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PRAYAS

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Lecture -10 | **Physics**

[redacted] Ray Optics

By- Saleem Ahmed Sir

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Topics *to be covered*

1. Snell's Law Continuous Form

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2.

3.

4.

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Snell's Law

* $\mu_1 \sin i = \mu_2 \sin r$
* $\delta = |i - r|$

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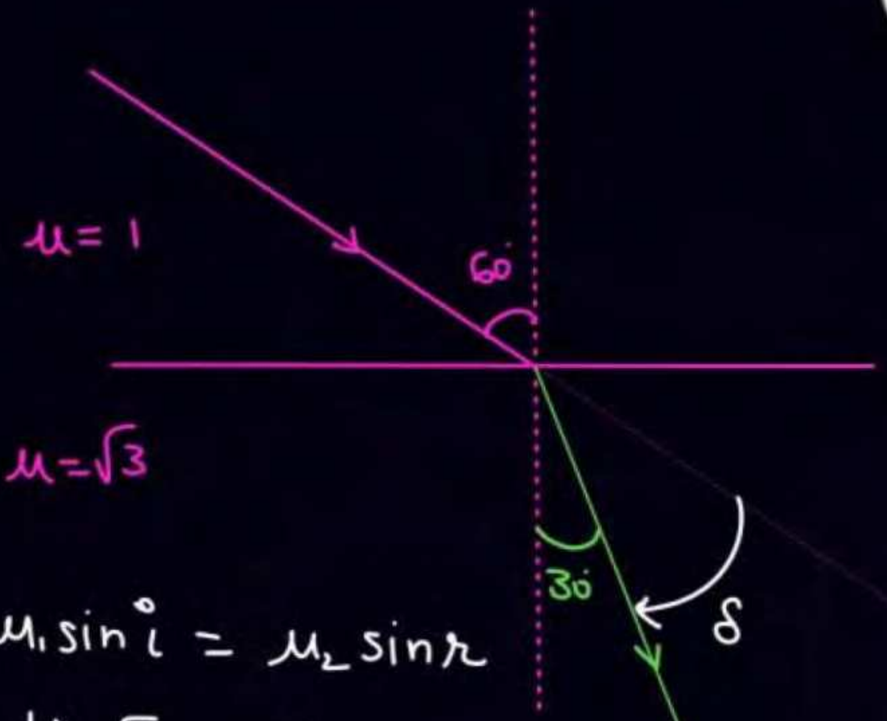

$\mu_1 \sin i = \mu_2 \sin r$

$1 \times \frac{\sqrt{3}}{2} = \sqrt{3} \sin r$

$\sin r = \frac{1}{2}$

$r = 30$

$30 + \delta = 60$

$\delta = 30$

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* Continous form of Snell's Law

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$\mu_1 \sin\theta_1 = \mu_2 \sin\theta_2$ (1^{st} refraction)

$\mu_2 \sin\theta_2 = \mu_3 \sin\theta_3$

$\mu_1 \sin\theta_1 = \mu_2 \sin\theta_2 = \mu_3 \sin\theta_3 = \mu_4 \sin\theta_4$

If $\mu_4 = \mu_2$

$\mu_2 \sin\theta_2 = \mu_4 \sin\theta_4$

$\theta_2 = \theta_4$

$\mu \sin\theta = \text{Const}$

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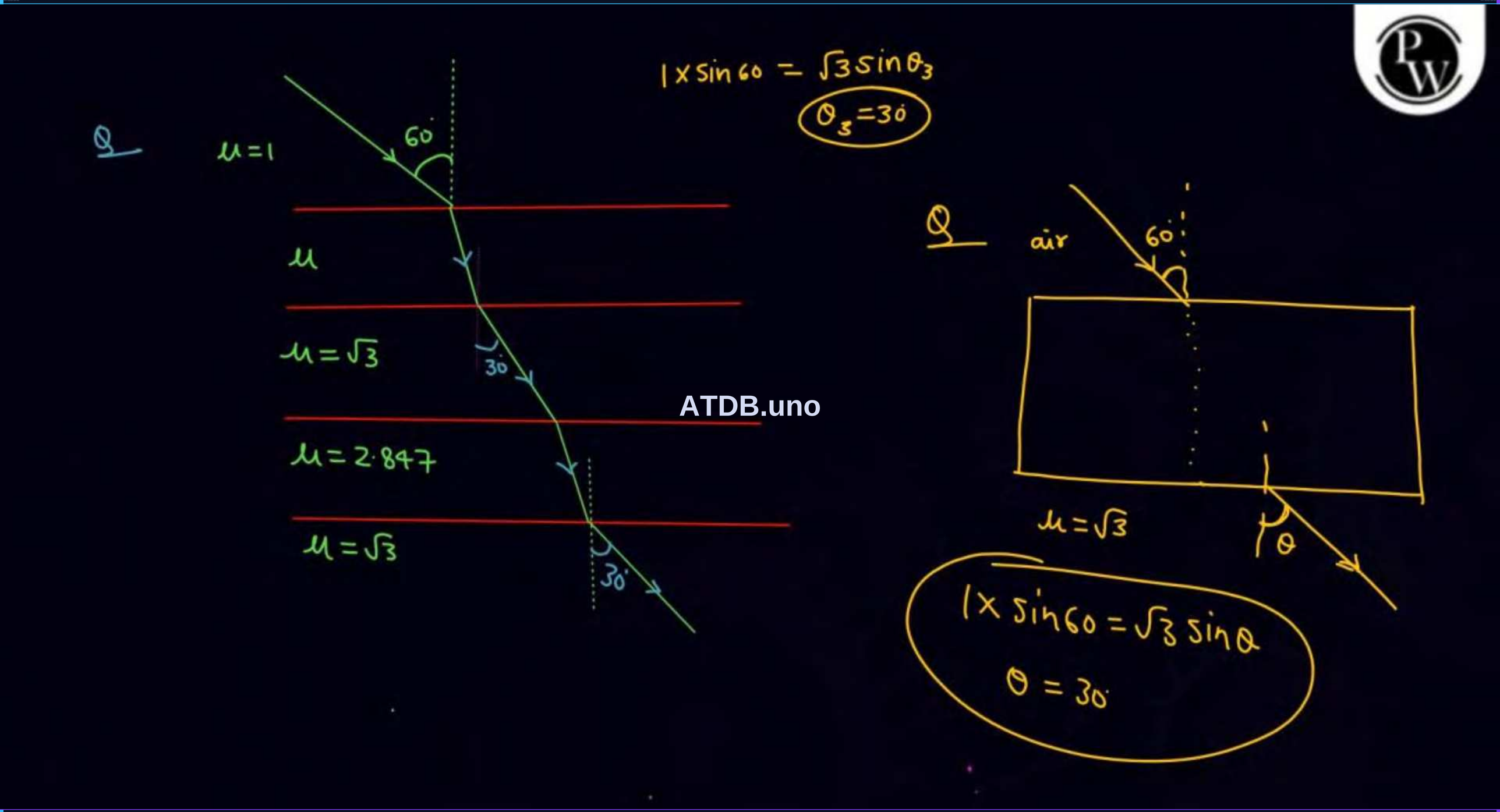

