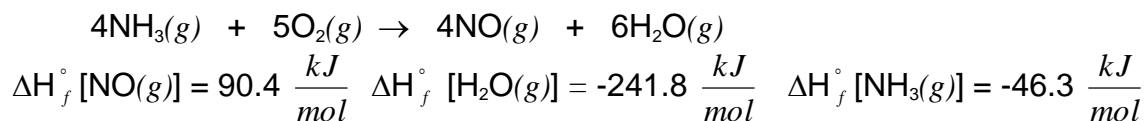


THERMODYNAMICS PROBLEMS

1. Calculate ΔH_{rxn}° for the following reaction at 25 °C.



2. Calculate the entropy change for $2\text{Na}(s) + \text{Cl}_2(g) \rightarrow 2\text{NaCl}(s)$

$$S^\circ \text{ values: Na}(s) = 51.05 \text{ J/mol}\cdot\text{K}, \text{Cl}_2(g) = 223.0 \text{ J/mol}\cdot\text{K}, \text{NaCl}(s) = 72.38 \text{ J/mol}\cdot\text{K}$$

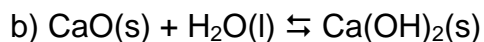
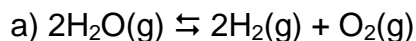
3. a) Calculate ΔG , given $\Delta H = -227 \text{ kJ}$, $\Delta S = -309 \text{ J/K}$, $T = 1450 \text{ K}$.

- b) Is this process spontaneous at this temperature? If not, calculate the temperature (in °C) at which this reaction becomes spontaneous.

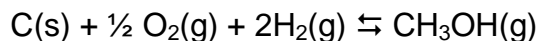
3. ΔG_f° in kJ/mol:



Calculate ΔG° for these reactions and predict whether they will be spontaneous or not.



4. ΔG° is -24.7 kJ/mol for the formation of methanol.



Calculate the equilibrium constant, K , at 25 °C for this reaction.

5. a) At 25 °C, K_a for acetic acid is 1.8×10^{-5} . Predict the sign of ΔG° at 25°C for $\text{CH}_3\text{COOH}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq})$. Calculate ΔG° at 25 °C.

b) Calculate ΔG at 25 °C for the acetic acid equilibrium reaction, when $[\text{H}_3\text{O}^+] = 0.020 \text{ M}$, $[\text{CH}_3\text{COO}^-] = 0.010 \text{ M}$, and $[\text{CH}_3\text{COOH}] = 0.10 \text{ M}$. (Use ΔG° from part a.)

6. ΔG° for the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2 \text{HI}(\text{g})$ is 2.60 kJ/mol at 25°C.

In one experiment, the initial pressures are $P_{\text{H}_2} = 4.3 \text{ atm}$, $P_{\text{I}_2} = 0.34 \text{ atm}$, and $P_{\text{HI}} = 0.23 \text{ atm}$. Calculate ΔG and predict the direction that this reaction will proceed.