Compiled Questions and Answer for Registered Master Electrician Licensure Exam
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1. What is “accessible” as applied to wiring methods?
Wiring that is readily available to inspection, repair, removal, etc., without disturbing the building structure or finish. Not permanently enclosed by the structure or finish of buildings.

2. What is “accessible” as applied to equipment?
Equipment that may be readily reached without climbing over obstacles or that is not in locked or other hard to reach areas. For example, panel boards in kitchen cabinets that are mounted in or on the walls above washers and dryers, or in closets or bath- rooms, are not accessible. Service-entrance equipment that can be reached only by going into a closet, behind a stairway, or around some other obstacle would not be considered accessible.

3. What does “ampacity” mean?
The amount of flowing current (in amperes) that a conductor can carry continuously for specific use conditions and not exceed the temperature rating of the conductor

4. What does “dead front” mean?
No live (energized) parts are exposed where a person operates electrical equipment.

5. What does “approved” mean?
Any appliance, wiring material or other electrical equipment that is acceptable to the enforcing authorities. Underwriters Laboratory is (by far) the most acceptable authority to inspectors.

6. What does “identified” mean as applied to equipment?
It means that the equipment will be suitable for the particular use or environment, that it has been evaluated by a qualified electrical testing organization, and that it features a product listing or label indicating its suitability

7. What is a branch circuit?
A branch circuit is the portion of a wiring system that extends beyond the last overcurrent-protective device. In interpreting this, you must not consider the thermal cutout or the motor overload protection as the beginning of the branch circuit. The branch circuit actually begins at the final fusing or circuit-breaker point where the circuit breaks off to supply the motor.

8. What is a small appliance branch circuit?
This is the circuit supplying one or more outlets connecting appliances only. There is no permanently connected lighting on this circuit, except the lighting that

may be built into an appliance. Refer to outlets for small appliance loads in kitchens, laundries, pantries, and dining and breakfast rooms of dwellings.

9. What is a general purpose circuit?
This is a branch circuit to which lighting and/or appliances may be connected.

10. What is a multiwire branch circuit?
A multiwire branch circuit has two or more ungrounded conductors with a potential difference between them and also has a grounded (neutral) conductor with an equal potential difference between it and each of the other wires. Examples are a three- wire 120/240-volt system or a 120/208-volt wye system, using two-or three-phase conductors and a grounded conductor. However, in either case, the “hot” wires must not be tied to one phase but must be connected to different phases to make the sys- tem a multiwire circuit

11. What is a circuit breaker?
A device that is designed not only to open and close a circuit nonautomatically but also to open the circuit automatically at a predetermined current-overload value. The circuit breaker may be thermally or magnetically operated. However, ambient temperatures affect the operation of the thermally operated type, so that the trip value of the current is not as stable as with the magnetic type.

12. What is a current-carrying conductor?
A conductor that is expected to carry current under normal operating conditions.

13. What is a noncurrent-carrying conductor?
One that carries current only in the event of a malfunction of equipment or wiring. An equipment grounding conductor is a good example. It is employed for protection and is quite a necessary part of the wiring system, but it is not used to carry current except in the case of faulty operation, where it aids in tripping the overcurrent-protective device.

14. What is a pressure connector (solderless)?
A device that establishes a good electrical connection between two or more conductors by some means of mechanical pressure. A pressure connector is used in place of soldering connections and is required to be of an approved type.

15. What is meant by “demand factor”?
This is the ratio between the maximum demand on a system or part of a system and the total connected load on the same sys- tem or part of the system.

16. What is meant by “explosionproof apparatus”?
Apparatus enclosed in a case that is able to sustain an explo- sion that may occur within the case and is also able to prevent ignition of specified gases or vapors surrounding the enclosure caused by sparks, flashes, or explosion of the gases or vapors

17. What is a feeder?
The circuit conductors between the service equipment, or the source of a separately derived system, and the final branch- circuit overcurrent device or devices. Generally, feeders are com- paratively large in size and supply a feeder panel, which is composed of a number of branch-circuit overcurrent devices

18. What is a fitting?
A mechanical device, such as a locknut or bushing, that is intended primarily for a mechanical, rather than an electrical, function.

19. What is meant by a “ground”?
An electrical connection, either accidental or intentional, that exists between an electrical circuit or equipment and the earth, or some other conducting body that serves in place of the earth.

20. What does “grounded” mean?
Connected to the earth or to some other conducting body that serves in place of the earth.

21. What is a grounded conductor?
A system or circuit conductor that has been intentionally grounded.

22. What is a grounding conductor?
A conductor that is used to connect equipment, devices, or wiring systems with grounding electrodes.

23. What is a grounding conductor (equipment)?
The conductor used to connect noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system grounding conductor at the service and/or the grounding electrode conductor.

24. What is a grounding electrode conductor?
A conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded conductor of the circuit at the service.

25. What is a dwelling unit?
A dwelling unit includes one or more rooms used by one or more persons, with space for sleeping, eating, living, and a permanent provision for cooking and sanitation.

26. What is an outlet?
A point in the wiring system at which current is taken to supply some equipment.

27. What is meant by “rain-tight”?
Capable of withstanding a beating rain without allowing water to enter.

28. What is a receptacle?
A receptacle is a contact device installed at the outlet for the connection of a single attachment plug. A single receptacle is a single device with no other contact device on the same yoke. A multiple receptacle is a single device containing two or more receptacles.

29. What does “rainproof” mean?
So constructed, protected, or treated as to prevent rain from interfering with the successful operation of the apparatus.

30. What is meant by the term “service”?
The conductors and equipment for delivering electrical energy from the secondary distribution system the street main, the distribution feeder, or the transformer—to the wiring system on the premises. This includes the service-entrance equipment and the grounding electrode.

31. What are service conductors?
The portion of the supply conductors that extend from the street main, duct, or transformers to the service-entrance
equipment of the premises supplied. For overhead conductors, this includes the conductors from the last line pole (not including the service pole) to the service equipment.

32. What is a service cable?
A service conductor manufactured in the form of a cable and normally referred to as SE cable, or USE cable

33. What is meant by “service drop”?
The overhead conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure. If there is a service pole with a meter on it, such as a farm service pole, the service drop does not stop at the service pole; all wires extending from this pole to a building or buildings are service drops, as well as the conductors from the last line pole to the service pole

34. What are service-entrance conductors (overhead system)?
That portion of the service conductors between the terminals of service equipment and a point outside the building, clear of building walls, where they are joined by a splice or tap to the ser- vice drop, street main, or other source of supply.

35. What are service-entrance conductors (underground system)? The service conductors between the terminals of the service equipment and the point of connection to the service lateral. Where service equipment is located outside the building walls, there may be no service-entrance conductors, or they may be entirely outside the building.

36. What are sets of service-entrance conductors?
Sets of service-entrance conductors are taps that run from main service conductors to service equipment.

37. What is meant by “service equipment”?
The necessary equipment, usually consisting of circuit break- ers or switches and fuses and their accessories, located near the point of where supply conductors enter a building, structure, or an otherwise defined area, and intended to constitute the main control and means to cut off the supply.

38. What is meant by “service lateral”?

The underground service conductors between the street main, including any risers at the pole or other structure, or from transformers, 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 where the service conductors enter the building.

39. What is meant by “service raceway”?
The rigid metal conduit, electrical metallic tubing, or other raceway that encloses service-entrance conductors.

40. What is meant by a “general-use switch”?
A device intended for use as a switch in general distribution and branch circuits. It is rated in amperes and is capable of interrupting its rated current at its rated voltage.

41. What is meant by a “T-rated switch”?
An AC general-use snap switch that can be used (a) on resistive and inductive loads that don’t exceed the ampere rating at the voltage involved, (b) on tungsten-filament lighting loads that don’t exceed the ampere rating at 120 volts, and (c) on motor loads that don’t exceed 80% of their ampere rating at the rated voltage.

42. What is meant by an “isolating switch”?
A switch that is intended to isolate an electric circuit from its source of power. It has no interrupting rating and is intended to be operated only after the circuit has been opened by some other means.

43. What is meant by a “motor-circuit switch”?

A switch, rated in horsepower, that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch, at the rated voltage.

44. What is meant by “watertight”?
So constructed that moisture won’t enter the enclosing case.

45. What is meant by “weatherproof”?
So constructed or protected that exposure to the weather won’t interfere with successful operation. Raintight or watertight may

fulfill the requirements for “weatherproof.” However, weather conditions vary, and consideration should be given to conditions resulting from snow, ice, dust, and temperature extremes.

46. What is the percentage of allowable voltage drop for feeders that are used for power and heating loads?
Maximum of 3%.

47. What is the percentage of allowable voltage drop for feeders that are used for lighting loads?
Maximum of 3%.

48. Give some examples of equipment that causes inductive reactance.
Motors, transformers, choke coils, relay coils, ballasts.

49. When only inductive reactance is present in an ac circuit, what happens to the current in relation to the voltage?
The current is said to lag behind the voltage.

50. What is a preheated-type fluorescent tube?
There are two external contacts at each end of a glass tube. Each set of contacts is connected to a specially treated tungsten filament. The inside of the tube is coated with a fluorescent powder, the type of powder used controls the color output of the tube. The tube is filled with an inert gas, such as argon, and a small drop of mercury to facilitate starting.

51. What kind of light does the fluorescent bulb produce within the bulb itself?
Ultraviolet light.

52. Do the filaments stay lit during the operation of a fluorescent bulb? Explain.
No. They remain lit only at the start to vaporize the mercury; they are then shut off by the starter. Current is supplied to one contact on each end, thereby sustaining the mercury arc within the tube.

