No. of Printed Pages/Questions: 10/33

O. P. JINDAL SCHOOL, SAVITRI NAGAR

Half Yearly Examination

(2025-26)

Class: XII **MM: 70**

Subject: Physics **Time: 3 Hrs**

Fifteen minutes extra for reading of the question paper.

General Instruction:-

(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 .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 x 108 m/s
ii. m_e = 9.1 x10-31 kg
iii. e = 1.6 x 10-19 C
iv. $\mu_0 = 4\pi$ x 10-7 TmA^{-1}
v. h = 6.63 x10-34 Js
vi. ε_0 = 8.854 x10-12 $C^2N^{-1}m^{-2}$

Section – A

1 The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then 1

(a) X is paramagnetic and Y is ferromagnetic
(b) X is diamagnetic and Y is ferromagnetic
(c) X and Y both are paramagnetic
(d) X is diamagnetic and Y is paramagnetic

2 The magnetic flux linked with the coil (in Weber) is given by the equation $\Phi = 5t^2 + 3t + 16$. The induced EMF in the coil at time, t=4 will be- 1

(a) -27 V
(b) -43 V
(c) -108 V
(d) 210 V

3 Correct match of column I with column II is 1

C-I (waves)	C-II (Production)
(1) Infra-red	P . Rapid vibration of electrons in aerials
(2) Radio	Q . Electrons in atoms emit light when they move from higher to lower energy level.
(3) Light	R . Klystron valve
(4) Microwave	S . Vibration of atoms and molecules

(a) 1-P, 2-R, 3-S, 4-Q
(b) 1-S, 2-P, 3-O, 4-R
(c) 1-Q, 2-P, 3-S, 4-R
(d) 1-S. 2-R, 3-P, 4-Q

4 The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B. 1

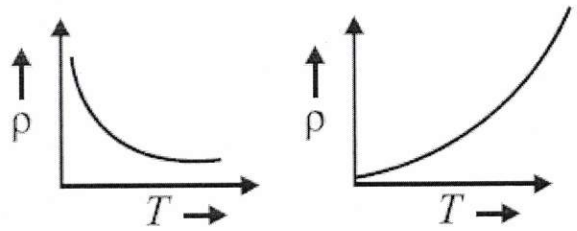


fig. (i) fig. (ii)

(a) material A is copper and material B is germanium
(b) material A is germanium and material B is copper
(c) material A is nichrome and material B is germanium
(d) material A is copper and material B is nichrome

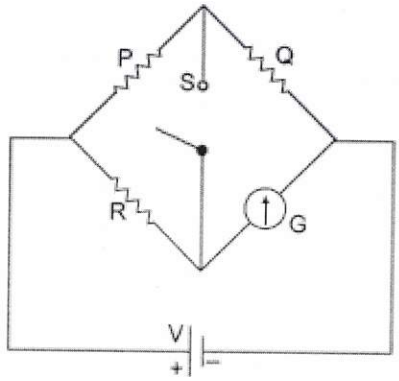
5 The electric potential on the axis of an electric dipole at a distance 'r from it's centre is V. Then the potential at a point at the same distance on its equatorial line will be 1

(a) 2V
(b) -V
(c) V/2
(d) Zero

6 Which of the following is NOT the property of equipotential surface?

(a) They do not cross each other.
(b) The rate of change of potential with distance on them is zero.
(c) For a uniform electric field they are concentric spheres.
(d) They can be imaginary spheres.

7 In the circuit given below P ≠ R and the reading of the galvanometer is same with switch S open or closed. Then: 1



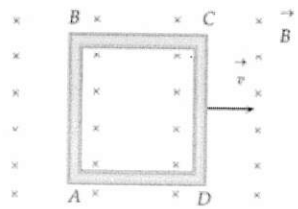
(a) $I_Q = I_R$

(b) $I_R = I_G$

(c) $I_P = I_G$

(d) $I_Q = I_G$

8 A conducting square loop of side 'L' and resistance 'R' moves in its plane with the uniform velocity 'v' perpendicular to one of its sides. A magnetic induction 'B' constant in time and space pointing perpendicular and into the plane of the loop exists everywhere as shown in the figure. The current induced in the loop is 1



(a) BLv/R Clockwise
(b) BLv/R Anticlockwise
(c) 2BLv/R Anticlockwise
(d)Zero

9 An electric dipole placed in an electric field of intensity $2 \times 10_5$ N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2 cm is 1

(a) 7 μC (b) 8 mC (c) 2 mC (d) 5 mC

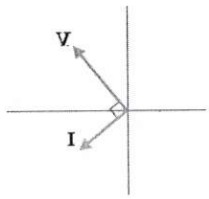
10 **Three Charges 2q, -q and -q lie at vertices of a triangle. The value of E and V at centroid of triangle will be-** 1

(a) E#0 and V#0
(b) E=0 and V=0
(c) E#0 and V=0
(d) E=0 and V#0

11 If a charged hollow sphere and a solid sphere of aluminum and copper of equal radii are in electrostatic equilibrium, then which of the following statements is true? 1

(a) Both the spheres are having equal charges.
(b) The hollow sphere will have more charge than solid sphere at its surface.
(c) The aluminum sphere will have more charge on its surface than copper sphere.
(d) If hollow sphere is also made up of aluminum then it will have more charge.

