B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

INDIAN PUBLIC SCHOOLS' CONFERENCE

PREBOARD-1 EXAMINATION (2025-26)

PHYSICS (042)

Class: XII **MARKING SCHEME** **Time: 3hrs**

1. (c) $q = \tau/[(2a)\ E \sin\theta] = \dfrac{4}{\bar{\text{i}}.^{2}\ \ 2\times10^{\ 5}\times 2\times 10\ \ \sin 30^\circ}$ 1

   $= 2 \times 10^{-3}$ C = 2 mC

2. (d) Diode is non-ohmic resistance 1
3. (d) Higher the frequency, greater is the stopping potential 1
4. (c) 1
5. (d) $I\ \Delta t = {}^{\Delta\Phi}/_{\Delta t}$ = Area under $I - t$ graph, R = 100 ohm 1

   $\Delta\Phi = 100 \times \dfrac{1}{2} \times 10 \times 0.5 = 250$ Wb. 1
6. (d) 1
7. (b) 100/π cycle/sec 1
8. (a) 1
9. (c) 1.5×10^{8} m/s 1
10. (b) Diffraction pattern becomes narrower 1
11. (b) 1

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12. (c) 1
13. (b) 1
14. (c) 1
15. (d) 1
16. (b) 1

SECTION B

17. $V = k[(3\times10^{-6}/2) - (2\times10^{-6}/2)]$ 2

    $= 9\times10^{9}(1\times10^{-6}/2)$

    $= 4.5\times10^{3}$ V
18. Copper wire because its resistivity is less. 2
19. (a) Slope and Magnetic Susceptibility (χ): The magnetic susceptibility of a material is given by the slope of the M vs. H curve (χ = M/H).

    1

    Material A: A positive and steep slope indicates a strong response to the applied field, characteristic of a ferromagnetic material, which is strongly attracted to magnetic fields and has a very high susceptibility.

    Material B: A positive but smaller slope indicates a weaker response than material A, typical of a paramagnetic material.

(b) Due to its inherent nature of strongly aligning magnetic domains, material B (ferromagnetic) gets more intensely magnetized than material A (paramagnetic) for the same applied field, resulting in its larger magnetic susceptibility. 1

Or

(a) A is diamagnetic and B is paramagnetic 1

(b) Susceptibility of diamagnetic is negative and of paramagnetic it's positive. 1

20. (a) Infrared

(b) UV Rays (1/2 +1/2)

Molecular Vibration: Molecules in any heated object vibrate, and this movement is converted into infrared radiation, which is a form of thermal or heat energy. (1/2 +1/2)

21. As λ = h / mv , v= h /mλ ----------------- (i) ½

Energy of photon E = hc /λ ½

& Kinetic energy of electron K =1/2 mv2 = ½ mh2 / m2 λ2 ------------- - (ii) ½

Simplifying equation i & ii we get E / K = 2λmc /h ½

Or

For α-particle, $\lambda_\alpha = \dfrac{h}{\sqrt{2m_\alpha q_\alpha V}}$

For proton, $\lambda_p = \dfrac{h}{\sqrt{2m_p q_p V}}$

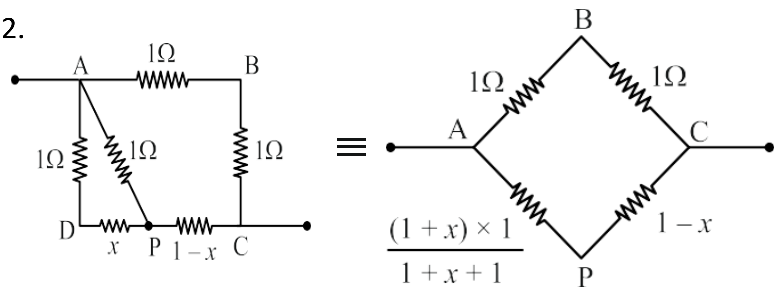
$\therefore \quad \dfrac{\lambda_\alpha}{\lambda_p} = \sqrt{\dfrac{m_p q_p}{m_\alpha q_\alpha}}$

But $\dfrac{m_\alpha}{m_p} = 4, \dfrac{q_\alpha}{q_p} = 2$

$\therefore \quad \dfrac{\lambda_\alpha}{\lambda_p} = \sqrt{\dfrac{1}{4} \cdot \dfrac{1}{2}} = \dfrac{1}{2\sqrt{2}}$ 2

Section-C

22.



