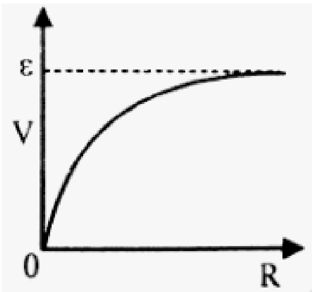
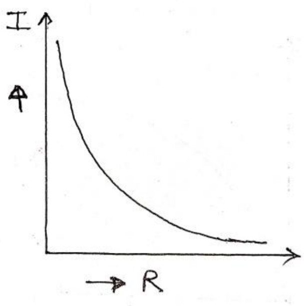
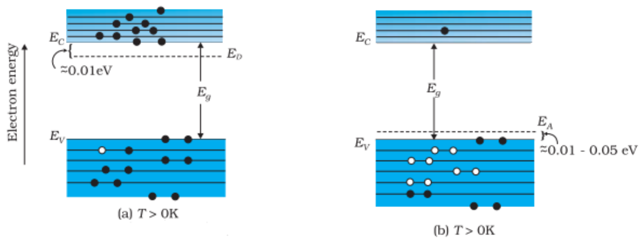
Marking Scheme **Strictly Confidential** **(For Internal and Restricted use only)** **Senior School Certificate Examination, 2025** **SUBJECT PHYSICS (042) (PAPER CODE 55/7/1)**	
<u>General Instructions: -</u>	
1	You are aware that evaluation is the most important process in the actual and correct assessment 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 guideline es 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 deliberation 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.

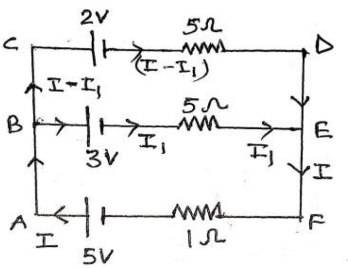
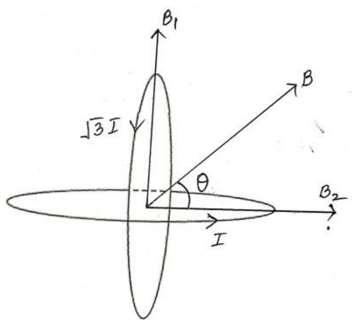
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **“Extra Question”**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks 0-70 (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:- 1. Leaving answer or part thereof unassessed in an answer book. 2. Giving more marks for an answer than assigned to it. 3. Wrong totaling of marks awarded on an answer. 4. Wrong transfer of marks from the inside pages of the answer book to the title page. 5. Wrong question wise totaling on the title page. 6. Wrong totaling of marks of the two columns on the title page. 7. Wrong grand total. 8. Marks in words and figures not tallying/not same. 9. Wrong transfer of marks from the answer book to online award list. 10. 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.) 11. 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.

Q.NO.	VALUE POINTS/EXPECTED ANSWERS	MARKS	TOTAL MARKS
	MARKING SCHEME : PHYSICS (042)		
	CODE: 55/7/1		
	SECTION- A		
1.	(A) 250 V	1	1
2.	(C) 16/3 Ω	1	1
3.	(A) BA sin α	1	1
4.	(A) 1/200 s	1	1
5.	(C) capacitive and inductive respectively	1	1
6.	(B) 0.2 mV	1	1
7.	(D) $\left[ML^2T^{-2}A^{-2}\right]$	1	1
8.	(B) 3.20×10^{14} Hz	1	1
9.	(C) holes and few electrons	1	1
10.	(A) n=4 to n=3	1	1
11.	(A) Both the potential barrier height and width of depletion layer decrease.	1	1
12.	(C) same neutron number but different atomic number.	1	1
13.	(D) Both Assertion (A) and Reason (R) are false.	1	1
14.	(C) Assertion(A) is true and Reason(R) is false.	1	1
15.	(B) Both Assertion(A) and Reason (R) are true but Reason(R) is **not** the correct explanation of Assertion(A).	1	1
16.	(B) Both Assertion(A) and Reason (R) are true but Reason(R) is **not** the correct explanation of Assertion(A).	1	1
	SECTION- B		
17.	Showing variation graphically (a)Terminal voltage with resistance R 1 (b)Current supplied by cell with resistance R 1		
	(a) 	1	
	(b) 	1	2

18.	(a) Deducing for (a)Size 1 (b)Location of the image produced by convex mirror 1		
	Let, u= nf		
	From the Mirror formula,		
	$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$	½	
	$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$		
	$=\frac{1}{f}+\frac{1}{nf}$		
	$v=\frac{nf}{n+1}$		
	$n=+ve \quad \therefore v<f$	½	
	$m=\frac{-v}{u}=\frac{1}{n+1}$	½	
	m is always positive & less than 1.	½	
	Note: **Award full credit if correctly concluded by any other method**.		
	OR		
	(b) Finding the nature & focal length of lens 1½ Stating answer for changing thickness ½		
	$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}$	½	
	$\frac{1}{12}=\frac{1}{10}-\frac{1}{15}+\frac{1}{f_3}$		
	$\frac{1}{f_3}=\frac{5-6+4}{60}$		
	$f_3=20\,cm$	½	
	Nature: Convex	½	
	Yes	½	2
19.	Difference between Interference & Diffraction patterns 1 Reason 1		

Interference pattern	Diffraction pattern
1. The interference pattern has a number of equally spaced bright and dark bands.	1. The diffraction pattern has a central bright maximum which is twice as wide as the other maxima.
2. The interference pattern is obtained by superposing two waves originating from the two narrow slits.	2. The diffraction pattern is obtained by superposition of a continuous family of waves originating from each point on a single slit.
3. The maximas are of same intensity.	3. The intensity falls as we go to successive maxima away from the centre, on either side.

	(Table above)	1	
	(Any two differences) The light wave coming out of two independent source of light will not have constant phase with time. **Alternatively**: Two sodium lamps are incoherent source of light.	1	2
20.	Drawing Energy band diagram of n type semiconductor ½ p type semiconductor ½ Showing donor/acceptor energy level ½+½ 	1+1	2
21.	Explaining energy produced in stars 1 Two examples of nuclear reactions involved ½+½ Energy is produced in stars due to Nuclear fusion. Two lighter nuclei fuse to form a heavier nucleus which is more stable, hence energy is released. **Alternatively:** Due the difference in masses in reactants and products, mass is converted into energy. Hence energy is released.	½ ½	

	$^{1}_{1}H+^{1}_{1}H\rightarrow\ ^{2}_{1}He+e^{+}+\nu$ $^{2}_{1}H+^{2}_{1}H\rightarrow\ ^{3}_{2}He+\ ^{1}_{0}n$ $^{3}_{2}He+^{3}_{2}He\rightarrow ^{4}_{2}He+^{1}_{1}H+^{1}_{1}H$ **Any two above equation.**	½+ ½	2
	SECTION- C		
22.	Calculating the current through cells A, B and C 3  In loop ABEFA, $5\text{-}3\text{-}5I_1\text{-}I=0$ $2=5I_1+I \qquad -----(1)$ In loop CBEDC, $2-3-5I_1+5I\text{-}5I_1=0$ $-1=10I_1-5I \qquad -----(2)$ Solving equation (1) and (2) $I=\frac{5}{7}A$ in arm AF/through the cell of 5V(A) $I_1=\frac{9}{35}A$ in arm BE/through the cell of 3V(B) $I-I_1=\frac{16}{35}A$ in arm CD/through the cell of 2V(C)	½ ½ ½ ½ ½ ½	3
23.	(a) (i)Writing Biot-Savart's Law in vector form 1 (ii)Finding magnitude & direction of net magnetic field at centre of two current carrying coils 2 (i) $\overrightarrow{dB}=\frac{\mu_0}{4\pi}\frac{I(\vec{dl}\times\vec{r})}{r^3}$ (ii) $B_1=\frac{\mu_0 I}{2R}$ $B_2=\frac{\mu_0\sqrt{3}I}{2R}$ $B=\sqrt{B_1^2+B_2^2}$ $\therefore B=\frac{\mu_0 I}{2R}\sqrt{1+3}$  	1 ½ ½	

$$B=\frac{\mu_0 I}{R}$$ ½

$$\tan\theta=\frac{B_1}{B_2}=\frac{1}{\sqrt{3}}$$ ½

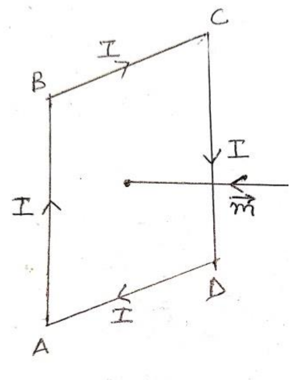
Direction of net magnetic field is 30° with direction of B_2/ 60° with the direction of B_1.

OR

(b)

Writing the expression for magnetic moment & showing its direction	1
Proving no net force	1
Torque $(\vec{\tau})=\vec{m}\times\vec{B}$	1

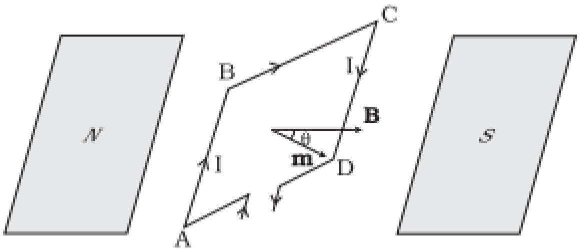
(i) $\vec{m}=I\vec{A}$ ½



½

(ii) $F_1=F_2=IbB$ $\quad F_1=$ Force on AB into the plane ½

$F_2=$ Force on CD out of the plane



Since forces are equal & opposite so net force = 0 ½

Both forces form a couple, magnitude of torque acting on the coil is

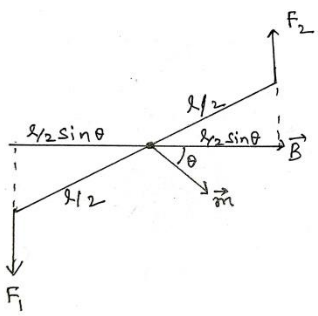
$$\therefore \tau=F_1\frac{l}{2}\sin\theta+F_2\frac{l}{2}\sin\theta$$ ½

