PADMA SESHADRI BALA BHAVAN SENIOR SECONDARY SCHOOL, CHENNAI

QUARTERLY EXAMINATION 2025-26

STD: XII **PHYSICS - CODE 2** **Marks: 70**

DATE : 15.09.25 **Writing Time : 3 Hrs**

Reading Time : 15min

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) All the sections are compulsory.

(4) **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study-based questions of four marks each and **Section E** contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8$ m/s

ii. $m_e = 9.1 \times 10^{-31}$ kg ; $m_p = 1.6 \times 10^{-27}$ kg

iii. $e = 1.6 \times 10^{-19}$ C

iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

v. $h = 6.63 \times 10^{-34}$ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

	SECTION A	1x16=16
1.	The electric field that can balance a charged particle of mass 3.2×10^{-27} kg is (given that the charge of the particle is 1.6×10^{-19} C) (a) 19.6×10^{-8} N/C (b) 19.6×10^{8} N/C (c) 19.6×10^{-6} N/C (d) 19.6×10^{6} N/C	1
2.	Three capacitors each of capacity 4μF are to be connected in such a way that the effective capacitance is 6μF . This can be done by (a) connecting two in parallel and one in series (b) Connecting all of them in series (c) Connecting them in parallel (d) Connecting two in series and one in parallel	1
3.	Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1 : 2. If they are connected in series , the ratio drift velocity of electrons in both the wires are (a) 1:1 (b) 1:2 (c) 2:1 (d) 4 : 1	1
4.	Two electric bulbs A and B are rated 220 V – 100 W and 220V – 60 W. The ratio of resistance of the bulb A to B is (a) 3/5 (b) 5/3 (c) 25/9 (d) 1	1
5.	A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of mobility of the free electrons (a) Increases (b) decreases (c) remains unchanged (d) first increases and then decreases	1
6.	A straight wire carrying a current of 13A is bent into a semi-circular arc of radius 2cm as shown in figure., then the magnetic field at the centre of the arc is  (a) Zero (b) 1.57×10^{-4}T (c) 31.4×10^{-4}T (d) 2.04×10^{-4} T	1
7.	A 1 cm segment of a wire lying along x-axis carries current of 0.5 A along $+x$ direction. A magnetic field $\boldsymbol{B}$=(0.4mT) **j** + (0.6mT) **k** is switched on, in the region. The force acting on the segment is (a) (2**j**+3**k**) mN (b) (−3**j**+2**k**) μN (c) (6**j**+4**k**)mN (d) (−4**j**+6**k**) μN	1
8.	A charged particle is projected along the axis of a current carrying loop. Which of the following statements is true? a) The acceleration of the charged particle will depend on the velocity with which it is projected. b) The acceleration of the charged particle will depend on the magnitude of the current passing through the coil c) The acceleration of the charged particle will depend on the radius of the coil. d) The charged particle will move with constant velocity.	1

