Sample Paper

Physics

Section - A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

1. A charge placed at a distance from an electric dipole in the end-on position experiences a force F. If the distance be doubled, the force will become:

(a) 2 F (b) $\frac{F}{2}$ (c) $\frac{F}{4}$ (d) $\frac{F}{8}$

2. Electric field is independent of distance of the given surface in which of the case:

(a) Infinitely long uniformly charged wire (b) Infinitely large uniformly charged plane
(c) Uniformly charged spherical shell (d) None of the above

3. Net flux linked to a closed surface around a charge particle is .... times the charge.

(a) ε_0 (b) $\frac{1}{\varepsilon_0}$ (c) ε_0^2 (d) None of these

4. What will the potential difference between the plates if the air between the plates of a capacitor is replaced by a medium of permittivity k.

(a) It will decreases k times (b) It will increases k times
(c) There will be no change (d) None of them

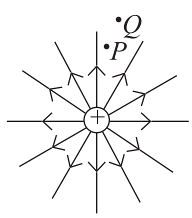
5. The electric potential at a point in free space due to a charge Q coulomb is $Q \times 10^{11}$ V. The electric field at that point is:

(a) $12\pi\varepsilon_0 Q \times 10^{22}$ Vm^{-1} (b) $4\pi\varepsilon_0 Q \times 10^{20}$ Vm^{-1}
(c) $12\pi\varepsilon_0 Q \times 10^{20}$ Vm^{-1} (d) $4\pi\varepsilon_0 Q \times 10^{22}$ Vm^{-1}.

6. Two point charges of +3 μC and +4 μC repel each other with a force of 10 N. If each is given an additional charge of −6 μC, the new force is:

(a) 6 N (b) 6.5 N (c) 7.5 N (d) 7 N

7. Figure shows the field lines of a positive point charge. The work done by the field in moving a small positive charge from Q to P is:



(a) zero (b) positive (c) negative (d) data insufficient.

8. A steady current flow in a metallic conductor of non-uniform cross-section. The quantity constant along the length of the conductor is:

(a) Current, electric field and drift speed (b) Drift speed only
(c) Current and drift speed (d) Current only

9. Potential gradient 'k' remains constant until:
(a) Current in potentiometer wire remains constant
(b) Potential difference across the potentiometer wire remains constant
(c) e.m.f. of the testing cell remains constant
(d) None

10. In current electricity, Ohm's law is obeyed by all:
(a) Solids (b) Metals
(c) Liquids (d) Gases

11. Consider a current carrying wire (current I) in the shape of a circle. Note that as the current progresses along the wire, the direction of J (current density) changes in an exact manner, while the current I remain unaffected. The agent that is essentially responsible for is:
(a) source of emf
(b) electric field produced by charges accumulated on the surface of wire.
(c) the charges just behind a given segment of wire which push them just the right way by repulsion.
(d) the charges ahead.

12. A metal wire is subjected to a constant potential difference. When the temperature of the metal wire increases, the drift velocity of the electron in it:
(a) increases, thermal velocity of electron increases
(b) decreases, thermal velocity of electron increases
(c) increases, thermal velocity of electron decreases
(d) decreases, thermal velocity of electron decreases

13. If N, e, τ and m are representing electron density, charge, relaxation time and mass of an electron respectively, then the resistance of wire of length l and cross-sectional area A is given by:
(a) $\frac{ml}{Ne^2A\tau}$ (b) $\frac{2m\tau A}{Ne^2 l}$ (c) $\frac{Ne^2\tau A}{2ml}$ (d) $\frac{Ne^2A}{2m\tau l}$

14. The direction of drift velocity in a conductor is:
(a) opposite to that of applied electric field (b) opposite to the flow of positive charge
(c) in the direction of the flow of electrons (d) All of these

15. A galvanometer is said to be sensitive, if it gives a:
(a) Small deflection for a small current (b) Small deflection for a large current
(c) Large deflection for a large current (d) Large deflection for a small current

