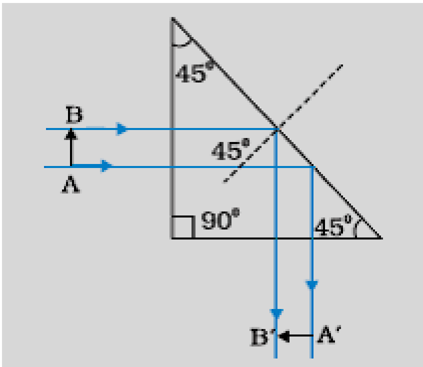
MARKING SCHEME
SET 55/1/1 (Compartment)

Q. No.	**Expected Answer / Value Points**	**Marks**	**Total Marks**
	Section A		
Set1,Q1 Set2,Q5 Set3,Q2	$\vec{m} = I\vec{A}$	1	1
Set1,Q2 Set2,Q3 Set3,Q1	**Note: Any two** i. Electromagnetic Damping ii. Magnetic Breaking iii. Induction Furnace iv. Electric Power meters	½ + ½	1
Set1,Q3 Set2,Q2 Set3,Q5	NAND gate / NOR Gate	1	1
Set1,Q4 Set2,Q4 Set3,Q3	Potentiometer does not draw any (net) current from the cell/ Voltmeter draws some current from cell, when connected across it, hence measures terminal voltage.	1	1
Set1,Q5 Set2,Q1 Set3,Q4	i. Local Area Networking ii. World Wide Web	½ ½	1
	Section B		
Set1,Q6 Set2,Q10 Set3,Q7	Formula ½ Substitution and Calculation 1 ½ Let n be the number of photons. then $Work\ function, W = \frac{nhC}{\lambda}$ $n = \frac{W\lambda}{h}$ $= \frac{3 \times 10^{-19} \times 26.5 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^{8}}$ $= 4 \times 10^{-2}$	 ½ 1 ½	2
Set1,Q7 Set2,Q9 Set3,Q6	Distinction between sky wave and space wave propagation 2 S.No | Sky Wave | Space Wave 1 | Restricted upto a few MHz frequency (30 to 40 MHz) | Can take place (even) beyond 40 MHz frequency 2 | Waves are reflected back from ionosphere | Space waves travel in a straight line, either direct from transmitting antenna to receiving antenna or , through satellite **[Alternatively: Any other two correct distinguishing characteristics.]**	 1 1	2

Set1,Q8 Set2,Q6 Set3,Q10	Formula ½ Substitution and Calculation 1½ Input Resistance $r_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)_{V_{CE}}$ $= \frac{(0.82 - 0.72)V}{(80 - 30) \times 10^{-6}}$ $= \frac{0.10}{50 \times 10^{-6}}$ $= \frac{100 \times 10^{3}}{50}$ $= 2000\Omega$	½ ½ ½ ½	2
Set1,Q9 Set2,Q7 Set3,Q8	Ray diagram 1 Necessary Condition 1  For total internal reflection $45^o > i_c$ $\therefore \sin 45 > \sin i_c$ $\frac{1}{\sqrt{2}} > \sin i_c$ $> \frac{1}{\mu}$ $\Rightarrow \mu > \sqrt{2}$ **OR** Redrawing necessary ray diagram 1 Obtaining expression for R 1	1 ½ ½	2

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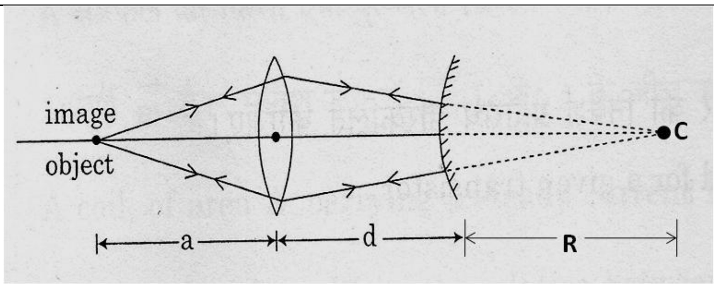

For convex lens u=-a, v=R+d

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

$$\frac{1}{f}=\frac{1}{(R+d)}-\frac{1}{(-a)}=\frac{1}{(R+d)}+\frac{1}{a}$$

$$\Rightarrow R=\left(\frac{af}{a-f}\right)-d$$
</td>
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½

½</td>
<td>2</td>
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<tr>
<td>Set1,Q10
Set2,Q8
Set3,Q9</td>
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Identifying permissible transitions	½
Formula	½
Calculation of wavelengths	½ + ½

For second excited state, n=3
Hence two possible transition of the Lyman series: 3→1 and 2→1.