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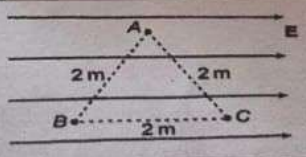
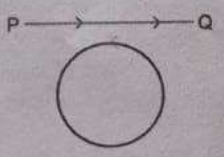
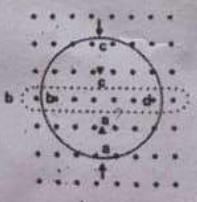
9.	A closely wound solenoid has 800 turns and area of cross section 2.5×10^{-4} m^2 carries a current of 3 A. The magnetic moment of the solenoid is (a) 0.60 Am^2 (b) 3.6 Am^2 (c) 7.5×10^{-4} Am^2 (d) 0.825×10^{-4} Am^2	1
10.	The magnetic flux linked with the given coil is given by $\phi = 5t^2-3t+5$. The magnitude of emf induced in the coil at time t =2 s will be (ϕ is in Wb and t is in seconds) (a) 11V (b) 15V (c) 17V (d) 12V	1
11.	Two coils are placed near each other. When the current in one coil is changed at a rate of 5 A/s, an emf of 2 mV is induced in the other. The mutual inductance of the two coils is (a) 0.4 mH (b) 2.5 mH (c) 10 mH (d) 2.5 H	1
12.	The emf generated by an AC generator is given by V=Vo sin ωt, where ω is angular frequency of armature of generator. What will be the emf if the angular frequency is doubled? (a) V=Vo sin 2ωt (b) V=2Vo sin ωt (c) V=2Vo sin 2ωt (d) V=Vo sin ωt	1
	Instruction for Q13-16: The following questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses. **(a) If both Assertion and Reason are correct and Reason correctly explains the Assertion.** **(b) If both Assertion and Reason are correct but Reason does not explain the Assertion.** **(c) If Assertion is correct but Reason is incorrect.** **(d) If both Assertion and Reason are incorrect**	
13.	**Assertion:** The resistance of insulator increases with increase in temperature. **Reason:** The number of free electrons decreases with increase in temperature	1
14.	**Assertion:** Work done in moving a charge over an equipotential surface is Zero. **Reason:** Electric lines of forces are always perpendicular to the equipotential surface.	1
15.	**Assertion:** The mutual inductance between the two coils is maximum when the coils are wound on each other. **Reason:** The flux linkage between the two coils is maximum when they are wound on each other.	1
16.	**Assertion:** The deflecting torque acting on a current carrying loop is Zero, when its plane is perpendicular to the direction of magnetic field. **Reason:** The deflecting torque acting on a loop of magnetic moment **M** and magnetic field **B** is given by dot product between **M** and **B**.	1
	SECTION B	2x5=10
17.	Consider the charges q, q and $-q$ placed at the vertices of an equilateral triangle of length l. Find the magnitude and direction of force on the charge $-q$.	2
18.	If uniform electric field E=10N/C acts as shown in the figure, calculate i) V_A-V_B ii) V_B-V_C 	2
19.	A conducting loop is held below the current carrying wire PQ as shown in figure. Depict the direction of the current induced in the loop when the current in the wire PQ is constantly increasing. Justify. 	1
	 Use Lenz's law to determine the direction of induced current, when the circular loop abcd deforms into narrow straight wire as shown in the figure.	1
	OR A conducting coil of 50 turns and area 5 π cm^2 is rotating with angular speed of 60 rad/s along the axis of solenoid of length 50cm and 2000 turns, carrying current of 5 A. What will be the value of maximum emf generated?	2

