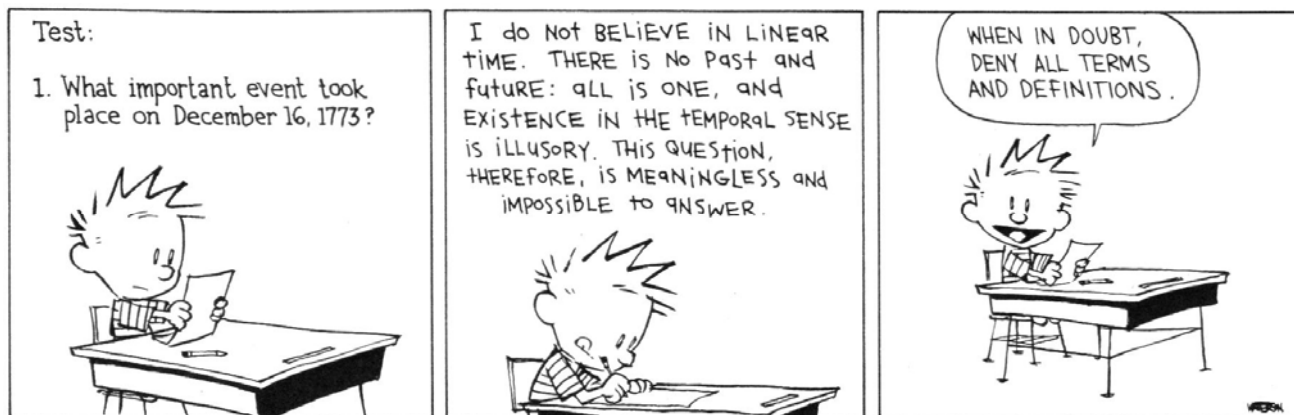


Name: \_\_\_\_\_

# EXAM 1

CHEM 1411

September 24, 2009



<b>Grade:</b>		<b>100</b>
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### 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. 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

2. 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.  $4.939 \times 10^5$  \_\_\_\_\_

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

- a.  $\text{CrCl}_2$  \_\_\_\_\_  
b.  $\text{BrCl}_3$  \_\_\_\_\_  
c.  $\text{Na}_2\text{SO}_4$  \_\_\_\_\_  
d.  $\text{CCl}_4$  \_\_\_\_\_

4. Calculate the number of moles in 62.5 g of  $\text{Mg}(\text{NO}_2)_2$ . (4 pts)

- \_\_\_\_\_ (a) 0.446 mol  
(b) 0.689 mol  
(c) 0.537 mol  
(d) 0.397 mol  
(e) 0.115 mol

5. A compound of sulfur and chlorine with a molecular mass of 135.03 g/mol contains 47.49% S and 52.51% Cl. Calculate the **empirical** and **molecular** formulas, arranging the atoms in the order SCl. (4 pts)

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

a.  $\text{MgCO}_3$  \_\_\_\_\_

b.  $\text{PF}_3$  \_\_\_\_\_

c.  $\text{Fe}_2\text{S}_3$  \_\_\_\_\_

d.  $\text{Ca}(\text{NO}_3)_2$  \_\_\_\_\_

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

a. chromium(III) nitrite \_\_\_\_\_

b. potassium sulfate \_\_\_\_\_

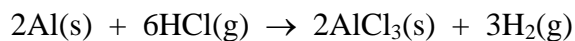
c. ammonium sulfide \_\_\_\_\_

d. magnesium phosphate \_\_\_\_\_

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

- \_\_\_\_\_ (a) 13400 nm  
(b) 1340 nm  
(c) 13.4 nm  
(d) 1.34 nm  
(e) 0.134 nm

9. Calculate the mass of hydrochloric acid, HCl, that will be needed to react with 125 g of Al in to the following reaction:



(MM: Al = 26.98 g/mol; HCl = 36.46 g/mol,  $\text{AlCl}_3$  = 133.34 g/mol;  $\text{H}_2$  = 2.02 g/mol) (4 pts)

