Residential Wiring According to 2011 NEC (Homestudy)

Utah Electrical License

This course will cover the requirements in the 2011 NEC for installing electrical systems in dwelling units. Code sections for residential wiring installations are organized by equipment type or location in the dwelling and include: Service and Subpanels, Kitchen and Dining Rooms, Bathrooms and Laundry, Living Areas (and Bedrooms), Stairways and Hallways, Luminaires, Fans and Switches, Outdoors, Garages, Basements, and Crawl Spaces, Heating and Cooling, Swimming Pools and Spas, Generators, Limited Energy.

Course# 6029 8 Core Credit Hours $95.00

This course is currently approved by the Utah Department of Commerce Division of Occupational & Professional Licensing under course number 6029.

Completion of this continuing education course will satisfy 8.000 credit hours of course credit type 'Core' for Electrical license renewal in the state of Utah. Course credit type 'Core'. Board issued approval date: 6/12/2013. Board issued expiration date: 6/12/2015.

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Residential Wiring According to 2011 NEC (Homestudy) - UT

Service and Subpanels

Question 1: 408.36 Panelboards. Overcurrent Protection.

Question ID#: 2113.1

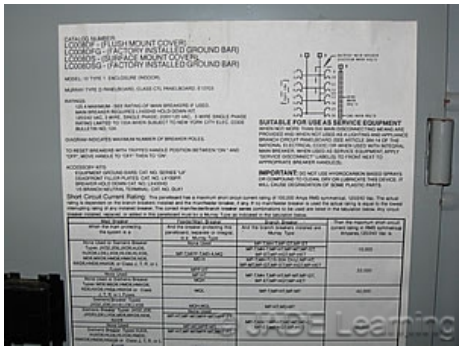
Panelboards are not limited to 42 overcurrent devices.

Panelboards must have a rating not less than the calculated load. The load is calculated according to Parts II, III, IV, or V of article 220. The rating of the panelboard cannot be less than the feeder capacity required to serve the load.

The overcurrent device that protects the panelboard cannot have a rating greater than the panelboard. The panelboard overcurrent protection can be located in the panelboard or at any point on the supply side of the panelboard.

If the overcurrent protection is in the panelboard, the situation is straightforward. A 200 amp main breaker protects a 200 amp panelboard; a 400 amp main breaker protects a 400 amp panelboard.

If the overcurrent device protecting the panelboard is on the supply side of the panelboard, the overcurrent device still cannot be greater than the rating of the panelboard. For example, a feeder protected at 200 amps could not feed two, 100 amp Main Lugs Only panelboards because the 200 amp overcurrent device protecting the feeder is greater than the rating of the 100 amp Main Lugs Only panelboards.



Overcurrent protection is determined by the rating of the panelboard.

Question 1: Which of the following is the maximum size overcurrent device permitted to protect a 3/0 THHN aluminum feeder supplying a 150-A, 3-wire, 120/240-volt, single-phase panelboard that does not include a main breaker?

A: 200-A circuit breaker.
B: 150-A circuit breaker.
C: 225-circuit breaker.
D: 175-A circuit breaker.

Question 2: 250.92 Bonding Services.

Question ID#: 2110.1

Service equipment enclosures are connected to the neutral by a main bonding jumper.

The noncurrent-carrying metal parts of service equipment must be bonded together. Conduits, enclosures, fittings, meters and boxes are bonded together so a fault at any point on the service equipment can be cleared.

Acceptable bonding methods include using threaded couplings or threaded bosses on enclosures made up wrenchtight; threadless couplings and connectors where made up tight for metal raceways; or bonding-type locknuts and bushings. Standard locknuts will not provide a bonding connection.

If metal conduit is installed between the meter enclosure and the service panel, a bonding bushing is required on one end of the conduit nipple.

A connection to the grounded conductor, called the main bonding jumper, ties all the noncurrent-carrying metal parts of the service equipment to the system neutral. The main bonding jumper is critical to the safety of the system because it is the key link between the neutral, service equipment and equipment grounding conductors. If there is a fault, the service neutral carries fault current and the main bonding jumper is the bridge to get fault current from anywhere in the system onto the neutral.

The main bonding jumper is sized according to Table 250.66, just like the grounding

electrode conductor, and is based on the size of the service entrance conductors. If the main bonding jumper is a screw, the head of the screw must be green and visible wherever the screw is installed.

Question 2: Which of the following is used as the main bonding jumper in the panel shown in the illustration?

A: The green screw.
B: The bare No. 6 copper conductor.
C: The metal strap connected to the grounded terminal strip and to the enclosure by the green screw.
D: The grounded terminal strip.

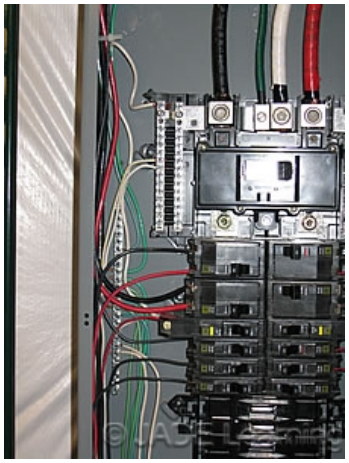
Question 3: 200.2(B) Continuity.

Question ID#: 2103.1

This section prohibits the continuity of the grounded conductor from depending on a connection to a raceway, metallic cable, or a metal enclosure. It applies to services, feeders and branch circuits. It is consistent with the effort to keep normal neutral current on grounded conductors, instead of on enclosures and raceways.

At the service, the grounded conductor is connected to the service enclosure with a wire, bus or screw. If a separate groundbar for equipment grounding conductors is installed, the service enclosure ties the equipment grounding conductor busbar to the grounded conductor busbar. Grounded, neutral conductors cannot be connected to a groundbar in such a way that the metal of the enclosure provides the pathway from a feeder or branch circuit neutral to the service neutral.

The continuity of the grounded conductor from the service equipment to the smallest branch circuit cannot depend on a connection to a metallic enclosure, raceway or cable armor.



Neutral conductor must connect to neutral terminal.

Question 3: How is the continuity of the grounded conductor permitted to be established?

A: By connecting it to a grounded metallic enclosure.
B: By connecting it to a terminal or busbar identified for connection of grounded conductors.
C: By connecting it to any type of grounded metallic raceway.
D: By connecting it to a grounded metallic Armored Cable sheath.

Question 4: 250.32(B) Ex. Buildings Supplied by Feeders or Branch Circuits. Grounded Systems.

Question ID#: 2107.1

Using a grounded conductor instead of an equipment grounding conductor to ground equipment and raceways in a separate building is permitted only for existing premises wiring systems. Any new installation must include an equipment grounding conductor.

On an existing 3-wire feeder to a second building, if the existing building disconnect is damaged or another branch circuit in the separate building is added, the old 3-wire feeder is not required to be changed.

On all new installations, an equipment grounding conductor is required to be installed with the feeder. A grounding electrode is installed at the second building and is connected to the equipment grounding conductor. On existing 3-wire installations, the grounding electrode is connected to the grounded, neutral conductor.

Equipment grounding conductor required with feeder conductors to separate buildings.

Question 4: A year after the single family home was built, a detached garage is built and wired. The garage will have a 240/120-volt sub-panel supplied by a feeder from a main panel in the house. The garage will have three 120-volt circuits and two 240-volt circuits.
Which of the following correctly describes a feeder installed in PVC conduit that supplies the garage if there is no other metal pathway between the house and the garage?

A: A 4-wire feeder with the neutral and an equipment grounding conductor with the equipment grounding conductor connected to the grounding electrode conductor at the house.
B: A 3-wire feeder with a grounded neutral used as an equipment grounding conductor without a grounding electrode being installed at the garage.
C: A 4-wire feeder including a neutral and an equipment grounding conductor, with the equipment grounding conductor connected to a grounding electrode at the garage.
D: A 3-wire feeder with a grounding electrode installed at the garage that is connected to the grounded, neutral conductor.

Question 5: 230.82 Equipment Connected to the Supply Side of Service Disconnect.

Question ID#: 2106.0

Equipment connected on the supply side of the service disconnect is limited.

For most residential services, equipment cannot be connected ahead of the service disconnect. An unlicensed person might be tempted to pull the meter and feed a new air conditioner or other load if the service panel didn't have room for additional breakers. This would be a serious violation. The installer could be cited for: (1) Breaking the seal on a utility meter, (2) Possibly overloading the service conductors, (3) Running unprotected service wires inside a building with no disconnecting means, (4) Violating the 1 wire per terminal rule, (5) Improper grounding, and a number of other important Code requirements.

Some equipment, like meter disconnects, can be connected to the supply side of the service. Also, taps ahead of the service disconnect are allowed to feed energy management and load control devices. Standby generator or secondary power sources can be connected upstream from the service disconnect if the equipment is suitable for use as service equipment and the conductors feeding the equipment are treated as service conductors.

Question 5: Which of the following statements about equipment connected to the supply side of the service disconnect is TRUE?

A: Devices with their own internal fuses or circuit breakers are permitted to be connected ahead of the service overcurrent protection.
B: Nothing is permitted to be connected ahead of the service overcurrent devices.
C: Meter disconnects that have all of their metal housings grounded are permitted to be connected on the supply side of the service.
D: Equipment is permitted to be connected on the supply side of the service overcurrent devices if the added load does not overload the service conductors.

Question 6: 250.66 Sizing Grounding Electrodes.

Question ID#: 2109.0

The size of the grounding electrode conductor connection to the water pipe is selected from Table 250.66. This table is based on the size of the service conductors. Service conductors for a 200 amp service are 2/0 copper or 4/0 aluminum, and would require a #4 copper grounding electrode conductor.

According to this section, if the grounding electrode conductor is the sole connection to a driven ground rod, the grounding electrode conductor is not required to be bigger than No. 6 copper or No. 4 aluminum. Likewise, any connection to a concrete-encased electrode, such as 1/2 in. rebar, does not need to be larger than No. 4 copper.

The reason for these limits is that the purpose of the grounding electrode conductor is not to carry fault current. The job of the grounding electrode conductor is to connect the non-current carrying parts of the electrical system to the earth and keep the potential on enclosures and conduit to 0 volts. The grounding electrode conductor does not have to be sized to carry large amounts of fault current to establish the ground reference. The grounding electrode conductor to an 8 ft. ground rod will not see much ground fault current anyway. The resistance of a ground rod will be much higher than the resistance of the water pipe system, and the fault current will be lower.

Grounding electrode conductors are sized according to table 250.66.

Question 6: The purpose of a grounding electrode conductor is to:

A: Shunt the fault current to ground.
B: Carry fault current.
C: Create a high resistance path for fault current.
D: Keep electrical enclosures at 0 volts.

Question 7: 250.52 Grounding Electrodes.

Question ID#: 2108.0

Metallic water line where 10 ft. or more is in contact with the earth is a grounding electrode.

Grounding electrodes can be any of the following: metal underground water pipe, including any metal well casing bonded to the pipe, metal frame of the building, concrete-encased electrode (rebar, also called ufer), a ground ring, rod and pipe electrodes, or other local metal underground systems or structures. A connection to the rebar is required if it is present in the foundation or footer. If more than one of these electrodes is present at the dwelling, all the grounding electrodes must be bonded together to form the grounding electrode system.

The connection to the metal water pipe must be made within 5 ft. of where the pipe enters the building or structure. The water pipe must also be in direct contact with the earth for 10 ft. or more. Jumpers must be installed around any water meters in the water line. Plumbers often use plastic pipe to repair copper pipe so a grounding connection close to where the metal pipe enters the dwelling helps to insure the continuity of the grounding electrode.

A metal water pipe used as a grounding electrode must have at least one additional electrode, called a supplemental electrode. Probably because of the danger of losing the grounding connection if the pipe gets cut, metal water pipes cannot be the sole grounding electrode. The second grounding electrode is usually a driven ground rod, but it can be any of the electrodes listed in 250.52(A).

Question 7: When more than one grounding electrode is used:

A: They must be either copper or aluminum.
B: They must be copper.
C: They must be in contact with the earth for 10 ft. or more.
D: They must be electrically connected to form a grounding electrode system.

Question 8: 110.12 Protecting Equipment During Construction. Busbars.

Question ID#: 2102.1

Panelboard interior must be protected during construction.

The integrity of electrical connections must be protected. In the past, the interiors of panelboards were regularly painted with overspray that contaminated the busbar area. If there was heavy overspray, the result would be poor or no electrical connection. This caused either overheating of the bus or voltage drop on circuits fed from the panelboard.

Trying to clean panelboard busbars doesn't work either. Steel brushes or corrosive chemicals will damage the bus finish. Other chemicals used for cleaning may not damage the bus itself, but can damage the plastic non-conductive portions of the panelboard which provide electrical insulation or circuit breaker support. Section 110.12(B) requires the internal parts of electrical equipment to be protected from the kinds of damage that can occur during construction and could prevent the safe operation of the equipment once the building is complete.

Question 8: If the busbars in a panelboard are accidentally spray-painted, which of the following is permitted by the NEC?

A: Removing the paint with an abrasive like a wire brush or sandpaper.
B: Replacing the damaged panelboard with a new undamaged panelboard.
C: Removing the paint with solvent.
D: Removing water based paint with soap and water.

Question 9: 408.4 Circuit Directory or Circuit Identification.

Question ID#: 2114.1

Circuits in panelboards must be specifically marked - unused breakers must be marked spare.

In a switchboard or panelboard a spare position that contains an unused overcurrent device must be identified. Also, no circuit can be described in a manner that depends on transient occupancy.

An unused circuit breaker in a panelboard is considered a spare. On the circuit directory it should be identified as "spare." If there is no overcurrent device in an empty panelboard space, then it is not required to be identified on the circuit directory, but the space would have to be covered.

An example of an incorrect circuit label is "Billy's Bedroom" or "Joe's Sandwich Shop." Billy's family might move and another tenant might take over the sandwich shop. The new residents or tenants wouldn't know how the circuits were identified. No circuit can be described in a way that depends on knowing the occupants of the premises.

Question 9: Which of the following does NOT have to be labeled in a circuit directory of a panelboard in a single family dwelling?

A: A 15-A, single pole circuit breaker for exterior lighting.
B: An unused space on the panelboard.
C: A spare 20-A, double pole circuit breaker.
D: A spare 15-A, single pole circuit breaker.

Question 10: 230.70(A)(1) Readily Accessible Location of Service Disconnects.

Question ID#: 2105.1

Every service must have a disconnecting means, and the disconnecting means must be in a readily accessible location. From Article 100 Definitions, a readily accessible location is a location which can be reached quickly for operation and does not require a person to climb over obstacles or use a ladder.

The readily accessible location may be outside a building or structure, or inside nearest the point of entrance of the service conductors. If the service disconnect is outside the building, it can be anywhere. It can be right next to the meter or it can be on the other side of the house. There are no restrictions about how far unfused service wires can be run on the outside of a building.

Once the service conductors are run from the utility meter into the building, however, the disconnect must be located nearest the point where the conductors enter the building. The service wires from the meter are not protected by fuses or circuit breakers. If there is a problem on an unfused wire, it is much more serious than if there was overcurrent protection ahead of the wire.

To reduce the danger of having unfused wires inside the house, the Code insists they be kept as short as possible. "Nearest the point of entrance of the service conductors" means different things in different jurisdictions. In some places it means the utility meter and service panel must be back-to-back, or at most one stud bay over. In other locations the service panel can be more remote from the point of entrance.

Service disconnects must be located nearest the point of entrance.

Question 10: If the utility meter is located on the exterior of a building and the service equipment is installed inside the building, what is the maximum length of unfused service conductors within the building permitted by the NEC?

A: 15 feet.
B: The NEC does not specify a maximum length.
C: 10 feet.
D: 6 feet.

Question 11: 310.15(B)(7) Single Phase Services and Feeders.

Question ID#: 2112.0

Table 310.15(B)(7) allows smaller conductors for dwelling unit service and main power feeder conductors than Table 310.15(B)(16).

Dwelling units have greater load diversity than other occupancies because fewer loads are on at the same time. Because of this load diversity, Table 310.15(B)(7) permits service conductors and main power feeders to panelboards supplying loads in dwellings to be smaller than would be permitted by table 310.15(B)(16).

