

**Exam 2 Chm 203 (Dr Mattson) 6 October 2014**

**Academic Integrity Pledge:** *In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.*

**Signature:**

**Name:**

**Circle your Folder group:**

H He Li Be B C N O F Ne Na Mg Al Si P

**Instructions:** Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. You will receive credit for **how** you worked each problem as well as for the correct answer. If you need more space, you may use the back of the periodic table provided — Write: "See PT" in the answer box and then hand the periodic table in with your exam. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be closed and stored on the floor under the table. Cell phones must be OFF and placed in your backpack/purse – not in your pocket. When you're done, hand in your exam and periodic table and you are free to go. May you do well!

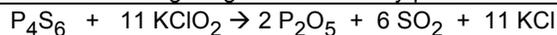
**Questions 1 – 6 refer to the reaction:**



1. (3 pts) How many moles of  $\text{P}_4\text{S}_6$  would be required to react stoichiometrically with 0.830 mol  $\text{KClO}_2$ ?

Answer with units: \_\_\_\_\_

2. (4 pts) Suppose 77.4 g  $\text{P}_4\text{S}_6$  (MM = 316.24 g/mol) and 269 g  $\text{KClO}_2$  (MM = 106.55 g/mol) were reacted together. What is the limiting reagent, and how many moles of the limiting reagent were initially present?



Limiting reagent \_\_\_\_\_ Moles of LR with units: \_\_\_\_\_

3. (4 pts) What **mass** of the excess reagent remains after the reaction is complete?

Answer with units: \_\_\_\_\_

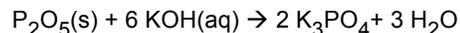
4. (3 pts) What is the percent by mass of **sulfur** in  $\text{P}_4\text{S}_6$ ?

Answer as %: \_\_\_\_\_ %

5. (3 pts) Another sulfide of phosphorus (besides  $\text{P}_4\text{S}_6$ ) is known to exist. It consists of 56.29 % P. What is the empirical formula for this compound?

Answer: \_\_\_\_\_

6. (4 pts) One of the products obtained,  $\text{P}_2\text{O}_5$ , reacts readily with aqueous KOH as shown here:



What volume of 0.944 M KOH(aq) is required to react completely with 2.682 g  $\text{P}_2\text{O}_5$  (MM = 141.94 g/mol)?

Answer with units: \_\_\_\_\_

- 7a. (4 pts) Suppose a 15.244 g sample of potassium sulfate was dissolved in water and diluted to a volume of 500.0 mL. What is the molar concentration of potassium ion **to the correct number of sig figs**?

Answer with units: \_\_\_\_\_

- 7b. (3 pts) Next, suppose 50.00 mL of the previous solution were diluted to 1.000 L. What is the new molar concentration of potassium sulfate **to the correct number of sig figs**?

Answer with units: \_\_\_\_\_

8. (4 pts) In a combustion analysis of an organic substance, known to contain only C, H, and O, a 8.5848 mg sample yields 18.861 mg CO<sub>2</sub> and 10.295 mg H<sub>2</sub>O. What is the empirical formula for this substance?

Answer: \_\_\_\_\_

9. (6 pts) Which of these compounds, all water-soluble, are strong electrolytes? **(More than one!)**  
 KNO<sub>3</sub> FeSO<sub>4</sub> HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> HBr CO(NH<sub>2</sub>)<sub>2</sub> Na<sub>2</sub>CO<sub>3</sub>

10. (6 pts) Which of these compounds are soluble in water? **(More than one!)**  
 CuCO<sub>3</sub> (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> PbBr<sub>2</sub> BaSO<sub>4</sub> Ag<sub>2</sub>SO<sub>4</sub> MgSO<sub>4</sub>

11. (6 pts) Which of these acids are also strong electrolytes? **(More than one!)**  
 HClO<sub>2</sub> HNO<sub>3</sub> HCN HF HI H<sub>2</sub>SO<sub>4</sub>

12. (4 pts) Which of these pairs of compounds, all in aqueous solution, would produce a precipitate when mixed? **(More than one!)**  
 A. BaCl<sub>2</sub> + CuSO<sub>4</sub> →    B. NaCl + Ag<sub>2</sub>SO<sub>4</sub> →  
 C. Na<sub>2</sub>S + FeCl<sub>2</sub> →    D. MgBr<sub>2</sub> + NaNO<sub>3</sub> →

13. Aqueous potassium phosphate and aqueous calcium chloride form a precipitate when mixed.

- 13a. (2 pts) Write the balanced chemical reaction, including phases, (s), (l), (g), (aq).

- 13b. (2 pts) Write the net ionic chemical reaction, including phases, (s), (l), (g), (aq).

