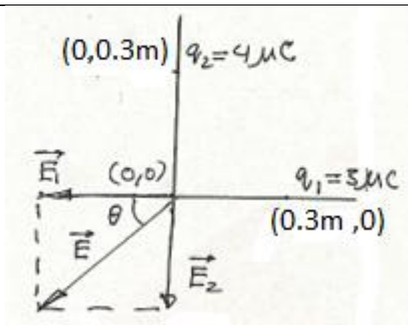
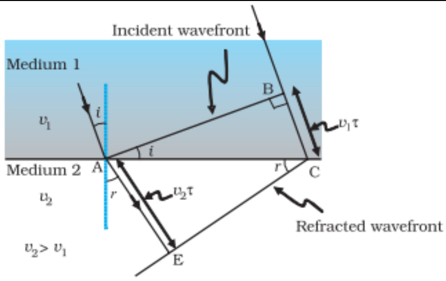
Marking Scheme Strictly Confidential (For Internal and Restricted use only) Senior School Certificate Examination, 2024 SUBJECT NAME PHYSICS [PAPER CODE 55/S/2]	
General Instructions: -	
1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. 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 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:- ● 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/S/2			
Q. No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
	SECTION A		
1.	(B) -0.925	1	1
2.	(B) 4:1	1	1
3.	(A) $V_A=V_B=V_C$	1	1
4.	(C) 20μF	1	1
5.	(A) Same number of neutrons but different number of protons	1	1
6.	(C) +y axis, $\frac{2\pi}{\lambda}$	1	1
7.	(B) 45^0	1	1
8.	(C)The number of alpha particles undergoing head on collision is small	1	1
9.	(D) 13.6 e V	1	1
10.	(D) First real and then virtual	1	1
11.	(B) Holes flow from p-side to n-side	1	1
12.	(B) Current flowing in the coil.	1	1
13.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	1	1
14.	(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 the Assertion (A).	1	1
16.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).	1	1
	SECTION B		
17. (a)	(i) Calculating e.m.f of cell 1 (ii) Calculating internal resistance of cell 1 $I = \frac{\varepsilon}{R+r}$ $0.25 = \frac{\varepsilon}{12+r}$ -----(1) $0.2 = \frac{\varepsilon}{16+r}$ -------(2) On solving eq (1) and eq (2) $r = 4\Omega$ $\varepsilon = 4\text{V}$	½ ½ ½ ½	
	OR		
(b)	Finding the magnitude of electric field 1 ½ Finding the direction of electric field ½		

	 $\vec{E}_1 = \frac{kq_1}{r_1^2}(-\hat{i}) = \frac{9\times10^9\times3\times10^{-6}}{(0.3)^2}(-\hat{i}) = 3\times10^5(-\hat{i})\,NC^{-1}$ $\vec{E}_2 = \frac{kq_2}{r_2^2}(-\hat{j}) = \frac{9\times10^9\times4\times10^{-6}}{(0.3)^2}(-\hat{j}) = 4\times10^5(-\hat{j})\,NC^{-1}$ $\vec{E} = \vec{E}_1 + \vec{E}_2$ $E = \sqrt{E_1^2 + E_2^2}$ $E = 5\times10^5\ NC^{-1}$ $\tan\theta = \frac{4}{3}$ $\theta = \tan^{-1}\left(\frac{4}{3}\right)$ inclination with respect to the x-axis (in III quadrant).	½ ½ ½ ½	2
18.	Difference between magnetization and the susceptibility 1 Susceptibility of paramagnetic and diamagnetic materials ½ + ½ Magnetization is equal to the net magnetic moment per unit volume. Alternatively $\vec{M} = \frac{\vec{m}_{net}}{V}$ Susceptibility is a measure of how a magnetic material responds to an external field. Alternatively $\vec{M} = \chi\vec{H}$ Susceptibility of paramagnetic material is between 0 & ε (where ε has small positive value) Alternatively O< $\chi < 1$ Susceptibility of diamagnetic material is between $-1 \le \chi < 0$	½ ½ ½ ½	2
19.	• Stating Huygens Principle 1 • Diagram 1 **Huygens Principle :** Each point of the wavefront is the source of a secondary disturbance and the wavelets emanating from these points spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common tangent to all these spheres, we obtain the new position of the wavefront at a later time.	1	