The definition of a main power feeder is: "the feeder between the main disconnect and the panelboard that supplies, either by branch circuits, or by feeders, or both, all loads that are part of or associated with the dwelling unit."

For example, if a service disconnect is mounted on the outside of a dwelling and a feeder supplies a single sub-panel inside the house, the feeder is a "main power feeder" and Table 310.15(B)(7) could be used to size the feeder. If additional subpanels were supplied from the first sub-panel, the feeder from the service to the first subpanel is still the "main power feeder." If two subpanels inside the house were fed from the outside service disconnect neither one of them is a "main power feeder."

A "main power feeder" must supply all the loads in the dwelling or all the loads which are associated with the dwelling. If associated loads from the dwelling are fed from the main panel, and not from a subpanel, then the feeder from the main panel to the subpanel is not the "main power feeder." The authority having jurisdiction will determine which loads are associated with the dwelling.

Question 11: Which of the following 100 amp loads is permitted to be supplied by a #4 CU THW feeder selected from Table 310.15 (B)(7)?

A: A 100-A panelboard that supplies all but the heating and cooling loads in a dwelling unit.
B: A 100-A panelboard that supplies all of the loads in a dwelling unit.
C: A 100-A subpanel in a detached garage at a dwelling unit.
D: A 100-A fused disconnect for an electric furnace.

Question 12: 250.104(B) Bonding Gas Piping.

Question ID#: 2111.1

Gas pipe bonding has been a very controversial electrical issue. In the past, gas piping was thought to be sufficiently bonded if a gas appliance was connected to a 15 ampere circuit with a 14 gauge equipment grounding conductor. This is no longer the case because of a lawsuit that claimed lightning caused holes in corrugated stainless steel tubing, and the leaking gas resulted in a house fire.

Everyone then began to rethink gas pipe bonding, referring back to the gas pipe manufacturers' instructions. The problem is that there are several brands of this type of gas tubing and the manufacturers have different ideas about gas pipe bonding. There has yet to be a consistent industry-wide consensus of what should be done about gas pipe bonding. Section 250.104(B) refers us to use Table 250.122 to select the size of the bonding jumper for gas piping.

Gas pipe bonding jumper sized according to circuit likely to energize it.

Question 12: A 20 amp circuit supplies electrical power to a gas furnace for its controls and for the blower motor. Copper tubing is used to supply natural gas to the furnace. What is the minimum size copper conductor required for a bonding jumper to bond the copper tubing to the service's grounding system?

A: No. 12 AWG.
B: No. 14 AWG.
C: No. 10 AWG.
D: No. 8 AWG.

Question 13: 230.24 Clearance of Overhead Conductors.

Question ID#: 2104.1

Clearance must be maintained where the overhead service conductors cross over grade or roofs.

Service conductors must maintain clearances above roofs and from grade. If the service mast passes through the roof, service conductors can be no closer than 18 in. from the overhanging portion of the roof, measured from the bottom of the drip loop. In order to qualify for this reduced clearance, the voltage between conductors is limited to 300 volts and not more than 6 ft. of service drop conductors can pass above the roof overhang [230.24(A) Ex. No.3].

Clearances from ground vary according to the voltage between conductors and the type of property the service conductors pass over. Service conductors that pass over streets and alleys that have truck traffic must always have 18 ft. clearance from ground.

If the service to a dwelling is 120/240 volts, single-phase, then the voltage to ground is less than 150 volts. Therefore the minimum clearance of 10 ft. from ground is measured from the bottom of the drip loop to final grade.

Question 13: If the service mast for a 240/120-volt service passes through a roof, and 6 feet or less of the service conductors pass over the roof, what is the minimum distance permitted between the service conductors and the overhanging portion of the roof?

A: 3 feet.
B: 8 feet.
C: 6 feet.

D: 18 inches.

Question 14: 408.54 Maximum Number of Overcurrent Devices.

Question ID#: 2115.1

Panelboards must now be manufactured so that they physically limit the number of circuit breakers which can be installed. The number of circuit breakers installed in any panel cannot be greater than the number listed for that panelboard. A 2-pole circuit breaker is considered as 2 devices and a 3-pole circuit breaker is considered 3 devices.

Panelboards may be listed to have more than 42 overcurrent devices. A 60 circuit panelboard must be manufactured to accept no more than 60 circuit breakers. A 42 circuit panelboard must prevent more than 42 circuit breakers from being installed.

To comply with this requirement, manufacturers will have to design panels so that tandem breakers cannot be installed in a panel if their installation would exceed the number of OCPDs for which the panel was listed.

Number of breakers in a panelboard now determined by manufacturer.

Question 14: According to the 2011 NEC, panelboards are required to be designed so that it is impossible to install more breakers than the panel is rated to hold.
Assume that a panelboard rated for 12 breakers has 11 single pole circuit breakers installed in it. If it were physically possible to install a tandem (side by side) breaker in the panel, what is the maximum number of tandem breakers that the NEC permits to be added to the 11 breakers already in the panelboard?

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

Kitchen, Pantry and Dining Rooms

Question 15: 210.52(C)(5) Receptacles Below the Countertop. Exception.

Question ID#: 2123.1

Outlets installed below a countertop are dangerous. They are permitted under special circumstances, but a cord hanging over the edge of a counter and plugged into a receptacle below the counter is a hazard, especially for small children who could pull on the cord and be injured by falling appliances or boiling liquids.

Receptacles can be installed below a countertop only if:

- They are mounted no more than 12 in. below the counter
- The countertop cannot have more than a 6 in. overhang from the support base
- There is no other place on the countertop, like a backsplash or underneath a hanging cabinet, to install a receptacle
- The kitchen will be used by physically impaired individuals

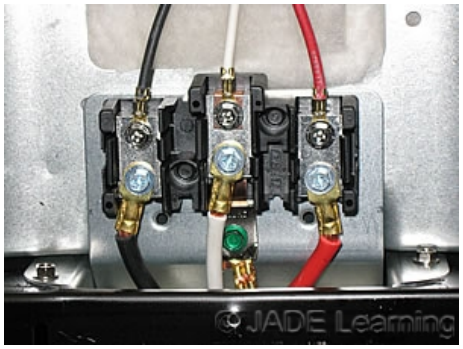
Required outlets shall be mounted not more than 12 in. below the countertop.

Question 15: In a kitchen, an island countertop without a backsplash has an overhang that extends 6 inches beyond the supporting base.
If the countertop is a single unbroken space, which of the following complies with the NEC requirements?

A: One receptacle mounted on the supporting base 14 inches below the countertop.
B: One receptacle mounted on an overhanging cabinet 24 inches above the countertop.
C: One receptacle mounted on the supporting base 6 inches below the countertop.
D: Since the kitchen was not designated as being for a physically impaired individual, no and receptacle is required.

Question 16: 250.142(B) Grounding Frames of Ranges.

Question ID#: 2124.0



Frames of Ranges are allowed to be grounded to the neutral in existing installations.

In an existing installation, a range can be installed with a 3-wire cord and plug. In new construction, all installations of ranges and dryers must use a 4-wire system where the 4th wire is an equipment grounding conductor.

In older installations, with a 3-wire cord and plug, the neutral does double duty. It is the return conductor for 120-volt range loads (clock and timer) and a grounding conductor at the same time. If there was a ground fault on the range, the neutral would act as an equipment ground and carry ground fault current.

Allowing the neutral conductor to carry fault current and serve 120-volt loads at the same time is only permitted in existing situations, not for installations in new construction.

Question 16: Which of the following is a TRUE statement about grounding the frames of ranges?

A: In an existing dwelling, if a homeowner replaces an older range that has a 3-wire plug with a new range that has a 4-wire plug and cord, you must replace the 3-wire receptacle with a 4-wire receptacle.
B: In new construction, new appliances are permitted to use the neutral as a grounding conductor.
C: In new construction, the neutral conductor is allowed to ground the frame of a range in a new installation.
D: In a new construction, if the manufacturer has installed a bonding jumper that connects the frame of the range to the grounded, neutral conductor the bonding jumper must be removed.

Question 17: 422.16(B) Kitchen Appliances Connected by Cord and Plug.

Question ID#: 2125.0

Kitchen appliances, like trash compactors, waste disposals and dishwashers, may be cord and plug connected. The plug must be the grounding type, unless the appliance is listed as having double insulation.

The cord for a waste disposal must be at least 18 in. long and for dishwashers and trash compactors the cord must be between 3 ft. and 4 ft.

The receptacle for the appliances has to be located so the cord will not be damaged when the appliance is fully installed. Also, the receptacle must be accessible.

In Article 100, accessible is defined as: "Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of a building." This is different than ***readily*** accessible, which means capable of being reached quickly without removing obstacles. So, a receptacle installed behind a dishwasher is OK because the dishwasher can be removed to service the cord or receptacle.

Some kitchen appliances may be cord and plug connected.

Question 17: The National Electrical Code requires dishwashers that are cord and plug connected to be installed:

A: On one of the kitchen small appliance circuits.
B: On a dedicated circuit.
C: So that the receptacle is accessible.
D: With a cord that is a minimum of 18 in.

Question 18: 210.52(B) Small Appliance Circuits.

Question ID#: 2117.0

At least two small appliance circuits are required in dwellings to supply receptacle outlets in the kitchen, pantry, breakfast room, or dining room. Both of the required circuits must serve the kitchen countertop outlets. All small appliance circuit outlets that serve the countertop must be GFCI protected. Additional small appliance circuits may be added if necessary.

Minimum of two small appliance circuits are required in dwellings.

Although the Code allows the 2 small appliance circuits to serve outlets in the areas mentioned above, many contractors limit the appliance circuits to kitchen countertop outlets. Wall outlets are required in the kitchen, just like any other area of the house. The 2 small appliance circuits cannot feed outlets in areas other than the kitchen, pantry, breakfast room or dining room. The small appliance circuits cannot feed outdoor receptacle outlets.

Two exceptions to 210.52(B)(2) will allow the small appliance circuits to feed an electric wall clock and a gas range in the kitchen that needs electricity to ignite the gas burner.

Question 18: Which of the following loads could NOT be served by the 2 small appliance circuits?

A: An electric frying pan plugged into an outlet in the dining room.
B: A wall clock.
C: A coffee pot plugged into a kitchen countertop receptacle.
D: A convenience outlet on a patio.

Question 19: 210.52(C)(2)&(3) Island and Peninsular Counter Spaces.

Question ID#: 2122.1

Island and peninsular counter tops require only one outlet.

Island counter spaces have different requirements than wall counter spaces. A single outlet must be installed if the island counter is at least 24 in. long and 12 in. or greater wide. But the 24 in. spacing that is required for wall counter spaces does not apply to island countertops. In other words, if the island counter was 48 in. x 48 in., only 1 receptacle outlet would be necessary, as long as the countertop was considered a single space.

The same is true for peninsular counters. A peninsular counter is a counter with access to both sides, like a breakfast bar. If the peninsular counter has a long dimension of 24 in. and a short dimension of 12 in. or greater, a receptacle outlet is required. The measurement is made from the connecting edge with the wall or other counter space. Of course, more outlets can be installed if desired.

Question 19: If it is unbroken by a sink, rangetop, or refrigerator, what is the minimum number of receptacles required for an island countertop that measures 24 inches wide and 6 feet long?

A: 1.
B: 4.
C: 2.
D: 3.

Question 20: 210.52(C)(1) Receptacles Behind Sink.

Question ID#: 2121.1

The countertop space directly behind a range, counter-mounted cooking unit or sink may require a receptacle. Whether or not a receptacle outlet is necessary depends on the distance from the sink, range or cooktop to the wall above the countertop.

If a sink is mounted in a corner, then no outlet is required if the space from the back edge of the sink to the wall is less than 18 in. If a sink, range, or cooktop is mounted parallel to the countertop wall, then no receptacle outlet is required if the distance to the wall is less than 12 in.

Outlet is not required behind a sink where the space is less than 18 in.

Figure 210.52(C)(1) shows these dimensions, and a receptacle outlet is required if the space behind the sink, range or cooktop is greater than what is shown in the drawing.

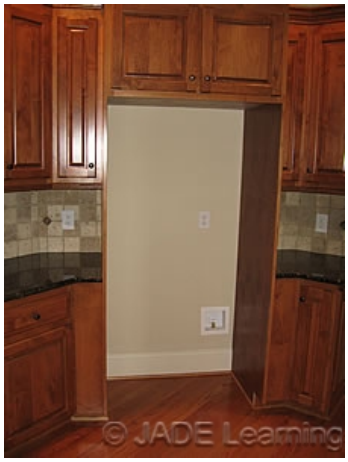
If a countertop appliance was placed behind the sink and there was not an outlet, then the appliance cord could possibly stretch across the sink or stove.

Question 20: A kitchen has a countertop that measures 3 1/2 feet wide by 8 feet long. If a 36 inch long rangetop is installed in the center of the counter so that there is 12 inches between the back of the rangetop and the wall, how many receptacles are required for the countertop?

A: 2.
B: 4.
C: 1.
D: 3.

Question 21: 210.52(B)(1) Refrigerator Circuit. Exception No. 2.

Question ID#: 2118.0



Refrigerator not required to be included on the small appliance circuit.

The refrigerator is allowed to be supplied from the 2 small appliance circuits. It may seem odd that refrigerators are permitted while outdoor outlets and other locations are not allowed on the small appliance circuits. Many large refrigerators draw more current than most equipment plugged into an outdoor outlet.

Exception No. 2 makes it clear the refrigerator is not required to be installed on the small appliance circuits. "The receptacle outlet for refrigeration equipment shall be permitted to be supplied from an individual branch circuit rated 15 amperes or greater."

How to feed the refrigerator outlet is left up to the installing electrician. The Code allows the refrigerator to be part of the small appliance circuits or connected by an individual branch circuit of 15 amps or greater. Many electrical contractors feed the refrigerator from a dedicated circuit.

Question 21: The receptacle outlet for a refrigerator:

A: Must be installed as an individual branch circuit.
B: Must be installed on the small appliance circuit.
C: Must be connected to a 15 amp circuit.
D: May be installed on a small appliance circuit.

Question 22: 210.52(C)(1) Spacing of Countertop Receptacles.

Question ID#: 2120.1

No point along the wall line can exceed 24 in. measured horizontally from a receptacle outlet.

The photograph of the kitchen countertop receptacle shows a Code violation. To avoid this mistake in the future, the installer needs to: (1) know the Code requirement to install a receptacle outlet so that an appliance sitting on the countertop with a 2 ft. cord will reach the outlet; (2) have the ability to properly scale drawings; and (3) communicate with the cabinet builders for any changes in the drawings.

It is best to have the cabinet builder draw out the actual cabinet design on the kitchen floor because the typical 1/4 in. per foot scale on the drawing is too tight a tolerance for the close kitchen layout. It is better to add an extra receptacle than to guess at the scale minimum. The location of framing members also affects receptacle layout; and, installing receptacles on studs regardless of their location relative to cutouts in the countertop may cause the receptacles to be spaced too far apart. In such cases, you may have to add studs or framing members to allow correct placement of receptacles.

Question 22: What is the minimum number of receptacles required for a countertop that is 5 feet long?

A: 4.
B: 1.
C: 2.
D: 3.

Question 23: 210.52(C) Countertops.

Question ID#: 2119.1

The outlets required by 210.52(C) apply to countertops in pantries, breakfast rooms and similar areas in dwelling units as well as in kitchens and dining rooms. The same rules for countertop receptacles that apply to ranges and sinks apply to countertop cooking units as well.

Also, on an island or peninsula countertop, the space on either side of a cooking unit, range or sink is to be considered a separate countertop if the width of the countertop behind the cooking unit, range, or sink is less than 12 inches.

At least one receptacle outlet shall be installed at each island or peninsula countertop space with a long dimension of 24 in. or greater and a short dimension of 12 in. or greater.

Receptacle spacing for countertops.

Question 23: An island countertop in a kitchen is 6 feet long and 3 feet wide. If a 33 inch long sink is installed in the center of the countertop, what is the minimum number of receptacles required for the island?

A: 3.
B: 1.
C: 4.
D: 2.