As the points B and P are at the same potential $\frac{1}{1} = \frac{\frac{(1+x)}{(2+x)}}{1-x}$

$\Rightarrow x = (\sqrt{2} - 1)\ ohm$ 3

23.

(a) Consider the case $r > a$. The Amperian loop, labelled 2, is a circle concentric with the cross-section. For this loop, $L = 2\pi r$

Using Ampere circuital Law, we can write,

$B(2\pi r) = \mu_o I$ or $B = \frac{\mu_o I}{2\pi r}$

Or $B \propto \frac{1}{r}$ 1.5

(b) Consider the case $r < a$. The Amperian loop is a circle labelled 1. For this loop, taking the radius of the circle to be r, $L = 2\pi r$

Now the current enclosed I_e is not I, but is less than this value. Since the current distribution is uniform, the current enclosed is,

$I_e = I\left(\frac{\pi r^2}{\pi a^2}\right) = \frac{I r^2}{a^2}$ Using Ampere's law, $B(2\pi r) = \mu_0 \frac{Ir^2}{a^2}$

$B = \left(\frac{\mu_0 I}{2\pi a^2}\right) r \qquad B \propto r \qquad (r < a)$ **1.5**

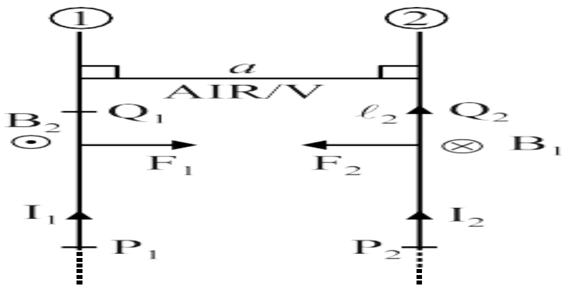
Or

(a)The electric field should be directed downwards, perpendicular to the magnetic field and the direction of motion. 1

(b) (i) Electric and magnetic forces will act in the opposite directions. No deflection of proton. 1

(ii) Both Electric and magnetic forces will act in the same direction (downwards), causing the electron to be deflected strongly. 1

24.



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. **F_{ab} = Force experienced by wire '*a*' of length '*l*' due to magnetic field of wire '*b*'.**
F_{ba} = Force experienced by wire '*b*' of length '*l*' due to magnetic field of wire '*a*'.
B_a = Magnetic field due to wire '*a*'.
B_b = Magnetic field due to wire '*b*'.

$$B_a = \frac{\mu_0 I_a}{2\pi d}$$

since $\vec{F} = i(\vec{l} \times \vec{B})$

$$F_{ba} = I_2 l \frac{\mu_0 I_1}{2\pi d}$$

1

$$\Delta F = B_1 I_2 \,\Delta L \sin 90°$$

$$\therefore \quad = \frac{\mu_0 I_1}{2\pi r} I_2 \Delta L$$

$\therefore$ The total force on conductor of length L will be

$$F = \frac{\mu_0 I_1 I_2}{2\pi r} \Sigma \Delta L = \frac{\mu_0 I_1 I_2}{2\pi r} L$$

$\therefore$ Force acting on per unit length of conductor

$$f = \frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi r} \text{ N/m} \qquad ...(2)$$

An **ampere** is defined as the current flowing in each of two long, straight and parallel wires exactly one meter apart so that there is a force of exactly 2 x 10^{-7} N per meter of length acting on the wires. **1**

25.