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Idea of apparent depth

$$\mu_1 \sin i = \mu_2 \sin r$$

(Paraxial rays assumption)
$\angle i$ & $\angle r$ are very small

$$\sin\theta \simeq \theta \simeq \tan\theta$$

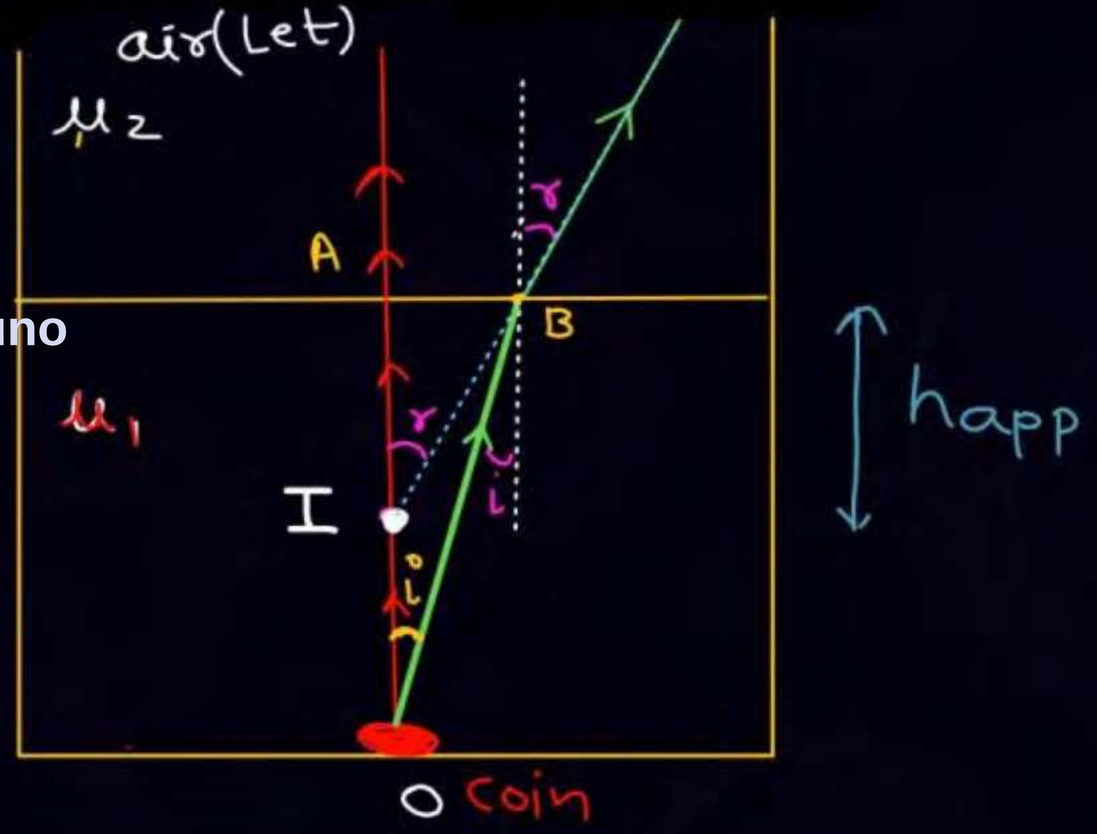
$$\mu_1 \tan i = \mu_2 \tan r$$

$$\mu_1 \frac{AB}{h_0} = \mu_2 \frac{AB}{h_{app}}$$

$$h_{app} = h_0 \frac{\mu_2}{\mu_1}$$

If μ_2 = air
$\mu_1 = \mu$

$$h_{app} = \frac{h_0}{\mu}$$



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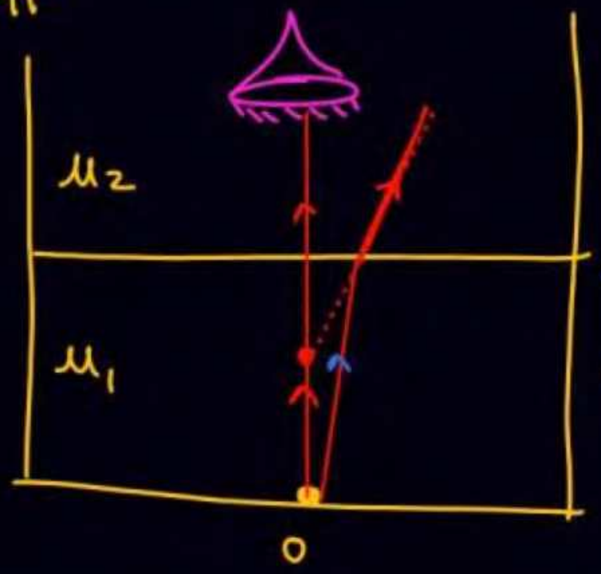
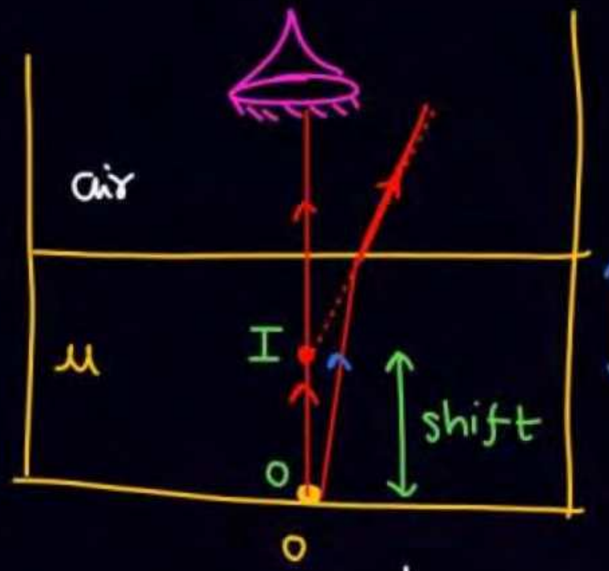


$$h_{app} = h_0 \frac{\mu_2}{\mu_1}$$

$$h_{app} = h_0 \frac{\mu \text{ जाने वाली}}{\mu \text{ आने वाली}}$$

Skc



$$h_{app} = h_0 \frac{\mu_2}{\mu_1}$$

$$h_{app} = \frac{h}{\mu}$$

$$\text{Shift} = h - \frac{h}{\mu} = h\left(1 - \frac{1}{\mu}\right)$$

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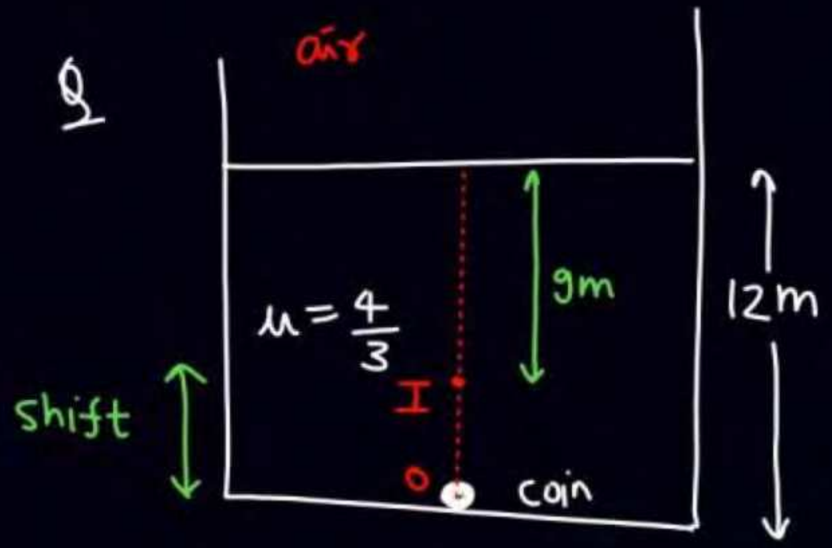
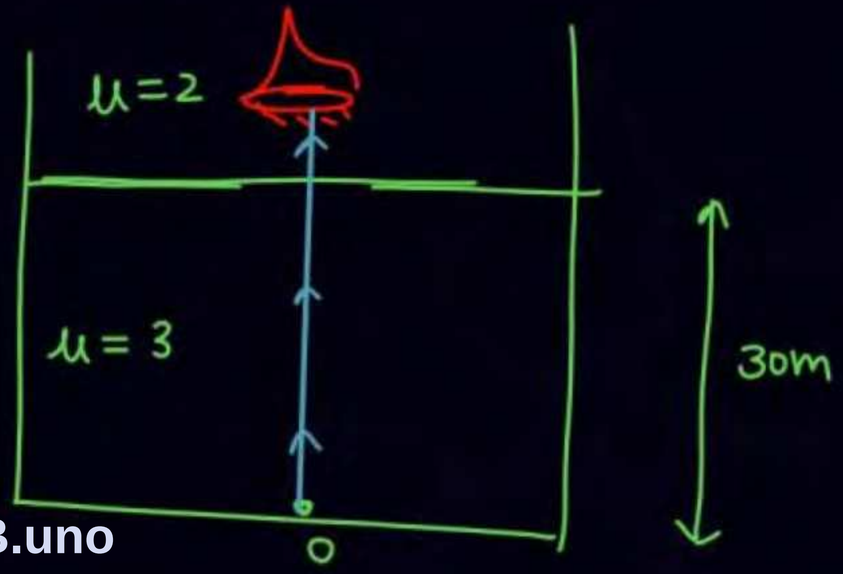


$$h_{app} = \frac{h}{\mu} = \frac{12}{4/3} = 9m$$

$$\text{shift} = 12 - 9 = 3$$

Q



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$$h_{app} = h_0 \frac{\mu_{\text{जोन}}}{\mu_{\text{आभा}}} = 30 \times \frac{2}{3} = 20m$$

