CBSE Sample Question Paper Term 1

Class – XII (Session : 2021 - 22)

SUBJECT - PHYSICS 042 - TEST - 02

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. In air the value of the total electric flux emitted from the unit positive charge is **[0.77]**

   a) ε_0 b) $(4\pi\varepsilon_0)^{-1}$

   c) $(\varepsilon_0)^{-1}$ d) $4\pi\varepsilon_0$

2. 0.2 F capacitor is charged to 600 V by a battery, on removing the battery, it is connected with another parallel plate condenser of 1 F. the potential decreases to: **[0.77]**

   a) 100 V b) 300 V

   c) 600 V d) 120 V

3. The SI unit of current is **[0.77]**

   a) joule b) coulomb

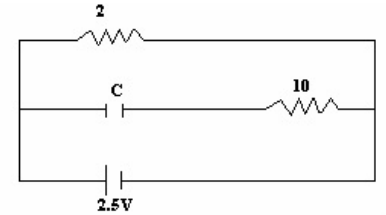
   c) ampere d) newton

4. If a positive charge is displaced against the electric field in which it was situated, then **[0.77]**

   a) the intensity of the electric field decreases b) work will be done by the electric field on the charge

   c) energy of the system will decrease d) energy will be provided by external source displacing the charge

5. A capacitor of capacitance C = 2 μF is connected as shown in the figure. If the internal resistance of the cell is 0.5Ω , the charge on the capacitor plates is **[0.77]**



a) 6 μC

b) 2 μC

c) zero

d) 4 μC

6. The specific resistance of a conductor increases with: **[0.77]**

a) decrease in cross-sectional area

b) increase in temperature

c) decrease in length

d) increase in cross-sectional area

7. On a cylindrical rod two coils are wound one above the other. What is the coefficient of mutual inductance if the inductance of each coil is 0.1H? **[0.77]**

a) 0.15H

b) 0.05H

c) 0.20H

d) 0.10H

8. At a point on the right bisector of a magnetic dipole, the magnetic: **[0.77]**

a) field varies as r^3

b) potential is zero at all points on the right bisector

c) field is perpendicular to the axis of dipole

d) potential varies as $\frac{1}{r^2}$

9. If two coils of inductances L_1 and L_2 are linked such that their mutual inductance is M, then the maximum value of M is **[0.77]**

a) L_1 - L_2

b) L_1 + L_2

c) $L_1 \times L_2$

d) $\sqrt{L_1 L_2}$

10. In an ac circuit an alternating voltage, e = $200\sqrt{2}\sin 100t$ volts is connected to a capacitor of capacity 1 μF. The rms value of the current in the circuit is **[0.77]**

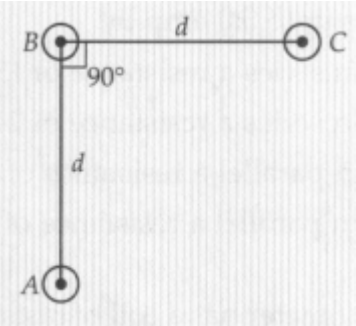
a) 20 mA

b) 100 mA

c) 200 mA

d) 10 mA

11. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current along the same direction is shown in the figure. The magnitude of force per unit length on the middle wire W is given by **[0.77]**



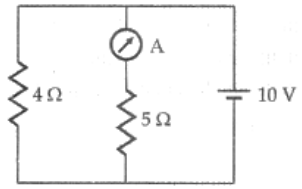
a) $\frac{\mu_0 I^2}{2\pi d}$

b) $\frac{\sqrt{2}\mu_0 I^2}{\pi d}$

c) $\frac{2\mu_0 I^2}{\pi d}$

d) $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$

12. In the given diagram, the reading of the ammeter (when the internal resistance of the battery is zero) is: **[0.77]**



a) 2 A

b) $\frac{5}{3}$ A

c) $\frac{10}{9}$ A

d) $\frac{40}{29}$ A

13. Expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid is **[0.77]**

a) $\frac{\mu_0 A}{2} Bl$

b) $\frac{\mu_0 \pi Bl}{2A}$

c) $\frac{1}{2\mu_0} B^2 Al$

d) $\frac{\pi A}{2lB}$

14. For high frequency, capacitor offers **[0.77]**

a) Less resistance

b) More resistance

c) None of these

d) Zero resistance

15. Three point charges +q, -2q and +q are placed at points (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are **[0.77]**

