Physics 1114: Unit 7 Homework

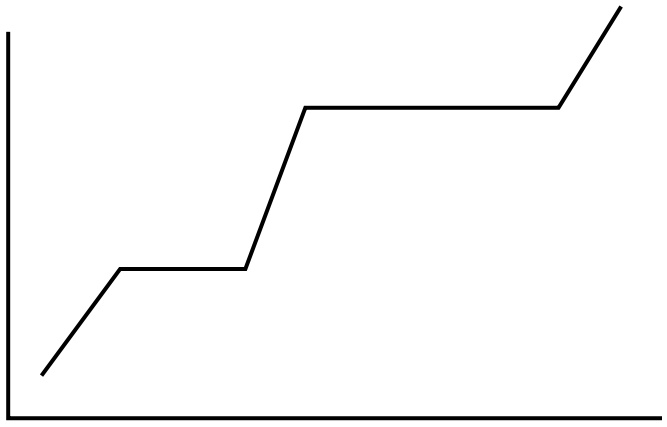
Use the table in your text for specific heat capacity values.

Problem set 1

1. How much energy is released when 7 kg (about 15 pounds) of fuel oil are burned? ($H_{\mathrm{C}} = 43\,\mathrm{MJ/kg}$).
2. An average person in the USA needs only 8.5 million joules of energy supply per day. How many kilograms of American cheese will supply this need? ($H_{\mathrm{C}} = 17\,\mathrm{MJ/kg}$).
3. How many kilocalories are required to heat 72 kg of water from 20°C to 26°C?
4. When 110 kilocalories are removed from 62 kg of water at 85°C, what will the final temperature be?
5. Coal is being burned to heat 108 kg of water from 18°C to 65°C. The efficiency of the transfer process is 80%. How much coal will be required if its Heat of Combustion is 3.3×10^7 J/kg?
6. What is the equilibrium temperature of 4.0 kg of aluminum at 80°C added to 10 kg of air at 20°C? [Specific heat capacity of air = 703 J/(kg C°) at constant volume.]
7. What is the specific heat capacity of a 2.5 kg object if it causes a 12 C° temperature drop in 10.0 kg of water? The object is initially at 5.0°C, and the water is initially at 80°C.

Problem set 2

1. When 0.80 kg of glass is added to 2.0 kg of water, the temperature of the water falls from 92°C to 86°C. What was the initial temperature of the glass?
2. Label the axes, significant temperatures and thermal processes on the phase diagram. (For example, for water.)



3. How much energy does a freezer have to remove from 1.5 kg of water at 20°C to make ice at -12°C?

4. How much heat energy is needed to melt 13.00 kg of silver that is initially at 20°C?

   Specific Heat of Silver = 236 J/(kg C°) Melting point = 961°C
   Heat of Fusion = 8.7990×10^4 J/kg Heat of Vaporization = 2.338 MJ/kg

5. A soda biscuit has a mass of 8.2×10^{-3} kg and a Heat of Combustion of 1.26×10^7 J/kg. How many such biscuits must a 90-kg man eat to supply sufficient energy for him to climb the stairs to the top of a building 80 m high assuming 20% of the energy is utilized for climbing?

Problem set 3

1. Name, define and give an example of the three methods of heat transfer. Use complete sentences.

2. State the First and Second Laws of Thermodynamics.

3. Draw and label schematic diagrams of a heat engine and a heat pump. Include Q_{H}, Q_{C}, T_{H}, T_{C}, and W. What is the major difference in your two schematic diagrams?

4. Calculate the maximum theoretical (Carnot) efficiency of a power plant that has a high-temperature reservoir of 520°C and a low-temperature exhaust of 57°C.

5. An engine takes in 9200 J of energy and performs 1720 J of work each cycle while operating between temperatures of 690°C and 400°C. Determine the engine's actual efficiency and its Carnot efficiency. Why are these values not the same?

6. Determine the maximum coefficient of performance of a heat pump used to heat the inside of a house to 22°C when the outside temperature is 6°C.

7. A refrigerator has a coefficient of performance of 6.0. What is the lowest temperature that can be obtained inside the refrigerator if the surrounding air temperature is 30°C?