$= I\ b\ B\ l\sin\theta$

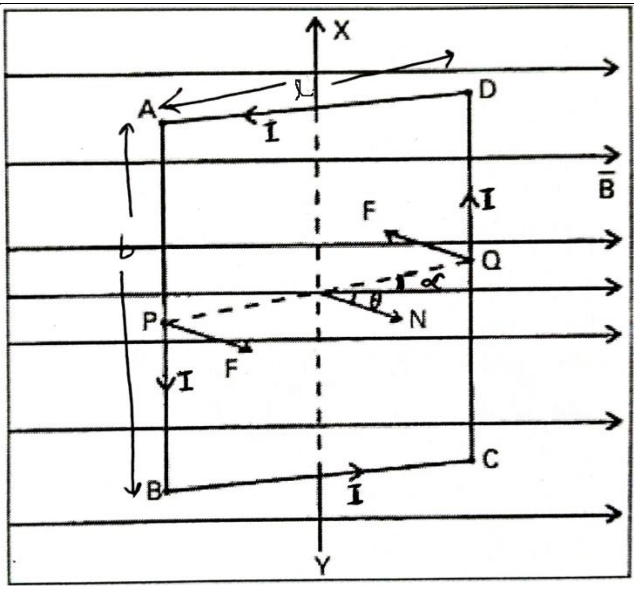
$= I\ A\ B\ \sin\theta$

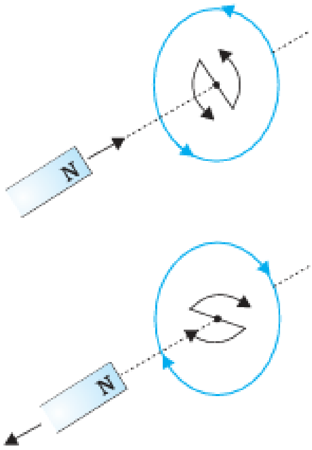
$= m\ B\sin\theta$

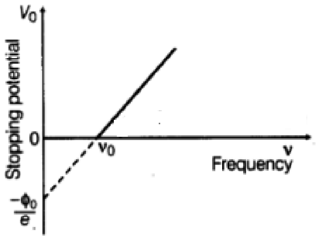
$\vec{\tau}=\vec{m}\times\vec{B}$ ½

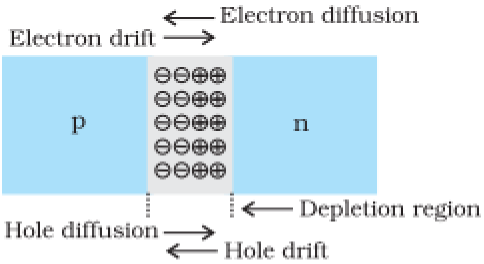


Alternatively:

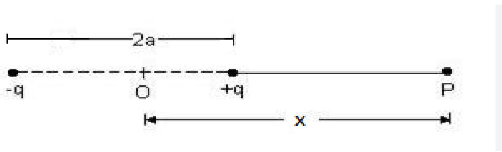
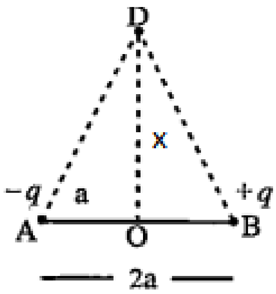
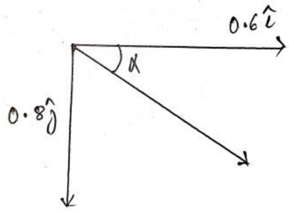
			
	If the plane of the current carrying coil makes an angle ∝ with the magnetic field $\vec{F}_{DA} = -\vec{F}_{Bc}$ (cancel each other) Force on the arm DC is into the plane of the paper	½	
	$\lvert F_{DC} \rvert = IbB$ Force on the arm AB is out of the plane of the paper. $\lvert F_{AB} \rvert = IbB$ Since forces are equal & opposite so net force = 0	½	
	Both of them form a couple and magnitude of torque acting on the coil is τ=either force ×perpendicular distance between the two forces. $\tau = IbB \times l \sin\theta$ $= IAB \sin\theta$	½	
	$\vec{\tau} = I\vec{A} \times \vec{B}$ $\vec{\tau} = \vec{m} \times \vec{B}$	½	3
24.	(a)Stating Faraday's law of electromagnetic Induction 1 Explaining the role of negative sign 1 (b)Explaining consistency of Lenz law with conservation of energy 1		
	(a) The magnitude of induced emf in a circuit is equal to the time rate of change of magnetic flux. Mathematically, $e = -{d\Phi}/{dt}$	1	
	Negative sign indicates that the direction of induced emf and hence induced current in closed loop opposes its cause.	1	
	(b) When magnet is moved closer/away from the loop, same/ opposite pole is developed on the approaching face of the loop. So, mechanical work is required to move a magnet which gets	1	

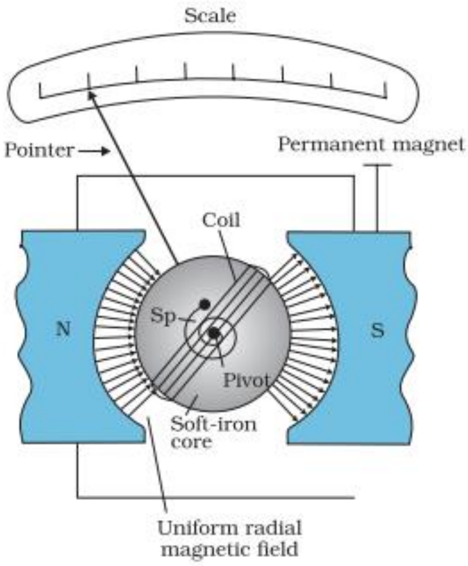
	converted into electrical energy which is consistent with law of conservation of energy.  **(Note: Please do not deduct marks for not showing figures)**		3
25.	(a)Similarity & dissimilarity between conduction & displacement current 1+1 (b)Explaining existence of em wave in free space 1 (a) **<u>Similarity</u>** Both give rise to magnetic field. **<u>Dissimilarity(any one)</u>** • Conduction current is due to flow of charges in the conductor. • Displacement current arises due to change in electric field/ time varying electric flux. (b) A magnetic field, changing with time, gives rise to an electric field. Then, an electric field changing with time gives rise to a magnetic field and is a consequence of the displacement current being a source of a magnetic field. Thus, time- dependent electric and magnetic fields give rise to each other and hence em wave is generated. **(Note: Please award ½ mark of this part if a child writes the expression only)** $\oint \vec{B}.\vec{dl} = \mu_0 I_c + \mu_0 \varepsilon_0 \frac{d\Phi_e}{dt}$	 1 1 1	3
26.	(a)Defining work function ½ Determining the value of work function from graph 1 (b)Calculating wavelength of light 1½ Minimum energy required by an electron to escape from metal surface. The intercept on the y axis for a graph between stopping potential & frequency gives ϕ_0/e .	 ½	

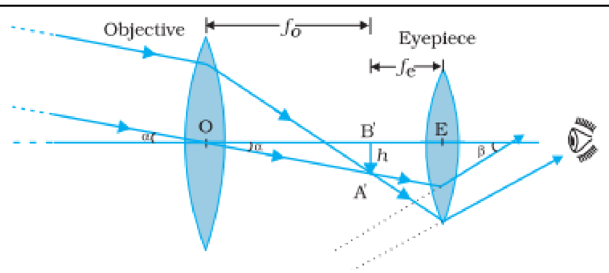
	$\therefore\ \phi_0 = e \times$ intercept on y-axis. **<u>Alternatively</u>**: Work function $\phi_0 = h \times$ intercept on x-axis. **(Note: Please award ½ mark, even if a student draws the following graph instead of determining the value of work function)**  (b) $eV_0 = \frac{hc}{\lambda} - \phi_0$ $0.6 = \frac{hc}{\lambda} - 2.4$ $3 = \frac{hc}{\lambda} \Rightarrow 3 \times 1.6 \times 10^{-19} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{\lambda}$ $\lambda = \frac{1241}{3} = 413.6 nm$	1 ½ ½ ½	 3
27.	Writing the mathematical form of postulates of Bohr's Theory 1½ Proving, (a) radius of the orbit is proportional to n^2 1 (b) Total energy of the atom is proportional to $1/n^2$ ½ Mathematical form of postulates of Bohr's Theory (i) $E_n = \frac{-13.6}{n^2} eV$ **Alternatively** : Electron revolve in stable orbits with definite energy called stationary orbits. (ii) $L = mvr = \frac{nh}{2\pi}$ (iii) $h\nu = E_f - E_i$ (a) $\frac{mv^2}{r} = \frac{Ze^2}{r^2}$ -----(1) $mvr = \frac{nh}{2\pi}$ -----(2) Solving (1) & (2) $r = n^2 \left(\frac{h}{2\pi}\right)^2 \frac{4\pi\varepsilon_0}{me^2}$ ----(3)	 ½ ½ ½ ½ ½	

	Since energy in the orbit $E_n = \dfrac{-e^2}{8\pi\varepsilon_0 r}$ Using eq (3) $E_n = \dfrac{-me^4}{8n^2\varepsilon_0^2h^2}$ or $E_n \propto \dfrac{1}{n^2}$	½	3
28.	Explaining the formation of depletion layer and potential barrier 1+1 Feature of junction diode for its use as rectifier 1 When an electron diffuses from n-side to p-side, it leaves behind an ionized donor on n side. Similarly when a hole diffuses from p-side to n-side, it leaves behind an ionized acceptor on p side. This space charge region consisting of immobile ions on either side of the junction is known as depletion layer. As diffusion process continues, width of depletion layer increases and consequently strength of electric field increases across the junction and thus the drift current. The potential that prevents the movement of electron from n region into p region is called potential barrier.  **(Note: Please award full credit of formation of depletion layer, even if a student draws above diagram)** Diode allows current to pass only when it is forward biased as resistance is small, whereas in reverse bias, its resistance is very large. **Alternatively**: Diode is unidirectional.	1 1 1	3
	SECTION -D		
29.	(i) (D) 1 (ii) (C) 3.75×10^6 (iii) (B) 500^0 C (iv) (a) (D) I decreases and II is almost constant **OR** (b) (D) All I, II and III change	1 1 1 1	4
30.	(i) (A) $1/\sqrt{n^2-1}$ (ii) (a) (B) 1.4 **OR**	1 1	