a) $\sqrt{2}$ qa along the line joining the points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

b) qa along the line joining the points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

c) $\sqrt{2}$ qa along +y direction

d) $\sqrt{2}$ qa along +x direction

16. The capacity of a pure capacitor is 1 farad. In DC circuit, its effective resistance will be **[0.77]**

a) infinite

b) zero

c) 1 ohm

d) 2 ohm

17. A magnetic field: **[0.77]**

a) always exerts a force on a charged particle

b) exerts a force, if the charged particle is moving along the magnetic field line

c) exerts a force, if the charged particle is moving across the magnetic field line

d) never exerts a force on charged particle

18. The voltage across the terminals of an ac power supply varies with time according to $V\cos\omega t$. The voltage amplitude is V = 45.0 V. Average potential difference between the two terminals of the power supply is **[0.77]**

a) 35.8 V

b) 33.8 V

c) 37.8 V

d) 0 V

19. A bar magnet having a magnetic moment of 2×10^4 JT^{-1} is free to rotate in a horizontal plane. A horizontal magnetic field B = 6×10^{-4} T exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is **[0.77]**

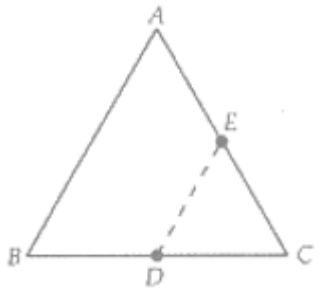
a) 0.6 J

b) 12 J

c) 2 J

d) 6 J

20. Three charges, each + q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, each equal to 2a. D and E are the midpoints of BC and CA The work done in taking a charge Q from D to E is: **[0.77]**



a) $\frac{qQ}{4\pi\varepsilon_0 a}$

b) zero

c) $\frac{3qQ}{8\pi\varepsilon_0 a}$

d) $\frac{3qQ}{4\pi\varepsilon_0 a}$

21. When air is replaced by a dielectric medium of dielectric constant K, the maximum force of attraction between two charges separated by a distance: **[0.77]**

a) decreases K^2 times

b) decreases K times

c) increases K times

d) remains unchanged

22. Inductance of an inductor whose reactance is 120 Ω at 80.0 Hz is **[0.77]**

a) 0.239 H

b) 0.209 H

c) 0.199 H

d) 0.219 H

23. What happens to the current in coil while accelerating a magnet inside it? **[0.77]**

a) Increases

b) Decreases

c) Reverses

d) Remains constant

24. The angle of dip at a place on the earth gives **[0.77]**

a) the direction of the earth's magnetic field

b) the horizontal component of the earth's magnetic field

c) the location of geographic meridian

d) the vertical component of the earth's field

25. An electron is projected with uniform velocity along the axis of a current-carrying long solenoid. Which of the following is true? **[0.77]**

a) The electron will continue to move with uniform velocity along the axis

b) The electron path will be circular about the axis.

of the solenoid.

c) The electron will be accelerated along the axis.

d) The electron will experience a force at 45° to the axis and hence execute a helical path.

Section B

Attempt any 20 questions

26. A circular current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field B. The work done to rotate the loop by 30° about an axis perpendicular to its plane is **[0.77]**

a) zero

b) $\frac{MB}{2}$

c) MB

d) $\sqrt{3}\frac{MB}{2}$

27. In bringing an electron towards another electron, the electrostatic potential energy of the system **[0.77]**

a) decreases

b) become zero

c) remains same

d) increases

28. If the net electric flux through a closed surface is zero, then we can infer **[0.77]**

a) no net charge is enclosed by the surface

b) electric potential varies from point to point inside the surface

c) charge is present inside the surface

d) uniform electric field exists within the surface

29. A series RC circuit is connected to an alternating voltage source. Consider two situations: **[0.77]**

i. when the capacitor is air-filled

ii. when the capacitor is mica filled

Current through the resistor is i and voltage across the capacitor is V, then:

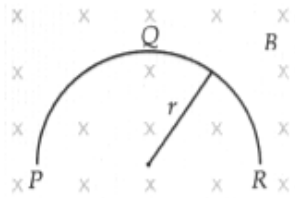
a) $i_a > i_b$

b) $V_a > V_b$

c) $V_a < V_b$

d) $V_a = V_b$

30. A thin semicircular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B, as shown in the figure. The potential difference developed across the ring when its speed is v, is **[0.77]**



a) zero

b) πrBv and R is at higher potential

c) 2rBv and R is at higher potential

d) $\frac{Bv\pi r^2}{2}$ and P is at higher potential

31. Which of the following is most suitable for the core of the electromagnets? **[0.77]**

a) Cu-Ni alloy

b) Soft iron

c) Steel

d) Air

32. For MRI, a patient is slowly pushed in a time of 10 s within the coils of the magnet where magnetic field is B = 2.0 T. If the patient's trunk is 0.8 m in circumference, the induced emf around the patient's trunk is **[0.77]**

a) 10.18×10^{-3}V

b) 10.18×10^{-2}V

c) 1.51×10^{-2}V

d) 9.66×10^{2}V

33. A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 10 m long. When the resistance R, connected across the given cell, has values of **[0.77]**

i. infinity

ii. 9.5 Ω

the balancing lengths, on the potentiometer wire are found to be 3 and 2.85 m, respectively. The value of internal resistance of the cell is:

a) 0.95 Ω

b) 0.75 Ω

c) 0.25 Ω

d) 0.5 Ω

34. Two spherical conductors each of capacity C are charged to potential V and -V. These are then connected by means of a fine wire. The loss of energy is: **[0.77]**

a) Zero

b) $2CV^2$

c) $\frac{1}{2}CV^2$

d) CV^2

35. Potentiometer measures the potential difference more accurately than a voltmeter, because **[0.77]**

a) It has a wire of low resistance.

b) It draws a heavy current from external circuit.

c) It does not draw current from external circuit.

d) It has a wire of high resistance.

36. What is the value of inductance L for which the current is maximum in a series LCR-circuit with C = 10 μF and ω = 1000 s^{-1}? **[0.77]**

a) 100 mH

b) cannot be calculated unless R is known

c) 10 mH

d) 1 mH

37. An inductor may store energy in **[0.77]**

a) its magnetic field

b) its electric field

c) both in electric and magnetic fields

d) its coils

38. The main use of studying a hysteresis curve for a given material is to estimate the **[0.77]**

a) voltage loss

b) hysteresis loss

c) current loss

d) power loss

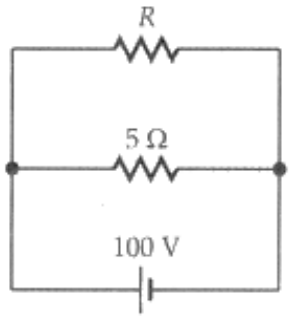
39. An LRC series circuit has phase angle 31.5°. The voltage amplitude of the source is 90.0 V. Voltage amplitude across the resistor is **[0.77]**

a) 68.7 V
b) 76.7 V
c) 74.7 V
d) 70.7 V

40. The dimension of electrical resistance is: **[0.77]**

a) $[ML^2T^{-3}A^1]$
b) $[ML^2T^{-3}A^{-2}]$
c) $[ML^3T^{-3}A^{-2}]$
d) $[ML^2T^{-3}A^{-1}]$

41. The power dissipated in the circuit shown in the figure is 30 watts. The value of R is: **[0.77]**



a) 10 Ω
b) 30 Ω
c) 15 Ω
d) 20 Ω

42. Two infinitely long parallel conducting plates having surface charge densities $+\sigma$ and $-\sigma$ respectively are separated by a small distance. The medium between the plates is a vacuum. If ε_0 is the dielectric permittivity of vacuum, then the electric field in the region between the plates is **[0.77]**

a) 0 Vm^{-1}
b) $\frac{\sigma}{\varepsilon_0}$ Vm^{-1}
c) $\frac{2\sigma}{\varepsilon_0}$ Vm^{-1}
d) $\frac{\sigma}{2\varepsilon_0}$ Vm^{-1}

