

Higher entropy = more disorder.

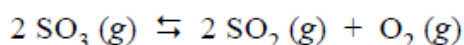
Lower entropy = more order.

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:



Initially, the vessel is charged at 1000 K with  $\text{SO}_3 (\text{g})$  at a partial pressure of 0.500 atm. At equilibrium, the  $\text{SO}_3$  partial pressure is 0.200 atm. Calculate the value of  $K_p$  at 1000 K.

<i>partial pressures</i>	$2 \text{SO}_3 (\text{g})$	$\rightleftharpoons$	$2 \text{SO}_2 (\text{g})$	$+$	$\text{O}_2 (\text{g})$
Initial	0.500 atm		0 atm		0 atm
Change	- 2x		+ 2x		+ x
Equilibrium	0.200 = 0.500 - 2x		2x		x

Solve to get  $x = 0.150 \text{ atm}$ .

So at equilibrium  $P_{\text{SO}_2} = 2x = 0.300 \text{ atm}$  and  $P_{\text{O}_2} = 0.150 \text{ atm}$ .

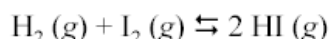
$$K_p = \frac{(P_{\text{SO}_2})^2 (P_{\text{O}_2})}{(P_{\text{SO}_3})^2} = \frac{(0.300)^2 (0.150)}{(0.200)^2}$$

$K_p = 0.388$  (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



If the initial concentrations of both  $\text{H}_2$  and  $\text{I}_2$  are  $6.00 \times 10^{-3} \text{ mol/L}$ , find the concentration of each reactant and product at equilibrium.

Molarity	$\text{H}_2(\text{g})$	+	$\text{I}_2(\text{g})$	$\rightleftharpoons$	$2 \text{HI}(\text{g})$
Initial	$6.00 \times 10^{-3} \text{ M}$		$6.00 \times 10^{-3} \text{ M}$		0 M
Change	$-x$		$-x$		$+2x$
Equilibrium	$(6.00 \times 10^{-3}) - x$		$(6.00 \times 10^{-3}) - x$		$2x$

$$Q_{\text{initially}} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{0}{(0.006)^2} = 0$$

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

$$\begin{aligned}
 K = 33 &= \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} \\
 &= \frac{(2x)^2}{(0.006-x)(0.006-x)} \\
 &= \frac{(2x)^2}{(0.006-x)^2} \\
 &= \left( \frac{2x}{0.006-x} \right)^2 \\
 \sqrt{33} &= \sqrt{\left( \frac{2x}{0.006-x} \right)^2} \\
 x &= 0.00445.
 \end{aligned}$$

$$\begin{aligned}
 [\text{HI}] &= 2x = 2(0.00445) = 0.00890\text{M} \\
 [\text{H}_2] &= 0.00600 - x = 0.00155\text{M} \\
 [\text{I}_2] &\dots \text{same as } \text{H}_2
 \end{aligned}$$