Chapter 10 Worksheet #2

1. Calculate the energy required (in calories) to heat 10.4 g of mercury from 37.0°C to 42.0°C. Specific heat of mercury is 0.14 J/g°C.

\[ q = m \cdot c \cdot \Delta t \]

\[ q = 10.4 \text{ g} \cdot 0.14 \text{ J/g}^\circ \text{C} \cdot 5.00 \text{ } \circ \text{C} = 7.28 \text{ J} = \frac{1 \text{ cal}}{4.184 \text{ J}} = 1.74 \text{ cal} \]

2. If 50. J of heat are applied to 10. g of iron, by how much will the temperature of the iron increase? The specific heat of iron is 0.45 J/g°C.

\[ \Delta t = \frac{q}{m \cdot c} \]

\[ \Delta t = \frac{50 \text{ J}}{10 \text{ g} \cdot 0.45 \text{ J/g}^\circ \text{C}} = 11 \text{ } \circ \text{C} \]

3. Calculate the amount of energy required (in calories) to heat 145 g of water from 22.3°C to 75.0°C.

\[ q = m \cdot c \cdot \Delta t \]

\[ q = 145 \text{ g} \cdot 1.00 \text{ J/g}^\circ \text{C} \cdot (75 \text{ } ^\circ \text{C} - 22.3 \text{ } ^\circ \text{C}) = 145 \text{ g} \cdot 1.00 \text{ J/g}^\circ \text{C} \cdot 52.7 \text{ } ^\circ \text{C} = 7641.5 \text{ cal} = 7640 \text{ cal} \]

4. If 52.5 kJ of heat is heated to a 1.02 kg block of metal, the temperature of the metal increases by 11.2°C. Calculate the specific heat capacity of the metal in J/g°C.

\[ c = \frac{q}{m \cdot \Delta t} \quad \text{convert units} \quad 52.5 \text{ kJ} = 52,500 \text{ J} \quad \text{and} \quad 1.02 \text{ kg} = 1,020 \text{ g} \]

\[ c = \frac{52,500 \text{ J}}{1,020 \text{ g} \cdot 11.2 \text{ } ^\circ \text{C}} = 4.60 \text{ J/g}^\circ \text{C} \]

5. If \(4.524 \times 10^3\) J of heat is applied to a 742.1 g sample of iron, by how many degrees Celsius will the temperature of the iron sample increase? Specific heat is 0.45 J/g°C.

\[ \Delta t = \frac{q}{m \cdot c} \]

\[ q = 4.524 \times 10^3 \text{ J} / 742.1 \text{ g} \cdot 0.45 \text{ J/g}^\circ \text{C} = \frac{4.524 \times 10^3 \text{ J} \cdot ^\circ \text{C}}{742.1 \text{ g} \cdot 0.45 \text{ J}} = 0.013547141 \text{ } ^\circ \text{C} = 0.01355 \text{ } ^\circ \text{C} \quad \text{or} \quad 1.355 \times 10^2 \text{ } ^\circ \text{C} \]
6. What was the initial temperature of a 32.5 g iron bar if 276.8 J of energy were applied resulting in a final temperature of 95.4°C? The specific heat capacity of solid iron is 0.45 J/g°C.

\[ \Delta t = \frac{q}{mc} \]

\[ \Delta t = \frac{276.8 \text{ J}}{32.5 \text{ g} \cdot 0.45 \text{ J/g°C} } = \frac{276.8 \text{ J} \cdot \text{g°C}}{32.5 \text{ g} \cdot 0.45 \text{ J}} = \frac{18.9 \text{ °C}}{95.4 \text{ °C} - 18.9 \text{ °C} } = 76.5 \text{ °C} \]

7. Are the following processes exothermic or endothermic?
   a. the combustion of gasoline in a car engine  
      Exothermic
   b. water condensing on a cold pipe  
      Endothermic
   c. \( \text{CO}_2 (s) \rightarrow \text{CO}_2 (g) \)  
      Endothermic
   d. \( \text{F}_2 (g) \rightarrow 2 \text{ F} (g) \)  
      Exothermic

8. Why does ice float on the surface of liquid water?

   It is less dense then water (the Crystallized structure).

9. Perform the following conversions.
   a. 850 cal to J  
      \[ 850 \text{ cal} \times \frac{4.184 \text{ J}}{1 \text{ cal}} = 3556.4 \text{ J} \]

   b. 5.901 J to cal  
      \[ 5.901 \text{ J} \times \frac{1 \text{ cal}}{4.184 \text{ J}} = 1.421 \text{ cal} \]