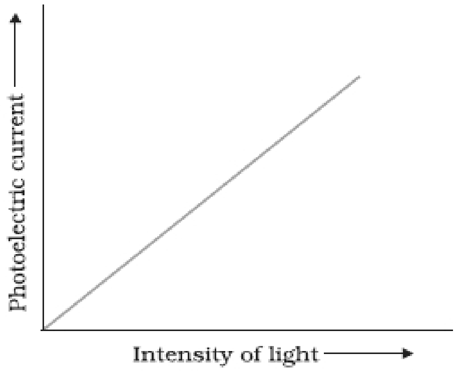
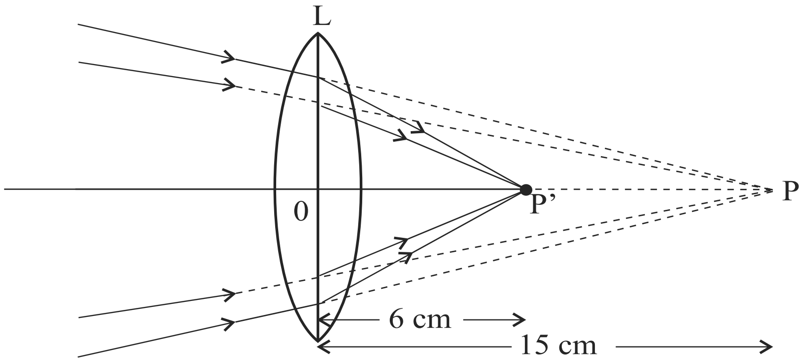
Set-2 MARKING SCHEME - PHYSICS 55/4/2

Sl. No.	Value Points / Expected Answers	Marks	Total
	SECTION - A		
Q1.	The ozone layer absorbs the UV radiations. OR When e.m. waves falls on charged particles, they set the charges into motion. This illustrates that the e.m waves have energy and momentum. **Alternatively** When the sun shines on your hand, you feel energy being absorbed from the e.m waves **Alternatively** The radio & TV signals carry energy from one place to another (Give full marks if student explains on the basis of any one of above example) **Example** – photo electric effect	1	1
Q2.	Above 30 MHz the signal penetrates the ionosphere & escape. Alternatively Upto 30 MHz signal are reflected by the Ionosphere.	1	1
Q3.	Repulsive **OR** Surface charge density on inner surface = $-\dfrac{Q}{4\pi R_1^2}$ Surface charge density on Outer surface = $+\dfrac{Q}{4\pi R_2^2}$	1 ½ ½	1 1
Q4.	Since the terminal potential, V = E – Ir / Due to potential drop across internal resistance of the cell	1	1
Q5.		1	
	SECTION - A		
Q6.	i) Labelled ray diagram ½ ii) Lens formula ½ iii) Substitution of values with sign convention ½ iv) Calculation and Results ½		

Sl. No.	Value Points / Expected Answers	Marks	Total



Marks: ½

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ (lens formula) — ½ — Total: 2

Here $u = +15cm$; $f = +10$ cm — ½

$\therefore \quad \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{15}$

$\Rightarrow \quad v = 6$ cm — ½

OR

i) Formula for magnification	½
ii) Mirror formula	½
iii) Substitution of values with sign convention	½
iv) Calculation and Results	½

Here, $m = +3$ and $f = -15$ cm

$m = \frac{v}{u} = 3 \quad \therefore \quad v = 3u$ — ½

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ — ½ — Total: 2

$\frac{1}{-15} = \frac{1}{3u} + \frac{1}{u}$ — ½

$\Rightarrow \quad u = -20$ cm — ½

Q7.

i) Dependance of magnifying power (with reason) on focal length	½+½
ii) With wavelength	½+½

Since magnifying power of compound microscope $m = \frac{L}{f_o} \times \frac{D}{f_e}$

i) Reciprocal to the focal length of objective lens. — 1 — Total: 2

ii) "Magnifying power of compound microscope is not independent of wavelength , instead it varies inversely with the wavelength of light." — 1

$M = L\,D / F_o\,F_e$

As focal length is directly proportional to wavelength.

Q8.

i) Relation between I_2, I_b & I_c	½
ii) Calculation of emitter current	½
iii) Formula for current gain	½
iv) Calculation of current gain	½

