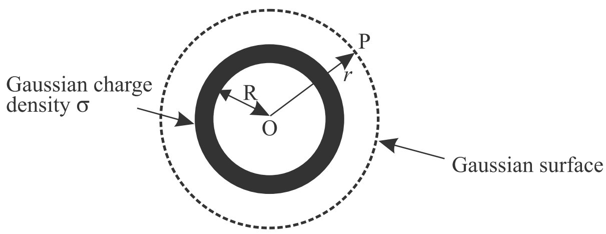
Set-1 MARKING SCHEME - PHYSICS 55/4/1

Sl. No.	Value Points / Expected Answers	Marks	Total
	SECTION - A		
Q1.	Repulsive	1	1
	OR		
	Surface charge density on inner surface = $-\dfrac{Q}{4\pi R_1^2}$	½	1
	Surface charge density on Outer surface = $+\dfrac{Q}{4\pi R_2^2}$	½	
Q2.	When R+nr = nR+r **Alternatively** r = R	1	1
Q3.	The ozone layer absorbs the UV radiations.	1	1
	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		
Q4.	Metal Q has smaller threshold wavelength.	½	1
	Since $\lambda_0 = \dfrac{c}{\nu_0}$	½	
Q5.	The attenuation of ground waves increases very rapidly with increase in frequency and becomes quite high above 1500 kHz frequency **Alternatively** To overcome the weakening of ground waves due to absorption of energy by the earth surface (since energy loss increases with increase in frequency) (Any one of above)	1	1
	SECTION - B		
Q6.	i) Labelled diagram ½ ii) Flux through Gaussian surface ½ iii) Calculation & Result ½+½		
		½	

Sl. No.	Value Points / Expected Answers	Marks	Total

Flux through the small section of Gaussian surface

$$\phi = \oint \vec{E}.\vec{ds}$$

$$\therefore \phi = \oint E ds \cos\theta$$

$$\because E \parallel \vec{ds}, \ \theta = 0$$

$$\therefore \phi = E.4\pi R^2 \quad \text{.......................} (1)$$ — ½

Applying Gauss's theorem — Total: 2

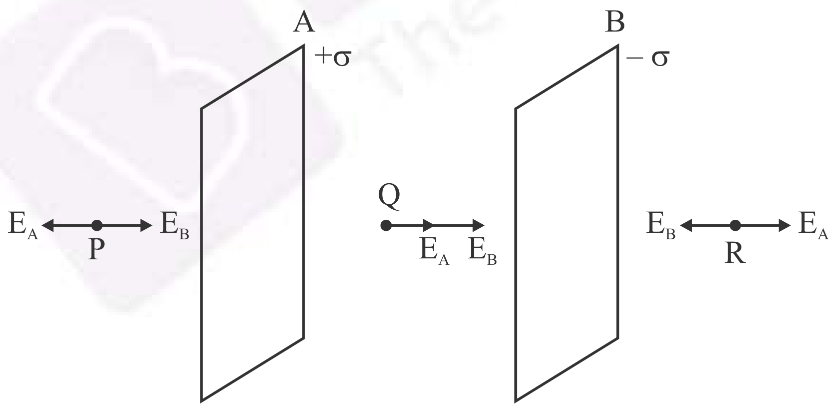
$$\phi = \frac{q}{\varepsilon_0} \quad \text{.......................} (2)$$

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



½

Now Electric field Intensity due to a plane sheet of charge

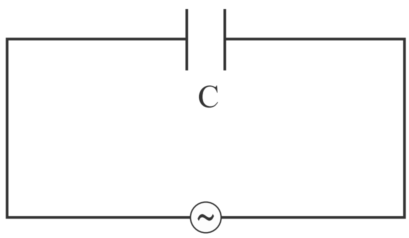
$$E = \frac{\sigma}{2\varepsilon_0}$$ — ½

