CHE 112 - Exam Practice - Chapter 14 - S21 - ver 1 Score: ____/56

Name: ______________________ Class: ________________ Date: ________________

[6 pt] 1. What are the definitions of acid and base according to Arrhenius, Bronsted-Lowry and Lewis?

	Arrhenius	**Bronsted-Lowery**	**Lewis**
Acid			
Base			

[4 pt] 2. What is the difference between a strong acid and a weak acid. Write a chemical equation illustrating each.

[3 pt] 3. List the 6 strong acids (Name or Formula)

[6 pt] 4. For a pH = 8.62 solution, calculate the following:

(a) $[H^+]$ 4(a) __________

(b) pOH 4(b) __________

(c) $[OH^-]$ 4(c) __________

(d) Is the solution (A)cidic, (B)asic, or (N)eutral? 4(d) __________

[6 pt] 5. For a $[H^+] = 5.28 \times 10^{-3}$ M solution, calculate the following:

(a) pH 5(a) __________

(b) pOH 5(b) __________

(c) $[OH^-]$ 5(c) __________

(d) Is the solution (A)cidic, (B)asic, or (N)eutral? 5(d) __________

[6 pt] 6. Buffer Question:

(a) Define the term buffer.

(b) What two classes of compounds are mixed to form a buffer?

(c) What two factors determine how strong a buffer will be?

(d) Give an example of one possible buffer solution.

(e) Assuming a 50/50 mixture what would the pH of the buffer solution be? Explain.

[9 pt] 7. Will the following solution be (A)cidic, (B)asic, or (N)eutral. Write a chemical equation as part of your explaination.

(a) NH_4Cl 7(a) ____________

(b) $Mg(C_2H_3O_2)_2$ 7(b) ____________

(c) KNO_3 7(c) ____________

[16 pt] 8. A solution of 80.0 mL of 0.25 M $HC_2H_3O_2$ is titrated with 1.0 M KOH. Calculate the pH of the titration at each of the following points. Explain. Show all work on the following page.

(a) Initial pH: 8(a) ______________

(b) After adding 15.0 mL of KOH: 8(b) ______________

(c) After adding 20.0 mL of KOH: 8(c) ______________

(d) After adding 45.0 mL of KOH: 8(d) ______________

Equilibrium Constants at 25°C

TABLE C.1 Acid-Dissociation Constants at 25°C

Acid	Formula	K_{a1}	K_{a2}	K_{a3}
Acetic	CH_3CO_2H	1.8×10^{-5}		
Acetylsalicylic	$C_9H_8O_4$	3.0×10^{-4}		
Arsenic	H_3AsO_4	5.6×10^{-3}	1.7×10^{-7}	4.0×10^{-12}
Arsenious	H_3AsO_3	6×10^{-10}		
Ascorbic	$C_6H_8O_6$	8.0×10^{-5}		
Benzoic	$C_6H_5CO_2H$	6.5×10^{-5}		
Boric	H_3BO_3	5.8×10^{-10}		
Carbonic	H_2CO_3	4.3×10^{-7}	5.6×10^{-11}	
Chloroacetic	CH_2ClCO_2H	1.4×10^{-3}		
Citric	$C_6H_8O_7$	7.1×10^{-4}	1.7×10^{-5}	4.1×10^{-7}
Formic	HCO_2H	1.8×10^{-4}		
Hydrazoic	HN_3	1.9×10^{-5}		
Hydrocyanic	HCN	4.9×10^{-10}		
Hydrofluoric	HF	3.5×10^{-4}		
Hydrogen peroxide	H_2O_2	2.4×10^{-12}		
Hydrosulfuric	H_2S	1.0×10^{-7}	$\sim 10^{-19}$	
Hypobromous	HOBr	2.0×10^{-9}		
Hypochlorous	HOCl	3.5×10^{-8}		
Hypoiodous	HOI	2.3×10^{-11}		
Iodic	HIO_3	1.7×10^{-1}		
Lactic	$HC_3H_5O_3$	1.4×10^{-4}		
Nitrous	HNO_2	4.5×10^{-4}		
Oxalic	$H_2C_2O_4$	5.9×10^{-2}	6.4×10^{-5}	
Phenol	C_6H_5OH	1.3×10^{-10}		
Phosphoric	H_3PO_4	7.5×10^{-3}	6.2×10^{-8}	4.8×10^{-13}
Phosphorous	H_3PO_3	1.0×10^{-2}	2.6×10^{-7}	
Saccharin	$C_7H_5NO_3S$	2.1×10^{-12}		
Selenic	H_2SeO_4	Very large	1.2×10^{-2}	
Selenious	H_2SeO_3	3.5×10^{-2}	5×10^{-8}	
Sulfuric	H_2SO_4	Very large	1.2×10^{-2}	
Sulfurous	H_2SO_3	1.5×10^{-2}	6.3×10^{-8}	
Tartaric	$C_4H_6O_6$	1.0×10^{-3}	4.6×10^{-5}	
Water	H_2O	1.8×10^{-16}		