53. Is a fluorescent fixture more efficient than an incandescent fixture?
Yes. However, no fixed efficiency can be quoted because it varies with the size of the bulb, the ballast, etc. As a rule of thumb, a 40-watt fluorescent bulb is generally considered to put out about the same amount of light as a 100-watt incandescent bulb.

54. Does room temperature affect the operation of fluorescent lamps?
Yes. The normal fluorescent lamp is designed for operation at 50 F or higher.

55. If the operating temperature is expected to be below 50°F, what measures should be taken when using fluorescent lamps?
Use special lamps and starters that are designed for lower temperatures.

56. Do fluorescent lamps produce a stroboscopic effect? Explain.
Yes. This effect is due to the fact that at 60 hertz the current passes through zero 120 times a second.

57. How can the strobe effect be compensated for in a two-bulb system?
When the power factor is corrected, the capacitor is so con- nected that at the instant the current in one bulb is passing through zero, the current in the other bulb is not at zero, and the strobe effect goes unnoticed.

58. What is another way to minimize the strobe effect?
By using a higher frequency, such as 400 hertz.

59. Does a 400-hertz frequency have any other advantages?
Yes. Smaller and lighter ballasts can be used. This makes it feasible to use simple capacitance-type ballasts, which produce an overall gain in efficiency.

60. Does frequent starting and stopping of fluorescent lighting affect the bulb life?
The life of fluorescent bulbs is affected by starting and stop- ping. A bulb that is constantly left on will have a much longer life than one that is turned on and off frequently.

61. When lighting an outdoor activity area with large incandescent bulbs, how can the light output of the bulbs be increased?
By using bulbs of a lower voltage rating than that of the source of supply. For example, by using a bulb that is rated at 105 volts on a 120-volt supply, the output can be increased by roughly
30%, but the life of the bulb will be cut by about 10%.

62. How is the light output of lamps rated?
In lumens.

63. How are light levels rated?

In foot-candles.

64. What is a foot-candle?
The amount of direct light emitted by one international can- dle on a square foot of surface, every part of which is one foot away.

65. Is the nec a law?
It is not a law, but it is adopted into laws that are established by governmental agencies; it may be adopted in its entirety, in part, or with amendments.

66. Who has the responsibility for Code interpretations?
The administrative authority that has jurisdiction over endorsement of the Code has the responsibility for making Code interpretations

67. When are rules in the nec mandatory and when are they advisory?
When the word “shall” is used, the rules are mandatory.

68. According to the nec, what are voltages?
Throughout the Code, the voltage considered shall be that at which the circuit operates. This is often expressed as, for exam- ple, 600 volts, nominal

69. When referring to conductors, what material is referred to? Copper, unless otherwise specified. When other materials are to be used, the wire sizes must be changed accordingly

70. In what manner must the work be executed?
All electrical equipment must be installed in a neat and work- manlike manner

71. May wooden plugs be used for mounting equipment in masonry, concrete, plaster, etc.?
No

72. How must conductors be spliced or joined together?
They must be spliced or joined together by approved splicing devices or by brazing, welding, or soldering with a fusible metal or alloy

73. When soldering, what precautions must be used?
All joints or splices must be electrically and mechanically secure before soldering and then soldered with a noncorrosive flux This does not apply to conductors for grounding purposes; soldering is not allowed on these conductors.

74. How should splices or joints be insulated?
They must be covered with an insulation that is equivalent to the original conductor insulation

75. Can an autotransformer be used on an ungrounded system? The autotransformer must have a grounded conductor that is common to both primary and secondary circuits and tied into a grounded conductor on the system supplying the autotransformer
An autotransformer may be used to extend or add an individ- ual branch circuit in an existing installation for equipment load without the connection to a similar grounded conductor when transforming from a nominal 208-volt supply or similarly from
240 volts to 208 volts.

76. On No. 6 or smaller conductors, what means must be used for the identification of the grounded conductors?
Insulated conductors of No. 6 or smaller, when used as grounded conductors, must be white, natural gray, or colored
(but never green) with three longitudinal white stripes. On Type MI cable, the conductors must be distinctively marked at the ter- minal during installation

77. How should conductors larger than No. 6 be marked to indi- cate the grounded wire?
By the use of white, natural gray, or colored (but never green) insulation with three longitudinal white stripes, or by identifying with a distinctive white marking at the terminals during installation

78. How is the high-leg conductor of a 4-wire delta identified? When the midpoint of one phase is grounded to supply lighting and similar loads on a 4-wire delta-connected secondary, the phase conductor with the higher voltage to ground shall be orange in color or be indicated by tagging or other effective means at the point where a connection is to be made if the neutral conductor is present

79. On a grounded system, which wire must be connected to the screw shell of a lampholder?
The grounded conductor

80. What will determine the classification of branch circuits?
The maximum permitted setting or rating of the overcurrent- protective device in the circuit

81. What color-coding is required on multiwire branch circuits? The grounded conductor of a branch circuit shall be identi- fied by a continuous white or natural gray color. Whenever con- ductors of different systems are installed in the same raceway, box, auxiliary gutter, or other types of enclosures, one system grounded conductor, if required, shall have an outer covering of white or natural gray. Each other system grounded conductor, if required, shall have an outer covering of white with an identifi- able colored stripe (not green) running along

the insulation or another means of identification. Ungrounded conductors of different voltages shall be a different color or identified by other means

82. How must a conductor that is used only for equipment and grounding purposes be identified?
By the use of a green color, or green with one or more yellow stripes, or by being bare (only grounding conductors may be bare).

83. Can green-colored wire be used for circuit wires?
No. Green is intended for identification of equipment- grounding conductors only

84. What voltage is used between conductors that supply lamp- holders of the screw-shell type, receptacles, and appliances in dwellings?
Generally speaking, a voltage of 120 volts between conductors is considered the maximum. There are, however, some exceptions

85. How must you ground the grounding terminal of a grounding- type receptacle?
By the use of an equipment-grounding conductor of green cov- ered wire, green with one or more yellow stripes, or bare conduc- tors. However, the armor of Type AC metal-clad cable, the sheath of MI cable, or a metallic raceway is acceptable as a grounding means. PEC does not permit the general use of flexible metal conduit as a grounding means unless it and the connec- tors are listed.

86. How can you ground the grounding terminal on a grounding- type receptacle on extensions to existing systems?
Run the grounding conductor to a grounded water pipe near the equipment

87. What is the minimum size for branch-circuit conductors?
They cannot be smaller than No. 8 for ranges of 8¾ kW or higher rating and not smaller than No. 14 for other loads

88. What is the requirement concerning all receptacles on 15- and 20-ampere branch circuits?
All receptacles on 15- and 20-ampere branch circuits must be of the grounding type. A single receptacle installed on an indi- vidual branch circuit must have a rating of not less than the rat- ing of the branch circuit.

89. What are the requirements for spacing receptacles in dwelling occupancies?
All receptacles in kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, sun rooms, recreation rooms, and bedrooms must be installed so that no point along the wall space, measured horizontally, is more than 6 feet from a receptacle. This includes wall space that is 2 feet or wider and any space

occupied by sliding panels on exterior walls. Sliding glass panels are excepted. At least one outlet must be installed for the laundry.

90. A fastened-in-place appliance is located on a 15- or 20- ampere branch circuit on which there is a lighting fixture. What is the maximum rating that would be permitted on the appliance? 50 percent of the branch circuit rating

91. A cord-and-plug-connected appliance is used on a 15- or 20- ampere branch circuit. What is the maximum rating permitted for the appliance?
80 percent of the branch circuit rating

92. What is the smallest size wire permissible for a feeder circuit?
No. 10 wire

93. What are the permissible voltage drops allowable on feeders and branch circuits?
On feeders, not more than 3 percent for power, heating, and lighting loads or combinations thereof, and a total maximum voltage drop not to exceed 5 percent for conductors and for combinations of feeders and branch circuits

94. What is the basis for figuring the general lighting loads in occupancies?
They are figured on a volt-amperes-per-square-foot basi

95. What measurements are used to determine the number of watts per square foot?
The outside dimensions of the building and the number of floors, not including open porches or garage

96. What is the unit load per square foot (in volt-amperes) for a hospital?
2 volt-amperes

97. What is the unit load per square foot (in volt-amperes) for a school?
3 volt-amperes

98. How many volt-amperes per square foot are required to be included for general-purpose receptacle outlets when a set of plans does not show their locations in an office building?
1 volt-ampere per square foot

99. What is the unit load per square foot (in volt-amperes) for a warehouse used for storage?
1⁄4 volt-ampere

100. What voltages are used for purposes of computing feeder and branch-circuit loads when other voltages are not specified?

120, 120/240, 208Y/120, 240, 480Y/277, 480, and 600 volts

101. How are continuous and noncontinuous loads for feeder rat- ings calculated?
Branch circuits must be rated no less than the noncontinuous load, plus at least 125 percent of the continuous load

102. Are unfinished basements of dwellings used in figuring watts per square foot?
Yes, if adaptable for future use. If these spaces are not adapt- able, they are not used

103. What loads are used in figuring outlets for other than general illumination?
Outlets supplying specific loads and appliances must use the ampere rating of the appliance. Outlets supplying heavy-duty lampholders must use 600 volt-amperes; calculations for other outlets must use 180 volt-amperes

104. What load must be figured for show-window lighting?
Not less than 200 volt-amperes for each linear foot measured horizontally along the base

105. What are the receptacle requirements in dwelling occupancies for kitchen, family room, laundry, pantry, dining room, and break- fast room?
There shall be a minimum of two 20-ampere small-appliance circuits for the kitchen, family room, pantry, dining room, and breakfast room. There should also be a minimum of one 20- ampere circuit for the laundry

106. What is the unit load per square foot (in volt-amperes) for a store?
3 volt-amperes

107. Outlets for heavy-duty lampholders are to be based on a load of how many volt-amperes?
600

108. Are demand factors permitted in determining feeder loads?
Yes

109. What size feeders must be installed in dwelling occupancies? The computed load of a feeder must not be less than the sum of all branch circuit loads supplied by the feeder. The demand
factors can be used in the calculation of feeder sizes.

