter of the largest non-shielded conductor or cable.

A. 42
B. 48
C. 32
D. 30

30. Aluminum electrode ____ permitted to be used.

A. shall not be
B. shall be
C. either A or B
D. neither A or B

31. Electrical non-metallic tubing shall be clearly and durably marked at least every

A. 2,000 mm
B. 1,000 mm
C. 3,000 mm
D. 1,500 mm

32. Which of the following sizes of fuse NOT standard?

A. 80 A
B. 45 A
C. 125 A
D. 75 A

RME Board April 1996

33. The Philippine Electrical Code, Part 1 does not cover wiring of equipment installed within or to or from one of the following. Which one is this?

A. Trailers
B. Mobile homes
C. Water crafts
D. Airplanes

34. The smallest electrical trade size of intermediate metal conduit.

A. 15 mm
B. 20 mm
C. 12 mm
D. 25 mm

35. The use of electrical metallic tubing shall be permitted for _____.

A. exposed works
B. concealed works
C. both A and B
D. neither A or B

36. The zone of protection of an overhead ground wire is conventionally taken as a

A. cone
B. cylinder
C. triangular prism
D. all of these

37. The minimum spacing between bare metal parts of opposite polarity where mounted on the same surface shall be ____ for voltages rated not over 250 V nominal.

A. 26 mm
B. 32 mm
C. 30 mm
D. 28 mm

38. The maximum electrical trade size of flexible metallic tubing shall be ____.

A. 15 mm
B. 20 mm
C. 32 mm
D. 100 mm

39. A protective device for limiting surge voltages by discharging or by passing surge current.

A. Arrester
B. Circuit breaker
C. Lightning rod
D. Thermocouple

RME Board October 1994

40. A convenience outlet circuit consisting of 8 outlets connected across a 220-V supply considering 180 W per outlet, what is the maximum circuit current?

A. 4.56 A
B. 6.54 A
C. 8 A
D. None of these

41. Plug fuses and fuse holders shall NOT be installed or used in circuits exceeding ___ between conductors.

A. 200 V
B. 250 V
C. 230 V
D. 150 V

RME Board October 1994

42. The standard length of rigid metal conduit is

A. 30 feet
B. 10 feet
C. 8 feet
D. 20 feet

43. For warehouses, the feeder demand load for the general lighting and small appliance load for the first 12,500 VA or less is 100 %, while the remainder over 12,500 VA is charged at ____.

    A. 40 %
    B. 60 %
    C. 70 %
    D. 50 %

44. Liquidtight flexible non-metallic conduit shall NOT be used in lengths longer than

    A. 1,500 mm
    B. 1,800 mm
    C. 2,000 mm
    D. 2,500 mm

45. Line and ground connecting conductors to surge arresters shall NOT be smaller than ____ copper or ____ aluminum.

    A. 2.0 mm^2, 2.0 mm^2
    B. 3.5 mm^2, 2.0 mm^2
    C. 3.5 mm^2, 3.5 mm^2
    D. 2.0 mm^2, 3.5 mm^2

46. Electrical metallic tubing shall be securely fastened in place at least every ___.

    A. 2,000 mm
    B. 1,800 mm
    C. 3,000 mm
    D. 1,500 mm

47. For the purpose of lightning protection, class I ordinary building is one that is at less than ____ in height.

    A. 20 m
    B. 22 m
    C. 24 m
    D. 23 m

RME Board October 1994

48. For dwelling units, the demand factor for the first 3000 volt-amperes of load is

    A. 95 %
    B. 85 %
    C. 100 %
    D. 80 %

49. Ventilating pipes for motors, generators or other rotating electric machinery or for enclosures for electric equipment shall be of metal NOT less than __ in thickness.

    A. 0:50 mm
    B. 0.45 mm
    C. 0.40 mm
    D. 0.60 mm

50. Direct burial cables or conductors with nominal voltage of 600 V or less and passes under streets, hi-ways, roads, alleys, driveways and parking lots shall have a minimum cover distance of _____.

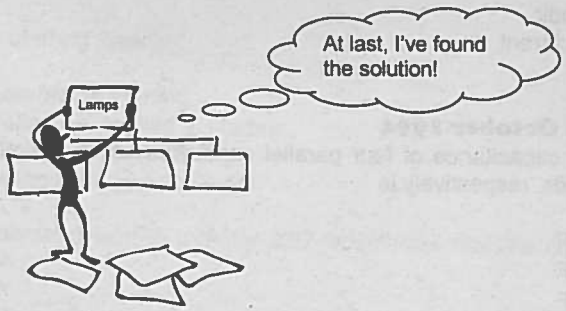
    A. 500 mm
    B. 600 mm
    C. 460 mm
    D. 550 mm

Master Electricians' work tip:

.....If a fluorescent tube is flickering and both ends looks blackish or reddish in color, the TUBE itself is defective.

.....If a fluorescent tube is flickering and both ends are not blackish or reddish in color, the STARTER is defective.

.....If a fluorescent tube lights a few seconds and then stops (no more lights), the BALLAST is defective.



TEST 31

TECHINCAL SUBJECT

1. The emf a cell depends upon the following EXCEPT one. Which one is this?

   A. type of electrolyte used
   B. type of material used as electrodes
   C. spacing between electrodes
   D. concentration of electrolyte used

RME Board October 1996

2. How long apiece of aluminum wire 1 mm in diameter is needed to give a resistance of 4 ohms? Resistivity of aluminum is 2.8×10^{-8} ohm-meter.

   A. 95 meters
   B. 120 meters
   C. 128 meters
   D. 112 meters

   $d = 1mm = 0.001 m$
   $A = \frac{\pi d^2}{4} = \frac{\pi (0.001)^2}{4} = 7.85 \times 10^{-7} m^2$
   $L = \frac{RA}{P} = \frac{4(7.85 \times 10^{-7})}{2.8 \times 10^{-8}} = 112.14 m$

3. The use of an impressed emf from an external power source used to buck out the corrosion current is called _____ protection.

   A. differential
   B. cathodic
   C. overcurrent
   D. ionic

RME Board October 1994

4. The total capacitance of four parallel capacitors which are 10, 15, 25 and 30 microfarads, respectively is

   A. 60 μF
   B. 40 μF
   C. 80 μF
   D. 20 μF

5. This tool is used to cut away the rough edges inside the end of the pipe after it has been cut with a cutter.

   A. Pipe threader
   B. Reamer
   C. Puller
   D. Hickey

6. Unit of inductance

   A. Farad
   B. Ohm
   C. Henry
   D. Siemen

RME Board October 1995

7. The starting capacitor of a single-phase motor is generally a

   A. ceramic capacitor
   B. paper capacitor
   C. electrolytic capacitor
   D. none of these

8. How many 1.5 A lighting fixtures can be connected to a 20-A noncontinuous duty branch circuit?

   A. 14
   B. 15
   C. 12
   D. 13

9. A trimmer capacitor is connected in _____ with a variable capacitor to change the capacity range.

   A. series
   B. parallel
   C. either A or B
   D. neither A or B

10. Direct on line starting means _____.

    A. reduced current at starting
    B. full line voltage is applied at starting
    C. reduced line voltage at starting
    D. starting without using a contactor

11. What is the demand load in kVA for 220 receptacles that are connected to a feeder circuit?

    A. 24.8 kVA
    B. 39.6 kVA
    C. 31.5 kVA
    D. None of these

12. What is the amperage of the neutral with a 300 A load?

    A. 260 A
    B. 210 A

C. 280 A
D. None of these

RME Board October 1996

13. The main part in a battery ignition system

A. ignition coil
B. distributor
C. battery and spark plug
D. all of these

14. To obtain the most satisfactory and economical designs for busbars in power stations and substations, consideration must be given to choice NOT only of material but also of _____.

A. color
B. availability
C. volume
D. shape

15. In star-connected system the line current is

A. greater than the phase current
B. lesser than the phase current
C. equal to the phase current
D. any of these (dependent on size of load)

16. How many 2-wire, 20-A single-phase branch circuit(s) is required to supply thirty 1.5 A ballasts?

A. Two
B. Three
C. Four
D. One

17. Which of the following is one of the reasons why the armature core of a DC machine is placed very closed to the pole face of the magnet?

A. To minimize leakage flux
B. To reduce copper losses
C. To control the flux flow
D. To facilitate commutation

18. Which of the following is NOT a factor that contributes to excessive wear on the contacts of a contactor?

A. Excessive jogging
B. High voltage to the coil
C. Low voltage to the coil
D. None of these

19. What is the hot resistance of a 100-watt, 220 V incandescent lamp?

A. 440 ohms
B. 484 ohms
C. 510 ohms
D. 465 ohms

20. Which of the following is NOT included in the field of practice of a Registered Master Electrician?

A. Installation of electric machinery
B. Maintenance and repair of electric machinery
C. Sale and distribution of electric machinery
D. All of these

RME Board October 1996

21. Sensitivity of the voltmeter is expressed in

A. volts/ohm
B. ohm/volts
C. 1 ohm-volt
D. ohm-volt

22. For a current to flow, what are basic circuit requirements?

A. Voltage source, and a conductor
B. Voltage source and a switch
C. Voltage source, a switch and a conductor
D. Voltage source, a dielectric and a conductor

23. Which of the following contacts should never be filed?

A. copper
B. silver
C. both A and B
D. neither A or B

24. If a current of one ampere lows in a 200-ohm resistance for 1/2 minute, how much energy does the resistance draw?

A. 6 kJ
B. 1 kJ
C. 3 kJ
D. None of these

25. The total voltage and amperage of four 0.5 A, 1.5 A cells connected in parallel is

A. 1.5 V, 2 A
B. 1.5 V, 0.5 A
C. 6 V, 0.5 A

D. 6 V, 2 A

RME Board October 1996

26. A low voltage is measured on a higher scale of the voltmeter. The measurement would have

A. low precision
B. low accuracy
C. low resolution
D. all of these

27. Magnetic material which can easily be magnetized.

A. Hard magnetic material
B. Soft magnetic material
C. Either A or B
D. Neither A or B

28. Circuit breakers hold approximately ___ times their rating for different periods of time based on the frame size of the unit.

A. 3
B. 4
C. 2
D. 5

RME Board April 1996

29. What is the common method of cooling transformer?

A. Natural cooling
B. Air cooling
C. Air blast cooling
D. Oil cooling

30. A sinusoidal current wave which has an effective value of 10 A, has a maximum value of ____.

A. 14.14 A
B. 17.32 A
C. 10 A
D. 7.07 A

31. Which of the following is a possible way of minimizing corrosion effects?

A. Avoidance of metal combinations that are not compatible
B. Avoiding the presence of an electrolyte
C. Electrical insulation between dissimilar metals that have to be used together
D. All of these

32. Which of the following works only with DC supply?

A. Vacuum cleaner
B. Electroplating
C. Electric stove
D. Synchronous motor

RME Board April 1995

33. Three resistances of 8.4 ohms, 6.8 ohms and 4.8 ohms are connected in series across a 100-V source. What is the voltage across the 6.8-ohm resistor?

A. 28 V
B. 34 V
C. 24 V
D. 42 V

34. In the nameplate data of an electric motor, what does "PH" means?

A. Horsepower output of the motor
B. Frequency rating
C. Number of phases
D. Normal rise in temperature

35. In the absence of a voltmeter, which of the following instruments is used to measure potential difference?

A. Clamp-on ammeter
B. Oscilloscope
C. Wattmeter
D. None of these

36. What is the total VA rating of 230 V, three phase circuit supplied by a 20 A 3PCB?

A. 4,600 VA
B. 7,967 VA
C. 13,800 VA
D. None of these

37. Relay that functions when the circuit impedance, admittance or reactance increases or decreases beyond predetermined values.

A. Undervoltage relay
B. Overload relay
C. Distance relay
D. Reverse power relay

38. The primary consideration in the grouping of cells is the required _____.

A. voltage
B. current
C. internal resistance

D. power rating

RME Board October 1994

39. A circle of circular cross section has a diameter of 0.20 of an inch. Its area in circular mils is

A. 40,000 CM
B. 20,000 CM
C. 60,000 CM
D. 30,000 CM

40. A voltmeter consists of a meter movement in series with _____.

A. a battery
B. a high resistance resistor
C. a resistor of negligible resistance
D. a battery and a resistor

41. If the specific gravity of the electrolyte of a lead acid cell decreases, the internal resistance of the cell is _____.

A. increased
B. decreased
C. not affected
D. zero

42. When electrons can move easily from atom to atom in a material, the material is

A. a conductor
B. a semi-conductor
C. either A or B
D. an insulator

43. Electrical symbol represented by a circle with a letter F inside.

A. Fused-type outlet
B. Wall fan outlet
C. Fluorescent lamp outlet
D. Ceiling fan outlet

RME Board April 1994

44. What is the actual load in watts if the current drawn is 40 amperes with a voltage and power factor of 110 volts and 95 percent, respectively.

A. 7,240 W
B. 18 W
C. 418 W
D. 4,180 W

45. A transformer is used to alter the values of ____

A. impedance
B. voltage
C. current
D. all of these

46. Two 100-V incandescent lamps rated 60 W and 200 W are connected in series across a 200-V supply. What current will flow through each lamp?

A. 0.84 A
B. 0.92 A
C. 0.72 A
D. 0.68 A

47. When measuring resistance with a multi-tester, make sure the circuit is

A. grounded
B. closed or energized
C. open or de-energized
D. not grounded

48. DC motor suitable to drive elevators.

A. Series motor
B. Shunt motor
C. Differential compound motor
D. Cumulative compound motor

49. Lithium cell has a nominal open circuit voltage of ____.

A. 3.0 V
B. 1.5 V
C. 1.35 V
D. 2.1 V

RME Board April 1994

50. The approximate power factor of an incandescent lamp is

A. 1.0
B. 0.8
C. 0.9
D. 0.7

TEST 32

PHILIPPINE ELECTRICAL CODE

1. A factory assembly of parallel conductors formed integrally with an insulating material web specifically designed for field installation in metal surface raceway.

   A. type FC
   B. type MI
   C. type TC
   D. type FCC

2. Snap switches shall not be grouped or ganged in enclosures unless they can be so arranged that the voltage between adjacent switches does NOT exceed ___.

   A. 250 V
   B. 300 V
   C. 150 V
   D. 100 V

3. Wiring located above heated ceilings shall be spaced not less than ____ above the heated ceiling and shall be considered as operating at an ambient of 50 °C.

   A. 100 mm
   B. 50 mm
   C. 75 mm
   D. 40 mm

RME Board April 1994

4. Are rectangular sheet metal enclosures equipped with removable covers providing access to conductors inside.

   A. Metal clad cable
   B. Multiple cable conductors
   C. Busways
   D. Wireways

5. Each unit length of heating cable shall have a permanent legible marking of each non-heating lead located within ____ of the terminal end.

   A. 75 mm
   B. 70 mm
   C. 80 mm
   D. 85 mm

6. Metal faceplates of receptacles shall be of ferrous metal not less than ____ in thickness or of non-ferrous metal not less than ____ in thickness.

   A. 0.76 mm, 1.0 mm
   B. 0.76 mm, 1.2 mm
   C. 0.64 mm, 1.0 mm
   D. 0.64 mm, 1.2 mm

7. Surface mounted incandescent fixture shall be permitted to be installed in clothes closets provided there is a minimum clearance of ____ between the fixture and the nearest point of the storage area.

   A. 150 mm
   B. 200 mm
   C. 250 mm
   D. 300 mm

8. Thermal insulation shall not be installed within ___ of the recessed fixture enclosure.

   A. 40 mm
   B. 35 mm
   C. 38 mm
   D. 42 mm

9. Lighting track load shall NOT be installed where less than ____ above the finished floor EXCEPT where protected from physical damage.

   A. 1,800 mm
   B. 1,500 mm
   C. 2,000 mm
   D. 1,000 mm

10. Where circuit breakers are used to protect the primary side of a transformer over 600 V nominal, their continuous current rating shall NOT exceed ___ of the rated primary current.

    A. 250 %
    B. 300 %
    C. 175 %
    D. 200 %

11. The lowest standard size of disconnect is _____.

    A. 20 A
    B. 30 A
    C. 60 A
    D. 15 A

RME Board April 1995

12. The primary winding of a step down transformer shall be protected on the primary side by an overcurrent device rated NOT more than a certain percentage of the primary current. Which is this percentage?

    A. 110 %
    B. 125 %
    C. 80 %
    D. 150 %

13. For a two-wire FCC cable system with grounding, the grounding conductor shall be _____ conductor.

    A. the middle
    B. the rightmost
    C. the leftmost
    D. any

14. Where passing through wood cross members in plastered partitions, conductors in concealed knob and tube wiring shall be protected by insulating tubes extending NOT less than ___ beyond the wood member.

    A. 80 mm
    B. 70 mm
    C. 76 mm
    D. 64 mm

15. Branch circuit conductors supplying a single motor shall have an ampacity NOT less than ___ percent of the motor full load current rating.

    A. 115
    B. 120
    C. 125
    D. 130

RME Board October 1995

16. In indoor wet locations, the entire wiring system including all boxes, fittings, control boards and panelboards shall be installed on walls with a minimum clearance. What is this clearance?

    A. 10 mm
    B. 5 mm
    C. 20 mm
    D. 15 mm

17. Type NM cable shall NOT be installed _____.

    A. where exposed to corrosive material
    B. where embedded in concrete
    C. in a shallow chase in masonry, concrete or adobe

    D. all of these

18. Dry type transformers installed indoors and rated 112.5 kVA or less shall have a separation of at least ____ from combustible material.

    A. 500 mm
    B. 400 mm
    C. 300 mm
    D. 200 mm

19. A factory assembly of two or more insulated conductors in an extruded core of moisture resistant, flame retardant non-metallic material covered with an overlapping spiral metal tape and wire shield and jacketed with an extruded moisture, flame, oil, corrosion, fungus and sunlight resistant non-metallic material.

    A. type SNM cable
    B. type NM cable
    C. type SE cable
    D. type AC cable

RME Board October 1996

20. To cut rigid metal conduits, an electrician should do one of the following. Which one is this?

    A. Order it cut to size from the supplier
    B. Use a three-wheel pipe cutter
    C. Use a cold chisel and ream the ends
    D. Use a hack saw and ream the ends

21. Where the overload relay selected using the factor 125 % is not sufficient to start the motor or to carry the load, the multiplying factor shall be increased but shall NOT exceed ____percent.

    A. 130
    B. 140
    C. 150
    D. 125

22. Where the protection of a motor-compressor load is not sufficient for the starting current of the motor, the rating or setting shall be increased but not more than ____ of its rated load current.

    A. 200 %
    B. 225 %
    C. 250 %
    D. 275 %

23. An insulator designed to electrically insulate the end of a type FCC cable.

A. Spool insulator
B. Bonding insulator
C. Insulating end
D. Cable connector

RME Board October 1994

24. Consists of three or more flat copper conductor placed edge to edge separated and enclosed within an insulating assembly.

A. Armored cable
B. Flat cable assemblies
C. Sheathed cable
D. Flat conductor cable

25. Lampholders installed in wet or damp locations shall be of the ____ type.

A. heavy-duty
B. waterproof
C. weatherproof
D. all of these

26. The single-phase conductors supplying the phase converter shall have an ampacity NOT less than ____ times the full load current rating of the motor or load being served.

A. 2.50
B. 1.25
C. 2.16
D. 1.75

27. An assembly of two insulated conductors within a non-metallic jacket or an extruded thermoplastic covering.

A. Shielded non-metallic sheathed cable
B. Non-metallic sheathed cable
C. Non-metallic extension
D. None of these

28. Dry type transformers rated over _____ volts, shall be installed in vaults.

A. 25,000
B. 10,000
C. 35,000
D. 50,000

29. In walls or ceilings of concrete, tile, or other non-combustible materials, boxes and fittings shall be installed that the front edge of the box or fitting will NOT set back of the finished surface more than ____.

A. 5.0 mm
B. 6.4 mm
C. 6.2 mm
D. 7.6 mm

RME Board April 1994

30. A type of cable which is a single or multi-conductor solid dielectric insulated cable rated 2001 volts or higher.

A. MC
B. MV
C. FCC
D. AC

31. In selecting the maximum setting of an instantaneous trip CB to be used to protect all AC motors from short circuit, a multiplying factor of ____shall be used.

A. 250 %
B. 300 %
C. 150 %
D. 700 %

32. The paper spacer thickness of type IGS cable having a conductor size of 125 mm^2 to 500 mm^2 shall be ___.

A. 1.20 mm
B. 1.02 mm
C. 0.92 mm
D. 1.12 mm

RME Board October 1995

33. What is the maximum number of overcurrent devices of a lighting and appliance panel board that shall be installed in a cabinet?

A. 36 devices
B. 24 devices
C. 48 devices
D. 52 devices

34. Intermediate metal conduit shall be firmly fastened within ___ of each outlet box, junction box, cabinet or fitting.

A. 750 mm
B. 1,000 mm
C. 800 mm
D. 900 mm

35. Resistance type heating elements in electric space heating equipment shall be protected at NOT more than _____.

A. 50 A
B. 30 A
C. 40 A
D. 60 A

36. Heavy-duty lighting track is a lighting track identified for use exceeding ___.

A. 15 A
B. 20 A
C. 30 A
D. 10 A

37. For three-phase motors supplied by any 3-phase system, the number of overload units required shall be _____.

A. three, one in each phase
B. two, in any two of each phase
C. one, in any one phase
D. none of these

RME Board October 1996

38. As compared with solid wires, stranded wires of the same cross sectional area have the following advantage EXCEPT one. Which one is this?

A. It is larger in overall diameter
B. It is easier to skin off the insulation
C. It is better for high voltage
D. It has a higher current rating

39. Each length of the rigid metal conduit shall be clearly and durably identified in every _____ as required.

A. 3,000 mm
B. 2,000 mm
C. 4,000 mm
D. 1,000 mm

40. For all single phase motors, to protect them from short circuits and ground faults, a multiplying factor of ___ of its full load current rating shall be used the protective device selected is a non-time delay fuse and ___ if the protective device is a time delay fuse.

A. 300 %, 175 %
B. 300 %, 150 %
C. 250 %, 175 %
D. 250 %,150 %

41. Flexible metal conduit shall be supported within ____ on each side of every outlet box, junction box, cabinet or fitting.

A. 300 mm
B. 200 mm
C. 460 mm
D. 150 mm

42. The maximum electrical trade size of electrical metallic tubing shall be _____.

A. 125 mm
B. 150 mm
C. 100 mm
D. 200 mm

RME Board October 1996

43. For installations of 2.0 mm^2 conductors in 600-V circuits. What is the minimum insulation resistance allowed by the Philippine Electrical Code?

A. 1,000,000 ohms
B. 750,000 ohms
C. 250,000 ohms
D. 500,000 ohms

44. Askarel insulated transformers installed indoors and rated over ____ kVA shall be furnished with a pressure relief vent.

A. 37.5
B. 25
C. 50
D. 15

45. In straight pulls, the length of the pull box shall NOT be less than ____ times the trade diameter of the largest raceway.

A. 8
B. 6
C. 10
D. 5

46. Busways shall be securely supported at intervals NOT exceeding ____unless otherwise designed and marked.

A. 1,000 mm
B. 2,000 mm
C. 2,500 mm
D. 1,500 mm

47. The smallest electrical trade size of a liquidtight flexible non-metallic conduit shall be

A. 15 mm
B. 12 mm

A. 20 mm
B. 25 mm

48. Boxes intended to enclose flush devices shall have an internal depth of NOT less than _____.

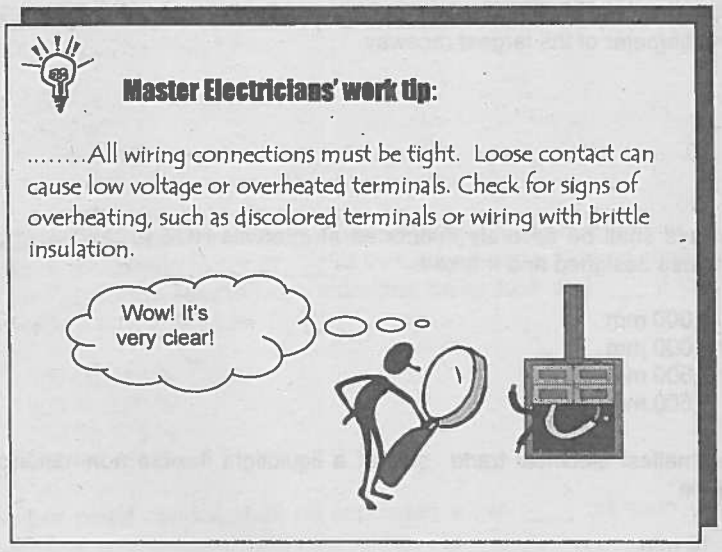
A. 24 mm
B. 20 mm
C. 16 mm
D. 28 mm

49. A branch circuit supplying a fixed storage type water heater having a capacity of 450 liters or less shall have a rating not less than ____ of the nameplate rating of the water heater.

A. 100 %
B. 115 %
C. 120 %
D. 125 %

50. Defined as the shortest distance measured between a point on the top surface of any direct buried conductor, cable, conduit and the top surface of finish grade.

A. Trench
B. Cover
C. Tray
D. Duct



TEST 33

TECHINCAL SUBJECT

RME Board October 1995

1. Electrolyte of a storage battery is formed by adding

A. water to sulphuric acid
B. sulphuric acid to water
C. hydrochloric acid to water
D. water to hydrochloric acid

2. The terminal voltage of a battery falls from 12 V to 10 V when a 10-ohm resistor is connected across its terminals. What is the internal resistance of the battery?

A. 1.5 Ω
B. 2.0 Ω
C. 1.0 Ω
D. None of these

3. What is the VA rating of a 7920 VA machine used at continuous duty?

A. 7,920 VA
B. 6,336 VA
C. 5,148 VA
D. 9,900 VA

RME Board October 1996

4. The following are included in the specific powers, functions, duties and responsibilities of the Board of Electrical Engineering, EXCEPT

A. Issue subpoena duces tecum, to secure the attendance of respondents or witnesses or the production of documents relative to the investigation conducted by the Board.
B. Coordinate with the Commission and the Department of Education Culture and Sports (DECS) in prescribing, amending and or revising the courses
C. Supervise and regulate the practice of electrical engineering in the Philippines.
D. None of these

5. Alternating current can be changed to direct current using a device called __.

A. inverter
B. synchronizer

C. rectifier
D. amplifier

6. Which of the following method is used to test or troubleshoot a capacitor?

A. Resistance measurement
B. Spark test
C. Bridging
D. All of these

RME Board April 1996

7. The most effective method of starting a large squirrel cage motor is by the use of

A. transformer reduced voltage method
B. star-delta switching
C. dropping resistors
D. partial winding method

8. Split phase motors are all noisy because they vibrate at a frequency ____ the operating frequency.

A. equal to
B. twice
C. thrice
D. less than

9. What current will 10 cells in series, each having an emf of 1.5 V and an internal resistance of 0.5 ohm send through a load resistance of 5 ohms?