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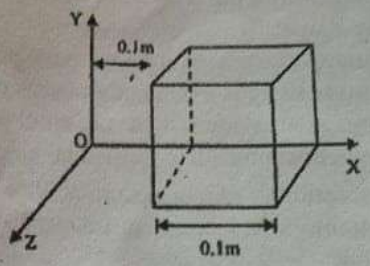
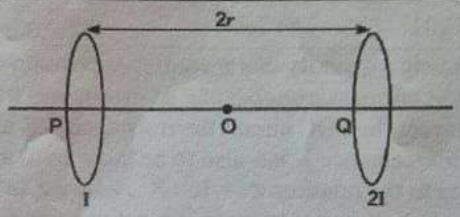
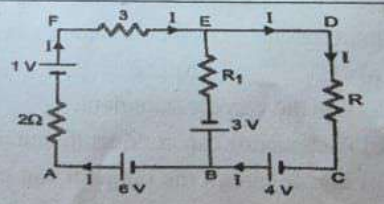
20.	Define mutual inductance. Obtain the expression for mutual inductance of a pair of coaxial solenoids.	2
21.	Two similar bars made from two different materials P and Q, are placed one by one, in a non-uniform magnetic field. It is observed that a) bar p tends to move from the weak to the strong field region b) bar q tends to move from the strong to the weak field region. Identify the magnetic material used for making these two bars. How does the relative permeability of P differ from Q?	2
	SECTION C	7x3=21
22.	The electric field components due to a charge inside the cube of side 0.1 m are as shown in the figure. $E_x = \alpha x\, \mathbf{i}$, where $\alpha = 500$(N/Cm), $E_y = E_z = 0$ Calculate (i) the flux through the cube, and (ii) the charge inside the cube 	3
23.	Define electric dipole moment and give its unit. Obtain the expression for electric field at a point on the equatorial line of an electric dipole.	3
24.	Two identical circular loops P and Q each of radius R carrying currents I and 2I respectively are lying in parallel planes such that they have a common axis. The direction of current in P is clockwise and Q is anti-clockwise as seen from O which is equidistant from the both loops. Find the magnitude of the net magnetic field at point O. 	3
25.	A moving coil galvanometer has a resistance of 15Ω and takes 20m A to produce full scale deflection. How can the galvanometer be converted into i) ammeter of range 0 to 10A ? ii) voltmeter of range 0 to 100 V ?	3
26.	Use Kirchhoff's law to determine the value of resistance R and potential difference between A and D when no current flows in the arm BE of the electrical network shown below  **OR** A wire of length L_0 has a resistance R_0. It is gradually stretched till its length becomes 1.5 L_0. a) Plot the graph showing variation of its resistance R with its length L during stretching. b) What will be its resistance when its length becomes 1.5 L_0 ?	3
27.	A rectangular wire loop of sides 8 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is 1cms^{-1} in a direction normal to the i) longer side? ii) shorter side of the loop? iii) For how long does the induced voltage last in each case?	3
28.	An ac voltage $E=E_0 \sin\omega t$ is applied across a capacitor of capacitance C. Obtain an expression for the current I. Show the phase relationship between current and voltage in a phasor diagram.	3
	SECTION D CASE STUDY	4x2=8
29.	Before 19th century, scientists believed that magnetic properties were confined to few materials like iron, cobalt, nickel. Curie and Faraday discovered that all the materials in the universe are magnetic to some extent. These magnetising substances are categorized in to two groups. Weak magnetic materials are called diamagnetic and paramagnetic materials and strong magnetic materials are called ferromagnetic materials. According to modern theory of magnetism, the magnetic response of any material is due to circulating electrons in the atoms.	

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i) which of the following is weakly repelled by a magnetic field? 1
a) iron b) steel c) cobalt d) copper

ii) A Solenoid with 1000 turns/metre has a core material with relative permeability 400. The windings of the solenoid are insulated from the core carry a current of 2A . The magnetic intensity (H) of the solenoid is (in Am^{-1}) 1
a) 4000 b) 500 c) 8000 d) 2000

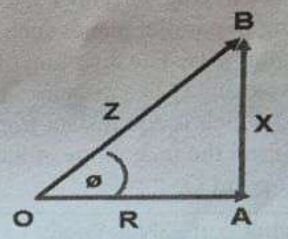
iii) Among the following properties describing diamagnet, identify the property that is wrongly stated: 1
a) diamagnetic materials do not have permanent magnetic moment.
b) diamagnetism is explained in terms of electromagnetic Induction.
c) diamagnetic materials have a small positive susceptibility
d) magnetic moments of individual electrons neutralize each other

iv) The susceptibility of magnesium at 300K is 1.2×10^{-5} . The temperature at which the susceptibility will increase to 1.8×10^{-5} is 1
a) 100K b) 200K c) 400K d) 150K

OR

v) The permeability of the iron bar kept in a magnetising field of 1500 A/m is 12.56×10^{-4} m/A, then the susceptibility of the bar is
a) 1001 b) 269 c) 999 d) 257

30. Impedance is a quantity that measures opposition of a circuit to the flow of current through it and so determines the magnitude of the current. In a DC circuit the resistance is R alone. In an AC circuit reactance X has also to be taken in to account, according to the relation: $Z^2 = R^2+X^2$, where Z is the impedance. Impedance triangle is a right angle triangle in which the base represents resistance R , perpendicular represents reactance X and the hypotenuse represents impedance Z.



