Chapter 4 Exam-Blank

1. **(5 points)** Which compound or compounds in each of the following groups is(are) expected to be insoluble in water? Circle the compounds in each group that are insoluble. **This is NOT a multiple-choice question. You need to answer each part.**
   (a) FeO, $FeCl_2$, and $FeCO_3$

   (b) PbI_2, $Pb_3(PO_4,)_2$ and $AgNO_3$

   (c) RbOH, $Ba(OH)_2$, $Co(OH)_2$

2. **(6 points)** Write the molecular, ionic and net ionic equations for the reaction of an aqueous potassium bromide solution mixing with an aqueous silver nitrate solution. Clearly label states and charges if any.

(a) Molecular:
(b) Ionic:
(c) Net ion:

3. **(6 points)** Write the molecular, ionic and net ionic equations for the reaction of a sodium hydroxide solution mixing with a copper(II) chloride solution. Clearly lbel states and charges if any.

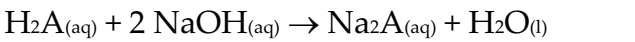
(a) Molecular:
(b) Ionic:
(c) Net ionic:

4. **(6 point)** In the laboratory 7.52 g of $Sr(NO_3)_2$ is dissolved in enough water to form 0.75L of $Sr(NO_3)_2$ solution.
   (a) What is the concentration of this solution?
   (b) A 0.100L sample is withdrawn from this stock solution and titrated with a 0.0425 M solution of Na_2CrO_4. What volume of Na_2CrO_4 solution is needed to precipitate the entire amount of strontium ion as $SrCrO_4$? [Hint: Write a balanced equation]

5. **(5 points)** A solution is made by mixing 50.0 mL of 6.00 M HCl, 100.0 mL of 1.00 M HCl, 50.0mL of 0.500M $CaCl_2$ and enough water to make 250.0 mL of solution. What is the molarity of the chloride ion (Cl^-) in the final solution?

6. **(4 points)** When ethanol, CH_3CH_2OH, is dissolved in water, a non-conducting solution results. When nitrous acid is dissolved in water, the resulting solution is weakly conducting and acidic in nature. Describe what happens upon dissolution in the two cases and account for the different results.

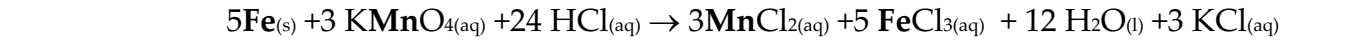
7. **(5 points)** You have 0.954 g of an unknown acid H_2A, which reacts with NaOH according to the reaction below.



$$H_2A_{(aq)} + 2\ NaOH_{(aq)} \rightarrow Na_2A_{(aq)} + H_2O_{(l)}$$

If 36.04 mL of 0.509 M NaOH is required to titrate the acid to the equivalence point, what is the molar mass of the acid?

8. **(6 points)** When iron metal is reacted with potassium permanganate in acid, the following reaction occurs.
In the equation below, determine which reactant is oxidized and which reactant is reduced. How many electrons were gained for the reactant that was reduced?

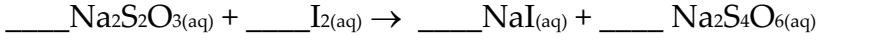


$$5\mathbf{Fe}_{(s)} + 3\ K\mathbf{Mn}O_{4(aq)} + 24\ HCl_{(aq)} \rightarrow 3\mathbf{Mn}Cl_{2(aq)} + 5\ \mathbf{Fe}Cl_{3(aq)} + 12\ H_2O_{(l)} + 3\ KCl_{(aq)}$$

   (a) **(4 points)** Oxidation number of the element in bold :
   (b) **(0.5 point)** Compound that contains the oxidized element and identity of that element:
   (c) **(0.5point)** Compound that contains the reduced element and identity of that element:
   (d) **(0.5 point)** Oxidizing agent:
   (e) **(0.5 point)** Reducing agent