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

Sl. No.	Value Points / Expected Answers	Marks	Total
	(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
Q7.	i) Formula for Magnetic field ½ ii) Formula for force ½ iii) Calculation & Results ½ iv) Direction of force ½		
	Magnetic field at Point P due current carrying straight wire AB $B = \frac{\mu_o}{2\pi} \frac{I}{r}$	½	
	Force acting on the moving proton in the magnetic field $F = Bqv\sin\theta$	½	
	Therefore $F = \frac{\mu_o}{2\pi} \frac{I}{r} \times qv\sin\theta$ $= \frac{2\times10^{-7}\times4\times1.6\times10^{-19}\times4\times10^{6}\sin 90}{0.2}$ $= 2.56\times10^{-18}$ N	½	2
	Direction of force at point P is towards right. (away from AB)	½	
Q8.	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 Electric flux $= \phi_E(t)$ $= \frac{Q(t)}{\varepsilon_0}$ Now $Q(t) = CV(t)$ $= Cv_0 \sin\omega t$  	½	
	∴ 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	

Sl. No.	Value Points / Expected Answers	Marks	Total

Also, Conduction current i_c leads the voltage by $\pi/2$

$$\therefore \quad i_c = \frac{V_0}{(1/\omega C)} \sin(\omega t + \pi/2)$$

$$= \omega C V_o \sin\omega t \qquad \text{½} \qquad 2$$

Hence $i_d = i_c$ — ½

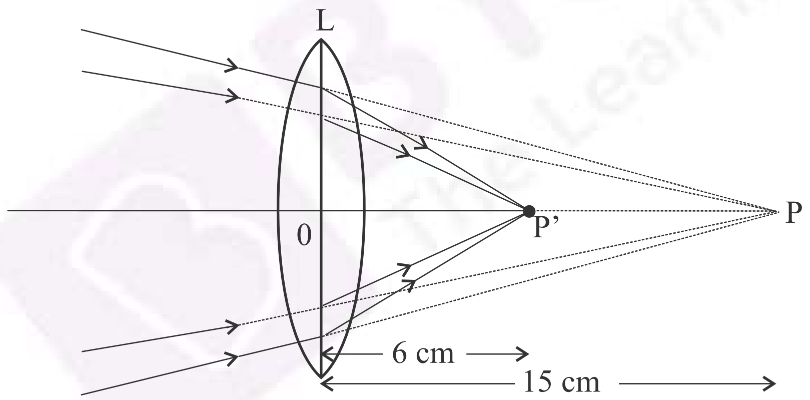
Note 1 : Award two marks even if the student just writes "with an a.c. source, the conduction current, as well as the displacement current, are present at all instants. As per Maxwell's explanation instantaneous displacement current = instantaneous conduction current"

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.

Q9.

i)	Ray diagram	½
ii)	Lens formula	½
iii)	Substitution of values with sign convention	½
iv)	Calculation and Result	½



½

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \text{(lens formula)} \qquad \text{½} \qquad 2$$

Here $u = +15\text{cm}$; $f = +10$ 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 Result	½

Sl. No.	Value Points / Expected Answers	Marks	Total
	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	2
	$\frac{1}{-15} = \frac{1}{3u} + \frac{1}{u}$	½	
	$\Rightarrow \quad u = -20$ cm	½	
Q10.	i) Dependance of Resolving Power on frequency with reason — 1 ii) Dependance of Resolving Power on the focal length of the objective lens with reason — 1		
	Resolving power of a compound microscope $= \frac{2\mu \sin\theta}{1.22\lambda}$	½	
	Therefore, it is clear that the resolving power $= \frac{2\mu \sin\theta \times \nu}{1.22\ c}$		2
	a) increases with the frequency of incident light, and	½	
	b) Resolving power of the compound microscope is not independent of the focal length of objective lens, instead it varies inversely with focal length of objective lens. As per the formula	½	
	$d_{min} = \frac{1.22 f \lambda}{D}$,		
	$R.P. = \frac{1}{d_{min}}$	½	
	Resolving power is inversely proportional to focal length		
Q11.	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 $\beta = y_n - y_{n-1}$		
	$\beta = \frac{\lambda D}{d}$	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		

Sl. No.	Value Points / Expected Answers	Marks	Total

Q12.

