

# NASCLA Journeyman Electrician - Quiz Questions with Answers

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## Interpreting Plans and Specifications

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Interpreting Plans and Specifications

1.

For plans, what are the three types of dimensions?

**Location, size, written**

Length, height, width

Scale, not to scale, TBD

Architectural, mechanical, civil

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*Correct answer: Location, size, written*

*Location dimensions indicate where a feature is located.*

*Size indicates the height, length, or width of a feature.*

*Written dimensions always supersede any measurement or scaling done on site.*

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**2.**

What is the easiest increment of measurement to calculate most jobsite calculations to or in?

**Inches**

Feet

Meters

Centimeters

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*Correct answer: Inches*

*Using the inch as a common denominator is often the fastest way to calculate measurements. Most measurements are within the size of standard-sized rooms.*

*Using a foot as the common denominator can easily result in errors calculating the decimals back to inches.*

*Fraction to decimal calculations are easily memorized to associate as needed.*

*Also, tape measures are available with standard increments on one edge and metric on the other. Some plans do reference metric measurements.*

*The other options are also reasonable, but more difficult or seldom used.*

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**3.**

What is an instrument with evenly spaced graduations that is used for scaling drawings?

**Scale**

Wiggy's

Laser level

Slide rule

*Correct answer: Scale*

*There are two common definitions for a scale that are used in print drawings:*

- *An instrument with evenly spaced graduation that is used for measuring*
  - *A mathematical size relationship between the actual object and a drawing of the object*
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**4.**

What characteristic do mechanical and architectural scales have in common that is beneficial for use in all plan and blueprint reading?

**Each has graduation marks at each end of the scale**

They are flat or triangular

They may have mixed engineering and architectural calibrations

They may be used in construction drawings

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*Correct answer: Each has graduation marks at each end of the scale*

*These graduation marks will be 1/2, 3/8, 1/4, etc. On each scale, there is a different calibration increment for each of the six edges of a triangular scale.*

*Engineers may have metric designators. Architects have designators that are most common to standard construction increments.*

*To use, place one of the two points to be measured on the zero line. The other point will most likely fall between two whole numbers. Then slide the scale, bringing the point that was at zero into the fractions until the other point is on a whole number.*

*Your measurement is the sum of the whole numbers plus the fraction. Because of this, they must be read backwards at times. A little practice and you'll get the hang of it.*

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5.

Many architectural plans are drawn  $1/8" = 1'$ . Without an architect's scale, what common tool could be used to determine measurements for laying out outlets?

**Tape measure**

Eyeball it

String and a ruler

A laser distance measurer

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*Correct answer: Tape measure*

*All standard tape measures have 1/8 increments. This is what most electricians use to scale drawings with. It is a learned skill and takes a bit of practice. But in a short time, you can get good at it.*

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**6.**

Triangles, protractors, compasses, and dividers are tools for what aspect of electrical work?

**Interpretating plans and specifications**

Layout of outlets

Reflected ceiling plans

Lighting schedules

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*Correct answer: Interpretating plans and specifications*

*These common tools used in middle and high school math and science classes are tools of the trade when reading plans and determining specifications. They will help you find the dimensions and positions in the structure you are building.*

*Triangles come in set dimensions, usually 15-degree increments. Protractors help find angles not standard to triangles. A compass or divider can accurately make circles or arcs and can be used to provide equal spacing.*

*The other options are things you will find in plans.*

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**7.**

The submitted RFI has been approved. What must you receive before you can begin work?

**Change orders**

Revision

As-builts

Addenda

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*Correct answer: Change orders*

*Just because the RFI was approved, it does not mean that a change order has been issued. This means they want to do what you requested, not that they will pay for it. RFIs go back and forth, often with the needed information approved. Without this change order in hand, any material and labor costs could be incurred by your company.*

*Change orders often require several signatures before one is actually issued. These change orders may result or come back as revisions.*

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**8.**

Your foreman tells you to redline what you and your apprentice did the last few days. What is he asking you to do?

**As-builts**

Revisions

Change orders

Addenda

*Correct answer: As-builts*

*As-builts are the field corrections to the plans/drawings showing the actual work done according to the change orders for which a revision was not issued. Foreman most often draw these as-builts. They are often done in red ink.*

*However, many foremen allow competent journeymen to redline their own work. As a journeyman, you know exactly what measurements you went by and where you mounted what.*

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**9.**

When considering where a device is located from the prints, what primary dimension are you looking for first?

**Center or edge**

Length

Height

Width

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*Correct answer: Center or edge*

*When considering where devices, lighting, or equipment is to be located, determine whether the plans are using measurements taken to or from the center or the edge.*

*Edge dimensions will have a distinct extension line from the edge to measure from.*

*Normal devices are most often measured from the center. If necessary, a device will be depicted with a bullseye on the appropriate schedule, denoting common take-off.*

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**10.**

How do you calculate area?

$$A = L \times W$$

$$V = L \times W \times H$$

$$C = \pi \times \text{radius}^2$$

$$V = \pi \times r^2 \times H$$

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*Correct answer:  $A = L \times W$*

*Area = Length x Width*

*This is useful in numerous applications on the jobsite. Lighting area requirements are based on square footage of areas to be illuminated.*

*Basic construction calculations are abundant on the web. Brush up on them as needed.*

*The other options are the area of a circle, and the volume of a cube and cylinder.*

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**11.**

What does a fraction represent?

**A part of a whole**

A numerator

A denominator

A reduction

*Correct answer: A part of a whole*

*A fraction represents a part of a whole. For example,  $1/8$  is 1 part of the 8 possible parts of something.*

*The numerator is the top number of a fraction. It is how many parts you have. The denominator is the bottom part of a fraction. It is how many equal parts of the whole there are.*

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12.

There is missing or inaccurate information on the plans. What do you submit?

RFI

Change order

Revision

Addenda

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*Correct answer: RFI*

*A request for information (RFI) is often done by the foreman or GF, but this information starts with each journeyman. Journeymen must be the ones to understand what is correct and incorrect about any and every ongoing installation they are a part of. When the plans aren't right, and they are frequently wrong, it is important to get the right information.*

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13.

What is a change to prints or specifications before bids are opened known as?

**Addenda**

Change order

As-builts

Revision

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*Correct answer: Addenda*

*Addendas are often changes the architect has received from the client. These are very important to the bid process. Bids can be off by a lot if an addenda is missing.*

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**14.**

What is the calculation for volume?

$$V = L \times W \times H$$

Cubic ft x Cubic yd

$$T = L \times W \times \frac{1}{2}$$

$$A = \pi \times r^2$$

*Correct answer:  $V = L \times W \times H$*

*Volume = Length x Width x Height*

*This calculation is important to know because electricians pour a lot of concrete at times. Cylindrical light pole setting often falls to electricians. Being accurate at this calculation can save a lot of time, money, and headaches.*

*The volume of a cylinder is also found in Ugly's.*

*The other options are misnomers or recognizable. T is a triangle and A is the area of a circle. This is all you may see on plans at times.*

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**15.**

When a fraction is multiplied by a whole number, what is the whole number placed over?

**One**

Itself

The numerator

The denominator

*Correct answer: One*

*For example:  $1/4 \times 8$  becomes  $1/4 \times 8/1$ .*

*There are numerous books and free sites available to find remedial assistance with simple math you may have forgotten. In the electrical field, you will be using whole numbers and fractions a lot. Take time to study the basics if needed.*

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**16.**

What does CAD stand for?

