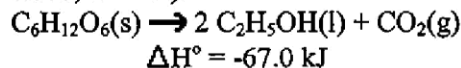


Stoichiometry and Heat Capacity

1. Calculate the heat evolved (kJ) for the reaction in which 9.00 g of $C_6H_{12}O_6$ is fermented to form ethyl alcohol

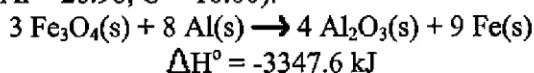
(Atomic weights: C = 12.01, H = 1.008, O = 16).



$$9.00 \text{ g } C_6H_{12}O_6 \times \frac{1 \text{ mol } C_6H_{12}O_6}{180 \text{ g } C_6H_{12}O_6} \times \frac{-67.0 \text{ kJ}}{1 \text{ mol } C_6H_{12}O_6} = \boxed{-3.35 \text{ kJ}}$$

2. Calculate the heat energy (kJ) released when 15 g of Fe_3O_4 reacts with excess Al according to the following reaction.

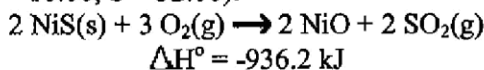
(Atomic weights: Fe = 55.85, Al = 26.98, O = 16.00).



$$15.0 \text{ g } Fe_3O_4 \times \frac{1 \text{ mol } Fe_3O_4}{231.6 \text{ g } Fe_3O_4} \times \frac{-3347.6 \text{ kJ}}{3 \text{ mol } Fe_3O_4} = \boxed{-72.3 \text{ kJ}}$$

3. What quantity of heat is liberated by a reaction that produces 50.0 g of SO_2 in the following reaction?

(Atomic weights: Ni = 58.69, O = 16.00, S = 32.06).



$$50.0 \text{ g } SO_2 \times \frac{1 \text{ mol } SO_2}{64 \text{ g } SO_2} \times \frac{-936.2 \text{ kJ}}{2 \text{ mol } SO_2} = \boxed{-366 \text{ kJ}}$$

4. A 25.0 g piece of copper at 25.0°C is put into an insulated vessel containing 100 g of water at 40.0°C . What will be the final temperature ($^\circ\text{C}$) of the water? The specific heat of copper and water are $0.385 \text{ J/g}^\circ\text{C}$ and $4.18 \text{ J/g}^\circ\text{C}$ respectively.

$$m_1 s_1 \Delta T_1 = m_2 s_2 \Delta T_2$$

$$m_{Cu} s_{Cu} \Delta T_{Cu} = - m_{H_2O} s_{H_2O} \Delta T_{H_2O}$$

$$(25.0 \text{ g})(0.385 \text{ J/g}^\circ\text{C})(T_f - 25.0^\circ\text{C}) = - (100 \text{ g})(4.18 \text{ J/g}^\circ\text{C})(T_f - 40.0^\circ\text{C})$$

$$9.625 T_f - 240.625 = -418 T_f + 16720$$

$$427.625 T_f = 16960.625$$

$$T_f = 39.7^\circ\text{C}$$

5. How much heat energy (kJ) must be supplied to heat 400.0 g of isopropyl alcohol from 20.0°C to 60.0°C in a stainless steel vessel weighing 550.0 g. The specific heat of isopropyl alcohol and stainless steel are $2.58 \text{ J/g}^\circ\text{C}$ and $0.51 \text{ J/g}^\circ\text{C}$ respectively.

$$q_{\text{total}} = q_{\text{alcohol}} + q_{\text{vessel}} = (400.0 \text{ g})(2.58 \text{ J/g}^\circ\text{C})(60.0 - 20.0^\circ\text{C}) + (550.0 \text{ g})(0.51 \text{ J/g}^\circ\text{C})(60 - 20)$$

$$q = 52500 \text{ J} = \boxed{52.5 \text{ kJ}}$$

6. A sheet of 10.0 g of copper at 22.0°C is placed on a 20.0 g sheet of aluminum at 75.0°C . What is the final temperature of the two metals assuming that no heat is lost to the surroundings. The specific heats of copper and aluminum are $0.385 \text{ J/g}^\circ\text{C}$ and $0.900 \text{ J/g}^\circ\text{C}$ respectively.

$$m_{Cu} s_{Cu} \Delta T_{Cu} = - m_{Al} s_{Al} \Delta T_{Al}$$

$$(10.0 \text{ g})(0.385 \text{ J/g}^\circ\text{C})(T_f - 22.0^\circ\text{C}) = - (20.0 \text{ g})(0.900 \text{ J/g}^\circ\text{C})(T_f - 75.0^\circ\text{C})$$

$$3.85 T_f - 84.7 = -18 T_f + 1350$$

$$21.85 T_f = 1434.7$$

$$T_f = 65.7^\circ\text{C}$$