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CBSE 2021-22 (TERM-1)

DATE: 10-12-2021

Questions Paper

SERIES: SSJ/2 | CODE : 055/2/4 | SET-4

SUBJECT : PHYSICS

TIME ALLOWED: 90 MINUTES **MAXIMUM MARKS : 35**

NOTE

(i) Please check that this question paper contains 18 pffrinted pages.

(ii) Please check that this question paper contains 55 multiple choice questions (MCQs.)

(iii) QP Code given on the right hand side of the question paper should be written at the appropriate place of the OMR Sheet by the candidates.

(iv) 20 minute additional time has been allotted to read this question paper prior to actual time of commencement of examination.

GENERAL INSTRUCTIONS:

(i) This question paper contains 55 questions out of which 45 questions are to be attempted. All questions carry equal marks.

(ii) The question paper consists of three Sections – Section A, B and C.

(iii) Section – A contains 25 questions. Attempt any 20 questions from Q. No. 01 to 25.

(iv) Section – B contains 24 questions. Attempt any 20 questions from Q.No. 26 to 49.

(v) Section – C contains 6 questions. Attempt any 5 questions from Q.No. 50 to 55.

(vi) The first 20 Questions attempted in Section – A & Section – B and first 5 questions attempted in Section – C by a candidate will be evaluated.

(vii) There is only one correct option for every multiple choice question (MCQ). Marks will not be awarded for answering more than one option.

(viii) There is no negative marking.

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 questions** will be considered for evaluation.

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 most possibility for the object Z ?

(a) Positively charged only (b) negatively charged only

(c) neutral or positively charged (d) neutral or negatively charged

Ans. **(c)**

2. In an experiment three microscopic latex spheres are sprayed into a chamber and become charged with charges +3e, +5e and –3e respectively. All the three spheres came in contact simultaneously for a moment and got separated. Which one of the following are possible values for the final charge on the spheres ?

(a) +5e, –4e, +5e (b) +6e, +6e, –7e (c) –4e, +3.5e, +5.5e (d) +5e, –8e, +7e

Ans. **(b)**

Sol. By conservations of charge

3e + 5e + –3e = 5e

Option (b)

6e + 6e – 7e = 5e

3. An object charge of 1 C and gains 5.0×10^{18} electrons. The net charge on the object becomes

(a) – 0.80 C (b) + 0.80 C (c) + 1.80 C (d) + 0.20 C

Ans. **(d)**

Sol. q = 1C

gains 5×10^{18} electrons

$q = \pm ne$

$= -5 \times 10^{18} \times 1.6 \times 10^{-19}$

$= -8.0 \times 10^{-1}$

q = –0.8C

Net charge = 1 – 0.8 = 0.20C

4. Kirchhoff's first rule $\Sigma I = 0$ second rule $\Sigma IR = \Sigma E$ (where the symbols have their usual meanings) are respectively based on

(a) conservation of momentum and conservation of charge

(b) conservation of energy, conservation of charge

(c) conservation of charge, conservation of momentum

(d) conservation of charge, conservation of energy

Ans. **(d)**

5. The electric power consumed by a 220 V – 100 W bulb when operated at 110 V is

(a) 25 W (b) 30 W (c) 35 W (d) 45 W

Ans. (a)

Sol. $P = \frac{v^2}{R}$

$100 = \frac{(220)^2}{R}$

$R = \frac{220 \times 220}{100}$

$R = 484\Omega$

$\because \quad v = 110\ \Omega$

$P = \frac{V^2}{R} = \frac{(110)^2}{484} = 25W$

6. Which of the following has negative temperature coefficient of resistivity ?

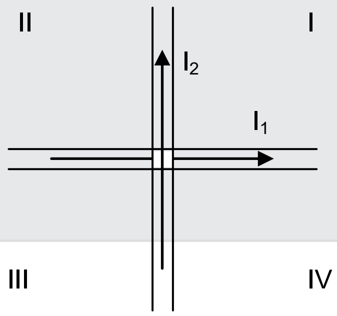
(a) metal (b) metal and semiconductor

(c) semiconductor (d) metal and alloy

Ans. (c)