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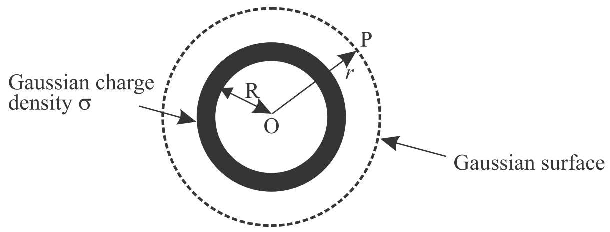
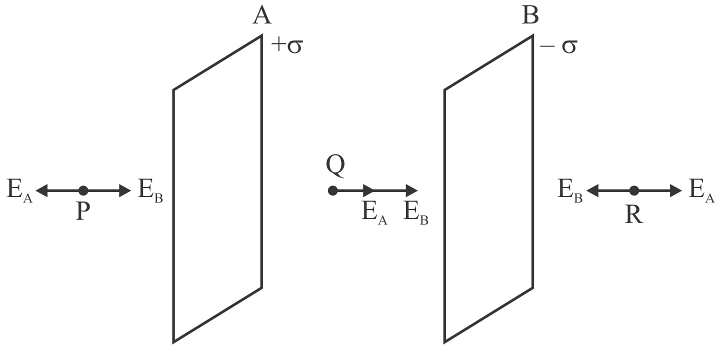
Sl. No.	Value Points / Expected Answers	Marks	Total
	a) Since $I_e = I_b + I_c$	½	
	$= 40\mu A + 6mA$		
	$= 6.04\ mA$	½	2
	b) $\beta = \frac{I_c}{I_b}$	½	
	$= \frac{6\times10^{-3}}{40\times10^{-6}} = 150$	½	
Q9	i) Labelled diagram ½ ii) Flux through Gaussian surface ½ iii) Calculation & Result ½+½		
		½	
	Flux through the small section of Gaussian surface		
	$\phi = \oint \vec{E}.\vec{ds}$		
	$\therefore \phi = \oint Eds\cos\theta$		
	$\because E \parallel \vec{ds} \quad \theta = 0$		
	$\phi = E.4\pi R^2$ .... (1)		
	Applying Gauss's theorem		2
	$\phi = \frac{q}{\varepsilon_0}$ .... (2)	½	
	from equations 1 and 2		
	$E = \frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{R^2}$	½	
	OR		
	i) Electric field at a point due to a plane sheet of charge ½ ii) Diagram with direction of field ½ iii) Electric field between the sheets ½ iv) Electric field outside the sheets ½		

Sl. No.	Value Points / Expected Answers	Marks	Total



½

Now Electric field Intensity due to a plane sheet of charge

$$E = \frac{\sigma}{2\varepsilon_0}$$ ½

Here

$$E_A = \frac{+\sigma}{2\varepsilon_0} \text{ and } E_B = \frac{-\sigma}{2\varepsilon_0}$$

(i) Electric field at Point Q (In between the sheets)

$$\vec{E} = \vec{E}_A + \vec{E}_B = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$ ½

(ii) Field at the point P or R

$$\vec{E} = \vec{E}_A + \vec{E}_B = \frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} = 0$$ ½ | 2

Q10.

i)	Formula for Magnetic field	½
ii)	Formula for force	½
iii)	Calculation & Results	½
iv)	Direction of force	½

Force on Proton

$F = Bqv$

$$B = \frac{\mu_0 I}{2\pi a} \quad (\theta = 90°)$$ ½

$$F = \frac{\mu_0 IqV}{2\pi a}$$ ½

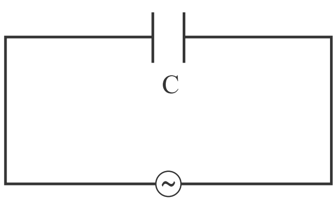
$$= \frac{4\pi \times 10^{-7} \times 3 \times 1.6 \times 10^{-19} \times 5 \times 10^{6}}{2\pi \times 0.3} = \frac{30 \times 1.6 \times 10^{-20}}{0.3} = 1.6 \times 10^{18} \text{ N}$$ ½ | 2

Direction - right at point P / away from AB ½

Q11.

i)	Expression for net charge	½
ii)	Expression for displacement current	½
iii)	Expression for conduction current	½
iv)	Result	½

When the capacitor is getting charged, we have



$V = V_0 \sin wt$

Electric flux $= \phi_E(t)$

$$= \frac{Q(t)}{\varepsilon_0}$$

Now $Q(t) = CV(t)$

Sl. No.	Value Points / Expected Answers	Marks	Total
	$= Cv_0 \sin\omega t$	½	
	$\therefore$ Displacement current $i_d = \varepsilon_0 \frac{d\phi_E}{dt}$		
	$= \varepsilon_0 , \frac{1}{\varepsilon_0} . \frac{d}{dt}(CV_0 \sin\omega t)$		
	$= \omega C V_0 \cos\omega t$		
	$= \omega C V_0 \sin(\omega t + \pi/2)$	½	
	Also, Conduction current i_c leads the voltage by $\pi/2$		
	$\therefore \quad i_c = \frac{V_0}{(1/\omega C)} \sin(\omega t+\pi/2)$		
	$= \omega CV_o \sin\omega t$	½	2
	Hence $i_d = i_c$	½	
	Note 1 : Award two marks even if the student just writes "with an a.c. source, the conduction current, as well as the displacement current, are present at all instants. As per Maxwell's explanation instantaneous displacement current = instantaneous conduction current"		
	Note 2 : Award 2 marks if even if the student just writes "As per Maxwell's explanation, displacement current = conduction current, at all instants"		
	Note 3 : Award 2 marks if the student proves conduction current = displacement current, with a d.c source.		
Q12.	i) Calculation of path difference ½ ii) Condition for constructive interference ½ iii) Expression for fringe width 1		
	The path difference $S_2P - S_1P = \left(\frac{y_n d}{D} + \frac{\lambda}{4}\right)$	½	
	For constructive interference		
	Path difference $= n\lambda$ where n=0,1,2,3	½	
	$\frac{y_n d}{D} + \frac{\lambda}{4} = n\lambda$		2
	Position of n^{th} bright fringe	½	
	$y_n = (n - \frac{1}{4}) \frac{\lambda D}{d}$		
	Fringe width $\beta = y_n - y_{n-1}$		
	$\boxed{\beta = \frac{\lambda D}{d}}$	½	
	Note : If the student solves the question by taking the path difference $S_2P - S_1P = \frac{\lambda_n d}{D}$; 1 Mark may be awarded		

