A travelling microscope is focused on to a scratch on the bottom of a beaker. Water of refractive index 4/3 is poured in it. Then the microscope is to be lifted through 2 cm focus it again. Find the depth of water in the beaker.
 (1) 4 cm
 (2) (2) 8 cm
 (3) (3) 8/7 cm
 (4) (4) 8/3 cm

Solution:

Apparent depth is depth that a transparent material such as water appears to have when viewed from above. This is less than its real depth because of the refraction that takes place when light passes into a less dense medium.

$$d_{real} - d_{app} = 2 \text{ cm}$$

The ratio of the real depth to the apparent depth of a transparent material is equal to its refractive index.
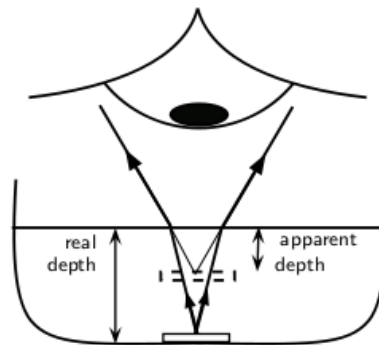
Refractive index n = Real depth/Apparent depth.
Thus,

$$n = \frac{d_{real}}{d_{app}} = \frac{4}{3}$$

We have system of equation

$$\begin{cases} d_{real} - d_{app} = 2 \\ \dfrac{d_{real}}{d_{app}} = \dfrac{4}{3} \end{cases}$$

A solution of a system is

$$d_{app} = \frac{3}{4} d_{real}$$

$$d_{real} - \frac{3}{4} d_{real} = 2$$

$$\frac{1}{4} d_{real} = 2$$

$$d_{real} = 8$$

Answer. (2) 8 cm.