Answer on Question#70502 - Physics - Optics

A glass hemisphere of refractive index $\mu = 4/3$ and of radius 4 cm is placed on a plane mirror . A point object is placed at distance ' d ' on the axis of this sphere. If the final image is formed at infinity then find the value of d.
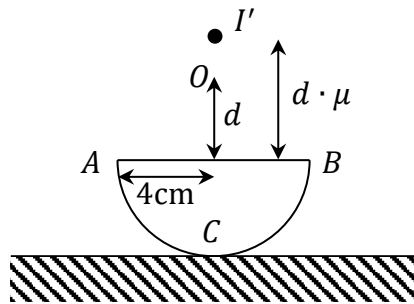
Given answer = 3 cm

Solution:

Image of object O due to refraction at AB is at $d\mu$ from surface AB.

Now due to ACB surface.

$$\frac{1}{v} + \frac{4/3}{4 + d\mu} = \frac{1 - 4/3}{-4}$$

$$\frac{1}{v} = \frac{d - 9}{12 \cdot (3 + d)}$$

Now suppose $d > 9$ then image is formed below the mirror at distance $v' = \frac{12 \cdot (3+d)}{d-9}$ from mirror.

Now this image of mirror will act as object for refraction again at surface ACB (light goes from air to glass).

So,

$$\frac{4}{3v} - \frac{1}{v'} = \frac{4/3 - 1}{4} = \frac{1}{12}$$

$$\frac{4}{3v} - \frac{d - 9}{12 \cdot (3 + d)} = \frac{4/3 - 1}{4} = \frac{1}{12}$$

For the final image to be at infinity $v = \infty$.

So,

$$-\frac{d - 9}{12 \cdot (3 + d)} = \frac{1}{12}$$

$$d = 3 \text{ cm}$$

Answer: 3 cm.