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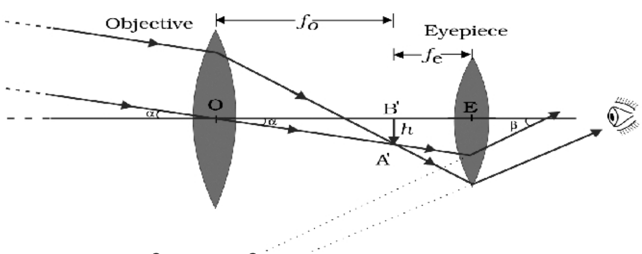
Sl. No.	Value Points / Expected Answers	Marks	Total
Q13.	a) Trajectory of charged particle with explanation 1 ½ b) Condition for undeflected motion 1 ½		
	(a) Since velocity $\vec{v}$ is in x direction		
	$\vec{B}$ is in -Ve Z direction		
	Force $\vec{F} = q(\vec{V} \times \vec{B})$	½	
	$= q(\lvert\vec{V}\rvert\lvert\vec{B}\rvert)(\text{i} \times (\text{-k})$	½	
	$= -q\,VB(-\hat{j})$		
	$\vec{F} = qVB\ \hat{j}$	½	3
	Therefore, $\vec{F}$ is perpendicular to $\vec{V}$ The path is circular	½	
	(b) For indeflected motion megnetic force on the charge = electric force on charge	½	
	i.e. qvB = qE		
	Alternatively		
	$v = \frac{E}{B}$	½	
Q14.	i) Labelled ray diagram 1½ ii) Formula for angular magnification ½ iii) Importance and limitations 1		
		1½	
	Angular magnification $m = \frac{-f_0}{f_e}$ or $\frac{f_0}{f_e}$	½	3
	Important considerations :		
	For achieving large resolution, the objective of large aperture is required.	½	
	Consequent Limitation : Heavy, hence difficult to make and support by their edge / suffers with chromatic aberrations (any one of above)	½	
	OR		
	i) Graph between δ and I 1 ii) Derivation of expression for refractive index 2		

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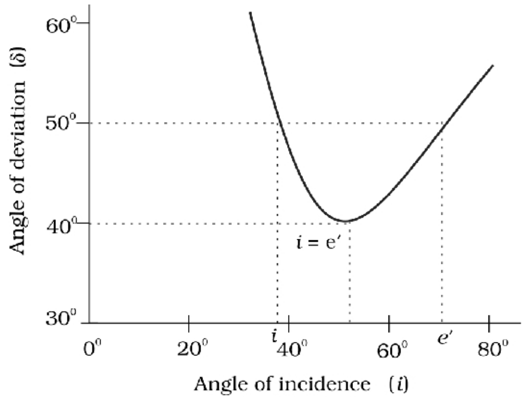
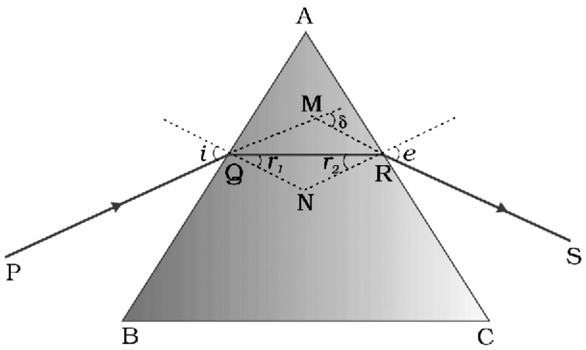
Sl. No.	Value Points / Expected Answers	Marks	Total

a)



1



½

Since $n_{21} = \dfrac{\sin i}{\sin r}$ ½ 3

From the figure and calculations

$r_1 + r_2 = A$

At minimum deviation i.e. $\delta = \delta m$, $i = e$ and $r_1 = r_2 = r$

$\therefore \quad r = A/2$ .... (eq^n 1)

From the figure

$\delta = (i - r_1) + (e - r_2)$

$\therefore \quad \delta_m = (i + e) + (r_1 + r_2)$ ½

$i = \dfrac{A + \delta_m}{2}$ .... (eq^n 2)

$\therefore \quad n_{21} = \dfrac{\sin i}{\sin r} = \dfrac{\text{Sin}\, \dfrac{A + \delta_m}{2}}{\sin A/2}$ ½

Q15.

i) Expression for radius of n^{th} orbit	2
ii) Explanation of de-Broglie hypocesis on stability	1

$\dfrac{mv_0^2}{r_n} = \dfrac{1}{4\pi\epsilon_0} \dfrac{Ze^2}{r_n^2}$ ½

$mv_0^2 = \dfrac{1}{4\pi\epsilon_0} \dfrac{Ze^2}{r_n}$ .... (i)

