Welcome to AP Chemistry! I am looking forward to working with you next year. In order for you to be prepared to take on the challenges of AP Chemistry, I have prepared the following assignment for you to complete during the next two months. If you should have any difficulty with any portion of the assignment, please feel free to contact me via email at lisa.cole@bufordcityschools.org

Part 1: Summer Reading

This summer we will be reading *The Disappearing Spoon* by Sam Kean. This book is available at most local bookstores. You will be creating a technology based game addressing the information covered in the book. Information and additional details about this portion of the assignment will be available on my website on or after June 13. My website can be accessed at the following address: http://www.bufordcityschools.org/bhs/teachers/lisacole/index.htm

Part 2: Review of the Fundamentals of Chemistry

Please complete the exercises and problems contained in the "AP Chemistry Summer Assignments and Review Material" in preparation for next year. The material is general information that you should know from 1st year chemistry. In case you have forgotten some of it, I have included general notes and resource materials that should assist you. The material will be reviewed briefly at the beginning of the course in the fall, but the stronger your foundation and the more knowledge you bring to the course, the easier you will find the new material.

The work that you complete in the packet will be collected the first day of class in August and will count as a test grade. Also, be prepared for a quiz over the polyatomic ions and basic math calculations sometime during the first week.

Good luck and I look forward to working with you next year.
Ms. Cole

AP Chemistry

Summer Assignments and Review Material

Notes: Metric Prefixes and Conversions

tera- (T-)	10^{12}	1 trillion
giga- (G-)	10^{9}	1 billion
mega- (M-)	10^{6}	1 million
kilo- (k-)	10^{3}	1 thousand
hecto- (h-)	10^{2}	1 hundred
deka- (da-)**	10	1 ten
deci- (d-)	10^{-1}	1 tenth
centi- (c-)	10^{-2}	1 hundredth
milli- (m-)	10^{-3}	1 thousandth
micro- (μ-)	10^{-6}	1 millionth
nano- (n-)	10^{-9}	1 billionth
pico- (p-)	10^{-12}	1 trillionth
femto- (f-)	10^{-15}	1 quadrillionth

Problems:

1. Perform each of the following conversions.
    A. 8.43 cm to meters.
    B. 2.41×10^{2} cm to meters.
    C. 294.5 nm to centimeters.
    D. 1.445×10^{4} m to kilometers.
    E. 235.3 m to millimeters.
    F. 903.3 nm to micrometers.
    G. 6.50×10^{2} terameters to nanometers
    H. 1 microgram to picograms
    I. 25 femtograms to kilograms
    J. 8.0 dm^3 to liters

2. A mole of helium gas contains 6.02×10^{23} helium atoms. How many helium atoms are there in a millimole of helium? In a kilomole?

Notes: Significant Digits

Rules for Counting Significant Digits:

1. Nonzero integers are always significant.
2. Zeroes between significant digits are significant.
3. Leading zeroes (zeroes that precede all nonzero digits) are never significant.
4. Trailing zeroes (zeroes at the right end of the number) are significant only if the number contains a decimal point.
5. Exact numbers (numbers obtained by counting instead of measuring) have an infinite number of significant digits.

Rules for Significant Digits in Mathematical Operations:

1. Multiplication and Division: The number of significant digits in the answer is the same as the number of **significant digits** in the least precise measurement used in the calculation.
2. Addition and Subtraction: The number of significant digits in the answer has the same number of **decimal places** as the least precise measurement used in the calculation.

Problems:

1. How many significant digits are in each of the following?
    a. 12
    b. 2001
    c. 2.001×10^3
    d. 0.0400101
    e. 0.0048
    f. 0.00480
    g. 100
    h. 100.00

2. Use exponential notation to express the number 480 to
    a. one significant digit
    b. two significant digits
    c. three significant digits
    d. four significant digits

3. Perform the following mathematical operations and express each result to the correct number of significant digits.
    a. 4.184 x 100.62 x (25.57-24.16)
    b. (9.04 – 8.23 + 21.954 + 81.0) / 3.1416
    c. 0.1654 + 2.07 + 2.114
    d. (9.5 + 4.1 + 2.8 + 3.175) / 4
    e. 0.102 x 0.0821 x 273 / 1.01
    f. 0.14 x 6.022 x 10^{23}

Notes: Density and Temperature Conversion

Density = mass/ volume Kelvin = °C + 273

1 cm^3 = 1 mL and 1 dm^3 = 1 L

Problems:

1. A rectangle has dimensions 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 g. What are the volume and density of the block?

2. A sample containing 33.42 g of metal pellets is poured into a graduated cylinder containing 12.7 mL of water, causing the water level in the cylinder to rise to 21.6 mL. Calculate the density of the metal.

