BYJU'S Full Test for Board Term I
(CBSE Grade 12)
PHYSICS ANSWER KEYS and SOLUTIONS

ANSWER KEYS

Q1	B.	Q20	B.	Q39	A.
Q2	A.	Q21	B.	Q40	C.
Q3	B.	Q22	B.	Q41	D.
Q4	A.	Q23	C.	Q42	B.
Q5	C.	Q24	B.	Q43	D.
Q6	A.	Q25	B.	Q44	B.
Q7	D.	Q26	B.	Q45	D.
Q8	B.	Q27	A.	Q46	A.
Q9	B.	Q28	D.	Q47	A.
Q10	A.	Q29	C.	Q48	C.
Q11	B.	Q30	D.	Q49	C.
Q12	C.	Q31	A.	Q50	A.
Q13	A.	Q32	D.	Q51	C.
Q14	C.	Q33	B.	Q52	C.
Q15	C.	Q34	C.	Q53	B.
Q16	B.	Q35	A.	Q54	D.
Q17	D.	Q36	D.	Q55	A.
Q18	C.	Q37	A.		
Q19	A.	Q38	B.		

SOLUTIONS

Q1 When a person combs his hair, static electricity is sometimes generated by which process?

A. Induction between the comb and hair
B. Friction between the comb and hair results in the transfer of electrons
C. Nuclear force between the comb and hair
D. Contact between comb and hair results in a charge transfer

Answer: (B)
Solution:
While combing hair, friction between the comb and the hair results in the transfer of electron.

Q2 A sphere encloses an electric dipole within it. The total flux through the sphere is

A. Zero
B. Double that due to a single charge
C. Half that due to a single charge
D. Dependent on the position of dipole with in the sphere

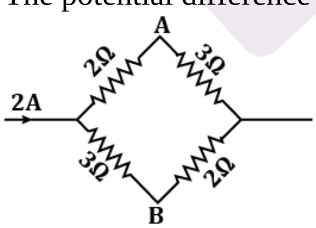
Answer: (A)
Solution:
From Gauss's law, electric flux is.

$\phi_E = \frac{Q_{enclosed}}{\epsilon_0}$

$Q_{enclosed} = -q + q = 0$

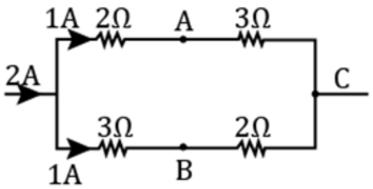
$\therefore \phi_E = 0$

Q3 The potential difference between A and B for the circuit shown in the figure is



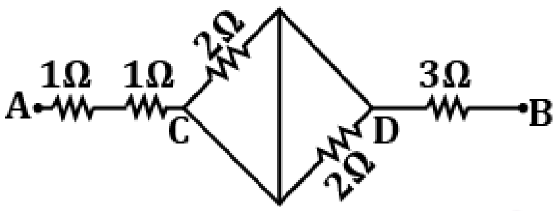
A. 2 V
B. 1 V
C. 3 V
D. Zero

Answer: (B)
Solution:



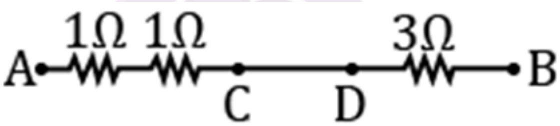
From the figure, current through both the arms will be equal i.e., 1 A.
Now $V_A - V_C = 3 \times 1 = 3\ V$ and $V_B - V_C = 2 \times 1 = 2\ V$
$\Rightarrow V_A - V_B = (V_A - V_C) - (V_B - V_C)$
= 3 – 2
= 1 V

Q4 The equivalent resistance between points *A* and *B* is



A. 5 Ω
B. 6 Ω
C. 9 Ω
D. 7 Ω

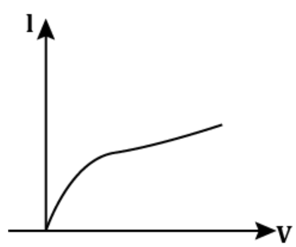
Answer: (A)
Solution:
The circuit is redrawn as



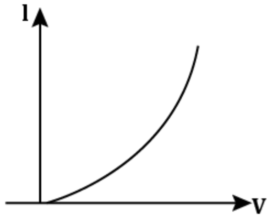
The resistance of 2 Ω between points C and D are short circuited.
Hence $R_{eq} = (1 + 1 + 3)\Omega$
$= 5\ \Omega$

Q5 Which among the following *I*-*V* characteristic represents ohmic conductors?

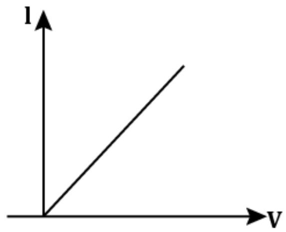
A.



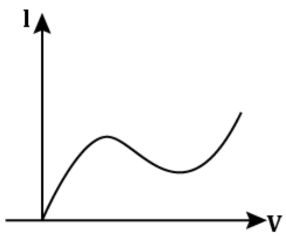
B.



C.



D.



Answer: (C)
Solution:
From Ohm's Law, $V = IR$ is a linear equation. Hence, I – V characteristics for ohmic conductor is also a straight line.

