Chem 116 Lecture 16 (JL)
10-28-08

Higher entropy = more disorder.

Lower entropy = more order.

Reaction will take place in the phase where the highest entropy (therefore most disordered) is.

## A simple example of using ICE

*Practice Exercise on p. 645*

Sulfur trioxide decomposes at high temperature in a sealed container:

$$2\ SO_3\ (g) \leftrightarrows 2\ SO_2\ (g) + O_2\ (g)$$

Initially, the vessel is charged at 1000 K with $SO_3$ (*g*) at a partial pressure of 0.500 atm. At equilibrium, the $SO_3$ partial pressure is 0.200 atm. Calculate the value of $K_p$ at 1000 K.

| *partial pressures* | $2\ SO_3\ (g)$ | $\leftrightarrows$ | $2\ SO_2\ (g)$ | + | $O_2\ (g)$ |
|---|---|---|---|---|---|
| Initial | 0.500 atm | | 0 atm | | 0 atm |
| Change | $-2x$ | | $+2x$ | | $+x$ |
| Equilibrium | 0.200 = 0.500 – $2x$ | | $2x$ | | $x$ |

Solve to get x = 150atm.

So at equilibrium $P_{SO_4} = 2x = .300$atm and $P_{O_2} = 0.150$atm.

$$K_p = \frac{(P_{SO_4})^2(P_{O_2})}{(P_{SO_3})^2} = \frac{(0.300)^2(0.150)}{(0.200)^2}$$

Kp = 0.388 (there is no unit)

# If you know the value of $K_c$ and the initial conditions you can figure out the final concentrations – Use an ICE table

*To complement Practice Exercises on pp. 644-645*

At some temperature, $K_c$ = 33 for the reaction

$$H_2\,(g) + I_2\,(g) \leftrightarrows 2\,HI\,(g)$$

If the initial concentrations of both $H_2$ and $I_2$ are $6.00 \times 10^{-3}$ mol/L, find the concentration of each reactant and product at equilibrium.

| Molarity | $H_2\,(g)$ | + | $I_2\,(g)$ | $\leftrightarrows$ | $2\,HI\,(g)$ |
|---|---|---|---|---|---|
| Initial | $6.00 \times 10^{-3}$ M | | $6.00 \times 10^{-3}$ M | | 0 M |
| Change | $-x$ | | $-x$ | | $+2x$ |
| Equilibrium | $(6.00 \times 10^{-3}) - x$ | | $(6.00 \times 10^{-3}) - x$ | | $2x$ |

Q initially = $\dfrac{[HI]^2}{[H_2][I_2]} = \dfrac{0}{(0.006)^2} = 0$

Generally speaking it's a good idea to calculate initial Q and compare to K. If $Q_{initial} < K$, then products ↑ and reactants ↓. If $Q_{initial} > k$, then opposite direction.

$$K = 33 = \frac{[HI]^2}{[H_2][I_2]}$$

$$= \frac{(2x)^2}{(0.006-x)(0.006-x)}$$

$$= \frac{(2x)^2}{(0.006-x)^2}$$

$$= \left(\frac{2x}{0.006-x}\right)^2$$

$$\sqrt{33} = \sqrt{\left(\frac{2x}{0.006-x}\right)^2}$$

$$x = 0.00445.$$

$[HI] = 2x = 2.(0.00445)$
$= 0.00890M$

$[H_2] = 0.00600 - x = 0.00155M$

$[I_2]$ ... same as $H_2$