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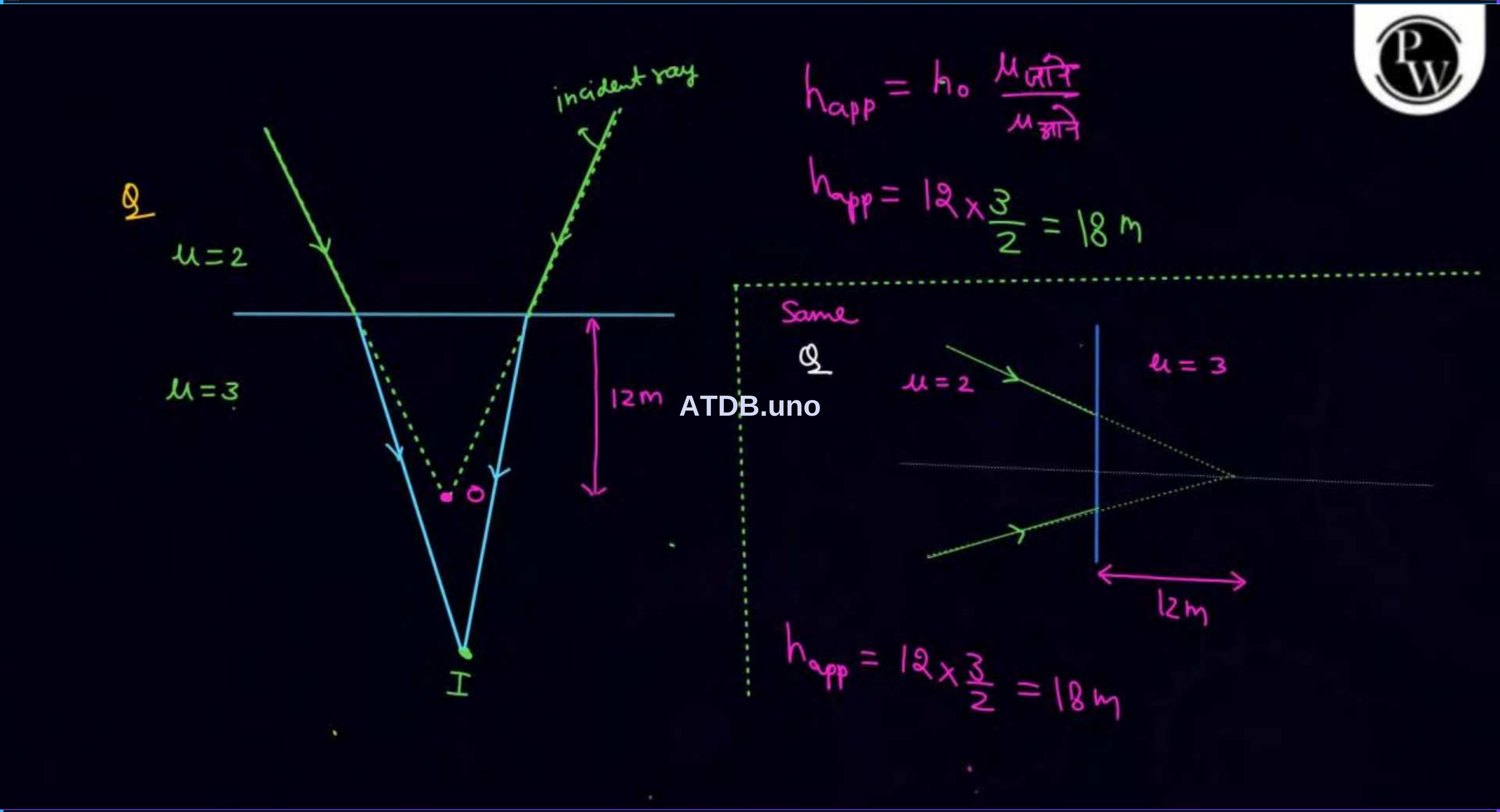

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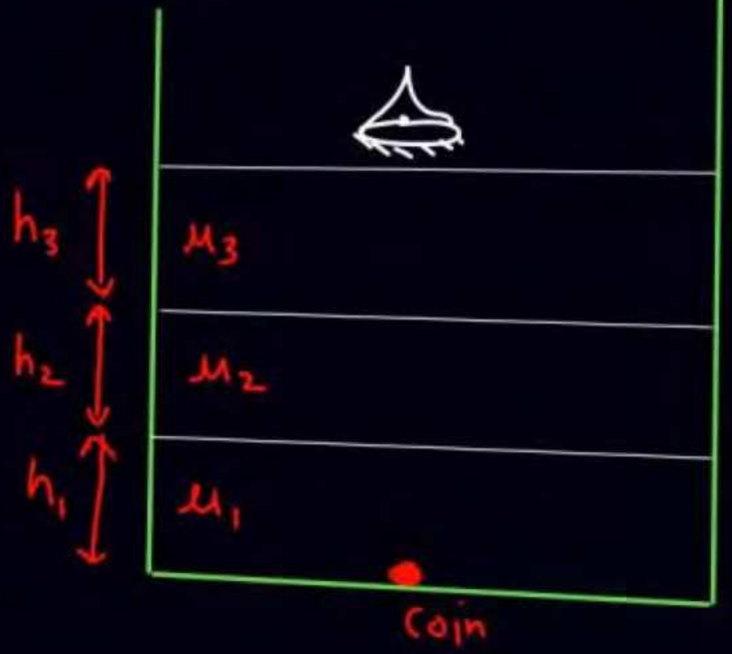

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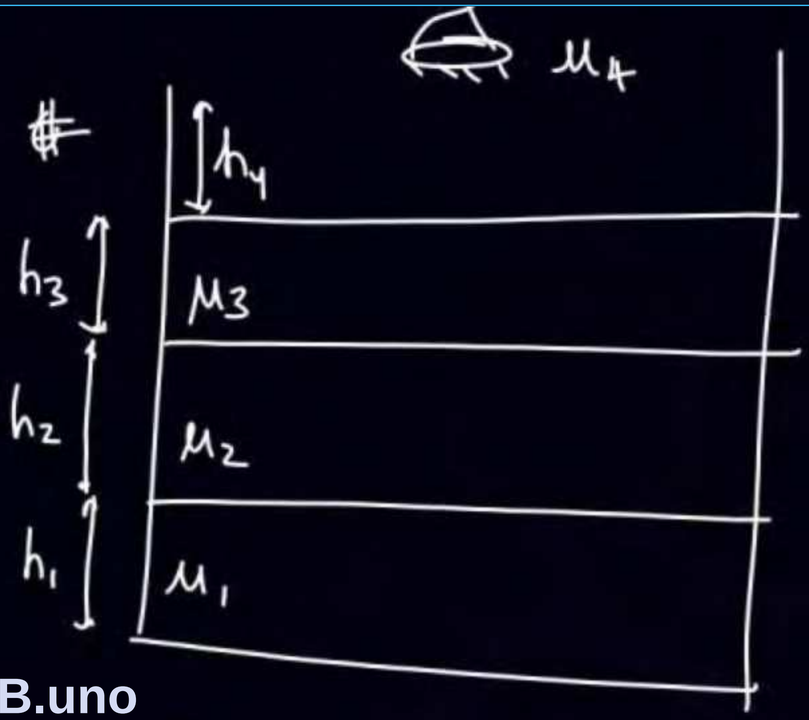

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$$h_{app} = \mu_{observer}\left(\frac{h}{\mu_1} + \frac{h_2}{\mu_2} + \frac{h_3}{\mu_3}\right)$$

Shift = ✓

$$h_{app} = \mu_4\left[\frac{h_1}{\mu_1} + \frac{h_2}{\mu_2} + \frac{h_3}{\mu_3} + \frac{h_4}{\mu_4}\right]$$

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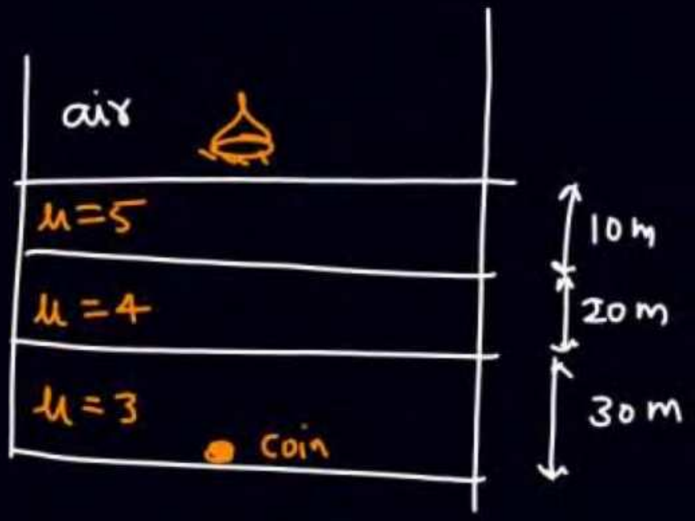
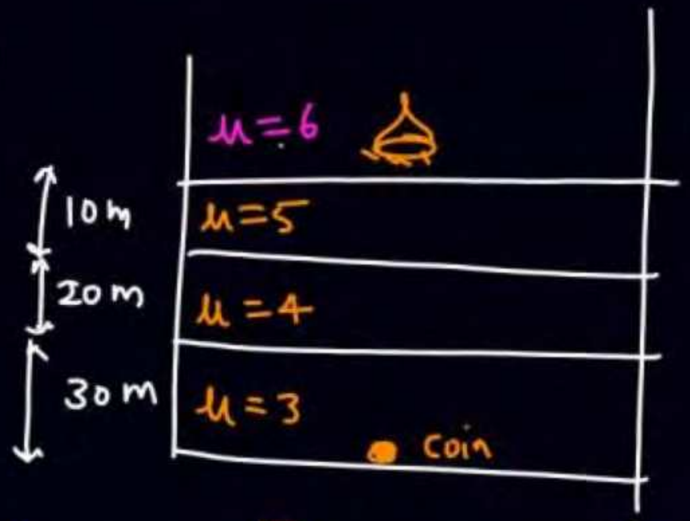


