CLASS XII

PRACTICE QUESTION PAPER-2 (2023-24)

BLUE PRINT

S.No.	Unit	MCQ (1Mark)	A&R (1Mark)	SA I (2Marks)	SA II (3Marks)	CSB (4Marks)	LA (5marks)	Total	Marks
1	**Electrostatics**	1(1)		2(1)	6(2)			9(4)	**16(7)**
2	**Current electricity**	1(1)	1(1)				5(1)	7(3)	
3	**Moving charges and Magnetism And Magnetism and matter**	1(1)		2(1)			5(1)	8(3)	**17(8)**
4	**EMI and AC**	2(2)	1(1)		6(2)			9(5)	
5	**EM Waves**	1(1)		2(1)				3(2)	**18(9)**
6	**Optics**	3(3)	1(1)		6(2)		5(1)	15(7)	
7	**Dual nature of matter and Radiation**	1(1)				4(1)		5(2)	**12(6)**
8	**Atoms & Nuclei**	1(1)	1(1)	2(1)	3(1)			7(4)	
9	**Semi conductor Electronic devices**	1(1)		2(1)		4(1)		7(3)	**7(3)**
		12(12)	**4(4)**	**10(5)**	**21(7)**	**8(2)**	**15(3)**	**70(33)**	**70(33)**

CLASS: XII

SESSION: 2023-24

PRACTICE QUESTION PAPER-2

SUBJECT: PHYSICS (THEORY)

Maximum Marks: 70 M **Time Allowed: 3 hours.**

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, one question in each CBQ in Section D 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 x 10^8 m/s

ii. m_e = 9.1 x10^{-31} kg

iii. e = 1.6 x 10^{-19} C

iv. μ_0 = 4π x 10^{-7} TmA^{-1}

v. h = 6.63 x10^{-34}Js

vi. ε_0 = 8.854 x$10^{-12}C^2N^{-1}m^{-2}$

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

SECTION-A

1. Identify the false statement from the following.

(A) Field lines start from positive charges and end at negative charges.

(B) In a charge-free region, electric field lines can be taken to be discontinuous curves without any breaks.

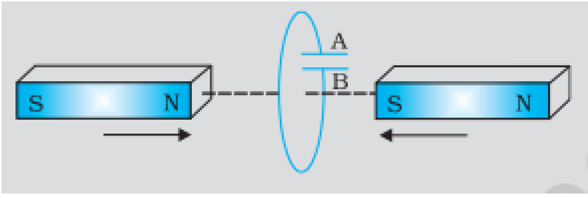
(C) Two field lines can never cross each other.

(D) Electrostatic field lines do not form any closed loops.

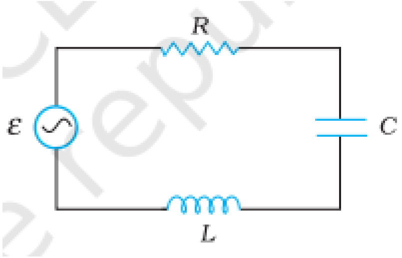
2. A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging?
(A) 10 V (B) 11 V (C) 11.5 V (D) 8 V

3. A solenoid of length 0.5 m has a radius of 1 cm and is made up of 500 turns. It carries a current of 5 A. What is the magnitude of the magnetic field inside the solenoid?
(A) $\pi \times 10^{-3}$ T (B) $2\pi \times 10^{-3}$ T (C) $3\pi \times 10^{-3}$ T (D) $4\pi \times 10^{-3}$ T

4. Predict the polarity of the capacitor in the situation described by Fig.
(A) A positive and B negative
(B) both A and B are positive
(C) A negative and B positive
(D) Both A and B are negative.



5. Figure shows a series LCR circuit connected to a variable frequency 230 V source. L = 5.0 H, C = 80μF, R = 40 Ω. Determine the source frequency which drives the circuit in resonance?
(A) all possible frequencies.
(B) 150 rad/s
(C) 75 rad/s
(D) 50 rad/s



6. Production of infra-red Rays is due to
(A) Rapid acceleration and decelerations of electrons in aerials
(B) Klystron valve or magnetron valve
(C) Vibration of atoms and molecules
(D) Inner shell electrons in atoms moving from one energy level to a lower level.