43. The magnetic field at the centre of a current-carrying circular loop having 1 A current and number of turns one will be (radius of the loop is 1 m): **[0.77]**

a) $2\mu_0$
b) $\frac{\mu_0}{4}$
c) $\frac{\mu_0}{2}$
d) $4\mu_o$

44. A Rowland ring of mean radius 15 cm has 3500 turns of wire wound on a ferromagnetic core of relative permeability 800. What is the magnetic field B in the core for a magnetising current of 1.2A? **[0.77]**

a) 3.48 T
b) 5.48 T
c) 4.08 T
d) 4.48 T

45. **Assertion (A):** Electric potential and electric potential energy are different quantities. **[0.77]**
Reason (R): For a system of positive test charge and point charge electric potential energy = electric potential.

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):** A disc-shaped magnet deviates above a superconducting material that has been cooled by liquid nitrogen. **[0.77]**

Reason (R): Superconductors repel a magnet.

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):** Magnetic flux can produce induced e.m.f. **[0.77]**

Reason (R): Faraday established induced e.m.f. experimentally.

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):** An alternating current does not show any magnetic effect. **[0.77]**

Reason (R): Alternating current varies with time.

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):** The tyres of aircraft are slightly conducting. **[0.77]**

Reason (R): If a conductor is connected to ground, the extra charge induced on conductor will flow to ground.

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.

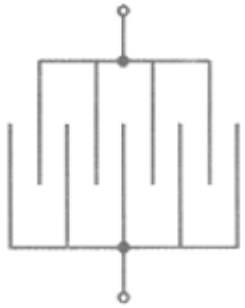
c) A is true but R is false.

d) A is false but R is true.

Section C

Attempt any 5 questions

50. A gang capacitor is formed by interlocking a number of plates as shown in the figure. The distance between the consecutive plates is 0.885 cm and the overlapping area of the plates is 5 cm^2. The capacity of the unit is **[0.77]**



a) 12.72 pF

b) 4 pF

c) 6.36 pF

d) 1.06 pF

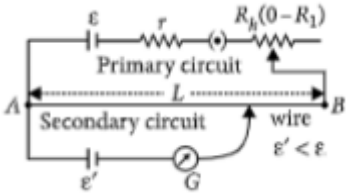
51. A cylindrical conductor is placed near another positively charged conductor. The net **[0.77]**

charge acquired by the cylindrical conductor will be

a) either positive or negative
b) zero
c) positive only
d) negative only

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

Potentiometer is an apparatus used for measuring the emf of a cell or potential difference between two points in an electrical circuit accurately. It is also used to determine the internal resistance of a primary cell. The potentiometer is based on the principle that, if V is the potential difference across any portion of the wire of length l and resistance R, then $V \propto l$ or $V = kl$ where k is the potential gradient. Thus, potential difference across any portion of potentiometer wire is directly proportional to length of the wire of that portion. The potentiometer wire must be uniform. The resistance of the potentiometer wire should be high.



52. Which one of the following is true about potentiometer? **[0.77]**

a) It measures the emf of a cell very accurately.
b) Its sensitivity is low.
c) It is based on deflection method.
d) none of these

53. A current of 1.0 mA is flowing through a potentiometer wire of length 4 cm and of resistance 4 Ω. The potential gradient of the potentiometer wire is **[0.77]**

a) 10^{-3} Vm^{-1}
b) 10^{-5} Vm^{-2}
c) 4×10^{-3} V m^{-1}
d) 2×10^{-3} V m^{-1}

54. Sensitivity of a potentiometer can be increased by **[0.77]**

a) decreasing potential gradient along the wire
b) increasing current through the wire
c) decreasing current through the wire
d) increasing potential gradient along the wire

55. A potentiometer is an accurate and versatile device to make electrical measurements of EMF because the method involves **[0.77]**

a) a combination of cells, galvanometer and resistances
b) cells
c) a condition of no current flow through the galvanometer
d) potential gradients