Q6 In a potentiometer, a cell of emf 2.5 V gives a balance point at 42 cm length of the wire. If this cell is replaced by another cell, then the balance point shift to 105 cm, then the emf of the second cell is

A. 6.25 V
B. 7.5 v
C. 5.75 V
D. 5.25 V

Answer: (A)
Solution:
For comparison of two cells, using potentiometer

$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

$$\Rightarrow E_2 = \frac{l_2}{l_1} E_1 = \frac{105}{42} \times 2.5$$

$$= 6.25\ V$$

Q7

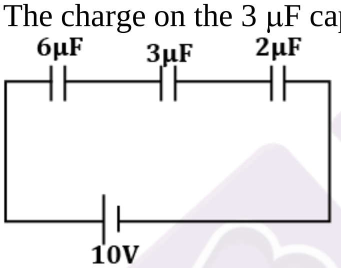
During charging of a capacitor, the ratio of energy stored in the capacitor to the energy dissipated in form of heat is

A. 1 : 2
B. 2 : 1
C. 1 : 3
D. 1 : 1

Answer: (D)
Solution:
Work done by the battery in charging a capacitor up to voltage V is
$W = CV^2$
The energy stored in a capacitor $U = \frac{1}{2}CV^2$
Now heat dissipated = W – U
$= CV^2 - \frac{1}{2}CV^2 = \frac{1}{2}CV^2$
Now, $\frac{U}{Heat} = \frac{\frac{1}{2}CV^2}{\frac{1}{2}CV^2} = 1$

Q8

The charge on the 3 μF capacitor as shown in the figure



A. 1 μC
B. 10 μC
C. 100 μC
D. 7 μC

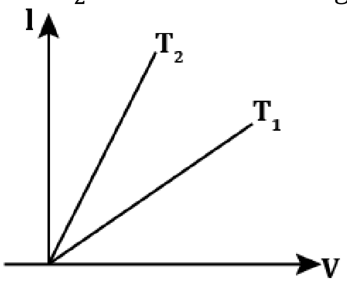
Answer: (B)
Solution:
The equivalent capacitance is
$\frac{1}{c_{eq}} = \frac{1}{6} + \frac{1}{3} + \frac{1}{2} = \frac{1+2+3}{6} = 1$
$C_{eq} = 1\ \mu F$
$Q = C_{eq}V = 1 \times 10^{-6} \times 10$
$= 10\ \mu C$

Q9

In a parallel plate capacitor, the capacitance increases if
A. Area of plate is decreased
B. Area of plate is increased

	C. Distance between plates is increased D. Charge on capacitor is increased **Answer:** (B) **Solution:** Since capacitance of a parallel plate capacitor is $C = \frac{K\,\epsilon_0 A}{d}$ $\Rightarrow C$ can be increased by increasing K and A or by decreasing d. Also, C is independent of charge Q and voltage V.
Q10	A parallel plate capacitor is charged and then isolated. The effect of increasing the plate separation on charge, potential difference and capacitance respectively are. A. Constant, Increases, Decreases B. Constant, Decreases, Increases C. Increases, Decreases, Constant D. Decreases, Constant, Increases **Answer:** (A) **Solution:** Since capacitance of parallel plate capacitor is $C = \frac{\epsilon_0 A}{d}$ Now, on increasing separation d, capacitance C will decrease. For isolated capacitor, Q remains same. Also. $Q = CV \Rightarrow V = \frac{Q}{C}$ As Q remains same and C decreases, potential difference V will increase
Q11	The electric field and the electric potential of a short electric dipole at axial position vary with distance r as A. $\frac{1}{r}, r$ B. $\frac{1}{r^3}, \frac{1}{r^2}$ C. $\frac{1}{r^2}, \frac{1}{r^2}$ D. $\frac{1}{r^2}, \frac{1}{r}$ **Answer:** (B) **Solution:** The electric field due to a short dipole $E_{axial} = \frac{p}{4\pi\epsilon_0 r^3}$ $\Rightarrow V \propto \frac{1}{r^2}$

Q12 The voltage (V) and current (I) graph for a conductor at two different temperatures, T_1 and T_2 are shown in the figure, Then



A. $T_1 = T_2$
B. $T_1 < T_2$
C. $T_1 > T_2$
D. $T_1 = \frac{1}{T_{-}}$

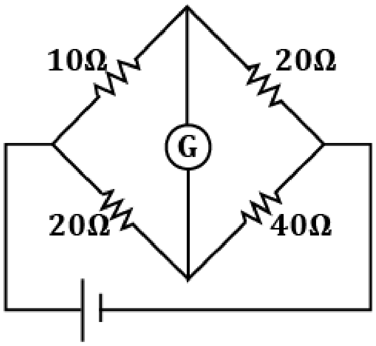
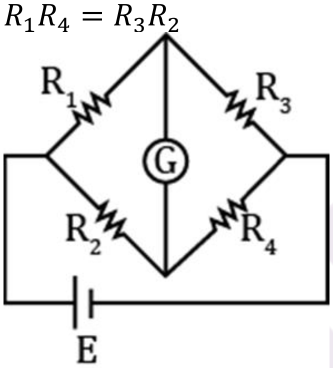
Answer: (C)
Solution:
Conductor have positive temperature coefficient of resistance i.e., on increasing the temperature resistance will increase.
Now from I – V characteristics, slope of I – V plot is $\frac{1}{R}$
Hence, $R_1 > R_2 \Rightarrow T_1 > T_2$

