Answer on Question #49688, Physics, Optics

A convex spherical refracting surface with radius R separates a medium having refractive index 5/2 from air. An object is moved towards the surface from far away from the surface along the central axis, its image-

a) changes from real to virtual when it is at a distance R from the surface.

b) changes from virtual to real when it is at a distance R from the surface.

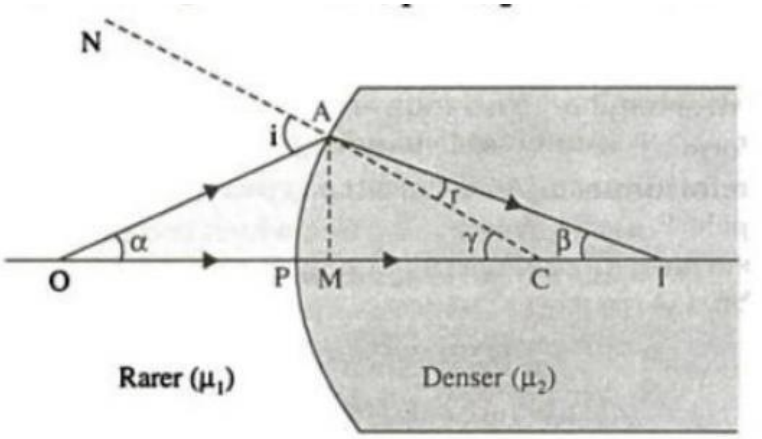
c) changes from real to virtual when it is at a distance 2R/3 from the surface.

d) changes from virtual to real when it is at a distance 2R/3 from the surface.

Solution:

$$\mu_1 = 1, \quad \mu_2 = \frac{5}{2} = 2.5$$

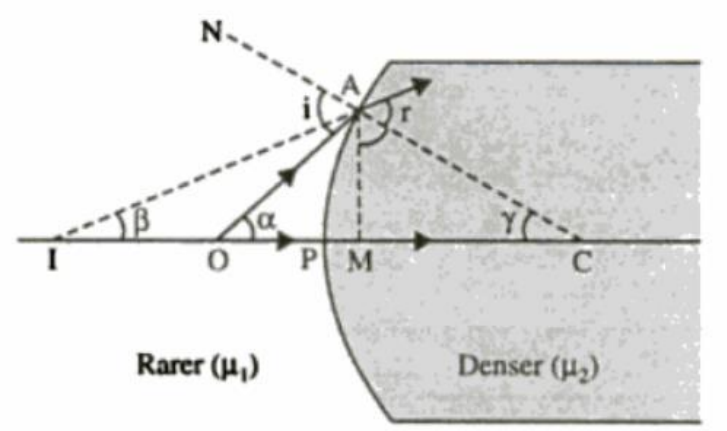
Formation of real image



$$OP = -u, \quad PI = v \ \ and \ R = PC$$

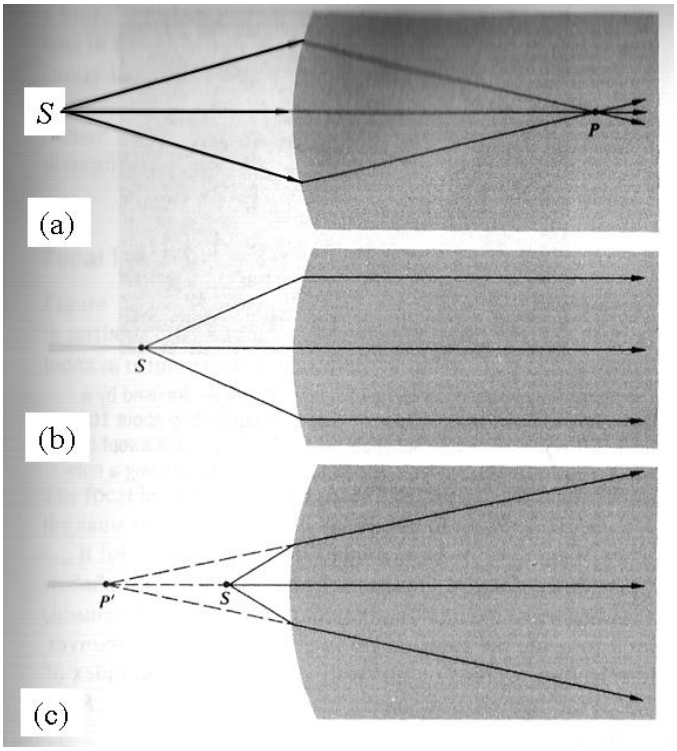
$$\frac{\mu_1}{-u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$$

Formation of virtual image



$$OP = -u, \quad PI = -v \ \ and \ R = PC$$

$$\frac{\mu_1}{-u}+\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$$



As the object distance is gradually reduced, the conjugate image point P gradually changes from real to virtual.

The image will be at $v=\infty$ when

$$\frac{1}{-u}+\frac{\mu_2}{\infty}=\frac{3}{2R}$$

$$-u=\frac{2R}{3}$$

Answer: c) changes from real to virtual when it is at a distance 2R/3 from the surface.