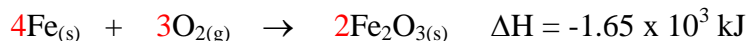


1. Iron is oxidized to rust when elemental iron reacts with oxygen in the presence of water. The unbalanced chemical equation for this process is shown below: (4 pts)



(a) How much heat is evolved when 0.100 kg of iron rusts?

$$0.100 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{\text{mol}}{55.8 \text{ g}} \times \frac{-1.65 \times 10^3 \text{ kJ}}{4 \text{ mol}} = -739.2 \text{ kJ}$$

(b) How many grams of rust forms when 4.93×10^3 kJ of heat is released?
released = exothermic (negative q)

$$-4.93 \times 10^3 \text{ kJ} \times \frac{2 \text{ mol}}{-1.65 \times 10^3 \text{ kJ}} \times \frac{159.6 \text{ g}}{\text{mol}} = 953.7 \text{ g}$$

2. Some cooking pans have a layer of copper on the bottom. How many joules are needed to raise the temperature of 125 g of copper from 22 °C to 325 °C, the specific heat (S_{cu}) of copper is 0.387 J/g °C? (3 pts)

$$q = m_{\text{cu}} \times S_{\text{cu}} \times \Delta T$$

$$q = 125 \text{ g} \times 0.387 \frac{\text{J}}{\text{g}^\circ\text{C}} \times (325^\circ\text{C} - 22^\circ\text{C}) = 14658 \text{ J}$$

3. A 505 g piece of copper tubing is heated to 99.9 °C and placed into a calorimeter containing 59.8 g of water at 24.8 °C. If the heat capacity (C_{cal}) for the calorimeter is 10.0 J/°C, what is the final temperature of the copper tubing? *Hint: The surroundings include the water and the calorimeter.* (3 pts)

$$S_{\text{cu}} = 0.387 \text{ J/g } ^\circ\text{C} \quad \Delta T = T_f - T_i$$

$$-q_{\text{cu}} = q_{\text{surroundings}}$$

$$-(m_{\text{cu}} \times S_{\text{cu}} \times \Delta T_{\text{cu}}) = C_{\text{cal}}\Delta T_w + m_w \times S_w \times \Delta T_w$$

$$\begin{aligned} -505 \text{ g} \times 0.387 \frac{\text{J}}{\text{g}^\circ\text{C}} \times (T_f - 99.9^\circ\text{C}) \\ = 10.0 \frac{\text{J}}{^\circ\text{C}} \times (T_f - 24.8^\circ\text{C}) + 59.8 \text{ g} \times 4.184 \frac{\text{J}}{\text{g}^\circ\text{C}} (T_f - 24.8^\circ\text{C}) \end{aligned}$$

$$-195.44 \frac{\text{J}}{^\circ\text{C}} T_f + 19524.46 \text{ J} = 10.0 \frac{\text{J}}{^\circ\text{C}} T_f - 248 \text{ J} + 250.2 \frac{\text{J}}{^\circ\text{C}} T_f - 6205.04 \text{ J}$$

$$-195.44 \frac{\text{J}}{^\circ\text{C}} T_f + 19524.46 \text{ J} = 260.2 \frac{\text{J}}{^\circ\text{C}} T_f - 6453.04 \text{ J}$$

$$25977.5 \text{ J} = 455.64 \frac{\text{J}}{^\circ\text{C}} T_f$$

$$T_f = \frac{25977.5 \text{ J}}{455.64 \text{ J/}^\circ\text{C}} = 57.0^\circ\text{C}$$