

Qualitative Chemistry

Angular Momentum of Electron,

$$mvr = \frac{nh}{2\pi}$$

m=mass of electron
v=linear velocity of electron
r=radius of orbit
n=number of orbit
h=Plank's Constant
=6.626 × 10⁻³⁴ Js
=6.626 × 10⁻²⁷ erg sec

If an electron travels from one orbit to another orbit ,
electron either consumes or leaves energy.

If electron is traveling from an orbit having energy of E₁ to
E₂ then the consumed or left energy of electron is ,

$$\Delta E = E_2 - E_1 = hv$$

h=Planks constant
v= frequency of the energy consumed
or left my electron

Energy of Hydrogen's n-th orbit:

$$E_n = \frac{-2\pi^2 me^4}{n^2 h}$$

Radius of power shells:

$$r_n = \frac{n^2 h^2}{4\pi^2 mZe^2}$$

Velocity of Electron,

$$v = \frac{nh}{2\pi mr}$$

m = mass of electron = 9.109 × 10⁻³¹ kg
= 9.109 × 10⁻²⁸ g

e = charge of electron = 1.602 × 10⁻¹⁹ C
= 4.8 × 10⁻¹⁰ esu

c = speed of light = 3 × 10⁸ ms⁻¹

h = Plank's Constant

n = number of shell

Z = Atomic number

Equation of de-Broglie:

$$\lambda = \frac{h}{mv}$$

Common terms about waves:

$$c = v\lambda$$

$$\bar{\nu} = \frac{v}{c} = \frac{1}{\lambda}$$

Here, c = speed of light , $\bar{\nu}$ =wave number,
v = frequency, λ = wave length

$\bar{\nu}$ =wave number

n₁ or n₂ is the number
of orbital from where and to where
the electron travels..

Tip: always n₁ is the higher orbit
number and n₂ is always lower,
because the value of $\bar{\nu}$ always has
to be positive

R_H = **Rydberg Constant**
= 1.097 × 10⁷ m⁻¹

Rydberg Equation:

$$\bar{\nu} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Solubility:

$$S = \frac{\text{Moles of Solute}}{\text{Volume of Solvent}} \quad ; \text{ Unit: mole/L or M}$$

$$S = \frac{100 \times \text{Mass of solute in grams}}{\text{Mass of solvent in gram}}$$

Effect of Pressure in Solubility (Henry's Law):

If applied pressure in a Gaseous Solute solution is P

$$S \propto P$$

$$S = K_H \times P$$

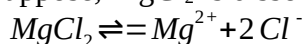
$$\frac{S_1}{P_1} = \frac{S_2}{P_2} = \frac{S_3}{P_3} = \dots\dots\dots$$

K_H = Henry's Proportional Constant
= S/P

Unit of K_H in SI standard is: M atm^{-1}

Solubility Product (K_{sp} and K_{ip}):

Suppose, MgCl_2 is dissolved in water. Hence the ionic equation as follow-



$$K_{sp} = [\text{Mg}^{2+}] + [\text{Cl}^-]^2$$

****Note:** In IUPAC standard the Solubility of a solution with a specific solute and solvent is measured in mole/Liter which essentially means the Molarity of the solution. So K_{sp} is the Ionic Product of the product ion. For example: in the example above shows how to find K_{sp} of a Solution. Which needs the molarity of Mg^{2+} and Cl^- . But because solubility is the molarity of the solution so we can say $[\text{Mg}^{2+}] = [\text{Cl}^-] = \text{Solubility or } S$

$$K_{sp} \text{ in the above reaction is, } K_{sp} = S \times S^2 = S^3$$

****In order to use this equation the given Solubility must be converted to mole/L or M. For example if the Given solubility is : $5 \times 10^{-4} \text{ g/L}$ we have to convert g/L to mole/L. In order to convert g/L to mole/L we have to divide the g/L by the Molar mass of solute**

**** The equation of K_{ip} and K_{sp} is the same . Difference between K_{ip} and K_{sp} is K_{sp} is the constant Ionic product for a solution in saturated state. It means we can identify K_{sp} only for saturated solutions. And it's value is constant in a specific solution and at a specific Temperature. But K_{ip} is essentially the ionic product of solute . K_{ip} can be changed if the Concentration of the solution is changed . Also K_{ip} can be calculated at any solution (saturated , unsaturated or over-saturated).

Relation between K_{sp} and K_{ip} :

if, $K_{ip} = K_{sp}$: The solution is saturated

if, $K_{ip} > K_{sp}$: The solution is over-saturated .

if, $K_{ip} < K_{sp}$: The solution is unsaturated .

UNIT CONVERSION REQUIRED FOR THIS CHAPTER

Name	SI	CGS
Length	meter(m)	Centimeter (cm)
Mass	kilogram(kg)	dyne
Energy	joule(J)	erg
Charge	Coulomb(C)	esu
Time	sec	sec

Unit Conversions:

$$1\text{mm} = 10^{-3} \text{ m}$$

$$1\mu\text{m} = 10^{-6} \text{ m}$$

$$1\text{nm} = 10^{-9} \text{ m}$$

$$1\text{\AA} = 10^{-10} \text{ m}$$

$$1\text{J} = 10^7 \text{ erg}$$