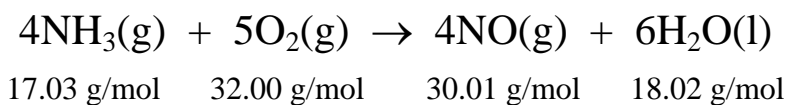
10. Write isotopic symbols of the form  ${}^A_ZX$  for the element with 13 protons and 14 neutrons.(2 pts)

11. 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. copper \_\_\_\_\_ c. argon \_\_\_\_\_

b. calcium \_\_\_\_\_ d. bromine \_\_\_\_\_

12. Ammonia,  $\text{NH}_3$ , reacts with molecular oxygen,  $\text{O}_2$ , to form nitric oxide,  $\text{NO}$ , and water according to the following reaction (the molar masses of the reactants and products are written under the equation):



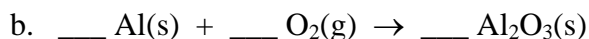
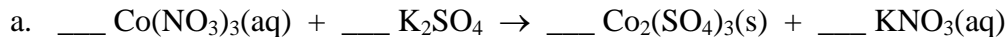
During an experiment, 145 g of  $\text{NH}_3$  and 145 g of  $\text{O}_2$  are mixed. (8 pts)

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

b. How many grams of  $\text{H}_2\text{O}$  will be formed?

c. If the actual yield of  $\text{NO}$  had been 101 g, what would be the percent yield of the reaction?

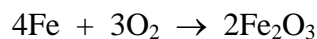
13. Balance each of the following chemical equations: (4 pts)



14. 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) mass number, Avogadro's number  
(c) atomic number, mass number  
(d) Avogadro's number, atomic number

15. Calculate the number of moles of Fe and O<sub>2</sub> that will be required to produce 2.50 mol of Fe<sub>2</sub>O<sub>3</sub> according to the following reaction: (4 pts)



- \_\_\_\_\_ (a) 3.00 mol Fe, 2.25 mol O<sub>2</sub>  
(b) 1.25 mol Fe, 1.67 mol O<sub>2</sub>  
(c) 4.00 mol Fe, 3.00 mol O<sub>2</sub>  
(d) 5.00 mol Fe, 3.75 mol O<sub>2</sub>  
(e) 10.0 mol Fe, 7.50 mol O<sub>2</sub>

16. How many molecules are in 42 g of H<sub>2</sub>O<sub>2</sub>? (4 pts)

17. 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)

18. 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.

19. 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

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

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

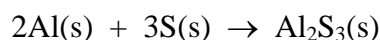
	<b>protons</b>	<b>electrons</b>
a. $O^{2-}$	_____	_____
b. $Ca^{2+}$	_____	_____

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

23. **Isotopes** of an element have the same number of \_\_\_\_\_ but different numbers of \_\_\_\_\_. (2 pts)
- \_\_\_\_\_ (a) neutrons, electrons      (c) neutrons, protons  
 (b) protons, neutrons      (d) electrons, protons

24. Which ONE of the following processes involves a *physical change*? (2 pts)
- \_\_\_\_\_ (a) Distilling water to remove sodium chloride.  
 (b) Electrolysis of water to produce hydrogen gas and oxygen gas.  
 (c) Burning a log in a campfire.  
 (d) The combination of sodium metal and chlorine gas to form sodium chloride.

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



If 3.0 mol Al and 3.0 mol S are mixed, what is the theoretical yield of  $\text{Al}_2\text{S}_3$  (in units of moles)? (4 pts)

- \_\_\_\_\_ (a) 0.50 mol  $\text{Al}_2\text{S}_3$   
 (b) 1.0 mol  $\text{Al}_2\text{S}_3$   
 (c) 1.5 mol  $\text{Al}_2\text{S}_3$   
 (d) 2.0 mol  $\text{Al}_2\text{S}_3$   
 (e) 2.5 mol  $\text{Al}_2\text{S}_3$

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  $4.50 \text{ g/cm}^3$ .

 **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 = $1.01325 \times 10^5$ 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 <sup>3</sup>	1 atm = 14.7 lb / in <sup>2</sup>
1 pound = 453.59237 g		1 atm = 101 kPa (not exact)