110. When figuring the neutral load to electric ranges, what is the maximum unbalanced load considered to be?
The maximum unbalanced load for electric ranges is consid- ered to be 70 percent of the load on the ungrounded conductors

111. How is the neutral load on a 5-wire, 2-phase system deter- mined?
It is figured at 140 percent of the load on the ungrounded conductors

112. How may the neutral-feeder load on a 3-wire dc or single- phase 3-wire ac system be determined?
The 70 percent demand factor may be used on range loads, and a further demand factor of 70 percent may be used on that portion of the unbalanced load in excess of 200 amperes

113. How do you calculate the unbalanced load on a 4-wire, 3-phase system?
The 70 percent demand factor may be used on range loads, and a further demand factor of 70 percent may be used on that portion of the unbalanced load in excess of 200 amperes

114. Can you make a reduction on the neutral feeder load where discharge lighting, data processing, or similar equipment is involved? No reduction can be made on the neutral capacity for the portion of the load that consists of electric discharge lighting, data processing, or similar equipment. The load on the neutral feeder must be taken at 100 percent of the ungrounded conduc-
tors

115. Why do discharge lighting loads require no reduction in neu- tral feeder capacity?
Because of the effect of the third harmonic on the current value in the neutral feeder. In fact, it's sometimes necessary to oversize the neutral in such circuits. The same effect occurs when a great deal of data processing equipment is connected to the circuits.

116. Are demand factors applicable to electric ranges?
Yes.

117. Can demand factors be used on electric-clothes-dryer loads in the same manner as they are used on electric ranges?
Yes

118. The demand factor for five household electric clothes dryers is calculated at what percentage?
80 percent

119. Where two or more single-phase ranges are supplied by a
3-phase, 4-wire feeder, how is the total load computed?
On the basis of twice the maximum number connected between any two phases

120. What is the maximum demand for two household electric ranges, wall-mounted ovens, counter-mounted cooking units, and other household cooking appliances rated at over 13⁄4 kW? 11 kW for ratings not over 12 kW

121. What computations are required for commercial cooking equipment? See nec, Table 220.20.

122. When computing the total load of a feeder for an electric heating system and an air-conditioning system that won't be used simultaneously, must both loads be added? No. The smaller of the two can be omitted

123. What are the minimum requirements for service-drop conductors? They must be of sufficient size to carry the load that is required of them, but they musn't be smaller than No. 8 copper wire or No. 6 aluminum, except under limited load conditions where they may not be smaller than No. 12 hard-drawn copper

124. What is the minimum clearance for service drops over buildings? They shall have a minimum clearance of 8 feet . However, if the voltage does not exceed 300 volts between conductors and the roof has a slope of not less than 4 inches in 12 inches, the clearance may be a minimum of 3 feet

125. What is the minimum height of point of attachment of service drops?
10 feet

126. What is the minimum clearance of service drops over com- mercial areas, parking lots, agricultural areas, and other areas sub- ject to truck traffic?
18 feet

127. What is the minimum clearance of service drops over side- walks?
12 feet

128. What is the minimum clearance of service drops over drive- ways, alleys, and public roads?
18 feet

129. What is the minimum clearance of service drops over residen- tial driveways?
12 feet

130. Can a bare neutral conductor be buried in the ground in an underground service?
No; it must be insulated, unless it is in a duct or conduit .There is an exception: bare copper for direct burial where bare copper is judged to be suitable for the soil conditions.

131. Where underground service conductors are carried up a pole, to what minimum height must they be given mechanical protection?
8 feet
132. Is sealing required where underground ducts or conduits enter buildings?
Yes, to prevent the entrance of gases or moisture into the building. Spare or unused conduits and ducts must also be sealed

133. What is the minimum size of service-entrance conductor nor- mally allowed?
Any approved conductor having an ampacity equal to the sum of the noncontinuous loads, plus 125 percent of continuous loads. However, if the service entrance conductors terminate in an overcurrent device and assembly listed for operation at 100 percent of its rating, the 125 percent multiplier need not be used

134. What is the minimum size service for a single-family dwelling with an initial load of 10 kVA or more?
The service must be a minimum of 100 amperes for a 3-wire service
135. A residence has more than six 2-wire branch circuits. What is the minimum size of service required for this residence?
The service entrance conductors shall have an ampacity of not less than 100 amperes for a 3-wire service

136. Are splices permitted in service-entrance conductors?
Yes. They may be spliced with clamped or bolted connections; or buried splices may be made with a listed underground splice kit

137. Are conductors other than service-entrance conductors per- mitted in the same raceways or cables?
No, except for grounding conductors and load management control conductors

138. What must be provided for the disconnection of service con- ductors from building conductors?
Some means must be provided for disconnecting all of the building conductors from the service-entrance conductors, and this means must be located in a readily accessible point nearest the point of entrance of the service conductors, on either the out- side or inside of the building, whichever is most convenient
139. What must the service disconnecting means consist of?
It may consist of not more than six switches or six circuit breakers in a common enclosure or in a group of separate enclo- sures, provided that they are grouped together. Two or three single-pole switches or circuit breakers may be installed on multi- wire circuits and counted as one, provided they have handle ties or handles, so that not more than six operations of the hand are required to disconnect all circuits

140. What may be connected ahead of the service entrance discon- necting switch?
Service fuses, meters, high-impedance shunt circuits (such as potential coils of meters), supply conductors for time switches, surge-protection capacitors, instrument transformers, lightning arresters, solar electric systems, interconnected electric power production sources, and circuits for emergency systems (such as fire-pump equipment, etc.)

141. In multiple-occupancy dwellings, must each occupant have access to his disconnecting means?
Yes, except if the disconnects are under constant supervision and maintenance; in this case, they can be accessible to the building management only

142. Is it permissible to install overcurrent-protective devices in the grounded service conductor?
Overcurrent-protective devices may not be installed in the grounded service conductor unless a circuit breaker is used that

143. What is the minimum size of service-entrance conductors operating at over 600 volts?
They musn't be smaller than No. 6 wire, unless in cable, where they may be a minimum of No. 8

144. What is the maximum circuit protection allowed with flexible cords, sizes No. 16 or No. 18, and tinsel cord?
30 and 20 amperes

145. What is the maximum overcurrent protection allowed on cords of 20 amperes capacity?
50 amperes

146. Give the standard ratings (in amperes) for fuses and circuit breakers.
Standard ratings are 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, 700, 800, 1000, 1200, 1600, 2000, 2500, 3000,
4000, 5000, 6000

147. Where can an overcurrent device be used in a grounded conductor?
No overcurrent device shall be placed in any permanently grounded conductor, except as follows:
Where the overcurrent device simultaneously opens all con- ductors of the circuit . A fuse shall also be inserted in the grounded conductor when the supply is 3-wire, 3-phase ac, one conductor grounded

148. May fuses be arranged in parallel?
No, except as factory assembled in parallel and approved as a unit

149. May breakers be paralleled?
No, only circuit breakers assembled in parallel that are tested and approved as a single unit

150. Are the secondary conductors of transformer feeder taps required to have overcurrent protection?

151. In what position must a knife switch with fuses be mounted? Why?
In a vertical position, so that when the switch is opened, the blades won't close by gravity; the line side must be connected so that when the switch is opened, the fuses will be deenergized

152. When overcurrent-protective device enclosures are mounted in a damp location, what precautions must be taken?
The enclosures must be of an identified type for the location and must be mounted with at least a 1⁄4-inch air space between the wall or supporting surface

153. Where may Edison-base plug fuses be used?
Plug fuses of the Edison-base type shall be used only for replacement in existing installations where there is no evidence of overfusing or tampering

154. What is the maximum voltage rating of plug fuses?
125 volts

155. What precautions must be taken if plug fuses are used on new installations?
Fuses, fuseholders, and adapters must be so designed that other Type S fuses may not be used

156. What are the size classifications of Type S fuses and adapters?
Not exceeding 125 volts at 0–15 amperes, 16–20 amperes, and 21–30 amperes

157. What is a Type S fuse?
A dual element fuse with special threads so that fuses larger than what the circuit was designed for may not be used. They are designed to make tampering or bridging difficult

158. Why are systems and circuits grounded?
To limit the excess voltage to ground, which might occur from lightning or exposure to other higher-voltage sources

159. Is it necessary to ground one wire on a two-wire dc system with not more than 300 volts between conductors?
Yes, in practically every case, although there are a few excep- tions

160. When should ac systems be grounded?
Ac circuits and systems must be grounded

161. When is the next higher overcurrent protective device permit- ted to protect a conductor where a standard fuse or circuit breaker is not available?
In general up to 800 amperes

162. When do circuits of 50 volts or less to ground have to be grounded? When do they not have to be grounded?
Circuits of less than 50 volts need not be grounded unless they are supplied from systems exceeding 150 volts to ground, where they are supplied by transformers from ungrounded systems, or where they run overhead outside buildings

163. If a grounded conductor is not going to be used in a building, must this grounded conductor be run to each service?
Yes. The grounded conductor must be run to each service. It need not be taken farther than the service equipment if it won't be required in any of the circuits

164. Is it necessary to ground each service on a grounded ac system?
Each individual service must have a ground, and this ground must be connected on the supply side of the service-disconnecting
means. If there is only one service from a transformer, there must be additional ground connection at the transformer or elsewhere in the transformer circuit for the installation to be approved