$$h_{app} = 1\left(\frac{30}{3} + \frac{20}{4} + \frac{10}{5}\right) = 17$$

$$\text{Shift} = (10+20+30) - (17)$$

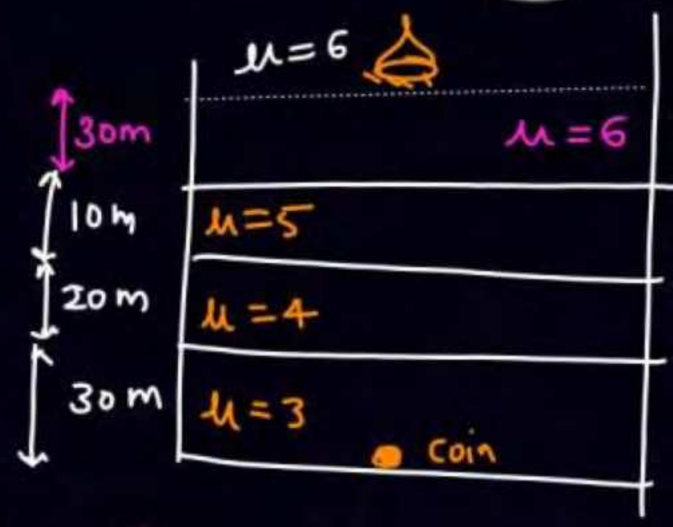
$$\text{Shift} = 30\left(1-\frac{1}{3}\right) + 20\left(1-\frac{1}{4}\right) + 10\left(1-\frac{1}{5}\right)$$

$$= (30+20+10) - \left(\frac{30}{3} + \frac{20}{4} + \frac{10}{5}\right)$$



$$h_{app} = 6\left[\frac{30}{3} + \frac{20}{4} + \frac{10}{5}\right]$$

$$h_{app} = 102$$



Ans (1) ⇒ 102+30 = 132

(M-2)

$$h_{app} = 6\left[\frac{30}{3} + \frac{20}{4} + \frac{10}{5} + \frac{30}{6}\right]$$

$$= 6\left[10+5+2+5\right] = 132$$

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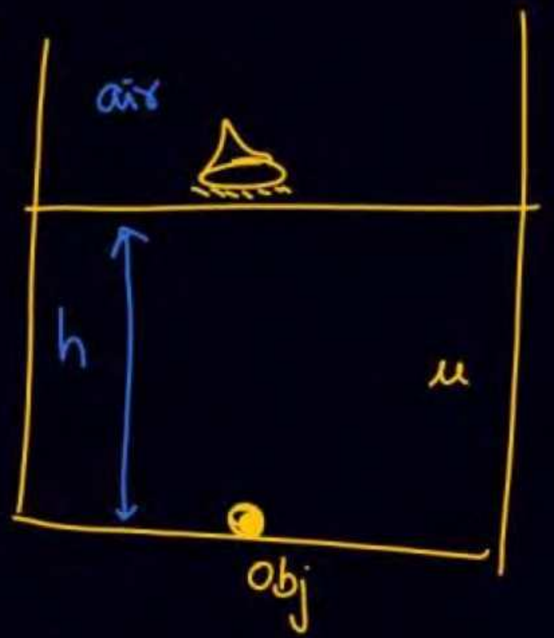
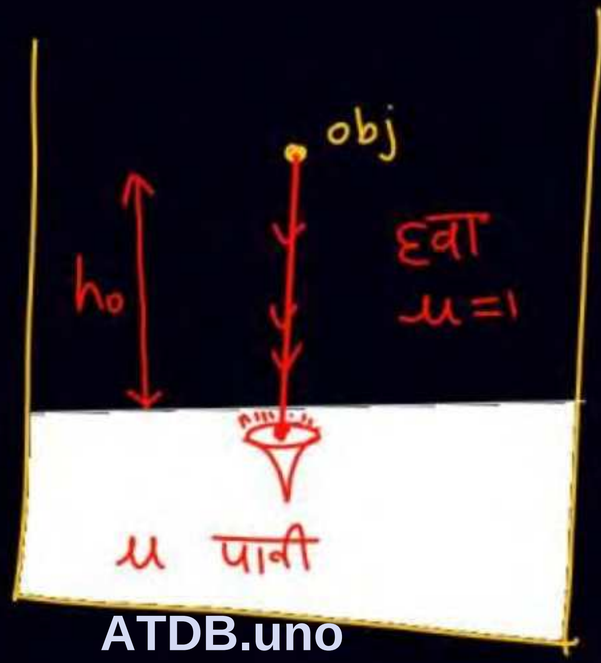


$$h_{app} = \frac{h}{\mu}$$

#



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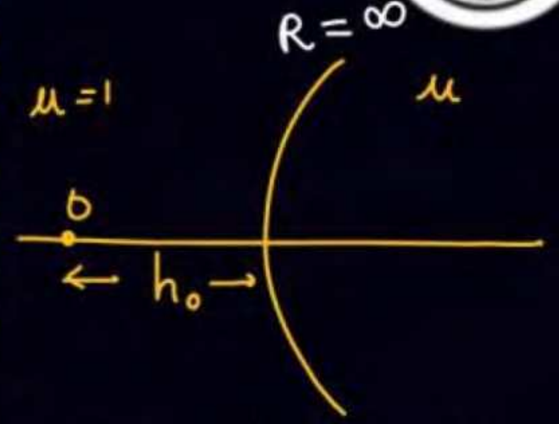
$$h_{app} = h_0 \frac{\mu_{\text{ज्यादा}}}{\mu_{\text{आना}}} = h_0 \frac{\mu}{1}$$

$$\boxed{h_{app} = h_0 \mu}$$

$$h_{app} = \mu \left(\frac{h_0}{1}\right)$$



$$\frac{\mu}{V} - \frac{1}{h_0} = \frac{\mu - 1}{R = \infty}$$

$$\frac{\mu}{V} - \frac{1}{h_0} = 0$$

$$\boxed{V = \mu h_0}$$

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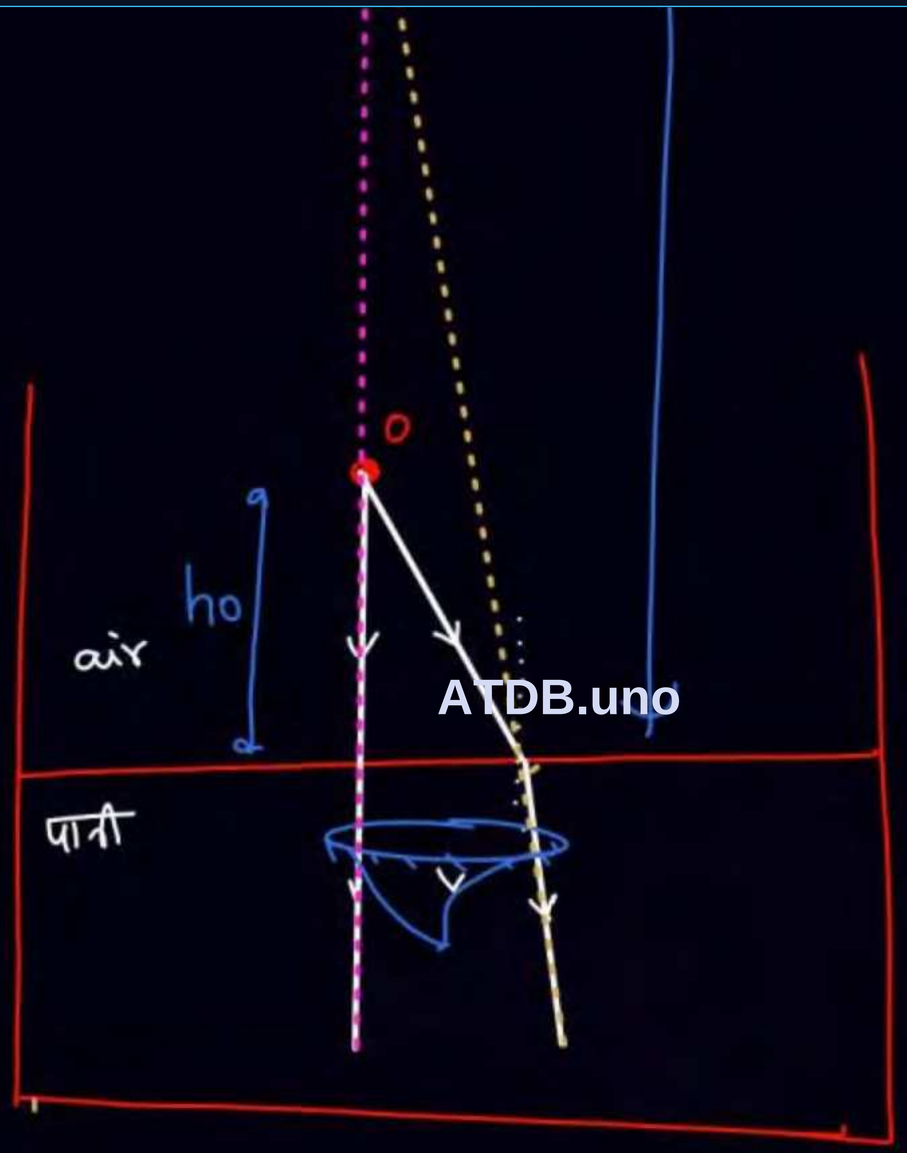

