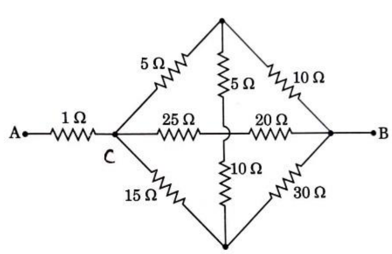
Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior School Certificate Examination, 2025
SUBJECT NAME PHYSICS (PAPER CODE 55/6/1)

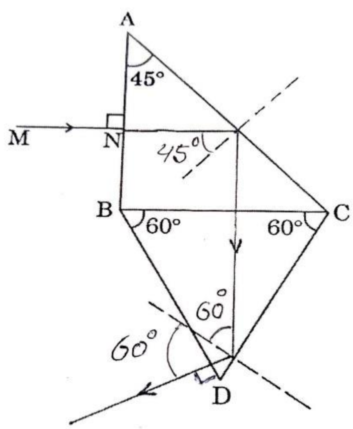
General Instructions: -

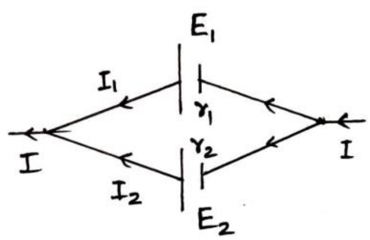
1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them. In class-X, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
4	The Marking scheme carries only suggested value points for the answers These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after delibration and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓) while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

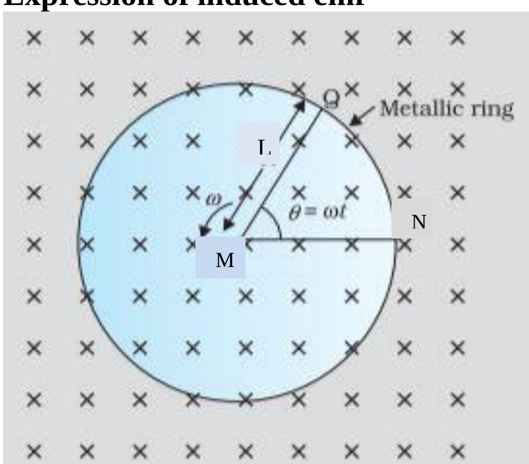
11	A full scale of marks 70 (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totaling on the title page. ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

MARKING SCHEME: PHYSICS(042)			
Code: 55/6/1			
Q.No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
	SECTION A		
1.	(D) $T_1 < T_2$	1	1
2.	(C) $\left[\frac{n^2-1}{n}\right]R$	1	1
3.	(C) $\frac{\mu_0 I}{4R}$	1	1
4.	(D) does not move at all	1	1
5.	(C) small resistance in parallel	1	1
6.	(B) $\frac{1}{2}$	1	1
7.	(C) g	1	1
8.	(A) 10 V	1	1
9.	(C) $2I_0$	1	1
10.	(A) Red Light	1	1
11.	(B) 1.326×10^{-27}	1	1
12.	(D) $F_{pp} = F_{pn} = F_{nn}$	1	1
13.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	1	1
14.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
15.	(D) Both Assertion (A) and Reason (R) are false.	1	1
16.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
	SECTION B		
17.	Finding equivalent resistance between points A and B 2 Resistance between points C and B $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R} = \frac{1}{15} + \frac{1}{45} + \frac{1}{45}$ R = 9 Ω  Equivalent resistance between points A and B	½ ½	

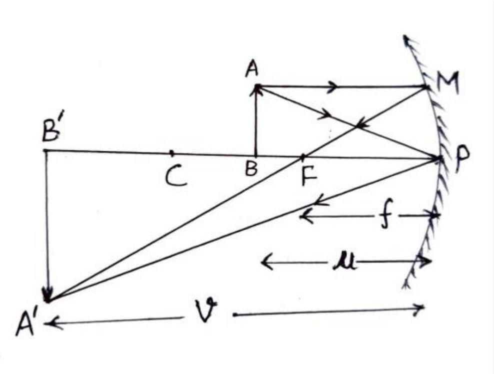
	$R_{eq} = R_1 + R_2$ R_{eq} = 1 + 9 = 10 Ω	½ ½	2
18.	(a) Finding the intensity for path difference of (i) $\frac{\lambda}{3}$ 1 (ii) $\frac{\lambda}{2}$ 1 (i) $\Delta\phi = \frac{2\pi}{\lambda}.\Delta x$ $\Delta\phi = \frac{2\pi}{\lambda}.\frac{\lambda}{3} = \frac{2\pi}{3}$ $I = 4I_0 \cos^2 \frac{\phi}{2}$ $I = 4I_0 \cos^2 \frac{\pi}{3}$ $I = I_0$ (ii) $\Delta\phi = \frac{2\pi}{\lambda}.\frac{\lambda}{2} = \pi$ $I = 4I_0 \cos^2 \frac{\pi}{2}$ $I = 0$ OR (b) Finding- The position of the image 1½ The nature of the image ½ $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ $\frac{1.5}{v} - \frac{1}{(-12)} = \frac{1.5-1}{30}$ v = -22.5 cm Image is virtual and erect.	½ ½ ½ ½ ½ ½ ½ ½	**2**

19.	Finding- (i) The energy of photon of the beam 1 (ii) The average number of photons emitted per second (N) 1 (i) $E = h\nu$ $= 6.63\times10^{-34}\times3.0\times10^{14}$ $= 1.99\times10^{-19}$ J (ii) $N = \frac{P}{E}$ $= \frac{9\times10^{-3}}{1.99\times10^{-19}}$ $= 4.5\times10^{16}$	½ ½ ½ ½	2
20.	Tracing the path of ray MN 2  Note: Please deduct ½ mark for not showing arrows with the rays.	1 1	2
21.	Explanation for higher electron concentration in n-type semiconductor in comparison to hole concentration 2 In a doped semiconductor the total number of conduction electrons is due to the electrons contributed by donors and those generated intrinsically, while the total number of holes is only due to the holes from the intrinsic sources.	2	2

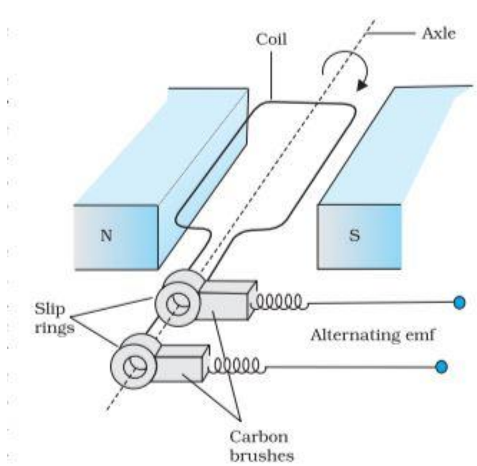
	SECTION - C		
22.	• Difference between emf and terminal voltage of a cell 1 Deriving expression for- • Equivalent emf of combination of cells 1½ • Equivalent internal resistance of combination of cells ½		
	(Any one difference) 1. Potential difference between the terminals of a cell in open circuit is emf and in closed circuit it is terminal voltage. 2. An emf does not depend on the external resistance, while terminal voltage depends on external resistance. 3. emf is the cause and terminal voltage is the effect.	1	
		½	
	$V = E_1 - I_1 r_1$ $V = E_2 - I_2 r_2$ $I = I_1 + I_2$ $I = \left(\frac{E_1 - V}{r_1}\right) + \left(\frac{E_2 - V}{r_2}\right)$ On comparing above equation with $I = \frac{E_{eq} - V}{r_{eq}}$	½	
	$E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$	½	
	$r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$	½	3
23.	Finding- (i) The torque acting on the loop 1 (ii) The magnitude and direction of net force 2		
	(i) $\tau = mB\, sin\theta$	½	
	As $\vec{m}$ and $\vec{B}$ are in same direction, $\theta = 0^0$ $\tau = 0$	½	
	(ii) $F = \frac{\mu_0 I_1 I_2\, l}{2\pi r}$	½	

	$F_{net} = \frac{\mu_0 I_1 I_2 l}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ $= \frac{4\pi \times 10^{-7} \times 2 \times 1 \times 5 \times 10^{-2}}{2\pi \times 10^{-2}}\left(1 - \frac{1}{2}\right)$ $F_{net} = 1 \times 10^{-6}$ N Net force on the loop is towards the long straight wire.	 ½ ½ ½	3
24.	(a) Stating Lenz's law 1 Obtaining expression for induced emf 2 **Lenz's law** The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it. **Expression of induced emf**  The magnitude of the emf generated across the length dr of the rod as it moves at right angles to the magnetic field is given by $d\varepsilon = B\text{v}\,dr$ $\varepsilon = \int d\varepsilon$ $= \int_0^L B\text{v}\,dr$ $\varepsilon = \int_0^L B\omega r\,dr$ $\varepsilon = \frac{1}{2}BL^2\omega$ **Alternatively:** Area of the sector (QMN) = $\frac{1}{2}L^2\theta$	 1 ½ ½ ½ ½ ½	