165. What are the grounding requirements when two or more buildings are supplied from one service?
Where two or more buildings or structures are supplied from a common service, the grounded system in each building or structure is required to have a grounded electrode as described in PEC, connected to the metal enclosure of the building disconnecting means and to the ac system grounded cir- cuit conductor on the supply side of the building or structure disconnecting means

166. Is it required to ground a separately derived system, and if so, where?
Premises wiring systems that are required by PEC to be grounded shall be grounded if the phase conductors are not physically connected to another supply system. They shall be grounded at the transformer, generator, or other source of sup- ply, or at the switchboard on the supply side of the disconnecting means

167. When must metal, noncurrent-carrying parts of fixed equip- ment that are likely to become energized be grounded?
When supplied by metal-clad wiring, when located in damp or wet places, when within reach of a person who can make con- tact with a grounded surface or object or within reach of a per- son standing on the ground, when in hazardous

locations, or where any switches, enclosures, etc., are accessible to unquali- fied persons

168. Must metal buildings be grounded?
If excessive metal in or on buildings may become energized and is subject to personal contact, adequate bonding and grounding will provide additional safety

169. What is the exception to grounding the noncurrent-carrying parts of portable tools and appliances?
Portable tools and appliances may have double insulation. If they have, they must be so marked and won't require grounding

170. What are the grounding requirements when lightning rods and conductors are present?
Lightning protection ground terminals must be bonded to the building's grounding system. In addition, metal enclosures with conductors should be kept at least 6 feet away from lightning conductors. Where this is not practical, they must be bonded together. However, this 6-foot rule is a Fine Print Note and not a requirement of the nec.

171. What is meant by effective grounding?
The path to ground must be permanent and continuous, must be capable of safely handling the currents that may be imposed on the ground, and must have sufficiently low impedance to limit the potential above ground to facilitate the opening of the overcurrent devices. The earth may not be used as the only equipment-grounding conductor

172. What is a grounding electrode conductor used for?
The grounding conductor for circuits is used for grounding equipment, conduit, and other metal raceways, including service conduit, cable sheath, etc.

7-54 What appliances may be grounded to the neutral conductor? Electric ranges and electric clothes dryers, provided that the neutral is not smaller than No. 10 copper wire . However, this is not allowed for equipment that is fed from feeder panels, in mobile homes, or in recreational vehicles.

173. Three-wire SE cable with a bare neutral is sometimes used for connecting ranges and dryers. Is it permissible to use this type of cable when the branch circuit originates from a feeder panel? No. The neutral must be insulated

174. What equipment, other than electric ranges and clothes dry- ers, may be grounded to the grounding conductor?
The grounding conductor on the supply side of the service- disconnecting means may ground the equipment, meter housing, etc. The load side of the

disconnecting means cannot be used for grounding any equipment other than electric ranges and dryers

175. How should continuity at service equipment be assured?
Threaded couplings and bosses, as well as threadless cou- plings and connections in rigid conduit or EMT (electrical metal- lic tubing), must be wrench-tight. Bonding jumpers must be used around concentric and eccentric knockouts and ordinary lock- nuts and bushings cannot be used for bonding

176. On flush-mounted grounded-type receptacles, is it necessary to bond the green grounding screw of the receptacle to the equip- ment ground?
Yes, with a few exceptions

177. Can conduit serve as the equipment ground?
Except for a few cases, such as special precautions in hazardous locations, conduit, armored cable, metal raceways, etc., can serve as the equipment ground

178. What is the preferred type of grounding electrode?
A metal underground water system where there are 10 feet or more of buried metal pipe, including well casings that are bonded to the system, is the preferred grounding electrode .A made electrode shall also be used in addition to the buried metal water pipe.

179. What is a “made” electrode?
A made grounding electrode may be a driven pipe, driven rod, buried plate, or other metal underground system approved for the purpose of grounding the equipment

180. What are the requirements for plate electrodes?
They musn’t have less than 2 square feet (.186 square meter) of surface exposed to the soil. Electrodes of iron or steel must be at least 1⁄4 inch (6.4mm) thick; if made of nonferrous metal, it must be at least 0.06 inch (1.5mm) thick

181. What should be the resistance of made electrodes?
If a single made electrode does not measure a resistance to ground of 25 ohms or less, it must be supplemented by another electrode that is not less than 6 feet away from the first electrode

182. May grounding electrode conductors be spliced?
No, splices are not permitted; grounding electrode conductors must be one piece for their entire length, although there are some exceptions

183. What is the smallest size grounding electrode conductor permissible?

No. 4 wire or larger may be attached to buildings; No. 6 wire may be used if properly stapled to prevent physical damage; and No. 8 wire may be used if in conduit or armored cable for pro- tection

184. When a grounding electrode conductor is enclosed in a metal enclosure, how is the metal enclosure to be installed?
It must be electrically continuous from point of attachment to cabinet or enclosure to the point of attachment to the ground clamp or fitting. Metal enclosures that are not physically and electrically continuous must be bonded to the grounding elec- trode conductor at both ends of the metal enclosure

185. May aluminum be used for a grounding electrode conductor? Yes, but it may not come in contact with masonry or the earth and cannot be run closer than 18 inches from the earth

186. If a water pipe is used as the grounding electrode, what pre- cautions must be taken?
The grounding connection should be made at the point of water-service entrance. If this cannot be done and there is a water meter on the premises, the water meter must be bonded with a jumper of sufficient length, so that the water meter may be read- ily removed without disturbing the bonding. The cold-water piping must be used, and it should be checked to make certain that there are no insulated connections in the piping

187. Where nonmetallic water pipe serves an apartment building, what grounding procedures are recommended?
The ground must also be bonded to the interior metal water piping system, including the hot-water piping, and also to the sewer, gas piping, air tracts, etc. This will provide additional safety

188. When reinforcing bar is used as the grounding electrode, are clamps required to be listed for connecting the grounding conduc- tor to the rebar?
Yes. Exothermic welding is also permitted

189. Can solder be used to attach connections to the grounding conductor?
Solder is never permitted; exothermic welding or listed pres- sure connectors are to be used

190. What means must be taken to maintain continuity at metal boxes when nonmetallic systems of wiring are used so that the equipment ground wire will be continuous?
The equipment grounds must be attached by means of a grounding screw (boxes are now available with a tapped hole having 10/32 threads) or by some other listed means

191. Are sheet-metal straps considered adequate for grounding a telephone system?
Yes, if attached to a rigid metal base that is seated on the water pipe or other ground electrode and listed for the purpose

192. What special precautions must be taken in the use of ground clamps?
They must be made of a material suitable for use in connec- tion with the materials that they are attaching to because elec- trolysis may occur if they are made of different metals. All surfaces must be clean and free of paint or corrosion

193. May aluminum grounding conductors be run to cold water piping?
Yes, but any clamps used with aluminum grounding conduc- tors must be approved for the purpose

194. May conductors of different systems occupy the same enclo- sure?
Conductors for light and power systems of 600 volts or less may occupy the same enclosure. The individual circuits may be ac or dc, but the conductors must all be insulated for the maximum voltage of any conductor in the enclosure except emergency systems

195. May conductors of systems over 600 volts occupy the same enclosure as conductors carrying less than 600 volts?
Under certain conditions

196. If the secondary voltage on electric-discharge lamps is 1000 volts or less, may its wiring occupy the same fixture enclosure as the branch-circuit conductors? Yes, if insulated for the secondary voltage involved

197. Is it permissible to run control, relay, or ammeter conductors that are used in connection with a motor or starter in the same enclosure as the motor-circuit conductors?
Yes, if the insulation of all the conductors is enough for the highest voltage encountered

198. When boxes, fittings, conduit, etc., are used in damp or cor- rosive places, how must they be protected?
They must be protected by a coating of approved corrosion- resistant material

199. In damp locations, what precautions must be taken against the corrosion of boxes, fitting, conduit, etc.?
There must be an air space of at least 1 inch between the wall

or supporting material and any surface-mounted conduit fit- tings, etc.

200. When raceways extend from an area of one temperature into an area of a widely different temperature, what precautions must be taken?
Precautions must be taken to prevent the circulation of air from a warmer to a colder section through the raceway

201. When raceways and conductors are run through studs, joints, and/or rafters, what precautions must be taken?
They should be run near the appropriate center of the wood members or at least 1⅛ inches from the nearest edge; if the mem- bers have to be notched or a 1⅛-inch protection cannot be given, the conduit or conductors must be covered by a steel plate not less than 1/6 inch in thickness

202. How much wire must be allowed at outlets and switch boxes for connections and splices?
There must be at least 6 inches of free conductor left for mak- ing the connections . It is a good practice, however, to leave more than 6 inches of free conductor at each box.