	(b) (D) increase by 19%. (iii) (C) First real and then virtual (iv) (A) 10cm	 1 1	 4
	SECTION- E		
31.	(a) (i) Finding the new value of capacitance 3 (ii) Finding the number of capacitors 2 (i) $C_0 = \frac{\varepsilon_0 A}{d}$ $C = \frac{\varepsilon_0 A}{(d-t) + \frac{t}{K}}$ $t = d/4$ $C = \frac{\varepsilon_0 A}{\left(d - \frac{d}{4}\right) + \frac{d}{4K}} = \frac{\varepsilon_0 A}{d\left(\frac{3}{4} + \frac{1}{4K}\right)}$ $= C_0 \frac{4K}{(3K+1)}$ **Alternatively**: When dielectric is inserted, the electric field between the plates is E= E_0/K The potential difference will be $V = E_0\left(\frac{3d}{4}\right) + E\left(\frac{d}{4}\right)$ $= E_0\left(\frac{3d}{4}\right) + \frac{E_0}{K}\left(\frac{d}{4}\right)$ $= V_0\left(\frac{3}{4} + \frac{1}{4K}\right)$ $V = V_0\left(\frac{3K+1}{4K}\right)$ $C = \frac{Q_0}{V} = \left(\frac{4K}{3K+1}\right)\frac{Q_0}{V_0}$ $C = C_0\left(\frac{4K}{3K+1}\right)$ (ii) Each capacitance can withstand 200V No. of capacitors in each row = $\frac{1200}{200} = 6$ Net capacitance of each row= 1/6 µF Number of rows = n $C_{eq} = C_1 + C_2 + \_\_\_\_\_\_ + C_n$ $C_{eq} = \frac{1}{6} + \frac{1}{6} + ------ n$ $2 = \frac{n}{6}$	 ½ ½ 1 1 ½ ½ 1 1 ½ ½	

	$\therefore n = 12$	½	
	Total no. of capacitors in the arrangement = 6 × 12		
	= 72	½	
	OR		
	(b) (i) Deriving the expression of electric potential due to dipole		
	I. along its axis 1½		
	II. along its bisector line 1½		
	(ii) Calculating the torque 2		
	I. Along its axis		
	$V_- = \frac{-kq}{x+a}$ 		
	$V_+ = \frac{kq}{x-a}$	½	
	$V = V_- + V_+$		
	$= kq\left(\frac{-1}{x+a} + \frac{1}{x-a}\right)$		
	$= kq\frac{2a}{(x^2-a^2)} = \frac{kp}{x^2-a^2}$	½	
	$x \gg a \quad \therefore V = \frac{kp}{x^2}$	½	
	II. Along the bisector line		
	$V_- = \frac{kq}{\sqrt{x^2+a^2}}$ 	½	
	$V_+ = \frac{-kq}{\sqrt{x^2+a^2}}$	½	
	$V = V_- + V_+$		
	$= 0$	½	
	(ii) $\vec{\tau} = \vec{p} \times \vec{E}$	½	
	$= (0.8\hat{i} + 0.6\hat{j}) \times 10^{-29} \times (1 \times 10^{7})\hat{k}$		
	$= \left[0.8(-\hat{j}) + 0.6\hat{i}\right] \times 10^{-22}$	½	
	$\tau = \left[\sqrt{(0.8)^2 + (0.6)^2}\right] \times 10^{-22}$		
	$= 10^{-22}\ Nm$	½	
	$\tan\alpha = \frac{\lvert 0.8 \rvert}{0.6}$ 		
	$\alpha = \tan^{-1}\left(\frac{4}{3}\right)$	½	
	$\alpha = 53^0$		5

32.	(a)		
	(i) Labelled diagram 1 Working principle of moving coil galvanometer 1 Use of (i) Radial magnetic field ½ (ii) Soft iron core ½ (ii) Defining current sensitivity 1 Reason 1		
		1	
	Principle:A current carrying coil placed in uniform magnetic field, experiences a torque.	1	
	(i) Radial magnetic field makes the scale linear **Alternatively**: Radial magnetic field provides maximum Torque.	½	
	(ii) Use of soft iron core is to increase the strength of magnetic field/ increase sensitivity of the galvanometer.	½	
	(ii) **Current sensitivity** is defined as deflection per unit current. **Alternatively**: $I_s = \frac{\Phi}{I} = \frac{NAB}{k}$	1	
	Voltage sensitivity $V_s = \frac{\Phi}{V} = \left(\frac{NAB}{k}\right)\frac{I}{V} = \left(\frac{NAB}{k}\right)\frac{1}{R}$	½	
	Increase in number of turns, increases the current sensitivity and resistance of the galvanometer in the same proportion of current sensitivity therefore Voltage sensitivity remains unchanged.	½	
	OR		

	(b) (i) (I) Writing Ampere circuital law & explaining the terms. 1 (II) Reason for magnetic field outside long solenoid approaching zero 1 (III) Reason for irregular shaped loop changing to circular loop in uniform magnetic field 1 (ii) Finding the value of Resistance R_3 2		
	(i) **(I)** $\oint \vec{B}.\vec{dl} = \mu_0 I_e$	½	
	I_e= Total current through the surface B= Magnetic field dl = length of small element	½	
	(II) As length of solenoid increases, it appears like a long cylindrical metal sheet, so field outside approaches zero.	1	
	(III) For a given perimeter, a circle encloses greater area than any other shape, which maximizes the flux.	1	
	(ii) $R_1 = \frac{V}{I_g} - G \quad \Rightarrow \frac{V}{I_g} = R_1 + G \quad$ -----(1)	½	
	$R_2 = \frac{V}{2I_g} - G \quad \Rightarrow \frac{V}{2I_g} = R_2 + G \quad$ -----(2)	½	
	Solving (1) & (2) $G = R_1 - 2R_2$	½	
	$R_3 = \frac{2V}{I_g} - G \quad$ -----(3) Solving using eq (1) & (3) $R_3 = 3R_1 - 2R_2$	½	5
33.	(a) (i) Drawing labeled Diagram 1½ Explanation ½ Writing expression of Magnifying power 1 (ii) Calculating the focal length of objective & eye piece 2		
	 **(Note: Deduct ½ mark, for not showing arrows with the rays)**	1½	

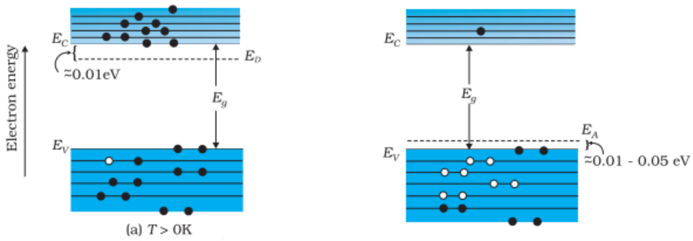
	Light from distant object enters the objective lens & forms a real image A'B' at f_o. This image A'B' acts as an object for eye piece and eye piece forms a magnified image at infinity.	½	
	Magnifying Power = f_o/f_e	1	
	(ii) Image is formed at least distance of distinct vision $20 = m_o \times m_e$ $m_o = \frac{20}{5} = 4$	½	
	$m_e = 1 + \frac{D}{f_e}$ $f_e = \frac{25}{4} cm$	½	
	$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$ $\frac{1}{-25} - \frac{1}{u_e} = \frac{4}{25}$ $u_e = -5cm$ $L = v_0 + \lvert u_e \rvert$ $v_0 = 9cm$	½	
	Given, $\frac{v_0}{u_0} = 4$ $\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$ $\frac{1}{f_0} = \frac{1}{9} - \left(-\frac{4}{9}\right)$ $f_0 = \frac{9}{5} cm$	½	
	OR (b) (i) Obtaining the expression for resultant intensity of interference pattern 2 Writing maximum & minimum values of resultant intensity 1 (ii) Calculating the distance of **(I)** First order minimum 1 **(II)** Second order maximum from centre of screen 1		
	(i) $y_1 = a\cos\omega t$ $y_2 = a\cos(\omega t + \phi)$	½	
	According to Principle of Superposition		

	$y = y_1 + y_2$ $= a\left[\cos\omega t + \cos(\omega t + \phi)\right]$ $= 2a\cos\phi/2\ \cos(\omega t + \phi/2)$ $y = A\cos\left(\omega t + \phi/2\right)$ where, $A = 2a\cos\phi/2$ $I = kA^2$ $I = k\left(4a^2\cos^2\phi/2\right)$ $I = 4I_0\cos^2\phi/2$ **Alternatively**: If student writes $I = I_1 + I_1 + 2\sqrt{I_1 I_1}\cos\phi$ **(award one mark)** Maximum value $I = 4I_0$ Minimum value $I = 0$ (ii) (**I**) Position of first order minimum $y = \frac{n\lambda D}{a}$ $y_1 = \frac{\lambda D}{a}$ $= \frac{600\times10^{-9}\times1.5}{3\times10^{-3}} = 3\times10^{-4}\text{m}$ (**II**) Position of second order maximum $y_n = (2n+1)\frac{\lambda D}{2a}$ $n = 2,\quad y_2 = \frac{5\lambda D}{2a}$ $= \frac{5\times600\times10^{-9}\times1.5}{2\times3\times10^{-3}} = 7.5\times10^{-4}\text{ m}$	½ ½ ½ ½ ½ ½ ½ ½ ½	 5

Marking Scheme Strictly Confidential (For Internal and Restricted use only) Senior School Certificate Examination, 2025 SUBJECT PHYSICS (042) (PAPER CODE 55/7/2)	
<u>General Instructions: -</u>	
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 deliberation 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:- 1. Leaving answer or part thereof unassessed in an answer book. 2. Giving more marks for an answer than assigned to it. 3. Wrong totaling of marks awarded on an answer. 4. Wrong transfer of marks from the inside pages of the answer book to the title page. 5. Wrong question wise totaling on the title page. 6. Wrong totaling of marks of the two columns on the title page. 7. Wrong grand total. 8. Marks in words and figures not tallying/not same. 9. Wrong transfer of marks from the answer book to online award list. 10. 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.) 11. 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.

