

- a. Derive the expression for current in a galvanometer using radial field how can we get maximum current. Write expression for current sensitivity.
- b. An ammeter reads up to 1 ampere. Its internal resistance is 0.81 ohm. Calculate the value of shunt to be added to increase the range to 10 A



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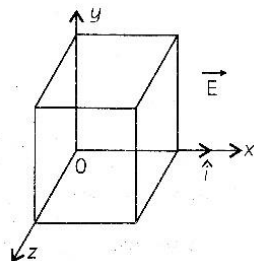
CLASS – XII
SUB – PHYSICS

FM – 70
TIME – 3 HR

SECTION A (MCQ)

- Consider two identical dipoles D_1 and D_2 Charges - q and q of dipole D_1 are located at $(0, 0)$ and $(a, 0)$ and that of dipole D_2 at $(0, a)$ and $(0, 2a)$ in x - y plane, respectively. The net dipole moment of the system is:
a. $qa(\hat{i} + \hat{j})$ b. $-qa(\hat{i} + \hat{j})$ c. $qa(\hat{i} - \hat{j})$ d. $-qa(\hat{i} - \hat{j})$
- An object has charge of 1C and gains 5.0×10^{18} electrons. The net charge of the object becomes:
(a) -0.80 C (b) +4.80 C (c) +0.80 C (d) +0.20 C
- Two-point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force 'F'. The electrostatic force between them in vacuum at the same distance r will be:
(a) $5F$ (b) $F/2$ (c) F (d) $F/5$
- Assertion (A): Work done in moving a charge around a closed path, in an electric field is always zero.**
Reason (R): Electrostatic force is a conservative force.
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.
- Two particles A and B of the same mass but having charges q and $4q$ respectively, are accelerated from rest through different potential difference V_A and V_B such that they attain same kinetic energies. The value of V_A/V_B is
a. $\frac{1}{4}$ b. $\frac{1}{2}$ c. 2 d. 4
- Equipotential surfaces:**
(a) are closer in regions of large electric fields compared to regions of lower electric fields.
(b) will be more crowded near sharp edges of a conductor.
(c) will never be equally spaced. (d) both (a) and (b) are correct

- 31.
- Using Gauss's law, show that the electric field E at a point due to a uniformly charged infinite plane sheet is given by $\vec{E} = \frac{\sigma}{2\epsilon_0}$ where symbols have their usual meanings.
 - Electric field E in a region is given by. $E = (5x^2 + 2) \hat{i}$ where E is in N/C and x is in meters. A cube of side 10 cm is placed in the region as shown in figure



Calculate (i) the electric flux through the cube, and (ii) the net charge enclosed by the cube.

OR

- Derive an expression for the electric field intensity at a point on the equatorial line of an electric dipole of dipole moment \vec{P} and length $2l$. What is the direction of this field
- Two charges q and $-3q$ are placed fixed on s -axis separated by distance 'd'. Where should a third charge $2q$ be placed such that, it will not experience any force?

32.

- A dipole of $+q$ and $-q$ separated by a distance $2l$ is placed on x axis with origin at the mid-point of the dipole. Find the expression for potential at $(x,0)$ where $x \gg l$ and $(0,y)$ where $y \gg l$
- Prove that for a equipotential surface the electric field is perpendicular to the surface.

OR

- Derive an expression for drift velocity of an electron in a conductor in an electric field.
- In a cylindrical conductor n no of electrons are flowing with velocity V_d . find the relation between current and drift velocity.
- How many no of electron will constitute 5A of current in one second in a conductor?

33.

- State and explain Biot-Savart law. Write its expression in vector form.
- Use it to derive the expression for magnetic field at the centre of a current carrying loop of radius a .