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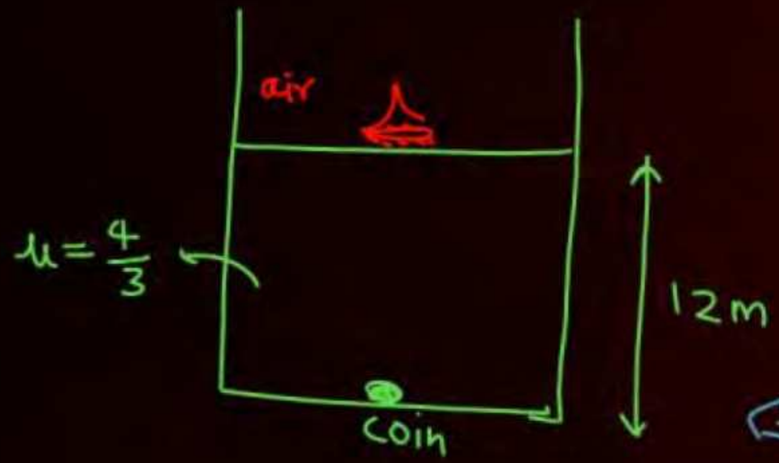
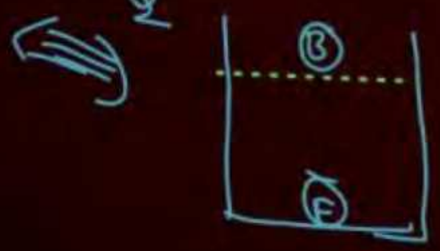
चिड़िया मछली वाले Ques
Bird fish problem



$$h_{app} = \frac{h}{\mu} = \frac{12}{4/3}$$

$$h_{app} = 9m$$

Q



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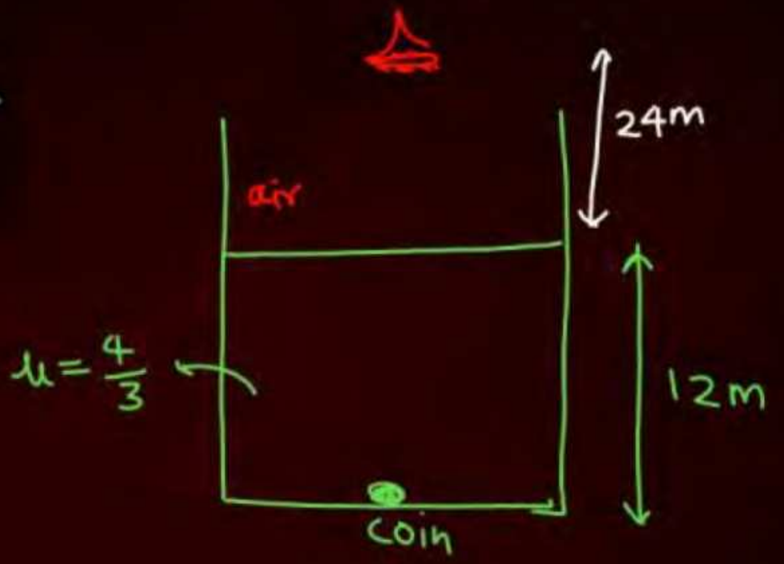

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Apparent depth of coin observed by eye

$$= 24 + \frac{12}{\mu} = 24 + \frac{12}{4/3}$$

$$= 24 + 9 = 33$$

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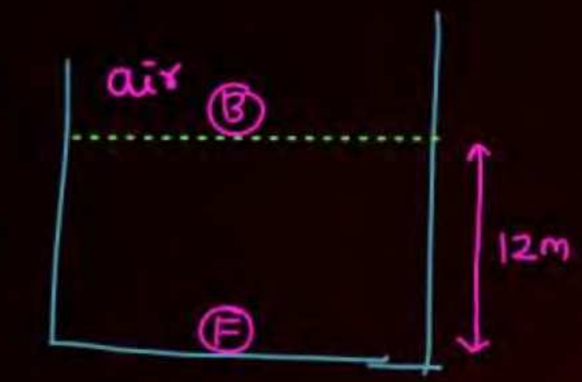
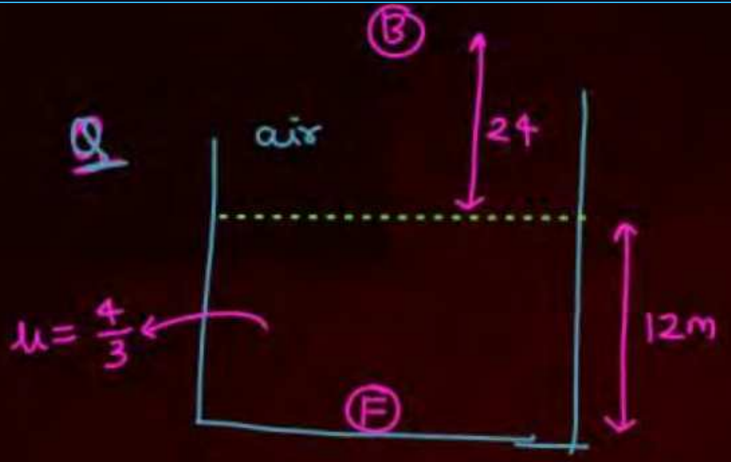


Apparent depth observed by bird $= \frac{h}{\mu} = \frac{12}{4/3} = 9m$

$h_{app} = 12 \times \frac{1}{4/3} = 9$

Q



Apparent depth observed by bird $= \frac{24}{4/3} + 9 = 24 + 9 = 33$

$= 24 + 12 \times \frac{1}{4/3} = 24 + 9 = 33$

5Kc

$$h_{app} = h_0 \frac{\mu_{\text{जानेवाली}}}{\mu_{\text{आनेवाली}}}$$

* देख कौन रहा है
* जो देख रहा है उसकी आरेखा में rays जाती है

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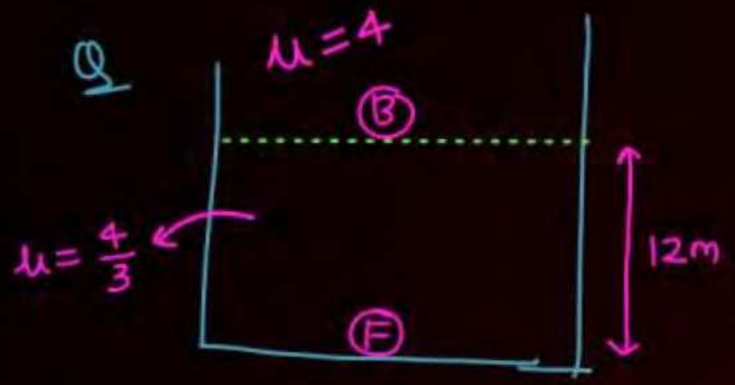
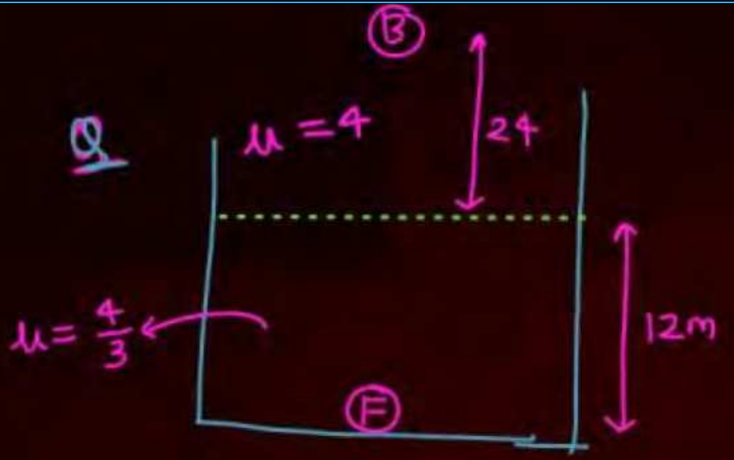


