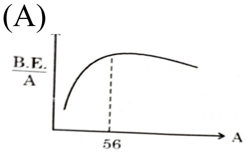
Marking Scheme Strictly Confidential (For Internal and Restricted use only) Senior School Certificate Examination, 2025 SUBJECT NAME PHYSICS (PAPER CODE 55/1/1)	
General Instructions: -	
1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. 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

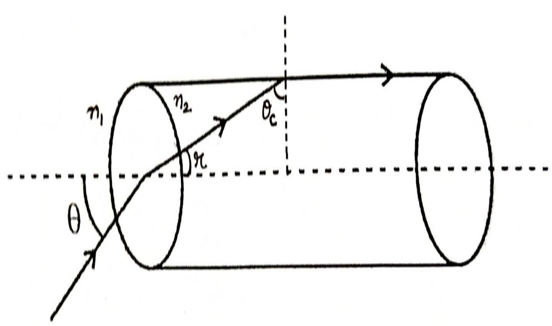
	deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number 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: 55/1/1

Q.No	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
	SECTION A		
1	(A) $q_2 < q_3 < q_1$	1	1
2	(C) $\frac{R}{8}$	1	1
3	(B) $\left(-3\hat{j}+2\hat{k}\right)\mu N$	1	1
4	(B) 0.30 C	1	1
5	(B) 2866	1	1
6	(D) $\frac{i_0 v_0}{2}\cos\phi$	1	1
7	(A) X- rays , Micro waves , UV radiation	1	1
8	(B) $\frac{3H}{4}$	1	1
9	(C) $\frac{h}{m}$	1	1
10	(B) $\lambda_e > \lambda_p > \lambda_d$	1	1
11	(A) 	1	1
12	(C) The barrier height and the depletion layer width both decrease.	1	1
13	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1
14	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1
15	(C) Assertion (A) is true but Reason (R) is false.	1	1
16	(D) Assertion (A) is false and Reason (R) is also false.	1	1
	SECTION - B		
17	Calculating the value of E 1 Calculating the value of r 1 $E = V + Ir$ In first case E = 5 + 2r In second case E = 4 + 4r After solving	 ½ ½	

	E= 6 V r = 0.5 Ω	½ ½	2
18	(a) **Calculating the width of the slit** 2 Condition for Minima a sinθ = nλ For First Minima n=1 $a \sin 30^\circ = 600 \times 10^{-9}$ m $a \times \frac{1}{2} = 600 \times 10^{-9}$ m $a = 1200 \times 10^{-9}$ m $= 1.2 \times 10^{-6}$ m OR (b) **Finding the Intensity** 2 Phase difference = $\frac{2\pi}{\lambda} \times$ path difference $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ $\because \Delta x = \frac{\lambda}{8}\ (given)$ $\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = I_\circ + I_\circ + 2\sqrt{I_\circ I_\circ}\cos\frac{\pi}{4}$ $= 2I_\circ + 2I_\circ \times \frac{1}{\sqrt{2}}$ $I = 2I_\circ\left(1 + \frac{1}{\sqrt{2}}\right)$ $= I_\circ(2 + \sqrt{2})$ $I = 3.414\,I_\circ$ **Alternatively** Phase difference = $\frac{2\pi}{\lambda} \times$ path difference	 1 ½ ½ ½ ½ ½ ½ ½	

	$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ $\because \Delta x = \frac{\lambda}{8}\ (given)$ $\Delta\phi = \frac{2\pi}{\lambda}\times\frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = 4I_{\circ}\cos^2\left(\frac{\phi}{2}\right)$ $I = 4I_{\circ}\cos^2\left(\frac{\pi}{8}\right)$	½ ½ ½	2
19	Calculating angle θ 2  For critical Angle $\frac{n_2}{n_1} = \frac{1}{\sin\theta_c}$ $n_1=1 \quad n_2=\frac{2}{\sqrt{3}}$ (given) $\frac{2}{\sqrt{3}} = \frac{1}{\sin\theta_c}$ $\sin\theta_c = \frac{\sqrt{3}}{2}$ $\theta_c = 60°$ $r = 90 - \theta_c$ $= 30°$ From Snell's law at air rod interface $n_1 \sin i = n_2 \sin r$	½ ½ ½	

	$n_2 = \frac{\sin\theta}{\sin r}$ $\frac{2}{\sqrt{3}} = \frac{\sin\theta}{\sin 30^0}$ $\frac{2}{\sqrt{3}} \times \frac{1}{2} = \sin\theta$ $\frac{1}{\sqrt{3}} = \sin\theta$ $\theta = \sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$	½	2
20	Proving Time period of Revolution ,T α n^3 2 $T = \frac{2\pi r}{v}$ ---------- (1) From Bohr's quantization condition $mvr = \frac{nh}{2\pi}$ $v = \frac{nh}{2\pi mr}$ ---------- (2) From (1) and (2) $T = \frac{2\pi r}{\left(nh/2\pi mr\right)}$ $T = \frac{2\pi r(2\pi mr)}{nh}$ $T = \frac{4\pi^2 mr^2}{nh}$ From $r = \frac{n^2h^2}{4\pi^2 mke^2}$ $T = \frac{4\pi^2 m}{nh}\left(\frac{n^2h^2}{4\pi^2 mke^2}\right)^2$ $T = \frac{n^3h^3}{4\pi^2 mk^2e^4}$ $\Rightarrow T \alpha n^3$ **Alternatively ---**	½ ½ ½ ½	

	$T=\frac{2\pi r}{v}$ $\because r \,\alpha\, n^2$ and $v\alpha\frac{1}{n}$ $\therefore T \,\alpha\, n^3$	½ ½ ½ ½	2
21	Finding the number of holes 1 One example 1 1 dopant atom for 5×10^7 Si atoms and number density of Si atoms = $5\times10^{28}\ \frac{\text{atoms}}{\text{m}^3}$ (*given*) No. of holes created per m^3 = $\frac{5\times10^{28}}{5\times10^{7}}=10^{21}$ Number of holes created per cubic centimeter $=\frac{10^{21}}{10^{6}}=10^{15}$ Any one example of dopant - Aluminium / Indium / Gallium	 1 1	2
	SECTION - C		
22	(a) Finding (i) Equivalent emf of combination 1 (ii) Equivalent internal resistance of combination 1 (iii) Current drawn from combination 1 (i) Because $E_{eq}=\frac{E_1r_2+E_2r_1}{r_1+r_2}$ $E_{eq}=\frac{3\times0.4+6\times0.2}{0.6}$ = 4 V (ii) $r_{eq}=\frac{r_1r_2}{r_1+r_2}$ $r_{eq}=\frac{0.2\times0.4}{0.2+0.4}=0.133\Omega$ (iii) $I=\frac{E}{R+r_{eq}}$ $I=\frac{4}{4+0.13}=\frac{4}{4.13}A$ $I=0.9A$	 ½ ½ ½ ½ ½ ½	

	OR (b) (i) Finding the relation (i) between R' and R 1 (ii) between v_d' and v_d 1 (ii) To identify whether all free electrons are moving in the same direction. 1 (i) $l' = 2l$ $Al = A'l'$ = volume of the wire $Al = A'(2l)$ $\frac{A}{2} = A'$ $R = \frac{\rho l}{A}$ $R' = \frac{\rho l'}{A'}$ $R' = \frac{\rho(2l)}{A/2}$ $\frac{R'}{R} = 4$ **Alternatively** $R' = n^2 R$ n= 2 $R' = 4R$ (ii) $v_d = \frac{eE}{m}\tau$ $v_d = \frac{eV}{ml}\tau$ $v_d' = \frac{eV}{ml'}\tau$ $\frac{v_d'}{v_d} = \frac{l}{l'} = \frac{1}{2}$ (ii) No	 ½ ½ ½ ½ ½ ½ 1	 3
23	Derivation for Magnetic field on the axis 2 ½ Magnetic field at the centre ½		

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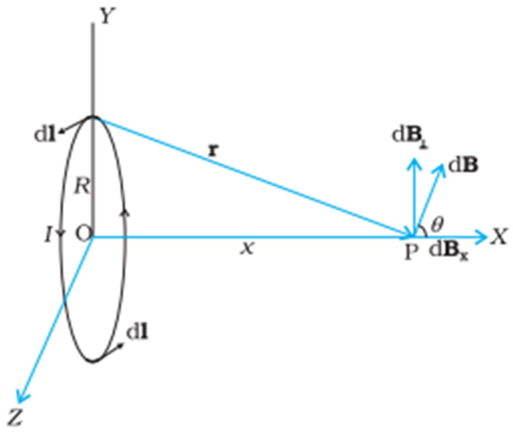
<tr><td></td><td></td><td>½</td><td></td></tr>
<tr><td></td><td>From Biot Savart' s Law
$\left|d\vec{B}\right| = \frac{\mu_\circ}{4\pi}\frac{I\left|d\vec{l}\times\vec{r}\right|}{r^3}$
Now $r^2 = x^2 + R^2$
Because $\left|d\vec{l}\times\vec{r}\right| = rdl$
$\therefore dB = \frac{\mu_\circ}{4\pi}\frac{idl}{(x^2+R^2)}$</td><td>½

½</td><td></td></tr>
<tr><td></td><td>$d\vec{B}$ has two components.
All the components perpendicular to x- axis are summed over and we obtain a null result.
Only x- components contribute. The net contribution along x- direction
$dB_x = dB\cos\theta$
$\cos\theta = \frac{R}{\left(R^2+x^2\right)^{\frac{1}{2}}}$
Thus :
$dB_x = \frac{\mu_\circ i}{4\pi}dl\frac{R}{\left(R^2+x^2\right)^{\frac{3}{2}}}$
Summing dB_x over the entire loop
$\oint dl = 2\pi R$
$\vec{B} = B_x\hat{i} = \frac{\mu_\circ iR^2}{2(x^2+R^2)^{\frac{3}{2}}}\hat{i}$
Magnetic field at the centre of the loop-
Here x= 0
$\therefore\vec{B} = \frac{\mu_\circ i}{2R}\hat{i}$</td><td>½