14. (4 pts) Assign oxidation numbers to the phosphorus atom in each of these compounds.

P <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>	PH <sub>3</sub>	P <sub>2</sub> O <sub>3</sub>
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15. (4 pts) Which of these are oxidation-reduction reactions? **(More than one!)**  
 A. HF(aq) + KOH(aq) → H<sub>2</sub>O(l) + KF(aq)  
 B. 2 Na(s) + Cl<sub>2</sub>(g) → 2 NaCl(s)  
 C. 2 Na<sub>2</sub>S(s) + SO<sub>2</sub>(g) → 3 S(s) + 2 Na<sub>2</sub>O(s)  
 D. Na<sub>2</sub>CO<sub>3</sub>(aq) + CaCl<sub>2</sub>(aq) → CaCO<sub>3</sub>(s) + 2 NaCl(aq)

16. In class we saw the reaction between metallic aluminum and aqueous copper(II) chloride. We saw that solid metallic copper was formed and the other product was colorless Al<sup>3+</sup>(aq).

- 16a. (2 pts) Write and balance the **net ionic** reaction that took place.

- 16b. (2 pt) **Circle** the oxidizing agent and **draw a box** around the reducing agent.

Note: If you are Nomenclature Certified you may stop.

17. (5 pts) Name these substances.

H <sub>2</sub> SO <sub>3</sub>
MnCO <sub>3</sub>
HClO <sub>3</sub>
KBrO <sub>4</sub>
P <sub>2</sub> S <sub>6</sub>

17. (5 pts) Circle the correct formula for each of these.

- A. chromium(VI) phosphate  
 Cr<sub>6</sub>(PO<sub>4</sub>)<sub>2</sub>    CrPO<sub>4</sub>    Cr(PO<sub>3</sub>)<sub>2</sub>  
 Cr<sub>6</sub>PO<sub>4</sub>    CrPO<sub>3</sub>    Cr(PO<sub>4</sub>)<sub>2</sub>
- B. potassium chlorate  
 PClO<sub>2</sub>    KClO<sub>4</sub>    K<sub>2</sub>ClO<sub>3</sub>  
 K<sub>2</sub>ClO<sub>2</sub>    KClO<sub>3</sub>    KClO
- C. acetic acid  
 H<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>    HC<sub>2</sub>H<sub>2</sub>O<sub>3</sub>    H<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>3</sub>  
 H<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>2</sub>    HC<sub>2</sub>H<sub>3</sub>O<sub>3</sub>    HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>
- D. nitrogen trioxide  
 NO<sub>2</sub>    NO<sub>3</sub>    NO<sub>2</sub><sup>-</sup>    NO<sub>3</sub><sup>-</sup>    N<sub>2</sub>O<sub>3</sub>
- E. ammonium sulfide  
 NH<sub>3</sub>S    NH<sub>4</sub>S<sub>2</sub>    (NH<sub>4</sub>)<sub>2</sub>S  
 (NH<sub>3</sub>)<sub>2</sub>S<sub>2</sub>    (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>    (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>

Subtotal from exam:	_____
Folder work: (20 max)	_____
Total:	_____

## Answers

1. 0.075 mol  $P_4S_6$

2. 2.53 mol  $KClO_2$

3. 4.82 g

4. 60.8%

5.  $P_4S_3$

6. 0.120 L

7a. 0.350 M  $K^+$

7b. 0.00875 M  $K_2SO_4$

8.  $C_3H_8O_1$

9.  $KNO_3$   $FeSO_4$   $HBr$   $Na_2CO_3$

10.  $(NH_4)_2SO_4$   $Ag_2SO_4$   $MgSO_4$

11.  $HNO_3$   $HI$   $H_2SO_4$

12. A, B, and C

13a.  $2 K_3PO_4(aq) + 3 CaCl_2(aq) \rightarrow$



13b.  $2 PO_4^{3-}(aq) + 3 Ca^{2+}(aq) \rightarrow Ca_3(PO_4)_2(s)$

14. 0, +5, -3, +3

15. B and C

16a.  $2 Al(s) + 3 Cu^{2+}(aq) \rightarrow 2 Al^{3+}(aq) + 3 Cu(s)$

16b. Oxidizing agent  $Cu^{2+}$  and the reducing agent is Al.

17. (5 pts) Name these substances.

$H_2SO_3$	sulfurous acid
$MnCO_3$	manganese(II) carbonate
$HClO_3$	chloric acid
$KBrO_4$	potassium perbromate
$P_2S_6$	diphosphorus hexasulfide

17.

A.  $Cr(PO_4)_2$

B.  $KClO_3$

C.  $HC_2H_3O_2$

D.  $NO_3$

E.  $(NH_4)_2S$