Please print:

Last name: ___Answer Key_____

First name: _____

## Chem 1061 Exam 1

## Fall 2004

## Andy Aspaas, Instructor

## Thursday, September 16, 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 on the last two pages of this exam. You may not use your own periodic table or conversion charts. All conversion factors from English to Metric or English to English required for this exam are provided in the conversion chart or the exam itself.

## Contents:



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. *(2 pts each)*

1. The term that is related to the reproducibility (repeatability) of a measurement is
   a. accuracy.
   b. precision.
   c. qualitative.
   d. quantitative.
   e. property.

2. The correct value of the expression $\left[\left(1\times10^{230}\times1\times10^{-280}\right)^{4}\right] / \left(1\times10^{270}\right)^{1/3}$ is
   a. $1\times10^{-340}$
   b. $1\times10^{-290}$ (note the correction)
   c. $1\times10^{-200}$
   d. $1\times10^{-180}$
   e. $1\times10^{-150}$

3. How many cubic decimeters equal one cubic meter?
   a. $10^{9}$ $dm^{3}$.
   b. $10^{6}$ $dm^{3}$.
   c. $10^{3}$ $dm^{3}$.
   d. $10^{-6}$ $dm^{3}$.
   e. $10^{-9}$ $dm^{3}$.

4. What is the best answer to report for $\frac{3.478\times1.164}{2.00}+0.354$?
   a. 2.3782
   b. 2.378
   c. 2.38
   d. 2.4
   e. 2

5. Liquid hydrogen boils at -423 °F. What is its boiling point on the Kelvin scale?
   a. 20 K.
   b. 30 K.
   c. 126 K.
   d. 426 K.
   e. 526 K.

6. The melting point of 1-decyne is –40 °C. This corresponds to
   a. –10 °F.
   b. 10 °F.
   c. –40 °F.
   d. –104 °F.
   e. 104 °F.

7. How many joules are there in 7.72 kcal? (1.000 cal = 4.184 joules)
   a. 1.78 J.
   b. 32.3 J.
   c. 1780 J.
   d. 12,900 J.
   e. 32,300 J.

8 A fictitious unit of length called the "zither" is defined by the relationship 7.50 cm = 1.00 zither. A 100.0 m distance would be described as
   a. 133 zither.
   b. 266 zither.
   c. 750 zither.
   d. $1.33 \times 10^3$ zither.
   e. $7.5 \times 10^4$ zither.

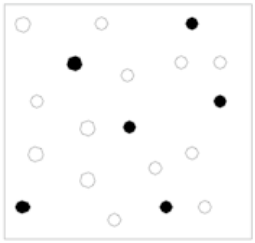
9. Calculate the mass of aluminum that occupies the same volume as 85.0 g of cobalt. The density of Co = 8.90 g/cm$^3$ and Al = 2.70 g/cm$^3$.
   a. 25.79 g.
   b. 25.8 g.
   c. 26 g.
   d. 32.3 g.
   e. 32 g.

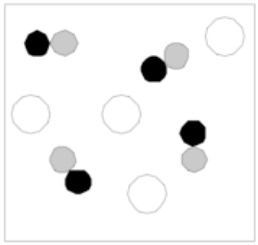
10. Two types of pure substances are
   a. compounds and homogeneous solutions.
   b. compounds and heterogeneous solutions.
   c. compounds and elements.
   d. elements and homogeneous solutions.
   e. elements and heterogeneous solutions.

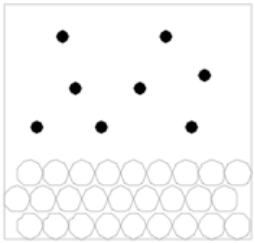
11. A sample that cannot be separated into two or more substances by physical means is
   a. a compound.
   b. an element.
   c. either a compound or an element.
   d. a homogeneous mixture.
   e. a heterogeneous mixture.