Sol. semiconductor

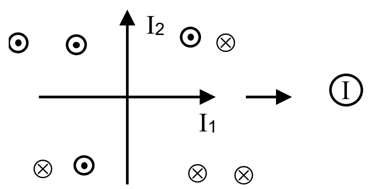
7. Two wires carrying currents I_1 and I_2 lie, one slightly above the other, in a horizontal plane as shown in figure. The region of vertically upward strongest magnetic field is



(a) I (b) II (c) III (d) IV

Ans. (b)

Sol. By Flemming right hand rule, So region of vertically upward strongest magnetic field in **II**



8. Two parallel conductors carrying current of 4.0 A and 10.0 A are placed 2.5 cm apart in vacuum. The force per unit length between them is

(a) 6.4×10^{-5} N/m (b) 6.4×10^{-2} N/m (c) 4.6×10^{-4} N/m (d) 3.2×10^{-4} N/m

Ans. **(d)**

Sol. $I_1 = 4A$

$I_2 = 10A$

$r = 2.5 \text{ cm} = 2.5 \times 10^{-2}$ m

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

$$= \frac{4\pi \times 10^{-7} \times 4 \times 10^{2}}{2\pi \times 2.5 \times 10^{-2}} = \frac{16}{5} \times 10^{-4} = 3.2 \times 10^{-4} \text{ N/m}$$

9. If an ammeter is to be used in place of a voltmeter, then we must connect with ammeter a

(a) low resistance in parallel (b) low resistance in series

(c) high resistance in parallel (d) high resistance in series

Ans. **(d)**

10. The magnetic field at the centre of a current carrying circular loop of radius R, is B_1. The magnetic field at a point on its axis at a distance R from the center of the loop is B_2. Then the ratio (B_1/B_2) is

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

Ans. **(a)**

Sol. $B_C = B_1 = \frac{\mu_0 I}{2R}$

$$B_2 = \frac{\mu_0 I R^2}{2(R^2 + R^2)^{3/2}} = \frac{\mu_0 I R^2}{2(2R^2)^{3/2}} = \frac{\mu_0 I R^2}{2 \times 2^{3/2} \times R^3}$$

$$\frac{B_1}{B_2} = \frac{\mu_0 I}{2R} \times \frac{2 \times 2^{3/2} R}{\mu_0 I} = 2^{3/2} = 2\sqrt{2}$$

11. The self- inductance of a solenoid of 600 turns is 108 mH. The self-inductance of a coil having 500 turns with the same length, the same radius and the same medium will be

(a) 95 mH (b) 90 mH (c) 85 mH (d) 75 mH

Ans. **(d)**

Sol. $N_1 = 600$ turns

$L_1 = 108$ mH $= 108 \times 10^{-3}$H

$N_2 = 500$

$L_2 = ?$

$\ell = \ell$

$r = r$

$$\because \quad L_1 = \frac{\mu_0 N_1^2 A}{\ell} = \frac{\mu_0 N_1^2 (\pi r_1^2)}{\ell}$$

$$L_2 = \frac{\mu_0 N_2^2 (\pi r^2)}{\ell}$$

$$\frac{L_1}{L_2} = \frac{N_1^2}{N_2^2}$$

$$\frac{108 \times 10^{-3}}{L_2} = \left(\frac{600}{500}\right)^2$$

$$\Rightarrow \quad L_2 = \frac{108 \times 10^{-3} \times 5 \times 5}{6 \times 6} = 75 \times 10^{-3}\text{ H} = 75\text{ mH}$$

12. The rms current in a circuit connected to a 50 Hz ac source is 15 A. The value of the current in the circuit $\left(\frac{1}{600}\right)$s after the instant the current is zero ,is

(a) $\frac{15}{\sqrt{2}}$A (b) $15\sqrt{2}$A (c) $\frac{\sqrt{2}}{15}$A (d) 8 A

Ans. **(a)**

Sol. $I_{rms} = 15$A

$f = 50$ Hz

$I = ?$

$t = \frac{1}{600}$ sec.

