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Your Personal Exams Guide

- NDA
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- SBI PO
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- RRB NTPC
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- RBI GRADE B
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RRB ALP 2019 (CBT 2) (Electrician Previous) Previous Year Papers (22 Jan 2019) Shift 1

Total Time: 1 Hour **Total Marks:** 75

Instructions

Sl No.	Section Name	No. of Question	Maximum Marks	Negative Marks	Positive Marks
1	Part B	75	75	0.33	1

1.) A total of 60 minutes is allotted for the examination.

2.) The server will set your clock for you. In the top right corner of your screen, a countdown timer will display the remaining time for you to complete the exam. Once the timer reaches zero, the examination will end automatically. The paper need not be submitted when your timer reaches zero.

3.) There will, however, be sectional timing for this exam. You will have to complete each section within the specified time limit. Before moving on to the next section, you must complete the current one within the time limits.

Part B

1. The maximum efficiency of a half-wave rectifier is **(+1, -0.33)**

   a. 33.3 %

   b. 40.6 %

   c. 66.6 %

   d. 72.9 %

---

2. Ammeter provides the path for: **(+1, -0.33)**

   a. Maximum voltage

   b. Minimum voltage

   c. Minimum current

   d. Maximum current

---

3. What is the SI unit of electromotive force? **(+1, -0.33)**

   a. Volt

   b. Newton

   c. Ampere

   d. Webers

---

4. The speed of a squirrel cage motor _ _ _ _ _ _ _ _ **(+1, -0.33)**

a. is changed by changing the number of stator poles

b. varies as per the stator line current

c. incorporates the resistance of rotor circuit

d. is changed by changing the rotor pole

---

5. A battery charger acts like a _ _ _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. converter

b. rectifier

c. cycloconverter

d. chopper

---

6. In an electric vehicle, a speedometer displays the speed of the vehicle, whereas a/an _ _ _ _ _ _ _ _ displays the speed of the motor: **(+1, -0.33)**

a. tachometer

b. barometer

c. magnetometer

d. altimeter

---

7. Grooves in cleat wiring are made of _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. porcelain

b. copper

c. glass

d. steel

---

8. What should be the insulation between the body of the electrical water heater and the connecting cable as per ISI? **(+1, -0.33)**

a. 0.01 kilo Ω

b. 1.00 kilo Ω

c. 0.01 mega Ω

d. 1.00 mega Ω

---

9. During electrical work which one of the following avoids electrical shock **(+1, -0.33)**

a. Dry wood

b. Wet rope

c. Metal rod

d. Wet wood

---

10. Lamp efficiency is measured in _ _ _ _ _ _ _ _ **(+1, -0.33)**

a. lumen/watt

b. lumen/lux

c. candela/watt

d. lux/watt

11. The speed of an induction motor falls slightly with the increase of: (+1, -0.33)

a. magnetic flux

b. load

c. resistance

d. capacitance

12. Which among the following is the temperature regulating component of an automatic electric iron? (+1, -0.33)

a. Heating element

b. Sole-plate

c. Thermostat

d. Pressure plate

13. How is a Lissajous pattern created? (+1, -0.33)

a. By drawing two square waves on different axis

b. By drawing square wave and sine wave on the same axis

c. By drawing two sine waves which are at right angles to each other

d. By drawing two sine waves on the same axis

14. What happens when an alternator is said to be over excited? (+1, -0.33)

a. Negative power factor

b. Unity power factor

c. Lagging power factor

d. Leading power factor

---

15. The recommended configuration for soldering is: (+1, -0.33)

a. Lap joint

b. Wave joint

c. Scarf joint

d. Butt joint

---

16. Which of the following electrodes is used for pipe earthing? (+1, -0.33)

a. Copper plate

b. Hollow GI rod

c. Solid GI rod

d. Copper solid rod

---

17. A three Input NOR gate gives high O/P when _ _ _ _ _ _ _. (+1, -0.33)

a. one I/P is high

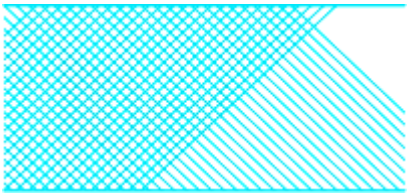
b. one I/P is low

c. all I/P are low

d. all I/P are high

---

18. Identify the type of file shown in the given figure. (+1, -0.33)



a. Curved cut file

b. Double cut file

c. Single cut file

d. RASP cut file

---

19. In which of the following transformers, the secondary winding is always kept closed? (+1, -0.33)

a. Current transformer

b. Potential transformer

c. Power transformer

d. Distribution transformer

---

20. Identify the type of lug used for connecting an aluminum cable to a copper bus bar. (+1, -0.33)

a. Insulated Sleeve Lug

b. Bi-Metallic Cable Connector

c. Bi-Metallic Cable Lug

d. Copper Lug

---

21. In a 3-phase system balanced star connected system, how many minimum watt-meters are sufficient to measure the total power? **(+1, -0.33)**

a. 4

b. 2

c. 1

d. 3

---

22. The pipe earthing resistance can be regulated by _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. replacing the conductor

b. adding a Copper rod

c. adding salt and water

d. replacing the earthing rod

---

23. If the resistance and impedance of the circuit is 10 ohms each, then its power factor is _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. zero

b. unity

c. leading

d. lagging

---

24. Which of the following is NOT an insulator? **(+1, -0.33)**

a. Glass

b. Mica

c. Wood

d. Gold

---

25. An alkaline cell is discharged at a steady current of 4A for 12 hours. To restore it to its original state of charge, a steady current of 3A for 20 hours is required. Calculate ah efficiency. **(+1, -0.33)**

a. 80%

b. 60%

c. 70%

d. 90%

---

26. The function of line supports in power transmission is to _ _ _ _ _ _ _. **(+1, -0.33)**

a. maintain adequate clearance between energized conductors and the ground

b. fix or hold service lines

c. to prevent lightning

d. act as a stay or guy wire

---

27. If the field of a DC shunt motor is opened while running, what will happen to the speed? **(+1, -0.33)**

a. Speed of the motor will remain constant

b. The motor will get locked

c. Speed of the motor will reduce

d. Speed of the motor will become dangerously high

---

28. Among the following, which meter is regarded as insulation tester? **(+1, -0.33)**

a. Megger

b. Frequency meter

c. Insulator

d. Wattmeter

---

29. Which of the following motor has the poorest speed regulation? **(+1, -0.33)**

a. Shunt motor

b. Series motor

c. Differential compound motor

d. Cumulative compound motor

---

30. Speed control of Universal Motors can be done by: **(+1, -0.33)**

a. magnitude control

b. Field flux control

c. Frequency control

d. Phase angle control

---

31. The frequency necessary to operate an electric stove is: **(+1, -0.33)**

a. 20 Hz

b. 50 Hz

c. 40 Hz

d. 10 Hz

---

32. _ _ _ _ _ _ _ _ _ _ _ type of relay is preferred for phase fault on short transmission line. **(+1, -0.33)**

a. Induction type

b. Impedance type

c. Reluctance type

d. Reactance type

---

33. If the armature of a DC motor has 39 slots with 12 conductors per slot. Then the total number of conductors are _ _ _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. 27

b. 468

c. 568

d. 51

---

34. During installation of a generator, one must carefully ensure that the generator terminals and all control wirings are correct so that the order of _ _ _ _ _ _ _ _ _ _ matches the system. (+1, -0.33)

a. Frequency sequence

b. Phase sequence

c. Amplitude sequence

d. Power sequence

---

35. Which among the given is the insulation resistance test voltage required for equipment running on a maximum of 600 volts? (+1, -0.33)

a. 100 V

b. 1000 V

c. 300 V

d. 500 V

---

36. Synchronous motors are_ _ _ _ _ _ _ _ _ _. (+1, -0.33)

a. Essentially self-starting

b. not-self starting

c. Self-starting

d. None of these

---

37. The turns ratio of an isolation transformer is: (+1, -0.33)

a. 1 : 1

b. 2 : 1

c. 1 : 3

d. 1 : 2

---

38. Choose the type of cable used for domestic appliances from the given options. (+1, -0.33)

a. Armored Cable

b. Submersible Flat Cable

c. Round Flexible Cable

d. Shielded Cable

---

39. A coil is connected across a 100V, 50 Hz supply. If the impedance of the circuit is 10 ohms, the current flowing through the circuit is _ _ _ _ _ _ _. (+1, -0.33)

a. 1000 A

b. 10 A

c. 1 A

d. 100 A

---

40. The inductive and capacitive reactances of an AC circuit are rated in _ _ _ _ _ _ _ _. (+1, -0.33)

a. volt-ampere reactive (var)

b. ohms

c. amperes

d. watt

---

41. Among the following, which metal is NOT usually preferred as flux for soldering applications? (+1, -0.33)

a. Borax

b. Zinc chloride

c. Ammonium chloride

d. Lead

---

42. What will be the backup time of a UPS if it is backed by 150 Ah, 12 V battery driving a load of 150 W? (+1, -0.33)

a. 14 h

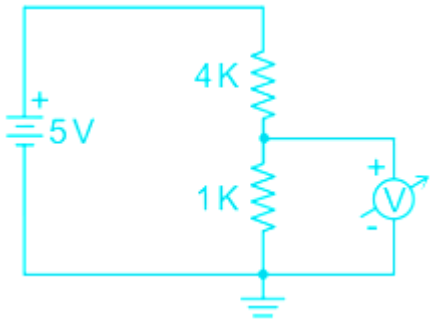
b. 10 h

c. 16 h

d. 12 h

---

43. What is the value displayed by the voltmeter in the given picture? **(+1, -0.33)**



a. 1 A

b. 4 V

c. 4 A

d. 1 V

---

44. Which of the following machines converts electrical energy into mechanical energy? **(+1, -0.33)**

a. Synchronous motor

b. SMPS

c. UPS

d. Dynamo

---

45. The conductor used in electrical wiring should be of _ _ _ _ _ _. **(+1, -0.33)**

a. iron

b. tin

c. copper

d. steel

---

46. Which among the following is the standard voltage used for primary distribution? (+1, -0.33)

a. 1 kV

b. 8 kV

c. 15 kV

d. 11 kV

---

47. The main purpose of flux in soldering is to: (+1, -0.33)

a. keep the metal surface clean and oxide - free

b. reduce melting point

c. ensure proper texture

d. reduce temperature

---

48. Which of the following meters are not used on D.C. circuit (+1, -0.33)

a. Commutator motor meters

b. Mercury motor meters

c. Induction meters

d. None of the above

---

49. The function of thermostat in an electric oven is to control the _ _ _ _ _ _ _ _ _ _. (+1, -0.33)

a. temperature

b. power

c. voltage

d. frequency

---

50. Which pliers are most suitable for cutting hard wires? (+1, -0.33)

a. Longnose pliers

b. Locking pliers

c. Wire strippers

d. Diagonal cutters

---

51. In Separately Excited Generator, the field windings are connected in: (+1, -0.33)

a. close circuit

b. Series with source

c. open circuit

d. Shunt with source

---

52. Which of the following acts as a protection against high voltage surges due to lightening and switching? (+1, -0.33)

a. Breather

b. Conservator

c. Horn gaps

d. Thermal overload relays

---

53. Trickle charging of storage battery helps to _ _ _ _ _ _ _ _ _ _ (+1, -0.33)

a. prevent sulphation

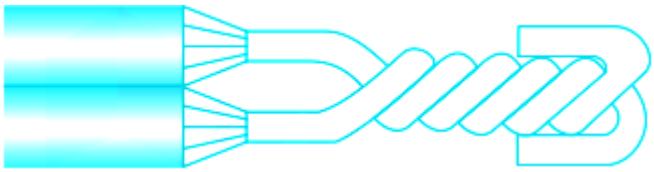
b. keep it fresh and fully charged

c. maintain the proper electrolyte level

d. increase its reserve capacity

---

54. Identify the type of joint shown in the picture from the given options. (+1, -0.33)



a. Scarfed Joint

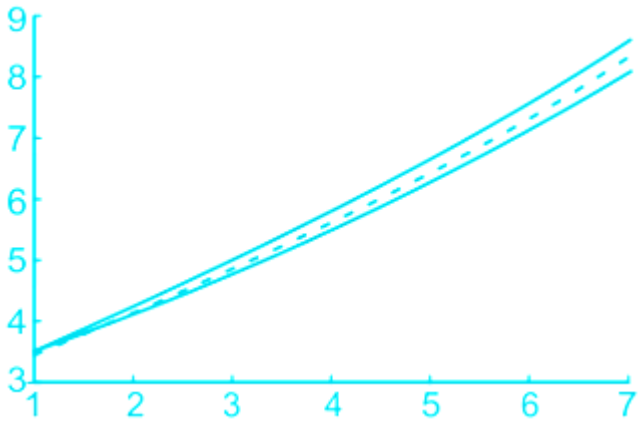
b. Tee Joint

c. Britannia Joint

d. Rat Tail Joint

---

55. Identify the type of error the instrument shows as in the given figure. **(+1, -0.33)**



a. Span Error

b. Hysteresis Error

c. Linearity Error

d. Zero Error

---

56. If a 200 kVA, 2000/200 V transformer has 100 turns in its secondary windings, then the number of turns in its primary are _ _ _ _ _ _ _ _ _ _. **(+1, -0.33)**

