Meritnation
Class 1st to 12th
A Unit of Aakash

Board Paper of Class 12 Physics Term-I 2021 Delhi(SET 4) - Solutions

Total Time: 90

Total Marks: 55.0

Section A

Solution 1

Like charges repel each other and opposite charges attract each other. Thus, if X (negative charged object) is repelled by object Y, the Y must be a negatively charged object. As Z is attracted towards Y, then Z must have charge opposite in nature to that of X, i.e., Z must be a positively charged object. But if induction is considered then object Z may be neutral.
Hence, the correct answer is option (c).

Solution 2

According to the principle of charge conservation, the sum of the charges will remain conserved.
Initially, sum of charges = $+3e + 5e - 3e = +5e$
If final charges are $+6e$, $+6e$, $-7e$, then the sum of charges will be $5e$. Also, all free charges are integral multiples of a basic unit of charge denoted by e. Thus charge on a body is always given by:
$q = ne$
Therefore, option (c) is not possible.
Hence, the correct answer is option (b).

Solution 3

Number of electrons gained, $n = 5\times10^{18}$
Charge on the object initially, $q_i = 1$ C
Net charge on the object, $Q = q_i + ne$
$Q = 1 - 5\times10^{18}\times1.6\times10^{-19}$
$= 1 - 0.8$
$= +0.2$ C
Hence, the correct answer is option (d).

Solution 4

The algebraic sum of every current entering and leaving the node has to be null. This is Kirchhoff first law and is based on conservation of charge

while Kirchhoff's second law is based on the conservation of energy principle.
Hence, the correct answer is option (d).

Solution 5

Resistance of the bulb,
$R = \frac{V^2}{P} = \frac{220^2}{100} = 484\ \Omega$
New power consumed by the bulb,
$P' = \frac{V'^2}{R}$
$= \frac{110^2}{484}$
$= 25\ \text{W}$

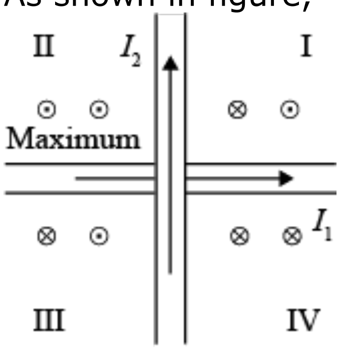
Hence, the correct answer is option (a).

Solution 6

Temperature coefficient of resistivity of semiconductor is negative.
Hence, the correct answer is option (c).

Solution 7

As shown in figure,



Using right hand thumb rule: When holding the current-carrying straight conductor in your right hand such that the thumb points towards the direction of the current, the finger of the right hand wraps around the conductor in the direction of the field lines of the magnetic field.
Hence, the correct answer is option (b).

Solution 8

Force per unit length between parallel current carrying wires is:
$f = \frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi R} = \frac{4\pi \times 10^{-7} \times 4 \times 10}{2\pi \times 2.5 \times 10^{-2}}$
$= 3.2 \times 10^{-4}\ \text{N/m}$

Hence, the correct answer is option (d).

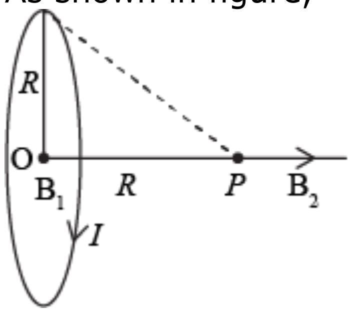
Solution 9

As, we have to measure voltage. So, to use an ammeter in place of the voltmeter, a high resistance must be connected in series with the ammeter to

make its resistance high.
Hence, the correct answer is option (d).

Solution 10

As shown in figure,



Magnetic field at the centre of the coil,

$$\mathrm{B}_1 = \frac{\mu_o I}{2R}$$

Magnetic field at a distance R on the axis of the coil,

$$\mathrm{B}_2 = \frac{\mu_o I R^2}{2(R^2+R^2)^{3/2}} = \frac{\mu_o I}{4\sqrt{2}R}$$

$$So,\ the\ ratio,$$

$$\frac{\mathrm{B}_1}{\mathrm{B}_2} = \frac{2\sqrt{2}}{1} = 2\sqrt{2}$$

Hence, the correct answer is option (a).

