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EXAM 1

CHEM 1411

September 25, 2009



Grade:		100
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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. 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 _____

2. 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 _____

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

- _____ (a) protons, neutrons (c) electrons, protons
(b) neutrons, electrons (d) neutrons, protons

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 nitrogen and oxygen with a molecular mass of 92.01 g/mol contains 30.45% N and 69.55% O. Calculate the **empirical** and **molecular** formulas, arranging the atoms in the order NO. (25 pts)

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

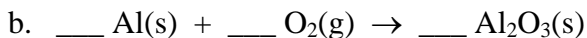
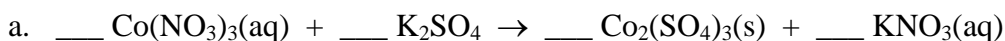
$$\frac{25.3 + 93.6854}{67.615} = ?$$

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

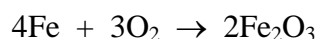
10. How many significant figures do each of the following numbers have? (For exact numbers, write "exact".) (4 pts)

- a. 0.0017010 _____ c. 1.7010×10^5 _____
b. 1701000 _____ d. 1000 m = 1 km _____

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



12. 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)



- _____ (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

13. 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)

14. 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. potassium _____
b. helium _____ d. fluorine _____

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

a. CCl_4 _____
b. NiSO_4 _____
c. AlCl_3 _____
d. S_2Cl_2 _____

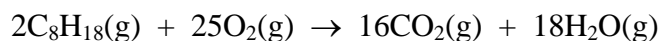
16. A sample of metallic element X, weighing 36.6 g, combines with 15.0 g of sulfur atoms, S, to form a metal oxide with the formula X_2S . Determine the atomic weight of X and use the periodic table to identify X. (4 pts)

_____ (a) 87.6 g/mol, Sr
(b) 63.5 g/mol, Cu
(c) 39.1 g/mol, K
(d) 23.0 g/mol, Na

17. 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

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



How many grams of CO_2 can form from 161 g of octane? (MM C_8H_{18} = 114.23 g/mol; MM CO_2 = 44.01 g/mol) (4 pts)

19. Write isotopic symbols of the form A_ZX for the element with 17 protons and 21 neutrons. (2 pts)

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

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

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

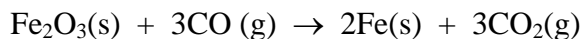
- _____ (a) a substance composed of two or more elements in fixed proportions that are chemically combined.
(b) a substance which consists of only one type of atom and cannot be broken down into simpler substances.
(c) a group of two or more substances which are physically intermingled in varying proportions.
(d) a structure consisting of two or more atoms that are chemically bound together and behave as an independent unit.

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

	protons	electrons
a. S^{2-}	_____	_____
b. K^+	_____	_____

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

24. 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

25. How many molecules are in 42 g of CH_4 ? (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 = $\frac{5}{9}(\text{°F} - 32)$	1 mmHg = 1 torr
3.281 ft = 1 m (not exact)	°F = $\frac{9}{5}\text{°C} + 32$	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)