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

a) Since $I_e = I_b + I_c$ — ½

$= 60mA+6mA$

$= 6.06\ mA$ — ½

b) $\beta = \frac{I_c}{I_b}$ — ½

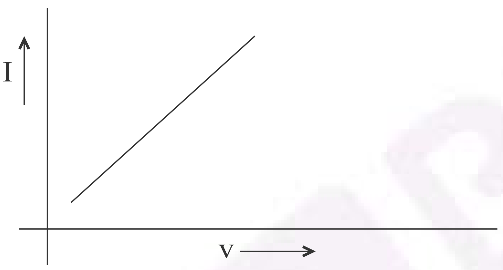
$= \frac{6\times10^{-3}}{60\times10^{-6}} = 100$ — ½

SECTION - C

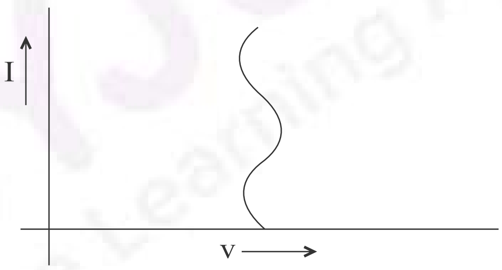
Q13.

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 — 1



OR



b) At a temperature of 4 K, the Resistance of Hg becomes zero. — 1 — Total: 3
Note - Award this 1 mark if the student writes that Hg becomes a super conductor at temperature of 4 K

c) Region BC ; since current is decreasing with increasing voltage — 1
Alternately :The graph has negative slope for this region.

Q14.

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. — ½
Justification - When R is decreased, I through the potentiometer increases. Hence potential gradient increases. Therefore balancing length decreases.

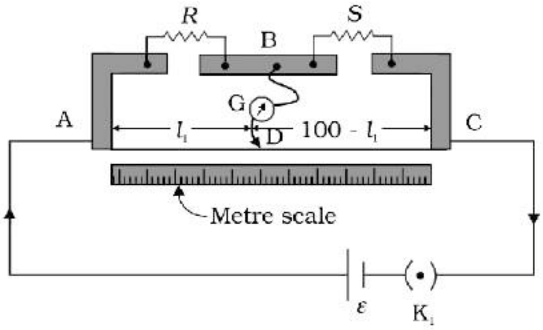
ii) When R_2 is increased, balancing length decreases — ½

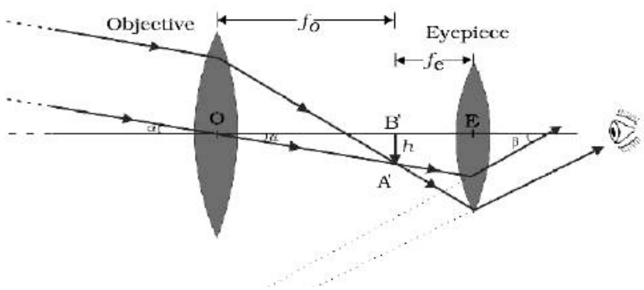
Justification : When R_2 is increased, current $I = \frac{E}{r+R_2}$ decreases. This increases V (= E–Ir) hence balancing length increases. — 1

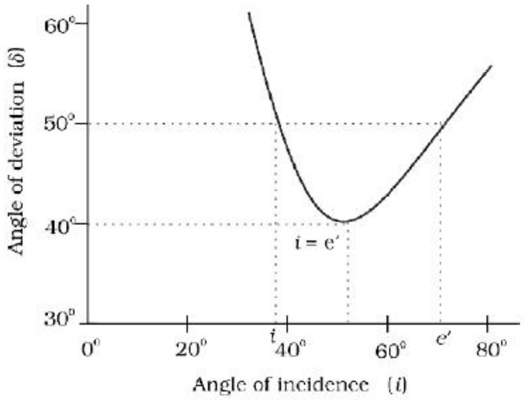
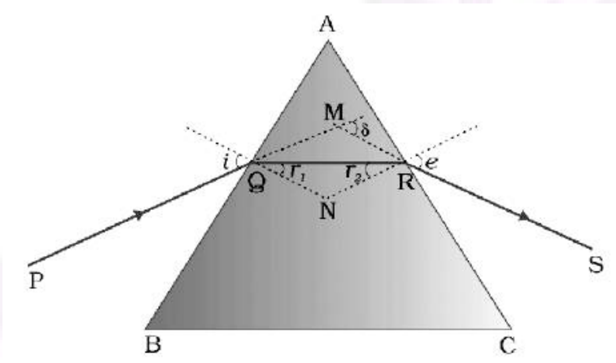
At balance, Potentiometer draws no current from the voltage source, measurement of emf/potential difference will be more accurate or any suitable justification. — 1