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

$I_0 = 15\sqrt{2}$

$I = I_0 \sin \omega t$

$= 15\sqrt{2} \sin 2\pi ft$

$= 15\sqrt{2} \sin 2\pi \times 50 \times \frac{1}{600} = 15\sqrt{2} \sin \frac{\pi}{6}$

$$I = 15\sqrt{2} \times \frac{1}{2} = \frac{15}{\sqrt{2}}\text{ A}$$

13. In a circuit the phase difference between the alternating current and the source voltage is $\frac{\pi}{2}$. Which of the following cannot be the element(s) of the circuit ?

(a) only C (b) only L (c) L and R (d) L or C

Ans. **(c)**

14. The electric potential V at any point (x, y, z) is given by $V = 3x^2$ where x is in metres and V in volts. The electric field at the point (1m, 0, 2m) is -

(a) 6 V/m along – x-axis (b) 6 V/m along + x-axis

(c) 1.5 Vm along –x-axis (d) 1.5 V/m along + x-axis

Ans. **(a)**

Sol. $v = 3x^2$

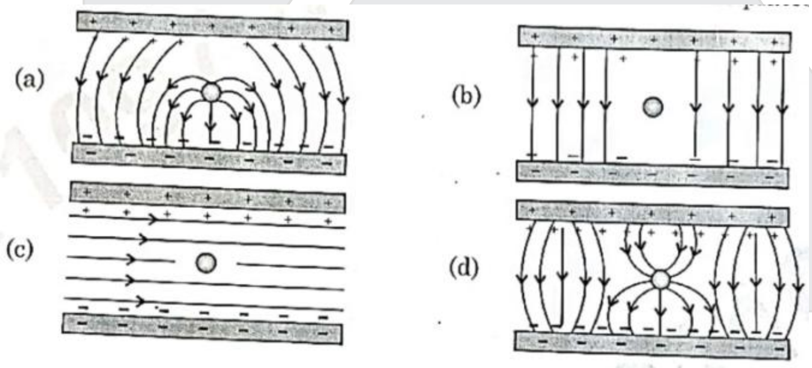
$E = -\frac{dv}{dr}$

$= -\frac{d}{dx}(3x^2)$

$E = -6x$

$E = -6 \times 1 = -6$ i.e. along to – x axis.

15. Which of the diagrams correctly represents the electric field between two charged plates if a neutral conductor is placed in between the plates?



Ans. **(d)**

16. A variable capacitor is connected to a 200 V battery. If its capacitance is changed from 2 μF to X μF, the decrease in energy of the capacitor is 2×10^{-2} J. The value of X is

(a) 1 μF (b) 2 μF (c) 3 μF (d) 4 μF

Ans. **(a)**

Sol. V = 200 V

C = 2 μF to x μF

$U_f = 2 \times 10^{-2}$ J

$U_i = \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 10^{-6} \times 200 \times 200$

$U_i = 4 \times 10^{-2}$ J

$U_f = \frac{1}{2}CV^2$

$2 \times 10^{-2} = \frac{1}{2} x \times (200)^2$

$x = \frac{4 \times 10^{-2}}{200 \times 200} = 10^{-6} = 1\ \mu F$

17. A potential difference of 200 V is maintained across a conductor' of resistance100 Ω. The number of electrons passing through it in 1s is

(a) 1.25×10^{19} (b) 2.5×10^{18} (c) 1.25×10^{18} (d) 2.5×10^{16}

Ans. **(a)**

Sol. V = 200 V

R = 100 Ω t = 1 sec

$I = \frac{q}{t}$

$I = \frac{ne}{t}$

$n = \frac{It}{e} = \frac{Vt}{Re}$

$n = \frac{200}{100 \times 1.6 \times 10^{-19}}$

$= \frac{10}{8} \times 10^{19}$

$= 1.25 \times 10^{19}$

18. The impedance of a series LCR circuit is-

(a) $R + X_L + X_C$ (b) $\sqrt{\frac{1}{X_C^2} + \frac{1}{X_L^2} + R^2}$ (c) $\sqrt{X_L^2 - X_C^2 + R^2}$ (d) $\sqrt{R^2 + (X_L - X_C)^2}$