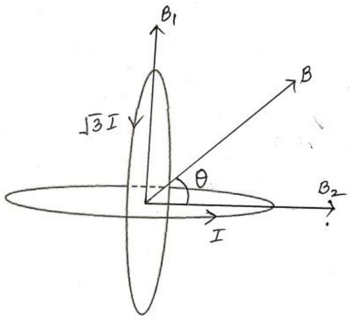
MARKING SCHEME : PHYSICS (042)			
CODE: 55/7/2			
Q.NO.	**VALUE POINTS/EXPECTED ANSWERS**	**MARKS**	**TOTAL MARKS**
	SECTION- A		
1.	(B) E = 0, V= V_0 (a constant)	1	1
2.	(D) $\left[ML^2T^{-2}A^{-2}\right]$	1	1
3.	(B) zero	1	1
4.	(B) 3.20×10^{14} Hz	1	1
5.	(B) 0.2 mV	1	1
6.	(C) holes and few electrons	1	1
7.	(C) 16/3 Ω	1	1
8.	(C) capacitive and inductive respectively	1	1
9.	(A) 1/200 s	1	1
10.	(D) 3/4	1	1
11.	(C) same neutron number, but different atomic number.	1	1
12.	(A) both the potential barrier height and width of depletion layer decrease.	1	1
13.	(C) Assertion(A) is true and Reason(R) is false.	1	1
14.	(D) Both Assertion (A) and Reason (R) are false	1	1
15.	(B) Both Assertion(A) and Reason (R) are true but Reason (R) is **not** the correct explanation of Assertion(A).	1	1
16.	(B) Both Assertion(A) and Reason (R) are true but Reason (R) is **not** the correct explanation of Assertion(A).	1	1
	SECTION- B		
17.	Finding the ratio of drift velocities when joined in (i) Series 1 (ii) Parallel 1		
	(i) Series		
	$I = neAv_d$	½	
	$\frac{v_{d_1}}{v_{d_2}} = \frac{A_2}{A_1}$	½	
	(ii) Parallel		
	$v_d = \frac{V}{RneA} = \frac{V}{\rho l ne}$	½	
	$\frac{v_{d_1}}{v_{d_2}} = \frac{1}{1}$	½	2
18.	Drawing Energy band diagram of n type semiconductor ½ p type semiconductor ½ Showing donor/acceptor energy level ½+½		

	 (a) $T > 0K$ (b) $T > 0K$	1+1	2
19.	Calculating the ratio of intensities 2 Given, $\frac{I_{max}}{I_{min}} = \frac{25}{9}$ $\frac{I_{max}}{I_{min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{25}{9}$ $3(a_1 + a_2) = 5(a_1 - a_2)$ $\frac{a_1}{a_2} = \frac{4}{1}$ $\frac{I_1}{I_1} = \frac{16}{1}$	½ ½ ½ ½	2
20.	(a) Deducing for (a)Size 1 (b)Location of the image produced by convex mirror 1 Let, u= nf From the Mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ $= \frac{1}{f} + \frac{1}{nf}$ $v = \frac{nf}{n+1}$ $n = +ve \quad \therefore v < f$ $m = \frac{-v}{u} = \frac{1}{n+1}$ m is always positive & less than 1. **(Note: Please award full credit if correctly concluded by any other method)** **OR**	½ ½ ½ ½	

	(b) Finding the nature & focal length of lens 1½ Stating answer for changing thickness ½ $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}$ $\frac{1}{12}=\frac{1}{10}-\frac{1}{15}+\frac{1}{f_3}$ $\frac{1}{f_3}=\frac{5-6+4}{60}$ $f_3=20\,\text{cm}$ Nature: Convex Yes	½ ½ ½ ½	2
21.	Calculating Binding Energy per nucleon 2 $\Delta m=\left(2m_n+2m_H\right)-m\left({}^4_2He\right)$ $=2\times1.008665+2\times1.007825-4.002603$ $=0.0303774u$ $BE=\Delta mc^2$ $=0.030377\times931$ $=28.2962\,\text{MeV}$ $\frac{\text{BE}}{\text{nucleon}}=\frac{28.2962}{4}=7.07\,\text{MeV}$	½ ½ ½ ½	2
	SECTION- C		
22.	Writing the mathematical form of postulates of Bohr's Theory 1½ Proving, (a) radius of the orbit is proportional to n^2 1 (b) total energy of the atom is proportional to $1/n^2$ ½ Mathematical form of postulates of Bohr's Theory (i) $E_n=\frac{-13.6}{n^2}\text{eV}$ **Alternatively** : Electron revolve in stable orbits with definite energy called stationary orbits. (ii) $\text{L}=\text{mvr}=\frac{\text{nh}}{2\pi}$ (iii) $h\nu=E_f-E_i$	½ ½ ½	

	(a) $\frac{mv^2}{r} = \frac{Ze^2}{r^2}$ -----(1) $mvr = \frac{nh}{2\pi}$ -----(2) Solving (1) & (2) $r = n^2\left(\frac{h}{2\pi}\right)^2 \frac{4\pi\varepsilon_0}{me^2}$ ----(3) Since energy in the orbit $E_n = \frac{-e^2}{8\pi\varepsilon_0 r}$ Using eq (3) $E_n = \frac{-me^4}{8n^2\varepsilon_0{}^2h^2}$ or $E_n \propto \frac{1}{n^2}$	½ ½ ½	3
23.	(a) Explaining Einstein's photoelectric equation 1 (b) Determining which metal will not show photoelectric emission 1½ Reason when source is brought closer ½ (a) $h\nu = \phi_0 + K_{max}$ $h\nu$ = Energy of incident radiation ϕ_0 = Work function or minimum energy required to emit an electron from metal surface K_{max} = maximum kinetic energy of emitted electron **Alternatively:** The energy of incident radiation E ($>\phi_0$) incident on a metal surface, a part of it is used to overcome the work function & remaining energy provides maximum kinetic energy to the electrons. (b) $\lambda = 330\,nm$ $E = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^8}{330\times10^{-9}\times1.6\times10^{-19}}$ $= 3.77\,eV$ Mo and Ni will not show photoelectric emission. No change.	1 ½ ½ ½ ½	3
24.	(a) (i)Writing Biot-Savart's Law in vector form 1 (ii)Finding magnitude & direction of net magnetic field at centre of two current carrying coils 2 (i) $\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I(\overrightarrow{dl}\times\vec{r})}{r^3}$	1	

(ii) $B_1 = \dfrac{\mu_0 I}{2R}$ ½



$B_2 = \dfrac{\mu_0 \sqrt{3} I}{2R}$

$B = \sqrt{B_1^2 + B_2^2}$

$\therefore B = \dfrac{\mu_0 I}{2R}\sqrt{1+3}$ ½

$B = \dfrac{\mu_0 I}{R}$ ½

$\tan\theta = \dfrac{B_1}{B_2} = \dfrac{1}{\sqrt{3}}$ ½

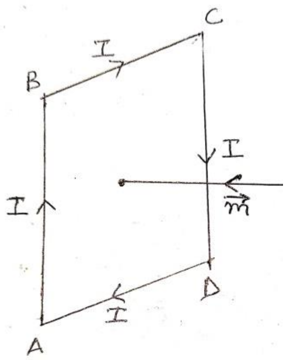
Direction of net magnetic field is 30° with direction of B_2/ 60° with the direction of B_1.

OR

(b)

Writing the expression for magnetic moment & showing its direction	1
Proving no net force	1
Torque $(\vec{\tau}) = \vec{m} \times \vec{B}$	1

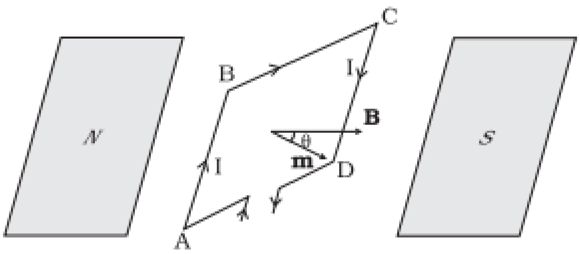
(i) $\vec{m} = I\vec{A}$ ½



½

(ii) $F_1 = F_2 = IbB$ $\quad F_1 =$ Force on AB into the plane

$F_2 =$ Force on CD out of the plane ½



Since forces are equal & opposite so net force = 0 ½

Both forces form a couple, magnitude of torque acting on the coil is

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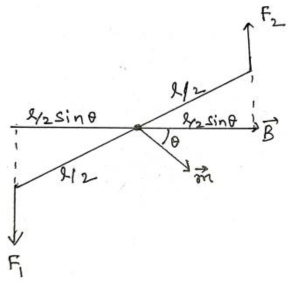
$\therefore \tau = F_1 \frac{l}{2}\sin\theta + F_2 \frac{l}{2}\sin\theta$

$= I\ b\ B\ l\sin\theta$

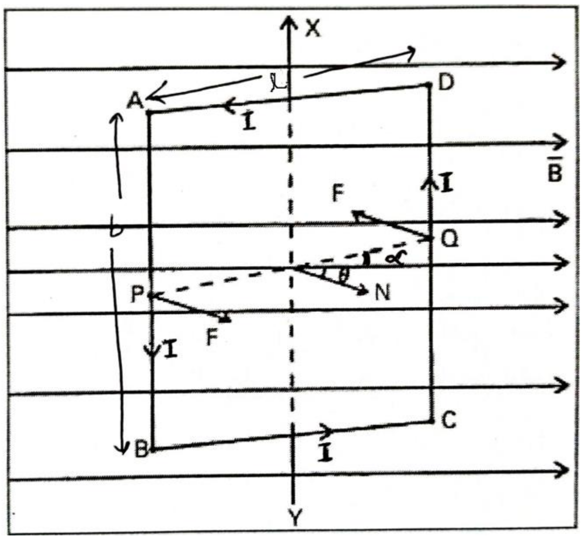
$= I\ A\ B\ \sin\theta$

$= m\ B\sin\theta$

$\vec{\tau} = \vec{m}\times\vec{B}$



Alternatively:



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

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

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

$|F_{DC}| = IbB$

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

$|F_{AB}| = IbB$

Since forces are equal & opposite so net force = 0

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

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

$\tau = IbB \times a\sin\theta$

$= IAB\sin\theta$

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

$\vec{\tau} = \vec{m}\times\vec{B}$

</td>
<td>½
½
½
½
½
½</td>
<td>3</td>
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<td>25.</td>
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(a) Production of em waves	1
(b) Writing the wavelength & use of	
(i) Microwaves	1
(ii) Ultraviolet waves	1

(a) Electromagnetic waves are produced by an oscillating or accelerated charge.