Wavelength for transition 3→1, n_f =1, n_i =3

$$\frac{1}{\lambda}=R\left(\frac{1}{{n_f}^2}-\frac{1}{{n_i}^2}\right)$$

$$\frac{1}{\lambda}=1.1\times 10^7\left(\frac{1}{1}-\frac{1}{9}\right)$$

$$=1.1\times 10^7\left(\frac{8}{9}\right)$$

$$\Rightarrow \lambda=\frac{9}{8\times 1.1\times 10^7}$$

$$=1.023\times 10^{-7}$$

$$=102.3\ nm$$

For transition 2→1, n_f =1, n_i =2

$$\frac{1}{\lambda}=1.1\times 10^7\left(1-\frac{1}{4}\right)$$

$$\Rightarrow \lambda=121\ nm$$
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<td>½

½

½

½</td>
<td>2</td>
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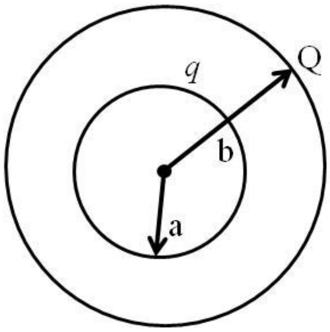
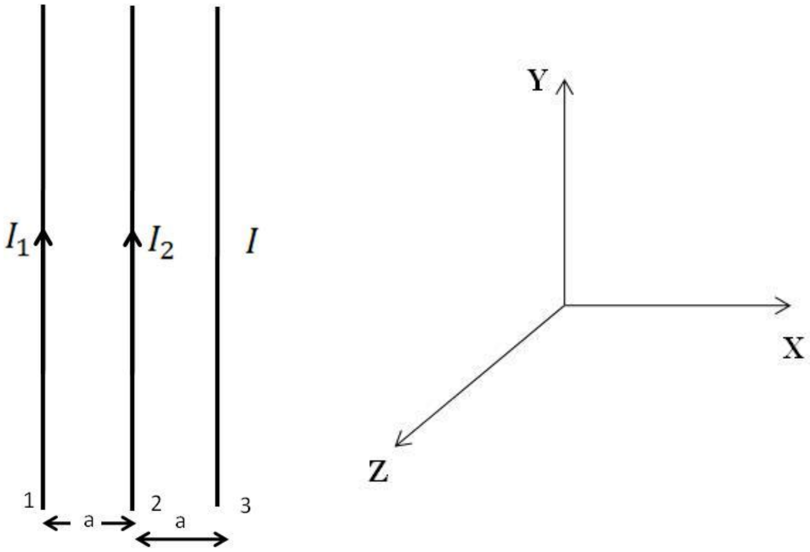
Section C			
Set1,Q11 Set2,Q18 Set3,Q17	Calculation of magnitudes of electric field 1+1+1  (i) For 0< x < a Point lies inside both the spherical shells. Hence, E(x)=0 (ii) For a ≤ x< b Point is outside the sphrical shell of radius 'a' but inside the spherical shell of radius 'b'. $\therefore E(x) = \frac{1}{4\pi\varepsilon_o}.\frac{q}{x^2}$ (iii)For b ≤ x ≤ ∞ Point is outside of both the spherical shells. Total effective charge at the centre equals (Q + q). $\therefore E(x) = \frac{1}{4\pi\varepsilon_0}.\frac{(q+Q)}{x^2}$	½ ½ 1 1	3
Set1,Q12 Set2,Q22 Set3,Q11	Finding the expression for the resistance X 3 (i) Current I when K_2 is open $I = \frac{\varepsilon}{R+X}$ (ii) Current I' when K_2 is closed $I' = \frac{\varepsilon}{R + \left(\frac{SX}{S+X}\right)} = \frac{\varepsilon\,(S+X)}{R(S+X)+SX}$ Current flowing through X, $\frac{I}{2} = \frac{I'S}{S+X} = \frac{\varepsilon S}{R(S+X)+SX}$ $\Longrightarrow \frac{\varepsilon}{2(R+X)} = \frac{\varepsilon S}{R(S+X)+SX}$ $\Longrightarrow 2(R+X)S = R(S+X)+SX$ $2RS + 2XS = RS + RX + SX$	½ ½ ½ ½ ½	