½

½</td><td>3</td></tr>
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24	a) Deriving the expression for energy stored in an inductor. 1 ½ b) Deriving the energy density of magnetic field. 1 ½		
	a) Induced emf in an inductor $\|\varepsilon\| = L\frac{dI}{dt}$	½	
	Rate of work done at any instant $\frac{dW}{dt} = \|\varepsilon\| I$	½	
	Total Amount of work done in establishing current I $W = \int dW = \int_0^I LIdI$ Energy required to build up current I is $W = \frac{1}{2} L I^2$	½	
	b) The Magnetic Energy is $W = U_B = \frac{1}{2} LI^2$ $= \frac{1}{2} L \left(\frac{B}{n\mu_0}\right)^2$ as $B = n\mu_0 I$	½	
	Using $L = \mu_0 n^2 Al$ $U_B = \frac{1}{2}\left(\mu_0 n^2 Al\right)\left(\frac{B^2}{\mu_0^2 n^2}\right)$	½	
	Energy density $= \frac{U_B}{\text{volume}}$ $\frac{U_B}{\text{volume}} = \frac{1}{2} \times \mu_0 n^2 Al \times \frac{B^2}{\mu_0^2 n^2} \times \frac{1}{Al}$ $= \frac{1}{2}\frac{B^2}{\mu_0}$	½	3
25	a) Showing that ($I_c + I_d$) has the same value. 2 b) Explanation of Kirchhoff's first rule at each plate of capacitor. 1		
	a) ∵ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$	½	
	∴ $I = I_c$ Inside the capacitor $I_c = 0$	½	

	$\therefore\ I = I_d = \varepsilon_0 \frac{d\phi_E}{dt}$ $= \varepsilon_0 \frac{d}{dt}[EA]$ $= \varepsilon_0 \frac{d}{dt}\left[\frac{\sigma}{\varepsilon_0} A\right]$ $= \frac{\varepsilon_0}{\varepsilon_0} A \frac{d}{dt}\left[\frac{Q}{A}\right]$ $I = \frac{dQ}{dt} = I_c$	½ ½	
	Alternatively $\because$ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$ $I = I_d = \varepsilon_0 \frac{d\phi_E}{dt}$ $= \varepsilon_0 \frac{d}{dt}\left[\frac{Q}{\varepsilon_0}\right]$ $I = \frac{dQ}{dt} = I_c$ hence $I_c + I_d$ has the same value at all points of the circuit.	½ ½ ½ ½	
	b) Yes Current entering the capacitor is (I_c) and between the plates capacitor is (I_d) $I_c = I_d$ which validates Kirchhoff's junction rule.	1	3
26	Reason for a) All photoelectrons not having same Kinetic Energy. 1 b) Having different saturation current for different intensity. 1 c) Stopping of emission of photoelectrons at a certain wavelength. 1		
	a) When monochromatic light is incident on a metal surface then more/less tightly bound electrons will emerge with less/more kinetic energy. So all the photoelectrons do not eject with same kinetic energy.	1	
	b) Maximum number of photoelectrons ejected per second (saturation current) is directly proportional to the Intensity of incident radiation Hence saturation current is different for different intensities.	1	

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<td>c) when λ increases , ν decreases and energy of incident photon ($h\nu$) also decreases. When $\lambda > \lambda_0$, $\nu < \nu_0$ (threshold frequency) , no photoelectron is ejected. Emission of photoelectrons stop at $\lambda > \lambda_0$.</td>
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a)	Defining Mass Defect	½
	Defining Binding Energy	½
	Describing Fission Process	½
b)	Calculation of Mass Defect	1
	Calculation of Energy	½

a) Difference in the mass of the nucleus and its constituents is defined as mass defect.
Binding Energy is the energy required to separate the nucleons from the nucleus.
In Fission process a heavy nucleus splits into lighter nuclei and energy is released. As a result the Binding Energy per nucleon increases.
b) $\Delta m = (m_p + m_n) - m_d$
$\Delta m = (1.007277 + 1.008665) - 2.013553$
$\Delta m = 0.002389$ u
Energy released = $\Delta m \times c^2$
Energy released = 0.002389×931.5
= 2.2253 MeV ≈2.22 MeV</td>
<td>½
½

½
½

½

½</td>
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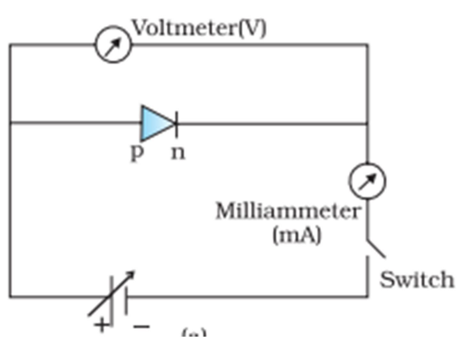
a) Circuit Arrangement for studying V–I characteristics.	1
b) Showing the shape of characteristic curves.	1
c) Two informations from the characteristics	½ + ½

a)



Circuit diagram for forward characteristics</td>
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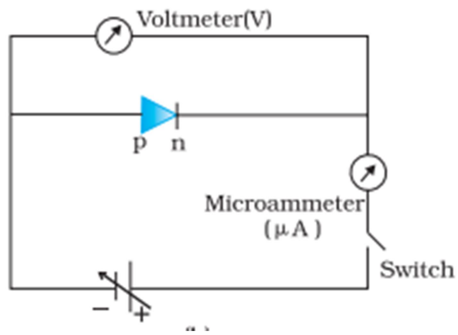
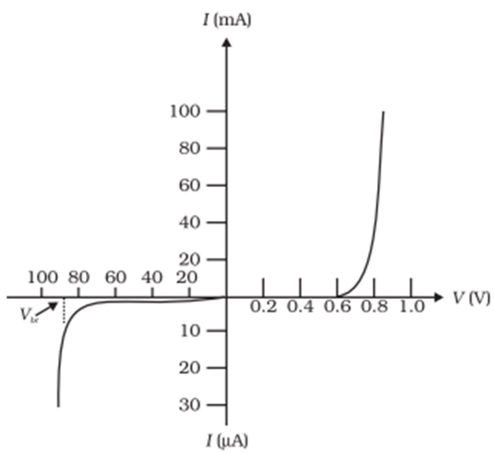
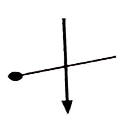
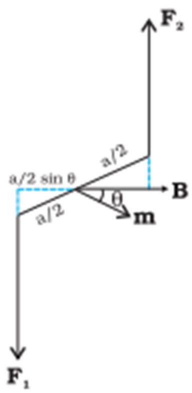
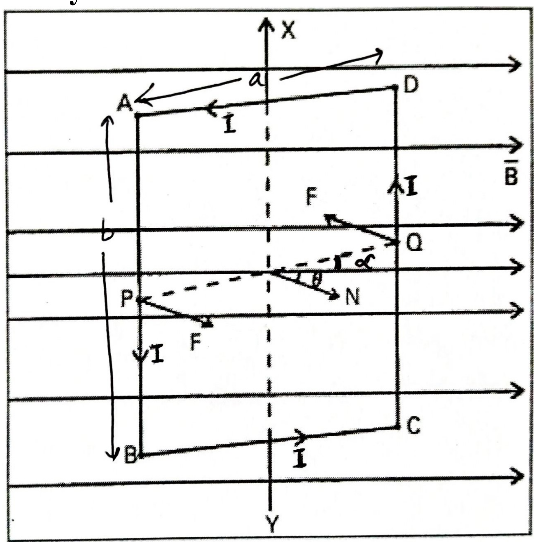
	 Circuit diagram for Reverse characteristics b)  Note : Please do not deduct marks for not writing values. c) Any two informations Knee voltage / reverse saturation current / Breakdown voltage / very low resistance in forward biasing / very high resistance in Reverse biasing.	½ 1 ½ + ½	3
	SECTION - D		
29	i) (B) 5mC ii) (A) zero iii) (D) [$M^0L^0TA^0$] iv) (A) $\frac{1}{2\sqrt{e}}mA$ **Note: 1 mark for this part may be given to all the students who have attempted other parts of the question.** OR (B) 0.5 mA	1 1 1 1	4
30	i) (C)  ii) (A) For a convex mirror magnification is always negative iii) (B) 2f	1 1 1	

	OR (B) 12 cm iv) (C) $\sqrt{X_1 X_2}$	1	4
	SECTION - E		
31	a) i) Calculating the change in electrostatic energy of the system 2 ii) (1) Finding the capacitance. 1 (2) Finding the potential difference. 1 (3) Answering and Reason ½ + ½		
	(i) $\vec{E} = \frac{3\times10^5}{r^2}\hat{r}$ (Given) $dV = -\vec{E}.d\vec{r}$ V = 3 × 10⁵ / r Electrostatic energy of the system in the absence of the field $U_i = \frac{Kq_1q_2}{r_{12}}$	½	
	Electrostatic energy in the presence of the field $U_f = \frac{Kq_1q_2}{r_{12}} + q_1V(\vec{r}_1) + q_2V(\vec{r}_2)$		
	$\Delta U = U_f - U_i = q_1V(\vec{r}_1) + q_2V(\vec{r}_2)$	½	
	$\Delta U = \frac{5\times10^{-6}\times3\times10^5}{3\times10^{-2}} - \frac{1\times10^{-6}\times3\times10^5}{3\times10^{-2}}$	½	
	$= 40$ J	½	
	ii) 1) $C = \frac{Q}{V} = \frac{80}{16} = 5\mu F$	1	
	2) $C' = KC$ $= 3\times5\mu F = 15\ \mu F$	½	
	$V' = \frac{Q}{C'} = \frac{80\mu C}{15\mu F} = 5.33V$	½	
	3) No,	½	
	The capacitance of the system depends on its geometry.	½	
	OR b) i) Comparing the magnitude of the Electric fields 2 ii) Calculating the work done on the charge 3		
	Total charge for A = Total charge for B = Total charge for C = +4q	1	
	As , $E = \frac{kQ}{r^2}$		