a. 1000 turns

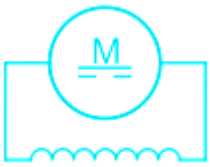
b. 10 turns

c. 100 turns

d. 10000 turns

---

57. The symbol in the given figure shows a: **(+1, -0.33)**



a. Servo motor

b. 3-phase induction motor

c. Synchronous motor

d. DC motor

---

58. A series of capacitance voltmeter can measure: (+1, -0.33)

a. DC current

b. AC voltage

c. DC voltage

d. AC current

---

59. Induced low voltage on metal equipment which causes low shock can be prevented using: (+1, -0.33)

a. phase line

b. earthing

c. neutral

d. insulated footwear

---

60. How many diodes are required to build a full wave rectifier from a Centre Tap transformer? (+1, -0.33)

a. 3

b. 1

c. 4

d. 2

---

61. For normal operation of NPN transistor: (+1, -0.33)

a. Emitter Base Junction must be reverse biased and Base-collector junction must be forward biased

b. Emitter Base Junction must be reverse biased and Base-collector junction must be reverse biased

c. Emitter Base Junction must be forward biased and Base-collector junction must be forward biased

d. Emitter-Base Junction must be forward biased and Base-collector junction must be reverse biased

---

62. How much energy is used by an 80% efficient, 2kW (input) motor running at a peak load for 5 hours? (+1, -0.33)

a. 4 kWh

b. 16 kWh

c. 2 kWh

d. 8 kWh

63. Series Generators are generally NOT used because of their terminal voltage: (+1, -0.33)

a. is very high

b. varies with load variation

c. is very low

d. does not vary with load variation

64. What is represented by the below symbol? (+1, -0.33)

a. Battery

b. Capacitor

c. capacitor polarized

d. Resistor

65. Which of the following methods cannot be used to reduce earth's resistance? (+1, -0.33)

a. Use of large size earth plates

b. Use of a mixture of powder, charcoal and salt

c. Burying the earth plate deep

d. Use of small size earth plates

66. Short _ _ _ _ _ _ _ Compound Generator is a type of DC generator. (+1, -0.33)

a. Shunt

b. Negative

c. Permanent

d. Series

67. Which device is used to increase the magnitude of the signal? (+1, -0.33)

a. Rectifier

b. Attenuator

c. Amplifier

d. Inverter

68. Transformers of rating above 500 kVA are called (+1, -0.33)

a. Varistor

b. Step-Up Transformer

c. Distribution Transformers

d. Dimmer-Stat

69. Which among the following starter CANNOT be used in DC motor? (+1, -0.33)

a. Three point starter

b. Four point starter

c. Star delta starter

d. Two point starter

---

70. The positive plate of nickel-iron cell is made up of (+1, -0.33)

a. Nickel hydroxide

b. Ferrous hydroxide

c. Lead peroxide

d. Potassium hydroxide

---

71. The lowest scale probe suitable for measuring 250 V DC using a CRO with I/P limit of 30 V is: (+1, -0.33)

a. 1000 X

b. 10 X

c. 1 X

d. 100 X

---

72. Insulator rings used for electricity delivery poles are made of _ _ _ _ _ _ _ _. (+1, -0.33)

a. Ceramic

b. Carbon Fiber

c. Bakelite

d. Epoxy

---

73. For which of the following purposes are low voltage lamps used? (+1, -0.33)

a. Flood lighting

b. Industrial lighting

c. Stadium lighting

d. Automotive lighting

---

74. Which tool is used for finishing a circular hole? (+1, -0.33)

a. Chisel

b. Half round file

c. Flat file

d. Drill

---

75. What will happen if the back emf of a D.C. motor vanishes suddenly? (+1, -0.33)

a. The motor will stop

b. The motor will continue to run

c. The armature may burn

d. The motor will run noisy

Answers

1. **Answer: b**

Explanation:

Concept :

The efficiency of a rectifier is defined as the ratio of dc output power to input power.

The efficiency of a half-wave rectifier will be:

$\eta = \frac{P_{dc}}{P_{ac}}$

$\eta = \frac{\frac{V_{dc}^2}{R_L}}{\frac{V_{rms}^2}{R_L}}$

V_{DC} = DC or average output voltage

R_L = Load Resistance

For a half-wave rectifier, the output DC voltage or the average voltage is given by:

$V_{DC} = \frac{V_m}{\pi}$

Also, the RMS voltage for a half-wave rectifier is given by:

$V_{rms} = \frac{V_m}{2}$

Calculation :

The efficiency for a half-wave rectifier will be:

$\eta = \frac{\left(\frac{V_m}{\pi}\right)^2}{\left(\frac{V_m}{2}\right)^2} = 40.6\ \%$

For Half wave rectifier maximum efficiency = 40.6%

Note : For Full wave rectifier maximum efficiency = 81.2%

2. **Answer: d**

Explanation:

Ammeter:

- It is used to measure the current.
- An ideal ammeter has zero internal resistance and thus it provides the path for maximum current.
- It is always connected in series as it measures current.
- The range of ammeter can be extended by using a low shunt resistance.

Voltmeter:

- It is used to measure the voltage.
- An ideal voltmeter has infinite resistance and thus it provides the path for minimum current.
- It is always connected in parallel as it measures voltage.
- The range of voltmeter can be extended by using a high series resistance.

---

3. **Answer: a**

Explanation:

- Electromotive force is the electric potential generated by either an electrochemical cell or a changing magnetic field; It is also known as voltage
- It is an electrical action produced by a non-electrical source, such as a battery (converts chemical energy to electrical energy) or generator (converts mechanical energy into electrical energy)
- Electromotive force is commonly denoted by the acronym emf , EMF or E
- The SI unit for electromotive force is the volt
- Electromotive force in a circuit maintains the potential difference

---

4. **Answer: a**

Explanation:

The speed of the induction motor can be controlled by the following methods:

1) V/f control (or) frequency control

2) Changing the number of stator poles

3) Controlling supply voltage

4) Changing winding resistance by adding rheostat in the stator circuit

We can apply all these methods to slip ring induction motors, but the adding resistance in the stator circuit is not possible for squirrel cage motors as rotor bars are short-circuited using end rings.

---

5. **Answer: b**

Explanation:

- A battery charger is a DC power supply source. Here a transformer is used to step down the AC mains input voltage to the required level as per the rating of the transformer.
- This transformer is always a high-power type and is able to produce a high current output as required by most lead-acid batteries.
- **A bridge rectifier configuration is used to rectify the low voltage AC into DC i.e. Rectifier is a device that converts AC into DC and** is further smoothed by a high-value electrolytic capacitor.
- This DC is fed to an electronic circuit which regulates the voltage into a constant level and is applied to the battery under charge, where the energy is stored through an internal process of the chemical reaction.
- In automatic battery chargers, a voltage sensor circuit is incorporated to sense the voltage of the battery undercharges. The charger is automatically switched OFF when the battery voltage reaches the required optimum level.

- **Chopper** is used to convert fixed dc to variable dc.
- **Cyclo-convertor** is a device that converts AC power at one frequency into AC power of adjustable but lower frequency without any DC current or DC stage in between.

---

6. **Answer: a**

Explanation:

A tachometer is an instrument measuring the rotation speed of a shaft or disk, as in a motor or other machine. The device usually displays the revolutions per minute (RPM) on a calibrated analogue dial, but digital displays are increasingly common.

---

7. **Answer: a**

Explanation:

- **In cleat wiring, VIR or PVC insulated wires are braided and compounded on walls or ceiling with the help of porcelain grooves** .
- In cleat wiring, weatherproof sheathed cables are used.
- Cleat wiring is Cheap, easy to repair, alteration and addition are also easy.
- In cleat wiring fault detection is easy.
- In the present days, this kind of wiring scheme is not recommended for a house or building. Only used for a temporary purpose. Because of bad appearance, chances for shock or fire, exposed to the weather to be affected by humidity, rain, smoke, sunlight, etc. It is not long-lasting.
- So, it is used in only 220 V in low ambient temperature.

---

8. **Answer: d**

Explanation:

- **Before commissioning or installing a water heater, the insulation resistance should not be less than 1.00 MΩ as per ISI.**

According to **I.E. Rule 48:**

- The insulation resistance between the wiring of installation and earth should be of such a value that the leakage current may not exceed 1/5000 the part or 0.02 percent of the full load current.
- The permissible voltage drop in a lighting circuit is 2% of the supply voltage plus one volt.
- The maximum permissible voltage drop in a power industrial circuit should not be more than 5% of the declared supply voltage.
- The insulation resistance of any wiring installation should not be less than 1MΩ.
- The earth resistance should not exceed the value of one Ω.

---

9. **Answer: a**

Explanation:

- **Dry wood comes under the category of insulator hence it avoids electrical shock during electrical work .**
- While wet wood and wet rope have electrical current conducting properties due to the presence of water molecules or moisture.
- The metal rod itself considered as a conductor of electricity.
- So that wet wood, wet rope & metal rod do not avoid electrical shock during electrical work.

---

10. **Answer: a**

Explanation:

Luminous effic iency: It is also known as radiant efficiency. It is defined as the ratio of energy radiated in the form of light, produces sensation of vision to the total energy radiated out by the luminous body.

Radiant efficiency = energy radiated in the form of light / total energy radiated by the body

Lamp efficiency is measured in lumen/watt.

Important Points:

Lamp	Lamp efficiency
Carbon filament lamp	3 – 4.5 lumen/watt
Osmium filament lamp	5 lumen/watt
Tantalum filament lamp	2 lumen/watt
Tungsten filament lamp	18 lumen/watt
Carbon arc lamp	9-12 lumen/watt
Flame arc lamp	8 lumen/watt
Neon discharge lamp	15 – 40 lumen/watt
Sodium vapour lamp(low pressure)	101-175 lumen/watt
Sodium vapour lamp(high pressure)	67- 121 lumen/watt
Mercury vapour lamp	30 – 40 lumen/watt
Fluorescent lamp	50 – 60 lumen/watt
Incandescent lamp	8 – 40 lumen/watt

11. **Answer: b**

Explanation:

- **When the load on the motor shaft increases, the load torque becomes higher than the motor torque. So that there is deceleration of rotor, due to which rotor speed is reduced** , which increases the slip of rotor w.r.t RMF.
- Due to increased slip induces more emf in the rotor and hence more current in the rotor circuit.
- The air gap power being transferred to the rotor is now higher than before and hence more current is drawn in from supply at stator terminals. Hence, the motor torque is increased.
- So, this increase in slip, rotor induced emf, rotor current, air gap power, motor torque goes on until the motor torque becomes equal to the required load torque. The increased load is now being driven at a lower speed.
- At no load, slip is quite small because the only amount of motor torque required is to overcome friction and windage.

