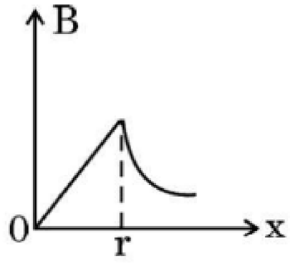
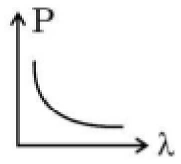
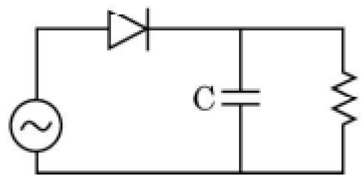
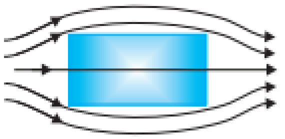
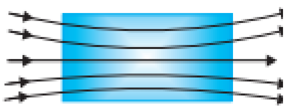
Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior Secondary School Supplementary Examination, July- 2023
SUBJECT NAME: PHYSICS SUBJECT CODE: 042 PAPER CODE : 55/C/3

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-XII, 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 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).
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- 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. ● Leaving answer or part thereof unassessed in an answer book. ● ● 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:			
Q.No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
1.	(b) $p_0(E_2 + E_1)\, k$	1	1
2.	(a) 	1	1
3.	(b) m and M/2	1	1
4.	(d) first decreases to become zero and then increases	1	1
5.	(d) x- rays	1	1
6.	(b) $\frac{I_0}{2}$	1	1
7.	(b) 	1	1
8.	(d) Both for the light nuclei and heavy nuclei.	1	1
9.	(a) increase	1	1
10.	(d) The voltage shown in V_1 lags behind in phase with the voltage shown in V_2 .	1	1
11.	(b) 1:1	1	1
12.	(a) 0^o	1	1
13.	(b) ($\frac{1}{2}$) revolution	1	1
14.	(c) 	1	1
15.	(b) $\frac{R}{2}$	1	1
16.	(c)Assertion (A) is true, but Reason (R) is false.	1	1
17.	(d) Assertion (A) is false and Reason (R) is also false.	1	1
18.	(c) Assertion (A) is true, but Reason (R) is false.	1	1

	SECTION -B		
19.	(a) Identification of parameters ½ + ½ (b) Two properties of medium ½ + ½ (a) Parameter relating wavelength is ‘k’($= \frac{2\pi}{\lambda}$) Parameter relating frequency is ’ ω ’ (= $2\pi\nu$) (b) 1. Electric properties of the medium 2. Magnetic properties of the medium Alternatively: i. Permittivity (ε) of the medium ii. Permeability (μ) of the medium	½ ½ ½ ½	2
20.	Showing the modifications in the pattern of magnetic field ½ + ½ Effect of increase in temperature ½ + ½  (a)  (b) No effect in case of diamagnetic materials. Magnetization/ magnetic susceptibility decrease in case of paramagnetic materials.	½ + ½ ½ ½	2
21.	Calculation of energy of incident light in ‘eV’ 1 Conclusion with justification ½ + ½ E = $\frac{\lambda c}{\lambda}$ $= \frac{6.63\times10^{-34}\times3\times10^{8}}{3500\times10^{-10}\times1.6\times10^{-19}}eV$ E = 3.55 eV Metal B Since energy of incident light is more than the work function of metal ‘B’.	½ ½ ½ ½	