12 If the phasor diagram for a device connected to AC supply is as shown in the fig, then which of the following statements is true? 1



(a) When the frequency of the AC source is increased than the impedance of the device decreases.
(b) This device behaves as conducting wire when connected across DC source.
(c) When the frequency of the AC source is decreased than the impedance of the device decreases.
(d)This device stores energy in the form of magnetic potential energy.

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false.
d) If both Assertion and Reason are false.

13 **Assertion (A) :** Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. 1
Reason (R) : Refractive index of the material of the cladding of the optical fiber is greater than that of the core

14 **Assertion (A) :** UV – radiations are used in LASIK eye surgery. 1
Reason (R) : Due to shorter wavelengths, UV-radiation can be focused into very narrow beams.

15 **Assertion(A) :** In a non uniform electric field, a dipole will have translatory as well as rotatory motion. 1
Reason(R): In a non uniform electric field, a dipole experiences a force as well as torque.

16 **Assertion (A) :**An electron has a higher potential energy when it is at a location associated with a negative value of potential and has a lower potential energy when at a location associated with a positive potential. 1
Reason (R) : Electrons move from a region of higher potential to a region of lower potential.

Section – B

17 Four point charges $q_A = 2\ \mu C$, $q_B = -5\ \mu C$, $q_C = 2\ \mu C$, and $q_D = -5\ \mu C$ are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of 1 μC placed at the centre of the square? 2

18 Using the data given below, state which two of the given lenses will be preferred to construct a 2

(i) telescope, and (ii) microscope. Also indicate which is to be used as objective and as eyepiece in each case.

Lenses	Power (P)	Aperture (A)
L_1	6 D	1 cm
L_2	3 D	8 cm
L_3	10 D	1 cm

19 (a) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid. (b) How does this magnetic energy compare with the electrostatic energy stored in a capacitor? 2

OR

(a) The peak voltage of an ac supply is 300 V. What is the rms voltage?

(b) The rms value of current in an ac circuit is 10 A. What is the peak current?

20 The magnetic field in a plane electromagnetic wave is given by $B_y = 2 \times 10^{-7} \sin (0.5\times10^3\ x+1.5\times10^{11}t)$ T What is the wavelength and frequency of the wave?

2

OR

The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is $B_0 = 510$ nT. What is the amplitude of the electric field part of the wave?

21 (a) Calculate the potential at a point P due to a charge of 4×10^{-7}C located 9 cm away. 2
(b) Plot the graph between electric field (E) and electric potential (V) verse distance ®.

Section – C

22 An a.c. source generating a voltage $\varepsilon = \varepsilon_0 \sin \omega t$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it. Plot a graph of ε and I versus wt to show that the current is ahead of the voltage by $\pi/2$. Also plot the phasor diagram.

OR

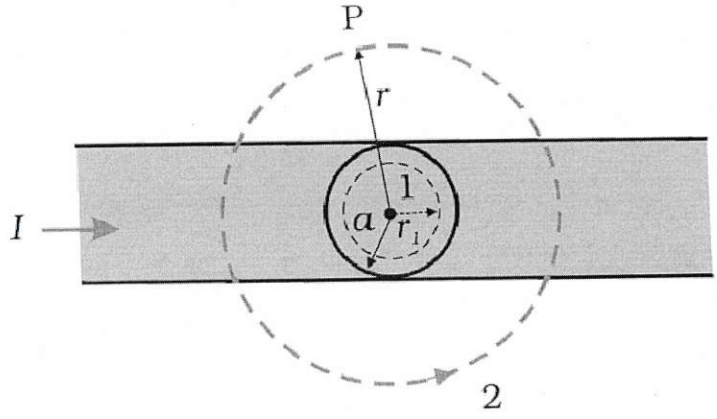
An ac voltage $V = V_0 \sin wt$ is applied across a pure inductor of inductance L. Find an expression for the current i, flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\pi/2$. Also draw graphs of V and i versus wt for the circuit. Also plot the phasor diagram.

23 (a) A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?