16. A current flow along the length of an infinitely long, straight thin-walled pipe. Then:
(a) the magnetic field at all points inside the pipe is same, but not zero
(b) the magnetic field at any point inside the pipe is zero
(c) the magnetic field is zero only on the axis of the pipe
(d) the magnetic field is different at different points inside the pipe

17. What will be the path of a charged particle moving along the direction of a uniform magnetic field?
(a) Circular path (b) Parabolic path
(c) Straight line path (d) None of them

18. Angle on the horizontal plane between magnetic North and true North is called:
(a) Magnetic declination (b) Electric declination
(c) Magnetic inclination (d) Electric inclination

19. The earth's magnetic field varies from point to point in space. Does it also change with time?
(a) Yes (b) No (c) Maybe (d) None of them

20. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?
(a) The electron will be accelerated along the axis.
(b) The electron path will be circular about the axis.
(c) The electron will experience a force at 45° to the axis and hence execute a helical path.
(d) The electron will continue to move with uniform velocity along the axis of the solenoid.

21. The property of coil by which a counter e.m.f. is induced in it when the current through the coil changes is known as :

(a) Self-induction (b) Mutual induction
(c) Capacitance (d) None of these

22. Faraday's laws are consequences of conservation of :

(a) energy and magnetic field (b) energy
(c) magnetic field (d) charge

23. In an AC circuit I = 100 sin 200πt. The time required for the current to achieve its peak value will be:

(a) $\frac{1}{200}$ s (b) $\frac{1}{400}$ s (c) $\frac{1}{100}$ s (d) $\frac{1}{300}$ s

24. The ratio of mean value over half cycle to rms value of AC is:

(a) $\sqrt{2} : 1$ (b) $2 : \pi$ (c) $2\sqrt{2} : \pi$ (d) $\sqrt{2} : \pi$

25. What is the resistance offered by a capacitor for the steady current?

(a) one (b) zero
(c) infinity (d) depends on the voltage value

Section - B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation

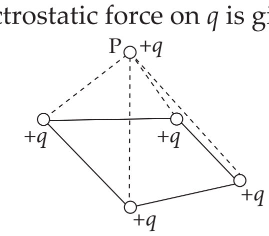
26. What will be the change in electric field, if the charge on an object in halved ?

(a) Electric field will be doubled (b) Electric field will also become half
(c) Electric field will remain same (d) None of them

27. If we increase the charge enclosed by the surface then electric flux will:

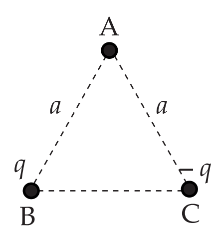
(a) Increases (b) Decrease (c) Remain same (d) Both (a) and (b)

28. The figure shows a charge +q at point P held in equilibrium in air with the help of four +q charges situated at the vertices of a square. The net electrostatic force on q is given by:



(a) Newton's law (b) Coulomb's law
(c) Principle of superposition (d) Net electric flux out the position of +q

29. As shown in the figure, charges +q and −q are placed at the vertices B and C of an isosceles triangle. The potential at the vertex A is:



(a) $\frac{1}{4\pi\varepsilon_0}.\frac{2q}{\sqrt{a^2}}$ (b) $\frac{1}{4\pi\varepsilon_0}.\frac{q}{\sqrt{a^2}}$ (c) $\frac{1}{4\pi\varepsilon_0}.\frac{(-q)}{\sqrt{a^2}}$ (d) zero

30. Four charges each equal to q are placed at the corners of a square of side l. The electric potential at the centre of the square is :

(a) $\frac{1}{4\pi\varepsilon_0}\frac{4q}{l}$ (b) $\frac{1}{4\pi\varepsilon_0}\frac{4q}{\sqrt{2}l}$ (c) $\frac{1}{\pi\varepsilon_0}\frac{\sqrt{2}q}{l}$ (d) $\frac{1}{\pi\varepsilon_0}\frac{2q}{l}$

31. At angular frequency 10^3 rad/s, the nature of circuit:

(a) Inductive (b) Capacitive (c) Resistive (d) None of these

32. Same current is flowing in two alternating circuits. The first circuit contains only inductance and the other contains only a capacitor. If the frequency of the emf of AC is increased, the effect on the value of the current will be:

(a) Increases in both the circuits

(b) Decreases in both the circuits

(c) Increases in the first circuit and decreases in the other

(d) Decreases in the first circuit and increases in the other

33. A student connects four cells, each of emf 1.5 V and internal resistance 0.25 Ω in series but one cell has its terminals reversed. This battery sends current in a 2 Ω resistor. What will be the current ?