203. What precautions must be taken to prevent induced currents in metal enclosures?
When conductors carry ac, all phase wires and the neutral wire, if one is used, and all equipment grounding conductors must run in the same raceway. When single conductors must be passed through metal having magnetic properties (iron and steel), slotting the metal between the holes will help keep down the inductive effect

204. When it is necessary to run wires through air-handling ducts or plenums, what precautions must be taken?
The conductors must be run in conduit, electrical metallic tubing, intermediate metal conduit, flexible steel conduit with lead-covered conductors, metal-clad cable, Type MI cable, inter- mediate metal conduit, or in a Plenum-rated cable

205. Does temporary wiring, such as for construction, Christmas lighting, carnivals, etc., come under the PEC?
Yes

206. Are ground-fault circuit interrupters required on temporary wiring for construction sites?
Yes, on all 15- and 20-ampere branch circuits (

207. When conductors are used underground in concrete slabs or other masonry that comes in direct contact with the earth, or where Condensation or accumulated moisture in raceways is apt to occur, what characteristic must the insulation have?
It must be suitable for use in a wet location

208. Name some insulations permitted for use in a wet location.
RHW, TW, THW, THWN, and XHHW type cable

209. What are the cable requirements for buried conductors?
Cables of one or more conductors for direct burial in the earth must be Type USE cable, except for branch circuits and feeders, which may use Type UF cable. Type UF cable cannot be used for service wires

210. What other rules apply to buried conductors?
All conductors, including the neutral, must be buried in the same trench and be continuous (without any splice). Extra mechanical protection may be required, such as a covering board, concrete pad, or raceway

211. What is the minimum size of conductors allowed by the PEC?
For power work, the smallest size is No. 14. However, smaller sizes are allowed for controls and in special circum- stances

212. What is the ruling on stranded conductors?
Except for bus bars, Type MI cable, and pool bonding, conductors of No. 8 and larger must be stranded

213. What is the minimum size of conductors that may be paralleled?
Conductors in sizes 1/0 and larger may be run in multiple, though there are exceptions

214. When conductors are run in parallel, what factors must be considered?
Each phase or neutral, if used, must be the same length and of the same conductor material; have the same circular-mil area and the same type of insulation; and be arranged to terminate at both ends so that there will be equal distribution of current between the conductors. Phases must be coordinated to eliminate
Any induction currents that may be caused to flow in the race- ways

215. How many conductors may be run in raceways or cables without having to apply a derating factor to the current-carrying capacity?
Three current-carrying conductors (neutrals not included); when more than three current-carrying conductors are run, a derating factor must be applied

216. What are the derating factors for more than three current- carrying conductors in raceways or cables?
4 to 6 conductors 80% rating
7 to 9 conductors 70% rating
10 to 24 conductors 70% rating
25 to 42 conductors 60% rating
43 conductors and above 50% rating

217. In derating, how is the neutral conductor considered?
Normally, the current in the neutral conductor is only the unbalanced current. Therefore, if the system is well balanced, the neutral is not considered as a current-carrying conductor and would not enter into derating

218. In determining the current in the neutral conductor of a wye system, how is the neutral classed?
In a 4-wire, 3-phase, wyes-connected system, a common conductor carries approximately the same current as the other conductors and is therefore not considered a neutral in determining the derating of current capacity

219. What size must the conductors be for a parallel feeder or service?
At least 1/0 and larger for aluminum, copper-clad aluminum, or copper conductors

220. What are the minimum sizes for conductors when operated at a voltage of 0 through 2000 volts?
No. 14 copper, No. 12 aluminum or copper-clad aluminum, with exceptions

221. Where installed in raceways, stranded conductors of what size must be used?
No. 8 and larger

222. What are the temperature limitations of conductors?

223. What are the principal determinants of conductor operating temperatures?
The maximum temperature that the conductor can with- stand over a prolonged period of time without serious degradation

224. How are grounded conductors identified?
They must be white or natural gray in color

225. How are equipment grounding conductors identified?
They must be green, green with a yellow stripe, or bare (

226. How are ungrounded conductors identified?
They must be distinguished by colors other than white, gray, or green

227. What does the term “electrical ducts” mean?
Suitable electrical raceways, run underground and embedded in concrete or earth

228. What is the ampacity of a No. 6 AWG copper type THW conductor? 65 amperes

229. What are the ampacity correction factors for a Type ac cable assembly when the ambient temperature is other than 30ºC (86ºF)?

230. What is the maximum operating temperature for a Type?
THWN conductor?
75ºC (167ºF) in wet locations
231. Under what conditions can a Type XHHW conductor are used in a wet location?
When it is rated at a temperature of 75ºC (167ºF)

232. What are the requirements when more than one calculated or tabulated ampacity could apply for a given circuit length?
The lowest value shall be used

233. Give the ampacities for Types ac or NM conductor assemblies based on an ambient air temperature of 30ºC (86ºF).

234. What advantages would two parallel 500-MCM cables have over one 1000-MCM cable?
They would be easier to handle and to pull into raceways. According to PEC, RH wire has a current-carrying capacity of 545 amperes, whereas 500-MCM cable has a current-carrying capacity of 380 amperes. Therefore, two 500-MCM cables in parallel would have the same circular-mil area as one 1000-MCM cable and a current-carrying capacity of
760 amperes compared to the 545-ampere current-carrying capacity of one 1000-MCM cable. This is approximately 40 percent more current-carrying capacity for the two 500-MCM cables. In addition, there is usually a cost advantage by using two 500-MCM conductors, rather than one 1000-MCM conductor.

235. May THW insulated conductors be run through a continuous row of fluorescent fixtures?
Yes

236. Are cable trays intended to be used with ordinary branch circuit conductor?
No. They are not intended for this purpose

237. Do cable trays have to be used as a complete system, or may they be used as only partial cable supports?
They must be used as a complete system, including boxes and fittings
238. Is grounding required on metallic cable trays?
They must be grounded but must not be used as the neutral conductor. If used as the equipment-grounding conductor, they must meet the requirements of PEC

239. Is open wiring on insulators, commonly known as knob-and- tube wiring, recognized by the Code?
Yes, although it is almost never approved by inspectors for new installations. It is in the PEC primarily because a great deal of it has been previously installed and must be properly maintained

240. What is Type MI cable?
Type MI cable is a cable in which one or more electrical conductors are insulated with a highly compressed refractory mineral insulation (magnesium oxide) and enclosed in a liquid-tight and gas-tight metallic sheathing (copper)
241. Where can Type MI cable be used?
This is one wiring material that can be used for practically every conceivable type of service or circuit. When it is exposed to cinder fill or other destructive corrosive conditions, it must be protected by materials suitable for these conditions

242. What precautions must be taken with Type MI cable to pre- vent the entrance of moisture?
Where Type MI cable terminates, an approved seal must be provided immediately after stripping to prevent the entrance of moisture into the mineral insulation; the conductors must be insulated with an approved insulation where they extend beyond the sheath

243. Does the outer sheath of Type MI cable meet the requirements for equipment grounding?
Yes. It provides an excellent path for equipment grounding purposes but not for use as a grounded or neutral conductor
244. What is armored cable commonly called?
Type AC cable, or in some locations “BX,” a name taken from the Bronx Cable Company

245. What is metal-clad cable commonly called? Type MC cable

246. What is Type MC cable?
Type MC cables are power and control cables in the size range from No. 14 and larger for copper and No. 12 and larger for aluminum and copper-clad aluminum. The metal enclosures are either a covering of interlocking metal tape or a smooth, impervious, close-fitting, or corrugated tube. Supplemental protection of an outer covering of corrosion- resistant material is required where such protection is needed

247. What is Type AC cable?
Type AC cables are branch-circuit and feeder cables with an armor of flexible metal tape. Cable of the AC type must have an internal bonding strip of copper or aluminum in tight physical con- tact with the armor for its entire length

248. At what intervals must Type MC cable be supported?

At intervals not exceeding 6 feet

249. At what intervals must Type AC cable be supported?
At intervals of not more than 4¼ feet and within 12 inches of boxes and fittings, except where cable is fished and except lengths of not over 2 feet at terminals where flexibility

250. How may bends be made in Type AC cable?
Bends must be made so that the cables are not damaged. The radius of the curve of the inner edge of any bend must not be less than 5 times the diameter of Type AC cable

251. What extra precaution is necessary with Type AC cable when attaching fittings?
An approved insulating bushing or equivalent approved protection must be provided between the conductors and the armor

252. What is nonmetallic-sheathed cable?
Nonmetallic-sheathed cable is an assembly of two or more insulated conductors having an outer sheath of moisture- resistant, flame-retardant, nonmetallic material

253. What are the available sizes of nonmetallic-sheathed cable?
Sizes No. 14 to No. 2 (AWG) inclusive

254. What is the difference between Type NM and Type NMC?
Cables?
In addition to having flame-retardant and moisture-resistant covering, Type NMC cable must also be fungus-resistant and corrosion-resistant

255. Where may Type NM cable be used?
It may be used for exposed and concealed work in normally dry locations. It may also be installed or fished in the air voids of masonry block or tile walls, where such walls are not exposed to excessive moisture or dampness

256. In dwelling occupancies, what, if any, restrictions have been added?
Types NM and NMC cables are permitted in one- and two- family dwellings or multifamily dwellings and other structures not exceeding three floors above grade

257. Where may Type NMC cable be installed?
Where exposed to corrosive fumes or vapors, for exposed and concealed work, in dry and moist or damp places, and inside or outside of masonry block or tile walls

258. Where is it not permissible to use Type NM or Type NMC? cable?
As service-entrance cable, in commercial garages, in theaters, and similar locations, except as provided in the PEC, Article 518, “Places of Assembly”

259. What supports are necessary for Types NM and NMC cable? The installation must not be subject to damage, and the cable must be secured in place at intervals not exceeding 41⁄2 feet and supported within 12 inches from boxes and fittings

260. What are the two types of service-entrance cable?
Type SE and Type USE

261. What type of outer sheath does a Type SE cable have?
It has a flame-retardant, moisture-resistant covering

262. What type of outer sheath does Type USE cable have?
For underground use, it has a moisture-resistant covering but is not required to have a flame-retardant covering

263. Can service-entrance cable be used as branch-circuit conductors or feeder conductors?
It may be used for interior wiring systems only when all circuit conductors of the cable are of the thermoplastic or rubber type. However, service-entrance cable without individual insulation on the grounded (neutral) conductor can be used to sup- ply ranges or clothes dryers when the cable does not have an outer metallic covering and does not exceed 150 volts to ground. It may also be used as a feeder when it supplies other buildings on the same premises. SE cable with a bare neutral must not originate in a feeder panel