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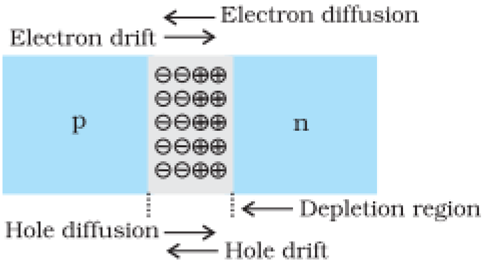
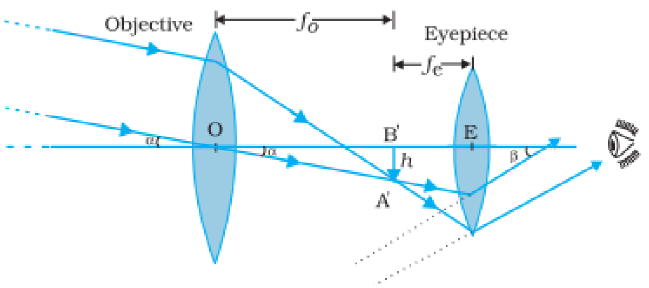
	Alternatively: An oscillating charge produces an oscillating electric field which produces an oscillating magnetic field which in turn is a source of oscillating electric field & so on. (b) (i) **Microwaves** **Wavelength**: 0.1 m to 1 mm **Use** : Radar used in aircraft navigation. Microwave ovens. **(Any one)** (ii) **Ultraviolet waves** **Wavelength**: 400 nm to 1 nm **Use** : Kill germs in UV purifiers. LASIK eye surgery. **(Any one)**	½ ½ ½ ½	3
26.	(a) Obtaining expression for mutual inductance of two concentric coils 2 (b) Finding self-inductance of the solenoid 1 (a) Magnetic field at centre of outer coil S_2 $B_2 = \frac{\mu_0 I_2}{2r_2}$ Flux linked with inner coil S_1 is $\phi_1 = B_2 A_1$ $= \frac{\mu_0 I_2}{2r_2} . \pi r_1^2$ Also, $\phi_1 = M_{12} I_2$ $\therefore M_{12} = \frac{\mu_0}{2r_2} . \pi r_1^2$ (b) $\varepsilon = -L\frac{dI}{dt}$ $L = \frac{0.4 \times 50 \times 10^{-3}}{4 \times 10^{-3}}$ $= 5\,H$	½ ½ ½ ½ ½ ½	3
27.	Explaining the formation of depletion layer and potential barrier 1+1 Feature of junction diode for its use as rectifier 1 When an electron diffuses from n-side to p-side, it leaves behind an ionized donor on n side. Similarly when a hole diffuses from p-side to n-side, it leaves behind an ionized acceptor on p side. This space charge region consisting of immobile ions on either side of the junction is known as depletion layer.	1	

	As diffusion process continues, width of depletion layer increases and consequently strength of electric field increases across the junction and thus the drift current. The potential that prevents the movement of electron from n region into p region is called potential barrier.  **(Note : Award full credit of formation of depletion layer even if a student draws above diagram)** Diode allows current to pass only when it is forward biased as resistance is small whereas in reverse bias, its resistance is very large. **Alternatively**: Diode is unidirectional.	1 1	3
28.	(a) Calculating work done to separate two charges 1 (b) Calculating electrostatic potential energy 2 (a) $U=\frac{kq_1q_2}{r}$ $=\frac{9\times10^9\times(-5\times10^{-6})\times(2\times10^{-6})}{10\times10^{-2}}$ $=-0.9\,J$ W = U(infinity) – U(r) = 0.9J (b) $E=\frac{-dV}{dr}$ $dV=\frac{-A}{r^2}dr$ $V=\frac{A}{r}$ $U=q_1V_1+q_2V_2+\frac{kq_1q_2}{r}$ $=(-5\times10^{-6})\left(\frac{8\times10^4}{4\times10^{-2}}\right)+(2\times10^{-6})\left(\frac{8\times10^4}{6\times10^{-2}}\right)-0.9$ $=-10+2.67-0.9$ $=-8.24\,J$	½ ½ ½ ½ ½ ½	3
	SECTION -D		
29.	(i) (A) $1/\sqrt{n^2\text{-}1}$ (ii) (a) (B) 1.4 **OR** (b) (D) increase by 19%	1 1	

<table>
<tr><td></td><td>(iii) (C) First real and then virtual
(iv) (A) 10cm</td><td>1
1</td><td>
4</td></tr>
<tr><td>30.</td><td>(i) (D) 1
(ii) (C) 3.75×10^{6}
(iii) (B) 500^{0} C
(iv) (a) (D) I decreases and II is almost constant
OR
(b) (D) All I, II and III change</td><td>1
1
1
1</td><td>

4</td></tr>
<tr><td></td><td>SECTION- E</td><td></td><td></td></tr>
<tr><td>31.</td><td>(a) (i) Drawing labeled Diagram 1½
Explanation ½
Writing expression of Magnifying power 1
(ii) Calculating the focal length of objective & eye piece 2


(Note: Deduct ½ mark, for not showing arrows with the rays)
Light from distant object enters the objective lens & forms a real image A'B' at f_o.
This image A'B' acts as an object for eye piece and eye piece forms a magnified image at infinity.
Magnifying Power = f_o/f_e
(ii) Image is formed at least distance of distinct vision
$20 = m_o \times m_e$
$m_o = \frac{20}{5} = 4$
$m_e = 1 + \frac{D}{f_e}$
$f_e = \frac{25}{4} cm$
$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$
$\frac{1}{-25} - \frac{1}{u_e} = \frac{4}{25}$
$u_e = -5cm$</td><td>1½

½

1

½

½</td><td></td></tr>
</table>

	$L = v_0 + \lvert u_e \rvert$ $v_0 = 9cm$ Given, $\frac{v_0}{u_0} = 4$ $\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$ $\frac{1}{f_0} = \frac{1}{9} - \left(-\frac{4}{9}\right)$ $f_0 = \frac{9}{5} cm$	½ ½	
	OR (b) (i) Obtaining the expression for resultant intensity of interference pattern 2 Writing maximum & minimum values of resultant intensity 1 (ii) Calculating the distance of **(I)** First order minimum 1 **(II)** Second order maximum from centre of screen 1		
	(i) $y_1 = a\cos\omega t$ $y_2 = a\cos(\omega t + \phi)$ According to Principle of Superposition $y = y_1 + y_2$ $= a[\cos\omega t + \cos(\omega t + \phi)]$ $= 2a\cos\phi/2 \cos(\omega t + \phi/2)$ $y = A\cos\left(\omega t + \phi/2\right)$ where, $A = 2a\cos\phi/2$ $I = kA^2$ $I = k\left(4a^2\cos^2\phi/2\right)$ $I = 4I_0\cos^2\phi/2$	½ ½ ½ ½	
	Alternatively: If student writes $I = I_1 + I_1 + 2\sqrt{I_1 I_1}\cos\phi$ **(award one mark)** Maximum value $I = 4I_0$ Minimum value $I = 0$	 ½ ½	
	(ii) **(I)** Position of first order minimum		

	$y=\frac{n\lambda D}{a}$ $y_1=\frac{\lambda D}{a}$	½	
	$=\frac{600\times10^{-9}\times1.5}{3\times10^{-3}}=3\times10^{-4}\text{m}$	½	
	(II) Position of second order maximum $y_n=(2n+1)\frac{\lambda D}{2a}$ $n=2,\quad y_2=\frac{5\lambda D}{2a}$	½	
	$=\frac{5\times600\times10^{-9}\times1.5}{2\times3\times10^{-3}}=7.5\times10^{-4}\text{ m}$	½	5
32.	(a) (i) Finding the value of capacitance 3 (ii) Finding the number of capacitors 2		
	(i) $C_0=\frac{\varepsilon_0 A}{d}$	½	
	$C=\frac{\varepsilon_0 A}{(d-t)+\frac{t}{K}}$	½	
	$t=d/4$ $C=\frac{\varepsilon_0 A}{\left(d-\frac{d}{4}\right)+\frac{d}{4K}}=\frac{\varepsilon_0 A}{d\left(\frac{3}{4}+\frac{1}{4K}\right)}$	1	
	$=C_0\frac{4K}{(3K+1)}$	1	
	Alternatively: When dielectric is inserted, the electric field between the plates is $E=E_0/K$ The potential difference will be $V=E_0\left(\frac{3d}{4}\right)+E\left(\frac{d}{4}\right)$	½ ½	
	$=E_0\left(\frac{3d}{4}\right)+\frac{E_0}{K}\left(\frac{d}{4}\right)$ $=V_0\left(\frac{3}{4}+\frac{1}{4K}\right)$ $V=V_0\left(\frac{3K+1}{4K}\right)$	1	
	$C=\frac{Q_0}{V}=\left(\frac{4K}{3K+1}\right)\frac{Q_0}{V_0}$ $C=C_0\left(\frac{4K}{3K+1}\right)$	1	
	(ii) Each capacitance can withstand 200V	½	

No. of capacitors in each row = $\frac{1200}{200} = 6$

Net capacitance of each row= 1/6 μF ½

Number of rows = n

$$C_{eq} = C_1 + C_2 + \_\_\_\_\_\_ + C_n$$

$$C_{eq} = \frac{1}{6} + \frac{1}{6} + ------ n$$

$$2 = \frac{n}{6}$$ ½

$$\therefore n = 12$$

Total no. of capacitors in the arrangement = 6 × 12 ½

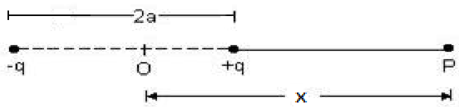
= 72

OR

(b)

(i) Deriving the expression of electric potential due to dipole	
I. along its axis	1½
II. along its bisector line	1½
(ii) Calculating the torque	2

