CHEM 115 A EXAM #1
Sept. 14, 2004

Circle the correct answer or fill in the blanks. (numbers 1 - 6, 2.5 points each)

1. The term used to describe a substance composed of two or more elements combined in a fixed ratio is:
   a. solution  b. homogeneous mixture  c. heterogeneous mixture
d. compound  e. aggregate

2. What do all isotopes of an element have in common?
   a. atomic mass  b. atomic number  c. number of nucleons
d. number of neutrons  e. mass number

3. Which of the following elements is an alkali metal?
   a. sodium, Na  b. argon, Ar  c. iron, Fe  d. zinc, Zn  e. barium, Ba

4. Which of the following elements has chemical properties similar to those of oxygen, O?
   a. iron, Fe  b. sulfur, S  c. magnesium, Mg  d. fluorine, F  e. potassium, K

5. Which of the following elements has chemical properties similar to those of lithium, Li?
   a. iron, Fe  b. oxygen, O  c. magnesium, Mg  d. chlorine, Cl  e. potassium, K

6. Which of the following is the smallest distance?
   a. 7.00 \( \mu \text{m} \)  b. 7.00 \( \times 10^{-4} \text{ cm} \)  c. 7.00 \( \times 10^{-3} \text{ mm} \)  d. 7.00 \( \times 10^{3} \text{ nm} \)  e. 700 pm

7. Write the following for ethanol: the (5 points)
   (a) molecular formula, (b) condensed structural formula and (c) molecular structure.

(6 points)
8. Specify the numbers of protons, neutrons, and electrons found in \( ^{65}\text{Zn} \) and \( ^{66}\text{Zn}^{2+} \).
   \[
   \begin{array}{c|ccc}
   & #n & #p & #e \\
   \hline
   ^{65}\text{Zn} & & & \\
   ^{66}\text{Zn}^{2+} & & & \\
   \end{array}
   \]
Fill in the blank with the appropriate word, phrase, or numerical answer.
(numbers 9 - 12, 2 points for each blank)

9. Matter commonly is found in three physical states. List the two that would be expected to have similar densities? _________________ and _________________.

10. A combination of two substances that has different regions of composition and properties is known as a __________________________mixture.

11. A scientist obtains the number 16.7249862 on a calculator. If this number actually has four (4) significant figures, how should it be written? ________________

12. Round 0.0034169 to four significant figures and express in scientific notation. ________

(4 points)
13. Concisely explain the ways in which a compound differs from a mixture.

(15 points)
14. (a) Calculate the volume of $1.35 \times 10^2$ g of aluminum (Al) given that this metal has a density of $2.70 \text{ g cm}^{-3}$.

(b) $27.0$ g of Al contains $6.022 \times 10^{23}$ atoms of Al, what number of Al atoms are present in $1.35 \times 10^2$ g of Al?

(c) If Al atoms occupy just about 67% of the volume of a chunk of Al, what is the diameter of an Al atom? Volume of a sphere $= \frac{4\pi r^3}{3}$ and $d = 2r$
15. What is the molecular formula for a compound with an empirical formula of CH₂ and a molar mass of 84.16 g/mole? What is it if the molar mass is 112.22 g/mole?

16. propane (g) + O₂ (g) → CO₂ (g) + H₂O (g)

   a. In the following space, write the balanced chemical equation for combustion of propane:

b. 15.00 g of propane is reacted with 75.00 g of O₂. If 20.58 g of O₂ is unreacted, how much CO₂ and H₂O (in combined grams) is formed?

c. What are the mass ratios of C and H found in propane?

d. If all 15.00 g of the propane reacts completely to form CO₂ and H₂O, what is the maximum mass of carbon available to form the CO₂?

e. Given the answer from part d and the fact that one carbon atom is found in each CO₂, what is the maximum mass of CO₂ that can be formed?
17. Write the names or formulas as needed. (15 points, 1 point each)

a. sodium hypochlorite

b. phosphoric acid

c. calcium chloride

d. copper (II) bromide

e. iron (III) sulfate

f. diphosphorus pentoxide

g. hexane

h. cyclohexane

i. AlCl$_3$·6 H$_2$O

j. Ni$_3$(PO$_4$)$_2$

k. SO$_2$

l. Fe$_2$O$_3$

m. CaSO$_4$

n. PCl$_5$

o. CH$_3$CH(OH)CH$_3$

(6 points)

18. Describe AND show by example the law of multiple proportions.
BONUS !!!!!!  (for up to 5 points complete the following).

Avogadro’s number is $6.022 \times 10^{23}$ . . . this is the number of Al atoms present in 27.0 g of Al or the number of water molecules present in just 18.0 g of water. To try to understand how big this number really is consider the following:

A basketball has a diameter of 9.4 inches. The Earth has a surface area of 196,935,000 sq miles. How many basketballs are required to cover the Earth with a single layer of basketballs?
For the sake of simplicity, assume the balls can cover the Earth’s surface with no space uncovered between them. (note: if your calculator does not have a key for $\pi$, try using $\frac{22}{7}$)

What fraction of Avogadro’s number is this number of basketballs?

What mass of aluminum contains a number of aluminum atoms equal to the number of basketballs found above?

WOW!