according to Bohr's Postulate

$mv_0 r_n = \dfrac{nh}{2\pi}$ ½

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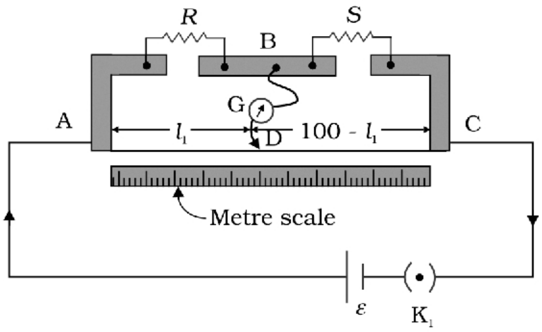
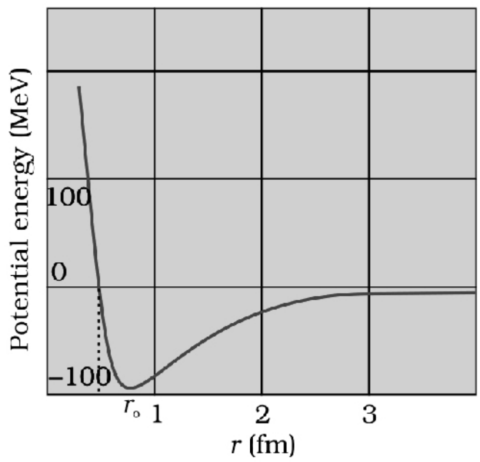
Sl. No.	Value Points / Expected Answers	Marks	Total
	$\therefore\ m^2 v_0^2 r_n^2 = \frac{n^2h^2}{2\pi}$ .... (ii) Dividing equation (ii) by equation (i) $r_n = \frac{\epsilon_0 h^2}{\pi m z e^2} \times n^2$ According to de-Brogle electron in its circular orbit must be seen as particel wave. Therfore, $2\pi r_n = n\lambda$ Since, de-Brogle wave length $(\lambda) = \frac{h}{p}$ Therefore, $2\pi r_n = \frac{nh}{mv_0}$ $mv_0 r_n = \frac{nh}{2\pi}$ This equation is the basis of explaining the discrete orbits and every level of H-atom, theis de-Broglie hypothesis explains the stability of H-atom.	 1 ½ ½	 3
Q16.	i) Fabrication of LED — 1 ii) Explanation — 1 iii) Two advantages — ½+½ LED is heavily doped p-n junction diode which emits spontaneous radiation in forward baising. The diode is encapsulated with a transparent cover so that emitted light can come out. When LED is forward biased the electrons and holes approaches to the junction boundaries and on each recombination of electron & hole at or near the junction & hole at or near the junction boundary the LED emits radiation/photon. Advantages – i) Low operational voltage and less power ii) Long life and ruggedness or any two advantages	 1 1 ½ ½	 3
Q17.	a) i) Effect on balancing length with decrease in R_1 with justification — ½+½ ii) Effect on balancing length with increase in R_2 with justification — ½+½ b) Reason for preferring Potentiometer over voltmeter. — 1 a) i) When R_1 is decreased, the balancing length decreases. Justification - When R is decreased, I through the potentio meter increases. Hence potential gradient increases. Therefore balancing length decreases. ii) When R_2 is increased, balancing length decreases Justification : When R_2 is increased, current $I = \frac{E}{r+R_2}$ decreases. This increases V (= E–Ir) hence balancing length increases. At Potentiometer draws no current from the voltage source, measurement of emf/potential difference will be more accurate or any suitable justification. OR i) Principle of meter bridge — 1 ii) Circuit diagram — 1 iii) Determination of unknown resistance — 1	 ½ ½ 1 1	

Sl. No.	Value Points / Expected Answers	Marks	Total
	Principle of meter bridge : - It works on the principle of balance condition of wheatstone bridge i.e $\frac{P}{Q} = \frac{R}{S}$	1	
	Circuit diagram  	1	3
	When the jockey is moved along the wire, at one position of jockey, the galvanometer will show no deflection. Let the distance of the jockey from the end A at the balanced point be l_1 then $\frac{R}{S} = \frac{l_1}{100- l_1}$ $R = S\left(\frac{l_1}{100- l_1}\right)$	1	
Q18.	a) Graph — 1 Indication of region of attraction & repulsion on the graph — ½ +½ b) Two characteristic properties of nuclear force — ½ +½		
	 	1	3
	Separation greater than r_0 - Attractive force	½	
	Separation less than r_0 - Repulsive force	½	
	b) Nuclear force is independent of charge.	½	
	Short ranged force (or any two characteristics)	½	

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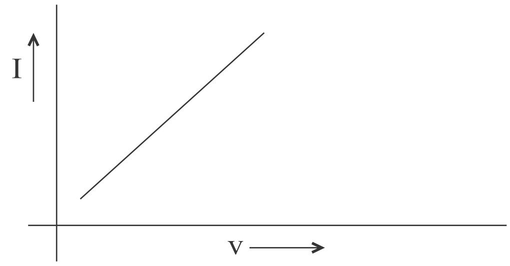
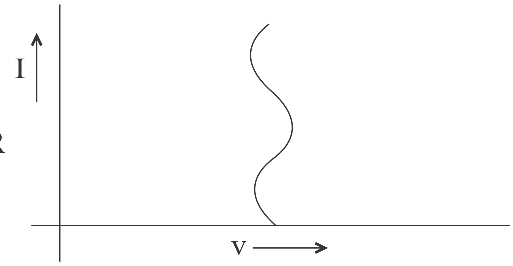
Sl. No.	Value Points / Expected Answers	Marks	Total
Q19.	a) Graph between V and I with external resistance R — 1 b) Behaviour of Hg at 4K — 1 c) Identification and result — 1		
	a) Note : Award this 1 mark even if the student draw the following or some other non linear graph		
	 **OR** 	1	
	b) At a temperature of 4 K, the Resistance of Hg becomes zero. Note - Award this 1 mark if the student writes that Hg becomes a super conductor at temperature of 4 K	1	3
	c) Region BC ; since current is decreasing with increasing voltage **Alternately** :The graph has negative slope for this region.	1	
Q20.	i) Conversion of a galvanometer into an ammeter — 1½ ii) Formula for shunt — ½ iii) Calculation and Result — 1		
	a) By connecting a small resistance called shunt (S) in parallel to coil of the galvanometer The value of S is related to the maximum current (I) to be measured as $S=I_g G/I-I_g$. (Note : If the student just draws the diagram, full marks may be awarded).	1½	
	b) $G = 15\,\Omega$ $I_g = 4\times10^{-3}A$ $I = 6A$		3
	$I_g G = (I-I_g)S$	½	
	$S = \frac{I_g G}{I-I_g} = \frac{4\times10^{-3}\times15}{6 - 4\times10^{-3}}$	½	
	$= 0.01\,\Omega$	½	
	OR		
	i) Conversion of a galvanometer into a voltmeter — 1½ ii) Formula — ½ iii) Calculation and results — 1		
	a) A galvanometer may be converted into voltmeter by connecting a high value resistance R in series with coil of the galvanometer. The value of (R) is related to the maximum voltage (V) to be measured as $R = \frac{V}{I_g} - G$ Note - Award full marks if a student just draws the labelled diagram.	1½	
	b) $I_g = \frac{V}{R_g + R}$	½	3
	$\frac{V}{R_g + 980} = \frac{V}{2(R_g + 470)}$	½	
	$2R_g + 940 = R_g + 980$		
	$R_g = 40\Omega$	½	