I. Along its axis



$$V_- = \frac{-kq}{x+a}$$

$$V_+ = \frac{kq}{x-a}$$ ½

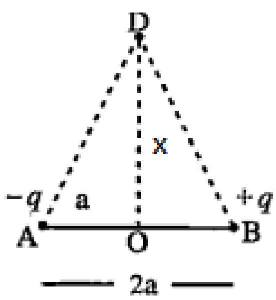
$$V = V_- + V_+$$

$$= kq\left(\frac{-1}{x+a} + \frac{1}{x-a}\right)$$

$$= kq\frac{2a}{(x^2-a^2)} = \frac{kp}{x^2-a^2}$$ ½

$$x \gg a \quad \therefore V = \frac{kp}{x^2}$$ ½

II. Along the bisector line



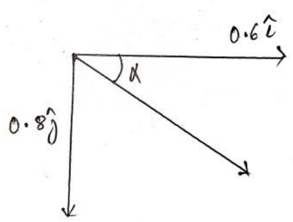
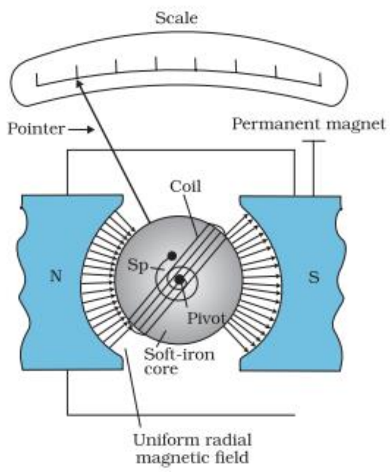
$$V_- = \frac{kq}{\sqrt{x^2+a^2}}$$ ½

$$V_+ = \frac{-kq}{\sqrt{x^2+a^2}}$$ ½

$$V = V_- + V_+$$ ½

$$= 0$$

(ii) $\vec{\tau} = \vec{p} \times \vec{E}$ ½

	$=(0.8\hat{i}+0.6\,\hat{j})\times10^{-29}\times(1\times10^{7})\,\hat{k}$		
	$=\left[0.8\left(-\hat{j}\right)+0.6\hat{i}\,\right]\times10^{-22}$	½	
	$\tau=\left[\sqrt{(0.8)^{2}+(0.6)^{2}}\,\right]\times10^{-22}$		
	$=10^{-22}\ Nm$	½	
	$\tan\alpha=\dfrac{\lvert 0.8\rvert}{0.6}$ 		
	$\alpha=\tan^{-1}\left(\dfrac{4}{3}\right)$	½	
	$\alpha=53^{0}$		5
33.	(a) (i) Labelled diagram — 1 Working principle of moving coil galvanometer — 1 Use of (i) Radial magnetic field — ½ (ii) Soft iron core — ½ (ii) Defining current sensitivity — 1 Reason — 1		
		1	
	Principle: A current carrying coil placed in uniform magnetic field experiences a torque.	1	
	(i) Radial magnetic field makes the scale linear **Alternatively**: Radial magnetic field provides maximum Torque.	½	
	(ii) Use of soft iron core is to increase the strength of magnetic field/ increase sensitivity of the galvanometer.	½	
	(ii) **Current sensitivity** is defined as deflection per unit current. **Alternatively**:	1	

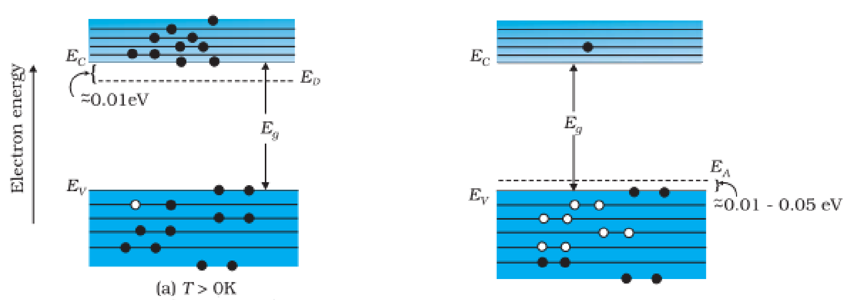
	$I_s = \frac{\Phi}{I} = \frac{NAB}{k}$ Voltage sensitivity $V_s = \frac{\Phi}{V} = \left(\frac{NAB}{k}\right)\frac{I}{V} = \left(\frac{NAB}{k}\right)\frac{1}{R}$ Increase in number of turns, increases the current sensitivity and resistance of the galvanometer in the same proportion of current sensitivity therefore Voltage sensitivity remains unchanged. **OR** (b) (i) (I) Writing Ampere circuital law & explaining the terms. 1 (II) Reason for magnetic field outside long solenoid approaching zero 1 (III) Reason for irregular shaped loop changing to circular loop in uniform magnetic field 1 (ii) Finding the value of Resistance R_3 2 (i) **(I)** $\oint \vec{B}.\vec{dl} = \mu_0 I_e$ I_e= Total current through the surface B= Magnetic field dl = length of small element **(II)** As length of solenoid increases, it appears like a long cylindrical metal sheet so field outside approaches zero. **(III)**. For a given perimeter, a circle encloses greater area than any other shape, which maximizes the flux. (ii) $R_1 = \frac{V}{I_g} - G \quad \Rightarrow \frac{V}{I_g} = R_1 + G$ -----(1) $R_2 = \frac{V}{2I_g} - G \quad \Rightarrow \frac{V}{2I_g} = R_2 + G$ -----(2) Solving (1) & (2) $G = R_1 - 2R_2$ $R_3 = \frac{2V}{I_g} - G$ -----(3) Solving using eq (1) & (3) $R_3 = 3R_1 - 2R_2$	½ ½ ½ ½ 1 1 ½ ½ ½ ½	5

Marking Scheme **Strictly Confidential** **(For Internal and Restricted use only)** **Senior School Certificate Examination, 2025** **SUBJECT PHYSICS (042) (PAPER CODE 55/7/3)**	
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 deliberation 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:- 1. Leaving answer or part thereof unassessed in an answer book. 2. Giving more marks for an answer than assigned to it. 3. Wrong totaling of marks awarded on an answer. 4. Wrong transfer of marks from the inside pages of the answer book to the title page. 5. Wrong question wise totaling on the title page. 6. Wrong totaling of marks of the two columns on the title page. 7. Wrong grand total. 8. Marks in words and figures not tallying/not same. 9. Wrong transfer of marks from the answer book to online award list. 10. 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.) 11. 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 : 55/7/3			
Q.NO.	**VALUE POINT/ EXPECTED ANSWERS**	**MARKS**	**TOTAL MARKS**
	SECTION- A		
1.	(C) 30 μC	1	1
2.	(C) holes and few electrons	1	1
3.	(C) 2.0 ^{0}C	1	1
4.	(D) $\left[ML^2T^{-2}A^{-2}\right]$	1	1
5.	(C) same neutron number, but different atomic number.	1	1
6.	(B) 0.2 mV	1	1
7.	(B) 3.20×10^{14} Hz	1	1
8.	(A) 1/200 s	1	1
9.	(A) BA sin α	1	1
10.	(C) 13.6 eV	1	1
11.	(C) capacitive and inductive respectively	1	1
12.	(A) Both the potential barrier height and width of depletion layer decrease.	1	1
13.	(B) Both Assertion(A) and Reason (R) are true but Reason(R) is **not** the correct explanation of Assertion(A).	1	1
14.	(D) Both Assertion (A) and Reason (R) are false.	1	1
15.	(B) Both Assertion(A) and Reason (R) are true but Reason(R) is **not** the correct explanation of Assertion(A).	1	1
16.	(C) Assertion(A) is true and Reason(R) is false.	1	1
	SECTION- B		
17.	Calculating current passing through battery 2		
	The given circuit forms a balanced Wheatstone bridge so no current flows through 5Ω resistor.	½	
	$R_{eq}=\frac{30\times60}{30+60}$	½	
	$=20\,\Omega$		
	$I=\frac{V}{R_{eq}}$	½	
	$=\frac{6}{20}=\frac{3}{10}A$	½	2
18.	Finding the intensity at a point on the screen 2		
	$I_0=I_1+I_2+2\sqrt{I_1}\sqrt{I_2}\cos\phi$	½	
	$=I+I+2I\cos0^0$	½	

	$= 2I + 2I = 4I$ $I = I_0 / 4$ Intensity at point P $I' = I + I + 2I \cos \pi/3$ $= 3I$ $= \frac{3I_0}{4}$ **Alternatively**: $I = I_o \cos^2 \phi/2$ $I = I_o \cos^2 \pi/6$ $= \frac{3I_0}{4}$	½ ½ 1 ½ ½	2
19.	Defining distance of closest approach ½ Deriving the expression for distance of closest approach 1½ The distance between the α particle and the target nucleus when whole kinetic energy of an α particle gets converted into potential energy. **Alternatively:** It is the distance from the nucleus at which alpha particle stops momentarily and then begins to retrace its path. At distance of closest approach K = U $K = \frac{(2e)(Ze)}{4\pi\varepsilon_0 d}$ $\therefore d = \frac{2Ze^2}{4\pi\varepsilon_0 K}$	½ 1 ½	2
20.	(a) Deducing for (a)Size 1 (b)Location of the image produced by convex mirror 1 Let, u= nf From the Mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$	½	

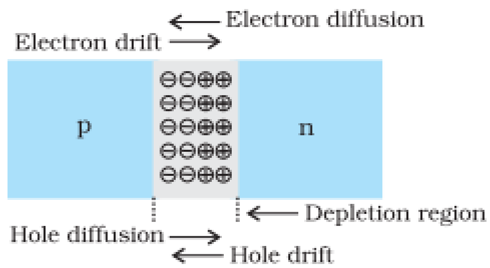
	$= \frac{1}{f} + \frac{1}{nf}$		
	$v = \frac{nf}{n+1}$		
	$n = +ve \quad \therefore v < f$	½	
	$m = \frac{-v}{u} = \frac{1}{n+1}$	½	
	m is always positive & less than 1.	½	
	Note: **Award full credit if correctly concluded by any other method.**		
	OR		
	(b) Finding the nature & focal length of lens 1½ Stating answer for changing thickness ½		
	$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$	½	
	$\frac{1}{12} = \frac{1}{10} - \frac{1}{15} + \frac{1}{f_3}$		
	$\frac{1}{f_3} = \frac{5-6+4}{60}$		
	$f_3 = 20\,\text{cm}$	½	
	Nature: Convex	½	
	Yes	½	2
21.	Drawing Energy band diagram of n type semiconductor ½ p type semiconductor ½ Showing donor/acceptor energy level ½+½		
	 (a) $T > 0K$ (b) $T > 0K$	1+1	2

SECTION- C

22.

Explaining the formation of depletion layer and potential barrier	1+1
Feature of junction diode for its use as rectifier	1

When an electron diffuses from n-side to p-side, it leaves behind an ionized donor on n side.
Similarly when a hole diffuses from p-side to n-side, it leaves behind an ionized acceptor on p side.
This space charge region consisting of immobile ions on either side of the junction is known as depletion layer. 1
As diffusion process continues width of depletion layer increases and consequently strength of electric field increases across the junction and thus the drift current.
The potential that prevents the movement of electron from n region into p region is called potential barrier. 1



<u>Note</u> : Award 1 mark if formation of depletion layer is shown with the help of above diagram.

Diode allows current to pass only when it is forward biased as resistance is small whereas in reverse bias resistance is very large. 1
Alternatively: Diode is unidirectional. 3

23.