OR

- The electric potential V at any point (x, y, z) is given $V = -5y^2$ where x is in metres and V in volts. The electric field at the point $(1 \text{ m}, 1, 2 \text{ m})$ is
 (a) -10 V/m along $-y$ -axis (b) 5 V/m along $+y$ -axis
 (c) -5 V/m along $-y$ -axis (d) 10 V/m along $+y$ -axis
- Two parallel plate capacitors X and Y have as the same area of plates and same separation between plates, X has air and Y has dielectric of constant 2, between its plates. They are connected in series to a battery of 12 V. The ratio of electrostatic energy stored in X and Y is:
 (a) 4:1 (b) 1:4 (c) 2:1 (d) 1:2
- The electron drift speed is so small, and the electron's charge is also very small, but we still obtain large amounts of current in a conductor which is due to:
 (a) potential difference (b) length of conductor
 (c) electron number density (d) area of cross-section
- The resistance of a metal wire increase with increasing temperature on account of:
 (a) decrease in free electron density (b) decrease in relaxation time
 (c) increase in mean free path (d) increase in the mass of electron
- The storage battery of a car has an emf 12 volt. If the internal resistance of the battery is 0.4 ohm the maximum current that can be drawn from the battery will be:
 (a) 15 A (b) 30 A (c) 12 A (d) 20 A
- Assertion (A): Kirchhoff's junction rule is based on conservation of charge.
 Reason (R): A resistor obeys Ohm's law while a diode does not.
 (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
 (c) If Assertion is true but Reason is false.
 (d) If Assertion and Reason are false.
- The time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of:
 (a) speed of the particle (b) mass of the particle
 (c) charge of the particle (d) magnetic field of the particle
- Assertion (A): When radius of a circular wire carrying current is doubled, its magnetic moment becomes four times.
 Reason (R): The magnetic moment of a current carrying loop is directly proportional to area of the loop

C) The work done by the electric field in moving a test charge between two points on the same equipotential surface is not zero.

(D) Equipotential surfaces do not exist near charges.

- i. Which of the following statements about equipotential surfaces is correct?

(A) Equipotential surfaces are always parallel to the electric field lines.

(B) Equipotential surfaces are perpendicular to electric field lines. C)

The work done by the electric field in moving a test charge between two points on the same equipotential surface is not zero. (D) Equipotential surfaces do not exist near charges.

30. CASE STUDY

A galvanometer is used in an electric circuit to detect current and in some experiments to locate the null point. The galvanometer cannot be used as such to measure the value of current. A galvanometer is a very sensitive device. It gives full scale deflection even for a very small current of the order of few microamperes. On the passage of a large current the galvanometer may get damaged either due to the breaking of the pointer or the coil may burn due the production of the excessive heat. A galvanometer can be converted an ammeter by the use of a shunt resistance.

- i. How is a moving coil galvanometer converted into an ammeter of desired range?

(a) Connecting a shunt resistance in series

(b) Connecting a shunt resistance in parallel

(c) Connecting large resistance in series

(d) Connecting a large resistance in parallel

- ii. A moving coil galvanometer of resistance G gives a full-scale deflection for a current I_g . It is converted into an ammeter of range 0-1 ampere. What should be the value of shunt resistance to convert it into an ammeter of desired range?

a. $S = \frac{I_g}{I - I_g} G$ b. $S = \frac{I - I_g}{I} G$ c. $S = \frac{I}{I_g} G$ d. $S = \frac{I_g}{I} G$

- iii. Which one will have the greatest resistance, a micro-ammeter, a milli-ammeter, or an ammeter?

(a) Microammeter

(b) Milliammeter

(c) Ammeter

(d) All will have the same resistance

- iv. The sensitivity of a galvanometer is 60 div/ampere. When a shunt resistance is connected its current sensitivity decreases to 10 div/ampere. What will be the shunt resistance if the resistance of the galvanometer is 20 ohms?

(a) 4 ohm (b) 5 ohm (c) 4.5 ohm (d) 5.5 ohm

SECTION E (LONG TYPE)

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If Assertion and Reason are false.

15. Two wires of the same length are shaped into a square of side 'a' and a circle with radius 'r'. If they carry same current, the ratio of their magnetic moment is:

(a) $2/\pi$

(b) $\pi/4$

(c) $\pi/2$

(d) $4/\pi$

16. Unit of magnetic flux

(a) tesla

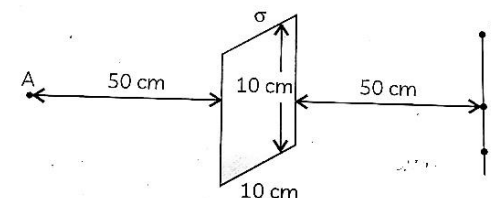
(b) gauss

(c) maxwell

(d) tesla/m²

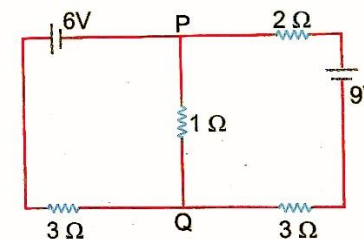
SECTION B (2 MARKS)

17. A uniformly charged large plane sheet has charge density $\sigma = \frac{1}{18\pi} \times 10^{-15}$ C/m². Find the electric field at point A which is 50 cm from the sheet. Consider a straight line with three points P, Q and R, placed 50 cm from the charged sheet on the right side as shown in the figure. At which of these points, does the magnitude of the electric field due to the sheet remain the same as that at point A and why?