Sl. No.	Value Points / Expected Answers	Marks	Total
Q21.	i) Expression for Force and its direction 1½+½ ii) Expression/Calculation of Power 1		
	a) The induced emf in the moving conductor MNOP $e = Blv$	½	
	The induced current, $i = \frac{e}{R} = \frac{Blv}{R}$		
	Force on the arm 'ON', $F = Bil$	½	3
	$= \frac{B^2l^2v}{R}$	½	
	The force is directed in the direction opposite to velocity of rod (v)	½	
	Note : Award the last half mark if the student write F = 0 as B = 0 in the position shown		
	b) Power $P = F \times v$	½	
	$= \frac{B^2l^2v}{R}$	½	
	Note : Award the last half mark if the student write P = 0 as B = 0 in the position shown		
Q22	a) Purpose and inference 1½ b) Ratio of accelerating potential 1½		
	a) Purpose of Davisson Germer Experiment was to verify the wave nature of electron.	1	
	It confirms the de Broglie relations for matter waves / Diffraction effect of electron beams from crystal	½	
	b) de Broglie wavelength		
	$\lambda = \frac{h}{\sqrt{2mqV}}$	½	
	$\therefore = \frac{h}{\sqrt{2m_peV_p}} = \frac{h}{\sqrt{2m_\alpha eV_\alpha}} = \lambda\alpha$	½	3
	$\therefore \frac{V_p}{V\alpha} = \frac{8}{1}$	½	
	OR		
	a) i) de Broglie wavelength associated with electron and proton with justification ½+½ ii) Momentum associated with e & p and justification ½+½ b) i) Relation between momentum and de Broglie wavelength & Graph ½+½		
	a) i) Since $\lambda = \frac{h}{\sqrt{2mqV}}$		
	$\lambda \propto \frac{1}{\sqrt{m}}$ (For other variables constant)	½	
	$\because m\rho > m_e$		
	Therefore $\lambda_{electron} > \lambda_{proton}$	½	

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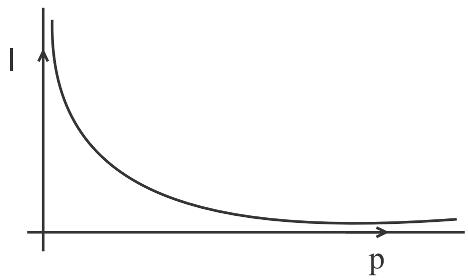
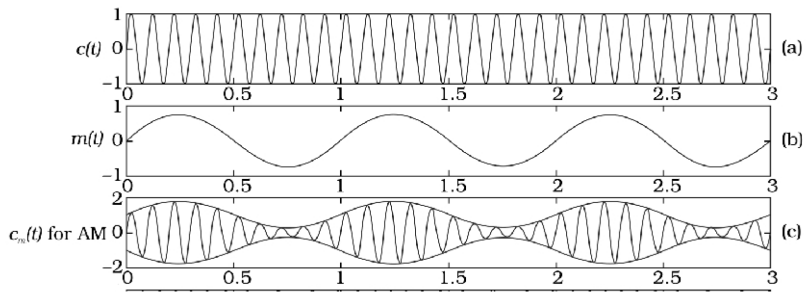
Sl. No.	Value Points / Expected Answers	Marks	Total
	ii) momentum $p = \frac{h}{\lambda}$	½	
	$\therefore \lambda_{electron} > \lambda_{proton}$ $\therefore$ momentum of electron is lesser.	½	3
	b) $\lambda = \frac{h}{p}$	½	
	Graph between p & λ 	½	
Q23	a) i) Definition of Amplitude modulation — 1 ii) Figure — ½ b) i) Modulation index — ½ ii) Definition of side bands — ½ iii) Significance of side bands — ½		
	a) Amplitude modulation - The amplitude of carrier is varied in accordance with information signal.	1	
		½	3
	(Credit may be given if a student draws only the modulated signal.)		
	b) Modulation Index - i) Ratio of amplitude of message signal to the amplitude of carrier signal is modulation Index.	½	
	or $m = \frac{A_m}{A_c}$		
	ii) The two sinusoidal waves in amplitude modulated wave having frequencies slightly different from frequency of carrier wave are called sidebands.	½	
	Significance of sidebands: It helps different broadcast stations to operate separately or individually.	½	