	Induced emf is $\varepsilon = B \times \frac{d}{dt}\left(\frac{1}{2}L^2\theta\right)$ $\varepsilon = \frac{1}{2}BL^2\frac{d\theta}{dt}$ $\varepsilon = \frac{1}{2}BL^2\omega$ OR (b) Definition of self inductance 1 Deriving expression for self inductance for a long solenoid 2 Self inductance of a coil is the ratio of the flux linkage to the current flowing in the coil. **Alternatively:** Self inductance of a coil is defined as the flux linked with the coil when unit current flows through it. **Alternatively**: Self inductance of a coil may be defined as the magnitude of emf induced in the coil when current changes at the rate of 1 A/s in the coil. **Expression for self inductance of a long solenoid:** The magnetic field due to current flowing in the solenoid, B = $\mu_0 nI$ Total flux linked with the given solenoid $N\phi_B = (nl)(\mu_0 nI)\,A$ $N\phi_B = \mu_0 n^2\,A\,lI$ Self inductance $L = \frac{N\phi_B}{I}$ $L = \mu_0 n^2\,A\,l$	½ ½ ½ 1 ½ ½ ½ ½	 3
25.	Naming the electromagnetic waves 1½ Writing wavelength range 1½ The electromagnetic waves used are (i) Microwaves (ii) Ultraviolet / Infrared (iii) X-Rays Wavelength range of electromagnetic waves used (i) 0.1 m to 1 mm (ii) 400 nm to 1 nm / 1mm to 700 nm (iii) 1 nm to 10^{-3} nm	 ½ ½ ½ ½ ½ ½	 3

26.	Drawing the ray diagram 1 Obtaining the mirror formula 2  **Note:** Please deduct ½ mark of this diagram if not showing arrows with the rays. In similar triangles $\Delta A'B'F$ and ΔMPF $\frac{A'B'}{MP}=\frac{B'F}{FP}$ or $\frac{A'B'}{AB}=\frac{B'F}{FP}$ $(\because MP=AB)$ ---------(1) In similar triangles $\Delta A'B'P$ and ΔABP $\frac{A'B'}{AB}=\frac{PB'}{PB}$ -------(2) from equation (1) and (2) $\frac{B'F}{FP}=\frac{PB'}{PB}$ $\frac{PB'-PF}{FP}=\frac{PB'}{PB}$ $\frac{(-v)-(-f)}{(-f)}=\frac{(-v)}{(-u)}$ on solving we get $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$	1 ½ ½ ½ ½	3
27.	• To state the necessary force for revolving electron around the nucleus ½ • Deriving the expression for total energy of electron in hydrogen atom 2 • Significance of negative sign ½ The electrostatic force of attraction between the electrons and the nucleus provides the necessary centripetal force required to an electron to revolve in the orbit.	½	

	$\frac{mv^2}{r}=\frac{e^2}{4\pi\varepsilon_0 r^2}$ -------(1) (Z = 1 for hydrogen atom) Kinetic energy of the electron $K=\frac{1}{2}mv^2$ $K=\frac{e^2}{8\pi\varepsilon_0 r}$ (from eq (1)) Potential energy of the electron $U=\frac{-e^2}{4\pi\varepsilon_0 r}$ $\left(\because U=\frac{q_1q_2}{4\pi\varepsilon_0 r}\right)$ Total energy of the electron E = K + U $E=\frac{-e^2}{8\pi\varepsilon_0 r}$ Note: Full credit of this part should be given if a student shows this derivation using alternative method Negative sign signifies that electron is bound to the nucleus OR force is attractive.	½ ½ ½ ½ ½	3
28.	Finding the amount of energy released 2 Showing the nuclear density is independent of mass number 1 $\Delta m=\left[m(^2_1H)+m(^3_1H)\right]-\left[m(^4_2He)+m(^1_0\mathrm{n})\right]$ = (2.014102 + 3.016049) – (4.002603 + 1.008665) = 0.018883u Q = $\Delta m\times 931$ = 0.018883 $\times$ 931 MeV Q = 17.58 MeV Nuclear density = $\frac{\text{Mass of nucleus}}{\text{Volume of nucleus}}$ $\rho=\frac{mA}{\frac{4}{3}\pi R^3}$ $R=R_0A^{1/3}$ $\rho=\frac{3m}{4\pi R_0^3}$ Independent of mass number (A)	½ ½ ½ ½ ½ ½	3

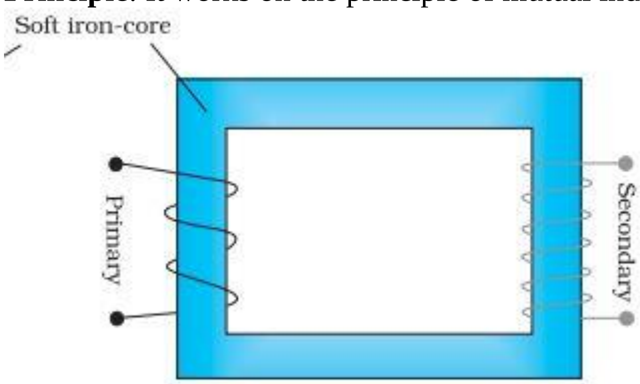
	SECTION - D		
29.	(i) (A) $\left(\frac{C}{4}\right)$ (ii) (B) $\frac{\sigma}{\sigma - \sigma_p}$ (iii) (C) $\frac{1}{2}\varepsilon_0 E^2 V$ (iv) (a) (D) 6 OR (b) (B) $\frac{2K}{K+1}$	1 1 1 1	4
30.	(i) (B) Antimony (ii) (C) 0.05 eV (iii) (B) A layer of positive charge on n side and a layer of negative charge on p side appear (iv) (a) (B) The applied voltage mostly drops across the depletion region OR (b) (C) 100 Hz	1 1 1 1	4
	SECTION - E		
31.	**(a)** (i) Writing principle of ac generator 1 Labelled diagram of ac generator 1 Working of ac generator 1 (ii) Finding rms voltages across three circuit elements 1½ Explanation of the algebraic sum of rms voltages across three circuit elements is more than the rms voltage source ½ **(i) Principle:** It works on the principle of electromagnetic induction. 	1 1	

		Working: The coil is mechanically rotated in the uniform magnetic field. The rotation of the coil causes the magnetic flux through it to change, so an emf is induced in the coil.	1	
	(i)	$Z=\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}$ $=\sqrt{(400)^2+\left(100\pi\times\frac{5}{\pi}-\frac{1}{100\pi\times\frac{50}{\pi}\times10^{-6}}\right)^2}$ $=500\,\Omega$ $I_{rms}=\frac{V_{rms}}{Z}$ $I_{rms}=\frac{140}{\sqrt{2}\times500}=\frac{0.28}{\sqrt{2}}$ A $\left(V_{rms}\right)_R=I_{rms}\ R$ $=\frac{0.28}{\sqrt{2}}\times400$ $=\frac{112}{\sqrt{2}}=56\sqrt{2}$ V	½	
		$\left(V_{rms}\right)_L=I_{rms}\,\omega\mathrm{L}$ $=\frac{0.28}{\sqrt{2}}\times500$ $=\frac{140}{\sqrt{2}}=70\sqrt{2}$ V	½	
		$\left(V_{rms}\right)_C=I_{rms}\ \frac{1}{\omega C}$ $=\frac{0.28}{\sqrt{2}}\times200$ $=\frac{56}{\sqrt{2}}=28\sqrt{2}$ V	½	
		The algebraic sum of voltages is more than the rms voltage of source because voltages across R, L and C are not in phase.	½	
		OR		

(b)

(i)	Writing principle of transformer	1
	Labelled diagram of step-up transformer	1
	Working of step-up transformer	1
(ii)	Finding-	
	• rms value of input current	1
	• expression for instantaneous output voltage	½
	• expression for instantaneous output current	½

(i) **Principle**: It works on the principle of mutual induction. 1



1

Working: When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf in it. Since the no. of turns are more in secondary windings an emf induced is proportional to the no. of turns. Therefore more emf is developed across the secondary windings. 1

(ii) $P_i = V_p I_p$ ½

$$200 = \frac{20}{\sqrt{2}} I_p$$

½

$$I_p = 10\sqrt{2}\text{A}$$

$$\frac{V_o}{V_i} = \frac{250}{50}$$

$$5 = \frac{V_o}{V_i}$$

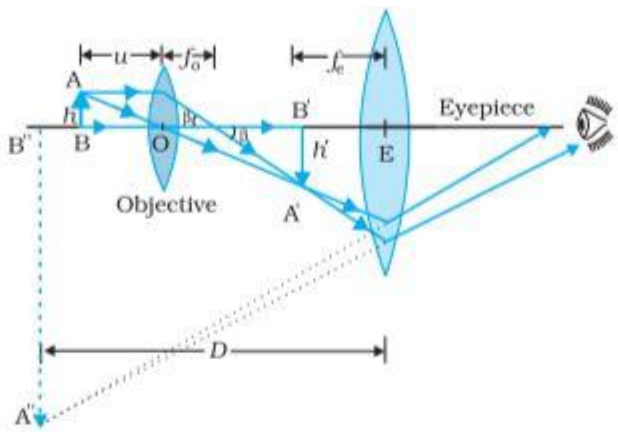
$$V_o \;\; = 100\sin(100\pi)\,\text{t V}$$