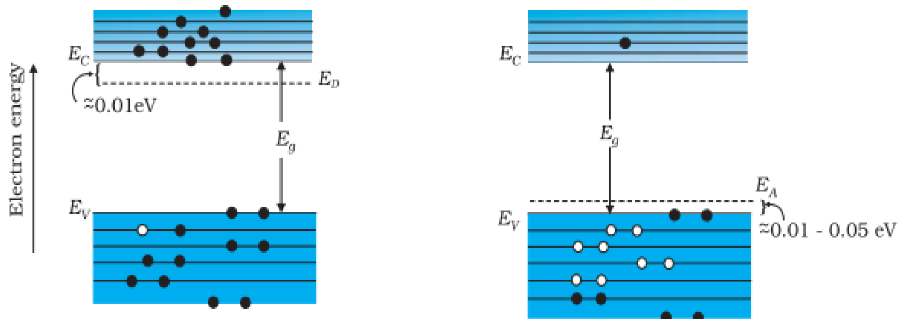
1 | 2

20.

Naming of impurity atom of
(a) p- type ½
(b) n- type ½
Energy band diagram
p- type ½
n- type ½

(a) Impurity atom of p- type is trivalent or group 13(acceptor impurity atom) ½

(b) Impurity atom of n- type is pentavalent or group 15(donor impurity atom) ½



(a) $T > 0K$
one thermally generated electron-hole pair + 9 electrons from donor atoms

(b) $T > 0K$

½ + ½ | 2

21.

(a)	Calculation of critical angle	1
(b)	Calculation of radius of circular light patch	1

(a) $\sin i_c = \frac{1}{\mu}$ ½

$\sin i_c = \frac{4}{5}$ $\quad (\because \mu = 1.25 = \frac{5}{4})$

$i_c = \sin^{-1}(\frac{4}{5})$ ½

$or\ i_c = 53^o$

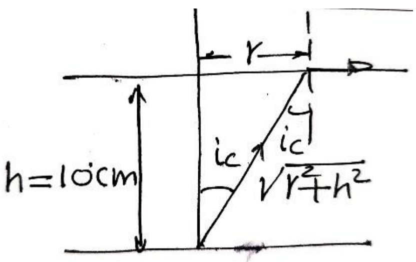
(b) $\sin i_c = \frac{r}{\sqrt{r^2 + h^2}}$ ½

$\frac{r^2}{r^2 + h^2} = \left(\frac{4}{5}\right)^2$

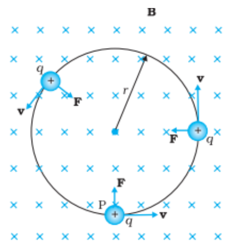
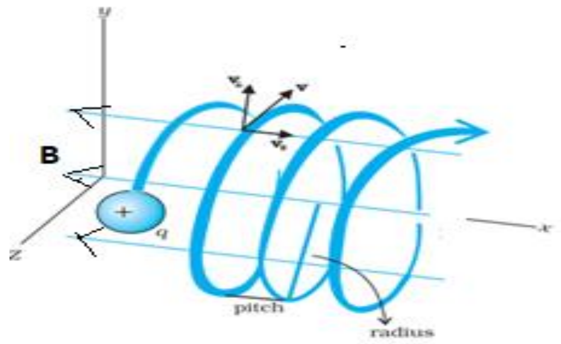
$25r^2 = 16r^2 + 16h^2$

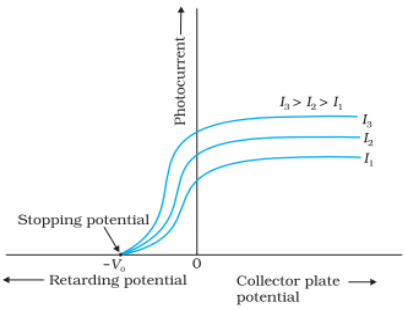
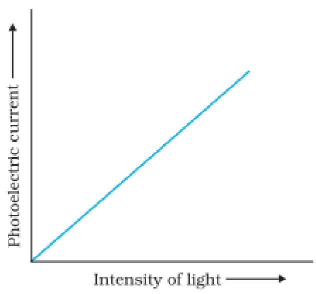
$9r^2 = 1600$