7. A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water?
(A) 1.55
(B) 2.33
(C)1.23
(D) 1.33

8. In Young's double-slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. What is the intensity of light at a point where path difference is λ /3?
(A) k
(B) k/2
(C)k/4
(D) zero

9. Which of the following is the form of energy?
(A) Light (B) Pressure (C) Momentum (D) Power

10. A proton and an alpha particle are accelerated through the same potential. What is the ratio of de Broglie Wavelength
(A) 2:1
(B) 1:2
(C) $2\sqrt{2}:1$
(D) $1:2\sqrt{2}$

11. What is the ratio of the nuclear density for the elements He_2^4 and N_7^{14}
(A) 4:1
(B) 2:7

(C) 7:2

(D) 1:1

12. In a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be

(A) 50Hz (B) 100 Hz (C) 70.7 Hz (D) 25 Hz

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:** Total energy of an electron in a hydrogen atom is positive**.**
Reason: Electron in an atom is not held by Colombian force.

14. **Assertion**: In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave
Reason: For a given frequency, intensity of light in the photon picture is determined by the number of photons crossing a unit area per unit time

15. **Assertion**: Lenz's law states that the polarity of the induced emf is such that it tends to produce a current which opposes the magnetic flux that produces it.
Reason: Lenz's law is a consequence of conservation of charge**.**

16. **Assertion**: Manganin and constantan materials are widely used in wire bound standard resistors.
Reason: They exhibit a very weak dependence of resistivity with temperature

SECTION-B

17. Two capacitors of capacitance of 6 μF anf 12 μF are connected in series with a battery. The voltage across the 6μF capacitor is 2V. Compute the total battery voltage.
18. Depict the behaviour of magnetic field lines near (i) diamagnetic and (ii) paramagnetic substances. Justify, giving reasons.
19. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1} .
   (a) What is the wavelength of the wave?
   (b) What is the amplitude of the oscillating magnetic field?
20. A difference of 2.3 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom makes a transition from the upper level to the lower level?

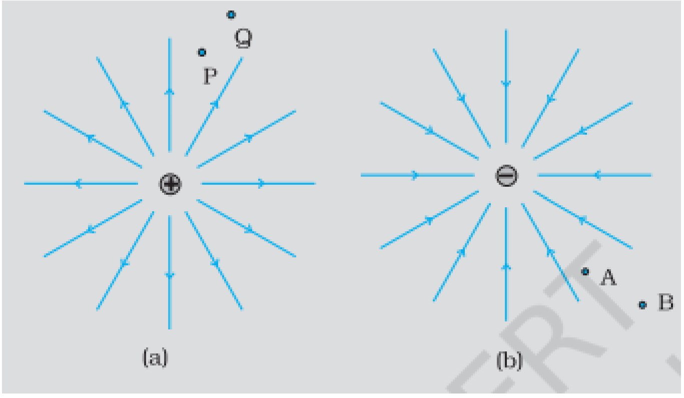
   OR

   A hydrogen atom initially in the ground level absorbs a photon, which excites it to the n = 4 level. Determine the wavelength and frequency of photon.
21. Explain with the help of a circuit diagram, the working of a p-n junction diode as a half wave rectifier.

SECTION-C

22. What is electric flux? Write its S.I unit. Using Gauss's theorem deduce an expression for the electric field at a point due to a uniformly charged infinite plane sheet.

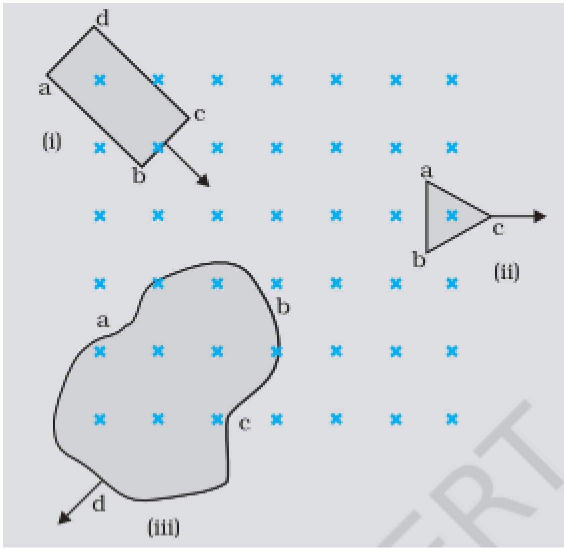
23. Figures (a) and (b) show the field lines of a positive and negative point charge respectively.
(a) Give the signs of the potential difference $V_P - V_Q$; $V_B - V_A$.
(b) Give the sign of the potential energy difference of a small negative charge between the points Q and P; A and B.
(c) Give the sign of the work done by the external agency in moving a small negative charge from B to A.