A. 1.0 A
B. 1.25 A
C. 2.0 A
D. 1.5 A

RME Board April 1996

10. A 50-kVA transformer has a primary voltage of 6600 volts and a secondary voltage of 250 volts. It has 52 secondary turns. Find the number of primary turns.

A. 1337 turns
B. 1373 turns
C. 1713 turns
D. 1733 turns

11. A hot smoky device is often a sign of _____.

A. a good circuit
B. a short circuit
C. a ground

D. all of these

12. The hot resistance of the filament of an incandescent lamp is higher than its cold resistance, due to _____.

A. the length of the filament has increased due to thermal expansion
B. the cross sectional area of the filament when heated increases
C. the temperature coefficient of resistance of the filament is positive
D. none of these

13. According to Ohm's law, current is directly proportional to _____.

A. temperature
B. resistance
C. voltage
D. charge

14. The terminal side of the capacitor that is banded with a dark line around it is the

A. base
B. gate
C. anode
D. cathode

RME Board October 1995, RME Board October 1996

15. The internal resistance of a discharge battery

A. is less
B. remains the same
C. is more
D. is negative

16. Ten 20-ohm resistors are connected across each other. If an 8-ohm resistor is connected in series with the parallel combination, what current will flow through each of the 20-ohm resistance if the whole circuit is feed from a 100-V source?

A. 2.5 A
B. 1.5 A
C. 1.0 A
D. None of these

RME Board April 1996

17. What is the overall efficiency of a 5-hp that draws 20 A at 240 volts?

A. 90 %
B. 87.8 %
C. 80 %
D. 77.7 %

18. Which of the following losses in DC machines vary with the load?

A. Stray power losses
B. Core losses
C. Copper losses
D. All of these

19. A certain alternator has 8 poles. At what speed must the alternator runs in order to have a generated emf whose frequency is 40 cps?

A. 580 rpm
B. 750 rpm
C. 700 rpm
D. 600 rpm

20. A 2 μF capacitor has a reactance of 1500 ohms. What is the frequency of the AC source?

A. 53 Hz
B. 47 Hz
C. 50 Hz
D. 60 Hz

RME Board April 1996

21. The self-starter in cars draws current

A. lowest
B. equal
C. highest
D. zero

22. Squeezing the turns of a coil together will _____ its inductance.

A. increase
B. decrease
C. either A or B
D. neither A or B

RME Board April 1996

23. Transformers are rated in

A. kWH
B. kVA
C. kW
D. kV

24. How much current will be drawn by a 50-W, 230 V incandescent lamp if the system voltage drops to 210 V? Assume the resistance of the lamp to be constant.

A. 198.5 mA
B. 200 mA

C. 167.5 mA
D. None of these

25. A bipolar generator has how many poles?

A. 4-pole
B. 2-poles
C. 3-poles
D. None of these

26. Find the amperage of a 20.8 kVA load on a 240 V, 3-phase branch circuit.

A. 50 A
B. 45 A
C. 52 A
D. 87 A

$I = \frac{S}{E\sqrt{3}} = \frac{20.8(1000)}{240(\sqrt{3})} = 50.A$

27. Commercially used in insulating magnet wire due to lowest in cost and best in space factor.

A. Rubber
B. Askarel
C. Polyvinyl chloride
D. Enamel

RME Board October 1995, RME Board October 1996

28. A registered master electrician's field of practice includes

A. maintenance and repair of electrical equipment
B. manufacture of electrical equipment
C. sale and distribution of electrical equipment
D. supervision of operation and maintenance of electrical equipment

29. A potentiometer is used to control the _____ of the circuit.

A. current
B. resistance
C. voltage
D. all of these

30. The Board of Electrical Engineering (BEE) is composed of many people?

A. 5
B. 2
C. 3
D. 4

31. Permanent magnet moving-coil meters uses a _____ scale.

A. linear

B. non-linear
C. either A or B
D. neither A or B

32. Which of the following does NOT affect the inductance of a coil?

A. number of turns
B. current flowing through the coil
C. distance between turns
D. shape of the coil .

RME Board April 1996

33. In a squirrel cage induction motor, which component is NOT a part of the motor?

A. Stator
B. Slip rings
C. Fan blades
D. Rotor

34. In order to be able to calculate the amount of current through a resistor by Ohm's law, it is necessary for that resistor to be _____.

A. a linear type
B. a non-linear type
C. a unilateral type
D. all of these

35. A series circuit includes twelve 24-ohm resistances. What is the total resistance of the circuit?

A. 2 ohms
B. 36 ohms
C. 288 ohms
D. None of these

$R_T = 12(24)$
$= 288\ \Omega$

36. The capacity of four-microfarad capacitor in series with a six-microfarad capacitor is _____.

A. 10 μF
B. 3.4 μF
C. 4.2 μF
D. None of these

SERIES
$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
$C_T = \frac{1}{4} + \frac{1}{6}$
$= 2.4\ \mu F$

37. What minimum size of CB is required to start and run a 54-A, 230-V, three-phase motor?

A. 125 A
B. 100 A
C. 150 A
D. 200 A

250% of $54A = 250\% (54)$
$= 135$

38. Carbon resistors can be obtained with a power rating from _____.

A. 1/8 to 2-W
B. 1/4 to 2-W
C. 1/2 to 2-W
D. none of these

39. Resistor whose resistance value depends on the amount of light present.

A. VDR
B. Varactor
C. Thermistor
D. LDR

RME Board October 1995

40. If three resistors of 175 ohms, 75 ohms, and 17 ohms, respectively are connected in parallel. The combined resistance will be

A. between 175 ohms and 75 ohms
B. between 75 ohms and 17 ohms
C. less than 17 ohms
D. greater than 175 ohms

41. Which of the following is a correct color band of a 100-ohm resistor?

A. brown, black silver
B. brown, black, red
C. brown, black, brown
D. brown, black, black

42. An open coil has

A. infinite resistance and inductance
B. zero resistance and inductance
C. zero resistance and infinite inductance
D. infinite resistance and zero inductance

43. Two coils have equal lengths, equal radii and the same number of turns but they are made with different wire sizes. Which of the following is true?

A. The one with the smaller wire will have the bigger inductance
B. The one with the bigger wire will have the bigger inductance
C. They will have both equal inductance
D. None of these

44. When using any electrical instruments to test or troubleshoot an electrical circuit, an electrician should consider first __.

A. the safety usage of the instrument
B. the background of the problem he is dealing with

C. his personal safety before anything else
D. none of these

45. Basically a transistor is equivalent to

A. two diodes connected back to back
B. a diode in series with a resistor
C. a capacitor in parallel with an inductor
D. none of these

RME Board October 1996

46. A VTVM is more reliable in measuring voltages across low impedance as compared to a multitester because

A. its sensitivity is high
B. it offers high input impedance
C. it does not alter the measured voltage
D. all of these

47. A measure of the lumen output per watt input produced by the light source.

A. Lumen
B. Efficacy
C. Coefficient of utilization
D. Quality factor

48. The insulation resistance of high voltage circuit breakers is in the order of ____or above.

A. 100 MΩ
B. 2 GΩ
C. 100 kΩ
D. 10 GΩ

49. How many amperes will a 200 A fuse hold to allow a motor to start and run (rule of thumb)?

A. 400 A
B. 600 A
C. 800 A
D. 1,000 A

50. Electrical symbol represented by a box with letter MCC inside.

A. Motor control center
B. Motor control cabinet
C. Main control cabinet
D. Main control center

TEST 34

PHILIPPINE ELECTRICAL CODE

1. A wall screen or fence less than ____ in height shall NOT be considered as a preventing access unless it has other features that provide a degree of isolation equivalent to the height of the fence in question.

A. 2,000 mm
B. 2,500 mm
C. 3,000 mm
D. 1,500 mm

RME Board April 1994

2. Branch circuit conductors supplying a single phase motor shall have an ampacity NOT exceeding

A. 100 %
B. 125 %
C. 200 %
D. 115 %

3. Pits within _____ horizontally from the flammable vapor source, shall be considered a hazardous location under Class I, Division 1 location.

A. 6,000 mm
B. 5,000 mm
C. 7,600 mm
D. 4,600 mm

4. Type TW conductor is a _____ type.

A. moisture and heat resistant
B. moisture and heat resistant thermoplastic
C. moisture resistant and thermoplastic
D. heat resistant and thermoplastic

5. The current in amperes a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

A. Ampacity
B. Capacitivity
C. Rating
D. Amperage

RME Board October 1995

6. Flat conductor cables maybe installed in any of the following location EXCEPT one. Which one is this?

   A. On hard concrete flooring
   B. In wet locations
   C. For branch circuits
   D. In damp locations

7. Operation of loads and for intervals of time, both of which maybe subject to wide variations.

   A. Periodic duty
   B. Intermittent duty
   C. Continuous duty
   D. Varying duty

8. For equipment rated 1200 A and over, 1,900 mm wide containing overcurrent devices and control devices at least one entrance of NOT less than ____ wide and ___ high shall be provided at each end.

   A. 600 mm, 2,000 mm
   B. 600 mm, 2,500 mm
   C. 800 mm, 2,000 mm
   D. 800 mm, 2,500 mm

9. Batteries and direct current circuits shall be physically separated by a t least a ___ gap or other approved means from circuits of a different power source.

   A. 12 mm
   B. 15 mm
   C. 20 mm
   D. 10 mm

10. Where contactors are used as the disconnecting means for fuses, an individually externally operable switch, such as tumbler switch for the control of each contactor shall be located at a distance of not more than ___ from the contactor.

    A. 1,500 mm
    B. 1,800 mm
    C. 2,000 mm
    D. 2,400 mm

11. No electrical installation, alteration and or addition shall be connected or r-connected to any power supply or any other sources of electrical energy without

    A. an electrical permit
    B. an application for inspection
    C. certificate of payment
    D. certificate of final inspection

RME Board April 1996

12. Four (4) 3-phase motor are supplied by one common feeder cable. The full load current ratings of the motors are 10 A, 20 A, 30 A and 40 A. what should be the minimum ampacity of the feeder cable?

    A. 110 A
    B. 125 A
    C. 150 A
    D. 100 A

13. Thermal barrier shall be required if the space between the resistors and reactors and any combustible material is less than ____.

    A. 600 mm
    B. 400 mm
    C. 500 mm
    D. 300 mm

14. The ampacity of conductors that connect a capacitor to the terminals of a motor circuit conductors shall not be less than ___ the ampacity of the motor circuit conductors and in no case less than 135 % of the rated capacitor current.

    A. one-third
    B. one-fourth
    C. one-half
    D. one-fifth

15. The load for each ungrounded feeder and service conductor supplying 5 to 8 receptacles that supply shore power for boats shall be calculated as ___ of the sum of the rating of the receptacles.

    A. 80 %
    B. 70 %
    C. 90 %
    D. 60 %

RME Board October 1994

16. A device actuated by the operation of some devices with which it is directly associated, to govern succeeding operations of some or allied devices.

    A. Selsyn
    B. Automatic
    C. Interlock
    D. Relay

17. The underground service conductors between the street main, including any risers at pole or other structure or from transformers and the first point of connection to the service entrance conductors.

A. Service drop
B. Service cable
C. Service lateral
D. None of these

18. For 101 A to 200 A circuits, the minimum insulation required shall be ____.

A. 50,000 ohms
B. 100,000 ohms
C. 250,000 ohms
D. 75,000 ohms

19. Which of the following is NOT a standard kVA rating of a single-phase transformer?

A. 175
B. 150
C. 167
D. 100

RME Board October 1995

20. For voltages above 600 V, the minimum insulation resistance shall be _____.

A. 1,500,000 ohms per kilovolt rating
B. 500,000 ohms per kilovolt rating
C. 1,000,000 ohms per kilovolt rating
D. 2,000,000 ohms per kilovolt rating

21. The rating of any cord and plug connected utilization equipment shall NOT exceed ____ of the branch circuit rating.

A. 100 %
B. 80 %
C. 125 %
D. 90 %

22. If there will six or more 2-wire branch circuits, the service disconnecting means shall NOT be smaller than ____.

A. 100 A
B. 90 A
C. 60 A
D. 30 A

23. For direct current motors, the multiplying factor to be used in selecting the size of overcurrent device using an inverse time CB shall be ___ percent of its full load current.

A. 125
B. 150

C. 175
D. 200

24. Specifications written on the plans or submitted on separate standard size sheets shall show _____.

A. types of wiring, i.e. service entrance, branch circuits, feeders, etc
B. nature of electrical service, i.e. no. of phase, voltage, frequency, etc
C. special equipment to be installed indicating ratings
D. all of these

25. An appliance which is fixed in one place to another in normal use.

A. Fixed appliance
B. Stationary appliance
C. Portable appliance
D. None of these

RME Board April 1996

26. In starting a large DC motor, a starter is primarily used in order to

A. save electrical power
B. limit the starting current
C. add more power
D. reduce the voltage drop

27. Hazardous locations in which easily ignitable fibers are stored and handled.

A. Class III, Division 2
B. Class III, Division 1
C. Class II, Division 2
D. Class II, Division 1

28. In commercial garages, repair and storage areas, the entire area up to a level of ____ above the floor shall be considered to be Class I, Division 2 hazardous location.

A. 400 mm
B. 500 mm
C. 460 mm
D. 450 mm

29. Conductors passing over roof surface, a vertical clearance of ____ shall be maintained.

A. 2,500 mm
B. 1,500 mm
C. 2,000 mm
D. 3,000 mm

RME Board April 1995

30. In this new Electrical Engineering Law, what is the official designation of "master electrician?

    A. Master Electrician
    B. Registered Electrician
    C. Licensed Electrician
    D. Registered Master Electrician

31. The maximum load consumed or produced by a unit or group of units in a stated period of time.

    A. Peak load
    B. Average load
    C. Connected load
    D. Continuous load

32. A transformer of the multiple winding type with the primary and secondary winding physically separated which inductively couples its secondary winding to the grounded feeder system that energize its primary winding.

    A. Distribution transformer
    B. Grounding transformer
    C. Instrument transformer
    D. Isolation transformer

RME Board October 1995

33. In judging the suitability of an electrical equipment for proper mounting, the following factors should be considered, one of which is the LEAST important. Which one is this?

    A. Type of enclosure
    B. Wire bending space
    C. Electrical insulation
    D. Mechanical strength

34. The branches of the emergency system in a hospital shall be installed and connected to the alternate power source so that all functions shall automatically restored to operation within ___ after interruption of the normal source.

    A. 5 seconds
    B. 3 seconds
    C. 10 seconds
    D. 8 seconds

35. The minimum distance of open conductors of not over 600 V nominal and above finished grade, side walks or from any flatform or projection which they might be reached where the supply conductors are limited to 150 V to ground and accessible to pedestrians only.

    A. 3,100 mm
    B. 3,700 mm
    C. 4,600 mm
    D. 5,500 mm

RME Board April 1996

36. Which of the following wiring cables is most suitable for shipboard installations?

    A. Flat cable assembly
    B. Shielded non-metallic sheathed cable
    C. Metal clad cable
    D. Armored cable

37. If there will be four or more appliances fastened in place and served by th same feeder, it shall be permissible to apply a demand factor of ____ to the tota nameplate rating s of the loads.

    A. 65 %
    B. 70 %
    C. 75 %
    D. 80 %

38. All exposed incandescent lamps in dressing rooms, where less than ____ fron the floor, shall be equipped with open end guards riveted to the outlet o otherwise locked in place.

    A. 2,500 mm
    B. 2,400 mm
    C. 3,000 mm
    D. 2,800 mm

RME Board October 1995

39. What is the maximum allowable voltage drop from the main circuit breaker to the farthest lamp load?

    A. 10 percent
    B. 5 percent
    C. 2 percent
    D. 3 percent

40. Where the voltage between conductors does not exceed 300 V and the roof has a slope of not less than 100 mm in 300 mm, a reduction to _____ of the distance of the service conductors from the roof surface shall be permitted.

    A. 900 mm
    B. 1,000 mm
    C. 1,100 mm
    D. 800 mm

41. If there are no overcurrent protective device rated 30 A or less with neutral connection, this panelboard is classified as a _____.

    A. lighting panelboard
    B. appliance panelboard
    C. power panelboard
    D. all of these

42. A branch circuit that supplies only one utilization equipment.

    A. Individual branch circuit
    B. Special purpose branch circuit
    C. Appliance branch circuit
    D. Single branch circuit

43. In halls, corridors, closets and stairways of any occupancy EXCEPT one family dwelling unit, a general lighting load of ___ VA/m^2 shall be considered.

    A. 2
    B. 3
    C. 4
    D. 5

44. At least one receptacle outlet shall be installed directly above a show window for each ___ linear meter length or a major fraction thereof.

    A. three
    B. one
    C. two
    D. four

45. The point of connection between the facilities of the serving utility and the premises wiring.

    A. Load center
    B. Service head
    C. Junction box
    D. Service point

RME Board April 1996

46. According to the Code the minimum insulation level for neutral conductor of residential installation which have solidly grounded system shall be _____.

    A. 300 V
    B. 600 V
    C. 750 V
    D. 1,000 V

47. A demand factor of ____ percent of maximum possible connected load for television studio sets shall be permitted for all portable feeders.

    A. 70
    B. 40
    C. 50
    D. 60

48. For office buildings, a general lighting load of ____ VA/m^2 shall be used.

    A. 12
    B. 16
    C. 24
    D. 28

49. An insulated conductor intended for use as a grounded conductor where contained within a flexible cord shall be identified by a white or a ____ outer finish color.

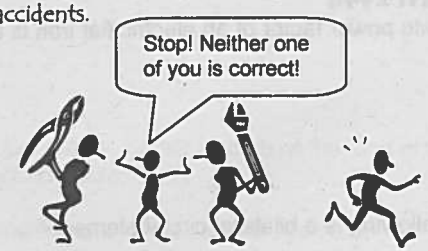
    A. green
    B. natural gray
    C. yellow
    D. green with yellow stripes

50. The allowable ampacities of conductors rated from 0 to 2,000 volts, 60 °C to 90 °C and not more than three of them in raceway, cable or earth is based on an ambient temperature of _____.

    A. 35 °C
    B. 40 °C
    C. 25 °C
    D. 30 °C

Master Electricians' work tip:

.....Avoid horseplay during any electrical works, to avoid unpredictable accidents.



TEST 35

TECHINCAL SUBJECT

1. A synchronous motor is generally used in applications requiring _____.

   A. variable speed
   B. frequent stopping
   C. occasional starting
   D. heavy loads at starting

RME Board April 1994

2. Ten identical resistors are in parallel. These resistors are connected across a 220-V supply. If the total current drawn is 15 A, calculate the value of each resistor.

   A. 146.67 ohms
   B. 156.50 ohms
   C. 130.25 ohms
   D. None of these

3. Which of the following statements is correct regarding condensers of different values connected in series?

   A. The charges and voltages across each condensers are equal
   B. The condenser with the highest capacitance has the biggest share of the total voltage
   C. The condenser with the lowest capacitance has the lowest charge accumulated
   D. The condenser with the lowest capacitance has the biggest share of the total voltage

RME Board April 1994

4. The approximate power factor of an electric flat iron is approximately equal to

   A. unity
   B. 0.9
   C. 0.8
   D. zero

5. Which of the following is a bilateral circuit element?

   A. Resistors
   B. Inductors

   C. Capacitors
   D. All of these

6. A nameplate data that will tell whether or not the motor is allowed to develop more than its rated nameplate horsepower without causing deterioration of its insulation.

   A. Service factor
   B. Reactive factor
   C. Power factor
   D. Use factor

RME Board April 1995

7. Wound rotor motors are usually started by the use of what type of starter?

   A. Secondary resistance starter
   B. Primary resistance starter
   C. Autotransformer type
   D. Wye-delta starter

8. The centrifugal switch of a capacitor start single-phase induction motor is connected in series _____.

   A. with the main windings
   B. with the auxiliary windings
   C. with the supply terminals
   D. none of these

RME Board October 1995

9. If the commutator is dirty, clean using

   A. sandpaper
   B. emery
   C. cloth
   D. oil

10. Unit of electric charge.

    A. Ohm
    B. Volt
    C. Coulomb
    D. Farad

11. For two alternators operating in parallel, some of the load of the first alternator is transferred to the second alternator by _____.

    A. increasing the power input of the second alternator
    B. decreasing the excitation of the second alternator while increasing the excitation of the first alternator

C. decreasing the power input of the second alternator while increasing its excitation
D. none of these

RME Board October 1995

12. Which one is a semi-conductor?

A. Phosphorus
B. Diamond
C. Gallium arsenide
D. Arsenic

13. Cooling methods used by small transformers rated below 5 kVA.

A. Forced air-cooled
B. Forced water-cooled
C. Oil-cooled
D. Natural air-cooled

14. The torque of an induction motor _____.

A. increases with a decrease in supply voltage
B. increases with an increase in supply voltage
C. either A or B
D. is constant

15. A 230-V, 60 Hz electrical appliance (inductive) is connected to a 230-V, 50 Hz electrical system. What happens?

A. The appliance draws more current
B. The appliance will not operate
C. The appliance draws lesser current
D. The appliance draws the same current

16. A combination of the arc discharge characteristics of a fluorescent lamp and the compact focusable shape of an incandescent lamp.

A. Sodium lamp
B. Quartz lamp
C. Mercury lamp
D. Tungsten halogen lamp

17. Two resistors of 4 and 6 ohms respectively are connected in series. If a 12-ohm resistor is connected across the series combination, what will be the total resistance of the whole circuit?

A. 2.0 ohms
B. 5.4 ohms
C. 2.4 ohms
D. 22 ohms

$$R_T = \frac{R_1(R_1 \| R_2)}{R_1 + R_2 + R_3}$$

18. Which of the following is a typical usage of an autotransformer?

A. Motor control transformer
B. Grounding transformer
C. Distribution transformer
D. Multi-voltage transformer

19. Rate of flow of electricity.

A. Energy
B. Voltage
C. Power
D. Current

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20. A residential house has a lighting load of 1000 W and a small appliance load of 2000 W. If they are used at the same time, what will be the monthly bill at an energy cost of P 0.40 per kilowatt-hour?

A. P 28.00
B. P 0.40
C. P 864.00
D. P 400.00

21. What is the VA rating for a feeder with a heating load of 20 kW and an air conditioning load of 8 kW?

A. 20 kW
B. 28 kW
C. 22.4 kW
D. 35 kW

RME Board October 1994

22. Are devices that serve to open or closed the electric circuits.

A. Plugs
B. Receptacles
C. Outlets
D. Switches

23. If the series field of a compound motor is connected in series with the supply terminals, the compound motor is particularly called _____.

A. long shunt compound motor
B. short shunt compound motor
C. cumulative compound motor
D. differential compound motor

24. If the speed of an alternator increases, the frequency of the voltage generated will _____.

A. remain unaffected
B. increase also
C. decrease
D. any of these

25. An ideal current source has _____ resistance.

A. negligible
B. infinite
C. definite
D. any of these

RME Board October 1996

26. A single-phase motor is taking 20 A from a 400-V supply at unity pf. What is the power taken?

A. 6,000 W
B. 8,000 W
C. 4,000 W
D. None of these

27. A 12-V car battery is composed of six _____ cells in series.

A. carbon-zinc
B. nickel-iron
C. zinc-chloride
D. lead-acid

28. An electrician may use a multi-tester to

A. measure the amount of voltage and illumination
B. measure the speed of an electric motor
C. measure power, resistance, illumination and current
D. measure resistance, voltage and current

29. The following are features of a synchronous motor. Which one is NOT included?

A. A dc supply is required for rotor excitation
B. It cannot be used for variable speed applications
C. The cost per horsepower is higher compared to induction motors
D. None of these

30. On alternators, which of the following tests is used to determine the synchronous impedance of the alternator?

A. No load test
B. Short circuit test
C. Both A and B
D. Neither A or B

31. The value of the voltage that is indicated on an AC voltmeter is called _____.

A. effective value
B. maximum value
C. average value
D. useful value

32. The internal resistance of a lead-acid cell is due to

A. material used as the positive plate
B. material used as the negative plate
C. both A and B
D. neither A or B

RME Board October 1996

33. Breaking capacity of a circuit breaker is expressed in

A. MW
B. Amp
C. Volts
D. MVA

34. Another name for a plugging switch.

A. Centrifugal switch
B. Zero-speed switch
C. Break-make switch
D. Rocker switch

35. If the resistance and reactance of a given circuit are equal in magnitude, the circuit power factor is

A. unity
B. 0.866
C. 0.707
D. 0.8

36. Which of the following DC motors has the best speed regulation?

A. Series motors
B. Shunt motors
C. Cumulative compound motors
D. Differential compound motors

37. Which of the following NOT one of the senses used by service technicians in troubleshooting faulty component in a circuit?

A. Sight
B. Taste
C. Touch

D. Smell

38. Which of the following causes extreme sparking at the brushes?

A. Worn bearings
B. Loose coupling
C. Dirt on the commutator segments
D. Shaft misalignment

39. Unit of apparent power.

A. Watts
B. Volt-amperes
C. Horsepower
D. Kilowatt-hours

RME Board October 1994

40. A 25-hp engine drives a DC generator, if the generator has an efficiency of 84 %, how much does it deliver?

A. 20 hp
B. 24 hp
C. 21 hp
D. 25 hp

41. Capacitors are used in electric circuits to _____.

A. store energy
B. introduce a voltage drop
C. produce a low opposition path to high frequencies
D. all of these

42. A certain resistor is color-coded red, red, red, gold. If the actual resistance is 2.52 kΩ,

A. the resistor is out of tolerance
B. the resistor has no color band symbolizing tolerance
C. the resistor is in tolerance
D. none of these

43. Three resistors of 5, 10, and 15-ohm resistances are connected in series across a 120 V source. Find the voltage drop across the 5-ohm resistor?

