55 pts

Heat Problems

1. (5 pts)How much heat energy is needed to raise 44.0 g of gold from 14°C to 47°C?

$$q = m s \Delta T = (44.0g)\left(\frac{.13\ J}{g\ °C}\right)(33°C) = 190\ J$$

$$\Delta T = T_f - T_i = 47°C - 14°C = 33°C$$

2. (5 pts)How much heat energy is needed to raise 2.53 L of water from 31°C to 100.°C?

$$m = 2.53\ L \times \frac{1000\ mL}{1\ L} \times \frac{1\ g}{1\ mL} = 2530\ g$$

$$\Delta T = 100 - 31 = 69°C$$

$$q = m s \Delta T = (2530g)\left(\frac{4.184\ J}{g\ °C}\right)(69°C) = 730{,}000\ J \text{ or } 730\ kJ$$

3. (5 pts)An aluminum pop can loses 583 J of heat energy when it goes from room temperature, 22°C to a fridge at 0.00°C. If the pop can has a mass of 28.5 g, what is the specific heat of this aluminum can?

$$q = m s \Delta T$$

$$s = \frac{q}{m \Delta T} = \frac{+583\ J}{(28.5g)(+22°C)} = \frac{.93\ J}{g\ °C}$$

$$\Delta T = 0 - 22 = -22°C$$

4. (5 pts)4.3 kJ of heat energy is needed to change the temperature of 13.3 g of water. What is the change in temperature for the water?

$$q = 4.3\ kJ \times \frac{1000\ J}{1\ kJ} = 4300\ J$$

$$q = m s \Delta T$$

$$\Delta T = \frac{q}{m s} = \frac{4300\ J}{(13.3g)\left(\frac{4.184\ J}{g\ °C}\right)} = 77°C$$

5. (5 pts)170 kJ of energy is required to heat a 1.00 kg iron skillet. If the initial temperature of the skillet is room temperature, what is the final temperature of the skillet?

$q = m s \Delta T$ $\qquad\qquad$ $\Delta T = T_f - T_i$

$\Delta T = \frac{q}{m s} = \frac{170{,}000\,J}{(1000\,g)\left(\frac{.45\,J}{g\,°C}\right)} = 378\,°C$ $\qquad$ $T_f = \Delta T + T_i$

$= 378 + 22 = 400.\,°C$

6. (10 pts)A piece of an unknown metal with a mass of 23.8 g is heated to 100.°C and dropped into 50.0 mL of water at 24.0°C. The final temperature of the system is 32.5°C. What is the specific heat of the metal?

$-q_L = q_g$

metal = water

$\Delta t_m = 32.5°C - 100°C = -67.5°C$

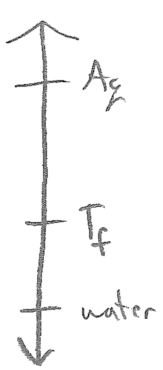
$50.0\,mL \times \frac{1\,g}{1\,mL} = 50\,g$

$\Delta t_w = 32.5°C - 24.0°C = 8.5°C$

$-m_m s_w \Delta T_m = m_w s_w \Delta t_w$

$S_m = \frac{m_w s_w \Delta t_w}{-m_m \Delta t_m} = \frac{(50.0\,g)\left(\frac{4.184\,J}{g\,°C}\right)(8.5\,°C)}{+(23.8\,g)(+67.5\,°C)} = 1.1\,\frac{J}{g\,°C}$

7. (10 pts)100.0 g of room temperature water is mixed with 200.0 g of silver metal with an initial temperature of 97°C. What is the final temperature of the mixture?



$-q_L = q_g$

$-m_s s_s \Delta T_s = m_w s_w \Delta T_w$

$-(200.0\,g)\left(\frac{.24\,J}{g\,°C}\right)(T_f - 97\,°C) = (100.0\,g)\left(\frac{4.184\,J}{g\,°C}\right)(T_f - 22\,°C)$

$-48 T_f + 4656 = 418.4\,T_f - 9205$

$+48\,T_f \quad + 9205 \qquad +48\,T_f \quad + 9205$

$\frac{13{,}861}{466.4} = \frac{466.4\,T_f}{466.4}$ $\qquad$ $T_f = 29.7\,°C$

or

$30.\,°C$