**Computer-aided design**

Canadian dollar

Computer-aided dispatch

Cadillac

*Correct answer: Computer-aided design*

*CAD is now the method most often used to prepare construction drawings. Once these are completed on the computer, they are sent to a printer or plotter. These produce large scale drawings with complex integrations on them. CAD allows “as builds” to be implemented sooner, and so drawings can be kept up to date.*

*All other options are correct, but not in the electrical field when talking about plans and specifications.*

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17.

What is a change to drawings by the client or architect known as?

**Revision**

Change order

Addenda

As-builts

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*Correct answer: Revision*

*Revisions are actual changes to the original plans/drawings. Plans and drawings are often under several revisions at once, so make sure you are reading from the latest one. Often, due to as-builts, there may be more than one revision on the table.*

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**18.**

How does Ugly's present the calculation for the area of a cylinder?

**V = Area of end x height**

$$V = \pi \times r^2 \times H$$

$$T = L \times W \times \frac{1}{2}$$

$$V = L \times W \times H$$

*Correct answer: V = Area of end x height*

*Ugly's calculation for the area of a cylinder is V = Area of end x height. The area of a circle follows this in Ugly's sequence of calculations.*

*Learn to communicate with, and in, the references at hand. There are many ways of expressing the very same thing. Translating on the fly is a useful skill to acquire.*

**Learn to find or figure out any missing information.** *That is the world of construction many electricians live in.*

*It is not so important to recall **calculations**. It is important to **know where they are when you need them**. Electricians use a host of reference materials for this purpose. Recognize what you need, when you need it; then remember where it is, and you'll do just fine.*

*The other options are ways of expressing the volume of a cylinder, cube, and triangle.*

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# Basic Electrical Safety

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Basic Electrical Safety

19.

Who is responsible for the application of safety-related work practices and procedures?

**Employers**

Employees

OSHA

NFPA

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*Correct answer: Employers*

*Each employer is responsible for coming up with these practices and procedures and must ensure each employee is then trained in them. Employees are then required to comply with them.*

*Employees are involved in the application of these practices and procedures, and OSHA and NFPA have guidance and oversight over them.*

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20.

Flexible cords and cables are required to be maintained to preserve what?

Insulation integrity

Electrical integrity

Manufacturer specifications

OSHA standards

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*Correct answer: Insulation integrity*

*Identify that **flexible cords and cables** are a **general maintenance requirement**. Cords and cables are to be inspected for worn, frayed, or damaged areas. If constructed strain reliefs are used, inspect these as well. Cords, cables, and strain reliefs are all required to be repaired or replaced as needed.*

*The other options are objectives and considerations of cable and cord inspections.*

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21.

What electrical installations does NFPA 70E apply to?

**Installations operating at 50 volts and above**

Installations operating at 1000 volts and above

Installations operating at 120 volts nominal

Installations operating both AC and DC

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*Correct answer: Installations operating at 50 volts and above*

*NFPA 70E applies to all electrical installations operating at 50 volts or above that are on the customer side of the service point. These include all standard voltages and power systems 120 and above.*

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**22.**

Who is OSHA 3071 Job Hazard Analysis designed for?

**Employers, foremen, and supervisors**

Management

Unqualified persons

Construction workers

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*Correct answer: Employers, foremen, and supervisors*

*3071 is directed towards employers, foremen, and supervisors. Yet, employees are encouraged to use the information as well to analyze their own jobs and recognize hazards. This is done in a step-by-step, easy to understand way.*

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**23.**

A barricade is a physical obstruction such as tapes, cones, or A-frame-type wood or metal structures intended to provide what?

**A warning and to limit access**

Accidental contact with equipment or energized parts

Protection from energized electrical conductors and circuit parts

A safe work place

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*Correct answer: A warning and to limit access*

*The NFPA's definition of a barricade is a physical obstruction such as tapes, cones, or A-frame-type wood or metal structures intended to provide a warning and to limit access.*

*The use of barricades is a primary protection for unqualified persons from entering work areas where qualified persons are engaged in electrical work. These are often used in conjunction with signs and/or attendants to ensure safety. See the Ugly's reference for further explanation.*

*A barricade should not be confused with a barrier. A barrier is generally inside of equipment or a panel providing protection from energized electrical conductors and circuit parts. A barricade is exterior to the equipment providing a safe workspace for qualified persons.*

*The other options are things a barricade may provide, or things we must prevent, but do not correctly describe what a barricade provides.*

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**24.**

Who is allowed to perform tasks such as testing, troubleshooting, and voltage measuring on electrical equipment where electrical hazards exist?

**Only qualified persons**

Engineers

Employers

Ex-military

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*Correct answer: Only qualified persons*

***Testing and test instruments and equipment*** are key elements of the **general requirements for electrical safety-related work practices**. An unqualified person cannot perform these tasks.

*Engineers, employers, and ex-military individuals are not inherently qualified, although it is possible that they are. Electrical engineers are an example of competent, qualified individuals, but engineers in general are not considered "qualified" in this case.*

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**25.**

The distance between a person's face and chest area and a prospective arc source is known as what?

**Working distance**

Touch potential

Step potential

Risk

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*Correct answer: Working distance*

*NFPA's simple definition of working distance is the distance between a person's face and chest area and a prospective arc source.*

*Touch potential is the potential gradient difference that can cause current to flow from hand to hand or hand to/through any other part of the body, other than foot to foot.*

*Step potential is a ground potential gradient difference that can cause current to flow foot to foot through the body.*

*Risk is any combination of the likelihood of occurrence of injury or damage to health or severe injury or damage to health that results from a hazard.*

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**26.**

A barrier is a physical obstruction that is intended to prevent contact with equipment or?

**Energized electrical conductors and circuit parts**

Accidental contact with equipment or energized parts

A safe work place

A warning and to limit access

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*Correct answer: Energized electrical conductors and circuit parts*

*The NFPA's definition of a barrier is a physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts. This is the cardboard-like, plastic, and other materials commonly found in electrical panels and equipment.*

*Review NFPA definitions for clarity on employing LOTO and other electrical safety measures. They are enlightening.*

*The other options may be provided by the definition, or are definitions of similar but different verbiage.*

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**27.**

Who is responsible for lockout/tagout (LOTO) principles?

**Each person**

The employer

OSHA

NFPA

*Correct answer: Each person*

***Employee involvement*** is what you need to identify here. ***Lockout/tagout principles*** are cornerstone to ***establishing an electrically safe work condition***. This is a ***general requirement for electrical safety-related work practices***.

NFPA 70E Article 120.2(A) says that ***each person*** who could be exposed directly or indirectly to a source of electrical energy ***shall be*** involved in the LOTO procedure. This means being included in the development of these procedures as well.

Here, employees have a duty to stand up and require these safety measures to be in place. Employers at large jobsites across the country now regularly say, "Everyone goes home healthy at the end of the day". Safe work practices ensure this. If your work practices do not, speak up!

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**28.**

Electrical safety training is required of all employees by all employers. This training is required to consist of what types of training?