Q13 A current in a wire is given by equation, $I = (3t^2 - 2t + 5)\ A$. The charge through the cross-section of wire in time interval $t = 0$ to $t = 3$ s is

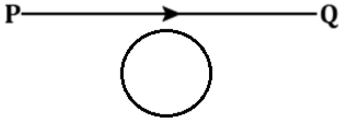
A. 33 C
B. 18 C
C. 27 C
D. 36 C

Answer: (A)
Solution:
Since, $Q = \int I dt$
$= \int_0^3 (3t^2 - 2t + 5)dt$
$= \left[\frac{3t^3}{3} - \frac{2t^2}{2} + 5t\right]$
$= 3^3 - 3^2 + 5 \times 3$
$= 27 - 9 + 15 = 33\ C$

Q14 In a Wheatstone bridge shown in the figure, if position of the battery and galvanometer are interchanged, then the deflection in galvanometer will

	 A. Be towards right B. Be towards left C. Remain zero D. None of these **Answer:** (C) **Solution:** In balanced condition $R_1 R_4 = R_3 R_2$  So, galvanometer will still read zero after interchange of battery and the galvanometer
Q15.	The magnetic force on a current carrying conductor of length L placed in an external uniform magnetic field $\vec{B}$ is given by (I is the current through conductor) A. $\frac{\vec{L} \times \vec{B}}{I}$ B. $I(\vec{B} \times \vec{L})$ C. $I(\vec{L} \times \vec{B})$ D. $I(\vec{L} \cdot \vec{B})$ **Answer:** (C) **Solution:** The magnetic force on a current carrying wire is given by $\vec{F} = I(\vec{L} \times \vec{B})$
Q16.	The SI unit of magnetic moment is

	A. Am B. Am^2 C. Nm^2 D. Cm **Answer:** (B) **Solution:** Since magnetic moment is given as M = NLA Hence, SI unit of magnetic moment is ampere $(\text{meter})^2$ i.e., Am^2
Q17	An electron having momentum $2.4 \times 10^{-24}\, kg\, m\, s^{-1}$ enters a region of uniform magnetic field of 0.15 T. The field vector makes an angle of 30° with the initial velocity vector of the electron. The radius of the helical path of the electron in the field will be A. 2 mm B. 1 mm C. 5 mm D. 0.05 mm **Answer:** (D) **Solution:** The radius of helical path is $R = \frac{mv \sin\theta}{qB}$ $= \frac{2.4\times10^{-24}\times\sin 30^0}{1.6\times10^{-19}\times0.15} = 5 \times 10^{-5} m = 0.05\, mm$
Q18	The angle of dip at magnetic poles and magnetic equator are A. $30^0, 60^0$ B. $10^0, 90^0$ C. $90^0, 0^0$ D. $45^0, 11.5^0$ **Answer:** (C) **Solution:** At poles, $B = B_v \Rightarrow B\ \sin\delta = B$ $\Rightarrow \sin\delta = 1$ $\Rightarrow \delta = 90^0$ At equator, $B = B_H \Rightarrow \cos\delta = B$ $\Rightarrow \cos\delta = 1$ $\Rightarrow \delta = 0^0$
Q19	At a given place on earth's surface, the horizontal component of earth's magnetic field is $2 \times 10^{-5}\, T$ and resultant magnetic field is 0.4 G. The angle of dip at this place is

	A. 60^0 B. 30^0 C. 45^0 D. 37^0 **Answer:** (A) **Solution:** The horizontal component of earth's magnetic field is $B_H = B\cos\delta$ $\Rightarrow \cos\delta = \frac{B_H}{B} = \frac{2\times10^{-5}}{4\times10^{-5}}$ $\Rightarrow \cos\delta = \frac{1}{2}$ $\Rightarrow \delta = 60^0$
Q20	. The coefficient of mutual inductance of two coils can be increased by A. Decreasing the number of turns in the coils B. Increasing the number of turns in the coils C. Winding the coil on wooden core D. Placing the coils in perpendicular orientation **Answer:** (B) **Solution:** Since, $M = \frac{\mu N_1 N_2 A}{l}$ Hence, mutual inductance can be increased by increasing the number of turns in the coils.
Q21	. Lenz's law is a consequence of the law of conservation of A. Charge B. Energy C. Induced emf D. Momentum **Answer:** (B) **Solution:** Lenz's law is a consequence of law of conservation of energy.
Q22	In the given figure, current from P to Q in the straight wire is increasing. The direction of induced current in the conducting loop is  A. Clockwise B. Anticlockwise

C. Changing
D. Nothing can be said

Answer: (B)
Solution:
Since current in straight wire is increasing. Hence inward flux inside the conducting loop is increasing.
So, from Lenz's law, an anticlockwise current will be induced in the loop.