12. **Answer: c**

Explanation:

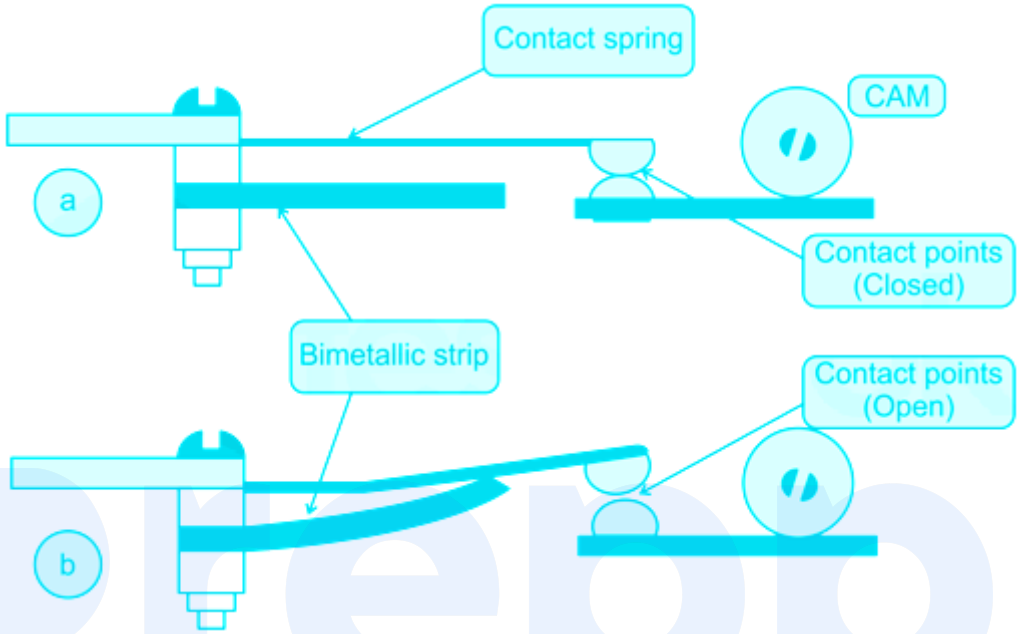
A thermostat is an important component of an electric iron that regulates its temperature. The main function of the thermostat in an electric iron is to make sure that the iron doesn't get too hot if it is left unattended to for a period of time.

When an electric current is passed through a coil in an electric iron, the coil becomes very hot. Through conduction, the heat is transferred to the flat base plate of the electric iron which is used to iron our clothes.

However, the heating element continues to get hotter so far there is a continuous drawing of electricity from the power supply. This result into a lot of energy wastage

and may damage the cloths.

At this point, thermostat comes in because it is important that the iron doesn't heat up to a temperature that is hazardous.



The thermostat in iron makes use of a bimetallic strip. This bimetallic strip is made up of two different types of metals (brass and iron) with a different coefficient of expansion bonded together.

Therefore, in the presence of heat, the bimetallic strip expands differently. The metallic strip is connected to a contact spring through small pins.

The bimetallic strip remains in physical contact with a contact point at a moderate temperature. However, at a temperature of the iron above a certain limit, the strip tends to bend towards the metal with a lower coefficient of expansion. At this point, the strip stops to be physically connected to the contact point and current stops flowing because of an opening of the circuit.

Position (a) is when the iron is at normal temperature

Position (b) is when the iron becomes too hot

13. **Answer: c**

Explanation:

- Lissajous figure is the pattern, which is displayed on the screen of CRO, when sinusoidal signals are applied to both horizontal & vertical deflection plates of CRO.
- **These patterns are generated by the junction of a pair of sinusoidal waves with axes that are perpendicular to one another** .
- These patterns will vary based on the amplitudes, frequencies and phase differences of the sinusoidal signals, which are applied to both horizontal & vertical deflection plates of CRO.
- Lissajous pattern is used for two types of measurement: frequency of the sinusoidal signal, phase difference between two sinusoidal signals

---

14. **Answer: c**

Explanation:

An overexcited alternator always supplies lagging current to the connected load, which means that load is of lagging nature. Lagging load take active and reactive power from the supply or alternator. Therefore, reactive power flows outwards from an over-excited alternator.

Important Points:

- Under excited alternator works at the leading power factor
- The normal excited alternator works at the unity power factor
- The overexcited alternator works at lagging power factor

For Synchronous motor its opposite of alternator,

- Under excited synchronous motor works at lagging power factor
- The normal excited synchronous motor works at the unity power factor
- The overexcited synchronous motor works at a leading power factor

15. **Answer: a**

Explanation:

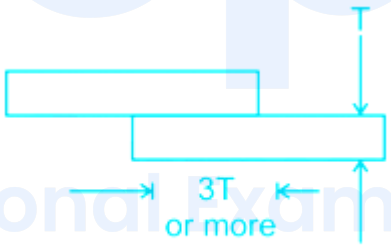
Both brazing and soldering are the metal joining processes in which parent metal does not melt but only filler metal melts filling the joint with capillary action.

Joint Design

a) Lap joint is the recommended form for these assemblies. Generally, the area of overlap in the joint is kept large in order to make it stronger than the weakest member of the assembly.

It is the recommended configuration for soldering.

A common thumb rule: Allow an overlap of at least three times the thickness of the thinnest member.



Lap joint (recommended)

b) Butt joints are avoided as they are weak due to small joint areas . They are not recommended unless strength requirements are very low and there is no need for a pressure seal at the joint.

Butt joint (not recommended)

c) Scarf Joint: To provide a greater joint area, scarf joints are recommended.

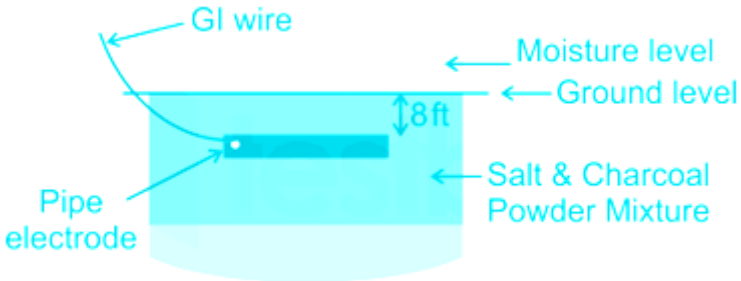
Scarf joint (not recommended)

---

16. **Answer: b**

Explanation:

- **Hollow GI rod electrode is used for pipe earthing** .
- In pipe earthing method the galvanized steel and perforated pipe of approved length and diameter in place upright in permanently wet soil.
- The size of the pipe depends upon the current to be carried and the type of soil.
- The size of the pipe uses for earthing is of diameter 40 mm and 2.5 meters in length for ordinary soil or greater length in case of dry and rocky soil.
- The depth at which the pipe must be buried depends on the moistures of the ground.
- The pipe is placed at 3.75 meters.
- The bottom of the pipe is surrounded by small pieces of coke or charcoal at a distance of about 15 cm.
- Alternate layers of coke and salt are used to increase the effective area of the earth and to decrease the earth's resistance respectively.
- Generally, 10 kg of charcoal and 10 kg of salt are used for this purpose.
- Another pipe of 19 mm diameter and a minimum length of 1.25 meters are connected at the top of the GI pipe by reducing the socket.



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17. **Answer: c**

Explanation:

The truth table of three Inputs (P, Q, R) NOR gate with 'Y' output is shown below

R	0	1	0	1	0	1	0	1
Q	0	0	1	1	0	0	1	1
P	0	0	0	0	1	1	1	1
Y	1	1	1	0	1	0	0	0

As shown in the truth table of three Input NOR gate, It gives high output when all the inputs are low or '0' .

---

18. **Answer: b**

Explanation:

The teeth of a file are formed by cuts made on its face. Files have cuts of different types.

Types of cut:

Basically there are four types: Single cut, Double cut, Rasp cut, and Curved cut.

Single cut File:

- A single cut file has rows of teeth cut in one direction across its face.
- The teeth are at an angle of 60° to the centerline.
- It can cut chips as wide as the cut of the file.

- Files with this cut are useful for filing soft metals like brass, aluminum, bronze, and copper.

Double cut file:

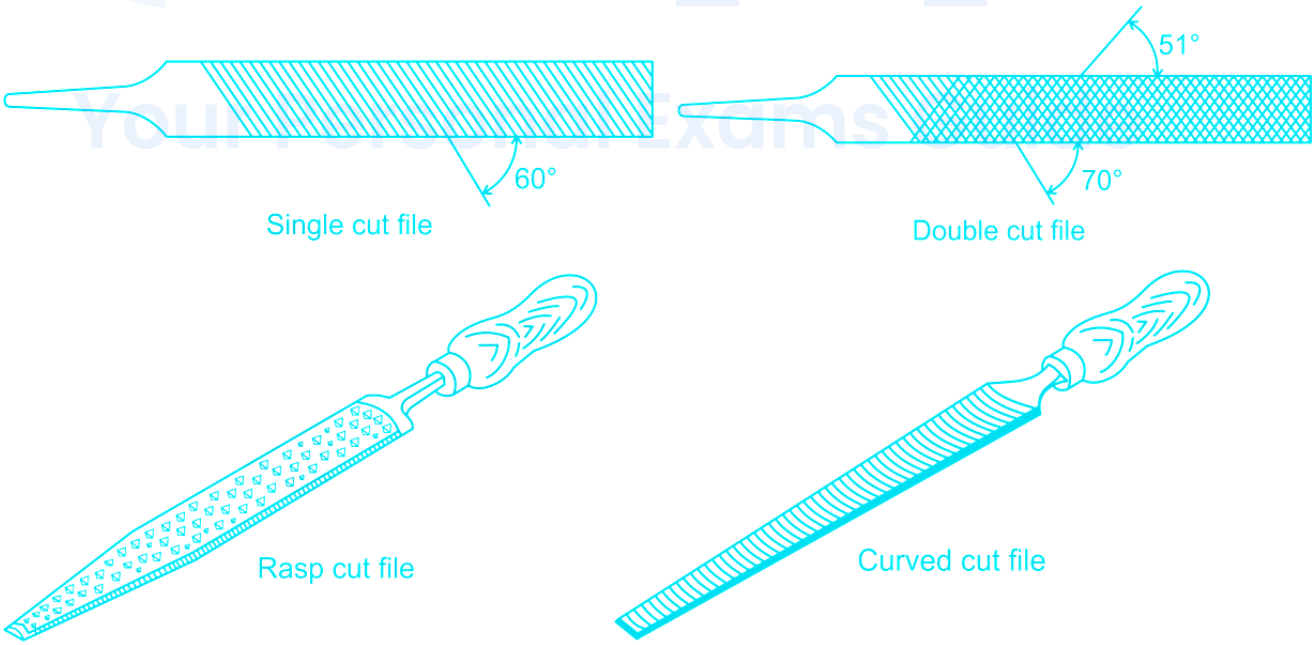
- A double cut file has two rows of teeth cut diagonal to each other.
- The first row of teeth is known as OVERCUT and they are cut at an angle of 70°. The other cut, made diagonal to this, is known as UPCUT. and is at an angle of 51°.
- This removes stock faster than the single-cut file.

Rasp Cut File:

- The rasp cut has individual, sharp, pointed teeth in a line, and is useful for filing wood, leather and other soft materials.
- These files are available only in half-round shape.