**Classroom, on the job, or a combination of the two**

Videos, text, or a combination of the two

Formal education, on the job, or a combination of the two

Self-study, on the job, or a combination of the two

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*Correct answer: Classroom, on the job, or a combination of the two*

*As with all NFPA, OSHA, or Code-type literature, learn to recognize the key words or elements of the question. This will help you find the references needed to find your answer in each question or scenario.*

*Here, those key elements are: **type of training, electrical safety training, and training requirements**. These are all **general requirements for electrical safety-related work practices**.*

*Be proactive in your company's safety programs. They are designed to keep you safe, to be there for loved ones. If someone does get hurt, there are always more people affected.*

*The other options may be a part of training, but do not satisfy the question.*

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**29.**

Many power tools are designed to accommodate guards. When are tools required to be equipped with these guards?

**When in use**

When needed

When injury might occur without them

When OSHA is on sight

*Correct answer: When in use*

*This is a **general OSHA requirement** for both **hand and power tools**.*

*The term **guarding** is also used for the barrier within electrical equipment to protect a person from incidental contact. There are many terms that may be synonymous, but are used by an entirely different definition throughout the various codes. Know what is being spoken about or addressed in each question and real-life situation.*

*The other options are simply incorrect. Guards must be in place.*

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**30.**

Exposed energized conductors, circuit parts and other electrical hazards within enclosures are required to be maintained for what purpose?

**To guard against unintentional contact**

For identification of circuits

For general maintenance

To identify components

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*Correct answer: To guard against unintentional contact*

***Guarding of energized conductors and circuit parts*** is the focus point to recognize here. This is a ***general maintenance requirement of NFPA 70E***.

*These guards are most often provided by manufacturers. Even if installed afterward, they are to be maintained.*

*The other options are all general maintenance requirements, but are separately addressed issues.*

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31.

Where required by applicable state, federal, or local codes and standards, when using power tools or cords, what are employers required to provide employees with?

**GFCI protection**

Safety training

PPE

Adequate ventilation

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*Correct answer: GFCI protection*

***GFCI protection is essential to establishing an electrically safe work condition. There are virtually no circumstances where this is no longer a requirement.***

*The other options are also employer requirements, but do not satisfy the question.*

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**32.**

An arc flash hazard is a source of possible injury or damage to health associated with what?

**The release of energy caused by an electric arc**

The explosion caused by a sudden release of electricity

The release of electrical energy from its intended path

The release of energy caused by a sudden electrical discharge

*Correct answer: The release of energy caused by an electric arc*

*The question and answer together are the definition of an arc flash hazard as specified by the NFPA. It is the energy of electricity that causes the damage here. This is what all electrical safety and all LOTO measures are intended to prevent: the unexpected, sudden release of energy. This will happen at times without warning. In almost all cases, there is clear evidence that someone made a preventable mistake that caused the hazard. Things don't blow up by themselves.*

*Often, it was an error made some time ago, such as leaving a nut or bolt in the top of a panel that was later unseen and fell onto the bus. The fire marshalls often find evidence for this type of example. There are many other reasons, all with the same ending: a ball of fire 5 feet in diameter reaching instantaneous temperatures as hot as the sun, but thousands of degrees for the several seconds these can last.*

*This ball of fire is led by liquid copper or aluminum nearly instantaneously hitting its melting point at 800-1100 degrees. The amperage and voltages make the windows of the melting point lower than the actual melting point of the metals. These blasts are rarely survivable.*

*Common electrical short circuits are mini arc blasts. Burns or flying copper and aluminum slag injuries need immediate medical attention.*

*If a person is 5-25 feet from this blast, it is common for the skin to quickly turn red (thus, the 25-foot boundary rule). Electricians affectionately call this sunburn. It needs immediate medical attention.*

*The other answers are descriptive, but fail to accurately define an arc flash hazard.*

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**33.**

A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury is known as what?

**Electrical hazard**

Energized

Working on

Risk

*Correct answer: Electrical hazard*

*The question is the NFPA definition of electrical hazard and what electricians' risk when working on energized parts. When anyone comes into contact with energized parts, this voltage source presents a likelihood that an injury could occur. Learn to identify electrical hazards to reduce the risks associated with those hazards.*

*The other options are closely related. See definitions of other options in NFPA 70E for further review. The differences will help with testing and application.*

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**34.**

Lockout/tagout is about the control of hazardous energy in machines and equipment. When does this apply?

**During servicing and/or maintenance**

When electrical hazards exist

When release of stored energy is possible

When unexpected energization is possible

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*Correct answer: During servicing and/or maintenance*

*OSHA is outlined like other codes. In this question, note that the focus is **control of hazardous energy**, and the **application** of that control.*

*OSHA 1910.147 is about all forms of stored energy, not just electrical. With many types of equipment and machinery, all forms of energy must be controlled by LOTO. This may come from:*

- *air pressure*
- *hydraulic pressure*
- *springs*
- *any other energy source which may be present in the machine or equipment being worked on*

*Make sure you know what forms of energy could be present and LOTO them.*

*All other options are things we protect against with LOTO, but are not the focus of the question.*

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**35.**

How many types of alarm boxes are recognized by the NFPA 72?

5

3

4

6

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*Correct answer: 5*

*The 5 types of fire alarm boxes are:*

- 1. Auxiliary Alarm Box*
  - 2. Combination Fire Alarm and Guard's Tour Box*
  - 3. Main Fire Alarm Box*
  - 4. Master Alarm Box*
  - 5. Publicly Accessible Alarm Box*
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**36.**

What is the first priority in the implementation of safety-related work practices?

**Hazard elimination**

Infeasibility

Reduction of hazardous conductors and circuits

Temporarily eliminating electrical hazards

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*Correct answer: Hazard elimination*

*Recognize **priority** as a **general requirement for safety-related work practices** here. This is a **general requirement for safety-related work practices**.*

*Electricians often know best which energized sources anyone could come in contact with. To accomplish this priority, appropriately eliminate these.*

*All other options are considerations or language from Article 110, but are not the first priority.*

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**37.**

To ensure an electrically safe work condition, after power is disconnected, LOTO measures employed, and stored energy blocked, released, or bled off as needed, what should be tested prior to contact with potentially live parts?

**Test for the absence of voltage**

Test for voltage

Test each leg of the system

Test grounded and ungrounded conductors

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*Correct answer: Test for the absence of voltage*

*Prior to contact with potentially live parts, you must test to ensure the **absence of voltage**. This is the 7<sup>th</sup> step to an electrically safe work condition in Ugly's Electrical Safety and NFPA 70E. While not official, Ugly's has been a tool of the trade for many years. These steps may differ from the SOP of your company, but they are a very good model.*

*You should also perform a "live-dead-live" test with your meter when performing this test for the absence of voltage. This tests a known live energy source both before and after the test for the absence of voltage to ensure the proper functioning of the meter.*

*See NFPA 70E for the definition of an electrically safe work condition.*

*The other options are how we speak of the test or things to test, but it is the absence of voltage that must be ensured.*

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**38.**

A person who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk is considered what?

**A qualified person**

An employer

An engineer

Ex-military

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*Correct answer: A qualified person*

*As defined by the NFPA, a qualified person is a person who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk.*

*The other options may think they are qualified, but only if they meet the criteria in the definition.*

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**39.**

Which of the following indicates a recommendation, or that which is advised but not required?

**Should**

Guidance

Encourage

Counsels

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*Correct answer: Should*

*This is a definition from the NFPA 72 National Fire Alarm and Signaling Code. The Fire Alarm section of the NFPA does have recommendations, and uses the word should. This is rare in the NFPA language and should always be heavily considered.*

*The other options are synonymous but inaccurate.*

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**40.**

An electrically safe work condition is a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage, and what?

