Chapter 16 – Problem Set 1

Michael Brodskiy
Instructor: Mr. Morgan

April 9, 2020

1.

$$\begin{aligned} 2\,CH_3OH &\longrightarrow 2\,CH_4 + O_2 \\ \Delta G_{CH_3OH} &= -166.3\left[\frac{kJ}{mol}\right] \\ \Delta G_{CH_4} &= -50.7\left[\frac{kJ}{mol}\right] \\ \Delta G_{O_2} &= 0\left[\frac{kJ}{mol}\right] \\ \Delta G = 2(-50.7) - 2(-166.3) &= 231.2[kJ] \\ \text{Not Thermodynamically Feasible} & \end{aligned} \tag{1}$$

2. (a)

$$\begin{aligned} \text{Formed: } & 0 \\ \text{Broken: } & N \equiv N \\ 0 - 950 &= 950\left[\frac{kJ}{mol}\right] \end{aligned} \tag{2}$$

   (b) It is becoming more orderly, so negative

   (c) It is this way because the sign of ΔS is negative. Because the sign is negative, ΔH is the only negative part of the formula. In this manner, the greater the temperature ΔS is multiplied by, the greater the ΔG

   (d) The kinetic energy of the molecules is too low to spontaneously collide at this low temperature.

3. (a) i.

$$\frac{75}{56} = 1.34[mol] \tag{3}$$

ii.

$$\begin{aligned} n &= \frac{PV}{RT} \\ \frac{2.66 \cdot 11.5}{298 \cdot .0821} &= 1.25[\text{mol}] \end{aligned} \tag{4}$$

(b)

$$\begin{aligned} \frac{1.34}{2} &= .67[\text{mol}_{\text{Fe}}] \\ \frac{1.25}{1.5} &= .83[\text{mol}_{\text{O}_2}] \\ \text{mol}_{\text{Fe}} &< \text{mol}_{\text{O}_2} \\ \text{So Fe is limiting} & \end{aligned} \tag{5}$$

(c)

$$\begin{aligned} \text{mol}_{\text{Fe}_2\text{O}_3} &= \frac{\text{mol}_{\text{Fe}}}{2} \\ \frac{1.34}{2} &= .67[\text{mol}_{\text{Fe}_2\text{O}_3}] \end{aligned} \tag{6}$$

(d) i.

$$\begin{aligned} \Delta G_f^\circ &= \Delta H_f^\circ - T\Delta S_f^\circ \\ -740 &= -824 - 298(\Delta S_f^\circ) \\ \Delta S_f^\circ &= -.282 \left[\frac{\text{kJ}}{\text{mol K}}\right] \end{aligned} \tag{7}$$

ii. Enthalpy because the magnitude of enthalpy >> the magnitude of entropy

(e)

$$\begin{aligned} -280 &= \Delta H_{\text{Fe}_2\text{O}_3} - 2\Delta H_{\text{FeO}} \\ \Delta H_{\text{FeO}} &= \frac{-280 + 824}{-2} \\ &= -272 \left[\frac{\text{kJ}}{\text{mol}}\right] \end{aligned} \tag{8}$$