Q23 The voltage over a cycle varies as

$$\begin{cases} V_0 \sin \omega t \; for \; 0 \le t \le \dfrac{\pi}{\omega} \\ -V_0 \sin \omega t \; for \dfrac{\pi}{\omega} \le t \le \dfrac{2\pi}{\omega} \end{cases}$$

The average value of the voltage for one cycle is

A. $\frac{V_0}{\sqrt{2}}$
B. $\frac{V_0}{2}$
C. $\frac{2V_0}{\pi}$
D. $\frac{V_0}{\pi}$

Answer: (C)
Solution:
The average value of the voltage is

$$V_{av} = \frac{\int_0^{2\pi/\omega} V dt}{\int_0^{2\,\pi/\omega} dt} = \frac{\int_0^{\pi/\,\omega} V_0 \sin\omega\, t\, dt + \int_{\pi/\omega}^{2\,\pi\omega} (-V_0 \sin \omega t\,)\, dt}{\frac{2\pi}{\omega}}$$

$$= \frac{\omega}{2\,\pi}\left[\left|\frac{-V_0 \cos \omega t}{\omega}\right|_0^{\frac{\pi}{\omega}} + \left|\frac{V_0 \cos \omega\, t}{\omega}\right|_{\frac{\pi}{\omega}}^{2\frac{\pi}{\omega}}\right]$$

$$= \frac{V_0}{2\,\pi}\,[(-\cos\pi + \cos 0\,)] + (\cos 2\,\pi - \cos \pi)$$

$$= \frac{V_0}{2\,\pi}\,[1 + 1 + 1 + 1] = \frac{2\,V_0}{\pi}$$

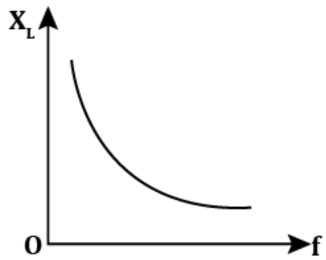
Q24 The quality factor has the dimensions same as that of

A. Time
B. Angle
C. Power
D. Frequency

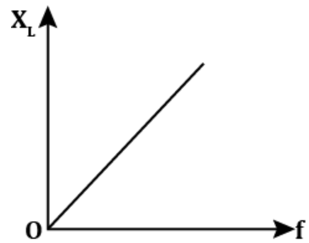
Answer: (B)
Solution:
Quality factor is defined as $Q = \frac{\omega_0 L}{R} = \frac{X_L}{R}$
So, it is a dimensionless quantity and its dimensions are same as of angle i.e., $[M^0 L^0 T^0]$

Q25 Which among the following graphs represents the correct variation of the inductive reactance (X_L) with frequency (f)?

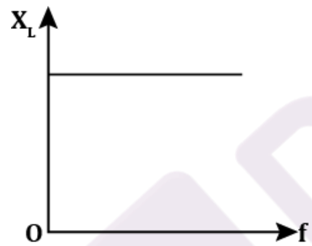
A.



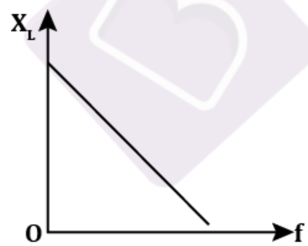
B.



C.



D.



Answer: (B)

Solution:

Inductive reactance $X_L = 2\,\pi f\ L$

$\Rightarrow X_L \propto f$

This represents a straight line

Q26 The phase difference between voltage and current in capacitor, in purely capacitive ac circuit is

A. π

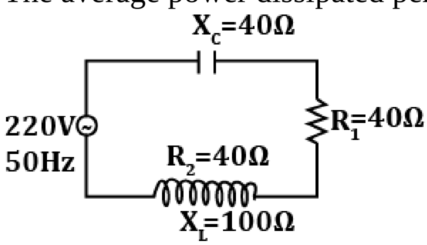
B. $\frac{\pi}{2}$

C. 0

D. $\frac{\pi}{3}$

Answer: (B)
Solution:
In a capacitive ac circuit, the voltage lags behind the current in phase by $\frac{\pi}{2}$ radian.

Q27 The average power dissipated per cycle in the circuit as shown in the figure is



A. 387.2 W
B. 287.2 W
C. 187.2 W
D. 400.8 W

Answer: (A)
Solution:
The impedance of the circuit is

$Z = \sqrt{(R_1 + R_2)^2 + (X_L - X_C)^2}$

$= \sqrt{(40 + 40)^2 + (100 - 40)^2} = 100\ \Omega$

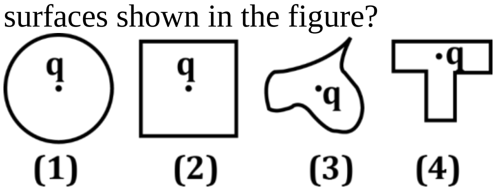
$I_{rms} = \frac{V_{rms}}{Z} = \frac{220}{100} = 2.2\ A$

$P_{av} = V_{rms}\, I_{rms} \cos\phi$

$= 220 \times 2.2 \times \frac{80}{100} \quad \left(\cos\phi = \frac{R}{Z}\right)$