Bathrooms and Laundry

Question 24: 410.10(D) Bathtub and Shower Areas.

Question ID#: 2130.1

The space up to 8 ft. above a bathtub or shower is either a damp or wet location.

"Luminaires located within the actual outside dimensions of the bathtub or shower to a height of 8 ft." above the bathtub rim or shower threshold shall be marked for damp locations, or if subject to shower spray, they are required to be marked for wet locations. It would be unusual for a luminary recessed in the ceiling over a shower to be subject to shower spray; if it is not subject to spray, it is only required to be marked for a damp location. However, if it were wall mounted in ceramic tile where it was likely to be subject to shower spray, it has to be marked for a wet location.

No cord-connected luminaires, lighting track, pendants or ceiling-suspended paddle fans can be located within a zone which includes the space inside the tub or shower and extends 3 ft. horizontally from the rim of the tub or shower threshold and 8 ft. vertically above it.

Question 24: A bathtub is located in a bathroom with an 8 foot ceiling. A luminaire is installed above the bathtub. The distance between the top rim of the tub and the ceiling is 7 feet 4 inches. Which of the following types of luminaires is permitted to be installed above the tub?

A: A track and track light listed for a wet location.
B: A cord connected luminaire suspended by a chain.
C: A recessed luminaire listed for a wet location.
D: A recessed luminaire listed for a dry location.

Question 25: 210.52(D) Receptacle Below the Basin Cabinet.

Question ID#: 2129.1

At least one receptacle outlet must be installed in bathrooms within 3 ft. of the outside edge of each basin. The receptacle outlet can be installed on the wall behind or next to the basin. If space is limited, the receptacle outlet can be installed on the side of a cabinet below the countertop level, as long as it is not more than 12 in. below the countertop.

Mounting receptacles in small bathrooms with limited space can be challenging. Being able to mount a receptacle in the side of the basin cabinet adds flexibility when no other options are available because of the placement of the bathroom mirror or tub.

Outlets in the bathroom to be installed within 3 ft. of basin.

Question 25: A large bathroom has two sinks (basins) installed in the countertop of a single bathroom cabinet. The distance between the outside edges of the two sinks measured at the closest point is 5 1/2 feet.
What is the minimum number of GFCI protected receptacles permitted for the bathroom?

A: 2.
B: 4.
C: 1.
D: 3.

Question 26: 210.11(C)(2) Laundry Branch Circuit.

Question ID#: 2127.1

The dedicated laundry circuit is for loads in the laundry area. The required 20 ampere branch circuit is not just for the washing machine. It is for the laundry receptacle outlet(s).

The 20 ampere branch circuit for the laundry can provide power to the washer outlet and a general purpose outlet in the laundry room and still meet the requirements of the code. The additional outlet is often used to provide power for ironing.

If there is a sink in the laundry area, any receptacle outlet within 6 ft. of the sink, including the outlet for the washing machine, must be GFCI protected.

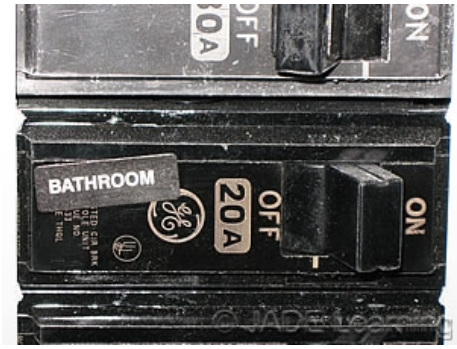
The 20 amp laundry circuit can have more than one outlet.

Question 26: Which of the following statements about the required laundry branch circuit is true?

A: The 20 amp laundry branch circuit is permitted to supply all receptacles and lighting outlets in the designated laundry area.
B: The laundry branch circuit is permitted to supply only one receptacle in the designated laundry area.
C: The laundry branch circuit is only permitted to supply receptacle outlets in the designated laundry area.
D: A 15 amp laundry branch circuit is permitted to supply all receptacles in the designated laundry area.

Question 27: 210.11(C)(3) Bathroom Branch Circuits.

Question ID#: 2128.1



A dedicated 20 amp branch circuit required for bathroom outlet(s).

A 20 amp circuit is required to supply the bathroom receptacle outlets. If other outlets in the same bathroom are connected to the 20 amp circuit, the circuit cannot leave the bathroom. However, if only receptacle outlets are served, then the 20 amp circuit can be run to additional bathrooms in the house.

For example, if a 20 amp circuit feeds the receptacles in the master bathroom and also supplies a light fixture and fan in that bathroom, the circuit is not permitted to supply receptacles or other outlets in another bathroom. However, if only the receptacle outlets in the master bathroom are connected to the 20 amp circuit , the circuit can be extended to other bathrooms throughout the house provided it only supplies receptacles outlets in the other bathrooms.

Appliances used in the bathroom like hair dryers and curling irons can draw a lot of current. A 1500 watt hair dryer operating at 120 volts will draw 12.5 amps. If two of them are being used at the same time in different bathrooms and are wired on the same circuit, a 20 amp breaker should trip.

Question 27: What is the minimum number of circuits required to comply with the NEC requirements for a single family dwelling with 2 1/2 bathrooms if in each of the 3 bathrooms the circuit that supplies the receptacle in that bathroom, also supplies the lights and vent fan in that bathroom?

A: 3.
B: 2.
C: 1.
D: 4.

Living Areas (and Bedrooms)

Question 28: Fire Alarm Code: Smoke Detectors.

Question ID#: 2132.0

NFPA 72 requires smoke detectors in dwellings.

The Fire Alarm Code, NFPA 72, requires smoke detectors to be installed inside of every sleeping room, outside of each sleeping area, in the immediate vicinity of the sleeping rooms, and on each additional story of a dwelling unit, including basements.

Smoke detectors must be powered by the building wiring and interconnected so that if one alarm goes off, all alarms will sound. Smoke alarms must be battery-backed in case the normal source of power fails. In general, arc fault protection is required for smoke or fire alarm outlets in bedrooms.

However, according to 210.12(A) Ex. 3 in the NEC, if the individual branch circuit to a fire alarm system is installed in rigid or intermediate metal conduit, electrical metalllic tubing, Type AC or Type MC cable, then the branch circuit to the fire alarm system does not require AFCI protection.

Question 28: A two-story dwelling unit without a basement has a master bedroom on the first floor and 3 bedrooms located closely together on the second floor. How many smoke detectors are required?

A: 6.
B: 7.
C: 5.
D: 4.

Question 29: 406.12 Tamper Resistant Receptacles.

Question ID#: 2137.0

In dwelling units, every kitchen, family room, dining room, living room, parlor, library, den, sunroom, bedroom, recreation room, bathroom, garage, basement, laundry and outdoor area, all 125-volt, 15- and 20-ampere receptacles shall be listed tamper resistant.

Tamper resistant receptacles are designed to prevent a child from being injured by inserting a foreign object into the receptacle. Manufacturers use several different techniques to make their receptacles tamperproof. Many children have been shocked and badly burned by sticking keys, hair pins and other objects into receptacles.

There are four exceptions that will not require tamper resistant receptacles. Tamper resistant GFCI receptacles are available.

Receptacles installed in dwellings must be listed tamper resistant.

Question 29: Which location requires tamper resistant receptacles?

A: A hotel lobby.
B: A bathroom in a public library.
C: A commercial garage.
D: A bedroom in an apartment.

Question 30: 210.12(B) AFCI. Dwelling Units.

Question ID#: 2133.1

Arc-fault circuit interruption protection is required for all 120-volt, single phase, 15- and 20 ampere branch circuits installed in most areas of dwelling units. A combination AFCI device, which provides protection from series and parallel arcs, must be installed.

Arc-fault circuit interrupter protection is required in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sun rooms, recreation rooms, closets, hallways, or similar rooms or areas.

AFCIs are not required in bathrooms, kitchens, laundry rooms, unfinished basements, garages, attics or outdoors.

More than 20,000,000 arc-fault circuit interrupter devices have been installed to protect branch circuits in residential bedrooms since they were first required in 2005. The electrical loads in the other areas of a house where AFCIs are now required are similar to the electrical loads in a bedroom. Bathroom, kitchen, garage and outdoor receptacle outlets supply different types of electrical loads. AFCI protection is not required in areas of a home where electrical loads may have different characteristics than bedroom loads. AFCI protection is only required in those areas of a dwelling with the types of loads that have a proven track record of being compatible with AFCI protection.

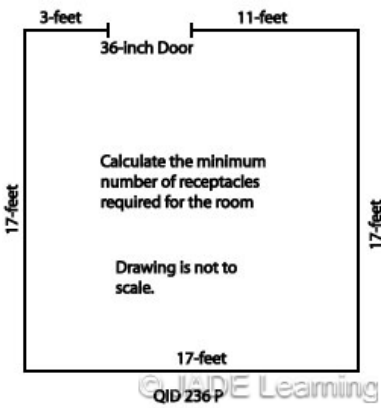
Combination type AFCI required in most rooms in a dwelling.

Question 30: Which of the following statements about requirements for AFCI protection in dwelling units built under the 2011 NEC is correct?

A: AFCI protection is only required for receptacles in bedrooms.
B: AFCI protection is not required for GFCI protected circuits in bathrooms.
C: AFCI protection is only required for receptacles and lighting circuits in bedrooms.
D: AFCI protection is required for all 120 and 240 volt circuits in a dwelling.

Question 31: 210.52(A)(1) Spacing of Receptacles.

Question ID#: 2136.1



No point in any wall space can be more than 6 ft from a receptacle.

"Receptacles shall be installed such that no point measured horizontally along the floor line in any wall space is more than 6 ft. from a receptacle outlet."

Most electrical appliances and standing light fixtures have 6 ft. cords. The reason for the 6 ft. receptacle spacing requirement is to allow them to reach an outlet without using an extension cord. Extension cords are a tripping hazard and the cause of many electrical home fires. Receptacle outlets are placed 12 ft. apart so that no space between the receptacles is more than 6 ft. from an outlet.

Receptacle outlets are required in any wall space which is 2 ft. or more in width and unbroken at the floor line by doorways or other openings. Fixed room dividers, like bar-type counters, are considered wall space and require receptacle outlets just like walls.

Question 31: A living room has an unbroken wall space that is 24 feet long. There is a door at one end of the wall and a fireplace that breaks the wall at the floor line at the opposite end of the wall.
What is the minimum number of general purpose receptacles required for the wall?

A: 4.
B: 3.
C: 1.
D: 2.

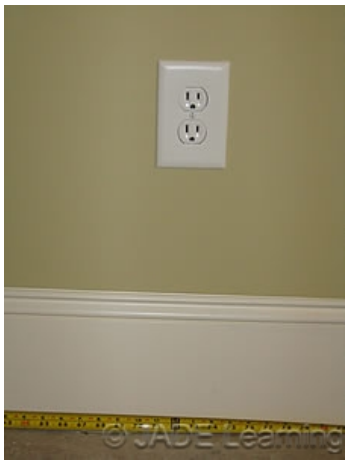
Question 32: 210.52 Dwelling Unit Receptacle Outlets.

Question ID#: 2135.1

A duplex receptacle where both receptacles are switched is not permitted to be counted as one of the required receptacle outlets in 210.52.

A switched receptacle outlet can be used instead of a lighting outlet in dwelling unit habitable rooms, except kitchens and bathrooms, according to 210.70(A)(1) Ex. No. 1. A switch controlled luminaire on an end table next to a chair or sofa is a common application for a switched receptacle.

If a duplex receptacle is a split receptacle, where one of the outlets is switched and the other is not, then the un-switched outlet can count as a required dwelling unit receptacle. Receptacles in dwelling units must be placed so that no space along the floor line is more than 6 ft. from a receptacle outlet.



A switched receptacle is not allowed as a required receptacle.

Question 32: In a single family dwelling, switched receptacles are permitted to be used as the only switch controlled lighting outlet in which of the following rooms?

A: A kitchen.
B: A guest bedroom.
C: A master bathroom.
D: A half bathroom for guests.

Question 33: 210.12(A) AFCI Protection. Exception No. 1.

Question ID#: 2134.0

AFCI device can be installed at first outlet.

In locations where arc-fault protection is required in dwelling units, the entire branch circuit must be protected. That means all the branch circuit wiring from the panelboard to the last outlet on the circuit must be protected because any of that wiring is subject to arcing faults.

Exception No. 1 permits a combination type AFCI device to be installed as the first outlet in the branch circuit, which provides protection for the remaining portion of the branch circuit. This leaves the home run wiring between the panelboard and the first outlet without AFCI protection. If Exception No. 1 is used the home run wiring must be installed in RMC, IMC, EMT, Type MC, or steel armored Type AC cables meeting the requirements of 250.118. Metal boxes are also required.

A combination AFCI device can be installed as the first outlet on the branch circuit at any distance from the panelboard as long as the homerun is installed in one of the metallic wiring methods described in the exception.

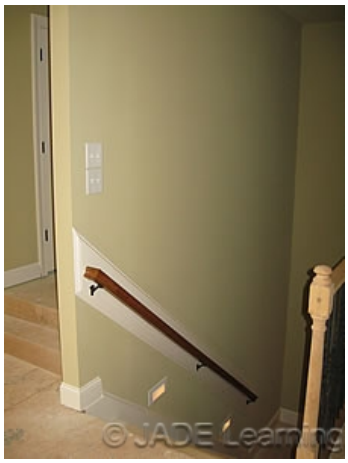
Question 33: When installed in a new dwelling, an AFCI device can be installed as the first outlet in the branch circuit, rather than as a circuit breaker in the panelboard, if:

A: The homerun is installed in EMT and the AFCI receptacle is installed in a metal box.
B: The entire branch circuit is installed in a metallic raceway.
C: The AFCI device is located within 6 ft. of the panelboard.
D: The homerun is installed in flexible metal conduit.

Stairways and Hallways

Question 34: 210.70(A)(2) Switches on Stairways.

Question ID#: 2140.1



Interior stairways with six or more risers must have a switch at top and bottom.

In interior stairways between floor levels with six or more stair risers, a switch is required at the top and bottom of the stairs. A switch is also required on any stairway landing that has an entry where someone can walk out onto the landing.

The 3-way switch required at each end of an interior stairway is in the Code to prevent travel up or down an unlit set of stairs. Climbing up or down stairs in the dark is an obvious tripping hazard. In multi-level, cut-up home designs, modern stairways have become more complex. A set of stairs may go up to a landing and have two entryways on the same landing before proceeding to the next floor level. Therefore, it is important to note that landings with a doorway are required to have a switch for the lighting outlet.

Question 34: The stairway in a three story townhouse goes from the foyer on the first floor up to a landing at the 2nd floor and then continues from the landing up to the 3rd floor. Two doors enter the landing on the 2nd floor. What is the minimum number of switches required for the stairway?

A: 2.
B: 1.
C: 3.
D: 4.

Question 35: 210.52(H) Receptacles in Hallways.

Question ID#: 2139.0

The spacing requirements for receptacles installed in bedrooms, living rooms, dining rooms and other spaces in a dwelling do not apply to hallways. Every hallway which is 10 ft. or longer, measured down the centerline of the hallway and not going through a doorway, needs at least one receptacle outlet.

Generally the only type of electrical equipment used in a hallway is a vacuum cleaner, and they have long cords. Most residential hallways can be cleaned with the vacuum cleaner plugged into a single outlet. Of course there is nothing in the Code which would prohibit installing more than one receptacle outlet in a hallway.

Receptacle spacing requirements are designed so extension cords will not be used. Many house fires have been caused by the careless use of extension cords. The Code requirements for installing receptacles throughout a dwelling has greatly reduced the use of extension cords and cut down on the number of house fires caused by faulty extension cords.

Hallways 10 ft. or more in length must have a receptacle.

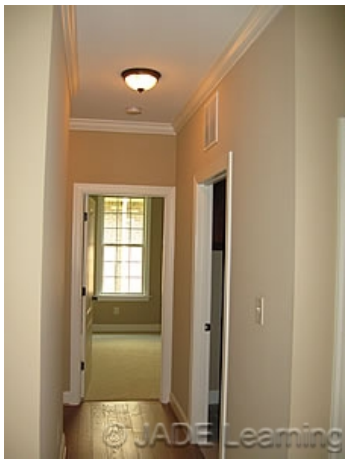
Question 35: A hallway in a single family dwelling is 15 ft. long. How many receptacle outlets are required?