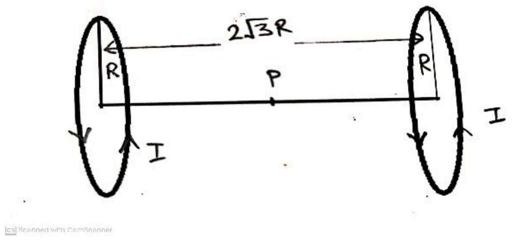
$r = \frac{40}{3} cm$ ½



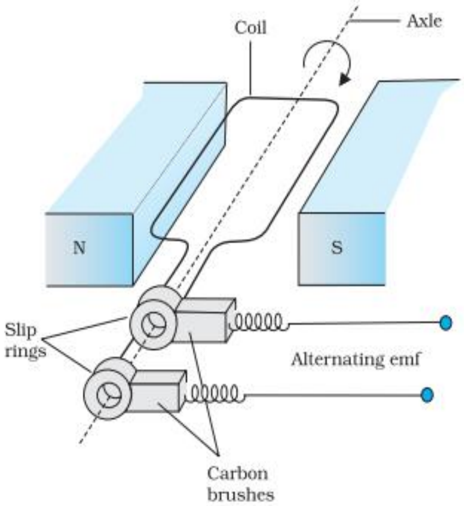
2

	SECTION C		
22	Shape of trajectory with reasons when the angle between $\vec{V}\,\&\,\vec{B}$ is (a) 0^0 ½ + ½ (b) 90^0 ½ + ½ (c) 120^0 ½ + ½ (a) We know $\vec{F} = q(\vec{v}\times\vec{B})$ $\vec{v}$ → → $\vec{B}$ Alternatively:- The particle moves in a straight line. As the angle between $\vec{v}\,\&\,\vec{B}$ is 0^0 hence $\vec{F} = 0$ (b)  Alternatively- The particle moves in a circular path. F is perpendicular to both $\vec{v}\,\&\,\vec{B}$ (c)  **Alternatively** The particle follows a helical path. $F = q\,v\,B\,Sin\theta$ Component of velocity parallel to magnetic field tends to move the particle along linear path while the component perpendicular to magnetic field tends to move the particle in circular path. As a consequence the particle moves in a helical path.	½ ½ ½ ½ ½ ½	3
23	(a) Identifying the medium ½ Justification ½ (b) (i)Finding the intensity for path difference $=\dfrac{\lambda}{2}$ 1 (ii) Finding the intensity for path difference $=\dfrac{\lambda}{3}$ 1 (a) Light travels faster in medium 'B' $\mu_1 = \dfrac{\sin i}{\sin r_1}$	½	

	$\mu_2 = \dfrac{\sin i}{\sin r_2}$		
	$\therefore \quad \dfrac{\mu_1}{\mu_2} = \dfrac{\sin r_2}{\sin r_1} = \dfrac{\sin 35^0}{\sin 30^0}$		
	$\Rightarrow \dfrac{\mu_1}{\mu_2} = \dfrac{v_2}{v_1} > 1$		
	$\therefore \quad v_2 > v_1$	½	
	(b)		
	$I = 4I_0 \cos^2 \dfrac{\phi}{2}$	½	
	(i) $\phi = \dfrac{2\pi}{\lambda} \times \dfrac{\lambda}{2} = \pi$	½	
	$I = 4I_0 (\cos \dfrac{\pi}{2})^2 = 0$		
	(ii) $\phi = \dfrac{2\pi}{\lambda} \times \dfrac{\lambda}{3} = \dfrac{2\pi}{3}$	½	
	$I = 4I_0 (\cos \dfrac{\pi}{3})^2$		
	$I = I_0$	½	3
24	(a) Showing the variation of photocurrent with collector plate potential 1 Explanation 1 (b) Showing the variation of photocurrent with intensity of incident radiation 1		
	(a)  	1	
	Yes, these curves meet at stopping potential	½	
	For any surface , as the energy of photons does not depend upon intensity of light, at the stopping potential current reduces to zero.	½	
	(b)  	1	3

