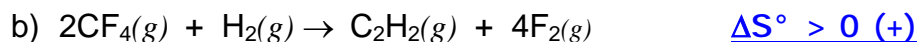


1. Predict whether $\Delta S^\circ > 0$ (+ ΔS) or $\Delta S^\circ < 0$ (- ΔS) for each of the following reactions. (6 pt)



Multiple Choice. (12 pt; 3 pts each)

B 2. Which of these elements does **not** have $\Delta H_f^\circ = 0$?:

- A. $\text{Br}_2(l)$ B. $\text{Cl}(g)$ C. $\text{Ar}(g)$ D. $\text{Ba}(s)$ E. $\Delta H_f^\circ = 0$ for all of these

D 3. Which of the following processes would have a negative value of ΔS ?:

- A. boiling water to form steam B. dissolving $\text{KCl}(s)$ in water
C. detonating a stick of dynamite D. Freezing water to form ice

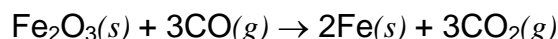
D 4. Select the equation that represents the standard enthalpy of formation, ΔH_f° , for the product:

- A. $\text{CO}(g) + \frac{1}{2}\text{O}_2(g) \rightarrow \text{CO}_2(g)$ B. $\text{Al}(s) + 3\text{Br}(l) \rightarrow \text{AlBr}_3(s)$
C. $2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(l)$ D. $3\text{Mg}(s) + \text{N}_2(g) \rightarrow \text{Mg}_3\text{N}_2(s)$

A 5. Which of these substances should have the **lowest** entropy?

- A. $\text{Mg}(s)$ B. $\text{C}_6\text{H}_{12}\text{O}_6(s)$ C. $\text{CH}_3\text{OH}(l)$ D. $\text{Ne}(g)$ E. $\text{C}_3\text{H}_8(g)$

6. For the following reaction, $\Delta H_{rxn}^\circ = -24.8 \frac{\text{kJ}}{\text{mol}}$ and $\Delta S_{rxn}^\circ = 15.0 \frac{\text{J}}{\text{K} \cdot \text{mol}}$:



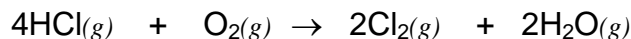
a. Calculate the value of ΔG_{rxn}° at 25 °C. (Provided equation: $\Delta G = \Delta H - T\Delta S$) (4 pts)

$$\Delta G = -24.8 \frac{\text{kJ}}{\text{mol}} - (298 \text{ K}) \left(15.0 \frac{\text{J}}{\text{K} \cdot \text{mol}} \right) \left(\frac{1 \text{ kJ}}{1000 \text{ J}} \right) = -24.8 \frac{\text{kJ}}{\text{mol}} - 4.47 \frac{\text{kJ}}{\text{mol}} = -29.3 \frac{\text{kJ}}{\text{mol}}$$

b. Is the reaction **spontaneous or nonspontaneous** at 25 °C? (2 pts)

spontaneous; $-\Delta G$

7. Calculate the **entropy change**, ΔS° , for the following reaction (6 pts):



$$S^\circ \left(\frac{\text{J}}{\text{K} \cdot \text{mol}} \right): \quad \begin{array}{cccc} 186.8 & 205.0 & 223.0 & 188.7 \end{array}$$

$$\Delta S_{rxn}^\circ = (2) \left(223.0 \frac{\text{J}}{\text{K} \cdot \text{mol}} \right) + (2) \left(188.7 \frac{\text{J}}{\text{K} \cdot \text{mol}} \right) - (4) \left(186.8 \frac{\text{J}}{\text{K} \cdot \text{mol}} \right) - (1) \left(205.0 \frac{\text{J}}{\text{K} \cdot \text{mol}} \right)$$

$$\Delta S_{rxn}^\circ = -128.8 \frac{\text{J}}{\text{K} \cdot \text{mol}}$$