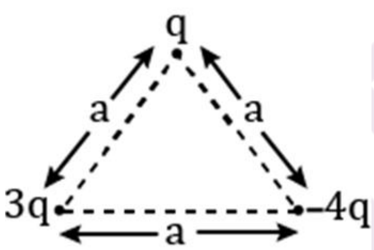
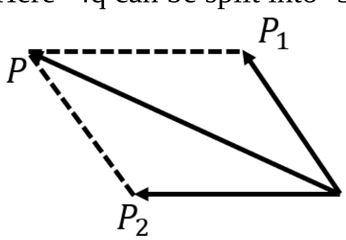
$= 387.2\ W$

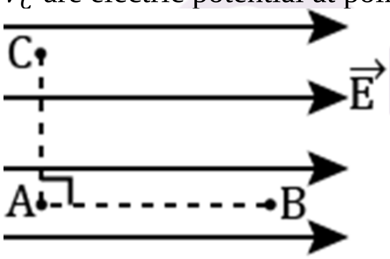
Q28 Which of the following statement is true regarding the electric flux through the closed surfaces shown in the figure?

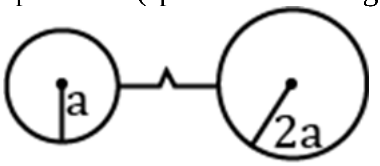
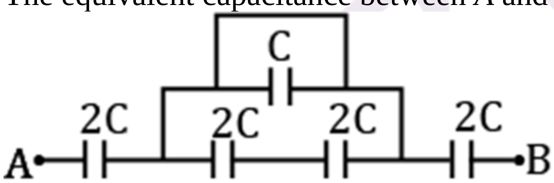
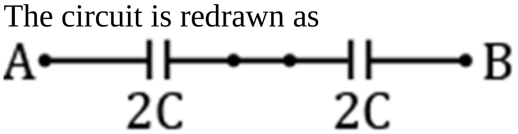


A. In figure (1) is largest
B. In figure (2) is least.
C. In figure (2) is same as in figure (4) but is smaller than in figure (1).
D. Is the same for all the figures

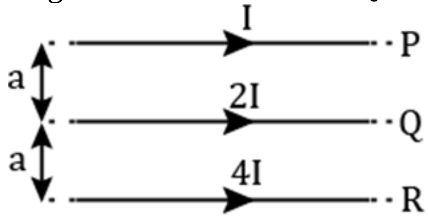
Answer: (D)
Solution:

	As per Gauss's theorem in electrostatics, the electric flux through a closed surface depends only on the amount of charge enclosed. Since $Q_{enclosed}$ is same for all, hence flux through all the surfaces will be same.
Q29	Two point charges having charge 3 μC and 4 μC have a repulsive force of 15 N, when placed at some distance apart. If the both charges are kept closer at the half the distance of the initial value, then the force between them will now be A. 30 N B. 15 N C. 60 N D. 20 N **Answer:** (C) **Solution:** $F_1 = \frac{Kq_1 q_2}{a^2}$ $F_2 = \frac{Kq_1q_2}{\left(\frac{a}{2}\right)^2} = 4\left(\frac{Kq_1q_2}{a_2}\right)$ $F_2 = 4\,F_1 = 4 \times 15 = 60\ N$
Q30	The magnitude of dipole moment of the following system is  A. $\sqrt{21}qa$ B. $\sqrt{7}qa$ C. $4qa$ D. $\sqrt{13}qa$ **Answer:** (D) **Solution:** Here -4q can be split into -3q and -q. So net dipole moment is represented as  $P_1 = qa,\ P_2 = 3qa$ $P_{net} = \sqrt{P_1^2 + P_2^2 + 2P_1P_2\cos\theta}$

	$P_{net} = \sqrt{P^2 + 9\,P^2 + 2P\,(3P)\cos 60^0}$ (Let $P_1 = P$) ($P_2 = 3P_1$) $= \sqrt{P^2 + 9\,P^2 + 3P^2} = P\sqrt{13}$ $= qa\sqrt{13}$
Q31	A charge $2\sqrt{3}\,nC$ is placed at one of the corners of a cube of side 2 cm. The potential at the corner which is diagonally opposite (body diagonal) to the charge, is A. 900 V B. 700 V C. 450 V D. $20\sqrt{3}V$ **Answer:** (A) **Solution:** $V = \frac{Q}{4\pi\epsilon_0 r}$ Here r = a$\sqrt{3}$ $= \frac{2\sqrt{3}\times10^{-9}}{4\pi\epsilon_0\times(2\sqrt{3}\times10^{-2})} = \frac{9\times10^9\times2\sqrt{3}\times10^{-9}}{2\sqrt{3}\times10^{-2}}$ $= 9\times10^2 V$ $= 900\,V.$
Q32	Figure shows three points A, B and C in a region of uniform electric field $\vec{E}$. If V_A, V_B and V_C are electric potential at points A, B and C respectively then  A. $V_A = V_B = V_C$ B. $V_A > V_B > V_C$ C. $V_A < V_B < V_C$ D. $V_A = V_C > V_B$ **Answer:** (D) **Solution:** Electric field lines are directed from high potential to low potential. The plane normal to electric field lines are equipotential surface. Hence $V_A = V_C > V_B$