**If necessary, temporarily grounded for personnel protection**

Grounded

If necessary, documented

Identified potential back feeds

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*Correct answer: If necessary, temporarily grounded for personnel protection*

*This is the NFPA definition of an **electrically safe work condition**. It is the combination of these items that ensures safety. Remember, disconnect, LOTO, test, ground if necessary.*

*The other options may be related and/or are not the NFPA definition.*

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**41.**

Who is responsible for establishing, documenting, and implementing a lockout/tagout (LOTO) program?

**Each employer**

Each person

OSHA

NFPA

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*Correct answer: Each employer*

*Each employer is required to develop a **lockout/tagout program** to establish an **electrically safe work condition**. This is a **general requirement for electrical safety-related work practices**.*

*This program will spell out the procedures to safeguard workers from exposure to electrical hazards.*

*While OSHA and NFPA guidelines are what these LOTO programs are based on, it is the employer's responsibility to provide this program. Employees must then utilize this for their own safety.*

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**42.**

A goal of this Code is to provide an environment for the occupants that is reasonably safe from what?

**Fire**

Electrical hazards

Electrical fires

All hazardous conditions

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*Correct answer: Fire*

*Fire is a general goal of NFPA 101, Life Safety Code. This NFPA publication addresses egress, safeguards, occupancies, and a host of other issues related to life safety regarding fire.*

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# Electrical Theory and Principles

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Electrical Theory and Principles

43.

What common device uses pressure to produce electricity?

**Microphones**

Photocells

Batteries

Phone screens

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*Correct answer: Microphones*

*When pressure is applied to some materials, the simple force of this pressure is enough to cause the electrons in the valence shell to begin their journey.*

*Microphones operate on this principle.*

*Other materials, such as crystals and salts, are used in phonograph records and earphones.*

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**44.**

What theory states that current flow is produced when an electron from one atom knocks electrons of another atom out of orbit?

**Bump theory**

Electrical theory

Centripetal theory

Big Bang theory

*Correct answer: Bump theory*

*When a free electron from one atom strikes a valence electron in the next atom, the energy of the first is transferred to the second. The free electron now stays in the valence shell, sending the struck electron out of orbit. This electron becomes a free electron traveling to the next atom. And the process continues. It is the centripetal force of gravity that keeps electrons in their orbits.*

*The **energy released** or transferred when the free electron strikes the valence electron is in the form of **heat**. This is why electrical cords can be warm and electricity can cause a fire.*

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**45.**

What must exist for current to flow?

**A complete path**

A grounded conductor

A grounding conductor

An ungrounded conductor

*Correct answer: A complete path*

*This complete path is a **complete circuit**. It is how electricians must think. In dc applications, the term closed circuit is often used. In dc circuits, a closed loop is formed by the **power source, conductors, and load**. A flashlight is a good example of this.*

*The other options are conductors in an ac circuit. They may be a path, but do not satisfy the question.*

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**46.**How is the *rate of doing work* expressed?**Horsepower**

Power

Watts

EMF

*Correct answer: Horsepower*

*Horsepower is a term the average person could understand when we still rode horses. It is still useful and thus used today. Horsepower is denoted by hp.*

*The same James Watt the watt is named for determined horsepower. The average horse working at a steady rate can do 550 foot-pounds of work per second: 1 hp = 550 ft-lbs/s.*

*It is also expressed per minute as 1 hp = 33,000 ft-lb/min.*

*It was later calculated that the amount of electric energy needed to produce 1 horsepower is 746 watts. Thus, it is used in electrical calculations. Motors are rated in hp.*

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47.

What is the primary characteristic of an insulator?

**It resists the flow of electricity**

It contains seven or eight electrons

Their atoms are extremely stable

The electrons are held tightly

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*Correct answer: It resists the flow of electricity*

*Insulators are materials that resist the flow of electricity. Rubber, plastic, glass, and wood are good examples.*

*Any material that has seven or eight valence electrons is known as an insulator. If a free electron strikes one of the electrons of the atom in an insulating material, the energy of the moving electron is divided so many times it has little effect on that atom.*

*That said, if wire insulation is thin from extrusion or there are nicks, electricity could easily find its way out, causing a hazard.*

*The other options are all molecularly true, but are not the primary characteristic of insulators.*

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**48.**

Which electrons are responsible for the flow of electrical current?

**Valence electrons**

Inner shell electrons

Electrons in the first orbit

Second orbit electrons

---

*Correct answer: Valence electrons*

*So called due to their position in the outer ring, orbit, or shell of an atom, known as the valence shell. Electrons are in orbit, yet move in a spherical fashion; thus, shell is the useful term.*

*It is these **valence electrons** moving one at a time, from one atom's valence shell to the next, that result in electrical current.*

*Thus, electricians deal with the actions of **valence electrons** that surround atoms in conductive materials: primarily gold, silver, copper, and aluminum.*

---

**49.**

What is a main function of the grounding conductor?

**To provide a low-resistance path to ground**

To fulfill NEC requirements

To provide a path for transient voltage

To complete an AC circuit

---

*Correct answer: To provide a low-resistance path to ground*

*The grounding conductor is used to help prevent a shock hazard in the event the hot or neutral comes in contact with the enclosures, raceways, or equipment. It is the safety valve of an electrical system. Without this, anyone touching any part of the enclosures, raceways, or equipment would complete the circuit to ground. The resulting shock could be fatal. **Bond, bond, bond.** Never cut off or bypass the grounding prong of a plug.*

*The other options may be true, but do not satisfy the question.*

---

**50.**

Positively charged objects have outward-going lines of force while negatively charged objects have in-ward lines of force. What will these lines of force never do?

**Cross each other**

Aline

Co-inside

Reverse

---

*Correct answer: Cross each other*

*This is due to the **law of charges**: opposite charges attract and like charges repel. These lines do connect at the ends of opposite charged electrons, but never cross. These charges, forces, and/or actions are involved in all forms of electricity.*

*These lines of force create and/or are involved in magnetism, inductance, eddy currents, and other issues where current lines may and do cross. Electricians must understand how these build on each other to provide safe electrical installations.*

---

51.

What is the primary difference between scientific and engineering notation?

**Steps of 10 vs. 1000**

Steps of 100 vs. 10

European vs. U.S. standards

SI vs. ANSI

---

*Correct answer: Steps of 10 vs. 1000*

*Metric prefixes are used in the electrical field because it is based on science. Electricians do use standard metric prefixes: Pico, Nano, Micro, etc. However, electricians often follow the engineering notations which are in steps of 1000 vs. the scientific steps of 10.*

---

**52.**

As a semiconductor is heated, what happens to its resistance?

**It decreases**

It increases

It remains constant

It changes with light

---

*Correct answer: It decreases*

*Materials that are neither good nor bad conductors are classified as semiconductors. These contain 4 valence electrons.*

*The resistance of conductors increases with temperature. Thus, the characteristics of these materials have many but very different applications in electrical designs. More and more, these two materials are found integrated throughout electrical designs.*

---

**53.**

dc current flows in one direction. What is this known as?

