CBSE Sample Question Paper Term 1

Class – XII (Session : 2021 - 22)

SUBJECT- PHYSICS 042 - TEST - 01

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 35**

General Instructions:

1. The Question Paper contains three sections.
2. Section A has 25 questions. Attempt any 20 questions.
3. Section B has 24 questions. Attempt any20 questions.
4. Section C has 6 questions. Attempt any 5 questions.
5. All questions carry equal marks.
6. There is no negative marking.

Section A

Attempt any 20 questions

1. An electric dipole placed in non-uniform electric field experiences: **[0.77]**

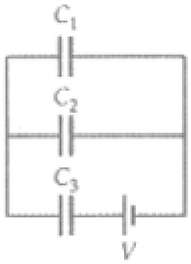
a) both a torque and a net force

b) no torque and no net force

c) only a force but no torque

d) only a torque but no net force

2. What would be the voltage across C_3? **[0.77]**



a) $\frac{(C_1+C_2)V}{C_1+C_2+C_3}$

b) $\frac{C_3V}{C_1+C_2+C_3}$

c) $\frac{C_2V}{C_1+C_2+C_3}$

d) $\frac{C_1V}{C_1+C_2+C_3}$

3. The charge flowing through a resistance R varies with time t as Q = at - bt^2, where a and b are positive constants. The total heat produced in R is: **[0.77]**

a) $\frac{a^3R}{b}$

b) $\frac{a^3R}{2b}$

c) $\frac{a^3R}{3b}$

d) $\frac{a^3R}{6b}$

4. A point charge Q is moved along a circular path around another fixed point charge. So, the work done is **[0.77]**

a) always zero

b) zero only if Q returns to it's starting position

c) zero only if the two charges have the same magnitude

d) zero only if the two charges have the same magnitude and opposite signs

5. A parallel plate capacitor of capacitance C is connected to a battery and is charged to a potential difference V. Another capacitor of capacitance 2C is similarly charged to a potential difference 2V. The charging battery is then disconnected and the capacitors are connected in parallel to each other in such a way that the positive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is - **[0.77]**

a) $\frac{25}{6}CV^2$

b) $\frac{3}{2}CV^2$

c) $\frac{9}{2}CV^2$

d) zero

6. A metal rod of length 10 cm and a rectangular cross-section of 1cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be **[0.77]**

a) same irrespective of the three faces

b) maximum when the battery is connected across 10 cm $\times 1$ cm

c) maximum when the battery is connected across 1cm $\times \frac{1}{2}$ cm

d) maximum when the battery is connected across 10 cm $\times \frac{1}{2}$ cm

7. The average emf induced in which current changes from 0 to 2 A in 0.05 sec is 8 V. The self-inductance of the coil is: **[0.77]**

a) 0.4 H

b) 0.2 H

c) 0.1 H

d) 0.8 H

8. The magnetic moment of a current (I) carrying circular coil of radius (r) and number of turns (n) varies as **[0.77]**

a) $\frac{1}{r^2}$

b) r

c) $\frac{1}{r}$

d) r^2

9. What should be the core of an electromagnet? **[0.77]**

a) none of above

b) soft iron

c) hard iron

d) rusted iron

10. The rms value of AC current which when passed through a resistor produces heat energy four times that produced by DC of 2 A through the same resistor in same time, is: **[0.77]**

a) 32 A

b) 8 A

c) 2 A

d) 4 A

11. A galvanometer having a resistance of 8Ω is shunted by a wire of resistance 2Ω. If the total current is 1 A, the part of it passing through the shunt will be: **[0.77]**