(a) 2 A (b) 4 A (c) 1 A (d) 3 A

34. A steady current of 1 A is flowing through the conductor. The number of electrons flowing through the cross-section of the conductor in 1 sec is:

(a) 6.25×10^{15} (b) 6.25×10^{17} (c) 6.25×10^{19} (d) 6.25×10^{18}

35. The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then:

(a) the resistance and the specific resistance both will remain unchanged

(b) the resistance will be doubled, and the specific resistance will be halved

(c) the resistance will be halved, and the specific resistance will remain unchanged

(d) the resistance will be halved, and the specific resistance will be doubled

36. Two wires A and B of the same material, having radii in the ratio 1 : 2 and carry currents in the ratio 4 : 1. The ratio of drift speed of electrons in A and B is:

(a) 16 : 1 (b) 1 : 16 (c) 1 : 4 (d) 4 : 1

37. In a balanced wheatstone network, the resistance in the arms Q and S are interchanged. As a result of this:

(a) network is not balanced

(b) network is still balanced

(c) galvanometer shows zero deflection

(d) galvanometer and the cell must be interchanged to balance.

38. The incorrect statement regarding the lines of force of the magnetic field B is :

(a) Magnetic lines of force form a close curve.

(b) Due to a magnet, magnetic lines of force never cut each other.

(c) Magnetic intensity is a measure of lines of force passing through unit area held normal to it.

(d) Inside a magnet, its magnetic lines of force move from north pole of a magnet toward is south pole.

39. A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is:

(a) $\frac{2\pi m}{qB}$ (b) $\frac{2\pi qB}{m}$ (c) $\frac{2\pi mq}{B}$ (d) $\frac{2\pi q^2 B}{m}$

40. In the case of bar magnet, lines of magnetic induction:

(a) run continuously through the bar and outside

(b) emerge in circular paths from the middle of the bar

(c) are produced only at the north pole like rays of light from a bulb

(d) start from the north pole and end at the south pole

41. Lenz's law gives:

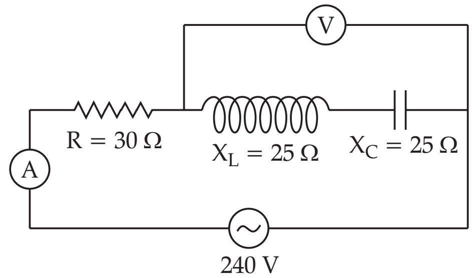
(a) the direction of the induced current

(b) the magnitude of the induced emf

(c) the magnitude of the induced current

(d) both the magnitude and direction of the induced current

42. In the circuit shown in figure neglecting source resistance the voltmeter and ammeter reading will respectively be:

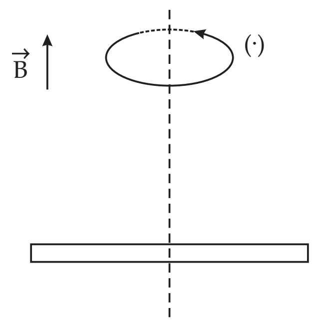


(a) 0 V, 3 A (b) 0 V, 8 A (c) 150 V, 3 A (d) 150 V, 6 A

43. The force of repulsion between two electrons at a certain distance is F. The force between two protons separated by the same distance is: ($m_p = 1836\, m_e$)

(a) 2F (b) F (c) 1836 F (d) $\frac{F}{1836}$

44. A conducting rod of length $2l$ is rotating with constant angular speed ω about its perpendicular bisector. A uniform magnetic field $\vec{B}$ exists parallel to the axis of rotation. The emf induced between two ends of the rod is:



(a) Zero (b) $B\omega l^2$ (c) $\frac{1}{2}B\omega l^2$ (d) $\frac{1}{8}B\omega l^2$

45. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): The 200 W bulbs glows with more brightness then 100 W bulbs.

