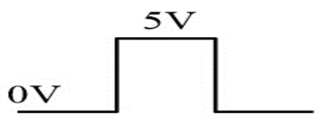
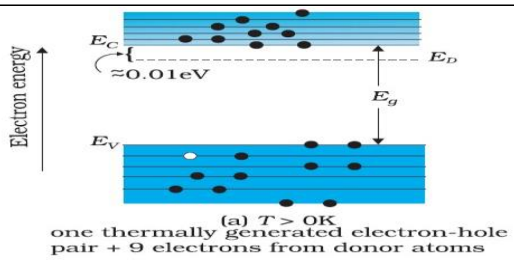
Class: XII Session 2023-24

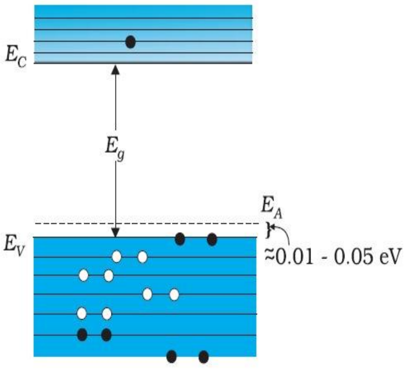
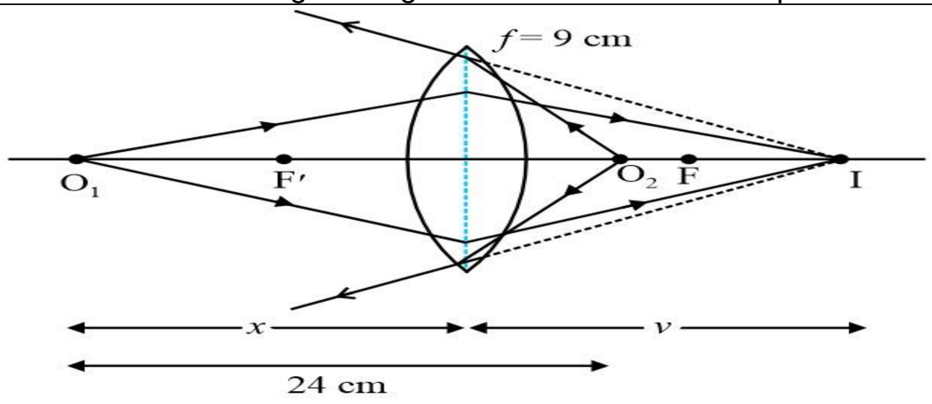
Additional Practice Question Paper

SUBJECT: PHYSICS(THEORY)

MARKING SCHEME

SN O.	DESCRIPTION	TOTAL MARKS
A1	c	1
A2	b	1
A3	c	1
A4	b	1
A5	c	1
A6	b	1
A7	c	1
A8	d	1
A9	b	1
A10	b	1
A11	b	1
A12	a	1
A13	c	1
A14	a	1
A15	b	1
A16	c	1
	SECTION B	
A17	E= h c / λ = 1245 / λ(nm) in eV= 1245/ 400 =3.1eV 1 Mo will not emit as work function is more than energy incident 1 OR $p_C = \|p_A\| + \|p_B\| = h/\lambda_A + h/\lambda_B = h/\lambda_C$ 1 $\lambda_C = \lambda_A \lambda_B / \lambda_A + \lambda_B$ 1	2
A18	The position of the *n*th bright fringe $x = \frac{n\lambda D}{d}$ 1 $\lambda = \frac{xd}{nD} = \frac{(1.2\times10^{-2})\times(0.28\times10^{-3})}{4\times1.4}$ = 6000 Å 1	2
A19	(a) The direction of motion of the em wave is along negative Y-axis. 1 M (b) Given, **E** = [3.1 N/C] cos [(1.8 rad/m)y + 5.4 × 10^8 rad/s)t $\hat{i}$ Comparing with E = E_0 cos [*ky* + ω*t*] K = 1.8 rad/m, ω = 5.4 × 10^8 rad/s and E_0 = 3.1 N/C 1M λ = 2π/ k = 3.5m	2
A20	The electrical potential energy of the two identical nuclei	

