

Multiple Questions & Answers on Electricity And Magnetism

PHY 104

1. Which of the following is most suitable for charging an ebonite rod
- Rubbing it with fur**
 - Touching with a charged metal rod
 - Hitting it on the ground

Explanation

Rubbing an ebonite rod with fur is the most suitable way for charging it

2. To convert a galvanometer to an ammeter, which of the following must be introduced (connection is to the galvanometer)
- High resistance, connected in series
 - Low resistance, connected in parallel**
 - High resistance, connected in parallel

Explanation

A galvanometer is converted into an ammeter by connecting a **low resistance in parallel** with the galvanometer. This low resistance is called shunt resistance.

3. What form of energy conversion occurs in an AC motor
- Mechanical-Electrical
 - Electrical-Mechanical**
 - Thermal-Electrical

Explanation

Both AC and DC motors are electric motors that convert electrical energy to mechanical energy. This AC motor takes alternating current as input whereas the DC motor takes in direct current.

4. A capacitor is charged through a potential difference of 200V, when a 0.1C charge is stored in it. The amount of energy released by it, when it is discharged is:
- 5J
 - 25J
 - 10J**

Explanation

$$U = 200\text{V}$$

$$Q = 0.1\text{C}$$

Energy stored, $U = ?$

$$\text{Recall; } U = \frac{1}{2}QV$$

$$U = \frac{1}{2}(0.1)(200)$$

$$U = 10\text{J}$$

5. Which of the following is false about an electrostaticoscope?
- Electrostaticoscope can tell whether a body is negatively charged or positively charged**
 - The deflection arm is a good conductor
 - A calibrated electrostaticoscope is called an electrometer

Explanation

An electrostaticoscope will not tell if the body is positively charged or negatively charged. It will only tell if the body is a charged body or the body has no charge.

6. Energy losses in a transformer include the following except
- Hysteresis loss
 - Eddy current loss
 - Transformation loss**

Explanation

Type of losses in a transformer

- Copper loss also known as I^2R loss
- Hysteresis loss
- Eddy current loss
- Stray loss (leakage flux)
- Dielectric loss

7. _____ is the process of removing excess charges on an object
- Grounding**
 - Depolarization
 - All

Explanation

Grounding is just the process of removing the excess charge on an object by means of transfer of electrons between it and another object

8. Which of the following is true about electric field lines
- They don't cross each other
 - Can extend from a negative charge to infinity**
 - Always start on positive charge and end in negative charge

Explanation

Properties of lines of force or Electric field lines

- They begin from positive charge and end on equal negative charge
- They do not cross each other
- They give direction of electric field at any point
- Where the field lines are close together, the field is strong, and where they are far apart, the field is weak. Also, where the lines are parallel and equally spaced, the field is uniform
- When moving along the direction of the arrow of a field line, the electric field potential decreases as a result of the movement from positive charge (which has a high potential) to a negative charge (which has a low potential)
- They cut equipotential surfaces such as conductors at right angles
- It extends from infinity to negative charge **and not from a negative charge to infinity**

9. To charge by friction, the two materials must have _____
- Same electron affinity
 - Different electronegativity
 - Different electron affinity**

Explanation

When charging by friction, the atoms of different materials are forced to come together.

The atom with lower electron affinity interacts with the nucleus of the atoms with high electron affinity.

Hence, there will be transfer of electrons from the lower electron affinity atoms to the higher one

10. The electric potential in a certain region of space is given by $V = -7.5x^2 + 3x$, where V is in volts and x is in meters. In this region, the equipotential surfaces are
- Planes parallel to the x -axis
 - Planes parallel to the y - z plane
 - Concentric spheres centered at the origin**

Explanation

In the region, the equipotential surfaces are concentric spheres centered at the origin

11. Charging by rubbing in an insulator involves
- Difference in quantized electrons
 - Difference in electron affinities**
 - Sameness in electrode potential

Explanation

How charging by rubbing works

When two insulators are rubbed together, the electron clouds of both insulators (from their electrons) are brought close enough for them to interact. As a result, they exchange electrons.