	Since Q = 4q and r = 3R $E = \frac{k(4q)}{9R^2} = \frac{4kq}{9R^2}$ $\therefore\ E_A = E_B = E_c$ ii) $V_c = \left[\frac{k\times6\times10^{-6}}{5\times10^{-2}} - \frac{k\times6\times10^{-6}}{5\times10^{-2}}\right]$ $= 0$ $V_A = \left[\frac{k\times6\times10^{-6}}{15\times10^{-2}} - \frac{k\times6\times10^{-6}}{5\times10^{-2}}\right]$ $= \frac{k\times6\times10^{-6}}{10^{-2}}\left[\frac{1-3}{15}\right]$ $= -\frac{9\times10^{9}\times6\times10^{-6}\times2}{15\times10^{-2}}$ $= -7.2\times10^{5}$ V $W = q\left[V_A - V_c\right]$ $= 5\times10^{-6}\left[-7.2\times10^{5} - 0\right]$ W = - 3.6 J	½ ½ 1 ½ ½ ½ ½	5
32	a) i) Finding the direction of magnetic field near points P,Q and R ½ + ½ + ½ Conclusion about the relative magnitude of magnetic field. ½ + ½ + ½ ii) Showing the given expression of magnetic moment. 2 i) <u>Near point P</u> Magnetic field is acting into the plane of the paper as Force is acting upwards. <u>Near point Q</u> Magnetic field is into the plane of paper as force is acting upwards. <u>Near point R</u> Magnetic field is acting out of the plane of the paper as $\vec{F}$ is acting downwards. <u>Relative Magnitude of the Magnetic field.</u> As $B\ \alpha \frac{1}{r}$ Therefore, Near point P, magnitude of B is small. Near point Q, B is relatively smaller than point P. Near point R, B is relatively larger than point P. $(B_Q < B_P < B_R)$ ii) Let r be the radius of the circular coil and I is the current in the coil then	½ ½ ½ ½ ½ ½	

	$B = \frac{\mu_0 I}{2r}$ or $I = \frac{2Br}{\mu_0}$	½	
	$A = \pi r^2$ $\quad\quad r = \sqrt{\frac{A}{\pi}}$	½	
	$M = IA$	½	
	$= \frac{2Br}{\mu_0} A$		
	$= \frac{2BA}{\mu_0}\sqrt{\frac{A}{\pi}}$	½	
	OR		
	b) i) Deriving the expression for the torque. 3 ii) 1) Finding the change in radius. 1 2) Finding the change in time period of Revolution. 1		
	i) 	½	
	$\vec{F}_1$ *and* $\vec{F}_2$ are the forces acting on two arms of the rectangular coil having sides a and b.		
	$\lvert\vec{F}_1\rvert = \lvert\vec{F}_2\rvert = I\,b\,B$ (b = length of the arm)	1	
	Forces constitute a couple. The magnitude of Torque on the loop is –		
	$\tau = F_1 \frac{a}{2}\sin\theta + F_2 \frac{a}{2}\sin\theta$		
	$= I\,a\,\,b B\sin\theta$	½	
	$= IA\,B\sin\theta$	½	
	$\vec{\tau} = I\vec{A}\times\vec{B}$	½	

Alternatively



½

If the plane of the current carrying coil marks an angle ∝ with the magnetic field

$\vec{F}_{DA} = -\vec{F}_{Bc}$ (cancel each other) . ½

Force on the arm DC is into the plane of the paper

$|F_{DC}| = IbB$. ½

Force on the arm AB is out of the plane of the paper.

$|F_{AB}| = IbB$ ½

Both of them form a couple and Torque acting on the coil is

τ=either force ×perpendicular distance between the two forces.

$\tau = IbB \times a\cos\alpha$

$= IabB\cos\alpha$

$\tau = IAB\cos\alpha$ ½

Let $\hat{n}$ =outward drawn normal to the plane of the coil.

$\theta + \alpha = 90^0$

$\alpha = 90^0 - \theta$

$\tau = IAB\cos(90 - \theta)$

$= IAB\sin\theta$ ½

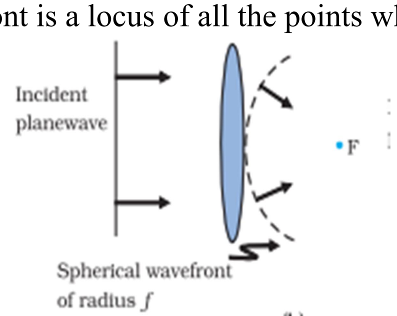
$\vec{\tau} = I\vec{A} \times \vec{B}$

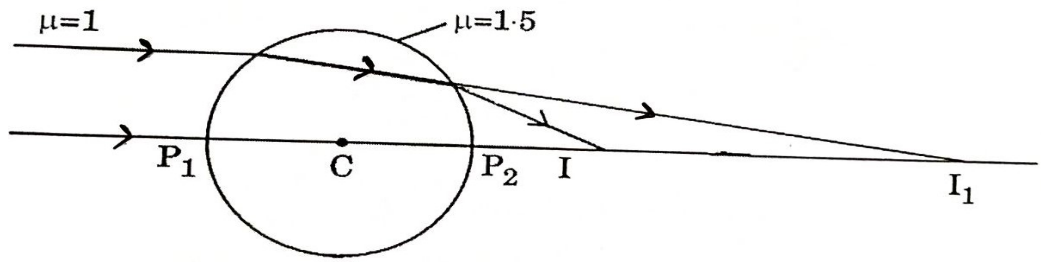
ii) 1) $r = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$ ½

$r \;\alpha\; \sqrt{K}$

$\frac{r'}{r} = \frac{\sqrt{K/2}}{\sqrt{K}} = \frac{1}{\sqrt{2}}$

$r' = \frac{r}{\sqrt{2}}$ ½

	2) $T=\dfrac{2\pi m}{qB}$	½	
	Time period does not depend on Kinetic Energy ∴ Time period will not change.	½	5
33	a) i) 1) Definition of coherent sources. 1 Necessity of coherent sources for sustained interference pattern 1 2) Explanation 1 ii) 1) Finding distance between adjacent bright fringes. 1 2) Finding angular width 1		
	i) 1) If the phase difference between the displacement produced by each of the wave from two sources does not change with time then two sources are said to be coherent.	1	
	Alternatively Two sources are said to be coherent if they emit light continuously of same frequency / wavelength and having zero or constant phase difference. Coherent sources are required to get constant phase difference.	1	
	2) Two independent sources will never be coherent because phase difference between them will not be constant.	1	
	ii) 1) Distance between adjacent bright fringe = fringe width $\beta = \dfrac{\lambda D}{d}$	½	
	$= \dfrac{600\times10^{-9}\times1.2}{0.1\times10^{-3}} = 7.2\,\text{mm}$	½	
	2) $\theta = \dfrac{\lambda}{d}$	½	
	$= \dfrac{600\times10^{-9}}{0.1\times10^{-3}} = 6\times10^{-3}$ rad= 0.34°	½	
	Give full marks if the student writes the answer in radians only. OR		
	b) i) Definition of wave front. 1 Drawing the incident and refracted wave front ½ + ½ ii) Drawing the ray diagram 1 Obtaining the position of final image 2		
	i) A wavefront is a locus of all the points which oscillate in phase.	1	
		½ + ½	

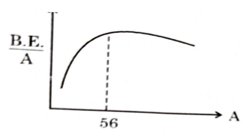
	ii)  From I[st] surface , Refraction is from rarer to denser medium and object is at ∞ $n_1 = 1$, $n_2 = 1.5$, R = 15 cm , u= ∞ $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ $\frac{1.5}{v} - \frac{1}{\infty} = \frac{1.5-1}{15}$ v= 45 cm From 2[nd] surface , Refraction is from denser to rarer medium and object is at 15 cm $n_1 = 1$, $n_2 = 1.5$, R = -15 cm , u= 15cm $\frac{n_1}{v} - \frac{n_2}{u} = \frac{n_1 - n_2}{R}$ $\frac{1}{v} - \frac{1.5}{15} = \frac{1-1.5}{-15}$ v= 7.5 cm	1 ½ ½ ½ ½	5

Marking Scheme Strictly Confidential (For Internal and Restricted use only) Senior School Certificate Examination, 2025 SUBJECT NAME PHYSICS (PAPER CODE 55/1/2)	
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: 55/1/2

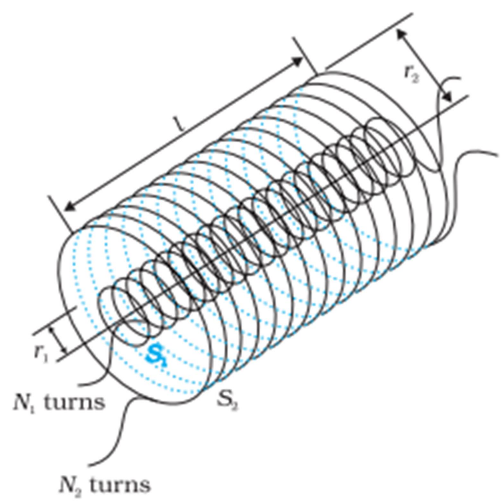
Q.No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
	SECTION A		
1	(C) C	1	1
2	(B) Using a wire of same radius and half length.	1	1
3	(B) $\left(-3\hat{j}+2\hat{k}\right)\mu N$	1	1
4	(C) 2	1	1
5	(B) 2866	1	1
6	(D) $\frac{i_0 v_0}{2}\cos\phi$	1	1
7	(B) Speed — Remains same; Wavelength — Decreases; Frequency — Increases	1	1
8	(A) medium '1' and at an angle greater that $\sin^{-1}\left(\frac{v_1}{v_2}\right)$	1	1
9	(A) 10^{16}	1	1
10	(A) 	1	1
11	(C) The barrier height and the depletion layer width both decrease.	1	1
12	(B) $\lambda_e > \lambda_p > \lambda_d$	1	1
13	(D) Assertion (A) is false and Reason (R) is also 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 Assertion(A).	1	1
16	A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1
	SECTION - B		
17	Obtaining Ohm's law from $\vec{E} = \rho\vec{j}$ — 1 ½ Writing the condition — ½ $\vec{E} = \rho\vec{j}$ $\frac{V}{l} = \rho\frac{I}{A}$	 ½ ½	