24. (a) Define the term self-inductance and write its S.I unit.
(b) Obtain the expression for the mutual inductance of two long co axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when the current I is setup in the outer solenoid.

OR

Figure shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.



25. A resistor of 200 ohm and a capacitor of 15.0 μF are connected in series to a 220 V, 50 Hz ac source. (a) Calculate the current in the circuit; (b) Calculate the voltage (rms) across the resistor and the capacitor.

26. (i) If f = 0.5 m for a glass lens, what is the power of the lens?

(ii) A convex lens has 20 cm focal length in air. What is focal length in water? (Refractive index of air-water = 1.33, refractive index for air-glass = 1.5.)

27. What is the shape of the wave front in each of the following cases:
(a) Light diverging from a point source.
(b) Light emerging out of a convex lens when a point source is placed at its focus.
(c) The portion of the wave front of light from a distant star intercepted by the Earth.

28. Calculate the binding energy per nucleon of iron nucleus.
Given mass of ${}^{56}_{26}Fe = 55.934939u$, mass of a neutron-1.008665u , mass of a proton=1.007825u.

SECTION-D

Case Study-1

29. When light falls on a metal surface, some electrons near the surface absorb enough energy from the incident radiation to overcome the attraction of the positive ions in the material of the surface. After gaining sufficient energy from the incident light, the electrons escape from the surface of the metal into the surrounding space

Hallwachs and Lenard also observed that when ultraviolet light fell on the emitter plate, no electrons were emitted at all when the frequency of the incident light was smaller than a certain minimum value, called the threshold frequency. This minimum frequency depends on the nature of the material of the emitter plate.

Some alkali metals such as lithium, sodium, potassium, caesium and rubidium were sensitive even to visible light. All these photosensitive substances emit electrons when they are illuminated by light. After the discovery of electrons, these electrons were termed as photoelectrons. The phenomenon is called photoelectric effect.

This maximum value of the photoelectric current is called saturation current. Saturation current corresponds to the case when all the photoelectrons emitted by the emitter plate C reach the collector plate A.

The minimum negative (retarding) potential V_0 given to the plate A for which the photocurrent stops or becomes zero is called the cut off or stopping potential.

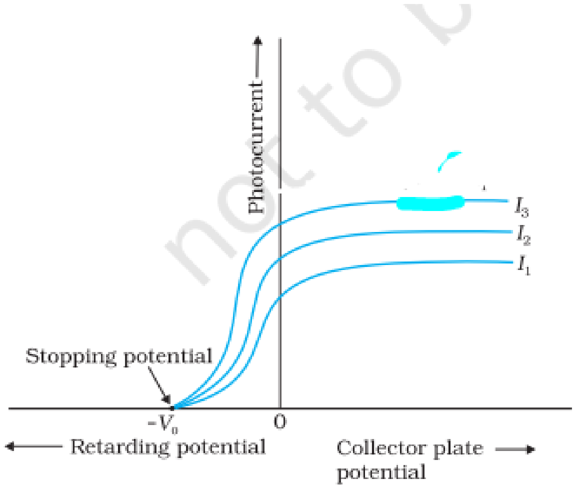
(i) Identify the relation between the intensity of radiation as shown in the figure.