264. Describe underground feeder and branch-circuit cable.
Underground feeder and branch-circuit cable must be an approved Type UF cable in sizes No. 14 copper or No. 12 aluminum or copper-clad aluminum to No. 4 0 AWG, inclusive. The ampacity of Type UF cable shall be that of 60ºC (140ºF) conductors in accordance with PEC. In addition, the cable can include a bare conductor for equipment grounding purposes only. The overall covering must also be suitable for direct burial in the earth

265. What is required as overcurrent protection for Type UF cable?
Underground feeder and branch-circuit cable may be used underground, including direct burial, provided they have over- current protection that does not exceed the capacity of the conductors

266. May conductors of the same circuit be run in separate trenches? All conductors of the same circuit must be run in the same trench or raceway

267. What depth must UF cable be buried?
In general, UF cable must be buried at a depth of 24 inches or more. However, there are circumstances under which it can be buried at lesser depths

268. May UF cable be used for interior wiring?
Yes, but it must be installed in accordance with Article 334 and must not be exposed to direct sunlight unless it is specifically identified for this purpose

269. Where can rigid metal conduit are used?
Practically everywhere; however, rigid metal conduit protected solely by enamel cannot be used outdoors. Also, where practicable, dissimilar metals should not come in contact anywhere in the system to avoid the possibility of galvanic action, which could prove destructive to the system

270. When subject to cinder fill, what precautions must be taken with rigid metal conduit?
It must be protected by a minimum of 2 inches of noncinder concrete

271. What is the minimum size of rigid metal conduit?
1⁄2-inch trade size, with a few exceptions

272. What are the requirements for couplings on rigid metal conduit?
Threaded or threadless couplings and connectors must be made tight. Where installed in wet locations or buried in concrete masonry or fill, the type used must prevent water from entering the conduit

273. Are running threads permitted on rigid metal conduit?
They cannot be used on conduit for connections at couplings

274. What is the maximum number of bends permitted in rigid metal conduit between outlets?
Not more than 4 quarter bends, or a total of 360º; this includes offsets, etc., at outlets and fittings

275. After a cut is made in rigid metal conduit, what precaution must be taken?
All cut ends of conduits must be reamed to remove any rough ends that might damage the wire when it is pulled in

276. What are the principal determinants of conductor operating temperatures?
The maximum temperature that the conductor can withstand over a prolonged period of time without serious degradation

277. How are grounded conductors identified?

They must be white or natural gray in color

278. How are equipment grounding conductors identified?
They must be green, green with a yellow stripe, or bare

279. How are ungrounded conductors identified?
They must be distinguished by colors other than white, gray, or green

280. What does the term “electrical ducts” mean?
Suitable electrical raceways run underground and embedded in concrete or earth

281. What are the requirements when more than one calculated or tabulated ampacity could apply for a given circuit length?
The lowest value shall be used

282. What is intermediate metal conduit?
It is a metal conduit, similar to rigid metal conduit, but slightly lighter weight

283. What precautions should be taken when installing rigid non- metallic conduit in extreme cold?
They should not be used in areas where they will be subjected to damage, since they can become brittle at low temperatures

284. May plastic water pipe be used as conduit?
No. It may not be used for this purpose

285. What uses are permitted for rigid nonmetallic conduit?
For 600 volts or less, except for direct burial where it is not less than 18 inches below grade and where the voltage exceeds
600 volts, in which case it must be encased in 2 inches of concrete; in concrete walls, floors, and ceilings; in locations subject to severe corrosive influences; in cinder fill; and in wet locations

286. Where is the use of nonmetallic rigid conduit prohibited?
In hazardous locations, for the support of fixtures or other equipment, where subject to physical damage, or where high temperatures are present

287. Where must expansion joints is used on rigid nonmetallic conduit?
Where required to compensate for thermal expansion and con- traction when the expansion

288. Are bushings required when rigid nonmetallic conduit is used?
Yes

289. What is electrical metallic tubing (EMT)?

A thin-walled metal raceway

290. May more or fewer conductors be contained in EMT than in rigid metal conduit?
The same number of wires applies to both raceways

291. When EMT is exposed to moisture or used outdoors, what types of fittings must be used?
They must be rain-tight fittings

292. When EMT is buried in concrete, what type fittings must be used?
They must be concrete-tight fittings

293. What is the maximum number of conductors permitted in metal wireways, and what is the maximum percentage of fill?
The maximum fill cannot exceed 20 percent of the interior cross-sectional area. A maximum of 30 current-carrying conductors at any cross section (unless derated); signal circuits or starter-control wires are not included

294. Are splices permitted in wireways?
Yes, provided that the conductors with splices do not take up more than 75 percent of the area of the wireway at any point

295. May the wireways be open at the ends?
No. The dead ends must be closed

296. Is the equipment-grounding conductor used in figuring the number of conductors allowed in a box?
Yes, but only one conductor is to be counted

297. What is the purpose of auxiliary gutters?
They are used to supplement wiring spaces at meter centers, distribution centers, switchboards, and similar points of wiring systems; they may enclose conductors or bus bars but cannot be used to enclose switches, overcurrent devices, or other appliances or apparatuses

298. What is the maximum number of conductors permitted in auxiliary gutters, and what is the maximum percentage of fill allowed?
The maximum fill cannot exceed 20 percent of the interior cross-sectional area. A maximum of 30 current-carrying conductors at any cross section (unless dated); signal circuits or starter-control wires are not included

299. What is the current-carrying capacity of bus bars in auxiliary gutters?
The current carried continuously in bare copper bars in auxiliary gutters shall not exceed 1000 amperes per square inch of cross section of the conductor. For

aluminum bars the current carried continuously shall not exceed 700 amperes per square inch of cross section of the conductor

300. May taps and splices be made in auxiliary gutters?
Yes; however, splices may not occupy more than 75 percent of the cross-sectional area at any point. All taps must be identified as to the circuit or equipment that they supply

301. May round boxes be used as outlet, switch, or junction boxes?
No. They cannot be used where conduits or connectors with locknuts or bushings are used

302. What are the requirements for pendant boxes?
Pendant boxes must be supported by either multiconductor cords or cables in an approved manner, or by conduit

303. Can a box be used to support a ceiling fan?
Yes

304. What protection must be given to conductors entering boxes or fittings?
They must be protected from abrasion, and the openings through which conductors enter must be adequately closed

305. In what position must knife switches be mounted?
Single-throw knife switches must be mounted so that gravity won't tend to close them. Double-throw knife switches may be mounted either vertically or horizontally; however, if mounted vertically, a locking device must be provided to ensure that the blades remain in the open position when so set

306. Do switches and circuit breakers have to be accessible and grouped?
Yes. Switches and circuit breakers, as far as is practical, must be readily accessible

307. What is the maximum number of overcurrent devices permitted on one panel board?
Not more than 42 overcurrent devices of a lighting and appliance branch-circuit panel board can be installed in any one cabinet or cutout box. A two-pole circuit breaker is considered as two overcurrent devices, and a three-pole circuit breaker is considered as three overcurrent devices in the interpretation of the question

308. How would you define a lighting and appliance branch- circuit panel board?
A branch-circuit panel board that has more than 10 percent of its overcurrent devices rated 30 amps or less

309. What methods are specified in the Code for protecting conductors in trenches from damage due to ground movement?
Coiling the conductor or cable

8-136 Must all underground metal conduit and fittings be grounded? Generally yes, but an exception is made for a metal conduit elbow in a rigid nonmetallic conduit run, if it is no less than 18 inches below grade, or if it is beneath a 4-inch-thick concrete
slab

310. What is a primary cell?
A primary cell is a cell that produces electric current from an electrochemical reaction but is not capable of being recharged.

311. What is a secondary cell?
A cell that is capable of being recharged by passing an electric current through it in the opposite direction from the discharging current.

312. How are automobile batteries rated?
In ampere-hours.

313. Explain the meaning of ampere-hours.
At full charge, the battery is capable of delivering x number of amperes for y number of hours; e.g., a 100-ampere-hour battery would be capable of delivering 10 amperes for 10 hours, 1 ampere for 100 hours, etc.

314. When adding water to a car battery, what precautions should be observed?
Use distilled water only, and fill the cells only to their pre- scribed levels.

315. Will a discharged car battery freeze easier than a fully charged battery?
Yes.

316. How can a lead-acid battery be recharged?
By connecting it to a dc source at slightly higher than battery voltage and passing a high current through it in the opposite direction from the discharging current.