A. 30 V
B. 60 V
C. 40 V
D. 20 V

44. Which of the following machines is commonly used in lifting machines?

A. Squirrel cage induction motor
B. DC series motor
C. Repulsion type induction motor
D. DC compound motor

45. A carbon composition resistor has no color band for its tolerance, what is the expected tolerance of this resistor?

A. ± 10%
B. ± 5%
C. ± 20 %
D. ± 3 %

46. The resistance of a human body is _____value.

A. a constant
B. not a constant
C. a fictitious
D. a negative

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47. Induction type single-phase energy meter is

A. an ampere-hour meter
B. a wattmeter
C. a true watt-hour meter
D. none of these

48. What is the energy stored in a 2-mH inductor carrying a current of 2 A?

A. 2 J
B. 4 J
C. 8 J
D. 10 J

49. An active element in a circuit is the one which _____.

A. receives the energy
B. delivers the energy
C. stores the energy
D. facilitates the transmission of energy

50. Number of brushes required on DC generators with lap windings.

A. Equal to the number of poles
B. Equal to the number of coils used
C. Always equal to two
D. Half the number of poles

TEST 36

PHILIPPINE ELECTRICAL CODE

RME Board April 1996

1. Busways shall be permitted to be installed behind panels if means of access are provided and if the conditions below are met. One of them is NOT valid. Which one is this?

   A. No overcurrent devices are installed on the busway other than for an individual fixture
   B. The busway is so installed that the joints between sections and fitting are accessible for maintenance purposes
   C. The busway is open and of the ventilator type
   D. The space behind the panels is not for air handling purposes

2. The OCPD for resistance welders shall NOT exceed _____ of the conductor's ampacity supplying the circuit.

   A. 200 %
   B. 250 %
   C. 300 %
   D. 400 %

3. For installations to supply only limited load of a single branch circuit, the service disconnecting means shall have a rating of NOT less than _____.

   A. 20 A
   B. 30 A
   C. 40 A
   D. 15 A

4. Metal clad cable (MC) can be used in systems of 600 V or ____.

   A. less
   B. more
   C. both A and B
   D. neither A or B

5. Open conductors passing over residential driveways and those commercial areas not subject to truck traffic where the voltage exceeds 300 V to ground shall have a vertical clearance of _____.

   A. 3,700 mm

   B. 4,600 mm
   C. 3,100 mm
   D. 5,500 mm

6. MC cable insulation shall have a maximum operating temperature of not less than _____.

   A. 75 °C
   B. 80 °C
   C. 90 °C
   D. 60 °C

7. The ampacity of conductors in non-metallic sheathed cable shall be used at ___.

   A. 75 °C
   B. 60 °C
   C. 90 °C
   D. 80 °C

RME Board October 1996

8. What is the radius of a solid round conductor, which is the nearest equivalent of a stranded conductor whose total area is exactly 8.0 mm^2?

   A. 1.597 mm
   B. 1.596 mm
   C. 3.191 mm
   D. 3.192 mm

$A = \frac{\pi d^2}{4}$; $d = \sqrt{\frac{4A}{\pi}}$

$r = \frac{d}{2}$

9. For high impedance grounding, the system _____ conductor shall not be connected to the ground EXCEPT through the grounding impedance.

   A. line
   B. neutral
   C. both A and B
   D. neither A or B

10. Service equipment rated over 600 V located on mezzanine floors shall be required to be accessible by permanent _____.

    A. stairways
    B. ladders
    C. both A and B
    D. neither A or B

11. The load for a household electric clothes dryer in a dwelling is the larger of the nameplate rating or _____ VA.

    A. 4,000
    B. 5,000
    C. 6,000

D. 8,000

12. Each lighting and appliance branch circuit panelboard shall be protected individually on the supply side by not more than two main CBs or two sets of fuses having a combined rating not ___ than that of the panelboard.

A. less
B. greater
C. both A and B
D. neither A or B

13. The long time rating for x-ray equipment is based on an operating time of ____ minutes or longer.

A. five
B. eight
C. six
D. ten

14. For circuits supplying loads consisting of motor operated utilization equipment that is fastened in place and that has a motor larger than 0.125 hp in combination with other loads, the total computed load shall be base on ___ percent of the largest motor load plus the sum of the other loads.

A. 100
B. 125
C. 150
D. 130

15. Exposed AC cable shall closely follow the _____ of the building.

A. finish
B. studs
C. both A and B
D. neither A or B

RME Board October 1996

16. A three-phase general purpose squirrel cage motor draws a full load current of 40 A. What is the maximum size of time delay fuses that may be used for short circuit protection?

A. 120 A
B. 80 A
C. 40 A
D. 100 A

17. A 5.5 mm^2 TW copper conductor has a conductor ampacity of ____.

A. 30 A
B. 40 A

C. 20 A
D. 50 A

18. The branch circuit load for continuous duty receptacles shall be calculated at ___ VA per receptacle.

A. 150
B. 175
C. 180
D. 200

19. Ground rod clamps shall be secured with at least ____ bolt(s) or cap screws.

A. one
B. two
C. three
D. four

20. Overcurrent protection devices in emergency systems shall _____.

A. be coordinated
B. clear in steps
C. not trip the main device
D. all of the above

RME Board October 1994

21. The underground service conductors between the street main, including any risers at the pole or other structure or from transformer and the first point of connection to the service entrance conductors in a terminal box. The point of connection is considered to be the point of entrance of the service conductors into the building.

A. Service entry
B. Service raceway
C. Service lateral
D. Service drop

22. Down conductors on a heavy duty smoke or vent stacks shall be protected from physical damage or displacement for a distance of NOT less than ___ above finish grade.

A. 2,000 mm
B. 2,300 mm
C. 2,500 mm
D. 2,400 mm

23. The PEC permits _____ 90° bends in a single conduit run.

A. one
B. two

C. three
D. four

24. A warning sign shall be posted where ___ voltage is available in service equipment.

A. high
B. low
C. both A and B
D. neither A or B

25. Circuits with a nominal voltage of 600 V or less in rigid metal or non-metallic conduit and placed under a minimum of 100 mm thick concrete exterior slab with no vehicular traffic shall have a minimum cover distance of ____.

A. 200 mm
B. 300 mm
C. 400 mm
D. 100 mm

26. Conductors supplying a group of motor-generator arc welders are sized at ___ of the third largest welder plus the percentage of the other welders.

A. 65 %
B. 85 %
C. 70 %
D. 75 %

RME Board October 1996

27. Which of the following statements on wiring in commercial garages and shops is NOT correct?

A. The ground conductor shall be connected to the ground terminal of the utilization equipment
B. Receptacles, attachment plugs and similar devices shall be of the polarized type
C. Lamps and lamp holders for fixed lighting that are located above vehicles shall be installed not lower than 2,500 mm
D. Battery chargers and batteries being charged shall not be located in location classified as hazardous

28. Conductors may travel horizontally through _____ sections of switchboards if isolated from busbars by a barrier.

A. horizontal
B. vertical
C. both A and B
D. neither A or B

29. There shall be no more than ____ disconnects per service grouped in ar location.

A. four
B. five
C. six
D. three

30. When a circuit breaker handles are operated vertically rather than horizontall the "up" position of the handle shall be the ___ position.

A. off
B. on
C. neutral
D. any of these

RME Board October 1996

31. AC equipment on board watercraft shall operate satisfactorily at the followin voltage limitations. Which one is correct?

A. Minus 5% to plus 10%
B. Minus 6% to plus 10%
C. Minus 10% to plus 6%
D. Minus 10% to plus 10%

32. Emergency power panel conductors supplying a building are tapped on ____.

A. the line side of the service
B. any subfed panel
C. any circuit breaker main
D. any feeder circuit

33. Where buildings exceed three stories or 15 meters in height, overhead line shall be arranged, where practicable, so that a clear space of at least ___ wid will be left to facilitate title raising of ladders when necessary for fire fighting.

A. 2,000 mm
B. 1,800 mm
C. 1,900 mm
D. 1,500 mm

34. For the purpose of lightning protection, a smoke or vent stack is classified a heavy duty if the cross sectional area of the flue is greater than ___ squar meter and the height is greater than 23 meters.

A. 0.50
B. 0.32
C. 0.42
D. 0.27

35. Voltage drop shall be considered to service laterals run at _____ distance.

A. short
B. long
C. both A and B
D. neither A or B

36. Conductors used in lightning protection system shall have no bend forming an included angle of less than ___.

A. 60°
B. 75°
C. 50°
D. 90°

37. Control conductors used for load management can be routed with the service entrance conductors in the same _____.

A. raceway
B. cable
C. either A or B
D. neither A or B

RME Board October 1996

38. A lighting fixture shall be wired with a flexible lighting cord with a cross sectional area of NOT less than a certain minimum area. Which is this?

A. 0.75 mm^2
B. 2.00 mm^2
C. 0.50 mm^2
D. 1.25 mm^2

39. Service conductors shall not be run in such a manner as to block _____ to buildings.

A. openings
B. driveways
C. both A and B
D. neither A or B

40. Continuous duty loads shall be figured at _____ percent for branch circuits.

A. 100
B. 115
C. 120
D. 125

41. Enclosures for overcurrent devices in damp or wet locations shall be identified for use in such locations and shall be mounted so there is at least ____ air space between the enclosure and the wall.

A. 10 mm
B. 12 mm
C. 15 mm
D. 20 mm

42. What type letter for conductors has a trade name "moisture and heat resistant rubber"?

A. RH
B. RHW
C. XHHW
D. THW

43. Grounding conductor installed over lightning cables for the purpose of interconnecting the system ground electrodes and providing lightning protection for the cables.

A. Anchor
B. Counterpoise
C. Elevation rod
D. Air terminal

RME Board October 1995

44. The surge arrester for services less than 1,000 volts connected by copper conductor to grounding electrode conductor or the equivalent grounding terminal shall NOT be smaller than _____.

A. 8.0 mm^2
B. 5.5 mm^2
C. 3.5 mm^2
D. 2.0 mm^2

45. The OCPD for arc welders with transformers shall NOT exceed ____ percent of the primary full load current.

A. 200
B. 300
C. 250
D. 400

46. On circuits of less than 1000 V, the rating of the surge arrester shall be ___ the maximum continuous phase to ground power frequency voltage available at the point of application.

A. equal to or greater than
B. not less than
C. not less than 125 % of
D. none of these

47. The long time rating used to select OCPDs to protect circuits to x-ray equipment shall be _____.

    A. 125 %
    B. 150 %
    C. 175 %
    D. 100 %

48. A 3.5 mm^2 TW copper conductor has an ampacity equal to _____.

    A. 20 A
    B. 15 A
    C. 30 A
    D. 12 A

RME Board October 1996

49. Which of the following statements on lighting fixtures NOT correct?

    A. Outdoor lighting fixtures and associated equipment shall be permitted to be supported by trees
    B. Metal fixtures and enclosures rated at 250 V and installed up in the ceiling shall be grounded
    C. Stranded conductors shall be used in wiring a fixture supporting chain and other movable flexible parts
    D. Fixtures and lighting equipment operating at over 250 V shall be grounded

50. Conductors from the service point to the service disconnecting means are considered service _____.

    A. subpanels
    B. conductors
    C. both A and B
    D. neither A or B

Master Electricians' work tip:

.....If power is applied to a single-phase motor and the motor just hums, spin the shaft with your hand. If the motor starts running, the problem is in the starting circuit.

.....However, if the motor start, but runs unevenly, slows down, then start again, the problem is in the running circuit.

TEST 37

TECHINCAL SUBJECT

RME Board October 1995

1. A shunt generator has an armature current of 400 A and a shunt field current of 5 A. What is its output in kW if the terminal voltage is 220 volts?

    A. 89.1 kW
    B. 80.5 kW
    C. 86.9 kW
    D. 84.6 kW

2. A bipolar alternator is driven at a speed of 3,600 rpm. What will be the frequency of the voltage generated by this machine?

    A. 50 Hz
    B. 30 Hz
    C. 40 Hz
    D. 60 Hz

3. A lead acid battery unlike other batteries should not be short circuited due to

    A. its internal resistance is very low
    B. its electrolyte will evaporate
    C. its charges will discharge very fast
    D. all of these

RME Board April 1996

4. An applicant for the registered master electricians' examination must have at least completed ____ of a five year Bachelor of Science in Electrical Engineering program and has a specific record of _____practice in electrical wiring and installation.

    A. 3 years, 1 year
    B. 2 years, 2 years
    C. 2 years, 1 year
    D. 3 years, 2 years

5. When two capacitors are placed in parallel, the breakdown voltage rating of the combination is equal to _____.

    A. the average of the two breakdown ratings
    B. the bigger of the two breakdown voltage ratings

C. the sum of the two breakdown voltage ratings
D. the smaller of the two breakdown voltage ratings

6. Transformer with only one winding.

A. Single-phase transformer
B. Current transformer
C. Unity transformer
D. Autotransformer

7. A boy leaves an electric heater on for a period of 4 hours. If the heater has a 2 kW element, calculate the energy expended kilojoules?

A. 8,000 kJ
B. 2,880 kJ
C. 28,800 kJ
D. 10,800 kJ

8. The largest size of a dry cell is _____.

A. size A
B. size AA
C. size C
D. size D

9. Three resistors are connected in delta. If the ohmic value of each resistance is 3 ohms, what is the ohmic equivalent of each resistance in wye configuration?

A. 9 ohms
B. 3 ohms
C. 1 ohm
D. 12 ohms

RME Board April 1996

10. Electric current in a wire is a flow of

A. atoms
B. valence electrons
C. free electrons
D. bound electrons

11. The temperature coefficient of resistance of a conductor _____.

A. increases when temperature increases
B. increases when temperature decreases
C. is constant
D. none of these

12. Unit of magnetomotive force.

A. Volt
B. Coulomb
C. Newton
D. Ampere-turn

13. The international system of units (SI) is based on seven base units namely,

A. meter, gram, second, ampere, kelvin, lux and mole
B. meter, kilogram, second, ampere, celcius, meter-candle and mole
C. meter, gram, second, ampere, celcius, lux and mole
D. meter, kilogram, second, ampere, kelvin, candela and mole

14. Three squirrel cage induction motors, whose current ratings are 20, 28 and 34 A respectively, is to be served by a common feeder circuit. What will be the minimum overcurrent feeder protection using an NTD fuse?

A. 125 A
B. 150 A
C. 175 A
D. None of these

RME Board October 1995

15. A 10-hp, 230-V DC motor of 84 % full load efficiency is located 500 ft. from the supply mains. What is the motor current?

A. 38.6 A
B. 29.3 A
C. 24.4 A
D. 40.5 A

16. An alloy containing 3 to 25 % tin and 75 to 97% copper.

A. Lead
B. Alnico
C. Steel
D. Bronze

17. Instrument used to determine the quantity of electricity flowing through a cell.

A. Ammeter
B. Calorimeter
C. Coulometer
D. Wattmeter

18. Quantity of electricity transported in one second by a current of one ampere.

A. Joule
B. Watt
C. Coulomb
D. Electron-volt

19. If an additional resistance is added to a series RL circuit, the overall power factor of the circuit will _____.

    A. decrease
    B. increase
    C. remain the same
    D. any of these

20. Which of the following electrical machines has the highest operating efficiency?

    A. Motors
    B. Generators
    C. Transformers
    D. Converters

21. A 120/208 V, 3-phase circuit has a total connected load of 28,800 VA. What is the ampacity?

    A. 65 A
    B. 80 A
    C. 135 A
    D. 100 A

22. The distinguishing characteristic of soft magnetic materials is _____.

    A. high permeability
    B. low permeability
    C. either A or B
    D. neither A or B

RME Board April 1996

23. A resistor of 6 ohms is connected in series with a 5-ohm resistor. What resistance must be placed across the 6-ohm resistor so that the total resistance shall be 7 ohms?

    A. 3 ohms
    B. 11 ohms
    C. 1 ohm
    D. 4 ohms

RME Board April 1996

24. Which of the following is a primary cell?

    A. Nickel-cadmium-alkaline
    B. Mercury-oxide
    C. Nickel-iron-alkaline
    D. Lead-acid

25. In a series circuit with different values of resistances, the current is _____.

    A. the same in each resistor
    B. different in each resistor
    C. largest in the smallest resistance
    D. largest in the largest resistance

26. A power factor meter will show relationship between _____.

    A. volts and amperes
    B. watts and volt-amperes
    C. true power and reactive power
    D. none of these

27. An inductive circuit has a resistance of 4 ohms and an inductance of 3 mH. What current will this circuit draw from a 12-V DC source?

    A. 2.4 A
    B. 4.0 A
    C. 3.0 A
    D. None of these

28. Two lamps rated 115-V are in series connected across a 230-V source. IF one lamp is rated 75-W and the other is rated 50-W, which lamp will suffer overcurrent condition?

    A. the 50-W lamp
    B. the 75-W lamp
    C. both lamps
    D. neither of the two lamps

29. Type of cell commonly used in hearing aids, electric watches, missiles and space applications.

    A. Mercury cell
    B. Alkaline cell
    C. Silver-zinc cell
    D. Carbon-zinc cell

30. A passive element in a circuit is the one that ____ the energy.

    A. supplies
    B. receives
    C. relays
    D. transmit

31. An electric motor takes 14.42 A at 115-V and has an efficiency of 90 %. How many horsepower does it deliver?

    A. 2
    B. 1
    C. 4

D. 3

RME Board October 1996

32. Very large 3-phase induction motor are started

A. autotransformer starting
B. direct on line
C. star-delta
D. none of these

33. Three resistors with ohmic values of 10 ohms each are connected in delta across the lines of a balanced 200-V, 3-phase system. What is the line current?

A. 14.14 A
B. 34.60 A
C. 28.28 A
D. 11.54 A

34. The speed of a synchronous motor _____.

A. is constant
B. decreases with load
C. increases with load
D. any of these

35. An alternating current wave has an equation 10 sin 157t. What is the period of the wave?

A. 0.03 second
B. 0.05 second
C. 0.04 second
D. 0.02 second

36. What is the cost of operating a lamp for eight hours a requiring 1 A on a 100-V line, if the cost of electric energy is P 4.50 per kW-hr?

A. P 3.60
B. P 10.80
C. P 45.00
D. None of these

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37. The members of the Board shall hold office for a term of ____ years from the date of appointment or until their successors shall have been appointed and qualified.

A. 5
B. 3
C. 6
D. 4

38. The load in an electrical circuit is use to

A. transmit the electrical energy
B. generate the electrical energy
C. cause a voltage drop
D. utilize the electrical energy

39. A constant current of 2-μA charges a 50-μF capacitor. How much charge is accumulated after 20 seconds?

A. 10 μC
B. 20 μC
C. 40 μC
D. 80 μC

40. Machine which converts AC to DC or DC to AC.

A. Tube rectifiers
B. Inverters
C. Synchronous converters
D. Turbo alternators

41. Two resistors 8 Ω and 12 Ω are connected in series across a 100-V source. What is the power absorbed in the 12 Ω resistor?

A. 200 W
B. 150 W
C. 100 W
D. 300 W

RME Board October 1995

42. If a low resistance is connected in parallel with a higher resistance, the combined resistance is

A. always more than the high resistance
B. always less than the low resistance
C. higher or lower than the low resistance depending on the value of the higher resistance
D. always between the values of the high and low resistance

43. A fuse wire should be made from a material with a ____ melting point.

A. low
B. high
C. either A or B
D. neither A or B

44. If the secondary voltage of the transformer is step-down, the primary will have

A. fewer turns as the secondary
B. more turns as the secondary
C. as many turns as the secondary
D. half as many turns as the secondary

45. How many 1.5-V cells are needed to supply a 12-V load if the cells are connected in series?

A. 6
B. 7
C. 8
D. 9

46. The SI unit of specific resistance.

A. Ohm per square meter
B. Ohm-meter
C. Ohm per meter
D. Ohm-circular mils per foot

RME Board April 1996

47. The rated frequency of the output voltage of an AC generator depends upon

A. power factor
B. excitation current
C. load
D. number of poles

48. At DC steady state, a capacitor acts like _____.

A. a short circuit
B. an open circuit
C. an inductor
D. a conductor

49. What type of electrolyte solution is used in a lead-acid cell?

A. Hydrochloric acid
B. Sulphuric acid
C. Phosphoric acid
D. None of these

50. How much current is needed by a 24-ohm resistance in order to dissipate 600 watts?

A. 5 A
B. 25 A
C. 15 A
D. 10 A

TEST 38

PHILIPPINE ELECTRICAL CODE

1. Connection or fittings shall not connect grounding electrode conductors to equipment by means of _____.

A. solder
B. lugs
C. pressure connectors
D. clamps

2. Each length of non-metallic conduit shall be clearly and durably marked at least every ____ as required.

A. 3,000 mm
B. 2,000 mm
C. 4,000 mm
D. 5,000 mm

3. Doors leading into a transformer vault shall be kept locked and access allowed only to _____.

A. the owner
B. qualified person
C. general public
D. any person working in the building

RME Board October 1996

4. Resistors and reactors shall not be installed in close proximity to combustible materials such that it constitutes a fire hazard. What minimum clearance is required by the Code?

A. 250 mm
B. 300 mm
C. 400 mm
D. 100 mm

5. The grounded conductor shall be equal to the largest _____ conductor.

A. bonding
B. phase
C. ungrounded service
D. equipment

6. Completely enclosed, ventilated transformers equipped with an 80 °C rise insulation may be installed in a room _____.

   A. with concrete walls
   B. designed as a vault
   C. of fire resistant construction
   D. built with tile blocks

RME Board April 1996

7. In a switchboard there shall be an air space of at least _____ between the energized metal part and the door of the cabinet.

   A. 30 mm
   B. 20 mm
   C. 15 mm
   D. 25 mm

8. Electrical metallic tubing shall be securely fastened in place within ___ of each outlet box, junction box, cabinet or fitting.

   A. 300 mm
   B. 600 mm
   C. 900 mm
   D. 800 mm

9. Lead-in antenna conductors for television or radio equipment shall be securely _____ to antennas.

   A. attached
   B. fastened
   C. both A and B
   D. neither A or B

10. Lighting fixtures approved for damp locations shall be installed only in ___ locations.

    A. damp
    B. wet
    C. flooded
    D. all of these

RME Board October 1996

11. What is the metric size equivalent of 1,000 MCM?

    A. 250 mm^2
    B. 750 mm^2
    C. 500 mm^2
    D. 1,000 mm^2

12. Antenna conductors for television equipment shall be installed so they will not ____ under open electric light or power conductors where possible.

    A. parallel
    B. cross
    C. both A and B
    D. neither A or B

13. For churches, the general lighting load shall be computed at ____.

    A. 8 VA/m^2
    B. 12 VA/m^2
    C. 16 VA/m^2
    D. 24 VA/m^2

14. Surface metal raceway shall NOT be used where the voltage is ___ volts or more between conductors unless the metal has a thickness of not less than one mm.

    A. 300 mm
    B. 250 mm
    C. 150 mm
    D. 400 mm

15. Electric discharge lighting shall be connected by flexible cord if the cord is visible for ____ percent of its entire length.

    A. 50
    B. 80
    C. 90
    D. 100

RME Board October 1995

16. What is the latest edition of the Philippine Electrical Code, Part 2?

    A. 1994
    B. 1990
    C. 1992
    D. 1988

17. All circuit conductors between the service equipment or the generator switchboard of an isolate plant, and the final branch circuit overcurrent device.

    A. Service
    B. Feeder
    C. Branch circuit
    D. All of these

18. A disruptive discharge through insulation.

    A. Breakdown
    B. Surge
    C. Overload
    D. Fault

RME Board April 1994

19. Insulators used to support wires under cross arms are

    A. pin
    B. spool
    C. suspension
    D. strain

20. A pliable corrugated raceway of circular cross-section with integral or associated couplings, connectors and fittings for the installation of electric conductors?

    A. Electrical metallic tubing
    B. Rigid non-metallic conduit
    C. Electrical non-metallic tubing
    D. Rigid metal conduit

21. The scope of the PEC covers all electrical conductors including optical fiber cable and equipment installed within or to or from any of the following premises, which one is NOT included?

    A. aircraft
    B. motor vehicles
    C. railway rolling stocks
    D. all of these

RME Board April 1995

22. The maximum size of liquid tight flexible metal conduit shall be ___ trade size.

    A. 50 mm
    B. 125 mm
    C. 150 mm
    D. 100 mm

23. Transformers that are installed in unsupervised locations and rated over 600 V are protected by fuses on the primary side and cannot exceed _____ percent of the primary full load current.

    A. 150
    B. 300
    C. 200
    D. 250

24. Each length of intermediate metal conduit shall be clearly and durably identified at ____ intervals with the letters "IMC".

    A. 760 mm
    B. 600 mm
    C. 900 mm
    D. 1,000 mm

RME Board April 1995

25. What is the maximum rating of a molded case circuit breaker to protect a 10 hp squirrel cage induction motor rated at 230 volts, 3-phase, 60 Hz with a full load rating of 28 A?

    A. 30 A
    B. 50 A
    C. 70 A
    D. 100 A

26. Conductors used only for grounding shall be ____.

    A. green, green with yellow stripes, or green and yellow
    B. green, yellow with green stripes, or yellow
    C. green, green with yellow stripes, or bare
    D. green, yellow, or bare

27. Screw type lampholders shall have the _____ conductor connected to the screw shell.

    A. hot
    B. grounded
    C. either A or B
    D. neither A or B

28. Ratio of the maximum demand of a system or part of a system to the total connected load of a system or the part of the system under consideration.

    A. Power factor
    B. Utilization factor
    C. Capacity factor
    D. Demand factor

29. Electrical non-metallic tubing smaller than ____ (outside diameter) electrical trade size shall NOT be used.

    A. 15 mm
    B. 12mm
    C. 20 mm
    D. 10 mm

30. Fixture studs in octagonal boxes used to mount lighting fixtures are computed on the _____ conductor entering the box.

    A. smallest
    B. longest
    C. shortest
    D. biggest

31. Type NM (non-metallic sheathed cable) shall be permitted for ____work in normally dry locations.

    A. exposed
    B. concealed
    C. both A and B
    D. neither A or B

32. Transformers rated over 600 V and installed in supervised locations are protected by circuit breakers on the primary side and cannot exceed ____ of the primary full load current.

    A. 600 %
    B. 500 %
    C. 300 %
    D. 700 %

RME Board April 1994, RME Board October 1994

33. The unit lighting for a dwelling unit expressed in watts per square meter shall be

    A. 8 watts
    B. 40 watts
    C. 24 watts
    D. 16 watts

34. A ___ branch circuit shall be permitted to supply lighting units, other than utilization equipment or a combination of both.

