IONIZATION OF WEAK ACIDS AND BASES

Weak acids and bases are miser kind of species, because even though they have H^+ or OH^- ions, they don't give them quickly and when they do give them, they only give a part of them. When weak acids/bases are dissolved in water they partly dissociate or ionize. To know how much H^+ or OH^- ions they will release in water, we need to study their ionization reactions.

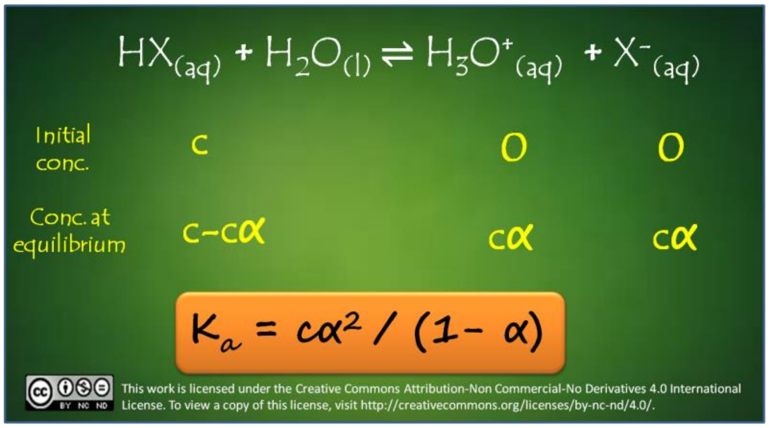
Let's take an example of a weak acid HX and study its ionization in water:

$$HX_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + X^-_{(aq)}$$

If we have taken c mol/lit of HX initially at time t=0, when the concentration of H_3O^+ and X^- were 0 and only a fraction of moles (α) underwent dissociation.

Suppose out of 1 mole of acid, α mole of acid undergoes dissociation.
Then from c moles of acid (c.α) will be dissociated.

At time t, (cα) moles of HX dissociate and produce (cα) moles of H_3O^+ and (cα) moles of X^-. So at the time of equilibrium HX is left with (c-cα) moles/lit and H_3O^+ and X^- each has (cα) moles/lit.



Now we will calculate the equilibrium constant K_a as it is the ionization reaction of an acid:

$K_a = (c\alpha)\,(c\alpha)/\,(c-c\alpha)$

$K_a = c\alpha^2 / (1-\alpha)$

K_a is the ionization or dissociation constant of acid HX and α is the degree of dissociation or the extent of ionization.

If we write equation of K_a in terms of molar concentration, we will get:

$K_a = [H_3O^+]\,[X^-]/\,[HX]$

Or

$K_a = [H^+]\,[X^-]/\,[HX]$

As you can see here that K_a is directly proportional to the H^+ concentration, which means acids which have higher K_a value are stronger.

Similarly you can calculate the equilibrium constant K_b for a weak base. Let's take an example of a weak base MOH and study its ionization in water:

$MOH_{(aq)} \rightleftharpoons M^+_{(aq)} + OH^-_{(aq)}$

If the initial concentration of MOH is c mole/lit and degree of dissociation is α, then at equilibrium MOH is left with ($c-c\alpha$) moles/lit and M^+ and OH^- each has ($c\alpha$) moles/lit. So the K_b will be:

$K_b = [M^+] [OH^-]/ [MOH]$

Or

$K_b = c\alpha^2 / (1- \alpha)$

K_b is directly proportional to the OH^- concentration, which means bases which have higher K_b value are stronger.

In the next post we will see if there is any relation between K_a and K_b.

Source : http://chemistrynotmystery.blogspot.in/2015/02/ionization-of-weak-acids-and-bases.html