ICE Charts

A useful tool in solving equilibrium problems is an ICE chart, where:

- "I" stands for the initial concentrations.
- "C" represents the change in the concentrations as the system moves towards equilibrium.
- "E" represents the equilibrium concentrations.

To Create an ICE Chart

1. Place initial concentrations of each molecule on the first row, making sure they are expressed in moles / liter.
2. In the second row write the change in concentrations according to the balanced equation:
   - let "x" stand for the change in concentrations
   - give the reactants a negative sign and the products a positive sign to show the decrease or increase in concentration, respectively
   - use coefficients to indicate if more than one molecule is involved
3. In the last row add the initial concentrations plus the change in concentrations.

Example: 0.20 moles of N_2O_4 were initially placed into a 2.0 sealed flask and allowed to reach equilibrium according to: $N_2O_{4\,(g)} \rightleftharpoons 2NO_{2\,(g)}$. At equilibrium, the amount of N_2O_4 was measured as 0.018 moles. Calculate the equilibrium concentration of NO2 and then find K_{eq}.

	$N_2O_{4(g)}$	$2NO_{2(g)}$
I	0.10	0
C	$-x$	$+2x$
E	$0.10-x$	$+2x$

① Calculate Molarity

$[N_2O_4] = \frac{0.20\ mol}{2.0\ L} = 0.10\ M$

assume $[NO_2] = 0$

② write the change in concns noting reactants get "used up" to make products

③ add I + C

④ find x given $[N_2O_4] = 0.018$ @ eq

$[N_2O_4] = \frac{0.018\ mol}{2.0\ L} = 0.009\ M$

$0.10 - x = 0.009$

$-x = -0.091$

$x = 0.091\ M$

⑤ sub x into NO_2 expression

$[NO_2] = 2x = 2 \times 0.091 = 0.18\ M$

⑥ solve for Keq

$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[0.18]^2}{[0.009]} = 3.6$

Example: A mixture of 0.100 moles NO, 0.050 moles H_2 and 0.100 moles H_2O was placed into a 1.0 L closed container and allowed to reach equilibrium according to:

$$2\ NO_{(g)} + 2\ H_{2(g)} \rightleftharpoons N_{2(g)} + 2\ H_2O_{(g)}$$

There was no N_2 present initially. At equilibrium, the amount of NO was found to be 0.062 moles. Calculate K_{eq}.

	$2NO_{(g)}$ +	$2H_{2(g)}$ ⇌	$N_{2(g)}$ +	$2H_2O_{(g)}$
I	0.10	0.050	0	0.10
② C	−2x	−2x	+x	+2x
③ E	0.1−2x	0.05−2x	x	0.10+2x

① Calculate molarity

$[NO] = \frac{0.10\ mol}{1\ L} = 0.10\ M$

$[H_2] = 0.050\ M$

$[N_2] = 0$

$[H_2O] = 0.10\ M$

④ $[NO] = \frac{0.062\ mol}{1\ L} = 0.062\ M$

$0.1 - 2x = 0.062$

$\frac{-2x}{-2} = \frac{-0.038}{-2}$

$x = 0.019\ M$

⑤ $[NO] = 0.062\ M$

$[H_2] = 0.05 - 2x = 0.05 - 2(0.019) = 0.012\ M$

$[N_2] = x = 0.019\ M$

$[H_2O] = 0.10 + 2x = 0.10 + 2(0.019) = 0.138\ M$

⑥ $K_{eq} = \frac{[N_2][H_2O]^2}{[NO]^2[H_2]^2}$

$= \frac{[0.019][0.138]^2}{[0.062]^2[0.012]^2}$

$= 653.7$

$K_{eq} = 650$