Reason (R): A 100 W bulb has more resistance than a 200 W bulb.

(a) Both A and R are true and R is also the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

46. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): When we rub a glass rod with silk, the rod gets negatively charged and the silk gets positively charged.

Reason (R): On rubbing, electrons from silk cloth move to the glass rod.

(a) Both A and R are true and R is also the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

47. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Two identical loops, one of copper and another of aluminium are rotated with the same speed in the same magnetic field. The emf induced in both the loop will be same.

Reason (R): The magnitude of induced emf is directly proportional to the rate of change of magnetic flux linked with the circuit.

(a) Both A and R are true and R is also the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

48. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): An alternating current shows magnetic effect.

Reason (R): Alternating current varies with time.

(a) Both A and R are true and R is also the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false and R is also false.

49. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): If three capacitors of capacitance $C_1 < C_2 < C_3$ are connected in parallel then their equivalent capacitance $C_p > C_s$.

Reason (R): $\frac{1}{C_p} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

(a) Both A and R are true and R is also the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

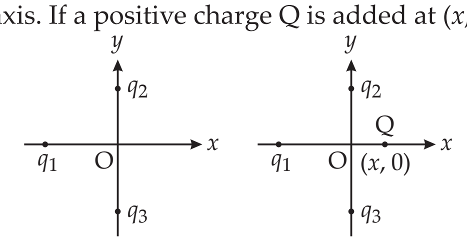
(c) A is true but R is false.

(d) A is false and R is also false.

Section - C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation

50. In figure, two positive charges, q_2 and q_3 fixed along the y-axis, exert a net electric force in the $+x$-direction on a charge fixed along the x-axis. If a positive charge Q is added at $(x, 0)$, the force on q_1:



(a) shall increase along the positive x-axis

(b) shall decrease along the positive x-axis

(c) shall point along the negative x-axis

(d) shall increase but the direction changes because of the intersection of Q with q_2 and q_3

51. The energy stored in a parallel plate capacitor is given by $V_E = \frac{Q^2}{2C}$. Now which of the following statements is not true ?

(I) The work done in charging a capacitor is stored in the form of electrostatic potential energy given by expression $V_E = \frac{Q^2}{2C}$.

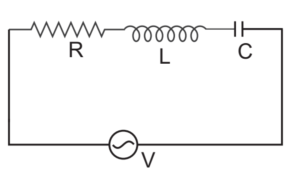
(II) The net charge on the capacitor is Q.

(III) The magnitude of the net charge on the plate of a capacitor is Q.

(a) (I) only (b) (II) only (c) (I) and (II) (d) (I), (II) and (III)

Case Study: Read the following paragraph and answer the questions:

The figure shows a series LCR circuit:



For such a circuit, the impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$, is given by where X_L and X_C are inductive and capacitive resistances respectively. As the frequency of a.c. is increased, at a particular frequency. X_L become, equal to X_C. For that frequency maximum current occurs. This is because impedance becomes equal is its least value R. Current through the circuit $I = \frac{V}{R}\cdot$ The circuit behaves like a pure resistive circuit and current and voltage will be in phase. This is called resonance. Frequency of a.c. at which resonance occurs is called resonant frequency. If frequency is less than the resonant frequency, then the capacitive reactance will be more. The circuit will be capacitive in nature and current leads voltage. On the other hand, if frequency is more than the resonant frequency inductive reactance will be more. Circuit is inductive in nature and current lags the voltage.

