1. (13) Find the maximum weight that a large cube of wood, 2.0 m on a side and having mass density 600 kg/m³, can support without sinking when floating in water.

\[ W = ? \]

\[ V_{\text{cube}} = (2 \text{ m})^3 = 8 \text{ m}^3 \]

\[ \text{Newton's I/Fw} \]

\[ \Sigma F_y = 0 \quad \uparrow + \]

\[ B - w_{\text{wood}} - w = 0 \]

or \[ W = B - w_{\text{wood}} \]

\[ W_{\text{wood}} = \rho_{\text{wood}} \cdot V_{\text{cube}} = (600 \text{ kg/m}^3) \cdot (0.8 \text{ m}^3) = 480 \text{ kg} \]

\[ B = W_{\text{wood}} \]

\[ W = B - w_{\text{wood}} \]

2. A large diameter pipe carrying water has its area reduced from 0.060 m² at point 1 to 0.010 m² at point 2. Both points are at the same elevation. The gauge pressure at point 1 is \( 10^4 \) Pa and the velocity of the water is 0.1 m/s.

(a) (5) Find the velocity of the water at point 2

\[ A_1 V_1 = A_2 V_2 \]

\[ (0.060 \text{ m}^2) \cdot 1 \text{ m/s} = (0.010 \text{ m}^2) \cdot V_2 \]

\[ V_2 = \frac{6 \text{ m/s}}{1} \]

(b) (6) Find the gauge pressure of the water at point 2.

\[ \rho = 10^3 \text{ kg/m}^3 \]

\[ p_{2c} - p_{1c} = \frac{1}{2} \rho (V_1^2 - V_2^2) + \rho g (y_1 - y_2) \]

\[ p_{2c} - 10^4 \text{ N/m}^2 = \frac{1}{2} \left( 10^3 \text{ kg/m}^3 \right) \left( 1 \text{ m/s}^2 \right)^2 - (1.6 \text{ m/s}^2) \]

\[ p_{2c} = 10,000 \frac{\text{N}}{\text{m}^2} - 175 \frac{\text{N}}{\text{m}^2} = 9825 \text{ Pa} \]

(c) (3) Find the absolute pressure of the water at point 2.

\[ p_{AB} = p_{2c} + p_{\text{atm}} = 9825 \text{ Pa} + 101,300 \text{ Pa} = 111,125 \text{ Pa} \]

3. (13) Find the total amount of heat that must be added to change 1.0 kg of ice at 0°C to 1.0 kg of liquid water at 50°C.

\[ \text{Heat to melt ice} = m \cdot L_f = (1 \text{ kg}) \cdot (334,000 \text{ J/kg}) = 334,000 \text{ J} \]

\[ \text{Heat to raise temp} = m \cdot c \cdot \Delta T = (1 \text{ kg}) \cdot (4190 \text{ J/kg} \cdot \text{K}) \cdot (50 \text{ °C}) = 209,500 \text{ J} \]

\[ \text{Total heat required} = 543,500 \text{ J} \]

Some equations:

\[ p_1 - p_2 = \rho g (y_2 - y_1) + \frac{1}{2} \rho (v_1^2 - v_2^2) \]

\[ A_1 v_1 = A_2 v_2 \]

\[ Q = m \cdot c \cdot \Delta T \]

\[ Q = m \cdot L_f \]

\[ 1 \text{ atm} = 1.013 \times 10^5 \text{ Pa} \]

\[ \rho_{\text{water}} = 1000 \text{ kg/m}^3 \]

\[ c_{\text{water}} = 4190 \text{ J/kg} \cdot \text{K} \]

\[ c_{\text{ice}} = 2100 \text{ J/kg} \cdot \text{K} \]

\[ m = \rho \cdot V \]

\[ \text{For ice} \]

\[ L_f = 334 \times 10^3 \frac{\text{J}}{\text{kg}} \]

\[ L_v = 2256 \times 10^3 \frac{\text{J}}{\text{kg}} \]