½

$$\text{P}_o \;\; = \left(V_o\right)_{rms} (I_o)_{rms}$$

$$200 = \frac{100}{\sqrt{2}} (I_o)_{rms}$$

$$\left(I_o\right)_{rms} = 2\sqrt{2}\text{A}$$

	$\therefore I_o = \left(2\sqrt{2}\right)\sqrt{2}\sin(100\pi)\,t$ $I_o = 4\sin(100\pi)\,t\,A$	½	**5**
32.	(a) (i) Drawing ray diagram of compound microscope 1½ Obtaining an expression for total magnification 1½ (ii) Calculating distance between the objective and the eye-piece 2 (i)  Note: Deduct ½ mark for not showing arrows with the rays. Magnification produced by objective $m_0 = \frac{h'}{h} = \frac{L}{f_o}$ Magnification produced by eye-piece $m_e = 1 + \frac{D}{f_e}$ If the final image is formed at infinity $m_e = \frac{D}{f_e}$ Total magnification $m = m_0 \times m_e$ $= \left(\frac{L}{f_o}\right)\left(\frac{D}{f_e}\right)$ (ii) $\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_0}$ $\frac{1}{v_o} - \frac{1}{(-1.5)} = \frac{1}{1.25}$ $v_o = 7.5\text{cm}$	1½ ½ ½ ½ ½ ½	

$L = |v_o| + |f_e|$ as final image is formed at infinity ($v_e = \infty, u_e = f_e$) ½

$L = 7.5 + 5$

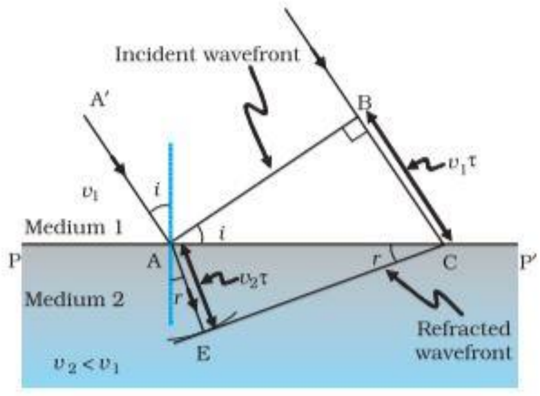
$L = 12.5$ cm ½

OR

(b)

(i) Explaining the refraction of a plane wavefront	1
Verification of Snell's law	2
(ii) Deducing that a convex mirror always produces a virtual image of an object	2

(i)



1

$$\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$$ ½

$$\sin r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$$ ½

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$

$$\frac{\sin i}{\sin r} = \frac{c/n_1}{c/n_2}$$ ½

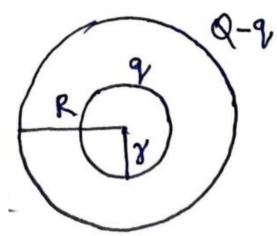
$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} \text{ or } n_1 \sin i = n_2 \sin r$$ ½

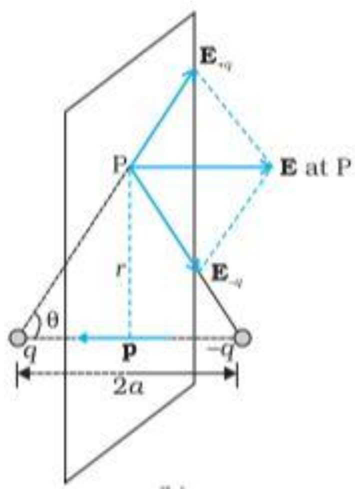
(ii) $$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$ ½

$u < 0$, $f > 0$

$$\frac{1}{v} + \frac{1}{(-u)} = \frac{1}{f}$$ ½

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$ ½

	$\frac{1}{v}$ is positive $\therefore$ v is positive $\Rightarrow$ virtual image	½	5
33.	(i) Finding the amount of work done — 2 (ii) Finding (I) The electric field at their common centre — 1 (II) The potential at their common centre — 2 (a) (i) $V = -\int \vec{E} \cdot \vec{dr}$ $= -\int 40\, x\, dx$ $= -20\, x^2$ Potential at A (0, 3m), $V_A = 0$ Potential at B (5m, 0), V_B = -500 V Work done in taking a unit positive charge from a point (0, 3m) to the point (5m, 0) $W = q(V_B - V_A)$ $= 1(-500 - 0)$ $W = -500\,J$ (ii) (I) Electric field at the common centre will be zero as the charge enclosed by the inner sphere is zero.  **Alternatively:** $q_{en} = 0$ $\phi_E = 0$ $\oint \vec{E}.\vec{ds} = 0$ $E = 0$ (II) $\because$ Surface charge densities are equal $\frac{q}{4\pi r^2} = \frac{Q-q}{4\pi R^2}$	 ½ ½ ½ ½ 1 ½ ½ ½	

	$q=\dfrac{Qr^2}{R^2+r^2}$	½	
	Potential at common centre $V=\dfrac{kq}{r}+\dfrac{k(Q\text{-}q)}{R}$	½	
	$V=\dfrac{k}{r}\dfrac{Qr^2}{(R^2+r^2)}+\dfrac{k}{R}\left[Q-\dfrac{Qr^2}{(R^2+r^2)}\right]$ $V=\dfrac{kQ(R+r)}{R^2+r^2}$	½	
	OR (b) (i) Obtaining expression for electric field due to a dipole on its equatorial plane — 2 Finding electric field: (I) At centre of the dipole — ½ (II) At a point r >> a — ½ (ii) Calculating net electric flux through cube — 2		
	(i)  	½	
	The magnitudes of the electric field due to two charges +q and -q are $E_{+q}=\dfrac{q}{4\pi\varepsilon_0}\dfrac{1}{\left(r^2+a^2\right)}$ $E_{-q}=\dfrac{q}{4\pi\varepsilon_0}\dfrac{1}{\left(r^2+a^2\right)}$	½	
	The total electric field $\vec{E}=-\left(E_{+q}+E_{-q}\right)\cos\theta\,\hat{p}$		

	$\vec{E} = -\dfrac{\vec{p}}{4\pi\varepsilon_0\left(r^2+a^2\right)^{3/2}}$	½	
	Direction of electric field is opposite to dipole moment ($\vec{p}$)	½	
	(I) At centre of dipole, r = 0		
	$\vec{E} = -\dfrac{-\vec{p}}{4\pi\varepsilon_0 a^3}$	½	
	(II) At a point r>>a		
	$\vec{E} = -\dfrac{-\vec{p}}{4\pi\varepsilon_0 r^3}$	½	
	(ii) $\vec{E} = (10x+5)\hat{i}$ N/C		
	$\phi_L = \int \vec{E}.\vec{ds}$		
	$= -E_L(L^2)$		
	$= -5L^2$	½	
	$\phi_R = E_R(L^2)$		
	$= (10L+5)L^2$	½	
	$\phi_{net} = \phi_L + \phi_R$		
	$= -5L^2 + (10L+5)L^2$	½	
	$= 10L^3 \;\; \text{Nm}^2/\text{C}$	½	5

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Senior School Certificate Examination, 2025
SUBJECT NAME PHYSICS (PAPER CODE 55/6/2)

General Instructions: -

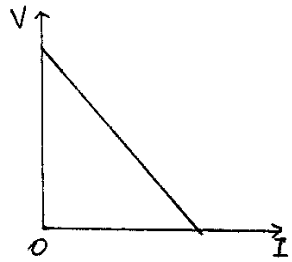
1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them. In class-X, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
4	The Marking scheme carries only suggested value points for the answers These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after delibration and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓) while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

11	A full scale of marks 70 (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totaling on the title page. ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

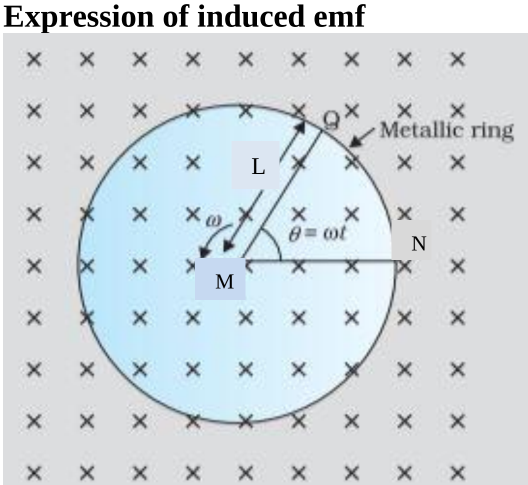
MARKING SCHEME: PHYSICS(042)