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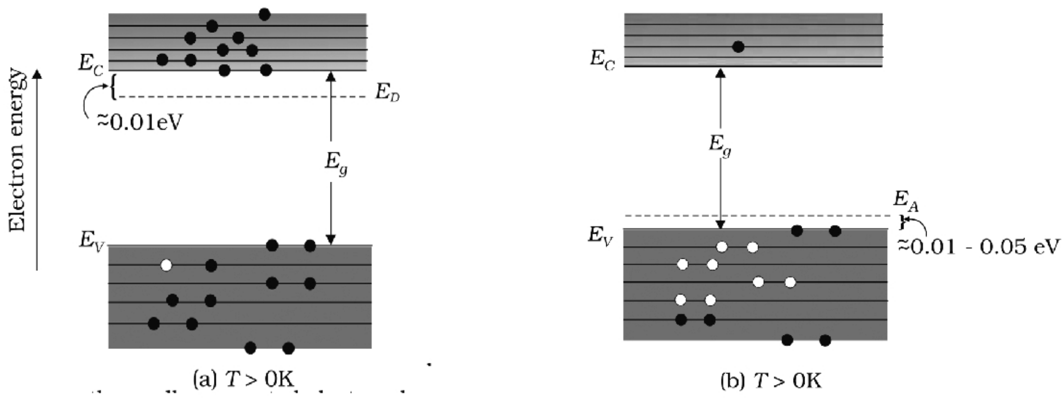
Sl. No.	Value Points / Expected Answers	Marks	Total

Q24

i) Energy band diagram (i) n type and (ii) p type	1+1
ii) Role of Acceptor and Donor energy level	1



Marks: 2 — Total: 3

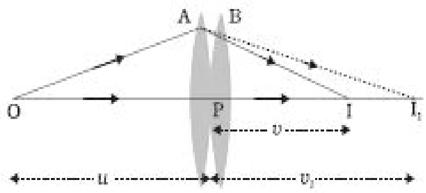
The donor energy level decreases the energy gap between conduction band and valence band. As a result the conduction band will get more electrons from the donor impurity with very small supply of energy. (½) Whereas in p type semiconductor the holes from acceptor level sinks down into valence band (½)

SECTION - D

Q25.

a. Relation for combined focal Length	2½
equivalent Power	2½
b. Calculation for Positive of image frame.	2

a. (½)



For less A

$$\frac{1}{f_1} = \frac{1}{v_1} - \frac{1}{u}$$ eg. (I) (½)

For less B eg. (ii) (½)

$$\frac{1}{f_2} = \frac{1}{v} - \frac{1}{v_1}$$

Adding eqn. (i) & eqn. (ii) (½)

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{\mathrm{v}_1} - \frac{1}{\mathrm{u}} + \frac{1}{\mathrm{v}} - \frac{1}{\mathrm{v}_1}$$

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{\mathrm{v}} - \frac{1}{\mathrm{u}}$$

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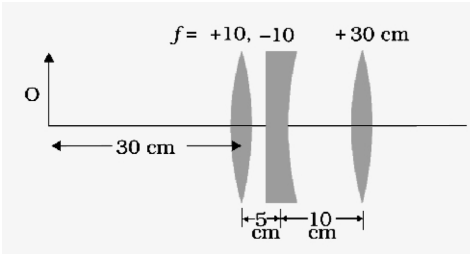
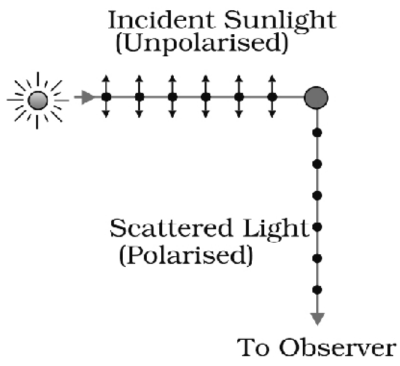
Sl. No.	Value Points / Expected Answers	Marks	Total
	$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F}$	½	
	∴ equivalent power $P = P_2 + P_2$	½	
	b) Image formed by lense of f = +10 cm		
			
	$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1}$ $\frac{1}{v_1} - \frac{1}{30} = \frac{1}{10}$		
	∴ $v_1 = 15$ cm	½	
	This image formed by the lens act as object from concave lens		
	∴ $u_2 = 15-5=10$ cm		
	$\frac{1}{f_2} + \frac{1}{v_2} = \frac{1}{u_2}$ $\frac{1}{-10} = \frac{1}{v} - \frac{1}{10}$	½	
	$v = \infty$		
	Therefore virtual image forms at right of concave lens at $v = \infty$ and act as convex lens. (f = +30 cm)		
	∴ $u_2 = 15 - 5 = 10$ cm	½	5
	$\frac{1}{v_3} = \frac{1}{4} - \frac{1}{f_3}$		
	$\frac{1}{v_3} = \frac{1}{\infty} = \frac{1}{30}$	½	
	$v_3 = 30$ cm	½	
	(If student calculate upto $V = \infty$, give full marks)		
	OR		

i)	Diagram	1
	Explanation	1
ii)	Variation of Intensity	½
	Graph	½
	No. of maxima and minima	½+½

Final corrected proof 11-03-2019

Sl. No.	Value Points / Expected Answers	Marks	Total



When light encounters the molecules of the atmosphere, the electrons in molecules acquire components of motion under the influence of electric field. Charges accelerated parallel to the double arrows do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecules are thus polarized light. — 2

b) Suppose I_0 be the intensity of polarised light after passing through polarized P_1.