Ans. **(d)**

19. When an alternating voltage $E = E_0 \sin \omega t$ is applied to a circuit, a current $I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$ flows through it. The average power dissipated in the circuit is

(a) $E_{rms} \cdot I_{rms}$ (b) $E_0 I_0$ (c) $\frac{E_0 I_0}{\sqrt{2}}$ (d) Zero

Ans. **(d)**

Sol. $E = E_0 \sin \omega t$

$I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

Phase difference $\phi = \omega t - \left(\omega t + \frac{\pi}{2}\right)$

$\phi = -\frac{\pi}{2}$

$< p > = V_{rms} I_{rms} \cos\frac{\pi}{2}$

$< p > = 0$

20. A current carrying wire kept in a uniform magnetic field, will experience a maximum force when it is

(a) perpendicular to the magnetic field (b) parallel to the magnetic field

(c) at an angle of 45° to the magnetic field (d) at an angle of 000 to the magnetic field

Ans. **(a)**

Sol. $F = BIL \sin \theta$

$(F)_{maxi} \Rightarrow \theta = 90^o$

So $B \perp \ell$

21. The voltage across a resistor, an inductor, and a capacitor connected in series to an ac source are 20 V, 15 V and 30 V respectively. The resultant voltage in the circuit is

(a) 5V (b) 20V (c) 25V (d) 65V

Ans. **(c)**

Sol. $V = \sqrt{V_R^2 + (V_C - V_L)^2}$

$V = \sqrt{400 + (15)^2} = \sqrt{625} = 25V$

22. In a dc circuit the direction of current inside the battery and outside the battery respectively are -

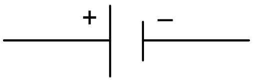
(a) positive to negative terminal and negative to positive terminal

(b) positive to negative terminal and positive to negative terminal

(c) negative to positive terminal and positive to negative terminal

(d) negative to positive terminal and negative to positive terminal

Ans. **(c)**

Sol. 

outside $\rightarrow$ (+ve) to –ve

inside $\rightarrow$ –ve to +ve

23. The magnitude of electric field due to a point charge 2q, at distance r is E. Then the magnitude of electric field due to a uniformly charged thin spherical shell of radius R with total charge q at a distance $\frac{r}{2}$ (r >> R) will be

(a) $\frac{E}{4}$ (b) 0 (c) 2E (d) 4E

Ans. (c)

Sol. $E = \frac{Kq}{r^2} = \frac{K(2q)}{r}$ r >> R

$E' = \frac{Kq}{\left(\frac{r}{2}\right)^2} = \frac{4Kq}{r^2} \Rightarrow 2E$

24. The horizontal component of earth's magnetic field at a place is 0.2 G whereas it's total magnetic field is 0.4 G. The angle of dip at the place is

(a) 30° (b) 45° (c) 60° (d) 90°

Ans. **(c)**

Sol. $B_H = 0.2$ G $B_H = B \cos \delta$

B = 0.4 G $0.2 = 0.4 \cos \delta$

$\cos \delta = \frac{1}{2} \Rightarrow \delta = 60^o$

25. The current in the primary coil of a pair of coils changes from 7 A to 3 A in 0.04 s. The mutual inductance between the two coils is 0.5 H. The induced emf in the secondary coil is –

(a) 50 V (b) 75 V (c) 100 V (d) 220 C

Ans. **(a)**

Sol. I = 7A to 3A

t = .04 sec

M = 0.5 H

$\epsilon_s = -\frac{\Delta\phi}{\Delta t}$ $\therefore$ $\phi = MI$

$= \frac{-M\Delta I}{\Delta t} = 0.5\left(\frac{7-3}{0.04}\right) = 50$ V

SECTION – B

Section-B consists **24** questions. Attempt any **20** questions from this section,

20 Questions attempted first, will only be evaluated.

26. A square sheet of side 'a' is lying parallel to XY plane at z = a. The electric field in the region is $\vec{E} = cz^2 \hat{k}$. The electric flux through the sheet is

