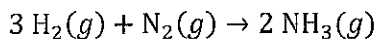


Unit 5 Multiple Choice Practice



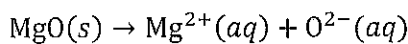
1. Gaseous hydrogen and nitrogen combine in the reaction above to form ammonia, NH_3 . Using the table of entropies provided below, calculate the standard entropy change, $\Delta S^\circ_{\text{rxn}}$, for the reaction shown at 25°C .

Substance	S° at 25°C (J/mol K)
$\text{H}_2(g)$	131
$\text{N}_2(g)$	192
$\text{NH}_3(g)$	193

- (a) -199 J/mol K b. -386 J/mol K c. $+199 \text{ J/mol K}$ d. $+386 \text{ J/mol K}$

$$\Delta S^\circ = \sum S^\circ(\text{pr}) - \sum S^\circ(\text{re}) = [2 \cdot \text{NH}_3] - [3 \cdot \text{H}_2 + \text{N}_2]$$

$$= [2(193)] - [3(131) + 192] = -199$$



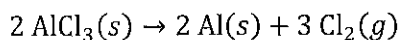
2. Is the process above endothermic or exothermic? Why?
- a. Exothermic, because one solid particle becomes two aqueous particles, increasing the total possible positions.
- b. Endothermic, because one solid particle becomes two aqueous particles, increasing the total possible positions.
- c. Exothermic, because overcoming the Coulombic forces within $\text{MgO}(s)$ releases energy.
- (d) Endothermic, because overcoming the Coulombic forces within $\text{MgO}(s)$ requires the input of energy.

relates to ΔS

3. When ammonium nitrate (NH_4NO_3) dissolves in water, the temperature of the water decreases dramatically. Which is the primary driving factor behind this reaction?

- (a) Entropy c. Both enthalpy and entropy
- b. Enthalpy d. Neither enthalpy and entropy

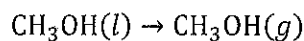
$\Rightarrow +\Delta H_{\text{soln}}$



4. The reaction above is spontaneous under standard conditions, but it becomes thermodynamically unfavorable as temperature decreases. Which of the following is true?

- (a) ΔS and ΔH are both negative. c. ΔS is negative, and ΔH is positive.
- (b) ΔS and ΔH are both positive. d. ΔS is positive, and ΔH is negative.

$\Rightarrow \text{fav. @ } \uparrow T$

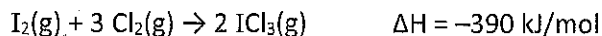


$\Rightarrow 298 \text{ K}$

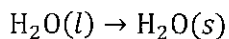
5. For the boiling of methanol, CH_3OH , $\Delta H^\circ = +37.6 \text{ kJ mol}^{-1}$ and $\Delta S^\circ = +111 \text{ J mol}^{-1} \text{ K}^{-1}$. Calculate the standard free energy change of this reaction, $\Delta G^\circ_{\text{rxn}}$.

- a. -4.5 kJ/mol b. -2.8 kJ/mol c. $+2.8 \text{ kJ/mol}$ d. $+4.5 \text{ kJ/mol}$

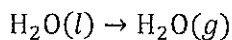
$$\begin{aligned}\Delta G^\circ &= \Delta H^\circ - T \Delta S^\circ = 37.6 \frac{\text{kJ}}{\text{mol}} - (298 \text{ K}) \left(0.111 \frac{\text{kJ}}{\text{mol} \cdot \text{K}} \right) \\ &= 37.6 -\end{aligned}$$



6. Which of the following statements accurately describes the above reaction?
- The entropy of the products exceeds that of the reactants.
 - $\text{I}_2(g)$ will always be the limiting reagent.
 - This reaction is never thermodynamically favored.
 - The temperature of the surroundings will increase as this reaction progresses.

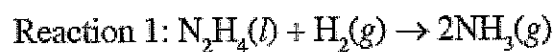


7. Is the process above endothermic or exothermic? Why?
- Exothermic, because forming new intermolecular attractions between water molecules releases energy.
 - Endothermic, because energy is needed to form new intermolecular attractions between water molecules.
 - Exothermic, because forming new bonds between water molecules releases energy.
 - Endothermic, because energy is needed to form new bonds between water molecules.

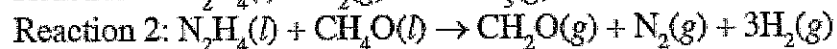


8. Which of the following is true for the above reaction?
- The value of ΔS is negative.
 - The value of ΔG is negative at 298 K.
 - The value of ΔH is positive.
 - The reaction is favored at 1.0 atm and 298 K.

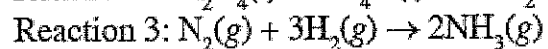
Use the following information to answer the next two questions.



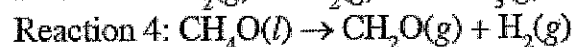
$$\Delta H = ?$$



$$\Delta H = -37 \text{ kJ/mol}_{\text{rxn}}$$



$$\Delta H = -46 \text{ kJ/mol}_{\text{rxn}}$$



$$\Delta H = -65 \text{ kJ/mol}_{\text{rxn}}$$

9. If reaction 4 (shown above) were repeated at a higher temperature, how would the reaction's value for ΔG be affected?

- a. It would become more negative because entropy is a driving force behind this reaction.
- b. It would become more positive because enthalpy is a driving force behind this reaction.
- c. It will stay the same because reaction 4 is never thermodynamically favorable.
- d. It will stay the same because reaction 4 is thermodynamically favorable at all temperatures.

10. Under what conditions would reaction 2 (shown above) be thermodynamically favored?

- a. It is always favored.
- b. It is never favored.
- c. It is only favored at low temperatures.
- d. It is only favored at high temperatures.

