Please print:

Last name: Answer Key

First name:_____

Chem 1061 Exam 2

Fall 2004

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Tuesday, October 12, 2004

Instructions:

Time: You have 85 minutes to complete this exam.

Allowed items: This exam will require the use of a calculator. A calculator and your writing instrument are the only personal items allowed on your table while the exam is being administered. A #2 pencil is required to fill out the Scantron form for the multiple choice questions. Please use pen on the problems section of the exam if you would like the opportunity for regrades beyond simple score-addition errors.

Provided information: A periodic table and conversion chart are provided for you inside this exam booklet.

Contents:

I.	**Multiple choice**, 14 questions, 3 points each.	42 points
II.	**Fill in the blank,** 10 questions, 4 points each.	40 points
III.	**Problems.** 2 questions, 10 points each.	20 points
		Total: 100 points

I, _____ have read and understand the directions given above, and pledge that I will follow all regulations with regard to Academic Dishonesty as outlined by this college when taking this exam.

Signature _____ Date and Time _____

I. Multiple choice

Choose the best answer from the choices given, and mark your choice on the provided Scantron sheet with a #2 pencil. *(3 points each)*

1. What is the molar mass of caffeine, $C_8H_{10}N_4O_2$?
   a. 102 g/mol
   b. 142 g/mol
   c. 164 g/mol
   d. 182 g/mol
   e. 194 g/mol

2. How many sulfur atoms are there in 25 g of Al_2S_3?
   a. 1.0×10^{23}
   b. 2.0×10^{23}
   c. 3.0×10^{23}
   d. 4.5×10^{21}
   e. 6.0×10^{21}

3. Which of the following samples contains the largest number of atoms?
   a. 1 g Li
   b. 1 g F_2
   c. 1 g C
   d. 1 g P_4
   e. 1 g N_2

4. Of the following, the only empirical formula is
   a. C_2H_4
   b. C_5H_{12}
   c. N_2O_4
   d. S_8
   e. N_2H_4

5. Sulfur trioxide, SO_3, is made from the oxidation of SO_2, and the reaction is represented by the equation

   $$2SO_2 + O_2 \longrightarrow 2SO_3$$

   A 16-g sample of SO_2 gives 18 g of SO_3. The percent yield of SO_3 is
   a. 60%
   b. 75%
   c. 80%
   d. 90%
   e. 100%

6. If 50.0 g of O_2 are mixed with 50.0 g of H_2 and the mixture is ignited, what mass of water is produced?
   a. 50.0 g
   b. 56.3 g
   c. 65.7 g
   d. 71.4 g
   e. 100.0 g

7. Which of the following is a weak base?
   a. HOCl
   b. LiOH
   c. $Ba(OH)_2$
   d. KOH
   e. NH_3

8. Which of the following compounds is ***insoluble*** in water?
   a. $(NH_4)_2CO_3$
   b. AgBr
   c. $CuSO_4$
   d. KI
   e. $LiNO_3$

9. Which of the following is a weak electrolyte in aqueous solution?
   a. acetic acid
   b. lithium acetate
   c. ammonium carbonate
   d. sulfuric acid
   e. strontium hydroxide

10. Which of the following reactions could be classified both as a precipitation reaction and an acid-base reaction?
    a. $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$
    b. $Ba(OH)_2 + H_2CO_3 \longrightarrow BaCO_3 + 2H_2O$
    c. $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$
    d. $CaSO_3 + 2HC_2H_3O_2 \longrightarrow Ca(C_2H_3O_2)_2 + SO_2 + H_2O$
    e. $PCl_5 + 4H_2O \longrightarrow H_3PO_4 + 5HCl$

11. The balanced net ionic equation for the reaction of calcium carbonate with nitric acid is
    a. $CaCO_3(s) + 2HNO_2(aq) \longrightarrow Ca^{2+}(aq) + 2NO_2^-(aq) + CO_2(g) + H_2O(l)$
    b. $CaCO_3(s) + 2HNO_3(aq) \longrightarrow Ca^{2+}(aq) + 2NO_3^-(aq) + CO_2(g) + H_2O(l)$
    c. $Ca(HCO_3)_2(s) + 2HNO_3(aq) \longrightarrow Ca^{2+}(aq) + 2NO_3^-(aq) + 2CO_2(g) + 2H_2O(l)$
    d. $Ca^{2+}(aq) + CO_3^{2-}(aq) + 2H^+(aq) + 2NO_3^-(aq) \longrightarrow Ca(NO_3)_2(aq) + CO_2(g) + H_2O(l)$
    e. $CaCO_3(s) + 2H^+(aq) \longrightarrow Ca^{2+}(aq) + CO_2(g) + H_2O(l)$

12. The oxidation numbers of nitrogen in N_2O and N_2F_4 are, respectively,
    a. -2 and -3
    b. -2 and +2
    c. +1 and -1
    d. +1 and +2
    e. +1 and -3

13. How much 0.54 M NaCl, "physiologic saline," can be prepared via the dilution of 100 mL of a 6.0 M NaCl solution?
    a. 1.1 L
    b. 910 mL
    c. 90 mL
    d. 540 mL
    e. 1.9 L

14. A solution that contains 50.0 g of NaOH in 750.0 mL of solution has what molarity?
    a. 0.600 M
    b. 0.800 M
    c. 1.07 M
    d. 1.25 M
    e. 1.67 M

II. Fill in the blank

All fill in the blank questions are *4 points each*.