(a) a^4c (b) $\frac{1}{3}a^3c$ (c) $\frac{1}{3}a^4c$ (d) 0

Ans. **(a)**

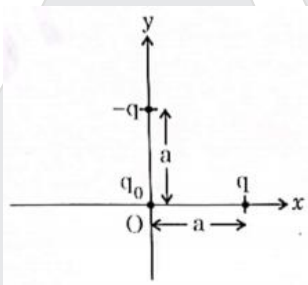
Sol. $E = Cz^2 \hat{k}$

$\phi = EdA\cos\theta$ $\theta = 0$

$= Cz^2 a^2$ $z = a$

$\phi = Ca^4$

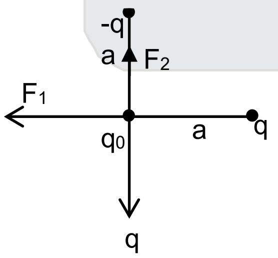
27. Three charges q, –q and q_0 are placed as shown in figure. The magnitude of the net force on the charge q_0 at point O is $\left[k = \frac{1}{(4\pi \in_0)}\right]$



(a) 0 (b) $\frac{2kqq_0}{a^2}$ (c) $\frac{\sqrt{2}\,kqq_0}{a^2}$ (d) $\frac{1}{\sqrt{2}}\frac{kqq_0}{a^2}$

Ans. **(c)**

Sol.



$F_1 = \frac{kqq_0}{a^2} = x$

$F_2 = \frac{kqq_0}{a^2} = x$

$F = \sqrt{x^2 + x^2} = \sqrt{2}\,x = \sqrt{2}\frac{kqq_0}{a^2}$

28. A + 3.0 nC charges Q is initially at rest at a distance of r_1 = 10 cm from a + 5.0 nC charge q fixed at the origin. The charge Q is moved away from q to a new position at r_2 = 15 cm. In this process work done by the field is

(a) 1.29×10^{-5} J (b) 3.6×10^{5} J (c) -4.7×10^{-7} J (d) 4.5×10^{-7} J

Ans. **(d)**

Sol. $Q = 3 \times 10^{-9}C$

$r_1 = 10$ cm

$r_2 = 15$ cm

$W = -q\Delta V$

$$= -3 \times 10^{-9}\left(\frac{K\times5\times10^{-9}}{15\times10^{-2}} - \frac{K\times5\times10^{-9}}{10\times10^{-2}}\right)$$

$= 4.5 \times 10^{-7}$ J

29. A car battery is charged by a 12 V supply, and energy stored in it is 7.20×10^5 J. The charge passed through the battery is

(a) 6.0×10^4 C (b) 5.8×10^3 J (c) 8.64×10^6 J (d) 1.6×10^5 C

Ans. **(a)**

Sol. P = VI

$$\frac{E}{t} = \frac{vq}{t}$$

$$q = \frac{E}{V} = \frac{7.20\times10^5}{12}$$

$= 6 \times 10^4$ C

30. A straight conducting rod of length ℓ and mass m is suspended in a horizontal plane by a pair of flexible strings in a magnetic field of magnitude B. To remove the tension in the supporting strings, the magnitude of the current in the wire is

(a) $\frac{mgB}{\ell}$ (b) $\frac{mg\ell}{B}$ (c) $\frac{mg}{\ell B}$ (d) $\frac{\ell B}{mg}$

Ans. **(c)**

Sol. Magnetic field is equal and opposite to the weight of the wire so,

$Mg = BI\ell$.

$$I = \frac{mg}{\ell B}$$

31. A constant current is flowing through a solenoid. An iron rod is inserted in the solenoid along its axis. Which of the following quantities will not increase?

(a) The magneitc field at the centre
(b) The magnetic flux linked with the solenoid
(c) The rate of heating
(d) The self-inductance of the solenoid

Ans. **(c)**

32. A circuit is connected to an ac source of variable frequency. As the frequency of the source is increased, the current first increase and then decreases. Which of the following combinations of elements is likely to comprise the circuit?

