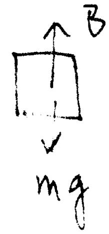
$$mg = \rho_{object} V_{object} g \quad , \quad B = \rho_{fluid} V_{fluid} g$$

Floating, $V_{object} \neq V_{fluid}$

Floating $\Rightarrow$ equilibrium



$$B - mg = 0 \quad , \quad B = mg$$

$$\rho_{fluid} V_{fluid} g = \rho_{object} V_{object} g$$

$$\frac{\rho_{object}}{\rho_{fluid}} = \frac{V_{fluid}}{V_{object}}$$

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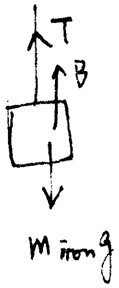


Top scale reads T

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

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

$$= m_{iron} g - \rho_{fluid} V_{fluid} g$$

Block is completely submerged

$$V_{fluid} = V_{iron} = \frac{m_{iron}}{\rho_{iron}}$$

$$T = m_{iron} g - \rho_{fluid} \frac{m_{iron}}{\rho_{iron}} g$$

$$= m_{iron} g \left(1 - \frac{\rho_{fluid}}{\rho_{iron}}\right)$$

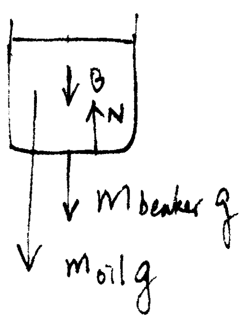
$$= 2(9.8)\left(1 - \frac{916}{7360}\right)$$

$$= 17.3\,N$$

Treat oil & beaker as one system

Newton's 3rd law, Iron exerts B on liquid

Bottom scale reads N



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

$$N = m_{oil} g + m_{beaker} g + \rho_{fluid} \frac{m_{iron}}{\rho_{iron}} g$$

$$= \left(m_{oil} + m_{beaker} + \rho_{fluid} \frac{m_{iron}}{\rho_{iron}}\right) g$$

$$= \left(2 + 1 + 916 \frac{2}{7860}\right) 9.8$$

$$= 31.7\,N$$

Bernoulli's equation

$$\text{Work} = \Delta KE + \Delta PE$$

$$F_1 \Delta X_1 - F_2 \Delta X_2 = (P_1 A_1)\Delta X_1 - (P_2 A_2)\Delta X_2 = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2 + mgy_2 - mgy_1$$

$$A_1 \Delta X_1 = A_2 \Delta X_2 = V \quad \text{volume}$$

$$m = \rho V$$

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

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

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

#55.

$$\text{Flow rate} = 1.8\times 10^{-4} = A_1 V_1$$

$$V_1 = \frac{1.8\times10^{-4}}{A_1} = \frac{1.8\times10^{-4}}{\pi\left(\frac{0.025}{2}\right)^2} = 0.37 \text{ m/s}$$

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

Horizontal flow $y_1 = y_2$, $P_1 = P_{atm} + \rho g h_1$

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

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

$$V_2^2 = 2g(h_1 - h_2) + v_1^2 = 2(9.8)(0.1 - 0.05) + (0.37)$$

$$v_2 = 1.06 \text{ m/s}$$

$$\text{Flow rate} = 1.8\times10^{-4} = A_2 V_2$$

$$A_2 = \frac{1.8\times10^{-4}}{V_2}$$

$$\pi\left(\frac{d_2}{2}\right)^2 = \frac{1.8\times10^{-4}}{1.06} \Rightarrow d_2 = 0.0147 \text{ m}$$