1.5

Reynolds Number

Cross-sectional area

$$A = \frac{\pi D^2}{4} = \frac{\pi \left(\frac{1.05}{12}\right)^2}{4} = 0.00601 \text{ ft}^2$$

Volumetric flow rate

$$Q = \frac{35}{7.48 \times 60} = 0.0780 \ \frac{\text{ft}^3}{\text{s}}$$

Mean velocity

$$u_m = \frac{Q}{A} = \frac{0.0780}{0.00601} = 12.98 \ \frac{\text{ft}}{\text{s}}$$

Reynolds number

$$Re = \frac{\rho u_m D}{\mu} = \frac{62.3 \times 12.98 \times 1.05/12}{1.2 \times 0.000672}$$

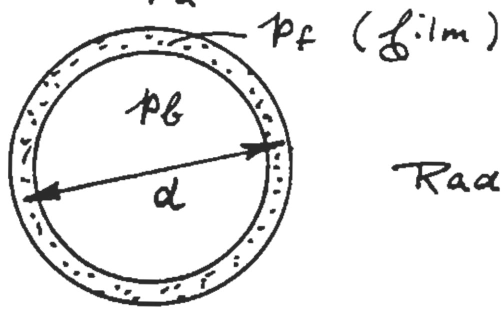
$$\left.\frac{\text{lbm}}{\text{ft}^3} \ \frac{\text{ft}}{\text{s}} \ \text{ft} \qquad \frac{\text{cP}}{\text{cP} \ \text{lbm}/\text{ft s}}\right\} \text{ All units cancel}$$

$$\doteq \underline{\underline{87,740}} \quad (\text{dimensionless})$$

1.6

Pressure in Bubble

Atmosphere p_a



Radius $a = \frac{d}{2}$

From notes, the increase in pressure as we go inwards across a convex surface is

$$\left.\begin{aligned} p_f - p_a &= \frac{2\sigma}{a} \\ p_b - p_f &= \frac{2\sigma}{a} \end{aligned}\right\} \text{Two surfaces are involved}$$

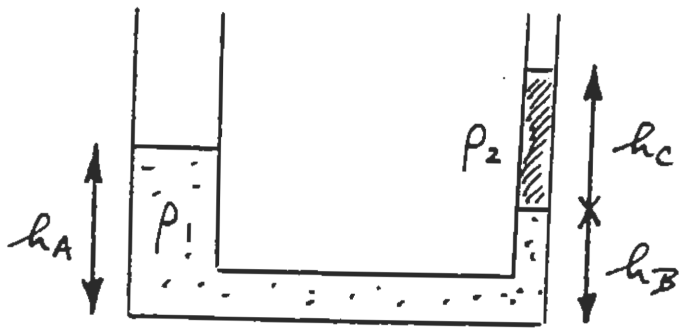
Hence, by addition,

$$p_b - p_a = \frac{4\sigma}{a} = \frac{8\sigma}{d}$$

$$p_b = p_a + \frac{8\sigma}{d}$$

1.10-1

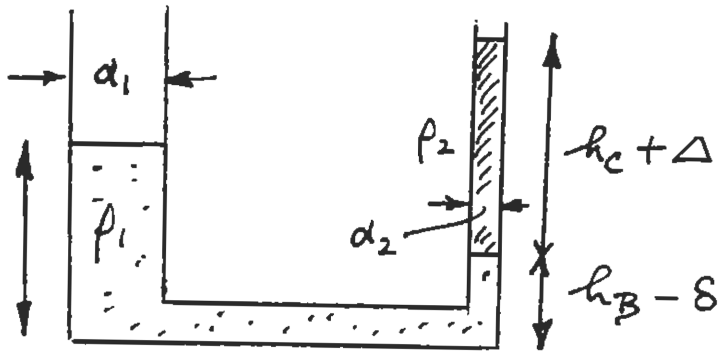
Differential Manometer



$$\rho_1(h_A - h_B) = \rho_2 h_c \qquad (1)$$

Before

Now add Δ to h_c and let h_B decline by δ



After

$$\rho_1\left(h_A + \delta\frac{d_2^2}{d_1^2} - (h_B - \delta)\right) = \rho_2(h_c + \Delta) \qquad (2)$$

Subtract (1) from (2)

$$\rho_1\,\delta\left(\frac{d_2^2}{d_1^2} + 1\right) = \rho_2\Delta = \rho_2\,\frac{v_2}{\frac{\pi}{4} d_2^2} \qquad (3)$$

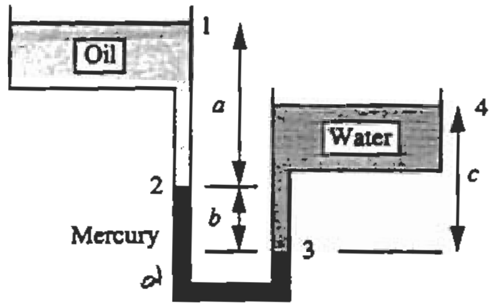
Equation (3) gives δ as a function of v_2, and also enables ρ_2 to be found by observing the value of δ.

1.10-2

Solution for δ gives:

$$\delta = \frac{\rho_2}{\rho_1} \frac{4 v_2}{\pi d_2^2} \left(\frac{d_1^2}{d_1^2 + d_2^2} \right)$$

1.15
Three-Liquid Manometer



From hydrostatics:

$$p_4 = p_1 + \rho_O a g + \rho_M b g - \rho_W c g = p_1$$

Cancel p_1 and divide by $\rho_W g$, with $s = \frac{\rho}{\rho_W}$

$$s_O a + s_M b = c$$

$$b = \frac{c - s_O a}{s_M} = \frac{48 - 0.8 \times 72}{13.6} = -0.706$$

Thus the diagram is incorrect as drawn, and the mercury rises on the right by 0.706 in.