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EXPERIMENT-3

Aim:

To find the refractive index of liquid by travelling microscope.

Theory:

When viewed vertically from the air a point object inside the liquid, it appears to be raised by a small amount, depending on its depth below the surface and R.I. of the liquid relative to the air.

If the ray starting from (p) object, appear to come from (p') which is the image of (p) object, appears to come relative to the air is given by $\mu = \frac{u}{v} = \frac{OP}{OP'}$

where OP = (u) real depth and OP' = (v) apparent depth

i.e.,

$$\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$$

Required Apparatus:

1) Travelling Microscope
2) Beaker (cross mark on the base)
3) Spirit level.
4) Tissue papper
5) Magnifying glass
6) Water

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TABLE

Table for Experimental Data

All readings are in cm.

S.No.	Reading of P			Reading of P'			Reading of Q			Real Depth	Apparent Depth
	Main Scale	Vernier Scale	Total	Main Scale	Vernier Scale	Total	Main Scale	Vernier Scale	Total	(Q - P) u	(Q - P') V
1.	5.1	1 1 x 0.001 = 0.001	5.101	5.8	2 2 x 0.001 = 0.002	5.802	7.8	2 2 x 0.001 = 0.002	7.802	2.701	2
2.	5.1	1 1 x 0.001 = 0.001	5.101	5.9	3 3 x 0.001 = 0.003	5.903	8.3	4 4 x 0.001 = 0.004	8.304	3.203	2.401
3.	5.1	1 1 x 0.001 = 0.001	5.101	6.0	2 2 x 0.001 = 0.002	6.002	8.6	6 6 x 0.001 = 0.006	8.606	3.505	2.604

Refractive Index of (given liquid) $\mu = \frac{\text{Real Depth}}{\text{Apparent Depth}}$

1) $u_1 = 2.701$ and $V_1 = 2$

$\therefore$ Refractive index of water $\mu_1 = \frac{u_1}{V_1} = \frac{2.701}{2} = 1.3505$

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2) $u_2 = 3.203$, $v_2 = 2.401$

then, R.I. (water) $\mu_2 = \frac{u_2}{v_2} = \frac{3.203}{2.401} = 1.3340$

3) $u_3 = 3.505$, $v_3 = 2.604$

then, R.I. (water) $\mu_3 = \frac{u_3}{v_3} = \frac{3.505}{2.604} = 1.3460$

Therefore mean R.I. $\mu_e = \frac{\mu_1 + \mu_2 + \mu_3}{3}$

$= \frac{1.3505 + 1.3340 + 1.3460}{3}$

$= \frac{4.0305}{3}$

$\mu_e = 1.3435$

Thus refractive index of water = 1.3435

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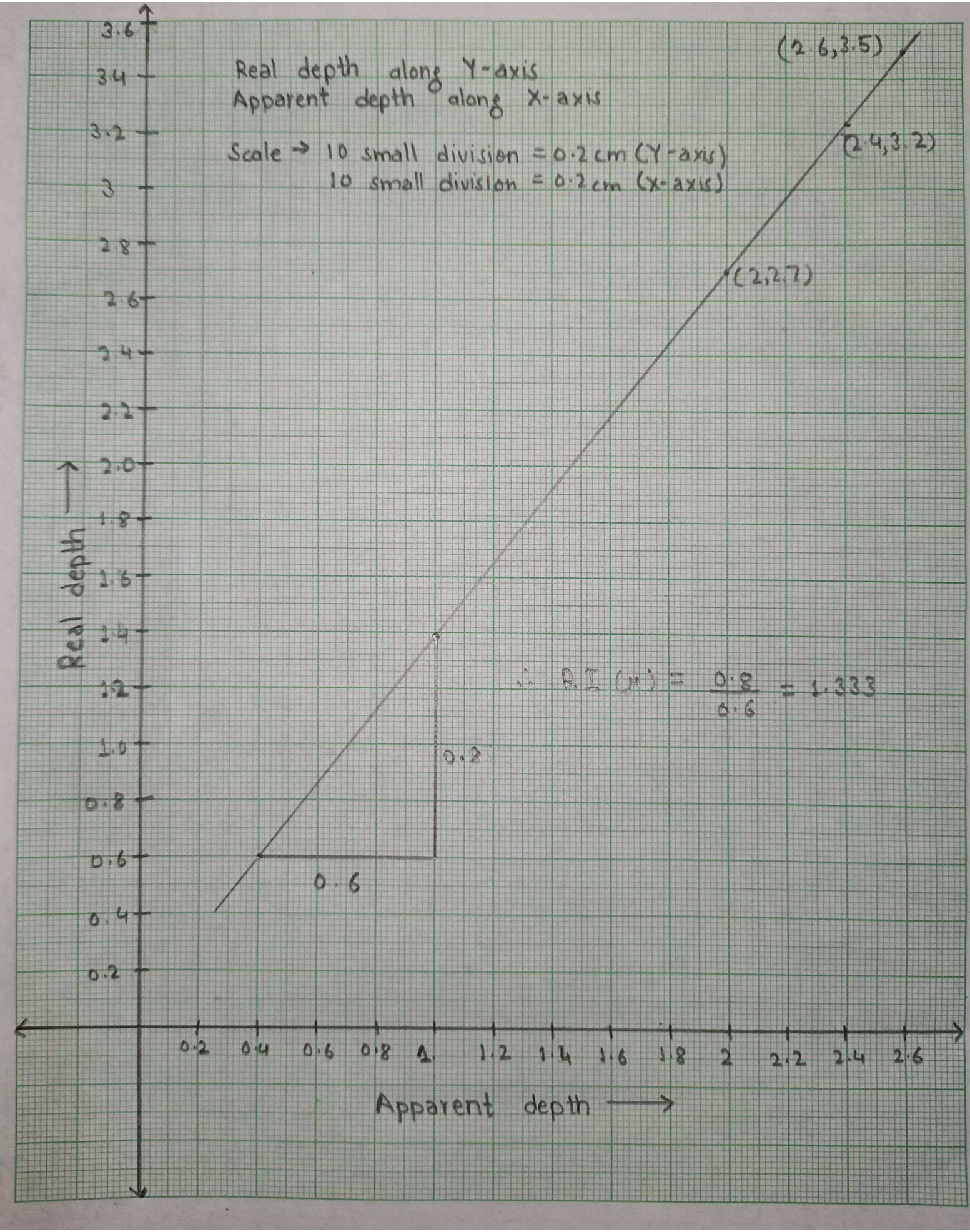
Real depth along Y-axis
Apparent depth along X-axis
Scale → 10 small division = 0.2 cm (Y-axis)
10 small division = 0.2 cm (X-axis)
(2.6, 3.5)
(2.4, 3.2)
(2, 2.7)
∴ RI (μ) = 0.8 / 0.6 = 1.333
0.8
0.6
Real depth
Apparent depth
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6