3. Convert the following Celsius temperatures to Kelvin.
    a. the boiling point of ethyl alcohol, 78.1°C
    b. a cold wintery day, -25°C
    c. the lowest possible temperature. -273°C
    d. the melting point of sodium chloride, 801°C

USING POWERS OF TEN TO DESCRIBE VERY BIG AND VERY SMALL NUMBERS.

Remember this stuff.

$10{,}000 = 10^4$
$1{,}000 = 10^3$
$100 = 10^2$
$10 = 10^1$
$1 = 10^0$
$0.1 = 10^{-1}$
$0.01 = 10^{-2}$
$0.001 = 10^{-3}$
$0.0001 = 10^{-4}$

$30{,}000 = 3\text{x } 10{,}000 = 3\text{x}10^4$
$30{,}000 = 30\text{x } 1000 = 30\text{x}10^3$
$30{,}000 = 30{,}000 \text{ x } 1 = 30{,}000\text{x}10^0$
$30{,}000 = 3{,}000{,}000\text{x } 0.01 =$
$3{,}000{,}000\text{x}10^{-2}$

All of the above are correct.
They all describe 30,000

Which is correct…..?

1. 300 is a) 3×10^1 b) 3×10^2 c) 3×10^3 d) 3×10^4
2. 420 is a) 4.2×10^1 b) 4.2×10^2 c) 4.2×10^3 d) 4.2×10^4
3. 0.34 is a) 3.4×10^{-1} b) 3.4×10^{-2} c) 3.4×10^{-3} d) 3.4×10^{-4}
4. 0.00034 is a) 3.4×10^{-1} b) 3.4×10^{-2} c) 3.4×10^{-3} d) 3.4×10^{-4}
5. 0.000000000034 is a) 3.4×10^{-10} b) 3.4×10^{-11} c) 3.4×10^{-12} d) 3.4×10^{-13}
6. 490000000000000000000000 is a) 4.9×10^{21} b) 4.9×10^{24} c) 4.9×10^{25}

Adding Exponents

$(4 \times 10^3) + (5 \times 10^2) = 4000 + 500 = 4500$
$(4.3 \times 10^4) + (4.3 \times 10^{-2}) = 43000 + 0.043 = 43000.043$
$(5.3 \times 10^3) - (2 \times 10^2) =$
$(6.72 \times 10^2) + (4.3 \times 10^{-1}) =$

Multiplying Exponents

$(4 \times 10^3) \times (5 \times 10^2) = 4 \times 5 \times 10^3 \times 10^2 = 20 \times 10^5 = 2 \times 10^6 = 0.2 \times 10^7$
$(4.3 \times 10^4) \times (4.3 \times 10^{-2}) = 4.3 \times 4.3 \times 10^4 \times 10^{-2} = 18.99 \times 10^2$
$(5.3 \times 10^3) \times (2 \times 10^2) =$
$(6.72 \times 10^2) \times (4.3 \times 10^{-1}) =$

Dividing Exponents

$(4 \times 10^3)) (5 \times 10^2) = (4) 5) \times (10^3) 10^{2)} = 20 \times 10^5 = 0.8 \times 10^1 = 8$
$(4.3 \times 10^4)) (4.3 \times 10^{-2}) = (4.3) 4.3) \times (10^4) 10^{-2)} = 1 \times 10^6$
$(5.3 \times 10^3)) (2 \times 10^2) =$
$(5.3 \times 10^3) \times (2 \times 10^2) =$

Entering very big and very small numbers into your calculator.

Say this… " **…times ten to the…**".
Pressing [2nd] [EE] on your calculator is the equivalent of saying " times ten to the".

So, how do you enter 4×10^5 into your calculator.
You would say this in the following way " 4 times ten to the 5".
You would enter into your calculator the following….

[4] [2nd] [EE] [5]

Enter these problems into your calculator…

$(3.9 \times 10^7) \times (2 \times 10^2)$

[3] [.] [9] [2nd] [EE] [7] [x] [2] [2nd] [EE] [2] [enter]

Your answer should be….?

$(3.9 \times 10^{-7}) \times (2 \times 10^2)$

[3] [.] [9] [2nd] [EE] [(-)] [7] [x] [2] [2nd] [EE] [2] [enter]

Your answer should be….?

$(-3.9 \times 10^{-7}) \times (2 \times 10^2)$

[(-)] [3] [.] [9] [2nd] [EE] [(-)] [7] [x] [2] [2nd] [EE] [2] [enter]

Your answer should be….?

Use your calculator to answer the following….

