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[TP] At 300 K, hydrogen and oxygen react explosively to form water. The free energy of formation of water is −237 kJ/mol. Based on this information, to decide what will happen to water at very high temperatures, we need to consider ...

20% 1. the sign of ΔH_{sur}
20% 2. the effect of T on the magnitude of ΔS_{sur}
20% 3. the relative magnitude of ΔS_{sys} and ΔS_{sur}
20% 4. All of the above
20% 5. Some other factor(s)

Response Counter 10 1

Lecture 35 CH102 A1 (MWF 9:05 am)

Wednesday, April 26, 2017

- Effect of temperature on equilibrium

Next lecture: Begin ch18: Definition of "rate"; rate versus [...] from experiment; making sense of rate versus [...]: Reaction mechanisms

Lecture 35 CH102 A1 (MWF 9 am) Spring 2017 Copyright © 2017 Dan Dill dan@bu.edu

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Effect of temperature on equilibrium

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ΔG, ΔH ,ΔS, S, Q, and K

Just as we did to discover that spontaneity in an electrochemical cell is proportional to $\ln(Q / K)$, ...

Let's see if we can guess how ΔG must depend on Q and K...

$\Delta G = R\,T \ln(Q / K)$

$R\,T$ has units (J / mol)

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ΔG, ΔH ,ΔS, S, Q, and K

$\Delta G = R\,T \ln(Q / K) = \Delta H - T\,\Delta S$

How about for standard states?

$\Delta G^{o} = R\,T \ln(1 / K) = \Delta H^{o} - T\,\Delta S^{o}$

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Effect of T on K

$\Delta G^{o} = -R\,T \ln(K) = \Delta H^{o} - T\Delta S^{o}$

For values of T near 298 K, ΔH^{o} and ΔS^{o} are nearly constant.

This means the graph of $\ln(K)$ versus $1/T$ is nearly ...???

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Using $R\,T \ln(1 / K) = \Delta H^{o} - T\,\Delta S^{o}$

Rearrange into the equation $y = m\,x + b$ for

$y = \ln(K)$

$x = 1/T$...

$$\ln(K) = -(\Delta H^{o} / R)\,(1/T) + \Delta S^{o} / R$$

$$y \quad = \quad m \quad x \quad + \quad b$$

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[TP] What do we need to know to sketch

$$\ln(K) = -(\Delta H^o / R)(1/T) + \Delta S^o/R$$

for the process steam → water?

17% 1. How K changes with T
17% 2. The sign of ΔH^o
17% 3. The sign of ΔS^o
17% 4. All of the above
17% 5. Either (1), or (2) and (3)
17% 6. Some other factor(s)

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Using $\ln(K) = -(\Delta H^o / R)(1/T) + \Delta S^o/R$

What do we need to make a sketch of $y = \ln(K)$ versus $x = 1/T$ for the process steam → water?

Can we get what we need to make the sketch?

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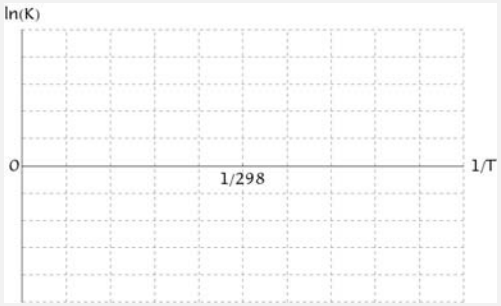
Using $\ln(K) = -(\Delta H^o / R)(1/T) + \Delta S^o / R$

Make a sketch of $y = \ln(K)$ versus $x = 1/T$ for the process steam → water



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[TP] For the reaction $H_2O(g) \rightarrow H_2O(l)$, at what temperature range will result in the greatest amount of products (biggest K)?

25% 1. Very low T
25% 2. Very high T
25% 3. The amount will be the same at all T
25% 4. More information needed

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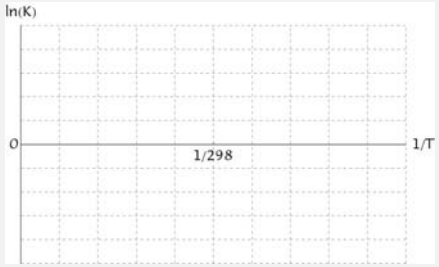
Effect of *T* on *K*

$\ln(K) = -(\Delta H^o / R)(1/T) + \Delta S^o / R$

Sketch $\ln(K)$ versus $1/T$ for an endothermic reaction for which the entropy change of the system is positive.



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[TP] For the reaction $2\ H_2O(g) \rightarrow 2\ H_2(g) + O_2(g)$, what temperature range will result in the greatest amount of products (biggest K)?

25% 1. Very low T
25% 2. Very high T
25% 3. The amount will be the same at all T
25% 4. More information needed

Response Counter

10

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