Relation between K_p & K_c

If partial pressure is taken as active mass for a gas, the equilibrium constant is called K_p and if concentration is taken as active mass then equilibrium constant is called K_c.

Therefore $K_c = \frac{[C]^x [D]^y}{[A]^m [B]^n}$ — (i)

If A, B, C & D all are gases then

$$K_p = \frac{P_C^x \times P_D^y}{P_A^m \times P_B^n} \quad \text{— (ii)}$$

For a gas —

$$PV = nRT$$

or, $P = \frac{n}{V} RT$ where $\frac{n}{V} = C$ = concentration

$\therefore P \propto C$ at constant temperature

or $P = CRT$

$\therefore P_A = C_A RT$

$P_B = C_B RT$

$P_C = C_C RT$

$P_D = C_D RT$

Hence, putting the value of P_A, P_B, P_C & P_D in equn (1).

~~Kp = ...~~

$$K_p = \frac{[C]^x [D]^y}{[A]^m [B]^n} \frac{(RT)^{x+y}}{(RT)^{m+n}}$$

or $K_p = K_c [RT]^{(x+y)-(m+n)}$

$\therefore K_p = K_c [RT]^{\Delta n}$ — (iii)

If $\Delta n = 0$

then

$K_p = K_c$ (iv)

Δn = no. of mole of Products − no. of moles of reactants