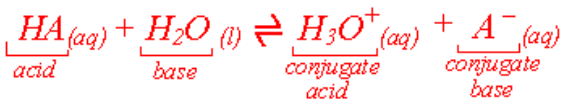
Weak Acid vs. Strong Acid

1. What is the BrΦnsted-Lowry defintion of an acid?

   A substance that donates H^+

2. Write the generalized equation for the dissociation of an acid.



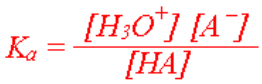
   The most complete description of an acid dissociating includes water. Water serves as the base, accepting the H^+ from the HA.

   Though the acid doesn't just spontaneously fall apart… this reaction is typically simplified to…

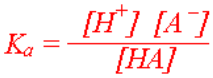
   Where the H^+ represents the hydronium ion (H_3O^+).

3. What is K_a?

   K_a is the acid dissociation constant.



   which can be simplified to



4. What defines the strength of an acid?

   How far to the right the equilibrium position of the acid dissociation lies.

The larger the K_a value the stronger the acid.

5. What are some properties of a strong acid?

   a. Equilibrium lies so far to the right that dissociation is said to go to completion.

   $[HA] = [H^+]$ produced

   b. Strong acids have *very* large K_a values.

   c. Strong acids yield conjugate bases that are weaker than water. These conjugates are no more than spectator ions in solution – therefore they have no affect on the pH of a solution.

6. List 7 strong acids

   a. HCl
   b. HBr
   c. HI
   d. $HClO_4$
   e. $HClO_3$
   f. H_2SO_4
   g. HNO_3

7. What are some properties of a weak acid?

   a. Equilibrium lies far to the left

   $[HA] >> [H^+]$ produced

   b. Have very small K_a values.

c. Weak acids yield a conjugate base that is stronger than water. This means they can affect the pH of a solution.

8. How can you tell if you are dealing with a weak acid?

It is not one of the seven strong acids listed above.

9. What is percent dissociation?

It is the percent of the original acid solution that dissociated.

$$\%\ dissociation = \frac{amount\ dissociated}{initial\ [\ ]}\ x\ 100\%$$

10. An acid, HX, is 25% dissociated in water. If the equilibrium concentration of HX is 0.30M, calculate K_a for HX.

This question is slightly more complicated in solving methodology. Don't get caught up in the many layers of the question – rather just start where you normally would.

$$HX_{(aq)} \rightleftharpoons H^+_{(aq)}\ X^-_{(aq)}$$

$$K_a = \frac{[X^-]\,[H^+]}{[HX]}$$

	$HX_{(aq)} \rightleftharpoons$	$H^+_{(aq)}$ +	$X^-_{(aq)}$
I	Y	0	0
C	$-x$	$+x$	$+x$
E	$Y-x$	x	x

$$K_a = \frac{[X^-]\,[H^+]}{[HX]} = \frac{(x)(x)}{(Y-x)}$$

You now have the basis for what you are going to solve for. The only pieces missing to solve for K_a are x and Y. Let's see what other information we have.

The equilibrium concentration of HX is 0.30M.
This means that: Y – x = 0.30M

We also know that HX has a % dissociation of 25%. This means that:

$$\frac{\text{the amount dissociated } x}{\text{the initial concentration } Y} = 0.25$$

With two equations and two unknowns we can easily solve!

$$\frac{x}{Y} = 0.25 \longrightarrow x = 0.25Y$$

$$Y - x = 0.30M \longrightarrow Y - 0.25Y = 0.30M$$

$$Y = 0.40M$$

$$x = 0.25Y \longrightarrow x = (0.25)(0.40)$$

$$x = 0.100M$$

Now you have the values needed to solve for K_a

$$K_a = \frac{[X^-][H^+]}{[HX]} = \frac{(x)(x)}{(Y-x)} = \frac{(0.100)(0.100)}{(0.30)} = \boxed{0.033}$$

This problem is often overwhelming for students. If you try to be as methodical as possible – you will have a clearer perspective when looking at a question that looks like it has a lot of disconnected information. Follow the data given – it will show you the way to the answer.