317. What derating factors must be applied to a flexible cord that contains six current-carrying conductors?
80 percent of the value

318. What are the requirements, with respect to exposed live parts, on lighting fixtures?
There may be no live parts exposed, except on cleat receptacles and lamp holders that are located at least 8 feet above the floor

319. What must be done to flexible cords and cables where they pass through holes in covers, outlets boxes, or similar enclosures?
They require protection in the form of bushings or fittings

320. Under what conditions may a light blue colored insulation is used for the identification of a grounded conductor in a flexible cord? For jacketed cords furnished with an appliance

321. Under what conditions may multiconductor cables rated at over 600 volts, nominal, be used?
To connect mobile equipment and mobile machinery

322. What precautions are necessary when installing fixture wires in temperatures colder than 10°C (14° F)?
Exercise care during installation, since the conductors may become brittle

323. What is the maximum operating temperature of a Type
TFFN fixture wire?
90 C

324. What are the requirements for fixtures installed near combustible materials?
They must be constructed, installed, or equipped with shades or guards so that combustible materials won't be subjected to temperatures in excess of 90 C (194 F)

325. Under what condition may a fixture is installed in a show window?
When it is chain-supported and externally wired

326. When a fixture weighs more than 50 pounds, may it be sup- ported from the outlet box?
It must be supported independently of the outlet box

327. What precautions must be taken in conductors for movable parts of fixtures?
Stranded conductors must be used and must be arranged so that the weight of the fixture or movable parts won't put tension on the conductors. These measures must be taken to protect the conductors

328. What types of insulation are permitted within 3 inches of a ballast within a ballast compartment?
Conductors rated at 90 C (194 F)

329. Which wire must be connected to the screw shells of lampholders?

The grounded, or white, conductor

330. What is the maximum wattage permitted on a medium lamp base?
300 watts

331. What is the maximum lamp wattage permitted for a mogul lamp base?
1500 watts

332. How must fixtures be grounded?
They may be connected to metal raceways, the armor of metal-clad cable, etc., if properly installed and grounded, or a separate equipment-grounding conductor not smaller than No.
14 wire may be used

333. On motor-driven appliances, what disconnecting means must be provided, and how must it be located?
The switch or circuit breaker that serves as the disconnecting means on a stationary motor-driven appliance must be located within sight of the motor controller or be capable of being locked in the open position

334. On all space-heating systems, what is the main requirement?
All heating equipment must be installed in an approved manner

335. What are the requirements for heating cables?
Heating cables must be supplied complete with factory- assembled nonheating leads of at least 7 feet in length

336. What markings must be present on heating cables?
Each unit length must have a permanent marking located within 3 inches of the terminal end of the nonheating leads, with the manufacturer's name or identification symbol, catalog number, and the rating in volts and watts or amperes. The leads on a
240-volt cable must be red; on a 120-volt cable the leads are yellow; 208-volt cable leads are blue; and on a 277-volt cable the leads are brown

337. What clearance must be given to wiring in ceilings?
Wiring above heated ceilings and contained within thermal insulation must be spaced not less than 2 inches above the heated ceiling and will be considered as operating at 50 C. Wiring above heated ceilings and located over thermal insulation having a minimum thickness of 2 inches requires no correction for temperature. Wiring located within a joist space having no thermal insulation must be spaced not less than 2 inches above the heated ceiling and will be considered as operating at 50

338. What are the restricted areas for heating?

Heating panels must not extend beyond the room or area in which they originate; cables must not be installed in closets, over cabinets that extend to the ceiling, under walls or partitions or over walls or partitions that extend to the ceiling

339. What clearance must be provided for heating cables and panels from fixtures, boxes, and openings?
Panels and heating cables must be separated by a distance of at least 8 inches from lighting fixtures, outlets, and junction boxes, and 2 inches from ventilation openings and other such openings in room surfaces, or at least a sufficient area must be provided
340. May embedded cables be spliced?
Only when absolutely necessary, and then only by approved means; in no case may the length of the cable be altered

341. May heating cable be installed in walls?
No

342. How must hermetic-type refrigeration compressors be marked?
They must have a nameplate, giving the manufacturer's name, the phase, voltage, frequency, and full-load current in amperes of the motor current when the compressor is delivering the rated output. If the motor has a protective device, the name- plate must be marked "Thermal Protection." For complete details

343. When using switches, fuses, and other disconnecting means, must the voltage of the switch coincide with that of the motor?
Yes. The voltage rating of the switch may not be less than
115 percent of the full load current rating of the motor

344. If a switch is used that has a current rating larger than is required, may it be adapted for less current?
Yes, adapters of the approved type are available for reducing the fuse size of the switch; fuses larger than the switch rating, however, may not be used.

345. May the enclosures for controllers and disconnecting means for motors be used as junction boxes?
Enclosures for controllers and disconnecting means for motors may not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to the other apparatus unless designs are employed that provide adequate space for this purpose

346. If a branch circuit supplies only one motor, how large must the conductor size of the branch circuit be in comparison to the cur- rent rating of the motor?
The branch-circuit conductors should be figured at not less than 125 percent of the full-load current rating of the motor

347. How shall equipment for hazardous (classified) locations be marked?
Approved equipment shall be marked to show the class, group, and operating temperature or temperature range, based on operation in a 40 C ambient for which it is approved
Exceptions are made for equipment of the nonheat-producing type, such as junction boxes, conduit, and fittings, which are not required to have a marked operating temperature.

348. What is a Class I location?
These are locations in which flammable gases or vapors are, or may be, present in the air in quantities sufficient to produce explosive or ignitable mixtures

349. What is a Class I, Division 1 location?
Locations in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently, or periodically under normal operating conditions; in which hazardous concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or in which breakdown or faulty operations of equipment or processes that might release hazardous concentrations of flammable gases or vapors might also cause simultaneous failure of electrical equipment

350. What is a group A atmosphere in a hazardous (classified) location?
One that contains acetylene

351. What is a group C atmosphere in a hazardous (classified) location?
One that contains cyclopropane, ethylether, ethylene, or gases or vapors of equivalent hazard

352. What is intrinsically safe wiring and equipment?
Equipment and wiring that is not capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific flammable or combustible atmospheric mixture in its most easily ignitable concentration

353. What precautions must be taken when installing intrinsically safe circuits?
They are required to be physically separated from wiring of all other circuits that are not intrinsically safe and from separate intrinsically safe circuits

354. What is a Class I, Division 2 location?
Locations in which flammable volatile liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; in which hazardous

concentrations of gases or vapors are normally prevented by positive mechanical ventilation, but which might become hazardous through failure or abnormal operation of the ventilating equipment; or which are adjacent to a Class I, Division 1 location and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure

ventilation from a source of clean air, and effective safeguards against ventilation failure are provided

355. What are Class II locations?
Locations that are hazardous because of the presence of combustible dust

356. What are Class II, Division 1 locations?
Locations in which combustible dust is, or may be, in suspension in the air continuously, intermittently, or periodically under normal operating conditions in quantities sufficient to pro- duce explosive or ignitable mixtures; where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, operation of protective devices, or from other causes; or in which dusts of an electrical conducting nature may be present

357. What are Class II, Division 2 locations?
Locations in which combustible dust won't normally be in suspension in the air or is not likely to be thrown into suspension by the normal operation of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures, but where deposits or accumulations of such dust may be sufficient to interfere with the safe dissipation of heat from electrical equipment and apparatus, or where such deposits or accumulations of dust on, in, or in the vicinity of electrical equipment might be ignited by arcs, sparks, or burning material from such equipment

358. What are Class III locations?
Locations that are hazardous because of the pressure of easily ignitable fibers or flyings, but in which such fibers or flyings are not likely to be suspended in the air in quantities sufficient to pro- duce ignitable mixtures

359. What are Class III, Division 1 locations?
Locations in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used

360. What are Class III, Division 2 locations?
Locations in which easily ignitable fibers are stored or handled, except in process or manufacture of the product

361. Where may meters, instruments, and relays is mounted in Class I, Division 1 locations?
Within enclosures approved for this location

362. Where may meters, instruments, and relays with make-and- break contacts be mounted in Class I, Division 2 locations?
Immersed in oil or hermetically sealed against vapor or gases

363. What type of wiring must be used in Class I, Division 1 areas? Rigid metal conduit (threaded), intermediate metal conduit, or Type MI cable

364. What type of fittings must be used in Class I, Division 1 areas? All boxes, fittings, and joints must be threaded. At least five full threads must be used and must be fully engaged, and all materials, including flexible connections, must be approved
(explosion-proof) by the inspecting authority for these locations

14-25 What type of wiring must be used in Class I, Division 2 areas? Threaded rigid metal conduit, threaded steel intermediate metal conduit, enclosed gasketed busways, or Type PLTC cable in accordance with the provisions of Article 725, Type MI, MC, MV, TC, or SNM cable with approved termination fittings

365. What type of fittings must be used in Class I, Division 2 areas? Only boxes, fittings, and joints that are approved for this location

366. Why is sealing needed in conduit systems and not in Type MI cable systems in Class I areas?
Seals are provided in conduit systems to minimize the pas- sage of gases, vapors, or fumes from one portion of the electrical

367. When connecting conduit to switches, circuit breakers, etc., where must seals be placed?
As close as possible to the enclosure, but not more than 18 inches away

368. When a conduit leaves a Class I, Division 1 location, where must the seal be located?
The seal must be placed at the first fitting when a conduit leaves this area; it may be on either side of the boundary

369. When a conduit leaves a Class I, Division 2 location, where must the seal be located?
The seal must be placed at the first fitting when a conduit leaves this area; it may be on either side of the boundary

370. If there is a chance that liquid will accumulate at a seal, what precautions must be taken?
An approved seal for periodic draining of any accumulation must be provided

371. What must be provided for switches, motor controllers, relays, fuses, or circuit breakers in Class I locations?
They must be provided with enclosures and must be approved for the location

372. Is grounding necessary in Class I locations?
Yes. It is highly important. All exposed noncurrent-carrying parts of equipment are required to be grounded. Locknuts and bushings are not adequate grounding; they must have bonding jumpers around them. Where flexible conduit is used as permitted, bonding jumpers must be provided around such conduit

373. Is surge protection required in Class I locations?
No, but if installed, lightning-protection devices are required on all ungrounded conductors. They must be connected ahead of the service-disconnecting means and must be bonded to the race- way at the service entrance

374. What are some of the precautions that must be taken when transformers are used in Class II, Division 1 locations?
Transformers containing a flammable liquid must be installed only in approved vaults that are constructed so that a fire cannot be communicated to the hazardous area. Transformers that don’t contain a flammable liquid must also be installed in vaults or must be enclosed in tight metal housings without ventilation

375. What type of wiring must be installed in Class II, Division 1 locations?
Rigid metal conduit (threaded), threaded steel intermediate metal conduit, or Type MI cable must be used. Boxes and fittings must have threaded bosses and tight-fitting covers and must be approved for the location