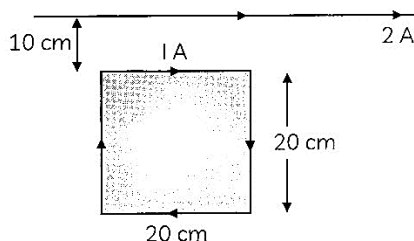


18. Inside two parallel plate capacitor a dielectric material of thickness t and constant k is introduced. Find the expression for capacitance of the capacitor.

19. Find the current through 1 ohm resistor.



20. What ampere's law? Use it to derive the expression for magnetic field at a distance d from a straight current carrying wire



Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor

28. Derive the capacitance of parallel plate capacitor with air inside it.

SECTION D (CASE STUDY)

29. CASE STUDY

Consider a system of two-point charges $+4\mu\text{C}$ and $-4\mu\text{C}$ and, placed 20 cm apart in a vacuum. The charges are fixed at points A and B respectively along the x-axis, with A at $x = -10\text{cm}$ and B at $x = +10\text{cm}$

The electric field and equipotential surfaces generated by these charges are symmetric about the midpoint between the two charges. Equipotential surfaces are surfaces on which the potential at every point is the same. Near the charges, these surfaces are nearly spherical, and at greater distances, the surfaces become elongated along the axis connecting the charges. At the midpoint between the charges, the potential is zero. However, the electric field at this point is not zero, as the electric fields due to the individual charges add up in magnitude but point in opposite directions. A small test charge is moved from a point at infinity to different positions in the vicinity of the charges, including points on equipotential surfaces.

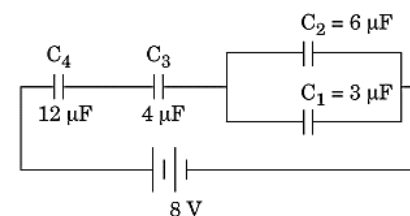
- ii. At the midpoint between the two charges (the origin), what is the electric potential?
 - (A) Zero
 - (B) Maximum positive
 - (C) Maximum negative
 - (D) Depends on the path taken
- iii. Which of the following statements about equipotential surfaces is correct?
 - (A) Equipotential surfaces are always parallel to the electric field lines.
 - (B) Equipotential surfaces are perpendicular to electric field lines.
 - (C) The work done by the electric field in moving a test charge between two points on the same equipotential surface is not zero.
 - (D) Equipotential surfaces do not exist near charges.
- iv. Which of the following statements about equipotential surfaces is correct?
 - (A) Equipotential surfaces are always parallel to the electric field lines.
 - (B) Equipotential surfaces are perpendicular to electric field lines

21. What is gauss law? What will be the flux through a sphere having dipole inside it.

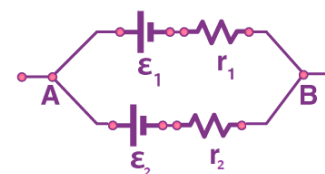
SECTION C (3 MARKS)

22. Derive the expression for the torque acting on an electric dipole, when it is held in a uniform electric field. Identify the orientation of the dipole in the electric field, in which it attains a stable equilibrium.
23. Two-point charges of $+1\mu\text{C}$ and $+4\mu\text{C}$ are kept 30 cm apart. How far from the $+1\mu\text{C}$ charge on the line joining the two charges, will the net electric field be zero? Write the dimension of electric field.

24.



- a. Calculate the net capacitance of the circuit.
 - b. Find net charge drawn from battery.
 - c. Find energy stored in the capacitor C_3 .
25. Find the expression for equivalent emf of the given combination of cells



26.

- a. Define the term 'Conductivity' of a metallic wire. Write its SI unit.
 - b. Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence, obtain the relation between current density and the applied electric field E .
27. A square loop of side 20 cm carrying current of 1 A is kept near an infinite long straight wire carrying a current of 2 A in the same plane as shown in the figure