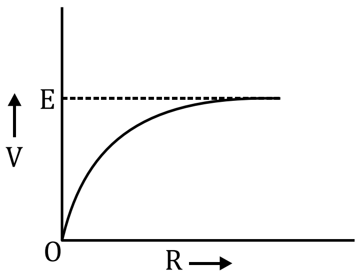
	U= K (50e) (50e) / 2R = 1 **= (9 x10^{9} x50 x1.6 x 10^{-16} x50 x 1.6 x10^{-16}) / { 2x1.28 x10^{-15} x $(125)^{1/3}$}** = 4.5 x 10^{-11} J 1	2
A21	$I = \frac{E+E}{R+r_1+r}$ $V_1 = E - Ir_1 =$ $E - \frac{2E}{r_1+r_2+R} r_1 = 0$ 1 $E = \frac{2Er_1}{r_1+r_2+R}$, $1 = \frac{2r_1}{r_1+r_2+R}$ $R = r_1 - r_2$ 1	2
	SECTION C	
A22	(a) The electric field intensity is E = V/*d*, $= \frac{0.50\ V}{5.0\times10^{-7} m} = 1.0 \times 10^{6}\ Vm^{-1}$. 1 (b)  1 (c) Rectifier 1	3
A23	Applying Kirchhoff's junction rule: $I_1 = I + I_2$ Kirchhoff's loop rule gives: $10 = 2I + 10I_1 = 2I + (10\ I + I_2\ )$ 1M $5 = I_2 + 6I$-------(1) $2 = 5\ I_2 - 2I$ ..... (ii) 1M I=5/8A, V= 1.25 Volt 1M	3
A24	**(a)** The width of central maximum=2λD/d When the slit width d is doubled, the width of the central maximum is halved. Its area becomes one fourth and hence the intensity becomes four times the initial intensity. 2M **(b)** When red light is replaced by blue light the linear width of the central maximum decreases because the wavelength of blue light is lesser than that of red light. **1**M	3
A25		3

	N type and majority charge carriers are electrons. The number density of electrons to the number density of holes is much greater than 1 for N type semiconductor. OR  (b) $T > 0K$ p- type and majority charge carriers are Holes. The number density of electrons to the number density of holes is much smaller than 1 for N type semiconductor.	
A26	**(a) A is Paramagnetic & B is Diamagnetic** **1M** **(b)**The magnetic susceptibility of A is positive and that of B is negative. 1M **(c)** The ball will move away from the magnet due to diamagnetic behavior. On being brought near a bar magnet, it will be feebly magnetized opposite to the direction of the magnetizing field and thus it will be repelled. **1M**	3
A27	 1M For the first point source O_1 $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$, $\frac{1}{v}-\frac{1}{(-x)}=\frac{1}{9}$ ½ M $\frac{1}{v}=\frac{1}{9}-\frac{1}{x}$ …(i) For the second point source O_2 $\frac{1}{v}-\frac{1}{(24-x)}=\frac{1}{(-9)}$ ½ M $\frac{1}{v}=\frac{-1}{9}+\frac{1}{(24-x)}$ …(ii)	3

From equation (i) and (ii),

$$\frac{1}{9}-\frac{1}{x}=\frac{-1}{9}+\frac{1}{24-x}, \quad \frac{1}{(24-x)}+\frac{1}{x}=\frac{2}{9}, \quad x = 18 \text{ cm or } 6 \text{ cm.}$$ 1M

A28 **(a)**



1 M

The terminal potential difference, V becomes equal to the emf E when R becomes infinitely large. ½ M

(b) $r=\left(\frac{E-V}{V}\right)R$ ½ M

Let after connecting another identical wire between terminals, the potential difference be V.