Solution

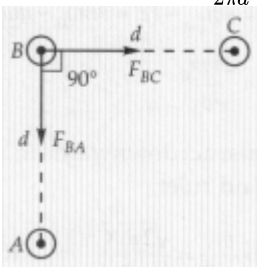
SUBJECT - PHYSICS 042 - TEST - 02

Class 12 - Physics

Section A

1. **(c)** $(\varepsilon_0)^{-1}$
   Explanation: $\phi_E = \frac{q}{\varepsilon_0} = \frac{1}{\varepsilon_0} = (\varepsilon_0)^{-1}$
2. **(a)** 100 V
   Explanation: By conservation of charge, 0.2 $\times$ 600 = (0.2 + 1) V
   $\therefore V = \frac{0.2\times600}{1.2}$ = 100 V
3. **(c)** ampere
   Explanation: Unit of electric current assigned by institute of standards is Ampere. 1 ampere is the constant current that will produce an attractive force of 2×10^{-7} newton per metre of length between two straight, parallel conductors of infinite length and negligible circular cross section placed one metre apart in a vacuum.
4. **(d)** energy will be provided by external source displacing the charge
   Explanation: Because the work done by the external force is the change in potential energy and work done by the external force is positive. Hence energy will be provided by external source displacing the charge.
5. **(d)** 4 μC
   Explanation: When capacitor is fully charged , no current flows through the capacitor.
   The total resistance in the circuit = 2 + 0.5 = 2.5 ohm
   Current I = $\frac{V}{R} = \frac{2.5}{2.5}$ = 1 A
   Since no current flows through the 10 Ω resistor, the potential drop across it = 0
   The potential drop across the 2 Ω resistor = potential across the capacitor = 1 × 2 = 2 volt
   Charge on the capacitor is given by Q = CV = (2μF) × 2 = 4μC
6. **(b)** increase in temperature
   Explanation: The specific resistance of a conductor increases with the increase in temperature.
7. **(d)** 0.10H
   Explanation: As one coil is wound over the other so that coupling is tight i.e. k = 1
   $M = k\sqrt{L_1L_2} = 1\sqrt{0.1 \times 0.1} = 0.1H$
8. **(b)** potential is zero at all points on the right bisector
   Explanation: The magnetic potential at any point is the amount of work done in bringing a unit north pole from infinity to that point. At any point on the right bisector, the potentials due to the two poles are equal and opposite.
9. **(d)** $\sqrt{L_1L_2}$
   Explanation: $M = k\sqrt{L_1L_2}$
   here k is coefficient of coupling. Its maximum value is 1 for tight coupling.
10. **(a)** 20 mA
    Explanation: $e_{rms} = \frac{e_0}{\sqrt{2}} = \frac{200\sqrt{2}}{\sqrt{2}} = 200$ V
    $X_C = \frac{1}{\omega C} = \frac{1}{100\times10^{-6}} = 10^4\Omega$
    $i_{\text{rms}} = \frac{e_{\text{rms}}}{X_C} = \frac{200}{10^4}$ A = 20 mA
11. **(d)** $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$
    Explanation:

$F_{BA} = F_{BC} = \frac{\mu_0 I^2}{2\pi d}$



But $F_{BA} \perp F_{BC}$

$\therefore F = \sqrt{2}F_{BA} = \sqrt{2}\frac{\mu_0 I^2}{2\pi d} = \frac{\mu_0 I^2}{\sqrt{2}\pi d}$

12. **(a)** 2 A

Explanation: Reading of the ammeter = Current through 5 Ω resistor = $\frac{10\text{ V}}{5\Omega}$ = 2 A

13. **(c)** $\frac{1}{2\mu_0}B^2Al$

Explanation: $U = \frac{1}{2}Li^2$

For a solenoid,

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

$B = \mu_0 \frac{N}{l} i$

$i = \frac{Bl}{\mu_0 N}$

Thus, $U = \frac{1}{2}\left(\frac{\mu_0 N^2 A}{l}\right)\left(\frac{Bl}{\mu_0 N}\right)^2$

$U = \frac{1}{2\mu_0}B^2Al$

14. **(a)** Less resistance

Explanation: Capacitive reactance,

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

So, $X_C \propto \frac{1}{f}$

Hence, for high frequency, capacitor offers less resistance.