    A. 15 A
    B. 20 A
    C. either A or B
    D. neither A or B

35. Type FCC cable shall be clearly and durably marked on both sides at intervals of not more than _____.

    A. 760 mm
    B. 1,000 mm
    C. 500 mm
    D. 600 mm

36. The starting winding of an induction motor is wound ___ of the main winding.

    A. on top
    B. at the bottom
    C. in the middle
    D. none of these

37. Outlet boxes are not required to have blank covers to prevent the escape of ___

    A. odor and heat
    B. dust and moist
    C. arcs and sparks
    D. none of these

38. A single or multi-conductor solid dielectric insulated cable rated 2, 001 volts or higher.

    A. type MI
    B. type MV
    C. type TC
    D. type IGS

39. Intermediate metal conduit shall be permitted to be installed in or under cinder fill where subject to permanent moisture when protected on all sides by a layer of non-cinder concrete not less than ____ thick.

    A. 50 mm
    B. 100 mm
    C. 75 mm
    D. 25 mm

40. A factory assembly of one or more conductors, each individually insulated and enclosed in a metallic sheath of interlocking tape or a smooth or corrugated tube.

    A. type MC cable
    B. type AC cable
    C. type MI cable
    D. type MV cable

RME Board April 1996

41. Which of the following listed materials is considered among the best insulation material for motor rewinding?

    A. Nomex
    B. Red fiber
    C. Mylar
    D. Fish paper

42. Individual open conductors and cables other than service entrance cables shall NOT be installed within ____ of grade level or where exposed to physical damage.

A. 3,100 mm
B. 3,700 mm
C. 4,600 mm
D. 5,500 mm

43. Bonding provides electrical continuity and safely conducts any ____.

A. voltage on the system
B. unbalanced current
C. fault current that may occur
D. load of the system

44. A barrier shall separate underground coaxial cable when entering ___.

A. ducts
B. pedestals
C. handholes
D. all of these

45. Heavy duty lighting tracks shall be identified to exceed ____ in rating.

A. 15 A
B. 20 A
C. 30 A
D. 40 A

RME Board October 1995

46. Where the conduits enter a switchboard at the bottom, a sufficient space shall be provided to permit installation of the conductors in the enclosure. The minimum spacing between the bottom of the enclosure and the non-insulated bus bar shall be ____.

A. 155 mm
B. 300 mm
C. 255 mm
D. 200 mm

47. What type of cable consists of three or more flat copper conductors placed edge to edge, separated and enclosed within an insulating assembly?

A. type AC
B. type FC
C. type FCC
D. type TC

48. The first choice for the grounding electrode of a separately derived system is a

A. ground ring
B. water pipe
C. building steel
D. driven rod

49. A fixture frame is considered grounded if connected by ___ in a continuous run.

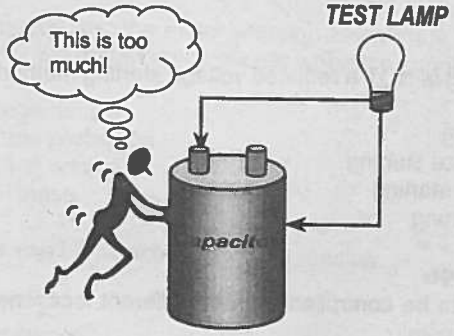
A. EMT
B. IMC
C. either A or B
D. neither A or B

50. Non-metallic extensions shall NOT be used _____.

A. from an existing outlet
B. exposed in dry location
C. non-metallic surface extension
D. as an aerial cable

Master Electricians' work tip:

.....To test the capacitor for a ground, a simple test can be used. Connect one of the leads of the test lamp to one of the terminals of the capacitor. Connect the other test lamp lead to the metal case of the capacitor. If the lamp lights, the capacitor is grounded.



TEST 39

TECHINCAL SUBJECT

1. The efficiency of a cell is ____ that of a DC generator.

   A. less than
   B. more than
   C. almost equal to
   D. none of these (cannot be foreseen)

2. Insulating liquid commonly used for insulating and cooling transformers and for arc interruption in oil circuit breakers.

   A. Mineral oil
   B. Askarel
   C. Either A or B
   D. Neither A or B .

RME Board October 1995

3. A DC generator supplies a load of resistance 1.4 ohms through a pair of wires having a total resistance of 0.10 ohm. The voltage at the DC generator terminals is 120 V, what is the voltage across the load?

   A. 110 V
   B. 105 V
   C. 112 V
   D. 115 V

   By VDT: $e_{load} = \frac{e_T R_{load}}{R_{load} + R_{wire}}$

4. Which of the following is NOT a reduced voltage starting method?

   A. Star-delta starting
   B. Primary resistance starting
   C. Autotransformer starting
   D. Part winding starting

RME Board April 1996

5. A staircase lamp is to be controlled at three different locations. What switches would an electrician install?

   A. two SPST and one 3-way switches
   B. two 3-way and one 4-way switches
   C. two 3-way and one SPST switches
   D. two 4-way and one SPST switches

6. Instrument use to check the motor shaft alignment.

   A. Growler
   B. Hydrometer
   C. Dial indicator
   D. Dynamometer

7. Coils placed at the neutral point midway between the main poles of a DC machine.

   A. Interpole windings
   B. Compensating windings
   C. Equalizer windings
   D. Damper windings

RME Board October 1995

8. Which of the following protection features, a motor starter is not readily needed?

   A. No-voltage protection
   B. Ground fault protection
   C. Single phasing protection
   D. Overload protection

RME Board October 1994

9. An electric range takes 8 kW and an air conditioning unit draws 10 A. The lighting load is 500 W and a water pump draws 8 A. The main supply is 220 volts. Find the total current taken from the supply.

   A. 60.12 A
   B. 56.63 A
   C. 54.21 A
   D. 58.63 A

10. This term means that the motor will stop when there is a supply voltage failure and the motor will restart automatically when the supply voltage is restored.

    A. No voltage release
    B. No voltage protection
    C. No voltage control
    D. None of these

11. An open coil can be detected by _____ reading.

    A. high current
    B. high resistance
    C. high voltage reading
    D. all of these

12. Which of the following is NOT a hand tool?

A. Pipe threader
B. Electrician's knife
C. Electric drill
D. None of these

13. A pipe bending tool.

A. Pipe vise
B. Pipe reamer
C. Hickey
D. Gimlet

14. Manually operated three-position three-pole rotaries switch, which carries a hp rating and is used for manually reversing electric motors.

A. Knife switch
B. Break-make switch
C. Drum switch
D. Rocker switch

RME Board October 1996

15. Is any waterborne unit, which is designed and built to have an electric plant.

A. Water vessel
B. Watercraft
C. Motor vessel
D. None of these

16. Cells are connected in _____when high voltage, as well as high current is desired.

A. series
B. parallel
C. series-parallel
D. none of these

RME Board April 1996

17. This is the greatest effective difference of potential that exists between any two conductors of a circuit.

A. Current
B. Resistor
C. Power
D. Voltage

18. Most single-phase induction motors has how many poles?

A. 2 poles
B. 4 poles
C. 6 poles

D. None of these

19. What is the maximum rating of a fastened in place appliance that can be connected to a 15-A circuit with two or more outlets? The branch circuit also supplies lighting outlets.

A. 12 A
B. 7.5 A
C. 8 A
D. 15 A

20. Three resistors of 100, 150 and 120-ohm resistance are connected in parallel. If the current in the 100-ohm resistance is equal to 1 A, how much is the total current supplied to the parallel circuit.

A. 22.5 A
B. 2.50 A
C. 2.45 A
D. 2.00 A

21. A 12-kW, 240-V DC load is supplied from a line that has a resistance of 0.15-ohm per conductor. Evaluate the total line losses?

A. 750 W
B. 375 W
C. 575 W
D. 725 W

RME Board October 1994

22. An electric heater works at 220 V and takes a current of 9.1 A, what is its rating?

A. 1,800 W
B. 2,500 W
C. 2,000 W
D. 2,002 W

23. The action of the acid in a chemical cell is to _____.

A. removes electrons from both plates
B. removes electrons from one plate and accumulate them on the other plate
C. provide additional free electrons
D. provide insulation between the two plates

24. The terminal voltage of this DC generator varies widely when a change in load occurs. Which one is this?

A. Series
B. Shunt
C. Long shunt compound
D. Short shunt compound

RME Board April 1996

25. Two incandescent lamps of 100 W, 200 V are connected in parallel across a 200-V supply. The total resistance will be

    A. 800 ohms
    B. 200 ohms
    C. 400 ohms
    D. 600 ohms

26. A tool specifically used to drive hexagonally shaped screws.

    A. Allen wrench
    B. Box wrench
    C. Vise grip
    D. Philip's screw driver

27. The impedance of a series resonant circuit is _____.

    A. minimum
    B. maximum
    C. either A or B
    D. approximately zero

RME Board April 1996

28. Motor fuses are usually used to

    A. provide inexpensive protection
    B. protect motors from overcurrent
    C. protect the feeder lines from short circuit currents
    D. have a safety factor of 10

29. Power measurement is to be done on a balanced delta connected load whose terminals cannot be simply open-circuited. What is the minimum number of wattmeter(s) needed?

    A. Only one
    B. Two
    C. Three
    D. Four

RME Board April 1995

30. What is the magnitude of the starting current in an induction motor compared to its full load current?

    A. 9 to 12 times
    B. 4 to 9 times
    C. 2 to 3 times
    D. 3 to 4 times

31. Power factor is the ratio of

    A. resistance to reactance
    B. impedance to reactance
    C. reactance to resistance
    D. resistance to impedance

32. For maximum power transfer, the internal resistance of the source must be ___. the resistance of the load

    A. equal to
    B. greater than
    C. less than
    D. any of these

33. A 440-V, 3-phase motor draws a current of 8-A from a line at a power factor of 0.8 lagging at rated load. What is the kVA rating of the motor?

    A. 3.52 kVA
    B. 10.56 kVA
    C. 2.82 kVA
    D. 6.09 kVA

$S = \sqrt{3}EI = \sqrt{3}(440)(8)$

RME Board April 1996

34. Each member of the Board of Electrical engineering must be at the time of his appointment

    A. must have practice electrical engineering for a period of not less than 5 years
    B. must be at least a registered electrical engineer
    C. must be at least 40 years of age
    D. none of these

35. The three special types of gears used in gearmotors are helical, spur and worm. Which of the types mentioned above is best in power high power applications?

    A. Helical
    B. Spur
    C. Worm
    D. All of these

36. Typical type of thermostat used in appliances with heating elements.

    A. Melting alloy
    B. Bimetallic
    C. Hot-wire
    D. All of these

37. The terminal voltage of a 150-kW shunt generator is 600-V. Calculate the armature current. Assume the armature resistance and shunt field resistances are 0.5 and 50 ohms respectively.

    A. 262 A
    B. 250 A
    C. 258 A
    D. None of these

RME Board October 1994

38. A resistance of 6 ohms is connected in parallel with a 3-ohm resistance. Both resistances are then connected in series with an 8-ohm resistance. If the supply is a 220-V source, what is the current through the 6-ohm resistance?

    A. 7.12 A
    B. 7.5 A
    C. 7.42 A
    D. 7.33 A

39. A 4-pole lap wound armature has 320 conductors wound on it. The flux produced per pole is 50 mWb. If the machine generates 240 V between its armature terminals, what is the speed of the prime mover driving this machine?

    A. 1,000 rpm
    B. 900 rpm
    C. 800 rpm
    D. 700 rpm

40. Any members of the Board shall be at least ____ years of age at the time of his appointment.

    A. 30
    B. 40
    C. 45
    D. 35

41. The power taken by an inductive circuit when connected to a 110-V, 60 Hz source is 500 watts. If the current drawn is 6 A, how much is the power factor of the load?

    A. 60.4 %
    B. 70.8 %
    C. 75.7 %
    D. 72.3 %

RME Board April 1996

42. If the current through the operating coil of a moving iron instruments is doubled, the operating force becomes

    A. two times
    B. tree times
    C. four times
    D. one-half times

43. Unit of elastance.

    A. Farad
    B. Ohm
    C. Siemen
    D. Daraf

44. A 200 V series motor takes 8 A and runs at 640 rpm. Its equivalent resistance is 0.6 ohm. Solve for the CEMF of the motor?

    A. 204.8 V
    B. 197.2 V
    C. 190.3 V
    D. None of these

45. The operating speed of a DC series motor is basically evaluated by

    A. field excitation
    B. equivalent motor resistance
    C. size of load
    D. types of armature winding

RME Board April 1995

46. For efficient operation, induction motors are always designed with a small ____.

    A. air gap
    B. voltage drop
    C. inductive reactance
    D. impedance

47. Batteries used to start the engine of automobiles are examples of what type of cell?

    A. Zinc-chloride
    B. Silver-oxide
    C. Manganese-dioxide
    D. Lead-acid

48. Which of the following is one the cause of overheating in motors?

    A. dirty lubrication
    B. worn bearings
    C. overloads
    D. loose parts

RME Board October 1995

49. A single-phase motor commonly used for small air compressor.

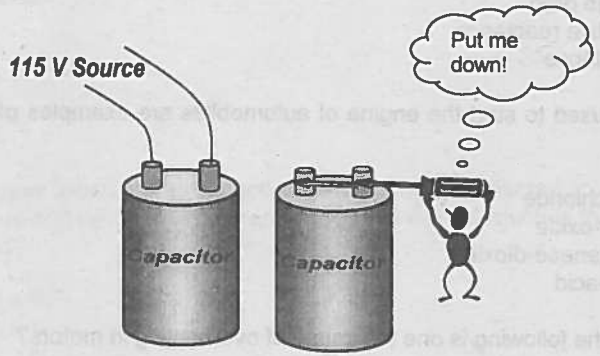
    A. Reluctive motor
    B. Universal motor
    C. Shaded pole motor
    D. Capacitor start, capacitor run

50. A 4-ohm resistor and an unknown resistor are connected in series across a 12-V source. If the current dawn of the resistors is equal to 2 A, find the value of the unknown resistance?

    A. 4 ohms
    B. 3 ohms
    C. 5 ohms
    D. 2 ohms

Master Electricians' work tip:

.....One simple method to test the condition of the capacitor used in a capacitor type motor is called the spark test. Connect the capacitor across the terminals of a 115 V line for just a second After removing the 115 V line, used a screw driver blade to short the two terminals of the capacitor. A good capacitor will show a spark. In the absence of a spark, the capacitor is defective.



TEST 40

PHILIPPINE ELECTRICAL CODE

1. The sum of all contained conductors of an auxiliary gutter at any cross section shall NOT exceed ___ of the interior cross sectional area of the said gutter.

    A. 10 %
    B. 15 %
    C. 20 %
    D. 25 %

2. Fluorescent lighting fixtures installed in _____ ceilings shall be attached to the framing of the ceiling by clips, bolts, screws, or rivets.

    A. rocked
    B. suspended
    C. both A and B
    D. neither A or B

RME Board April 1994

3. In rigid metal wiring conduit, conduits shall be supported at least every

    A. 2,000 mm
    B. 2,500 mm
    C. 3,500 mm
    D. 3,000 mm

4. Direct burial cables or conductors with a nominal voltage of 600 V or less and passes under airport runways including adjacent areas where trespassing is prohibited, shall have a minimum cover distance of ____.

    A. 460 mm
    B. 500 mm
    C. 600 mm
    D. 300 mm

5. If the voltage level is from 250 to 600 V, the air space between the wall, door or gutter partition of any cabinet shall be at least ____.

    A. 24 mm
    B. 22 mm
    C. 28 mm
    D. 26 mm

6. For motors with a marked service factor not less than 1.15, the multiplying factor to be used in determining for size of overload protection shall be ____.

   A. 110 %
   B. 115 %
   C. 120 %
   D. 125 %

RME Board October 1995

7. For a motor starter to be in sight of the controlled motor, it must NOT be more than _____ meters away.

   A. 20
   B. 10
   C. 25
   D. 15

8. Pipelines with impedance heating shall NOT operate at greater than ____ AC.

   A. 30 V
   B. 24 V
   C. 50 V
   D. 100 V

9. The area within ____ horizontally from an aircraft power plant shall be classified hazardous under Class I, Division 2 location.

   A. 1,200 mm
   B. 1,500 mm
   C. 1,800 mm
   D. 2,000 mm

10. Fixture chains shall be wired with ____ wire from the outlet box connections to the sockets of the fixture.

    A. solid
    B. stranded
    C. either A or B
    D. neither A or B

11. Metal faceplates for flush mounted snap switches shall be of ferrous metal NOT less than ___ in thickness.

    A. 0.6 mm
    B. 0.7 mm
    C. 0.8 mm
    D. 0.9 mm

12. Flexible metallic tubing smaller than ___ electrical trade size shall NOT be used.

    A. 20 mm
    B. 15 mm
    C. 12 mm
    D. 32 mm

13. The sum of the cross sectional areas of all contained conductors at any cross section of the wireway shall NOT exceed ___ percent of the interior cross sectional area of the wireway.

    A. 30
    B. 40
    C. 50
    D. 20

14. Where nails or screws are likely to penetrate non-metallic sheathed cable or electrical non-metal tubing, a steel sleeve or steel clip NOT less than ____ in thickness shall be used to protect the cable or tubing.

    A. 1.6 mm
    B. 1.5 mm
    C. 2.0 mm
    D. 1.8 mm

15. An auxiliary gutter shall NOT extend a greater distance than ____ beyond the equipment, which it supplements.

    A. 8,500 mm
    B. 8,900 mm
    C. 9,100 mm
    D. none of these

16. A clearance of NOT less than ___ shall be provided from recessed fixtures and their trims, ventilating openings and other such openings in room surfaces.

    A. 100 mm
    B. 70 mm
    C. 50 mm
    D. 30 mm

17. Storage batteries in solar photovoltaic systems for dwellings shall have cells operating at less than _____.

    A. 50 V
    B. 30 V
    C. 24 V
    D. 12 V

18. The minimum spacing between the bottom of enclosure and the insulated busbars, their supports and other obstructions shall be ____.

A. 200 mm
B. 210 mm
C. 215 mm
D. 205 mm

RME Board October 1994

19. Consist of a group of wire twisted to form a metallic string.

A. Duplex wire
B. Loomex wire
C. Solid wire
D. Stranded wire

20. Service drop conductors passing through sidewalk accessible only to pedestrians where the voltage is limited to 300 V to ground shall maintain a vertical clearance of NOT less than ____ at the electric service entrance to buildings.

A. 3,700 mm
B. 3,100 mm
C. 4,600 mm
D. 5,500 mm

21. Secondaries of transformers supplying voltage for impedance heating of vessels are computed at NOT less than ___ percent of the heating load.

A. 150
B. 100
C. 125
D. 130

22. The ampacity of supply branch circuit conductors supplying diagnostic equipment and the current rating of the overcurrent protective devices shall NOT be less than ___ percent of the momentary rating or ____ percent of the long time rating whichever is larger.

A. 50, 100
B. 60. 125
C. 60, 100
D. 50, 125

23. In dwelling units and guestrooms of hotels, motels and similar occupancies, the voltage shall NOT exceed ___ volts nominal between conductors that supply the terminals of medium base screw shell lampholders.

A. 250
B. 230
C. 300
D. 150

RME Board October 1996

24. The grounding electrode for grounding communications systems may be connected to the nearest accessible location on any of the following EXCEPT one. Which one is this?

A. Buried interior PVC water piping system
B. Grounding electrode conductor
C. Building structure of a concrete building
D. Grounding terminal of service equipment if provided by the utility company

25. Transformers used to step down voltage for general use are classified as ___ systems.

A. separately derived
B. classified
C. direct
D. emergency

26. For a portable motor rated at ____ horsepower or less, the controller shall be permitted to be an attachment plug and receptacle.

A. 0.25
B. 0.33
C. 0.125
D. none of these

27. Hazardous locations in which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures.

A. Class II, Division 1
B. Class II, Division 2
C. Class III, Division 1
D. Class III, Division 2

28. A fixture requiring supply wire rated higher than 90 °C shall be so marked in letters ___ high prominently displayed on the fixture.

A. 6.0 mm
B. 10 mm
C. 6.4 mm
D. 8.4 mm

29. Rosettes for exposed wiring shall be provided with bases that shall be high enough to keep the wires and terminals at least ___ from the surface wired over.

A. 10 mm
B. 12 mm
C. 13 mm
D. 15 mm

RME Board October 1995

30. Branch lighting circuits shall be protected by overcurrent devices not rated more than

    A. 40 A
    B. 20 A
    C. 30 A
    D. 50 A

31. Solar photovoltaic systems in a one-family dwelling units with circuits rated over ____ to ground while energized shall NOT be accessible to other than qualified persons.

    A. 50 V
    B. 150 V
    C. 100 V
    D. none of these

32. Where liquidtight flexible metal conduit is installed as a fixed raceway, it shall be secured at intervals NOT exceeding ____ .

    A. 1,500 mm
    B. 1,250 mm
    C. 1,400 mm
    D. 1,300 mm

33. An approved assembly of insulated conductors with fittings and conductor terminations in a completely enclosed ventilated protective metal housing.

    A. Cable tray
    B. Cablebus
    C. Gutter
    D. Busway

RME Board April 1994

34. The inner strand of ACSR is made of

    A. brass
    B. steel
    C. copper
    D. lead

35. If two or more buildings are supplied by a grounded system from one main service, each building shall have separate _____.

    A. phases
    B. neutrals
    C. grounding electrode systems
    D. service drops

36. The continuous load supplied by a branch circuit shall NOT exceed the branch circuit rating by more than _____ percent.

    A. 50
    B. 60
    C. 80
    D. 90

37. A cable provided with a wrapping or metal usually steel wires or tapes, primarily for the purpose of mechanical protection.

    A. Metal clad cable
    B. Metallic sheathed cable
    C. Armored cable
    D. Flat conductor cable

RME Board April 1995

38. In all cases where there are energized parts on the front of the switchboards or motor control centers, the working space in front of such equipment shall NOT be less than a minimum distance. What is this distance?

    A. 2,000 mm
    B. 500 mm
    C. 1,500 mm
    D. 1,000 mm

39. Border lights shall be installed around stages in theaters on circuits rated at ___ or less.

    A. 20 A
    B. 15 A
    C. 30 A
    D. 10 A

RME Board April 1995

40. Wirings allowed to be installed outside buildings are enumerated below EXCEPT one. Which one is this?

    A. Type MC cable
    B. Flat conductor cable
    C. Rigid metal conduit
    D. Open wires on insulators

41. Conductors supplying a heating unit shall be calculated at ____ percent times the heating load plus the blower motor.

    A. 110
    B. 100
    C. 130
    D. 125

42. Masts separate from the structure to be protected shall be a minimum of ___ from the protected structure.

A. 1,800 mm
B. 2,000 mm
C. 1,900 mm
D. 1,500 mm

43. Lighting track conductors shall be a minimum of ____ or equal and shall be copper.

A. 2.0 mm^2
B. 1.25 mm^2
C. 5.5 mm^2
D. 3.5 mm^2

44. The walls and roofs of transformer vaults shall be constructed of materials that have adequate structural strength for the condition with a minimum fire resistance of ___ hours.

A. 1.5
B. 2.0
C. 2.5
D. 3.0

RME Board April 1995

45. In order to protect a personnel and prevent shock, the equipment should be connected good earth ground through the

A. conduit pipe
B. hot water pipe
C. cold water pipe
D. rigid conduit pipe

46. When computing the service load with the standard method, more than three fixed appliances are computed with a demand factor of ____ of the nameplate rating.

A. 80 %
B. 65 %
C. 70 %
D. 75 %

47. When computing the service load with the standard method, a 20 kW electric space heating unit is computed at _____ percent.

A. 80
B. 100
C. 90
D. 125

48. Where knobs are used, conductors shall be securely tied thereto by ____ wires having insulation equivalent to that of the conductor.

A. tie
B. bonding
C. guy
D. splicing

49. A photovoltaic power source having one conductor of a 2-wire system over ___ volts shall be solidly grounded.

A. 100
B. 150
C. 50
D. 200

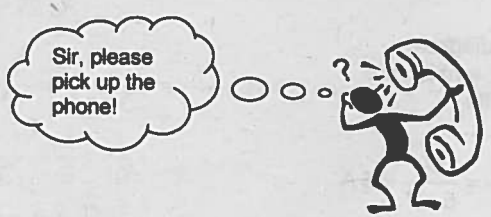
RME Board April 1996

50. The Code requires that all energized part of electrical equipment operating at ____ or more shall be guarded against accidental contacts by approved enclosures. What is this voltage?

A. 24 volts
B. 110 volts
C. 230 volts
D. 50 volts

Master Electricians' work tip:

.....Be alert! If there are some suspicious conditions that you think might be in failure later and can cause accidents or any damages to electrical equipment, report them immediately to proper authority before any further work is done. Remember, do NOT try restoring any, without proper order from superiors.



