Kwanten Polytechnic University
CHEM 1105

SAMPLE FINAL EXAM 1

Time allowed: 3 hours

1. For the following provide the correct name or formula. **[8]**

a) $Hg_2(NO_3)_2$ _____

b) $Mg(C_2H_3O_2)_2$ _____

c) $(NH_4)_2CO_3$ _____

d) $Ca(OH)_2$ _____

f) Perchloric acid _____

g) Dihydrogen sulfide _____

i) Barium phosphate _____

j) Copper(II) sulfate pentahydrate _____

2. Complete and balance the following reactions. Give states of products. In each case there is a reaction. Compounds of group I A and ammonium ion are soluble. All nitrates are soluble. **[6]**

a) $Na(s) + H_2O(l) \rightarrow$

b) $Pb(NO_3)_2(aq) + Na_3PO_4(aq) \rightarrow$

c) $H_2SO_4(aq) + KOH(aq) \rightarrow$

3. Give the net-ionic equations for part (b) of question # 2. **[1]**

4. Complete the following table. **[5]**

Isotopic Notation	Number of protons	Number of neutrons	Number of electrons	Net Charge
$^{197}Au^{3+}$				
	33	42		+3
	16	16	18	
	81	123		+1

5. The element europium exists in nature as two isotopes. Eu-151 has a mass of 150.9196 amu, and Eu-153 has a mass of 152.9209 amu. The weighted average atomic mass of europium is 151.96 amu. Calculate the relative percent abundance of the two isotopes. **[2]**

6. A compound used in the manufacture of Saran is 24.7 % C, 2.10 % H, and 73.2% Cl by mass. The storage of 3.557 g of the compound in a 750.0 mL vessel at 0^{o}C results in a pressure of 1.10 atm. Calculate the empirical (simplest) and molecular formula of the compound. **[6]**

7. Iron pyrite, FeS_2, reacts with O_2 according to the following reaction:

$$4\ FeS_2(s) + 11\ O_2(g) \rightarrow 2\ Fe_2O_3(s) + 8\ SO_2(g)$$

a) Calculate the mass of Fe_2O_3 that is produced from the reaction of 75.0 L of $O_2(g)$ at 2.33 atm and 150.0^oC with an excess of FeS_2. **[4]**

b) If the $SO_2(g)$ that is generated in (a) is dissolved to form 5.00 L of an aqueous solution, what is the molar concentration of resulting sulfurous acid, H_2SO_3, solution? **[2]**

8. A mixture of hydrogen peroxide, H_2O_2, and hydrazine, N_2H_4, can be used as a rocket propellant. The reaction is:

$$7\ H_2O_2(g) + N_2H_4(l) \rightarrow 2\ HNO_3(aq) + 8\ H_2O(l)$$

a) How many moles of H_2O_2 react with 0.477 mol N_2H_4? **[1]** _____

b) How many grams of HNO_3 can be produced in a reaction of 67.7 g H_2O_2 with excess N_2H_4? **[3]**

c) How many grams of HNO_3 can be produced in a reaction of 67.7 g H_2O_2 with 10.00 mL of N_2H_4 (d= 1.006 g/mL) if the yield of the reaction is 76.5 %? **[4]**

9. A 10.0 mL sample of 3.00 M KOH(aq) is transferred to a 250.0 ml volumetric flask and diluted to the mark. It was found that 38.5 ml of this diluted solution was needed to react the stoichimetric point in a titration of 10.0 mL of a phosphoric acid, H_3PO_4, solution. The reaction is:

$$3\ KOH(aq) + H_3PO_4(aq) \rightarrow K_3PO_4(aq) + 3\ H_2O(l)$$

a) Calculate the molarity of H_3PO_4 in the original solution. **[3]**

b) Calculate the percent , by mass, of H_3PO_4 in the original solution. Assume the density of the acid is 1.00 g/mL. **[2]**

10. The standard enthalpy of formation of alcohol, $C_2H_5OH(l)$, is –278 kJ/mol. Give the thermochemical equation corresponding to the enthalpy of formation of alcohol. **[2]**