	$RS = RX - SX$ $X = \dfrac{RS}{(R-S)}$	½	3
Set1,Q13 Set2,Q12 Set3,Q18	Finding the direction of currents in two cases ½ + ½ Obtaining the relation between magnitudes of currents I_1, I_2 and I 2  (i) Force experienced by wire (1) can be zero only when the current in wire(3) flows along $-\hat{j}$ i.e. downward. $Also, \quad \dfrac{\mu_0 I_1 I}{2\pi(2a)} = \dfrac{\mu_0 I_1 I_2}{2\pi(a)}$ $\therefore I = 2I_2$ (ii) When direction of current in wire (3) is reversed then current should be along $+\hat{j}$ i.e. upward. For this case force on wire 2 becomes zero (given) $\dfrac{\mu_0 I_1 I_2}{2\pi a} = \dfrac{\mu_0 I_2 I}{2\pi(a)}$ $\therefore I = I_1$ $\Rightarrow I = I_1 = 2I_2$	½ ½ ½ ½ ½ ½	3
Set1,Q14 Set2,Q13 Set3,Q21	Derivation of the average power 2 Definition of wattless current ½ Condition in which it is realized ½		

	$$v = v_m \sin \omega t$$ $$i = i_m \sin(\omega t + \varphi)$$ Power at any instant $$P = v\, i = v_m i_m \sin \omega t \sin(\omega t + \varphi)$$		
	$$P = \frac{v_m i_m}{2}[\cos \phi - \cos(2\omega t + \varphi)]$$	½	
	The average of second term in the above expression is zero over a full cycle.	½	
	$$\therefore \text{ Average Power} = \bar{P} = \frac{v_m i_m}{2} \cos \varphi$$		
	$$\bar{P} = \frac{v_m}{\sqrt{2}} \times \frac{i_m}{\sqrt{2}} \cos \varphi$$	½	
	$$\therefore \bar{P} = V_{rms} I_{rms} \cos \varphi$$	½	
	Wattless current is that which flows in the circuit but no power dissipation occurs.	½	
	It is realized only when circuit is purely inductive or capacitive , i.e when $\cos \varphi = 0 \; or \; \varphi = \pm \pi/2$	½	3
	OR		
	Derivation of expression of magnetic energy stored 1½ Obtaining expression for energy density 1½		
	Instantaneous Induced emf in an inductor when current changes through it $$e = -L\frac{dI}{dt}$$ Hence instantaneous applied voltage		
	$$e = V = L\frac{dI}{dt}$$	½	
	Work done $dW = V.dq = VIdt$ $$\therefore dW = LI\, dI$$	½	
	$$\Rightarrow \int dW = \int_0^I L\, I\, dI$$		
	$$W = \frac{1}{2}LI^2$$	½	
	$$\text{Energy Density (u)} = \frac{\text{total energy stored}}{\text{volume}}$$	½	

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$$u = \frac{\left(\frac{1}{2}\right)LI^2}{A\,l} = \frac{\frac{1}{2}(LI)I}{A\,l}$$

$$\text{Flux} = NBA = LI$$

$$and\ B = \frac{\mu_0 NI}{l} \Rightarrow I = \frac{Bl}{\mu_0 N}$$

$$\therefore u = \frac{\frac{1}{2}(NBA).\frac{Bl}{\mu_0 N}}{Al} = \frac{B^2}{2\mu_0}$$

</td><td>½

½</td><td>3</td></tr>
<tr><td>Set1,Q15
Set2,Q11
Set3,Q15</td><td>

(i) Identifying the two characteristics	½ + ½
(ii) Naming the quantity in two cases	½ + ½
(iii) Justification of existence of threshold frequency	1

(i) Graph 1:
Intensity

Graph 2
Frequency

(ii) Graph 1
Saturation current

Graph 2
Stopping potential

(iii) For a given photo sensitive surface electrons need a minimum energy to be emitted, this is called work function of the surface W.

∴ Photons energy $h\nu$ should be greater/equal to the work function.

$$\therefore h\nu \geq W$$

$$or\ \nu \geq \frac{W}{h}$$

∴ Minimum frequency for photo emission

$$\nu_0 = \frac{W}{h}$$

</td><td>½

½

½

½

½

½</td><td>3</td></tr>
<tr><td>Set1,Q16
Set2,Q21
Set3,Q14</td><td>

Obtaining expression $N = N_0 e^{-\lambda t}$	1½
Obtaining relation between half life and decay constant	1½

Let a sample of radioactive material have N_0 nuclei, at t=0
At time t, Number of nuclei =N

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	As per the decay law $$-\frac{dN}{dt}=\lambda N$$ $$\Rightarrow \int_{N_0}^{N}\frac{dN}{N}=\int_0^t -\lambda\, dt$$ $$\Rightarrow\ (\log_e N)_{N_0}^{N}=-\lambda(t_o)^t$$ $$\log_e N-\log_e N_0=-\lambda t$$ $$\frac{N}{N_0}=e^{-\lambda t}$$ $$\Rightarrow N=N_0e^{-\lambda t}$$ After one half life, Number of nuclei becomes $\frac{N_o}{2}$ $$\Rightarrow\ \frac{N_0}{2}=N_0e^{-\lambda T_{\frac{1}{2}}}$$ $$\Rightarrow 2=e^{\lambda T_{\frac{1}{2}}}$$ $$\Rightarrow \log_e 2=\lambda T_{\frac{1}{2}}$$ $$\Rightarrow \lambda T_{\frac{1}{2}}=0.6931$$ $$\Rightarrow T_{\frac{1}{2}}=\frac{0.6931}{\lambda}$$	½ ½ ½ ½ ½ ½	3
Set1,Q17 Set2,Q20 Set3,Q13	Reasons for parts (i), (ii) and (iii) 1 + 1+ 1 (i) It is because reverse break down voltage of LED is very low i.e. nearly 5V. (ii) Because solar cell can work with any light whose photon energy is more than the band gap energy. (iii) The heavy doping of p and n sides of pn junction, makes the depletion region very thin, hence for a small reverse bias volatge, electric field is very high.	1 1 1	3
Set1,Q18 Set2,Q15 Set3,Q22	Meaning of modulation 1 Identification of two types of modulation ½ + ½ Two advantages ½+ ½ Modulation is a process in which one of the characteristics (amplitude, frequency, phase) of a high frequency carrier wave is made to change in accordance with a given low frequency message signal.	1	