$(3 \times 10^3) \times (2 \times 10^2) =$

$(3 \times 10^3) + (2 \times 10^{-2}) =$

$(-3 \times 10^{-3}) / (2 \times 10^2) =$

$(3 \times 10^3) - (2 \times 10^2) =$

$(3 \times 10^3) \times (2 \times 10^{-2}) =$

$(-3 \times 10^{-3}) \times (2 \times 10^2) =$

Notes: Periodic Table

Horizontal rows on the table are called periods. Vertical columns are called groups. The groups are identified by number and by name. The groups are numbered from left to right. The names for the groups are:
Group 1: Alkali Metals
Group 2: Alkaline Earth Metals
Group 16: Chalcogens
Group 17: Halogens
Group 18: Noble Gases
Groups 3-12: Transition Elements

The metals are found on the left and in the middle of the table, and the nonmetals are found on the right side of the table.

Problems:

1. List the noble gas elements. Which of the noble gases has only radioactive isotopes? (This is indicated on most periodic tables by parentheses around the mass of the element.)

2. In the periodic table, how many elements are found in
    a. the second period?
    b. the third period?
    c. the fourth period?
    d. Group 5A?

3. What are the symbols for the following elements:
    a. gold
    b. silver
    c. mercury
    d. potassium
    e. iron
    f. antimony
    g. tungsten
    h. sodium
    i. calcium
    j. chlorine
    k. nickel
    l. strontium
    m. chromium
    n. aluminum

Notes: Atomic Structure

Atoms are made up of three subatomic particles. The proton is positively charged and is located in the nucleus of the atom. The neutron has no charge and is also located in the nucleus. The electron is negatively charged and orbits the nucleus in the empty space surrounding the nucleus of the atom. The atomic number is the number of protons. Since atoms are electrically neutral, the number of protons is equal to the number of electrons. The mass number is the number of particles in the nucleus (the number of protons and neutrons). Isotopes are atoms of the same element having different atomic masses due to differing numbers of neutrons. Isotope symbols, such as the one shown below, are often used to determine the structure of an atom.

$^{23}_{11}Na$ 11 protons
11 electrons
12 neutrons

A- mass number = # of protons + # of neutrons
Z- atomic number = # of protons (found on periodic table)

Cations are formed when atoms lose electrons resulting in the atom having a positive charge. Anions are formed when atoms gain electrons which results in a negative charge.

Problems:

1. Give the number of protons and neutrons in the nucleus of each of the following atoms:

a. ^{239}Pu d. ^{4}He

b. ^{65}Cu e. ^{60}Co

c. ^{52}Cr f. ^{133}Cs

2. Complete the following table:

Symbol	Number of protons	Number of neutrons	Number of electrons	Net Charge
$^{238}_{92}U$				
	20	20		2+
	23	28	20	
$^{89}_{39}Y$				
	35	44	36	
	15	16		3-

3. Classify the following elements as metals or nonmetals:

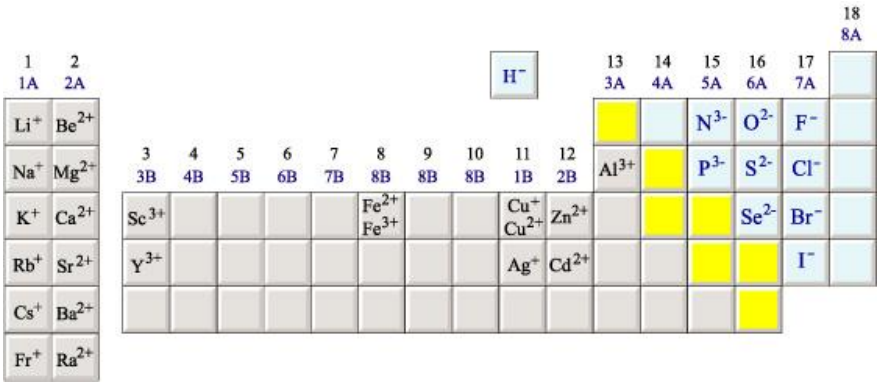
Mg	Si	Rn
Ti	Ge	Eu
Au	B	Am
Bi	At	Br

4. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?

a. Ra	b. In	c. P
d. Te	e. Br	f. Rb

Notes: Naming Compounds/Formula Writing

When naming binary ionic compounds (those containing a metal and a nonmetal), the metal is named first followed by a name derived from the root name of the nonmetal (the ending is usually changed to –ide). If the metal can form more than one cation (usually a transition element), the metal name is followed by a Roman numeral that indicates the cation charge. Polyatomic ions have special names that must be memorized along with their charges. (A list of polyatomic ions is attached at the end of this packet.) In compounds containing polyatomic ions, the cation name is given first followed by the anion name. For binary covalent compounds (those containing two nonmetals), the first element is named using the entire element name and the second element is named as if it were an anion. Prefixes are used to indicate the numbers of atoms present.