Identify the following reactions as either precipitation, redox, or acid-base.

15. acid-base $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$

16. redox $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

17. precipitation $Al_2(SO_4)_3 + 6NaOH \longrightarrow 2Al(OH)_3 + 3Na_2SO_4$

For the following combinations of aqueous solutions, if a precipitate will form, write the ***formula*** for that precipitate. If no reaction will occur, write NR.

18. potassium carbonate and ammonium chloride NR

19. lithium sulfate and barium hydroxide $BaSO_4$ (s)

20. silver(I) acetate and copper(II) chloride AgCl (*s*)

For the following redox reactions, write oxidation numbers for every underlined atom or molecule in the boxes above the atom or molecule, and ***circle*** the species that was ***oxidized.***

21. $\overset{\boxed{0}}{2\underline{Al}(s)} + \overset{\boxed{0}}{3\underline{Cl_2}(g)} \longrightarrow \overset{\boxed{+3}\ \boxed{-1}}{2\underline{Al}\underline{Cl_3}(s)}$

22. $\overset{\boxed{+3}}{\underline{Fe}_2O_3(s)} + \overset{\boxed{+2}}{3\underline{C}O(g)} \longrightarrow \overset{\boxed{0}}{2\underline{Fe}(s)} + \overset{\boxed{+4}}{3\underline{C}O_2(g)}$

Write the net ionic equations with appropriate phase labels (*aq),* (*s*), (*l*), or (*g*) for the following reactions in aqueous solution:

23. $3Ba(OH)_2 + 2H_3PO_4 \longrightarrow Ba_3(PO_4)_2 + 6H_2O$

$3Ba^{2+}(aq) + 6OH^-(aq) + 2H_3PO_4(aq) \longrightarrow Ba_3(PO_4)_2(s) + H_2O(l)$

24. $Al_2(SO_4)_3 + 6NaOH \longrightarrow 2Al(OH)_3 + 3Na_2SO_4$

$2Al^{3+}(aq) + 6OH^-(aq) \longrightarrow 2Al(OH)_3(s)$

III. Problems

25. 15.0 mL of NaOH was titrated with 4.38 mL of 6.00 M H_2SO_4. How many grams of NaOH are present in that 15.0 mL, ***and*** what is the molarity of the NaOH solution? *Hint:* a balanced chemical equation is necessary! Draw boxes around your answers. Show all your work for full credit. As always, round your final answer to the correct number of significant figures at the *end* of your calculations. (*9 points)*

$$2NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + 2H_2O$$

$$4.38\ \text{mL}\ H_2SO_4 \times \frac{6.00\ \text{mmol}\ H_2SO_4}{1\ \text{mL}\ H_2SO_4} \times \frac{2\ \text{mmol NaOH}}{1\ \text{mmol}\ H_2SO_4} = 52.\underline{5}6\ \text{mmol NaOH}$$

$$52.\underline{5}6\ \text{mmol NaOH} \times \frac{39.998\ \text{mg NaOH}}{1\ \text{mmol NaOH}} \times \frac{10^{-3}\ \text{g NaOH}}{1\ \text{mg NaOH}} = \boxed{2.10\ \text{g NaOH}}$$

$$\frac{52.\underline{5}6\ \text{mmol NaOH}}{15.0\ \text{mL}} = \boxed{3.50\ \text{M NaOH}}$$

26. Combustion analysis has shown that a certain sample contains 68.9% carbon, 4.92% hydrogen, and 26.2% oxygen. What is the empirical formula for this substance? Show all your work and place a box around your answer. (*10 points*)

Assume 100.0 g of sample. This would contain 68.9 g C, 4.92 g H, and 26.2 g O.

$$68.9\text{ g C} \times \frac{1\text{ mol C}}{12.01\text{ g C}} = 5.7\underline{3}7\text{ mol C} \qquad \frac{5.7\underline{3}7\text{ mol C}}{1.6\underline{3}8\text{ mol O}} = 3.50 \times 2 = 7$$

$$4.92\text{ g H} \times \frac{1\text{ mol H}}{1.008\text{ g H}} = 4.8\underline{8}1\text{ mol H} \qquad \frac{4.8\underline{8}1\text{ mol H}}{1.6\underline{3}8\text{ mol O}} = 2.98 \times 2 \cong 6$$

$$26.2\text{ g O} \times \frac{1\text{ mol O}}{16.00\text{ g O}} = 1.6\underline{3}8\text{ mol O} \qquad \frac{1.6\underline{3}8\text{ mol O}}{1.6\underline{3}8\text{ mol O}} = 1.00 \times 2 = 2$$

The empirical formula is $C_7H_6O_2$.

---END OF EXAM QUESTIONS---