ANSWERS & SOLUTIONS TO TESTS

TEST 1

1. B. 600 A

$$I = \frac{E}{R} = \frac{6}{0.01} = 600\ A$$

2. A. 0.6 leading

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad pf = \frac{R}{Z} = \frac{6}{10}$$

$$Z = \sqrt{6^2 + (10-18)^2} \qquad pf = 0.6 \text{ leading, since } X_C > X_L$$

$$Z = 10\,\Omega$$

3. B. Brass
4. A. increases
5. C. Galvanometer
6. A. relay
7. B. silver
8. A. 160 W

$$P = \frac{E^2}{R} = \frac{(20)^2}{2.5} = 160\ W$$

9. C. heating
10. D. volt
11. C. Wiring diagram
12. B. counter emf is zero
13. C. 125 watts

$$I_t = \frac{E_t}{R_t} = \frac{60}{5+7} = 5\ A$$

$$P = I_t^2 R = (5)^2(5)$$

$$P = 125\ W$$

14. B. drooping voltage characteristics
15. A. voltmeter, current meter and ohmmeter
16. D. resistance
17. D. far right
18. C. Hydrometer
19. C. 2
20. C. 3
21. B. Low side
22. B. 0.49 kW

$$P = I^2R = (3.5)^2(40) = 490\ W \times \frac{1\ kW}{1000\ W} = 0.49\ kW$$

23. B. Storage cell
24. A. 5 A

$$\text{By CDT: } I_1 = \frac{I_t R_2}{R_1 + R_2} = \frac{(9)(10)}{8+10} = 5\ A$$

25. D. 60 Hz

$$X_C = \frac{1}{2\pi fC}, \text{ thus } f = \frac{1}{2\pi X_C C}$$

$$f = \frac{1}{2\pi(53.05)(50 \times 10^{-6})} = 60\ Hz$$

26. C. 12 ohms

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}, \text{ since in parallel}$$

$$\frac{1}{3} = \frac{1}{4} + \frac{1}{R_2}$$

$$R_2 = 12\,\Omega$$

27. C. have no effect on the relay
28. A. 2.73 μF

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}, \text{ since in series}$$

$$\frac{1}{C_t} = \frac{1}{5} + \frac{1}{10} + \frac{1}{15}$$

$$C_t = 2.73\ \mu F$$

29. B. Connect in shunt across the load
30. C. Neutron

31. B. increasing the capacity of the cell
32. D. a battery
33. B. zero
34. B. Resistance of winding
35. B. Resonance
36. A. Micrometer
37. D. armature
38. A. 0 °C

$$R_2 = R_1(1+\alpha\Delta_t)$$
$$880 = 1000(1+0.006\Delta_t)$$
$$\Delta_t = -20\,°C$$

$$\Delta_t = t_2 - t_1$$
$$-20 = t_2 - 20$$
$$t_2 = 0\,°C$$

Soln
$880 = 1000(1+0.006\Delta t)$
$880 = 1000 + 6\Delta T$
$-1000+880 = 6\Delta T$
$-120 = 6\Delta T$
$\frac{-120}{6} = \Delta T$
$= -20$

39. A watts to volt-amps
40. C. valence electrons
41. C. 104

Solving for the area (circular mils of each strand):

$$CM = \frac{400{,}000}{37} = 10810.81 \text{ circular mils}$$
$$CM = d^2$$
$$d = \sqrt{CM} = \sqrt{10810.81} = 104 \text{ mils}$$

42. D. It will run in the reversed direction
43. C. 103.66 °C

Soln
$T + t_2 = \frac{R_2}{R_1}(T + t_1)$
$= \frac{90\,\Omega}{68\,\Omega}(234.5 + 21)$
$= 1.324(256.5)$
$t_2 = 339.28 - 234.5$
$= 103.7$

$$\frac{R_2}{R_1} = \frac{T+t_2}{T+t_1}$$
$$\frac{90}{68} = \frac{234.5+t_2}{234.5+21}$$
$$t_2 = 103.66\,°C$$

44. A. open
45. B. 360,000 coulombs

$$Q = It = (10)(10 \text{ hours})\left(\frac{3{,}600 \text{ seconds}}{1 \text{ hour}}\right) = 360{,}000 \text{ coulombs}$$

46. B. Only one
47. D. 0.3 A

$$I = \frac{E}{R_t} = \frac{1.45}{4+1} = 0.3\,A$$

48. C. Direct on line

49. C. 0 A

Since the three line currents are equal, the neutral current is zero.

50. A. 26 A

$$I = \frac{P}{E} = \frac{3120}{120} = 26\,A$$

TEST 2

1. D. 100 mm
2. C. Electrical permit
3. C. mandatory
4. B. 3
5. B. 30 A
6. D. type USE
7. D. 250 mm
8. A. 26 mm
9. C. 12 mm
10. C. 2.0 mm^2
11. B. Pendant
12. B. Motor's manufacturer
13. A. 45 A
14. D. None of these (Derating is applicable only if there are 3 or more wires)
15. B. Expansion bolt
16. B. 7.28 kW

Neutral load = 70% of demand load
= 0.7 (10.4) = 7.28 kW

17. C. 5
18. D. 890 Newtons
19. B. Class II
20. D. 30 A
21. C. 1,800 mm
22. C. Continuous duty
23. B. 300 mm
24. D. 6.4 mm
25. D. All of these
26. A. 600 V
27. B. Single solid conductor
28. D. should
29. D. Air terminal
30. B. copper
31. D. wires do not support the fixture
32. D. Fixed appliance

33. D. 110 A
34. C. 50 mm
35. D. None of these
36. B. 750 V
37. D. 660 W
38. C. 3,000 mm
39. C. 2,000 mm
40. A. 200 mm
41. C. 30
42. A. 25,000 ohms
43. D. intentionally grounded
44. A. 30 kVA
45. A. 23 m
46. D. setting of the overcurrent device
47. A. hoistways
48. A. TW
49. C. Reactor
50. D. Local Building Office

TEST 3

1. A. 1.6 mm

$$d = \sqrt{CM} = \sqrt{3969} = 63 \text{ mils}$$

$$d = 63 \text{ mils} \times \frac{1 \text{ inch}}{1000 \text{ mil}} \times \frac{25.4 \text{ cm}}{1 \text{ inch}} = 1.6 \text{ mm}$$

2. D. All of these
3. D. Weber
4. C. Long shunt compound generator
5. A. Pilot lamp
6. D. Voltmeter
7. C. talc
8. C. centrifugal switch
9. A. Brass
10. B. 0.12 A

$$I = \frac{E}{R} = \frac{120}{1{,}000} = 0.12 \text{ A}$$

11. C. very high
12. A. 8
13. B. Pull box
14. D. chemical
15. D. All of these
16. A. two, two

17. A. 100 W

$$P = \frac{E^2}{R} = \frac{(200)^2}{400} = 100 \text{ W}$$

18. C. 2,000 ohms

$$L = \frac{X_L}{2\pi f} = \frac{10{,}000}{2\pi(10{,}000)}$$

$$L = 0.1592 \text{ H}$$

$$X_L = 2\pi fL$$

$$= 2\pi(2{,}000)(0.1592)$$

$$X_L = 2{,}000 \ \Omega$$

19. B. 18 pesos

$$W = Pt = VIt$$

$$= (120)(15)(10)$$

$$= 18{,}000 \text{ W - hr}$$

$$W = 18 \text{ kW - hr}$$

Cost = W x cost per kW - hr

= 18 x 1 peso

Cost = 18 pesos

20. D. 5 mA

$$I = \frac{E}{R} = \frac{60}{12{,}000} = 0.005 \text{ A} = 5 \text{ mA}$$

21. C. Both frequency and voltage
22. B. Interrupting rating
23. B. 2 ohms

For identical resistances, $R_t = \frac{R}{n} = \frac{36}{18} = 2 \ \Omega$

24. D. 8

$$N = \frac{\text{Size of branch circuit}}{\text{load current x 125\%}} = \frac{15}{(15)(1.25)} = 8$$

25. C. Wattmeter
26. B. r / 16

Since there are four parts, then each part has a resistance of r / 4.

For identical resistances, $R_t = \frac{R}{n} = \frac{r/4}{4} = r/16 \ \Omega$

27. C. cross-sectional area
28. B. in series with the load
29. B. a semi-conductor
30. C. interrupting current
31. D. All of these
32. D. Volt

33. D. Kilowatt-hour
34. B. 0.25 ohm

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}, \text{ since in parallel}$$

$$\frac{1}{0.2} = \frac{1}{1} + \frac{1}{R_2}$$

$$R_2 = 0.25\,\Omega$$

35. C. Both A and B
36. C. lower than
37. B. capacitor start and run type
38. C. 92 ohms

$$R = \frac{E}{I} = \frac{230}{2.5} = 92\,\Omega$$

39. A. 3.66 ohms

$$R_{lamp} = \frac{E}{I} = \frac{220}{15} = 14.67\,\Omega$$

$$R_{total} = \frac{E}{I_{new}} = \frac{220}{12} = 18.33\,\Omega$$

$$R_{total} = R_{lamp} + R, \text{ since in series}$$

$$R = R_{total} - R_{lamp} = 18.33 - 14.67 = 3.66\,\Omega$$

40. B. 3,600
41. C. Conductance
42. D. all of these
43. C. 50 V

$$E = \frac{Q}{C} = \frac{20 \times 10^{-6}}{0.4 \times 10^{-6}} = 50\text{ V}$$

44. B. 6
45. C. Inductance
46. C. 180 ohms

$$R_t = R_1 + \frac{R_2 R_3}{R_2 + R_3}, \text{ since in series-parallel}$$

$$R_t = 120 + \frac{(120)(120)}{120 + 120} = 180\,\Omega$$

47. D. Continuing Professional Education
48. B. Only one diode

49. B. 100 watts, 240 volts

Since the replacement lamp is to be connected across the same supply, its resistance must be the same as that of the busted lamp, in order to draw the same amount of power.

$$R_{\text{busted lamp}} = \frac{E^2}{P} = \frac{(120)^2}{25} = 576\,\Omega$$

Using choice a : $R = \frac{(110)^2}{20} = 605\,\Omega$ (not possible)

Using choice b : $R = \frac{(240)^2}{100} = 576\,\Omega$ (answer)

50. D. 5.2 ohms

$$R_t = R_1 + \frac{R_2 R_3}{R_2 + R_3}, \text{ since in series-parallel}$$

$$R_t = 4 + \frac{(3)(2)}{3 + 2} = 5.2\,\Omega$$

TEST 4

1. B. 1,500 VA
2. A. 1,200
3. D. all of these
4. D. all of these
5. C. one-half
6. B. One
7. B. 1.35 mm
8. A. 48
9. D. Armored cable
10. C. Heath care facilities
11. B. 1,800 mm
12. A. Board of Electrical Engineering
13. D. 600 mm
14. B. 50 V
15. B. Raintight
16. A. 600 mm
17. B. be
18. D. Wires of the same size should be spliced together in line
19. B. Maritime Industry Authority
20. D. one year
21. A. 600 V
22. A. 7,600 mm
23. C. 300 mm

24. D. 8.0 mm^2
25. A. Class III, Division 1
26. A. 125 %
27. D. 40 or 50 A
28. A. receives its supply
29. A. 300 mm
30. B. 1,800 mm
31. D. Outlet
32. C. shall not be
33. A. bare conductor
34. A. 600 mm
35. B. Class II, Division 2
36. A. 1,000 mm
37. B. 3.5 mm^2
38. B. 900 mm
39. C. 76 mm
40. D. four
41. D. 40 %
42. A. Overload
43. C. 50 A
44. B. 80 %
45. B. Extended use of temporary installation shall not require a new approved electrical permit
46. C. 100 %
47. C. under RA 7920
48. C. 70 °C
49. B. 600 mm
50. B. 100 mm

TEST 5

1. A. 3 years
2. D. Monitoring relay
3. B. Element
4. D. 43.81 A

$$P_{in} = \frac{P_{out}}{\eta} = \frac{10(746)}{0.86} = 8674.42\ W$$

$$P_{in} = EIpf$$

$$I = \frac{P_{in}}{Epf} = \frac{8674.42}{220(0.9)} = 43.81\ A$$

5. A. Iron losses
6. D. reciprocal of impedance
7. C. c, b, e, a, d
8. B. Discharged the filter capacitor

9. B. The supply battery is weak
10. C. 8 ohms

$$R_t = R_1 + \frac{R_2R_3}{R_2 + R_3}, \text{since in series - parallel}$$

$$R_t = 4 + \frac{(8)(8)}{8+8} = 8\ \Omega$$

11. C. Emery
12. A. alternators
13. B. 8 cycles
14. A. 746
15. A. direction of the end connection
16. D. None of these *

$$R_t = \frac{R_1(R_2 + R_3)}{R_1 + (R_2 + R_3)}, \text{since in parallel - series}$$

$$R_t = \frac{4(3+1)}{4+3+1} = 2\ \Omega$$

17. A. 60 mΩ

Refer to the Theory section of this Reviewer for the diagram and formulas of an ammeter.

$$I_{sh} = I - I_m$$
$$= 5 - 0.001$$
$$I_{sh} = 4.999\ A$$
$$R_{sh} = \frac{I_mR_m}{I_{sh}} = \frac{0.001(300)}{4.999} = 0.06\ \Omega = 60\ m\Omega$$

18. C. Infinite resistance
19. D. all of these
20. B. open the disconnect switches
21. B. Oil
22. B. airgap
23. C. 83.33 %

$$\eta = \frac{P_{in} - P_{losses}}{P_{in}} = \frac{V_sI_s - P_{losses}}{V_sI_s} = \frac{(250)(30) - 1250}{(250)(3)} = 0.8333$$
$$\eta = 83.33\ \%$$

24. A. Anion
25. C. Three
26. A. voltage across R_2 is 100 V

27. A 6 μF

$$\frac{1}{C_t}=\frac{1}{C_1}+\frac{1}{C_2}, \text{since in series}$$
$$\frac{1}{2.4}=\frac{1}{4}+\frac{1}{C_2}$$
$$C_2 = 6\,\mu F$$

28. A. 50 A

$$\frac{I_1}{I_2}=\frac{N_2}{N_1}$$
$$I_1=\frac{I_2N_2}{N_1}=\frac{(2)(2500)}{100}=50\text{ A}$$

29. C. Compensating windings
30. C. 2,250 VA

Load = number of outlets x 180 VA/outlet x 125%
= 10(180)(1.25) = 2,250 VA

31. B. 50 ohms

For identical resistances, $R_t=\frac{R}{n}=\frac{1000}{20}=50\,\Omega$

32. A. low
33. C. voltage
34. C. force
35. C. maximum voltage
36. D. Power
37. A. AC as well DC power
38. B. 81.50 A

Feeder load = Sum of motors' FLA + 25 % of largest motor FLA
= 34 + 27 + 12 + (0.25)(34)
Feeder load = 81.5 A

39. D. None of these

$$\frac{1}{L_t}=\frac{1}{L_1}+\frac{1}{L_2}, \text{since in parallel}$$
$$\frac{1}{2}=\frac{1}{6}+\frac{1}{L_2}$$
$$L_2 = 3\,H$$

40. C. Gallium Arsenide
41. C. Separate the victim immediately from the circuit

42. D. Electrolytic capacitor
43. D. Thermocouple
44. C. 50 hp

$$HP=\frac{2\pi NT}{44760}=\frac{2\pi(480)(742)}{44760}=50\text{ hp}$$

45. D. None of these

$$R_2=R_1(1+\alpha\,\Delta_t)=30[1+(0.00385)(60-30)]=33.46\,\Omega$$

46. D. All of these
47. D. All of these
48. A. 10 ohms

In order for the load to operate successfully, the voltage across it must be 50 V and the current flowing in the series circuit must be 6 A also. Thus, the voltage drop across the additional resistance in series is 60 V (subtracting 50 V from 110V). And the resistance R in series is:

$$R=\frac{E_{drop}}{I}=\frac{60}{6}=10\,\Omega$$

49. B. Series motor
50. B. 3 A

$$I=\frac{E}{R_t}=\frac{75}{10+5+7+3}=3\text{ A}$$

TEST 6

1. D. 6.4 mm
2. A 1,900 mm
3. C. Electrical Inspector
4. D. 15 A
5. D. Guy
6. A. Insulation resistance
7. D. 12
8. C. It can be located inside clothes closets
9. D. Raceway shall be used as a means of support for other raceways
10. B. 180 VA
11. C. 300 mm
12. A. 360 degrees
13. D. 1.6 mm
14. D. Pull box
15. C. fully insulated

16. B. 20
17. A. 30 A
18. B. 40 A
19. D. 0.75 mm^2
20. A. 5.5 mm^2
21. D. Where exposed to corrosive atmosphere
22. A. 300 mm
23. A. 24 watts
24. D. all of these
25. B. shall not be
26. D. all of these
27. B. 250,000 ohms
28. A. 75 °C
29. D. Counterpoise
30. B. be permitted to be installed in a separate raceway
31. C. 80 %
32. D. Type UF
33. A. Guy insulator
34. D. 30 A
35. D. all of these
36. C. Class I, Division 1
37. A. switch-on position
38. A. Dry locations
39. C. 100 %
40. C. 30 A
41. C. 25,000 volts
42. A. 1500 mm
43. A. 3,680 volt-amperes
44. C. 600
45. D. 1,200 A
46. B. Busway
47. B. Damp locations
48. A. 1,800 mm
49. B. grounding electrode and system neutral
50. C. 50 V

TEST 7

1. C. It has a better speed control
2. B. emitter, base and collector
3. B. 1200 W

   $P = EI = (120)(10) = 1200\ W$

4. B. repulsion
5. B. 200 A

Size of none time delay fuse (NTDF) = 300 % of FLA
= 3(68) = 204 A

The closest lower standard rating to 204 A is a 200 A fuse.

6. D. None of these

$$R = \frac{E^2}{P} = \frac{(120)^2}{600} = 24\ \Omega$$

7. B. approximately zero
8. A. oil and soap
9. D. trap
10. D. All of these
11. A. additive
12. B. 600 W

$$P = EIpf = (400)(20)(0.75) = 6{,}000\ W$$

13. B. 0.833 A

$$I = \frac{P}{E} = \frac{100}{120} = 0.833\ A$$

14. A. voltmeter
15. C. 25 A

$$I_N = \sqrt{I_1^2 + I_2^2 + I_3^2 - I_1I_2 - I_2I_3 - I_1I_3}$$
$$= \sqrt{(68)^2 + (88)^2 + (96)^2 - (68)(88) - (88)(96) - (68)(96)}$$
$$I_N = 24.98\ A$$

16. C. 28 A

Note: 5 hp is the mechanical output of the motor at rated load, since efficiency is not given, then the electrical power input of the said motor cannot easily be solved.

From PEC table in motor currents, a 5 hp single-phase motor has an FLA (full load amperes) of 28 A.

17. C. Core or iron losses
18. B. incandescent lamps
19. D. left with its cover closed and padlocked
20. C. AC generator
21. A. a negligible effect on the circuit current
22. A. reamer

23. C. start measuring at the highest range
24. C. Tachometer
25. A. the temperature should remain constant
26. A. 480 A

Amperage of neutral = first 200 A at 100% + 70 % of the remainder

First 200 A at 100% = 200 A
Next 400 A at 70 % = 280 A
Total amperage = 200 + 280 = 480 A

27. A. 1.25 V

$$\text{By VDT: } E_{load} = \frac{E_t R_{load}}{R_{load} + R_{internal}} = \frac{(1.5)(0.1)}{0.1 + 0.02} = 1.25 \text{ V}$$

28. A. 24,000 ohms, 1/4 W

$$R = \frac{E}{I} = \frac{24}{0.001} = 24{,}000\ \Omega$$

$$P = I^2R = (0.001)^2(24{,}000) = 0.024 \text{ W}$$

29. C. Capacitor run motor
30. B. aluminum
31. B. heating, magnetic and electric shock
32. B. rubber footings
33. A. 0.2

200 joules/second = 200 W
200 W x 1 kW/1000 W = 0.2 kW

34. D None of these

VA rating = VI = (230)(20) = 4,600 VA

35. A. watts to volt-amperes
36. B. an inductor
37. D. All of these
38. A. 30 ohms

$$\frac{R_1}{R_2} = \frac{L_1 A_2}{L_2 A_1}$$

$$R_2 = \frac{R_1 L_2 A_1}{L_1 A_2} = \frac{(5)(3L_1)(A_1)}{L_1(0.5A_1)} = 30\ \Omega$$

39. C. increase in resistance per ohm per degree absolute
40. D. Gimlet
41. C. megohmmeter

42. C. Riser down
43. C. AC voltage to DC voltage and vice-versa
44. B. two 3-way and three 4-way switches
45. D. 6 ohms

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}, \text{ since in parallel}$$

$$\frac{1}{2} = \frac{1}{3} + \frac{1}{R_2}$$

$$R_2 = 6\ \Omega$$

46. A. 3.5 watts

$$I = \frac{E}{R_{internal} + R_{load}} = \frac{1.5}{0.02 + 0.6} = 2.419 \text{ A}$$

$$P_{load} = I^2 R_{load} = (2.419)^2(0.6) = 3.5 \text{ W}$$

47. A. switching any two of the three leads
48. D. incandescent
49. C. 18 V

$$\text{By VDT: } E_{load} = \frac{E_t R_{load}}{R_{load} + R_{internal}}$$

$$E_t = \frac{E_{load}(R_{load} + R_{internal})}{R_{load}} = \frac{12(10 + 5)}{10} = 18 \text{ V}$$

50. A. 121 ohms

$$R = \frac{E^2}{P} = \frac{(110)^2}{100} = 121\ \Omega$$

TEST 8

1. B. 200 mm
2. B. 4
3. C. Switchgear
4. D. 600 mm
5. A. 30 m
6. D. all of these
7. A. Earth
8. C. Service entrance cable
9. D. 0.75 mm^2
10. B. bushings
11. D. There shall be a robust door between the vault and any non-hazardous location
12. C. 5.5 mm^2

13. A. Jumper
14. A. In dry locations
15. D. 19 mm
16. B. Sulfur hexafluoride
17. A. Hazardous locations
18. D. all of these
19. A. 18 m
20. A. 24
21. D. Type AC
22. B. taps
23. A. 1.5 hours
24. D. Portable appliance
25. B. 90 %
26. C. 1,500 watts
27. A. 2,000 V
28. D. 600 mm
29. B. feeder
30. D. 900 mm
31. B. 15 mm
32. C. Locknuts
33. A. 900 mm
34. D. 97 %
35. C. 75 °C
36. A. 3,100 mm
37. D. white or natural gray
38. A. industrial
39. B. water from entering the box or fitting
40. B. 300 V
41. C. 1,300 mm
42. D. Split knobs
43. B. 125 mm^2
44. D. 1,000 mm
45. B. 6,000 mm
46. D. Copper
47. B. 6.4 mm
48. C. 100 %
49. C. thermoplastic
50. D. 600 V

TEST 9

1. C. higher fault current, shorter time needed to cut-off
2. B. alternating current
3. C. PEE
4. C. compound generators
5. C. two, two
6. A. normally open
7. C. 1.0

8. B. Shunt generators
9. A. Thermal relay
10. B. Fish tape
11. A. 2 ohms

$$R_{oven} = \frac{E}{I} = \frac{220}{11} = 20\,\Omega$$

$$R_{total} = \frac{E}{I_{new}} = \frac{220}{10} = 22\,\Omega$$

Since in series, the required resistance is equal to $2\,\Omega$

12. D. 5 ohms

$$R_{total} = \frac{E}{I} = \frac{1.45}{0.2} = 7.25\,\Omega$$

$R_{total} = R_{internal} + R_{load}$, since in series

$R_{internal} = 7.25 - 2.25 = 5\,\Omega$

13. D. The zero point is corrected with the help of this control
14. C. Commutator
15. C. Self inductance
16. A. 16 ohms

For identical resistances in series, $R_t = nR = 4(4) = 16\,\Omega$

17. A. spark of spark plug
18. A. The smaller the diameter of a conductor, the higher the resistance
19. A. 16 A

$$\text{By CDT}: I_1 = \frac{I_t R_2}{R_1 + R_2} = \frac{24(10)}{5+10} = 16\text{ A}$$

20. B. 4

a = 2 m = 2 (2) = 4 parallel paths (m = 2, since winding is duplex)

21. A. 15 V

$$E = IR = (0.5)(5+10+15) = 15\text{ V}$$

22. C. 600.6 V

$$I_a = I_L + I_{sh} = 400 + 6 = 406\text{ A}$$

$$V_L = E - I_a R_a = 625 - (406)(0.06) = 600.64\text{ V}$$

23. A. amperes
24. B. impedance
25. A. infinite
26. B. 220 V

$$E_{supply} = V_L + IR_{feeder}$$
$$E_{supply} = 200 + (250)(0.08) = 220\ V$$

27. B. lowers the voltage and increases the current
28. B. hard drawn copper
29. A. Inductance
30. D. moving iron meter
31. C. Puller
32. B. zero
33. C. It is easy to detect open, close or trip positions
34. B. lags
35. A. 10^{-12} of a unit
36. C. effective value
37. B. self excited
38. C. Admittance
39. D. Permanent magnet type
40. C. cross-sectional area
41. A. 18
42. D. Residual
43. C. back emf
44. C. yoke
45. A. the square of the current
46. B. linear
47. C. water
48. A. full scale deflection
49. A. DC supply has no frequency
50. C. Transistor

TEST 10

1. A. 20 A
2. A. shall be
3. C. Rigid non-metallic conduit
4. D. One or more sides
5. C. 125
6. C. 100 A
7. C. 125
8. C. Class III
9. C. one-half
10. D. Carbon dioxide gas
11. B. 1800 mm
12. A. 60 °C

13. C. Ventilation
14. A. 300 V
15. A. 15 V
16. B. 90 °C
17. D. 200 %
18. B. 10 mm
19. C. 2.0 mm^2
20. C. 14 mm^2
21. B. approved
22. D. all of these
23. A. one
24. D. 50 mm^2
25. D. 50 mm
26. D. 100 %
27. B. 300 volts
28. A. 50 mm
29. C. 600 V
30. D. Traveling cable
31. C. 23 kg
32. B. One, in the ungrounded conductor
33. C. 500,000 ohms
34. A. 4
35. A. 50 mm
36. C. 138 kPa
37. B. 15 mm
38. B. dry locations only
39. C. Direct burial in the earth
40. A. one
41. C. Rigid non-metallic conduit
42. A. 150 mm
43. A. 80 %
44. D. 80
45. B. watertight
46. D. Intermediate metal conduit
47. D. 150 mm
48. B. 87.5 %
49. B. 2,450 mm
50. D. Raceway

TEST 11

1. D. black
2. B. substitution
3. B. 225 V

$$E = V_L + I_a R_a$$
$$E = 224 + 5(0.2) = 225\ V$$

4. C. Conduit
5. D. None of these

$$I_1 = \frac{P_1}{E} = \frac{80}{100} = 0.8\ A$$
$$I_t = I_1 + I_2$$
$$I_2 = 2 - 0.8 = 1.2\ A$$

6. C. increase
7. B. 32 μF

$$Q_t = Q_1 + Q_2 = 3{,}000 + 5{,}000 = 8{,}000\ \mu C$$
$$C_t = \frac{Q_t}{E} = \frac{8{,}000}{250} = 32\ \mu F$$

8. C. reversing the field current
9. C. 1,840 W

$$P = EIpf = (230)(10)(0.8) = 1{,}840\ W$$

10. D. discharge and the electrolyte is drained
11. C. 440 W

$$P = \frac{E^2}{R} = \frac{(220)^2}{110} = 440\ W$$

12. A. 68.75 V

$$\text{By VDT}: E_1 = \frac{E_t R_1}{R_1 + R_2} = \frac{(110)(50)}{50 + 30} = 68.75\ V$$

13. C. Field changing contactor
14. C. good insulator
15. D. Element
16. B. Ground protective relay
17. C. 660 W

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$\frac{1}{R_t} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30}$$
$$R_t = 5.4545\ \Omega$$
$$P_t = \frac{E^2}{R_t} = \frac{(60)^2}{5.4545} = 660\ W$$

18. B. Toggle switch
19. A. external magnetic fields

20. A. Continuity
21. C. 0.50 V
22. C. Induction
23. B. filter
24. C. to invert the armature current
25. A. voltage
26. D. Electrician's knife
27. A. ampere-hours
28. B. Internal resistance
29. A. align pulleys correctly
30. C. Both A and B
31. B. leading
32. A. 100 W

$$P = \frac{E^2}{R} = \frac{(200)^2}{400} = 100\ W$$

33. B. Series generator
34. B. self-starter
35. A. connecting alternators in parallel
36. B. 10.76
37. B. siemen
38. D. reddish
39. D. Flat
40. B. 6 inches

$$\text{By ratio \& proportion}: \frac{1{,}000}{1\ sq.\ inch} = \frac{1{,}500}{A}$$
$$A = 1.5\ sq.inch$$
$$A = \text{length x width}$$
$$\text{width} = \frac{A}{\text{length}} = \frac{1.5}{1/4} = 6\ \text{inches}$$