	(Note: Give full credit of one mark if student writes 'Metal B' only.)		2
22.	(a) Calculation of electric flux ½ + ½ (b) Calculation of electric flux ½ + ½ (a) $\Phi = \vec{E}.A\hat{i} = EA$ $= 3\times10^{3}\times(100\times10^{-4})$ $= 30NC^{-1}m^{2}$ (b) $\Phi = EA\cos 60^{o}$ $= 15NC^{-1}m^{2}$	½ ½ ½ ½	
23.	Einstein's photoelectric equation ½ Relation between momentum and kinetic energy ½ de- Broglie relation ½ Relation between λ and E ½ hν = $\Phi_o + E_v^{max}$ As Φ_o *is negligible* $E^{max}_{v} = hv$ $E = hv$ $E = \frac{p^2}{2m}$ $p = \sqrt{2mE}$ $\lambda = \frac{h}{p}$ $\lambda = \frac{h}{\sqrt{2mE}}$	½ ½ ½ ½	2
24.	(i) Calculation of V_{OA} ½ + ½ (ii) Calculation of V_{OB} ½ + ½ (a) (i) V_{OA} = E (x_2-x_1) V_{OA} = 500 ×0 = 0 volt (ii) V_{OB} = -E (x_2-x_1) V_{OB} = -500 × (4 × 10^{-2}) = -20 V OR	½ ½ ½ ½	

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

Calculating of initial potential energy	1
Calculation of final potential energy	½
Calculation of net work done	½

Initial electrostatic potential energy of the system
$U_i = \frac{k}{r}[1\times(-1)+(-1)\times 2+(1)\times(2)]\times 10^{-12}$
$= \frac{9\times 10^{9}}{1}[-1-2+2]\times 10^{-12}$
$= -9\times 10^{-3}\,J$
Now $A_1B_1 = B_1C_1 = A_1C_1 = \frac{1}{2}$ m
Final electrostatic potential energy of the system
$U_f = \frac{-9\times 10^{-9}}{1/2} = -18\times 10^{-3}$ J
Amount of work done W= U_f - U_i
W= $-18\times 10^{-3} + 9\times 10^{-3} = -9\times 10^{-3}\,J$
</td><td>1
½
½</td><td>2</td></tr>
<tr><td>25.</td><td>

(a) For Answer	1
Reason	1

(a) Power delivered just after it is turned on, will be more because resistance of the bulb is low. After some time temperature of the bulb increases and resistance also increases and therefore power $(\frac{V^2}{R})$ becomes low.
OR

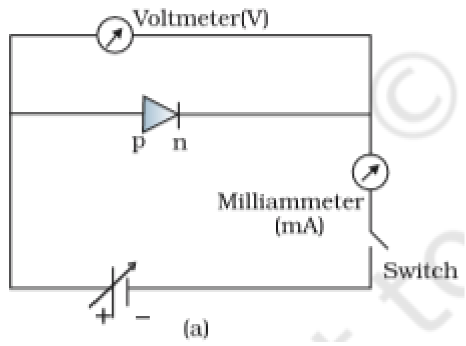
For series Answer	½
Justification	½
For parallel Answer	½
Justification	½

For series
Power dissipated will be maximum for 3R.
Because current is same and power is proportional to resistance.
For parallel
Power dissipated will be maximum for R.
Because voltage is same and power is inversely proportional to resistance.
</td><td>1
1
½
½
½
½</td><td>2</td></tr>
<tr><td></td><td>SECTION-C</td><td></td><td></td></tr>
</table>

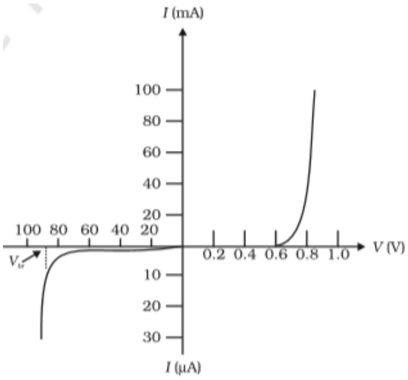
26.	(i) Obtaining the expression for e.m.f. 1 ½ (ii) Finding the force required 1 ½		
	(i) $\phi_B = Bl\,x$	½	
	$\varepsilon = -\dfrac{d\phi_B}{dt}$ $= -\dfrac{d}{dt}(Bl\,x)$ $= -Bl\dfrac{dx}{dt}$	½	
	$\varepsilon = -Bl\,v$	½	
	(ii) $i = \dfrac{\varepsilon}{r}$	½	
	$\vec{F} = i(\vec{l} \times \vec{B})$	½	
	$F = \dfrac{\varepsilon}{r}\, i\,B = \dfrac{Bl\,v}{r}(l\,B)$ $F = \dfrac{B^2 l^2 v}{r}$	½	3
27.	(a) (i) Name of spectral series ½ (ii) Calculation of λ_B ½ + ½ Calculation of λ_p ½ + ½ Calculation of ratio ½		
	(a) (i) Balmer series	½	
	(ii) $\dfrac{1}{\lambda_B} = R[\dfrac{1}{2^2} - \dfrac{1}{\infty}]$	½	
	$\dfrac{1}{\lambda_B} = \dfrac{R}{4}$	½	
	$\dfrac{1}{\lambda_p} = R[\dfrac{1}{3^2} - \dfrac{1}{\infty}]$	½	
	$\dfrac{1}{\lambda p} = \dfrac{R}{9}$	½	
	$\dfrac{\lambda_B}{\lambda p} = \dfrac{4}{9}$	½	
	OR		
	(b) (i) Obtaining expression for distance of closest approach 1½ (ii) Finding the ratio of closest approaches 1½		