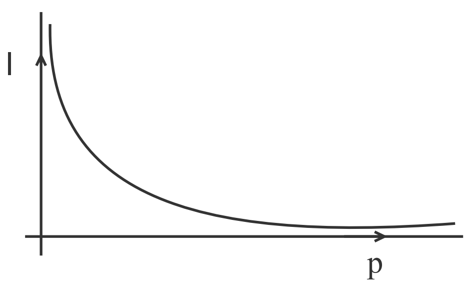
OR

i) Principle of meter bridge	1
ii) Circuit diagram	1
iii) Determination of unknown resistance	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		
	$\frac{R}{S} = \frac{l_1}{100 - l_1}$	1	
	$R = S\left(\frac{l_1}{100 - l_1}\right)$		
Q15.	i) Relation between K.E. and accelerating potential ½ ii) Comparison of Kinetic Energies 1 iii) Determination of radii of path of deuteron and alpha particle 1½		
	i)		
	Since $qV = \frac{1}{2} mv^2$	½	
	for proton $\frac{1}{2} m_p v_1^2 = qV$		
	For deuteron $\frac{1}{2} m_d v_2^2 = qV$		
	For alpha particle $\frac{1}{2} m_\alpha v_3^2 = 2qV$		
	$(K.E.)_p : (K.E.)_d : (K.E.)_\alpha : 1 : 1 : 2$	1	3
	ii) $Bqv = \frac{mv^2}{r}$		
	so $r = \frac{mv}{Bq} = 5$ cm;	½	
	$r_1 : r_2 : r_3 = 5 : 5\sqrt{2} : 5\sqrt{2}$ OR $1 : \sqrt{2} : \sqrt{2}$	1	
Q16.	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) $G = 15\ \Omega$ $I_g = 4 \times 10^{-3}$ A		

Sl. No.	Value Points / Expected Answers	Marks	Total
	$I = 6A$		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 $R = \frac{V}{I_g} - G$	1½	
	Note - Award full marks if a student just draws the labelled diagram.		
	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	
Q17.	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		
Q18.	i) Labelled ray diagram 1½ ii) Formula for angular magnification ½ iii) Importance and limitations 1		
		1½	

Sl. No.	Value Points / Expected Answers	Marks	Total
	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		
	a) 	1	
		½	
	Since $n_{21} = \frac{\sin i}{\sin r}$	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 $\delta = (i - r_1) + (e - r_2)$		
	$\therefore \quad \delta_m = (i + e) + (r_1 + r_2)$ $i = \frac{A + \delta_m}{2}$ .... (eq^n 2)	½	
	$\therefore \quad n_{21} = \frac{\sin i}{\sin r} = \frac{\text{Sin} \frac{A + \delta_m}{2}}{\sin A/2}$	½	

Sl. No.	Value Points / Expected Answers	Marks	Total
Q19	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		
	$\lambda = \dfrac{h}{\sqrt{2mqV}}$	½	
	$\therefore \dfrac{h}{\sqrt{2m_p eV_p}} = \dfrac{h}{\sqrt{2m_\alpha eV_\alpha}}$	½	3
	$\therefore \dfrac{V_p}{V\alpha} = \dfrac{8}{1}$	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 $\lambda = \dfrac{h}{\sqrt{2mqV}}$		
	$\lambda \propto \dfrac{1}{\sqrt{m}}$ (For other variables constant)	½	
	$\because m\rho > m_e$		
	Therefore $\lambda_{electron} > \lambda_{proton}$	½	
	ii) momentum $p = \dfrac{h}{\lambda}$	½	
	$\therefore \lambda_{electron} > \lambda_{proton}$ $\therefore$ momentum of electron is lesser.	½	3
	b) $\lambda = \dfrac{h}{p}$	½	
	Graph between p & λ		
		½	

