Name Mr. Perfect Data F11

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)

$$4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)} \quad \Delta H = -1.65 \times 10^3 \text{ kJ}$$

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

$$0.100\ kg \times \frac{1000\ g}{1\ kg} \times \frac{mol}{55.8\ g} \times \frac{-1.65x10^3 kJ}{4\ mol} = -739.2\ kJ$$

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

released = exothermic (negative q)

$$-4.93x10^3 kJ \times \frac{2\ mol}{-1.65x10^3 kJ} \times \frac{159.6\ g}{mol} = 953.7\ g$$

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)

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

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

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)

$S_{cu} = 0.387$ J/g °C $\qquad \Delta T = T_f - T_i$

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

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

$$-505g \times 0.387 \frac{J}{g°C} \times (T_f - 99.9°C)$$

$$= 10.0 \frac{J}{°C} \times (T_f - 24.8°C) + 59.8g \times 4.184 \frac{J}{g°C}(T_f - 24.8°C)$$

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

$$-195.44 \frac{J}{°C} T_f + 19524.46J = 260.2 \frac{J}{°C} T_f - 6453.04J$$

$$25977.5J = 455.64 \frac{J}{°C} T_f$$

$$T_f = \frac{25977.5\ J}{455.64\ J/°C} = 57.0°C$$