	$\frac{V}{I} = \rho \frac{l}{A}$ = constant (Ohm's Law) Condition for non- validity of Ohm's Law High temperature / in semiconductor	½ ½	 2
18	(a) **Calculating the width of the slit 2** Condition for Minima a sinθ = nλ For First Minima n=1 $a \sin 30^\circ = 600 \times 10^{-9}$ m $a \times \frac{1}{2} = 600 \times 10^{-9}$ m $a = 1200 \times 10^{-9}$ m $= 1.2 \times 10^{-6}$ m OR (b) **Finding the Intensity 2** Phase difference = $\frac{2\pi}{\lambda} \times$ path difference $\Delta\phi = \frac{2\pi}{\lambda} \Delta x$ $\because \Delta x = \frac{\lambda}{8}$ (given) $\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = I_\circ + I_\circ + 2\sqrt{I_\circ I_\circ} \cos\frac{\pi}{4}$ $= 2I_\circ + 2I_\circ \times \frac{1}{\sqrt{2}}$ $I = 2I_\circ\left(1 + \frac{1}{\sqrt{2}}\right)$ $= I_\circ(2 + \sqrt{2})$ $I = 3.414\, I_\circ$ **Alternatively**	 1 ½ ½ ½ ½ ½ ½	

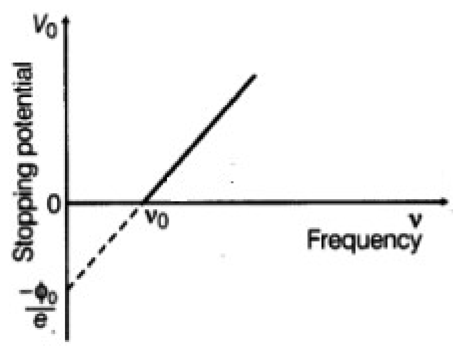
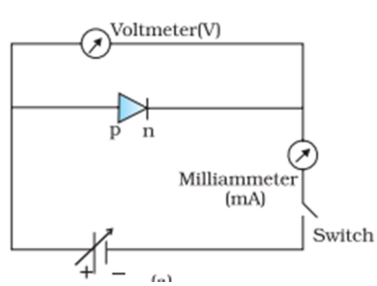
	Phase difference = $\frac{2\pi}{\lambda}\times$ path difference $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ $\because \Delta x = \frac{\lambda}{8}\ (given)$ $\Delta\phi = \frac{2\pi}{\lambda}\times\frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = 4I_{\circ}\cos^2\left(\frac{\phi}{2}\right)$ $I = 4I_{\circ}\cos^2\left(\frac{\pi}{8}\right)$	½ ½ ½ ½	2
19	Finding the position 1½ Nature of the Image formed ½ Refraction from rarer to denser medium $\frac{n_1}{-u}+\frac{n_2}{v}=\frac{n_2-n_1}{R}$ $u=-\frac{R}{2}, n_1=1, n_2=1.5$ $\frac{2}{R}+\frac{1.5}{v}=\frac{1.5-1}{R}$ $\frac{1.5}{v}=\frac{0.5}{R}-\frac{2}{R}$ $\frac{1.5}{v}=-\frac{1.5}{R}$ v = - R The image is virtual in air at distance R.	½ ½ ½ ½	2
20	Finding the Angular momentum 2 $E_n = -\frac{13.6}{n^2}eV$ $n^2 = \frac{-13.6}{-3.4} = 4$ n=2 Angular momentum	½ ½	

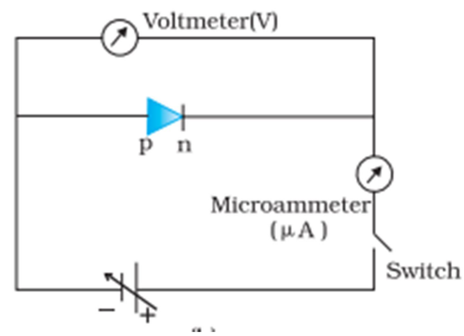
	$L = \frac{nh}{2\pi}$ $L = \frac{h}{\pi} = \frac{6.63\times10^{-34}}{3.14} = 2.11\times10^{-34}$ Js	½ ½	2
21	Finding the number of holes — 1 One example — 1 1 dopant atom for 5×10^{7} Si atoms and number density of Si atoms = $5\times10^{28}\ \frac{\text{atoms}}{\text{m}^3}$ (*given*) No. of holes created per m^3 = $\frac{5\times10^{28}}{5\times10^{7}} = 10^{21}$ Number of holes created per cubic centimeter $= \frac{10^{21}}{10^{6}} = 10^{15}$ Any one example of dopant - Aluminium / Indium / Gallium	1 1	2
	SECTION - C		
22	(a) Finding (i) Equivalent emf of combination — 1 (ii) Equivalent internal resistance of combination — 1 (iii) Current drawn from combination — 1 (i) Because $E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$ $E_{eq} = \frac{3\times0.4+6\times0.2}{0.6} = 4$ V (ii) $r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$ $r_{eq} = \frac{0.2\times0.4}{0.2+0.4} = 0.133\Omega$ (iii) $I = \frac{E}{R + r_{eq}}$ $I = \frac{4}{4+0.13} = \frac{4}{4.13}A$ $I = 0.9A$ OR	½ ½ ½ ½ ½ ½	

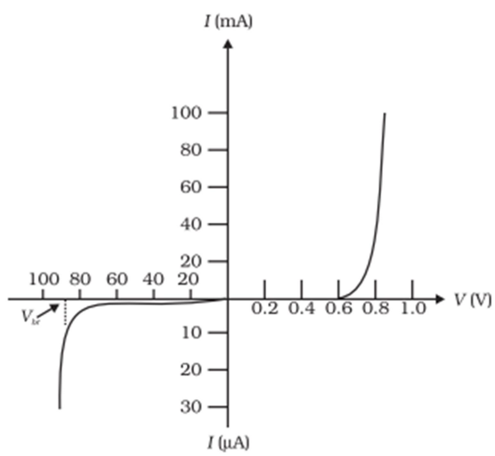
	(b) (i) Finding the relation (i) between R' and R 1 (ii) between v_d' and v_d 1 (ii) To identify whether all free electrons are moving in the same direction. 1		
	(i) $l' = 2l$ $Al = A'l'$ = volume of the wire $Al = A'(2l)$		
	$\frac{A}{2} = A'$	½	
	R $= \frac{\rho l}{A}$ $R' = \frac{\rho l'}{A'}$		
	$R' = \frac{\rho(2l)}{A/2}$	½	
	$\frac{R'}{R} = 4$		
	Alternatively	½	
	$R' = n^2 R$		
	n= 2	½	
	$R' = 4R$	½	
	(ii) $v_d = \frac{eE}{m}\tau$		
	$v_d = \frac{eV}{ml}\tau$ $v_d' = \frac{eV}{ml'}\tau$		
	$\frac{v_d'}{v_d} = \frac{l}{l'} = \frac{1}{2}$	½	
	(ii) No	1	3
23	a) Defining magnetic moment 1 SI unit of magnetic moment ½ b) Finding the magnitude of magnetic field 1½		
	a) Magnetic moment of a current carrying coil is defined as the product of	1	

	current flowing through the coil and Area of the coil. **Alternatively** $\vec{M} = I\vec{A}$ S.I. unit is Am^2	½	
	b) $\tau = NIABsin\theta$ $\tau_1 = 0.12 = 60 \times 2 \times 1.5 \times 10^{-3} \times Bsin\theta$ $Bsin\theta = \frac{2}{3}$	½	
	$\tau_2 = 0.05 = 60 \times 2 \times 1.5 \times 10^{-3} \times Bcos\theta$ $Bcos\theta = \frac{5}{18}$	½	
	$B = \sqrt{B^2\sin^2\theta + B^2\cos^2\theta}$ $= \sqrt{\left(\frac{2}{3}\right)^2 + \left(\frac{5}{18}\right)^2} = \frac{13}{18}T$	½	3
24	Deriving the expression for mutual Inductance 2 Showing $M_{21} = M_{12}$ 1		
		½	
	Let N_1 and N_2 be the total number of turns of coils S_1 and S_2 respectively. When current I_2 is set up in S_2, flux linkage with solenoid S_1 is – $N_1\phi_1 = M_{12}I_2$ --(i)	½	
	$N_1\phi_1 = (n_1 l)(\pi r_1^2)(\mu_0 n_2 I_2)$ $N_1\phi_1 = \mu_0 n_1 n_2 \pi r_1^2 l I_2$ --(ii)	½	
	From (i) and (ii) $M_{12} = \mu_0 n_1 n_2 \pi r_1^2 l$	½	

	Considering Reverse case, when I_1 current is set up in S_1 , flux linkage with S_2 is – $N_2\phi_2 = M_{21}I_1$ --(iii) $N_2\phi_2 = (n_2 l)(\pi r_1^2)(\mu_0 n_1 I_1)$ --(iv) From (iii) and (iv) $M_{21} = n_1 n_2 \pi r_1^2 l$ $\therefore M_{12} = M_{21}$	½ ½	3
25	a) Showing that ($I_c + I_d$) has the same value. 2 b) Explanation of Kirchhoff's first rule at each plate of capacitor. 1 a) $\because$ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$ $\therefore I = I_d = \varepsilon_0 \frac{d\phi_E}{dt}$ $= \varepsilon_0 \frac{d}{dt}[EA]$ $= \varepsilon_0 \frac{d}{dt}\left[\frac{\sigma}{\varepsilon_0} A\right]$ $= \frac{\varepsilon_0}{\varepsilon_0} A \frac{d}{dt}\left[\frac{Q}{A}\right]$ $I = \frac{dQ}{dt} = I_c$ **Alternatively** $\because$ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$ $I = I_d = \varepsilon_0 \frac{d\phi_E}{dt}$ $= \varepsilon_0 \frac{d}{dt}\left[\frac{Q}{\varepsilon_0}\right]$ $I = \frac{dQ}{dt} = I_c$ hence $I_c + I_d$ has the same value at all points of the circuit.	½ ½ ½ ½ ½ ½ ½ ½	