Solution 11

Self inductance,

$$L = \mu_0 \frac{N^2 i A}{l}$$

$$\frac{L_1}{L_2} = \frac{{N_1}^2}{{N_2}^2} = \left(\frac{600}{500}\right)^2$$

$$\frac{108\ \mathrm{mH}}{L_2} = \frac{36}{25}$$

$$L_2 = 75\ \mathrm{mH}$$

Hence, the correct answer is option (d).

Solution 12

Given:

$$f = 50\ \mathrm{Hz}$$
$$I_{rms} = 15\ \mathrm{A}$$
$$t = \frac{1}{600}\ \mathrm{s}$$

$$\mathrm{But,}\ I_{rms} = \frac{I_\mathrm{o}}{\sqrt{2}}$$

$$\Rightarrow I_\mathrm{o} = \sqrt{2}\, I_{\mathrm{rms}} = 15\sqrt{2}\ \ \mathrm{A}$$

Instantaneous current, $I=I_o\sin\omega t$
$\Rightarrow I=I_o\sin 2\pi ft$
$\Rightarrow I=15\sqrt{2}\times\sin\left(2\pi\times 50\times\frac{1}{600}\right)$
$\Rightarrow I=15\sqrt{2}\times\sin\frac{\pi}{6}$
$\Rightarrow I=\frac{15\sqrt{2}}{2}=\frac{15}{\sqrt{2}}\text{ A}$

Hence, the correct answer is option (a).

Solution 13

For an L - R series circuit, phase difference, $\tan\phi=\frac{\omega L}{R}$
For $\phi=\frac{\pi}{2}$, $\frac{\omega L}{R}$ must be equal to infinity.
Thus, resistance should be equal to zero.
Which is not possible for L - R series circuit.

For a circuit containing only an inductor (L) and resistor (R) in series, the phase difference can not be equal to $\frac{\pi}{2}$.

Hence, the correct answer is option (c).

Solution 14

Electric field along *x* - axis, $E_x=-\frac{d}{dx}\left(3x^2\right)=-6x$
For *x* = 1, $E_x=-6\text{ V/m}$

The electric field at any point along *y* and *z* – axis is zero as the potential varies only along *x* – axis.

The electric field at the point (1 m, 0, 2m) is 6 V/m along –*x*-axis.

Hence, the correct answer is option (a).

Solution 15

The positive side of the electric field shall induce negative charge on the upper side of the conductor, where the negative side of the electric field shall induce the positive charge on the lower side of the conductor.
The electric field lines always travel from a positive charge to a negative charge.

Hence, the correct answer is option (d).

Solution 16

Potential difference, $V=200\text{ V}$

Capacitance, $C = 2\ \mu\text{F}$
Energy stored, $E = \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 10^{-6} \times (200)^2$
$E = 4 \times 10^{-2}\ \text{J}$

When capacitance is decreased to $\text{X}\ \mu\text{F}$, $C' = \text{X}\ \mu\text{F}$
Energy stored,$E' = \frac{1}{2}C'V^2 = \frac{1}{2} \times \text{X} \times 10^{-6} \times (200)^2 = 2 \times 10^{-2} \times \text{X}$

Decrease in energy, $\Delta E = E - E' = 2 \times 10^{-2}\ \text{J}$
$\Rightarrow 2 \times 10^{-2} = 4 \times 10^{-2} - 2\text{X} \times 10^{-2}$
$\Rightarrow 2 = 4 - 2\text{X}$
$\Rightarrow \text{X} = 1$

The value of X is $1\ \mu\text{F}$.

Hence, the correct answer is option (a).

Solution 17

Potential difference, $V = 200\ \text{V}$
Resistance, $R = 100\ \Omega$
According to Ohm's law, $V = IR$
$\Rightarrow I = \frac{V}{R} = \frac{200}{100} = 2\ \text{A}$
But, $I = \frac{q}{t} = \frac{ne}{t}$
Where, q = amount of charge passing through conductor
$n =$no. of electrons
$e =$charge on an electron = $1.6 \times 10^{-19}\ \text{C}$
$t =$time = 1 s
$\Rightarrow n = \frac{It}{e} = \frac{2 \times 1}{1.6 \times 10^{-19}} = 1.25 \times 10^{19}$

Hence, the correct answer is option (a).

