

Diameter of plano-convex lens is 6 cm and thickness at the centre is 3 mm. If speed of light in material of lens is $2 \times 10^8 \text{m/s}$, the focal length of the lens is:

A 20 cm

B 30 cm

C 10 cm

D 15 cm

Solution

Correct option is

B)

The lens is as shown in the figure.

To determine the radius of curvature R of the curved surface, we can write

$$R^2 = 3^2 + (R - \frac{3}{10})^2$$

Solving this, we get

$$R = 15.15 \text{cm}$$

Speed of light in any medium is $\frac{c}{\mu}$ where $c = 3 \times 10^8 \text{m/s}$ and μ is the refractive index.

For the lens, $\frac{c}{\mu} = 2 \times 10^8 \text{m/s}$

$$\mu = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

Putting these values in the lens makers formula for plano convex lens, we have,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R}\right) = (1.5 - 1)\left(\frac{1}{15.15}\right) \text{cm}^{-1}$$

Solving this, we get $f \approx 30 \text{cm}$