Apparent depth observed by bird $= 12 \times \frac{4}{4/3} = 36\ m$



Apparent depth observed by bird $= 12 \times \frac{4}{4/3}$

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5Kc

$$h_{app} = h_0 \frac{\mu_{\text{जाने वाली}}}{\mu_{\text{आने वाली}}}$$

* देख कौन रहा है
* जो देख रहा है उसकी आरेख में rays जाती है

$$V_{app} = V_0 \frac{\mu_{\text{जाने}}}{\mu_{\text{आने}}}$$

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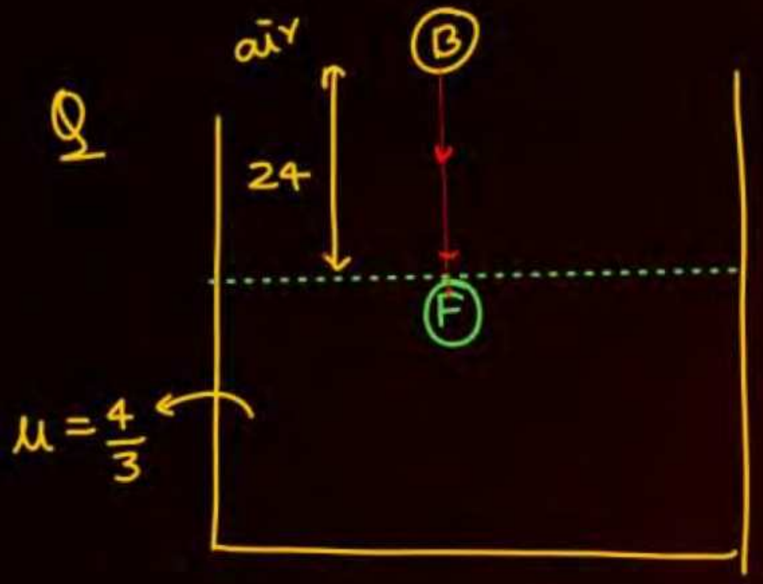
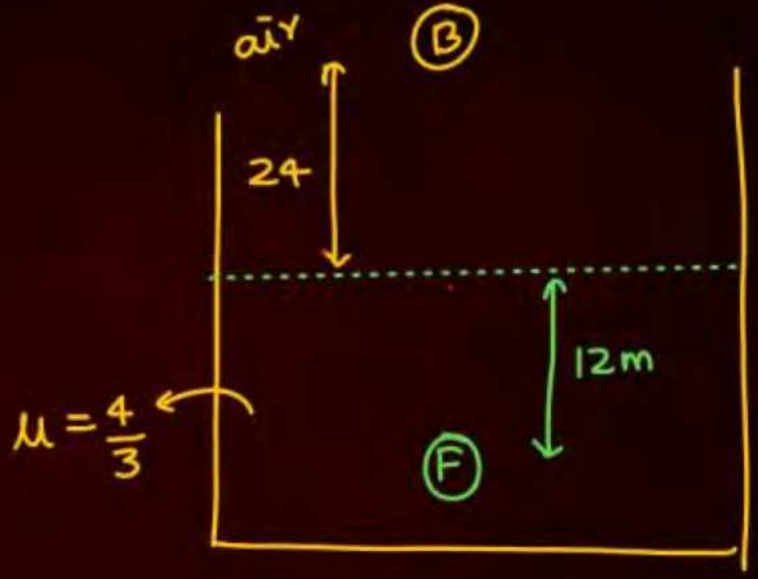


Apparent distance of bird observed by fish $= h_{act} \frac{\mu_{जाने}}{\mu_{आने}} = 24 \times \frac{4/3}{1}$

$= 32\,m$

Q



Apparent distance of bird observed by fish $= 12 + 24 \times \frac{4/3}{1}$

$= 12 + 32 = 44$

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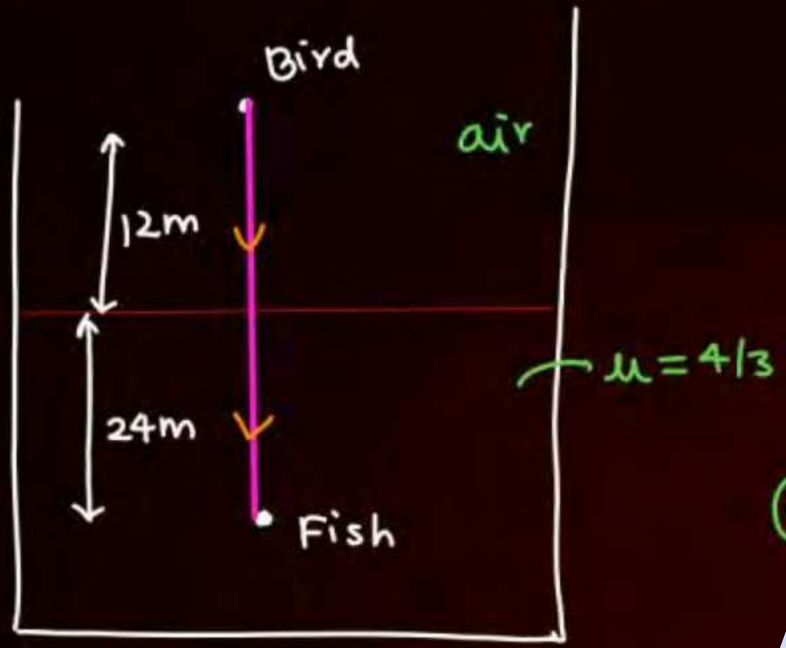

① Apparent depth of fish observed by Bird

$$= 12 + 24 \times \frac{1}{4/3} = 12 + 18 = 30\text{m}$$

② Apparent height of bird observed by fish

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$$= 24 + 12 \times \frac{4/3}{1} = 24 + 16$$

$$= 40$$

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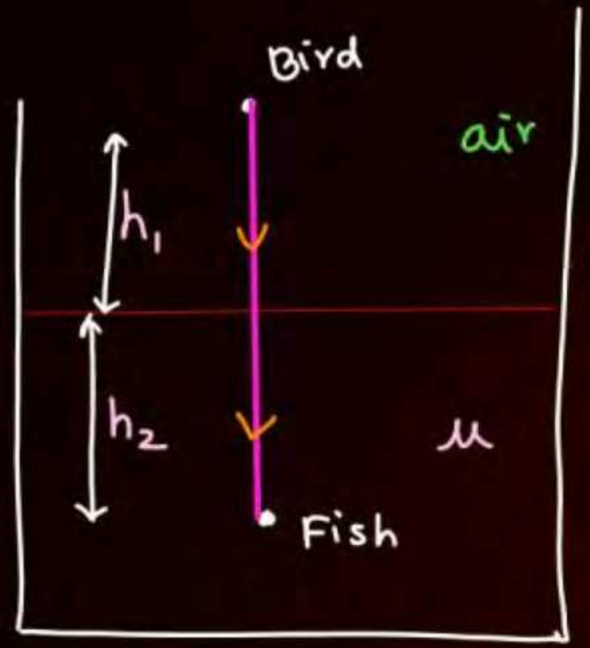

① Apparent depth of fish observed by Bird

$$= h_1 + \frac{h_2}{\mu}$$

② Apparent height of bird observed by fish

$$= h_2 + \mu h_1$$

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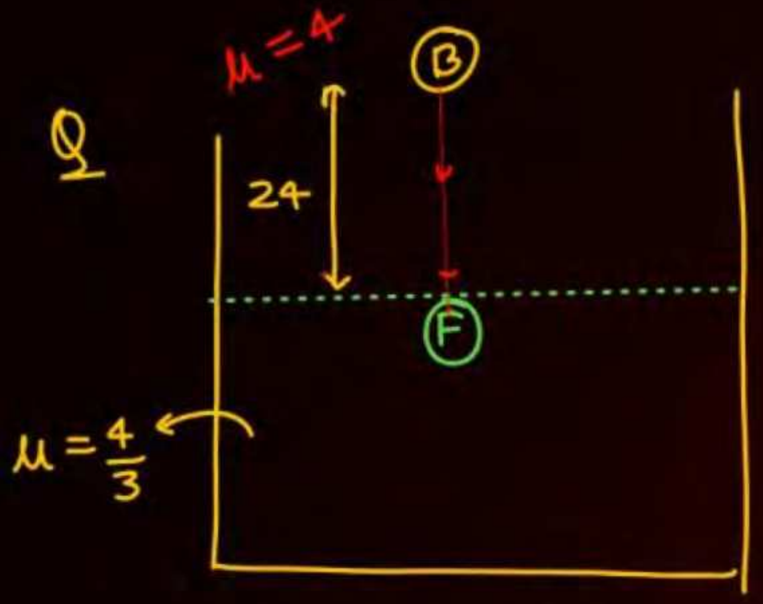

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Apparent distance of bird observed by fish $= h_{act} \frac{\mu_{जाने}}{\mu_{आने}} = 24 \times \frac{4/3}{4}$

