Slide 1

Some applications of Thermodynamics

Slide 2

At what temperatures is the following reaction spontaneous?

$2\ H_2\ (g) + O_2\ (g) \leftrightarrow 2\ H_2O\ (g)$

If you calculate $\Delta H^0$ (Appendix II) = -483.6 kJ
If you calculate $\Delta S^0$ (Appendix II) =-89 J/K

Slide 3

$2\ H_2\ (g) + O_2\ (g) \leftrightarrow 2\ H_2O\ (g)$

If you calculate $\Delta H^0$ (Appendix II) = -483.6 kJ
If you calculate $\Delta S^0$ (Appendix II) =-89 J/K

Enthalpy change good!
Entropy change bad!
The balance is…

Slide 4

## ΔG

$\Delta G = \Delta H - T\Delta S$

We assume that ΔH and ΔS aren't changing significantly with temperature:

$\Delta G = \Delta H^0 - T\Delta S0$

ΔG=(-483.6 kJ) –T(-0.089 kJ/K) [UNITS! UNITS!]

Slide 5

ΔG=(-483.6 kJ) –T(-0.089 kJ/K)

Spontaneous means ΔG<0

ΔG=(-#) –T(-#)

ΔG=(-#) +T(#)

If T is big enough, ΔG will become positive.

Slide 6

ΔG=(-483.6 kJ) –T(-0.089 kJ/K)

0=-483.6 kJ + T(0.089 kJ/K)

483.6 kJ = T(0.089 kJ/K)

5434 K = T

So for any T below 5434 K, the reaction is spontaneous. Above that, ΔG becomes (+) and the reaction is NOT spontaneous anymore.

Slide 7

## Caveat

5434 K is a pretty extreme temperature especially relative to STP (298 K). I have to wonder how good my assumption of ΔH and ΔS being constant actually is. We could try and establish ΔH and ΔS at 5434 K but that is much harder to do.

Slide 8

## Opposite Case

ΔG=(-483.6 kJ) –T(-0.089 kJ/K)

Spontaneous means ΔG<0

ΔG=(-#) –T(-#)

Suppose the signs were reversed:

ΔH=(+#)
ΔS=(+#)

Slide 9

## Opposite Case

Spontaneous means ΔG<0

ΔG=(+#) –T(+#)

Now the bigger T is, the better! At low temperatures the reaction is NOT spontaneous but at higher temperatures it is.

Slide 10

## The test ends here…

Topics for the test:

1. Titration curves
   1. Strong acid/strong base
   2. Weak acid/strong base or strong acid/weak base
   3. Buffers
   4. Salts
   5. Ka or Kb or Kw
2. Ksp
   1. Solubility
   2. Fractional precipitation
3. Thermodynamics
   1. ΔH, ΔS, ΔG
   2. Delta G = Delta H – T delta S
   3. K ($\Delta G = -RT \ln Q$)
4. Redox
   Balancing

Slide 11

## Don't forget

Exam review homework is due at 8 p.m. on Wednesday.

Complete solutions for exam review homework appear magically on myCourses under "Content" at 9:01 p.m. on Wednesday.