$$\left(\frac{6-5.6}{6}\right)R=\left(\frac{6-V}{V}\right)\frac{R}{2}$$ V = 5.25 V 1M

Marks: 3

SECTION D

A29	**1(b) 2(a) 3 (c) 4(a) OR (b)**	4
A30	**1(a) 2(a) 3 (c) OR (c) 4(d)**	4

SECTION E

A31 **(a)** The total electric flux coming out of a closed surface is 1/ ε_0 times the net charge enclosed by it. ½ M

(b) Electric field due to an infinite plane sheet of charge. Let us consider an infinite thin plane sheet of positive charge having a uniform surface charge density σ.

Let P be the point where electric field E is to be found. Let us imagine a cylindrical gaussian surface of length 2*r* and containing P as shown.

The net flux through the cylindrical gaussian surface

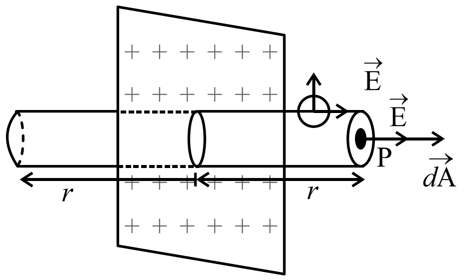
$$\varphi = \int_{RCF} EdA\cos 0° + \int_{LCF} EdA\cos 0° + \int_{CS} EdA\cos 90°$$ 1M

= E.A + EA + 0, ϕ = 2 EA ½M

Marks: 5

The total charge enclosed by the gaussian cylinder = σA

Using Gauss's theorem, $2EA = \frac{\sigma A}{\varepsilon_0}$, $E = \frac{\sigma}{2\varepsilon_0}$ **1 M**



½ M

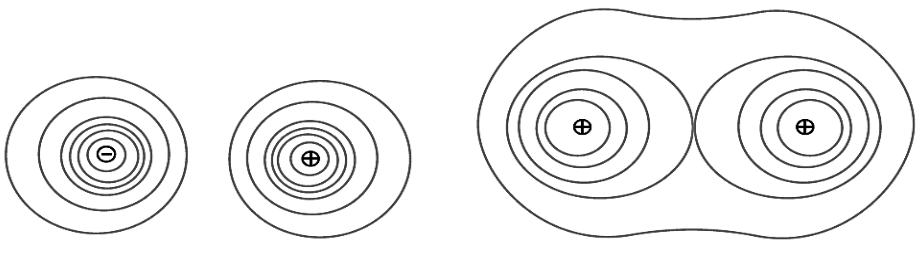
(b) The flux through an area is EA cos θ. Here the flux through the cone is the same as that through the triangular section of the cone in a vertical plane passing through the vertex. The area of this triangular section is = $\frac{1}{2}$[2R × *h*] and is perpendicular to the direction of electric field. ½ M

The electric flux is $E \times \frac{1}{2}(2R \times h)\cos 0°$ *i.e.*, ER*h* 1.M

OR

(a) Equipotential Surfaces 2Marks
(b) Three Characteristics 1.5Marks
(c) Numerical 1.5Marks

(a) **EQUIPOTENTIAL SURFACES** **1+1**



(a) (b)

(b) 1: Two equipotential surfaces never intersect each other.
2: The electric field intensity is always at right angles to an equipotential surface.
3: The work done in moving a test charge from one point to another point on an equipotential surface is always zero. 3x ½ M

(c) (i) E = $-\frac{dv}{dx} = \frac{-d}{dx}[5+4x^2]$

E = $-8x$. this shows that E $\propto x$, obviously electric field cannot be uniform. 1M .

