



ROLL NO.

ST. VIVEKANAND MILLENNIUM SCHOOL

HMT Township, Pinjore

Subject: Physics

HALF YEARLY EXAMINATION, 2025

(Proficiency Level)

Time allowed : 180 mins.

MM :70

CODE: XII/002

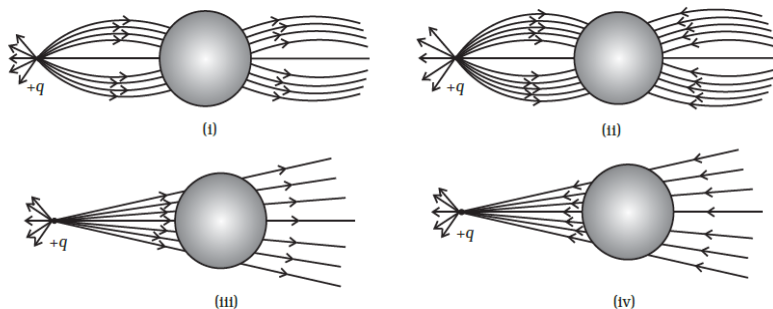
GENERAL INSTRUCTIONS:

1. All questions in all the sections are compulsory.
2. Marks for each question are indicated against it.

SECTION -A (Multiple Choice questions)

1 A point positive charge is brought near an isolated conducting sphere (as shown in Figure). The electric field is best given by: 1

- (a) Fig (i) (b) Fig (iii) (c) Fig (ii) (d) Fig (iv)



2 When air is replaced by a medium of dielectric constant K , the force of attraction between two charges separated by a distance 'r': 1

- (a) Decreases by K times (b) increases by K^2 times
(c) Increases by K times (d) remains unchanged

3 The electric potential at 0.9 m from a point charge is +50 V. Find the magnitude and nature of charge. 1

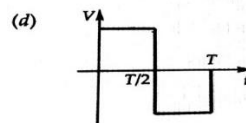
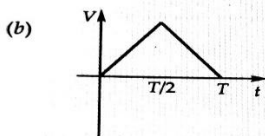
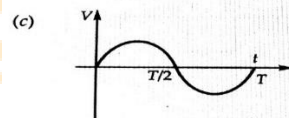
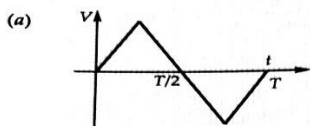
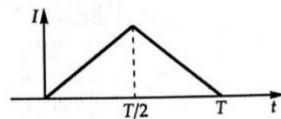
- (a) 5nC, +ve (b) 10nC, -ve (c) 5nC, -ve (d) 10nC, +ve

4 The net charge on a capacitor is 1

- (a) +q (b) -q (c) 0 (d) 2q

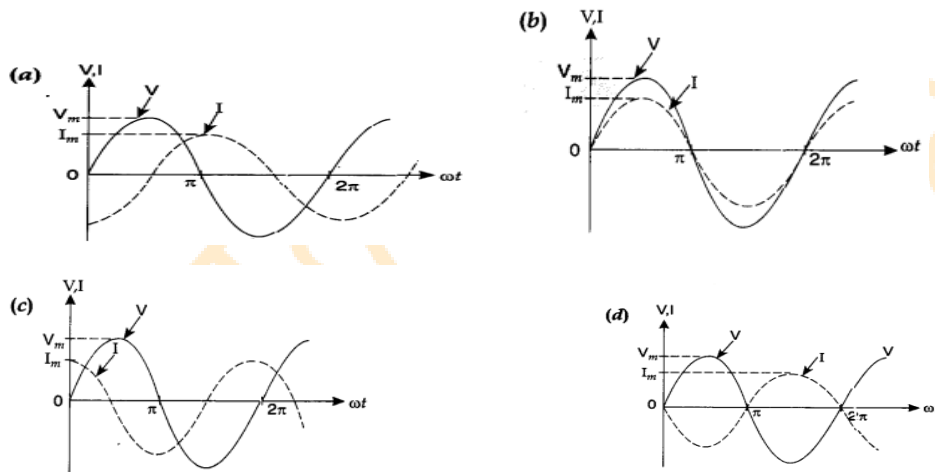
5 Which of the following characteristics of electrons determines the current in a conductor? 1

- (a) Drift velocity alone. (b) Thermal velocity alone.
 (c) Both drift velocity and thermal velocity
 (d) Neither drift nor thermal velocity
- 6 The mobility of charge carriers increases with 1
 (a) Increase in the average collision time
 (b) Increase in electric field
 (c) Increase in the mass of charge carrier
 (d) Decrease in charge of the mobile carriers
- 7 A long straight wire carries a current of 35 A. What is the magnitude of 1
 magnetic field at a point 20 cm from the wire?
 (a) 10T (b) 5T (c) 100T (d) none of these
- 8 A metallic wire coil is stationary in a non – uniform magnetic field. 1
 What is the emf. Induced in the coil?
 (a) 0 (b) 5T (c) 10T (d) 100T
- 9 The reactance of a capacitance C is X. If both the frequency and 1
 capacitance be doubled, then new reactance will be
 (a) X (b) 2 X (c) 4X (d) X/4
- 10 A bulb and a capacitor are connected in series to an a.c. source of 1
 variable frequency. How will the brightness of the bulb change on
 increasing the frequency of the a.c. source?
 (a) increase (b) first increases then decreases
 (c) decrease (d) remains same
- 11 The current (I) in the inductance is varying with time according to the 1
 plot shown in the figure
 Which one of the following is the correct variation of voltage with time
 in the coil?



