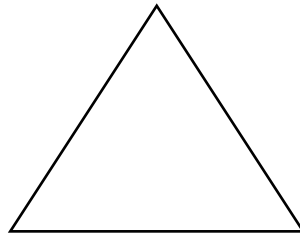


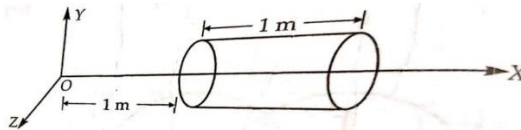


Chapter: Electric Charges and Field

1. A negatively charged object X is repelled by another charged object Y. However, an object Z is attracted to object Y. Which of the following is the best possibility for the object Z?
(a) positively charged only
(b) Negatively charged only
(c) Neutral or positively charged
(d) Neutral or negatively charged
2. Consider the charges q , q and $-q$ placed at the vertices of an equilateral triangle, as shown in fig. What is the force on each vertex?

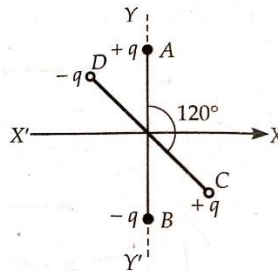


3. A hollow cylindrical box of length 1m and area of cross-section 25 cm^2 is placed in a three-dimensional coordinate system as shown in figure. The electric field in the region is given by $\vec{E} = 50x \hat{i}$, where E is in NC^{-1} and x is in metres.



Find

- (i) Net flux through the cylinder,
(ii) charge enclosed by the cylinder.
4. Two small identical electrical dipoles AB and CD, each of dipole moment 'p' are kept at an angle of 120° as shown in figure. What is the resultant dipole moment of this combination? If this system is subjected to electric field (\vec{E}) directed along +X direction, what will be the magnitude and direction of the torque acting on this?



5. An electric dipole is placed at an angle of 60° with an electric field of magnitude $4 \times 10^5 \text{ NC}^{-1}$. It experiences a torque of $8\sqrt{3} \text{ Nm}$. If the length of the dipole is 4 cm, determine the magnitude of either charge of the dipole.

For question numbers 6 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

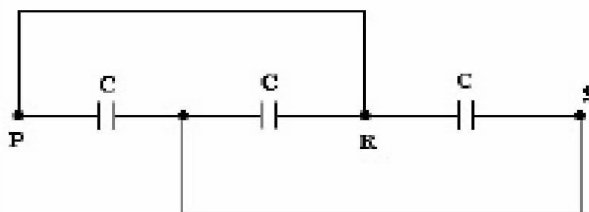
- a) Both A and R are true and R is the correct explanation of A
- b) Both A and R are true but R is NOT the correct explanation of A
- c) A is true but R is false
- d) A is false and R is also false

6. **Assertion (A):** Electric potential is constant within and at the surface of each conductor.

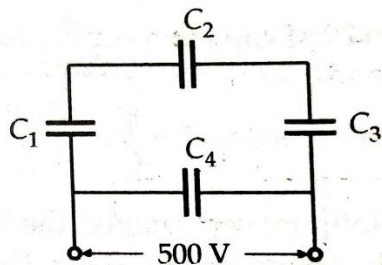
Reason(R): Electric field just outside a charged conductor is perpendicular to the surface of the conductor at every point.

Chapter: Electric Potential and Capacitance

1. Three capacitors, each of capacitance $C = 3 \text{ mF}$, are connected as shown in the figure. The equivalent capacitance between points P and S is

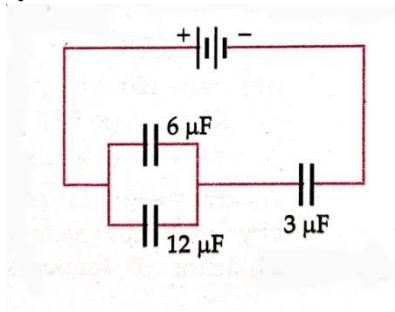


- (a) 3 mF
 - (b) 9 mF
 - (c) 1 mF
 - (d) 6 mF
2. If potential (in volts) in a region is expressed as $V(x, y, z) = 6xy - y + 2yz$, the electric field (in N/C) at point (1, 1, 0) is
- (a) $-(2\hat{i} + 3\hat{j} + \hat{k})$
 - (b) $-(6\hat{i} + 9\hat{j} + \hat{k})$
 - (c) $-(3\hat{i} + 5\hat{j} + 3\hat{k})$
 - (d) $-(6\hat{i} + 5\hat{j} + 2\hat{k})$
3. Three-point charges, $+Q$, $+2Q$ and $-3Q$ are placed at the vertices of an equilateral triangle ABC of side l . If these charges are displaced to the midpoints A_1 , B_1 and C_1 respectively, find the amount of the work done in shifting the charges to the new locations.
4. A network of four capacitors each of $12 \mu\text{F}$ capacitance is connected to a 500 V supply as shown in figure. Determine (a) equivalent capacitance of the network, (b) charge on each capacitor.