**Unidirectional**

Bidirectional

Repulsion

Attraction

*Correct answer: Unidirectional*

*This is a basic characteristic of dc current required for the understanding, building, and troubleshooting of electrical systems. It is best to understand dc first, then study ac.*

- *dc is **unidirectional**.*
- *dc only **flows in one direction**.*

*In a dc circuit, electrons are repelled from the negative terminal and attracted to the positive terminal.*

*The other options are associated terms or characteristics of electrons.*

---

**54.**

All electrical power sources produce a positive terminal and negative terminal. Which way do the electrons flow when a circuit is completed between these two terminals?

**From negative to positive**

From shell to shell

From valence ring to valence ring

From the orbit of one atom to the orbit of the next atom

---

*Correct answer: From negative to positive*

*By various methods, excess electrons are produced in one terminal and a deficiency of electrons in the other terminal. When a circuit is completed between these terminals, the negative electrons are repelled away from the negative terminal and attracted to the positive terminal.*

*The other options are descriptive, but inaccurate.*

---

55.

How do conductors permit electrons to flow through them?

**Easily**

With low resistance

Bump theory

From shell to shell

---

*Correct answer: Easily*

*Atoms that have only one or two valence electrons are loosely held electrons and given up easily for current flow. Silver, copper, and gold have only one valence electron and are the choice conductors for electricity in that order.*

*Aluminum has three valence electrons, yet is a good natural conductor and is used because it is relatively inexpensive.*

*The other options are deeper characteristics or descriptions, but are incorrect.*

---

**56.**

What is the measure for the amount of power being used in a circuit?

**Watt**

Coulomb

Volt

Ohm

*Correct answer: Watt*

*Wattage is the measure of power used in a circuit. It is denoted as  $P$  in most electrical applications.  $P = E \times I$ .*

*You may occasionally see  $W$ , for watts. Engineers may use this in their equations. Wattage is proportional to the amount of voltage and current flow. The watt is also the SI equivalent of the joule.*

---

**57.**

What is the potential difference between two points of a conductor carrying a constant current of 1 amp when the power dissipated between these points is 1 watt?

**Voltage**

Ohm

Newton

Calorie

*Correct answer: Voltage*

*Voltage is potential difference or EMF, electromotive force. It is denoted as  $E$ , from EMF.  $E = I \times R$  (resistance).*

*This is the force that pushes electrons through a wire. It can be thought of as electrical pressure. A volt is the amount of potential necessary to cause 1 coulomb to produce 1 joule of work. It is the electrical potential to do something; it pushes current through a conductor.*

---

**58.**

When electrons are forced to change to a lower energy state, photons can be produced. What common electrical devices use this operating principle?

**Sodium and mercury vapor lights**

Solar cells

Photovoltaic

Photoconductive

---

*Correct answer: Sodium and mercury vapor lights*

*Light particles are photons, which are pure energy. Producing electricity from light involves the use of these particles. It is in these vapor-filled lights that the current flow to them is used to change the electrons in the vapor to a lower energy state, thus producing light.*

*These devices may include a capacitor in their wiring to initially boost the current or they slowly light (heat) up.*

*The other options are related to the use of photons, but involve other principles.*

---

**59.**

How are the quantities of frequency, force, and capacitance expressed?

**Hertz, Newton, and Farad**

Joule, Siemens, and Watt

Hertz, foot pound, and Ohm

Henry, Volt, and Farad

---

*Correct answer: Hertz, Newton, and Farad*

*These units are part of the SI or System International. This is a European-based system; the United States has ANSI and other governing agencies. Most of these derive from or coincide with European standards organizations. Many electrical discoveries were made by Europeans over the last centuries. The U.S. cooperates with these agencies as equals for engineering purposes.*

---

**60.**

What are the three principal parts of an atom?

**Electron, neutron, proton**

Atomic number, element, charges

Nucleus, eddy currents, electrons

Neutron, nucleus, positive charges

---

*Correct answer: Electron, neutron, proton*

*All matter is comprised of atoms. Matter is any substance that has mass and occupies space. Matter has three basic forms or states: solid, liquid, and gas. Elements are substances that cannot be chemically divided into two or more simpler substances.*

- *An atom is the smallest part of an element*
- *Protons are positively charged*
- *Electrons are negatively charged*

*Neutrons are a principal part of an atom, within the nucleus of the atom. They are electrically neutral and have no effect on the electrical characteristics of a substance or material.*

*The other options are related terms, but incorrect.*

---

61.

Conventional current flow theory states that current flows from where to where?

**From the most positive point to the most negative point**

From the most negative point to the most positive point

From the north pole to south pole

All current flows to ground

---

*Correct answer: From the most positive point to the most negative point*

*Conventional flow theory was defined by Benjamin Franklin. It states that current flows from the most positive point to the most negative. It is why the positive battery terminal in a car should not touch ground.*

*Electron flow theory states that because electrons are negative particles, current flows from the most negative point in the circuit to the most positive. The electron flow theory is more widely accepted as being correct.*

*Since the mid 1900s, most electrician and technician training has used the more accurate term **electron current flow**, which is from negative to positive.*

---

**62.**

What measurement uses a velocity factor to calculate?

**Wavelength**

Watt

Ohm

Joule

*Correct answer: Wavelength*

*The formula to calculate wavelength is:*

*L = length in feet*

*V = velocity factor*

*f = frequency in MHz*

*$L = V / f$*

*This is the length of the wave or the distance current travels during one AC cycle.*

*Frequency will be a given from the situation at hand. Velocity factors are found in engineering tables. This formula is a building block of ac theory.*

---

**63.**

What is the amount of resistance that allows 1 ampere of current to flow when the applied voltage is 1 volt?

**1 ohm**

1 watt

1 calorie

2 teslas

*Correct answer: 1 ohm*

*An **ohm** is the unit of **resistance** to current flow. It is denoted as  $R$ .  $R = E / I$ .*

*All materials have resistance. While resistance happens at the molecular level due to impurities and general physics, it is like a kink in a garden hose that restricts water flow.*

*Any time current flows through resistance, heat is produced. Larger wire size results in less resistance. Less resistance reduces voltage drop, and thus, the amount of power loss due to heating the conductor.*

---

**64.**

In a dc circuit, a short circuit occurs when too much current is allowed to flow. What has happened to this current?

**Current has bypassed the load**

Current has gone to ground

Current has stopped

Current has met increased resistance

---

*Correct answer: Current has bypassed the load*

*Every load offers resistance to the circuit and limits the amount of current that can flow. A short circuit has little or no resistance. Often, in a dc circuit, the conductors have touched, creating the short circuit, and the wires or circuit board will blow.*

*In an ac circuit, this condition is called a grounded circuit. The current has left the hot or neutral and touched ground somewhere. This is why we bond everything.*

*The other options can happen to current in a system and may cause a short circuit, but are incorrect.*

---

**65.**

Which way does current flow in electron flow theory?

**From negative to positive**

From positive to negative

From south to north

All current flows to ground

---

*Correct answer: From negative to positive*

*Electron flow theory is widely used and accepted as the more correct theory.*

*This is how we think of ac throughout the electrical industry.*

*Conventional current flow states that current flows from the most positive point to the most negative. It is used in engineering applications.*

*Since the mid 1900s, most electrician and technician training has used the more accurate term, **electron current flow**, which is from negative to positive.*

*The other options are all paths, but incorrect.*

---

**66.**

What does 1 volt to push 1 amp through 1 ohm describe?