- 12 The phase relationship between current and voltage in a pure capacitive circuit is best represented by

1



Q13- Q16 are Assertion Reason type questions.

The following question consists of two statements each, printed as Assertion and Reason.

While answering these questions, you are required to choose any one of the following 4 responses.

- If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- If Assertion is true but the Reason is false.
- If both Assertion and Reason are false.

- 13 **ASSERTION:** The connecting wires are made up of copper.

1

REASON: Copper has very high electrical conductivity

- 14 **ASSERTION** The force experienced by a moving charge will be maximum when the charge is moving at right angle to the magnetic field.

1

REASON: The force also depends upon the sine of the angle between the charge and the magnetic field.

- 15 **ASSERTION:** An induced current has a direction such that the magnetic field due to the current opposes the change in the magnetic flux that induces the current.

1

REASON : Above statement is in accordance with conservation of

energy.

- 16 **ASSERTION:** No force is experienced by a stationary charge in a magnetic field. 1

REASON: Force is directly proportional to the velocity of the charge.

SECTION -B (Very short answer type questions)

- 17 Draw a graph showing variation of resistivity versus temperature for Copper. 2
- 18 Define mobility of electrons. Write its SI unit. 2
- 19 State Gauss's law of electrostatics. 2
- 20 Mention any two uses of X-rays. 2

OR

The oscillating electric field of an em wave is given by

$$E_y = 35 \sin(5 \times 10^{11} t + 300 \pi x) \text{ Vm}^{-1}$$

(i) Obtain the value of wavelength of the em wave.

(ii) Write down the expression for oscillating magnetic field.

- 21 Write a relation between peak and rms value of current in AC circuit. 2

OR

Calculate the current drawn by the primary coil of a transformer which steps down from 200 V to 20V to operate a device of resistance 20 Ω . Given efficiency of the transformer to be 80%.

SECTION -C (Short answer type questions)

- 22 Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time. 3
- 23 Two straight long parallel conductors carry currents I_1 and I_2 in the same direction respectively. 3
- (i) Derive the relation for the force per unit length between them.
- (ii) Define 1 Ampere.
- 24 Derive an expression for electric field due to a dipole at axial point. 3
- 25 Derive an expression for the torque experienced by a current loop in uniform magnetic field B. 3
- 26 How is the mutual inductance of a pair of coils affected when (1+1
a) Separation between the coils is increased. +1=3

- b) The number of turns of each coil is increased.)
- c) A thin iron sheet is placed between two coils, other factors remaining the same.

Explain answer in each case.

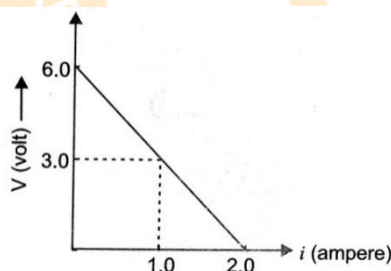
- 27 Suppose that the electric field part of an electromagnetic wave in vacuum is $\mathbf{E} = \{(3.1 \text{ N/C}) \cos [(1.8 \text{ rad/m}) y + (5.4 \times 10^6 \text{ rad/s})t]\} \hat{i}$. (1+1
+1=3
)
- a) What is the direction of propagation?
- b) What is the amplitude of electric field ?
- c) What is the frequency ν ?

OR

An em wave is travelling in a medium with a velocity $v = v \hat{i}$. The electric field oscillations of this em wave are along z-axis.

- a) Identify the direction in which the magnetic field oscillations are taking place, of the em wave .
- b) How are the magnitudes of the electric field and magnetic fields in the electromagnetic wave related to each other ?
- 28 4 cells of identical emf E , internal resistance r , are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of the combination with the current output. 3

- a) Find the emf of each cell.
- b) Calculate internal resistance of each cell.
- c) Calculate the value of current for maximum power dissipation.

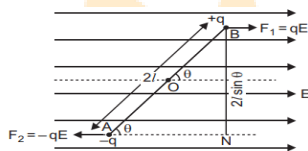


SECTION -D (Case study Questions)

29 Electric dipole in a uniform Electric Field:

(1×4

When electric dipole is placed in uniform electric field, its two charges experience equal and opposite forces, which cancel each other and hence net force on electric dipole in uniform electric field is zero. However these forces are not collinear, so they give rise to some torque on the dipole. Since net force on electric dipole in uniform electric field is zero, so no work is done in moving the electric dipole in uniform electric field. However some work is done in rotating the dipole against the torque acting on it.



