

Thermodynamics

True / False

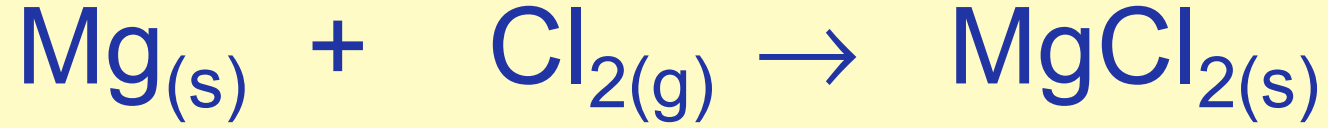
Chapter 19

A mole of $\text{CH}_3\text{OH}_{(\text{L})}$ has more entropy than a mole of $\text{O}_{2(\text{g})}$ because they are larger molecules.

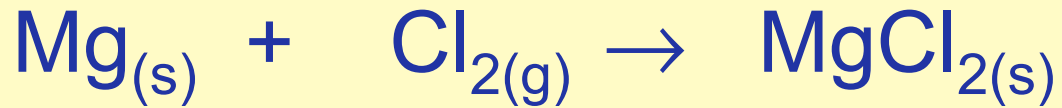
A mole of $\text{CH}_3\text{OH}_{(\text{L})}$ has more entropy than a mole of $\text{O}_{2(\text{g})}$ because they are larger molecules.

- **False**
- Larger molecules do generally exhibit more entropy, but $\text{O}_{2(\text{g})}$ has more entropy because the fact that it is a gas is far more significant than the size factor.

In this reaction entropy decreases:

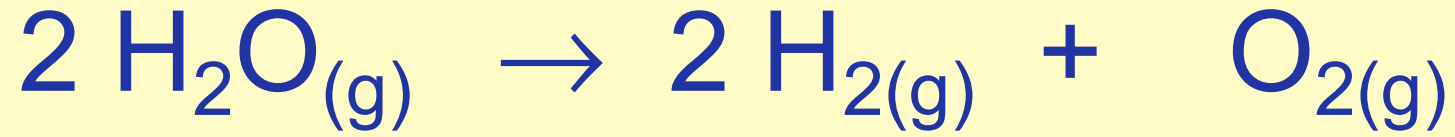


In this reaction entropy decreases:

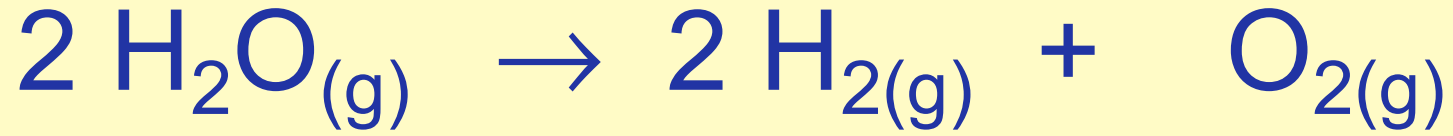


- True
- Because a solid crystal has far less entropy than a gas and a metallic solid.

In this reaction entropy decreases:



In this reaction entropy decreases:



- False
- Because two gas molecules are converted into three gas molecules.

The sign of ΔG for a spontaneous reaction is always negative.

The sign of ΔG for a spontaneous reaction is always negative.

- True

ΔG for water at its melting point is 0

ΔG for water at its melting point is 0

- True
- This is an equilibrium situation, and ΔG is always 0 at equilibrium.

If a reaction as written is nonspontaneous, the reverse reaction will be spontaneous.

If a reaction as written is nonspontaneous, the reverse reaction will be spontaneous.

- True
- ΔG reverses its sign when the reaction is reversed.

According to the Third Law of Thermodynamics, the entropy of the universe is always increasing.