Calculating	
(a) Net outward flux through the cylinder	2
(b) Net charge inside the cylinder	1

$\phi_L = \vec{E}.\overrightarrow{\Delta S}$

$=100\left(-\hat{i}\right).\Delta S\left(-\hat{i}\right)$ ½

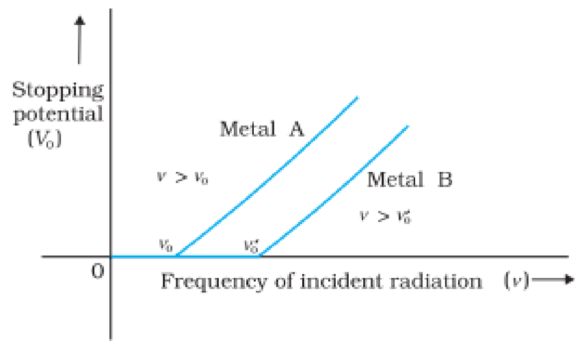
$=100\times\pi\left(2\times10^{-2}\right)^2$

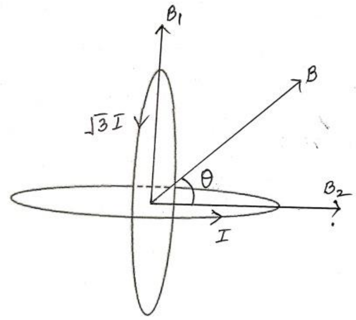
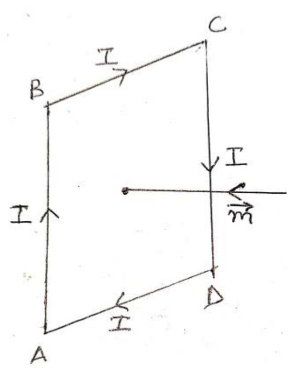
$=4\pi\times10^{-2}\ \text{Nm}^2/\text{C}$ ½

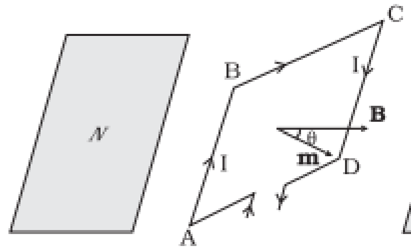
$\phi_R = 100\left(\hat{i}\right).\Delta S\left(\hat{i}\right)$

$=100\times\pi\left(2\times10^{-2}\right)^2$

$=4\pi\times10^{-2}\ \text{Nm}^2/\text{C}$

	$\phi_{\text{total}} = \phi_L + \phi_R$ $= 8\pi \times 10^{-2}\ \text{Nm}^2/\text{C}$ $= 25.12 \times 10^{-2}\ \text{Nm}^2/\text{C}$ Charge $q = \varepsilon_0\, \phi_{total}$ $= 25.12 \times 10^{-2} \times 8.85 \times 10^{-12}$ $= 0.22 \times 10^{-11}\ \text{C}$	½ ½ ½ ½	3
24.	Reason for (a) Independence of maximum kinetic energy of photoelectrons & intensity of incident radiation 1 (b) Increase in photoelectric current with increase in intensity of incident radiation 1 (c) Linear variation in stopping potential with frequency of incident radiation 1 (a) With the variation in the intensity of incident radiations, there is a change in the number of photons not on the energies of the photons so the maximum kinetic energy of photoelectrons remains same. (b)With the increase in intensity of incident radiation number of photons increases as a result photoelectric current increase. (c) With the increase in frequency of incident radiation , the maximum kinetic energy of photoelectrons increases. Hence higher value of stopping potential (retarding potential) is required.  **Alternatively:** $K_{\max} = eV_o = h\nu - h\nu_o$	1 1 1	3
25.	(a) (i)Writing Biot-Savart's Law in vector form 1 (ii)Finding magnitude & direction of net magnetic field at centre of two current carrying coils 2		

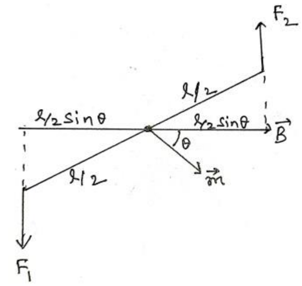
	(i) $\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I(\overrightarrow{dl}\times\vec{r})}{r^3}$	1	
	(ii) $B_1 = \frac{\mu_0 I}{2R}$	½	
	$B_2 = \frac{\mu_0\sqrt{3}I}{2R}$ 		
	$B = \sqrt{B_1^2 + B_2^2}$	½	
	$\therefore B = \frac{\mu_0 I}{2R}\sqrt{1+3}$		
	$B = \frac{\mu_0 I}{R}$	½	
	$\tan\theta = \frac{B_1}{B_2} = \frac{1}{\sqrt{3}}$	½	
	Direction of net magnetic field is 30° with direction of B_2/ 60° with the direction of B_1.		
	OR		
	(b) Writing the expression for magnetic moment & showing its direction 1 Proving no net force 1 Torque $(\vec{\tau}) = \vec{m}\times\vec{B}$		
	(i) $\vec{m} = I\vec{A}$	½	
		½	
	(ii) $F_1 = F_2 = IbB$ F_1 = Force on AB into the plane F_2 = Force on CD out of the plane	½	



Since forces are equal & opposite so net force = 0 ½

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

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



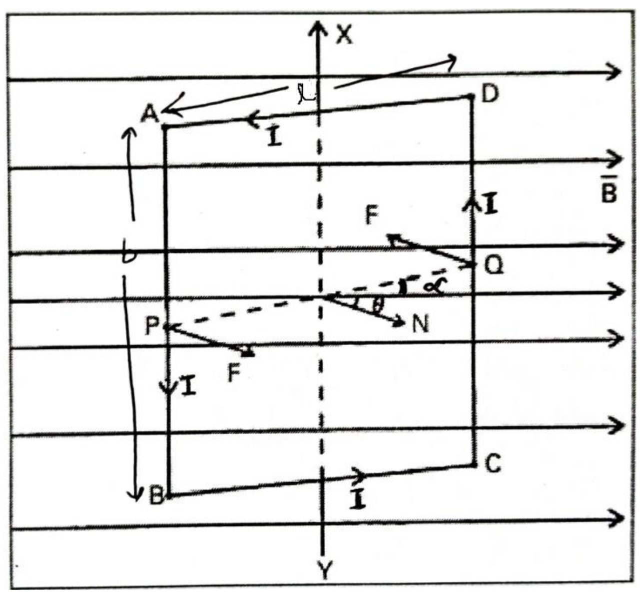
$= \mathrm{I\ b\ B}\ l \sin\theta$

$= \mathrm{I\ A\ B}\ l \sin\theta$

$= \mathrm{m\ B} \sin\theta$ ½

$\vec{\tau} = \vec{m} \times \vec{B}$

Alternatively:



If the plane of the current carrying coil makes 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

$|F_{DC}| = IbB$

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

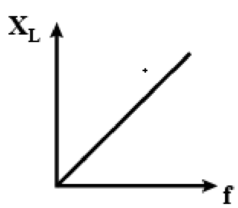
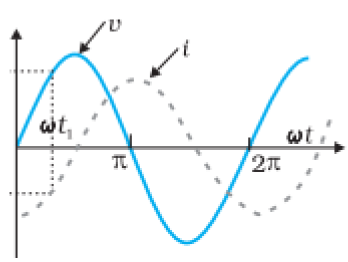
$|F_{AB}| = IbB$ ½

Since forces are equal & opposite so net force = 0

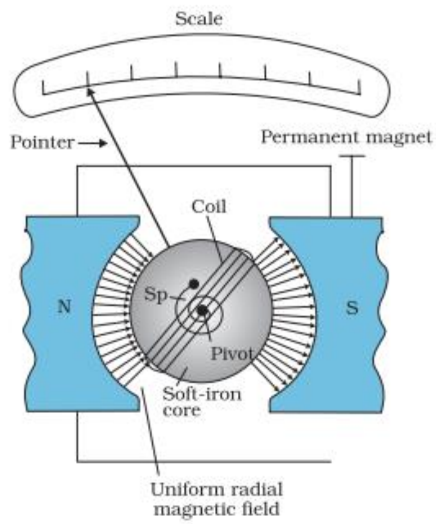
Both of them form a couple and magnitude of torque acting on the coil is

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

$\tau = IbB \times a \sin\theta$

	$\tau = IbB \times l \sin\theta$ $\vec{\tau} = I\vec{A} \times \vec{B}$ $\vec{\tau} = \vec{m} \times \vec{B}$	½ ½	 3
26.	Naming the electromagnetic radiation & writing their frequency range 3 (a) **Name**: X- rays **Frequency Range**: 10^{16} - 10^{20} Hz (b) **Name**: Infra-red radiation **Frequency Range**: $10^{12} – 10^{14}$ Hz (c) **Name**: Radio waves **Frequency Range**: $10^{5} – 10^{9}$ Hz	 ½ ½ ½ ½ ½ ½	 3
27.	(a) Identifying element X and writing expression for reactance 1 (b) Plotting a graph to show variation of reactance with frequency 1 (c) Plotting variation of voltage & current with time 1 (a) Inductor $X_L = 2\pi fL$ (b)  (c) 	 ½ ½ 1 1	 3
28.	Writing the mathematical form of postulates of Bohr's Theory 1½ Proving, (a) radius of the orbit is proportional to n^2 1 (b)Total energy of the atom is proportional to $1/n^2$ ½		

	Mathematical form of postulates of Bohr's Theory (i) $E_n = \frac{-13.6}{n^2} eV$ **Alternatively** : Electron revolve in stable orbits with definite energy called stationary orbits. (ii) $L = mvr = \frac{nh}{2\pi}$ (iii) $h\nu = E_f - E_i$ (a) $\frac{mv^2}{r} = \frac{Ze^2}{r^2}$ -----(1) $mvr = \frac{nh}{2\pi}$ -----(2) Solving (1) & (2) $r = n^2 \left(\frac{h}{2\pi}\right)^2 \frac{4\pi\varepsilon_0}{me^2}$ ----(3) Since energy in the orbit $E_n = \frac{-e^2}{8\pi\varepsilon_0 r}$ Using eq (3) $E_n = \frac{-me^4}{8n^2\varepsilon_0^2 h^2}$ or $E_n \propto \frac{1}{n^2}$	½ ½ ½ ½ ½ ½	3
	SECTION- D		
29.	(i) (a) (D) I decreases and II is almost constant **OR** (b) (D) All I, II and III change (ii) (B) 500^0 C (iii) (C) 3.75×10^6 (iv) (D) 1	1 1 1 1	4
30.	(i) (C) First real and then virtual (ii) (A) 10cm (iii) (A) $1/\sqrt{n^2-1}$ (iv) (a) (B) 1.4 **OR** (b) (D) increase by 19%	1 1 1 1	4
	SECTION- E		
31.	(a) (i) Labelled diagram 1 Working principle of moving coil galvanometer 1 Use of (i) Radial magnetic field ½ (ii) Soft iron core ½ (ii) Defining current sensitivity 1 Reason 1		



1

Principle:A current carrying coil placed in uniform magnetic field experiences a torque. 1

(i) Radial magnetic field makes the scale linear ½
Alternatively: Radial magnetic field provides maximum Torque.

