## 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 $n=4 / 3$.

$$
\begin{gathered}
x=30-h \\
P A=20-x=20-(30-h)=h-10
\end{gathered}
$$

By using Snell's law, we get

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

So,

$$
\begin{gathered}
\sin 45^{\circ}=\frac{4}{3} \frac{h-10}{\sqrt{h^{2}+(h-10)^{2}}} \\
\frac{9}{2}\left(h^{2}+(h-10)^{2}\right)=16(h-10)^{2} \\
9 h^{2}=23(h-10)^{2} \\
h=\frac{\sqrt{23} \cdot 10}{\sqrt{23}-3}=26.7 \mathrm{~cm}
\end{gathered}
$$

Answer: 26.7 cm

