General Chemistry 106
February 3, 1999
Exam 1

Name ________________________________

Multiple Choice (25 points) __________

Problem #1 (25 points) __________
Problem #2 (25 points) __________
Problem #3 (25 points) __________
raw score __________ = _________ %
Multiple Choice (25 points) Circle the best answer

1) Which of the following molecules does not have a dipole moment?
   a) CH₂=CH₂
   b) NH₃
   c) CH₃NH₂
   d) HCl

2) Which of the following has the weakest intermolecular forces?
   a) CH₃F
   b) HCl
   c) N₂
   d) CO

3) Which covalent bond is the most polar?
   a) N-F
   b) C-F
   c) Cl-F
   d) F-F

4) Which of the following compounds exhibits hydrogen bonding?
   a) CH₃Cl
   b) HI
   c) H₃C-O-CH₃
   d) NH₃

5) Arrange the following in order of increasing boiling point.
   CH₃CH₂OH  CH₃CH₂CH₃  H₃C-O-CH₃  CH₃CH₂OH
   I  II  III  IV
   a) IV < III < II < I
   b) II < III < IV < I
   c) I < IV < III < II
   d) II < III < I < IV
6) What is the final liquid level of water if 1.130 ounces of aluminum is dropped into a graduated cylinder containing 15.90 ml of water? \((\rho_{Al} = 2.702 \text{ g/cm}^3, \ 1.000 \text{ kg} = 2.205 \text{ lb.}, \ 16.00 \text{ oz.} = 1.000 \text{ lb.})\)
   a) 17.08 ml
   b) 21.66 ml
   c) 27.75 ml
   d) 47.93 ml

7) A mass of Hg occupies 0.750 liters. What volume would an equal mass of ethanol occupy? \((\rho_{Hg} = 13.546 \text{ g/ml} \ \text{and} \ \rho_{ethanol} = 0.789 \text{ g/ml})\)
   a) 0.0437 liters
   b) 0.0777 liters
   c) 12.9 liters
   d) 22.9 liters

8) A sample of pure lithium carbonate is 18.8% lithium by mass. What is the % lithium by mass in a sample of pure lithium carbonate with twice the mass of the first sample?
   a) 9.40%
   b) 18.8%
   c) 37.6%
   d) 75.2%

9) Which of the following pair of atoms are isotopes?
   a) \(^{12}\text{C}\) and \(^{14}\text{C}\)
   b) \(^{24}\text{Mg}\) and \(^{12}\text{C}\)
   c) \(^{40}\text{Ar}\) and \(^{40}\text{Ca}\)
   d) \(^{35}\text{Cl}\) and \(^{80}\text{Br}\)

10) An element has two naturally occurring isotopes. One has an abundance of 37.4% and an isotopic mass of 184.953 amu, and the other has an abundance of 62.6% and a mass of 186.956 amu. What is the atomic weight of the element?
    a) 185.702 amu
    b) 185.954 amu
    c) 186.207 amu
    d) 186.956 amu
11) What type of bonding is found in the compound PCl$_5$?
   a) covalent
   b) hydrogen
   c) ionic
   d) metallic

12) Which of the following is an acid?
   a) BaO
   b) CH$_4$
   c) HBr
   d) KOH

13) The compound Cu(ClO$_3$)$_2$ is named
   a) copper chlorate (II)
   b) copper (I) chlorate
   c) copper (I) chlorate (II)
   d) copper (II) chlorate

14) What is the coefficient for oxygen when the following equation is balanced using the
    lowest, whole numbered coefficients?
    $\underline{\text{____ C}_3\text{H}_8\text{O} (g)} + \underline{\text{____ O}_2(g)} \rightarrow \underline{\text{____ CO}_2(g)} + \underline{\text{____ H}_2\text{O}(g)}$
    a) 3
    b) 5
    c) 7
    d) 9

15) How many grams are there in 0.500 moles of dichlorodifluoromethane, CF$_2$Cl$_2$?
    a) 33.2 g
    b) 60.5 g
    c) 121 g
    d) 242 g

16) What mass of dinitrogen monoxide, N$_2$O, has the same number of molecules as 3.00 g
    of trichlorofluoromethane, CCl$_3$F?
a) 0.320 g
b) 0.961 g
c) 1.04 g
d) 3.12 g

17) How many grams of calcium chloride are needed to produce 10.0 g of potassium chloride?

\[ \text{CaCl}_2(\text{aq}) + \text{K}_2\text{CO}_3(\text{aq}) \rightarrow 2\text{KCl(\text{aq}) + CaCO}_3(\text{s}) \]

a) 3.36 g
b) 7.44 g
c) 14.0 g
d) 29.8 g

18) What is the concentration when 10.0 g of FeCl$_3$ is dissolved in enough water to make 275 ml of solution?

a) $2.24 \times 10^{-4}$ M
b) 0.224 M
c) 4.46 M
d) $4.46 \times 10^3$ M

19) Which of the following compounds contains the smallest percent oxygen by mass?

a) CO$_2$
b) N$_2$O$_4$
c) P$_4$O$_{10}$
d) SO$_2$

20) Which one of the following is not an empirical formula?

a) CHO
b) CH$_2$O
c) C$_2$H$_4$O
d) C$_2$H$_4$O$_2$
**Problem #1** (25 points) You must show your work to receive full credit.

Avogadro hypothesized that equal volumes of any two gases at the same temperature and pressure would have the same number of molecules.

a) Based on the information below, what is the number of liters that 1.0078 g of hydrogen and that 35.45 g of chlorine will occupy at 0°C and 1.00 atm?

ρ(H₂) = 0.0899 g/l at 0°C and 1.00 atm
ρ(Cl₂) = 3.214 g/l at 0°C and 1.00 atm

b) Using the results in part a) and Avogadro’s hypothesis, estimate the volume occupied by one mole of any gas at 0°C and 1.00 atm
Problem #2 (25 points) You must show your work to receive full credit.

a) A compound composed only of magnesium and nitrogen was found to have 36.66% Mg by mass. What is the empirical formula for this compound?

b) The molecular weight of this compound is found to be around 67 g/mole. What is the molecular formula for this compound and what is its name?
Problem #3 (25 points) You must show your work to receive full credit.

When 2.15 grams of zinc(II) carbonate is added to 25.0 ml of 0.805 M nitric acid, carbon dioxide bubbles out of the solution.

a) Balance the equation which describes the reaction.

$$\_\_\_\ ZnCO_3(s) + \_\_\_\ HNO_3(aq) \rightarrow \_\_\_\ Zn(NO_3)_2(aq) + \_\_\_\ H_2O(l) + \_\_\_\ CO_2(g)$$

b) What is the limiting reagent?

c) What is the theoretical yield of zinc(II) nitrate in grams?