(a) L, C and R (b) L and C (c) L and R (d) R and C

Ans. **(a)**

33. If n, e, τ and m have their usual meanings, then the resistance of a wire of length l and cross-sectional area A is given by

(a) $\frac{ne^2A}{2m\tau\ell}$ (b) $\frac{m\ell}{ne^2\tau A}$ (c) $\frac{m\tau A}{ne^2\ell}$ (d) $\frac{ne^2\tau A}{2m\ell}$

Ans. **(b)**

34. A proton and an alpha particle move in circular orbits in a uniform magnetic field. Their speeds are in the ratio of 9 : 4. The ratio of radii of their circular orbits $\left(\frac{r_p}{r_{alpha}}\right)$ is :

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{8}{9}$ (d) $\frac{9}{8}$

Ans. **(d)**

Sol. $\frac{vp}{v\alpha} = \frac{9}{4}$

$$\frac{r_p}{r_\alpha} = \frac{m_p v_p}{q_p B} \times \frac{q_\alpha B}{m_\alpha v_\alpha} = \frac{m_p \times 9 \times 2q_p}{q_p \times 4m_p \times 4} = \frac{9}{8}$$

35. A coil of area 100 cm^2 is kept at an angle of 30° with a magnetic field of 10^{-1} T. The magnetic field is reduced to zero in 10^{-4} s. The induced emf in the coil is :

(a) $5\sqrt{3}$ V (b) $50\sqrt{3}$ V (c) 5.0 V (d) 50.0 V

Ans. **(c)**

Sol. $\varepsilon = \frac{-\Delta\phi}{\Delta t} = \frac{-(B_2 - B_1)A\cos\theta}{\Delta t}$

$= -\frac{(0-10^{-1})\times 100\times 10^{-4}}{10^{-4}} \times \frac{1}{2} = 5V$

36. A 15Ω resistor, an 80 mH inductor and a capacitor of capacitance C are connected in series with a 50 Hz ac source. If the source voltage and current in the circuit are in phase, then the value of capacitance is :

(a) 100 μF (b) 127 μF (c) 142 μF (d) 160 μF

Ans. **(b)**

Sol. $\tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R} = 0$

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

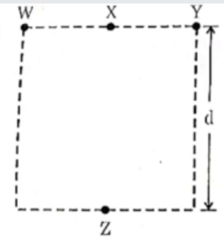
$C = \frac{1}{\omega^2 L}$

$\omega = 2\pi f$

$\omega = 2 \times 3.14 \times 50 = 314\ s^{-1}$

$C = \frac{1}{(314)^2 \times 80 \times 10^{-3}} = 1.27\times 10^{-4} F = 127\mu F$

37. Four objects W, X, Y and Z, each with charge +q are held fixed at four points of a square of side d as shown in the figure. Objects X and Z are on the midpoints of the sides of the square. The electrostatic force exerted by object W on object X is F. Then the magnitude of the force exerted by object W on Z is:



(a) $\frac{F}{7}$ (b) $\frac{F}{5}$ (c) $\frac{F}{3}$ (d) $\frac{F}{2}$

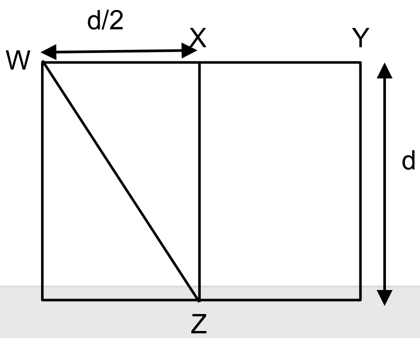
Ans. **(b)**

Sol. $WZ = \sqrt{\left(\frac{d}{2}\right)^2 + d^2}$

$= \sqrt{5}\,\frac{d}{2}$

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

$F' = \frac{kq^2}{\left(\frac{d\sqrt{5}}{2}\right)^2} = \frac{4kq^2}{5d^2} \Rightarrow \frac{F}{5}$