11. Calculate the ΔH^o for the reaction

$$2\ Al(s) + 3\ Cl_2(g) \rightarrow 2\ AlCl_3(s)$$

from the following reactions (ΔH^o are given in kJ): **[4]**

$2\ Al(s) + 6\ HCl(aq) \rightarrow 2\ AlCl_3(aq) + 3\ H_2(g)$	-1049
$HCl(g) \rightarrow HCl(aq)$	-74.8
$H_2(g) + Cl_2(g) \rightarrow 2\ HCl(g)$	-184.6
$AlCl_3(s) \rightarrow AlCl_3(aq)$	-323

12. 50.0 mL of 0.100 M $AgNO_3$ were mixed with 50.0 mL 0.100 M HCl. The two solutions were initially at 22.60°C. The final temperature of the reaction mixture was 23.40°C. Assuming that the density of each solution is 1.00 g/mL and that specific heat is 4.184 J/g °C. Calculate ΔH for the following reaction. **[4]**

$$AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$$

13. Give the oxidation number for the underlined atom. **[2]**

a) $\underline{S}O_3^{2-}$ _____ b) $Mg_2\underline{P}_2O_7$ _____

c) $\underline{N}F_3$ _____ d) $\underline{U}O_2^{2+}$ _____

14. a) Balance the following redox reaction that occurs in an acidic solution. **[4]**

$$As_2O_3(aq) + NO_3^-(aq) \rightarrow H_3AsO_4(aq) + NO(g)$$

b) Give the oxidizing agent. **[1]**_____

15. Write the equilibrium constant expression for the reactions. **[2]**

a) $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ K =

b) $Ca(OH)_2(s) \Leftrightarrow Ca^{2+}(aq) + 2\ OH^-(aq)$ K =

16. From the expression for K_c given below, write the appropriate equilibrium equation. **[2]**

$$K_c = \frac{[Ni(CO)_4]}{[CO]^4}$$

17. 2.40 moles of HBr are placed in a 2.00 L vessel at 500 K and the equilibrium is established. Calculate the concentrations of all the participants. **[4]**

$2\ HBr(g) \Leftrightarrow H_2(g) + Br_2(g)$ $\qquad K_c = 7.7 \times 10^{-11}$ at 500 K

18. The following equilibrium is exothermic. **[4]**

$$4\ NH_3(g) + 5\ O_2(g) \Leftrightarrow 4\ NO(g) + 6\ H_2O(g)$$

State the effect (for increase circle I, for decrease circle d, and circle nc for no change) that the change has on the original equilibrium value of the quantity in the second column.

Add NO	Amount of H_2O	I	d	nc
Add NO	Amount of O_2			
Remove H_2O	Amount of NO			
Add NH_3	Value of K_c			
Add NH_3	Amount of O_2			
Remove NO	Amount of NH_3			
Decrease volume of the container	Amount of NH_3			
Increase the temperature	Value of K_c			

19. Write the correct formula for the conjugate partner of the acid or the base. **[2]**

Acid	base
$H_2PO_4^-$	
OH^-	
	CH_3NH_2
	SO_4^{2-}

20. The value of K_w for water at 37°C is 2.5×10^{-14}. Calculate the pH of water and tell if water is acidic, basic, or neutral at this temperature. **[2]**

21. Calculate the pH, pOH, and % ionization of a 0.100 M $NH_3(aq)$. **[4]**

$NH_3(aq) + H_2O(l) \Leftrightarrow NH_4^+(aq) + OH^-(aq)$ $\quad K_b = 1.8 \times 10^{-5}$

22. The pH of a 0.100 M chlorous acid, $HClO_2$, (aq) was found to be 1.2. Calculate K_a of chlorous acid. **[3]**

23. A 10.00 g sample of potassium acetate, $KC_2H_3O_2$, is dissolved to make 250.0mL of a solution. Calculate the pH of the solution. $K_a(HC_2H_3O_2) = 1.8 \times 10^{-5}$ **[4]**

24. Calculate the pH for the following situations. **[4]**

a) 40.0 mL of 0.100 M $HC_2H_3O_2$ is mixed with 20.0 mL of 0.100 M NaOH.

b) 40.0 mL of 0.100 M $HC_2H_3O_2$ is mixed with 20.0 mL of 0.200 M NaOH. **[4]**

25. A 10.0 g sample of p-dichlorobenzene, a component of mothballs, is dissolved in 80.0 g of benzene, C_6H_6. The freezing-point of the solution is 1.20°C. The freezing point of benzene is 5.48°C. The molal freezing–point constant, k_f, for benzene is 5.12°C/m. Calculate the apparent molar mass of p-dichlorobenzene. **[4]**