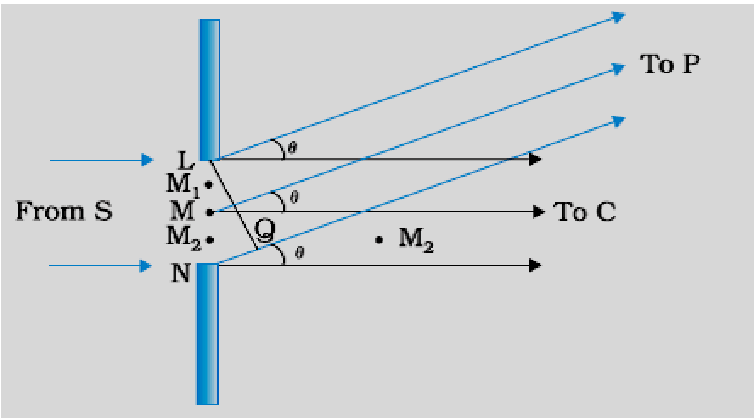
Modulated wave 1: Frequency Modulation ½
Modulated wave 2: Amplitude Modulation ½

Two advantages of FM over AM:
(i) Lower noise, better power efficiency. ½
(ii) Higher operating range ½
(iii) Higher fidelity reception.
[Any two]

[**Alternatively**, Two advantages of AM over FM ½
(i) Simple circuits are required. ½
(ii) Lower frequency space for transmission.] 3

Set1,Q19
Set2,Q17
Set3,Q16

Appropriate reasoning of (i) and (ii)	1+1
Writing expression for total linear width of central maxima	1



½

(i) At central point C, angle θ is zero , all path differences are zero. Hence all the parts of the slit contribute in same phase. This gives maximum intensity at point C. ½

(ii) From figure

$$NP - LP = NQ$$

$$= a \sin\theta$$

$$= a\theta$$

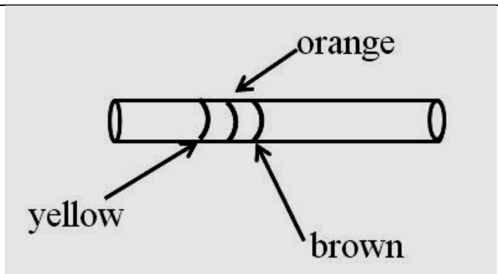
When $\theta = \dfrac{\lambda}{a}$

Path difference $NP - LP = a\theta = \lambda$

Hence, $MP - LP \approx NP - MP \approx \dfrac{\lambda}{2}$ ½

It implies that the contribution from corresponding points in two halves of the slit have a phase difference of π. Therefore, contributions from two halves cancel each other in pairs, resulting in a zero net intensity at point P on the screen. ½

	Half angular width of central maxima $= \frac{\lambda}{a}$ $\Rightarrow$ Half Linear width $= \frac{\lambda D}{a}$ $\Rightarrow$ Linear width of central maximum on the screen $= \frac{2\lambda D}{a}$	½ ½	3
Set1,Q20 Set2,Q16 Set3,Q19	Formula ½ Calculation of the magnetic field at the required point 2½ The plane of coil is XY plane and field point is on the Z-axis. $\therefore$ Magnetic field on the axial point $B = \frac{\mu_0 I R^2 N}{2(R^2+z^2)^{\frac{3}{2}}}$ $= \frac{4\pi \times 10^{-7} \times \frac{2}{\pi} \times (0.2)^2 \times 100}{2\left[(0.2)^2 + \left(0.2\sqrt{3}\right)^2\right]^{\frac{3}{2}}} T$ $= \frac{8 \times 0.04 \times 10^{-7} \times 100}{2 \times 0.04 \times 8 \times 0.2} T$ $= 25\,\mu T$	½ 1 ½ ½ ½	3
Set1,Q21 Set2,Q14 Set3,Q12	Calculation of Resistance R_1 and R_2 at 100^{o} C 2 Showing colour code diagram for series combination 1 $R_t = R_0(1+\alpha\Delta t)$ For Resistance R_1 $R_1{}' = R_1(1+\alpha\Delta t)$ $= 200(1+0.0031\times 100)$ $= 262\Omega$ For Resistance R_2 $R_2{}' = 100(1+0.0068\times 100)$ $= 168\Omega$ Hence, Total Resistance in series combination of R_1 and R_2 at 100^{o} C: $R = R_1{}' + R_2{}' = 262 + 168$ $= 430\Omega$	½ ½ ½ ½	