Curved cut file:

- These files have deeper cutting action and are useful for filing soft materials like- aluminum, tin, copper, and plastic.
- The curved cut files are available only in a flat shape.



19. **Answer: a**

Explanation:

Secondary side of the current transformer is always kept short-circuited in order to avoid core saturation and high voltage induction so that the current transformer can be used to measure high values of currents.

- The current transformer works on the principle of shorted secondary.
- It means that the burden on the system Z b is equal to 0.
- Thus, the current transformer produces a current in its secondary which is proportional to the current in its primary.

Important Points:

- The most important precaution in the use of a CT is that in no case should it be open-circuited (even accidentally).
- As the primary current is independent of the secondary current, all of it acts as a magnetizing current when the secondary is opened.
- This results in deep saturation of the core which cannot be returned to the normal state and so the CT is no longer usable.
- Again, due to large flux in the core the flux linkage of secondary winding will be large which in turn will produce a large voltage across the secondary terminals of the CT.
- This large voltage across the secondary terminals will be very dangerous and will lead to the insulation failure and there is a good chance that the person who is opening the CT secondary while primary is energized will get fatal shock.

---

20. **Answer: c**

Explanation:

- **Bimetallic Lugs are mostly useful where an aluminum cable has to be terminated by a copper bus bar or copper contact.**

- If Cable Lugs of only copper or aluminum are used, a galvanic action occurs due to dissimilar contact. The use of bimetallic lugs thus ensures a technically sound and durable joint.
- The Aluminium barrel is friction welded to the copper palm thereby achieving the best possible transition between barrel & palm.
- Copper lugs (cable lugs) are devices used for connecting cables to electrical appliances, other cables, surfaces, or mechanisms.
- The clamps that connect wires to an automotive battery are a common example of copper lugs, as are the ends of battery jumper cables

---

21. Answer: c

Explanation:

According to **Blondel's** theorem:

- When a system contains 'N' number of phases & 'N+1' wires, then 'N' number of watt-meters is required to calculate the total power of the system.
- When a system contains 'N' number of phases & 'N' wires, then 'N-1' number of watt-meters is required to calculate the total power of the system.
- In a 3-phase balanced and unbalanced star-connected system, two watt-meters are sufficient to measure the total power.
- **But if a 3-phase star connected system is balanced then only one wattmeter is sufficient to measure the total power** .

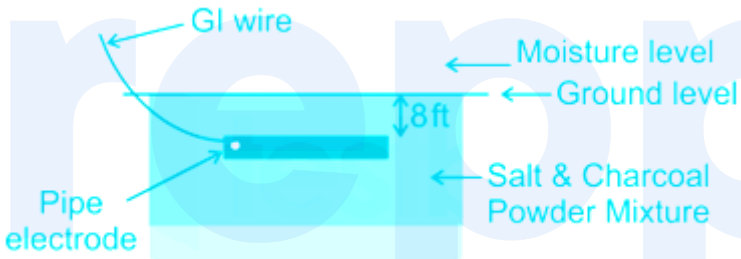
---

22. Answer: c

Explanation:

- **The pipe earthing resistance can be regulated by adding salt and water.**
- In **pipe earthing** method the galvanized steel and perforated pipe of approved length and diameter in place upright in permanently wet soil.

- The size of the pipe depends upon the current to be carried and the type of soil.
- The size of the pipe uses for earthing is of diameter 40 mm and 2.5 meters in length for ordinary soil or greater length in case of dry and rocky soil.
- The depth at which the pipe must be buried depends on the moistures of the ground.
- The pipe is placed at 3.75 meters.
- The bottom of the pipe is surrounded by small pieces of coke or charcoal at a distance of about 15 cm.
- **Alternate layers of coke and salt are used to increase the effective area of the earth and to decrease the earth's resistance respectively** .
- Generally, 10 kg of charcoal and 10 kg of salt are used for this purpose.
- Another pipe of 19 mm diameter and a minimum length of 1.25 meters are connected at the top of the GI pipe by reducing the socket.



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23. Answer: b

Explanation:

Concept:

In AC circuits, the power factor is defined as the ratio of the real power flowing to the load to the apparent power in the circuit.

Power factor = cos ϕ

Where ϕ is the angle between voltage and current.

If the current lags the voltage, the power factor will be lagging.

If the current leads the voltage, the power factor will be leading.

Power factor = cos ϕ = R/Z

$Z = \sqrt{R^2 + X^2}$

Where,

R = resistance

Z = impedance

X = reactance

The power factor is unity when the circuit is purely resistive.

Calculation:

Power factor = R/Z = 10/10 = 1 (unity)

---

24. **Answer: d**

Explanation:

In the above question except 'Gold', all given options are the examples of insulators.

Good Conductors	Fair Conductors	Good Insulators (Non-conductors)
Silver	Carbon	Oil
Copper	Human body	Fur
Gold	Moist human skin	Silk
Aluminum	Acid solutions	Wool
Magnesium	Salt water	Rubber
Tungsten	Earth	Porcelain, glass
Nickel	Water vapour (in air)	Plastic
Mercury		Wood
Platinum		Paper
Iron		Wax
		ebonite

25. **Answer: a**

Explanation:

Concept:

Ah Efficiency (η) = (Output ah)/(input ah)

Calculation:

Output ah = 4 × 12 = 48 ah

Input ah = 3 × 20 = 60 ah

Ah Efficiency (η) = 48/60 = 0.8

η% = 0.8 × 100 = **80%**

---

26. **Answer: a**

Explanation:

- Different types of structure (poles or towers) used for supporting the overhead lines or wires, such types of structures are called line supports.
- Line support plays a major role in power transmission. **It kept the proper spacing between the conductors and maintained the conductor at the prescribed distance from its ground parts** .
- It also maintained the specified ground clearance. These clearances are decided by electrical and mechanical considerations.
- The main requirement of the line supports is a low cost, low maintenance expense, and long life. The line supports are made up of wood, concrete, steel or aluminum.
- Types of Line Supports

1. Electric pole
2. Electric tower

- **Electric pole –:** A pole which is used for supporting the small voltage (not more than 115 kV) transmission lines, such type of pole is called an electrical pole. It is usually made up of woods, concrete or steel. These poles are mainly classified into three types

1. Wooden poles
2. RCC poles
3. Steel poles

- **Electric tower –:** The electrical tower is defined as the tower which is used for carrying the high voltage (above 230 kV) transmission lines.
- Such types of towers are made up of aluminum or steel which gives them strength for supporting the heavy electrical conductor. The electrical towers are broadly classified into various types .

1. Self- Supporting Towers
2. Guyed or Stayed Towers

---

27. Answer: d

Explanation:

In a DC shunt motor, $E_b \propto N\phi$

For a constant back emf, flux is inversely proportional to the speed of the motor.

If field winding is disconnected accidentally, the speed would dangerously increase in order to maintain the back emf of the motor. For a constant back emf, flux is inversely proportional to the speed of the motor.

In the case of a series machine if field winding disconnected, then the motor circuit is open and no current will pass through the armature, for the operation of machine interaction of two fluxes is necessary thus the machine won't operate.

---

28. **Answer: a**

Explanation:

- **The megger is known as an insulation tester.**
- Megger is a portable instrument to measure high insulation resistances.
- It works on the principle of electromagnetic induction.
- The electrical power to a megger is provided by a permanent magnet D.C. generator.
- The test voltages are usually of order 500, 1000, or 2500 V are generated by hand-driven generator (permanent magnet D.C. generator).
- The operation of a megger is based on moving coil meter.
- Earth pit resistance is measured with an earth tester, also called earth megger which can test the resistance across a range of currents and distances.
- Insulation megger is used to measure the insulation resistance of the cables.
- **Frequency meter** is used for measuring the unknown frequency of a signal. The frequency meter consists of one inductive and one resistive coil.
- When the frequency of the signal varies from standard frequency, the current distribution across the coils becomes changes.
- **The wattmeter** is an instrument used for the measurement of power.

---

29. **Answer: b**

Explanation:

The speed regulation of a DC motor is defined as the change in speed from no load to full load. It is expressed as a fraction or a percentage of the full load speed.

Percentage speed regulation $= \frac{N_{nl}-N_{fl}}{N_{fl}} \times 100$

No load speed of a DC series motor is very high. So, it has poorest speed regulation.

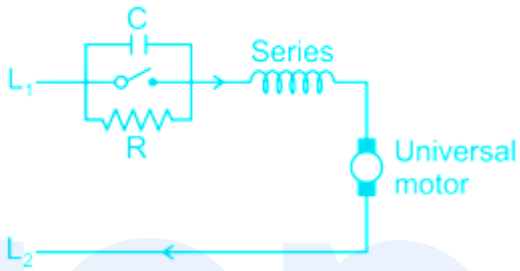
---

30. **Answer: b**

Explanation:

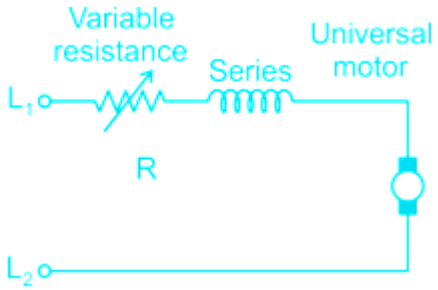
There are various methods to control the speed and to avoid the universal motor running at dangerous speed. One method is to build the universal motor into a device so that the motor would never run at no load. These types of motor are used for small applications that favour connecting the motor directly to the system that it drives. Other ways of controlling speed of a universal motor are

Centrifugal Mechanism for Speed Control:



If the motor speed rises above that set by the lever, the centrifugal device or switch opens two contacts and inserts a resistance R in the power circuit to the motor, which causes the motor speed to decrease. If the motor runs too slowly, the centrifugal device will close the two contacts and short circuit the resistance so that the motor speed rises. This process is repeated so rapidly that variations in speed are not noticeable. A resistance is connected across the centrifugal switch or device to perform this function. A capacitor C is used across the contact points in order to reduce sparking produced due to the opening and closing of these points.

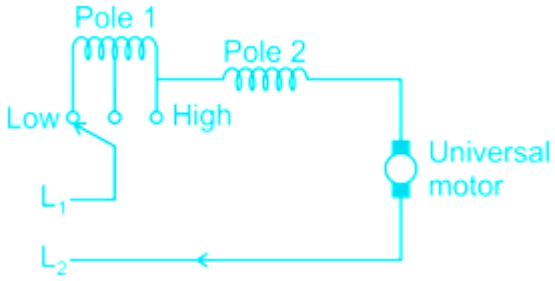
Resistance Method for Speed Control:



In this method, the speed of the electric motor is controlled or set by connecting a variable resistance R in series with the motor. Due to having the resistance before

the motor, the current to the motor is reduced, which in turns reduces the speed of the motor according to the setting of that variable resistance.

Field Tapping Method for Speed Control:



In this method, the field poles are tapped at various points so that the speed of the motor can be varied by varying the field strength. If there are more tapings from the field, then we can have various speeds for the motor. For this purpose of speed setting, the field poles are wound in various sections with different series of wire and taps are brought out from each section.

---

31. Answer: b

Explanation:

- **An electric stove is a domestic appliance, which is operating at 240 V, 50 Hz frequency.**
- A regular electric oven has a large coiled resistor as a heating element.
- A high electric current is passed through this element which generates heat, similar to the tungsten filament of an incandescent light bulb.
- Where induction stove doesn't generate heat itself, but rather induces it into the pot or pan. It happens due to a rapidly oscillating magnetic field.
- This field induces an electric current in a ferromagnetic pan which generates heat, thus heating the food.
- Generally, induction stoves operate at 25 kHz frequency.

---

32. Answer: d

Explanation:

- Reactance relay is suitable for the protection of a short transmission line because its operation is independent of arc resistance.
- **Reactance relay is used for the phase faults in a short transmission line.**

Important points:

- The relay which is selected for a long transmission line should be less affected due to power swings. Hence Mho relay is preferred.
- Mho relay is used for the phase faults in a long transmission line.
- Impedance relay is used for the phase faults in the medium transmission line.