Solution 18

Impedance for a series LCR circuit: Impedance is defined as a combination of resistance and reactance. It is basically an obstruction to the flow of electrons in an electric circuit. Z is the symbol used for describing the impedance. The unit of impedance is the ohm.

$$\text{Z} = \sqrt{\text{R}^2 + (\text{X}_\text{L} - \text{X}_\text{C})^2}$$

Hence, the correct answer is option (d).

Solution 19

Average power of an A.C circuit, $P_{av} = E_{rms}I_{rms}\cos\phi$
Where, ϕ is the phase difference between EMF and current.
In the given question EMF lags behind current by $\frac{\pi}{2}$ radian.

$\Rightarrow P_{av} = E_{rms} I_{rms}\ \cos\frac{\pi}{2}$
$\Rightarrow P_{av} = 0 \qquad\qquad (\because\ \cos\frac{\pi}{2} = 0)$
Hence, the correct answer is option (d).

Solution 20

Force experienced by a conductor of length *l* carrying current I when placed in a uniform magnetic field *B* is, $F = BIl\sin\theta$
Where, θ is the angle between current element and magnetic field.
For a given current, length, and magnetic field, the force experienced by the conductor is maximum when it is placed perpendicular to the magnetic field $(\theta = 90^\circ)$.

Hence, the correct answer is option (a).

Solution 21

Given:
$V_R = 20\text{ V}$

$\mathrm{V_L} = 15\text{ V}$

$\mathrm{V_C} = 30\text{ V}$

The resultant voltage for the series LCR circuit, $V = \sqrt{{V_R}^2 + (V_C - V_L)^2}$

$\Rightarrow V = \sqrt{20^2 + (30 - 15)^2}$

$\Rightarrow V = \sqrt{20^2 + 15^2} = \sqrt{625}$

$\Rightarrow V = 25\text{ V}$

Hence, the correct answer is option (c).

Solution 22

In a dc circuit the direction of current inside the battery is from negative terminal to positive terminal whereas outside the battery the direction of current is from positive terminal to the negative terminal of the battery.

Hence, the correct answer is option (c).

Solution 23

Electric field due a point charge 2*q*, at distance *r* is *E*, mathematically,
$E = k\frac{2q}{r^2} = 2\frac{kq}{r^2}$
$E = 2\frac{kq}{r^2} \qquad\qquad .....(1)$
Let the electric field due to a uniformly charged thin spherical shell of radius *R* with a total charge *q* at a distance $\frac{r}{2}$ be E'.
Mathematically,

$$E' = k\frac{q}{\left(\frac{r}{2}\right)^2} = 4\frac{kq}{r^2}$$

$$\Rightarrow E' = 4\frac{kq}{r^2} \qquad \ldots\ldots(2)$$

Dividing equation (2) by equation (1):

$$\Rightarrow \frac{E'}{E} = \frac{4\frac{kq}{r^2}}{2\frac{kq}{r^2}} = 2$$

$$\Rightarrow E' = 2E$$

Hence, the required electric field is two times *E*.

Solution 24

Given:

$B_H = 0.2\ \mathrm{G}$

$B = 0.4\ \mathrm{G}$

But, $B_H = B\cos\delta$

Where, δ is the angle of dip

$\Rightarrow \cos\delta = \frac{B_H}{B}$

$\Rightarrow \cos\delta = \frac{0.2\ \mathrm{G}}{0.4\ \mathrm{G}} = \frac{1}{2}$

$\delta = 60^\circ$

Angle of dip at that place is 60°.

Hence, the correct answer is option (c).

Solution 25

Given:

Change in current, $\Delta I = I_2 - I_1 = 3 - 7 = -4\ \mathrm{A}$

Change in time, $\Delta t = 0.04 = 4 \times 10^{-2}\ \mathrm{s}$

Mutual inductance, $M = 0.5\ \mathrm{H}$

EMF induced, $E = -M\frac{\Delta I}{\Delta t}$

$\Rightarrow E = -0.5\left(\frac{-4}{4\times10^{-2}}\right)$

$\Rightarrow E = 50\ \mathrm{V}$

Hence, the correct answer is option (a).

