Phy 2 2018/07

Q1.

For a floating object:

$$F_b = P \rightarrow P = \rho_{water} g V_{sub} = 10^3 \times 9.8 \times 0.6 = 5880 \text{ (N)}$$

Q2.

Equation of continuity:

$$A_1 v_1 = A_2 v_2 \rightarrow v_1 = \frac{A_2 v_2}{A_1} = \frac{9.5 \times v_2}{1.9} = 5 v_2 \text{ (1)}$$

Bernoulli's equation:

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$\leftrightarrow p_1 + \frac{1}{2} \times 1000 \times v_1^2 + 0 = p_2 + \frac{1}{2} \times 1000 \times v_2^2 + 0$$

$$\rightarrow 500(v_1^2 - v_2^2) = p_2 - p_1 = 7.2 \times 10^3 \text{ (2)}$$

From (1) and (2), Solve for v_1 and v_2:

$$\begin{cases} v_1 = 3.87 \text{ (m/s)} \\ v_2 = 0.77 \text{ (m/s)} \end{cases}$$

Thus, the mass flow rate is:

$$R_m = \rho A v = 1000 \times 1.9 \times 10^{-2} \times 3.87 = 73.59 \text{ (kg/m}^3\text{)}$$

Q3.

Iron: $525°\text{C} \xrightarrow{Q_1} T_f °\text{C}$

Water: $15°\text{C} \xrightarrow{Q_2} T_f °\text{C}$

Thermal equilibrium equation:

$$\sum Q = 0 \leftrightarrow Q_1 + Q_2 = 0$$

$$\leftrightarrow m_{iron} c_{iron} (T_f - 525) + m_w c_w (T_f - 15) = 0$$

$$\leftrightarrow 65 \times 0.451 \times (T_f - 525) + 635 \times 4.18 (T_f - 15) = 0$$

$$\leftrightarrow T_f = 20.57 \text{ (°C)}$$

Q4.

For adiabatic process: $Q_{AB} = 0$ (J)

$$\rightarrow Q_{net} = Q_{AB} + Q_{BC} + Q_{CA} = 0 + 23 - 10 = 13 \text{ (J)}$$

For a closed cycle: $\Delta E_{int} = 0 \rightarrow W_{net} = Q_{net} = 13$ (J)

Q5.

For the first slab:

$$P_{cond} = A \frac{T_H - T_L}{\sum L/K} = k_1 A \frac{T_H - T_{12}}{L_1}$$

$$\rightarrow \frac{30 - 15}{\frac{L_1}{k_1} + \frac{L_2}{k_2} + \frac{L_3}{k_3}} = k_1 \frac{30 - T_{12}}{L_1}$$

$$\rightarrow \frac{15}{\frac{L_1}{k_1} + \frac{0.7 L_1}{0.9 k_1} + \frac{0.35 L_1}{0.8 k_1}} = k_1 \frac{30 - T_{12}}{L_1}$$

$$\rightarrow T_{12} = 23.23 \text{ (°C)}$$

Similarly for second slab, we obtain $T_{23} = 17.96$ (°C)