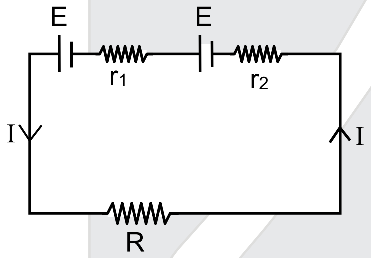


38. Two sources of equal emf are connected in series. This combination is, in turn connected to an external resistance R. The internal resistance of two sources are r_1 and r_2 ($r_2 > r_1$). If the potential difference across the source of internal resistance r_2 is zero, then R equals to :

(a) $\frac{r_1 + r_2}{r_2 - r_1}$ (b) $r_2 - r_1$ (c) $\frac{r_1 r_2}{r_2 - r_1}$ (d) $\frac{r_1 + r_2}{r_1 r_2}$

Ans. **(b)**

Sol.



Net Emf $E_{net} = E + E = 2E$

Net Resistance $R_{net} = R + r_1 + r_2$

Current $I = \frac{E_{net}}{R_{net}} = \frac{2E}{R + r_1 + r_2}$

$\therefore$ Potential difference across cell of internal resistance is r_2 is zero so

$E - Ir_2 = 0$

$E - \frac{2E}{R + r_1 + r_2} = 0$

$\Rightarrow R + r_1 + r_2 - 2r_2 = 0$

$R = r_2 - r_1$

39. Which of the following statements is correct ?

(a) Magnetic field lines do not form closed loops.

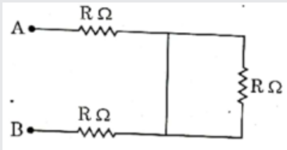
(b) Magnetic field lines start from north pole and end at south pole of a magnet.

(c) The tangent at a point on a magnetic field line represents the direction of the magnetic field at that point.

(d) Two magnetic field lines may intersect each other.

Ans. **(c)**

40. The equivalent resistance between A and B of the network shown in figure is :



(a) 3R Ω (b) $\left(\frac{3}{2}\right)$RΩ (c) 2R Ω (d) $\left(\frac{2}{3}\right)$RΩ

Ans. **(c)**

Sol. Here R + R = 2R Ω

41. A bar magnet has magnetic dipole moment $\vec{M}$. Its initial position is parallel to the direction of uniform magnetic field $\vec{B}$. In this position, the magnitudes of torque and force acting on it respectively are :

(a) 0 and MB (b) MB and MB (c) 0 and 0 (d) $|\vec{M}\times\vec{B}|$ and 0

Ans. **(c)**

42. Two charges 14 μC and –4m μC are placed at (–12 cm, 0, 0) and (12 cm, 0, 0) in an external electric field E = $\left(\frac{B}{r^2}\right)$, where B = 1.2 × 10^6 N/(cm^2) and r is in meters. The electrostatic potential energy of the configuration is :

(a) 97.9 J (b) 102.1 J (c) 2.1 J (d) –97.9 J

Ans. **(a)**

Sol. $Ur = q_1 V + q_2 V + \frac{1}{4\pi \in_0} . \frac{q_1 q_2}{r}$

$= q_1 Er_1 + q_2 Er_2 + \frac{1}{4\pi \in_0} . \frac{q_1 q_2}{r}$ $\because E = \frac{V}{r}$

$= q_1 \frac{B}{r_1^2} r_1 + q_2 \frac{B}{r_2^2} r_2 + \frac{1}{4\pi \in_0} \frac{q_1 q_2}{r}$

$= \frac{Bq_1}{r_1} + \frac{Bq_2}{r2} + \frac{1}{4\pi \in_0} \frac{q_1 q_2}{r}$

$= \frac{1.2\times10^6}{10^{-4}} \times \frac{14\times10^{-6}}{12\times10^{-2}} + \frac{1.2\times10^{-6}}{10^{-4}} \times \frac{(-4)\times10^{-6}}{12\times10^{-2}} + \frac{9\times10^9 \times 14 \times (-4) \times 10^{-12}}{24\times10^{-2}}$

= 97.9J

43. A 300Ω resistor and a capacitor of $\left(\frac{25}{\pi}\right)\mu F$ are connected in series to a 200V – 50 Hz ac source. The current in the circuit is :