(ii) At $x = -1$m, E = +8 Vm^{-1}

∴ Force on charge of 1C placed at x =–1 m is 1 × 8 = 8 N ½ M

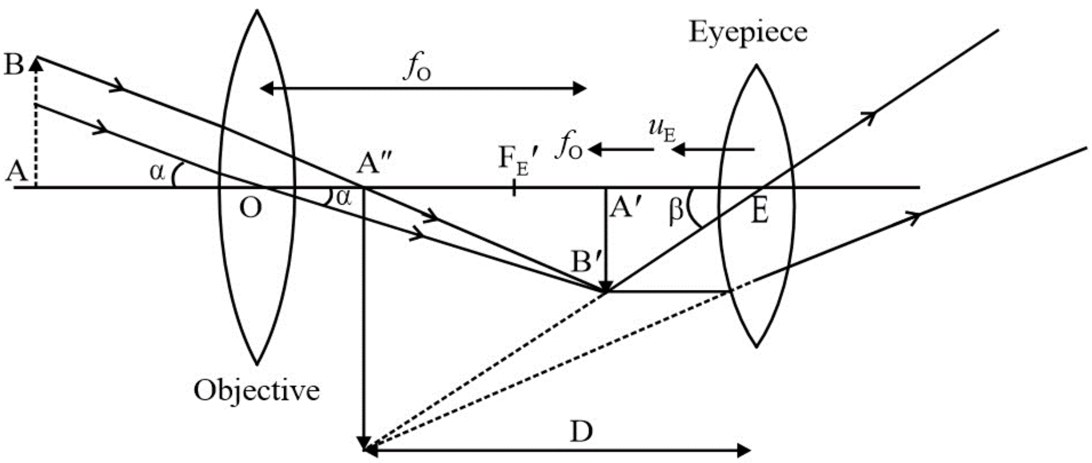
A32

Labelled Ray Diagram: **1.5 M**

Magnification: **1.5M**

Numerical: **2 M**

5



Magnifying Power:

M = $\frac{\text{the angle subtended by the final image at the eye when formed at LDDV}}{\text{the angle subtended by the object at the eye when seen directly}}$

$= \frac{\beta}{\alpha} = \frac{\tan\beta}{\tan\alpha}$ …(1)

From ΔEA′B′ $\tan\beta = \frac{A'B'}{EA'}$ …(2)

Δ OA′B′ $\tan\alpha = \frac{A'B'}{OA'}$ …(3)

From equations (1), (2) and (3),

$M = \frac{OA'}{EA'}$ ⇒ M = $\frac{+f_0}{-u_E}$ … (4)

Case: When the final image is formed at infinity.

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ for eyepiece …(5)

Required value of $v = -\infty$, object distance = $-u_E$, focal length = $+f_E$ ---(6)

From (5) & (6), $u_E = f_E$

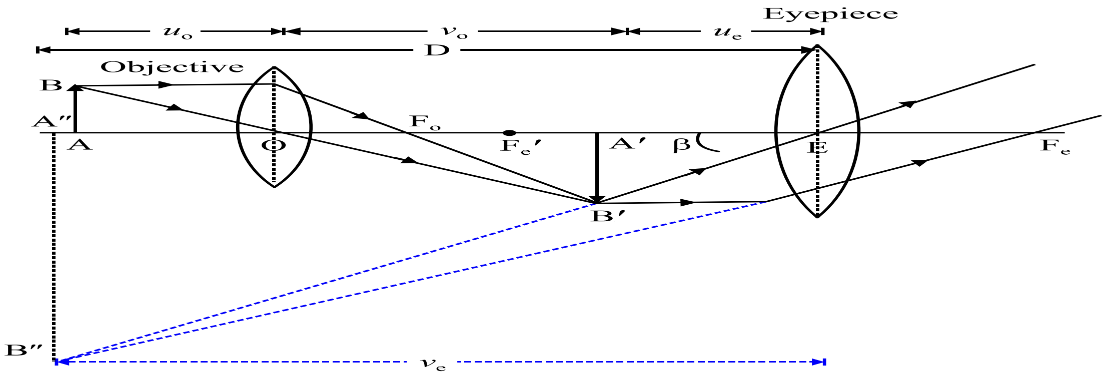
$$M = \frac{-f_0}{f_E}$$

M=-144/ 6 =-24 & L = 144 + 6 =150cm.

