Phy 2 2017/08

Q1.

To touch the floor:

$$\Delta L_{sphere} + \Delta L_{cable} = 2 \text{ (mm)}$$
$$\rightarrow 0.35 \times 2 \times 10^{-5}(T - 20) + 10.5 \times 1.2 \times 10^{-5}(T - 20) = 2 \times 10^{-3}$$
$$\rightarrow T = 35.04 \text{ (°C)}$$

Q2.

$$\Delta E_{int} = Q - W = L_F m - p\Delta V$$
$$= 2.26 \times 10^6 \times 10^{-3} - 1.013 \times 10^5 \times (1671 - 1) \times 10^{-6}$$
$$= 2090.83 \text{ (J)}$$

Q3.

Ice: -20°C $\xrightarrow{Q_1}$ 0°C (solid) $\xrightarrow{Q_2}$ 0°C (liquid) $\xrightarrow{Q_3}$ 30°C

Water: 75°C $\xrightarrow{Q_4}$ 30°C

Thermal equilibrium equation:

$$\sum Q = 0 \leftrightarrow Q_1 + Q_2 + Q_3 + Q_4 = 0$$
$$\leftrightarrow m_{ice}c_{ice}\big(0 - (-20)\big) + L_F m_{ice} + m_{ice}c_w(30 - 0) + m_w c_w(30 - 75) = 0$$
$$\leftrightarrow m_{ice} \times 2220 \times 20 + 333 \times 10^3 m_{ice} + m_{ice} \times 4190(30) + 0.75 \times 4190(-45) = 0$$
$$\leftrightarrow m_{ice} = 0.28 \text{ (kg)}$$

Q4.

Bernoulli's equation:

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$
$$\leftrightarrow 2 \times 10^5 + \frac{1}{2} \times 1000 \times 1^2 + 0 = 1.013 \times 10^5 + \frac{1}{2} \times 1000 \times v_2^2 + 0$$
$$\rightarrow v_2 = 14.09 \text{ (m/s)}$$