a) 0.8 A

b) 0.3 A

c) 0.5 A

d) 1.2 A

12. $m^2V^{-1}s^{-1}$ is the SI unit of which of the following? **[0.77]**

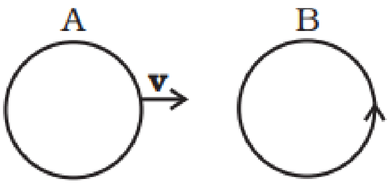
a) Potential gradient

b) Mobility

c) Drift velocity

d) Resistivity

13. There are two coils A and B as shown in Figure. A current starts flowing in B as shown when A is moved towards B and stops when A stops moving. The current in A is counterclockwise. B is kept stationary when A moves. We can infer that **[0.77]**



a) there is a constant current in the counterclockwise direction in A

b) there is a constant current in the clockwise direction in A

c) there is no current in A

d) there is a varying current in A

14. A 200 ohm resistor is connected in series with a $5\mu F$ capacitor. The voltage across the resistor is V_R = 1.20 cos(2500t). Capacitive reactance is **[0.77]**

a) 70 Ω

b) 80 Ω

c) 60 Ω

d) 90 Ω

15. What is the flux through a cube of side a if a point charge q is at one of its corners? **[0.77]**

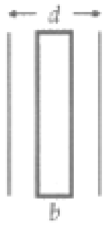
a) $\frac{2q}{\varepsilon_0}$

b) $\frac{q}{\varepsilon_0}$

c) $\frac{q}{8\varepsilon_0}$

d) $\frac{q}{2\varepsilon_0}$

16. A copper plate of thickness b is placed inside a parallel plate capacitor of plate distance d and area A as shown in the figure. The capacitance of a capacitor is **[0.77]**



a) $\frac{A\varepsilon_0}{b}$

b) ∞

c) $\frac{A\varepsilon_0}{d-b}$

d) $\frac{A\varepsilon_0}{d-b}$

17. The SI unit of magnetic pole strength is **[0.77]**

a) ampere metre^2

b) ampere metre^{-2}

c) ampere per metre

d) ampere metre

18. A transmitting station transmits radiowaves of wavelength 360 m. Find the inductance of the coil required with a condenser of capacity 1.20 pF in the resonant circuit. **[0.77]**

a) 3.07×10^{-8} H

b) 2.25×10^{-8} H

c) 1.25×10^{-8} H

d) 1.9×10^{-8} H

19. The force between two magnetic poles is F. If the distance between the poles and pole strengths of each pole are doubled, then the force experienced is: **[0.77]**

a) F

b) $\frac{F}{4}$

c) 2F | d) $\frac{F}{2}$

20. Submarine cables act as **[0.77]**

a) spherical capacitor
b) cylindrical capacitor with inner cylinder earthed
c) parallel plate capacitor
d) cylindrical capacitor with outer cylinder earthed

21. If a charge q is placed at the centre of the line joining two equal charges Q such that the system is in equilibrium, then the value of q is : **[0.77]**

a) $-\frac{Q}{2}$
b) $\frac{Q}{4}$
c) $-\frac{Q}{4}$
d) $\frac{Q}{2}$

22. A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be **[0.77]**

a) $0 \cdot 8$
b) $1 \cdot 125$
c) $0 \cdot 4$
d) $1 \cdot 25$

23. The current flowing in a step down transformer 220 V to 22 V having impedance 220Ω is **[0.77]**

a) 0.1 A
b) 0.1 mA
c) 1 A
d) 1 mA

24. The magnetic moment has dimensions of **[0.77]**

a) $[L^2A]$
b) $[L^2T^{-1}A]$
c) $[LT^{-1}A]$
d) [LA]

25. A charged particle enters a magnetic field H with its initial velocity making an angle of 45° with H. The path of the particle will be: **[0.77]**

a) a straight line
b) an ellipse
c) a circle
d) a helical

Section B

Attempt any 20 questions

26. If the resistance of a galvanometer is 6Ω and it can measure a maximum current of 2 A. Then required shunt resistance to convert it into an ammeter reading up to 6 A, will be: **[0.77]**

a) 2Ω
b) 3Ω
c) 5Ω
d) 4Ω

27. An electric dipole of moment p is placed in an electric field of intensity E. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when $\theta = 90^\circ$, the torque and the potential energy of the dipole will respectively be **[0.77]**

a) $pE\sin\theta, -pE\cos\theta$
b) $pE\cos\theta, -pE\cos\theta$
c) $pE\sin\theta, 2pE\cos\theta$
d) $pE\sin\theta, -2pE\cos\theta$

