Weak Acids and Bases Practice -- Chemistry 121A Hanson

OK, what's new here really is just **percent ionization**. The way to think of this is that it is just a form of percent yield. It runs from 0% (all reactants) to 100% (all products). This is simply more convenient than Q, which runs from 0 to infinity. The way I look at it is this for a weak acid:

$$\%\text{ionization} = [A^-]\text{eq}/[HA]\text{o} \times 100\%$$

That is, the "final" concentration of A^- at equilibrium divided by the "initial" concentration of HA times 100%. What's interesting is that since when you start with a weak acid as the sole principal species in solution, we have:

$$HA + H_2O \rightleftharpoons A^- + H_3O^+$$

and since both A^- and H_3O^+ come from the same process in that case, **their concentrations are the same at equilibrium**. Right? Think about the implications. We can easily answer questions like:

1. What is the percent ionization of 0.10 M HF (K_a 7.2 x 10^{-4})?

[We know K_a, so we can get $[H_3O^+]$ easily enough using an ICE table. Try that. You should get 8.1%.]

2. A 0.10 M solution of an acid HA is found to be 3.5% ionized. What is the Ka of this acid?

[Actually, this is easier. Just fill in the ICE table "puzzle" with numbers and calculate Q_{eq}. Answer: 1.3 x 10^{-4}]

or

3. *A 0.10 M solution of an acid HA is found to have a pH of 6.22. What is the percent ionization of this acid?*

[Answer: only 6.0 x 10^{-4} %]

4. *What is its K_a?*

[Answer: 3.6 x 10^{-10}]

Turns out this also works with bases. Consider:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

Here we define percent ionization as:

$$\%\text{ionization} = [NH_4^+]\text{eq}/[NH_3]\text{o} \times 100\%$$

This time we have $[NH_4^+] = [OH^-]$ at equilibrium as long as we just start with NH_3. And we can ask:

5. What is the percent ionization of 0.10 M NH_3 (K_b 1.8 x 10^{-5})?

[We know K_b, so we can get $[OH^-]$ easily enough using an ICE table. Answer: 1.3%]

Ready for a harder one?

6. A 0.10 M solution of a weak base B is found to have pH 9.20. What is the Kb of this base?

Want more? Google *weak acid practice* or *weak base problems* or such. You will find plenty!