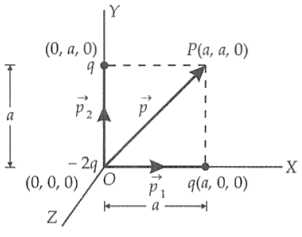
15. **(a)** $\sqrt{2}$ qa along the line joining the points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

Explanation:

The given charge assembly is equivalent to two dipoles. One dipole of charges -q and +q has dipole moment $\vec{p}_1$ along +ve X-direction and other dipole of charges -q and +q has dipole moment $\vec{p_2}$ along +ve Y-direction. The resultant dipole moment $\vec{p}$ has magnitude,

p = $\sqrt{p_1^2 + p_2^2} = \sqrt{q^2a^2 + q^2a^2} = \sqrt{2}qa$

$\vec{p}$ is directed along $\overrightarrow{OP}$, where P is (a, a, 0).



16. **(a)** infinite

Explanation: Capacitor does not allow DC to pass through it. The effective capacitance or the capacitive reactance,

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

where ω is the frequency of voltage source.

Since DC current is a constant current, its frequency is zero.

The capacitive reactance is therefore infinity.

17. **(c)** exerts a force, if the charged particle is moving across the magnetic field line
Explanation: A magnetic field exerts a force on a charged particle if $F = qvB\sin\theta$ is non-zero.

18. **(d)** 0 V
Explanation: Average value of AC voltage for a half cycle is positive and similarly, the mean value of AC voltage for other half cycle is negative.
Average potential difference between the two terminals for complete full cycle,
$V_{av} = (0.637V_0) + (-0.637V_0) = 0$ V

19. **(d)** 6 J
Explanation: W = $mB(\cos\theta_1 - \cos\theta_2)$
= $2 \times 10^4 \times 6 \times 10^{-4}$ (cos 0° - cos 60°) = 6J

20. **(b)** zero
Explanation: $V_E - V_D = \frac{q}{4\pi\varepsilon_0}\left[\left(\frac{1}{EA} + \frac{1}{EB} + \frac{1}{EC}\right) - \left(\frac{1}{DA} + \frac{1}{DB} + \frac{1}{DC}\right)\right]$
$= \frac{q}{4\pi\varepsilon_0}\left[\left(\frac{1}{EA} + \frac{1}{EB} + \frac{1}{EC}\right) - \left(\frac{1}{EB} + \frac{1}{EA} + \frac{1}{EC}\right)\right] = 0$
W = Q(V_E - V_D) = 0

21. **(b)** decreases K times
Explanation: when air is replaced by dielectric medium, **electrostatic force** decreases by K times

22. **(a)** 0.239 H
Explanation: $X_L = 120\Omega$, f = 80Hz
Now,
$X_L = \omega L = 2\pi f L$
$L = \frac{X_L}{2\pi f} = \frac{120}{2\times3.14\times80} = 0.239H$

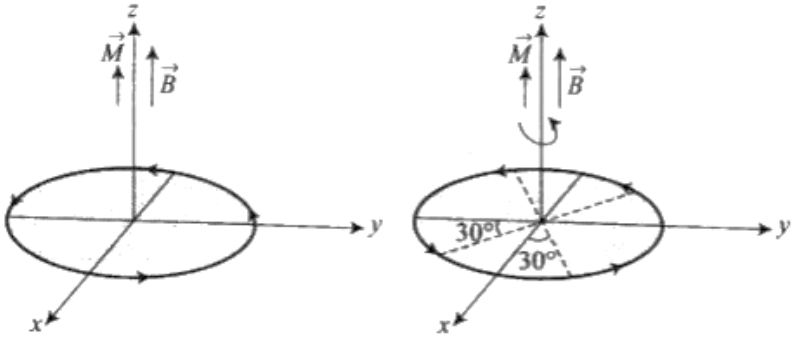
23. **(a)** Increases
Explanation: A change in the magnetic field induces an emf. When there is an emf, there has to be current. Hence, when the magnet is moved inside a coil, the current in it increases.

24. **(a)** the direction of the earth's magnetic field
Explanation: The angle of dip gives the direction of the earth's magnetic field.