Hence, the atoms of material with greater affinity for electrons (electron affinity) will gain electrons from the other material which is of lower electron affinity

The material with greater affinity will be negatively charged while the other will be positively charged due to less electrons than protons

12. For polarization to take place, there must be _____
- electric field**
 - dielectric material
 - an insulator

Explanation

Polarization occurs when an electric field distorts the negative cloud of electrons around positive nuclei in a direction opposite to the field

This slight separation of charge makes one side of the atom somewhat positive and the opposite side somewhat negative

13. A moving rod 45cm slides to the right with a speed of 2m/s in a magnetic field of 8T. What is the induced EMF?
- 4.6V
 - 7.2V**
 - 10.6V

Explanation

Length of the rod, $l = 45\text{cm} = 0.45\text{m}$

$$v = 2\text{m/s}$$

$$B = 8\text{T}$$

$$\text{Recall: Induced EMF, } e = Blv$$

Therefore,

$$e = 8 \times 0.45 \times 2$$

$$e = 7.2\text{V}$$

14. Positive charge is distributed uniformly throughout a non-conducting sphere. The highest electric potential occurs
- at the center**
 - at the surface
 - halfway between the center and the surface

Explanation

Note that the highest electric potential **occurs at the center** when a positive charge is distributed uniformly throughout a non-conducting sphere

15. Which of the following statements is not true?
- When the current flows in a wire, the electrons as a whole acquire a fast drift speed
 - When current flows in a wire, the magnetic force on the moving electron is transmitted to the wire
 - When a wire is placed in a magnetic field, it experiences no force**

Explanation

Is true because when current flows in a wire, the electrons move at high speed. Current is just like a group of electrons moving in a wire

Is not true because a wire carrying current has a magnetic field due to the following charges. Since it has a magnetic field, it will certainly experience a magnetic force

Is true because when current flows in a wire, the electrons possess a magnetic field and an electric field. The magnetic fields of each electron are combined to form the magnetic field of the wire

Is true because a magnetic field can only exist as a dipole (i.e. having both north and south poles, not one of them)

16. For an ohmic resistor, resistance is the proportionality constant for
- current and potential difference**
 - current and electric field
 - potential difference and electric field

Explanation

An ohmic conductor is a conductor that obeys Ohm's law and Ohm's law states that the voltage across a conductor is directly proportional to the current flowing through it, provided that all physical conditions such as temperature remain constant.

Mathematically,

$$V \propto I$$

$$V = IR$$

Hence, resistance is the proportionality constant for voltage/potential difference and current.

17. Which of the following is not correct?
- The direction of magnetic field inside the solenoid is determined by the right-hand thumb rule
 - Fleming's left-hand rule applies in a dynamo**
 - Fleming's right-hand rule determines the direction of induced current within an electric generator

Explanation

B is wrong. A dynamo is a machine that converts mechanical energy into light energy. A dynamo can also be referred to as an electrical generator and Fleming's right-hand rule is applied within an electric generator (**Option A**)

Hence, Fleming's right-hand rule is applied in a dynamo, not Fleming's Left-hand rule.

Note that Fleming's left-hand rule is applied in **electric motor or DC motor**

18. The electric field _____
- is always perpendicular to an equipotential surface**
 - is always tangent to an equipotential surface
 - makes an angle to an equipotential surface that depends on the amount of charge

Explanation

All points on an equipotential surface have the same potential (i.e. the same voltage). The electric force neither helps nor hinders the motion of an electric charge along an equipotential surface. **Electric field lines are always perpendicular to an equipotential surface**

19. A magnetic field exerts a force on a charged particle
- always
 - if the particle is moving along the field lines
 - if the particle is moving across the field lines**

Explanation

When a charged particle moves along (in the same direction) the field lines, no force is exerted by the magnetic field

Magnetic field only exerts a force on a charged particle when it moves at an angle from the field lines (i.e. when the electric charge moves across the field lines)

20. J.J. Thomson's experiment, involving the motion of an electron beam in mutually perpendicular electric and magnetic fields, gave the value of
- mass of electron
 - charge of electron**
 - mass ratio of electrons

Explanation

Thomson's experiment shows that the **charge of an electron** can be determined when the electron moves in both magnetic fields which are mutually perpendicular to each other so that the net force on the electron is made zero