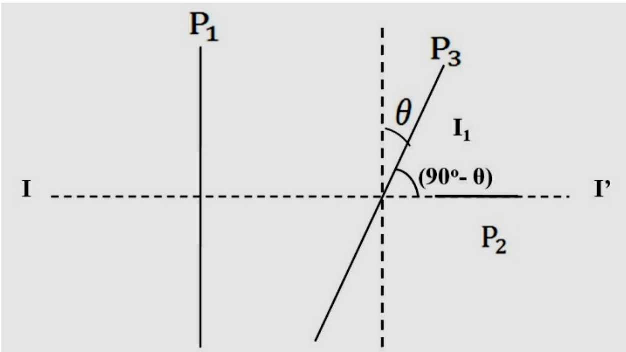


1

3

Set1,Q22
Set2,Q19
Set3,Q20

Finding the formula for the ratio $\frac{I'}{I}$	2
Calculating for	
(i) θ=30°	½
(ii) θ=45°	½



½

Intensity of unpolarised light is given as I,

It becomes $\frac{I}{2}$ on passing polaroid P_1

∴Using law of Malus, for the intensity passing through P_3 ½

$$I_1 = \left(\frac{I}{2}\right)cos^2\theta$$

This intensity I_1 is incident on P_2 ½

Hence using law of Malus for Polaroid P_2

$$I' = I_1 cos^2(90^o - \theta)$$

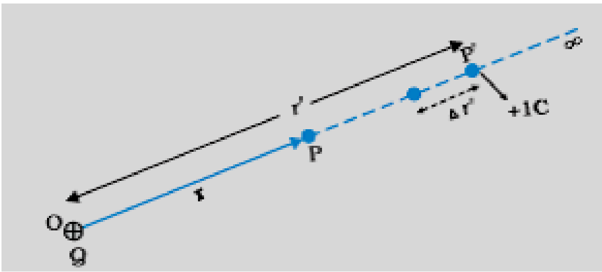
$$= \frac{I}{2}cos^2\theta \times sin^2\theta$$

$$= \frac{I}{8}.(2\ \sin\theta\cos\theta)^2$$ ½

$$= \frac{I}{8}(\sin 2\theta)^2$$

(i) When $\theta = 30^o$

Then $I' = \frac{I}{8}(\sin 60^o)^2$ ½

	$\Rightarrow \frac{I'}{I} = \frac{3}{32}$ (ii) When $\theta = 45^o$ $\Rightarrow \frac{I'}{I} = \frac{1}{8}$	½	3
Section D			
Set1,Q23 Set2,Q23 Set3,Q23	Answer of (a), (b) and (c) 1+1+2 (a) The cream used by players helps to protect the skin of the face from harmful sun rays. (b) Because it absorbs harmful ultraviolet radiations. (c) Rakesh and Rajesh :Curious , keen observer, scientific temperament. Teacher: cooperative, supportive and encouraging **(or any other two relevant values.)**	1 1 1 1	4
Section E			
Set1,Q24 Set2,Q25 Set3,Q26	(a) Obtaining expression for potential 2½ (b) Showing the dependence of potential on r due to an electric dipole 2½ (a)  Consider a point charge ‘Q’ kept at point O. Let P be the field point at distance r. At some intermediate point p', the electrostatic force on the unit positive charge is: $= \frac{Q \times 1}{4\pi\varepsilon_0 r'^2}$ Work done against this force from r' to $r' + \Delta r'$ is $\Delta W = -\frac{Q}{4\pi\varepsilon_0 r'^2}\Delta r'$	½ ½ ½	

Total Work done ‘W’ by the external Force from ∞ to r

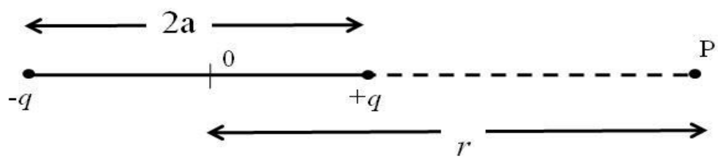
$$W = -\int_{\infty}^{r} \frac{Q}{4\pi\varepsilon_0 r'^2} \Delta r'$$ ½

$$W = \frac{Q}{4\pi\varepsilon_0 r}$$

Hence potential at this point

$$V = W = \frac{Q}{4\pi\varepsilon_0 r}$$ ½

(b)