Q33	Two charged conducting spheres of radii a and $2a$ are connected to each other by a conducting wire as shown in the figure. The ratio of electric fields at the surfaces of two spheres is (spheres are at large distance)  A. 1 B. 2 C. 4 D. 8 **Answer:** (B) **Solution:** When both conductors are connected with a conducting wire then their potential will be same. $\frac{KQ_1}{a} = \frac{KQ_2}{2a} \Rightarrow Q_1 = \frac{Q_2}{2}$ Now, $\frac{E_1}{E_2} = \frac{\frac{KQ_1}{a^2}}{\frac{KQ_2}{(2a)^2}} = \frac{4Q_1}{Q_1} = \frac{4}{2} = 2$
Q34	The equivalent capacitance between A and B for the network shown in the figure is  A. $\frac{C}{2}$ B. $\frac{2C}{3}$ C. C D. $2C$ **Answer:** (C) **Solution:** The circuit is redrawn as  Now, $C_{AB} = \frac{2C \times 2C}{2C+2C} = C$

Q35 Three infinitely long parallel straight current carrying wires *P*, *Q* and *R* are kept as shown in the figure. If the force per unit length between wire *P* and *R* is *F*, then force per unit length between wire *P* and *Q* will be



A. F
B. 2F
C. $\frac{F}{2}$
D. 4F

Answer: (A)
Solution:
The magnetic force per unit length is given as

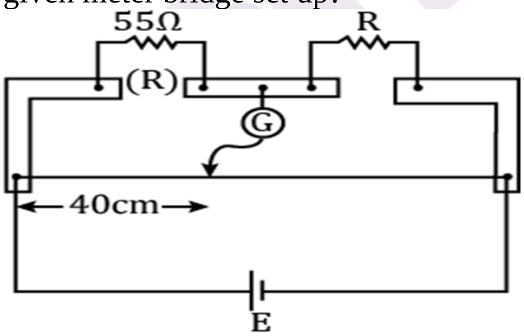
$\frac{F}{l} = \frac{\mu_0 l_1 l_2}{2\,\pi d}$

Now, $F_{PR} = \frac{\mu_0 4\,l^2}{2\,\pi(2a)} = \frac{\mu_0 l^2}{\pi a}$

$F_{PQ} = \frac{\mu_0 l\,(2l)}{2\,\pi a} = \frac{\mu_0 l^2}{\pi a}$

$\Rightarrow F_{PQ} = F_{pr} = F$

Q36 What is the value of unknown resistance *R*, if galvanometer shows null deflection in the given meter bridge set up?



A. 110 Ω
B. 55 Ω
C. 92.5 Ω
D. 82.5 Ω

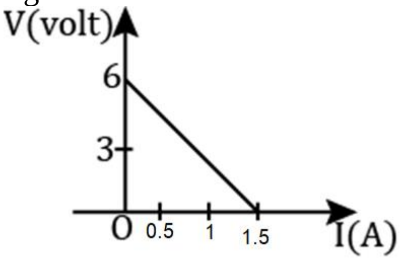
Answer: (D)
Solution:
From balanced bridge condition

$\frac{R_{known}}{R_{unknown}} = \frac{l}{100-l}$

$\frac{55}{R} = \frac{40}{60}$

$R = \frac{3}{2} \times 55 = 82.5\ \Omega$

Q37 The plot of terminal potential difference (V) of a cell with current (I) is shown in the figure. The emf and internal resistance of cell are



A. $6V, 4\ \Omega$
B. $3\ V\ 2\ \Omega$
C. $6\ V, 2\ \Omega$
D. $3\ V, 1.5\ \Omega$

Answer: (A)
Solution:
Terminal potential equation, from the graph is
$V = \left(\frac{6-0}{0-15}\right)\ l + 6$
$V = \ -4\ I + 6$
Comparing with V = E – Ir
E = 6 V and $r\ =\ 4\ \Omega$

Q38 Two electric bulbs having resistances in ratio 1 : 4 are connected in parallel to a voltage source of 220 V. The ratio of power dissipated in them is

A. 2 : 1
B. 4 : 1
C. 1 : 3
D. 3 : 2

Answer: (B)
Solution:
Power dissipated through a resistor when connected through a voltage source is
$P = \frac{V^2}{R}$
Now, $\frac{P_1}{P_2} = \frac{V^2}{R_1} \times \frac{R_2}{V^2} = \frac{R_2}{R_1}$
$\Rightarrow P_1 : P_2 = R_2 : R_1$
$\Rightarrow P_1 : P_2 = 4 : 1$

Q39 The angle of dip at a certain place, where the horizontal and vertical components of the earth’s magnetic field are equal, is

A. 45^0
B. 90^0
C. 60^0
D. 30^0

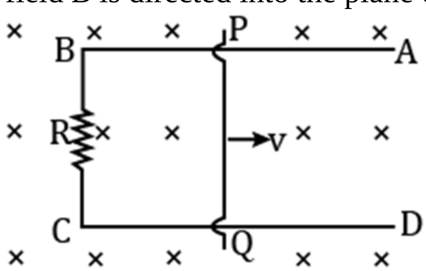
Answer: (A)
Solution:
The B_H, B_V and δ are related as
$\tan\delta = \frac{B_V}{B_H}$
Since, $B_V = B_H$
$\Rightarrow \tan\ \delta\ = 1$
$\Rightarrow \delta = 45^0$

Q40 The magnetic flux linked with a coil is ϕ and the emf induced in it is E, then select the correct option

A. If $\phi = 0, E$ must be zero
B. If $\phi \neq 0, E$ must be zero
C. If $E \neq 0, \phi$ may or may not be zero
D. All of these

Answer: (C)
Solution:
Induced emf, $\epsilon = \left|d\frac{\phi}{dt}\right|$
If ϕ = constant $\Rightarrow E = 0$
Also, during variation of flux, if flux through a loop become zero, then at that moment emf induced becomes maximum.