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

Question 36: 210.70(A)(2)(a) Switch Controlled Lighting Outlets.

Question ID#: 2141.0

Section 210.70 gives details to provide enough lighting outlets in rooms for general occupancy and safe passage from one living area to another. Without lighting outlets for passageways such as hallways, stairways, etc., lighting would only be in rooms and would not provide enough illumination to travel safely throughout the dwelling.



Hallways, stairways and attached garages must have a switched light.

Question 36: Which of the following statements about this picture of a dwelling unit hallway is correct?

A: 3-way switches are required for lighting outlets located in hallways.
B: One wall switch-controlled lighting outlet is required in hallways.
C: There must be a lighting outlet at each end of the hallway.
D: Hallway lighting outlets are required to be GFCI protected.

Question 37: 240.24(F) Not Located Over Steps.

Question ID#: 2142.0

Overcurrent devices cannot be located over steps. Overcurrent devices in panelboards located over steps create a hazard for the installer and the building occupant. Standing on a stairway tread, or two treads on different levels, puts the installer at risk for losing his balance and falling. Trying to reset a circuit breaker located in a stairway, when the circuit which has tripped could be a lighting circuit for the stairway, is very dangerous.

Stairways are routes of egress from buildings. NFPA 101, The Life Safety Code, requires routes of egress to be kept clear and open. A panelboard with overcurrent devices installed on a stairway could interfere with exit paths out of a building.

Section 110.26(B), Clear Spaces, requires a guard or barrier to be set up if the work space is in a passageway or general open space. It is clearly not practical to set up guards on stairways and would be a violation of The Life Safety Code.

For all these reasons, overcurrent devices will no longer be permitted over steps.

Question 37: Overcurrent devices are permitted to be installed in:

A: Kitchen cabinets.
B: Stairways.
C: Clothes closets.
D: Hallways.

Luminaires, Fans and Switches

Question 38: 210.70(A)(3) Storage and Equipment Space Lighting.

Question ID#: 2145.0

Equipment that requires servicing, like heat pumps or fixed electric space heating, must have a lighting outlet and receptacle installed near the equipment. The lighting outlet is installed at the equipment, with the wall switch located at the usual point of entry to the equipment space. For basements, utility rooms, attics and crawl spaces, the light fixture can contain the switch (pull chain) if the equipment is close to the entrance to the space.

Storage areas in attics and utility rooms, as well as basements and crawl spaces, also require a lighting outlet. An attic without a floor is not considered storage space and would not require a light. But if flooring is installed at any point in the attic, then a lighting outlet is required. A crawl space is also not storage space and would not need a lighting outlet if there was no equipment there which required servicing.

Spaces used for storage or equipment must have a light.

Question 38: An attic with a pull down ladder has a 5 ft. x 10 ft. area which is floored. Which of the following statements is TRUE?

A: A lighting outlet is required.
B: A lighting outlet is not required.
C: There is not enough storage space in the attic to require a lighting outlet.
D: There is no storage space in this attic.

Question 39: 410.16 Luminaires in Clothes Closets.

Question ID#: 2151.1

Electricians who find this section of the Code confusing usually have difficulty:

- determining what part of a closet is defined by the Code as Clothes Storage Space.
- determining what clearances are required for different types of luminaires.

Section 410.16(A) lists the types of luminaires permitted in clothes closets.

Section 410.16(C) specifies the minimum distance between the Clothes Storage Space and various types of luminaires.

- Surface mounted LED or incandescent luminaries having a completely enclosed light source require a 12 in. clearance from the storage space (not from the wall).
- Surface mounted fluorescent luminaries on the ceiling or on a wall above a door require a 6 in. clearance from the storage space (not from the wall).
- Recessed LED or incandescent luminaries having a completely enclosed light source require a 6 in. clearance from the storage space (not from the wall).
- Recessed fluorescent luminaries installed in a ceiling or wall require a 6 in. clearance from the storage space (not from the wall).

Luminaires in clothes closets must have proper clearance to storage area.

Question 39: Which of the following requires the least clearance between the luminaire and the clothes storage space within a clothes closet?

A: A recessed fluorescent luminaire with a completely enclosed light source.
B: An incandescent pendant luminaire with a completely enclosed light source.
C: A surface mounted incandescent luminaire with a completely enclosed light source.
D: A surface mounted LED luminaire with a completely enclosed light source.

Question 40: 404.9(B)(1) Grounding Snap Switches.

Question ID#: 2149.1

A general use snap switch can be grounded by using metal screws to mount the snap switch to a metal box or metal cover.

If the snap switch is mounted in a metal box or metal cover, without attaching the equipment grounding conductor to the snap switch, the metal box or cover must be connected to an equipment grounding conductor. If the box is nonmetallic, it must have an integral means for connecting an equipment grounding conductor to the screws used to mount the switch.

The most common way to ground a general use snap switch to a box is to connect an equipment grounding conductor or equipment bonding jumper directly to the equipment grounding green screw of the snap switch.

Bonding jumper is not required for a switch mounted to a grounded metal box.

Question 40: A general use snap switch is not required to be grounded if:

A: It is mounted on a metal box cover that is supported on a nonmetallic box.
B: It is installed in a nonmetallic box.
C: It is installed on a circuit which includes an equipment grounding conductor.
D: It is replacing a switch in a box where the wiring system does not include an equipment grounding conductor.

Question 41: 404.14(E) Dimmer Switches for Luminaires Only.

Question ID#: 2148.0

General-use dimmer switches can be used for permanent incandescent luminaires only.

"General-use dimmer switches shall be used only to control permanently installed incandescent luminaires (lighting fixtures) unless listed for the control of other loads and installed accordingly."

A general use dimmer switch cannot be used to control a ceiling paddle fan or a wall receptacle. Motor loads, like ceiling fans, need special control which is not available in a general use dimmer switch.

If a dimmer switch is used to control a receptacle and if an appliance is plugged into the receptacle, it could be damaged if the dimmer switch was set at less than full scale. Dimmer switches reduce the voltage to the load. Appliances like TVs, stereos, vacuum cleaners or computers are designed to work at full voltage. At reduced voltages the internal wiring of the appliance would overheat and the appliance could be seriously damaged.

Question 41: General use dimmer switches may be used to control:

A: Cord and plug connected appliances.
B: Incandescent luminaires.
C: Receptacles.
D: Ceiling Fans.

Question 42: 314.27(C) Boxes at Ceiling-Suspended Fan Outlets.

Question ID#: 2147.0

Two products became increasingly popular in the early 1980's. One was the use of plastic and fiber boxes for fixture support, the other was ceiling fans. These two products seemed to be working against each other. Prior to the 80's, most ceiling fixture support boxes were octagonal metal boxes which had no problems supporting standard paddle fans. The plastic and fiber boxes had difficulty supporting paddle fans, especially if the fans were not properly balanced. The screws would gradually work loose from these boxes until they fell out, usually damaging the box threads and making reattachment of the fan difficult. These issues, coupled with the fact that heavier custom paddle fans came onto the market, resulted in the requirement for paddle fan boxes to be listed for the purpose. If a ceiling fan weighs more than the Code will allow, it must be supported independently of the box.

Boxes used to support ceiling fans must be listed for ceiling fan support.

Question 42: Outlet boxes used as the sole support for paddle fans shall be _____.

A: Listed, steel boxes, approved for lighting fixture support of at least 35 lbs.
B: Listed, marked suitable for the purpose, and support no more than 70 lbs.
C: Listed, marked suitable for the purpose, and support no more than 70 kg.
D: Approved, labeled suitable for the purpose, and support no more than 35 kg.

Question 43: 410.116(A) Non-IC Luminaires.

Question ID#: 2153.1

Thermal insulation cannot be installed above or within 3 in. of a non-IC luminaire. Type non-IC luminaires are usually provided with a thermal protective device and have a higher lamp wattage rating. They are generally constructed in a manner that does not allow heat to escape. If a non-IC luminaire is covered with thermal insulation, nuisance tripping and moisture condensation can occur in the short term. Conductor breakdown and ground faults can occur in the long term, possibly causing a fire hazard.

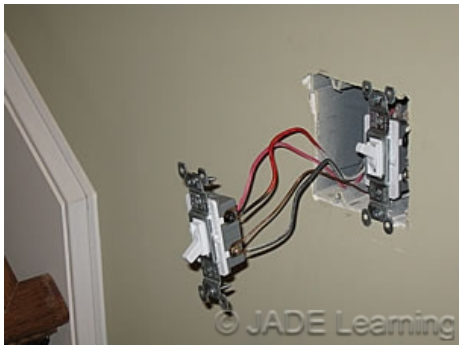
Recessed luminaires must maintain 3 in. clearance to thermal insulation.

Question 43: If a recessed luminaire does not have a Type IC rating, what is the minimum clearance between recessed parts of the luminaire and combustible materials?

A: 12 inches.
B: 3 inches.
C: 8 inches.
D: 1/2 inch.

Question 44: 200.7(C)(1) Indentifying the Ungrounded Conductor in a Switch Leg.

Question ID#: 2144.0



The white wire in cable assemblies used as a switch leg must be reidentified.

A switch leg, or switch loop, supplies a single-pole switch with a hot conductor and returns a switched hot conductor back to the lighting outlet. A switch loop for a 3-way switch supplies a hot conductor and returns 2 switched traveler conductors to the lighting outlet.

The white wire must be used as the supply to the switch in a cable assembly (NM, UF, AC, MC, etc) and not as a return conductor to the switched outlet.

This Code section requires the white wire in a 2-conductor or 3-conductor cable to be permanently re-identified by painting or taping to make it clear it is being used as part of a switch leg, and is not a neutral conductor.

This requirement has been in the NEC since 1999. It was added because many homeowners or "handymen" were replacing light fixtures with ceiling fans and got into trouble by mistaking the white wire in a switch leg for a neutral.

Question 44: When NM cable is used in a switch leg, the white wire:

A: Must be the return wire to the switched outlet.
B: Can be used as an equipment ground.
C: Can supply the switch and remain white in color.
D: Must be re-identified so it is clearly not a grounded conductor.

Question 45: 410.74 Luminaire Rating.

Question ID#: 2150.1

Luminaire name plate protected during construction.

The requirement for maximum wattage markings located where visible during relamping helps to minimize the age old problem of installing lamps with wattages higher than the fixture rating. Code section 110.12(B) also requires protection of electrical equipment from paint or foreign materials. The lampholders generally come with some type of device to prevent entry of paint, but they often fall out during the construction process. It is also not good practice to allow paint to cover the thermal protector.

Question 45: Which of the following bulbs is permitted to be used in a luminaire that is marked "maximum 60 W"?

A: An incandescent bulb marked 100 W.
B: An incandescent bulb marked 82 W.
C: A CFL bulb marked 25W with the lumen rating of a 100 W bulb.
D: An incandescent bulb marked 75 W.

Question 46: 410.116(A)(2) Type IC Luminaires.

Question ID#: 2152.0

Recessed luminaires in contact with thermal insulation to be marked type IC.

Type IC (Insulation Contact) luminaires are tested to release less heat to the surrounding building materials when covered by thermal insulation. The IC rating is achieved by thermal protectors that disconnect power to the lamp when excessive heat builds up in the luminaire. In some models, there is also a heat shield that creates a separation between the lamp section and the top of the can. There are also some type IC rated luminaires that are dual rated: IC and NON IC, and this is based solely on the lamp wattage.

Due to the ever growing need to conserve energy, codes such as the model energy code and the international building code are requiring airtight recessed cans. In order to meet this requirement, manufacturers are enclosing the entire housing to prevent air movement across the luminaire. The luminaire trims are gasketed to further seal the luminaire. When these energy codes are in force, only type IC luminaries can be installed to ensure protection of the thermal envelope.

Question 46: For the IC recessed luminaire shown here, what is the minimum clearance to thermal insulation?

A: 3 in.
B: 0 in.
C: 1/2 in.
D: 2 in.

Question 47: 314.27(A) Maximum Weight of a Luminaire Supported by a Box. Exception.

Question ID#: 2146.0

Wall mounted device boxes can be used to support luminaires up to six pounds.

Device boxes are commonly used in masonry construction for wall hung luminaires with brick veneers because the shape and size of these boxes make installation practical. Even though the boxes are not listed for luminaire support, the Code allows luminaires weighing not more than 6 lbs. to be supported by device boxes.

Device boxes usually come designed for use with #6 screws. Luminaire boxes most commonly are designed for use with #8 screws. The wording of the 314.27 exception lets us know that as long as the support is provided with #6 screws, no additional tapping for larger screws is required.

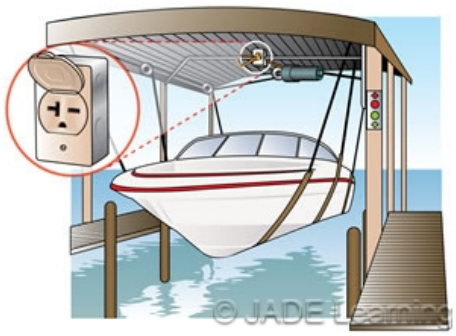
Question 47: An exterior wall mounted luminaire mounted on a device box weighs 2.45 kg (5.4 lbs.). What is the minimum means of support?

A: The luminaire or its supporting yoke must be secured to the device box by two #6 screws.
B: The luminaire shall be secured to a device box, not rated for luminaire support, by two #4 screws.
C: The luminaire must be secured to the structure, not by the outlet box.
D: An outlet box suitable for luminaire support and rated for 30 lbs.

Outdoors, Garages, Basements, and Crawl Spaces

Question 48: 210.8(C) Boat Hoists.

Question ID#: 2160.0



Boat hoist outlets must be GFCI protected.

"GFCI protection shall be provided for outlets not exceeding 240 volts that supply boat hoists installed in dwelling unit locations."

Both 120-volt and 240-volt receptacles that supply boat hoists at residential locations must have GFCI protection.

The Consumer Product Safety Commission reported four fatalities between 1994 and 2003 from electrocutions that were caused by faulty residential boat hoists.

Boat hoists are often subject to rough use and are located in naturally wet areas. The cord supplying the boat hoist or the pendant controller can easily get tangled with the boat hoist chain or sling and be damaged. Boat hoists rated at 240-volts are common and present an even greater danger to boat owners than 120-volt boat hoists.

Question 48: At a residential location which of the following statements about boat hoists is TRUE?

A: Boat hoists must have built in GFCI protection.
B: A 240-volt receptacle supplying a boat hoist is required to be GFCI protected.
C: Receptacles supplying boat hoists do not need GFCI protection if the receptacle is a single contact device.
D: A boat hoist that is double insulated does not need GFCI protection.

Question 49: Article 411 Landscape Lighting.

Question ID#: 2165.0

Low voltage landscape wiring is very popular for a number of reasons. The burial depths in Table 300.5 are only 6 in. if the system is limited to 30 volts and does not go underneath a driveway. Normal 120 volt wiring, protected by GFCI, must be buried at least 12 in. Also, the fixtures themselves are usually mounted on stakes which can be easily pushed into the ground, avoiding support and conductor protection issues.

- The lighting transformer for the low voltage landscape lighting cannot be supplied by a branch circuit greater than 20 amps
- The maximum rating of the secondary of the transformer is 25 amps
- The lighting system must be listed for the purpose
- Low voltage lighting systems cannot be installed through the wall of a dwelling, unless protected by a raceway, and cannot be installed within 10 ft. of swimming pools, spas or fountains
- The lighting transformer must be an isolating type which insulates the secondary low voltage side from the primary branch circuit.

Landscape lighting operating at less than 30 volts is covered in article 411.

Question 49: Which of the following statements about limited energy landscape lighting is TRUE?

A: The supply circuit to the low voltage transformer cannot have a rating greater than 20 amps.
B: Low voltage landscape wiring must be installed in conduit.
C: The supply circuit to the low voltage transformer must be GFCI protected.
D: Low voltage landscape wiring must be buried at least 12 in. in the ground.