½

Potential at point P due to charge (-q)

$$V_1 = \frac{-1}{4\pi\varepsilon_0} \frac{q}{(r+a)}$$

Potential due to charge +q

$$V_2 = \frac{1}{4\pi\varepsilon_0} \frac{q}{(r-a)}$$ ½

Hence total potential at point P

$$V = V_1 + V_2 = \frac{q}{4\pi\varepsilon_0}\left[\frac{-1}{(r+a)} + \frac{1}{(r-a)}\right]$$

$$= \frac{q \times 2a}{4\pi\varepsilon_0 (r^2 - a^2)^2}$$ ½

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{p}{(r^2 - a^2)} \quad where\ \vec{p} = q \times 2a = dipole\ moment$$ ½

$For\ r \gg a$

$$\Rightarrow V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{P}{r^2}$$

$$\Rightarrow V \propto \frac{1}{r^2}$$ ½

5

OR

(a)	Definition of SI unit	1
(b)	Obtaining expression for capacitance	2
(c)	Derivation of expression of effective capacitance of n capacitors	2

(a) When a charge of one coulomb, produces a potential difference of one volt between the plates of capacitor, the capacitance is one farad. 1

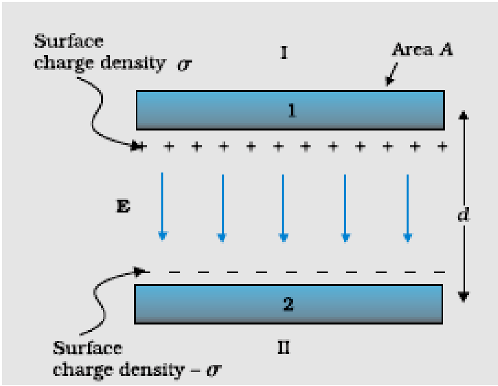
[Alternatively,

$$Q = CV \Rightarrow C = \frac{Q}{V}$$

$$When\ Q = 1\ coulomb, V = 1 volt$$

$$1\ farad = \frac{1\ coulomb}{1\ volt}]$$

(b)



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Electric field in the region between the plates of capacitor.

$$E = E_1 + E_2$$

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

where σ is surface charge density $= \frac{Q}{A}$

∴ potential difference between the plates

$$V = Ed$$

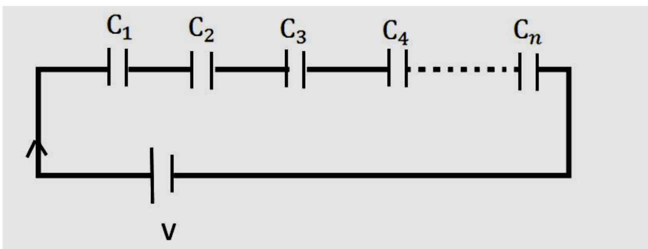
$$= \frac{\sigma}{\varepsilon_0} d$$

$$V = \frac{Q}{\varepsilon_0 A} d$$ ½

⇒ Capacitance of parallel plate capacitor

$$C = \frac{Q}{V} = \frac{\varepsilon_0 A}{d}$$ ½

(c)



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<tr><td></td><td>In series combination, charge on each capacitor is same.
Let it be Q.
$$V_1 = \frac{Q}{C_1}$$
$$V_2 = \frac{Q}{C_2}$$
$$\vdots$$
$$V_n = \frac{Q}{C_n}$$
Total potential
$$V = V_1 + V_2 + V_3 \pm \cdots + V_n$$
$$V = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3} + \cdots + \frac{Q}{C_n}$$
$$\frac{V}{Q} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_n}$$
$$\Rightarrow \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_n}$$</td><td>½
½
½</td><td>5</td></tr>
<tr><td>Set1,Q25
Set2,Q26
Set3,Q24</td><td>Application of Faraday’s law in ac generator 1
Obtaining an expression for induced emf 2
Graphs for magnetic flux and induced emf 2

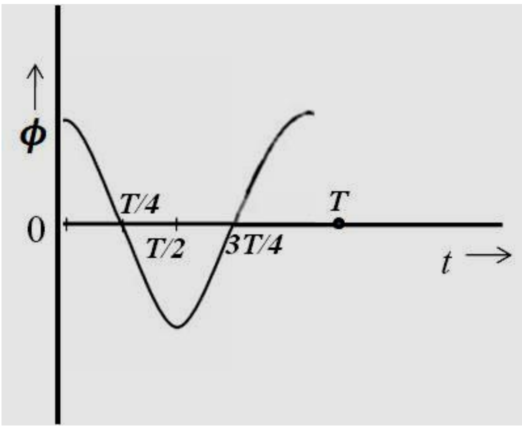
In an ac generator, the change in magnetic flux is brought about by rotating the coil in magnetic field. According to Faraday’s law, induced emf is set up in the coil on changing the magnetic flux linked with it. Hence mechanical energy, which is supplied to rotate the coil, gets converted into electrical energy.