TABLE C.2 Acid-Dissociation Constants at 25°C for Hydrated Metal Cations

Cation	K_a	Cation	K_a
$Fe^{2+}(aq)$	3.2×10^{-10}	$Be^{2+}(aq)$	3×10^{-7}
$Co^{2+}(aq)$	1.3×10^{-9}	$Al^{3+}(aq)$	1.4×10^{-5}
$Ni^{2+}(aq)$	2.5×10^{-11}	$Cr^{3+}(aq)$	1.6×10^{-4}
$Zn^{2+}(aq)$	2.5×10^{-10}	$Fe^{3+}(aq)$	6.3×10^{-3}

Note: As an example, K_a for $Fe^{2+}(aq)$ is the equilibrium constant for the reaction

$$Fe(H_2O)_6^{2+}(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + Fe(H_2O)_5(OH)^+(aq)$$

Figure 1

TABLE C.3 Base-Dissociation Constants at 25°C

Base	Formula	K_b
Ammonia	NH_3	1.8×10^{-5}
Aniline	$C_6H_5NH_2$	4.3×10^{-10}
Codeine	$C_{18}H_{21}NO_3$	1.6×10^{-6}
Dimethylamine	$(CH_3)_2NH$	5.4×10^{-4}
Ethylamine	$C_2H_5NH_2$	6.4×10^{-4}
Hydrazine	N_2H_4	8.9×10^{-7}
Hydroxylamine	NH_2OH	9.1×10^{-9}
Methylamine	CH_3NH_2	3.7×10^{-4}
Morphine	$C_{17}H_{19}NO_3$	1.6×10^{-6}
Piperidine	$C_5H_{11}N$	1.3×10^{-3}
Propylamine	$C_3H_7NH_2$	5.1×10^{-4}
Pyridine	C_5H_5N	1.8×10^{-9}
Strychnine	$C_{21}H_{22}N_2O_2$	1.8×10^{-6}
Trimethylamine	$(CH_3)_3N$	6.5×10^{-5}

TABLE C.4 Solubility Product Constants at 25°C

Compound	Formula	K_{sp}
Aluminum hydroxide	$Al(OH)_3$	1.9×10^{-33}
Barium carbonate	$BaCO_3$	2.6×10^{-9}
Barium chromate	$BaCrO_4$	1.2×10^{-10}
Barium fluoride	BaF_2	1.8×10^{-7}
Barium hydroxide	$Ba(OH)_2$	5.0×10^{-3}
Barium sulfate	$BaSO_4$	1.1×10^{-10}
Cadmium carbonate	$CdCO_3$	6.2×10^{-12}
Cadmium hydroxide	$Cd(OH)_2$	5.3×10^{-15}
Calcium carbonate	$CaCO_3$	5.0×10^{-9}
Calcium fluoride	CaF_2	1.5×10^{-10}
Calcium hydroxide	$Ca(OH)_2$	4.7×10^{-6}
Calcium phosphate	$Ca_3(PO_4)_2$	2.1×10^{-33}
Calcium sulfate	$CaSO_4$	7.1×10^{-5}
Chromium(III) hydroxide	$Cr(OH)_3$	6.7×10^{-31}
Cobalt(II) hydroxide	$Co(OH)_2$	1.1×10^{-15}
Copper(I) bromide	$CuBr$	6.3×10^{-9}
Copper(I) chloride	$CuCl$	1.7×10^{-7}
Copper(II) carbonate	$CuCO_3$	2.5×10^{-10}
Copper(II) hydroxide	$Cu(OH)_2$	1.6×10^{-19}
Copper(II) phosphate	$Cu_3(PO_4)_2$	1.4×10^{-37}
Iron(II) hydroxide	$Fe(OH)_2$	4.9×10^{-17}
Iron(III) hydroxide	$Fe(OH)_3$	2.6×10^{-39}
Lead(II) bromide	$PbBr_2$	6.6×10^{-6}
Lead(II) chloride	$PbCl_2$	1.2×10^{-5}
Lead(II) chromate	$PbCrO_4$	2.8×10^{-13}
Lead(II) iodide	PbI_2	8.5×10^{-9}
Lead(II) sulfate	$PbSO_4$	1.8×10^{-8}
Magnesium carbonate	$MgCO_3$	6.8×10^{-6}
Magnesium fluoride	MgF_2	7.4×10^{-11}
Magnesium hydroxide	$Mg(OH)_2$	5.6×10^{-12}
Manganese(II) carbonate	$MnCO_3$	2.2×10^{-11}
Manganese(II) hydroxide	$Mn(OH)_2$	2.1×10^{-13}
Mercury(I) bromide	Hg_2Br_2	6.4×10^{-23}