An LCR circuit with a resistance 50 Ω has a resonant angular frequency 2×10^3 rad/s. At resonance, the voltage across the resistance and inductance are 25 V and 20 V respectively. Then:

52. The value of inductance is:

(a) 20 mH (b) 10 mH (c) 40 mH (d) 25 mH

53. The value of capacitance is:

(a) 25 μF (b) 1 μF (c) 2 μF (d) 12.5 μF

54. The impedance at resonance is:

(a) 50 W (b) 16 W (c) 64 W (d) 25 W

55. Which of the following angular frequency of a.c. will see the circuit as inductive in nature?

(a) 1.5×10^3 rad/s (b) 10^3 rad/s (c) 2×10^3 rad/s (d) 5×10^3 rad/s

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Answers

Sample Paper

Section-A

1. (d) $\frac{F}{8}$

Explanation: The electric field at a distance r from the dipole is $\vec{E} = \frac{2P}{r^3}$,

So, $$E \propto \frac{1}{r^3}$$

Force on charge q is $F = qE$ also $F \propto \frac{1}{r^3}$

If distance r is doubled, then force will $F' = \frac{F}{8}$.

2. (b) Infinitely large uniformly charged plane

Explanation: Electric field due to the infinitely large uniformly charged plane sheet is $\frac{\sigma}{2\varepsilon_0}$, which is independent of distance.

3. (b) $\frac{1}{\varepsilon_0}$

Explanation:

$$\phi_S = \int \vec{E}.d\vec{S}$$
$$= \frac{q_{enc}}{\varepsilon_0}$$
$$= \frac{1}{\varepsilon_0}$$

4. (a) It will decreases *k* times

Explanation: The potential difference between the plates will decrease *k* times.

5. (d) $4\pi\varepsilon_0 Q \times 10^{22}$ Vm^{-1}.

Explanation: Given that,

$$V = \frac{Q}{4\pi\varepsilon_0 r} = Q \times 10^{11} V$$

$\therefore$ $$4\pi\varepsilon_0 r = 10^{-11} \quad \text{...(i)}$$

Now, $$E = \frac{Q \times 4\pi\varepsilon_0}{(4\pi\varepsilon_0 r)^2}$$

$$= \frac{Q \times 4\pi\varepsilon_0}{(10^{-11})^2} \quad \text{...[By using (i)]}$$

$$= 4\pi\varepsilon_0 Q \times 10^{22} \text{ Vm}^{-1}$$

6. (c) 7.5 N

Explanation: Given that,

$q_1 = 3$ μC, $q_2 = +4$ μC, F = 10 N

$q_1' = +3 - 6 = -3$ μC, $q_2' = +4 - 6 = -2$ μC

$\therefore$ $$\frac{F'}{F} = \frac{(q_1')(q_2')}{q_1 q_2}$$

$$= \frac{(-3)\times(-2)}{2\times 4} = \frac{3}{4}$$

$\therefore$ $$F' = \frac{3}{4} \times F$$

$$= \frac{3}{4} \times 10$$

$$= 7.5 \text{ N}$$

7. (c) negative

Explanation: In moving a small positive charge from Q to P, work has to be done by an external agent against the electric field. Therefore, work done by the field is negative.

8. (d) Current only

Explanation: Current does not depend upon the area of cross-section, hence it remains a constant.

9. (a) Current is potentiometer wire remains constant

Explanation: Potential gradient depends on the strength of the current and resistance per cm of the wire. So, it remains constant till current remains constant.

10. (b) Metals

Explanation: Ohm's law states that the electric current between two points is directly proportional to voltage. The material that follow Ohm's law are ohmic conductors while others are non-ohmic conductors. In current electricity Ohm's law is obeyed by metals.

11. (b) Electric field produced by charges accumulated on the surface of wire.

Explanation: $$\vec{J} = \sigma\vec{E} = \frac{\vec{E}}{\rho}$$

Where, σ is conductivity and ρ is the resistivity.

12. (b) decreases, thermal velocity of electron increases

Explanation: When the temperature increases, resistance increases. As the emf applied is the same, the current density decreases the drift velocity decreases. But the rms velocity of the electron due to thermal motion is proportional to $\sqrt{T}$. Therefore, the thermal velocity increases.