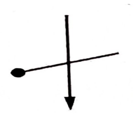
	b) Yes Current entering the capacitor is (I_c) and between the plates capacitor is (I_d) $I_c = I_d$ which validates Kirchhoff's junction rule.	1	3
26	a) Drawing a plot of frequency(ν) as a function of stopping potential (V_0) 1 Obtaining information from intercept ½ b) Calculating i) the momentum 1 ii) de Broglie wavelength ½ a)  Value of work function can be obtained from intercept. b) i) $p=\sqrt{2mK}$ $= \sqrt{2\times9.1\times10^{-31}\times80\times1.6\times10^{-19}}$ $= 4.8 \times10^{-24}$ kg m/s ii) $\lambda=\frac{h}{p}=\frac{6.63\times10^{-34}}{4.8\times10^{-25}}=1.38\times10^{-9}m$	1 ½ ½ ½ ½	3
27	a) Circuit Arrangement for studying V–I characteristics. 1 b) Showing the shape of characteristic curves. 1 c) Two informations from the characteristics ½ + ½ a)  Circuit diagram for forward characteristics	½	

<table>
<tr><td></td><td>

Circuit diagram for Reverse characteristics</td><td>½</td><td></td></tr>
<tr><td></td><td>b)

</td><td>1</td><td></td></tr>
<tr><td></td><td>Note : Please do not deduct marks for not writing values.</td><td></td><td></td></tr>
<tr><td></td><td>c) Any two informations
Knee voltage / reverse saturation current / Breakdown voltage / very low resistance in forward biasing / very high resistance in Reverse biasing.</td><td>½ + ½</td><td>3</td></tr>
<tr><td>28</td><td>

a)	Defining Mass Defect	½
	Defining Binding Energy	½
	Describing Fission Process	½
b)	Calculation of Mass Defect	1
	Calculation of Energy	½

</td><td></td><td></td></tr>
<tr><td></td><td>a) Difference in the mass of the nucleus and its constituents is defined as mass defect.</td><td>½</td><td></td></tr>
<tr><td></td><td>Binding Energy is the energy required to separate the nucleons from the nucleus.</td><td>½</td><td></td></tr>
<tr><td></td><td>In Fission process a heavy nucleus splits into lighter nuclei and energy is released. As a result the Binding Energy per nucleon increases.</td><td>½</td><td></td></tr>
</table>

	b) $\Delta m = (m_p + m_n) - m_d$ $\Delta m = (1.007277 + 1.008665) - 2.013553$ $\Delta m = 0.002389$ u Energy released = $\Delta m \times c^2$ Energy released = 0.002389×931.5 $= 2.2253$ MeV ≈ 2.22 MeV	½ ½ ½	3
	SECTION - D		
29	i) (C)  ii) (A) For a convex mirror magnification is always negative iii) (B) 2f OR (B) 12 cm iv) (C) $\sqrt{X_1 X_2}$	1 1 1 1	4
30	i) (B) 5mC ii) (A) zero iii) (D) [$M^0L^0TA^0$] iv) (A) $\frac{1}{2\sqrt{e}} mA$ **Note: 1 mark for this part may be given to all the students who have attempted other parts of the question.** OR (B) 0.5 mA	1 1 1 1	4
	SECTION - E		
31	a) i) 1) Definition of coherent sources. 1 Necessity of coherent sources for sustained interference pattern 1 2) Explanation 1 ii) 1) Finding distance between adjacent bright fringes. 1 2) Finding angular width 1 i) 1) If the phase difference between the displacement produced by each of the wave from two sources does not change with time then two sources are said to be coherent. **Alternatively** Two sources are said to be coherent if they emit light continuously of same frequency / wavelength and having zero or constant phase difference. Coherent sources are required to get constant phase difference. 2) Two independent sources will never be coherent because phase difference between them will not be constant. ii) 1) Distance between adjacent bright fringe = fringe width	 1 1 1	

$$\beta = \frac{\lambda D}{d}$$ ½

$$= \frac{600 \times 10^{-9} \times 1.2}{0.1 \times 10^{-3}} = 7.2\,\text{mm}$$ ½

2) $$\theta = \frac{\lambda}{d}$$ ½

$$= \frac{600 \times 10^{-9}}{0.1 \times 10^{-3}} = 6\times10^{-3}\ \text{rad} = 0.34°$$ ½

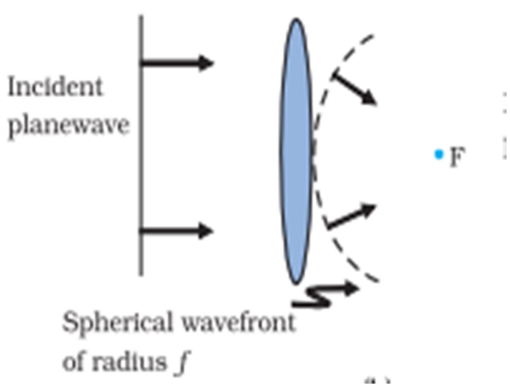
Give full marks if the student writes the answer in radians only.

OR

b)

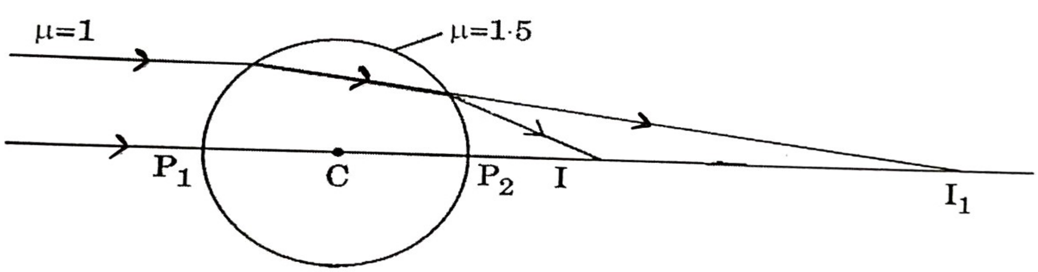
i) Definition of wave front.	1
Drawing the incident and refracted wave front	½ + ½
ii) Drawing the ray diagram	1
Obtaining the position of final image	2

i) A wavefront is a locus of all the points which oscillate in phase. 1



½ + ½

ii)



1

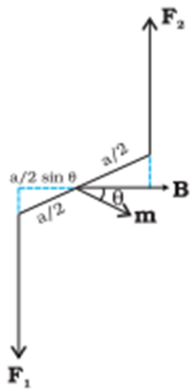
From I[st] surface , Refraction is from rarer to denser medium and object is at ∞

$n_1 = 1$, $n_2 = 1.5$, R = 15 cm , u= ∞

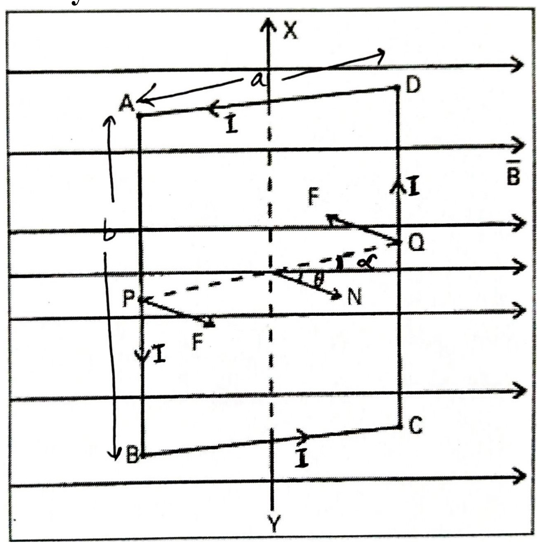
$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$ ½

	$\frac{1.5}{v}-\frac{1}{\infty}=\frac{1.5-1}{15}$ v= 45 cm From 2nd surface , Refraction is from denser to rarer medium and object is at 15 cm n_1 =1 , n_2 =1.5, R = -15 cm , u= 15cm $\frac{n_1}{v}-\frac{n_2}{u}=\frac{n_1-n_2}{R}$ $\frac{1}{v}-\frac{1.5}{15}=\frac{1-1.5}{-15}$ v= 7.5 cm	½ ½ ½	5
32	a) i) Calculating the change in electrostatic energy of the system — 2 ii) (1) Finding the capacitance. — 1 (2) Finding the potential difference. — 1 (3) Answering and Reason — ½ + ½ (i) $\vec{E}=\frac{3\times10^5}{r^2}\hat{r}$ (Given) $dV=-\vec{E}.d\vec{r}$ V = 3 × 10⁵ / r → $V = 3\times10^5 / r$ Electrostatic energy of the system in the absence of the field $U_i=\frac{Kq_1q_2}{r_{12}}$ Electrostatic energy in the presence of the field $U_f=\frac{Kq_1q_2}{r_{12}}+q_1V(\vec{r}_1)+q_2V(\vec{r}_2)$ $\Delta U = U_f - U_i = q_1V(\vec{r}_1)+q_2V(\vec{r}_2)$ $\Delta U=\frac{5\times10^{-6}\times3\times10^5}{3\times10^{-2}}-\frac{1\times10^{-6}\times3\times10^5}{3\times10^{-2}}$ = 40 J ii) 1) $C=\frac{Q}{V}=\frac{80}{16}$ = 5μF 2) $C'=KC$ = 3×5μF = 15 μF $V'=\frac{Q}{C'}=\frac{80\mu C}{15\mu F}$=5.33V 3) No, The capacitance of the system depends on its geometry. OR	½ ½ ½ ½ 1 ½ ½ ½ ½	