$= 8$

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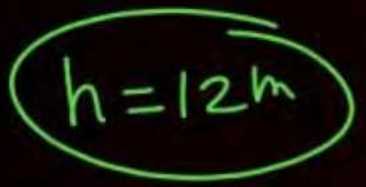
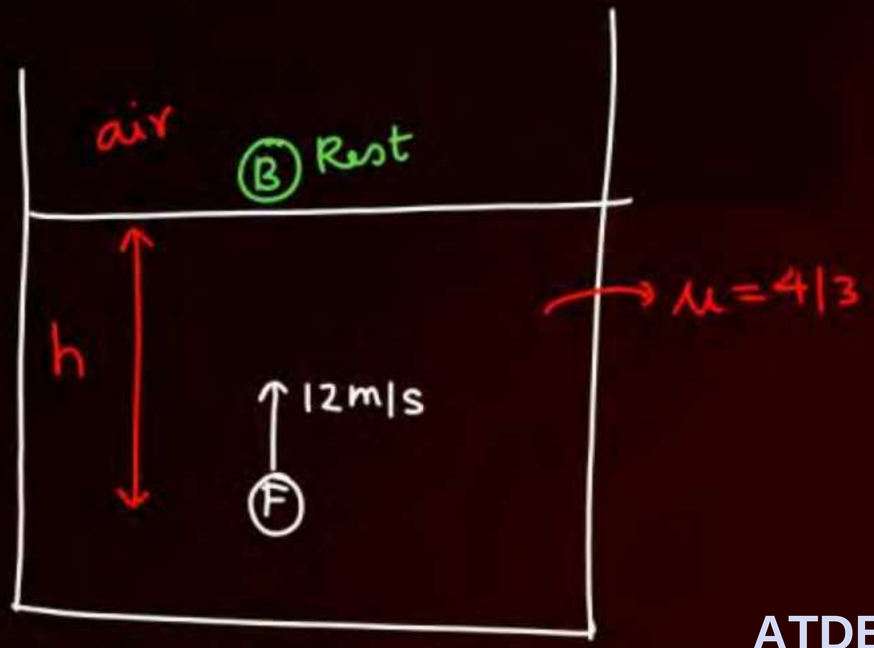


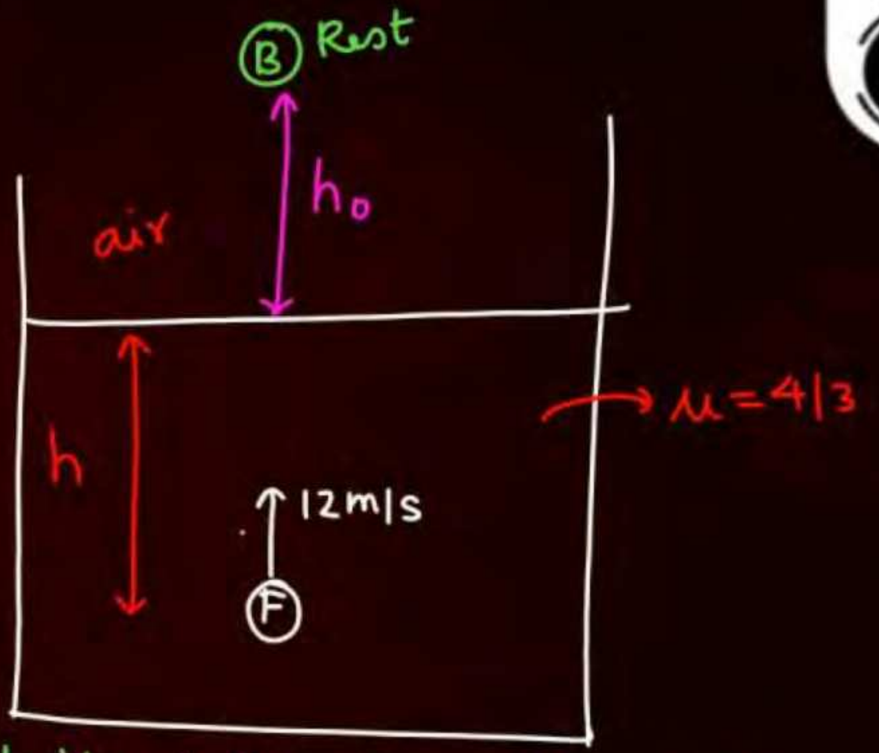


Velocity of fish observed by Bird =

$$= V_{app} = V_0 \frac{\mu_{\text{जाने}}}{\mu_{\text{आने}}} = 12 \times \frac{1}{4/3}$$

$$= 9\ m/s$$

Q



Velocity of fish observed by Bird =

Ans ≡ Same – 9m/s

$$h_{app} = h_0 + \frac{h}{\mu}$$

$$\frac{dh_{app}}{dt} = V_{app} = 0 + \frac{1}{\mu} V_0$$

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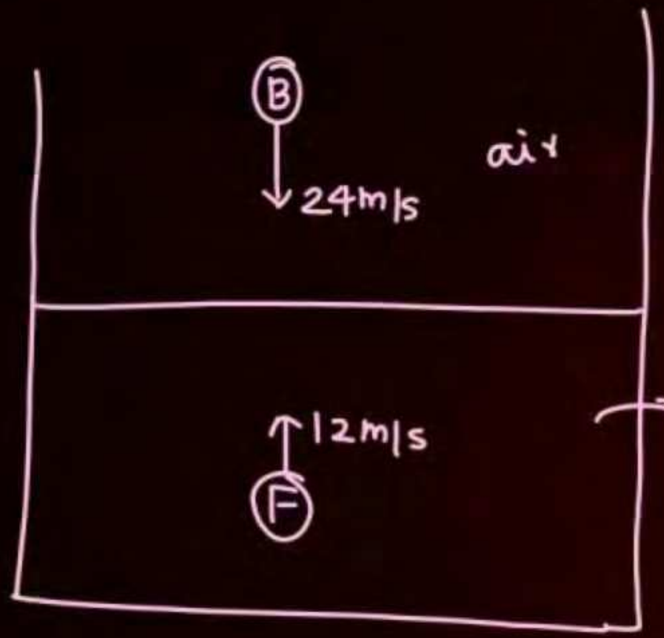
Q2



Velocity of fish observed by bird

= $24 + 12 \times \frac{1}{4/3}$

← पहले Bird रोकदी

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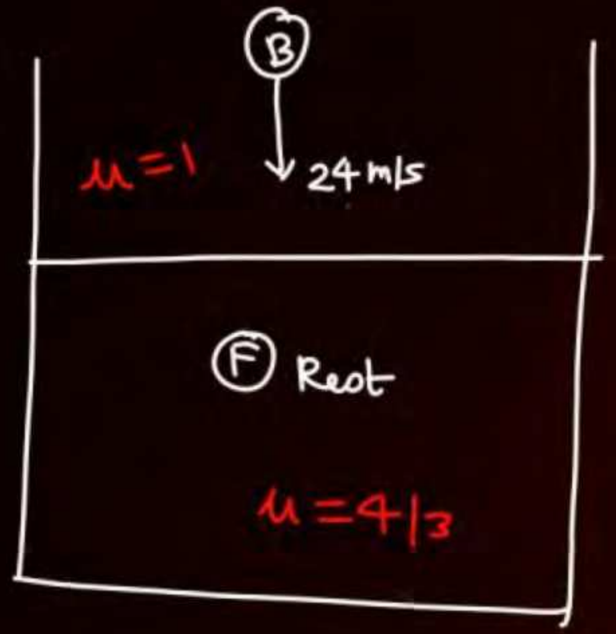
Q2



(a) find velocity of bird observed by fish

$= 24 \times \frac{4/3}{1} = 32 \text{ m/s}$

(b) if fish start moving upward with speed 10m/s find velocity of bird observed by fish

$= 10 + 32$

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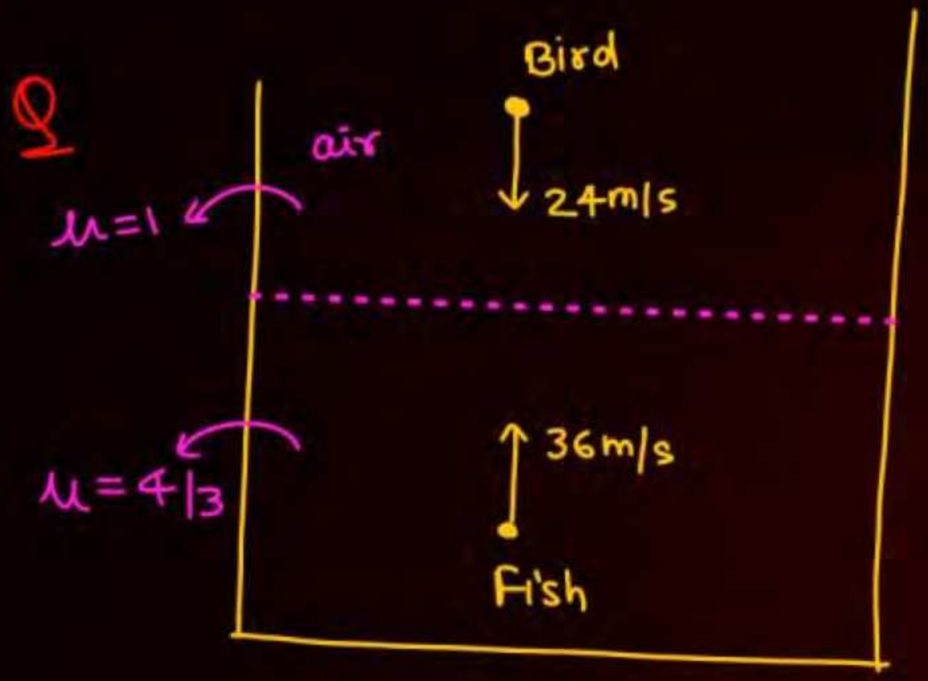