13. (a) $\frac{ml}{Ne^2A\tau}$

Explanation: If N, e, τ and m are representing electron density, charge, relaxation time and mass of an electron respectively, then the resistance of wire of length l and cross-sectional area A is,

$$\frac{ml}{Ne^2A\tau}$$

14. (d) All of these

Explanation: The direction of drift velocity in a conductor is opposite to that of applied electric field, opposite to the flow of positive charge, and in the direction of the flow of electrons.

15. (d) Large deflection for a small current

Explanation: A galvanometer is a device to detect current in a circuit. A galvanometer is said to be sensitive if it shows large scale deflection even when a small current is passed through it or a small voltage is applied across it.

16. (b) The magnetic field at any point inside the pipe is zero

Explanation: Using Ampere's circuital law over a circular loop of any radius less than the radius of the pipe, we can see that net current inside the loop is zero. Hence, magnetic field at every point inside the loop will be zero.

17. (c) Straight line path

Explanation: The path of a charged particle will be a straight-line path as no force acts on the particle.

18. (a) Magnetic declination

Explanation: The angle between the geographical meridian and the magnetic meridian at a place is called the magnetic declination.

19. (a) Yes

Explanation: Yes, earth's field undergoes a change with time for example daily change *dl*, annual changes *dl*, secular changes *etc*. Even field reversals have also occurred.

20. (d) The electron will continue to move with uniform velocity along the axis of the solenoid

Explanation: $F = -evB \sin 180° = 0$ (*i.e.,* $0 = 0°$ or $180°$ in both cases $F = 0$). The electron will continue to move with uniform velocity or will go undeflected along the axis of the solenoid.

21. (a) Self-induction

Explanation: The property of coil by which a counter e.m.f. is induced in it when the current through the coil changes is known as self-induction.

22. (b) energy

Explanation: Faraday's laws involve conversion of mechanical energy into electric energy. This is in accordance with the law of conservation of energy.

23. (b) $\frac{1}{400}$ s

Explanation: The current takes $\frac{T}{4}$ s to reach the peak value.

In the given question,

$$\frac{2\pi}{T} = 200\pi$$

$$\Rightarrow \quad T = \frac{1}{100} \text{ s}$$

$$\therefore \quad \text{Time to reach the peak value} = \frac{1}{400} \text{ s.}$$

24. (c) $2\sqrt{2} : \pi$

Explanation: We know that,

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

and

$$I_m = \frac{2I_0}{\pi}$$

$$\therefore \quad \frac{I_m}{I_{rms}} = \frac{2\sqrt{2}}{\pi}$$

25. (c) Infinity

Explanation: When the capacitor is connected to the battery and the circuit is closed then the capacitor gets progressively charged until the potential difference across the plates becomes equal to the potential difference across the terminals of the battery. As soon as this happens, the charging of the capacitor stops. Thus, during the capacitor is being charged, an electric current does flow through the rest of the circuit. So, the resistance offered by a capacitor for the steady current is infinity.

Section-B

26. (b) Electric field will also become half

Explanation: If the charge on the object is halved than the electric field will also become half as electric field is directly proportional to the charge.

27. (a) Increase

Explanation: $$\text{Total flux} = \frac{\text{Net enclosed charge}}{\varepsilon_0}$$

Hence, we can say the electric flux depends only on net enclosed charge by surface.

28. (c) Principle of superposition

Explanation: The weight mg of the charge hold in air is in equilibrium with net electrostatic force exerted by the four charges situated at the corners. The net electrostatic force is given by the vector sum of the individual forces exerted by the charges at the corners. This is principle of superposition.

