

CHM152 QUIZ #9 25 Pts Spring 2005 NAME: Key

Formulas: $\Delta G = \Delta H - T\Delta S$ $\Delta E = q + w$ $\Delta S^\circ = \sum n\Delta S_f^\circ(\text{products}) - \sum n\Delta S_f^\circ(\text{reactants})$

$\Delta H_{\text{rxn}}^\circ = \sum n\Delta H_f^\circ(\text{products}) - \sum n\Delta H_f^\circ(\text{reactants})$

$\Delta G^\circ = \sum n\Delta G_f^\circ(\text{products}) - \sum n\Delta G_f^\circ(\text{reactants})$ $\Delta G = \Delta G^\circ + RT\ln Q$

1. Which of the following substances is likely to have the highest standard entropy in the liquid state? **BE SURE TO EXPLAIN YOUR REASONING.**

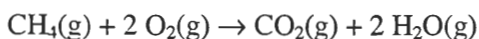
- a. CH₂Cl₂
- b. CCl₄
- c. CH₃OH
- d. C₅H₁₂
- e. C₅H₁₈

Largest structure has most possible disorder (stretching, vibrating, etc.)

2. Of the following product-favored processes, which are endothermic?

- 1. the combustion of methane to produce water and carbon dioxide
- 2. the expansion of an ideal gas
- 3. the melting of ice at temperatures greater than 0°C.

3. Calculate the standard molar entropy change for the combustion of methane.



Species	S° (J/K·mol)
CH ₄ (g)	186.3
O ₂ (g)	205.1
CO ₂ (g)	213.7
H ₂ O(g)	188.8

$\Delta S^\circ = \sum n S^\circ_{\text{prod}} - \sum n S^\circ_{\text{react}}$

$\Delta S^\circ = -5.2 \frac{\text{J}}{\text{K}\cdot\text{mol}}$

4. Predict the signs of ΔH and ΔS for the evaporation of water at 35°C.

- a. $\Delta H > 0$ and $\Delta S > 0$
- b. $\Delta H > 0$ and $\Delta S < 0$
- c. $\Delta H < 0$ and $\Delta S > 0$
- d. $\Delta H < 0$ and $\Delta S < 0$
- e. Not enough information is provided to answer this question.

$\Delta H (+)$ $\Delta S (+)$
endothermic more disorder

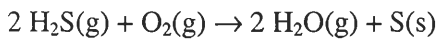
Key

5. The dissolution of ammonium nitrate occurs spontaneously in water. As NH_4NO_3 dissolves, the temperature of the water decreases. What are the signs of H , S , and G for this process?

- a. $\Delta H < 0, \Delta S < 0, \Delta G < 0$
- b. $\Delta H < 0, \Delta S > 0, \Delta G < 0$
- c. $\Delta H < 0, \Delta S > 0, \Delta G < 0$
- d. $\Delta H > 0, \Delta S > 0, \Delta G < 0$**
- e. $\Delta H > 0, \Delta S < 0, \Delta G > 0$

Endothermic $\Delta H = (+)$
 Spont $\Delta G = (-)$
 $\Delta S = (+)$

6. Calculate $\Delta G_{\text{rxn}}^\circ$ for the reaction below at 25.0°C

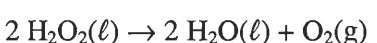


given $\Delta H_{\text{rxn}}^\circ = -442.4 \text{ kJ}$, and $\Delta S_{\text{rxn}}^\circ = -175.4 \text{ J/K}$.

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$$

$$= -442.4 \text{ kJ} - 298 \text{ K} \left(\frac{-0.1754 \text{ kJ}}{\text{K}} \right) = -390 \text{ kJ}$$

7. Calculate $\Delta G_{\text{rxn}}^\circ$ for the reaction below at 25.0°C

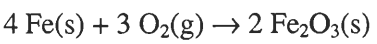


given $\Delta G_f^\circ[\text{H}_2\text{O}_2(\text{l})] = -120.35 \text{ kJ/mol}$, $\Delta G_f^\circ[\text{H}_2\text{O}(\text{l})] = -237.13 \text{ kJ/mol}$, $\Delta G_f^\circ[\text{O}_2(\text{g})] = 0 \text{ kJ/mol}$.

$$\Delta G = \sum n G_{\text{prod}}^\circ - \sum n G_{\text{react}}^\circ$$

$$\Delta G_{\text{rxn}}^\circ = [2(-237.13) + 0] - [2(-120.35)] = -233.56 \text{ kJ}$$

8. Calculate ΔG° for the reaction below at 25.0°C .



Species	$\Delta H_f^\circ(\text{kJ/mol})$	$S_f^\circ(\text{J/K}\cdot\text{mol})$
Fe(s)	0	27.78
O ₂ (g)	0	205.14
Fe ₂ O ₃ (s)	-824.2	87.40

$$\Delta H^\circ = (2(-824.2)) - 0 = -1648.4 \text{ kJ}$$

$$\Delta S^\circ = (2(87.4)) - (4(27.78) + 3(205.14)) = -551.74 \text{ J}$$

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$$

$$= -1648.4 \text{ kJ} - 298(-0.55174) \text{ kJ}$$

$$\Delta G^\circ = -1484 \text{ kJ}$$