	b) i) Comparing the magnitude of the Electric fields 2 ii) Calculating the work done on the charge 3		
	Total charge for A = Total charge for B = Total charge for C = +4q	1	
	As , $E = \frac{kQ}{r^2}$ Since Q = 4q and r = 3R $E = \frac{k(4q)}{9R^2} = \frac{4kq}{9R^2}$	½	
	$\therefore E_A = E_B = E_c$	½	
	ii) $V_c = \left[\frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}} - \frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}}\right]$ $= 0$	1	
	$V_A = \left[\frac{k \times 6 \times 10^{-6}}{15 \times 10^{-2}} - \frac{k \times 6 \times 10^{-6}}{5 \times 10^{-2}}\right]$	½	
	$= \frac{k \times 6 \times 10^{-6}}{10^{-2}}\left[\frac{1-3}{15}\right]$ $= -\frac{9 \times 10^9 \times 6 \times 10^{-6} \times 2}{15 \times 10^{-2}}$		
	$= -7.2 \times 10^5$ V	½	
	$W = q\left[V_A - V_c\right]$ $= 5 \times 10^{-6}\left[-7.2 \times 10^5 - 0\right]$	½	
	W = - 3.6 J	½	5
33	a) i) Finding the direction of magnetic field near points P,Q and R ½ + ½ + ½ Conclusion about the relative magnitude of magnetic field. ½ + ½ + ½ ii) Showing the given expression of magnetic moment. 2		
	i) <u>Near point P</u> Magnetic field is acting into the plane of the paper as Force is acting upwards.	½	
	<u>Near point Q</u> Magnetic field is into the plane of paper as force is acting upwards.	½	
	<u>Near point R</u> Magnetic field is acting out of the plane of the paper as $\vec{F}$ is acting downwards.	½	
	<u>Relative Magnitude of the Magnetic field.</u> As $B \, \alpha \frac{1}{r}$ Therefore,		
	Near point P, magnitude of B is small.	½	
	Near point Q, B is relatively smaller than point P.	½	

	Near point R, B is relatively larger than point P. ($B_Q < B_P < B_R$)	½	
	ii) Let r be the radius of the circular coil and I is the current in the coil then $B = \frac{\mu_0 I}{2r}$ or $I = \frac{2Br}{\mu_0}$ $A = \pi r^2$ $\quad r = \sqrt{\frac{A}{\pi}}$ M = IA $= \frac{2Br}{\mu_0} A$ $= \frac{2BA}{\mu_0}\sqrt{\frac{A}{\pi}}$	½ ½ ½ ½	
	OR		
	b) i) Deriving the expression for the torque. 3 ii) 1) Finding the change in radius. 1 2) Finding the change in time period of Revolution. 1		
	i) 	½	
	$\vec{F}_1$ and $\vec{F}_2$ are the forces acting on two arms of the rectangular coil having sides a and b. $\lvert\vec{F}_1\rvert = \lvert\vec{F}_2\rvert = I\,b\,B$ (b = length of the arm) Forces constitute a couple. The magnitude of Torque on the loop is – $\tau = F_1 \frac{a}{2}\sin\theta + F_2 \frac{a}{2}\sin\theta$ $= I\,a\,b\,B\sin\theta$ $= IA\,B\sin\theta$ $\vec{\tau} = I\vec{A} \times \vec{B}$	1 ½ ½ ½	

Alternatively



½

If the plane of the current carrying coil marks an angle $\propto$ with the magnetic field

$\vec{F}_{DA} = -\vec{F}_{Bc}$ (cancel each other) . ½

Force on the arm DC is into the plane of the paper

$|F_{DC}| = IbB$. ½

Force on the arm AB is out of the plane of the paper. ½

$|F_{AB}| = IbB$

Both of them form a couple and Torque acting on the coil is

τ=either force ×perpendicular distance between the two forces.

$\tau = IbB \times a\cos\alpha$

$= IabB\cos\alpha$

$\tau = IAB\cos\alpha$ ½

Let $\hat{n}$ =outward drawn normal to the plane of the coil.

$\theta + \alpha = 90^0$

$\alpha = 90^0 - \theta$

$\tau = IAB\cos(90 - \theta)$

$= IAB\sin\theta$ ½

$\vec{\tau} = I\vec{A} \times \vec{B}$

ii) 1) $r = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$ ½

$r \ \alpha \ \sqrt{K}$

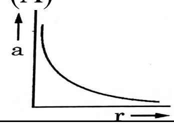
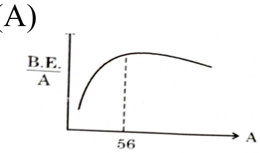
$\frac{r'}{r} = \frac{\sqrt{K/2}}{\sqrt{K}} = \frac{1}{\sqrt{2}}$

$r' = \frac{r}{\sqrt{2}}$ ½

	2) $T=\frac{2\pi m}{qB}$ Time period does not depend on Kinetic Energy ∴ Time period will not change.	½ ½	5

Marking Scheme Strictly Confidential (For Internal and Restricted use only) Senior School Certificate Examination, 2025 SUBJECT NAME PHYSICS (PAPER CODE 55/1/3)	
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.

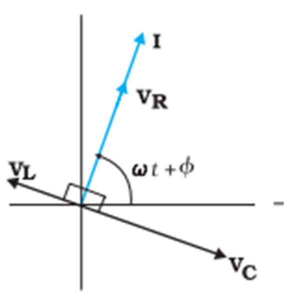
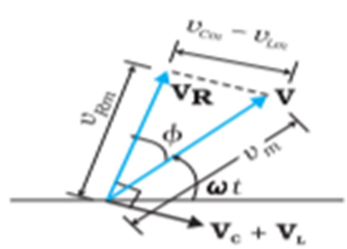
MARKING SCHEME: PHYSICS(042)			
Code: 55/1/3			
Q.No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
	SECTION A		
1	(A) 	1	1
2	(A) 2	1	1
3	(B) $\left(-3\hat{j}+2\hat{k}\right)\mu N$	1	1
4	(D) 0.1 A	1	1
5	(B) 2866	1	1
6	(D) $\frac{i_0 v_0}{2}\cos\phi$	1	1
7	(B) have wavelength smaller than that of ultraviolet radiation	1	1
8	(B) $\frac{\pi H^2}{(n^2-1)}$	1	1
9	(C) 2.5eV	1	1
10	(C) The barrier height and the depletion layer width both decrease.	1	1
11	(B) $\lambda_e > \lambda_p > \lambda_d$	1	1
12	(A) 	1	1
13	(C) Assertion (A) is true but Reason (R) is false.	1	1
14	(D) Assertion (A) is false and Reason (R) is also false.	1	1
15	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1
16	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion(A).	1	1
	SECTION - B		
17	Calculating the potential difference 2 Net e.m.f = (n-4)E $\therefore I=\frac{(n-4)E}{nr}$ Potential difference across' X' V= E +Ir	 ½ ½	

	$= E + \frac{(n-4)E}{nr} \times r$ $= \frac{(2n-4)E}{n}$	½ ½	2
18	(a) **Calculating the width of the slit 2** Condition for Minima a sinθ = nλ For First Minima n=1 $a \sin 30^\circ = 600 \times 10^{-9}$ m $a \times \frac{1}{2} = 600 \times 10^{-9}$ m $a = 1200 \times 10^{-9}$ m $= 1.2 \times 10^{-6}$ m OR (b) **Finding the Intensity 2** Phase difference = $\frac{2\pi}{\lambda} \times$ path difference $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ $\because \Delta x = \frac{\lambda}{8}$ (given) $\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = I_\circ + I_\circ + 2\sqrt{I_\circ I_\circ}\cos\frac{\pi}{4}$ $= 2I_\circ + 2I_\circ \times \frac{1}{\sqrt{2}}$ $I = 2I_\circ\left(1 + \frac{1}{\sqrt{2}}\right)$ $= I_\circ(2 + \sqrt{2})$ $I = 3.414 I_\circ$ **Alternatively**	 1 ½ ½ ½ ½ ½ ½	

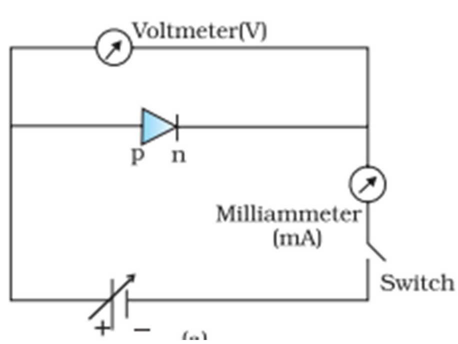
	Phase difference = $\frac{2\pi}{\lambda} \times$ path difference $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ $\because \Delta x = \frac{\lambda}{8}\ (given)$ $\Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{8}$ $\Delta\phi = \frac{\pi}{4}$ $I = 4I_\circ \cos^2\left(\frac{\phi}{2}\right)$ $I = 4I_\circ \cos^2\left(\frac{\pi}{8}\right)$	½ ½ ½ ½	2
19	Finding the focal length in water 2 $\frac{1}{f} = \left(\frac{n_g}{n_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ For double convex lens R_1=R and R_2= -R $\frac{1}{f} = \left(\frac{1.5}{1.33} - 1\right)\left(\frac{2}{R}\right)$ $= \left(\frac{1.5 - 1.33}{1.33}\right)\left(\frac{2}{17}\right)$ $f = 66.5$ cm	½ ½ ½ ½	2
20	Calculation of change in the radius 2 $E_n = \frac{-13.6}{n^2} eV$ $For\ E_n = -1.51 eV$ $-1.51 = \frac{-13.6}{n^2}$ n=3 $For\ E_n = -3.40 eV$ $-3.40 = \frac{-13.6}{n^2}$ n= 2	½ ½ ½	