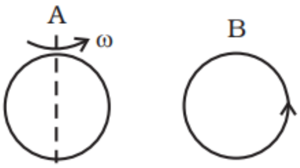
28. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimension of permittivity is **[0.77]**

a) $ML^{-2}T^{2}A$
b) $MLT^{-2}A$
c) $ML^{2}T^{-1}A^{2}$
d) $M^{-1}L^{-3}T^{4}A^{2}$

29. A choke coil has **[0.77]**

a) high inductance and high resistance
b) low inductance and high resistance
c) low inductance and low resistance
d) high inductance and low resistance

30. There are two coils A and B. A current starts flowing in B if the coil A is made to rotate about a vertical axis (Figure). No current flows in B if A is at rest. The current in coil A, when the current in B (at t = 0) is counterclockwise and the coil A is as shown at this instant, t = 0, is **[0.77]**

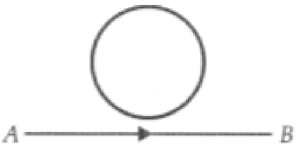


a) constant current counterclockwise
b) constant current clockwise
c) varying current counterclockwise
d) varying current clockwise

31. In the magnetic meridian of a certain place, the horizontal component of the earth's magnetic field is 0.26 G and the dip angle is 60^{o}. What is the magnetic field of the earth at this location? **[0.77]**

a) 0.52 G
b) 0.58 G
c) 0.65 G
d) 0.62 G

32. The current flows from A to B as shown in the figure. The direction of the induced current in the loop is **[0.77]**



a) none of these
b) anticlockwise
c) clockwise
d) straight line

33. On increasing the temperature of a conductor, its resistance increases because the: **[0.77]**

a) relaxation time increases
b) relaxation time decreases
c) relaxation time remains constant
d) electron density decreases

34. Four capacitors each of 25μF are connected in parallel. The voltmeter across them shows a dc of 200 V. The charge on each plate of capacitor is: **[0.77]**

a) $\pm 2 \times 10^{-3} C$
b) $\pm 5 \times 10^{-2} C$
c) $\pm 2 \times 10^{-2} C$
d) $\pm 5 \times 10^{-3}\ C$

35. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite **[0.77]**

directions. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emfs is:

a) 5 : 4
b) 3 : 4
c) 3 : 2
d) 5 : 1

36. In a transformer, number of truns in the primary is 140 and that in the secondary is 280. If current in primary is 4 A, then that in the secondary is: **[0.77]**

a) 6 A
b) 10 A
c) 2 A
d) 4 A

37. In a coil of self-induction 5 H, the rate of change of current is 2 A s^{-1}. Then, e.m.f. induced in the coil is **[0.77]**

a) 10 V
b) -10 V
c) -5 V
d) 5 V

38. The susceptibility of ferromagnetic material is: **[0.77]**

a) inversely proportional to square of temperature
b) inversely proportional to temperature
c) independent of temperature
d) directly proportional to temperature

39. The wiring for a refrigerator contains a starter capacitor. A voltage of amplitude 170 V and frequency 60 Hz applied across the capacitor is to produce a current amplitude of 0.850 A through the capacitor. Capacitance required is **[0.77]**

a) 17.8 μF
b) 13.3 μF
c) 15.3 μF
d) 23.4 μF

40. Fuse wire should have: **[0.77]**

a) high resistance, low melting point
b) high resistance, high melting point
c) low resistance, high melting point
d) low resistance, low melting point

