A plano-convex lens has thickness 4 cm. When placed on a horizontal table with the curved surface in contact with it, the apparent depth of the bottom-most point of the lens is found to be 3 cm. If the lens is inverted such that the plane face is in contact with the table, the apparent depth of the centre of the plane face of the lens is found to be 25/8 cm. The focal length of the lens is $x \times 15$. Then value of x is:

**Solution**

Correct option is A)

When the curved surface of the lens (refractive index $\mu$) is in contact with the table, the image of the bottom-most point of lens (in glass) is formed due to refraction at plane face. The image of O appears at $I_1$.

Here, $u_1 = AO = -4cm, v_1 = AI_1 = 3cm$,

$\mu_1 = \mu$, and $\mu_2 = 1$, and $R_1 = \infty$

$\therefore \frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R_1}$ gives $\frac{1}{-3} - \frac{\mu}{-4} = \frac{1-\mu}{\infty}$ (i)

When the plane surface of the lens in contact with the table, the image of center of the plane face is formed due to refraction at curved surface. The image of O is formed at $I_2$.

Here, $u = AO = -4cm, v = AI_2 = -25/8cm$

$\mu_1 = \mu, \mu_2 = 1$, and $R_2 = -R$

$\therefore \frac{\mu_2}{v_2} - \frac{\mu_1}{\mu_2} = \frac{\mu_2 - \mu_1}{R_2}$

Gives $\frac{1}{(-\frac{25}{8})} - \frac{\mu}{-4} = \frac{1-\mu}{-R}$

From Eq. (i), $\mu = 4/3$, therefore this equation gives

$-\frac{8}{25} + \frac{4/3}{4} = -\frac{(1-\frac{4}{3})}{R} - \frac{8}{25} + \frac{1}{3} = \frac{1}{3R}$ or $\frac{1}{75} = \frac{1}{3R}$

This gives $R = 25cm$

The focal length (f) of plano-convex lens ($R_1 = R$ and $R_2 = \infty$) is $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right) = \frac{\mu-1}{R} = \frac{\frac{4}{3}-1}{25} =$

$\frac{1}{75} \Rightarrow f = 75cm$