	(i) At the distance of closest approach.		
	$K = \frac{(Ze)2e}{4\pi\varepsilon_o d}$	½	
	$d = \frac{2Ze^2}{4\pi\varepsilon_o K}$	1	
	$d = \frac{2(Ze)q}{\frac{1}{2}mv^2 \times 4\pi\varepsilon_o}$	½	
	$d = \frac{(Ze)q}{mv^2 \pi\varepsilon_o}$		
	$d \alpha \frac{q}{m}$	½	
	$\frac{d_p}{d_\alpha} = \frac{e}{2e} \times \frac{4m}{m} = \frac{2}{1}$	½	3
28.	(a) (i) Answer — 1 (ii) i. Calculation of distance — 1 ii. calculation of angular spread — 1		
	(i) slit formed by two blades	1	
	(ii) (i) separation between two dark lines $= \frac{2\lambda D}{d}$	½	
	$= \frac{2 \times 6000 \times 10^{-10} \times 1.5}{1 \times 10^{-4}} = 18 \times 10^{-3} m$	½	
	(ii) $\phi = \frac{\lambda}{a}$	½	
	$= \frac{6000 \times 10^{-10}}{1 \times 10^{-4}}$ $= 6 \times 10^{-3}$ rad	½	
	OR		
	(b) (i) Answer — ½ Justification — ½ (ii) Formula — ½ Calculation — 1 Answer — ½		
	(b) (i) White.	½	
	The interference pattern due to different component colors of white light overlap (incoherently). The central bright fringes for different colors are at the same position. Therefore the central fringe is white.	½	

	(ii) $\lambda_n = \frac{n\lambda D}{d}$ $\lambda = \frac{\lambda_n d}{nD}$ $\lambda = \frac{1.8\times10^{-2}\times0.3\times10^{-3}}{6\times1.5}$ $\lambda = 6000 A^o$	½ 1 ½	3
29.	(a) Explanation 1 (b) Explanation 1 (c) Answer ½ Explanation ½ (a) It will not measure accurate value of current because its high resistance will affect the current in the circuit. (b) To reduce the galvanometer resistance a small resistance is connected in parallel. (c) It is less than the actual value of current because it has some resistance	1 1 1	3
30.	(a) Give reason for no current even with e.m.f. induced in loop 1 (b) Giving reason for damping of the copper plate 1 (c) Giving reason for no power consumption in pure inductor 1 (a) Even in the open loop e.m.f. can be induced but since circuit is open no current can flow. (b) When copper plate oscillates between poles of a strong magnet eddy currents are generated in the plate opposing the change in flux. (c) Power consumed by a pure inductor oscillates. For first half of the cycle it is positive and for the next half it is negative. So for a complete cycle it is zero.	1 1 1	3
	SECTION-D		
31.	(a) (i)Circuit diagram 1 I-V characteristics 1 Moving of threshold voltage ½ Significance of threshold voltage ½ (ii) Finding voltage difference between A and B 2		