---

33. Answer: b

Explanation:

Total number of conductor (Z) = (Total number of slots) (conductor per slot)

Z = (39) (12) **= 468**

---

34. Answer: b

Explanation:

- Waveform and phase sequence is fixed by the construction of the generator and its connections to the system.
- **During the installation of a generator, careful checks are made to ensure that the generator terminals and all control wiring are correct so that the order of phases (phase sequence) matches the system** .
- Connecting a generator with the wrong phase sequence will result in a short circuit as the system voltages are opposite to those of the generator terminal voltages.

- The voltage, frequency, and phase angle must be controlled each time a generator is to be connected to a grid.

---

35. **Answer: b**

Explanation:

- All the given test voltages in the question except 1000 V are less than the equipment maximum voltage of 600 V.
- Hence **the insulation resistance test voltage required for equipment running on a maximum of 600 volts is 1000 V.**
- The test voltages are usually of order 500, 1000, or 2500 V are generated by the hand-driven generator.
- The insulation resistance test is an electrical test that uses a certain type and level of voltage to measure insulation resistance in Ohms.
- The table below shows the required test voltage and the minimum required resistance in accordance with BS 7671.

Normal circuit voltage	Test voltage	Minimum resistance
Between 0 V to 50 V AC	250 V DC	0.5 MΩ
Between 50 V to 500 V AC	500 V DC	1 MΩ
Between 500 V to 1000 V AC	1000 V DC	1 MΩ

---

36. **Answer: b**

Explanation:

Characteristics of synchronous motors:

- Runs at constant speed at all loads
- Used for power factor improvement
- Inherently not self-starting
- The speed of operation of is in synchronism with the supply frequency
- It has the unique characteristics of operating under any electrical power factor
- It is used where high power at low speed is required such as rolling mills, chippers, mixers, pumps, pumps, compressor etc.

---

37. Answer: a

Explanation:

- An isolation transformer is a transformer used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source
- Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected
- Isolation transformers block transmission of the DC component in signals from one circuit to the other but allow AC components in signals to pass
- Transformers that have a ratio of 1 to 1 between the primary and secondary windings are often used to protect secondary circuits and individuals from electrical shocks between energized conductors and earth ground

---

38. Answer: c

Explanation:

- **Most of our domestic electrical appliances and light pendants will use round flexible cables, as it allows for flexible connections to the PowerPoint** .
- The round flexible cable is formed in a cross-section, normally with 2 or 3 cores insides a PVC outer sleeve coating.
- All of our general internal power cables within your home will probably use twin-core and earth cabling. As the name suggests, this type of cabling is formed from two cores, insulated with PVC outer sleeve, and an earth core between the two.
- An area such as a production/factory floor where heavy equipment being used is a prime example of a place where we might consider a **shielded cable** .
- For outside use, **Steel Wired Armoured (SWA)** cable is used to move power underneath the ground by burying the cable, or overhead using a catenary wire.

---

39. Answer: b

Explanation:

Current (I) flowing through the circuit can be calculated as

$I = \frac{V}{Z}$

Where,

V = Voltage across the circuit in volts

Z = Impedance of the circuit in Ω

$I = \frac{100}{10} = 10\ A$

---

40. Answer: b

Explanation:

- Inductive reactance (X_L), capacitive reactance (X_C), impedance (Z) & resistance (R) are calculated/rated in ohm (Ω).
- Reactive power (Q) is calculated/rated in VAR.
- Current (i) is calculated/rated in ampere.
- Active power (P) is calculated in watt.

---

41. Answer: d

Explanation:

- **Among the all given options except lead, all metals are usually preferred as a flux for soldering applications.**
- Soldering is the process by which metallic materials are joined with the help of another liquified metal (solder).
- All metal rust to some extent, when exposed to the atmosphere because of oxidation. The layer of the rust must be removed before soldering. For this, a chemical compound applied to the joint is called flux.

Different types of fluxes are given below

Inorganic fluxes:

Hydrochloric acid : Concentrated hydrochloric acid is a liquid that fumes when it comes into contact with air. It is used as a flux for sheet metals of zinc-iron or galvanized sheets. This is also known as muriatic acid.

Zinc chlorides: Zinc chlorides are known as killed spirits. It is mainly used for soldering copper, brass and tin sheets.

Ammonium chloride or Sal-Ammoniac : It is a solid white crystalline substance used when soldering copper, brass, iron, and steel (cast iron sheets).

Phosphoric acid: It is mainly used as a flux for stainless steel.

Borax: It is used in various household laundry and cleaning products. A mixture of borax and ammonium chloride is used as a flux when welding iron and steel. Borax is

also used mixed with water as a flux when soldering jewelry metals such as gold or silver.

Organic fluxes:

Resin: It is used for soldering copper, brass, bronze, tin plate, cadmium, nickel, silver and some alloys of these metals.

Tallow: It is a form of animal fat. It is used when soldering lead, brass, and electrical joints.

---

42. Answer: d

Explanation:

Concept:

Load Power = 150 watts

Rating of battery used in UPS = 12 Volts, 150 Ah

The energy supplied by battery = Voltage x Ah

Energy supplied by battery = 12 × 150 = 1800 watt-hour

∴ A battery can supply energy of 1800 watt-hour

Backup time = (Energy supplied by the battery)/(Load Power)

Backup time $= \frac{1800}{150} = 12\ h$

---

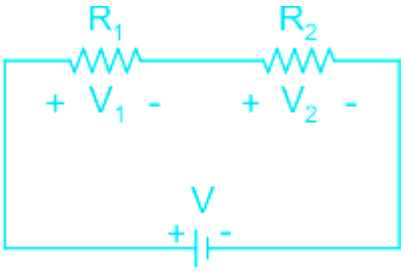
43. Answer: d

Explanation:

Concept:

Let the given voltmeter is ideal so that **resistance of voltmeter is infinity.**

Now by applying the Voltage division rule in the circuit diagram given in the question.



$V_1 = \frac{R_1}{R_1+R_2} \times V$

$V_2 = \frac{R_2}{R_1+R_2} \times V$

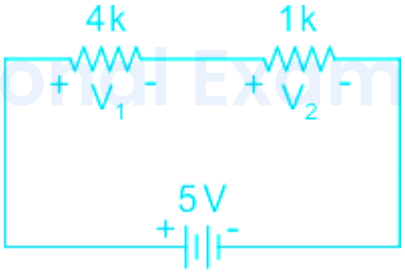
V $_1$ = voltage across R $_1$ resistance

V 2 = voltage across R 2 reistance

V = Total voltage

Calculation:

Given: V = 5 V



So, voltage across 1kΩ is,

$V_1 = \frac{R_1}{R_1+R_2} \times V$

$V_2 = \frac{1}{1+4} \times 5 = 1\ V$

---

44. Answer: a

Explanation:

- **An electric motor is an electrical machine that converts electrical energy into mechanical energy** .
- Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of rotation of a shaft.
- An **electric generator (Dynamo)** is mechanically identical to an electric motor, but operates in the reverse direction, converting mechanical energy into electrical energy.
- An **uninterruptible power supply (UPS**), also known as a battery backup, provides backup power when your regular power source fails, or voltage drops to an unacceptable level.
- A UPS allows for the safe, orderly shutdown of a computer and connected equipment.
- **SMPS stands for switch-mode power supply** . Its job is to convert wall-voltage AC power to lower voltage DC power.
- Most computer chips in modern computers require power generally of 1.2 - 3.3V, with some older devices requiring between 5 - 12V DC.

---

45. Answer: c

Explanation:

Electrical wire is made of materials like copper, aluminium and silver. As silver is expensive, mostly copper and aluminium are used in wiring.

Copper:

- It is a good conductor of electricity.
- It is used in wiring materials in cables.
- Is has low resistance and is used for conduction of electricity at high, medium and low voltage.

Aluminium:

- It is light weight and cheaper in comparison to copper. Therefore, this type of conducting material is mostly used in electrical wiring
- It is silvery–white in colour and it has a soft texture. It is often used in wiring and making cable.

---

46. Answer: d

Explanation:

Transmission lines and distribution lines can be discriminated by their operating voltage. The voltage levels of transmission and distribution are given below.

Power carrying system	Voltage level
Primary transmission	66 kV, 132 kV, 220 kV or 400 kV
Secondary transmission	33 kV
Primary distribution	11 kV
Secondary distribution	400 V

Important Points:

The differences between transmission and distribution lines are given below.

Transmission line	Distribution lines
It helps in the movement of electricity from the power plant to the substations	It carries electricity from the substation to the consumer's end
It carries electricity in three-phase supply system	It requires a single-phase supply system for carrying electricity
Carries electricity at a very high voltage	It carries electricity at a very low and safe level
These are thick lines	These are thin as compared to the transmission line

47. **Answer: a**

Explanation:

The main purpose of flux:

- In high-temperature metal joining process like welding, soldering The primary function purpose of flux material is to prevent oxidation of base and filler material.
- It also allows free flow of solder material on joints instead of forming beads.
- **It cleans the surface removing dirt and metal oxides also lowers the melting point of solder.**

⭐ Important Points

Fluxes used in soldering:

- There are two types of fluxes used in soldering
    1. Corrosive type
    2. Non-corrosive type
- The common corrosive fluxes are Zinc chloride , mixtures of Zinc chloride and ammonium chloride
- The flux must be washed off after soldering to prevent corrosion.
- The non-corrosive fluxes are rosin and a mixture of rosin and alcohol.
- These are essential for electrical connections where corrosion can create local high resistance and even loss of conduction.

---

48. **Answer: c**

Explanation:

- Mercury motor meters and commutator motor meter are used on DC circuit.
- In mercury motor meter the speed of motor is directly proportional to the circuit current.
- A counting mechanism is attached to the rotor which record the number of revolution of the rotor in the given time.
- The counting mechanism consists of worm wheel, spindle and gears.
- **Induction motor meter are used on AC circuit only.**

---

49. **Answer: a**

Explanation:

- **The thermostat is the part of the oven that is charged with regulating the oven's temperatur** e.
- This component monitors the interior temperature of the oven, turning on and shutting off the heat source according to the temperature setting.
- Thermostats are present in both gas and electric ovens.

---

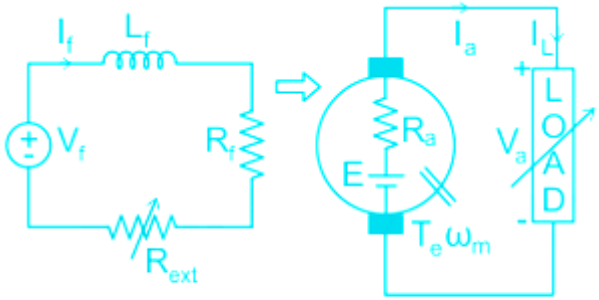
50. **Answer: d**

Explanation:

- **Diagonal pliers (or wire cutters or diagonal cutting pliers or diagonal cutters or side cutting pliers) are pliers intended for the cutting of wire (they are generally not used to grab or turn anything).**
- It is defined by the cutting edges of the jaws intersects the joint rivet at an angle or "on a diagonal".
- Diagonal pliers are useful for cutting copper, brass, iron, aluminum and steel wire.
- Lower quality versions are generally not suitable for cutting tempered steel, such as piano wire, as the jaws are not hard enough.
- Attempting to cut such material will usually cause indentations to be made in the jaws, or a piece to break out of one or both jaws, thus ruining the tool.
- However higher quality side cutters can cut hardened steel, such as 2 mm piano wire.
- **Needle-nose pliers** (also known as **pointy-nose pliers** ,**long-nose pliers** , pinch-nose pliers or snipe-nose pliers) are both cutting and holding pliers used by artisans, jewelry designers, electricians, network engineers and other tradesmen to bend, re-position and snip wire.
- Needle-nose wire cutters are often used by electricians because the sharply tapered jaws make it easy to bend and insert the wire into a switch-gear in electrical panels, where there is often not enough space to use any other type of pliers or cutters.
- **Locking pliers, mole grips (mole wrench) or vise-grips** are pliers that can be locked into position, using an over-center action.
- One side of the handle includes a bolt that is used to adjust the spacing of the jaws, the other side of the handle (especially in larger models) often includes a lever to push the two sides of the handles apart to unlock the pliers.
- A **wire stripper** is a portable handheld tool used by workers, especially electricians, for removing the protective coating of an electric wire to replace or repair the wire.
- It is also capable of stripping the end portions of an electric wire to connect them to other wires or terminals.