Code: 55/6/2

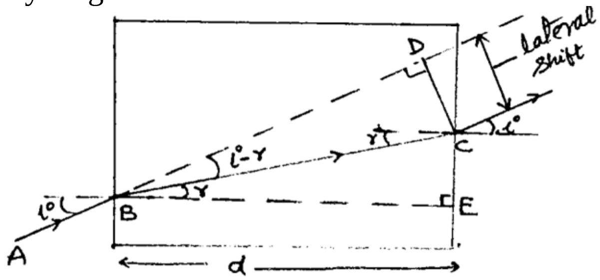
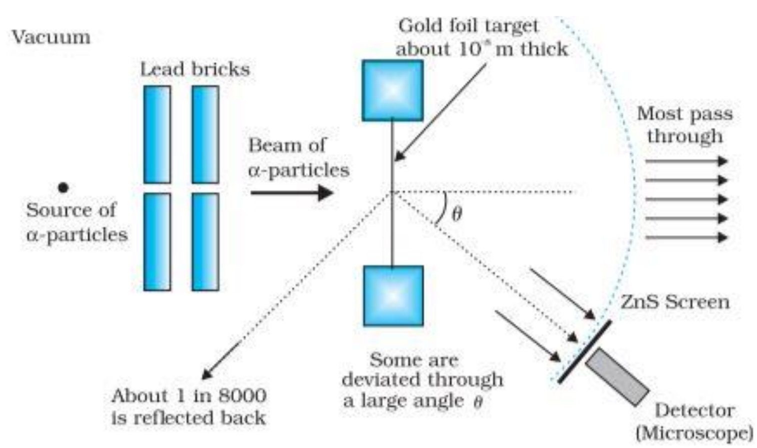
Q.No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
	SECTION A		
1.	(A) $\frac{P}{4}$	1	1
2.	(C) g	1	1
3.	(B) $(-0.16\hat{j}+0.12\hat{k})N$	1	1
4.	(A) 10 V	1	1
5.	(B) $\frac{1}{2}$	1	1
6.	(C) $2I_0$	1	1
7.	(C) $\left[\frac{n^2-1}{n}\right]R$	1	1
8.	(C) small resistance in parallel	1	1
9.	(D) $F_{pp}=F_{pn}=F_{nn}$	1	1
10.	(D) 0.55 nm	1	1
11.	(D) does not move at all	1	1
12.	(B) 1.326×10^{-27}	1	1
13.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
14.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	1	1
15.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
16.	(D) Both Assertion (A) and Reason (R) are false.	1	1
	SECTION B		
17.	Plotting the graph 1 Explaining how to find emf and internal resistance of cell ½ + ½ Graph showing the variation of terminal voltage V of the cell as a function of current I.		

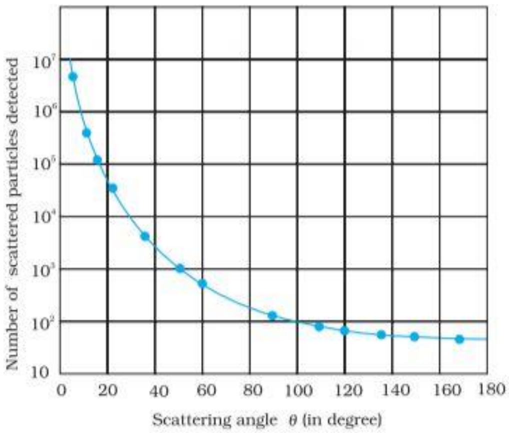
	 $V = E - Ir$ E = intercept on y-axis (i.e. V-axis) r = $\lvert \text{slope of graph} \rvert$	1 ½ ½	2
18.	Explanation for higher electron concentration in n-type semiconductor in comparison to hole concentration 2 In a doped semiconductor the total number of conduction electrons is due to the electrons contributed by donors and those generated intrinsically, while the total number of holes is only due to the holes from the intrinsic sources.	2	2
19.	Finding force exerted by laser beam 2 No. of photons ejected per second = $\frac{P}{E}$ $= \frac{P}{\left(\frac{hc}{\lambda}\right)}$ Momentum of photon, $p = \frac{h}{\lambda}$ Force exerted by laser beam $F = 2 \times \frac{P}{\left(\frac{hc}{\lambda}\right)} \times \frac{h}{\lambda}$ $= \frac{2P}{c}$ $= \frac{2 \times 5 \times 10^{-3}}{3 \times 10^{8}}$ $F = 3.33 \times 10^{-11}$ N	½ ½ ½ ½	2
20.	Finding angle of incidence 1 Finding angle of refraction on face AB 1		

	In a prism we know $A+\delta=i+e \quad and\ A=r_1+r_2$ At minimum deviation $i=e\ \ and\ \ r_1=r_2=r$ $A+D_m=2i$ $i=\frac{A+D_m}{2}$ $A=2r$ $r=A/2$	½ ½ ½ ½	2
21.	(a) Finding the intensity for path difference of (i) $\frac{\lambda}{3}$ 1 (ii) $\frac{\lambda}{2}$ 1 (i) $\Delta\phi=\frac{2\pi}{\lambda}.\Delta x$ $\Delta\phi=\frac{2\pi}{\lambda}.\frac{\lambda}{3}=\frac{2\pi}{3}$ $I=4I_0\cos^2\frac{\phi}{2}$ $I=4I_0\cos^2\frac{\pi}{3}$ $I=I_0$ (ii) $\Delta\phi=\frac{2\pi}{\lambda}.\frac{\lambda}{2}=\pi$ $I=4I_0\cos^2\frac{\pi}{2}$ $I=0$ OR (b) Finding- The position of the image 1½ The nature of the image ½ $\frac{n_2}{v}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$	 ½ ½ ½ ½ ½	

	$\frac{1.5}{v} - \frac{1}{(-12)} = \frac{1.5-1}{30}$ v = -22.5 cm Image is virtual and erect.	½ ½ ½	2
	SECTION - C		
22.	(a) Defining drift velocity 1 (b) Derivation of formula for current density in terms of relaxation time 2 (a) Drift velocity is the average velocity with which the free electrons move under external electric field in a conductor. (b) Current density $j = \frac{I}{A}$ $\because I = neA\text{v}_d$ $\therefore j = ne\text{v}_d$ $But\ \text{v}_d = \frac{eE\tau}{m}$ $\therefore j = \frac{ne^2\tau E}{m} = \frac{ne^2\tau}{m}\left(\frac{V}{l}\right)$	1 ½ ½ ½ ½	3
23.	(a) Stating Lenz's law 1 Obtaining expression for induced emf 2 **Lenz's law** The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it. **Expression of induced emf** 	1	

	The magnitude of the emf generated across the length dr of the rod as it moves at right angles to the magnetic field is given by $d\varepsilon = B\text{v}\,dr$ $\varepsilon = \int d\varepsilon$ $= \int_0^L B\text{v}\,dr$ $\varepsilon = \int_0^L B\omega r\,dr$ $\varepsilon = \frac{1}{2}BL^2\omega$ **Alternatively:** Area of the sector (QMN) = $\frac{1}{2}L^2\theta$ Induced emf is $\varepsilon = B \times \frac{d}{dt}\left(\frac{1}{2}L^2\theta\right)$ $\varepsilon = \frac{1}{2}BL^2\frac{d\theta}{dt}$ $\varepsilon = \frac{1}{2}BL^2\omega$ OR (b) Definition of self inductance — 1 Deriving expression for self inductance for a long solenoid — 2 Self inductance of a coil is the ratio of the flux linkage to the current flowing in the coil. **Alternatively:** Self inductance of a coil is defined as the flux linked with the coil when unit current flows through it. **Alternatively**: Self inductance of a coil may be defined as the magnitude of emf induced in the coil when current changes at the rate of 1 A/s in the coil. **Expression for self inductance of a long solenoid:** The magnetic field due to current flowing in the solenoid, B = $\mu_0 nI$ Total flux linked with the given solenoid $N\phi_B = (nl)(\mu_0 nI)\,\text{A}$ $N\phi_B = \mu_0 n^2\,\text{A}\,lI$ Self inductance	½ ½ ½ ½ ½ ½ ½ ½ 1 ½ ½	

	$L = \dfrac{N\phi_B}{I}$ $L = \mu_0 n^2 A l$	½ ½	3
24.	Obtaining expression for lateral shift 2½ Condition for shift to be minimum ½ Ray diagram  $\sin(i - r) = \dfrac{CD}{BC}$ --------(1) $\cos r = \dfrac{BE}{BC} = \dfrac{d}{BC}$ Putting in equation (1) $CD = \dfrac{d \sin(i - r)}{\cos r}$ Shift will be minimum for minimum angle of incidence.	1 ½ ½ ½ ½	3
25.	Describing briefly Geiger- Marsden scattering experiment 1 Graph showing the variation of number of scattered particles 1 Lead from the graph to discovery of nucleus 1 	1	

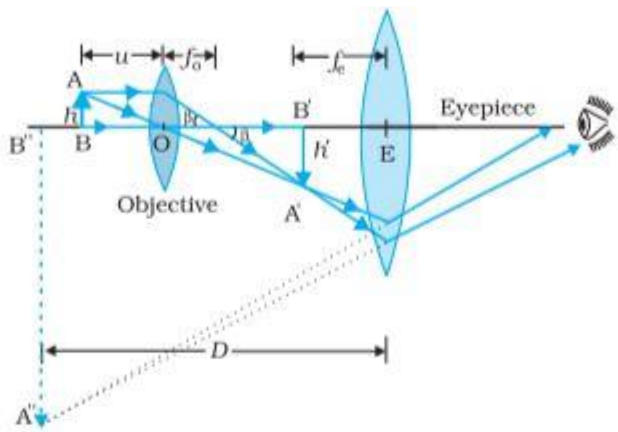
	 A small fraction of number of incident α -particles rebound back. It indicates that the number of α -particles undergoing head on collision is very small. From this we conclude that the positive charge is concentrated in a very small volume called nucleus.	1 1	3
26.	Finding Q value of given reaction 2½ Writing nature of reaction ½ Mass defect Δm = mass of the reactants – mass of the products $\Delta m = 2\times 12 - 19.992439 - 4.002603$ $\Delta m = 0.004958u$ $Q = \Delta m \times 931$ $= 0.004958 \times 931$ $= 4.62\,\text{MeV}$ The reaction is exothermic.	½ ½ ½ ½ ½ ½	3
27.	Finding- (i) The torque acting on the loop 1 (ii) The magnitude and direction of net force 2 (i) $\tau = mB\,sin\theta$ As $\vec{m}$ and $\vec{B}$ are in same direction, $\theta = 0^0$ $\tau = 0$ (ii) $F = \dfrac{\mu_0 I_1 I_2\, l}{2\pi r}$ $F_{net} = \dfrac{\mu_0 I_1 I_2\, l}{2\pi}\left(\dfrac{1}{r_1} - \dfrac{1}{r_2}\right)$	½ ½ ½	