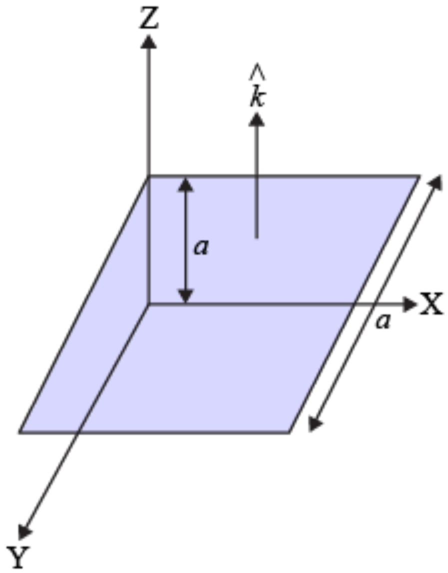
Section B

Solution 26

Electric field, $\overrightarrow{E} = cz^2\widehat{\mathrm{k}}$

Surface area, $S = a \times a = a^2$

Let the area vector of the sheet will be in the + z-direction.



$\overrightarrow{S} = a^2\hat{k}$

Electric flux, $\phi = \overrightarrow{E}\,.\,\overrightarrow{S}$

$\phi = ca^2\hat{k}.\,a^2.\,\hat{k} = a^4c$

The electric flux through the sheet is a^4c units.

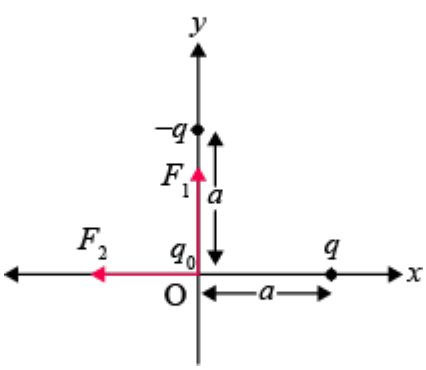
Hence, the correct answer is option (a).

Solution 27

Force experienced by charge q_o due to charge $-q$,

$F_1 = -k\frac{qq_o}{a^2}$ (along $+y$ axis)

Force experienced by charge q_o due to charge q, $F_2 = k\frac{qq_o}{a^2}$ (along $-x$ axis)



Resultant force, $F = \sqrt{(F_1)^2 + (F_2)^2 + 2F_1F_2\cos\theta}$

From the figure, $\theta = 90^\circ$

Now, resultant force, $F = \sqrt{(F_1)^2 + (F_2)^2}$

$$\Rightarrow F=\sqrt{\left(-k\frac{qq_o}{a^2}\right)^2+\left(k\frac{qq_o}{a^2}\right)^2}$$

$$\Rightarrow F=\sqrt{2\left(k\frac{qq_o}{a^2}\right)^2}$$

$$\Rightarrow F=\sqrt{2}\,k\frac{qq_o}{a^2}$$

Hence, the correct answer is option (c).

Solution 28

For case I (distance = $r_1=10\ \mathrm{cm}=10\times10^{-2}\ \mathrm{m}$):
Potential energy:
$U_1=-k\,\frac{5\ \mathrm{nC}\times3\ \mathrm{nC}}{(10\times10^{-2})\mathrm{m}}=-13.5\times10^{-7}\ \mathrm{J}$

For case II (distance = $r_2=15\ \mathrm{cm}=15\times10^{-2}\ \mathrm{m}$):
Potential energy:
$U_2=-k\,\frac{5\ \mathrm{nC}\times3\ \mathrm{nC}}{(15\times10^{-2})\mathrm{m}}=-9\times10^{-7}\ \mathrm{J}$
Net work done, $W=U_2-U_1$
$\Rightarrow W=(-9+13.5)\times10^{-7}\ \mathrm{J}$
$\Rightarrow W=4.5\times10^{-7}\ \mathrm{J}$

Work done by the field is $4.5\times10^{-7}\ \mathrm{J}$.

Hence, the correct answer is option (d).

Solution 29

Energy stored = qV = 7.20 × 10^5 J
$q=\frac{7.2\times10^5}{12}=6\times10^4\ \mathrm{C}$
Hence, the correct answer is option (a).

Solution 30

To suspend the rod by removing the tension in the springs, we have:
Force of gravity = Force on currying carrying rod due to magnetic field
$mg=BIl$
$I=\frac{mg}{Bl}$

Hence, the correct answer is option (c).

Solution 31

On inserting the iron rod inside the solenoid, magnetic field will increase. Thus, due to increase in magnetic field, there will be increase in flux linked which in

turn increases the inductance.
But joule's heating is dependent on current and resistance which remains same in the solenoid even after inserting the rod, so rate of heating will not get affected by insertion of iron rod in the solenoid.
Hence, the correct answer is option (c).