25. **(a)** The electron will continue to move with uniform velocity along the axis of the solenoid.
Explanation: The Lorentz force acts on a charged particle in a magnetic and electric field is F = q (v $\times$ B).
F = qvB sin θ
As the charge is moving in the direction of the electric field hence θ = 0, so force due to electric field is zero, so it will not affect the velocity of moving charged particle.

Section B

26. **(a)** zero
Explanation:



The rotation of the loop by 30° about an axis perpendicular to its plane makes no change in the angle made by the axis of the loop with the direction of the magnetic field , potential energy doesnot change. therefore, the work done to rotate the loop is zero.

27. **(d)** increases
Explanation: P.E of a system is defined as work done in bringing a system of charges from infinity to a particular point.

$U = \frac{q_1 q_2}{4\pi\epsilon_0 r}$

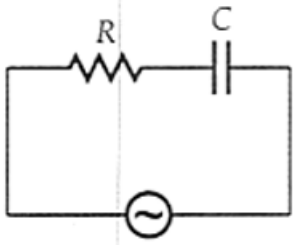
So, as the separation among charges decreases, the potential energy of the system will increase.

28. **(a)** no net charge is enclosed by the surface

Explanation: Gauss' Law states that net electric flux passing through a closed surface is given by $\oint E.ds = q_{inclosed}/\epsilon_0$ Given that the flux through a surface is zero. So no net charge is enclosed by the surface.

29. **(b)** $V_a > V_b$

Explanation:



$I = \frac{V}{\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}}$

$V_C = \frac{V}{\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}} \times \frac{1}{\omega C}$

$= \frac{V}{\sqrt{(\omega RC)^2+1}}$

When the capacitor is filled with mica, its capacitance increase, and the voltage across it decreases.

30. **(c)** 2rBv and R is at higher potential

Explanation: $\varepsilon = Bl_{eff}v = B \times 2r \times v$

= 2rBv

31. **(b)** Soft iron

Explanation: Soft iron is preferred for the core of electromagnets because of its high permeability and low retentivity.

32. **(a)** 10.18×10^{-3}V

Explanation: Change in magnetic field in 10s = 2.0 T

As $\varepsilon = \frac{-d\phi}{dt} = -A\frac{dB}{dt}$ $(\because \phi = BA)$

Circumference of patient's trunk,

$2\pi r$ = 0.8m (given)

$\therefore r = \frac{0.8}{2\pi}\text{m} = \frac{0.4}{\pi}\text{m}$

Area of cross-section,

$A = \pi r^2 = \pi\left(\frac{0.4}{\pi}\right)^2 = \frac{0.16}{\pi}\text{m}^2$

$\therefore |\varepsilon| = \frac{0.16}{\pi} \times \frac{2}{10}$ V

$\approx 10.18 \times 10^3$ V

33. **(d)** 0.5 Ω

Explanation: r = $\left(\frac{l_1}{l_2} - 1\right) R = \left(\frac{3}{2.85} - 1\right) \times 9.5$

= $\frac{0.15}{2.85} \times 9.5 = 0.5\Omega$

34. **(d)** CV^2

Explanation: When two charged conductors are connected by a conducting wire, flow of charge will continue until they acquire same potential. Here the two spheres are oppositely charged. So after connecting common potential will be

$V_c = \frac{V+(-V)}{2}$ = 0

Initial energy of system is

$U_i = \frac{CV^2}{2} + \frac{C(-V)^2}{2}$

$U_i = CV^2$

Final potential is zero, so $U_f = 0$

$\Delta U = U_i - U_f = CV^2$

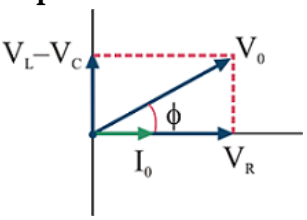
35. **(c)** It does not draw current from external circuit.
Explanation: Potentiometer measures the potential difference using null deflection method, where no current is drawn from the cell; whereas voltmeter needs a small current to show deflection. So, accurate measurement of p.d is done using a potentiometer.