29. (d) zero

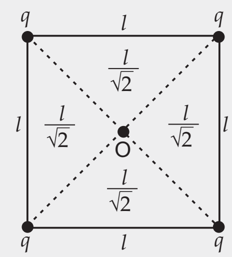
Explanation: Potential at A = Potential due to ($+q$) charge + Potential due to ($-q$) charge

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{\sqrt{a^2}} + \frac{1}{4\pi\varepsilon_0}\frac{(-q)}{\sqrt{a^2}} = 0$$

30. (c) $\frac{1}{\pi\varepsilon_0}\frac{\sqrt{2}q}{l}$

Explanation: As we know that,

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$



Electric potential due to each charge at the centre of the square is $\frac{1}{4\pi\varepsilon_0}\frac{\sqrt{2}q}{l}$

Hence total potential is,

$$= 4 \times \frac{1}{4\pi\varepsilon_0}\frac{\sqrt{2}q}{l}$$

$$= \frac{1}{\pi\varepsilon_0}\frac{\sqrt{2}q}{l}$$

31. (b) Capacitive

Explanation: If $\omega < \omega_r$, the circuit will be capacitive in nature.

32. (d) decreases in the first circuit and increases in the other

Explanation: For the first circuit,

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

$$= \frac{V}{\sqrt{R^2 + \omega^2 L^2}}$$

$\therefore$ Increase in ω will cause a decrease in I.
For the second circuit,

$$I = \frac{V}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}}$$

$\therefore$ Increase in ω will cause an increase in I.

33. (c) 1 A

Explanation: Equivalent emf in series combination is given by $E_{eq} = E_1 + E_2$ .... In the given question it will be $E_{eq} = 1.5 + 1.5 + 1.5 + 1.5$ $R_{eq} = 0.25 + 0.25 + 0.25 + 0.25 = 2\ \Omega$

Now, $$1 = \frac{R_{eq}}{E_{eq}} 1 = 1\text{ A}$$

34. (d) 6.25×10^{18}

Explanation: As we know that,

$$q = It$$

$\Rightarrow$ $$ne = It$$

$\therefore$ $$n = \frac{It}{e}$$

$$= \frac{1 \times 1}{1.6 \times 10^{-19}}$$

$$= 6.25 \times 10^{18}.$$

35. (c) the resistance will be halved, and the specific resistance will remain unchanged

Explanation: According to the given condition,

$$R = \frac{\rho l_1}{A_1}$$

now, $$l_2 = 2l_1$$

$$A_2 = \pi(r_2)^2$$

$$= \pi(2r_1)^2 = 4\pi r_1^2 = 4A_1$$

$\therefore$ $$R_2 = \frac{\rho(2l_1)}{4A_1} = \frac{\rho l}{2A} = \frac{R}{2}$$

Resistance is halved, but specific resistance remains the same.

36. (a) 16:1

Explanation: Current flowing through the conductor, $I = nev_dA$. Hence,

$$\frac{4}{1} = \frac{nev_{d_1}\pi(1)^2}{nev_{d_2}\pi(2)^2}$$

$\Rightarrow$ $$\frac{v_{d_1}}{v_{d_2}} = \frac{4 \times 1}{1}$$

$$= \frac{16}{1}.$$

37. (a) network is not balanced

Explanation: In a balanced Wheatstone network, the resistances in the arms Q and S are interchanged. As a result of this network is not balanced.

38. (d) Inside a magnet, its magnetic lines of force move from north pole of a magnet towards its south pole.

Explanation: Inside a magnet, magnetic lines of force move from South pole to North pole.

39. (a) $\frac{2\pi m}{qB}$

Explanation: Equating magnetic force to centripetal force.

$$\frac{mv^2}{r} = qvB \sin 90°$$

$$r = \frac{mv}{qB} \quad \text{..(i)}$$

Time to complete one revolution,

$$T = \frac{2\pi r}{v} = \frac{2\pi m}{qB} \quad \text{...(from (i))}$$

40. (a) run continuously through the bar and outside

Explanation: In the bar magnet, lines of magnetic induction run continuously through the bar and outside.

41. (a) the direction of the induced current

Explanation: Lenz's law states that an induced electric current flows in a direction such that the current opposes the change that induced it.