	$=\dfrac{4\pi\times10^{-7}\times2\times1\times5\times10^{-2}}{2\pi\times10^{-2}}\left(1-\dfrac{1}{2}\right)$ $F_{net}=1\times10^{-6}$ N Net force on the loop is towards the long straight wire.	½ ½ ½	3
28.	Naming the electromagnetic waves 1½ Writing wavelength range 1½ The electromagnetic waves used are (i) Microwaves (ii) Ultraviolet / Infrared (iii) X-Rays Wavelength range of electromagnetic waves used (i) 0.1 m to 1 mm (ii) 400 nm to 1 nm / 1mm to 700 nm (iii) 1 nm to 10^{-3} nm	½ ½ ½ ½ ½ ½	3
	SECTION- D		
29.	(i) (B) Antimony (ii) (C) 0.05 eV (iii) (B) A layer of positive charge on n side and a layer of negative charge on p side appear (iv) (a) (B) The applied voltage mostly drops across the depletion region OR (b) (C) 100 Hz	1 1 1 1	4
30.	(i) (A) $\left(\dfrac{C}{4}\right)$ (ii) (B) $\dfrac{\sigma}{\sigma-\sigma_p}$ (iii) (C) $\dfrac{1}{2}\varepsilon_0E^2V$ (iv) (a) (D) 6 OR (b) (B) $\dfrac{2K}{K+1}$	1 1 1 1	4

	SECTION - E		
31.	(a)		

(i)	Drawing ray diagram of compound microscope	1½
	Obtaining an expression for total magnification	1½
(ii)	Calculating distance between the objective and the eye-piece	2

(i)



1½

Note: Deduct ½ mark for not showing arrows with the rays.

Magnification produced by objective

$$m_0 = \frac{h'}{h} = \frac{L}{f_o}$$ ½

Magnification produced by eye-piece

$$m_e = 1 + \frac{D}{f_e}$$

If the final image is formed at infinity

$$m_e = \frac{D}{f_e}$$ ½

Total magnification

$$m = m_0 \times m_e$$

$$= \left(\frac{L}{f_o}\right)\left(\frac{D}{f_e}\right)$$ ½

(ii) $$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_0}$$ ½

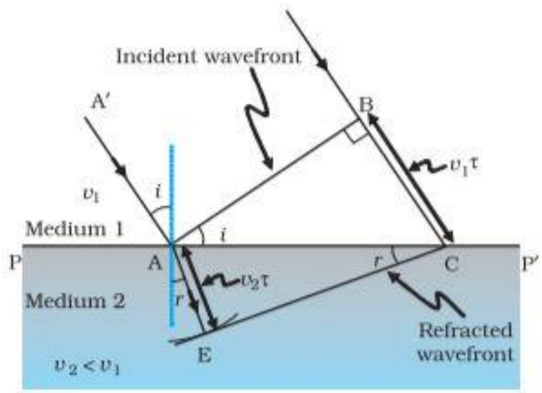
$$\frac{1}{v_o} - \frac{1}{(-1.5)} = \frac{1}{1.25}$$

$v_o = 7.5\,\text{cm}$ ½

$L = |v_o| + |f_e|$ as final image is formed at infinity ($v_e = \infty, u_e = f_e$) ½

L = 7.5 + 5

L= 12.5 cm ½

	OR (b) (i) Explaining the refraction of a plane wavefront 1 Verification of Snell's law 2 (ii) Deducing that a convex mirror always produces a virtual image of an object 2		
	(i) 	1	
	$\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$	½	
	$\sin r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$	½	
	$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$ $\frac{\sin i}{\sin r} = \frac{c/n_1}{c/n_2}$	½	
	$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$ or $n_1 \sin i = n_2 \sin r$	½	
	(ii) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$	½	
	$u < 0$, $f > 0$ $\frac{1}{v} + \frac{1}{(-u)} = \frac{1}{f}$	½	
	$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$	½	
	$\frac{1}{v}$ is positive $\therefore$ v is positive $\Rightarrow$ virtual image	½	5

32.

(i) Finding the amount of work done	2
(ii) Finding	
(I) The electric field at their common centre	1
(II) The potential at their common centre	2

(a)

(i) $V = -\int \vec{E}\cdot\overrightarrow{dr}$

$= -\int 40\,x\,dx$

$= -20\,x^2$ ½

Potential at A (0, 3m), $V_A = 0$

Potential at B (5m, 0), V_B = -500 V ½

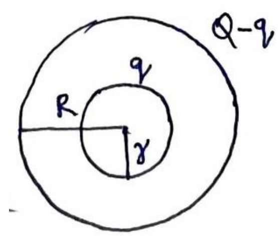
Work done in taking a unit positive charge from a point (0, 3m) to the point (5m, 0)

$W = q(V_B - V_A)$ ½

$= 1(-500 - 0)$

$W = -500\,J$ ½

(ii) (I) Electric field at the common centre will be zero as the charge enclosed by the inner sphere is zero. 1



Alternatively: $q_{en} = 0$ ½

$\phi_E = 0$

$\oint \vec{E}.\overrightarrow{ds} = 0$

$E = 0$ ½

(II) ∵ Surface charge densities are equal

$$\frac{q}{4\pi r^2} = \frac{Q-q}{4\pi R^2}$$ ½

$$q = \frac{Qr^2}{R^2 + r^2}$$ ½

Potential at common centre

$$V = \frac{kq}{r} + \frac{k(Q-q)}{R}$$ ½

$$V=\frac{k}{r}\frac{Qr^2}{(R^2+r^2)}+\frac{k}{R}\left[Q-\frac{Qr^2}{(R^2+r^2)}\right]$$

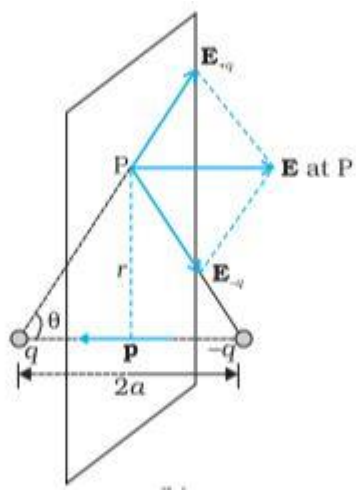
$$V=\frac{kQ(R+r)}{R^2+r^2}$$ ½

OR

(b)

(i)	Obtaining expression for electric field due to a dipole on its equatorial plane	2
	Finding electric field:	
	(I) At centre of the dipole	½
	(II) At a point r >> a	½
(ii)	Calculating net electric flux through cube	2

(i)



½

The magnitudes of the electric field due to two charges +q and -q are

$$E_{+q}=\frac{q}{4\pi\varepsilon_0}\frac{1}{\left(r^2+a^2\right)}$$

$$E_{-q}=\frac{q}{4\pi\varepsilon_0}\frac{1}{\left(r^2+a^2\right)}$$ ½

The total electric field

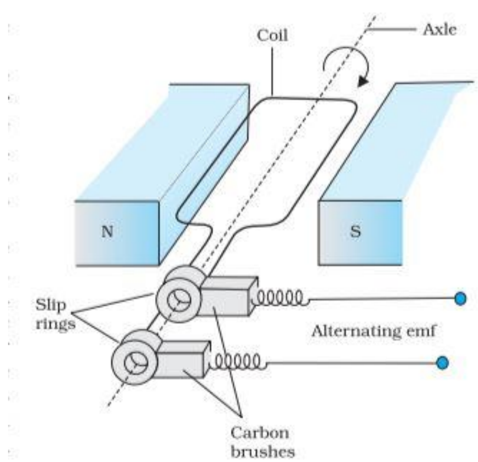
$$\vec{E}=-\left(E_{+q}+E_{-q}\right)\cos\theta\,\hat{p}$$

$$\vec{E}=-\frac{\vec{p}}{4\pi\varepsilon_0\left(r^2+a^2\right)^{3/2}}$$ ½

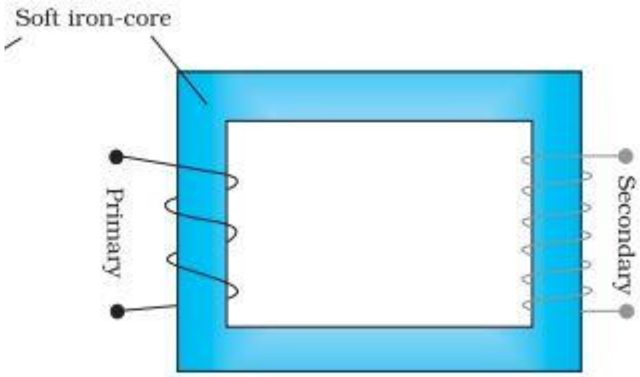
Direction of electric field is opposite to dipole moment ($\vec{p}$) ½