25	**Calculating electrostatic potential energy of the system 3** Electrostatic potential energy of the system : $U = \frac{kq_1q_2}{r_{12}} + q_1V_1 + q_2V_2$ $\frac{kq_1q_2}{r_{12}} = \frac{9\times10^9\times10\times10^{-6}\times20\times10^{-6}}{9\times10^{-2}} = 20\text{J}$ $q_1V_1 = q_1\frac{A}{r_1} = \frac{10\times10^{-6}\times2\times10^6}{4\times10^{-2}} = 500\text{J}$ $q_2V_2 = q_2\frac{A}{r_2} = \frac{20\times10^{-6}\times2\times10^6}{5\times10^{-2}} = 800\text{J}$ $\text{U} = (20+500+800)\,\text{J}$ $\text{U} = 1320\,\text{J}$	1 ½ ½ ½ ½	3
26	**Calculating the self- inductance of the inductor 3** Resistance (R) $= \frac{V}{I} = \frac{200}{1} = 200\Omega$ Impedance(Z) = $\frac{V}{I} = \frac{200}{0.5} = 400\Omega$ $z = \sqrt{R^2 + X_L^2}$ $(400)^2 = (200)^2 + \omega^2L^2$ On solving $L = \frac{2\sqrt{3}}{\pi}$ H Or $L = \frac{2}{\sqrt{3}}$ H	½ ½ ½ ½ 1	3
27	**Finding the magnitude of net magnetic field 2** **Direction of net magnetic field 1**  		

	Magnetic field due to a circular coil having N number of turns at point on the axis of the coil $B = \frac{N\mu_0 IR^2}{2(a^2+R^2)^{3/2}}$ Net field at mid point $= B_1 + B_2$ $= \frac{N\mu_0 IR^2}{(a^2+R^2)^{3/2}}$ $\left(As\ \ a = \sqrt{3}R\right)$ Net magnetic field $B = \frac{N\mu_0 IR^2}{(3R^2+R^2)^{3/2}}$ $B = \frac{N\mu_0 I}{8R}$ Direction of the net field will be towards left or right along the axis depending on direction of current in the two loops.	½ ½ ½ ½ 1	3
28.(a) (b)	(i) Variation of electric field and justification ½ + ½ (ii) Variation of current density and justification ½ + ½ (iii) Variation of mobility of electrons and justification ½ + ½ With the decrease in area of cross-section. (i) $E = \frac{I}{A}\rho$, electric field increases (ii) $j = \frac{I}{A}$, current density increases (iii) $\mu_e = \frac{e\tau}{m}$, mobility remains same OR Finding the net electric field ($\vec{E}$) at points A,B & C 1+1+1 Electric field at A($\vec{E}_A$) $\vec{E}_A = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\varepsilon_0}(-\hat{i}) + \frac{3\sigma}{2\varepsilon_0}(\hat{i})$ $\vec{E}_A = \frac{\sigma}{\varepsilon_0}(\hat{i})$ Electric field at B ($\vec{E}_B$) $\vec{E}_B = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\varepsilon_0}\hat{i} + \frac{3\sigma}{2\varepsilon_0}\hat{i}$ $= \frac{2\sigma}{\varepsilon_0}\hat{i}$ Electric field at C ($\vec{E}_C$)	 ½+½ ½+½ ½+½ ½ ½ ½ ½	

	$\vec{E}_c = \vec{E}_1 + \vec{E}_2$ $= \frac{\sigma}{2\varepsilon_0}\hat{i} + \frac{3\sigma}{2\varepsilon_0}(-\hat{i})$ $= \frac{\sigma}{\varepsilon_0}(-\hat{i})$	½ ½	3
	SECTION - D		
29.	(i) (A) B_1 only	1	
(a)	(ii) (B) A, C	1	
	OR		
(b)	(C) unidirectional with ripple		
	(iii) (D) holes, electrons	1	
	(iv) (C) 100 Hz	1	4
30.	(i) (B) $qd(\hat{i}+\hat{j})$	1	
	(ii) (C) 2	1	
	(iii) (A) 2.5 x 10^{-5} Nm	1	
(a)	(iv) (C) $\frac{1}{2}evr$	1	
	OR		
(b)	(B) $5.0\times10^{-3}\,\text{Am}^2$		4
	SECTION - E		
31. (a)	(i) Labelled diagram of ac generator 1 Working of ac generator 1 Obtaining expression for e.m.f 1 (ii) Finding magnitude of force and direction 2		
		1	
	Working of ac generator When coil is rotated in a uniform magnetic field with a constant angular speed ω, magnetic flux through it changes. As a result, an e.m.f is induced in the coil.	1	
	Flux linked with the coil at any instant 't' is $\varphi_B = BA\cos\omega t$	½	