Question 50: 340.10(1) UF Cable. Uses Permitted.

Question ID#: 2163.0

Underground Feeder (UF) cable provides an option to installing wire in conduit for underground wiring. Type UF cable can be directly buried in the ground. Typical installations include well pumps, landscape lighting, branch circuits and feeders.

UF cable cannot be used as service entrance cable, overhead cable or embedded in poured cement or concrete. Type UF cable cannot be installed where exposed to the direct rays of the sun or exposed to physical damage, unless listed for use in direct sunlight.

Table 300.5 lists the cover requirements for UF cable and other underground wiring methods. In residential locations the cables and raceways may not need to be buried as deeply as in other locations. If the underground circuit is limited to 120-volts, 20 amperes and is GFCI protected, the burial depth is reduced even further.

UF cable must be buried 24 in. deep.

Question 50: Which of the following underground installations would be an acceptable wiring method?

A: Non-metallic sheathed cable buried 18 in. in residential parking areas.
B: Type SE cable on a residential branch circuit rated 120-volts with GFCI protection and buried 12 in. below grade.
C: Type UF cable buried 24 in. and powering a 240-volt, 20 ampere branch circuit.
D: Rigid non-metallic conduit buried 12 in. under a residential parking lot, with wires providing power to a 120-volt, 20 ampere lighting circuit.

Question 51: 210.52(G) Basements and Garages.

Question ID#: 2157.0

At least one general use receptacle outlet must be installed in garages and unfinished basements in one-family dwellings. This convenience outlet cannot be dedicated to specific equipment. Sump pumps, fans, stationary tools, exercise equipment, washing machines, water filters or other types of fixed equipment can be cord and plug connected to a receptacle. If a receptacle is dedicated to a piece of equipment, it cannot be used for general purposes, like running hand tools, vacuums or battery chargers.

In basements and garages where a portion of the area is finished for living space, and one or more areas are left unfinished, a receptacle which is not intended for a specific appliance or piece of equipment must be installed in each unfinished area.

All locations except industrial establishments, 125-volt, single-phase, 15 and 20 ampere outdoor receptacle outlets require GFCI protection.

Receptacle required in garages and unfinished basements.

Question 51: In a large basement there is a finished entertainment room and two unfinished areas on either side. Excluding the entertainment room, how many receptacles are required that are not dedicated to specific equipment?

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

Question 52: 210.52(E)(3) Outdoor Outlets.

Question ID#: 2155.1

Outdoor Outlets covers (1) One-Family and Two-Family Dwellings; (2) Multi-Family Dwellings and (3) Balconies, Decks, and Porches. The required outdoor outlets must be accessible while standing at grade level. _

A receptacle must be installed within the perimeter of the balcony, deck or porch if the balcony, deck or porch is accessible from inside the dwelling unit. The receptacle outlet must be installed no more than 6 1/2 ft. above the balcony, deck or porch.

Installing a receptacle outlet on a porch or balcony will eliminate residents running extension cords into the house to play radios, run lights or power appliances. Indoor outlets are not GFCI protected, and an extension cord run through a doorway can easily be damaged when the door is closed.

Receptacle required on decks, porches and balconies.

Question 52: If a single family dwelling built under the 2011 NEC, has a receptacle outlet installed on a second story balcony that is accessed from a bedroom, which of the following statements is correct?

A: The receptacle is not required to be GFCI protected.
B: The receptacle must be GFCI protected.
C: It is permitted to count as one of the two required outside GFCI protected receptacles.
D: The receptacle is not required if the balcony has less than 20 square feet.

Question 53: 225.26 Outside Wiring Cannot be Supported by Vegetation.

Question ID#: 2161.0

Vegetation such as trees cannot be used for the support of overhead outside wiring. Also, service wires cannot be supported by trees, per section 230.10. Branch circuits and feeders used as temporary wiring, in section 590.4(J), cannot be supported by trees either.

Outdoor luminaires can be supported by trees, however. Section 410.36(G): "Outdoor luminaires and associated equipment shall be permitted to be supported by trees." Temporary wiring for holiday lighting is also exempted from the general rule by an exception in 590.4 (J). It is permissible to install the conduit or cable underground, attach it to the tree trunk and feed a light fixture fastened to the tree. What is not permitted is overhead spans run from one tree to another. If cable was installed between trees, the movement of the trees during storms could damage the cable.

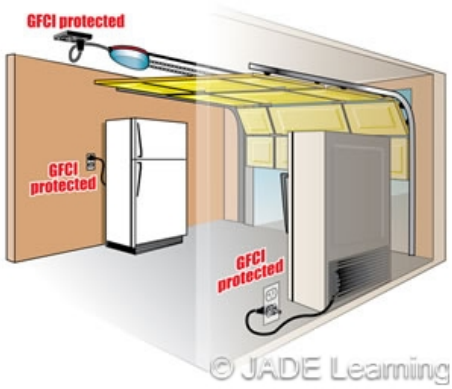
Trees shall not be used to support overhead conductors.

Question 53: Which of the following overhead spans may be supported by trees?

A: Service conductors.
B: Feeders used to supply branch circuits for lighting ski slopes.
C: Branch circuits for lighting a used car lot.
D: Temporary wiring used for holiday lighting.

Question 54: 210.8(A)(2) GFCI Protection.

Question ID#: 2158.1



Receptacles in garages and accessory buildings must be GFCI protected.

All receptacle outlets installed in dwelling unit garages, accessory buildings having floors at or below grade level that are used for storage and work areas, and receptacle outlets in unfinished basements must have GFCI protection for personnel.

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in garages, accessory buildings and unfinished basements must be GFCI protected. The only exception is for a receptacle supplying a fire alarm or burglar alarm system in an unfinished basement.

It doesn't matter if the receptacle outlet is behind dedicated equipment which is not easily moved, like a freezer. It doesn't matter if the receptacle outlet is not readily accessible, like an outlet for a garage door opener. Both types of outlets, because they are located in the garage, must be GFCI protected.

Question 54: In a single family dwelling built under the 2011 NEC, which of the following receptacle outlets in a garage/workshop is required to provide GFCI protection?

A: A 125-volt 20 amp general purpose receptacle.
B: A 125-volt, 30 amp receptacle for a jointer.
C: A 240-volt, 15 amp receptacle installed on the ceiling.
D: A 240-volt, 20 amp receptacle for a table saw.

Question 55: 406.9(A)&(B) Receptacles in Damp and Wet Locations.

Question ID#: 2164.0

Outlets installed in wet or damp locations must be listed weather-resistant.

All 15- and 20-ampere non-locking receptacles, rated 125 and 250 volts, installed in damp and wet locations must be a listed weather-resistant type.

Currently, standard 15- and -20 ampere receptacles installed in damp and wet locations are protected from the weather by weatherproof enclosures or weatherproof covers. Unfortunately, poor installation or assembly practices have often allowed water into the enclosure and damaged the receptacle. For a number of reasons, outdoor receptacles are subject to harsher conditions than indoor receptacles. A NEMA/UL study found the failure rate of GFCI receptacles installed outdoors was more than double the failure rate in other locations. Because of this high failure rate, the 2008 NEC no longer permits standard receptacles in damp or wet locations.

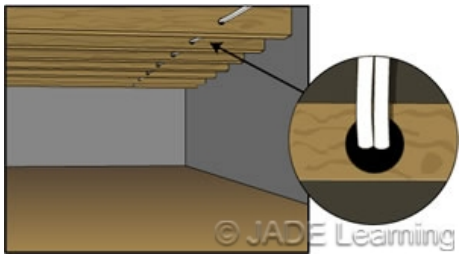
The NEC now requires 15- and 20-ampere non-locking receptacles, rated 125 and 250 volts installed in damp and wet locations to be weather resistant. These receptacles are coated with a conformal weather resistant coating that is not used on standard non-weather resistant receptacles. In damp and wet location weather resistant receptacles are still required to be installed in weatherproof enclosures or using weatherproof covers for recessed boxes.

Question 55: Which of the following statements about 15- and 20 ampere receptacles installed outdoors is TRUE?

A: Receptacles installed outdoors in a damp location must have an enclosure that is weatherproof whether or not a plug cap is installed.
B: Receptacles installed outdoors in a wet location must have an enclosure that is weatherproof when the attachment plug cap is not inserted and the receptacle covers are closed.
C: A 125 volt, 20 amp receptacle non-locking receptacle must be weather-resistant when installed in a wet location.
D: Twist-lock receptacles must be weather-resistant when installed in damp or wet locations.

Question 56: 334.15(C) Exposed Work in Unfinished Basements and Crawl Spaces.

Question ID#: 2162.1



NM cables through bored holes in crawl spaces.

In unfinished basements and crawl spaces, NM cable in sizes #14, #12, and #10 AWG is required to be installed on running boards or through bored holes when run at angles to the joists in crawl spaces.

Cables with two #8 AWG conductors must also be installed through bored holes or protected by running boards, but cables having more than two #8 conductors can be secured directly to the bottom of the joists. If the conductors in a cable are larger than #8 AWG, they are permitted to be secured directly to the bottom of floor joists without any protection.

Although the location is quite different, cable installed in crawl spaces and unfinished basements cannot be fastened to the bottom of the floor joists. In unfinished basements there is a danger of the homeowner damaging exposed NM cable by using it to support clothing or yard and garden tools. The same danger does not exist in crawl spaces. Although crawl space is not defined, its name suggests not being able to stand up. The types of activities common to an unfinished basement are not done in a crawl space. Wiring in a crawl space is not exposed to the same physical damage as in an unfinished basement.

However, the requirements for protecting NM cable in a crawl space are identical to protecting NM cable in an unfinished basement. Many jurisdictions have not adopted this requirement. Check with the Authority Having Jurisdiction about enforcement of this section.

Question 56: In a crawlspace, when installed without a running-board or raceway, which of the following cables is permitted to be run at right angles to the floor joists secured with staples directly to the bottom edge of the joist?

A: A #12/2/w grd. NM-B Cable.
B: A #10/3/ w grd. NM-B Cable.
C: An #8/2/w grd. NM-B Cable.
D: An #8/3/w grd. NM-B Cable.

Question 57: 210.52(E) Outdoor Outlets. Balconies. Exception.

Question ID#: 2156.0

If a deck, porch, or balcony is accessible from inside a dwelling unit, a receptacle outlet is required regardless of the size of the balcony, deck, or porch.

A balcony, deck, and porch of any dimension is required to have at least one receptacle installed if the area is accessible from inside the dwelling.

Small balconies and porches are commonly used to display holiday lighting, or as a place to put radios, fans or other appliances. If an outlet is not installed on the balcony or porch, extension cords are often run through doorways and plugged into outlets that do not have GFCI protection.

Requiring balconies and porches that can be accessed from inside the dwelling to have a GFCI protected receptacle outlet, regardless of the size of the porch, will eliminate the double hazard of running extension cords through doorways and plugging appliances into outlets without GFCI protection.

Question 57: Which of the following dwelling unit locations requires a GFCI protected receptacle outlet?

A: A balcony that measures 6 ft. x 3 ft. with a door into the inside of the dwelling.
B: A balcony that measures 8 ft. x 6 ft. without a door leading into the dwelling.
C: A space that is accessible while standing on a fire escape.
D: A landing on steps used for access to a 2nd floor apartment.

Question 58: 210.8(A)(3) Outdoors.

Question ID#: 2159.1

The general rule for dwellings requires that all 125-volt, single-phase, 15- and 20-ampere receptacle outlets installed outdoors must have GFCI protection. The only exception to this general rule exempts receptacles that are not readily accessible and which are supplied by a branch circuit dedicated to electric snow melting, deicing, or heat tracing tape for pipes and vessel heating equipment.

At dwelling units, other than receptacles covered by this exception, 125-volt, single-phase, 15- and 20-ampere outdoor receptacle outlets require GFCI protection.

Receptacles located outdoors must be GFCI protected.

Question 58: At a dwelling, which of the following outdoor outlets is required to be GFCI protected?

A: A lighting outlet for a flood light.
B: A pole mounted lighting outlet beside a sidewalk.
C: A 125 volt, 30 amp receptacle outlet.
D: A wall receptacle outlet on an outdoor patio.

Heating and Cooling

Question 59: 440.14 Disconnect for HVAC Equipment.

Question ID#: 2171.1

A disconnecting means is required to be located within sight of the equipment for the safety of service personnel working on the equipment. If you can see the disconnect, you can prevent someone from turning it back on while you are working on it.

The disconnect must be readily accessible. This means it can't be located more than 50 ft. away from the equipment. If the disconnecting means is attached to the equipment itself, it cannot cover the data tag. With the data tag covered, it is impossible to read important information such as operating voltage, maximum size overcurrent protection allowed, and minimum circuit size.

HVAC equipment requires a disconnect to be located within sight of equipment.

Question 59: Excluding exceptions, the disconnect for the condenser unit of a heat-pump is required to be readily accessible and:

A: Within 50 feet but not necessarily within sight of the equipment.
B: Within 50 feet and within sight of the equipment.
C: Within 25 feet but not necessarily within sight of the equipment.
D: Within 25 feet and within sight of the equipment.

Question 60: 338.10(B)(4) Ampacity of SE Aluminum Cable.

Question ID#: 2169.0

SE aluminum cable is one of the most commonly used wiring methods for wiring up to the HVAC disconnecting means. Most brands of heating equipment require the connection to their equipment to be copper so the whip to the equipment is typically copper. The high cost of copper has made the use of aluminum more attractive.

For many years, SE cable was sized using the 75Âº C column. Now the feeder and branch circuit size for SE cable installed in thermal insulation must be selected from the 60Âº C column. This means that larger sizes of SE cable will be necessary. For example, a cooling unit with a minimum circuit ampacity of 38 amps requires a #6 SE Aluminum cable. If using the 75Âº C column of Table 310.15(B)(16) was permitted, a #8 SE Aluminum cable would have been big enough.

For interior wiring the ampacity of SE cable installed in thermal insullation shall be figured at 60Â° C.

Question 60: The branch circuit from the panelboard to a heating unit disconnect is type SE aluminum and must be sized for a minimum circuit ampacity of 59 amps. What is the correct size conductors when installed in thermal insulation?

A: #4 AWG.
B: #3 AWG.
C: #6 AWG.
D: #1 AWG.

Question 61: Article 424 Electric Heating Equipment.

Question ID#: 2170.1

All equipment must be installed according to manufacture's listing and labeling.

Because all fixed electric heating equipment is considered to be a continuous load, the supply conductors are sized to carry 125% of the rated ampacity of the unit. When wiring electric heating equipment, such as electric furnaces or heat pumps, the nameplate rating for the appliance is the best way to select the branch circuit conductor size, overcurrent protection and disconnect size. The values on the equipment nameplate must be followed. If the nameplate says the maximum fuse size is 100 amps then the maximum size allowed is 100 amps and a circuit breaker cannot be used instead of fuses.

If the nameplate on a furnace or heat-pump specifies a minimum conductor size then that is the minimum size we use. The minimum conductor size listed on the nameplate is the conductor size we use because the manufacturer has already included the 25% increase for continuous loading in the data on the nameplate.

Similarly, if the nameplate specifies the maximum amperage rating of an overcurrent protective device (OCPD) such as a fuse or circuit breaker, that is the maximum size OCPD permitted for the unit; and, it is not necessary to increase the OCPD to carry 125% of the units rated ampacity.

If, however, the nameplate does not specify either the minimum conductor size or maximum rating for an OCPD, we have to calculate the values for each of these based on 125% of the rated ampacity of the unit given on the nameplate.

Example #1: If the nameplate specifies a maximum OCPD rating of 30 amps, and a minimum conductor size of No. 10 AWG. The smallest conductor we are permitted to use is a No. 10 AWG; however, we can use a larger wire if needed to compensate for voltage drop for lengthy circuits. Regardless of the conductor size, the largest OCPD we are permitted to install is a fuse or circuit breaker rated at 30 amps.

Example #2: If the nameplate specifies the unit amperage at 40 amps; but, does not specify the minimum conductor size or maximum OCPD, we have to calculate the size for each based on the amperage rating of the unit as follows: Circuit ampacity= 40-A X 125% = 50 amps, Smallest AL conductor is No. 4 AWG SE cable or No. 6 CU cable.