$$Image\ Distance:\ u = -(f_0 + f_e)$$

$from\ mirror\ formula,$

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

$$or,\ \frac{1}{f_e} = \frac{1}{v} - \frac{1}{-(f_0+f_e)}$$

$$or,\ \frac{1}{v} = \frac{1}{f_e} - \frac{1}{(f_0+f_e)}$$

$$or,\ \frac{1}{v} = \frac{f_0+f_e-f_e}{f_e(f_0+f_e)} \quad or,\ \frac{1}{v} = \frac{f_0}{f_e(f_0+f_e)}$$

$$or,\ v = \frac{f_e(f_0+f_e)}{f_0}$$

$$The\ magnification\ M = \frac{Image\ height}{Object\ height} = -\frac{v}{u}$$

$$or,\ \frac{I}{L} = \frac{f_e(f_0+f_e)}{f_0(f_0+f_e)}$$

$$or,\ \frac{I}{L} = \frac{f_e}{f_0}$$

$Magnification\ of\ Telescope\ in$

$$Normal\ adjustment:\ M = \frac{f_0}{f_e}$$

26. A wave front is an imaginary surface where all points of a wave are in the same phase of vibration.

Angle of incidence i = ∠PAN = 90^0 – ∠NAB = ∠BAC

Angle of reflection r = ∠NAD = 90^0 – ∠DAC = ∠DCA

In right angled triangles ABC and ADC

∠B = ∠D = 90^0

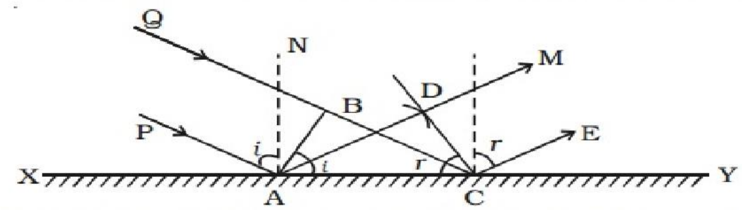
BC = AD and AC is common

∴ The two triangles are congruent

∠BAC = ∠DCA

i.e. i = r

Thus the angle of incidence is equal to angle of reflection.



27. Number of atoms in 3 gram of Cu coin = $(6.023 \times 10^{23} \times 3) / 63 = 2.86 \times 10^{22}$

½ Each atom has 29 Protons & 34 Neutrons

Thus Mass defect $\Delta m = 29 \times 1.00783 + 34 \times 1.00867 - 62.92960\ u = 0.59225u$ 1

Nuclear energy required for one atom $= 0.59225 \times 931.5$ MeV

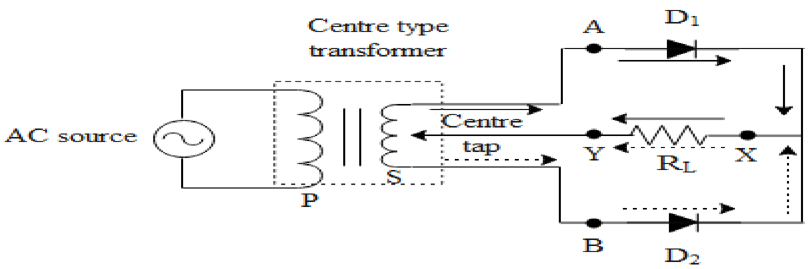
½ Nuclear energy required for 3 gram of Cu $= 0.59225 \times 931.5 \times 2.86 \times 10^{22}$ MeV

$= 1.58 \times 10^{25}$ MeV 1

28. (a) The depletion layer is a region at a p-n junction where mobile charge carriers (electrons and holes) are absent due to diffusion and recombination, leaving behind immobile ions. The potential barrier is the electric potential difference that forms across this depletion layer due to the separated immobile charges, creating an electric field that opposes the further

diffusion of carriers and establishes equilibrium. 1

(b) The device is a full wave rectifier its circuit diagram:



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SECTION-D

29. (i) d (ii) c (iii) c (iv) b OR d (1+1+1+1)

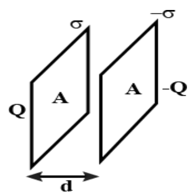
30. (i) Cutoff voltage for A and B same but for C it's greater. Saturation current for B and C are same and greater than A. 2

