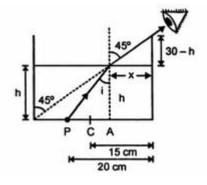
Answer on Question #63449, Physics / Optics

A cylindrical vessel, whose diameter and height both are equal to 30 cm, is placed on a horizontal surface and a small particle P is placed in it at a distance of 5.0 cm from the centre. An eye is placed at a position such that the edge of the bottom is just visible. The particle P is in the plane of drawing. Up to what minimum height should water be poured in the vessel to make the particle P visible?

Solution:



The refractive index of water is n = 4/3.

$$x = 30 - h$$

PA = 20 - x = 20 - (30 - h) = h - 10

By using Snell's law, we get

$$\sin r = n \sin i$$
$$\sin i = \frac{h - 10}{\sqrt{h^2 + (h - 10)^2}}$$

So,

$$\sin 45^{\circ} = \frac{4}{3} \frac{h - 10}{\sqrt{h^2 + (h - 10)^2}}$$
$$\frac{9}{2}(h^2 + (h - 10)^2) = 16(h - 10)^2$$
$$9 h^2 = 23(h - 10)^2$$
$$h = \frac{\sqrt{23} \cdot 10}{\sqrt{23} - 3} = 26.7 \text{ cm}$$

Answer: 26.7 cm

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