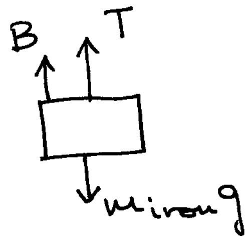
P - 43



$$\Rightarrow \quad T + B - m_{iron} g = 0$$

$$\Rightarrow T = m_{iron} g - B$$

$$= 2 \times 9.8 - \rho_{fluid} V_{fluid} g$$

Since block is completely submerged:

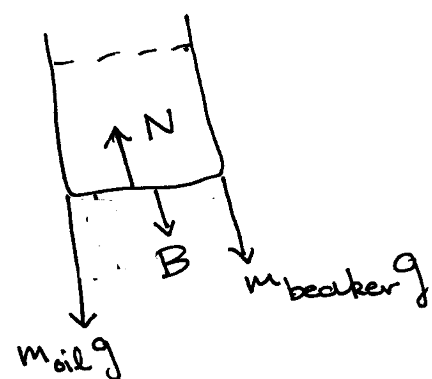
$$V_{fluid} = V_{object} = V_{iron} = \frac{m_{iron}}{\rho_{iron}} = \frac{2}{7.86 \times 10^3}$$

$$\rho_{fluid} = \rho_{oil} = 916 \text{ kg/m}^3$$

$$\Rightarrow \quad T = 19.6 - 916 \times \frac{2}{7.86 \times 10^3} \times 9.8$$

$$= 17.3 \text{ N}$$

<u>Oil & beaker</u>



N is what the lower scale reads.

$$\Rightarrow N - m_{oil} g - B - m_{beaker} g = 0$$

$$\Rightarrow N = 3 \times 9.8 + B = 3 \times 9.8 + \rho_{fluid} V_{fluid} g$$

Using equations from earlier part:

$$\Rightarrow N = 3 \times 9.8 + 916 \times \frac{2}{7.86 \times 10^3} \times 9.8 = 31.7 \text{ N}$$

Bernoulli's equation (see figure in lecture slides)

$W_{nc} = \Delta KE + \Delta PE$

$P_1 A_1 \Delta x_1 - P_2 A_2 \Delta x_2 = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2 + mgy_2 - mgy_1$

$A_1 \Delta x_1 = A_2 \Delta x_2 = V$ (V = volume flowing in time Δt)

$\Rightarrow m = \rho V$

$\Rightarrow P_1 \cancel{V} - P_2 \cancel{V} = \frac{1}{2} \rho \cancel{V} v_2^2 - \frac{1}{2} \rho \cancel{V} v_1^2 + \rho \cancel{V} g y_2 - \rho \cancel{V} g y_1$

$\Rightarrow P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$

$\Rightarrow P + \frac{1}{2} \rho v^2 + \rho g y = \text{constant}$

P - 55

$P_1 = P_{atm} + \rho g h_1 \rightarrow$ ①

$P_2 = P_{atm} + \rho g h_2 \rightarrow$ ②

$A_1 v_1 = 1.8 \times 10^{-4} = A_2 v_2 \rightarrow$ ③

$A_1 = \frac{\pi d_1^2}{4} = 4.91 \times 10^{-4}\ m^2$

Using ③ $\Rightarrow$ $v_1 = 0.37\ m/s \rightarrow$ ④

Since flow is horizontal : $y_1 = y_2$

Use Bernoulli's equation:

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2 \quad (\because y_1 = y_2).$$

Using ① & ②

$$\Rightarrow P_{atm} + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_{atm} + \rho g h_2 + \frac{1}{2}\rho v_2^2$$

$$\Rightarrow \rho g h_1 + \frac{1}{2}\rho v_1^2 = \rho g h_2 + \frac{1}{2}\rho v_2^2$$

$$\Rightarrow v_1^2 - v_2^2 = 2g(h_2 - h_1)$$

$$= 2 \times 9.8\,(0.05 - 0.1) = -0.98$$

$$\Rightarrow v_2^2 = v_1^2 + 0.98 = 1.117 \quad (\text{Using ④})$$

$$\Rightarrow v_2 = 1.06 \text{ m/s} \rightarrow ⑤$$

Using ③ $\quad A_2 v_2 = 1.8 \times 10^{-4}$

$$\Rightarrow A_2 = 1.7 \times 10^{-4} \text{ m}^2 \quad (\text{Using ⑤})$$

$$\Rightarrow \frac{\pi d_2^2}{4} = 1.7 \times 10^{-4} \Rightarrow d_2 = 0.0147 \text{ m}$$