Solution 32

When the frequency of the source is increased, then the current first increases and then decreases.
It is a condition of resonance in which resistance, capacitance and inductance are used.

Hence, the correct answer is option (a).

Solution 33

Resistance of a wire is given by,

$$\mathrm{R}=\frac{\rho l}{\mathrm{A}}$$

$$Now,\ \rho=\frac{\mathrm{m}}{\mathrm{ne}^2\tau}$$

$$\Rightarrow \mathrm{R}=\frac{\frac{\mathrm{m}}{\mathrm{ne}^2\tau}l}{\mathrm{A}}$$

$$=\frac{\mathrm{m}l}{\mathrm{ne}^2\tau\mathrm{A}}$$

Hence, the correct answer is option (b).

Solution 34

When a charged particle moves in a circular orbit in the magnetic field, then radius of the circular orbit of the particle is given by:
$\mathrm{r}=\frac{mv}{qB}$
Now, we have

$$m_\alpha=4m_p$$

$$q_\alpha=2q_p$$

$$\frac{v_p}{v_\alpha}=\frac{9}{4}$$

Thus, the ratio of the radii of circular orbits of a proton and an alpha particle is:

$$\frac{\mathrm{r_p}}{\mathrm{r}_\alpha}=\frac{\frac{m_pv_p}{q_pB}}{\frac{m_\alpha v_\alpha}{q_\alpha B}}$$

$$=\frac{m_pv_p}{m_\alpha v_\alpha}\times\frac{q_\alpha}{q_p}$$

$$=\frac{1}{4}\times\frac{9}{4}\times 2$$

$$=\frac{9}{8}$$

Hence, the correct answer is option (d).

Solution 35

Area of coil, A = 100 cm^2
Magnetic field, B = 0.1 T
(Angle between area vector and the field is $\theta = 90^\circ - 30^\circ = 60^\circ$)
$\text{Flux through coil, } \phi = BA\cos\theta$

$\phi_i = \frac{1}{2} \times 10^{-3}$

$\phi_f = 0$

Time taken, Δt = 10^{-4} s

$$\text{Induced emf, } \varepsilon = -\frac{(\phi_f - \phi_i)}{\Delta t}$$
$$= \frac{100}{10} \times \frac{1}{2}$$
$$= 5 \text{ V}$$

Hence, the correct answer is option (c).

Solution 36

Resistance, R = 15 Ω
Inductance, L = 80 mH

It is given that the current and the voltage are in phase (ϕ = 0),
So, $X_L = X_C$

$f = \frac{1}{2\pi\sqrt{LC}}$

$\Rightarrow 50 = \frac{1}{2\pi\sqrt{80 \times 10^{-3} \times C}}$

$\Rightarrow 2\pi\sqrt{80 \times 10^{-3} \times C} = \frac{1}{50}$

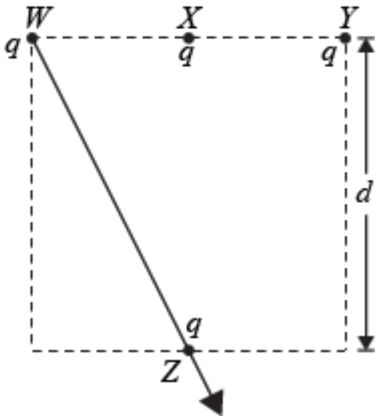
Squaring both sides:
$C = 126.79\ \mu\text{F}$

$\approx 127\ \mu\text{F}$

Hence, the correct answer is option (b).

Solution 37

Given: Electrostatic force exerted by object W on object X = F



Electrostatic force by *W* on *X*:

$$F = \frac{kq^2}{\left(\frac{d}{2}\right)^2}$$

$$F = \frac{4kq^2}{d^2}$$

Magnitude of electrostatic force on object *W* due to *Z*:

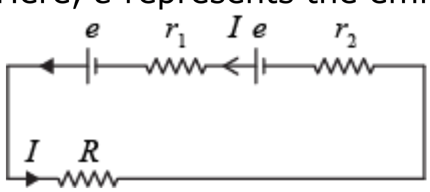
$$F' = \frac{kq^2}{\left(\sqrt{d^2+\left(\frac{d}{2}\right)^2}\right)^2}$$

$$F' = \frac{4kq^2}{5d^2} = \frac{F}{5}$$

Hence, the correct answer is option B.