376. What type of wiring must be installed in Class II, Division 2 locations?
Rigid metal conduit, intermediate metal conduit, dust-tight wireways, electrical metallic tubing, or Type MI, MC, or SNM cable. Boxes, fittings, and joints must be made to minimize the entrance of dust

377. Is grounding and bonding necessary in Class II locations?
Yes. All exposed noncurrent-carrying parts of equipment must be grounded. Locknuts and bushings are not adequate grounding; they must use bonding jumpers

378. Is surge protection required in Class II locations?

If installed, lightning-protection devices of the proper type are required on all ungrounded conductors; they must be connected ahead of the service-disconnecting means and must be bonded to the raceway at the service entrance

379. What type of wiring is required in Class III, Division 1 locations?
Threaded rigid metal conduit, threaded steel intermediate metal conduit, or Types MI, MC, SNM; boxes and fittings must have tight-fitting covers. There must not be any screw-mounting holes within the box through which sparks might escape

380. What vehicles are included under the commercial-garages classification?
These locations include places of storage, repairing, or servicing of self-propelled vehicles, including passenger automobiles, buses, trucks, tractors, etc., in which flammable liquids or flammable gases are used for fuel or power (

381. What is a gasoline-dispensing and service station?
This includes locations where gasoline or other volatile flammable gases are transferred to the fuel tanks (including auxiliary fuel tanks) of self-propelled vehicles. Lubritoriums, service rooms, repair rooms, offices, sales-rooms, compressor rooms, and similar locations

382. What types of conductors are typically found in a set of network-powered broadband cables?
Coaxial, twisted-pair, fiber optic, and power conductors

383. What is a fault protective device?
A device for a network-powered broadband system that is designed to protect people and equipment in the case of faults in the system

16-1 Which is the primary article of the PEC governing data cabling?

16-2 When data conductors enter buildings, how far must they be kept from power drops?
A minimum of 12 inches

16-3 What is a “protector”?
A type of surge suppression device specifically designed for communication circuits

16-4 What is the minimum size of grounding conductor for communication circuits?
No. 14 AWG

16-5 Is firestopping required for data cables that pass through fire-resistant barriers?
Yes

16-7 For structured cabling, what is the horizontal distance limit between closet and desktop?
100 meters.

16-8 What is the most widely used type of data cable?
Unshielded twisted pair, also known as UTP.

16-9 Must telecommunications test equipment be listed?
No

A city block

16-11 What types of distribution circuits don't require protectors?
Underground circuits that are unlikely to contact power circuits

16-12 How far must communication circuits be separated from lightning protection conductors?
6 feet, but exceptions are made when this spacing is "impractical."

16-13 What restriction is placed on the installation path of a grounding conductor for communication circuits?
That it be run in a straight line

16-14 May a metal power service conduit serve as the grounding electrode conductor for a communication grounding system?
Yes

16-15 What part of a communications cable must be grounded?
The metallic sheath.

16-16 Where must a communications cable be grounded once it enters a building?
As close as possible to the point of entrance.

16-17 What option to grounding exists?
The interruption of the cable sheath with an insulating interrupting device.

16-18 When a protector is installed on a mobile home, what is the minimum size of conductor that it must be bonded with?
No. 12 AWG

16-19 What rating of communication cable is designed for installation in plenums?
Type CMP

16-20 What rating of communication cable is designed for installation in risers?
Type CMR

16-21 What rating of communication cable is designed for installation under carpets?
Type CMUC

16-22 May communications circuits share a raceway with a community antenna television system?
Yes

16-23 What types of communication cables may be installed in cable trays?
Types MPP, MPR, MPG, MP, CMP, CMR, CMG, and CM

16-24 What is meant by the word “premises”?
A user property on the far side of the demarcation point

16-25 How should CATV conductors be installed on power poles?
Below power conductors

16-26 What part of a coaxial cable must be grounded?
The outer conductive sheath.

16-27 What is the required clearance above a roof for a coaxial cable entering a building?
8 feet, with two exceptions.

16-28 If a grounding conductor for a coaxial system is run in metal conduit, what other requirement must be met?
Both ends of the raceway must be bonded to the grounding conductor, terminal, or electrode

16-29 What types of conductors are typically found in a set of network-powered broadband cables?
Coaxial, twisted-pair, fiber optic, and power conductors (

16-30 What is a fault protective device?

A device for a network-powered broadband system that is designed to protect people and equipment in the case of faults in the system

16-32 May network-powered broadband cables be installed with messenger wire?
Yes

16-33 What is the minimal clearance above roofs for network- powered broadband cables?
8 feet, with exceptions for garages, overhangs, and sloped roofs.

16-34 Are protectors required for network-powered broadband systems?
Yes

16-35 What is the minimum size of grounding conductor that may be used for network-powered broadband systems?
No. 14 AWG

16-36 May a power service enclosure serve as a grounding electrode for a network-powered broadband system?
Yes

16-37 If separate electrodes are used for power system grounding and for network-powered broadband grounding, what is required? The two electrodes must be bonded with a conductor of no
less than No. 6 AWG. An exception is made for bonding at mobile homes, if the mobile home is supplied with power via cord and plug, or where the mobile home has no service equipment or disconnecting means

16-38 What is the maximum permitted length for Type BLX cable?
50 feet

16-39 What types of network-powered broadband cables may be installed in plenum areas?
Type BLP. Type BLX is also acceptable, provided that it is installed according to the requirements of PEC

16-40 What are the maximum and minimum sizes of Type ITC
cable conductors?
A minimum of No. 22 AWG and a maximum of No. 12
AWG are permitted for Instrumentation Tray Cables

16-41 Why are optical fiber cables preferable to copper conductors for communications?

Because they can carry many times as many signals, with far less degradation of the signals. One pair of optical fiber cables can carry thousands of telephone conversations with better clarity and requiring far fewer amplifiers along its path.

16-42 What are the three basic parts of optical fiber cables?
The core, the cladding, and the outer covering.

16-43 What are the two most important things to remember when installing optical fiber cables?
First, that the pulling force should not be applied to the optical fiber, but to a "strength member." Second, that optical fiber cables cannot be sharply bent.

16-44 What is the most difficult operation of connecting optical fiber cables?
Terminating or splicing them. This can be a time-consuming and difficult process.

16-45 Optical fiber cables don't carry electricity. Why are they covered within the PEC?
For two reasons: first, because they are often installed with electrical cables and by the same installers; second, because they are dependent upon the electrical and electronic equipment to which they are connected.

16-46 Does the PEC cover all optical fiber installations?
No.

16-47 Can optical fiber cables be installed in cable trays?
Yes

16-48 What types of optical fiber cables are allowed in plenums? Types OFNP and OFPC. Also, if installed according to the rules of PEC, OFNR, OFCR, OFN, OFNG, OFC, and OFCG may also be installed in plenums

16-49 What does the term photovoltaic mean?
Generating electricity from light.

16-50 What is a photovoltaic cell?
A special type of semiconductor that generates a small volt- age when exposed to light, generally about one half volt.

16-51 What type of electricity do photovoltaic cells generate?
Direct current only.

16-52 What is an array?
An assembly of photovoltaic panels

16-53 Why are blocking diodes required for photovoltaic systems?

To prevent battery currents from flowing backward through the photovoltaic cells when no sunlight is present.

16-54 Do photovoltaic systems require special disconnects?
Yes. A disconnecting means must be installed that will disconnect photovoltaic conductors from all other system conductors

16-55 Can any recognized type of wiring be used for photovoltaic systems?
Yes

16-56 Must a 12-volt photovoltaic system be grounded?
No

16-57 Name two types of communications signals.
Analog and digital.

16-58 In general, what type of signal is better?
Digital; it provides a much clearer and stronger signal.

16-59 What is a protector?
Protectors are surge-suppressor-type devices. They are required for many outdoor communication circuits

16-60 What is the smallest grounding conductor that can be used for communication circuits?
No. 14 copper

16-61 What steps must be taken when communication grounding conductors are installed in metal conduit?
The metal conduit must be bonded on both ends

16-62 Should communication grounds be bonded to power system grounds?
Yes

16-63 How far must communication circuits be separated from power circuits?
At least 2 inches

16-64 In what part of the PEC would you find requirements for fire alarm systems and circuits?

16-65 What is a closed-loop system?
A special type of power distribution that is controlled jointly by signals from the controlling equipment and the utilization equipment.

16-66 What types of disconnects are required in data processing areas?
They require a disconnect for all electronic equipment in these areas. In addition, there must be another disconnect for all
HVAC equipment in these areas. These can be combined into one unit

16-67 Are ventilated underfloor areas in computer rooms exempted from the special air-handling area requirements PEC? Yes

16-69 Conductors from a television antenna to a building must be kept how far from a 120/240 electrical service?
2 feet

16-70 How far apart must supports for antenna cables be placed?
No specific distance is mentioned in the Code, just that they must be made secure

16-71 What size conductor is required to connect a communications grounding electrode and a power grounding electrode?
At least No. 6 AWG copper

16-72 Which article of the Code covers cable television systems?
Article 820 covers all such systems that are wired in coaxial cable, as almost all cable TV systems are.

16-74 How far must coaxial cables be kept from the conductors of lighting systems?
6 feet

16-75 What size conductor is required to connect a television sys- tem grounding electrode and a power grounding electrode?
At least No. 6 AWG copper

16-76 Which conductor of a coaxial cable can be grounded?
When the cable is to be grounded, it is the outer conductor that is connected to ground

16-77 What types of coaxial cables may be run as risers in a building?
Types CATVP. Types CATVR, MPP, CMP, MPR, and CMR may be used if installed according to PEC

16-80 What is the minimum size of conductor that can be used to interconnect storage batteries?
No. 2/0 AWG copper

16-81 What do the letters OFCP represent for type OFCP cable?
Optical Fiber Conductive Plenum.