1. **Find the pH of 0.1 M $HClO_4$**

   This is a strong acid, so $[H^+] = 0.1$ M.

   pH= –log(0.1) = 1

2. **Find the pH of 0.1 M $Ca(OH)_2$**

   This is a strong base, and there are two OH's for every $Ca(OH)_2$, so $[OH^-] = 0.2$ M

   pOH = -log(0.2) = 0.699

   pH = 14 - .699 = 13.3

3. **Find the pH and % ionization of 0.1 M HNO_2, $K_a = 4.5x10^{-4}$**

   K_a is too big to use $[H^+] = \sqrt{K_a C}$

   So use $[H^+] = \dfrac{-K_a + \sqrt{K_a^2 + 4K_a C}}{2}$

   $[H^+] = \dfrac{-4.5\times10^{-4} + \sqrt{(4.5\times10^{-4})^2 + 4(4.5\times10^{-4})(0.1)}}{2} = 0.00649$ M

   pH = -log(0.00649) = 2.19

   % ionization = (0.00694/0.1)x100 = 6.49%

4. **Find the pH and % ionization of 0.1 M NH_3, $K_b = 1.8x10^{-5}$**

   K_b is small enough to use $[OH^-] = \sqrt{K_b C}$

   $[OH^-] = \sqrt{(1.8\times10^{-5})(0.1)} = 0.00134$ M

   pOH = -log(0.00134) = 2.87

   pH = 14 – 2.87 = 11.13

   % ionization = (0.00134/0.1)x100 = 1.34%

5. **Find the pH and % hydrolysis of 0.1 M $NaNO_2$**

   Na^+ is the salt of a strong base (NaOH) and NO_2^- is the salt of a weak acid (HNO_2).

   Therefore this salt will make the solution basic.

   Use the K_a of HNO_2 and switch it to a K_b.

   $K_b = 1x10^{-14}/4.5x10^{-4} = 2.2x10^{-11}$

   $[OH^-] = \sqrt{K_b C}$

   $[OH^-] = \sqrt{(2.2\times10^{-11})(0.1)} = 1.48x10^{-6}$ M

   $pOH = -\log(1.48x10^{-6}) = 5.82$

   $pH = 14-5.82 = 8.18$

   % hydrolysis = $(1.48x10^{-6}/0.1)x100 = 0.00148\%$

6. **Find the pH and % hydrolysis of 0.1 M NH_4Cl**

   NH_4^+ is the salt of a weak base (NH_4OH or NH_3) and Cl^- is the salt of a strong acid (HCl).

   Therefore this salt will make the solution acidic.

   Use the K_b of NH_3 and switch it to a K_a.

   $K_a = 1x10^{-14}/1.8x10^{-5} = 5.6x10^{-10}$

   $[H^+] = \sqrt{K_a C}$

   $[H^+] = \sqrt{(5.6\times10^{-10})(0.1)} = 7.48x10^{-6}$ M

   $pH = -\log(7.48x10^{-6}) = 5.13$

   % hydrolysis = $(7.48x10^{-6}/0.1)x100 = 0.00748\%$

Note: question 5 could have asked “Find the pH and % hydrolysis of 0.1 M NO_2^-“ and it would mean the exact same thing. Similarly, question 6 could just as easily have asked “Find the pH and % hydrolysis of 0.1 M NH_4^+“.