36. **(a)** 100 mH
Explanation: Current is maximum at resonance which occurs when
$x_L = x_c$ or $\omega L = \frac{1}{\omega C}$
$\therefore L = \frac{1}{\omega^2 C}$
$= \frac{1}{(1000)^2 \times 10 \times 10^{-6}} \text{H}$
$= \frac{1}{10} \text{H} = 100 \text{ mH}$

37. **(a)** its magnetic field
Explanation: The energy is stored inside an inductor in the form of magnetic field.

38. **(b)** hysteresis loss
Explanation: The area of hysteresis loop gives an idea of hysteresis loss of the magnetic material.

39. **(b)** 76.7 V
Explanation: Consider RLC circuit phasor diagram:



Hence,
$\cos\phi = \frac{V_R}{V_o}$
$\cos 31.5^\circ = \frac{V_R}{90}$
Thus, $V_R = 90 \times \cos 31.5^\circ = 90 \times 0.852 = 76.7V$

40. **(b)** $[ML^2T^{-3}A^{-2}]$
Explanation: Power = $i^2R \Rightarrow \frac{\text{Work done}}{\text{Time}} - \frac{\text{Force} \times \text{Dis tance}}{\text{Time}}$
$\Rightarrow [R] = \left[\frac{MLT^{-2}L}{T}\right]\left[\left(\frac{1}{A^2}\right)\right]$
$\Rightarrow [R] = ML^2T^{-3}A^{-2}$

41. **(a)** 10 Ω
Explanation: $P = \frac{V^2}{R_{cy}}$
$\Rightarrow 30 = \frac{100}{\frac{5R}{5+R}}$
$\Rightarrow 150\ R = 500 + 100\ R$
$\Rightarrow R = 10\ \Omega$

42. **(b)** $\frac{\sigma}{\varepsilon_0}$ Vm^{-1}
Explanation: $E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$ Vm^{-1}

43. **(c)** $\frac{\mu_0}{2}$
Explanation: $B = \frac{\mu_o NI}{2a} = \frac{\mu_e \times 1 \times 1}{2 \times 1} = \frac{\mu_0}{2}$

44. **(d)** 4.48 T
Explanation: $B = \frac{\mu_o \mu_r Ni}{2\pi r} = \frac{4\pi \times 10^{-7} \times 800 \times 3500 \times 1.2}{2\pi \times 15 \times 10^{-2}}$ = 4.48 T

45. **(c)** A is true but R is false.
Explanation: Potential and potential energy are different quantities and cannot be equated.

46. **(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.

47. **(d)** A is false but R is true.
Explanation: E.M.F. induces when there is a change in magnetic flux. Faraday did an experiment in which, there is relative motion between the coil and magnet, the flux linked with the coil changes, an e.m.f. induces.

48. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation: Like direct current, an alternating current also produces a magnetic field. But the magnitude and direction of the field go on changing continuously with time.

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

Section C

50. **(b)** 4 pF
Explanation: The system is equivalent to a parallel combination of eight capacitors.
$\therefore C = \frac{8\varepsilon_0 A}{d}$
$= \frac{8\times 8.854\times 10^{-12}\times 5\times 10^{-4}}{0.885\times 10^{-2}}$ F
=4 $\times$ 10^{-12} F = 4 pF

51. **(b)** zero
Explanation: The net charge acquired during induction is zero. There is only the transfer of electrons from one part to another.

52. **(a)** It measures the emf of a cell very accurately.
Explanation: It measures the emf of a cell very accurately.

53. **(a)** 10^{-3} Vm^{-1}
Explanation: Given, I = 1.0 mA = 10^{-3} A; R = 4 Ω; L= 4m
Potential drop across potentiometer wire,
V = IR = 10^{-3} $\times$ 4V
Potential gradient, k = $\frac{V}{L} = \frac{4\times 10^{-3}}{4}$ = 10^{-3} V m^{-1}

54. **(a)** decreasing potential gradient along the wire
Explanation: decreasing potential gradient along the wire

55. **(c)** a condition of no current flow through the galvanometer
Explanation: A potentiometer is an accurate and versatile device to make electrical measurements of EMF because the method involves a condition of no current flow through the galvanometer. It can be used to measure potential difference, internal resistance of a cell and compare EMF's of two sources.