OR

Ray Diagram : 1.5 M
Expression : 1M
Numerical : 2.5M

COMPOUND MICROSCOPE



The magnifying power of compound microscope for final image formed at near point is

$$M = \frac{-v_0}{u_0}\left[+\frac{D}{f_E}\right]$$

Given, focal length of objective f_O = 1.25 cm

Focal length of eyepiece f_E = 5 cm

For objective

$$\frac{1}{v_0} - \frac{1}{(-2.5)} = \frac{1}{1.25} \Rightarrow v_0 = 2.5 \text{ cm}$$

For eyepiece $\frac{1}{(-\infty)} - \frac{1}{(-u_e)} = \frac{1}{5}$

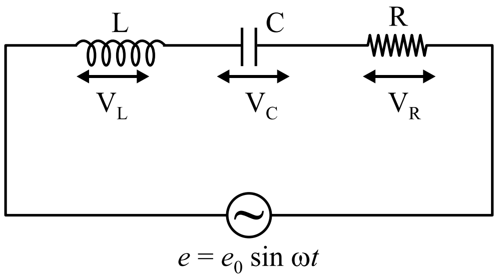
u_e = 5 cm.So, if the final image is formed at infinity, then the distance between the objective and the eyepiece is (v_0 +u_e) *i.e.* 7.5 cm.

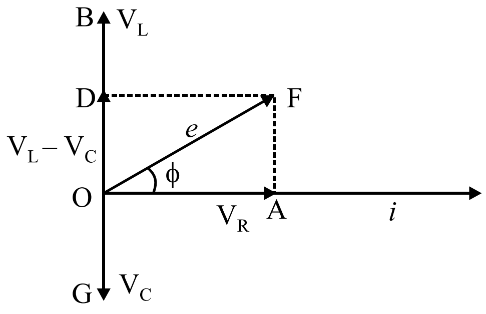
A33	**(a) Expression for Average Power 3M** **(b) Reason 1M** **(c) Numerical 1M** (a) Average power in an a.c. circuit Let the instantaneous values of alternating emf and current applied to an ac circuit be given by $e = e_0 \sin \omega t$ and $i = i_0 \sin(\omega t + \phi)$ where ϕ is the phase difference between A small work done by the ac source in the circuit in the dt is given by $dW = e\, i\, d\, t = e_0\, i_0 \sin \omega t \sin(\omega t + \phi)\, dt$ The total work done by AC source in one complete cycle is $\int dW = \int_0^T e\, i\, dt = e_0\, i_0 \int_0^T \sin \omega t \sin(\omega t + \phi)\, dt$ $= e_0\, i_0 \int_0^T \sin \omega t \left[\sin \omega t \cos \phi + \cos \omega t \sin \phi\right] dt$ $= e_0\, i_0 \int_0^T \cos \phi \sin^2 \omega t\, dt + e_0\, i_0 \int_0^T \sin \phi \sin \omega t \cos \omega t\, dt$ $= \frac{e_0\, i_0 \cos \phi}{2} \int_0^T (1 - \cos 2\omega t)\, dt + \frac{e_0\, i_0}{2} \sin \phi \int_0^T \sin 2\omega t\, dt$ $W = \frac{e_0\, i_0}{2} \cos \phi\, T$ $\therefore$ The average power dissipated per cycle is $P_{av} = \frac{W}{T} = \frac{e_0}{\sqrt{2}} \frac{i_0}{\sqrt{2}} \cos \phi$ $\Rightarrow$ $P_{av} = E_{RMS} \cdot I_{RMS} \cos \phi$ $\therefore$ True power = Apparent power × Power factor (b) To transport a given power, low power factor means large current through the transmission line, resulting in large power loss. (c) **Case-1 :**Given, $X_L = R$ Power factor, $P_1 = \frac{R}{\sqrt{R^2 + X_L^2}} = \frac{1}{\sqrt{2}}$ **Case-2:** Given, $X_L = X_C$ $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$ Power factor $= \frac{R}{Z} = \frac{R}{R} = 1$ $\therefore$ $\frac{P_1}{P_2} = \frac{1}{\sqrt{2}}$	5

