Solution of Home-Works of Last 3 classes

(1) Refractive index of water with respect to air is 4/2 while that of glass is 3/2. What will be the refractive index of glass with respect to water?

⇒ We know that, $_1\mu_2 = \frac{\mu_2}{\mu_1}$

$\therefore {}_w\mu_g = \frac{\mu_g}{\mu_w} = \frac{3}{2} \times \frac{3}{4}$

$\therefore {}_w\mu_g = \frac{9}{8}$, Ans.

(2) A ray of light, travelling in water, is incident at an angle of 30° on a water-glass interface. Calculate the angle of refraction in glass, if refractive index of water is 4/3 and glass is 3/2.

⇒ Applying Snell's law,

$$\frac{\sin i}{\sin r} = {}_w\mu_g$$

But, ${}_w\mu_g = \frac{\mu_g}{\mu_w} = \frac{3/2}{4/3} = \frac{9}{8}$

Since, $i = 30°$

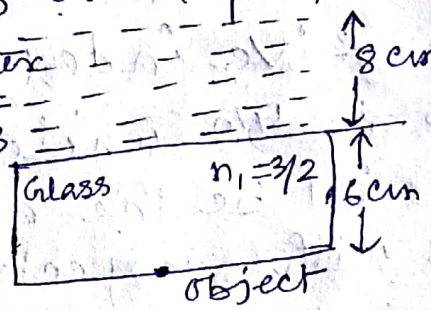
$\therefore \frac{\sin 30°}{\sin r} = \frac{9}{8}$

or, $\sin r = \frac{8}{9} \times \sin 30° = \frac{8}{9} \times \frac{1}{2}$

$\therefore \sin r = 4/9 = 0.4444$

or, $r = \sin^{-1}(0.4444) = 26.4°$

3. What will be the apparent position of an object below a rectangular block of glass ($n_1 = 3/2$) 6 cm thick, if a layer of water 8 cm is on top of the glass ($n_2 = 4/3$) ?



$\Rightarrow$

Apparent shift,

$$S = t_1\left(1 - \frac{1}{n_1}\right) + t_2\left(1 - \frac{1}{n_2}\right)$$

Here, $t_1 = 6$ cm, $n_1 = 3/2$

$t_2 = 8$ cm, $n_2 = 4/3$

$$S = 6\left(1 - \frac{1}{3/2}\right) + 8\left(1 - \frac{1}{4/3}\right)$$

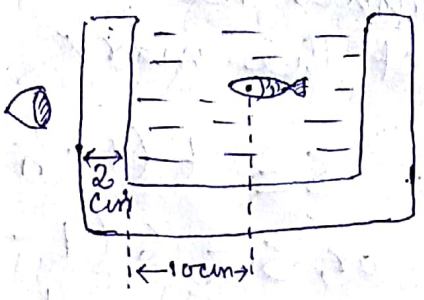
$$S = 6(1 - 2/3) + 8(1 - 3/4)$$

$$S = 6 \times \frac{1}{3} + 8 \times 1/4$$

$\therefore S = 4$ cm

Object will appear to be displaced in upward direction through the distance 4 cm.

4. A fish is located at a distance of 10 cm from the wall of a fish pond. The thickness of the glass wall is 2 cm. Find the apparent position of the fish. [Given $a_{lg} = 3/2$, $a_{lw} = 4/3$]



⇒ The apparent distance of fish is given by,

$$d_a = \frac{d_{wall}}{a_{lg}} + \frac{d_{water}}{a_{lw}}$$

$$= \frac{2}{3/2} + \frac{10}{4/3}$$

$$= \frac{4}{3} + \frac{30}{4}$$

$$= 1.33 + 7.5$$

$$= 8.83 \text{ cm.}$$

5. A mark is made at the bottom of a beaker and a microscope is focussed on it. The microscope is then raised 20 mm. To what height water must be poured into the beaker to bring the mark again into focus? [$a_{lw} = 4/3$]

⇒ On pouring water, apparent shift will be observed in the position of mark.

This shift, $S = t\left(1 - \frac{1}{n}\right)$

Here, t is the height upto which water must be poured.

$$\therefore 20 = t\left(1 - \frac{1}{n}\right)$$

$$\Rightarrow 20 = t\left(1 - \frac{3}{4}\right)$$

$$\therefore t = 80 \text{ mm.}$$

6. A microscope is focused on a piece of paper and then a slab of thickness 6 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?

$\Rightarrow$ $S = t\left(1 - \frac{1}{n}\right)$

or, $S = 6\left(1 - \frac{1}{1.5}\right)$

or, $S = 6 \times \frac{1}{3}$

$\therefore S = 2$ cm.

This shift will be upward, so microscope should be moved 2cm upward to get the mark in focus again.

7. The depth of water in a tank is 2.5 m. If the refractive index of water is 1.33, by how much does the bottom of the tank appears to be raised?

$\Rightarrow$ Real depth $= t = 2.5$ m.

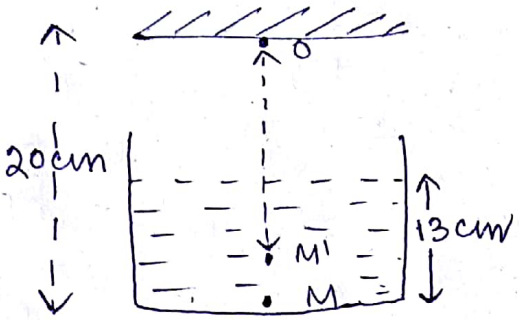
Distance by which the bottom appears to be raised

$S = t\left(1 - \frac{1}{n}\right)$

$\therefore S = 2.5\left(1 - \frac{1}{1.33}\right)$

$\therefore S = 1.36$ m

(8) A beaker contains water to a height of 13.3 cm. A plane mirror is kept at a height 20 cm above the bottom of the beaker. Find the position of the image of a dot mark at the bottom, formed by the mirror (n of water $= 1.33$)



⇒ The shift in the position of the mark.

$$M = S = t\left(1 - \frac{1}{n}\right)$$

$$S = MM' = 13.3\left(1 - \frac{1}{1.33}\right) = 3.3 \text{ cm}.$$

The apparent distance of the mark M from the mirror

$= OM' = 20 - 3.3 = 16.7$ cm.

So, the image formed by the plane mirror is at distance of 16.7 cm behind the mirror.