Maximum OCPD = 40-A X 125% = 50 amps; Largest OCPD is a 50 amp fuse or circuit breaker. We are required to use either a fuse or circuit breaker if the type device is specified on the nameplate.

The branch circuit conductors are sized at 125% of the rated current of the electric heating equipment. Even if 90Â° C conductors are used, many times the 60Â° C column from Table 310.15(B)(16) must be used to select the proper conductor if the ampacity is 100 amperes or less. If the ampacity is over 100 amperes, then you are permitted to use the 75Â° C column in table 310.15(B)(16).

The overcurrent protection is also sized at 125% of the rated current of the electric heating appliance. If the size of the required overcurrent device does not match a standard size fuse or circuit breaker, the next higher size from 240.6(A) may be used.

The disconnecting means for electric heating equipment must be located within sight of the equipment.

Question 61: If the nameplate on the air-handler for a heat-pump specifies the overcurrent protective device (OCPD) is to be a 40 amp fuse, which of the following is permitted as the disconnect and OCPD for the equipment?

A: A 40 amp inverse time circuit breaker.
B: A 60 amp combination starter with 40 amp MSCPs.
C: A 60 amp disconnect with 40 amp TD fuses installed in it.
D: A 60 amp disconnect with 50 amp TD fuses installed in it.

Question 62: 210.63 HVAC Equipment Outlet.

Question ID#: 2168.1

Need a receptacle located within 25 ft. of HVAC equipment.

A 125-volt, single-phase, 15- or 20 ampere receptacle outlet is required to be provided near air conditioning equipment because tools needed for servicing HVAC equipment do not work well with high voltage drop.

The outlet must be on the same level as the HVAC equipment and cannot be connected to the load side of the equipment disconnecting means.

Locating the outlet near the equipment also helps prevent service personnel from opening a window and running an extension cord to the nearest outlet (which may not provide GFCI protection).

Question 62: At a dwelling a 20 amp, 125 volt GFCI protected receptacle is installed for use by personnel servicing HVAC equipment. The receptacle is required to be:

A: Located within 25 feet of the HVAC equipment but not necessarily within sight of the HVAC equipment.
B: Within 25 feet of the HVAC equipment and within sight of the HVAC disconnect.
C: Within 50 feet of but not necessarily within sight of the HVAC equipment.
D: Within sight of the HVAC equipment.

Question 63: Table 110.26(A)(1) Working Space.

Question ID#: 2167.0

Table 110.26(A)(1) requires clear working space in front of equipment such as the heat pump in the photo. Some jurisdictions allow the disconnect to be located behind the equipment as long as there is ready access and the doors will open to 90Â°.

Often it is difficult to maintain the working space. The vegetation located in this area does not allow ready access and as the plant grows it will impede access altogether and affect appliance operation. The installation shown in the photo is a Code violation.

Shrubbery cannot interfere with working space.

Question 63: The voltage to ground on a certain piece of equipment is 120 volts. According to Table 110.26(A)(1), what is the required depth of the working space?

A: 3 ft.
B: 3 ft. 6 in.
C: 4 ft.
D: 4 ft. 6 in.

Swimming Pools and Spas

Question 64: 680.43(A)&(B) Receptacles and Luminaires Near Indoor Spas.

Question ID#: 2176.1

Fixtures and paddle fans located between 7 ft. 6 in. and 12 ft. must be GFCI protected.

One GFCI protected receptacle, 125-volt, 15- or 20 amp, must be located between 6 ft. and 10 ft. from the inside wall of the spa or hot tub. Receptacles that provide power for a spa or hot tub must be ground-fault circuit-interrupter protected.

If a luminaire or paddle fan does not have GFCI protection, it must be hung at least 12 ft. above the spa or hot tub. If it does have GFCI protection, it may be mounted no lower than 7 ft. 6 in. Luminaires may be mounted closer than 7 ft. 6 in. to the hot tub or spa if they are GFCI protected and are recessed with a glass or plastic lens, with electrically isolated trim and suitable for a damp location. Surface-mounted luminaires may also be mounted closer than 7 ft. 6 in. if they have a glass or plastic globe, a nonmetallic or electrically isolated body and are suitable for a damp location.

Question 64: A paddle fan and light combination that is suspended directly above a spa is connected to a GFCI protected circuit. What is the minimum distance between the water level in the spa and the lowest point of the fan/light combination?

A: 10 feet.
B: 7 feet.
C: 7 feet 6 inches.
D: 12 feet.

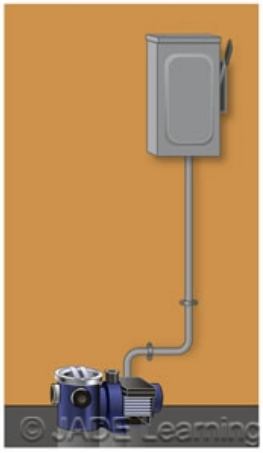
Question 65: 680.21(C) GFCI Protection.

Question ID#: 2175.1

Pool pump motors rated 15 or 20 amperes, 120 volt through 240 volt, single phase must be provided with ground-fault circuit-interrupter protection for personnel, whether by receptacle or hardwired.

There is just as much of a shock hazard if a pool pump is hard wired as when it is connected to a receptacle. The environment is wet and corrosive, and motor leads which are directly connected to a branch circuit can deteriorate, just like a cord and plug. Even though a pool pump motor which is hardwired is not as likely to be moved as a pump connected to a receptacle, problems in the wiring can develop.

This requirement applies to permanently installed pools at all locations, not just dwelling units. If a pool pump motor is cord-connected to a receptacle or the branch circuit is hardwired directly to the pump, GFCI protection for personnel must be provided for the pump.



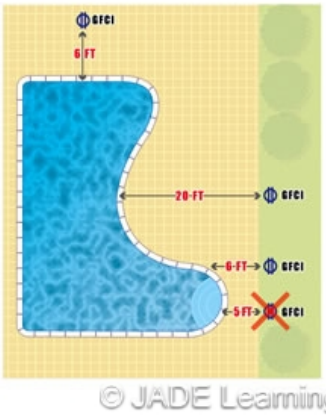
Most pool pump motors must be GFCI protected.

Question 65: Which of the following pool pump motors is not required to be GFCI protected?

A: A pump motor that is hard-wired to a 240 volt, 15 amp single-phase branch circuit.
B: A hard-wired pool pump motor that is connected to 240 volt, 20 amp, single-phase branch circuit.
C: A pump motor that is hard-wired to a 240 volt, 30 amp single-phase branch circuit.
D: A cord and plug connected, double insulated pool pump motor connected to a 125 volt, 15 amp single-phase branch circuit.

Question 66: 680.22(A) Receptacles.

Question ID#: 2174.1



Receptacles must be located a minimum of 6 ft. from the inside wall of the pool.

The required distances from the inside walls of the pool to several different types of receptacles are as follows:

Type of Receptacle	***Distance***
Circulation and Sanitation (non-GFCI, non-locking) receptacle outlets	10 ft.
Circulation and Sanitation (GFCI, locking, single receptacle)	6 ft.
Other Receptacles	6 ft.
At dwelling units, at least one 125-volt, 15-or 20-amp receptacle outlet is required	between 6 ft. and 20 ft.
All receptacle outlets required to be GFCI protected	between 6 ft. and 20 ft.

Other outlets cannot be less than 10 ft. from the inside walls of the pool. An informational note gives examples of ***other outlets*** as communication circuits (telephone), remote-control, signaling (computer), and fire alarm. CATV outlets also qualify as ***other outlets***.

Question 66: A GFCI protected, non-locking type, single outlet receptacle for the circulation and sanitation pump for a swimming pool is permitted to be within:

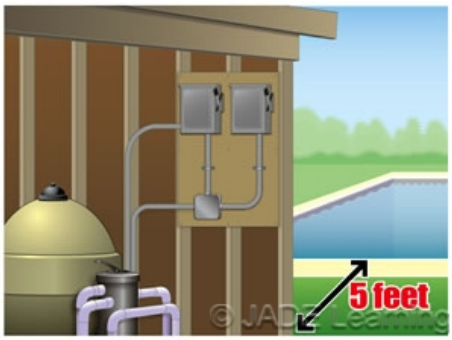
A: 6 feet of the inside walls of a pool.
B: 4 feet of the inside walls of a pool.
C: 12 feet of the inside walls of a pool.
D: 5 feet of the inside walls of a pool.

Question 67: 680.12 Maintenance Disconnecting Means.

Question ID#: 2173.0

A maintenance disconnecting means is required for all utilization equipment except lighting. The disconnect must simultaneously disconnect all ungrounded conductors, and it must be accessible and within sight of the equipment.

If a barrier is not installed between the maintenance disconnect and the edge of the pool, each disconnecting means must be located no closer than 5 ft. horizontally from the inside walls of the pool, spa or hot tub. The purpose of the barrier is to ensure that the minimum travel distance between the edge of the pool and the maintenance disconnects is at least 5-feet. For example, if a barrier such as a wall, fence or other partition is installed between the edge of the pool and the disconnect, as long as the distance it takes to walk around the barrier is 5-feet or more, the installation complies with the requirements in 680.12.



The maintance disconnect must be located at least 5 ft. from inside wall of a pool.

The disconnect can be closer than 5 ft. to the inside walls of the pool, spa or hot tub if there is a barrier installed that would require 5 ft. of travel to reach the disconnect.

Other electrical equipment around swimming pools, spas and hot tubs are required to maintain horizontal distances from the edge of the water. Receptacles for pool-pump motors and general use receptacles must be no closer than 6 ft. from the inside wall of the pool. Luminaires and paddle fans cannot be installed overhead within 5 ft. of the edge of the pool. Switching devices must be located at least 5 ft. horizontally from the inside walls of a pool, unless a barrier is installed.

Question 67: Which of the following statements about maintenance disconnects for swimming pools is Correct?

A: All utilization equipment, including lighting, for swimming pools, spas, and hot tubs require maintenance disconnects.
B: Maintenance disconnects are permitted to be located less than 5 ft. from the edge of the pool without a barrier being installed.
C: If a barrier is not installed between the water and a maintenance disconnect, maintenance disconnects are required to be 5 or more feet from the edge of the pool.
D: The maintenance disconnects are not required to be within sight of the utilization equipment.

Question 68: 680.71 Hydromassage Bathtubs. Protection.

Question ID#: 2177.1

Hydromassage bathtubs must be on an individual branch circuit and protected by a readily accessible ground-fault circuit-interrupter.

The tub heaters and hydromassage pump are a large enough load that they need to be on an individual branch circuit. An individual branch circuit is one that supplies a single piece of utilization equipment. Luminaires, convenience receptacles or other loads cannot be connected to the dedicated hydromassage circuit. The rating of the required circuit is not specified.

A GFCI receptacle outlet for the circuit cannot be located in the pump enclosure or cavity if it is not considered readily accesible. Readily accessible means it must be reached quickly, and a receptacle outlet behind a panel may not be reached quickly.

Also, the distance from the inside edge of the tub to receptacles requiring GFCI protection must be 6 ft. to make it consistent with the distance requirements for GFCI protected receptacles from a pool.

Hydromassage bathtub must be on an individual branch circuit.

Question 68: A GFCI receptacle for a cord and plug connected hydromassage bathtub is required to be:

A: A 30 amp, 125 volt twist lock receptacle.
B: More than 6 feet from the inside wall of the tub.
C: Installed on a 125 volt, 15 or 20 amp branch circuit that supplies the tub and lighting outlets within 5 feet horizontally and 8 feet vertically of the tub.
D: Readily accessible and on an individual circuit that supplies no other loads.

Generators

Question 69: 702.7 Signs.

Question ID#: 2180.1

A sign must be located at the service to indicate the location of the generator.

Brutal storms and a weakening utility power-grid have made generators more popular.

Generators at residential dwellings are classified as Optional Standby Systems. They are installed mostly as a convenience when the normal power goes out. The life safety of the occupants does not depend on the generator.

Generators are a second power source to a dwelling and signs must be installed at the service-entrance equipment location identifying the type and location of the optional standby system. Generators with automatic transfer switches will start automatically when utility power is lost. This can pose a real hazard to someone who is unaware of the generator as a second source of power.

Question 69: Optional Standby Systems are required to:

A: Provide power for Life Safety loads.
B: Automatically come online upon the loss of normal power and to have an automatic transfer switch.
C: Provide power within 30 seconds of loss of normal power.
D: Have a sign at the service indicating the location and type of Optional Standby System.

Question 70: 702.4 Optional Standby Systems. System Capacity.

Question ID#: 2179.1

Calculating the load supplied by a generator is the same as calculating the load for a building supplied by a utility service. Use Article 220.

However, the size and capacity of the generator for an Optional Standby System depends on the type of transfer equipment used: manual or automatic.

For Optional Standby Systems using manual transfer switches, the generator must have enough capacity to supply all of the equipment intended to be operated at one time. The user of the Optional Standby System is permitted to select the loads connected to the generator.

For Optional Standby Systems using automatic transfer switches, the generator must be rated to carry the full load that is transferred by the automatic transfer equipment. If there is a load management system which can determine which loads are supplied at any one time, the generator must be rated to supply the maximum load which will be supplied simultaneously.

The load a generator can supply is based on the generator's KW rating and whether the transfer switch is manual or automatic.

Question 70: An Optional Standby System is supplied by a 20 KW Generator with a 120/240 volt output that is connected to its loads by a manual transfer switch. If the loads are manually selected, what is the largest load in amps that the generator can carry?

A: 50 amps.
B: 75 amps.
C: 83.33 amps.
D: 66.67 amps.

Question 71: 250.35 Grounding Permanently Installed Generators.

Question ID#: 2181.1

Standby generators can be Separately Derived Systems or Nonseparately Derived Systems. Most standby generators are nonseparately derived systems. A standby generator used as a nonseparately derived system does not switch the neutral. It is directly connected to the utility neutral. Nonseparately derived systems never switch the neutral in the transfer switch.

For nonseparately derived systems an equipment bonding jumper is required to be installed from the generator overcurrent device to the first disconnect. Usually this equipment bonding jumper is on the load side of the generator overcurrent device and is sized according to Table 250.122, based on the size of the generator overcurrent device.

Grounding depends on whether the generator is a separately derived system.

Question 71: A 25 KW generator is connected as a nonseparately derived system operating at 120/240 volts. The generator has an onboard OCPD rated at 80 amperes. What is the minimum size copper equipment bonding jumper required for the system?

A: No. 10 AWG.
B: No. 6 AWG.
C: No. 4 AWG.
D: No. 8 AWG.

Limited Energy

Question 72: 800.156 Dwelling Unit Communications Outlet.

Question ID#: 2186.1

A minimum of one communications outlet shall be installed in new construction.

New construction must include at least one communications outlet in dwellings. Section 800.156 requires the following: "For new construction, a minimum of one communications outlet shall be installed within the dwelling in a readily accessible area and cabled to the service provider demarcation point."

Because the definition of ***communications circuits*** in 800.2 includes a wide variety of communications systems, the outlet required by section 800.156 is not required to be a phone outlet, but that will be the most commonly installed type of outlet.

Having a hardwired telephone outlet in every dwelling unit will give the occupants a reliable way to contact emergency personnel or the fire department. A telephone outlet is necessary for fire alarm and security systems that use auto-dialers. Having a communications outlet installed in the rough-in stage will reduce the need to fish communications wire inside walls and along unseen pathways used for electrical conductors.

Question 72: Which of the following is required to be installed in new dwellings?

A: At least one telephone outlet.
B: A Network Powered Broadband Communications System Outlet.
C: At least one telephone outlet in each habitable room.
D: At least one communications outlet.

Question 73: 250.94 Bonding for Other Systems.

Question ID#: 2183.0

An intersystem bonding termination is required to be installed at the service equipment and at the disconnecting means for any additional buildings. The purpose of the intersystem bonding termination is to provide a means to connect bonding and grounding conductors from other systems, like Cable TV and telephone. The intersystem bonding termination must be installed external to any enclosure and be accessible for connection and inspection. It must have the capacity to connect not less than three intersystem bonding conductors.