(I) At centre of dipole, r = 0

$$\vec{E}=-\frac{-\vec{p}}{4\pi\varepsilon_0 a^3}$$ ½

	(II) At a point r>>a $\vec{E} = -\dfrac{-\vec{p}}{4\pi\varepsilon_0 r^3}$ (ii) $\vec{E} = (10x+5)\hat{i}$ N/C $\phi_L = \int \vec{E}.\vec{ds}$ $= -E_L(L^2)$ $= -5L^2$ $\phi_R = E_R(L^2)$ $= (10L+5)L^2$ $\phi_{net} = \phi_L + \phi_R$ $= -5L^2 + (10L+5)L^2$ $= 10L^3 \;\; \text{Nm}^2/\text{C}$	½ ½ ½ ½ ½	5
33.	**(a)** (i) Writing principle of ac generator 1 Labelled diagram of ac generator 1 Working of ac generator 1 (ii) Finding rms voltages across three circuit elements 1½ Explanation of the algebraic sum of rms voltages across three circuit elements is more than the rms voltage source ½ **(i) Principle:** It works on the principle of electromagnetic induction.  **Working:** The coil is mechanically rotated in the uniform magnetic field. The rotation of the coil causes the magnetic flux through it to change, so an emf is induced in the coil. (i) $Z = \sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega C}\right)^2}$	1 1 1	

	$= \sqrt{(400)^2 + \left(100\pi \times \frac{5}{\pi} - \frac{1}{100\pi \times \frac{50}{\pi} \times 10^{-6}}\right)^2}$ $= 500\,\Omega$ $I_{rms} = \frac{V_{rms}}{Z}$ $I_{rms} = \frac{140}{\sqrt{2} \times 500} = \frac{0.28}{\sqrt{2}}$ A $(V_{rms})_R = I_{rms}\ R$ $= \frac{0.28}{\sqrt{2}} \times 400$ $= \frac{112}{\sqrt{2}} = 56\sqrt{2}$ V $(V_{rms})_L = I_{rms}\ \omega \mathrm{L}$ $= \frac{0.28}{\sqrt{2}} \times 500$ $= \frac{140}{\sqrt{2}} = 70\sqrt{2}$ V $(V_{rms})_C = I_{rms}\ \frac{1}{\omega C}$ $= \frac{0.28}{\sqrt{2}} \times 200$ $= \frac{56}{\sqrt{2}} = 28\sqrt{2}$ V The algebraic sum of voltages is more than the rms voltage of source because voltages across R, L and C are not in phase.	½ ½ ½ ½		
	OR **(b)** (i) Writing principle of transformer — 1 Labelled diagram of step-up transformer — 1 Working of step-up transformer — 1 (ii) Finding- • rms value of input current — 1 • expression for instantaneous output voltage — ½ • expression for instantaneous output current — ½			

	(i) **Principle**: It works on the principle of mutual induction.  **Working:** When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf in it. Since the no. of turns are more in secondary windings an emf induced is proportional to the no. of turns. Therefore more emf is developed across the secondary windings.	1 1 1	
	(ii) $P_i = V_p I_p$ $200 = \frac{20}{\sqrt{2}} I_p$ $I_p = 10\sqrt{2}\text{A}$ $\frac{V_o}{V_i} = \frac{250}{50}$ $5 = \frac{V_o}{V_i}$ $V_o = 100\sin(100\pi)\,\text{t V}$ $\text{P}_o = (V_o)_{rms}(I_o)_{rms}$ $200 = \frac{100}{\sqrt{2}}(I_o)_{rms}$ $(I_o)_{rms} = 2\sqrt{2}\text{A}$ $\therefore I_o = (2\sqrt{2})\sqrt{2}\sin(100\pi)\,\text{t}$ $I_o = 4\sin(100\pi)\,\text{t A}$	½ ½ ½ ½	5

Marking Scheme
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(For Internal and Restricted use only)
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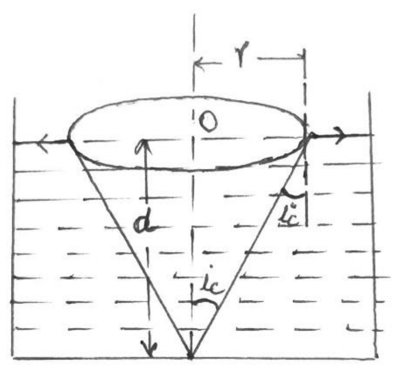
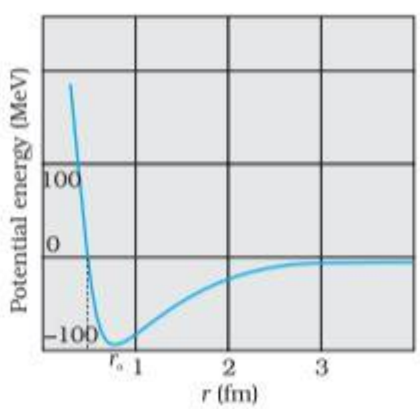
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

11	A full scale of marks 70 (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totaling on the title page. ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

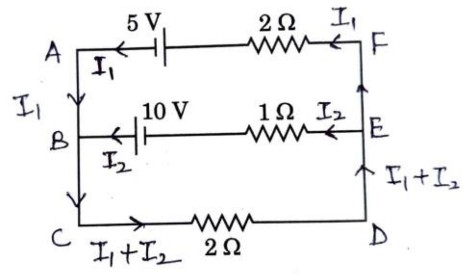
MARKING SCHEME: PHYSICS(042)			
Code: 55/6/3			
Q.No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
	SECTION A		
1.	(D) 2	1	1
2.	(C) $2I_0$	1	1
3.	(C) $\left[\frac{mv^2}{qE}\right] in\, X-Y\ plane$	1	1
4.	(C) g	1	1
5.	(D) $F_{pp}=F_{pn}=F_{nn}$	1	1
6.	(A) 10 V	1	1
7.	(B) $\frac{1}{2}$	1	1
8.	(C) $\left[\frac{n^2-1}{n}\right]R$	1	1
9.	(D) does not move at all	1	1
10.	(D) linear momentum	1	1
11.	(C) small resistance in parallel	1	1
12.	(B) 1.326×10^{-27}	1	1
13.	(D) Both Assertion (A) and Reason (R) are false.	1	1
14.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
15.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	1	1
16.	(C) Assertion (A) is true, But Reason (R) is false.	1	1
	SECTION - B		
17.	Explanation for higher electron concentration in n-type semiconductor in comparison to hole concentration 2 In a doped semiconductor the total number of conduction electrons is due to the electrons contributed by donors and those generated intrinsically, while the total number of holes is only due to the holes from the intrinsic sources.	2	2

18.	(a) Difference between velocity and drift velocity of electrons in a conductor 1 (b) Find the cross-sectional area of the wire 1 (a) **Velocity** is the rate of change of displacement with time. **Drift velocity** is the average velocity of free electrons under the influence of external electric field. (b) $I = neAv_d$ $A = \frac{I}{nev_d}$ $A = \frac{3.4}{8.5\times10^{28}\times1.6\times10^{-19}\times0.2\times10^{-3}}$ $A = 1.25\times10^{-6}\ \text{m}^2$	½ ½ ½ ½	2
19.	(a) Finding the intensity for path difference of (i) $\frac{\lambda}{3}$ 1 (ii) $\frac{\lambda}{2}$ 1 (i) $\Delta\phi = \frac{2\pi}{\lambda}.\Delta x$ $\Delta\phi = \frac{2\pi}{\lambda}.\frac{\lambda}{3} = \frac{2\pi}{3}$ $I = 4I_0\cos^2\frac{\phi}{2}$ $I = 4I_0\cos^2\frac{\pi}{3}$ $I = I_0$ (ii) $\Delta\phi = \frac{2\pi}{\lambda}.\frac{\lambda}{2} = \pi$ $I = 4I_0\cos^2\frac{\pi}{2}$ $I = 0$ OR	½ ½ ½ ½	2

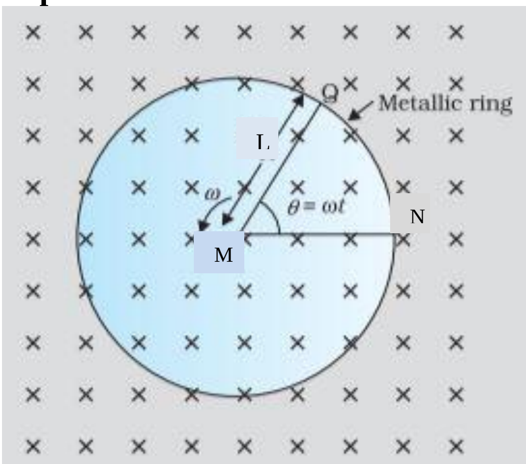
	(b) Finding- The position of the image 1½ The nature of the image ½ $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ $\frac{1.5}{v} - \frac{1}{(-12)} = \frac{1.5-1}{30}$ v = -22.5 cm Image is virtual and erect.	½ ½ ½ ½	
20.	Theoretical justification for same value of distance of closest approach 2 For a given nucleus, the distance of closest approach for a charged particle depends only on the accelerating potential difference. Since both α -particle and a deuterium ion are accelerated through same potential difference, therefore distance of closest approach will be same for both. **Note:** Award 1 mark if a student proves it mathematically.	2	2
21.	Calculating the diameter of opaque disc on the liquid surface 2 $\sin i_c = \frac{1}{\sqrt{2}}$ $i_c = 45^0$ $\tan i_c = \frac{r}{d}$ $r = d \tan 45^0$ $r = 30 \times 1 \text{ cm}$ $D = 2r = 60 \text{ cm}$  **Alternatively:** $D = 2r = \frac{2d}{\sqrt{n^2 - 1}}$ $= \frac{2 \times 30}{\sqrt{(\sqrt{2})^2 - 1}}$ $D = 60 \text{cm}$	½ ½ 1 1 ½ ½	2

