Equilibrium Expression

for $aA + bB \rightleftharpoons cC + dD$

forward rate = $K[A]^a[B]^b$

reverse rate = $K'[C]^c[D]^d$

at equilibrium forward rate = reverse rate

$\therefore K[A]^a[B]^b = K'[C]^c[D]^d$

$\therefore \frac{K}{K'} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$

$$\therefore \boxed{K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}}$$

where $K_{eq} = \frac{K}{K'}$ which is a number!

K_{eq} is the equilibrium constant
- experimentally determined
- it is a number
- units are dropped!
- K_{eq} is temperature dependent
- K_{eq} will also depend the way the equilibrium is written

$\frac{[C]^c[D]^d}{[A]^a[B]^b}$
- only components (compounds or ions etc) with variable concentation are included
- gas (g), aqueous (aq) are variable and in the equilibrium expression
- (s) and (l) are not

products / reactants

$$K_{eq} = \frac{1}{[H_2O(g)]}$$

(Keq value since its effect and concentration are constant)

$$H_2O(l) \rightleftharpoons H_2O(g)$$

$$K_{eq} = [H_2O(g)]$$

eg2 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$$K_{eq} = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

eg3 $CaCO_3(s) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$

$$K_{eq} = [Ca^{2+}][CO_3^{2-}]$$

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