Equilibrium Practice Questions

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Weak acid pH - Ka and the Approximation Method**

To calculate the precise pH of weak acid & bases you can use Ka (or Kb) values (see your Chemistry Data Booklet's acid-base table) and the quadratic method. If the weak acid/base concentration is more than 1000 times the Ka/Kb value an approximate answer very close to the true value can be calculated as shown in the worked example below.

Generally speaking, for any equilibrium system, if the smallest [reactant] >1000 K(a,b,c,p,etc) then the change in concentration, x, is so small as to be negligible. More appropriately ±x, or a multiple thereof, is negligible. *Any concentration you add to or subtract it from is unaffected.*

Example 1. What is the pH of a 0.10 mol/L ethanoic acid solution?

 CH3COOH(aq) + H2O(g) $⇌$ H3O+(aq) + CH3COO–(aq)

Initially 0.10 mol/L — — —

Equilibrium 0.10 - x — x x

So $K\_{a}=\frac{x^{2}}{\left[0.10-x \right]} but \frac{0.10}{K\_{a}} >1000 so \pm x is negligible$

Therefore $K\_{a}≅\frac{x^{2}}{0.10} which gives x =\sqrt{0.10×K\_{a}} $

$$ = \sqrt{0.10×1.8×10^{-5}} $$

 = 1.3 × l0-3 mol/L

 and pH = –log(1.3 × l0-3 mol/L) = 2.88

 % Ionization = 1.3 % 

1. What is the [H3O+(aq)], % Ionization, and the pH of 1.0 mol/L ethanoic acid?

2. What is the [H3O+(aq)], % Ionization, and the pH of 0.25 mol/L hypochlorous acid?

3. What is the [H3O+(aq)], % Ionization, and the pH of 0.50 mol/L oxalic acid?

4. What is the [H3O+(aq)], % Ionization, and the pH of 1.2 mol/L hydrofluoric acid?

5. What is the [H3O+(aq)], % Ionization, and the pH of 0.20 mol/L aqueous ammonium chloride?

6. What is the [H3O+(aq)], % Ionization, and the pH of 3.0 mol/L sulfurous acid?