42. (b) 0 V, 8 A

Explanation: The voltage V_L and V_C are equal to opposite so voltmeter reading will be zero

Also, $R = 30\ \Omega$

$X_L = X_C = 25\ \Omega$

So,

$$i = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$$

$$= \frac{V}{R}$$

$$= \frac{240}{30}$$

$$= 8$$

43. (b) F

Explanation: Electrostatic force is given by,

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$

Here, charge and distance are same. So, force between two protons will be same.

44. (a) Zero

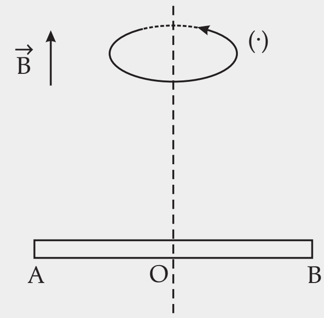
Explanation: Potential difference between O and A is,

$$V_O - V_A = \frac{1}{2} B l^2 \omega$$

Potential difference between O and B is,

$$V_O - V_B = \frac{1}{2} B l^2 \omega$$

So, $V_A - V_B = 0$



45. (a) Both A and R are true and R is also the correct explanation of A.

Explanation: As we know that,

$$P = \frac{V^2}{R}$$

$$\Rightarrow \quad R = \frac{V^2}{P}$$

$$\Rightarrow \quad R \propto \frac{1}{P}$$

That means higher is the wattage of a bulb, lesser is the resistance and so it will glow bright.

46. (d) A is false and R is also false.

Explanation: When we rub a glass rod with silk cloth, electrons from the glass rod are transferred to the silk cloth. Thus the rod gets positively charged and the silk gets negatively charged.

47. (a) Both A and R are true and R is also the correct explanation of A.

Explanation: Since both the loops are identical (same area and number of turns) and moving with a same speed in same magnetic field. Therefore, same emf is induced in both the coils. But the induced current will be more in copper loop as its resistance will be lesser as compared to that of the aluminium loop.

48. (b) Both A and R are true but R is not the correct explanation of A.

Explanation: Like direct current, an alternating current also produces magnetic field. But the magnitude and direction of the field goes on changing continuously with time.

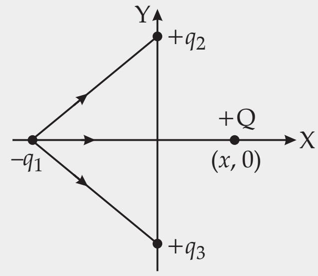
49. (c) A is true but R is false.

Explanation: Equivalent capacitance of parallel combination is $C_p = C_1 + C_2 + C_3$.

Section-C

50. (a) shall increase along the positive x-axis

Explanation: As shown in the figure, since positive charge q_2 and q_3 exert a net force in the +X-direction on the charge q_1 fixed along the x-axis, the charge q_1 is negative. Obviously, due to addition of positive charge Q at $(x, 0)$, the force on $-q$ shall increase along the positive x-axis.



51. (b) (II) only

Explanation: There is equal and opposite charge on the plates of a parallel plate capacitor. Therefore there is no net charge on capacitor.

52. (a) 20 mH

Explanation:

$$X_L = \frac{V_L}{I}$$

$$I = \frac{V_R}{R} = \frac{25}{50} = \frac{1}{2}$$

$$X_L = \frac{20}{\frac{1}{2}} = 20\ \Omega$$

But

$$X_L = \omega L$$

$$L = \frac{X_L}{\omega} = \frac{40}{2 \times 10^3}$$

$$= 20 \times 10^{-3} = 20\text{ mH}$$

53. (d) 12.5 μF

Explanation:

$$\omega^2 = \frac{1}{L_C}$$

$\Rightarrow$

$$C = \frac{1}{\omega^2 L}$$

$$= \frac{1}{(2 \times 10^3) \times 20 \times 10^{-13}} = 12.5\ \mu F$$

54. (a) 50 W

Explanation: At resonance, the impedance equal just resistance.

55. (d) 5×10^3 rod/s

Explanation: For inductive nature $\omega > \omega_r$.