41. A wire of resistance 10 Ω is elongated by 10%. The resistance of the elongated wire is: **[0.77]**

a) 12.1 Ω
b) 13.1 Ω
c) 10.1 Ω
d) 11.1 Ω

42. Gauss's law is valid for **[0.77]**

a) any open surface
b) only irregular open surfaces
c) only regular closed surfaces
d) any closed surface

43. In a coil of 0.1 m radius and 100 turns, 0.1 amp current is passed. What will be the magnetic field at the centre of the coil? **[0.77]**

a) $6.28 \times 10^{-4}\ T$
b) 4.31×10^{-2}T
c) 2×10^{-1}T
d) 9.81×10^{-4}T

44. The intensity of magnetic field is H and the moment of a magnet is M Maximum potential energy is: **[0.77]**

a) 4 MH

b) 3 MH

c) MH

d) 2 MH

45. **Assertion (A):** Circuits containing high capacity capacitors, charged to high voltage should be handled with caution, even when the current in the circuit is switched off. **[0.77]**

Reason (R): When an isolated capacitor is touched by hand or any other part of the human body, there is an easy path to the ground available for the discharge of the capacitor.

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 but R is true.

46. **Assertion (A):** Gauss's law of magnetism is different from that for electrostatics. **[0.77]**

Reason (R): Isolated magnetic poles are not known to exist.

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 but R is true.

47. **Assertion (A):** Eddy currents are produced in any metallic conductor when the magnetic flux is changed around it. **[0.77]**

Reason (R): Electric potential determines the flow of charge.

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 but R is true.

48. **Assertion (A):** Ac is more dangerous than dc. **[0.77]**

Reason (R): The frequency of ac is dangerous for the human body.

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 but R is true.

49. **Assertion (A):** Electron move away from a region of lower potential to a region of higher potential. **[0.77]**

Reason (R): An electron has a negative charge.

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 but R is true.

Section C

Attempt any 5 questions

50. A hollow metal sphere of radius 10 cm is charged such that the potential at its surface is 80 V. The potential at the centre of the sphere is: **[0.77]**

a) 80 V

b) 8 V

c) 800 V

d) Zero

51. A body can be negatively charged by **[0.77]**

a) Giving some protons to it

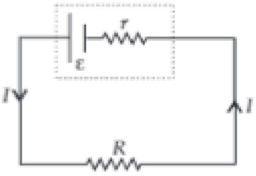
b) Giving excess of electrons to it

c) removing some electrons from it

d) Removing some neutrons from it

Question No. 52 to 55 are based on the given text. Read the text carefully and answer the questions:

Emf of a cell is the maximum potential difference between two electrodes of the cell when no current is drawn from the cell. Internal resistance is the resistance offered by the electrolyte of a cell when the electric current flows through it. The internal resistance of a cell depends upon the following factors; (i) distance between the electrodes (ii) nature and temperature of the electrolyte (iii) nature of electrodes (iv) area of electrodes.



For a freshly prepared cell, the value of internal resistance is generally low and goes on increasing as the cell is put to more and more use. The potential difference between the two electrodes of a cell in a closed circuit is called terminal potential difference and its value is always less than the emf of the cell in a closed circuit. It can be written as $V = \varepsilon - Ir$

52. The terminal potential difference of two electrodes of a cell is equal to emf of the cell when **[0.77]**

a) neither $I \neq 0$ and $I = 0$

b) $I \neq 0$

c) $I = 0$

d) both $I \neq 0$ and $I = 0$

53. A cell of emf ε and internal resistance r gives a current of 0.5 A with an external resistance of 12Ω and a current of 0.25 A with an external resistance of 25Ω. What is the value of internal resistance of the cell? **[0.77]**

a) 7 Ω

b) 3 Ω

c) 1 Ω

d) 5 Ω

54. Choose the wrong statement. **[0.77]**

a) Terminal potential difference of the cell when it is being charged is given as $V = \varepsilon + Ir$.

b) Internal resistance of a cell decrease with the decrease in temperature of the electrolyte.

c) Potential difference across the terminals of a cell in a closed circuit is always less than its emf.

d) Potential difference versus current graph for a cell is a straight line with a -ve slope.