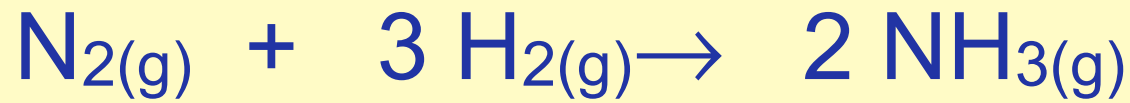
According to the Third Law of Thermodynamics, the entropy of the universe is always increasing.

- False
- Entropy of the universe is always increasing, however, this is the Second Law of Thermodynamics

ΔG°_f , ΔH°_f , and S° for an element like $O_{2(g)}$ in their standard state are 0

ΔG°_f , ΔH°_f , and S° for an element like $O_{2(g)}$ in their standard state are 0

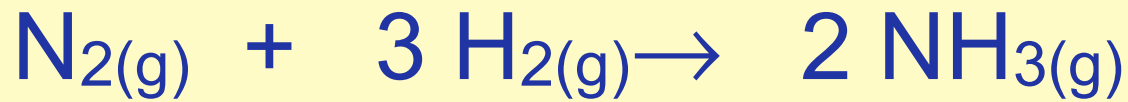
- False
- ΔG_f° , ΔH_f° are 0, but S° has a positive value because oxygen at 25°C has far more entropy than a pure crystal of O_2 at 0 K



$\text{N}_{2(g)} S^\circ = 200 \text{ J}$, $\text{H}_{2(g)} S^\circ = 125 \text{ J}$

and $\Delta S_{rx} = -200$

then S° for $\text{NH}_{3(g)}$ must be 125



$\text{N}_{2(g)} S^\circ = 200 \text{ J}$, $\text{H}_{2(g)} S^\circ = 125 \text{ J}$

and $\Delta S_{rx} = -200$

then S° for $\text{NH}_{3(g)}$ must be 125

- False - what is it then?
- $2(x\text{NH}_3) - [200 \text{ J} + 3(125 \text{ J})] = -200 \text{ J}$
- Solve for $(x\text{NH}_3) = 187.5 \text{ J}$

Increasing temperature can make all reactions spontaneous that would otherwise be nonspontaneous.

Increasing temperature can make all reactions spontaneous that would otherwise be nonspontaneous.

- **False**
- If a reaction has $+\Delta H$ and $-\Delta S$, the reaction can only be nonspontaneous. More on this on the next slide....

Increasing temperature may be able to make a nonspontaneous reaction that has $-\Delta H$ and $-\Delta S$ become spontaneous.

Increasing temperature may be able to make a nonspontaneous reaction that has $-\Delta H$ and $-\Delta S$ become spontaneous.

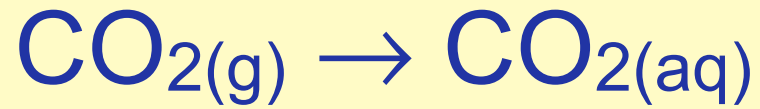
- **False**
- Increasing the temperature will increase the already unfavorable entropy factor making ΔG even more positive.
- It is possible that lowering the temperature may reduce the unfavorable entropy factor enough to change the ΔG sign to negative.

Some reactions are spontaneous at *all* temperatures.

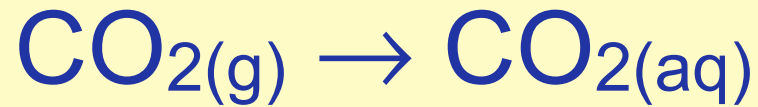
Some reactions are spontaneous at *all* temperatures.

- True
- This would be true for a reactions that has a
 - ✓ negative ΔH (favorable) and a
 - ✓ positive ΔS (favorable)

The ΔS° of the following reaction shows an increase in entropy ($+\Delta S$)



The ΔS° of the following reaction shows an increase in entropy ($+\Delta S$)



- **False**
- Dissolving of solids and liquids is an increase in entropy but the dissolving of a gas actually decreases its disorder when dissolved in solution.

Standard conditions for ΔG° are 25°C, 1 M for solutions, and 1 atm for gases

Standard conditions for ΔG° are 25°C, 1 M for solutions, and 1 atm for gases

- True