Solution 38

Here, *e* represents the emf:



While discharging, potential difference:

$V = e - Ir_2$

It is given that potential difference across the source of internal resistance r_2 is zero

$\Rightarrow 0 = e - Ir_2$

$\Rightarrow e = Ir_2$

Applying Ohm's law

$I = \frac{2e}{R+r_1+r_2}$

$\Rightarrow e = \frac{2er_2}{R+r_1+r_2}$

$\Rightarrow R + r_1 + r_2 = 2r_2$

$\Rightarrow R = r_2 - r_1$

Hence, the correct answer is option (b).

Solution 39

The properties of magnetic field lines are:
1. The magnetic field lines of a magnet (or a solenoid) form continuous closed loops.
2. The tangent to the field line at a given point represents the direction of the net magnetic field B at that point.
3. The magnetic field lines do not intersect, for if they did, the direction of the magnetic field would not be unique at the point of intersection
Hence, the correct answer is option (c).

Solution 40

The equivalent resistance between A and B is given as:
R_{eq} = R + R = 2R
Hence, the correct answer is option (c).

Solution 41

Given: Magnetic dipole moment $\overrightarrow{\mathrm{M}}$ is parallel to the direction of uniform magnetic field $\overrightarrow{\mathrm{B}}$.
Torque:

$$\overrightarrow{\tau} = \overrightarrow{M} \times \overrightarrow{B}$$
$$= MB\sin\theta$$
$$= MB\sin 0^{o} = 0$$

Force due to a bar magnet will exert in opposite directions due to which net force will be zero.
Hence, the correct answer is option (c).

Solution 42

Electric potential:

$$V = -\int E.dr$$
$$V = -\int \frac{B}{r^2}.dr$$
$$V = -B\left(-\frac{1}{r}\right) = \frac{B}{r}$$

Total electrostatic potential energy of the system:

$$P.E = k\frac{q_1 q_2}{r} + q_1\frac{B}{r_1} + q_2\frac{B}{r_2}$$

Here, $q_1 = 14\ \mu\mathrm{C},\ q_2 = -4\ \mu\mathrm{C},\ r = 24\times10^{-2}\ \mathrm{m},\ r_1 = r_2 = 12\times10^{-2}\ \mathrm{m}$
$B = 1.2\times10^{6}\ \mathrm{N}/\left(\mathrm{cm}^2\right)$
By putting the values we can get the total potential energy,
$P.E. = -2.1 + 140 - 40 = 97.9\ \mathrm{J}$
Hence, the correct answer is option (a).

Solution 43

For a R- C series circuit:

$$I=\frac{E}{\sqrt{R^2+(X_C)^2}}$$

$$I=\frac{E}{\sqrt{R^2+\left(\frac{1}{2\pi fC}\right)^2}}$$

Now, $E=200\ \text{V},\ R=300\ \Omega,\ f=50\ \text{Hz}\ \text{ and } C=\frac{25}{\pi}\ \mu\text{F}$

$$I=\frac{200}{\sqrt{(300)^2+\left(\frac{1}{2\pi\times50\times\frac{25}{\pi}\times10^{-6}}\right)^2}}$$

$$I=\frac{200}{500}=0.4\ \text{A}$$

Hence, the correct answer is option (b)

Solution 44

Eddy currents are undesirable since they heat up the core and dissipate electrical energy in the form of heat. Eddy currents are minimised by using laminations on the core of a magnet.
Hence, the correct answer is option (d).

Solution 45

For negatively charged particles force acts in the direction opposite to the direction of the field.

$$\overrightarrow{F}=q\overrightarrow{E}$$

Thus for negatively charged particles will move in opposite direction of the electric field.
Hence, the correct answer is option (d).

Solution 46

Magnet acts as a dipole, so poles cannot be separated. It means magnetic poles always occur in pairs, north pole and south pole.
Hence, the correct answer is option (a).

Solution 47

Magnetic dipole moment of the current loop, $M=nIA$

$\Rightarrow M=nI\pi r^2$

When the radius of the coil is doubled, then the new magnetic moment:

$$\begin{aligned}M_{new}&=nI\pi(2r)^2\\&=4nI\pi r^2\\&=4M\end{aligned}$$

It means the magnetic moment becomes four times when the radius is doubled.
Hence, the correct answer is option (a).

