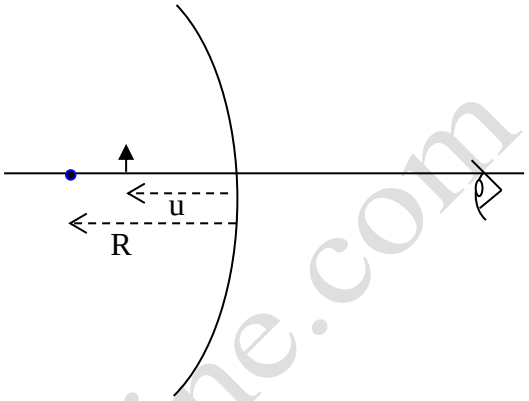
Q- A fish is 10. cm from the front surface of a spherical fish bowl of radius 17 cm.
(a) How far behind the surface of the bowl does the fish appear to someone viewing the fish from in front of the bowl?

The formula for refraction from curved surfaces is to be used. The fish in the bowl is the object viewed from outside.



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

Here

μ_1 = 1.33
μ_2 = 1.00

u = - 10 cm
v =?
R = - 17 cm

Substituting the values, we get

$$\frac{1}{v} - \frac{1.33}{-10} = \frac{1-1.33}{-17}$$

Or $$\frac{1}{v} = \frac{0.33}{17} - \frac{1.33}{10}$$

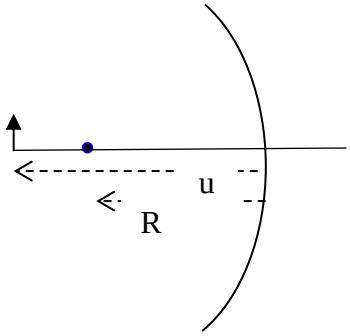
Gives v = - 8.8 cm

Thus, the fish will appear at a distance of 8.8 cm from the front surface of the bowl.

(b) By what distance does the fish's apparent location change (relative to the front surface of the bowl) when it swims away to 30 cm from the front surface?

In this case

μ_1 = 1.33
μ_2 = 1.00
u = - 30 cm
v =?
R = - 17 cm



Substituting the values, we get

$$\frac{1}{v} - \frac{1.33}{-30} = \frac{1-1.33}{-17}$$

Or $$\frac{1}{v} = \frac{0.33}{17} - \frac{1.33}{30}$$

Gives v = - 40.1 cm

Hence the change in the *distance* of the image of the fish will be

40.1 – 8.8 = 31.3 cm