① Velocity of fish observed by bird

$$= 24 + 36 \times \frac{1}{4/3}$$

② Velocity of bird observed by fish.

$$= 36 + 24 \times \frac{4/3}{1}$$

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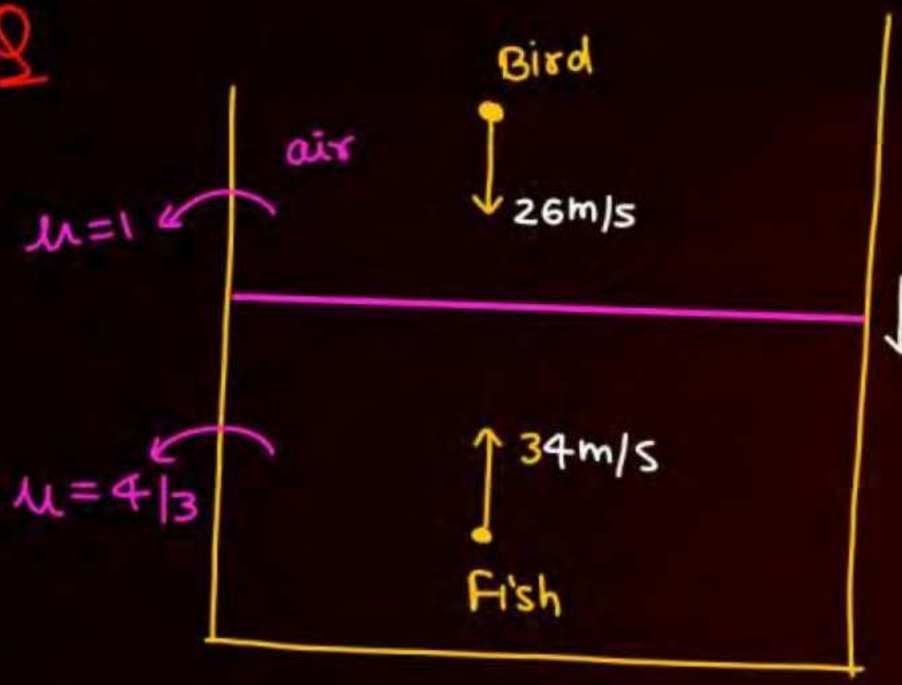
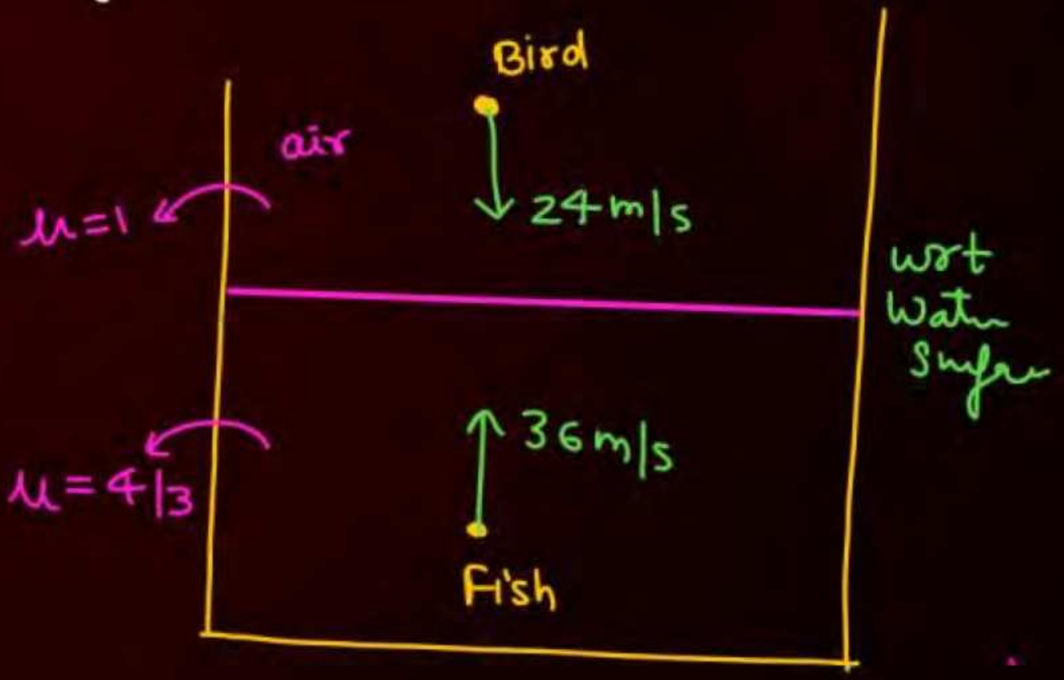


Water Surface को रोक दो उसके Ropert में Velocity निकाल लो

≡



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Lateral shift by slab

$$d = \frac{t \sin(i - r)}{\cos r}$$

$$\sin(i - r) = \frac{d}{PQ}$$

$$\cos r = \frac{t}{PQ}$$

$$\frac{\sin(i - r)}{\cos r} = \frac{d}{t}$$

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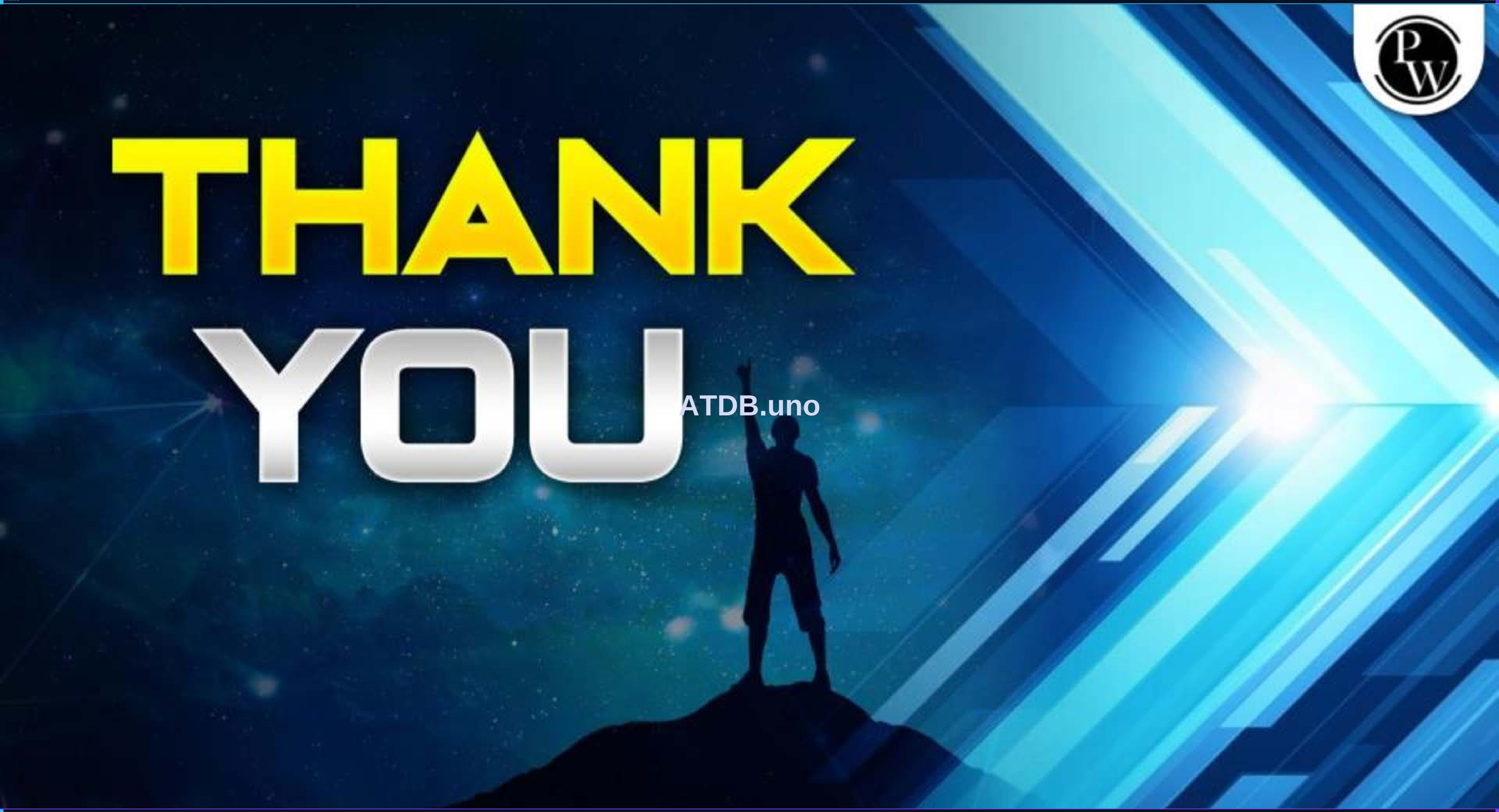

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