Solution 48

For increasing the range, the resistance of an ammeter needs to be lower down.
A shunt is a resistance that is very less in value, when a shunt is added to an ammeter then more current will divert from the shunt because it offers less resistance. So, as the amount of current going through the shunt is more means more amount of current will flow from the ammeter arrangement.
Lesser is the value of shunt, lesser will be the effective resistance as it is connected in parallel. It means to increase the range of an ammeter additional shunt is added in parallel to it.
Hence, the correct answer is option (c).

Solution 49

By changing the number of turns of the primary and secondary coil, the step-up transformer can be changed to the step-down transformer.
EMF is not linked with the direction.
Hence, the correct answer is option (d).

Section C

Solution 50

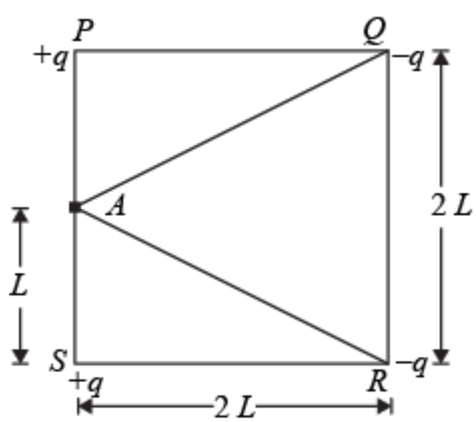
At larger distances, the collection of charges can be considered as the point charges whose sum is not zero.
Electric potential due to point charge *q* is given as:

$V = \frac{kq}{r}$

$V \propto \frac{1}{r}$

This implies that electric potentials due to point charge are the same for all points which are equidistant. The locus of these equidistant points, which are at same potential, form a sphere.
Hence, the correct answer is option (a).

Solution 51



Given:
Side of the square = *2L*

A is the midpoint of *PS*
It means *PA* = *AS* = *L*

$AR = AQ = \sqrt{(SR)^2 + (AS)^2} = \sqrt{(2L)^2 + (L)^2} = L\sqrt{5}$

Electric potential at point A due to the given charge configuration is

$$V_A = \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{PA} + \frac{q}{AS} + \frac{-q}{AQ} + \frac{-q}{AR}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{L} + \frac{q}{L} + \frac{-q}{L\sqrt{5}} + \frac{-q}{L\sqrt{5}}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left[1 - \frac{1}{\sqrt{5}}\right]$$

Hence, the correct answer is option (a).

Solution 52

Potential is same in between the points where no resistance is being used.
Hence, the correct answer is option (b).

Solution 53

Given: R_1 = 10 Ω, R_2 = R_3 = 5 Ω, *r* = 0 Ω and *E* = 5 V
Net resistance in branch *cf* as they are connected in series:

$R' = 5 + 5 = 10\ \Omega$

Net resistance between branches *bg* and *cf* as they are connected in parallel:

$R'' = \frac{10\times10}{10+10} = 5\ \Omega$

Applying Ohm's law, *E* = *IR*

$I = \frac{5}{5} = 1\ \mathrm{A}$

The current 1 A will get equally distributed in branch *bg* and *cf*, thus current in branch *bg* will be $\frac{1}{2}\ \mathrm{A}$.

Hence, the correct answer is option (c).

Solution 54

Given: R_1 = 10 Ω, R_2 = R_3 = 5 Ω, *r* = 0 Ω and *E* = 5 V
Current in-branch *bg,* $I_1 = \frac{1}{2}\ \mathrm{A}$
Power dissipated, $P = I_1^2 R$

$\Rightarrow P = \left(\frac{1}{2}\right)^2 \times 10 = 2.5\ \mathrm{W}$

Hence, the correct answer is option (b).

Solution 55

Given: R_1 = 10 Ω, R_2 = R_3 = 5 Ω, *r* = 0 Ω and *E* = 5 V
Current in branch *cf,* $I_2 = \frac{1}{2}\ \mathrm{A}$
Applying Ohm's law, potential difference across R_3 is:

$$E' = I_2 R_3$$

$$= \frac{1}{2} \times 5$$

$$= 2.5\ \mathrm{V}$$

Hence, the correct answer is option (c).