1



1

½

Beyond threshold voltage in forward bias diode current increases significantly even for very small increases in diode bias voltage. ½

(ii) $V_A - 5\times10^3 \times 0.2\times10^{-3} - 0.3 - 5\times10^3 \times 0.2\times10^{-3} - V_B = 0$ 2

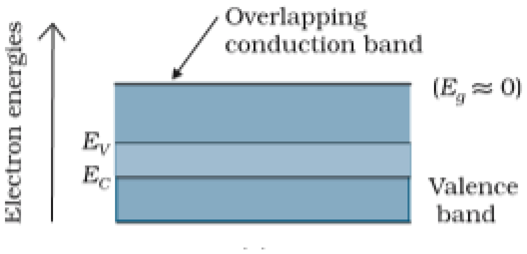
$V_A - V_B$ =2.3 volt

OR

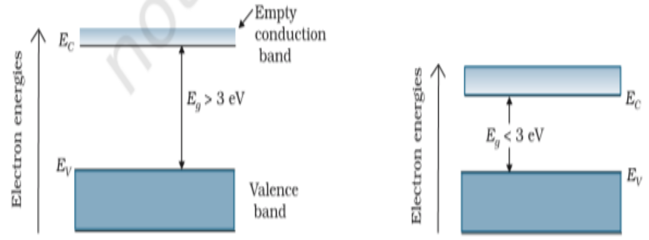
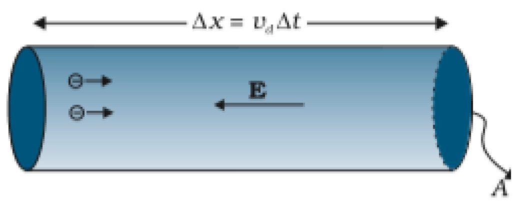
(b)

(i) Energy bond diagrams	1 ½
Description	1 ½
(ii) Calculation of dynamic resistance	2

(i)



½

	 For Eg> 3eV material is insulate For Eg < 3eV material is semiconductor For Eg=0 or overlapping of conduction and valence band material is conductor. (ii) $r_d = \frac{\triangle V}{\triangle I} = \frac{0.7-0.6}{(20-10)\times 10^{-3}}$ $r_d = 10\ \Omega$	½+ ½ ½ + ½+ ½ ½ + ½ 1	5
32.	(a) (i) Derivation of relation between I and v_d 2 Explanation 1 (ii) Calculating internal resistance of each battery 2 (a) (i)  Total charge transported across the area A in time Δt is $\Delta Q = -neAv_d \Delta t$ ------(1) Also the amount of charge crossing area 'A' in time Δt is $\Delta Q = I \Delta t$ ------(2) Comparing equation (1) and (2) $I = neAv_d$ With increase in temperature, average speed of electrons increases resulting in more frequent collisions Hence relaxation time τ decreases As $R = \frac{ml}{ne^2\tau A}$ Resistance increases. (ii) For series $I = \frac{E}{R+r}$ $\frac{1}{2} = \frac{3}{R+2r}$ $R + 2r = 6$ --------(1)	½ ½ ½ ½ 1 ½	

For parallel $\frac{1}{3} = \frac{1.5}{R+\frac{r}{2}}$

2R+ r = 9 ----------(2) ½

After solving r = 1 Ω 1

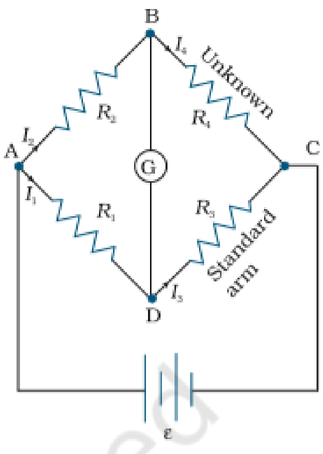
OR

(b)

(i) Statement of Kirchhoff two rules	½ + ½
Obtaining the balanced condition	2
(ii) Finding current in branches MN, T0 and SP	2

(i) Kirchhoff's junction rule - at any junction, the sum of the current entering the junction is equal to the sum of currents leaving the junction. ½