51. **Answer: b**

Explanation:



Equivalent circuit of a separately excited DC generator

- **Separately excited dc generator requires an independent dc external source for energizing the field winding.**
- **The field windings in a separately excited generator connected in series with dc external source.**
- The equivalent circuit representation under steady-state condition is shown in Figure.

The equations under steady-state are:

$V_f = I_f R_t$

$R_t = R_f + R_{ext}$

$V_a = E + I_L R_a$

$I_L = I_a$

Where V_f = External dc source

I_f = Field winding current

R_t = Net resistance across external source side

R_f = Field winding resistance

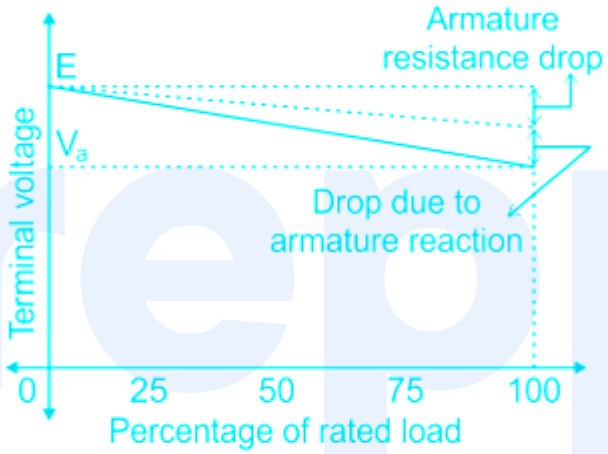
V_a = Voltage across load

E = Generated emf

I_L = Load current

I_a = Armature current

R_a = Armature resistance



V-I characteristics of separately excited DC generator

- When the field current is held constant and the armature is rotating at a constant speed, the induced emf in an ideal separately excited dc generator is independent of the armature current.
- As the load current IL increases, the terminal voltage decreases as indicated by a solid line. If the armature reaction is neglected, decrement in V_a should be linear and equal to the voltage drop across R_a and carbon brushes.
- However, if the generator is operated at the knee point in the magnetization curve the armature reaction causes a further drop in terminal voltage.

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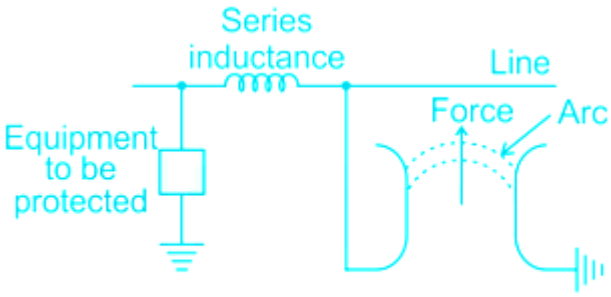
52. Answer: c

Explanation:



Horn gap connected in the system for protection

- **The horn gap acts as a protection device for an electrical power system from high voltage surges** .
- The horn gap consists of two horn-shaped rods separated by a small distance. One end of this is connected to the line and the other to the earth as shown in the figure with or without a series resistance.
- The choke connected between the equipment to be protected and the horn gap serves two purposes:
  - The steepness of the wave incident on the equipment to be protected is reduced.
  - It reflects the voltage surge back on to the horn.
- Whenever a surge voltage exceeds the breakdown value of the gap a discharge takes place and the energy content in the rest part of the wave is by-passed to the ground.
- An arc is set up between the gap, which acts as a flexible conductor and rises upwards under the influence of the electromagnetic forces, thus increasing the length of the arc which eventually blows out.
- **Thermal overload** relay works on the heat produced by the excessive overload current. The heat produced by the overload current is utilized to trip the motor circuit.
- These are mostly used for the protection of low-voltage squirrel cage induction motors or DC motors of lower output rating.

---

53. Answer: b

Explanation:

Whenever a storage battery is used as an emergency reserve, as in the case of un-interrupted power supply (UPS), it is necessary to keep the batteries fully charged and ready for use at any time if the mains supply fails.

A fully charged battery, which is not connected to any load is expected to maintain its terminal voltage. But, due to internal leakage in the battery and other open circuit losses, the battery voltage slowly falls even in idle or open circuit condition.

Therefore, **to keep it in fully charged condition, the battery should be supplied with a charging current which is small and just sufficient to compensate the idle condition or open circuit losses. This small current charging is known as Trickle charging.**

Trickle charging keeps the battery always fully charged and in ready to use condition, so that, the battery can be fully made use of in emergency conditions.

---

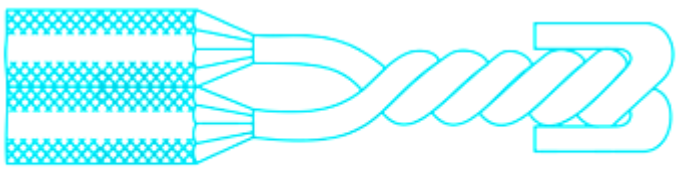
54. **Answer: d**

Explanation:

Pig Tail:

This joint is also called as Pig-tail/Rat-tail/Twisted joint.

This joint is suitable for pieces where there is no mechanical stress on the conductors, as found in the junction box or conduit accessories box



RAT TAIL JOINT

Married joint:

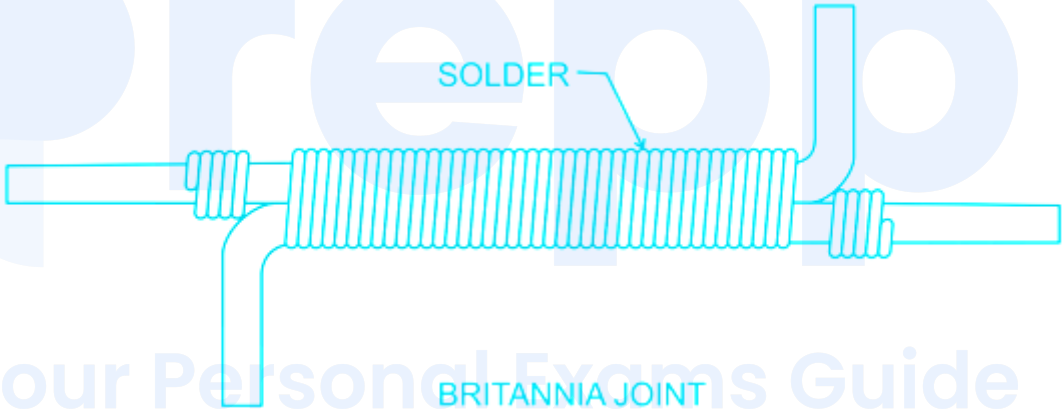
A married joint is used in places where appreciable electrical conductivity is required, along with compactness.

As the mechanical strength is less, this joint could be used at places where the tensile stress is not too great.

MARRIED JOINT

Britannia joint:

This joint is used in overhead lines where considerable tensile strength is required. It is also used both for inside and outside wiring where single conductors of diameter 4 mm or more are used.



BRITANNIA JOINT

---

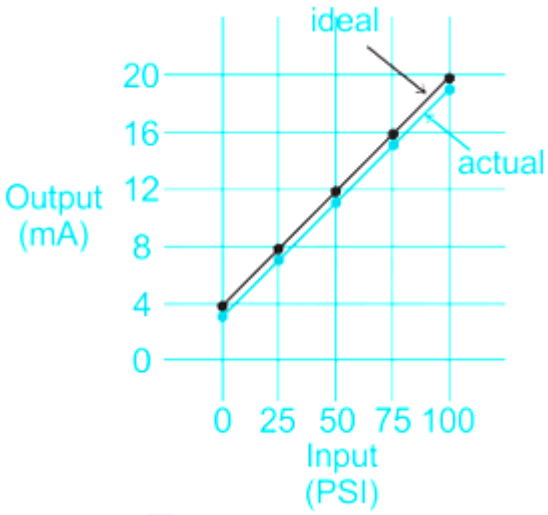
55. Answer: b

Explanation:

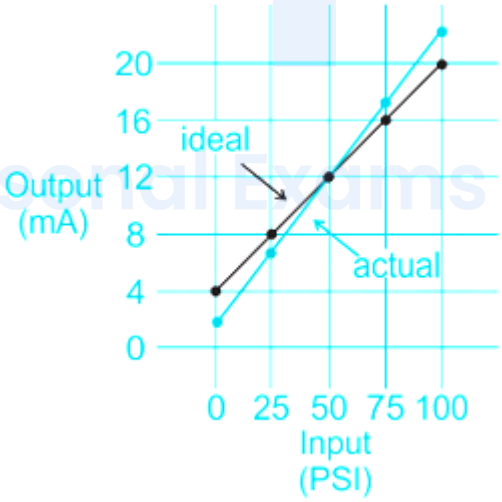
The type of error the instrument shows as in the given figure is of **Hysteresis Error**

Hysteresis error : The difference between the indications of a measuring instrument when the same value of the measured quantity is reached by increasing or by decreasing that quantity.

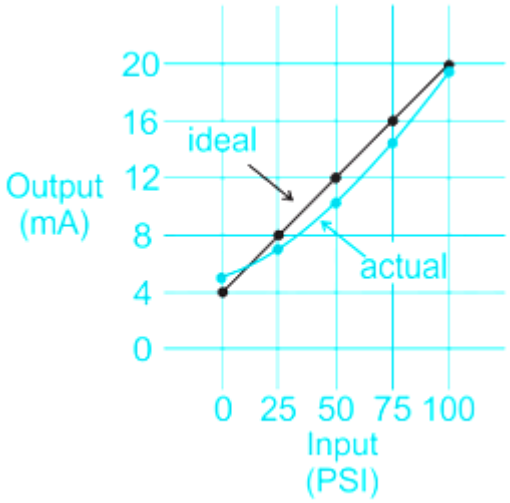
Zero error: It is a type of error in which an instrument gives a reading when the true reading at that time is zero. For example, the needle of ammeter failing to return to zero when no current flows through it.



Span Error: The normal mode error band defined by the maximum deviation of the span from its specified value. It may include sensitivity calibration temperature, linearity, hysteresis, repeatability, and stability deviations.



Linearity error: It is the deviation of the sensor output curve from a specified straight line over the desired pressure range. This linearity error is also defined as non-linearity.