OR

(a) Phasor Diagram : 1/2 M
Expression for Current : 1M
Phase angle : 1M
Condition for Resonance : 1M
(b) Proof : 1.5M

An ac circuit containing an inductor, a capacitor and a resistor in series.





Let an alternating emf $e = e_0 \sin \omega t$ be applied to LCR series combination.

Let i be the current in the circuit at any instant of time and V_R, V_L and V_C be the voltages across R, L and C respectively at that instant. Then

$V_R = iR$, $V_L = i\, X_L$ and $V_C = i\, X_C$

Now V_R is in phase with i, V_L leads i be 90° while V_C lags behind i by 90°. In the phasor diagram, the vector OA is representing V_R which is in phase with i, the vector OB represent V_L (which leads i by 90°) and the vector OG is representing V_C (which lags behind i by 90°). If $V_L > V_C$ then their resultant will be $(V_L - V_C)$ which is represented by the vector OD. The vector OF is representing the resultant of V_R and $(V_L - V_C)$. Thus,

$$e = \sqrt{V_R^2 + [V_L - V_C]^2}$$

$$e = i\sqrt{R^2 + (X_L - X_C)^2}$$

$$i = \frac{e}{\sqrt{R^2 + (X_L - X_C)^2}}$$

Here, $\sqrt{R^2 + (X_L - X_C)^2}$ is the effective resistance or impedance of the circuit. Therefore,

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

As $X_L = \omega L$ and $X_C = 1/\omega C$

$\therefore \quad Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$

The phasor diagram shows that in LCR series circuit, the applied emf *e* leads the current *i* by a phase angle ϕ, given by

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R} = \frac{\omega L - 1/\omega C}{R}$$

The following 3 cases arise:

(i) If $X_L > X_C$, then ϕ is positive. In this case the emf *e* leads the current *i*

(ii) If $X_L < X_C$, then ϕ is negative. In this case the emf *e* lags behind the current

(iii) If $X_L = X_C$, then $\phi = 0$. In this case the emf *e* and the current *i* are in phase and Z = R = minimum. This is the case of series resonance. Hence at resonance

$X_L = X_C$

$\omega L = 1/\omega C \quad \Rightarrow \quad \boxed{\omega = 1/\sqrt{LC}}$

$2\pi f L = \frac{1}{2\pi f C} \quad \Rightarrow \quad \boxed{f = \frac{1}{2\pi\sqrt{LC}}}$ Resonant linear frequency.

(b)

Given: $Z_{f_1} = Z_{f_2}$

As R is same in both cases

$$X_{f_1} = X_{f_2}$$

$$(X_L - X_C)_{f_1} = (X_C - X_L)_{f_2}$$

$$(X_L)_{f_1} + (X_L)_{f_2} = (X_C)_{f_2} + (X_C)_{f_1}$$

$$2\pi L(f_1 + f_2) = \frac{1}{2\pi C}\left(\frac{1}{f_1} + \frac{1}{f_2}\right)$$

$$2\pi L(f_1 + f_2) = \frac{1}{2\pi C}\frac{(f_1 + f_2)}{f_1 f_2}$$

$$4\pi^2 LC = \frac{1}{f_1 f_2}$$

$$2\pi\sqrt{LC} = \frac{1}{\sqrt{f_1 f_2}}$$

Resonant frequency = $\frac{1}{2\pi\sqrt{LC}} = \sqrt{f_1 f_2}$