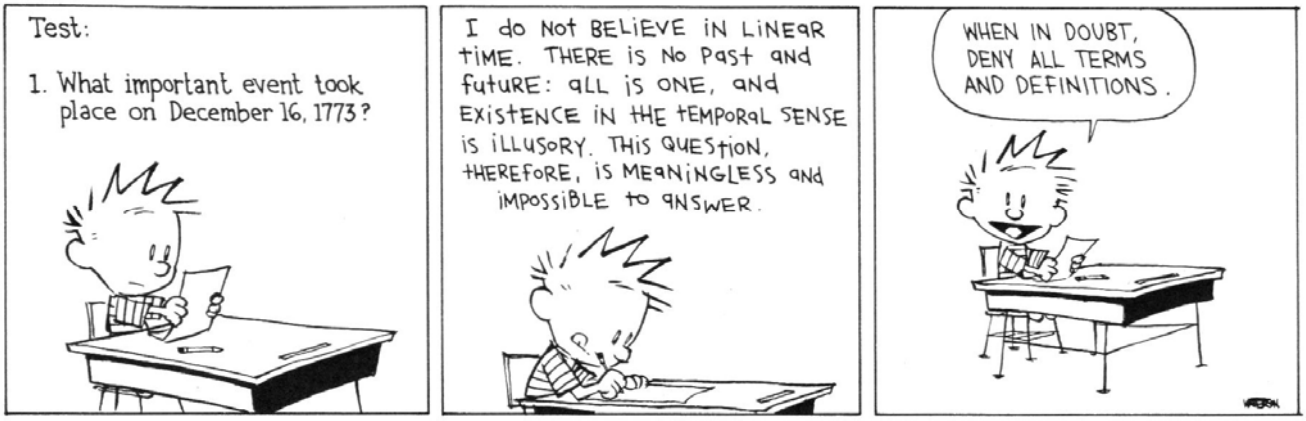
Name: _____

EXAM 1

CHEM 1411

September 24, 2009



Grade:		**100**

Instructions:

1. There are **7 pages** in this exam. Put your initials on every page.
2. You have 1 hour to complete the exam.
3. You may use calculators. You may not use cell phones or PDAs.
4. **Write only in ink!** Exams taken in pencil will not be accepted for regrades.
5. For non-multiple-choice questions, *show all work*; answers must include the correct units and be to the correct number of significant figures.
6. *Partial credit will be given on many problems*, so it is to your advantage to write at least something for every question.

1. Provide names for the following ionic and molecular compounds. (8 pts)

a. Fe_2S_3 _____

b. $Ca(NO_3)_2$ _____

c. $MgCO_3$ _____

d. PF_3 _____

2. Write the formulas for the compounds that correspond to the following names. (8 pts)

a. magnesium phosphate _____

b. chromium(III) nitrite _____

c. potassium sulfate _____

d. ammonium sulfide _____

3. **Isotopes** of an element have the same number of _____ but different numbers of _____. (2 pts)

(a) neutrons, protons (c) neutrons, electrons
____ (b) electrons, protons (d) protons, neutrons

4. Which ONE of the following processes involves a *physical change*? (2 pts)

(a) Burning a log in a campfire.
____ (b) Electrolysis of water to produce hydrogen gas and oxygen gas.
(c) Distilling water to remove sodium chloride.
(d) The combination of sodium metal and chlorine gas to form sodium chloride.

5. A compound of carbon and hydrogen with a molar mass of 58.12 g/mol contains 82.66% C and 17.34% H. Calculate the **empirical** and **molecular** formulas, arranging the atoms in the order CH. (4 pts)

6. The number of protons in the nucleus of an atom is known as the _____ and the sum of the protons and neutrons is known as the _____. (2 pts)

(a) mass number, atomic number
____ (b) atomic number, mass number
(c) Avogadro's number, atomic number
(d) mass number, Avogadro's number

7. How many molecules are in 42 g of H_2O_2? (4 pts)

8. Ammonia, NH_3, reacts with molecular oxygen, O_2, to form nitric oxide, NO, and water according to the following reaction (the molar masses of the reactants and products are written under the equation):

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$$

17.03 g/mol 32.00 g/mol 30.01 g/mol 18.02 g/mol

During an experiment, 65.0 g of NH_3 and 185 g of O_2 are mixed. (8 pts)

a. Which of the two reactants is the limiting reagent, and how many grams of NO will be formed?

b. How many grams of H_2O will be formed?

c. If the actual yield of NO had been 101 g, what would be the percent yield of the reaction?