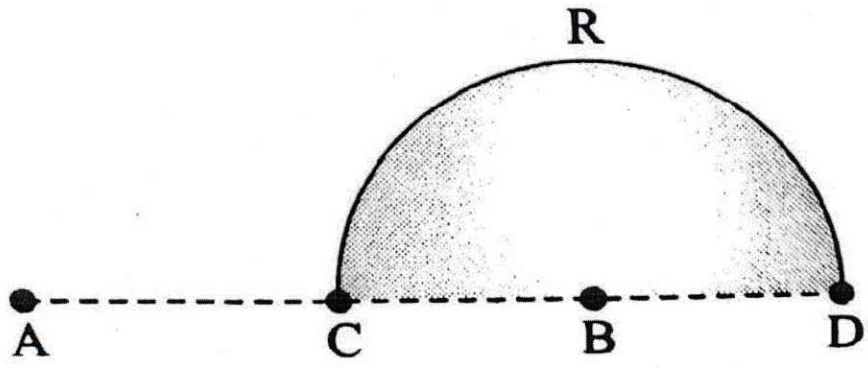
(b) A long straight wire carries a current of 35 A. What is the magnitude of the field B at a point 20 cm from the wire? 3

OR

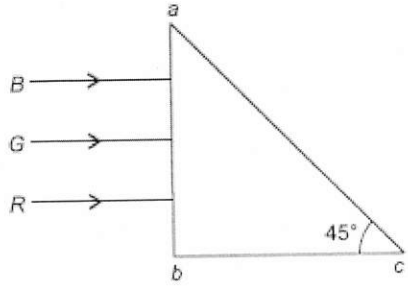
The given figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region $r < a$ and $r > a$.



24 Charges ($+q$) and ($-q$) are placed at the points A and B respectively which are a distance 2L apart. C is the midpoint between A and B. What is the work done in moving a charge +Q along the semicircle CRD. 3



25 Three light rays red (R), green (G) and blue (B) are incident on the right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are respectively 1.39, 1.44 and 1.47. Trace the paths of these rays reasoning out the difference in their behavior. 3

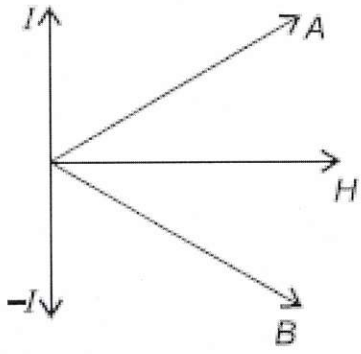


26 Two charges 3×10^{-8} C and -2×10^{-8} C are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. 3

OR

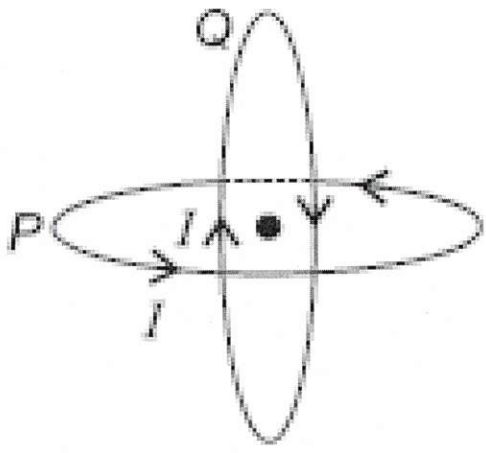
A slab of material of dielectric constant K has the same area as the plates of a parallel-plate capacitor but has a thickness (3/4)d, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates?

27 The following figure shows the variation of intensity of magnetisation versus the applied magnetic field intensity H, for two magnetic materials A and B: 3



(a) Identify the materials A and B.
(b) Draw the variation of susceptibility with temperature for B.

28 Two identical circular wires P and Q each of radius R and carrying current I are kept in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils. 3



Section – D

29 An electric dipole is a system consisting of the two equal and opposite point charges separated by a small and finite distance. If dipole moment of this system is $\vec{p}$ and it is placed in a uniform electric field $\vec{E}$. 4

(i) What is the expression of torque experienced by a dipole?

(a) $\vec{E} \times \vec{p}$ (b) $\vec{p} \times \vec{E}$

(c) $\vec{p} \times \vec{F}$ (d) pE

(ii) Identify two pairs of perpendicular vectors in the above expression

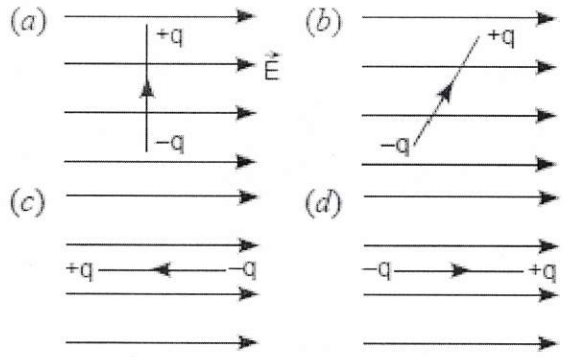
(a) Force is perpendicular to both $\vec{p}$ and $\vec{E}$.