	SECTION - C		
22.	Naming the electromagnetic waves 1½ Writing wavelength range 1½ The electromagnetic waves used are (i) Microwaves (ii) Ultraviolet / Infrared (iii) X-rays Wavelength range of electromagnetic waves used (i) 0.1 m to 1 mm (ii) 400 nm to 1 nm / 1mm to 700 nm (iii) 1 nm to 10^{-3} nm	 ½ ½ ½ ½ ½ ½	 3
23.	(a) Differentiating between 'Nuclear fission' and 'Nuclear fusion' with example 1 + 1 (b) Drawing the graph 1 (a) **Nuclear fission** is the process of splitting up of a heavy nucleus into lighter ones with a release of energy. $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{236}_{92}U \rightarrow ^{144}_{56}Ba + ^{89}_{36}Kr + 3^{1}_{0}n$ (or any other reaction) **Nuclear fusion** is the process of fusing of two lighter nuclei to form a heavier nucleus with the release of energy. $^{1}_{1}H + ^{1}_{1}H \rightarrow ^{2}_{1}H + e^{+} + \nu + 0.42\,\text{MeV}$ (or any other reaction) (b)  	 ½ ½ ½ ½ 1	 3
24.	Finding- (i) The torque acting on the loop 1 (ii) The magnitude and direction of net force 2		

	(i) $\tau = mB\sin\theta$ As $\vec{m}$ and $\vec{B}$ are in same direction, $\theta = 0^0$ $\tau = 0$ (ii) $F = \frac{\mu_0 I_1 I_2 l}{2\pi r}$ $F_{net} = \frac{\mu_0 I_1 I_2 l}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ $= \frac{4\pi \times 10^{-7} \times 2 \times 1 \times 5 \times 10^{-2}}{2\pi \times 10^{-2}}\left(1 - \frac{1}{2}\right)$ $F_{net} = 1 \times 10^{-6}$ N Net force on the loop is towards the long straight wire.	½ ½ ½ ½ ½ ½	3
25.	(a) Calculating • Object distance 1 • Image distance 1 (b) Justification if the silver coating around the centre of a concave mirror is removed 1 (a) $m = -\frac{v}{u}$ $-2 = -\frac{v}{u}$ $v = 2u$ $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ $\frac{1}{-10} = \frac{1}{2u} + \frac{1}{u}$ $u = -15$ cm $v = -30$ cm (b) Yes, same image is formed with reduced intensity, because reflecting area get reduced and laws of reflection still hold good for remaining part of the mirror.	½ ½ ½ ½ 1	3
26.	Stating Kirchoff's laws ½ + ½ Finding the values of current in all the three branches 2 **Junction rule:** At any junction, the sum of the currents entering the junction is equal to the sum of the currents leaving the junction. **Loop rule:** the algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero.	½ ½	

	In closed loop $BCDEB$ $\quad 2I_1+3I_2=10 \quad -----(1)$ In closed loop $ABCDEFA$ $\quad 4I_1+2I_2=-5 \quad -----(2)$ On solving eq. (1) and (2) $I_1=-\frac{35}{8}\text{A}$ $\quad$ *in arm AF* $I_2=\frac{25}{4}\text{A}$ $\quad$ *in arm BE* $I_1+I_2=-\frac{15}{8}\text{A}$ $\quad$ *in arm CD* 	½ ½ ½ ½	3
27.	Finding the value of- (i) Angular momentum of electron 1 (ii) Radius of the orbit 1 (iii) Kinetic energy of electron 1 (i) $L=\frac{nh}{2\pi}$ *for* $n=2$ $L=\frac{2\times6.63\times10^{-34}}{2\times3.14}$ $=2.11\times10^{-34}\ kg\,m^2\,s^{-1}$ (ii) $r_n=n^2r_0$ $r_2=4(0.5\overset{0}{\text{A}})$ $r_2=2\overset{0}{\text{A}}$ (iii) Total energy of electron $=-\frac{13.6}{n^2}$ eV $E=-3.4\text{eV} \quad (n=2)$ $K=-E$ $K=3.4\text{eV}$	½ ½ ½ ½ ½ ½	3
28.	(a) Stating Lenz's law 1 Obtaining expression for induced emf 2 **Lenz's law** The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it.	1	

Expression of induced emf



The magnitude of the emf generated across the length dr of the rod as it moves at right angles to the magnetic field is given by

$d\varepsilon = B\mathrm{v}\,dr$ ½

$\varepsilon = \int d\varepsilon$

$= \int_0^L B\mathrm{v}\,dr$ ½

$\varepsilon = \int_0^L B\omega r\,dr$ ½

$\varepsilon = \frac{1}{2}BL^2\omega$ ½

Alternatively:

Area of the sector (QMN) = $\frac{1}{2}L^2\theta$ ½

Induced emf is $\varepsilon = B\times\frac{d}{dt}\left(\frac{1}{2}L^2\theta\right)$ ½

$\varepsilon = \frac{1}{2}BL^2\frac{d\theta}{dt}$ ½

$\varepsilon = \frac{1}{2}BL^2\omega$ ½

OR

(b)

Definition of self inductance	1
Deriving expression for self inductance for a long solenoid	2

Self inductance of a coil is the ratio of the flux linkage to the current flowing in the coil. 1

Alternatively:

	Self inductance of a coil is defined as the flux linked with the coil when unit current flows through it. **Alternatively**: Self inductance of a coil may be defined as the magnitude of emf induced in the coil when current changes at the rate of 1 A/s in the coil. **Expression for self inductance of a long solenoid:** The magnetic field due to current flowing in the solenoid, B = $\mu_0 nI$ Total flux linked with the given solenoid $N\phi_B = (nl)(\mu_0 nI)\,\mathrm{A}$ $N\phi_B = \mu_0 n^2\,\mathrm{A}\,lI$ Self inductance $L = \frac{N\phi_B}{I}$ $L = \mu_0 n^2\,\mathrm{A}\,l$	½ ½ ½ ½	3
	SECTION – D		
29.	(i) (a) (D) 6 OR (b) (B) $\frac{2K}{K+1}$ (ii) (C) $\frac{1}{2}\varepsilon_0 E^2 V$ (iii) (B) $\frac{\sigma}{\sigma - \sigma_p}$ (iv) (A) $\left(\frac{C}{4}\right)$	1 1 1 1	4
30.	(i) (a) (B) The applied voltage mostly drops across the depletion region OR (b) (C) 100 Hz (ii) (B) A layer of positive charge on n side and a layer of negative charge on p side appear (iii) (C) 0.05 eV (iv) (B) Antimony	1 1 1 1	4

SECTION – E

31.

(i)	Finding the amount of work done	2
(ii)	Finding	
(I)	The electric field at their common centre	1
(II)	The potential at their common centre	2

(a)

(i) $V = -\int \vec{E} \cdot \overrightarrow{dr}$

$= -\int 40\, x\, dx$

$= -20\, x^2$ ½

Potential at A (0, 3m), $V_A = 0$

Potential at B (5m, 0), V_B = -500 V ½

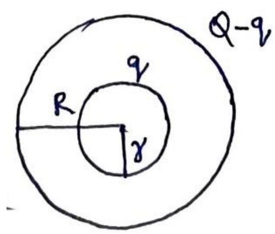
Work done in taking a unit positive charge from a point (0, 3m) to the point (5m, 0)

$W = q(V_B - V_A)$ ½

$= 1(-500 - 0)$

$W = -500\,J$ ½

(ii) (I) Electric field at the common centre will be zero as the charge enclosed by the inner sphere is zero. 1



Alternatively: $q_{en} = 0$ ½

$\phi_E = 0$

$\oint \vec{E}.\overrightarrow{ds} = 0$

$E = 0$ ½

(II) $\because$ Surface charge densities are equal

$\frac{q}{4\pi r^2} = \frac{Q-q}{4\pi R^2}$ ½

$q = \frac{Qr^2}{R^2 + r^2}$ ½

Potential at common centre

$V = \frac{kq}{r} + \frac{k(Q\text{-}q)}{R}$ ½

$$V=\frac{k}{r}\frac{Qr^2}{(R^2+r^2)}+\frac{k}{R}\left[Q-\frac{Qr^2}{(R^2+r^2)}\right]$$

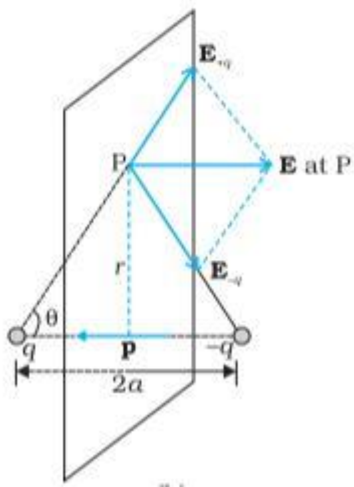
$$V=\frac{kQ(R+r)}{R^2+r^2}$$ ½

OR

(b)

(i)	Obtaining expression for electric field due to a dipole on its equatorial plane	2
	Finding electric field:	
	(I) At centre of the dipole	½
	(II) At a point r >> a	½
(ii)	Calculating net electric flux through cube	2