(i) The dipole moment of a dipole in a uniform external field \vec{E} is \vec{p} . Then the torque τ acting on dipole is \vec{E}

a) torque = $\vec{p} \cdot \vec{E}$

b) torque = $\vec{p} + \vec{E}$

c) torque = $\vec{p} \times \vec{E}$

d) torque = \vec{p} / \vec{E}

(ii) An electric dipole consists of two opposite charges, each of magnitude $1.0 \mu\text{C}$ separated by a distance of 2.0 cm . The dipole is placed in an external field of 10^5 NC^{-1} . The maximum torque on the dipole is

a) $0.2 \times 10^{-3} \text{ Nm}$

b) $1 \times 10^{-3} \text{ Nm}$

c) $2 \times 10^{-3} \text{ Nm}$

d) $4 \times 10^{-3} \text{ Nm}$

(iii) Torque on a dipole in uniform electric field is minimum when θ is equal to

a) 0°

b) 90°

c) 180°

d) Both (a) and (c)

(iv) When an electric dipole is held at an angle in a uniform electric field, the net force F and torque τ on the dipole are

a) $F=0, \tau=0$

b) $F \neq 0, \tau \neq 0$

c) $F=0, \tau \neq 0$

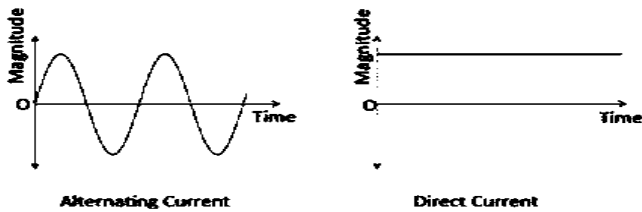
d) $F \neq 0, \tau=0$

30 MEASUREMENT OF AC:

(1×4

An alternating current can be defined as a current that changes its magnitude and polarity at regular intervals of time. It can also be defined as an electrical current that repeatedly changes or reverses its direction opposite to that of Direct Current or DC which always flows in a single direction as shown below.

=4)



From the graph, we can see that the charged particles in AC tend to start moving from zero. It increases to a maximum and then decreases back to zero completing one positive cycle. The particles then reverse their direction and reach the maximum in the opposite direction after which AC again returns to the original value completing a negative cycle. The same cycle is repeated again and again.

Alternating currents are also accompanied usually by alternating voltages. Besides, alternating current is also easily transformed from a higher voltage level to a lower voltage level.

(i) The frequency of an alternating voltage is 50 cycles/s and its amplitude is 120 V. Then its rms value(in V) will be

- (a) 84.8 (b) 42.4 (c) 56.5 (d) 75.5

(ii) In the a.c circuit, the current is expressed as $I = 100 \sin(200\pi t)$. In this circuit the current rises from zero to peak value in time

- (a) $1/300$ s (b) $1/400$ s (c) $1/100$ s (d) $1/200$ s

(iii) The peak value of an alternating emf e given by $e = e_0 \cos \omega t$ is 10V and its frequency is 50Hz. At time $t = 1/600$ s, the instantaneous emf is

- (a) 1V (b) 5V (c) 10V (d) $5\sqrt{3}$ V

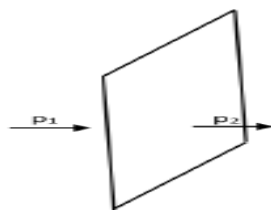
(v) The unit of (emf/current) is

- (a) 1/ohm (b) ohm (c) volt ohm (d) J/ampere

SECTION -E (Long answer type questions)

- 31 a) Define electric flux. (1+3
 b) Derive an expression for electric field due to an infinitely long charged wire. +1=5
)
 c) An electric dipole is first kept to the left and then to the right of a negatively charged infinitely plane sheet having a uniform surface charge density. The arrows p_1 and P_2 show the directions of its electric dipole moment in two cases.

Identify for each case whether dipole is in stable or unstable equilibrium. Justify each case.



OR

- a) Define Electric field.
- b) Derive an expression for electric field due to a dipole at equatorial point of dipole.
- c) Will the expression for electric field remain same for axial point.

- 32 a) Draw the diagram for a moving coil galvanometer . (1+3
 b) Derive an expression for current in moving coil galvanometer. +1=5
 c) The deflection in the moving coil galvanometer is reduced to half)
 when it is shunted with a 40 ohm coil. Find the resistance of the galvanometer.

OR

- a) Draw the diagram for conversion of Galvanometer to Ammeter.
- b) Derive an expression for current sensitivity and voltage sensitivity in moving coil galvanometer.
- c) The deflection in the moving coil galvanometer is doubled when it is shunted with a 100 ohm coil. Find the resistance of the galvanometer.

- 33 a) Draw a circuit diagram of Wheatstone bridge. (1+3
 b) Use Kirchhoff's rules to obtain the balance condition in terms of the +1=5
 resistances.)
 c) Will the resistance ratios still remain same, even if we have unbalanced condition?

OR

- a) Draw a circuit diagram of three cells in series combination.
- b) Derive an expression for equivalent resistance for cells in series combination.
- c) Evaluate the equivalent emf for case (a).

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