5. In the following arrangement of capacitors, the energy stored in the $6 \mu\text{F}$ capacitor is E. Find the value of the following:
- (i) Energy stored in $12 \mu\text{F}$ capacitor.

- (ii) Energy stored in $3 \mu\text{F}$ capacitor.
 (iii) Total energy drawn from the battery.



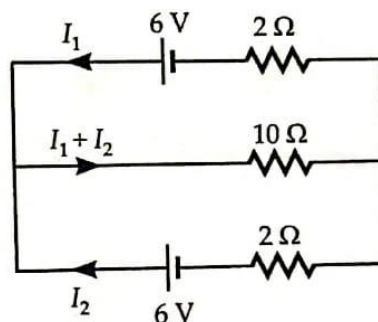
For question numbers 6 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is the correct explanation of A
 (b) Both A and R are true but R is NOT the correct explanation of A
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 (d) A is false and R is also false

6. **Assertion (A):** If a dielectric is placed in external field, then field inside dielectric will be less than applied field
Reason(R): Electric field will induce dipole moment opposite to field direction.
7. Using gauss's law obtains the expression for the electric field due to a uniformly charged shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r , for $r > R$ and $r < R$.

Chapter: CURRENT ELECTRICITY

1. The potential difference across a cell in an open circuit is 8 V. It falls to 4V when a current of 4 A is drawn from it. The internal resistance of the cell is
 (a) 4Ω
 (b) 3Ω
 (c) 2Ω
 (d) 1Ω
2. Electric current through resistance 10Ω in the circuit shown is

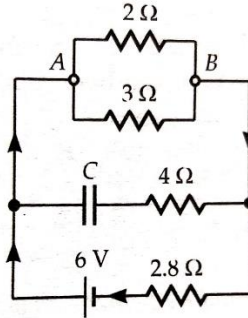


- (a) 0 A
 (b) 0.5 A

(c) 6/11 A

(d) 2 A

- Two cells of emf E_1 , E_2 and internal resistances r_1 and r_2 respectively are connected in parallel. Derive the expression for the emf and internal resistance of a cell which replace this combination.
- Calculate the steady-state current through 2Ω resistor in the circuit shown in figure. The internal resistance of the battery is negligible and $C = 2\mu\text{F}$



- Derive the relation between current density j and potential difference V across a current carrying conductor of length l , area of cross-section A and the number density n of free electrons.

For question numbers 6 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

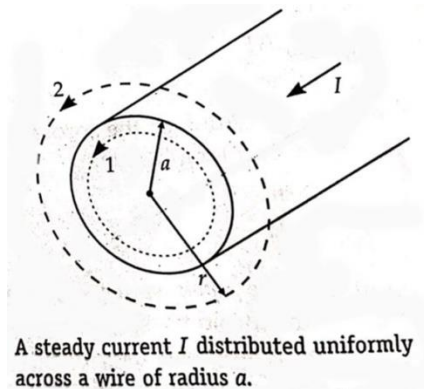
- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
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- Assertion:** The drift velocity of electrons in a metallic wire will decrease, if the temperature of the wire is increased.
Reason: On increasing temperature, conductivity of metallic wire decreases.

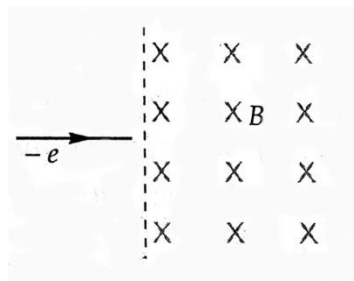
Chapter: Moving Charges and Magnetism

- The resistance of a galvanometer is 50Ω and the maximum current which can be passed through it is 0.002 A . What resistance must be connected to it in order to convert it into an ammeter of range $0-0.5\text{ A}$?
 - 0.2Ω
 - 0.02Ω
 - 0.002Ω
 - 0.5Ω
- A long straight wire of radius a carries a steady current i . The current is uniformly distributed across its cross section. The ratio of the magnetic field at $a/2$ and $2a$ from its axis is
 - $1/2$
 - 2
 - $2/3$
 - $3/2$

3. A straight thick long wire of uniform cross-section of radius 'a' is carrying a steady current I. Use Ampere's circuital law to obtain a relation showing the variation of the magnetic field (B_r) inside and outside the wire with distance r, ($r \leq a$) and ($r > a$) of the field point from the centre of its cross-section. Plot a graph showing the variation of field B with distance r.