Kirchhoff second rule:
The algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero. ½



½

In balanced fridge Ig=0,
Hence $I_1 = I_3$ and $I_2 = I_4$
Using Kirchhoff's loop rule for closed loops ADBA and CBDC

$- I_1R_1 + 0 + I_1R_1 = 0$ (Ig=0) -----(1) ½

In the second loop $I_3 = I_1$, $I_4 = I_2$

$I_2R_4 + 0 - I_1R_3 = 0$ -----(2) ½

From equation (1) and (2)

$\frac{I_1}{I_2} = \frac{R_2}{R_1}$ *and* $\frac{I_1}{I_2} = \frac{R_4}{R_3}$

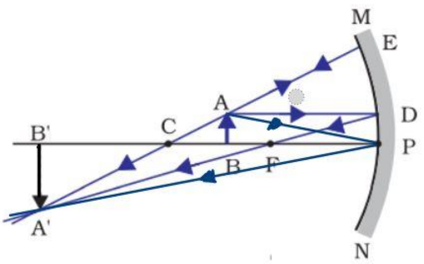
½

$\frac{R_2}{R_1} = \frac{R_4}{R_3}$

This is the condition for balanced Wheatstone bridge

<table>
<tr>
<td></td>
<td>(ii) In loop MNOTM
$2I + 4I_1 = 8$ ------(1)
Loop OPSTO
$-I + 5I_1 = -4$ ------(2)
On solving
Current in MN, I = 4A
Current in TO, $I_1 = 0A$
Current in SP, $I - I_1 = 4A$</td>
<td>½

½

1</td>
<td>5</td>
</tr>
<tr>
<td>33.</td>
<td>
<table>
<tr><td>(a)</td><td></td></tr>
<tr><td>(i) Ray diagram</td><td>1</td></tr>
<tr><td>Derivation of mirror equation</td><td>2</td></tr>
<tr><td>(ii) Finding the position of image</td><td>1½</td></tr>
<tr><td>Finding the nature of image</td><td>½</td></tr>
</table>
(a)
(i)


From $\triangle A'B'C' \sim \triangle DPF$
$\frac{B'A'}{BA} = \frac{B'F}{FP} (\because PD = AB)$ ---------(1)
Form $\triangle A'B'P \sim \triangle ABP$
$\frac{B'A'}{BA} = \frac{B'P}{BP}$ ---------(2)
Comparing equation (1) and (2)
$\frac{B'F}{FP} = \frac{B'P - FP}{FP} = \frac{B'P}{BP}$
Here B'P = - v
FP = -f
BP = - u
$\frac{-v+f}{-f} = \frac{-v}{-u}$
$\frac{v-f}{f} = \frac{v}{u}$
</td>
<td>1

½

½

½</td>
<td></td>
</tr>
</table>

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

On solving we get ½

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

(ii) u= -30 cm

f= + 12 cm

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

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{12} + \frac{1}{30} = \frac{7}{60}$$ 1

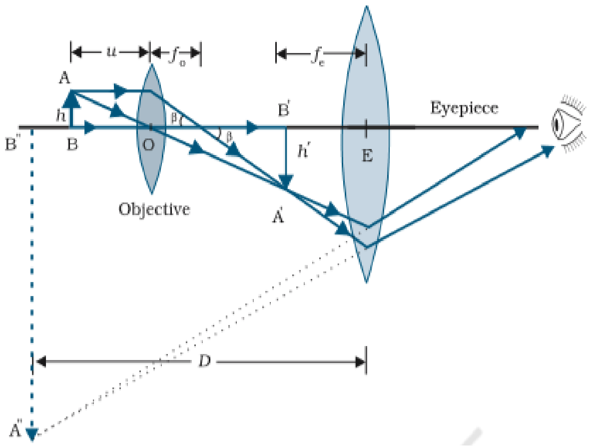
v= $\frac{60}{7}$ cm ½

Since v is positive image is virtual and erect.