Means to bond three other systems must be provided at the service.

The intersystem bonding termination must be one of the following:

"(1) A set of terminals securely mounted to the meter socket enclosure and electrically connected to the meter socket enclosure. The terminals and the enclosure shall be listed for grounding.

(2) A bonding bar near the service equipment enclosure, meter socket enclosure or raceway for service conductors. The bonding bar shall be connected with a minimum 6 AWG copper conductor to an equipment grounding conductor(s) in the service equipment enclosure, meter socket enclosure or exposed nonflexible metallic raceway.

(3) A bonding bar near the grounding electrode conductor. The bonding bar shall be connected to the grounding electrode conductor with a minimum 6 AWG copper conductor."

Low voltage systems like Cable TV, Satellite TV, and telephone are bonded to the power grounding electrode system to prevent differences of potential from developing between them and the electrical system. If a high voltage is impressed on one of the

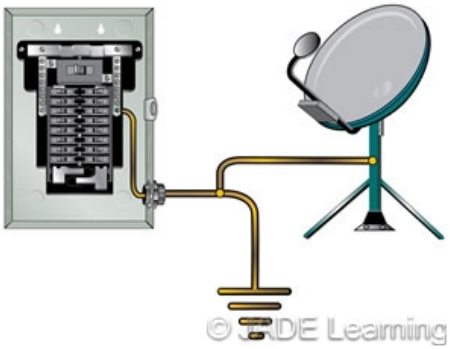
systems because of a lightning strike or contact with outside electrical distribution wires, and it is not bonded to the premises wiring system, a shock hazard exists and arcing can occur between the normal premises wiring system and the low voltage system.

Question 73: The intersystem bonding termination is required to be installed:

A: External to service equipment enclosures.
B: Within 6 ft. of the service disconnecting means.
C: Next to to the telephone primary protector.
D: Inside the meter socket enclosure.

Question 74: 250.94 Bonding for Other Systems. Exception.

Question ID#: 2184.0



Intersystem bonding not required for existing buildings.

In existing buildings installation of the Intersystem Bonding Termination is not required. An accessible means outside of the service equipment enclosures must be provided to allow for the connection of bonding and grounding conductors for optical fiber cables, telephone, TV, CATV, and Network Powered Broadband Communications Systems.

Grounding and bonding conductors from the low voltage systems can be connected by: (1) Exposed nonflexible metallic raceways; (2) Exposed grounding electrode conductor; (3) Approved means for external connection of a copper conductor to the grounded raceway or equipment.

Referring to item number (3) an informational note says: "A 6 AWG copper conductor with one end bonded to the grounded nonflexible metallic raceway or equipment and with 6 inches or more of the other end made accessible on the outside wall is an example of the approved means."

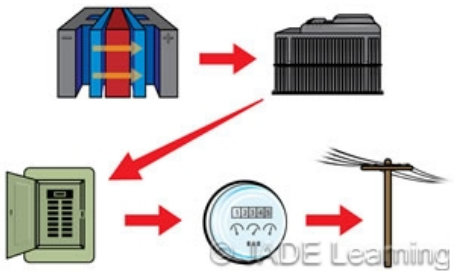
Question 74: A satellite dish is installed at a mobile home in a rural area. The existing service is run in PVC conduit. Which of the following is a TRUE statement?

A: A set of terminals must be mounted to the meter socket enclosure.
B: A bonding jumper must be attached to the service conduit.
C: A bonding bar is required to be installed next to the service disconnect.
D: The grounding conductor from the satellite system can be connected to the service grounding electrode conductor.

Question 75: 692.65 Utility-Interactive Point of Connection.

Question ID#: 2185.0

Utility-interactive inverters used with fuel cells (or solar photovoltaic panels) supply alternate power to connected loads and feed any excess power back to the electric utility. The utility uses net metering to credit the building owner with power which is generated by the fuel cell and subtracts it from the monthly bill. No transfer switch is required for utility-interactive systems and the fuel cell is disabled if the utility loses power.



Fuel cells supply alternate power to loads and feed excess load back to utility.

The point of connection between the alternate energy source (fuel cell, photovoltaic system, wind generator) is installed according to section 705.12. Article 705 is ***Interconnected Electric Power Production Sources.***

The utility-interactive inverter can be connected to the supply side or the load side of the service disconnect. In a typical installation, the output from the inverter ***backfeeds*** a circuit breaker in the premises distribution system. The rating of the circuit breaker cannot be more than 120 % of the rating of the busbar in the panel. The distribution equipment must be marked to indicate there are multiple sources of supply to the panel. Circuit breakers, when backfed, must be suitable for backfeeding.

The backfed circuit breaker is not required to have additional fastening means. A permanent warning label must be installed in the distribution equipment with the wording: WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE.

Question 75: Utility-interactive inverters supplying premises distribution panels are:

A: Required to be connected to the load side of service disconnects.
B: Required to be connected to the supply side of the service disconnects.
C: Permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises.
D: Are not permitted to be connected to the supply side of the service disconnect.

Installation and Wiring Methods

Question 76: 210.24 Branch Circuit Requirements – Summary & 210.21(B)(1) Outlet Devices.

Question ID#: 2190.1

Branch circuit requirements are based on single and multiple outlet circuits.

Most of the wiring in a dwelling is branch circuit wiring. A branch circuit can have a single outlet device or multiple outlets. For multi-outlet circuits, the NEC does not say how many outlets are permitted on a single circuit. In commercial wiring, each outlet is figured at 180 volt-amps (watts), but there is no such requirement for residential wiring. Most electricians do not put more than 12 outlets on a 15 amp circuit or 15 outlets on a 20 amp circuit.

If a branch circuit has two or more receptacle outlets for cord and plug connected loads, no single receptacle can supply more than 80% of the branch circuit rating. If a branch circuit supplies lighting outlets and equipment which is fastened in place (not cord and plug connected), no single piece of equipment can be rated more than 50% of the branch circuit rating. However, if a branch circuit has only one receptacle on it, the assumption is that the circuit was installed for a specific load and that it needs to be rated to carry that load; so, the receptacle is required to have the same rating as the circuit.

The receptacle rating for 20 amp circuits can be 15 or 20 amps. The receptacle rating for 40 amp circuits can be 40 amps or 50 amps. But if a branch circuit is a dedicated circuit and supplies a single outlet, section 210.21(B)(1) requires that the receptacle have a rating not less than the rating of the branch circuit.

The NEC says branch circuit wiring and overcurrent protection for continuous loads must be calculated at 125% of the actual load. This is because devices (See Article 100) are not rated continuously, but the wires are rated for continuous loading. Exactly which loads in a dwelling unit are continuous and which ones are not continuous is not spelled out. Most electricians use an 80% rule and don't load a 15 amp circuit to more than 12 amps and a 20 amp circuit to more than 16 amps in order to account for continuous loading.

How circuits are laid out in a residence is mostly left up to the installing electrician.

Question 76: If a 20 ampere branch circuit supplies two or more 20 amp receptacle outlets, what is the maximum amperage permitted for a single cord and plug connected load that is supplied by that circuit?

A: 12 amps.
B: 16 amps.
C: 10 amps.
D: 20 amps.

Question 77: 334.30 Securing and Supporting NM Cable.

Question ID#: 2202.1

NM cable must be supported every 4 1/2 ft. and within 12 in. of a box or cabinet.

Nonmetallic-sheathed cable must be supported every 4 1/2 ft. and within 12 in. of every cabinet, box or fitting. NM cable may be secured with staples, cable ties, straps or hangers.

Nonmetallic-sheathed cable is considered supported when fished in concealed spaces and when run through bored holes in studs. When installed in bored holes in studs, the studs cannot be spaced further than 4 1/2 ft. apart and the cable must be supported within 12 in. of a box. The hole in the stud cannot be closer than 1 1/4 in. from the face of the stud, or a 1/16 in. steel plate must be installed to protect the cable from sheet rock nails or other wall penetrations.

In one- and two-family dwellings and multi-family dwellings, nonmetallic sheathed cable can be installed in dropped or suspended ceilings. NM cable is permitted to be run 4 1/2 ft. from the last point of support in an accessible ceiling. This means if light luminairea in an accessible ceiling are no more than 4 1/2 ft. apart, NM cable can be installed from fixture to fixture without support, and junction boxes will not be necessary.

Question 77: Which of the following installations of NM Cable is a violation of the NEC?

A: An 8 foot length of NM Cable run vertically without support through the top and bottom plates of an 8 foot high stud wall.
B: An 8 foot length of NM Cable installed vertically in a section of PVC conduit that is secured to a block wall.
C: A 20 foot length of NM Cable installed without staples that is run horizontally through bored holes in studs spaced on 16 inch centers.
D: NM Cable unsupported for 8 feet where it is fished within a void of a block wall.

Question 78: 334.12(B)(4) NM Cable Not Permitted in Damp Locations.

Question ID#: 2200.1

NM cable not allowed to be installed in wet or damp locations.

NM cable is not permitted in damp or wet locations. Even if it is installed in a raceway, if the installation is outdoors or in another wet location, NM cable cannot be used.

Section 300.9 says that when raceways are installed in wet locations (outdoors), the interior of the raceways are considered a wet location and only conductors suitable for a wet location can be used. Since NM cable is not permitted in a damp or wet location, it cannot be used outdoors, even if installed in a raceway. See Table 310.104(A) for conductors which are suitable for a wet location.

Many existing installations use NM cable for air conditioning whips from the disconnecting means to the equipment. This is a Code violation in any new installation.

Question 78: Which of the following installations of NM Cable is a violation of the NEC?

A: NM Cable fished in air voids in masonry block or tile walls of a single family home.
B: NM Cable used in a damp location of a single family home.
C: NM Cable used to supply a cooktop in a single family home.
D: NM Cable used for a branch circuit in a detached garage of a single family home.

Question 79: Table 300.5 Burial Depth of Conductors and Raceways.

Question ID#: 2194.0

PVC conduit must be buried at least 18 in. when under a residential driveway.

Residential circuits which have GFCI protection, rated 120 volts or less, and maximum overcurrent protection of 20 amps must be buried at least 12 inches below the surface. If the installation is underneath a residential driveway or residential parking area, the required depth is still 12 in. If the circuit goes underneath a street or alleyway, the distance increases to 24 in.

Landscape lighting operating at 30 volts or less and installed with UF or other outdoor cable must be buried 6 in. below the surface. If passing underneath a residential driveway or residential parking area, the depth is 18 in. The required burial depth is 24 in. if installed below a street or alleyway.

Circuits of any voltage or ampere rating can be installed in rigid nonmetallic conduit on residential property if buried 18 in. If under a one- or two-family driveway or parking area, the raceway must also be buried 18 in. If passing underneath a street, the burial depth goes to 24 in.

Question 79: An underground feeder from a single family dwelling to the garage cuts across the backyard and is installed in rigid nonmetallic conduit. What is the required burial depth?

A: 18 in.
B: 6 in.
C: 24 in.
D: 12 in.

Question 80: 334.12(A)(9) NM Cable Installation.

Question ID#: 2199.0

NM cable not allowed to be embedded in masonry.

The photo shows two examples of NM cable used per Article 334.

The NM cable installed to the masonry box shown in the right corner of the photo will pass through the air gap between the brick and sheathing and will not be embedded in the masonry. Therefore the cable is not required to be sleeved.

The two orange cables in the left-center of the photo will be embedded in the masonry and must be sleeved.

Question 80: What is the purpose of the conduit sleeve on the two NM cables on this house with masonry veneer?

A: To prevent moisture from going into the structure.
B: To protect the NM cable and prevent it from being embedded in the masonry.
C: To make sure the cable comes out in the proper location.
D: To keep the mason from covering the wire.

Question 81: 314.20 Listed Box Extender.

Question ID#: 2197.1

Recently more has been done to dress up dining areas such as adding columns, tray ceilings and installing receptacles in the baseboards instead of at the standard wall height.

The rules for installing boxes in combustible walls and ceilings are different than when installing boxes in noncombustible walls and ceilings. Section 314.20 permits boxes, plaster rings, extension rings, or listed extenders installed in combustible surface material such as wood to be either flush with the finished surface or project from the finished surface. In no case are they permitted to be recessed in the combustible material.

If the box is not flush with a combustible surface, a listed extender is required to be installed so that it is flush with or extends beyond the finished surface.

In combustible walls and ceilings listed box extenders can be used.

Question 81: A wall switch is installed in a device box that is covered with 1/4 inch wood paneling.

A: The box is permitted to be recessed into the wall up to 1/4 inch.
B: If the box is not flush with the finished wall surface, a box extender is required to be installed so that the extender is flush with or extends beyond the finished wall surface.
C: The box has to be removed and reset correctly if it is not flush with the finished wall.
D: If the box is not flush with the finished wall, a box extender is required to be installed so that the extender is not more than 1/8 inch from the finished wall surface.

Question 82: 110.(3)(B) Installation Instructions.

Question ID#: 2189.0

Instantaneous water heaters are being used more and more in replacement and new construction installations because of savings on utility bills. As with any new product, questions come up about the proper installation and wiring.

The electrical consumption for this gas appliance is only for the ignition circuit and the exhaust blower. The motor is variable and uses more electricity to move the exhaust as the demand for more hot water is increased.

All equipment must installed according to manufacture's listing and labeling.

Question 82: The tankless water heater shown here is listed and labeled. The instructions require a disconnecting means at the unit. The amp rating is .7 amps at 120 volts and the horsepower is less than 1/8. Which of the following statements is TRUE?

A: No disconnect is necessary with motors rated 1/8 horsepower or less.
B: A disconnecting means is required at the unit because listed or labeled equipment shall be installed according to instructions.
C: A disconnect is not required because the appliance is less than 300 VA.
D: The disconnecting means shall be rated at least 20 amperes.

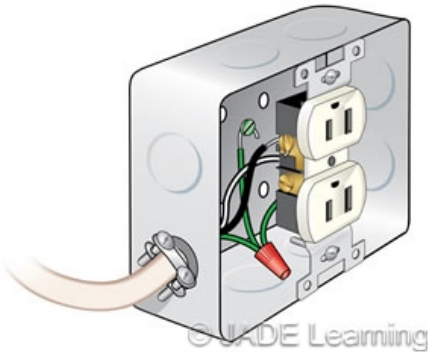
Question 83: 250.8 Connection of Grounding and Bonding Equipment.

Question ID#: 2191.0

There are two parts to this section: (A) Permitted Methods and (B) Not Permitted Methods. Not Permitted is any device that depends solely on solder for a connection.

Listed pressure connectors (any color wire nut) and exothermic welding are permitted. Pressure connectors listed as grounding and bonding equipment (green wire nuts) are also permitted. Terminal bars have been added as a permitted way to connect grounding conductors and bonding jumpers. Connections which are part of a listed assembly and other listed means are permitted.

Section 250.8(A)(5) & (6) includes two methods to connect grounding and bonding conductors: ***"machine screw-type fasteners that engage not less than two threads or are secured with a nut; and thread-forming machine screws that engage not less than two threads in the enclosure."***



Grounding screws are used to ground metal boxes.

Question 83: Which of the following devices is permitted as a method of connecting grounding and bonding equipment?

A: A sheet metal screw.
B: A solid wire wrapped around a metal post and soldered.
C: A listed red wire nut.
D: A wood screw.

Question 84: Table 110.28 Enclosure Selection Table.

Question ID#: 2188.0

Table for enclosure selection no longer just for motor installations.

When selecting an enclosure type, it is important to pay attention to the enclosure type number. Without the correct number selection, it is possible to select enclosures that are not at all suitable for the specific installation.

Enclosures that are most commonly used outdoors, like panelboards and switchboards, for example, are rarely installed with the wrong type of enclosure. However, other equipment that can be installed outdoors, like wireways, gutters, and transformer enclosures is sometimes installed in a way which is not suitable for outdoor use.

Table 110.28 applies to all enclosures, not just motor enclosures.

Question 84: The combo panel, shown here, is located outdoors and is subject to rain, sleet, and snow. Which of the following is the correct enclosure type number?