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From the above graph R.I. of water (μ_g) = 1.333

So, R.I. of water $\mu = \frac{\mu_e + \mu_g}{2} = \frac{1.343 + 1.333}{2} = 1.338$

$\therefore \mu = 1.338$

Result :

Hence the refractive of water calculated here is 1.338 (approx.)

$$\text{Percentage error} = \frac{\text{Difference of true value \& calculate value}}{\text{true value}} \times 100$$

$$= \frac{1.338 - 1.339}{1.333} \times 100\ \%$$

$$\%\ \text{error} = 0.375\ \%$$

Precautions :-

1) To take accurate reading use magnifying glass.
2) Do not alter distance of eye piece and object after taking initial reading.
3) After reading for error mark (p), do not adjust the adustable screw of the eye piece, while reading of p' and q. Only adust the adjustable screw of the vertical seale screw.

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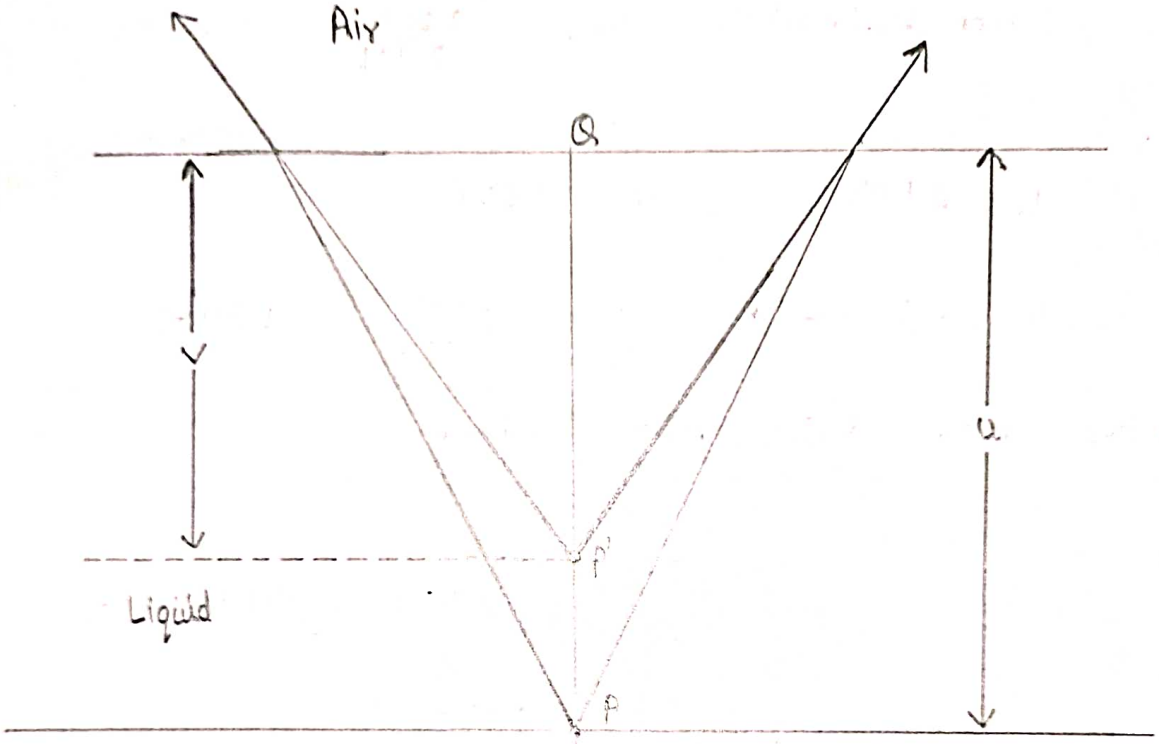

Rey Diagram

Real Depth and apparent depth of a fixed point below the liquid