Some Useful Information for Figuring Out Acid/Base Calculations

symbol	H^+	HA	BH^+	B	A^-	OH^-
type	Strong acid	Weak acid I	Weak acid II (salt of weak base)	Weak base I	Weak Base II (salt of weak acid)	Strong base
example	HNO3	Acetic acid	Ammonium chloride	ammonia	Sodium acetate	Potassium hydroxide
K range	$K_a =$	$K_a = 10^{-2}$ to 10^{-10}	$K_a = 10^{-2}$ to 10^{-10}	$K_b= 10^{-2}$ to 10^{-10}	$K_b = 10^{-2}$ to 10^{-10}	$K_b =$
equation	$[H^+] = C_{H+}$	$[H^+] = (K_aC_{HA})^{1/2}$	$[H^+] = (K_aC_{BH+})^{1/2}$	$[OH^-] = (K_bC_B)^{1/2}$	$[OH^-] = (K_aC_{A-})^{1/2}$	$[OH^-] = C_{OH-}$
pH range	0-2	3-6	3-6	8-11	8-11	12-14
pOH range	12-14	8-11	8-11	3-6	3-6	0-2

Useful thoughts in working acid-base problems:

1. The first thing you do when you work an acid base problem is identify each compound as one of the 6 types of acids or bases: H^+, HA, BH^+, A^-, B, OH^-.

2, If the problem involves a single acid or base, work the simple strong or weak acid problem as above.

3. Before you work a problem, estimate the pH of the answer. Note the simple relationship between K and pH. The larger the K for an acid or base, the more dissociation of H^+ or OH^- and the smaller the pH or pOH, respectively.

4. When working problems involving more than one compound, the first step after identifying the kind of acid or base is to neutralize. This will result in a reduction in the types of compounds present because of the formation of H_2O.

6. The results of neutralization will be one of the following eight categories, regardless of the starting materials. It is actually pretty amazing to think that after neutralization, things simplify this much.

Type of solution after neutralization	Type of equation to solve for H+ or OH-	Equations assuming approximations
H^+ alone	Strong acid	$[H^+] = C_{H+}$
OH^- alone	Strong base	$[OH^-] = C_{OH-}$
HA or BH^+ alone	Weak acid	$[H^+] = (K_aC_{HA})^{1/2}$
B or A^- alone	Weak base	$[OH^-] = (K_bC_B)^{1/2}$
HA and A^- or	Acid buffer	$[H^+] = K_aC_{HA}/C_{A-}$
B and BH^+	Basic buffer	$[OH^-] = K_bC_B/C_{BH+}$
H^+ and HA or H^+ and BH^+	Strong acid/weak acid	$[H^+] = C_{H+}$
OH^- and B or OH^- and A^-	Strong base/weak base	$[OH^-] = C_{OH-}$

7. As always, remember your friends, the equations that allow you to switch between acid and base terrains:

switching between Ka and Kb $\quad K_w = K_aK_b = 10^{-14} \quad$ or $\quad pK_w = pK_a + pK_b = 14$

switching between pH and pOH $\quad K_w = [H^+][OH^-] = 10^{-14} \quad$ or $\quad pK_w = pH + pOH = 14$