(a) $I_1=I_2=I_3$

(b) $I_1<I_2<I_3$

(c) $I_1>I_2>I_3$

(d) $I_2<I_1<I_3$



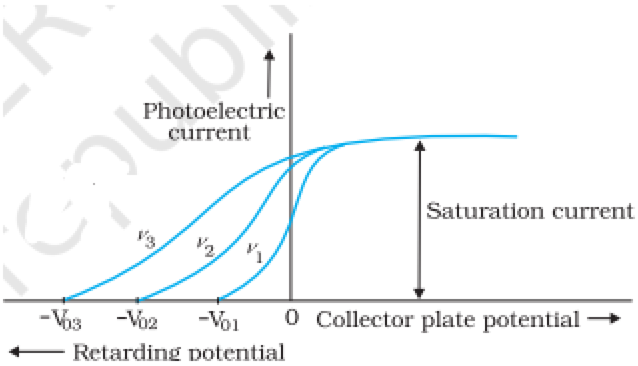
(ii) Identify the relation between the frequency of radiation as shown in the figure.

(a) $\nu_1=\nu_2=\nu_3$

(b) $\nu_1<\nu_2<\nu_3$

(c) $\nu_1>\nu_2>\nu_3$

(d) $\nu_2<\nu_1<\nu_3$



(iii) For a given photosensitive material and frequency of incident radiation (above the threshold frequency), the photoelectric current is directly proportional

(a) to the intensity of incident light.

(b) to frequency of incident light

(c) on frequency and intensity of incident light.

(d) None of these

(iv) Above the threshold frequency, the stopping potential or equivalently the maximum kinetic energy of the emitted photoelectrons

(a) increases linearly with the frequency of the incident radiation.

(b) dependent of its intensity of incident radiation.

(c) decreases linearly with the frequency of the incident radiation.

(d) None of these.

OR

(v) The photoelectric cut-off voltage in a certain experiment is 1.5 V. What is the maximum kinetic energy of photoelectrons emitted?

(a) Zero (b) 1 eV (c) 1.5 J (d) 2.4 X 10^{-19} J

Case Study-2

30. A p-n junction is the basic building block of many semiconductor devices like diodes, transistor, etc. Two important processes occur during the formation of a p-n junction: diffusion and drift. This space-charge region on either side of the junction together is known as depletion region as the electrons and holes taking part in the initial movement across the junction depleted the region of its free charges. The potential tends to prevent the movement of electron from the n region into the p region, it is often called a barrier potential.

When an external voltage V is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal it is said to be forward biased.

When an external voltage (V) is applied across the diode such that n-side is positive and p-side is negative, it is said to be reverse biased. For diodes, we define a quantity called dynamic resistance as the ratio of small change in voltage ΔV to a small change in current ΔI:

Answer the following Questions:

(i) In an unbiased p-n junction, holes diffuse from the p-region to n-region because

(a) free electrons in the n-region attract them.

(b) they move across the junction by the potential difference.

(c) hole concentration in p-region is more as compared to n-region.

(d) All the above.

(ii) When a forward bias is applied to a p-n junction, it

(a) Raises the potential barrier.

(b) Reduces the majority carrier current to zero.

(c) Lowers the potential barrier.

(d) None of the above.

(iii) In forward bias the width of depletion region

(a) Increases (b) decrease (c) either increases or decreases (d) remains same

(iv) Draw the variation of reverse current with increasing Reverse Bias voltage?

OR

(v) Explain the role of diffusion current in the formation of P N junction diode?

SECTION-E

31. (i) Define the term drift velocity.

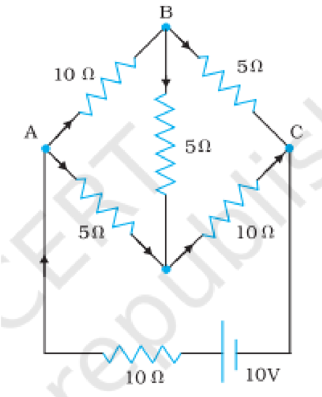
(ii) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?

(iii) Why alloys like constantan and Manganin are used for making standard resistors?

OR

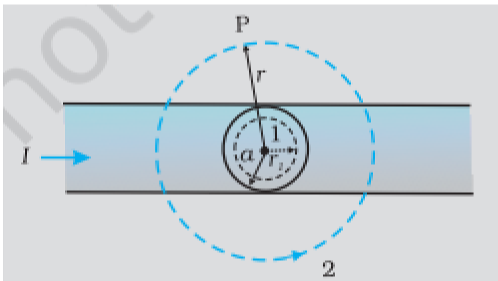
(i) State the two Kirchhoff's laws.