Let the coil be rotated with a constant angular speed, ‘ω’, The angle ‘θ’ between magnetic field $\vec{B}$, and area vector $\vec{A}$, of the coil at any instant, is $\theta = \omega t$.
∴ Magnetic flux at any instant
$$\phi = BA\cos\omega t - - - - (i)$$
From Faraday’s law,

Induced emf
$$e = -N\frac{d\phi}{dt}$$
$$e = -NBA\,\frac{d(\cos\omega t)}{dt}$$</td><td>1
½
½
½</td><td></td></tr>
</table>

$$e = NBA\omega \ \sin\omega t \ \ --- (ii)$$ ½

Graphs for Magnetic Flux $\phi = BA \ \cos\omega t$ and induced emf $e = NBA\omega \sin\omega t$



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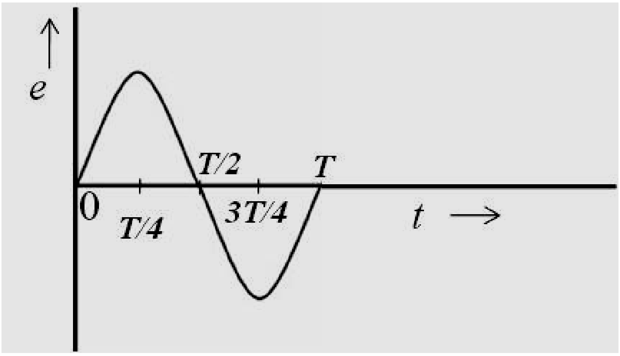

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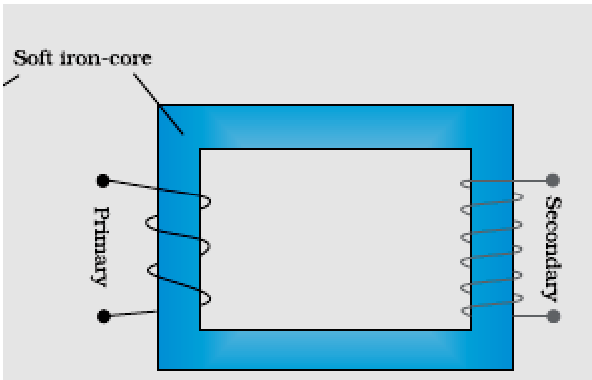
OR

Drawing of an arrangement	1
Underlying principle	1
Deduction of ratio of voltages	1
Obtaining ratio for Primary and Secondary currents	1
Two reasons for energy losses	½ + ½



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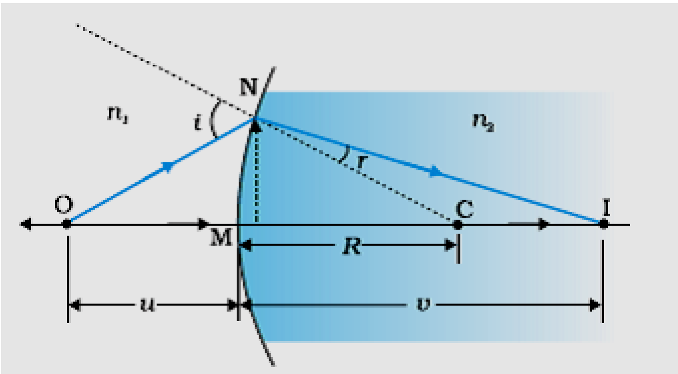
	Principle: When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf in it. Induced emf, or voltage, ε_s, in the secondary, with 'N$_s$' number of turns, $\varepsilon_s = -N_s \frac{d\phi}{dt}$ Back emf in the primary with N_p turns, $\varepsilon_p = -N_p \frac{d\phi}{dt}$ Since $\varepsilon_s = V_s \; and \; \varepsilon_p = V_p$ $\Rightarrow \frac{V_s}{V_p} = \frac{N_s}{N_p}$ For an ideal transformer, Input power=output power $i_p V_p = i_s V_s$ $\Rightarrow \frac{V_s}{V_p} = \frac{i_s}{i_p}$ Two reasons for energy losses **(Any two)** Flux leakage / joule heat losses in the windings / Eddy currents/hysteresis	1 ½ ½ ½ ½ ½ + ½	5
Set1,Q26 Set2,Q24 Set3,Q25	(a) Drawing ray diagram and obtaining relation 3 (b) Writing of Lens maker's formula and its use to obtain the range 2 of value of µ (a)  From the given diagram, for small angles: $\tan \angle NOM = \frac{MN}{OM} = \angle NOM$	1	