41. A. area of its plate
42. D. Manganese-dioxide
43. C. Cast steel
44. B. Prime mover
45. B. Mho
46. D. all of these
47. B. eddy current loss
48. C. Inductors
49. C. constant
50. A. wye

TEST 12

1. A. 8.0 mm^2

4. C. Conduit
5. D. None of these

$$I_1 = \frac{P_1}{E} = \frac{80}{100} = 0.8\ A$$
$$I_t = I_1 + I_2$$
$$I_2 = 2 - 0.8 = 1.2\ A$$

6. C. increase
7. B. 32 μF

$$Q_t = Q_1 + Q_2 = 3{,}000 + 5{,}000 = 8{,}000\ \mu C$$
$$C_t = \frac{Q_t}{E} = \frac{8{,}000}{250} = 32\ \mu F$$

8. C. reversing the field current
9. C. 1,840 W

$$P = EIpf = (230)(10)(0.8) = 1{,}840\ W$$

10. D. discharge and the electrolyte is drained
11. C. 440 W

$$P = \frac{E^2}{R} = \frac{(220)^2}{110} = 440\ W$$

12. A. 68.75 V

$$\text{By VDT}: E_1 = \frac{E_t R_1}{R_1 + R_2} = \frac{(110)(50)}{50 + 30} = 68.75\ V$$

13. C. Field changing contactor
14. C. good insulator
15. D. Element
16. B. Ground protective relay
17. C. 660 W

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$\frac{1}{R_t} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30}$$
$$R_t = 5.4545\ \Omega$$
$$P_t = \frac{E^2}{R_t} = \frac{(60)^2}{5.4545} = 660\ W$$

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19. A. external magnetic fields

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21. C. 0.50 V
22. C. Induction
23. B. filter
24. C. to invert the armature current
25. A. voltage
26. D. Electrician's knife
27. A. ampere-hours
28. B. Internal resistance
29. A. align pulleys correctly
30. C. Both A and B
31. B. leading
32. A. 100 W

$$P = \frac{E^2}{R} = \frac{(200)^2}{400} = 100\ W$$

33. B. Series generator
34. B. self-starter
35. A. connecting alternators in parallel
36. B. 10.76
37. B. siemen
38. D. reddish
39. D. Flat
40. B. 6 inches

$$\text{By ratio \& proportion}: \frac{1{,}000}{1\,\text{sq. inch}} = \frac{1{,}500}{A}$$
$$A = 1.5\ \text{sq.inch}$$
$$A = \text{length x width}$$
$$\text{width} = \frac{A}{\text{length}} = \frac{1.5}{1/4} = 6\ \text{inches}$$

41. A. area of its plate
42. D. Manganese-dioxide
43. C. Cast steel
44. B. Prime mover
45. B. Mho
46. D. all of these
47. B. eddy current loss
48. C. Inductors
49. C. constant
50. A. wye

TEST 12

1. A. 8.0 mm^2

2. B. 100 %
3. D. 100 mm
4. D. 140 %
5. A. 2
6. B. as service entrance
7. C. 6
8. C. 50
9. C. Arc welding
10. C. Direct burial
11. A. 2.5 mm
12. D. 25 %
13. C. White
14. A. Rosette
15. D. 15 A
16. D. 115
17. B. copper
18. C. Overcurrent devices may be located inside clothes closets
19. A. Bus
20. C. 135 %
21. A. 1.5 hours
22. A. hoistways
23. B. 1,200
24. A. isolate from energized buses, equipment which are not in service
25. B. 900 mm
26. C. 115
27. A. 30 conductors
28. C. Only one
29. A. 50
30. C. Elevator
31. A. Extension cord
32. D. 1,640
33. D. 75 mm
34. C. Flashover
35. A. 10
36. C. corroded terminals and defective cord
37. B. 14 mm^2
38. D. Lamp
39. A. 3,600 mm
40. D. 13 mm
41. B. Rated frequency
42. D. 4,500 mm
43. A. 6 A
44. B. where exposed to destructive corrosive conditions
45. B. 30 A
46. B. natural gray
47. A. 0.80 mm
48. D. 600 V
49. D. all of these
50. B. through the grounding impedance

TEST 13

1. B. Lead-acid cell
2. A. Permanent magnet moving coil
3. D. 14 A

$$R_t = \frac{R_1(R_2 + R_3)}{R_1 + (R_2 + R_3)}, \text{ since in parallel - series}$$

$$R_t = \frac{(20)(5+10)}{20+5+10} = 8.57\,\Omega$$

$$I_t = \frac{E}{R_t} = \frac{120}{8.57} = 14\text{ A}$$

4. C. the sum of all resistances
5. D. voltage
6. B. three
7. D. power factor
8. B. 0.833

$$pf = \frac{P}{EI} = \frac{110}{(110)(1.2)} = 0.833$$

9. A. from the positive to the negative terminals of the battery
10. C. Dummy coil
11. B. a column of mercury
12. D. None of these

$$W = \frac{Q^2}{2C}, \text{thus } Q = \sqrt{2WC}$$

$$Q = \sqrt{2(50)(0.125 \times 10^{-6})} = 3.53\text{ mC}$$

13. C. 23.04 Ω

$$P = \frac{W}{t} = \frac{20}{8} = 2.5\text{ kW} = 2{,}500\text{ W}$$

$$R = \frac{E^2}{P} = \frac{(240)^2}{2{,}500} = 23.04\,\Omega$$

14. C. both A and B
15. A. Ampere
16. D. none of these
17. C. filter DC currents and pass AC currents

18. B. 0.77 A

$$I = \frac{E}{R} = \frac{230}{300} = 0.77\ A$$

19. C. increasing the prime mover speed
20. A. one watt-second
21. D. 120 V

$$E = IR = (10)(12) = 120\ V$$

22. D. manganin
23. C. two voltages can be used
24. A. two
25. A. 441 W

$$P = \frac{E^2}{R} = \frac{(115)^2}{30} = 441\ W$$

26. A. 133 MCM

$$d = 2r = 2(0.1823) = 0.3646\ inch = 364.6\ mils$$

$$CM = d^2 = (364.6)^2 = 132{,}933\ CM \approx 133\ MCM$$

27. D. Polyvinyl chloride
28. A. frequency
29. C. Melting alloy
30. C. either A or B
31. B. Resistance split-phase motor
32. B. 5 ohms

$$Z = \sqrt{R^2 + X^2} = \sqrt{4^2 + 3^2} = 5\ \Omega$$

33. B. a DC current
34. D. ~~3.75 A~~

$$E = I_3R_3 = (1)(150) = 150\ V$$

SInce in parallel, the voltage across the three resistors are equal.

$$I_1 = \frac{E}{R_1} = \frac{150}{100} = 1.5\ A \text{ and } I_2 = \frac{E}{R_2} = \frac{150}{120} = 1.25\ A$$

$$I_t = I_1 + I_2 + I_3 = 1.5 + 1.25 + 1 = 3.75\ A$$

35. A. the power drawn by each will be decreased by 75 %

When connected across, the power drawn by each is $\frac{E^2}{R}$.

When reconnected in series, the voltage across each is 0.5 E since the two resistors are identical. The power drawn by each will be $\frac{(0.5E)^2}{R} = \frac{0.25\,E^2}{R}$ which means, that the power drawn by each is reduced by 75%.

36. B. 100 hours

The ampere-hour capacity of the battery is 0.5(20) = 10 Ah
If the discharging current is reduced to 100 mA, the battery can last about,

$$h = \frac{Ah}{I} = \frac{10\ Ah}{100 \times 10^{-3}\ A} = 100\ hours$$

37. C. decrease to half as much
38. A. a commutator
39. D. a conductor
40. D. stray
41. C. varying the resistance of the circuit
42. A. By using an ohmmeter
43. B. Wire wound resistors
44. C. very high
45. A. 4 ohms

$$X = \sqrt{Z^2 - R^2} = \sqrt{4.47^2 - 2^2} = 4\ \Omega$$

46. D. watts
47. D. electrolytes
48. D. all of these
49. C. There should be a change in flux linking the coil
50. D. 12 volts

$$\text{By VDT}: E_1 = \frac{E_tR_1}{R_1 + R_2} \text{ thus, } E_t = \frac{E_1(R_1 + R_2)}{R_1}$$

$$E_t = \frac{4(3+6)}{3} = 12\ V$$

TEST 14

1. D. sustained overload
2. B. 5
3. D. 300 mm

4. B. 230 volts AC
5. A. hoistways
6. C. 90 days
7. A. Type THHN
8. D. Impulse
9. C. 1,500 VA
10. A. Substation plan
11. C. 50 V
12. A. 20 A
13. D. 150 mm
14. A. copper
15. C. 600 V
16. B. 12.7 mm
17. D. Bonding
18. D. all of these
19. A. 150 V
20. A. One or more
21. C. 60 A
22. C. It shall be of type approved for extra hard usage
23. D. Load center
24. A. 90
25. A. 300 %
26. D. 28
27. B. 25 %
28. D. None of these
29. B. Professional Regulation Commission
30. A. Wireways
31. A. 1,200 VA
32. C. Schedule of maintenance
33. D. 50 mm
34. D. 55 A
35. C. 25 mm
36. A. 1,500 mm
37. A. 10
38. A. 600 V
39. C. 76 mm
40. C. 1.6 mm

#14 AWG = 2.0 mm^2

$$A = \frac{\pi d^2}{4} \text{ thus, } d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4(2)}{\pi}} = 1.6\,mm$$

41. A. 1,300 mm
42. B. 20.5 A

Feeder ampacity = Sum of motors' FLA + 25 % of largest motor FLA
= 8 + 10 + (0.25)(10) = 20.5 A

43. C. 5

44. B. 1,800 mm
45. B. 8 A
46. B. 125 %
47. A. shall be
48. A. 6 A
49. D. 2,100 mm
50. B. 25

TEST 15

1. B. 60 Hz

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(0.2)(35 \times 10^{-6})}} = 60.15\,Hz$$

2. D. 1.5 V
3. B. Anti-plugging
4. A. 1.44 kW

$P = EIpf = (120)(12)(1) = 1{,}440\ W = 1.44\ kW$

Note : The pf of the lamps is assumed to be unity

5. A. The pointer of the meter will deflect downscale
6. B. 10^6
7. D. 0.89

$$Z = \sqrt{R^2 + X^2} \qquad pf = \frac{R}{Z} = \frac{10}{11.18}$$
$$Z = \sqrt{10^2 + 5^2} \qquad pf = 0.89$$
$$Z = 11.18\,\Omega$$

8. B. a short circuit
9. D. 6.25×10^{18}
10. A. 1500 coulombs

$$Q = It = (50)\left(0.5\ min \times \frac{60\ seconds}{1\ min}\right) = 1{,}500\ coulombs$$

11. B. lagging
12. B. 2.55 kW

$P = \sqrt{3}VIpf = \sqrt{3}(230)(8)(0.8) = 2{,}549.57\ W \approx 2.55\ kW$

13. C. 7.5 V

E = n x voltage per cell = 5(1.5) = 7.5 V

14. D. 0.50
15. D. braking action on the meter pointer
16. A. low resistance
17. A. 5 A

The equivalent internal resistance of the two identical cells in parallel is $\frac{0.2}{2} = 0.1\Omega$ and the total circuit resistance is 0.1 + 0.2 = 0.3 Ω.

Thus the load current, $I = \frac{E}{R_t} = \frac{1.5}{0.3} = 5\ A$

18. D. 2.5 ohms

$R_t = \frac{E}{I} = \frac{7.5}{2} = 3.75\ \Omega$

$R_t = r + R$, since in series

$R = 3.75 - 1.25 = 2.50\ \Omega$

19. A. Fluorescent lamp outlet
20. A. 2.7 kΩ

$R_t = \frac{E}{I} = \frac{3}{0.001} = 3{,}000\ \Omega$

$R_t = R_m + R_{se}$, since in series

$R_{se} = 3{,}000 - 300 = 2{,}700\ \Omega = 2.7\ k\Omega$

21. A. Series wound motor
22. C. Efficiency
23. A. the current capacity of the cells
24. D. Hydroelectric power plant
25. D. an ion
26. C. a two-pole switch
27. A. remove the load from the off going generator
28. D. 0.80
29. B. 12.5 A

$I = \frac{\text{VA rating}}{E} = \frac{25{,}000}{2{,}000} = 12.5\ A$

30. C. 22.5 V

By VDT: $E_1 = \frac{E_t R_1}{R_1 + R_2}$ thus, $E_t = \frac{E_1(R_1 + R_2)}{R_1}$

$E_t = \frac{15(10 + 5)}{10} = 22.5\ V$

31. B. 80 V

$R_t = R_1 + \frac{R_2 R_3}{R_2 + R_3}$, since in series parallel

$R_t = 10 + \frac{(12)(24)}{12 + 24} = 18\ \Omega$ and $I = \frac{E}{R_t} = \frac{144}{18} = 8\ A$

$E_1 = IR_1 = (8)(10) = 80\ V$

32. B. Fish tape
33. A. stronger
34. A. One
35. C. increase the voltage rating of the voltmeter
36. C. applied voltage
37. D. None of these

$I = \frac{P}{\sqrt{3}Epf} = \frac{5{,}000}{\sqrt{3}(6.6)(0.8)} = 546.7\ A$

38. C. Ammeter
39. B. 7
40. C. kVAR
41. A. Back emf
42. B. acid to distilled water
43. C. 1.20 A

Total emf (E) = 10(1.5) = 15 V

Total internal resistance = 10(0.25) = 2.5 Ω

$I = \frac{E}{R_t} = \frac{15}{2.5 + 10} = 1.2\ A$

44. C. both A and B
45. C. Peak inverse voltage
46. D. None of these

$\frac{I_1}{I_2} = \frac{E_2}{E_1}$

$I_1 = \frac{I_2 E_2}{E_1} = \frac{(50)(230)}{2300} = 5\ A$

47. B. reactance
48. D. Synchronous motor
49. D. kilowatt-hour
50. D. Differential compound motor

TEST 16

1. D. 11
2. C. Rigid non-metallic conduit
3. D. any of these
4. D. Lighting panelboard
5. D. 100 %
6. C. 5,000 ohms
7. C. ampere rating
8. B. Where exposed to direct sunlight
9. A. 125
10. C. 16 A

    New ampacity = Ampacity x derating for six wires
    = 20 x 80 % = 16 A
11. B. 125 %
12. A. 30 A

    Ampacity = 125 % of load current
    = 1.25 (21.5)
    = 26.875 A, use a 30-A branch circuit
13. A. primary
14. C. 50 A
15. D. 135
16. D. 1,100 mm
17. B. 150 V
18. B. 12 A

    Load = 80 % of rating
    = 0.8 (15)
    Load = 12 A

19. A. 460 mm
20. B. two
21. A. 0.40 mm
22. C. 300 mm
23. C. 1:100
24. D. 1,500 mm
25. A. an autotransformer
26. A. Motor operation sequence switch
27. B. 20 A
28. B. 217 mm x 279 mm
29. D. Sparkover
30. C. 8.0 mm^2
31. D. 6 m
32. A. 200 mm
33. D. Ground check
34. B. 100 %
35. A. 5
36. B. 100 A
37. B. Device
38. C. 760 mm

39. B. Fuse
40. A. 10 A

    The additional load shall NOT exceed 50 % of the branch circuit rating.
    Thus, load = 0.50 (20) = 10 A.

41. A. He asks that the instruction be repeated and clarified
42. A. 5,000 VA
43. D. 3,000 mm
44. D. 1,900 mm
45. C. green
46. B. Connected load
47. D. Expansion bolts
48. D. 30 A
49. B. 1,800 mm
50. D. all of these

TEST 17

1. D. all of these
2. D. None of these

$$\frac{E_1}{E_2} = \frac{N_1}{N_2}$$

$$E_2 = \frac{E_1 N_2}{N_1} = \frac{(100)(40)}{200} = 20\ V$$

3. A. One
4. A. ~~231 V~~ 260.10

$$I_a = I_L + I_{sh} = 500 + \frac{250}{50} = 505\ A$$

$$E = V_L + I_a R_a = 250 + (505)(0.02) = 260.1\ V$$

5. B. moving coil
6. B. Tungsten halogen lamp
7. C. 0.707
8. C. Induction motors
9. A. commutator
10. C. Conductance
11. C. 192 W

$$\text{Since in parallel, } R_t = \frac{R}{n} = \frac{9}{3} = 3\ \Omega$$

$$P_t = \frac{E^2}{R_t} = \frac{(24)^2}{3} = 192\ W$$

12. A. 1.85 μF

$$\frac{1}{C_t}=\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}, \text{since in series}$$

$$\frac{1}{C_t}=\frac{1}{4}+\frac{1}{6}+\frac{1}{8}$$

$$C_t = 1.85\ \mu F$$

13. C. 25 mWb

$$E=\frac{PNZ\phi}{60a} \text{ and } a = mP \text{ since lap winding is used}$$

$$\phi=\frac{60Ea}{PNZ}=\frac{60(120)[(1)(4)]}{4(600)(480)}=0.025\ Wb = 25\ mWb$$

14. B. 25 hours

$$h=\frac{Ah}{I}=\frac{200}{8}=25\ hours$$

15. D. inversely as the square of the cross sectional area
16. B. 100 V

$$E = IR = 4(25) = 100\ V$$

17. A. the area of the plates
18. B. Parallel
19. C. parallel, series
20. B. Wattmeter
21. C. 3-wire star connected load
22. A. Field
23. C. The Commissioner of the Professional Regulations Commission
24. C. 240 meters

$$\frac{R_1}{R_2}=\frac{L_1}{L_2}, \text{resistance is directly proportional to length}$$

$$L_2=\frac{R_2L_1}{R_1}=\frac{60(500)}{125}=240\ m$$

25. B. Zener
26. C. square of the distance from the light source
27. B. 120 V

$$V_P=\frac{V_L}{\sqrt{3}}=\frac{208}{\sqrt{3}}=120\ volts$$

28. A. keep the electrolyte level low
29. A. Cumulative compound motor
30. B. AC
31. B. not self-starting
32. D. Four
33. A. Condenser
34. C. one-third the value of one resistor
35. D. Programmable Logic Controller
36. A. Plugging
37. A. air capacitor
38. D. Demand factor
39. A. 100 μC

$$Q = CE = 2 \times 10^{-6}(50) = 0.0001\,C = 100\ \mu C$$

40. D. Insulator
41. B. ground current
42. C. 505 A

$$I_a = I_L + I_{sh} = I_L + \frac{V_L}{R_{sh}} = 500 + \frac{250}{50} = 505\ A$$

43. A. Lumen
44. A. negative
45. B. conductors separated by an insulator
46. A. 2.1 V
47. C. 240 V

$$E=\frac{PNZ\phi}{60a} \text{ and } a = mP \text{ since lap winding is used}$$

$$E=\frac{4(600)[(120)(4)](50 \times 10^{-3})}{60[(1)(4)]}=240\ volts$$

48. B. 95.9 %

$$\eta=\frac{P_{out}}{P_{in}}=\frac{P_{out}}{EI}=\frac{45(746)}{100(350)}=0.959=95.9\,\%$$

49. B. lagging
50. C. Heater output will decrease

For the same voltage rating on lamps, **the bigger the power rating of the lamp, the smaller is its resistance.**

Since a **smaller wattage** (60-W) is replaced and knowing that its resistance is **bigger** compared to the resistance of the 750-W lamp, **the resulting circuit will draw lesser amount of current.** Thus, the output of the heater will decrease.

TEST 18

1. B. 8.0 mm^2
2. D. THHN
3. C. 1000 mm
4. A. 1,800 mm
5. D. all of these
6. C. Splice or joints are allowed
7. C. Where subject to corrosive vapors
8. C. as branch circuit conductors
9. D. 2,400 mm
10. A. 50
11. C. Putting it inside the baking oven and control the oven temperature
12. A. Controller
13. D. 2,400 mm
14. B. 50 mm
15. D. 460 mm
16. A. type RH
17. C. Bonding
18. B. shall not be
19. C. 300 V
20. D. Chemical Engineering Code
21. A. type MTW
22. B. parallel
23. C. 150 mm
24. D. Steel cables
25. A. 20 mm
26. C. 40 A
27. B. 600 mm
28. C. Transformer vault
29. D. 15 A, 20 A
30. A. 3,000 mm
31. B. Flash point
32. B. 15 m
33. C. 2,400 mm
34. A. Filtering
35. D. all of the these
36. D. None of these
37. A. 0.65 mm
38. C. 125 mm^2
39. C. 150
40. B. 150 mm
41. C. Outlet with blank cover
42. D. 125 %
43. A. 115
44. B. one, in either ungrounded conductor
45. B. 150 %
46. D. 1.35 mm

47. A. 100 mm
48. D. 2. 0 V
49. A. Class I, Division 2
50. D. 900 mm

TEST 19

1. A. P 6.00

$W = Pt = (100)(20) = 2{,}000\ W - hr = 2\ kW - hr$

Cost = W x cost/kW - hr

$Cost = 2(3) = 6$ pesos

2. C. Alternator
3. D. 308 A

$$I = \frac{S}{\sqrt{3}E} = \frac{128{,}000}{\sqrt{3}(240)} = 308\ A$$

4. A. 1.5 V
5. A. 1,350 VA

Load = n x 180 x 125 %

$Load = 6(180)(1.25) = 1{,}350\ VA$

6. C. Repulsion start induction run motor
7. C. low voltage
8. D. 0.707

If the apparent and true powers are equal, the phase angle (θ) must be 45 °. Thus the power factor: $\cos\theta = \cos 45° = 0.707$

9. A. Single convenience outlet
10. C. Doping
11. C. 6 ohms

$$\text{Rated current of lamp}: I = \frac{E_{lamp}}{R_{lamp}} = \frac{50}{10} = 5\ A$$

Since in series the voltage across the resistor must be 30 V and in order for the lamp to operate properly the current in the series circuit must be equal to 5 A. Thus, the value of the resistance required is :

$$R = \frac{E_{drop}}{I} = \frac{30}{5} = 6\ \Omega$$

12. D. To reduce the motor line current at starting

13. B. 5 A

$$\text{By CDT: } I_1 = \frac{I_t R_2}{R_1 + R_2} = \frac{(9)(10)}{8+10} = 5\text{ A}$$

14. B. Instantaneous-trip relay
15. C. Silver
16. D. the fourth band must be silver
17. D. any of these
18. C. Worn bearings
19. A. 75 %
20. B. 9.9 kW

For or more appliances, a demand factor of 75% shall permissible.
Demand load = 0.75(6.5 + 1.6 + 1.5 + 3.6) = 9.9 kW

21. C. Cover with canvas
22. A. Three 4-way and two 3-way switches
23. B. Universal motors
24. D. Growler
25. D. All of these
26. C. Generator
27. B. 440 W

$$P = \frac{E^2}{R} = \frac{(220)^2}{110} = 440\text{ W}$$

28. A. Unity
29. B. an open
30. A. use a hack saw and ream the ends
31. C. current
32. C. Professional Electrical Engineer
33. B. High side
34. C. lags behind
35. B. extract moisture in air
36. C. protect the generator from power reversal
37. B. 50 Hz

$$f = \frac{PN}{120} = \frac{10(600)}{120} = 50\text{ Hz}$$

38. B. iron loss
39. B. 5 A

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{600}{24}} = 5\text{ A}$$

40. C. Mercury

41. B. approximately no
42. A. hard, highly conductive & non corroding metals
43. B. 63 %
44. A. Primary
45. A. 20 A

$$I_N = \sqrt{I_1^2 + I_2^2 + I_3^2 - I_1 I_2 - I_2 I_3 - I_1 I_3}$$
$$= \sqrt{(50)^2 + (50)^2 + (30)^2 - (50)(50) - (50)(30) - (50)(30)}$$
$$I_N = 20\text{ A}$$

46. B. Double pole double throw switch
47. A. 1.25 A

$$I = \frac{E}{R} = \frac{10}{8} = 1.25\text{ A}$$

48. D. Part winding type
49. D. nickel/silver
50. C. 50 Hz

$$f = \frac{w}{2\pi} = \frac{314}{2\pi} = 50\text{ Hz}$$

TEST 20

1. A. 1,000 mm
2. D. Span
3. A. 60 °C
4. B. Service conductors
5. B. 1,300 mm
6. B. closed
7. D. d = 2.65 mm

$$A = \frac{\pi d^2}{4} \text{ thus, } d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4(5.5)}{\pi}} = 2.65\text{ mm}$$

8. A. type MI
9. C. 40
10. C. 50 mm^2
11. A. 760 mm
12. A. 900 mm
13. B. 20 A
14. B. two
15. A. 100 %

16. C. 300 mm
17. D. 15 mm
18. D. 1,300 mm
19. D. all of these
20. A. 1,300 mm
21. A. 100 mm
22. D. 600 V
23. C. 15
24. C. LS
25. B. exposed work only
26. C. 10 ft
27. A. flame retardant and moisture resistant
28. A. Cleat
29. D. where exposed to direct rays of the sun
30. C. 216 %
31. D. 20 mm
32. A. 300 mm
33. D. All of these
34. B. 300 mm
35. D. junction boxes
36. B. 50 mm^2
37. C. 900 mm
38. C. 180 volt-ampere
39. A. 6.4 mm
40. C. 75 %
41. B. 1,000 mm
42. A. 500,000 ohms
43. D. 48
44. A. 255 mm
45. B. Knife
46. C. 3,700 mm
47. A. 15 mm
48. D. Intermittent duty
49. C. 4,500 mm
50. A. 1,000 mm

TEST 21

1. C. 19.2 W

$$P = I^2R = (0.8)^2(30) = 19.2\,\Omega$$

2. C. compensator
3. D. it limits the starting current to a safe value
4. B. low voltage
5. B. period
6. C. By means of a rectifier
7. C. increase the voltage rating of the combination

8. A. 40 %

$$I = \frac{E}{R_t} = \frac{60}{10+15} = 2.4\,A$$

$$P_t = I^2R_t = (2.4)^2(25) = 144\,W$$

$$P_1 = I^2R_1 = (2.4)^2(10) = 57.6\,W$$

$$\text{Percentage} = \frac{P_1}{P_t} = \frac{57.6}{144} = 0.4 = 40\,\%$$

9. D. 4,324 W

$$P_{in} = V_sI_s = (230)(18.8) = 4{,}324\,W$$

10. A. 10

$$N = \frac{\text{Branch circuit rating}}{\text{Current x 125 \%}} = \frac{20}{1.5(1.25)} = 10.66$$

