

Relationship between Kc, Kp and Kx

Relationship between Kp ,Kc, Kx and Kn

Kp=Equilibrium constant in terms of partial pressure.

Kc=Equilibrium constant in terms of concentration.

Kx=Equilibrium constant in terms of mole fraction.

Kn=Equilibrium constant in terms of number of moles.

Kp and Kc are related as $K_p = K_c (RT)^{\Delta n}$ (eq 1)

Relationship between Kp and Kn

$$K_p = \frac{P_C^c \times P_D^d}{P_A^a \times P_B^b} \dots\dots\dots(\text{eq 2})$$

From ideal gas equation, $PV=nRT$

$$\Rightarrow P=n(RT/V)$$

Where, n is the number of moles

So, $P_A = n_A(RT/V)$, $P_B = n_B(RT/V)$, $P_C = n_C(RT/V)$ and $P_D = n_D(RT/V)$

Replacing equation 2 by the above value we get that,

$$[n_C(RT/V)]^c \cdot [n_D(RT/V)]^d$$

$$K_p = \frac{\text{-----}}{\text{-----}}$$

$$[n_A(RT/V)]^a \cdot [n_B(RT/V)]^b$$

$$n_C^c \cdot n_D^d$$

$$\Rightarrow K_p = \frac{\text{-----}}{\text{-----}} \cdot (RT/V)^{(c+d)-(a+b)}$$

$$n_A^a \cdot n_B^b$$

$$\Rightarrow K_p = K_n \cdot (RT/V)^{\Delta n}$$

$$\Rightarrow K_p = K_n \cdot (P_T/n_T)^{\Delta n}$$

Δn = number of gaseous moles of product – number of gaseous moles of reactant

Relation between K_p and K_x

$$K_p = \frac{P_C^c \times P_D^d}{P_A^a \times P_B^b} .$$

From above (eq..... 2)

Partial pressure(P) = Mole fraction(x) . Total pressure(P_T)

$$\text{So, } P_A = x_A \cdot P_T$$

$$P_B = x_B \cdot P$$

$$P_C = x_C \cdot P_T$$

$$P_D = x_D \cdot P_T$$

Putting the values in whole equation:

$$(x_C \cdot P_T)^c \cdot (x_D \cdot P_T)^d$$

$$K_p = \frac{\text{-----}}{\text{-----}}$$

$$(x_A \cdot P_T)^a \cdot (x_B \cdot P_T)^b$$

$$x_C^c \cdot x_D^d$$

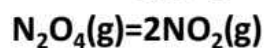
$$= \frac{\text{-----}}{P_T^{(c+d) - (a+b)}}$$

$$x_A^a \cdot x_B^b$$

$$\Rightarrow K_p = K_x (P_T)^{\Delta n}$$

K_p=K_c(RT)ⁿ where R is the gas constant, T is the Temperature and n is the change in no. of gaseous moles in the **reaction**.

Q1. Calculate K_c and K_x for the given reaction



Hints: $K_p = 0.157$

Q2. a) What is the difference between homogeneous and heterogeneous equilibria?

b) List the examples.

Q3. Under what conditions are the values of K_C and K_P for a given gas phase equilibrium the same?

Q4. What is the relation between K_P , K_C and K_X ?