55. An external resistance R is connected to a cell of internal resistance r, the maximum current flows in the external resistance, when **[0.77]**

a) $R = r$

b) $R > r$

c) $R < r$

d) $R = \frac{1}{r}$

Solution

SUBJECT- PHYSICS 042 - TEST - 01

Class 12 - Physics

Section A

1. **(a)** both a torque and a net force
   Explanation: In a non-uniform electric field, an electric dipole experiences both a torque and a net force.

2. **(a)** $\frac{(C_1+C_2)V}{C_1+C_2+C_3}$
   Explanation: Parallel combination of C_1 and C_2 is in series with C_3. So
   $C_{cq} = \frac{(C_1+C_2)C_3}{C_1+C_2+C_3}$
   Charge on C_3,
   Q = $(C_1 + C_2)$V
   $= \frac{(C_1+C_2)C_3V}{C_1+C_2+C_3}$
   Voltage across $C_3 = \frac{Q}{C_3} = \frac{(C_1+C_2)V}{C_1+C_2+C_3}$

3. **(d)** $\frac{a^3R}{6b}$
   Explanation: Q = at - bt^2
   I = $\frac{dQ}{dt}$ = a - 2bt
   When t = $\frac{a}{2b}$, I = 0
   That is current will exist till t = $\frac{a}{2b}$
   ∴ Total heat produced in resistance R,
   H = $= \int_0^t I^2 Rdt = \int_0^{2b} (a-2bt)^2 Rdt$
   = $\int_0^{2b} \left(a^2 + 4b^2t^2 - 4abt\right) Rdt$
   = $\left[a^2t + 4b^2\frac{t^3}{3} - 4ab\frac{t^2}{2}\right]_0^{2b} \times R$
   = $\left[a^2\frac{a}{2b} + \frac{4b^2}{3}\left(\frac{a}{2b}\right)^3 - 2ab\left(\frac{a}{2b}\right)^2\right] R$
   = $\left[\frac{a^3}{2b} + \frac{a^3}{6b} - \frac{a^3}{2b}\right] R = \frac{a^3R}{6b}$

4. **(a)** always zero
   Explanation: Since that circular path behaves as equipotential surface, so work done is always zero.

5. **(b)** $\frac{3}{2}CV^2$
   Explanation: The charges Q_1 and Q_2 on the two capacitors Q_1 = CV; Q_2 = (2C)(2V) = 4CV
   The capacitors are connected in parallel in such a way that the positive plate of one is connected to the negative plate of the other.
   The common potential $V = \frac{Q_2-Q_1}{C+2C} = \frac{4CV-CV}{3C} = V$
   The final energy $U_f = \frac{1}{2}CV^2 + \frac{1}{2}(2C)V^2 = \frac{3}{2}CV^2$

6. **(c)** maximum when the battery is connected across 1cm $\times \frac{1}{2}$ cm
   Explanation: As we know $R = \rho \cdot \frac{l}{A}$, where length is constant l=10cm.So resistance is directly proportional to 1/A. The maximum resistance will be when the value of $\frac{1}{A}$ is maximum, i.e., 'A' must be minimum, it is minimum when the area of cross-section is 1cm $\times \frac{1}{2}$cm

7. **(b)** 0.2 H
   Explanation: $\varepsilon = L\frac{dI}{dt}$
   or $8 = L\frac{2-0}{0.05}$
   or L = 0.2 H

8. **(d)** r^2

Explanation: M = IA = I $\times$ πr^2 i.e., $M \propto r^2$

9. **(b)** soft iron

Explanation: soft iron

10. **(d)** 4 A

Explanation: $I_{rms}^2 Rt = 4 I_{dc}^2 Rt$

$I_{rms} = 2 I_{dc} = 2 \times 2$ = 4 A

11. **(a)** 0.8 A

Explanation: P.D. across the galvanometer = P.D. across the shunt

$(I - I_g)G = I_s S$

or $I_s = \frac{IG}{G+S} = \frac{1 \times 8}{8+2} = 0.8$ A

12. **(b)** Mobility

Explanation: The charge carrier in most metals is the negatively charged electron. The mobility of the charge carrier is defined as the drift velocity of the charge carrier per unit electric field. It is denoted by μ and$\mu = v_d / E$ is given as. The Sl unit of μ is m2V-1s-1.