Q41 A conducting rod PQ of length L is moving with a constant velocity v on a frictionless frame $ABCD$ connected with a resistance R as shown in the figure. A uniform magnetic field B is directed into the plane of frame. The heat dissipated in the loop per second is

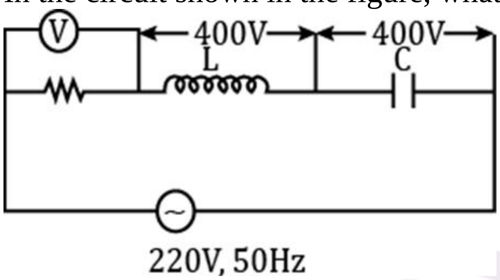


A. $\frac{B^2 L v^2}{2R}$
B. $\frac{B^2 L v^2}{R}$

C. $\frac{B^2L^2v^2}{2R}$
D. $\frac{B^2\,L^2v^2}{R}$

Answer: (D)
Solution:
Induced emf $\epsilon = \;\; BL\,v$
Induced current, $I = \frac{\epsilon}{R} = \frac{BLv}{R}$
$P = \epsilon\, l = BLv\left(\frac{BLv}{R}\right)$
$= \frac{B^2L^2v^2}{R}$

Q42 In the circuit shown in the figure, what will be the reading of the voltmeter?



A. 200 V
B. 220 V
C. 110 V
D. 440 V

Answer: (B)
Solution:
Given $V_L = V_C \;\rightarrow\; X_L = X_C$
This indicated that circuit is at resonance. Hence reading of voltmeter is $V = V_R = 220\,V$

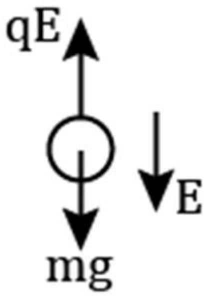
Q43 In a step up transformer, the turn ratio is 2 : 3. A dc voltage source of emf 6 V is connected across the primary coil of transformer. The voltage across the secondary coil will be
A. 9 V
B. 4 V
C. 6 V
D. Zero

Answer: (D)
Solution:
Since transformer works on the principle of mutual induction. The voltage at primary is dc *i.e.*, current is not changing with time in the primary windings, so no voltage is induced at the secondary.

Q44 An oil drop of 10 excess electrons is held stationary under a constant electric field $4.9 \times 10^4\ N/C$. The mass of the drop is $(g = 9.8\ m/s^2)$

A. $9 \times 10^{-15} kg$
B. $8 \times 10^{-15} kg$
C. $4 \times 10^{-14}\ kg$
D. $8 \times 10^{-19} kg$

Answer: (B)
Solution:



From F.B.D
Mg = qE

$m = \frac{neE}{g} = \frac{10 \times 1.6 \times 10^{-19} \times 4.9 \times 10^4}{9.8}$

$= 8 \times 10^{-15}\ kg$

Q45 Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Resistance of metallic wire increases with decrease in temperature.
Reason (R): On decreasing the temperature, relaxation time decreases.
Select the most appropriate answer from the options 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.

Answer: (D)
Solution:
On decreasing the temperature, rms speed of charge carrier decreases and hence relaxation time increases.

Now, $R = \frac{L}{\sigma A}$, where $\sigma = \frac{ne^2\tau}{m}$

$R = \frac{L\,m}{ne^2\tau A}$

$R \propto \frac{1}{\tau}$

Q46 Given below are two statements labelled as Assertion (A) and Reason (R).

	Assertion(A): The weight of a body which is charged by rubbing may increase or decrease. **Reason(R):** In electrification, due to rubbing few electrons are transferred from one body to other. Select the most appropriate answer from the options 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. **Answer:** (A) **Solution:** In electrification some electrons get transferred from one body to other body, hence the body which gain the electron becomes little heavier and the body which loses the electrons becomes little lighter.
Q47	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion(A):** Work done by magnetic field on a moving point charge is zero **Reason(R):** The magnetic force is perpendicular to velocity of particle Select the most appropriate answer from the options 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. **Answer:** (A) **Solution:** The magnetic force $\vec{F} = q\,(\vec{v} \times \vec{B})$ This implies that magnetic force is always normal to velocity hence work done by the magnetic force is zero
Q48	Given below are two statements labelled as Assertion (A) and Reason (R) **Assertion(A):** Induced electric field is non-conservative. **Reason(R):** Work done in a closed path in induced electric field is zero Select the most appropriate answer from the options 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. **Answer:** (C) **Solution:**