Sl. No.	Value Points / Expected Answers	Marks	Total

Q20

i) Derivation of expression for the orbital period	2
ii) Rydberg's formula and name of the series of H_α line	½+½

a) Orbital Period of electron in hydrogen atom

$$T = \frac{2\pi r_n}{v_n} \quad \text{.. (eq}^n 1)$$ ½

From Bohr's postulates

$$mv_n r_n = \frac{nh}{2\pi}$$

We have $r_n = \frac{n^2h^2\varepsilon_0}{\pi me^2}$ ½

and velocity of electron in n^{th} orbital — Total: 3

$$v_n = \frac{e^2}{2\varepsilon_0 nh}$$ ½

On substituting the values of r_n and v_n in equation (1) we have

$$T = \frac{4n^3h^3\varepsilon_0^2}{me^4}$$ ½

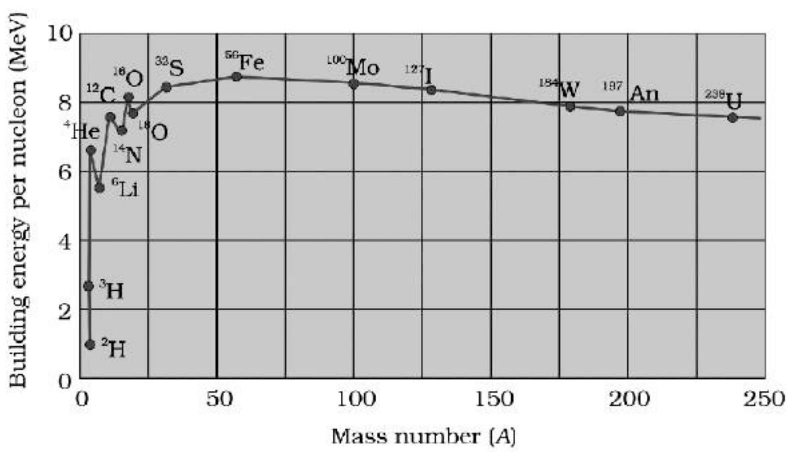
b) Rydberg's formula for wavelengths of the spectral lines

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$ ½

H_α belongs to **Balmer series**. ½

Q21

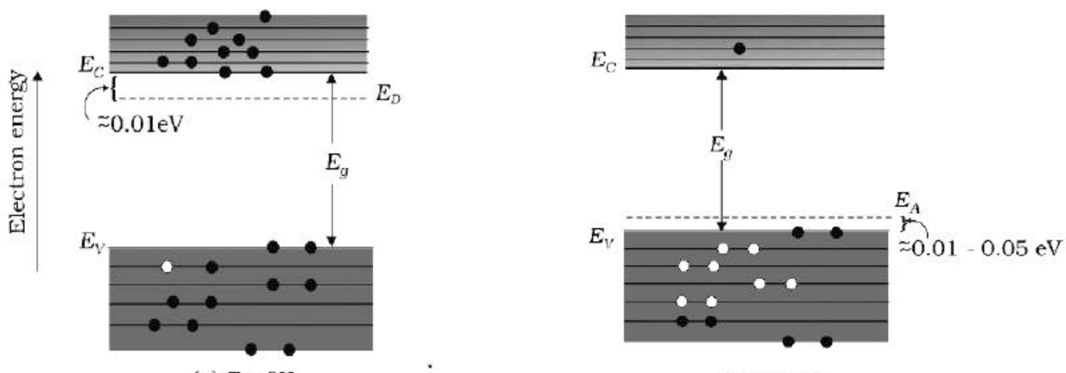
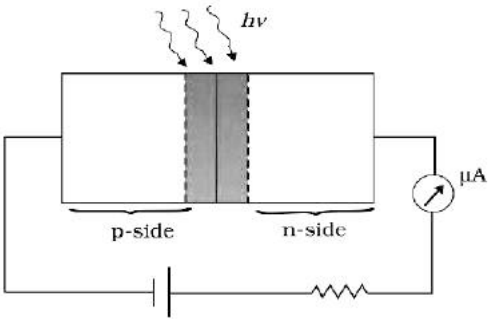
i) B.E / nucleon graph	1
ii) Salient features of graph	½+½
iii) Explanation of Fission and Fusion	½+½

