CHM 1010 **GAGE**

PROBLEM SET FOR ACIDS AND BASES

1. From the list of compounds below, determine which compounds are:

a.	Arrhenius acids	H_2SO_4, HBr
b.	Bronsted-Lowry bases	NH_3, KOH, $CaCO_3$, Na_2CO_3, $Ba(OH)_2$, $KHCO_3$
c.	weak bases	NH_3, $CaCO_3$, Na_2CO_3, $KHCO_3$
d.	Lewis acids	H_2SO_4, HBr, BCl_3
e.	salts	Na_2SO_4, KBr

NH_3, KOH, Na_2SO_4, H_2SO_4, $CaCO_3$, Na_2CO_3, H_2O, $Ba(OH)_2$, HBr, $KHCO_3$, KBr, BCl_3

2. How many mL of 0.234 M HCl are required to neutralize 45.0 mL of 0.135 M KOH? 35.0 mL of 0.88M $Mg(OH)_2$?

$$HCl + KOH \text{ ----------> } KCl + H_2O$$
$$2\ HCl + Mg(OH)_2 \text{ ----------> } MgCl_2 + 2\ H_2O$$

For 1:1 stoichiometry $M_aV_a = M_bV_b$

$0.234\ M \times V_a = 0.135\ M \times 45.0\ mL$

$V_a = 26.0\ mL\ HCl$

For stoichiometry other than 1:1 you need to use stoichiometric ratios

$M_bV_b = mol_b = 0.088\ M \times 35.0\ mL = 3.08\ mmol\ Mg(OH)_2$

$$3.08\ mmol\ Mg(OH)_2 \times \frac{2\ mol\ HCl}{1\ Mg(OH)_2} = 6.16\ mmol\ HCl$$

$$M = \frac{mol}{L} \qquad L = \frac{mol}{M} = \frac{6.16\ mmol}{0.234\ M} = 26.3\ mL\ HCl$$

3. Complete and balance the following reactions:

$$Mg(OH)_2 + 2\ HF \text{ -------> } MgF_2 + 2\ H_2O$$

$$3\ BaCO_3 + 2\ H_3PO_4 \text{ ---------> } Ba_3(PO_4)_2 + 3\ CO_2 + 3\ H_2O$$

$$NH_3 + HI \text{ ----------> } NH_4I$$

4. A 10.67 g sample of a solution of alanine (a monoprotic aminoacid with the formula $CH_3CH(NH_2)COOH$) requires 42.3 mL of a 0.250 M NaOH solution to be neutralized. What is the w/w% of the acid solution?

$M_b V_b = mol_b = \frac{0.250 mol}{L} \times 0.0423\ L = 0.0106\ mol\ NaOH = 0.0106\ mol\ alanine$

$0.0106\ mol\ alanine \times \frac{89.0\ g\ alanine}{1\ mol\ alanine} = 0.943\ g\ alanine$

$\frac{0.943\ g\ alanine}{10.67\ g\ solution} \times 100\% = 8.84\ \%\ w/w\ alanine$

5. Determine the pH and pOH of the following solutions:

$pH = -\log [H^+]$ $pOH = -\log [OH^-]$ $pH + pOH = 14$

		pH	pOH
a.	3.4×10^{-3} M HCl	2.47	11.53
b.	7.78×10^{-4} M NaOH	10.891	3.109
c.	4.55×10^{-6} M $Mg(OH)_2$	8.959	5.041
d.	0.000822 M HNO_3	3.085	10.915

6. Determine the H^+ and OH^- concentrations for solutions that have:

$H^+ = 10^{-pH}$ $OH^- = 10^{-pOH}$ $[H^+][OH^-] = 1.00 \times 10^{-14}$ or $pH + pOH = 14$

		H^+	OH^-
a.	pH = 4.56	2.8×10^{-5}	3.6×10^{-10}
b.	pOH = 11.90	7.9×10^{-3}	1.3×10^{-12}
c.	pH = 12.78	1.7×10^{-13}	6.0×10^{-2}
d.	pH = 6.6	2.5×10^{-7}	4.0×10^{-8}