Approximately only 10 outlets

11. B. 761 ohms

$$Z = \sqrt{R^2 + X_L{}^2} = \sqrt{R^2 + (wL)^2} = \sqrt{100^2 + [(377)(2)]^2} = 761\,\Omega$$

12. A. 12.5 A

$$I = \frac{S}{V} = \frac{1{,}500}{120} = 12.5\,A$$

13. A. a battery
14. C. equal to
15. A. Series motor
16. C. its own generated emf
17. B. Hydrometer
18. D. Wire wound
19. A. quadrupled

$$\frac{R_1}{R_2} = \frac{L_1A_2}{L_2A_1}$$

$$R_2 = \frac{R_1L_2A_1}{L_1A_2} = \frac{(R_1)(2L_1)(A_1)}{L_1(0.5A_1)} = 4R_1$$

20. B. changing number of turns of operating coil
21. C. equal to

22. A. 13

$$N = \frac{\text{Branch circuit rating}}{\text{CUrrent x 100\%}} = \frac{20}{1.5(1)} = 13.33$$

Approximately only 13 lighting fixtures

23. B. 0.30 A

$$X_L = 2\pi fL = 2\pi(60)(2) = 754\,\Omega$$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(60)(25 \times 10^{-6})} = 106\,\Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{10^2 + (754 - 106)^2} = 648\,\Omega$$

$$I = \frac{E}{Z} = \frac{200}{648} = 0.3\text{ A}$$

24. B. 820 MCM

For the same length : $\frac{R_1}{R_2} = \frac{\rho_1 A_2}{\rho_2 A_1}$

Since $R_1 = R_2 : \rho_1 A_2 = \rho_2 A_1$

$$A_2 = \frac{\rho_2 A_1}{\rho_1} = \frac{17(500)}{10.37} = 820\text{ MCM}$$

For aluminum :
$\rho = 17\,\Omega$ - CM/ft

For copper :
$\rho = 10.37\,\Omega$ - CM/ft

25. C. 8 Ω

$$R = \frac{E}{I} = \frac{40}{5000 \times 10^{-3}} = 8\,\Omega$$

26. C. 10 poles

$$P = \frac{120f}{N} = \frac{120(50)}{600} = 10\text{ poles}$$

27. A. 0.02 J

$$W = \frac{1}{2}LI^2 = \frac{1}{2}(10 \times 10^{-3})(2)^2 = 0.02\text{ J}$$

28. D. 60 %

$$pf = \frac{P}{EI} = \frac{3310}{110(50)} = 0.60 = 60\,\%$$

29. C. 10 ohms, 50 W

30. D. None of these

$$I = \frac{S}{\sqrt{3}E} = \frac{10{,}000}{\sqrt{3}(208)} = 27.76\text{ A}$$

31. B. 55.26 μF

$$C = \frac{1}{2\pi f X_C} = \frac{1}{2\pi(60)(48)} = 55.26\,\mu\text{F}$$

32. B. its cross sectional area
33. D. neither A or B (The correct answer is "equal to")
34. A. reduce the line voltage at starting
35. B. 100 A

$$\frac{I_1}{I_2} = \frac{E_2}{E_1}$$

$$I_2 = \frac{I_1 E_1}{E_2} = \frac{(10)(2400)}{240} = 100\text{ A}$$

36. D. Repulsion start induction run motor
37. D. Mica capacitors
38. D. overload relay
39. C. maximum value
40. D. 16.217 A

$$I = \frac{P}{E} = \frac{5(746)}{230} = 16.217\text{ A}$$

41. A. 10.42 %

$$\%\text{Reg} = \frac{E_{NL} - E_{FL}}{E_{FL}} = \frac{530 - 480}{480} = 0.1042 = 10.42\,\%$$

42. B. Depreciation factor
43. B. 14.08 kW

$$P = EI = (440)(32) = 14{,}080\text{ W} = 14.08\text{ kW}$$

44. D. All of these
45. D. smaller than the smallest resistance in the combination
46. D. 6 V, 0.5 A

Since in series the total voltage is the sum of the voltage across each cell while the current capacity is the same as the current in one cell.

47. D. capacitors

48. A. Susceptance
49. C. physical size
50. C. iron

TEST 22

1. D. Receptacle
2. C. the insulation should not be used as the only protective measure
3. B. 40 A
4. A. above the
5. A. Flashover
6. A. 5.5 mm^2
7. B. 250 V
8. C. 3 hours
9. C. 2,400 mm
10. A. 3.5 mm^2
11. D. Air terminal
12. B. the next larger standard size
13. D. 8.0 mm^2
14. C. warning sign
15. A. 1,800 mm
16. D. 16 A

    Permitted load = 80 % of the branch circuit rating
    Pemitted load = 0.80(20) = 16 A

17. A. 2 VA/m^2
18. B. 600 VA
19. A. Expansion bolts
20. D. Ground terminal
21. C. 5,500 mm
22. B. 8.0 mm^2
23. B. 250,000 ohms
24. C. Insulation resistance test
25. C. 80 %
26. D. the use of flux
27. C. 460 mm
28. C. 1.5 mm
29. A. 125 %
30. B. a certificate of inspection
31. C. 200 A
32. B. 10
33. A. 2,000 mm
34. A. 8
35. D. Primary winding should be opened
36. A. 760 mm
37. C. to detect alterations or damages

38. C. square millimeters
39. A. shall
40. B. 4,600 mm
41. B. grounding electrode and the neutral derived from a grounding transformer
42. A. 100 V
43. C. 25 ohms
44. D. 1,900 mm
45. B. Board of Electrical Engineering
46. B. 3.5 mm^2
47. B. 254 mm
48. C. 1,800 mm
49. A. duplex switch
50. C type RH

    To be applicable for wet locations, a letter W shall be included in the type letter of the conductor. Without W, the conductor is applicable only in dry locations.

TEST 23

1. B. directly as the square of the length
2. B. inserting a capacitor in parallel with the contacts
3. D. All of these
4. A. 1.5 kΩ

$$R_t = \frac{E}{I} = \frac{30}{10 \times 10^{-3}} = 3{,}000\ \Omega$$

Since identical each resistance must be equal to 1,500 Ω or 1.5 kΩ

5. B. low
6. C. 377 radians per second

$$w = 2\pi f = 2\pi(60) = 377\ \text{rad/sec}$$

7. A. Size and length of the service drop conductors
8. B. Schematic diagram
9. D. 200 ohms

    Since the terminal of the third resistor is left open circuited, the reading of the ohmmeter is only equivalent to the resistance of the other two resistances connected in series. Thus the value is 200 ohms.

10. B. prime mover speed
11. B. Elastance
12. A. Metal halide lamp
13. C. 90 to 110 ohms

The value is expected 10 % lower up to 10 % higher.

14. B. to close the contacts when actuating quantity reaches a certain predetermined value
15. C. Yoke
16. B. series-opposing
17. C. Carbon
18. A. 4,700 Ω, 1 W
19. C. Governor
20. D. type of material used in the plates
21. A. Size AAA
22. C. 3 years, 1 year
23. A. Residual flux
24. A. 2.5 Ω

Since the identical cells are in series: $E_t = 5(1.5) = 7.5\ V$

$$R_{internal} = 5(0.25) = 1.25\ \Omega$$

$$R_t = \frac{E_t}{I_t} = \frac{7.5}{2} = 3.75\ \Omega \text{ which also equal to: } R_{internal} + R_{load}$$

$$R_{load} = R_t - R_{internal} = 3.75 - 1.25 = 2.5\ \Omega$$

25. A. 6 ohms

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}, \text{ since in parallel}$$

$$\frac{1}{3} = \frac{1}{6} + \frac{1}{R_2}$$

$$R_2 = 6\ \Omega$$

26. A. supplies energy
27. A. electromotive force
28. D. Squirrel cage induction motor
29. A. 5.71 A

$$R_t = R_1 + \frac{R_2 R_3}{R_2 + R_3}, \text{since in series-parallel}$$

$$R_t = 15 + \frac{(7)(11)}{7+11} = 19.28\ \Omega$$

$$I = \frac{E}{R_t} = \frac{110}{19.28} = 5.71\ A$$

30. A. 25 Hz

$$f = \frac{PN}{120} = \frac{2(1{,}500)}{120} = 25\ Hz$$

31. D. Series Motor
32. B. 1 / a

$$\frac{E_1}{E_2} = a, \text{ thus } \frac{E_2}{E_1} = \frac{1}{a}$$

$$\frac{I_1}{I_2} = \frac{E_2}{E_1} = \frac{1}{a}$$

33. C. Shunt generators
34. C. AC high potential test
35. A. 30 ohms

For the same size and types of wire: $\frac{R_1}{R_2} = \frac{L_1}{L_2}$

$$R_2 = \frac{R_1 L_2}{L_1} = \frac{50(600)}{1000} = 30\ \Omega$$

36. B. zero

The equivalent resistance of a parallel combination is **smaller than the smallest resistance in the group**. Since the 6-ohm resistance is shorted, which means **that its resistance becomes approximately zero**, then the equivalent resistance of the whole circuit becomes approximately equal to zero also.

37. C. Valence electrons
38. D. 90 A

Rating = 300% of FLA = 3(30) = 90 A

39. B. less than 1 ohm
40. B. equivalent parameters on the high side
41. C. increases
42. C. 18.2 V

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\frac{1}{C_t} = \frac{1}{5} + \frac{1}{10} + \frac{1}{15}$$

$$C_t = 2.73\ \mu F$$

$$Q_t = C_t E_t = (2.73)(100) = 273\ \mu C$$

Since in series $Q_t = Q_1 = Q_2 = Q_3$

$$E_3 = \frac{Q_3}{C_3} = \frac{273}{15} = 18.2\ V$$

43. D. Flux
44. B. more than 12 V
45. D. master selector switch
46. A. Universal motor
47. C. 0.06 ohm

$$R_{internal} = \frac{E_{oc}}{I_{sc}} = \frac{1.5}{25} = 0.06\,\Omega$$

48. C. To produce magnetic flux lines
49. B. Potentiometer
50. A. specific gravity

TEST 24

1. B. vertical
2. B. 1,900 mm
3. C. 15 A
4. A. 300 mm
5. B. Duct
6. A. The use of an inductive ballast for fluorescent lamps is usually because it is the most efficient
7. A. two
8. D. 15
9. B. 900 mm
10. C. 60 °C
11. A. underground including direct burial to earth
12. D. 0.50 mm
13. A. 5.75 A

Setting = 115% of FLA if motor SF is 1.0
Setting = 1.15(5) = 5.75 A

14. B. natural gray
15. D. 50 %
16. C. yellow
17. D. 3,000 mm
18. C. 0.75 mm^2
19. C. the contact resistance between the bare wire and the person at the point of contact
20. A. 15 mm
21. C. Inverse time
22. D. type IGS
23. C. Three classes
24. B. 125 %
25. B. 15 m
26. A. Non-metallic sheathed cable
27. D. 4,900 mm
28. A. Separate the victim from the electric wire as soon as possible making sure that you do not become another victim
29. D. Fastener
30. D. 45
31. C. 5 %

32. B. 600 mm wide x 2,000 mm high
33. D. 300 mm
34. C. 100 mm
35. A. 50 mm
36. C. 15 A
37. A. 300
38. C. Toggle bolt
39. B. 30 A
40. A. 15 kV
41. B. 1.25 mm^2
42. B. 91 %
43. D. 3,000 mm
44. B. 200
45. D. all of these
46. C. 1,300 mm
47. C. Dumbwaiter
48. B. Wye-delta starter
49. A. 95 %
50. D. all of these

TEST 25

1. A. 2 V

$$\text{Volt} = \frac{\text{Joules}}{\text{Coulomb}}, \text{thus } E = \frac{W}{C} = \frac{10}{5} = 2\,V$$

2. B. Inching
3. D. Increasing the size of the electrodes, increases the emf of the cell
4. A. the plates will become sulphated
5. D. Mil
6. A. carbon-zinc dry cell
7. D. air capacitor
8. A. parallel combination of a resistor and a capacitor
9. C. 3.43 Ω

$$R_t = \frac{E}{I} = \frac{10}{5} = 2\,\Omega \text{ and } \frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R}$$

$$\frac{1}{R} = \frac{1}{R_t} - \left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{1}{2} - \left(\frac{1}{8} + \frac{1}{12}\right)$$

$$R = 3.43\,\Omega$$

10. A. it gives a higher line voltage
11. D. dynamometer
12. C. phase voltage is equal to line voltage
13. B. 0.5 ohm

$R_t = \frac{E}{I}$, since E and I are equal, then R_t is equal to 1 ohm.

Thus, each resistance is equal to 0.5 ohm.

14. C. ammonium chloride and zinc chloride
15. B. 157 radians per second

$w = 2\pi f = 2\pi(25) = 157$

16. B. Two
17. A. increase lumen output
18. D. Volta effect
19. D. Silver
20. A. Open wiring
21. A. VOM
22. C. weakest
23. C. increases
24. B. low voltage, high current
25. B. Silicon
26. B. 10,000 VA

Demand load = 125 % of the Continuous duty load
Demand load = 1.25 (8,000) = 10,000 VA

27. A. insulation and cooling
28. D. 4-wire star connection
29. A. below 5 %
30. C. 301 A

$$I_{primary} = \frac{\text{VA rating}}{\sqrt{3}E_{primary}} = \frac{250{,}000}{\sqrt{3}(480)} = 300.7 \approx 301\,A$$

31. B. Two
32. C. Steam turbine
33. B. gold
34. C. power factor
35. A. leading
36. D. None of these

$E_1 = I_1R_1 = (4)(12) = 48\,V$

$E_1 = E_2 = E_3$, since in parallel

$I_2 = \frac{E_2}{R_2} = \frac{48}{4} = 12\,A$

$I_3 = \frac{E_3}{R_3} = \frac{48}{16} = 3\,A$

$I_t = I_1 + I_2 + I_3$

$I_t = 4 + 12 + 3 = 19\,A$

37. C. to limit the current through the lamp
38. C. energy
39. A. 1,000
40. D. Compound
41. B. 57.96 A

Refer to the Theory section of this Reviewer for the diagram and formulas of a DC shunt motor:

$$P_{in} = \frac{P_{out}}{\eta} = \frac{15(746)}{0.87} = 12{,}862.068\,W \text{ and } P_{in} = V_sI_s$$

$$I_s = \frac{P_{in}}{V_s} = \frac{12862.068}{220} = 58.46\,A$$

$$I_a = I_s - I_{sh} = 58.46 - \frac{220}{440} = 57.96\,A$$

42. D. All of these
43. A. very low
44. C. 6 ohms

To operate the lamp correctly, the voltage across it must be 50 V and the current flowing in the circuit must be 10 A Thus, the voltage drop across the additional resistance in series is found by subtracting 50 V from 110V which is equal to 60 V. Finally, the resistance R required in series is:

$$R = \frac{E_{drop}}{I} = \frac{60}{10} = 6\,\Omega$$

45. B. 208 V

$V_P = \sqrt{3}V_P = \sqrt{3}(120) = 208\,V$

46. B. leads
47. A. Thermometer
48. A. 25 Hz

$$f = \frac{PN}{120} = \frac{2(15{,}00)}{120} = 25\,Hz$$

49. B. 0.90 Ω

$R_t = \frac{E}{I} = \frac{1.45}{0.5} = 2.9\,\Omega$

$R_t = R_{internal} + R_{load}$

$R_{internal} = R_{total} - R_{load} = 2.9 - 2.0 = 0.9\,\Omega$

50. B. apply petroleum jelly

TEST 26

1. B. 8
2. D. all of these
3. A. 7
4. C. Conduits shall be permitted to be used in sand fill which is subject to permanent moisture
5. A. 5
6. B. 30 A
7. B. 24 A

   Load permitted shall NOT exceed 80 % of the branch circuit rating

8. A. One
9. C. 3,000 mm
10. B. 5 %
11. A. Open wiring on insulators
12. D. 26 mm
13. A. 20 A
14. A. Cable tray
15. A. breather effectiveness
16. C. 125
17. A. 50 mm
18. D. bushing
19. C. 14.0 mm^2
20. C. 16 VA/m^2
21. A. one-fifth square meter
22. C. 5
23. A. Branch circuit conductors
24. C. 40 mm
25. C. Periodic duty
26. C. type TC
27. D. 16 mm
28. D. 2.0 mm^2
29. A. 300 mm
30. B. for service entrance
31. D. 200 mm
32. D. 300 V
33. D. All of these
34. C. RA 7920
35. B. 4
36. B. For interior wiring
37. A. 15 mm
38. B. 1,300 mm
39. D. Motor vehicles
40. C. Pilot wire

41. D. 2,500 mm
42. C. 75
43. B. 15 mm
44. A. 4,600 mm
45. C. 1,800 mm
46. A. personal injury
47. D. all of these
48. A. 1,000 mm
49. C. 2.0 mm
50. A. 5.5 mm^2

TEST 27

1. B. 3 A

$$I = \frac{E}{R_t} = \frac{75}{10+4+6+5} = 3\ A$$

2. D. 8

   $a = mP = 2(4) = 8$ Note : m = 2, since the winding is duplex

3. C. ohms
4. B. tungsten
5. C. One electron volt
6. D. 4
7. A. 10 ohms

   For the same size and type of wires : $\frac{R_1}{R_2} = \frac{L_1}{L_2}$

$$R_2 = \frac{R_1 L_2}{L_1} = \frac{32(250)}{800} = 10\ \Omega$$

8. B. 360 kJ

$$W = EIt = (120)(5)\left(10\ min\ x\ \frac{60\ sec}{1\ min}\right) = 360{,}000\ J = 360\ kJ$$

9. D. intrinsic
10. B. magnetic starter
11. C. It has a constant speed over a wide load range
12. B. eddy current losses
13. B. Cathode
14. D. Electrical interlock
15. A. The current flowing through one resistor is equal to the current flowing through the other resistors in the combination
16. D. whenever fault on the line occurs
17. C. 9.6 ohms

$$R = \frac{\rho L}{A} = \frac{(1.6 \times 10^{-8}\,\Omega - m)(180\,m)}{0.3\,mm^2 \times \frac{1\,m^2}{(1{,}000\,mm)^2}} = 9.6\,\Omega$$

18. C. properly grounded
19. A. 3.8 A

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(60)(100 \times 10^{-6})} = 26.52\,\Omega$$

$$I = \frac{E}{X_C} = \frac{100}{26.52} = 3.8\,A$$

20. B. Horsepower rating
21. D. Each lamp will give lesser output lights
22. B. wye-delta
23. C. both A and B
24. A. 1,870 W

$$P = EIpf = (220)(10)(0.85) = 1{,}870\,W$$

25. B. DC circuits only
26. C. voltage across the capacitor will increase
27. D. 5
28. C. Three
29. D. 20 A

$$Z = \sqrt{R^2 + X_L{}^2} = \sqrt{3^2 + 4^2} = 5\,\Omega$$

$$I = \frac{E}{Z} = \frac{100}{5} = 20\,A$$

30. A. 33 kW

$$P_{in} = \frac{P_{out}}{\eta} = \frac{300}{0.9} = 333.33\,kW$$

$$P_{losses} = P_{in} - P_{out} = 333.33 - 300 = 33.33\,kW$$

31. D. All of these
32. D. Apparent power
33. C. either A or B
34. A. Phase sequence
35. D. J/s
36. B. 1×10^{-6}
37. A. 276 W

$$P = EIpf = (230)(1.5)(0.8) = 276\,W$$

38. D. 80 V

$$E_b = V_s - I_a R_a = 110 - 50(0.6) = 80\,V$$

39. B. 180 V

$$E = IR_t = (4)(10 + 15 + 20) = 180\,V$$

40. D. Thermocouple type
41. A. 6 A

$$\text{By CDT}: I_1 = \frac{I_t R_2}{R_1 + R_2} = \frac{10(6)}{4 + 6} = 6\,A$$

42. D. Minimize arcing effect between contacts
43. C. The holding circuit interlock was welded
44. D. 24 A

$$I = \frac{S}{\sqrt{3}E} = \frac{8640}{\sqrt{3}(208)} = 24\,A$$

45. C. remote control
46. A. noise
47. D. any of these
48. B. low
49. D. low voltage
50. B. continuity

TEST 28

1. D. 100 %
2. D. 460 mm
3. C. three
4. D. Frequency rating
5. A. 600 V
6. A. Continuous load
7. A. 2.0 mm^2
8. B. 125
9. C. 6 wires
10. A. One
11. C. 12 A

    Load permitted shall NOT exceed 80 % of the branch circuit rating

12. A. 125 %

13. B. 2.3 mm
14. A. 8
15. D. all of these
16. B. 14. 0 mm^2
17. D. 8.0 mm^2
18. B. 115
19. D. 300 A
20. D. Transfer switch
21. C. 75
22. A. Electric locomotive
23. A. green
24. D. none of these
25. C. Where installed in industrial establishment where a registered master electrician will service the installation
26. C. 800 mm
27. A. 60 A
28. C. 2.0 kW
29. D. Field winding
30. D. 150 %
31. C. Concealed knob and tube wiring
32. A. 125 %
33. C. Both commutator and slip ring
34. C. 2,400 mm
35. A. Corona
36. D. General purpose branch circuit
37. B. total computed load and the rating of the circuits used
38. A. 0.75 mm^2, 500 mm^2
39. A. 86 %
40. B. The reading will be independent of the varying current
41. C. 460 mm
42. B. 8.0 mm^2
43. C. 250 V
44. A. 75 mm
45. B. indoors
46. C. 125 %
47. A. 24
48. D. any of these
49. D. 1,640
50. A. an unspliced conductor run

TEST 29

1. B. 600 rpm

$$N = \frac{120f}{P} = \frac{120(40)}{8} = 600 \text{ rpm}$$

2. B. 50 Hz

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(0.2)(50 \times 10^{-6})}} = 50.33 \text{ Hz}$$

3. A. SPDT
4. C. any number of times
5. C. 1.5 kΩ
6. C. ignition switch
7. D. Capacitor start motor
8. D. coulomb
9. D. 3.66 ohms

$$R_{oven} = \frac{E}{I} = \frac{220}{15} = 14.67\,\Omega \qquad R_t = R_{oven} + R$$

$$R_t = \frac{E}{I_{new}} = \frac{220}{12} = 18.33\,\Omega \qquad R = R_t - R_{oven}$$

$$R = 18.33 - 14.67 = 3.66\,\Omega$$

10. D. the square of the armature current
11. C. It makes the operation of each appliance independent with each other
12. A. Electron
13. A. short circuit protection
14. B. amperage of the circuit
15. B. 18 mH

Since identical, $L_t = nL = 3(6) = 18$ mH

16. A. 4,339 ft

d = 0.30 in = 300 mils

$$L = \frac{RA}{\rho} = \frac{d^2R}{\rho} = \frac{(300)^2 0.5}{10.37} = 4{,}339.44 \text{ ft}$$

17. B. 3 ohms

Since identical, $R_t = \frac{R}{n} = \frac{6}{2} = 3\,\Omega$

18. B. coulomb per second
19. C. Claw hammer
20. B. the voltage across each branch are equal
21. B. negative
22. D. high voltage
23. D. By interchanging any two line conductors
24. A. insulation resistance
25. D. Two 3-way switches
26. D. Cation
27. A. high voltage DC generators

28. B. series
29. C. 4.03 Ω

$$R = \frac{E^2}{P} = \frac{(110)^2}{3{,}000} = 4.03\,\Omega$$

30. A. Electrolytic
31. D. 12 ohms

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$

$$\frac{1}{R_4} = \frac{1}{R_t} - \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) = \frac{1}{1.2} - \left(\frac{1}{6} + \frac{1}{4} + \frac{1}{3}\right)$$

$$R_4 = 12\,\Omega$$

32. C. lumens per square meter
33. A. 16.67 A

$$\text{Neglecting resistance in line, } I = \frac{P}{E} = \frac{10{,}000}{600} = 16.67\text{ A}$$

34. D. All of these
35. C. Kilowatt-hour meter
36. B. 0.69 Fc

$$E = \frac{I}{d^2} = \frac{100}{(12)^2} = 0.69\,\text{Fc}$$

37. A. 1,000
38. B. 20.8 A

$$P_{in} = \frac{P_{out}}{\eta} = \frac{5(746)}{0.78} = 4782.05\text{ W}$$

$$I_s = \frac{P_{in}}{V_s} = \frac{4782.05}{230} = 20.8\text{ A}$$

39. C. either A or B
40. A. any two of the three stator lines are interchange
41. D. any of these
42. B. No voltage protection
43. C. both A and B
44. B. 3.77 ohms

$$X_L = 2\pi fL = 2\pi(60)(10 \times 10^{-3}) = 3.77\,\Omega$$

45. A. 1.732 times

46. C. For the same power rating, star-connected alternators require smaller sizes of windings
47. B. 800 W

$$P_a = I_a{}^2 R_a = (40)^2(0.5) = 800\text{ W}$$

48. B. joule per coulomb
49. A. it needs less maintenance
50. B. kVA

TEST 30

1. D. all of these
2. B. 8.0 mm^2
3. D. Class I
4. A. grounding impedance
5. B. 6.4 mm
6. A. 9.5 mm, 12.7 mm
7. A. 150 mm
8. D. 2,500 mm
9. B. 3,000 mm
10. C. 230 V
11. B. Sideflash
12. B. 12 mm
13. C. 150 mm
14. B. four
15. B. two
16. A. 5.5 mm^2
17. D. Messenger supported wiring
18. D. 600 mm
19. A. same size and type
20. B. Coaxial
21. A. 3,000 mm
22. B. Cord
23. B. where in electrical contact with wooden floor
24. C. 2,400 mm
25. D. 1.6 mm
26. B. 460 mm
27. A. star-delta
28. A. 2,000 mm
29. C. 32
30. A. shall not be
31. C. 3,000 mm
32. D. 75 A
33. D. Airplanes
34. A. 15 mm
35. C. both A and B

36. C. triangular prism
37. B. 32 mm
38. B. 20 mm
39. A. Arrester
40. B. 6.54 A

$$I = \frac{E}{I} = \frac{180(8)}{220} = 6.54\ A$$

41. B. 250 V
42. B. 10 feet
43. D. 50 %
44. B. 1,800 mm
45. D. 2.0 mm^2, 3.5 mm^2
46. C. 3,000 mm
47. D. 23 m
48. C. 100 %
49. A. 0.50 mm
50. B. 600 mm