(ii) Determine the current in each branch of the network shown in Fig.



32. (i) State and explain Ampere's circular law?

(ii) 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



OR

(i) With the help of a neat and labelled diagram, explain the underlying principle and working of a moving coil galvanometer.

(ii) what is the function (a) uniform radial field (b) Soft iron core in such a device.

33. Draw a labelled diagram for the formation of image by a compound microscope. Deduce an expression for the total magnification of a compound microscope? Explain why both the objective and the eyepieces of a compound microscope must have short focal lengths.

OR

(i) Draw a ray diagram to show refraction of a ray of monochromatic light passing through a glass prism.

(ii) Deduce the expression for the refractive index of glass in terms of angle of prism and angle of minimum deviation.

CLASS XII

PRACTICE PAPER-2

SESSION: 2023-24

SUBJECT: PHYSICS (THEORY)

HINTS AND SOLUTIONS

SECTION A

1. B

   In a charge-free region, electric field lines can be taken to be continuous curves without any breaks

2. C

   $i = \frac{V-E}{R+r}$ and $V = E + ir$

3. B

   $B = \mu_0 ni$

4. A

   By using Lenz Law

5. D

   Resonant frequency $f = \frac{1}{2\pi\sqrt{LC}}$

6. C

   Conceptual

7. D

   $\mu = \frac{realdepth}{apparentdepth}$

8. C

   $\Delta\phi = \frac{2\pi}{\lambda} pathdifference$

   $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\Delta\phi$

9. A

   Conceptual

10. C

    $\lambda = \frac{h}{\sqrt{2mVq}}$

11. D

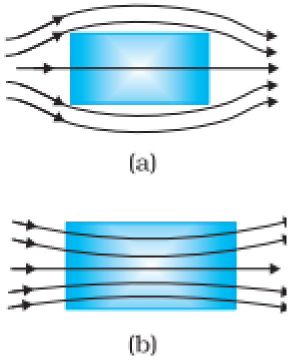
    Nuclear density is independent of mass number.

12. B Conceptual
13. D Conceptual
14. B Conceptual
15. D Conceptual
16. A Conceptual

SECTION B

17. Formula 1 M

    Calculation 1 M

18.	**FIGURE 5.7** Behaviour of magnetic field lines near a (a) diamagnetic, (b) paramagnetic substance.

19. $(i)\, c = f\lambda$

$(ii)\, c = \frac{E_0}{B_0}$

20. $E = h\upsilon$ formula 1 M

Calculation 1M

21. Circuit 1M

Working 1M

22. Definition and unit 1M

Derivation 2 M

SECTION C

23. (a) As V ∝ 1/r , VP > VQ . Thus, (VP – VQ) is positive. Also VB is less negative than VA . Thus, VB > VA or (VB – VA) is positive.

(b) A small negative charge will be attracted towards positive charge. The negative charge moves from higher potential energy to lower potential energy. Therefore the sign of potential energy difference of a small negative charge between Q and P is positive. Similarly, (P.E.)A > (P.E.)B and hence sign of potential energy differences is positive.

(c) In moving a small negative charge from B to A work has to be done by the external agency. It is positive.

24. (a) Definition and unit 1M

(b) Derivation 2M

OR

(i) The magnetic flux through the rectangular loop abcd increases, due to the motion of the loop into the region of magnetic field, The induced current must flow along the path bcdab so that it opposes the increasing flux. 1M

(ii) Due to the outward motion, magnetic flux through the triangular loop abc decreases due to which the induced current flows along bacb, so as to oppose the change in flux.

1M

(iii) As the magnetic flux decreases due to motion of the irregular shaped loop abcd out of the region of magnetic field, the induced current flows along cdabc, so as to oppose change in flux. Note that there are no induced current as long as the loops are completely inside or outside the region of the magnetic field. 1M

25. $(a)\, Z = \sqrt{R^2 + X_c{}^2}\ and\ I = \frac{V}{I}$ and calculation 2 M

$(b) V_R = IR \, and \, V_c = IX_c$ (1/2 M +1/2 M)

26. (i) $P = \frac{1}{f}$ and calculation 1 M

(ii) $\frac{1}{f} = \left(\frac{\mu_{lens}}{\mu_{liquid}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 1 M