13. **(a)** there is a constant current in the counterclockwise direction in A

Explanation: Coil A must be carrying a constant current in counter-clockwise direction. When coil A moves towards coil B with constant velocity so the rate of change of magnetic flux due to coil B in coil A will be constant gives constant current in A in the same direction as in B by Lenz's law.

14. **(b)** 80 Ω

Explanation: V_R = 1.20 cos(2500t)

Thus, $\omega = 2500 rad/s$

$C = 5\mu F = 5 \times 10^{-6} F$

Capacitive reactance,

$X_C = \frac{1}{\omega C} = \frac{1}{2500 \times 5 \times 10^{-6}} = 80\Omega$

15. **(c)** $\frac{q}{8\varepsilon_0}$

Explanation: When the charge q is placed at one corner of the cube, only one-eighth of the flux emerging from the charge q passes through the cube.

$\therefore \phi_E = \frac{q}{8\varepsilon_0}$

16. **(c)** $\frac{A\varepsilon_0}{d-b}$

Explanation: Electric field inside the copper plate is zero. It exists only in the region of thickness d - b.

$\therefore C = \frac{\varepsilon_0 A}{d-b}$

17. **(d)** ampere metre

Explanation: ampere metre

18. **(a)** 3.07×10^{-8} H

Explanation: Frequency,

$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{360} = \frac{1}{12} \times 10^7$ Hz

Required inductance,

$L = \frac{1}{4\pi^2 f^2 C} = \frac{1}{4\pi^2 \left(\frac{1}{12} \times 10^7\right)^2 \times 1.2 \times 10^{-6}}$

= 3.07×10^{-8} H

19. **(a)** F

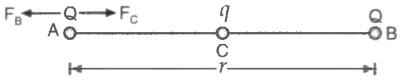
Explanation: $F \alpha \frac{q_m q_m'}{r^2}$

Hence $\frac{F'}{F} = \left(\frac{2q_m 2q_m'}{4r^2}\right) / \frac{q_m q_m'}{r^2} = 1$

or F' = F

20. **(d)** cylindrical capacitor with outer cylinder earthed
Explanation: A submarine cable consists of an inner conductor which carries power. This conductor is covered by an insulator, which acts as a dielectric. The dielectric material is covered by a metal coating called shield, which is connected to ground. The cable acts as a cylindrical capacitor, with the conductor acting as the inner cylinder, and the metal shield as the outer cylinder which is connected to earth.

21. **(c)** $-\frac{Q}{4}$
Explanation:
Two equal charges of Q each are placed at the points A and B at a distance r apart and the charge q, at the centre C of the line joining the two equal charges as shown in the figure.



Let us first consider the equilibrium of the charge Q placed at point A. Let F_B and F_C be the forces on it due to the charges at the points B and C. For the equilibrium of charge Q at the point A, the net force on it must be zero i.e.
$F_B + F_C = 0$
$\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q\times Q}{r^2}+\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q\times q}{(r/2)^2}=0$
or Q + 4 q = 0
or q = $-\frac{Q}{4}$
It follows that the forces due to charges at the points A and B on the charge q are equal and opposite and hence it will also be in equilibrium.

