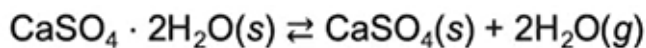


AP Chemistry Daily Videos

9.3 Gibbs Free Energy and Thermodynamic Favorability

[Video #1](#)

1. What is Gibbs free energy?
2. What does ΔG° represent?
3. What values of ΔG° indicate a thermodynamically favorable process?
4. What is the equation used to calculate ΔG° for a reaction?
5. Pause the video @ 3:55 and try the problem on your own. Then evaluate your work and identify any errors you may have made.



The hydrate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}(s)$ can be heated to form the anhydrous salt $\text{CaSO}_4(s)$, as shown by the reaction represented above. Using the data in the table below, calculate the value of ΔG° , in $\text{kJ/mol}_{\text{rxn}}$, for the reaction at 298 K.

Substance	ΔG°_f at 298 K (kJ/mol)
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}(s)$	-1795.70
$\text{CaSO}_4(s)$	-1320.30
$\text{H}_2\text{O}(g)$	-228.59

6. What are the takeaways?

Video #2

1. What is the equation used to calculate the Gibbs free energy based on both entropy and enthalpy?
2. Complete the table with the temperature conditions necessary for a process to be thermodynamically favorable.

ΔH°	ΔS°	Symbols	$\Delta G^\circ < 0$, favored at:
< 0	> 0	< >	
> 0	< 0	> <	
> 0	> 0	> >	
< 0	< 0	< <	

3. Under which circumstances is a calculation for ΔG° necessary to determine favorability?

4. Pause the video @ 4:55 and try the problem on your own. Then evaluate your work and identify any errors you may have made.



A student investigates the reaction between $\text{Ag}(s)$ and $\text{HNO}_3(aq)$ represented by the equation above.

- Predict the sign of the entropy change, ΔS° , for the reaction. Justify your answer.
- Use the information in the table below to calculate the value of ΔH_{rxn}° , the standard enthalpy change for the reaction, in kJ/mol_{rxn} .
- Based on your answers to parts (a) and (b), is the reaction more likely to be thermodynamically favorable at 25°C or at 95°C ? Justify your answer.
- The student runs the reaction using a 3:4 mole ratio of $\text{Ag}(s)$ to $\text{HNO}_3(aq)$. Suggest a method the student could use to isolate solid AgNO_3 from the other products of the reaction.

Substance	$\text{HNO}_3(aq)$	$\text{AgNO}_3(aq)$	$\text{NO}(g)$	$\text{H}_2\text{O}(l)$
Standard Heat of Formation, ΔH_f° (kJ/mol)	-207	-101	90.	-286



5. What are the takeaways?