**Ohm's law**

PIE

BTU

Force

---

*Correct answer: Ohm's law*

*Georg Simon Ohm discovered the correlations we commonly use in the PIE chart. These calculations are often done in an electrician's head. While we do not always remember all of it, it is the basis for all necessary electrical formulas and the sticker may be the most useful tool on your tool box lid.*

---

67.

What is produced when light hits a semiconductor?

Electricity

Resistance

Inductance

Current draw

---

*Correct answer: Electricity*

*Light is photons, which is energy. This energy acts on the electrons in semiconductors to produce electricity. This is the simple operating principle of all photovoltaic devices. The most common device is the photocell that we install in dusk to dawn lighting.*

---

**68.**

One ampere is equal to one coulomb per:

**second**

meter

foot

inch

---

*Correct answer: second*

*The ampere is the measurement we use to express the amount of current flowing through a conductor. This is also known as load. This comes from the fact that electrons are on the move over a certain measurement of time. In electrical formulas, current and amps are most often expressed by the letter I. This I stands for the intensity of current.*

---

**69.**

Why is the PIE chart useful?

**It shows 4 values and 12 electrical formulas**

As a lunch box sticker

As reference for voltage requirements

As an engineering reference

---

*Correct answer: It shows 4 values and 12 electrical formulas*

*Any two known values of the P,I,R,E, chart may be used to find the solution to any of the 12 calculations electricians use daily.*

*The other options are true, but do not best articulate why the PIE chart is useful.*

---

**70.**

What is a coulomb?

**A measure of charge**

An ampere

Current flow

Charles de Coulomb

*Correct answer: A measure of charge*

*A coulomb is the charge transferred by 1 ampere of current in one second. Coulomb is abbreviated C.*

*This unit of electrical charge is equal to the total charge possessed by  $6.25 \times 10^{18}$  electrons. That is, 6.25 quintillion electrons pass a single point in one second. André-Marie Ampère defined an ampere as 1 coulomb of electrons flowing past a single point in one second.*

*The other options are related, but inaccurate.*

---

**71.**

Of the six basic methods for producing electricity, which is the most common?

**Magnetism**

Water flow

Natural gas

Coal

*Correct answer: Magnetism*

*This is done through electromagnetic induction. It is the primary operating principle of generators and alternators.*

*The principle of electromagnetic induction is:*

- When a conductor is introduced to magnetic flux lines, voltage is induced into the conductor.*

*Electricity is always there; we just harness it. This is the reason harnessed is the more accurate term for producing electricity, though produced is still the more popular term.*

*Other methods of producing electricity are chemicals (used in batteries), pressure, heat, friction, and light.*

*The other options are the energy magnetism is created from.*

---

**72.**

In an ac circuit, what has happened when a path other than the one intended is established?

**The circuit has grounded**

The current has met increased resistance

A short circuit

The current has stopped

---

*Correct answer: The circuit has grounded*

*In ac circuits, there is a hot, neutral, and ground. The hot supplies the load and the neutral provides the return path for unused current. The ground bonds all enclosures, raceways, and equipment on the circuit in the event a fault occurs. Current only flows through the grounding conductor when a circuit fault develops. This is a hazard and it is why we have overcurrent protection on all circuits.*

***It is why we bond everything in an ac circuit.***

*In dc circuits, this is called a short circuit. The term is often used for an ac grounded circuit, but is a misnomer.*

*The other options are descriptive of circuits, but incorrect.*

---

# Equipment for General Use

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Equipment for General Use

73.

How is a receptacle marked that is designed for the direct connection of aluminum conductors and rated 20 amperes or less?

**CO/ALR**

Alum

No copper conductors

With a green triangle

---

*Correct answer: CO/ALR*

*A receptacle for aluminum conductors is found under **receptacles** under **equipment for general use**.*

*CO/ALR means aluminum, or a certain aluminum copper mix was used to construct the conductors.*

---

**74.**

What force is not to be transmitted to joints or terminals when flex cord is connected to devices or fittings?

**Tension**

Stress

Gravity

Electromagnetic

*Correct answer: Tension*

*Think about **pull at joints and terminals**. This is a **general** requirement of **flex cords and cables**, which are **equipment** and not conductors for **general use**.*

*Tension can cause undue stress on already expanding and contracting equipment due to heat. Connected cables and cords will wear out by design. Inspect them regularly for normal wear and tear.*

*The other options play a role, but are not the correct answer.*

---

**75.**

What is required to be rated not less than the control device controlling receptacle outlets that are supplied by permanently connected cord pendants for cord and plug connected loads on general-purpose branch circuits?

**The overcurrent protection device**

The GFCI

The AFCI

The circuit breaker

*Correct answer: The overcurrent protection device*

*Here, we have more items or keywords to identify than are required to find the answer. In order, they are: **control device, receptacles, cord pendants, cord connectors, cord and plug connected loads, attachment plugs, and general-purpose branch circuits.** The question is about **overcurrent protection devices**, a section all its own, but this is not needed.*

*Not obvious but needed is **equipment for general use, switches, and rating and use of switches.** A control device is a switch. There are eleven total topics, all of which should be recognized.*

*These are the four items in the order you need to find your answer:*

- **Equipment for general use**
- **Switches**
- **Rating and use of switches**
- **Cord and plug connected loads**

*All of the other options are overcurrent protection devices, but do not satisfy the question. Several would be applied in real life. The required rating would be on one of these devices, but any overcurrent protection device with the required rating could fulfill this requirement.*

*This actually imposes the overcurrent protection device rating (minimum 15 amps) on the snap switches or control devices, which are available in lower amperages.*

---

**76.**

Flexible cords, cables, and their associated fittings are required to be suitable for what condition(s)?

**Of use and location**

Of general purpose

In non-hazardous locations

In dry locations

---

*Correct answer: Of use and location*

***Suitability*** is the key word here. It concerns ***flexible cords and cables***, which are ***equipment for general use***.

Here we see that ***suitability*** is a simple requirement in the NEC. When this is the case, answers are often found nearer the ***general*** chapters. For more involved conditions, you may need to go further on in the Code, and at times multiple articles may become involved.

The other options are terms describing uses and locations, but do not satisfy the answer.

---

**77.**

A switch with a marked OFF position is required to completely disconnect which conductor(s) to the load it controls?

**All ungrounded conductors**

All circuit conductors

The ungrounded conductor

All grounding conductors

---

*Correct answer: All ungrounded conductors*

*First, see this is about **off indication**. It is also about the disconnecting means, thus, a **construction specification** concerning switches. **Switches are equipment for general use**. Off indication is under construction specs because not all switches are made this way.*

*This OFF indication is only used where the construction of the switch will disconnect all ungrounded conductors.*

---

**78.**

In accordance with 310.14(B), what are conductor ampacities of flexible cables permitted to be calculated under?

**Engineering supervision**

Article 400.5

Article 400.2

AHJ review

---

*Correct answer: Engineering supervision*

***Engineering supervision** is the key word to identify here, which is not obvious. Learn to see these things in Code questions. It is about **flexible cords and cables**, and not calculations.*

*While there are many calculations that electricians must do, there are some we are not qualified to do. Our real job is to check the engineers' calculations and speak up if we see an issue. We are often more experienced with real-world field conditions than engineers may be. Trust but verify.*

*The other answers may be applicable provisions, but not the correct answer.*

---

**79.**

Class 2 circuitry that is integral with a 125-volt, 15- or 20-amp receptacle is designed for what?