(ii) by ultraviolet radiations 1

(iii) $\emptyset = hc/\lambda = 12345/5000$ eV$=2.45$ eV 1

SECTION-E

31. (i) Derivation of the expression for the capacitance **2**



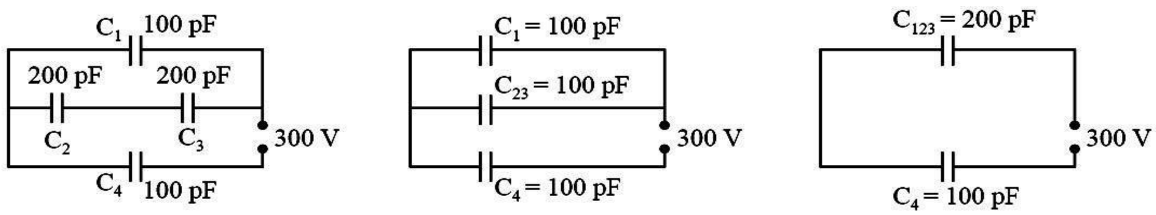
Let the two plates be kept parallel to each other separated by a distance d and cross-sectional area of each plate is A. Electric field by a single thin plate $E = \sigma/2\epsilon_o$

Total electric field between the plates $E = \sigma/\epsilon_o = Q/A\epsilon_o$

Potential difference between the plates $V=Ed = [Q/A\epsilon_o]\, d$.

Capacitance $C = Q/V = A\epsilon_o/d$

(ii)



1

The equivalent capacitance = $\dfrac{200}{3}$ pF

charge on $C_4 = \dfrac{200}{3} \times 10^{-12} \times 300 = 2 \times 10^{-8}$ C, ½

potential difference across $C_4 = \dfrac{200 \times 10^{-12} \times 300}{3 \times 100 \times 10^{-12}} = 200$ V potential difference across C_1 = 300 – 200 = 100 V

charge on $C_1 = 100 \times 10^{-12} \times 100 = 1 \times 10^{-8}$ C ½

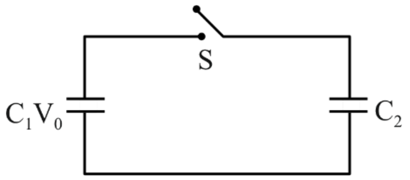
potential difference across C_2 and C_3 series combination = 100 V potential difference across C_2 and C_3 each = 50 V

charge on C_2 and C_3 each $= 200 \times 10^{-12} \times 50 = 1 \times 10^{-8}$ C ½+½

OR

(i) Derivation of the expression for capacitance with dielectric slab ($t < d$) **3**

(ii)



Before the connection of switch S, ½

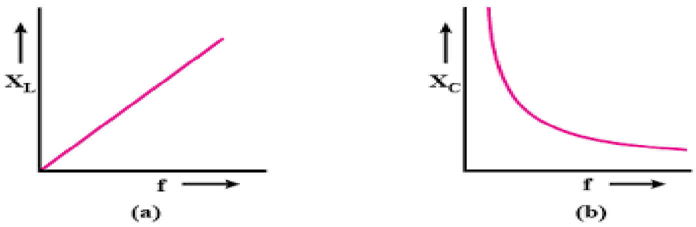
After the connection of switch S

common potential $V = \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2} = \dfrac{C_1V_o}{C_1 + C_2}$ ½

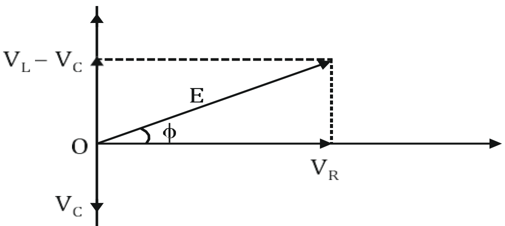
Final energy = $U_f = \dfrac{1}{2}(C_1 + C_2)\dfrac{(C_1V_0)^2}{(C_1 + C_2)^2} = \dfrac{1}{2}\dfrac{C_1^2V_0^2}{(C_1 + C_2)}$ ½

$U_f : U_i = C_1 /(C_1 + C_2)$ ½

32(a) (1/2+1/2)



(b)



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(c)(i) In device X, Current lags behind the voltage by π /2, X is an inductor

