Phy 2 2011/11

Q1.

$$\rho = 1.04\ (\text{g/cm}^3) = 1040\ (kg/m^3)$$
$$p = p_0 + \rho gh = 1.01 \times 10^5 + 1040 \times 9.8 \times 10 = 2.03 \times 10^5\ (\text{Pa})$$

Q2.

Equation of continuity:

$$A_1 v_1 = A_2 v_2 \rightarrow v_2 = \frac{A_1 v_1}{A_2} = \frac{5 \times 4}{8} = 2.5\ (\text{m/s})$$

Bernoulli's equation:

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$
$$\leftrightarrow 1.5 \times 10^5 + \frac{1}{2} \times 1000 \times 5^2 + 1000 \times 9.8 \times 10 = p_2 + \frac{1}{2} \times 1000 \times 2.5^2 + 0$$
$$\rightarrow p_2 = 2.57 \times 10^5\ (\text{Pa})$$

Q3.

We have:

$$\Delta A = A_0 \alpha_A \Delta T \rightarrow 0.11 = 8^2 \times (2\alpha) \times 50 \rightarrow \alpha = 1.72 \times 10^{-5}\ (^\circ\text{C}^{-1})$$

Q4.

Ice: $-10^\circ\text{C} \xrightarrow{Q_1} 0^\circ\text{C}$ (solid) $\xrightarrow{Q_2} 0^\circ\text{C}$ (liquid)

Water: $20^\circ\text{C} \xrightarrow{Q_3} 0^\circ\text{C}$ (liquid)

Thermal equilibrium equation:

$$\sum Q = 0 \leftrightarrow Q_1 + Q_2 + Q_3 = 0$$
$$\leftrightarrow m_{ice} c_{ice}\big(0 - (-10)\big) + L_F m_{ice} + m_w c_w (0 - 20) = 0$$
$$\leftrightarrow m_{ice} \times 2220 \times 10 + 333 \times 10^3 m_{ice} + 4 \times 4190(-20) = 0$$
$$\leftrightarrow m_{ice} = 0.94\ (\text{kg})$$

Q5.

For a closed counter clockwise cycle

$$W = -\frac{1}{2} BC.CA = -\frac{1}{2}(p_C - p_B)(V_C - V_A) = -\frac{1}{2}(2-1)(5-3) = -1\ (\text{kJ})$$