

Name: _____

EXAM 1

CHEM 1411

September 25, 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. Perform the following calculation, reporting the answer with the correct number of significant figures. (2 pts)

$$\frac{25.3 + 93.6854}{67.615} = ?$$

- _____
- (a) 1.76
 - (b) 1.760
 - (c) 1.7597
 - (d) 1.75975
 - (e) 1.759749

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

a. 1701000 _____ c. 0.0017010 _____

b. 1000 m = 1 km _____ d. 1.7010×10^5 _____

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

a. NiSO₄ _____

b. AlCl₃ _____

c. S₂Cl₂ _____

d. CCl₄ _____

4. Perform the following conversion: 35 microliters to centiliters (4 pts)

- _____
- (a) 0.0035 cL
 - (b) 0.035 cL
 - (c) 0.35 cL
 - (d) 3.5 cL
 - (e) 35 cL

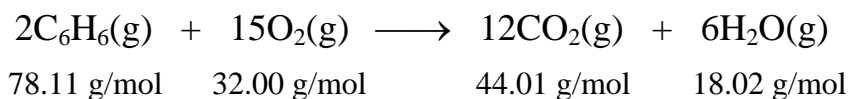
5. A compound of nitrogen and fluorine with a molecular mass of 71.00 g/mol contains 19.72% N and 80.28% F. Calculate the **empirical** and **molecular** formulas, arranging the atoms in the order NF. (4 pts)

6. Write isotopic symbols of the form A_ZX for the element with 18 protons and 22 neutrons.(2 pts)

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

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

8. Benzene, C_6H_6 , burns as follows in the presence of molecular oxygen, O_2 (the molecular weights of the reactants and products are written beneath the equation):



During an experiment, 102 g of C_6H_6 and 285 g of O_2 are mixed. (8 pts)

a. Which of the two reactants is the limiting reagent, and how many grams of CO_2 will be formed?

b. How many grams of H_2O will be formed?

c. If the actual yield of carbon dioxide had been 285 g, what would be the percent yield of the reaction?

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

a. $\text{Mg}(\text{NO}_3)_2$ _____

b. K_2S _____

c. FeCO_3 _____

d. SO_3 _____

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

a. potassium carbonate _____

b. ammonium sulfate _____

c. iron(III) nitrite _____

d. aluminum oxide _____

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)

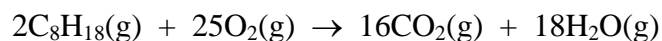
a. nickel _____

c. helium _____

b. potassium _____

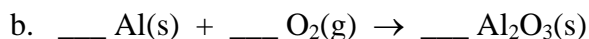
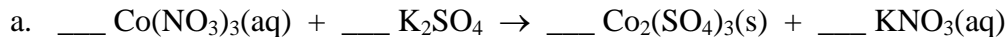
d. fluorine _____

12. The octane, C_8H_{18} , in gasoline burns according to the following equation:



How many grams of CO_2 can form from 265 g of octane? (MM C_8H_{18} = 114.23 g/mol; MM CO_2 = 44.01 g/mol) (4 pts)

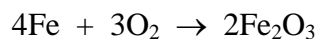
13. Balance each of the following chemical equations: (4 pts)



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 O₂ that will be required to produce 2.50 mol of Fe₂O₃ according to the following reaction: (4 pts)



- _____ (a) 3.00 mol Fe, 2.25 mol O₂
(b) 1.25 mol Fe, 1.67 mol O₂
(c) 4.00 mol Fe, 3.00 mol O₂
(d) 5.00 mol Fe, 3.75 mol O₂
(e) 10.0 mol Fe, 7.50 mol O₂

16. How many molecules are in 42 g of CH₄? (4 pts)

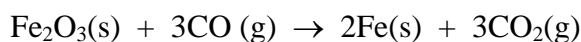
17. What is the mass of 1.00 gallons of octane (a component of gasoline)? The density of octane is 0.703 g/mL. (4 pts)

- 18. A molecule 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 36.6 g, combines with 15.0 g of sulfur atoms, S, to form a metal oxide with the formula X_2S . Determine the atomic weight of X and use the periodic table to identify X.** (4 pts)
- (a) 23.0 g/mol, Na
 - _____ (b) 39.1 g/mol, K
 - (c) 63.5 g/mol, Cu
 - (d) 87.6 g/mol, Sr
- 20. Calculate the number of grams in 0.081 mol of magnesium.** (4 pts)
- 21. How many protons and electrons are in each of the following ions?** (4 pts)
- | | protons | electrons |
|-------------|----------------|------------------|
| a. S^{2-} | _____ | _____ |
| b. K^+ | _____ | _____ |
- 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. Iron(III) oxide, Fe_2O_3 , can be converted into pure iron, Fe, by the following reaction:



If 3.0 mol Fe_2O_3 and 6.0 mol CO are mixed, what is the theoretical yield of Fe (in moles)?(4 pts)

- _____ (a) 2.0 mol Fe
 (b) 4.0 mol Fe
 (c) 6.0 mol Fe
 (d) 8.0 mol Fe
 (e) 9.0 mol Fe

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 = 1.01325×10^5 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) |