OR

(b) (i) Ray diagram	1
Obtaining the expression for total magnification	2
(ii)Finding total magnification	2

(b) (i)



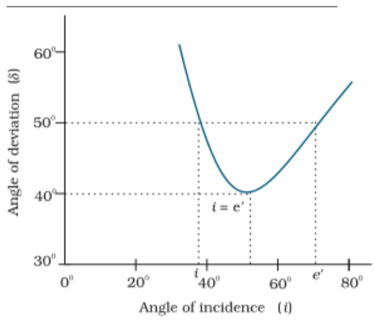
1

Magnification due to objective

$$m_0 = \frac{h'}{h} = \frac{L}{f_0} \qquad \left(\because \tan\beta = \frac{h}{f_0} = \frac{h'}{L} \right)$$

Magnification due to eye piece when final image is formed at the near point ½

	$m_e = 1 + \frac{D}{f_e}$ Total magnification $m = m_0\, m_e$ $m = \frac{L}{f_0}\left(1 + \frac{D}{f_e}\right)$ $m = \frac{L}{f_0}\left(1 + \frac{D}{f_e}\right)$ (ii) $m = \frac{LD}{f_o\, f_e}$ $m = \frac{24 \times 25}{2 \times 6} = \frac{600}{12} = 50$	½ ½ ½ 1 1	5
	SECTION-E		
34.	(a) Finding dielectric constant 1 (b) Finding equivalent capacitance 1 (c) Effect on potential difference and justification ½ + ½ Effect on energy stored and justification ½ + ½ **OR** Calculation of effective capacitance 2 (a) $K = \frac{C}{C_0}$ $K = \frac{80\mu F}{10\mu F} = 8$ (b) $\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + ...+ \frac{1}{C_n}$ $\frac{1}{C_S} = \frac{n}{C}$ $C_S = \frac{C}{n}$ (c) Charge is constant $Q_1 = Q_2$ $C_2 = KC_1$ $C_1 V_1 = K\, C_1 V_2$ $V_2 = \frac{V_1}{K}$ Potential diff decreases by a factor (1/K)	½ ½ ½ ½ ½ ½	

	$U_2 = \frac{1}{2}\frac{Q^2}{C_2}$ $= \frac{1}{2}\frac{Q^2}{kC_1} = \frac{1}{k}\left(\frac{Q^2}{2C_2}\right)$ $U_2 = \frac{U_1}{K}$ Energy reduces by a factor of 1/K. OR For calculating effective capacitance = 2 C.	½ ½ ½ 2	4
35.	(a) Variation of δ with i — 1 (b) Derivation of equation for small angle prism — 1 (c) Calculation of μ in terms of A — 2 OR Calculation of angle of incident (i) — 2 (a)  (b) $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin A/2}$ For small angle $\mu = \frac{\frac{A+\delta_m}{2}}{A/2}$ $\mu = \frac{A+\delta_m}{A}$ $\mu = 1 + \frac{\delta_m}{A}$ (c) $i + e = A$	1 ½ ½ ½	

	$r = \frac{A}{2}$	½	
	$\mu = \frac{\sin i}{\sin r}$	½	
	$\mu = \frac{\sin A}{\sin A/2}$	½	
	$\mu = \frac{2\sin(A/2)\cos(A/2)}{\sin(A/2)} = 2\cos(A/2)$	½	
	OR		
	$\frac{\sin i}{\sin r} = \sqrt{2}$		
	$\frac{\sin r_2}{\sin 90^0} = \frac{1}{\sqrt{2}}$	½	
	$\sin r_2 = \frac{1}{\sqrt{2}}$		
	$r_2 = 45^0$	½	
	$r_1 + r_2 = A$		
	$r_1 + 45^0 = 75^0$		
	$r_1 = 30^0$	½	
	$\frac{\sin i}{\sin r_1} = \sqrt{2}$		
	$\frac{\sin i}{\sin 30^0} = \sqrt{2}$		
	$\sin i = \sqrt{2} \times \frac{1}{2}$	½	
	$\sin i = \frac{1}{\sqrt{2}}$		
	$i = 45^0$		4