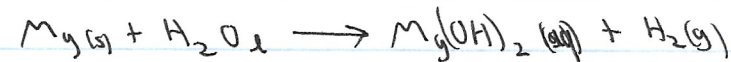


# Thermo HW 7

1.)



$$m_{\text{Mg}} = 9.5 \text{ g}$$

$$m_w = 28.35 \text{ g}$$

Need: 2 H<sub>2</sub>O for 1 Mg

$$\therefore n_{\text{Mg}} = \frac{m_{\text{Mg}}}{M_{\text{Mg}}} = \frac{9.5 \text{ g}}{24.305 \text{ g/mol}} = 0.391 \text{ mol}$$

$$n_w \geq 2(n_{\text{Mg}}) \therefore \boxed{\text{We have enough water}}$$

$$n_w = \frac{m_w}{M_w} = \frac{28.35 \text{ g}}{18.015 \text{ g/mol}} = 1.574 \text{ mol}$$

1.)

$$H_f - H_i \stackrel{!}{=} 0$$

$$n_f \epsilon = n_i \epsilon + n_i \epsilon_c$$

$$H_i(\text{O}) = n (\Delta H_{\text{TR}}^f + C_p \Delta T)$$

$T_i - T_R$

$$H_{i,w} = \left( \frac{600 \text{ g}}{18 \text{ g/mol}} + 1.574 \right) \left( -285.8 + 0.0753 (293.15 - 298.15) \right)$$

$$H_{i,w} = -9981.63 \text{ kJ}$$

$$H_{i,\text{Mg}} = 0.391 \left( 0 + 0.0249 (293.15 - 298.15) \right) = -0.049 \text{ kJ}$$

$$H_{i,\text{Mg(OH)}_2} = 0$$

$$H_i \text{ H}_2 = 0$$

$$H_{f,w} = -9622.11 \text{ kJ}$$

$$\Delta H_{f,\text{Mg}} = 0$$

$$H_{f,\text{Mg(OH)}_2} = -360,106 \text{ kJ}$$

$$H_{f,\text{H}_2} = 0.5391 \text{ kJ}$$

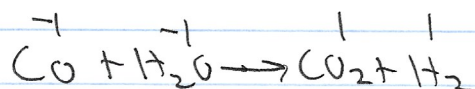
$$H_{i,\text{tot}} = -9981.7$$

$$H_{f,\text{tot}} = -9981.68$$

When  $\Delta H = 0$ ,  $\boxed{T = 72.89^\circ\text{C}}$

Solved in Excel

2.  $T_1 = 298.15 \text{ K}$ ,  $T_2 = 1250 \text{ K}$



$$\Delta H_T = \Delta H_R + \Delta a (T - T_R) + \frac{\Delta b}{2} (T^2 - T_R^2) + \frac{\Delta c}{3} (T^3 - T_R^3) + \frac{\Delta d}{4} (T^4 - T_R^4)$$

$$\Delta H_R = \sum v_i \Delta H_{f,i}$$

$$\Delta a = \sum v_i a_i$$

@ 298.15 K :  $T = T_R \therefore \Delta H_T = \Delta H_R + 0 \rightarrow \Delta H_T = \sum v_i H_{f,i}$   
 $\therefore \Delta H_T = -41.145 \frac{\text{kJ}}{\text{mol}}$  (Solved in excel)

@ 1250 K :  $\Delta a = 0.031(-1) + 0.32(-1) + 0.0198(1) + 0.027(1)$   
 $\Delta a = -1.62 \times 10^{-2}$

Repeat with values of b, c, d  
 (Solved in excel)

$$\Delta a = -1.62 \times 10^{-2}$$

$$\Delta b = 9.36 \times 10^{-5}$$

$$\Delta c = -1.08 \times 10^{-7}$$

$$\Delta d = 4.11 \times 10^{-11}$$

$$\therefore \Delta H_T = -41.145 + \Delta a (1250 - 298.15) + \frac{\Delta b}{2} (1250^2 - 298.15^2) + \frac{\Delta c}{3} (1250^3 - 298.15^3) + \dots$$

Solved in excel :  $\Delta H_T = -32.1 \frac{\text{kJ}}{\text{mol}}$

3.) Closed, steady, Reversible :  $\frac{ds}{dt} = \sum \frac{Q}{T} + S_{gen}$   
 $\downarrow$   $\downarrow$   
 $\frac{ds}{dt} = 0$   $S_{gen} = 0$

$$0 = \sum \frac{\dot{Q}}{T} = \frac{1200 \text{ kW}}{1000 \text{ K}} - \frac{300 \text{ kW}}{450 \text{ K}} - \frac{500 \text{ kW}}{X \text{ K}}$$

$$\frac{500}{X} = \frac{12}{10} - \frac{30}{45} \rightarrow \frac{500}{X} = 0.533 \rightarrow X = \frac{500}{0.533} = 938 \text{ K}$$