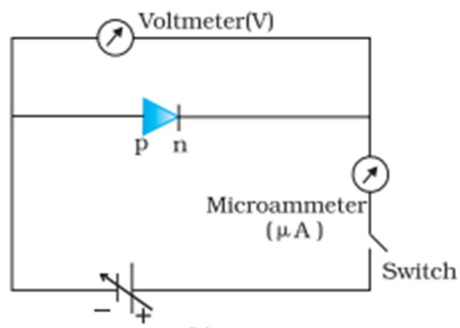
	$\because r = 0.53n^2 \overset{\circ}{A}$ $\therefore$ change in radius $\Delta r = 0.53[3^2 - 2^2]$ $= 0.53 \times 5$ $= 2.65 \overset{\circ}{A}$	½	2
21	Finding the number of holes 1 One example 1 Doping - 1 dopant atom for 5×10^7 Si atoms and number density of Si atoms = $5\times10^{28} \dfrac{\text{atoms}}{\text{m}^3}$ (given) $\therefore$ No. of holes created per m^3 = $\dfrac{5\times10^{28}}{5\times10^7} = 10^{21}$ Number of holes created per cubic centimeter $= \dfrac{10^{21}}{10^6} = 10^{15}$ Any one example of dopant - Aluminium / Indium / Gallium	1 1	 2
	SECTION - C		
22	(a) Finding (i) Equivalent emf of combination 1 (ii) Equivalent internal resistance of combination 1 (iii) Current drawn from combination 1 (i) Because $E_{eq} = \dfrac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$ $E_{eq} = \dfrac{3\times0.4 + 6\times0.2}{0.6} = 4\text{ V}$ (ii) $r_{eq} = \dfrac{r_1 r_2}{r_1 + r_2}$ $r_{eq} = \dfrac{0.2\times0.4}{0.2+0.4} = 0.133\Omega$ (iii) $I = \dfrac{E}{R + r_{eq}}$ $I = \dfrac{4}{4+0.13} = \dfrac{4}{4.13} A$ $I = 0.9A$	½ ½ ½ ½ ½ ½	

	OR		
	(b) (i) Finding the relation (i) between R' and R 1 (ii) between V_d' and V_d 1 (ii) To identify whether all free electrons are moving in the same direction. 1		
	(i) $l' = 2l$		
	$Al = A'l'$ = volume of the wire		
	$Al = A'(2l)$		
	$\frac{A}{2} = A'$		
	R = $\frac{\rho l}{A}$	½	
	$R' = \frac{\rho l'}{A'}$		
	$R' = \frac{\rho(2l)}{A/2}$		
	$\frac{R'}{R} = 4$	½	
	Alternatively		
	$R' = n^2 R$	½	
	n= 2		
	$R' = 4R$	½	
	(ii) $v_d = \frac{eE}{m}\tau$	½	
	$v_d = \frac{eV}{ml}\tau$		
	$v_d' = \frac{eV}{ml'}\tau$		
	$\frac{v_d'}{v_d} = \frac{l}{l'} = \frac{1}{2}$	½	
	(ii) No	1	3
23	Finding a) The magnetic field $\vec{B}$ 1 b) The magnetic force $\vec{F}_m$ 1 c) The electric field $\vec{E}$ 1		

	a) $\vec{B}=\frac{\mu_\circ I}{2\pi d}\left(-\hat{K}\right)$ b) $\vec{F}_B=q\left(\vec{v}\times\vec{B}\right)=\frac{qv\mu_\circ I}{2\pi d}\left(-\hat{j}\right)$ c) $q\vec{F}_e=-\vec{F}_B$ (For undeviation of charge particle) $\therefore\ \vec{F}_e=\frac{qv\mu_\circ I}{2\pi d}\left(\hat{j}\right)$ $\vec{F}_e=q\vec{E}$ $\therefore\ \vec{E}=\frac{\mu_\circ vI}{2\pi d}\hat{j}$	1 1 ½ ½	3
24	Drawing phasor diagram 1 Obtaining the expression for Impedance of the circuit 1 ½ Phase difference ½ a)  b)  $V_{Rm}=i_mR$, $V_{Cm}=i_mX_c$, $V_{Lm}=i_mX_L$ From Phasor diagram $V_m{}^2=V_{Rm}{}^2+(V_{Cm}-V_{Lm})^2$ $V_m{}^2=\left(i_mR\right)^2+\left(i_mX_c-i_mX_L\right)^2$	½ + ½ ½	

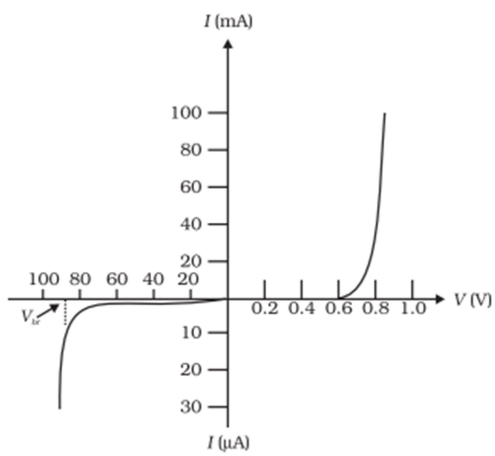
	$=(i_m)^2\left[R^2+(X_c-X_L)^2\right]$ Or $i_m=\frac{V_m}{\sqrt{R^2+(X_c-X_L)^2}}$ $\therefore i_m=\frac{V_m}{Z}$ $\therefore Z=\sqrt{R^2+(X_c-X_L)^2}$ From phasor diagram $\tan\theta=\frac{V_{Cm}-V_{Lm}}{V_{Rm}}$ $=\frac{X_c-X_L}{R}$ $\therefore \theta=\tan^{-1}\left(\frac{X_c-X_L}{R}\right)$	½ ½ ½	3
25	a) Showing that ($I_c + I_d$) has the same value. 2 b) Explanation of Kirchhoff's first rule at each plate of capacitor. 1 a) $\because$ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$ $\therefore I = I_d = \varepsilon_0\frac{d\phi_E}{dt}$ $=\varepsilon_0\frac{d}{dt}[EA]$ $=\varepsilon_0\frac{d}{dt}\left[\frac{\sigma}{\varepsilon_0}A\right]$ $=\frac{\varepsilon_0}{\varepsilon_0}A\frac{d}{dt}\left[\frac{Q}{A}\right]$ $I=\frac{dQ}{dt}=I_c$ **Alternatively** $\because$ Total current $I = I_c + I_d$ outside the capacitor $I_d = 0$ $\therefore I = I_c$ Inside the capacitor $I_c = 0$	½ ½ ½ ½ ½ ½	

	$I = I_d = \varepsilon_0 \frac{d\phi_E}{dt}$ $= \varepsilon_0 \frac{d}{dt}\left[\frac{Q}{\varepsilon_0}\right]$ $I = \frac{dQ}{dt} = I_c$ hence $I_c + I_d$ has the same value at all points of the circuit. b) Yes Current entering the capacitor is (I_c) and between the plates capacitor is (I_d) $I_c = I_d$ which validates Kirchhoff's junction rule.	½ ½ 1	 3
26	a) Mentioning three features 1 ½ b) Calculating the value of Planck's constant 1 ½ a) Three features i) The existence of threshold frequency ($\upsilon_\circ$) ii) Maximum Kinetic energy of photoelectrons is independent of intensity of incident radiation. iii) Instantaneous nature of photoelectric effect. b) slope = $\frac{h}{e}$ $\therefore h = e \times \text{slope}$ $= 1.6\times10^{-19}\times4.12\times10^{-15}$ $= 6.6\times10^{-34}$ Js	 ½ ½ ½ 1 ½	 3
27	a) Circuit Arrangement for studying V–I characteristics. 1 b) Showing the shape of characteristic curves. 1 c) Two informations from the characteristics ½ + ½ a)  Circuit diagram for forward characteristics	 ½	



Circuit diagram for Reverse characteristics — ½

b)



1

Note : Please do not deduct marks for not writing values.

c) Any two informations — ½ + ½

Knee voltage / reverse saturation current / Breakdown voltage / very low resistance in forward biasing / very high resistance in Reverse biasing.

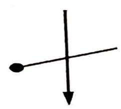
3

28

a)	Defining Mass Defect	½
	Defining Binding Energy	½
	Describing Fission Process	½
b)	Calculation of Mass Defect	1
	Calculation of Energy	½

a) Difference in the mass of the nucleus and its constituents is defined as mass defect. — ½

Binding Energy is the energy required to separate the nucleons from the — ½

	nucleus. In Fission process a heavy nucleus splits into lighter nuclei and energy is released. As a result the Binding Energy per nucleon increases. b) $\Delta m = (m_{p} + m_{n}) - m_d$ $\Delta m = (1.007277 + 1.008665) - 2.013553$ $\Delta m = 0.002389$ u Energy released $= \Delta m \times c^2$ Energy released $= 0.002389 \times 931.5$ $= 2.2253$ MeV ≈ 2.22 MeV	½ ½ ½ ½	 3
	SECTION - D		
29	i) (C)  ii) (A) For a convex mirror magnification is always negative iii) (B) 2f OR (B) 12 cm iv) (C) $\sqrt{X_1 X_2}$	1 1 1 1	 4
30	i) (B) 5mC ii) (A) zero iii) (D) [$M^0L^0TA^0$] iv) (A) $\frac{1}{2\sqrt{e}} mA$ **Note: 1 mark for this part may be given to all the students who have attempted other parts of the question.** OR (B) 0.5 mA	1 1 1 1	 4
	SECTION - E		
31	a) i) 1) Definition of coherent sources. 1 Necessity of coherent sources for sustained interference pattern 1 2) Explanation 1 ii) 1) Finding distance between adjacent bright fringes. 1 2) Finding angular width 1 i) 1) If the phase difference between the displacement produced by each of the wave from two sources does not change with time then two sources are said to be coherent. **Alternatively** Two sources are said to be coherent if they emit light continuously of same frequency / wavelength and having zero or constant phase difference. Coherent sources are required to get constant phase difference. 2) Two independent sources will never be coherent because phase difference between them will not be constant.	 1 1 1	

ii) 1) Distance between adjacent bright fringe = fringe width

$$\beta = \frac{\lambda D}{d}$$ ½

$$= \frac{600\times10^{-9}\times1.2}{0.1\times10^{-3}} = 7.2\,\text{mm}$$ ½

2) $$\theta = \frac{\lambda}{d}$$ ½

$$= \frac{600\times10^{-9}}{0.1\times10^{-3}} = 6\times10^{-3}\ \text{rad} = 0.34°$$ ½

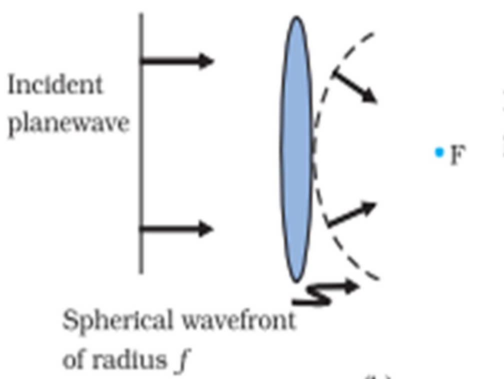
Give full marks if the student writes the answer in radians only.