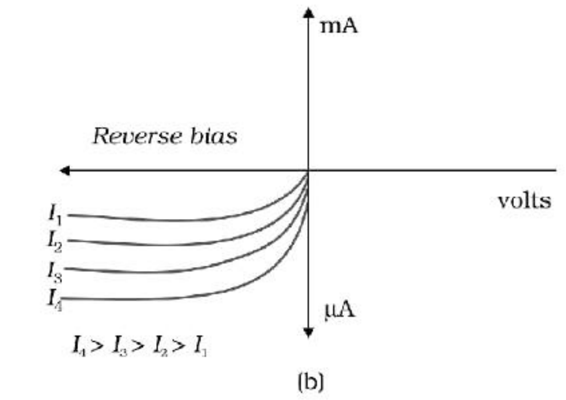
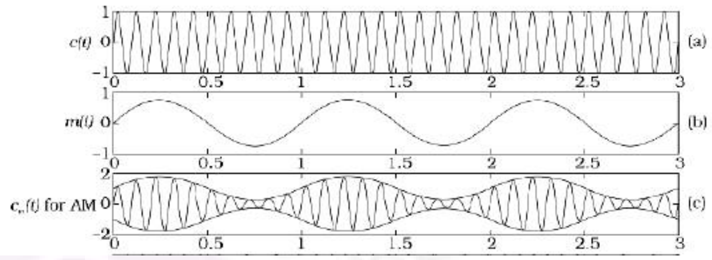


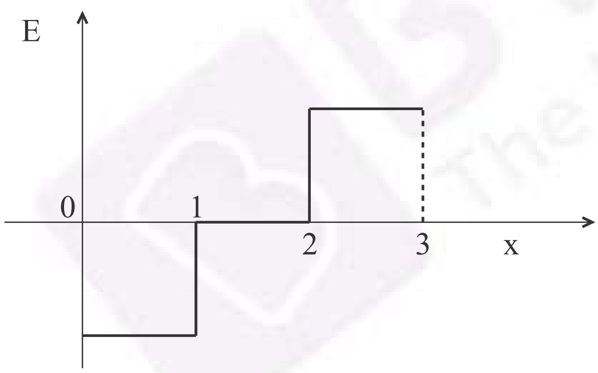
1

Salient feature of B.E. curve

i) B.E/nucleon is pratically constant i.e. independent of the atomic number for nuclei of middle mass number (30<A<17) ½

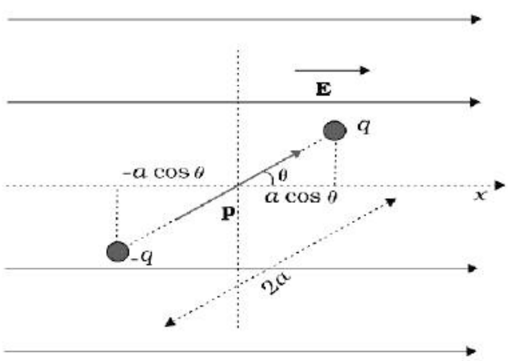
Sl. No.	Value Points / Expected Answers	Marks	Total
	ii) Binding energy per nucleon is lower for both light nuclei (A<30) and heavy nuclei (A>170) Very heavy nucleus has lower B.E./nucleon will undergo fission and split into two medium sized nuclei with large B.E./nucleon and release tremendous amount of energy (Fission process) When two very light nuclei, having low binding energy per nucleon combine together and form a medium sized nuclei of higher B.E. per nucleon releases enormous amount of energy (Fusion process)	½ ½ ½	3
Q22	i) Energy band diagram (i) n type and (ii) p type — 1+1 ii) Role of Acceptor and Donor energy level — 1 (a) $T > 0K$ (b) $T > 0K$ 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. Whereas in p type semiconductor the holes from acceptor level sinks down into valence band	2 ½ ½	3
Q23	i) Point of consideration in fabrication of Photodiode — ½ ii) Working of photodiode with diagram — 1½ iii) VI graph - Role of photodiode in detecting the optical signal — ½+½ A photodiode is fabricated with a transparent window to allow light to fall on the diode. and the generation of e-h pairs takes place in or near the depletion region of the diode. Working of photodiode - When photodiode is illuminated with light of suitable frequency, the electron hole pairs are generated near depletion region due to its specific fabrication. The junction potential separates electrons and holes before their recombination and e^- releases to n^- side and holes reaches to p^- side to the direction of electric field and hence current flows across the photodiode when connected with load.	½ 1	