(i)



½

The magnitudes of the electric field due to two charges +q and -q are

$$E_{+q}=\frac{q}{4\pi\varepsilon_0}\frac{1}{\left(r^2+a^2\right)}$$

$$E_{-q}=\frac{q}{4\pi\varepsilon_0}\frac{1}{\left(r^2+a^2\right)}$$ ½

The total electric field

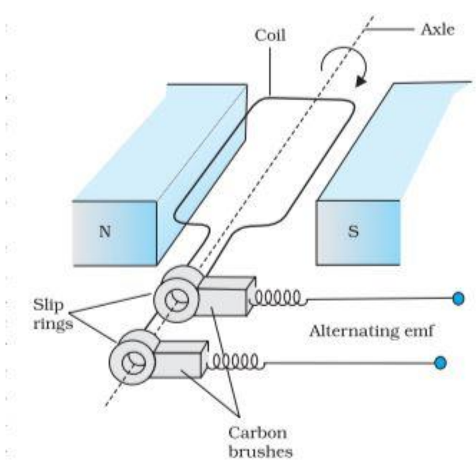
$$\vec{E}=-\left(E_{+q}+E_{-q}\right)\cos\theta\,\hat{p}$$

$$\vec{E}=-\frac{\vec{p}}{4\pi\varepsilon_0\left(r^2+a^2\right)^{3/2}}$$ ½

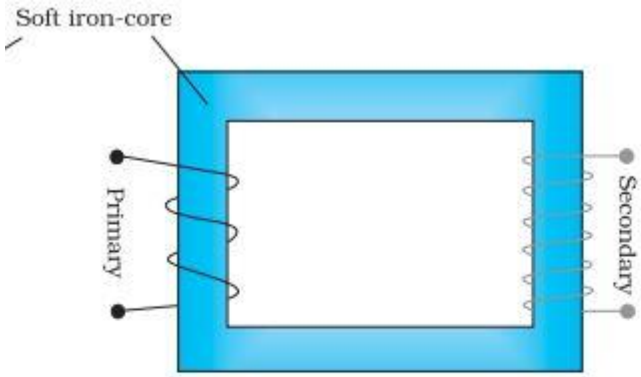
Direction of electric field is opposite to dipole moment ($\vec{p}$) ½

(I) At centre of dipole, r = 0

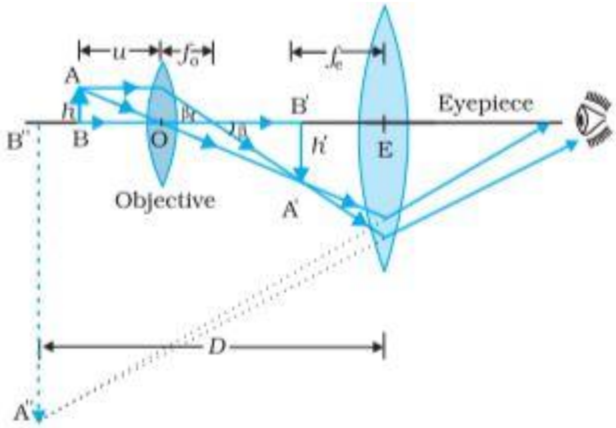
$$\vec{E}=-\frac{-\vec{p}}{4\pi\varepsilon_0 a^3}$$ ½

	(II) At a point r>>a $\vec{E} = -\frac{-\vec{p}}{4\pi\varepsilon_0 r^3}$	½	
	(ii) $\vec{E} = (10x+5)\hat{i}$ N/C $\phi_L = \int \vec{E}.\vec{ds}$ $= -E_L(L^2)$ $= -5L^2$ $\phi_R = E_R(L^2)$ $= (10L+5)L^2$ $\phi_{net} = \phi_L + \phi_R$ $= -5L^2 + (10L+5)L^2$ $= 10L^3 \ \ \mathrm{Nm^2/C}$	½ ½ ½ ½	5
32.	**(a)** (i) Writing principle of ac generator 1 Labelled diagram of ac generator 1 Working of ac generator 1 (ii) Finding rms voltages across three circuit elements 1½ Explanation of the algebraic sum of rms voltages across three circuit elements is more than the rms voltage source ½ **(i) Principle:** It works on the principle of electromagnetic induction.	1	
		1	
	Working: The coil is mechanically rotated in the uniform magnetic field. The rotation of the coil causes the magnetic flux through it to change, so an emf is induced in the coil.	1	
	(i) $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$		

	$= \sqrt{(400)^2 + \left(100\pi \times \frac{5}{\pi} - \frac{1}{100\,\pi \times \frac{50}{\pi} \times 10^{-6}}\right)^2}$ $= 500\,\Omega$ $I_{rms} = \frac{V_{rms}}{Z}$ $I_{rms} = \frac{140}{\sqrt{2} \times 500} = \frac{0.28}{\sqrt{2}}$ A $(V_{rms})_R = I_{rms}\ R$ $= \frac{0.28}{\sqrt{2}} \times 400$ $= \frac{112}{\sqrt{2}} = 56\sqrt{2}$ V $(V_{rms})_L = I_{rms}\ \omega$L $= \frac{0.28}{\sqrt{2}} \times 500$ $= \frac{140}{\sqrt{2}} = 70\sqrt{2}$ V $(V_{rms})_C = I_{rms}\ \frac{1}{\omega C}$ $= \frac{0.28}{\sqrt{2}} \times 200$ $= \frac{56}{\sqrt{2}} = 28\sqrt{2}$ V The algebraic sum of voltages is more than the rms voltage of source because voltages across R, L and C are not in phase. **OR** **(b)** (i) Writing principle of transformer 1 Labelled diagram of step-up transformer 1 Working of step-up transformer 1 (ii) Finding- • rms value of input current 1 • expression for instantaneous output voltage ½ • expression for instantaneous output current ½	½ ½ ½ ½	

	(i) **Principle**: It works on the principle of mutual induction.	1	
		1	
	Working: When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf in it. Since the no. of turns are more in secondary windings an emf induced is proportional to the no. of turns. Therefore more emf is developed across the secondary windings.	1	
	(ii) $P_i = V_p I_p$	½	
	$200 = \frac{20}{\sqrt{2}} I_p$	½	
	$I_p = 10\sqrt{2}\text{A}$		
	$\frac{V_o}{V_i} = \frac{250}{50}$		
	$5 = \frac{V_o}{V_i}$		
	$V_o = 100\sin(100\pi)\,\text{t V}$	½	
	$\text{P}_o = (V_o)_{rms}\,(I_o)_{rms}$		
	$200 = \frac{100}{\sqrt{2}}(I_o)_{rms}$		
	$(I_o)_{rms} = 2\sqrt{2}\text{A}$		
	$\therefore I_o = (2\sqrt{2})\sqrt{2}\sin(100\pi)\,\text{t}$		
	$I_o = 4\sin(100\pi)\,\text{t A}$	½	5
33.	(a)		
	(i) Drawing ray diagram of compound microscope — 1½		
	Obtaining an expression for total magnification — 1½		
	(ii) Calculating distance between the objective and the eye-piece — 2		

(i)



1½

Note: Deduct ½ mark for not showing arrows with the rays.

Magnification produced by objective

$$m_0 = \frac{h'}{h} = \frac{L}{f_o}$$ ½

Magnification produced by eye-piece

$$m_e = 1 + \frac{D}{f_e}$$

If the final image is formed at infinity

$$m_e = \frac{D}{f_e}$$ ½

Total magnification

$$m = m_0 \times m_e$$

$$= \left(\frac{L}{f_o}\right)\left(\frac{D}{f_e}\right)$$ ½

(i) $$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_0}$$ ½

$$\frac{1}{v_o} - \frac{1}{(-1.5)} = \frac{1}{1.25}$$

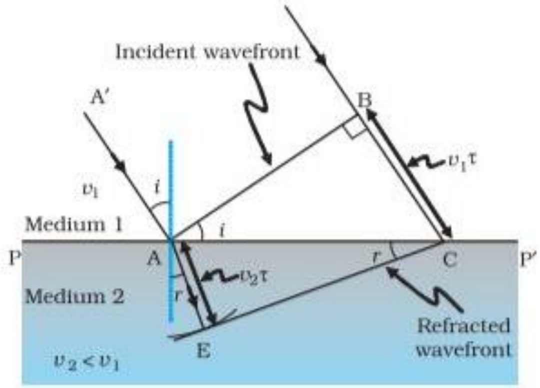
$v_o = 7.5\text{cm}$ ½

$L = |v_o| + |f_e|$ as final image is formed at infinity ($v_e = \infty, u_e = f_e$) ½

L = 7.5 + 5

L= 12.5 cm ½

OR

	(ii) (i) Explaining the refraction of a plane wavefront 1 Verification of Snell's law 2 (ii) Deducing that a convex mirror always produces a virtual image of an object 2 (i)  	1	
	$\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$	½	
	$\sin r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$	½	
	$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$ $\frac{\sin i}{\sin r} = \frac{c/n_1}{c/n_2}$	½	
	$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$ or $n_1 \sin i = n_2 \sin r$	½	
	(ii) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $u < 0$, $f > 0$	½	
	$\frac{1}{v} + \frac{1}{(-u)} = \frac{1}{f}$	½	
	$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$ $\frac{1}{v}$ is positive	½	
	$\therefore$ v is positive $\Rightarrow$ virtual image	½	5