Calculating the Equilibrium Constant, K_{eq}

If K_{eq} is...	____ reaction is favored.
$= 1$	neither
< 1	reverse
> 1	forward

Ex. $2\,NO(g) + Cl_2(g) \rightleftharpoons 2\,NOCl(g)$

Calculate K_{eq} if $[NO] = .0250M$, $[Cl_2] = .0200M$, & $[NOCl] = .500M$. Is the forward or reverse reaction favored?

$$K_{eq} = \frac{[NOCl]^2}{[NO]^2 \cdot [Cl_2]} = \frac{[.500M]^2}{[.0250M]^2 \cdot [.0200M]} \cdot \frac{M^2}{M^2 \cdot M} = 20000\,\frac{1}{M}$$

forward is favored

&) $2\,O_3(g) \rightleftharpoons 3\,O_2(g)$

Calculate K_{eq} if $[O_3] = 1.6 \times 10^{-2} M$ and $[O_2]$ is $1.9 \times 10^{-2} M$. Forward or reverse reaction favored?

$$K_{eq} = \frac{[O_2]^3}{[O_3]^2} = \frac{[1.9 \times 10^{-2} M]^3}{[1.6 \times 10^{-2} M]^2} \cdot \frac{M^3}{M^2} = .027\,M$$

reverse is favored.

(3) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

K_{eq} is .212M & $[NO_2] = .0875M$. Calculate the $[N_2O_4]$? Which reaction is favored?

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

$$[N_2O_4] \cdot .212M = \frac{[.0875M]^2 \cdot [N_2O_4]}{[N_2O_4]}$$

$$\frac{[N_2O_4] \cdot .212M}{.212M} = \frac{[.0875M]^2}{.212M} \quad \frac{M \cdot M}{M}$$

$[N_2O_4] = .0361\,M$ reverse is favored!

(4) $3NO(g) \rightleftharpoons NO_2(g) + N_2O(g)$

5.50 mol NO, 3.30 mol NO_2, & 2.20 mol N_2O are all dissolved in .300L of solution. Calculate K_{eq}. Which reaction is favored?

$M = \frac{n}{V}$

$$[NO] = \frac{5.50\,mol}{.300L} = 18.3M$$

$$[NO_2] = \frac{3.30\,mol}{.300L} = 11.0M$$

$$[N_2O] = \frac{2.20\,mol}{.300L} = 7.33M$$

$$K_{eq} = \frac{[NO_2][N_2O]}{[NO]^3}$$

$$K_{eq} = \frac{[11.0M][7.33M]}{[18.3M]^3}$$

$K_{eq} = .0132 \frac{1}{M}$ $\quad \frac{M \cdot M}{M \cdot M \cdot M}$

reverse is favored