

CH301H: Principles of Chemistry I: Honors
Spring 2016, Unique 49420

Quiz 1, 26 January 2016

Hydrogen and oxygen gases combine to form hydrogen peroxide, H_2O_2 , which is a liquid at room temperature.

- a) What is the change in enthalpy of the system due to this reaction?
- b) Do you expect this reaction to proceed spontaneously? Justify your answer.

The following information may be helpful.

$$\Delta H_f^0(\text{H}_2\text{O}_2) = -187.8 \text{ kJ mol}^{-1}$$

$$\Delta H_{\text{com}}^0(\text{H}_2\text{O}_2) = -57.2 \text{ kJ mol}^{-1}$$

$$\Delta H_{\text{com}}^0(\text{H}_2) = -285.8 \text{ kJ mol}^{-1}$$

a)

$$\Delta H_{\text{rxn}} = \sum_{\text{Prod.}} \Delta H_f^{\circ} - \sum_{\text{Reac.}} \Delta H_f^{\circ} = \Delta H_f^{\circ}(\text{H}_2\text{O}_2) - (\Delta H_f^{\circ}(\text{O}_2) + \Delta H_f^{\circ}(\text{H}_2))$$

$$\Delta H_{\text{rxn}} = -187.8 \text{ kJ} \cdot \text{mol}^{-1} - (0 + 0)$$

$$\Delta H_{\text{rxn}} = -187.8 \text{ kJ} \cdot \text{mol}^{-1}$$

b) In order to determine whether this reaction proceeds spontaneously, we need to consider both ΔH_{rxn} and ΔS_{rxn} . Above we determined that $\Delta H_{\text{rxn}} < 0$, however $\Delta S_{\text{rxn}} < 0$ due to the reaction going from 2 moles of gas to 1 mole of liquid. Thus, the reaction will probably not proceed spontaneously.