Calculation and final answer with unit 1 M

27. (a) Sphrical wave front 1M

(b) Plane wavefront 1M

(c) Plane wave Front 1M

28. $mass \, defect (\Delta m) = (Zm_p + (A - Z)m_n) - M_{actual}$ and calculation 1M

$Binding \, energy = \Delta mc^2 = 931.5 \Delta m \, MeV$ and Calculation 1M

$Binding \, energy \, per \, nucleon = \frac{B.E}{A}$ and Calculation 1M

SECTION D

29. (i) B

Photo current increase with increase in intensity of radiation. 1M

(ii) B

Stopping potential increase with increase in frequency of incident radiation. 1M

(iii) A 1M

(iv) A 1M

OR

(v) D $K.E_{\max} = eV_0$ 1M

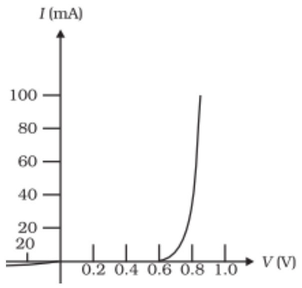
SECTION E

30. (i) C 1M

(ii)C 1M

(iii) B 1M

(iv)Correct diagram 1M



OR

(v) During the formation of p-n junction, and due to the concentration gradient across p-, and n- sides, holes diffuse from p-side to n-side and electrons diffuse from n-side to p-side . This motion of charge carries gives rise to diffusion current across the junction.

1M

31. (i) Definition of drift velocity 1M

(ii) Derivation for resistivity 2M

Resistivity depends on nature of the conductor and temperature 1M

(iii) They exhibit a very weak dependence of resistivity with temperature. 1M

OR

(i) Each correct statement carry 1M each 2M

(ii) Circuit with current distribution ½ M

Two Loop equations each carries ½ M each 1M
Calculation of current in each branch 1 ½ M

32. (i) Statement 1M
Explanation 1M
(ii) 2+1 M

Consider the case $r > a$. The Amperian loop, labelled 2, is a circle concentric with the cross-section. For this loop,

$L = 2\pi r$

I_e = Current enclosed by the loop = I

The result is the familiar expression for a long straight wire

$B(2\pi r) = \mu_0 I$

$$B = \frac{\mu_0 I}{2\pi r} \qquad [4.19(a)]$$

$$B \propto \frac{1}{r} \qquad (r > a)$$

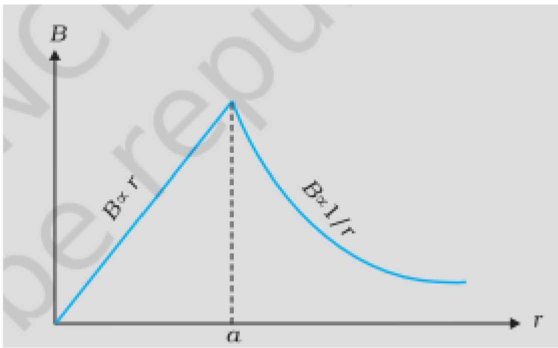
Now the current enclosed I_e is not I, but is less than this value. Since the current distribution is uniform, the current enclosed is,

$$I_e = I\left(\frac{\pi r^2}{\pi a^2}\right) = \frac{I r^2}{a^2}$$

Using Ampere's law, $B(2\pi r) = \mu_0 \frac{I r^2}{a^2}$

$$B = \left(\frac{\mu_0 I}{2\pi a^2}\right) r \qquad [4.19(b)]$$

$B \propto r \qquad (r < a)$



OR

(i) Neat diagram 1M
Principle of moving coil Galvonometer 1M
Woking of moving coil galvanometer 1M
(ii) (a) Due to uniform radial field the coil will experience maximum torque in any orientation. 1 M
(b) A cylindrical soft iron core which not only makes the field radial but also increases the strength of the magnetic field. 1M

33. Labelled diagram of compound microscope 1 M
Derivation for total magnification in compound microscope 3M
Explanation why both the objective and the eyepieces of a compound microscope must have short focal lengths. 1M

OR

Ray diagram through Prism 1M
Minimum deviation graph 1M
Derivation 3M