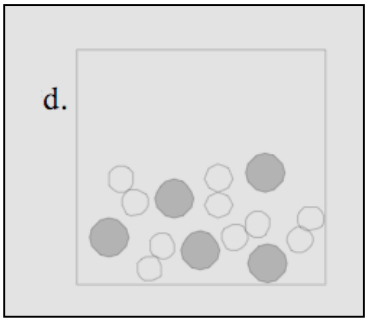
12. All of the following statements are correct **EXCEPT**
    a. The conversion of compounds into elements is a chemical change.
    b. The conversion of sugar to carbon and water is a chemical change.
    c. The conversion of elements into compounds is a chemical change.
    d. The conversion of liquid water to gaseous water is a chemical change.
    e. The evaporation of water is a physical change.

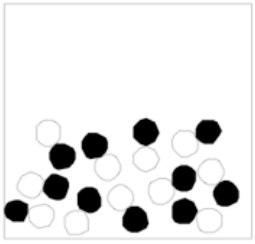
13. Which of the following pictures is a particulate representation of a liquid mixture of two elements?

a. 

b. 

c. 

d. 

e. 

f. None of these

14. What is the symbol of the ion having 13 protons and 10 electrons?
    a. $Mg^{2+}$
    b. $Al^{3+}$
    c. $P^{3-}$
    d. $S^{2-}$
    e. $Cl^{-}$

15. Which combination represents a $^{57}Fe^{3+}$ ion?
    a. 57p, 26n, 23e
    b. 57p, 26n, 54e
    c. 26p, 31n, 29e
    d. 26p, 31n, 26e
    e. 26p, 31n, 23e

16. An element, X, has the following isotopic composition: X-200, 90%; X-199, 8.0%; and X-202, 2.0%. Its atomic mass is **CLOSEST** to
    a. 199 amu.
    b. 200 amu.
    c. 201 amu.
    d. 202 amu.
    e. It cannot be determined.

17. One gram on TNT, $C_7H_5N_3O_6$, has $1.33 \times 10^{22}$ hydrogen atoms. How many carbon atoms are there in 1.00 g of TNT?
    a. $7.95 \times 10^{21}$
    b. $9.26 \times 10^{21}$
    c. $1.33 \times 10^{22}$
    d. $1.59 \times 10^{22}$
    e. $1.86 \times 10^{22}$

18. The names of the elements whose symbols are Si, P, Mn, and S are, respectively,
    a. silicon, potassium, manganese, and sulfur.
    b. silver, phosphorus, magnesium, and sodium.
    c. silicon, potassium, magnesium, and sulfur.
    d. silver, potassium, manganese, and sodium.
    e. silicon, phosphorus, manganese, and sulfur.

## II. Nomenclature

Write the correct systematic name or chemical formula in the blank. *(2 pts each)*

19. sodium hydroxide NaOH

20. $CaSO_3$ calcium sulfite

21. potassium chlorate $KClO_3$

22. $NH_4NO_3$ ammonium nitrate

23. magnesium oxalate $MgC_2O_4$

24. $Al_2(S_2O_3)_3$ aluminum thiosulfate

25. hydrogen cyanide HCN

26. $Fe(NO_2)_3$ iron(III) nitrite

27. sulfurous acid $H_2SO_3$

28. $HNO_2$ nitrous acid or hydrogen nitrite

## III. Problems

Neatly ***show your work*** in all problems involving calculations. As always, be careful that your numerical answers are rounded to the correct number of significant figures.