(a) 0.1A (b) 0.4A (c) 0.6A (d) 0.8A

Ans. **(b)**

Sol. $I_0 = \frac{V_0}{\sqrt{R^2 + X_C^2}}$

$= \frac{V_0}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}}$ $\because \omega = 2\pi f$

$I_0 = 0.4$ A

44. The core of a transformer is laminated to reduce the effect of

(a) flux leakage (b) copper loss (c) hysteresis loss (d) eddy current

Ans. **(d)**

Question No. 45 to 49 are **Assertion (A)** and **Reason (R)** type questions. Given below are the two statements labeled as **Assertion (A)** and **Reason (R)**. Select the most appropriate answer from the options given below as :

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

(b) Both (A) & (R) are true, and (R) is not correct explanation of (A).

(c) (A) is true, but (R) false

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

45. **Assertion (A) :** A negative charge in an electric field moves along the direction of the electric field

Reason (R) : On a negative charge a force acts in the direction of the electric field.

Ans. **(d)**

46. **Assertion (A) :** The poles of a bar magnet cannot be separated.

Reason (R) : Magnetic monopoles do not exist.

Ans. **(a)**

47. **Assertion (A) :** When radius of a current carrying loop is doubled, its magnetic moment becomes four times.

Reason (R) : The magnetic moment of a current carrying loop is directly proportional to the area of the loop.

Ans. **(a)**

48. **Assertion (A) :** Higher the range, lower is the resistance of a ammeter.

Reason (R) : To increase the range of an ammeter additional shunt is added in series to it.

Ans. **(c)**

49. **Assertion (A) :** A step-up transformer cannot be used as a step-down transformer.

Reason (R) : A transformer works only in one direction.

Ans. **(d)**

SECTION – C

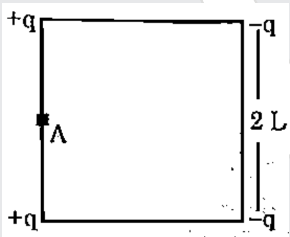
Section-C consists **6** questions. Attempt any **5** questions from this section.

50. Equipotential at a large distance from a collection of a charges whose total sum is not zero are -

(a) spheres (b) planes (c) ellipsoids (d) paraboloids

Ans. **(a)**

51. For charges –q, –q, +q and +q are placed at the corners of a square of side 2 L is shown in figure. The electric potential at point A midway between the two charges +q and +q is –



(a) $\frac{1}{4\pi \in_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$ (b) $\frac{1}{4\pi \in_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$

(c) $\frac{1}{4\pi \in_0}\frac{q}{2L}\left(1-\frac{1}{\sqrt{5}}\right)$ (d) zero

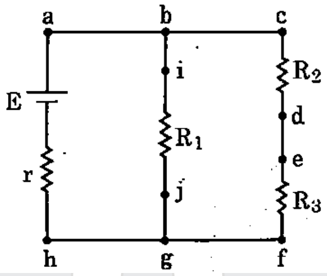
Ans. **(a)**

Sol. $V = \frac{kq}{L}+\frac{kq}{L}-\frac{kq}{\sqrt{5}L}-\frac{kq}{\sqrt{5}L}$

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

Case study:

An experiment was set up with the circuit diagram shown in figure. Given that R_1 = 10 Ω, R_2 = R_3=5Ω, r = 0 Ω, and E = 5 V.



52. The points with the same potential are –

(a) b, c, d (b) f, h, j (c) d, e, f (d) a, b, j

Ans. **(b)**

53. The current through branch bg is -

(a) 1 A (b) $\frac{1}{3}$A (c) $\frac{1}{2}$A (d) $\frac{2}{3}$A

Ans. **(c)**

54. The power dissipated in R_1 is–

(a) 2 W (b) 2.5 W (c) 3 W (d) 4.5 W

Ans. **(b)**

Sol. **P = I^2R**

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

55. The potential difference across R_3 is –

(a) 1.5 V (b) 2 V (c) 2.5 V (d) 3 V

Ans. **(c)**

V = IR

$$= \frac{1}{2} \times 5 = 2.5 \text{ V}$$