(b) $\vec{E}$ is perpendicular to both $\vec{F}$ and .

(c) Torque is perpendicular to both and .

(d) $\vec{p}$ is perpendicular to both torque and force

(iii) Which of the following orientation is for maximum torque?



(iv) Which of the following is a condition for stable equilibrium?

(a) $\vec{p} \parallel \vec{E}$ (b) $\vec{p} \perp \vec{E}$

(c) Angle between and is 180° (d) Angle between and is 30°

OR

(iv) If the dipole is placed in non-uniform electric field then

(a) $F = 0$ but $\tau \neq 0$

(b) $F = 0$ and $\tau = 0$

(c) $F \neq 0$ but $\tau \neq 0$

(d) $F \neq 0$ but $\tau = 0$

30 **Read the following paragraph and answer the questions that follow.**

Types of Lenses and their combination

A convex or converging lens is thicker at the centre than at the edges. It converges a beam of light on refraction through it. It has a real focus. Convex lens is of three types: Double convex lens, Plano convex lens and Concavo-convex lens. Concave lens is thinner at the centre than at the edges. It diverges a beam of light on refraction through it. It has a virtual focus. Concave lenses are of three types: Double concave lens, Plano concave lens and Convexo-concave lens. When two thin lenses of focal lengths f1 and f2 are placed in contact with each other along their common principal axis, then the two lens system is regarded as a single lens of focal length *f* and

$$1/f = 1/f1 + 1/f2$$

If several thin lenses of focal length *f*1, *f*2, ...*fn*are placed in contact, then the effective focal length of the combination is given by

$$1/F = 1/f_1 + 1/f_2 + 1/f_3 + \ldots\ldots\ldots\ldots\ldots\ldots 1/fn$$

and in terms of power, we can write

$$P = P1 + P2 + \ldots\ldots\ldots\ldots\ldots\ldots + Pn$$

The value of focal length and power of a lens must be used with proper sign consideration.

i. Two thin lenses are kept coaxially in contact with each other and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be

(a) -26.7cm (b) 60cm
(c) 80cm (d) 30cm

ii. A spherical air bubble is embedded in a piece of glass. For a ray of light passing through the bubble, it behaves like a

(a) converging lens (b) diverging lens
(c) mirror (d) thin plane sheet of glass

iii. Lens generally used in magnifying glass is

(a) single concave lens
(b) single convex lens
(c) combination of convex lens of lower power and concave lens of lower focal length
(d) Planoconcave lens

iv. The magnification of an image by a convex lens is positive only when the object is placed

(a) at its focus F
(b) between F and 2F
(c) at 2F
(d) between F and optical centre

OR

A convex lens of 20 cm focal length forms a real image which is three times magnified. The distance of the object from the lens is

(a) 13.33 cm (b) 14 cm
(c) 26.66 cm (d) 25 cm

Section – E

31 (a) Define electric flux. Write its SI units. 5

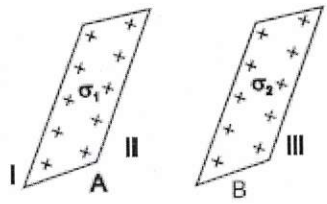
(b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

(c) How is the field directed if (i) the sheet is positively charged, (ii) negatively charged?

OR

(a) A point charge ($+Q$) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate.

(b) Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of net fields in the regions marked II and III.



32 (a) Using Biot–Savart's law, derive the expression for the magnetic field in the vector form at a point on the axis of a circular current loop. 5

(b) What does a toroid consist of? Find out the expression for the magnetic field inside a toroid for N turns of the coil having the average radius r and carrying a current I. Show that the magnetic field in the open space inside and exterior to the tortoid is zero.

OR

(a) Explain, giving reasons, the basic difference in converting a galvanometer into (i) a voltmeter, and (ii) an ammeter.

(b) Two long straight parallel conductors carrying steady current I_1 and I_2 are separated by a distance d. Explain briefly, with the help of a suitable diagram, how the magnetic field due to one force acting between the two conductors. Mention the nature of this force.

33 (a) Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2. Hence derive lens maker's formula.

(b) A converging lens has a focal length of 10 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length.

OR

(A) Define angle of deviation in a prism? Obtain the relation $A+\delta=i+e$ for a prism where A is the angle of prism, δ is the angle of deviation, i is the angle of incidence and e is the angle of emergence.

(B) Plot the graph between angle of incident and angle of deviation.

(C) Write the condition for minimum deviation. Write the formula for refractive index of prism.