14. Two identical glass rods S_1 and S_2 (refractive index = 1.5) have one convex end of radius of curvature 10 cm. They are placed with the curved surfaces at a distance d as shown in the figure, with their axes (shown by the dashed line) aligned. When a point source of light P is placed inside rod S_1 on its axis at a distance of 50 cm from the curved face, the light rays emanating from it are found to be parallel to the axis inside S_2. The distance d is
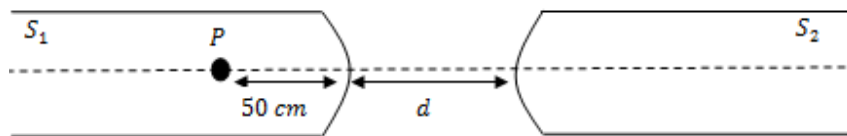
(A) 60 cm   (B) 70 cm   (C) 80 cm   (D) 90 cm

Answer:
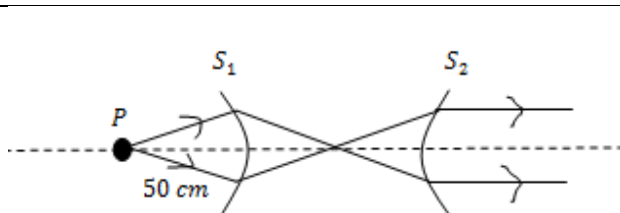
Applying refraction formula
for single surface at S₁
$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$
Here $\mu_2 = image\ medium\ where$
$\quad\quad the\ refracted\ rays\ meet = 1$
$\mu_1 = Object\ medium$
$from\ where\ the\ incident\ strikes$
$refracting\ surface = 1.5$
$$\frac{1}{v} - \frac{1.5}{(-50)} = \frac{1 - 1.5}{10}$$

$or\ \dfrac{1}{v} = \dfrac{5}{100} - \dfrac{1.5}{50}$
$or\ \dfrac{1}{v} = \dfrac{1}{50} \rightarrow (1)$
$v = 50\ therefore\ object\ distance$
$from\ S_2 = d - 50$

Applying refraction formula at S2
Object medium $\mu_1 = 1$
Image medium $\mu_2 = 1.5$
Image distance $v = \infty$
Object distance $u = d - 50$

$\dfrac{1.5}{\infty} - \dfrac{1}{-(d-50)} = \dfrac{1.5-1}{10}$

$or\ d - 50 = 20\ or\ d = 70\ cm$

Correct option is (B) 70 cm