22. **(a)** $0\cdot 8$
Explanation: Power factor $cos\phi=\frac{R}{Z}$
Here, R = 12 ohm and Z = 15 ohm
∴ power factor = $\frac{12}{15}$ = $0\cdot 8$

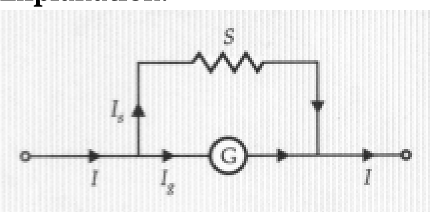
23. **(a)** 0.1 A
Explanation: Current in the secondary coil is given by ,$i=\frac{V_s}{Z}=\frac{22}{220}=0.1A$

24. **(a)** $[L^2A]$
Explanation: Magnetic moment = Current × area
[M] = $[L^2A]$

25. **(d)** a helical
Explanation: The charged particle will follow a helical path with its axis parallel to the field. The component vcos 45° of initial velocity parallel to H will make the particle move along H while the perpendicular component ucos 45° will compel it to follow a circular path.

Section B

26. **(a)** 2Ω
Explanation:



$I_g \times G = I_s \times S$
2 × 6 = 6 × S
S = 2Ω

27. **(a)** $pE\sin\theta, -pE\cos\theta$
Explanation: $\tau = pE\sin\theta$
U = -pEcosθ

28. **(d)** $M^{-1}L^{-3}T^4A^2$

Explanation: Dimension of Permittivity is given by = $[Charge]^2 \times [Force]^{-1} \times [Distance]^{-2}$

Or, $\varepsilon_0 = [AT]^2 \times [M^1 L^1 T^{-2}]^{-1} \times [M^0 L^1 T^0]^{-2} = [M^{-1} L^{-3} T^4 A^2] = M^{-1}L^{-3}T^4A^2$

29. **(d)** high inductance and low resistance

Explanation: A choke coil has high inductance and low resistance.

30. **(b)** constant current clockwise

Explanation: This problem is solved by using Lenz's law. At t = 0 current in B is counter-clockwise and coil A is considered above B. The counter-clockwise flow of the current in B is equivalent to the north pole of the magnet and magnetic field lines are emanating upward to coil A. When coil A start rotating at t = 0, the current in A is constant along clockwise direction by Lenz's rule. As for flux changes across coil A by rotating it near the N-pole formed by flowing current in B in anticlockwise.

31. **(a)** 0.52 G

Explanation: $B = \frac{H_E}{cos\delta} = \frac{0.26}{0.5} = 0.52\ G$

32. **(c)** clockwise

Explanation: The magnetic field due to the current AB acts normally out of the plane of the loop. By Lenz's law, the induced current must produce inward flux i.e., induced current must flow clockwise in the loop.

33. **(b)** relaxation time decreases

Explanation: On increasing the temperature of a conductor, n does not change but electrons collide more frequently. So the relaxation time τ decreases and resistance $\left(R = \frac{ml}{ne^2\tau A}\right)$ increases.

34. **(d)** $\pm 5 \times 10^{-3}\ C$

Explanation: In parallel combination, potential across each capacitor will be same thus charge

Hence, charge on each capacitor is given by :-Q =$\pm$ CV

$Q = \pm 25 \times 10^{-6} \times 200$

$Q = \pm 5 \times 10^{-3} C$

35. **(c)** 3 : 2

Explanation: Lek k be the potential gradient in $\frac{V}{cm}$. Then

$\varepsilon_1 + \varepsilon_2$ = 50 k

$\varepsilon_1 - \varepsilon_2$ = 10 k

$\therefore \varepsilon_1$ = 30 k and ε_2 = 20 k

$\frac{\varepsilon_1}{\varepsilon_2} = \frac{3}{2} = 3 : 2$

36. **(c)** 2 A

Explanation: Here, N_p = 140; N_s = 280 and I_p = 4 A

$\therefore I_s = I_p \times \frac{N_p}{N_s} = 4 \times \frac{140}{280} = 2A$

37. **(b)** -10 V

Explanation: The induced e.m.f.

$= -L(\frac{dl}{dt}) = -5 \times 2$ = -10V

38. **(b)** inversely proportional to temperature

Explanation: Susceptibility of a ferromagnetic material varies inversely with temperature.