9. **(5 points)** Balance the following equations by putting the correct coefficient in the space provided. If the coefficient is one, put a **1** in the space. **DO NOT LEAVE ANY SPACES BLANK, YOU WILL LOSE POINTS. ALSO MAKE SURE THAT THE EQUATIONS ARE IN THE PROPER FORM.** After you have balanced the equations, indicate which reaction is best described as a redox [R], combination[C], decomposition [D], precipitation [P], acid base [A], or combustion reaction [CO]. could be more than one answer.

$$\_\_\_\_C_4H_8N_8O_{8(s)} + O_{2(g)} \rightarrow \_\_\_\_CO_2 + \_\_\_\_H_2O_{(l)} + \_\_\_\_\ N_{2(aq)}$$



$$\_\_\_\_Na_2S_2O_{3(aq)} + \_\_\_\_I_{2(aq)} \rightarrow \_\_\_\_NaI_{(aq)} + \_\_\_\_\ Na_2S_4O_{6(aq)}$$

____ $(NH_4)_2Cr_2O_{7(aq)} \rightarrow$ ____$Cr_2O_{3(s)}$ + ____$H_2O_{(l)}$ + ____$N_{2(g)}$

____$C_5H_{10(l)}$ + ____$O_{2(g)} \rightarrow$ ____$CO_{2(g)}$ + ____$H_2O_{(l)}$

10. **(6 points)** A student has a solution that might contain any or all of the following cations: Cu^{2+}, Pb^{2+}, Ba^{2+}, and Mn^{2+}. Address the following statements about the "mixture" of ions in the solution to determine the identity of ion(s) in the solution. Give a **brief** explanation of each choice based on solubility rules.
    (a) Addition of HCl solution to the unknown solution causes a precipitate to form. What is the precipitate that forms?
    (b) After filtering off the precipitate from (a), a solution of $H_2SO_{4(aq)}$ is added to the remaining (UK) solution of ions and another precipitate forms. What is the precipitate that forms?
    (c) This precipitate from (b) is filtered off and a solution of NaOH is added to the resulting solution. No precipitation forms.
    (d) What are the cations present in the solution?

11. **(6 points)** You know that an unlabeled bottle contains one of the following: $Hg_2(NO_3)_2$, $BaCl_2$, or $MnSO_4$. A friend suggests that you test a portion of the bottle with a sodium chloride solution, a sodium sulfate solution, and a sodium hydroxide solution.
    (a) No reaction occurs when sodium chloride solution is added to a sample of the solution from the bottle.
    (b) No reaction occurs when sodium sulfate solution is added to a sample of the solution from the bottle.
    (c) A precipitate forms with the sodium hydroxide solution is added to a sample of the solution from the bottle.
    (d) What cation(s) are present in the bottle? Explain your choice(s).

12. (**6 points)** Consider solutions in which 0.10 mol of each of the following compounds is dissolved in 1 L of water: $Ca(NO_3)_2$, $C_6H_{12}OH$, $NaC_2H_3O_2$, HF, $Al_2(SO_4)_3$. Rank the solutions in order of increasing electrical conductivity (which ones will be the worst conductors of electricity to the best conductors of electricity), based on the number of ions in solution. Explain your choices BRIEFLY.
13. **(12 points)** A precipitate forms when aqueous sodium sulfide is mixed with aqueous copper(II) chloride.
    (a) **(2 points)** Write the molecular and ionic equation.
    (b) **(1 points)** Identify the spectator ions.

(c) **(2 points)** Calculate the mass of the precipitate that forms when 75.0 mL of 1.50 M sodium sulfide is mixed with 100.0 mL 0.500 M copper(II) chloride.

(d) **(3 points)** Calculate the moles of all the dissolved ions at the end of the reaction (this includes spectator and excess ions)

(e) **(1 point)** What is the final volume of the solution?