i) If L and R denote inductance and resistance respectively, then the dimension of L / R is 1
a) $[M^0L^0T^0]$ b) $[M^0L^0T^1]$ c) $[M^2L^0T^2]$ d) $[MLT^2]$

ii) In an LCR circuit, capacitance is changed from C to 4C. For the resonant frequency to remain unchanged, the inductance should be changed from L to 1
a) 2L b) L/2 c) L/4 d) 4L

iii) Choose the correct statement. 1
a) A capacitor can conduct dc but an inductor cannot conduct dc.
b) In a dc circuit the inductor can conduct but capacitor cannot conduct.
c) Both the inductor and capacitor cannot conduct dc.
d) The inductor offers infinite resistance to dc.

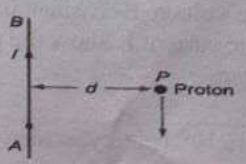
iv) A voltage $V=V_0 \sin\omega t$ applied to a circuit drives a current $i=i_0 \sin(\omega t+\phi)$ in the circuit. The average power consumed in the circuit over a cycle is 1
a) 0 b) $i_0V_0\cos\phi$ c) $i_0V_0/2$ d) $i_0V_0\cos\phi/2$

OR

v) If $X_L - X_C = R$ in an LCR circuit, then the phase angle between current and voltage is
a) 0 b) $\pi/4$ c) $\pi/2$ d) $2\pi/3$

SECTION E 5x3=15

31. a) Derive an expression for the force between two long parallel current carrying conductors. 3
b) Use the expression to define SI unit of current I. 1
c) A proton P travels with speed v, parallel to the wire at a distance 'd' from it in a direction opposite to the current as shown in figure. What is the magnitude and direction of force experienced by the proton? 1



OR

a) State Ampere's circuital law. Use this law to derive magnetic field due to straight infinitely long current carrying wire. 3
b) An α particle and a proton are moving in the plane of paper in a region where the uniform magnetic field (**B**) directed normal to the plane of the paper. If the two particles have equal linear momenta, what will be the ratio of 2
i) radii of their trajectories?
ii) time periods in the field?

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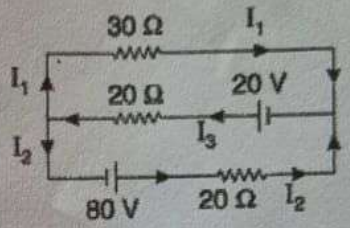
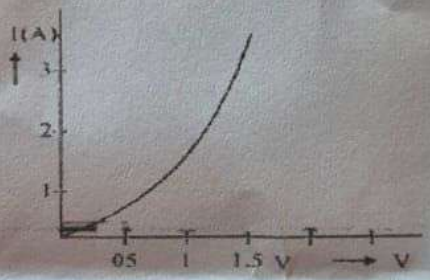
	a) Obtain the expression for electric potential at any point due to an short electric dipole.	3
	b) A hollow metal sphere is charged with 0.4 μC of charge and has radius of 0.1m. Find the potential i) at a point 0.05m from the centre of the sphere ii) at a point 0.6 m from the centre of the sphere.	2
	OR	
	a) Derive an expression for the potential energy of an electric dipole in a uniform electric field. Write the conditions of stable and unstable equilibrium.	3
	Three point charges +Q, +2Q and -3Q are placed at the vertices of a triangle of side l. If these charges are displaced to midpoints of each side respectively. Find the amount of work done in shifting the charges.	2
33.	a) Obtain the condition for Bridge Balance in a Wheatstone network.	3
	b) Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure. 	2
	OR	
	a) Two cells of different emf and internal resistance are connected in parallel with one another. Derive the expression for equivalent emf and equivalent internal resistance of the cells.	3
	b) A cell of emf 1·5 V and internal resistance 0.5 Ω is connected to a (non-linear) conductor whose V-I graph is shown in fig. Obtain graphically the current drawn from the cell and its terminal voltage. 	2

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