39. **(b)** 13.3 μF

Explanation: V = 170 volt, f = 60 Hz, i = 0.85 A

$V = iX_C = i\frac{1}{\omega C} = \frac{i}{2\pi fC}$

Thus, Capacitance required,

$C = \frac{i}{2\pi fV} = \frac{0.85}{2 \times 3.14 \times 60 \times 170} = 13.3 \times 10^{-6} F = 13.3\mu F$

40. **(a)** high resistance, low melting point

Explanation: A fuse wire has HIGH resistance & LESS melting point, so that it can protect the electrical appliances by undergoing melting due to excess heat produced because of high resistance. As a result, circuit is not complete, so no current flow in it.

41. **(a)** 12.1 Ω

Explanation: New length, l' = l + 10% of l = 1.1 l

As V = Al = $A'l'$

$\therefore \frac{A}{A'} = \frac{l'}{l} = 1.1$

$\frac{R'}{R} = \frac{l'}{l} \times \frac{A}{A'} = 1.1 \times 1.1$ = 1.21

R' = 1.21 R = 1.21 $\times$ 10 = 12.1 Ω

42. **(d)** any closed surface

Explanation: Gauss's law is valid for any closed surface.

43. **(a)** $6.28 \times 10^{-4}\ T$

Explanation: Magnetic field at the center of the coil $B = \frac{\mu_0 n I}{2r}$

$= \frac{4\pi \times 10^{-7} \times 100 \times 0.1}{2 \times 0.1}$

$= 6.28 \times 10^{-4}$ T

44. **(d)** 2 MH

Explanation: U_{max} = -2 MH cos 180° = +2 MH

45. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A

46. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Gauss's law of magnetism is different from that for electrostatics because electric charges do not necessarily exist in pairs but magnetic monopoles do not exist.

47. **(b)** Both A and R are true but R is not the correct explanation of A.

Explanation: Both the statements are independently correct.

48. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: The effect of ac on the body depends largely on the frequency. Low-frequency currents of 50 to 60 Hz (cycles/sec), which are commonly used, are usually more dangerous than high-frequency currents and are 3 to 5 times more dangerous than dc of the same voltage and amperage (current). The usual frequency of 50 cps (or 60 cps) is extremely dangerous as it corresponds to the fibrillation frequency of the myocardium. This results in ventricular fibrillation and instant death.

49. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

Section C

50. **(a)** 80 V

Explanation: A hollow metal sphere is a conductor in which charge always reside on the surface. Thus electric field inside the sphere will be zero and potential at the center is the same as that on its surface, hence potential will be constant and equal to as that on the surface i.e. V = 80 Volt

51. **(b)** Giving excess of electrons to it

Explanation: Giving excess of electrons to it.

52. **(c)** I = 0

Explanation: I = 0

53. **(c)** 1 Ω

Explanation: As I = $\frac{\varepsilon}{R+r}$

In first case, I = 0.5 A; R = 12 Ω

$0.5 = \frac{\varepsilon}{12+r} \Rightarrow \varepsilon = 6.0 + 0.5r$ ...(i)

ε = 6.25 + 0.25r ....(ii)

From equation (i) and (ii), r = 1 Ω

54. **(b)** Internal resistance of a cell decrease with the decrease in temperature of the electrolyte.

Explanation: Internal resistance of a cell decrease with the decrease in temperature of the electrolyte.

55. **(a)** R = r

Explanation: Current in the circuit I = $\frac{E}{R+r}$

Power deliverd to the resistance R is

P = $I^2 R = \frac{E^2 R}{(R+r)^2}$

It is maximum when $\frac{dP}{dR}$ = 0

$\frac{dP}{dR} = E^2 \left[\frac{(r+R)^2 - 2R(r+R)}{(r+R)^4} \right]$ = 0

or $(r + R)^2 = 2R(r + R)$ or R = r