Therefore intensity of polarised light after passing through P_2

$I = I_0 \cos^2\theta$

Since Polarised P_1 and P_2 are crossed, the angle between their pass axes will be (90-θ) — ½

$I = I_0 \cos^2\theta.\cos^2(90-\theta)$

$= I_0 \cos^2\theta.\sin^2$

$I = \frac{I_0}{4}\sin^2 2\theta$

1) When θ = 0

$I = \frac{I_0}{4}\sin^2 2.0 = 0$

2) When $\theta = \frac{\pi}{4}$

$I = \frac{I_0}{4}\sin^2 2\pi/2$

$= I_0 / 4$

3) When $\theta = \frac{\pi}{2}$

$I = \frac{I_0}{4}\sin^2 2\pi/2$

$I = 0$

4) When $\theta = \frac{3\pi}{4}$

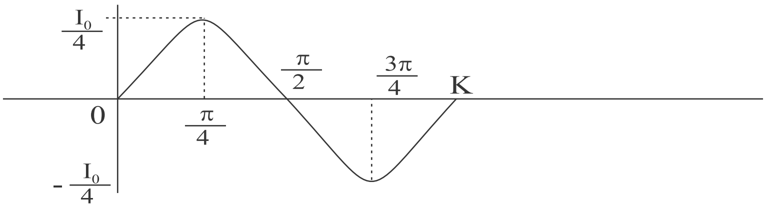
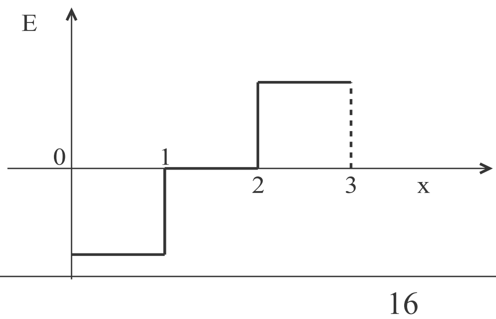
$I = \frac{I_0}{4}\sin^2 2 \times 3\pi/4 = -\frac{I_0}{4}$

5) When θ = n

$I = \frac{I_0}{4}\sin 2\pi$

$I = 0$

Final corrected proof 11-03-2019

Sl. No.	Value Points / Expected Answers	Marks	Total
		½	
	Two maxima and two minima	½+½	
Q26	a) Explanation of charging of capacitor with DC battery — 1 b) i) Effect on electric field with justification — 1½ ii) Effect on energy stored in capacitor with justify. — 1½ c) Graph between E & x — 1		
	a) Charging of capacitor with dc battery whenever parallel plate capacitor is connected with dc source, plates start acquiring charge in accordance with the terminals of the battery till potential difference across the plate becomes equal to terminal potential of dc battery.	1	
	Note : Any other relevant explanation may also be accepted.		
	b) i) The electric field between the plates of parallel plate capacitor $E_0 = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$	½	
	If dielectric is inserted $E' = \frac{Q}{\varepsilon_0 A.K} = \frac{\varepsilon_0}{K}$	½	
	So, the electric field intensity decreases to 1/K times.	½	
	ii) Since Energy stores in the capacitor $U = \frac{Q^2}{2C} = \frac{Q^2 d}{2\varepsilon_0 A}$ .... (1)	½	
	Similarly $U' = \frac{Q^1}{2C'} = \frac{Q^2 d_1}{2K\varepsilon_0 A}$ $= \frac{2}{K}\left(\frac{Q^2 d_1}{2\varepsilon_0 A}\right)$		5
	$= \frac{2U}{K}$	½	
	i<k<2 Therefore energy stored between the plates increases	½	
	iii) 	1	

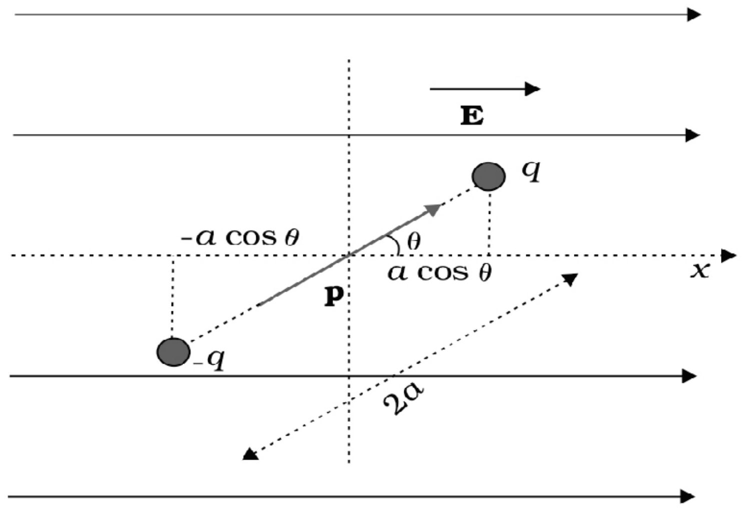
Final corrected proof 11-03-2019

Sl. No.	Value Points / Expected Answers	Marks	Total

OR

i) Derivation of Potential energy of an electric dipole.	2
ii) Condition for stable and unstable equilibrium	2
iii) Possibility and example	½+½

a)