4. An electron moving horizontally with a velocity of 4×10^4 m/s enters a region of uniform magnetic field of 10^{-5} T acting vertically downward as shown in figure. (a) Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



5. Two long straight parallel conductors carrying steady currents I_1 and I_2 are separated by a distance d. Explain briefly with the help of a suitable diagram, how the magnetic field due to one conductor acts the other. Hence, deduce the expression for the force acting between the two conductors. Mention the nature of this force. Using the concept of force between two infinitely long parallel current carrying conductors define one ampere of current.

Chapter: Magnetism and Matter

- The magnetic susceptibility is negative for
 - diamagnetic material only
 - paramagnetic material only
 - ferromagnetic material only
 - paramagnetic and ferromagnetic materials
- If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is
 - repelled by the north pole and attracted by the south pole
 - repelled by both the poles
 - attracted by both the poles
 - attracted by the north pole and repelled by the south pole

- Distinguish the magnetic properties of dia-, para- and ferro-magnetic substances in terms of (i) susceptibility, (ii) magnetic permeability and (iii) coercivity. Give one example of each of these materials. Draw the field lines due to an external magnetic field near a (i) diamagnetic and (ii) paramagnetic substance.
- Derive an expression for the intensity of the magnetic field at an axial point of a short magnetic dipole.
- A circular coil of n turns and radius r carries a current I . It is unwound and rewound to make another coil of radius $r/2$ current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

Chapter: Electromagnetic Induction

- A metal ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The magnet falls with an acceleration:
 - Equal to g
 - Less than g
 - Greater than g
 - none
- Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon
 - the materials of the wires of the coils
 - Relative position and orientation of the two coils
 - the current in the two coils
 - the rates at which currents are changing in the two coils
- Deduce an expression for the self-induction of a long solenoid of N turns, having a core of relative permeability μ_r .
- Define mutual inductance. Deduce an expression for the mutual inductance of two long solenoids of length l having different radii and different number of turns.
- A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field of 1 T parallel to the axis is present everywhere. What is the emf between the centre and the metallic ring?

For question numbers 6 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

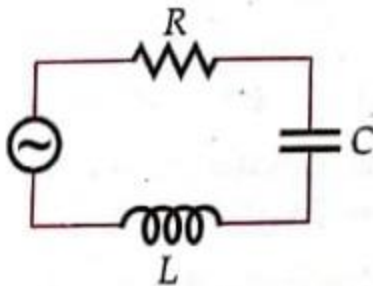
- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
- A is true but R is false
- A is false and R is also false

- Assertion:** The presence of large magnetic flux through a coil maintains a current in the coil, if the circuit is continuous.
Reason: Only a change in magnetic flux will maintain an induced current in the coil.

Chapter: Alternating Current

- The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is:
 - 0.8
 - 1.0

- (c) 0.4
(d) 0.5
2. The core of transformer is laminated because
- the weight of the transformer may be reduced
 - rusting of the core may be prevented
 - energy losses due to eddy currents may be minimised
 - ratio of in primary and secondary may be increases
3. A 0.3 H inductor, $60 \mu\text{F}$ capacitor and a 50Ω resistor are connected in series with a 120 V, 60 Hz supply. Calculate
- Impedance of the circuit
 - Current flowing in the circuit.
4. A series LCR circuit with $L = 4.0 \text{ H}$, $C = 100 \mu\text{F}$ and $R = 60 \Omega$ is connected to a variable frequency 240 V source as shown in Fig.



Calculate:

- the angular frequency of the source which drives the circuit at resonance.
 - the current at the resonating frequency.
 - the rms potential drop across the inductor at resonance.
5. The primary coil of an ideal step-up transformer has 100 turns and the transformation ratio is also 100. The input voltage and the power are 220 V and 1100 W respectively. Calculate:
- number of turns in the secondary
 - the current in the primary
 - voltage across the secondary
 - the current in the secondary
 - power in the secondary.

For question numbers 6 two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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6. **Assertion:** In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
Reason: At resonance, the inductive reactance exceeds the capacitive reactance.