9. What is the appropriate number of significant figures in the result of the following calculation? (2 pts)

$15.234 - 15.208 = ?$

(a) 1 (d) 4
____ (b) 2 (e) 5
(c) 3

10. How many significant figures do each of the following numbers have? (For exact numbers, write "exact".) (4 pts)

a. 1700610 _____ c. 0.001700610 _____

b. 100 cm = 1 m _____ d. 4.939×10^5 _____

11. Classify each of the following compounds as **ionic** or **molecular**. (4 pts)

a. CCl_4 _____

b. $CrCl_2$ _____

c. $BrCl_3$ _____

d. Na_2SO_4 _____

12. Balance each of the following chemical equations: (4 pts)

a. ___ $Co(NO_3)_3(aq)$ + ___ K_2SO_4 → ___ $Co_2(SO_4)_3(s)$ + ___ $KNO_3(aq)$

b. ___ $Al(s)$ + ___ $O_2(g)$ → ___ $Al_2O_3(s)$

13. Calculate the mass of hydrochloric acid, HCl, that will be needed to react with 85.2 g of Al in to the following reaction:

$$2Al(s) + 6HCl(g) \rightarrow 2AlCl_3(s) + 3H_2(g)$$

(MM: Al = 26.98 g/mol; HCl = 36.46 g/mol, $AlCl_3$ = 133.34 g/mol; H_2 = 2.02 g/mol) (4 pts)

14. Perform the following conversion: 134 picometers to nanometers (4 pts)

(a) 0.134 nm
____ (b) 1.34 nm
(c) 13.4 nm
(d) 1340 nm
(e) 13400 nm

15. Calculate the number of moles in 62.5 g of $Mg(NO_2)_2$. (4 pts)

(a) 0.115 mol
____ (b) 0.689 mol
(c) 0.397 mol
(d) 0.446 mol
(e) 0.537 mol

16. Write isotopic symbols of the form ${}^{A}_{Z}X$ for the element with 16 protons and 17 neutrons.(2 pts)

17. How many protons and electrons are in each of the following ions? (4 pts)

	protons	**electrons**
a. O^{2-}	_____	_____
b. Ca^{2+}	_____	_____

18. Match each of the following descriptions to the elements listed below: **alkali metal**, **halogen**, **alkaline earth metal**, **transition metal**, **noble gas**, **lanthanide**, **actinide**. (4 pts)

a. bromine _____ c. argon _____

b. calcium _____ d. copper _____

19. What is the mass of 1.00 gallons of octane (a component of gasoline)? The density of octane is 0.703 g/mL. (4 pts)

20. Calculate the number of grams in 0.055 mol of sulfur. (4 pts)

21. A **compound** is (2 pts)

(a) a substance composed of two or more elements in fixed proportions that are chemically combined.

____ (b) a substance which consists of only one type of atom and cannot be broken down into simpler substances.

(c) a group of two or more substances which are physically intermingled in varying proportions.

(d) a structure consisting of two or more atoms that are chemically bound together and behave as an independent unit.

22. A sample of metallic element X, weighing 20.69 g, combines with 5.219 g of sulfur atoms, S, to form a metal sulfide with the formula X_2S. Determine the atomic weight of X and use the periodic table to identify X. (4 pts)

(a) 22.99 g/mol, Na

____ (b) 39.10 g/mol, K

(c) 47.90 g/mol, Ti

(d) 52.00 g/mol, Cr

(e) 63.54 g/mol, Cu

23. Aluminum reacts with sulfur according to the following equation:

$$2Al(s) + 3S(s) \rightarrow Al_2S_3(s)$$

If 3.0 mol Al and 3.0 mol S are mixed, what is the theoretical yield of Al_2S_3 (in units of moles)? (4 pts)

(a) 2.5 mol Al_2S_3

____ (b) 2.0 mol Al_2S_3

(c) 1.5 mol Al_2S_3

(d) 1.0 mol Al_2S_3

(e) 0.50 mol Al_2S_3

24. Calculate the number of moles of Fe and O_2 that will be required to produce 2.50 mol of Fe_2O_3 according to the following reaction: (4 pts)

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

(a) 3.00 mol Fe, 2.25 mol O_2
____ (b) 5.00 mol Fe, 3.75 mol O_2
(c) 4.00 mol Fe, 3.00 mol O_2
(d) 1.25 mol Fe, 1.67 mol O_2
(e) 10.0 mol Fe, 7.50 mol O_2

25. Gold has a density of 19.30 g/mL. Calculate the density of gold in units of lb/in^3. (4 pts)

26. Bonus. A pure titanium cube has an edge length of 2.00 in. How many titanium atoms does it contain? Titanium has a density of 4.50 g/cm^3.

Physical Constants

Avogadro's number $N_A = 6.022 \times 10^{23}$ units/mol

Conversion Factors

(Conversion factors are exact except where indicated.)

1 in = 2.54 cm	°C = $\frac{5}{9}$ (°F – 32)	1 mmHg = 1 torr
3.281 ft = 1 m (not exact)	°F = $\frac{9}{5}$ °C + 32	1 atm = 1.01325 x 10^5 Pa
1.609 km = 1 mi (not exact)	K = °C + 273.15	1 atm = 760 mmHg
5280 ft = 1 mi		1 atm = 760 torr
1 gal = 3.785 L (not exact)	1 mL = 1 cm^3	1 atm = 14.7 lb / in^2
1 pound = 453.59237 g		1 atm = 101 kPa (not exact)