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56. **Answer: a**

Explanation:

Concept:

In a transformer, the voltage & number of turns are related as

$\frac{V_1}{V_2} = \frac{N_1}{N_2}$

Where,

V_1= Voltage across primary side of the transformer

V_2= Voltage across the secondary side of the transformer

N_1= Number of turns in primary side of transformer

N_2= Number of turns in secondary side of transformer

Calculation:

V_1= 2000

V_2= 200

$N_2 = 100$

$\frac{2000}{200} = \frac{N_1}{100}$

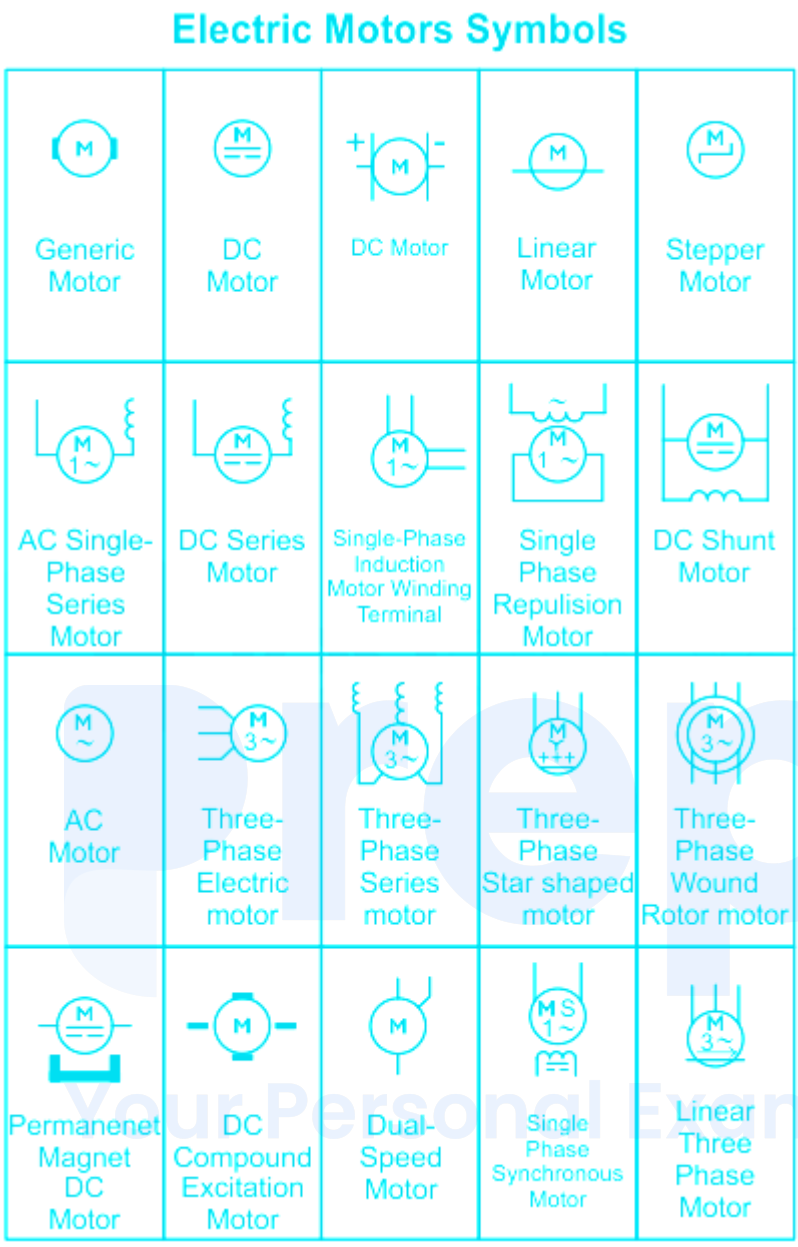
$\Rightarrow N_1 = 1000$

---

57. Answer: d

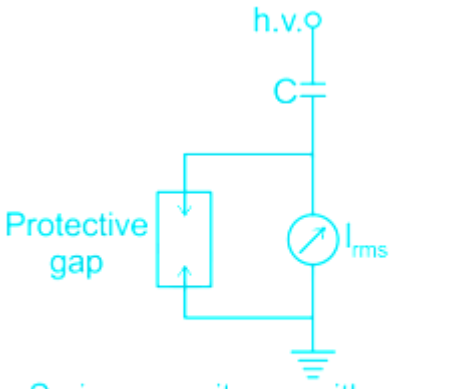
Explanation:

Given figure shows the symbol of DC shunt motor



58. **Answer: b**

Explanation:



Series capacitance with a milliammeter for measurement of high a.c. voltages

- **A series capacitance voltmeter is used instead of a resistor for A.C. high voltage measurements.**
- Series capacitance voltmeters are used with cascade transformers for measuring rms values up to 1000 kV.
- The series capacitance is formed as a parallel plate capacitor between the high voltage terminal of the transformer and a ground plate suspended above it.
- A rectifier ammeter is used as an indicating instrument and is directly calibrated in high voltage rms value.
- The meter is usually a 0-100 μA moving coil meter and the over-all error is about 2%

---

59. **Answer: b**

Explanation:

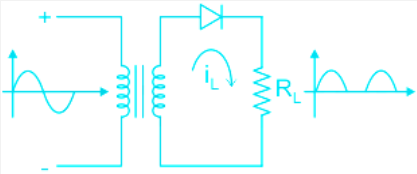
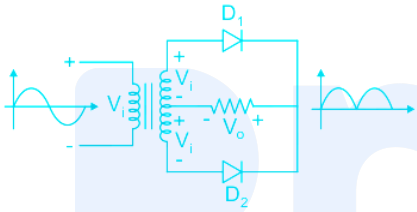
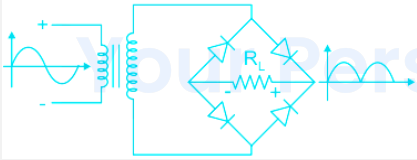
- **Induced low voltage on metal equipment which causes low shock can be prevented using earthing.**
- The main function of the earth wire is to prevent the live wire from overloading and absorbs the excess electrons & flows to the ground.
- Earthing is necessary to give protection against the danger of electric shock.
- The earthing protects the apparatus and personnel from the high voltage surges and lightning discharge.

- The earthing provides the easiest path to the flow of short circuit current even after the failure of the insulation.
- The earthing protects the personnel from the short circuit current hence it provides safety against shock.

---

60. **Answer: d**

Explanation:

CIRCUIT DIAGRAM	Number of Diodes	Average DC Voltage (V dc)	RMS Current (I rms)	Peak Inverse Voltage (PIV)
 Half-Wave Rectifier	1	$\frac{V_m}{\pi}$	$\frac{I_m}{2}$	V_m
 Center-Tap Full Wave Rectifier	2	$\frac{2V_m}{\pi}$	$\frac{I_m}{\sqrt{2}}$	$2V_m$
 Bridge-Type Full Wave Rectifier	4	$\frac{2V_m}{\pi}$	$\frac{I_m}{\sqrt{2}}$	V_m

61. **Answer: d**

Explanation:

The modes of operation of an NPN transistor are as follow:

Emitter-base junction	Collector-Base junction	Mode
Reverse bias	Reverse bias	Cutoff
Reverse bias	Forward bias	Reverse active
Forward bias	Reverse bias	Active
Forward bias	Forward bias	Saturation

From the above table, we can conclude that for normal operation (active mode) of NPN transistor, emitter-base Junction must be forward biased and base-collector junction must be reverse biased .

---

62. **Answer: d**

Explanation:

Concept:

Efficiency (η) = (Output power)/(Input power)

Energy = (Power) (Time)

Calculation:

Output power = (Input power) (Efficiency) = 2 x 0.8

Output power = 1.6 kW

Output energy = 1.6 x 5 = 8 kWh

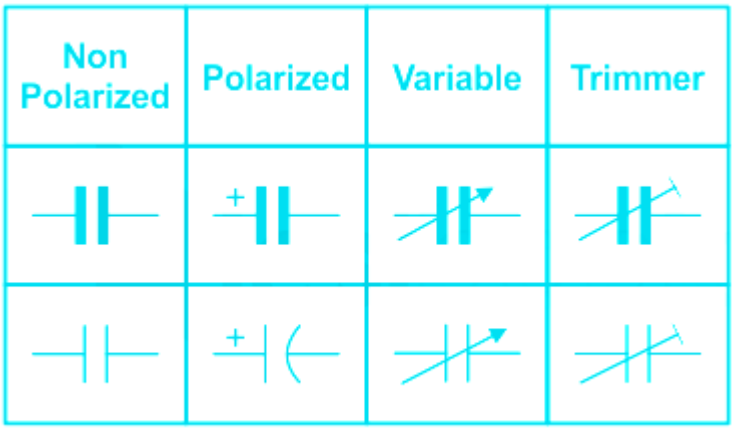
63. **Answer: b**

Explanation:

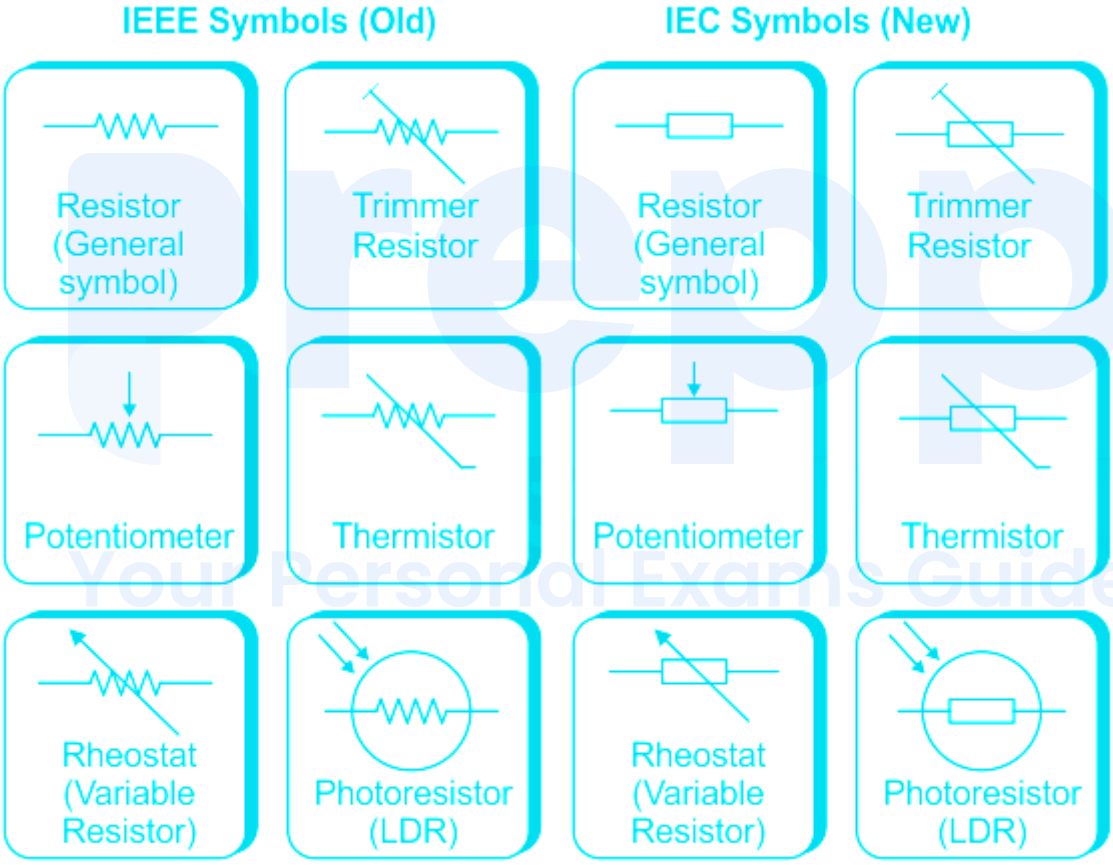
- In the series dc machine, there is one field winding wound over the main poles with fewer turns and a large cross-sectional area.
- Series winding is meant to be connected in series with the armature and naturally to be designed for rated armature current.
- So, there will be practically no voltage or very small voltage due to the residual field under no-load condition ($I_a = 0$).
- However, the field gets strengthened as the load will develop rated voltage across the armature with reverse polarity, is connected and terminal voltage increases.
- **Variation in load resistance causes the terminal voltage to vary. The terminal voltage will start falling, at saturation armature reaction effect becomes pronounced at large load current.**
- **Hence, series generators are not used for delivering power at a constant voltage.** Series generator found application in boosting up the voltage in d.c transmission system.