(ii) Use of soft iron core is to increase the strength of magnetic field/ increase sensitivity of the galvanometer. ½

(ii) **Current sensitivity** is defined as deflection per unit current. 1
Alternatively:

$$I_s = \frac{\Phi}{I} = \frac{NAB}{k}$$

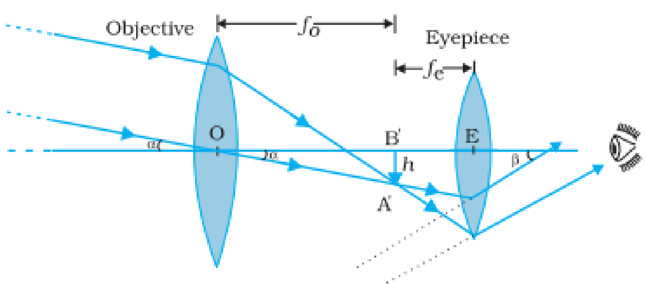
Voltage sensitivity $V_s = \frac{\Phi}{V} = \left(\frac{NAB}{k}\right)\frac{I}{V} = \left(\frac{NAB}{k}\right)\frac{I}{R}$ ½

Increase in number of turns, increases the current sensitivity and resistance of the galvanometer in the same proportion of current sensitivity therefore Voltage sensitivity remains unchanged. ½

OR

(b)

(i) (I) Writing Ampere circuital law & explaining the terms.	1
(II) Reason for magnetic field outside long solenoid approaching zero	1
(III) Reason for irregular shaped loop changing to circular loop in uniform magnetic field	1
(ii) Finding the value of Resistance R_3	2

	(i) **(I)** $\oint \vec{B}.\vec{dl} = \mu_0 I_e$ I_e= Total current through the surface B= Magnetic field dl = length of small element **(II)** As length of solenoid increases, it appears like a long cylindrical metal sheet so field outside approaches zero. **(III)** For a given perimeter, a circle encloses greater area than any other shape, which maximizes the flux. (ii) $R_1 = \frac{V}{I_g} - G \qquad \Rightarrow \frac{V}{I_g} = R_1 + G$ -----(1) $R_2 = \frac{V}{2I_g} - G \qquad \Rightarrow \frac{V}{2I_g} = R_2 + G$ -----(2) Solving (1) & (2) $G = R_1 - 2R_2$ $R_3 = \frac{2V}{I_g} - G$ -----(3) Solving using eq (1) & (3) $R_3 = 3R_1 - 2R_2$	½ ½ 1 1 ½ ½ ½ ½	5
32.	(a) (i) Drawing labeled Diagram 1½ Explanation ½ Writing expression of Magnifying power 1 (ii) Calculating the focal length of objective & eye piece 2  **(Note: Deduct ½ mark, for not showing arrows with the rays)** Light from distant object enters the objective lens & forms a real image A'B' at f_o. This image A'B' acts as an object for eye piece and eye piece forms a magnified image at infinity.	1½ ½	

Magnifying Power = f_o / f_e 1

(ii) Image is formed at least distance of distinct vision

$$20 = m_o \times m_e$$ ½

$$m_o = \frac{20}{5} = 4$$

$$m_e = 1 + \frac{D}{f_e}$$ ½

$$f_e = \frac{25}{4} cm$$

$$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$$

$$\frac{1}{-25} - \frac{1}{u_e} = \frac{4}{25}$$

$$u_e = -5cm$$

$$L = v_0 + |u_e|$$

$$v_0 = 9cm$$ ½

Given, $\frac{v_0}{u_0} = 4$

$$\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$$

$$\frac{1}{f_0} = \frac{1}{9} - \left(-\frac{4}{9}\right)$$

$$f_0 = \frac{9}{5} cm$$ ½

OR

(b)

(i) Obtaining the expression for resultant intensity of interference pattern	2
Writing maximum & minimum values of resultant intensity	1
(ii) Calculating the distance of	
(I) First order minimum	1
(II) Second order maximum from centre of screen	1

(i) $y_1 = a\cos\omega t$

$$y_2 = a\cos(\omega t + \phi)$$ ½

According to Principle of Superposition

$$y = y_1 + y_2$$

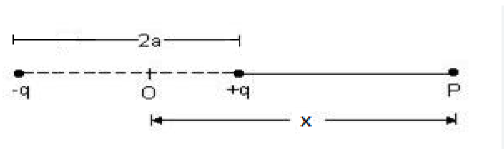
$$= a\left[\cos\omega t + \cos(\omega t + \phi)\right]$$ ½

	$=2a\cos\phi/2\,\cos(\omega t+\phi/2)$ $y=A\cos\left(\omega t+\phi/2\right)$ where, $A=2a\cos\phi/2$ $I=kA^2$ $I=k\left(4a^2\cos^2\phi/2\right)$ $I=4I_0\cos^2\phi/2$ **<u>Alternatively</u>**: If student writes $I=I_1+I_1+2\sqrt{I_1I_1}\cos\phi$ **(award one mark)** Maximum value $I=4I_0$ Minimum value $I=0$ (ii) (**I**) Position of first order minimum $y=\frac{n\lambda D}{a}$ $y_1=\frac{\lambda D}{a}$ $=\frac{600\times10^{-9}\times1.5}{3\times10^{-3}}=3\times10^{-4}\,m$ (**II**) Position of second order maximum $y_n=(2n+1)\frac{\lambda D}{2a}$ $n=2,\quad y_2=\frac{5\lambda D}{2a}$ $=\frac{5\times600\times10^{-9}\times1.5}{2\times3\times10^{-3}}=7.5\times10^{-4}\,m$	½ ½ ½ ½ ½ ½ ½ ½	5
33.	(a) (i) Finding the new value of capacitance 3 (ii) Finding the number of capacitor 2 (i) $C_0=\frac{\varepsilon_0 A}{d}$ $C=\frac{\varepsilon_0 A}{(d-t)+\frac{t}{K}}$ $t=d/4$	½ ½ 1	

	$$C=\frac{\varepsilon_0 A}{\left(d-\frac{d}{4}\right)+\frac{d}{4K}}=\frac{\varepsilon_0 A}{d\left(\frac{3}{4}+\frac{1}{4K}\right)}$$	1	
	$$=C_0\frac{4K}{(3K+1)}$$	½	
	Alternatively: When dielectric is inserted, the electric field between the plates is E= E_0/K The potential difference will be	½	
	$$V=E_0\left(\frac{3d}{4}\right)+E\left(\frac{d}{4}\right)$$ $$=E_0\left(\frac{3d}{4}\right)+\frac{E_0}{K}\left(\frac{d}{4}\right)$$ $$=V_0\left(\frac{3}{4}+\frac{1}{4K}\right)$$	1	
	$$V=V_0\left(\frac{3K+1}{4K}\right)$$ $$C=\frac{Q_0}{V}=\left(\frac{4K}{3K+1}\right)\frac{Q_0}{V_0}$$	1	
	$$C=C_0\left(\frac{4K}{3K+1}\right)$$	½	
	(ii) Each capacitance can withstand 200V No. of capacitors in each row = $\frac{1200}{200}=6$	½	
	Net capacitance of each row= 1/6 μF Number of rows = n $C_{eq}=C_1+C_2+\_\_\_\_\_\_+C_n$ $C_{eq}=\frac{1}{6}+\frac{1}{6}+-----n$ $2=\frac{n}{6}$	½	
	$\therefore n=12$ Total no. of capacitors in the arrangement = 6 × 12 = 72	½	
	OR		
	(b) (i) Deriving the expression of electric potential due to dipole I. along its axis 1½ II. along its bisector line 1½ (ii) Calculating the torque 2		

I. Along its axis

$$V_- = \frac{-kq}{x+a}$$



$$V_+ = \frac{kq}{x-a}$$ ½

$$V = V_- + V_+$$

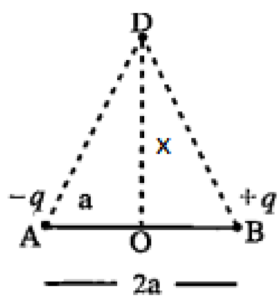
$$= kq\left(\frac{-1}{x+a} + \frac{1}{x-a}\right)$$

$$= kq\frac{2a}{\left(x^2-a^2\right)} = \frac{kp}{x^2-a^2}$$ ½

$$x \gg a \quad \therefore V = \frac{kp}{x^2}$$ ½

II. Along the bisector line

$$V_- = \frac{kq}{\sqrt{x^2+a^2}}$$ ½



$$V_+ = \frac{-kq}{\sqrt{x^2+a^2}}$$ ½

$$V = V_- + V_+$$ ½

$$= 0$$

(ii) $\vec{\tau} = \vec{p} \times \vec{E}$ ½

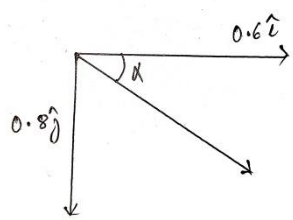
$$= (0.8\hat{i} + 0.6\hat{j}) \times 10^{-29} \times (1 \times 10^7)\hat{k}$$

$$= \left[0.8\left(-\hat{j}\right) + 0.6\hat{i}\right] \times 10^{-22}$$ ½

$$\tau = \left[\sqrt{(0.8)^2 + (0.6)^2}\right] \times 10^{-22}$$

$$= 10^{-22}\ Nm$$ ½

$$\tan\alpha = \frac{|0.8|}{0.6}$$



$$\alpha = \tan^{-1}\left(\frac{4}{3}\right)$$ ½

$$\alpha = 53^0$$

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