½

b) Since torque acting on dipole

$$\vec{\tau} = \vec{p} \times \vec{E}$$
$$\vec{\tau} = pE \sin\theta.\hat{n}$$ ½

work done $d\omega = \tau.d\theta$

$= pE\sin\theta d\theta$

$$w = \int_{\theta_1}^{\theta_2} dw \quad pE\int_{\theta_1}^{\theta_2} \sin\theta \, d\theta$$ ½

$$w = pE[-\cos\theta]_{\theta_1}^{\theta_2}$$

$$= pE[\cos\theta_1 - \cos\theta_2]$$

if $\theta_1 = 0, \theta_2 = \theta$

$$w = pE(1-\cos\theta)$$ ½

Conditions- 5

For stable equilibrium - When electric dipole is parallel to electric field. 1

For unstable equilibrium - Anti Parallel to electric field. 1

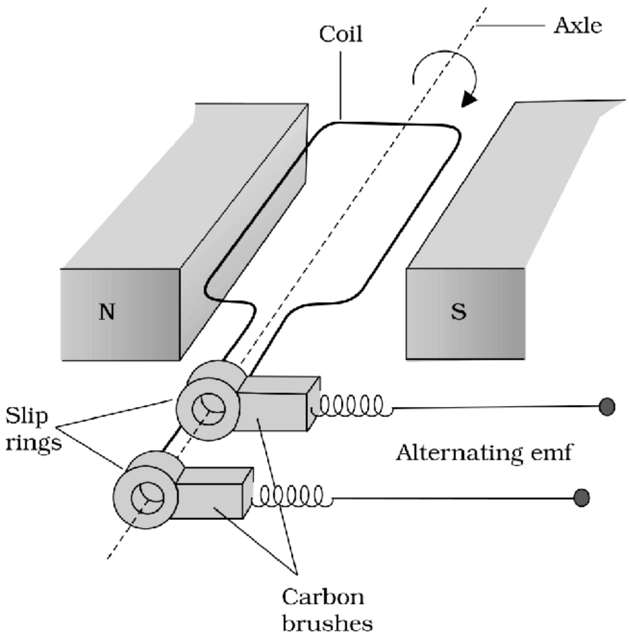
b) No. ½

Inside equipotential surface ½

Sl. No.	Value Points / Expected Answers	Marks	Total
Q27	a) Sharpness of resonance ½ Relation of sharpness with Q factor ½ Factor affecting the sharpness ½ Identification of graph ½ b) Finding of the frequency 1 Calculation of maximum current 1 Calculation of inductive and capacitance reactance ½+½		
	a) The circuit would be set to have a high Sharpness of Resonance, if the current in the circuit drops rapidly as the frequency of the applied AC source shifts from its resonant value. (Also accept Sharpness of Resonance = $\omega_0/2\Delta\omega$).	½	
	Sharpness of Resonance is measured by the quality factor $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$	½	
	Note : Accept the answer if the student write sharpness of resonance = Q- factor		
	Sharpness of resonance for given value L and C / value of ω_r depends on R.	½	
	R is minimum for circuit C	½	
	b) $v = \frac{1}{2\pi\sqrt{LC}}$	½	
	$= \frac{1}{2\times3.14\sqrt{8\times2\times10^{-6}}}$		
	$= \frac{1000}{8\times3.14}$		
	= 39.81 or 40 Hz (Approximately)	½	
	$V_0 = 200$ V		
	$i_0 = \frac{V_0}{Z} = \frac{V_0}{R}$ ($\because$ Z=R at resonance)	½	
	$= \frac{200}{100}$		
	= 2 Ampere	½	
	At resonance		
	$X_L = X_C$		
	$X_L = \omega L = 2\pi v L$	½	
	$= 2\pi\times39.81\times8$		
	$= 2000\ \Omega$	½	5
	OR		
	a) Schematic Diagram of AC Generator 1 Working ½ Expression for emf 1 Graphical representation ½ b) i) Calculation of max and average induced emf ½+½ ii) Calculation of max. current and average power loss ½+½		

Sl. No.	Value Points / Expected Answers	Marks	Total

a)



(Marks: 1)

Working of AC Generator -

Whenever coil placed in uniform magnetic field is rotated, flux linked with it changes, and an emf induces in the coil. The ends of the coil are connected to an external circuit by means of slip rings and brushes. ½

Flux linked with the coil of Area a, placed in uniform magnetic field 'B'

$\phi_B = BA\cos\theta$

or $\phi_B = BA\cos\omega t$ .... ($eq^n 1$)

$\therefore$ From Faraday's law

e.m.f induced in the coil

$\varepsilon = -N\dfrac{d\phi_B}{dt}$ ½

$-NBA\dfrac{d}{dt}\cos\omega t$ ½

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

or $\varepsilon = \varepsilon_0\sin\omega t$ where $\varepsilon_0 = NBA\omega$ ½

Note Award full marks if student explains theoretically)

b) i) $r = 10$ cm, $N = 20$ turns, $w = 50$ rad s^{-1}

$B = 3.0 \times 10^{-2}$ T

$\varepsilon_0 = NBA\omega$

$= 20 \times 3 \times 10^{-2} \times \pi\,(10 \times 10^{-2}) \times 50$

$= 0.942$ volt ½

$\varepsilon_{AV} = 0$, over a cycle

Sl. No.	Value Points / Expected Answers	Marks	Total
	ii) $i_0 = \frac{e_0}{R} = \frac{0.942}{10}$		
	$= 0.094$ A	½	
	$P = \frac{1}{2}\ \varepsilon_0 \times I_0$	½	
	$= \frac{1}{2} \times 0.942 \times 0.094$		
	$= 0.045$ watt.	½	