**A USB charger**

Harmonic reduction

A fire alarm circuit

Data center use

*Correct answer: A USB charger*

*The question describes **equipment for general use**. It does say **receptacle**. Continue then to find where **USB chargers** are addressed.*

*A reasonable idea is to begin searching class 2 circuitry. But the class 2 circuitry addressed in the question is that described under **USB chargers**. Here, it is not in the Code outline prior to the description. Some of these may be found from the index, but don't rely solely on that. It's not designed that way. Familiarize yourself with the concepts the outlines address within the articles. Here, receptacle is far more important to the question than the circuitry.*

---

80.

What is the minimum size for fixture wire?

18 AWG

16 AWG

14 AWG

20 AWG

---

*Correct answer: 18 AWG*

*Fixture wire is equipment for general use. It is not a wiring method or a conductor for general use. It is important to understand these differences in seemingly similar materials. They are logically categorized within the Code.*

---

**81.**

What are snap switches, dimmers, and control switches required to provide to connect metal faceplates to the equipment bonding jumper?

**A means**

A method

Equipment

A lead

*Correct answer: A means*

*There are four items to identify in this question:*

- **Equipment for general use**
- **Switches**
- **General-use snap switches, dimmers, and control switches**
- **Grounding**

*This is the order in the Code. But any items identified can then be ordered to find the answer.*

*This is the Code way of saying the device must have a ground screw. Learning how the Code applies the various definitions of these words will help you locate answers in the Code.*

*The other options are nearly synonymous, but not accurate.*

---

**82.**

Screws that attach a dimmer to their box are required to be the type provided with the listed device. Or, they may be machine screws with how many threads per inch?

**32 threads per inch**

16 threads per inch

24 threads per inch

20 threads per inch

*Correct answer: 32 threads per inch*

*There are four items to identify in this question.*

- **Equipment for general use**
- **Switches**
- **Mounting of general-use snap switches, dimmers, and control switches**
- **Box mounted**

*This is the order in the Code. But any items identified can then be ordered to find the answer. There are generally two to five items. Be aware of references to other sections of the Code within these identified items.*

*Electricians use several types of small screws. These are not interchangeable.*

---

**83.**

Motor-circuit switches are allowed to be what type of switch?

**Knife-switch**

Isolating-switch

Transfer-switch

General-use switch

---

*Correct answer: Knife-switch*

*There are four items to identify in this question.*

- ***Equipment for general use***
- ***Switches***
- ***General-use snap switches, dimmers, and control switches***
- ***Knife-switches***

*This is the order in the Code. But any items identified can then be ordered to find the answer.*

*Motor-circuit switches are rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.*

---

**84.**

In electric ranges and dryers where a single conductor is allowed to be used for both equipment grounding and the unbalanced load, what is this conductor considered?

**A current-carrying conductor**

An ungrounded conductor

A grounded conductor

A grounding conductor

---

*Correct answer: A current-carrying conductor*

*This is addressed under **ampacity tables** concerning the **ampacities for flex cable**, which is **equipment for general use**.*

*Here, we have ampacities for current-carrying conditions considered beyond the ampacity considerations under conductors for general wiring. These are general considerations of neutrals specifically addressed in several ways in Article 400.5(A).*

*This is specifically provided for at times under 250.140. Verify these provisions and allowances carefully to ensure they apply.*

*The other options are how conductors are addressed, but not specifically here.*

---

**85.**

Why are flex cords not to be grouped together by circuit, wiring method, or the number of conductors in such a way that this is exceeded?

**The limiting temperature of the conductors**

The maximum voltage ratings

The maximum amperage ratings

The maximum operating temperature

---

*Correct answer: The limiting temperature of the conductors*

**Ultimate insulation temp** is the issue to identify in this question. Also, **flex cords** are equipment for general use.

*All cords and cables are constructed to sustain certain temperatures. Flex cables and cords limiting temps must be taken seriously as they may be moved while under load. This can create an even more hazardous condition if limiting temps (working condition temps) are not adhered to.*

*The other options are all considerations, but not the correct answer here.*

---

**86.**

What is used to protect flex cables if they pass through holes in covers or outlet boxes?

**Bushings or fittings**

Chinese fingers or airplane cable

Tension or strain relief

Strain insulators or tension relief devices

---

*Correct answer: Bushings or fittings*

***Protection from damage*** is the focus of the question. This is a **general** requirement of **flex cords and cables**, which are **equipment** and not conductors for **general use**.

*The thin character of the structure of these holes means they can cut through cables. Remember, everything vibrates. This is a constant consideration for electricians. Vibrations plus cuts, nicks, or sharp edges will create a hazardous situation.*

*The other options are other types of support not used here.*

---

**87.**

A flexible cable on a 4-wire, 3-phase, wye circuit has more than 50 percent of the load consisting of nonlinear loads. Why is this neutral considered a current-carrying conductor?

**Harmonic currents**

Eddy currents

Unbalanced currents

Phase currents

*Correct answer: Harmonic currents*

*This is addressed under **ampacity tables** concerning the **ampacities for flex cable** which is **equipment for general use**.*

*Here, we have ampacities for current-carrying conditions considered beyond the ampacity considerations under conductors for general wiring. Previously, much is covered for straight ampacity calculations, which this section refers back to.*

*Specifically addressed here are wye- (star) connected systems. Many applications of this wye system will be non-linear load applications. Wye (star) is the more stable and versatile system and so is becoming or is the standard in many situations.*

*Due to their harmonics, the neutral potential actually has twice the current-carrying capacity. This does happen, especially on 480v systems, so it is important to be careful.*

---

**88.**

Individual conductors of flex cord and cable are required to be made of what?

**Copper flexible stranding**

Copper and aluminum

Solid conductors

Stranded wire

*Correct answer: Copper flexible stranding*

**Conductors** should be recognized here. These are **construction specs for flex**, which are **equipment for general use**, not conductors for general use.

*Here, the conductor of cable is seen in contrast to the conductor for general wiring, even though we generally use flex cord and cable. Identify distinctions like these to determine where to look in the Code for the issue at hand.*

*These conductors also have size requirements in Table 400.4. There are many construction requirements for flex in this section that electricians should be familiar with. We check these at installation.*

*The other options are inaccurate. Stranded is different than flex strands.*

---

**89.**

Is the neutral conductor in a 3-wire flex cable that carries only the unbalanced current from two phases of a 4-wire, 3-phase, wye-connected system considered to be a current-carrying conductor?

**Yes, the neutral conductor carries only the unbalanced current resulting from the phase differences.**

Yes, the neutral carries unbalanced current, but not necessarily the same current as each of the phase conductors.

No, the presence of flex sheathing does not influence whether the neutral carries unbalanced current.

No, it does not carry any current under balanced load conditions.

---

*Correct answer: Yes, the neutral conductor carries only the unbalanced current resulting from the phase differences.*

*In a 3-phase, 4-wire, wye-connected system, the neutral conductor is essential for carrying the net unbalanced current arising from the phase-to-neutral loads. This can vary depending on the balance and nature of the loads connected to each phase. Under purely balanced load conditions, the neutral would ideally carry no current. This scenario is specifically covered under guidelines and standards concerning ampacity calculations for flex cables, taking into account the specific characteristics and requirements of neutral conductors in wye-connected systems.*

---

**90.**

How many circuits can feed a multipole, general purpose snap switch?