Sl. No.	Value Points / Expected Answers	Marks	Total
		1	3
	If reverse bias is applied across the photodiode, the photo current changes with the change in intensity of light. Hence, it can be used to detect the optical signals	½	
Q24	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	
	 (Credit may be given if a student draws only the modulated signal.)	½	3
	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	
Q25	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. **Note :** Any other relevant explanation may also be accepted.	1	

Sl. No.	Value Points / Expected Answers	Marks	Total
	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		
	$U' = \frac{Q^1}{2C'} = \frac{Q^2 d_1}{2K\varepsilon_0 A}$		5
	$= \frac{2}{K}\left(\frac{Q^2 d_1}{2\varepsilon_0 A}\right)$		
	$= \frac{2U}{K}$	½	
	$i<k<2$ Therefore energy stored between the plates increases	½	
	iii) 	1	

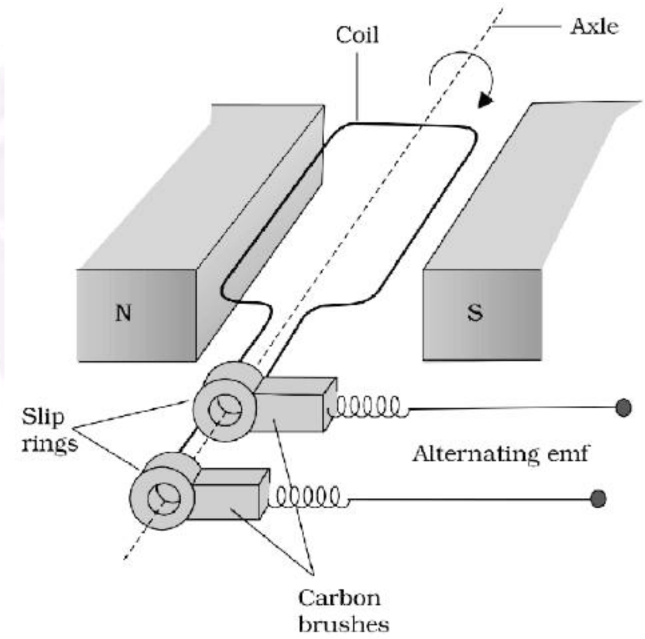
OR

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

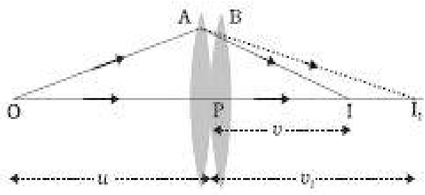
Sl. No.	Value Points / Expected Answers	Marks	Total
	a) Since torque acting on dipole		
	$\vec{\tau} = \vec{p} \times \vec{E}$		
	$\vec{\tau} = pE\sin\theta.\hat{n}$	½	
	work done $d\omega = \tau.d\theta$ $= pE\sin\theta d\theta$		
	$w = \int_{\theta_1}^{\theta_2} dw \quad pE\int_{\theta_1}^{\theta_2} \sin\theta\, d\theta$	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	
Q26	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	

Sl. No.	Value Points / Expected Answers	Marks	Total
	$V_0 = 200$ 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		
	$X_L = X_C$		
	$X_L = \omega L = 2\pi \nu L$	½	
	$= 2\pi \times 39.81 \times 8$		
	$= 2000\ \Omega$	½	5
	OR		
Q26	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		
	a) 	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'		