Figure 2

TABLE C.4 Solubility Product Constants at 25°C (*continued*)

Compound	Formula	K_{sp}
Mercury(I) chloride	Hg_2Cl_2	1.4×10^{-18}
Mercury(I) iodide	Hg_2I_2	5.3×10^{-29}
Mercury(II) hydroxide	$Hg(OH)_2$	3.1×10^{-26}
Nickel(II) hydroxide	$Ni(OH)_2$	5.5×10^{-16}
Silver bromide	AgBr	5.4×10^{-13}
Silver carbonate	Ag_2CO_3	8.4×10^{-12}
Silver chloride	AgCl	1.8×10^{-10}
Silver chromate	Ag_2CrO_4	1.1×10^{-12}
Silver cyanide	AgCN	6.0×10^{-17}
Silver iodide	AgI	8.5×10^{-17}
Silver sulfate	Ag_2SO_4	1.2×10^{-5}
Silver sulfite	Ag_2SO_3	1.5×10^{-14}
Strontium carbonate	$SrCO_3$	5.6×10^{-10}
Tin(II) hydroxide	$Sn(OH)_2$	5.4×10^{-27}
Zinc carbonate	$ZnCO_3$	1.2×10^{-10}
Zinc hydroxide	$Zn(OH)_2$	4.1×10^{-17}

TABLE C.5 Solubility Products in Acid (K_{spa}) at 25°C

Compound	Formula	K_{spa}
Cadmium sulfide	CdS	8×10^{-7}
Cobalt(II) sulfide	CoS	3
Copper(II) sulfide	CuS	6×10^{-16}
Iron(II) sulfide	FeS	6×10^{2}
Lead(II) sulfide	PbS	3×10^{-7}
Manganese(II) sulfide	MnS	3×10^{10}
Mercury(II) sulfide	HgS	2×10^{-32}
Nickel(II) sulfide	NiS	8×10^{-1}
Silver sulfide	Ag_2S	6×10^{-30}
Tin(II) sulfide	SnS	1×10^{-5}
Zinc sulfide	ZnS	3×10^{-2}

Note: K_{spa} for MS is the equilibrium constant for the reaction

$$MS(s) + 2\,H_3O^+(aq) \rightleftharpoons M^{2+}(aq) + H_2S(aq) + 2\,H_2O(l)$$

We use K_{spa} for metal sulfides rather than K_{sp} because the traditional values of K_{sp} are now known to be incorrect since they are based on a K_{a2} value for H_2S that is greatly in error (see R. J. Myers, *J. Chem. Educ.*, **1986**, *63*, 687–690).

TABLE C.6 Formation Constants for Complex Ions at 25°C

Complex Ion	K_f	Complex Ion	K_f
$Ag(CN)_2^-$	3.0×10^{20}	$Ga(OH)_4^-$	3×10^{39}
$Ag(NH_3)_2^+$	1.7×10^{7}	$Ni(CN)_4^{2-}$	1.7×10^{30}
$Ag(S_2O_3)_2^{3-}$	4.7×10^{13}	$Ni(NH_3)_6^{2+}$	2.0×10^{8}
$Al(OH)_4^-$	3×10^{33}	$Ni(en)_3^{2+}$	4×10^{17}
$Be(OH)_4^{2-}$	4×10^{18}	$Pb(OH)_3^-$	8×10^{13}
$Cr(OH)_4^-$	8×10^{29}	$Sn(OH)_3^-$	3×10^{25}
$Cu(NH_3)_4^{2+}$	5.6×10^{11}	$Zn(CN)_4^{2-}$	4.7×10^{19}
$Fe(CN)_6^{4-}$	3×10^{35}	$Zn(NH_3)_4^{2+}$	7.8×10^{8}
$Fe(CN)_6^{3-}$	4×10^{43}	$Zn(OH)_4^{2-}$	3×10^{15}

Figure 3