TEST 31

1. C. spacing between electrodes
2. D. 112 meters

$$d = 1mm = 0.001m$$

$$A = \frac{\pi d^2}{4} = \frac{\pi(0.001)^2}{4} = 7.85 \times 10^{-7} m^2$$

$$L = \frac{RA}{\rho} = \frac{(4)(7.85 \times 10^{-7})}{2.8 \times 10^{-8}} = 112.14\ m$$

3. B. cathodic
4. C. 80 μF

$$C_t = C_1 + C_2 + C_3 + C_4, \text{since in parallel}$$
$$C_t = 10 + 15 + 25 + 30 = 80\ \mu F$$

5. B. Reamer
6. C. Henry
7. C. electrolytic capacitor
8. D. 13

$$N = \frac{\text{Branch crcuit rating}}{\text{Current} \times 100\%} = \frac{20}{1.5(1)} = 13.33$$

Approximately only 13 lighting fixtures

9. B. parallel
10. B. full line voltage is applied at starting
11. A. 24.8 kVA

Load = 220(180) = 39,600 VA = 39.6 kVA
Demand load = First 10 kVA or less at 100% + 50 % of the remainder
Demand load = 10 + 0.5(39.6 - 10) = 24.8 kVA

12. D. None of these

Amperage = 100% demand for the first 200 A or less + 70 % demand of the remainder above 200 A
Amperage = 200 + 0.7(100) = 270 A

13. D. all of these
14. D. shape
15. C. equal to the phase current
16. B. Three

Load = 30(1.5) = 45 A

$$\text{Number of circuits} = \frac{\text{Load}}{\text{Branch circuit rating}} = \frac{45}{20} = 2.25$$

Thus, a minimum of three 20 - A branch circuits

17. A. To minimize leakage flux
18. D. None of these
19. B. 484 ohms

$$R = \frac{E^2}{P} = \frac{(220)^2}{100} = 484\ \Omega$$

20. C. Sale and distribution of electric machinery
21. B. ohm/volts
22. A. Voltage source, and a conductor
23. B. silver
24. A. 6 kJ

$$W = Pt = I^2Rt = (1)^2(200)(30) = 6{,}000\ J = 6\ kJ$$

Note : 0.5 min = 30 seconds

25. A. 1.5 V, 2 A

Since in parallel, the voltage rating is equivalent to the voltage across one cell while the current rating is the sum of the current rating of each cell

26. D. all of these
27. B. Soft magnetic material
28. A. 3
29. D. Oil cooling
30. A. 14.14 A

$$I_{max} = \sqrt{2}\, I_{rms} = \sqrt{2}(10) = 14.14 \text{ A}$$

31. D. All of these
32. B. Electroplating
33. B. 34 V

$$I = \frac{E}{R_t} = \frac{100}{8.4 + 6.8 + 4.8} = 5 \text{ A}$$

$$E_2 = IR_2 = (5)(6.8) = 34 \text{ V}$$

34. C. Number of phases
35. B. Oscilloscope
36. B. 7,967 VA

$$S = \sqrt{3}EI = \sqrt{3}(230)(20) = 7{,}967 \text{ VA}$$

37. C. Distance relay
38. A. voltage
39. A. 40,000 CM

$$d = 0.20 \text{ inch} = 200 \text{ mils}$$

$$CM = d^2 = (200)^2 = 40{,}000 \text{ CM}$$

40. B. a high resistance resistor
41. A. increased
42. A. a conductor
43. D. Ceiling fan outlet
44. D. 4,180 W

$$P = EIpf = (110)(40)(0.95) = 4{,}180 \text{ W}$$

45. D. all of these
46. B. 0.92 A

$$R_1 = \frac{E^2}{P_1} = \frac{(100)^2}{60} = 166.67\ \Omega \qquad R_2 = \frac{E^2}{P_2} = \frac{(100)^2}{200} = 50\ \Omega$$

$$I = \frac{E}{R_t} = \frac{200}{166.67 + 50} = 0.92 \text{ A}$$

47. C. open or de-energized
48. D. Cumulative compound motor
49. A. 3.0 V
50. A. 1.0

TEST 32

1. A. type FC
2. B. 300 V
3. B. 50 mm
4. D. Wireways
5. A. 75 mm
6. A. 0.76 mm, 1.0 mm
7. D. 300 mm
8. C. 38 mm
9. B. 1,500 mm
10. B. 300 %
11. B. 30 A
12. B. 125 %
13. A. the middle
14. C. 76 mm
15. C. 125
16. A. 10 mm
17. D. all of these
18. C. 300 mm
19. A. type SNM cable
20. D. Use a hack saw and ream the ends
21. B. 140
22. B. 225 %
23. C. Insulating end
24. D. Flat conductor cable
25. C. weatherproof
26. C. 2.16
27. C. Non-metallic extension
28. C. 35,000
29. B. 6.4 mm
30. B. MV
31. D. 700 %
32. B. 1.02 mm
33. C. 48 devices
34. D. 900 mm

35. D. 60 A
36. B. 20 A
37. A. three, one in each phase
38. B. It is easier to skin off the insulation
39. A. 3,000 mm
40. A. 300 %, 175 %
41. A. 300 mm
42. C. 100 mm
43. D. 500,000 ohms
44. B. 25
45. A. 8
46. D. 1,500 mm
47. C. 20 mm
48. A. 24 mm
49. D. 125 %
50. B. Cover

TEST 33

1. B. sulphuric acid to water
2. B. 2 Ω

$$I = \frac{E_{load}}{R_{load}} = \frac{10}{10} = 1\,A$$

$$R_{internal} = \frac{E_{drop}}{I} = \frac{12-10}{1} = 2\,\Omega$$

3. D. 9,900 VA

Demand load = Load x 125 % = 7,920(1.25) = 9,900 VA

4. D. None of these
5. C. rectifier
6. D. All of these
7. A. transformer reduced voltage method
8. B. twice
9. D. 1.5 A

$$E = 10(1.5) = 15\,V \text{ and } R_{internal} = 10(0.5) = 5\,\Omega$$

$$I = \frac{E}{R_{internal} + R_{load}} = \frac{15}{5+5} = 1.5\,A$$

10. B. 1373 turns

$$\frac{E_1}{E_2} = \frac{N_1}{N_2}, \text{thus } N_1 = \frac{E_1 N_2}{E_2} = \frac{6600(52)}{250} = 1373 \text{ turns}$$

11. B. a short circuit
12. C. the temperature coefficient of resistance of the filament is positive
13. C. voltage
14. D. cathode
15. C. is more
16. C. 1.0 A

Equivalent resistance of ten 20 - Ω in parallel is : $R_{eq} = \frac{R}{n} = \frac{20}{10} = 2\,\Omega$

$I = \frac{E}{R_t} = \frac{100}{8+2} = 10\,A$ and since identical resistances, the current that flows through each of the 20 - Ω resistance is : $I = \frac{10}{10} = 1\,A$

17. D. 77.7 %

$$\eta = \frac{P_{out}}{P_{in}} = \frac{P_{out}}{V_s I_s} = \frac{5(746)}{240(20)} = 0.777 = 77.7\,\%$$

18. C. Copper losses
19. D. 600 rpm

$$N = \frac{120f}{P} = \frac{120(40)}{8} = 600 \text{ rpm}$$

20. A. 53 Hz

$$f = \frac{1}{2\pi X_C C} = \frac{1}{2\pi(1500)(2 \times 10^{-6})} = 53.05\,Hz$$

21. C. highest
22. A. increase
23. B. kVA
24. A. 198.5 mA

$$R = \frac{E^2}{P} = \frac{(230)^2}{50} = 1{,}058\,\Omega \;\&\; I = \frac{E}{R} = \frac{210}{1058} = 0.1985\,A = 198.5\,mA$$

25. B. 2-poles
26. A. 50 A

$$I = \frac{S}{\sqrt{3}E} = \frac{20{,}800}{\sqrt{3}(240)} = 50\,A$$

27. D. Enamel
28. A. maintenance and repair of electrical equipment
29. C. voltage
30. C. 3
31. A. linear
32. B. current flowing through the coil
33. B. Slip rings
34. A. a linear type
35. C. 288 ohms

$R_t = 12(24) = 288\,\Omega$

36. D. None of these

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{4} + \frac{1}{6}$$
$$C_t = 2.4\,\mu F$$

37. A. 125 A

Size = 250 % of FLA = 2.5(54) = 135 A
The closest minimum size is a 125 A CB

38. B. 1/4 to 2-W
39. D. LDR
40. C. less than 17 ohms

For resistances in parallel, the equivalent resistance is smaller than the smallest in the resistance in the group

41. C. brown, black, brown
42. D. infinite resistance and zero inductance
43. C. They will have both equal inductance
44. C. his personal safety before anything else
45. A. two diodes connected back to back
46. D. all of these
47. B. Efficacy
48. B. 2 GΩ
49. C. 600 A (It will hold 3 times its rating)
50. A. Motor control center

TEST 34

1. B. 2,500 mm
2. B. 125 %
3. C. 7,600 mm

4. C. moisture resistant and thermoplastic
5. A. Ampacity
6. B. In wet locations
7. D. Varying duty
8. A. 600 mm, 2,000 mm
9. A. 12 mm
10. B. 1,800 mm
11. D. certificate of final inspection
12. A. 110 A

Feeder ampacity = Sum of FLAs + 25 % of largest FLA
Feeder ampacity = 10 + 20 + 30 + 40 + 0.25(40) = 110 A

13. D. 300 mm
14. A. one-third
15. C. 90 %
16. C. Interlock
17. C. Service lateral
18. A. 50,000 ohms
19. A. 175
20. C. 1,000,000 ohms per kilovolt rating
21. B. 80 %
22. A. 100 A
23. B. 150
24. D. all of these
25. B. Stationary appliance
26. B. limit the starting current
27. A. Class III, Division 2
28. C. 460 mm
29. A. 2,500 mm
30. D. Registered Master Electrician
31. A. Peak load
32. D. Isolation transformer
33. C. Electrical insulation
34. C. 10 seconds
35. A. 3,100 mm
36. D. Armored cable
37. C. 75 %
38. B. 2,400 mm
39. B. 5 percent
40. B. 1,000 mm
41. C. power panelboard
42. A. Individual branch circuit
43. C. 4
44. A. three
45. D. Service point
46. A. 300 V
47. C. 50
48. D. 28

49. B. natural gray
50. D. 30 °C

TEST 35

1. C. occasional starting
2. A. 146.67 ohms

Since identical current in each branch is : $I = \frac{15}{10} = 1.5\ A$

$$R = \frac{E}{I} = \frac{220}{1.5} = 146.67\ \Omega$$

3. D. The condenser with the lowest capacitance has the biggest share of the total voltage
4. A. unity
5. D. All of these
6. A. Service factor
7. A. Secondary resistance starter
8. B. with the auxiliary windings
9. C. cloth
10. C. Coulomb
11. A. increasing the power input of the second alternator
12. C. Gallium arsenide
13. D. Natural air-cooled
14. B. increases with an increase in supply voltage
15. A. The appliance draws more current

The appliance will draw more current due to the impedance of the circuit is decreased due to the decreased in supply frequency.

16. C. Mercury lamp
17. B. 5.4 ohms

$$R_t = \frac{R_1(R_2 + R_3)}{R_1 + (R_2 + R_3)} = \frac{12(4+6)}{12+4+6} = 5.4\ \Omega$$

18. D. Multi-voltage transformer
19. D. Current
20. C. P 864.00

$$W = Pt = (1{,}000 + 2{,}000)\left(\frac{24\ hrs}{day}\right)\left(\frac{30\ days}{month}\right) = 2{,}160{,}000\ W\text{-}hr$$

$W = 2160\ kW\text{-}hr$

$Cost = (2160)(0.40) = 864$ pesos

21. A. 20 kW

Since the two loads does not operate at the same time, the feeder lo is selected as the higher VA rating between the two.

22. D. Switches
23. B. short shunt compound motor
24. B. increase also
25. B. infinite
26. B. 8,000 W

$P = EIpf = (400)(20)(1) = 8{,}000\ W$

27. D. lead-acid
28. D. measure resistance, voltage and current
29. D. None of these
30. C. Both A and B
31. A. effective value
32. D. neither A or B (The resistance is due to the electrolyte used)
33. D. MVA
34. B. Zero-speed switch
35. C. 0.707

If the resistance and reactance are equal the phase angle is 45 °. Thus the power factor is: cos 45 ° = 0,707

36. B. Shunt motors
37. B. Taste
38. C. Dirt on the commutator segments
39. B. Volt-amperes
40. C. 21 hp

$P_{out} = P_{in}(\eta) = 25(0.84) = 21\ hp$

41. D. all of these
42. A. the resistor is out of tolerance

Red, red, red, gold = 2,200 Ω or 2.2 kΩ with ±5% tolerance. The expected value is between 5% below, **2.09 kΩ** (2.2 x 0.95) or higher, **2.31 kΩ** (2.2 x 1.05). Thus, by comparison the given readin out of tolerance.

43. D. 20 V

$$I = \frac{E}{R_t} = \frac{120}{5+10+15} = 4\ A$$

$E_1 = IR_1 = (4)(5) = 20\ V$

44. B. DC series motor
45. C. ± 20 %

46. B. not a constant
47. C. a true watt-hour meter
48. B. 4 J
49. B. delivers the energy
50. A. Equal to the number of poles

TEST 36

1. C. The busway is open and of the ventilator type
2. C. 300 %
3. D. 15 A
4. B. more
5. B. 4,600 mm
6. C. 90 °C
7. B. 60 °C
8. C. 3.191 mm

$$A = \frac{\pi d^2}{4};\ d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4(8)}{\pi}} = 3.191\,\text{mm}$$

9. B. neutral
10. C. both A and B
11. B. 5,000
12. B. greater
13. A. five
14. B. 125
15. A. finish
16. B. 80 A

    Size = 175 % of FLA = 1.75(40) = 70 A
    The closest higher standard rating is an 80 A fuse.

17. A. 30 A
18. C. 180
19. B. two
20. D. all of the above
21. C. Service lateral
22. D. 2,400 mm
23. D. four
24. A. high
25. D. 100 mm
26. B. 85 %
27. C. Lamps and lamp holders for fixed lighting that are located above vehicles shall be installed not lower than 2,500 mm
28. B. vertical
29. C. six
30. B. on

31. A. Minus 5% to plus 10%
32. A. the line side of the service
33. C. 1,900 mm
34. B. 0.32
35. B. long
36. D. 90°
37. C. either A or B
38. A. 0.75 mm^2
39. A. openings
40. D. 125
41. A. 10 mm
42. B. RHW
43. B. Counterpoise
44. D. 2.0 mm^2
45. A. 200
46. A. equal to or greater than
47. D. 100 %
48. A. 20 A
49. D. Fixtures and lighting equipment operating at over 250 V shall be grounded
50. B. conductors

TEST 37

1. C. 86.9 kW

    Refer to the Theory section of this Reviewer for the diagram and formulas of a DC shunt generator.

    $I_L = I_a - I_{sh} = 400 - 5 = 395\ A$
    $P_L = V_L I_L = (220)(395) = 86{,}900\ W = 86.9\ kW$

2. D. 60 Hz

    $$f = \frac{PN}{120} = \frac{2(3600)}{120} = 60\,\text{Hz}$$ Note : Bipolar means 2 - poles.

3. A. its internal resistance is very low
4. A. 3 years, 1 year
5. D. the smaller of the two breakdown voltage ratings
6. D. Autotransformer
7. C. 28,800 kJ

    $$W = Pt = 2\left(4\ \text{hrs} \times \frac{3{,}600\ \text{sec}}{\text{hr}}\right) = 28{,}800\ \text{kJ}$$

8. D. size D
9. C. 1 ohm

Since identical, $R_y = \frac{R_\Delta}{3} = \frac{3}{3} = 1\Omega$

10. C. free electrons
11. B. increases when temperature decreases
12. D. Ampere-turn
13. D. meter, kilogram, second, ampere, kelvin, candela and mole
14. B. 175 A

OCPD of largest motor in the group = 300 % of FLA
= 3(34) = 102 A, use 100 A fuse

Size of feeder OCPD = largest motor OCPD + sum of other FLAs
= 100 + 20 + 28
= 148 A, use 150 A fuse

15. A. 38.6 A

$$P_{in} = \frac{P_{out}}{\eta} = \frac{10(746)}{0.84} = 8880.95\,W \;\&\; I_s = \frac{P_{in}}{V_s} = \frac{8880.95}{230} = 38.6\,A$$

16. D. Bronze
17. C. Coulometer
18. C. Coulomb
19. B. increase
20. C. Transformers
21. B. 80 A

$$I = \frac{S}{\sqrt{3}E} = \frac{28{,}800}{\sqrt{3}(208)} = 80\,A$$

22. B. low permeability
23. A. 3 ohms

$R_t = R_1 + \frac{R_2R_3}{R_2+R_3}$, since in series - parallel

$7 = 5 + \frac{6R_3}{6+R_3}$; simplifying & solving for R_3,

$R_3 = 3$ ohms

24. B. Mercury-oxide
25. A. the same in each resistor
26. B. watts and volt-amperes
27. C. 3.0 A

Since the supply is a DC source, $I = \frac{E}{R} = \frac{12}{4} = 3\,A$

28. A. the 50-W lamp

$R_1 = \frac{E^2}{P_1} = \frac{(115)^2}{75} = 176.33\,\Omega$ and $I_1 = \frac{P_1}{E} = \frac{75}{115} = 0.652\,A$

$R_2 = \frac{E^2}{P_2} = \frac{(115)^2}{50} = 264.5\,\Omega$ and $I_2 = \frac{P_2}{E} = \frac{50}{115} = 0.435\,A$

When in series, $I = \frac{E_{new}}{R_{total}} = \frac{230}{176.33 + 264.5} = 0.522\,A$

Since 0.522 > 0.435, the 50 - W lamp will suffer overcurrent.

29. C. Silver-zinc cell
30. B. receives
31. A. 2

$P_{out} = \eta P_{in} = \eta V_s I_s$

$= (0.90)(115)(14.42) = 1492.47\,W \times \frac{1\,hp}{746\,W} = 2\,hp$

32. A. autotransformer starting
33. B. 34.60 A

$I_{phase} = \frac{V_{line\ to\ line}}{R} = \frac{200}{10} = 20\,A$

$I_{line} = \sqrt{3}\,I_{phase} = \sqrt{3}(20) = 34.64\,A$

34. A. is constant
35. C. 0.04 second

$f = \frac{w}{2\pi} = \frac{157}{2\pi} = 25\,Hz$ and $T = \frac{1}{f} = \frac{1}{25} = 0.04$ second

36. A. P 3.60

$W = Pt = EIt = (100)(1)(8) = 800\,W\text{-}hr = 0.8\,kW\text{-}hr$

$Cost = 0.8(4.5) = 3.6$

37. B. 3
38. D. utilize the electrical energy
39. C. 40 μC

$Q = It = (2 \times 10^{-6})(20) = 40 \times 10^{-6}\,C = 40\,\mu C$

40. C. Synchronous converters
41. D. 300 W

$$I = \frac{E}{R_t} = \frac{100}{8+12} = 5\text{ A} \text{ and } P_{12\Omega} = I^2R_{12\Omega} = (5)^2(12) = 300\text{ W}$$

42. B. always less than the low resistance
43. A. low
44. B. more turns as the secondary
45. C. 8
46. B. Ohm-meter
47. D. number of poles
48. B. an open circuit
49. B. Sulphuric acid
50. A. 5 A

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{600}{24}} = 5\text{ A}$$

TEST 38

1. A. solder
2. A. 3,000 mm
3. B. qualified person
4. B. 300 mm
5. B. phase
6. C. of fire resistant construction
7. D. 25 mm
8. C. 900 mm
9. C. both A and B
10. A. damp
11. C. 500 mm^2
12. B. cross
13. A. 8 VA/m^2
14. A. 300 mm
15. D. 100
16. D. 1988
17. B. Feeder
18. A. Breakdown
19. C. suspension
20. C. Electrical non-metallic tubing
21. D. all of these
22. D. 100 mm
23. B. 300
24. A. 760 mm
25. C. 70 A

Size = 250 % of FLA = 2.5(28) = 70 A

26. C. green, green with yellow stripes, or bare
27. B. grounded
28. D. Demand factor
29. C. 20 mm
30. D. biggest
31. C. both A and B
32. A. 600 %
33. C. 24 watts
34. C. either A or B
35. D. 600 mm
36. A. on top
37. C. arcs and sparks
38. B. type MV
39. A. 50 mm
40. A. type MC cable
41. D. Fish paper
42. A. 3,100 mm
43. C. fault current that may occur
44. D. all of these
45. B. 20 A
46. C. 255 mm
47. C. type FCC
48. C. building steel
49. C. either A or B
50. D. as an aerial cable

TEST 39

1. B. more than
2. C. Either A or B
3. C. 112 V

$$\text{By VDT}: E_{load} = \frac{E_t R_{load}}{R_{load} + R_{wire}} = \frac{120(1.4)}{1.4+0.10} = 112\text{ V}$$

4. D. Part winding starting
5. B. two 3-way and one 4-way switches
6. C. Dial indicator
7. A. Interpole windings
8. B. Ground fault protection
9. B. 56.63 A

$$I_{range} = \frac{P}{E} = \frac{8{,}000}{220} = 36.36\text{ A}; \quad I_{light} = \frac{P}{E} = \frac{500}{220} = 2.27\text{ A}$$

$$I_{total} = I_{range} + I_{light} + I_{aircon} + I_{pump} = 36.36 + 2.27 + 10 + 8 = 56.6$$

10. A. No voltage release
11. B. high resistance
12. C. Electric drill
13. C. Hickey
14. C. Drum switch
15. B. Watercraft
16. C. series-parallel
17. D. Voltage
18. B. 4 poles
19. B. 7.5 A

    Additional permitted load shall NOT exceed 50 % of the branch circuit rating.

20. B. 2.50 A

$$E_1 = I_1R_1 = (1)(100) = 100\text{ V and since parallel, } E_1 = E_2 = E_3$$
$$I_2 = \frac{E_2}{R_2} = \frac{100}{150} = 0.667\text{ A and } I_3 = \frac{E_3}{R_3} = \frac{100}{120} = 0.833\text{ A}$$
$$I_t = I_1 + I_2 + I_3 = 1 + 0.667 + 0.833 = 2.5\text{ A}$$

21. A. 750 W

$$I = \frac{P}{E} = \frac{12{,}000}{240} = 50\text{ A, since there are two wires, } R_{wires} = 0.30\,\Omega$$
$$P_{wires} = I^2R_{wires} = (50)^2(0.30) = 750\text{ W}$$

22. D. 2,002 W

$$P = EI = (220)(9.1) = 2{,}002\text{ W}$$

23. B. removes electrons from one plate and accumulate them on the other plate
24. A. Series
25. B. 200 ohms

$$R_t = \frac{E_t^2}{P_t} = \frac{(200)^2}{100+100} = 200\,\Omega$$

26. A. Allen wrench
27. A. minimum
28. B. protect motors from overcurrent
29. B. Two
30. B. 4 to 9 times
31. D. resistance to impedance
32. A. equal to

33. D. 6.09 kVA

$$S = \sqrt{3}\,EI = \sqrt{3}(440)(8) = 6{,}096.8\text{ VA} = 6.09\text{ kVA}$$

34. D. none of these
35. B. Spur
36. B. Bimetallic
37. A. 262 A

    Refer to the Theory section of this Reviewer for the diagram and formulas of a DC shunt generator.

$$I_a = I_L + I_{sh} = \frac{P_L}{V_L} + \frac{V_L}{R_{sh}} = \frac{150{,}000}{600} + \frac{600}{50} = 262\text{ A}$$

38. D. 7.33 A

$$R_t = R_1 + \frac{R_2R_3}{R_2+R_3} = 8 + \frac{6(3)}{6+3} = 10\,\Omega\ \&\ I_t = \frac{E_t}{R_t} = \frac{220}{10} = 22\text{ A}$$
$$\text{By CDT}: I_2 = \frac{I_tR_3}{R_2+R_3} = \frac{22(3)}{6+3} = 7.33\text{ A}$$

39. B. 900 rpm

$$E = \frac{PNZ\phi}{60a}\text{, thus } N = \frac{E60a}{PZ\phi} = \frac{240(60)(4)}{4(320)(50\times10^{-3})} = 900\text{ rpm}$$
$$\text{Note}: a = mP = 1(4) = 4$$

40. D. 35
41. C. 75.7 %

$$pf = \frac{P}{EI} = \frac{500}{110(6)} = 0.757 = 75.7\%$$

42. C. four times

    In a moving coil instrument the **torque developed** is directly proportional to the **square of the current.**

43. D. Daraf
44. D. None of these

    Refer to the Theory section of this Reviewer for the diagram and formulas of a DC series motor.

$$E_b = V_s - I_aR_{equivalent} = 200 - (8)(0.6) = 195.2\text{ V}$$

45. C. size of load
46. A. air gap
47. D. Lead-acid
48. C. overloads
49. D. Capacitor start, capacitor run
50. D. 2 ohms

$$R_t = \frac{E}{I} = \frac{12}{2} = 6\,\Omega \text{ and } R_t = 4 + R$$
$$R = R_t - 4 = 6 - 4 = 2\,\Omega$$

TEST 40

1. C. 20 %
2. B. suspended
3. D. 3,000 mm
4. A. 460 mm
5. D. 26 mm
6. D. 125 %
7. D. 15
8. A. 30 V
9. B. 1,500 mm
10. B. stranded
11. C. 0.8 mm
12. B. 15 mm
13. D. 20
14. A. 1.6 mm
15. C. 9,100 mm
16. C. 50 mm
17. A. 50 V
18. D. 205 mm
19. D. Stranded wire
20. B. 3,100 mm
21. B. 100
22 A. 50, 100
23. A. 250
24. A. Buried interior PVC water piping system
25. A. separately derived
26. B. 0.33
27. A. Class II, Division 1
28. C. 6.4 mm
29. C. 13 mm
30. B. 20 A
31. B. 150 V
32. D. 1,300 mm
33. B. Cablebus
34. B. steel

35. C. grounding electrode systems
36. C. 80
37. C. Armored cable
38. D. 1,000 mm
39. A. 20 A
40. B. Flat conductor cable
41. D. 125
42. A. 1,800 mm
43. D. 3.5 mm^2
44. D. 3.0
45. C. cold water pipe
46. D. 75 %
47. B. 100
48. A. tie
49. B. 150
50. D. 50 volts