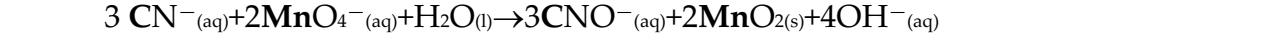
(f) **(3 points)** Calculate the individual concentrations of all dissolved ions at the end of the reaction.

14. **(5 points)** A solution is prepared by dissolving 1.5842 g of acetic acid ($HC_2H_3O_2$, 60.05 g/mol) in enough water to make 100.00 mL of solution. A 10.00 mL portion of the newly made solution is then diluted to a final volume of 350. mL. What is the final molarity of the acetic acid solution

15. **(3 points)** Classify each of the following aqueous solutions as non-electrolyte (NE), weak electrolyte (WE) or strong electrolyte(SE).

$HClO_2$	$HBr_{(aq)}$	KOH	$CoSO_4$	$C_6H_{12}O_6$	O_2

16. **(5 points)** In the equation below, determine which reactant is oxidized and which reactant is reduced. How many electrons were gained for the reactant that was reduced? [hint: the nitrogen in CNO^- has a -3 oxidation state]



$3\,\mathbf{C}N^-_{(aq)} + 2\mathbf{Mn}O_4^-{}_{(aq)} + H_2O_{(l)} \rightarrow 3\mathbf{C}NO^-_{(aq)} + 2\mathbf{Mn}O_{2(s)} + 4OH^-_{(aq)}$

(a) (2 points) Determine the oxidation numbers of the elements in bold:

(b) (1 point) Compound that contains the oxidized element and identity of that element:

(c) (1 point) Compound that contains the reduced element and identity of that element:

(d) (0.5 point) What is the oxidizing agent:

(e) (0.5 point) What is the reducing agent:

17. (5 points) Propionic acid, $HC_3H_5O_2$, is less than 5% ionized in dilute solution. One of its salts, calcium propionate, is used as a food preservative.

(a) Is propionic acid a strong, weak, or non-electrolyte? Explain.

(b) Is it a strong or weak acid?

(c) c) Should it be represented in reaction side of the net ionic equations as $HC_3H_5O_2$ (aq) or as H^+ (aq) and $C_3H_5O_2^-$ (aq)?

18. (4 points) In the equation below, determine which **reactant** is oxidized and which reactant is reduced by determining the oxidation number for the element in bold. [Notes, $Cr_2O_4^{2-}(aq)$ has a 2- charge; $NO_3^-(aq)$ and $NO_2^-(aq)$ have a -1 charge.] Show your work and clearly identify the oxidized and reduced species.

$3\ \mathbf{N}O_2^{-}(aq) + \mathbf{Cr}_2O_7^{2-}(aq) \rightarrow 2\ \mathbf{Cr}^{3+}(aq) + 3\ \mathbf{N}O_3^{-}(aq)$

19. (8 points) The distinctive odor of vinegar is due to acetic acid, $HC_2H_3O_2$. Acetic acid reacts with sodium hydroxide to make sodium acetate, $NaC_2H_3O_2$ and water.
    a. If 25.0 mL of vinegar requires 34.9 mL of 0.0960 M NaOH to completely neutralize the acid in the solution (this is the equivalence or stoichiometric end point), how many grams of acetic acid are in a 3.00 gal sample of this vinegar. (4 qt = 1 gal; 1 qt = 0.94635 L) [MM acetic acid = 60.05 amu]

$NaOH(aq) + HC_2H_3O_2(aq) \rightarrow NaC_2H_3O_2(aq) + H_2O(l)$

20. (5 points) Oxalic acid ($H_2C_2O_4$) reacts with rust [iron(III) oxide] using the following reaction:

$Fe_2O_3(s) + 6\ H_2C_2O_4(aq) \rightarrow 2\ Fe(C_2O_4)_3^{3-}(aq) + 3\ H_2O(l) + 6\ H^+(aq)$

Calculate the grams of rust that can be removed by 300. mL of 0.250 M solution of oxalic acid.[MM rust = 159.7 g/mol].