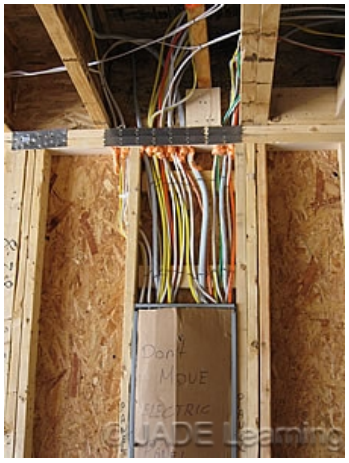
A: 3R.
B: 1.
C: 5.
D: 12.

Question 85: 334.80 Ampacity.

Question ID#: 2203.0

When more than 2 NM cables are installed through a bored hole in wood framing that is required to be fire-stopped with insulation or other identified material, the current carrying capacity of each conductor must be derated.

Derating is done by applying the same table used to derate conductors in conduit, Table 310.15(B)(3)(a). The Table requires 4 to 6 conductors to be derated to 80% of their rating from Table 310.15(B)(16) and 7 to 9 conductors derated to 70% of their value in Table 310.15(B)(16). Higher derates apply to a larger number of conductors. According to 334.80, the ampacity of NM cable is 60Â° C, but the 90Â° C rating is permitted to be used for derating purposes.



Ampacity of NM cable to be calculated at 60Â° C.

Question 85: What is the ampacity of each conductor in a 12/3 with ground NM cable if it passes through a 1 in. fire-stopped hole in wood framing with 2 other 12/2 with ground NM cables? Assume all conductors except grounds are current carrying and rated for 30 amps (90Â° C rating from Table 310.15(B)(16)).

A: 30 amps.
B: 21 amps.
C: 12 amps.
D: 24 amps.

Question 86: 314.20 Boxes in Wall or Ceiling.

Question ID#: 2196.1

Boxes in noncombustible walls or ceilings can be set back 1/4 in.

Boxes in noncombustible walls such as tile or drywall can be set back in the wall up to 1/4 in. and have receptacles or switches installed without any alterations. However, once the box is recessed more than a 1/4 in. a box extender must be used.

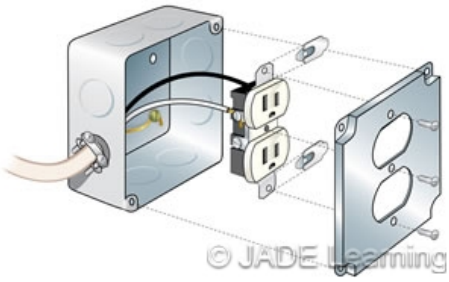
The most common extenders are the plastic fire rings shown in the picture. Prior to the plastic fire rings, similar metal rings were used in many cases, but because they were metal, they could create ground faults and short circuits.

Question 86: A ceiling box is installed in a ceiling covered with gypsum board (or sheet-rock). A box extender is required:

A: If the box is recessed at all.
B: If the box is recessed more than 1/4th of an inch.
C: If the box is recessed more than 1/8th of an inch.
D: If the box is recessed more than 1/10th of an inch.

Question 87: 250.146(A) Surface Mounted Box.

Question ID#: 2192.0



Metal to metal contact approved for grounding receptacle in surface mounted metal box.

When a metal box is surface mounted, the direct metal to metal contact between the box and the contact yoke of the receptacle is an acceptable way to ground the receptacle to the box. A bonding jumper from the receptacle to the box is not required.

If two conditions are met, a cover mounted receptacle can also be grounded to a box without a bonding jumper. The two conditions are***: "(1)The device is attached to the cover with at least two fasteners that are permanent (such as a rivet) or have a thread locking or screw*** locking ***means; (2) When the cover mounting holes are located on a flat non-raised portion of the cover. "***

Exposed work metal covers must have two ***permanent*** fasteners to attach the receptacle to the cover in order to be listed. The ***flat, non-raised portion of*** crushed corner design of a listed exposed work metal cover provides good metal to metal contact between the cover and the box.

Question 87: A surface mounted receptacle:

A: Must have a bonding jumper installed between the receptacle and the cover.
B: Must have a bonding jumper installed between the receptacle and the box.
C: Is considered grounded if it is installed in a listed exposed metal work cover.
D: Is considered grounded if installed with a mud-ring attached to a listed metal box extension.

Question 88: 334.23 & 320.23 NM Cable in Accessible Attics.

Question ID#: 2201.0

Nonmetallic sheathed cable is installed in accessible attics the same way as armored cable is installed in attics. Section 320.23 describes the procedure.

If NM cable is run parallel with the rafters or floor joists, it does not require further protection as long as the cable is installed no closer than 1.25 in. from the leading edge of the framing member. If the cable is installed closer than 1.25 in. to the face of the rafter or floor joist, then a steel plate or sleeve must be installed to protect the cable.

When run across the top of floor joists, or across the face of rafters within 7 ft. of the floor joists, then NM cable must be protected by guard strips which are at least as high as the cable. If the attic does not have permanent stairs or ladders, then the guard strips are not required, except for an area within 6 ft. of the scuttle hole or attic entrance.

NM cable must be protected in accessible attics.

Question 88: NM cable installed in an accessible attic:

A: Needs to be protected by guard strips if the NM cable is within 10 ft. of the scuttle hole.
B: Must be protected by guard strips if run across the top of floor joists in an attic that is accessible by permanent stairs.
C: Must be protected by guard strips in all attic locations if installed across the top of floor joists.
D: Does not require guard strips in any attic location if installed across the face of rafters.

Question 89: 406.5(A) Receptacle Mounting in Boxes that Are Set Back.

Question ID#: 2205.1

When a receptacle is mounted in a plastic box in a sheetrock wall, the receptacle must be firmly supported to the box. If the box is recessed 1/4 in. into the wall, the receptacle may not seat firmly into the box. The rigid support for receptacles is necessary in order to prevent damage to the receptacle cover or the receptacle itself. Movement of receptacles that are not rigidly attached may allow the equipment grounding conductor to come into contact with the ungrounded conductor.

A common way to prevent this is to install an adapter that holds the receptacle against the finished surface, as in the photo.

Receptacles set back in the wall 1/4 in. must be held rigidly in place.

Question 89: If a receptacle is set back in a noncombustible wall:

A: The receptacle is required to be installed so that the mounting yoke or strap is held rigidly at the finished surface.
B: The receptacle cover plate is permitted to hold the receptacle at the finished wall surface without the mounting strap or the yoke touching the box.
C: The box is required to be removed and replaced flush with the finished wall surface.
D: The receptacle is permitted to be recessed behind the surface of the finished wall.

Question 90: 314.16(B)(4) Device or Equipment Fill.

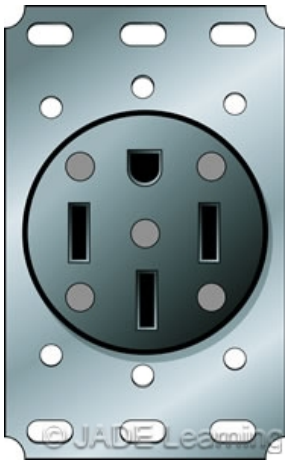
Question ID#: 2195.0

A device like a range or dryer receptacle, which will not fit into a single gang box, is counted as four conductors, rather than two conductors, if a 2-gang box is used.

"A device or utilization equipment wider than a single 50 mm (2 in.) device box as described in Table 314.16(A) shall have double volume allowances provided for each gang required for mounting."

Common sense indicates that if two single-gang spaces are required to install a device, it should not be counted the same as a device that can be installed in a single gang space. Now, the Code makes it clear that if a device requires two single gang spaces and is ***" wider than a single 50 mm (2 in.) device box,"*** the device is counted as four of the largest conductors connected to it.

The volume requirements of the conductors are added to the volume requirement of the device to get the total volume of the box.



If a device requires a two gang box conductor fill is counted as four conductors.

Question 90: If a double gang box is used and two single gang spaces are required to mount the device, what is the minimum volume required for a 4-wire range receptacle supplied by #8 AWG conductors?

A: 12 cubic in.
B: 15 cubic in.
C: 24 cubic in.
D: 20 cubic in.

Question 91: 338.10(B)(4) Ampacity of SE Cable.

Question ID#: 2204.0

Ampacity of SE cable used for interior wiring to be calculated at 60Â° C.

Service Entrance (SE) cable must be sized from the 60Â°C column of Table 310.15(B)(16) when installed in thermal insulation. In a previous example above, the size of SE cable run to an HVAC disconnect had to be increased a whole size because the 60Â°C column was used instead of the 75Â°C column.

SE cable is often used to feed subpanels in single family and multi-family dwellings. Sizing the SE cable feeder from the 60Â°C column of Table 310.16 will result in larger feeders for subpanels and other types of equipment.

Question 91: An aluminum SE cable feeder is used to supply a 100 amp load. What is the minimum size feeder when installed in thermal insulation?

A: #2 AWG.
B: 1/0 AWG.
C: #1 AWG.
D: 2/0 AWG.

Question 92: 314.24 Minimum Depth of Boxes.

Question ID#: 2198.0

Boxes must be deep enough to contain devices or equipment installed in them without damaging the device or its conductors.

Outlet and device boxes shall have sufficient depth to allow equipment installed within them to be mounted properly and without likelihood of damage to conductors within the box.

Outlet boxes that do not enclose devices or utilization equipment shall have a minimum internal depth of 1/2 inch.

Outlet and device boxes that enclose devices or utilization equipment must be large enough to accomodate the device, utilization equipment and the conductors that supply the device or equipment.

If equipment projects into the box more than 1 7/8 in. box depth shall be 1/4 in. deeper than the equipment.

Boxes containing #4 AWG and larger conductors shall be identified for their function.

Boxes containing #4, #6, or #8 AWG conductors shall have a minimum depth of 2 1/16 inches.

Boxes containing #12 or #10 AWG conductors shall have a minimum depth of 1 3/16 inches.

Boxes containing #14 or smaller AWG conductors shall have a minimum depth of 15/16 inches.

Boxes must be deep enough to protect the device and conductors being installed.

Question 92: What is the minimum depth for a box containing utilization equipment supplied by #10 AWG conductors?

A: 1 ^{3/16} in.
B: 15/16 in.
C: 1 ^{1/2} in.
D: 1 ^{7/8} in.

Question 93: 300.4(A)(1) Cables and Raceways Through Wood Studs.

Question ID#: 2193.0

The photo shows the use of type UF cable run through bored holes in wood members with the use of protective plates because the holes are drilled less than 11/4 in. from the edge.

Metal plates protect the conductor from being damaged by sheet rock nails or nails used to hang objects on the wall after construction is complete.

An exception to 300.4(A)(1) permits steel plates to be omitted if rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing are used through bored holes in wood studs. UF cable is not mentioned in the exception.

Nail plates required when cables are less than 11/4 in. from edge of framing member.

Question 93: The cables shown in this photo are run through bored holes in wood members. Which of the following is correct?

A: The protective plates are required to be 1/8 in. thick minimum.
B: The protective plates are required when the edge of the hole is 1 3/8 in. from the edge of the wood member.
C: The protective plates are required when the edge of the hole is less than 11/4 in. from the edge of the wood member.
D: The protective plates are not required because of the type of cable.

Practical Exercises

Question 94: Weather Resistant Receptacles.

Question ID#: 2211.0

Use the blueprint to answer the question.

Use this blueprint to answer the question.Location of weather resistant receptacles.

Question 94: Weather resistant receptacle outlets are required to be installed:

A: Within 6 ft. of a sink.
B: In wet and damp locations.
C: In garages.
D: In basements and crawl spaces.

Question 95: Bonding Jumper for Gas Pipe.

Question ID#: 2212.1

Use the blueprint to answer the question.

Question 95: What is the minimum size copper bonding jumper required for bonding a copper gas pipe that supplies gas to set of fireplace logs that includes an automatic igniter and a small fan connected to a 15 amp circuit, 120 volt circuit?

A: No. 10 AWG.
B: No. 8 AWG.
C: No. 12 AWG.
D: No. 14 AWG.

Question 96: Garage GFCI Receptacles.

Question ID#: 2207.0

Use the blueprint to answer the question.

Use this blueprint to answer the question.Number of receptacles in the garage to be GFCI protected.

Question 96: How many receptacle outlets in the garage must be GFCI protected?

A: 6.
B: 5.
C: 4.
D: 8.

Question 97: Indoor Switch for Outdoor Lights.

Question ID#: 2213.0

Use the blueprint to answer the question.

Use this blueprint to answer the question.Switch on bedroom circuit and located in bedroom feeding outside flood light.

Question 97: The switch for the rear outdoor floodlights is supplied by the bedroom circuit & is located in the master bedroom (not shown on blueprints). Which of the following statements about the switch and floodlights is TRUE?

A: The switch and floodlight must be GFCI protected.
B: The floodlights must be IC rated.
C: The switch and floodlight must be AFCI protected.
D: The floodlights must be cord-and-plug connected to a weather-resistant receptacle outlet.

Question 98: Tamper Resistant Outlets.

Question ID#: 2209.1

Use the blueprint to answer the question.

Use this blueprint to answer the question.Number of tamper resistant receptacles in the kitchen.

Question 98: In a single family dwelling, which of the following 15 and 20 amp, 125 volt receptacles is required to be tamper resistant?

A: A general purpose receptacle installed in a hall.
B: A receptacle located in a dedicated space for garbage compactor.
C: A nongrounding receptacle installed as a replacement in an existing dwelling.
D: A receptacle that is part of an appliance.

Question 99: AFCI Protected Outlets.

Question ID#: 2208.1

Use the blueprint to answer the question.

Use this blueprint to answer the question.Number of AFCI's required.

Question 99: At a single family dwelling, which of the following are required to have AFCI protection?

A: A 20 amp, 120 volt circuit that supplies receptacle outlets in two bathrooms.
B: A 20 amp, 120 volt circuit that supplies receptacles serving a countertop in a kitchen.
C: A 15 amp, 120 volt circuit that supplies receptacle outlets in a garage.
D: A 15 amp, 120 volt circuit supplying a receptacle and lighting outlet in a hall.

Question 100: Ampacity Rating of SE Cable.

Question ID#: 2210.0

Use the blueprint to answer the question.

Use this blueprint to answer the question.Size the SE cable to the range.

Question 100: The range in the kitchen is rated for 40 amperes. What is the minimum size aluminum SE cable that can be installed to the range when installed in thermal insulation?

A: #8 AWG.
B: 1/0 AWG.
C: #6 AWG.
D: #4 AWG.

Answer Sheet **Darken the correct answer. Sample: A ● C D**

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1.) A B C D	21.) A B C D	41.) A B C D	61.) A B C D	81.) A B C D
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3.) A B C D	23.) A B C D	43.) A B C D	63.) A B C D	83.) A B C D
4.) A B C D	24.) A B C D	44.) A B C D	64.) A B C D	84.) A B C D
5.) A B C D	25.) A B C D	45.) A B C D	65.) A B C D	85.) A B C D
6.) A B C D	26.) A B C D	46.) A B C D	66.) A B C D	86.) A B C D
7.) A B C D	27.) A B C D	47.) A B C D	67.) A B C D	87.) A B C D
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10.) A B C D	30.) A B C D	50.) A B C D	70.) A B C D	90.) A B C D
11.) A B C D	31.) A B C D	51.) A B C D	71.) A B C D	91.) A B C D
12.) A B C D	32.) A B C D	52.) A B C D	72.) A B C D	92.) A B C D
13.) A B C D	33.) A B C D	53.) A B C D	73.) A B C D	93.) A B C D
14.) A B C D	34.) A B C D	54.) A B C D	74.) A B C D	94.) A B C D
15.) A B C D	35.) A B C D	55.) A B C D	75.) A B C D	95.) A B C D
16.) A B C D	36.) A B C D	56.) A B C D	76.) A B C D	96.) A B C D
17.) A B C D	37.) A B C D	57.) A B C D	77.) A B C D	97.) A B C D
18.) A B C D	38.) A B C D	58.) A B C D	78.) A B C D	98.) A B C D
19.) A B C D	39.) A B C D	59.) A B C D	79.) A B C D	99.) A B C D
20.) A B C D	40.) A B C D	60.) A B C D	80.) A B C D	100.) A B C D

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