	$$\tan\angle NCM = \frac{MN}{MC} = \angle NCM$$		
	$$\tan\angle NIM = \frac{MN}{MI} = \angle NIM$$	½	
	$$For\ \Delta NOC, \angle i\ is\ the\ exterior\ angle.$$		
	$$\Rightarrow \angle i = \angle NOM + \angle NCM$$		
	$$= \frac{MN}{OM} + \frac{MN}{MC}$$	½	
	Similarly, $$\Rightarrow \angle r = \angle NCM + \angle NIM$$ $$r = \frac{MN}{MC} + \frac{MN}{MI}$$		
	By Snell's Law $$n_1 \sin i = n_2 \sin r$$		
	$$n_1 i = n_2 r$$	½	
	$$\Rightarrow n_1\left(\frac{MN}{OM} + \frac{MN}{MC}\right) = n_2\left(\frac{MN}{MC} - \frac{MN}{MI}\right)$$		
	$$\Rightarrow n_1\left(\frac{1}{OM} + \frac{1}{MC}\right) = n_2\left(\frac{1}{MC} - \frac{1}{MI}\right)$$		
	$$\Rightarrow \frac{n_1}{OM} + \frac{n_2}{NI} = \frac{n_2}{MC} - \frac{n_1}{MC}$$		
	$$OM = -u, \qquad MI = +v, \qquad MC = +R$$		
	$$\Rightarrow \frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$	½	
	(b) Lens Maker's formula $$\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$	½	
	For equiconvex lens: $$R_1 = +ve = R$$		
	$$R_2 = -ve = -R$$		
	$$\Rightarrow \frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$$	½	

For f to be greater than R

$$2(\mu - 1) < 1$$ ½

$$\Rightarrow 2\mu - 2 < 1$$

$$2\mu < 3$$

$$\mu < 1.5$$

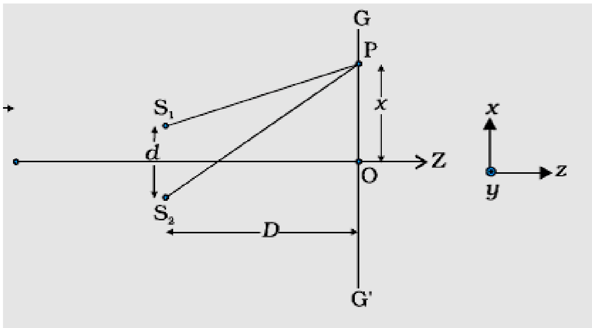
Hence required range is

$$1.0 < \mu < 1.5$$ ½ 5

OR

(a) Drawing a diagram and obtaining the expression	4
(b) Effect on the interference pattern when source slit is moved upward	1

(a)



½

From figure,

$$(S_2P)^2 - (S_1P)^2 = \left[D^2 + \left(x + \frac{d}{2}\right)^2\right] - \left[D^2 + \left(x - \frac{d}{2}\right)^2\right]$$ ½

$$= 2xd$$ ½

$$\Rightarrow S_2P - S_1P = \frac{2xd}{(S_2P + S_1P)}$$

$$Since\ S_2P \approx S_1P \approx D$$ ½

$$S_2P - S_1P = \frac{xd}{D}$$ ½

For constructive interference,

$$S_2P - S_1P = n\lambda, \qquad n = 0,1,2,3$$

$$\Rightarrow \frac{xd}{D} = n\lambda$$ ½

$$x = \frac{n\lambda D}{d}$$

	∴ position of the n^{th} bright fringe on screen: $$=\frac{n\lambda D}{d}$$ And position of the $(n+1)^{th}$ bright fringe on screen $$=\frac{(n+1)\lambda D}{d}$$ ∴ Fringe Width $$=\frac{(n+1)\lambda D}{d}-\frac{n\lambda D}{d}$$ $$=\frac{\lambda D}{d}$$ **[Alternatively**, condition for destructive interference: $$S_2P-S_1P=\left(n+\frac{1}{2}\right)\lambda$$ $$\Rightarrow \frac{xd}{D}=\left(n+\frac{1}{2}\right)\lambda$$ $$x=\left(n+\frac{1}{2}\right)\frac{\lambda D}{d}$$ For $(n+1)^{th}$ Dark Fringe $$x'=\left[(n+1)+\frac{1}{2}\right]\frac{\lambda D}{d}$$ $\Rightarrow Fringe\ width=\frac{\lambda D}{d}$] (b) On shifting principal source point 'S' little upwards i.e. towards S_1, the position of the central maximum on the screen will shift downwards on the screen, i.e. below its previous position, Hence whole interference pattern will get shifted little downwards but Fringe width will remain same as that of the initial arrangement.	 ½ ½ ½ ½	 5