Sl. No.	Value Points / Expected Answers	Marks	Total
	$\phi_B = BA\cos\theta$		
	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	
	$-NBA\dfrac{d}{dt}\cos\omega t$		
	$\varepsilon = NBA\omega\sin\omega t$		
	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, $\omega = 50$ rad s^{-1}		
	$B = 3.0 \times 10^{-2}$ T		
	$\varepsilon_0 = NBA\omega$		
	$= 20 \times 3 \times 10^{-2} \times \pi\left(10 \times 10^{-2}\right)^2 \times 50$		
	$= 0.942$ volt	½	
	$\varepsilon_{AV} = 0$, over a cycle		
		½	
	ii) $i_0 = \dfrac{e_0}{R} = \dfrac{0.942}{10}$		
	$= 0.094$ A	½	
	$P = \dfrac{1}{2}\varepsilon_0 \times I_0$	½	
	$= \dfrac{1}{2} \times 0.942 \times 0.094$		
	$= 0.045$ watt.	½	

Sl. No.	Value Points / Expected Answers	Marks	Total
Q27.	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

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{v_1} - \frac{1}{u} + \frac{1}{v} - \frac{1}{v_1}$$

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

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F}$$ ½

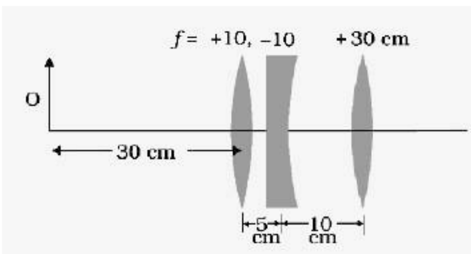
∴ equivalent power

$P = P_2 + P_2$ ½

b) Image formed by lense of f = +10 cm

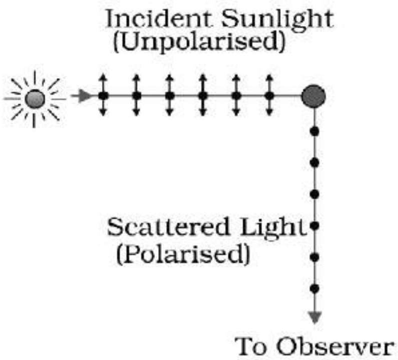
$$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1}$$

$$\frac{1}{v_1} - \frac{1}{30} = \frac{1}{10}$$



Sl. No.	Value Points / Expected Answers	Marks	Total
	$\therefore$ $v_1 = 15$ cm	½	
	This image formed by the lens act as object from concave lens		
	$\therefore$ $u_2 = 15-5=10$ 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)		
	$\therefore$ $u_2 = 15 - 5 = 10$ cm	½	5
	$\frac{1}{v_3} = \frac{1}{4} - \frac{1}{f_3}$		
	$\frac{1}{v_3} = \frac{1}{\infty} = \frac{1}{30}$		
	$v_3 = 30$ cm	½	
	(If student calculate upto $v = \infty$, give full marks)		
	OR		

i)	Diagram	1
	Explanation	2
ii)	Variation of Intensity	½
	Graph	½
	No. of maxima and minima	½+½



(1 mark)

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 marks)

Sl. No.	Value Points / Expected Answers	Marks	Total

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 $(90-\theta)$ 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 $\theta = 0$

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

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

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

$= I_0 / 4$

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

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

$I = 0$

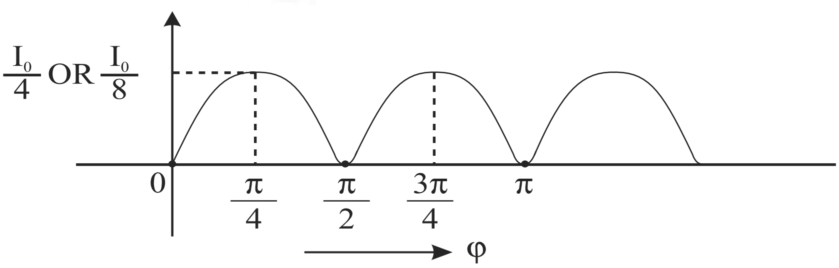
4) When $\theta = \frac{3\pi}{4}$

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

5) When $\theta = n$

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

$I = 0$



½

Two maxima and two minima

If light is unpolarised then maximum intensity is $\frac{I_0}{8}$

If light is polarised then maximum intensity is $\frac{I_0}{4}$ ½+½

(Accept both answers)