In device Y, Current in phase with the applied voltage, Y is resistor **½ + ½**

(ii) We are given that

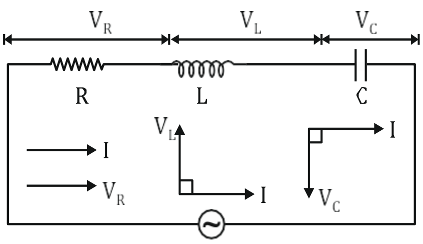
$0.25=220/X_{L},\ X_L = 880\Omega$, Also $0.25=220/R$, $R = 880\Omega$ **1**

For the series combination of X and Y,

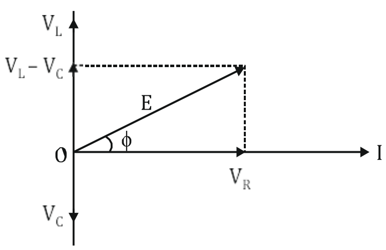
Equivalent impedance $Z = 880\sqrt{2}\ \Omega$, I= 0.177 A **1**

OR

a.



LCR Circuit



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$E = E_0 \sin\omega t$ is applied to a series LCR circuit. Since all three of them are connected in series the current through them is same. But the voltage across each element has a different phase relation with current. The potential difference V_L, V_C and V_R across L, C and R at any instant is given by

$V_L = IX_L$, $V_C = IX_C$ and $V_R = IR$, where I is the current at that instant.

V_R is in phase with I. V_L leads I by 90° and V_C lags behind I by 90° so the phasor diagram will be as shown

Assuming $V_L > V_C$, the applied emf E which is equal to resultant of potential drop across R, L & C is given as

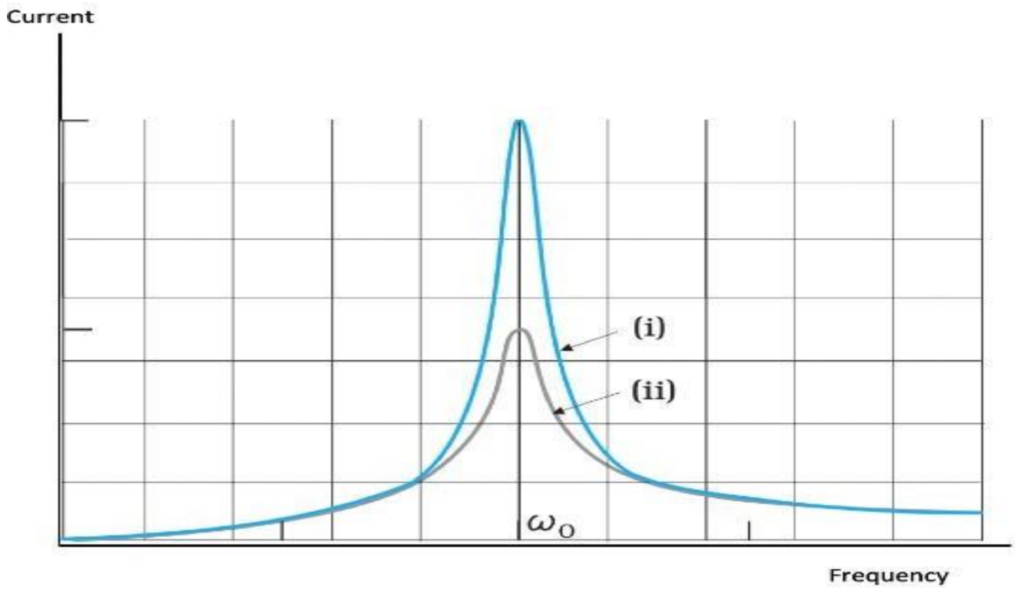
$E^2 = I^2 [R^2 + (X_L - X_C)^2]$

$I= E/\sqrt{R^2+(X_L-X_C)^2}$

$=E/Z$ where Z is Impedance. **3**

Emf leads current by a phase angle φ as $\tan\varphi = \frac{V_L - V_C}{R} = \frac{X_L - X_C}{R}$

