Chapter 14 Questions

Sections 14.1 & 14.2

1) Give the conjugate base of the following Bronsted-Lowry acids:

a) H_2SO_3 d) NH_4^+
b) $HC_2H_3O_2$ *e) $CH_3NH_3^+$*
c) $H_2AsO_4^-$ *f) HPO_3^{-2}*

2) Give the conjugate acid of the following Bronsted-Lowry bases:

a) $C_7H_5O_2^-$ d) $H_2AsO_4^-$
b) BrO_2^- *e) HPO_3^{-2}*
c) NH_3 *f) C_6H_5N*

3) Designate the Bronsted-Lowry acid and base on the left side of each of the following equations and also designate the conjugate acid and conjugate base on the right side.

a) NH_4^+ (aq) + CN^{-1} (aq) <==> HCN (aq) + NH_3 (aq)
b) $(CH_3)_3N$ (aq) + H_2O (l) <==> $(CH_3)_3NH^+$ (aq) + OH^- (aq)
c) $HCHO_2$ (aq) + PO_4^{-3} (aq) <==> CHO_2^- (aq) + HPO_4^{-2} (aq)
d) CO_3^{-2} (aq) + HSO_4^{-1} (aq) <==> SO_4^{-2} (aq) + HCO_3^{-1} (aq)
e) H_2O (l) + H_3AsO_4 (aq) <==> $H_2AsO_4^{-1}$ (aq) + H_3O^+ (aq)

4a) Write an equation for the reaction in which $H_2PO_4^{-1}$ (aq) acts as a base in H_2O (l).
b) Write an equation for the reaction in which $H_2PO_4^{-1}$ (aq) acts as an acid in H_2O (l).
c) What is the conjugate acid of $H_2PO_4^{-1}$ (aq)? What is its conjugate base?

5a) Write a chemical equation that illustrates the autoionization of water.
b) Write the expression for the ion product constant for water, K_w. Why is $[H_2O]$ absent from this expression?
c) A solution is described as basic. What is meant by this statement?

6) Calculate $[H^+]$ for each of the following solutions:
a) $[OH^-]$ = 0.00005 M
b) A 100 mL solution containing 1.46 g of HCl
c) *$[OH^-] = 3.2 \times 10^{-9}$ M*

7) Calculate the $[OH^-]$ for each of the
a) $[H^+] = 1.9 \times 10^{-9}$ M
b) a 250 mL solution containing 4.3 g of NaOH
c) *A solution in which $[OH^-]$ is 100 times greater than $[H^+]$.*

Sections 14.3 & 14.4

8) By what factor does $[H^+]$ change for a pH change of
a) 2.0 units b) 6.0 units *c) 0.50 units*

9a) If NaOH is added to water, how does $[H^+]$ change? How does pH change?
b) If $[H^+]$ = 0.0003 M, what is the pH of the solution? Is the solution acidic or basic?
c) If $[OH^-]$ = 0.0003 M, what is the pH of the solution? Is the solution acidic or basic?
d) If pH = 7.8, what are the molar concentration of H^+ (aq) and OH^- (aq) in the solution?
e) If pOH = 4.5, what are the molar concentration of H^+ (aq) and OH^- (aq) in the solution?

10a) What is a strong acid?
b) A solution is labeled 0.500 M HCl. What is $[H^+]$ for the solution?
c) Which of the following are strong acids: HF, HCl, HBr, HI?

11a) What is a strong base?
b) A solution is labeled 0.125 M $Sr(OH)_2$. What is $[OH^-]$ for the solution?
c) Is the following statement true or false? Because $Mg(OH)_2$ is not very soluble, it cannot be a strong base. Explain.

12) Complete the following table by calculating the missing entries and indicating whether the solution is acidic or basic.

$[H^+]$ M	$[OH^-]$ M	pH	pOH	Acid or base?
7.5×10^{-3}				
	3.6×10^{-10}			
		8.3		
			5.7	
			7.9	
		3.8		
	8.1×10^{-2}			

13) Calculate the pH of each of the following strong acid solutions:
a) 8.5×10^{-3} M HBr
b) 1.52 g of HNO_3 in 575 mL of solution
c) 5.00 mL of 0.250 M $HClO_4$ diluted to 50.0 mL
d) 3.00 g of HBr in 2.00 L of solution
e) 1.00 mL of 12 M HCl diluted to 750 mL

14) Calculate $[OH^-]$ and pH for
a) 1.5×10^{-3} M $Sr(OH)_2$
b) 2.250 g of LiOH in 250.0 mL solution
c) 1.00 mL of 0.175 M NaOH diluted to 2.00 L.
d) 3.95 g of $Ca(OH)_2$ in 3.00 L of solution
e) 1.00 mL of 6 M KOH diluted to 2.00 L

Section 14.5

15) Write the chemical equation and the K_a expression for the ionization of each of the following acids in aqueous solution:
a) $HBrO_2$
b) $HC_3H_5O_2$
c) HF
d) HNO_2

16) A 0.100 M solution of bromoacetic acid, $BrCH_2COOH$, is 13.2 percent ionized. Using this information, calculate $[BrCH_2COO^-]$, $[H^+]$, $[BrCH_2COOH]$ and K_a for bromoacetic acid.