OR

b)

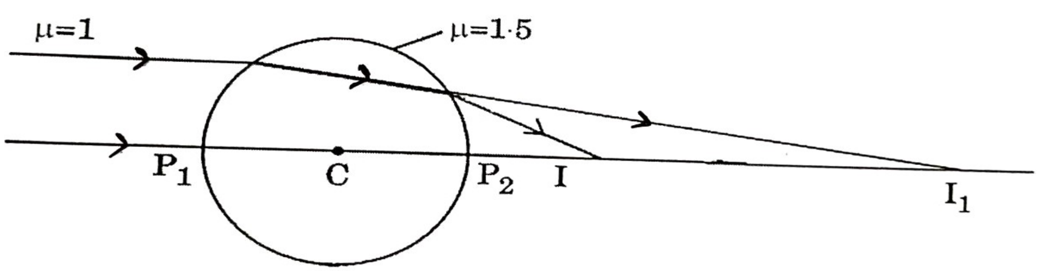
i) Definition of wave front.	1
Drawing the incident and refracted wave front	½ + ½
ii) Drawing the ray diagram	1
Obtaining the position of final image	2

i) A wavefront is a locus of all the points which oscillate in phase. 1



½ + ½

ii)



1

From I[st] surface , Refraction is from rarer to denser medium and object is at ∞

$n_1 = 1$, $n_2 = 1.5$, $R = 15$ cm , $u = \infty$

	$\frac{n_2}{v}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$ $\frac{1.5}{v}-\frac{1}{\infty}=\frac{1.5-1}{15}$ v= 45 cm From 2nd surface , Refraction is from denser to rarer medium and object is at 15 cm $n_1=1$, $n_2=1.5$, R = -15 cm , u= 15cm $\frac{n_1}{v}-\frac{n_2}{u}=\frac{n_1-n_2}{R}$ $\frac{1}{v}-\frac{1.5}{15}=\frac{1-1.5}{-15}$ v= 7.5 cm	½ ½ ½ ½	5
32	a) i) Calculating the change in electrostatic energy of the system 2 ii) (1) Finding the capacitance. 1 (2) Finding the potential difference. 1 (3) Answering and Reason ½ + ½ (i) $\vec{E}=\frac{3\times10^5}{r^2}\hat{r}$ (Given) $dV=-\vec{E}.d\vec{r}$ $V = 3\times10^5 / r$ Electrostatic energy of the system in the absence of the field $U_i=\frac{Kq_1q_2}{r_{12}}$ Electrostatic energy in the presence of the field $U_f=\frac{Kq_1q_2}{r_{12}}+q_1V(\vec{r}_1)+q_2V(\vec{r}_2)$ $\Delta U = U_f - U_i = q_1V(\vec{r}_1)+q_2V(\vec{r}_2)$ $\Delta U=\frac{5\times10^{-6}\times3\times10^5}{3\times10^{-2}}-\frac{1\times10^{-6}\times3\times10^5}{3\times10^{-2}}$ $= 40$ J ii) 1) $C=\frac{Q}{V}=\frac{80}{16}=5\mu F$ 2) $C'=KC$ $=3\times5\mu F=15\ \mu F$ $V'=\frac{Q}{C'}=\frac{80\mu C}{15\mu F}=5.33V$ 3) No,	½ ½ ½ ½ 1 ½ ½ ½	

	The capacitance of the system depends on its geometry. OR b) i) Comparing the magnitude of the Electric fields 2 ii) Calculating the work done on the charge 3 Total charge for A = Total charge for B = Total charge for C = +4q As , $E = \frac{kQ}{r^2}$ Since Q = 4q and r = 3R $E = \frac{k(4q)}{9R^2} = \frac{4kq}{9R^2}$ $\therefore E_A = E_B = E_c$ ii) $V_c = \left[\frac{k\times 6\times 10^{-6}}{5\times 10^{-2}} - \frac{k\times 6\times 10^{-6}}{5\times 10^{-2}}\right]$ $= 0$ $V_A = \left[\frac{k\times 6\times 10^{-6}}{15\times 10^{-2}} - \frac{k\times 6\times 10^{-6}}{5\times 10^{-2}}\right]$ $= \frac{k\times 6\times 10^{-6}}{10^{-2}}\left[\frac{1-3}{15}\right]$ $= -\frac{9\times 10^{9}\times 6\times 10^{-6}\times 2}{15\times 10^{-2}}$ $= -7.2\times 10^{5}$ V $W = q\left[V_A - V_c\right]$ $= 5\times 10^{-6}\left[-7.2\times 10^{5} - 0\right]$ W = - 3.6 J	½ 1 ½ ½ 1 ½ ½ ½ ½	 5
33	a) i) Finding the direction of magnetic field near points P,Q and R ½ + ½ + ½ Conclusion about the relative magnitude of magnetic field. ½ + ½ + ½ ii) Showing the given expression of magnetic moment. 2 i) <u>Near point P</u> Magnetic field is acting into the plane of the paper as Force is acting upwards. <u>Near point Q</u> Magnetic field is into the plane of paper as force is acting upwards. <u>Near point R</u> Magnetic field is acting out of the plane of the paper as $\vec{F}$ is acting downwards. <u>Relative Magnitude of the Magnetic field.</u> As $B \propto \frac{1}{r}$	 ½ ½ ½	

Therefore,

Near point P, magnitude of B is small. ½

Near point Q, B is relatively smaller than point P. ½

Near point R, B is relatively larger than point P. ½

($B_Q < B_P < B_R$)

ii) Let r be the radius of the circular coil and I is the current in the coil then

$$B = \frac{\mu_0 I}{2r} \quad or \quad I = \frac{2Br}{\mu_0}$$ ½

$A = \pi r^2$ $\qquad r = \sqrt{\frac{A}{\pi}}$ ½

$M = IA$ ½

$$= \frac{2Br}{\mu_0} A$$

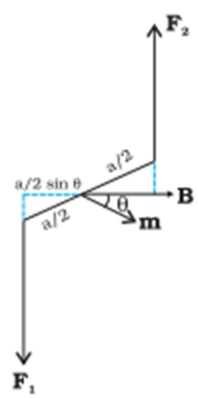
$$= \frac{2BA}{\mu_0}\sqrt{\frac{A}{\pi}}$$ ½

OR

b)

i) Deriving the expression for the torque.	3
ii) 1) Finding the change in radius.	1
2) Finding the change in time period of Revolution.	1

i)



½

$\vec{F_1}$ and $\vec{F_2}$ are the forces acting on two arms of the rectangular coil having sides a and b.

$\left|\vec{F_1}\right| = \left|\vec{F_2}\right| = I\,b\,B$ (b = length of the arm) 1

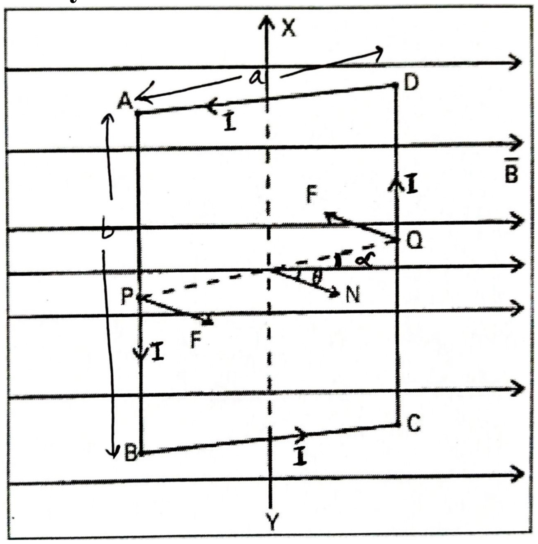
Forces constitute a couple. The magnitude of Torque on the loop is –

$$\tau = F_1 \frac{a}{2}\sin\theta + F_2 \frac{a}{2}\sin\theta$$ ½

$$= I\,a\,\,b\,B\sin\theta$$

$$= IA\,B\sin\theta$$ ½

$$\vec{\tau} = I\vec{A}\times\vec{B}$$ ½

	Alternatively		
		½	
	If the plane of the current carrying coil marks an angle ∝ with the magnetic field		
	$\vec{F}_{DA} = -\vec{F}_{Bc}$ (cancel each other) .	½	
	Force on the arm DC is into the plane of the paper		
	$\|F_{DC}\| = IbB$.	½	
	Force on the arm AB is out of the plane of the paper.		
	$\|F_{AB}\| = IbB$	½	
	Both of them form a couple and Torque acting on the coil is		
	τ=either force ×perpendicular distance between the two forces.		
	$\tau = IbB \times a\cos\alpha$		
	$= IabB\cos\alpha$		
	$\tau = IAB\cos\alpha$	½	
	Let $\hat{n}$ =outward drawn normal to the plane of the coil.		
	$\theta + \alpha = 90^0$		
	$\alpha = 90^0 - \theta$		
	$\tau = IAB\cos(90 - \theta)$		
	$= IAB\sin\theta$		
	$\vec{\tau} = I\vec{A} \times \vec{B}$	½	
	ii) 1) $r = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$	½	
	$r \; \alpha \; \sqrt{K}$		
	$\frac{r'}{r} = \frac{\sqrt{K/2}}{\sqrt{K}} = \frac{1}{\sqrt{2}}$		
	$r' = \frac{r}{\sqrt{2}}$	½	

	2) $T=\frac{2\pi m}{qB}$ Time period does not depend on Kinetic Energy ∴ Time period will not change.	½ ½	5