AP Chemistry – Acid and Base Equilibria Worksheet

1) Fill in the missing information in the following table:

Solution	pH	pOH	$[H^+]$	$[OH^-]$	Acidic/Basic
A	9.65				
B				3.1×10^{-6}	
C			0.018		
D		11.40			

2) Using the K_a values given in the table, calculate the concentrations of all species present and the pH for each of the following.

Values of K_a for Some Common Monoprotic Acids

Formula	Name	Value of K_a
HSO_4^-	Hydrogen sulfate ion	1.2×10^{-2}
$HClO_2$	Chlorous acid	1.2×10^{-2}
$HC_2H_2ClO_2$	Monochloracetic acid	1.35×10^{-3}
HF	Hydrofluoric acid	7.2×10^{-4}
HNO_2	Nitrous acid	4.0×10^{-4}
$HC_2H_3O_2$	Acetic acid	1.8×10^{-5}
$[Al(H_2O)_6]^{3+}$	Hydrated aluminum(III) ion	1.4×10^{-5}
HOCl	Hypochlorous acid	3.5×10^{-8}
HCN	Hydrocyanic acid	6.2×10^{-10}
NH_4^+	Ammonium ion	5.6×10^{-10}
HOC_6H_5	Phenol	1.6×10^{-10}

↑ Increasing acid strength

(a) 0.20 *M* $HC_2H_3O_2$ (b) 1.3 *M* HNO_2 (c) 0.020 *M* HF

For all three find: $[H^+]$, $[X^-]$, [HX], $[OH^-]$, pH

3) Calculate the percent dissociation of the acid in each of the following solutions

(a) 0.48 *M* acetic acid (b) 0.048 *M* acetic acid (c) 0.0048 *M* acetic acid

4) An acid HX is 40.% dissociated in water. If the equilibrium concentration of HX is 0.36 *M*, calculate the K_a value for HX.

5) What mass of KOH is necessary to prepare 798.8 mL of a solution having a pH = 11.43?

6) Calculate the $[OH^-]$, $[H^+]$, and the pH of 0.32 *M* solutions of each of the following amines.

(a) triethylamine [$(C_2H_5)_3N$, $K_b = 4.0 \times 10^{-4}$]

(b) hydroxylamine ($HONH_2$, $K_b = 1.1 \times 10^{-8}$)

7) Calculate the value for the equilibrium constant for each of the following aqueous reactions. (Use K_a values from list above)

(a) $NH_3 + H_3O^+ \rightleftharpoons NH_4^+ + H_2O$

(b) $NO_2^- + H_3O^+ \rightleftharpoons HNO_2 + H_2O$

(c) $NH_4^+ + CH_3CO_2^- \rightleftharpoons NH_3 + CH_3CO_2H$

(d) $H_3O^+ + OH^- \rightleftharpoons 2\ H_2O$

(e) $NH_4^+ + OH^- \rightleftharpoons NH_3 + H_2O$

(f) $HNO_2 + OH^- \rightleftharpoons H_2O + NO_2^-$

8) Calculate the mass of $HONH_2$ required to dissolve in enough water to make 250.6 mL of solution having a pH of 10.25 ($K_b = 1.1 \times 10^{-8}$).

9) Calculate the pH after 0.020 mol NaOH is added to 1.00 L of each of the four solutions

(a) 0.100 *M* propanoic acid ($HC_3H_5O_2$, $K_a = 1.3 \times 10^{-5}$)

(b) 0.100 *M* sodium propanoate ($NaC_3H_5O_2$)

(c) pure H_2O

(d) 0.100 *M* $HC_3H_5O_2$ and 0.100 *M* $NaC_3H_5O_2$

10) A solution is 0.65 *M* HF and 1.02 *M* KF. Calculate the pH after 0.14 mol of NaOH is added to 1.00 L of the solution of HF and KF, and calculate the pH after 0.28 mol of HCl is added to 1.00 L of the solution of HF and KF

11) What volumes of 0.59 *M* HNO_2 and 0.56 *M* $NaNO_2$ must be mixed to prepare 1.00 L of a solution buffered at pH = 3.60?

12) A 14.40 g sample of an ionic compound NaA, where A^- is the anion of a weak acid, was dissolved in enough water to make 100.0 mL of solution and was then titrated with 0.100 *M* HCl. After 500.0 mL of HCl was added, the pH was 5.00. The experimenter found that 1.00 L of 0.100 *M* HCl was required to reach the stoichiometric point of the titration.

(a) What is the molar mass of NaA?

(b) Calculate the pH of the solution at the stoichiometric point of the titration.