17) When HF ionizes in water, only 2.5% of the acid becomes ions. If 3.4 g of HF dissolve in 2.0 L of solution, what is the $[H^+]$ and the pH?

18) Lactic acid, $HC_3H_5O_3$, has one acidic hydrogen. A 0.10 M solution of lactic acid has a pH of 2.44. Calculate K_a.

19) In a 0.20 M solution of HCN, the pH is 5.0. What is the K_a for HCN?

20) The acid dissociation constant for hypochlorus acid, HClO, is 3.0×10^{-8}. Calculate the concentration of H^+, ClO^- and HClO at equilibrium if the initial concentration of the acid is 0.075 M

21) A sample of vinegar has a pH of 2.90. Assuming that vinegar contains only acetic acid ($K_a = 1.8 \times 10^{-5}$), calculate the concentration of acetic acid in vinegar.

22) Determine the pH of each of the following solutions (K_a values are given in Appendix 5.2):
a) 0.125 M hypochlorus acid
b) 0.0085 M phenol
c) 0.095 M propanoic acid
d) 0.0010 M boric acid
e) 6.0 M acetic acid

Section 14.6

23) Write the chemical equation and the K_b expression for the reaction of each of the following bases with water:
a) proplyamine, $C_3H_7NH_2$
b) hydrazine, H_2NNH_2
c) HPO_4^{-2}
d) pyridine, C_5H_5N
e) $H_2AsO_4^{-1}$

24a) Calculate the molar concentration of OH^- ions in a 0.075 M solution of ethylamine, $C_2H_5NH_2$ ($K_b = 6.4 \times 10^{-4}$).
b) Calculate the pH of the solution.

25) A 1.00 M solution of diethylamine, $(C_2H_5)_2NH$, has a 3.6% ionization. What is the K_b for diethylamine?

26) Ephedrine, a central nervous system stimulant, is a weak organic base: $C_{10}H_{15}ON (aq) + H_2O (l) \Longleftrightarrow C_{10}H_{15}ONH^+ (aq) + OH^- (aq)$. A 0.035 M solution of ephedrine has a pH of 11.33.
a) Calculate the equilibrium concentrations of all materials.
b) Calculate the K_b for ephedrine.

27) Determine the pH of each of the following solutions (K_b values are given in Appendix 5.3):
a) 0.095 M hydroxylamine
b) 0.135 M pyridine
c) 1.00 M ammonia
d) 0.001 M aniline

Section 14.8

28) Although the acid dissociation constant for phenol, C_6H_5OH, is listed in Appendix 5, the base dissociation constant for the phenolate ion, $C_6H_5O^-$, is not.
a) Explain why it is not necessary to list both K_a for phenol and K_b for the phenolate ion.
b) Calculate the K_b for the phenolate ion.
c) Is the phenolate ion a weaker or stronger base than ammonia?

29a) Given that K_b for ammonia is 1.8×10^{-5} and that for methylamine is 4.4×10^{-4}, which is the stronger base?
b) Which is the stronger acid, the ammonium ion or the methylammonium ion?

30a) Given that K_a for acetic acid is 1.8×10^{-5} and that for hypchlorous acid is 3.0×10^{-8}, which is the stronger acid?
b) Which is the stronger base, the acetate ion or the hypochlorite ion?
c) Calculate K_b for $C_2H_3O_2^-$ and ClO^-.

31) Based on your knowledge of strong and weak acids and bases, would the salt created from HCl and NaOH be acidic, basic or neutral?

32) Predict the pH (7, below 7, above 7) for the salts produced by the following mixtures:
a) calcium hydroxide and hydrofluoric acid
b) ammonia and nitric acid
c) iron (III) hydroxide and sulfuric acid
d) phosphoric acid and potassium hydroxide
e) hydrobromic acid and rubidium hydroxide

33) Predict whether aqueous solutions of the following compounds are acidic, basic or neutral:
a) NH_4Br
b) $FeCl_3$
c) Na_2CO_3
d) $KClO_4$
e) $NaHC_2O_4$
f) CsBr
g) $Al(NO_3)_3$
h) KCN

Review

1) 3.00 g of iron are placed in 250 mL of 1.25 M HCl. What volume of hydrogen gas will be produced in a room at 13.9 psi and 23 ^{O}C?

2) Determine the oxidation state of S in each of the following compounds:
a) $CaSO_4$
b) SO_3^{-2}
c) Na_2S
d) SF_6

3) Write a net ionic equation for the reaction of
a) $CaCl_2$ (aq) + $AgNO_3$ (aq)
b) Ca (s) + O_2 (g)
c) C_2H_4 (g) + O_2 (g)
d) $Cr(NO_3)_3$ (aq) + K (s)

4) Describe the difference in the density, kinetic energy, rms speed and effusion of two 10.0 L samples of gas at 295 K, one sample being N_2 and the other being CO_2.

5) A equilibrium is established for the reaction N_2 (g) + 3 H_2 (g) <==> 2 NH_3 (g). What would happen to reestablish equilibrium when the following changes are made to the reaction flask?
a) more N_2 is added.
b) the pressure is decreased
c) Argon is added to the flask