Phy 2 2014/03

Q1.

Let p_1 be the pressure at the intersection of oil and water, p_0 be the atmospheric pressur.

For oil: $p_1 = p_0 + \rho_{oil} g L$ (1)

For water: $p_1 = p_0 + \rho_w g(L - h)$ (2)

From (1) and (2), we obtain:

$$\rho_{oil} g L = \rho_w g(L - h) \rightarrow 0.85L = 1(L - 1.5) \rightarrow L = 10 \text{ (cm)}$$

Q2.

Equation of continuity:

$$A_1 v_1 = A_2 v_2$$

$$\leftrightarrow \frac{\pi d_1^2}{4} v_1 = 40 \frac{\pi d_2^2}{4} v_2$$

$$\rightarrow v_2 = \frac{d_1^2 v_1}{40 d_2^2} = \frac{1^2 \times 2}{40 \times 0.05^2} = 20 \text{ (m/s)}$$

Q3.

From the problem, each rod have to expand $\Delta L = 0.5$ (mm) to touch the point A.

$$\Delta L = L_0 \alpha \Delta T \rightarrow 0.5 \times 10^{-3} = 1 \times 11 \times 10^{-6}(T - 29) \rightarrow T = 74.45 \text{ (°C)}$$

Q4.

$$P_{cond} = \frac{Q}{t} = \frac{L_f m}{t} = \frac{0.25 \times 333 \times 10^3}{3600} = 23.13 \text{ (W)}$$

And,

$$P_{cond} = kA \frac{T_H - T_L}{L} \rightarrow 23.13 = k(6 \times 0.6^2) \frac{30 - 0}{0.03}$$

$$\rightarrow k = 0.011 \text{ (Wm}^{-1}\text{K}^{-1}\text{)}$$

Q5.

Given that: $Q_{BA} = -4.16$ (kJ)

We have: $E_A = E_B \rightarrow \Delta E_{AB} = \Delta E_{BA} = 0$

$$W_{BA} = Q_{BA} - \Delta E_{BA} = -4.16 \text{ (kJ)}$$

$$W_{AB} = \frac{1}{2}(p_A + p_B)(V_B - V_A) = \frac{1}{2}(2 + 1)(6 - 3) = 4.5 \text{ (kJ)}$$

Therefore,

$$W_{net} = W_{AB} + W_{BA} = 4.5 - 4.16 = 0.34 \text{ (kJ)}$$