b. The curve (i) is for R_1 and the curve (ii) is for R_2 **1**



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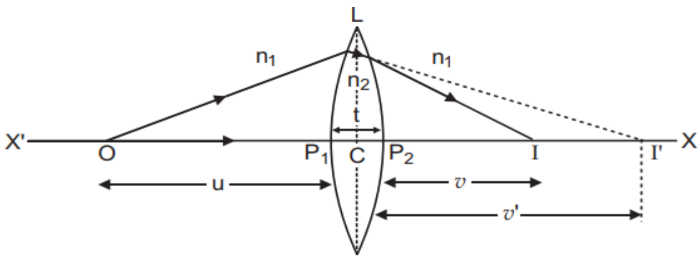


1

$$\frac{n_2}{v'} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \quad ...(i)$$

$$\frac{n_1}{v} - \frac{n_2}{(v' - t)} = \frac{n_1 - n_2}{R_2} \quad ...(ii)$$

$$\frac{n_1}{v} - \frac{n_2}{(v')} = -\frac{n_2 - n_1}{R_2} \qquad ...(iii)$$

$$\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

or $$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

i.e. $$\frac{1}{v} - \frac{1}{u} = ({}_1n_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad ...(iv)$$

$$\frac{1}{f} - \frac{1}{\infty} = ({}_1n_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

i.e. $$\frac{1}{f} = ({}_1n_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad ...(v)$$

2

(b)

Since $$\frac{1}{f} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

In first case, $\mu = 1$, $\mu_2 = 1.6$ and $f = 20$ cm.

$$\therefore \qquad \frac{1}{20} = (1.6 - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$= 0.6\left[\frac{1}{R_1} - \frac{1}{R_2}\right] \qquad ....(1)$$

In second case,

$$\mu_1 = 1.3$$

$$\therefore \qquad \frac{1}{f} = \left(\frac{16}{13} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

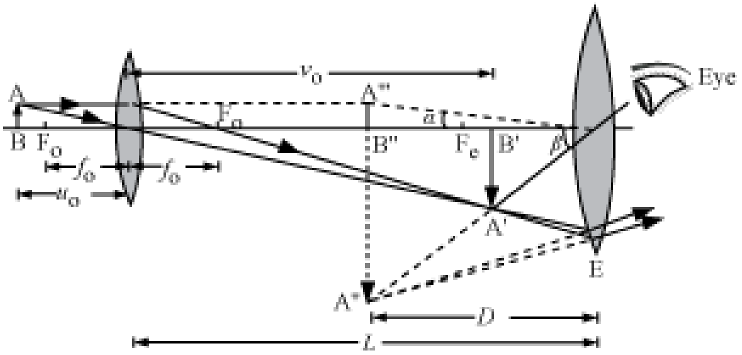
$$\frac{1}{f} = \frac{3}{13}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad ... (2)$$

2

F=108 cm

Or

(a)



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(b)

Here, $f_0 = 2.0$ cm; $f_e = 6.25$ cm, $u_0 = ?$

(a) $v_e = -25$ cm $\because \frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$ $\therefore \frac{1}{u_e} = \frac{1}{v_e} - \frac{1}{f_e} = \frac{1}{-25} - \frac{1}{6.25} = \frac{-1-4}{25} = \frac{-5}{25} \Rightarrow u_e = -5$ cm

As distance between objective and eye piece = 15 cm; $v_0 = 15 - 5 = 10$ cm

$\because \frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0} \therefore \frac{1}{u_0} = \frac{1}{v_0} - \frac{1}{f_0} = \frac{1}{10} - \frac{1}{2} = \frac{1-5}{10} \Rightarrow u_0 = \frac{-10}{4} = -2.5$ cm

(b) $\because v_e = \infty$, $u_e = f_e = 6.25$ cm $\therefore v_0 = 15 - 6.25 = 8.75$ cm. ? ??

$\because \frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0} \Rightarrow \frac{1}{u_0} = \frac{1}{v_0} - \frac{1}{f_0} = \frac{1}{8.75} - \frac{1}{20} = \frac{2-8.75}{17.5} \Rightarrow u_0 = \frac{-17.5}{6.75} = -2.59$ cm

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