Physics 260 Homework Assignment 7

1 PSE6 20.P.002

The work done on the falling block is equal to the work done on the water due to the rotating blades, which increase the internal energy of the system,

$$2M_{block}gh = M_{water}c\Delta T$$
$$\Delta T = \frac{2M_{block}gh}{M_{water}c}$$

2 PSE6 20.P.003

$$c = \frac{Q}{m\Delta T}$$

3 PSE6 20.P.004

$$\Delta T = \frac{Q}{mc}$$
$$T_f = \frac{Q}{mc} + T_i$$

4 PSE6 20.P.007

$$Q_{cold} = Q_{hot}$$
$$M_{H_2O}c_{H_2O}(T_f - T_{H_2O}) = M_{Fe}c_{Fe}(T_f - T_{Fe})$$

Solve for T_f.

5 PSE6 20.P.013

The mass of 1.00m^3 of water is 1000kg. To raise it this amount of water from the initial temp to final temp requires the following amount of heat,

$$Q = mc(T_f - T_i)$$

The power from the solar collector is $P = IA$. The amount of time it requires is P/Q.

6 PSE6 20.P.015

This problem consists five steps. First, temperature of the ice cube changes from T_{ice} to 0°C. Then, a phase change occurs. Some heat is required for the ice liquidize. Once the ice is completely melted, the temperature of the water start to rise from 0°C to 100°C. After this, the water starts to vaporize. Finally, after all the water has vaporized, the temperature of the steam increases from 100°C to final temperature T_f. Therefore, the total energy required is

$$Q = mc_{ice}(0°\text{C} - T_i) + mL_f + mc_{water}(100°\text{C} - 0°\text{C}) + mL_v + mc_{watervapor}(T_f - 100°\text{C})$$

7 PSE6 20.P.017

To find out the amount of ice melted, we need to first calculate the heat(energy) released by the bullet. Since the bullet can't melt all the ice, the final temperature of the bullet is 0°C. Also, the final speed of the bullet is $0m/s$ since it is embedded. All the kinetic energy is transformed into heat to melt the ice. Therefore, the amount of melt ice is

$$\frac{1}{2}m_{bullet}v^2 + m_{bullet}c_{lead}\Delta T = m_{meltice}L_f$$

8 PSE6 20.P.019

$$m_{cu}c_{cu}(77.3K - T_i) = m_{N_2}L_{vN_2}$$

9 PSE6 20.P.021

a. Since the heat required to melt the given amount of ice at 0°C exceeds the heat required to cool the temperature of the water to 0°C, the final temperature of the system is 0°C.

b. Assume m grams of ice remains when the system reaches equilibrium, then the amount of ice melt is $(m_{ice} - m)$. We have

$$(m_{ice} - m)L_f = m_{water}c_{water}(T_i - 0°\text{C})$$

10 PSE6 20.P.024

a. The work done on the fluid is equal to the negative of the area under the curve, $W = -\int PdV$.

b. Since the process is reversed, the value you get for this part should be negative of part (a).

11 PSE6 20.P.028

a.

$$W = -P\Delta V = -P(V_f - V_i)$$

b. Since energy leaves the gas by heat, Q is negative. The change in the internal energy is

$$\Delta E_{int} = Q + W$$

12 PSE6 20.P.030

a. Since its is a cyclic process, the internal energy is not changed. So $Q = -W =$ area of the triangle.

b. Negative of the value found in part (a).

13 PSE6 20.P.035

a. Energy is transferred to the gas by heat, so Q is positive. The change in the internal energy is

$$\Delta E_{int} = Q + W = Q - P(V_f - V_i)$$

b.

$$\frac{V_i}{T_i} = \frac{V_f}{T_f}$$