29. *(11 pts)* A spherical weather balloon filled with helium has a diameter of 3.00 feet.

    a. What is the volume of this weather balloon in liters? $V = (4/3)\pi r^3$ *(3 pts)*

$$dia = 3.00 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ dm}}{10^{-1} \text{ m}} = 9.1\underline{4}4 \text{ dm}$$

$$r = \frac{dia}{2} = \frac{9.1\underline{4}4 \text{ dm}}{2} = 4.5\underline{7}2 \text{ dm}$$

$$V = \tfrac{4}{3}\pi r^3 = \tfrac{4}{3}\pi(4.5\underline{7}2 \text{ dm})^3 \times \frac{1 \text{ L}}{1 \text{ dm}^3} = 40\underline{0}.31998... \text{ L} \xrightarrow{3 \text{ s.f.}} 400. \text{ L}$$

    b. What mass of helium in grams is contained in this balloon? The density of helium at room temperature and normal pressure is 0.166 g/L. *(2 pts)*

$$d = \frac{m}{V} \quad m = Vd = 40\underline{0}.31998... \text{ L} \times \frac{0.166 \text{ g}}{1 \text{ L}} = 66.\underline{4}5311... \text{ g} \xrightarrow{3 \text{ s.f.}} 66.5 \text{ g}$$

    c. Objects with density equal to air will float in place (neither rise nor sink). What total mass (including helium) would this weather balloon need in order to float in place? Dry air at sea level has a density of 1.2929 g/L. *(4 pts)*

$$d = \frac{m}{V} \quad m = Vd = 40\underline{0}.31998... \text{ L} \times \frac{1.2929 \text{ g}}{1 \text{ L}} = 51\underline{7}.57371... \text{ g} \xrightarrow{3 \text{ s.f.}} 518. \text{ g}$$

    d. What is its mass when deflated? *(2 pts)*

$$m_{deflated} = m_{total} - m_{helium} = 51\underline{7}.57371... \text{ g} - 66.\underline{4}5311... \text{ g} = 45\underline{1}.1206... \text{ g} \xrightarrow{0 \text{ d.p.}} 451. \text{ g}$$

30. *(5 pts)* Balance the following equation: $NBr_2 + NaOH \rightarrow N_2 + NaBr + HOBr$

$$2NBr_3 + 2NaOH \longrightarrow N_2 + 2NaBr + 2HOBr$$

31. *(10 pts)* Cobalt(II) sulfate heptahydrate has pink-colored crystals. When heated carefully, it produces cobalt(II) sulfate monohydrate, which has red crystals.

    a. Write the formulas of these two hydrates. *(2 pts)*

    _____$CoSO_4 \bullet 7H_2O$__ _____$CoSO_4 \bullet 1H_2O$_____

    b. Write a balanced chemical equation for this reaction. *(2 pts)*

    $$CoSO_4 \bullet 7H_2O \xrightarrow{\Delta} CoSO_4 \bullet 1H_2O + 6H_2O$$

    c. If 3.548 g of the heptahydrate yields 2.184 g of the monohydrate after heating, what mass of water must be given off? Show your work. *(2 pts)*

    $$m_{\text{heptahydrate}} = m_{\text{monohydrate}} + m_{H_2O}$$
    $$m_{H_2O} = m_{\text{heptahydrate}} - m_{\text{monohydrate}}$$
    $$= 3.548\ \text{g heptahydrate} - 2.189\ \text{g monohydrate} = 1.364\ \text{g } H_2O$$

    d. If the monohydrate is heated further, all the water can be driven off and anhydrous cobalt(II) sulfate can be obtained. What mass of anhydrous cobalt(II) sulfate would you expect? Show your work. *(4 pts)*

    The answer to part c. is the mass of 6 units of $H_2O$, as seen from the balanced equation. So, we first solve for the mass of 1 unit of $H_2O$:

    $$m_{1H_2O} = \frac{m_{6H_2O}}{6} = \frac{1.364\ \text{g } H_2O}{6} = 0.2273\ \text{g}$$
    $$m_{\text{anhydrous}} = m_{\text{monohydrate}} - m_{1H_2O}$$
    $$= 2.184\ \text{g} - 0.2273\ \text{g} = 1.9567\ \text{g} \xrightarrow{\text{3 d.p.}} 1.957\ \text{g}$$

**--END OF EXAM QUESTIONS--**