$$\varepsilon = -N\frac{d\varphi_B}{dt}$$

$$\varepsilon = NBA\omega \sin \omega t$$ ½

(ii) $$F = \frac{\mu_0 I_1 I_2 l}{2\pi r}$$

force on arm MN of the loop

$$F_1 = \frac{4\pi\times10^{-7}\times3\times1\times10\times10^{-2}}{2\pi\times20\times10^{-2}}$$

$$F_1 = 3\times10^{-7}\ \text{N}$$ ½

Force is directed away from the wire

Force on arm SP of the loop

$$F_2 = \frac{4\pi\times10^{-7}\times3\times1\times10\times10^{-2}}{2\pi\times30\times10^{-2}}$$

$$F_2 = 2\times10^{-7}\ \text{N}$$ ½

Force is directed towards the wire

Net force on the loop ½

$$F = F_1 - F_2 = 10^{-7}\ \text{N}$$ ½

Net force on the loop is away from the wire.

OR

(b)

(i)	Statement of Faraday's law of electromagnetic induction	½
	Utility of Lenz's law	½
	Obtaining expression for self inductance	2
(ii)	(1) calculating angular frequency	1
	(2) calculating impedance of the circuit	1

(i) The magnitude of induced e.m.f in a circuit is equal to the time rate of change of magnetic flux through the circuit ½

Utility of Lenz's law

It give polarity of the induced e.m.f . ½

Expression for self inductance

Consider a long solenoid of cross-sectional area A and length l, having n turns per unit length. If I is the current flowing in the solenoid, magnetic field inside the solenoids is

$$B = \mu_0 n I$$ ½

Total magnetic flux linked with the solenoid is

$$N\varphi_B = (nl)(\mu_0 n I)(A)$$

$$N\varphi_B = \mu_0 n^2 A l I$$ ½

Self inductance

$$L = \frac{N\varphi_B}{I}$$

$$L = \mu_0 n^2 A l$$ ½

If solenoid is filled with a material of relative permeability μ_r , then

$$L = \mu_r \mu_0 n^2 A l$$ ½

(ii) (1) Resonant angular frequency is

$$\omega_0 = \frac{1}{\sqrt{LC}}$$ ½

$$\omega_0 = \frac{1}{\sqrt{50\times10^{-3}\times80\times10^{-6}}} = 500\ \text{rad}\,\text{s}^{-1}$$ ½

(2) When frequency of supply is equal to natural frequency of the circuit ½

$$Z = R$$

$$Z = 20\ \Omega$$ ½ 5

32. (a)

(i) Two main considerations for designing objective and eye piece	1
Obtaining expression for magnifying power of telescope	2
(ii) Calculating	
(1) Angle of deviation	1
(2) Refractive index	1

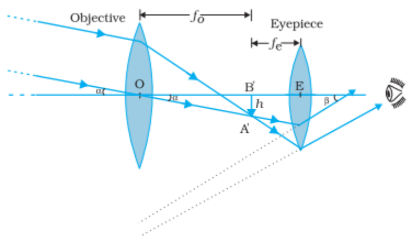
Two main considerations

Objective should have ½

1. Larger diameter
2. Larger focal length

Eye piece should have

1. Smaller diameter
2. Smaller focal length ½



1

Magnifying power of telescope

Magnifying power is the ratio of the angle β subtended at the eye by the final images to the angle α which the object subtends at the lens or eye

$$m \approx \frac{\beta}{\alpha} \approx \frac{h}{f_e} \cdot \frac{f_0}{h} = \frac{f_0}{f_e}$$ 1

(ii) $i + e = D + A$

$$at \quad D = D_m \quad , \quad i = e$$

$$2i = D_m + A$$

$$2 \times 45 = D_m + 60^0$$ 1

$$D_m = 30^0$$

$$\mu = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\mu = \frac{\sin\left(\frac{60^0 + 30^0}{2}\right)}{\sin\left(\frac{60^0}{2}\right)}$$

$$= \sqrt{2}$$ 1

OR

(b)