One

Two

Three

Four

---

*Correct answer: One*

*There are four items to identify in this question:*

- ***Equipment for general use***
- ***Switches***
- ***Accessibility and grouping***
- ***Multipole snap switches***

*This is the order of items in the Code, but items may be identified in any order throughout the question. We all think differently. Then, recognize the priority of each item in the Code. This should lead you to your answer.*

*These push button switches are designed as one, two, and three circuit switches. Two and three circuit switches must be both listed and marked as such.*

---

91.

When there is an orange triangle on the front of an outlet, what does the receptacle have the means to reduce?

**Electromagnetic interference**

Harmonics

Neutral potential

Circuit failure

---

*Correct answer: Electromagnetic interference*

*This marking is an **isolated ground receptacle**. Receptacles are found under **equipment for general use**.*

*This marking is on the receptacle itself and not just the cover. You may see older models that are orange with a green triangle on the orange receptacle and receptacle cover.*

---

**92.**

In bathrooms, habitable rooms, stairways, or occupiable spaces, the neutral for controlled lighting circuit is required to be in at least how many switch locations?

**One**

Two

No locations

Three

*Correct answer: One*

*Here, **switches controlling lighting loads** is the focus. This is about the **installation of switches**, which are **equipment for general use**.*

*Identifying any 2-3 items like this, in any Code question, will provide a good place to begin your search in the Code. Here, begin with **equipment for general use**, then find the other items within that chapter.*

*As for the neutral, locating the neutral in one of these boxes allows it to be found if it is needed for testing or troubleshooting.*

*There are several conditions listed in the reference where this is not required.*

---

**93.**

When used as permitted, flexible cord is required to be energized from a receptacle outlet or cord connector body. If energized from a receptacle outlet, what else is then required?

**An attachment plug**

A female outlet

A male adapter

A female adapter

---

*Correct answer: An attachment plug*

***An attachment plug is an item to identify here. Attachment plug is under uses permitted, which is under a general address of flex cords and equipment for general use.***

*While this is a simple question, with temporary power, connections are sometimes chosen that are not the best and may not be safe. People have inserted flex cord wires into an outlet in temporary situations. This section forbids this.*

*Spider boxes have been known to have male plugs unsafely hot in rental equipment. It was believed these male plugs would be plugged into dead circuit receptacles to extend the supply of electricity during outages, back feeding the system. Rental shops don't always employ electricians to set up or repair temporary power equipment. Check, check, check.*

*The other options may be used with plugs and outlets, but are incorrect.*

---

94.

When initially installed, flex cord is required to be continuous and without what?

**Splices or taps**

Knicks or abrasions

Kinks

Damage

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*Correct answer: Splices or taps*

***Splices*** are the focus here. The question is a **general** address of **flex cords** and **equipment for general use**.

*Hard-service cord and junior hard-service cord 14 AWG and larger do have permissions with requirements. No other permissions are listed here.*

*The other options are things to check for, but not the answer here.*

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**95.**

Switches and circuit breakers may not disconnect which conductor of a circuit?

**Grounded conductor**

Ungrounded conductor

Bonding conductor

Grounding conductor

*Correct answer: Grounded conductor*

**Switches are equipment for general use.** The focus of the question is **grounded conductors**. Identify key words or phrases to find the path to your answer in the Code.

*Grounded conductors are mentioned throughout the Code. Identify 2-3 items in the question to see chapter headings, uses, materials, equipment, conditions, etc. Think about where the Code addresses them. This will lead you to your answer.*

*The grounded conductor may be disconnected if all the conductors of the circuit are disconnected simultaneously or if the grounded conductor cannot be disconnected until all the ungrounded conductors are disconnected.*

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**96.**

Temperature correction factors from Table 310.15(B)(1) that correspond to the temperature rating of the cord or cable are required to be applied to the ampacity in Table 400.5(A)(1) and Table 400.5 (A)(2) when the cord or cable is used in ambient temperatures other than what?

**30°C**

60°C

75°C

90°C

*Correct answer: 30°C*

***Ampacity tables*** are the issue here. However, the answer is not in the tables. This is about ***ampacities for flexible cords and flexible cables***, which are ***equipment for general use***.

*Temperature is a condition. Conditions are most often addressed in Code sections that refer you to tables. While temperature is a condition listed in many, if not most, tables, there are times certain conditions are addressed in sections. These are often a pivotal or a basic consideration which then leads you to tables or other references for correct uses and applications.*

***Other than*** in the question is a term most often found in sections. Look for additional references when you see this term.

*The other options are common temperature factors.*

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**97.**

What is required to be attached to the coil reel or carton of flexible cords and cables?

**Printed tags**

Maximum operating temperature

Sunlight resistant markings

Limited smoke markings

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*Correct answer: Printed tags*

**Standard markings** is what should come to mind in this question. This is a **general requirement for flex cable and cord**, which is **equipment for general use**. Flex cord and cable is different than conductors for general use. Cables and cords contain conductors but are not conductors themselves.

*This is an example of learning to think like the Code. Code questions may seem like the answer could be in one article or section, but the real issue is addressed in another article or section. Ask yourself: What materials, applications, or conditions are in the question?*

*Here again, an electrician's job consists of checking that the right materials are being used for the installation at hand.*

*The other options are optional markings that may be on the tags.*

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**98.**

What is a building or structure, or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less?

**Child care facility**

Hospital day care

A youth hostile

Day care facilities

*Correct answer: Child care facility*

*This is a prime example of why the NEC is never taught line by line. This definition is found under **equipment for general use**, then **receptacles**, **cord connectors**, and **attachment plugs (caps)**, then **definitions**.*

*Why? The Code has a history of placing items where a need arises for them to be addressed. But it does not articulate what the need was.*

*Code measures solve the problem.*

*We all know that little kids are curious about outlets. One possibility is this: Outlets have progressively provided more protection, from tamper resistance to GFCIs to tamper resistant AFCIs.*

*Seemingly misplaced addresses within the NEC directly apply to the situations, people or children the protection is focused on. Do child care facilities for children under 7 years old need the safest receptacles? Yes.*

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**99.**

The neutral conductor of a flexible cable that carries only the unbalanced current from other conductors of the same circuit is not required to meet the requirements of what?

**A current carrying conductor**

An ungrounded conductor

A grounded conductor

A grounding conductor

*Correct answer: A current-carrying conductor*

*This is addressed under **ampacity tables** concerning the **ampacities for flex cable**, which is **equipment for general use**.*

*Here, we have ampacities for current-carrying conditions considered beyond the ampacity considerations under conductors for general wiring. This is a general consideration of neutrals specifically addressed here. Essentially, delta systems by design operate this way safely.*

*The following paragraphs quickly address wye (star) systems, which is becoming the more common commercial system and thus the more common consideration for neutrals. Wye systems are addressed at several places in the Code. These can have twice the potential on a neutral.*

*The other options are how conductors are addressed, but not specifically here.*

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**100.**

Snap switches, dimmers, and control switches are required to be connected to which conductor?

**Equipment bonding jumper**

Supply-side bonding jumper

System bonding jumper

Main bonding jumper

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*Correct Answer: Equipment bonding jumper*

*There are four items to identify in this question.*

- **Equipment for general use**
- **Switches**
- **General-use snap switches, dimmers, and control switches**
- **Grounding**

*This is the order in the Code. But any items identified can then be ordered to find the answer.*

*These switches require a ground, as people touch them!*

*It is important to memorize bonding jumpers from their definitions in Article 100.*

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