	The work done in a closed path, in an induced electric field is non-zero, hence the induced electric field is non-conservative
Q49	Given below are two statements labelled as Assertion (A) and Reason (R). **Assertion(A):** Average power in series LCR ac circuit is maximum at resonance. **Reason(R):** At resonance circuit is purely inductive. Select the most appropriate answer from the options 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. **Answer:** (C) **Solution:** $P_{av} = \frac{V^2}{Z}\cos\phi = \frac{V^2}{Z^2}R$ Z is minimum at resonance, so power will be maximum. At resonance $Z = R$ and circuit is purely resistive.
Q50	An electric dipole is made of two charges 10 μC and -10 μC, placed 1 mm apart. A point P is a general point at a distance 1 m from the midpoint of the two charges, Then A. Electric field at point P, if it lies on axis of dipole is 180 N/C B. Electric field at point P, if it lies on equatorial line is 180 N/C C. Electric field at the centre of dipole is 90 N/C D. Electric field at the point P, if it lies on equatorial line is 360 N/C **Answer:** (A) **Solution:** Electric field due to a short dipole on axial position is $E_{axial} = \frac{2p}{4\pi\epsilon_0 r^3} = \frac{2\times10^{-5}\times10^{-3}}{4\pi\epsilon_0\times1^3}$ $= 9\times10^9\times2\times10^{-8} = 180\ N/C$ Electric field at equation line is $E_{equatorial} = \frac{p}{4\pi\epsilon_0 r^3}$ $E_{equatorial} = \frac{9\times10^9\times10^{-8}}{1^3} = 90\ N/C$ Electric field at the centre of dipole is $E = \frac{q}{4\pi\epsilon_0 l^2} + \frac{q}{4\pi\epsilon_0 l^2} = \frac{2q}{4\pi\epsilon_0 l^2}$ $= \frac{2\times10^{-5}\times9\times10^9}{(5\times10^{-4})^2} = \frac{18\times10^4}{25\times10^{-5}}$ $= 0.72\times10^{12} N/C$ $= 7.2\times10^{11} N/C$
Q51	Consider two capacitors C_1 = 10 μF and C_2 = 40 μF. Which of the following statement(s) is/are true?

	(a) The net capacitance, if both are connected in series, is 50 μF (b) The net capacitance, if both are connected in parallel, is 50 μF (c) The net capacitance, if both are connected in series, is 8 μF A. (a) only B. (b) only C. (b) and (c) only D. (a) and (b) only **Answer:** (C) **Solution:** $C_{series} = \frac{C_1 C_2}{C_1+C_2} = \frac{10\ \mu F \times 40\ \mu F}{50\ \mu F} = 8\ \mu F$ $C_{parallel} = C_1 + C_2 = 10\ \mu F + 40\ \mu F = 50\ \mu F$
Case study: Read the following paragraph and answer the questions: A charged particle is released from origin with velocity $\vec{v} = V_0\ \hat{\imath}$ in a uniform magnetic field $\vec{B} = \frac{B_0}{2}\ \hat{\imath} + \frac{\sqrt{3}}{2}\ B_0\ \hat{\jmath}$. The magnetic force on a charged particle is given by $\vec{F} = q\ (\vec{v} \times \vec{B})$. The charge and mass of the particle are q and m respectively	
Q52	The path described by the charged particle is A. Circular B. Straight line C. Helical D. Elliptical. **Answer:** (C) **Solution:** If velocity makes some angle (θ ≠ 90°) with magnetic field, then path described by the particle is helical.
Q53	The time period of revolution of charged particle is A. $\frac{\pi\ m}{q\ B_0}$ B. $\frac{2\ \pi m}{q\ B_0}$ C. $\frac{2\ \pi m}{\sqrt{3\ q\ B_0}}$ D. $\frac{4\ \pi m}{\sqrt{3}\ q\ B_0}$ **Answer:** (B) **Solution:** Time period, $T = \frac{2\ \pi m}{qB}$

	Here, $\left\|\vec{B}\right\| = \sqrt{\left(\frac{B_0}{2}\right)^2 + \left(\frac{\sqrt{3}\,B_0}{2}\right)^2} = B_0$
Q54	The radius of circular cross-section of path described by particle is A. $\frac{\sqrt{3}\,mv_0}{q\,B_0}$ B. $\frac{mv_0}{q\,B_0}$ C. $\frac{2\,mv_0}{q\,B_0}$ D. $\frac{\sqrt{3}\,mv_0}{2\,q\,B_0}$ **Answer:** (D) **Solution:** $R = \frac{mv_\perp}{qB} = \frac{mv\sin 60^0}{q\,B_0} = \frac{\sqrt{3}\,mv}{2q\,B_0}$
Q55	The displacement of the charged particle along the magnetic field in one time period is A. $\frac{\pi mv_0}{q\,B_0}$ B. $\frac{2\,\pi mv_0}{qB_0}$ C. $\frac{\sqrt{3}\,\pi mv_0}{qB_0}$ D. $\frac{\pi\,m\,v_0}{\sqrt{3}\,\,q\,B_0}$ **Answer:** (A) **Solution:** Displacement of the charged particle along magnetic field in time period is called pitch and it is given as Pitch $= \frac{2\,\pi m}{qB_0} V_B$ $= \frac{2\,\pi m}{q\,B_0}\; v_0 \cos 60^0$ $= \frac{2\,\pi m\,v_0}{2q\,B_0}$ $= \frac{\pi mv_0}{q\,B_0}$