64. **Answer: c**

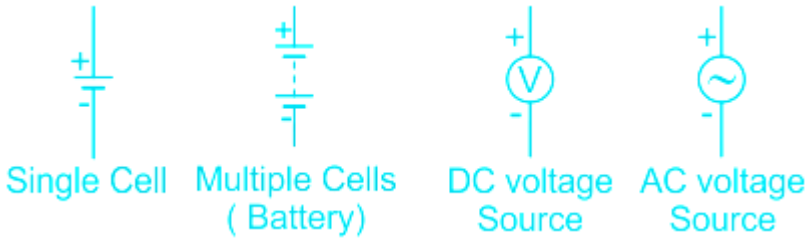
Explanation:



Symbols of Capacitors



Resistor & Different Symbols of Resistors



65. **Answer: d**

Explanation:

The resistance of earth is the resistance between infinite earth and earth electrode. It is depending on the condition of the soil, moisture content, dissolved salts and temperature of the soil.

There are several ways we can improve earth electrode resistance:

- By pouring water in the earth pit at repeated intervals
- **By increasing the plate area**
- **By using longer rod deeper into the earth**
- By using multiple rods
- To reduce soil resistivity, it is necessary to dissolve in the moisture particle in the soil; **Some substance like salt/charcoal is highly conductive in water solution.**

Important Point:

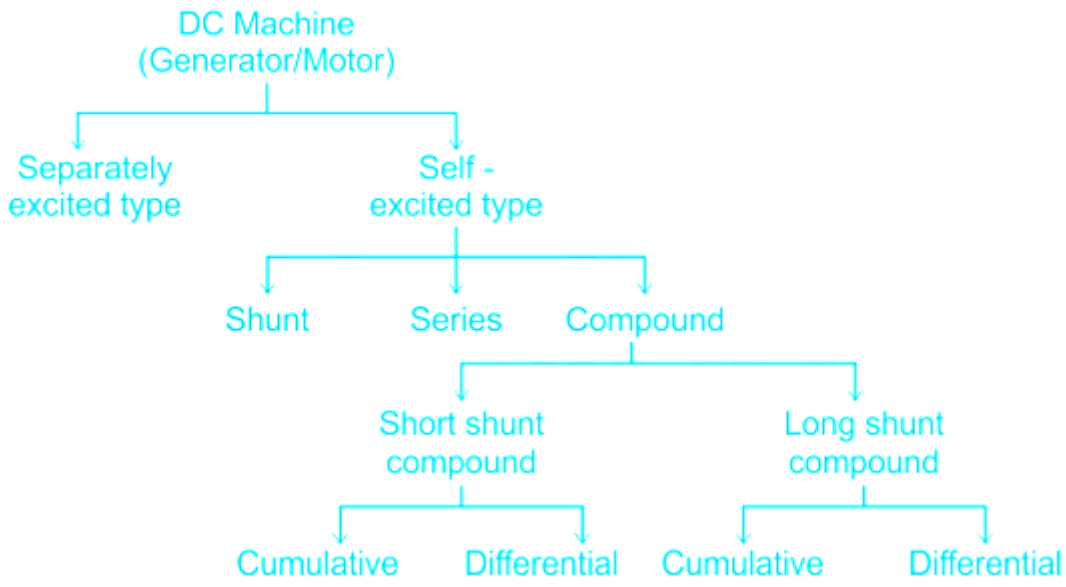
Methods of earth resistance measurement:

- 2-point dead earth method
- 3-point or fall of potential method
- 4-point method
- Clamp-on method

66. **Answer: a**

Explanation:

Classification of DC machine (generator/motor)



67. **Answer: c**

Explanation:

- **The Amplifier is an electronic circuit that is used to increase the strength of a weak input signal in terms of voltage, current, or power.**
- The process of increasing the strength of a weak signal is known as amplification.
- An amplifier is used to obtain an amplification of the frequency response of a communication signal.
- It is because reactance of the capacitors in the circuit changes with signal frequency and hence affects the output voltage.
- The curve drawn between voltage gain and the signal frequency of an amplifier is known as frequency response.
- **An attenuator** is an electronic device that reduces the magnitude of an electrical signal without appreciably distorting its waveform.
- An attenuator is effectively the opposite of an amplifier. An amplifier provides gain, while an attenuator provides loss, or gain less than 1.
- **A rectifier** is an electronics device that converts ac signals into dc signals.
- **An inverter** is an electronics device that converts dc signals into ac signals.

68. **Answer: c**

Explanation:

- **Distribution transformers have rating above 500 kVA.**
- Distribution transformers are used for lower voltage distribution networks as a means to end user connectivity. (11kV, 6.6 kV, 3.3 kV, 440V, 230V) and are generally **rated less than 200 MVA** .
- Power transformers are used in transmission network of higher voltages for step-up and step-down application (400 kV, 200 kV, 110 kV, 66 kV, 33kV) and are generally rated above 200MVA.
- Dimmer-stat is controlling device used in electrical circuits. Generally, they are resistance coil/induction coil serve as like as a potentiometer/autotransformer does. Dimmer-stat is used to adjust the output potential/voltage to an electrical circuit.
- All single-phase dimmer-stat are rated for 240 V, 50 Hz single phase supply. 3 phase dimmer-stat are rated for 415 V, 50 Hz 3 phase 4 wire supply.
- A transformer that increases the voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a step-up transformer.
- Multi-layer varistor (MLV) devices provide electrostatic discharge protection to electronic circuits from low to medium energy transients in sensitive equipment operating at 0-120 volts dc.
- They have peak current ratings from about 20 to 500 amperes, and peak energy ratings from 0.05 to 2.5 joules.

69. **Answer: c**

Explanation:

- **A star-delta starter is the most commonly used method for the starting of a 3 phase induction motor.**

- In star-delta starting an induction motor is connected in through a star connection throughout the starting period.
- When the motor reaches about 80% of its full load speed, it will begin to run in a delta connected stator winding.
- **There are various types of dc motor starters, such as 2 point starter, 3 point starter, 4 point starter, no-load release coil starter, thyristor controller starter, etc.**
- The basic concept behind every DC motor starter is adding external resistance to the armature winding during starting.
- **3 point starters and 4 point starters are used for starting dc shunt-wound motors and dc compound wound motors.**
- **2 point starter is used for starting dc series motors.**
- However, very small dc motors may be started directly by connecting them to the supply with the help of a contractor or a switch. It does not result in any harm because they gather speed quickly due to small rotor inertia.
- In this case, the large starting current will die down quickly because of the fast rise in the back emf.

---

70. **Answer: a**

Explanation:

Nickel-Iron cell:

- Nickel-iron cell is in the charged condition, **the active material on positive plates is $Ni(OH)_4$** and that on the negative plates is iron (Fe)
- The positive and negative plates are held in a nickel-plated steel container; the plates being insulated from each other by hard rubber strips
- The container contains 21 per cent solution of KOH (electrolyte) to which is added a small amount of lithium hydrate (LiOH) for increasing the capacity of the cell
- It has lesser weight and longer life than that of a lead-acid cell
- The emf of this cell is about 1.36 V
- These cells are very suitable for portable work

71. **Answer: b**

Explanation:

- **As the given input limit is 30 V and we have to measure the 250 V DC. Then suitable lowest scale probe would be 10 X .**
- Because it provides a measurement range of up-to 300 V.
- We can't use 1 X scale probe here, because it provides measurement up-to 30 V only.
- While we can use 100 X & 1000 X scale probe for measuring 250 V DC as it provides measurement up-to 3000 V & 30000 V respectively.
- But inaccuracy occurred in measuring 250 V DC by using 100 X & 1000 X probe.

---

72. **Answer: a**

Explanation:

- **Insulator rings used for electricity delivery poles are generally made of glazed porcelain or toughened glass or ceramic or steatite.**
- Insulators are made from clay, quartz or alumina and feldspar, and are covered with a smooth glaze to shed water.
- **The materials used for porcelain are silica 20%, feldspar 30%, and clay 50%. Porcelain has a dielectric strength of about 4–10 kV/mm .**
- Glass has higher dielectric strength, but it attracts condensation and the thick irregular shapes needed for insulators are difficult to cast without internal strains.
- So that manufacturers stop making glass insulators and switching to ceramic materials.

Properties of overhead line insulators:

- High mechanical strength to withstand the conductor load, wind load, etc.

- High electrical resistance (insulation strength) to minimize the leakage currents.
- The high relative permittivity of insulating material so that the dielectric strength is high.
- High ratio of puncture strength to flashover.
- It should not be porous.

---

73. **Answer: d**

Explanation:

- **In earlier days low voltage incandescent lamps are used for automotive lighting. These lamps are available for 6, 12, and 24 V applications.**
- Incandescent bulbs radiate invisible infrared light along with visible light.
- Then low voltage halogen lamps are used for automotive lighting. Whish has twice the light output, higher color temperature, and double service life than incandescent lamps.
- Nowadays low voltage LED lamps are being used for automotive lighting.

Important:

Type	Application	Advantage	Disadvantage
Standard Incandescent bulbs	Domestic use Localized decorative lighting	Direct connection without intermediate switchgear Reasonable purchase price Compact size Instantaneous lighting Good color rendering	The low luminous efficiency and high electricity consumption Significant heat Short service life
Halogen Incandescent bulbs	Spotlighting Intense lighting	Direct connection Instantaneous efficiency Excellent color rendering	Average luminous efficiency
Fluorescent tube	Shops, offices, workshops Outdoors	High luminous efficiency Average color rendering	The low light intensity of a single unit Sensitive to extreme temperature
High-	Workshops, halls	Good luminous	Lighting and relighting

pressure mercury vapor	hanger. Factory floors	efficiency Acceptable color rendering Compact size	time of a few minutes
High-pressure sodium	Outdoors Large halls	Very good luminous efficiency	Lighting and relighting time of a few minutes
Low-pressure sodium	Outdoors Emerging lighting	Good visibility in foggy weather Economical to use	Long lighting time (S min) Mediocre color rendering Lighting and relighting time of a few minutes
Metal halide	Large areas Halls with high ceilings	Good luminous efficiency Good color rendering Long service life	Lighting and relighting time of a few minutes
LED	Signaling (3-color traffic lights “exit” signs and emergency lighting) Automotive lighting	Insensitive to the number of switching operations	A limited number of colors A low brightness of the single unit

		Low energy consumption Low temperature	

74. **Answer: b**

Explanation:

- **The half-round file is used for finishing a circular hole.**
- One typical series for hole making can be - (i) Centering, (ii) Drilling, (iii) Boring, (iv) Reaming and (v) Honing.
- **Centering** is carried out to locate the hole by using **chise** l for easy and accurate alignment of a drill. Although it is optional, centering can improve precision. Drilling is a process of originating a hole, while boring enlarges the diameter of an existing hole. Reaming and honing are used to improve the surface finish and tolerance of the existing hole.
- **Drilling** : Drilling is a cutting process that uses a **drill bit** to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool.
- **Boring** : Boring is an operation to enlarging of an existing hole, which may have been made by a drill or maybe the result of a core in a casting.
- **Reaming** : Reaming is a sizing operation that removes a small amount of metal from a hole already drilled. It is done for two purposes: to bring holes to a more exact size and to improve the finish of an existing hole.
- **Honing** is a superfinishing process carried out using abrasive sticks or **half-round file** for the removal of stock from metallic and non-metallic surfaces. This process produces a high surface finish, corrects the profiles of cylindrical surfaces, removes taper.

75. **Answer: c**

Explanation:

If back emf of a dc motor vanishes suddenly, motor circuit will try to retain back emf by drawing more current from supply.

The voltage equation of dc motor is, $E_b = V - I_a R_a$

As the back emf vanishes zero, the whole supply voltage appears across armature and heavy current flows.

If supplying unit didn't trip down by this time, excess current in armature may heat up the armature and it may cause burning of armature winding.