(i) Describing activity to observe diffraction pattern due to a single slit	2
(ii) Finding refractive index of the liquid	3

	(i) We hold two razor blades in such a way that their edges are parallel and with a narrow slit in between. Keep the slit parallel to the filament of electric bulb, right in front of the eye. **A** diffraction is seen with its bright and dark bands.	2	
	(ii) $\frac{1}{f}=(\mu-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$	½	
	Focal length of convex lens, $f_1=30\,\text{cm}$		
	$\frac{1}{30}=(1.5-1)\left[\frac{1}{R}-\frac{1}{(-R)}\right]$		
	$R = 30\,\text{cm}$	½	
	focal length of combination, f = 45 cm		
	focal length of plane concave lens of liquid.		
	$\frac{1}{f_2} = \frac{1}{f}-\frac{1}{f_1}$	½	
	$\frac{1}{f_2} = \frac{1}{45}-\frac{1}{30}$		
	$f_2 = -90\,\text{cm}$	½	
	Using lens maker's formula		
	$\frac{1}{-90} = (\mu_l -1)\left[\frac{1}{-30}-\frac{1}{\infty}\right]$	½	
	$\mu_l = \frac{4}{3}$	½	5
33. (a)	(i) Defining matter waves — 1 Obtaining expression for de- Broglie wavelength — 2 (ii) (1) Calculating energy of photon — 1 (2) Calculating number of photons per second — 1		
	(i) Wave associated with a mass in motion is called matter wave.	1	
	Particle of mass m and charge q gains energy in the form of kinetic energy.		
	$\frac{1}{2}m\text{v}^2 = qV$	½	
	$(m\text{v})^2 = 2qVm$ $m\text{v} = \sqrt{2mqV}$	½	
	Accordingly to de-Broglie relation		
	$\lambda = \frac{h}{m\text{v}}$	½	
	$\lambda = \frac{h}{\sqrt{2mqV}}$	½	
	(i) (1) $E = hv$	½	
	$= 6.63\times10^{-34}\times5\times10^{14}$ $= 3.315\times10^{-19}\,\text{J}$	½	
	(2) $n = \frac{P}{E}$	½	

	$= \frac{3.315\times10^{-3}}{3.315\times10^{-19}} = 10^{16}\text{s}^{-1}$	½	
	OR		
(b)	(i) Bohr's postulates ½ x 3 Deriving expression for energy of electron in n^{th} orbit of hydrogen atom 2 (ii) Calculating Binding Energy per nucleon 1 ½		
	(i) **Bohr's Postulates** (a) Bohr's first postulate was that an electron in an atom could revolve in certain stable orbits without the emission of radiant energy,	½	
	(b) Bohr's second postulate defines these stable orbits. This postulate states that the electron revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of h/2 π where h is the Planck's constant.	½	
	(c) Bohr's third postulate states that an electron might make a transition from one of its specified non-radiating orbits to another of lower energy. When it does so, a photon is emitted having energy equal to the energy difference between the initial and final states.	½	
	Derivation Total energy of electron in the stationary state of hydrogen atoms is $E = -\frac{e^2}{8\pi\varepsilon_0 r_n}$ -------------------(1)	½	
	Where r_n is radius of n^{th} orbit $r_n = \frac{n^2h^2\varepsilon_0}{\pi me^2}$ ---------------------(2)	½	
	Substituting eq (2) in eq (1) $E_n = -\frac{me^4}{8n^2\varepsilon_0^2h^2}$	1	
	(ii) Mass defect, $\Delta m = \left[6m({}^1_0n) + 6m({}^1_1H)\right] - m({}^{12}_6C)$	½	
	$\Delta m = (6\times1.008665 + 6\times1.007825) - 12.000000$ $\Delta m = 0.09894\,\text{u}$	½	
	$B.E. = \Delta m \times 931.5\,\text{MeV}$ $= 92.16\text{MeV}$ Binding energy per nucleon, $E_{bn} = \frac{E_b}{A}$ $= \frac{92.16}{12}$ =7.68MeV	½	5