Prefixes Used to Indicate Subscripts in Covalent Molecules

Prefix	Number
1	Mono
2	Di
3	Tri
4	Tetra
5	Penta
6	Hexa
7	Hepta
8	Octa
9	Nona
10	Deca

Problems:

1. Name each of the following compounds:
   a. NaCl
   b. Rb_2O
   c. CsF
   d. Ag_2S
   e. TiO_2
   f. NI_3
   g. SF_2
   h. CaS
   i. AlI_3
   j. Li_3N
   k. MnO_2
   l. Sr_3P_2
   m. PCl_3
   n. N_2F_4

2. Name each of the following compounds:
   a. $HC_2H_3O_2$
   b. NH_4NO_2
   c. CO_2S_3
   d. ICl
   e. $Pb_3(PO_4)_2$
   f. KIO_3
   g. H_2SO_4
   h. Sr_3N_2
   i. $Al_2(SO_3)_3$
   j. SnO_2
   k. Na_2CrO_4
   l. HClO

3. Write the formula for each of the following compounds:
    a. cesium bromide
    b. barium sulfate
    c. ammonium chloride
    d. chlorine monoxide
    e. silicon tetrachloride
    f. chlorine trifluoride
    g. beryllium oxide
    h. magnesium fluoride

4. Write the formula for the following compounds:
    a. ammonium hydrogen phosphate
    b. mercury (I) sulfide
    c. silicon dioxide
    d. sodium sulfite
    e. aluminum hydrogen sulfate
    f. nitrogen trichloride
    g. hydrobromic acid
    h. bromous acid
    i. perbromic acid
    j. potassium hydrogen sulfide
    k. calcium iodide
    l. cesium perchlorate

Notes: Mole Concept

A mole is a unit of measure equal to the number of carbon atoms in exactly 12 grams of pure carbon-12. This number has been determined experimentally to be 6.02214×10^{23}, which is called Avogadro's number. One mole of any substance contains Avogadro's number of units. One mole of an element has a mass equal to the element's atomic mass in grams.

Problems:

1. Calculate the molar mass of the following substances.
    a. NH_3
    b. N_2H_4
    c. $(NH_4)_2Cr_2O_7$

2. How many moles of compound are present in 1.00 g of each of the compounds in the problem above?

3. How many molecules (or formula units) are present in 1.00 g of each of the compounds in problem 1?

Notes: Balancing Equations

Atoms are conserved in chemical reactions. The same number of each type of atom must be found among the reactants and products. In order for equations to adequately represent the reactions that are actually taking place, they must often be balanced. The formulas of the compounds must never be changed in balancing a chemical equation. That is, the subscripts in a formula cannot be changed. Only coefficients can be added.

Problems:

Balance the equations on the following page.

Notes: Writing Chemical Equations.

In order to successfully predict the products that result from a given set of reactants, the type of reaction must first be determined. There are 7 general types of reactions: synthesis, decomposition, single replacement, double replacement, combustion, oxidation-reduction (redox), and complex ion reactions. Synthesis reactions occur when two or more reactants combine to form a single compound. The reactants are generally elements or simple compounds. Decomposition reactions occur when a single reactant is broken down into two or more products. Single replacement reactions involve an element replacing one part of a compound. Metals replace metals and nonmetals replace nonmetals. Double replacement reactions occur when the cations and anions of two compounds appear to switch partners. Combustion reactions involve the combination of hydrocarbons and other organic compounds with excess oxygen to produce carbon dioxide and water. Redox reactions and the complex ion reactions will be addressed in class.

Balancing Equations

Balance the following equations. Use the smallest possible coefficients. Identify the type of reaction.

1. $K + Cl_2 \rightarrow KCl$

2. $NaNO_3 \rightarrow NaNO_2 + O_2$

3. $H_2 + O_2 \rightarrow H_2O$

4. $Br_2 + KI \rightarrow KBr + I_2$

5. $Al + HCl \rightarrow AlCl_3 + H_2$

6. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

7. $AgNO_3 + MgCl_2 \rightarrow AgCl + Mg(NO_3)_2$

8. $H_2O_2 \rightarrow H_2O + O_2$

9. $AlBr_3 + K_2SO_4 \rightarrow KBr + Al_2(SO_4)_3$

10. $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

11. $P_4O_{10} + H_2O \rightarrow H_3PO_4$

12. $Na_3PO_4 + BaCl_2 \rightarrow Ba_3(PO_4)_2 + NaCl$

Problems:

For each set of reactants listed below, identify the type of reaction, predict the products that will be formed, and then write correctly balanced molecular equations.

1. A piece of aluminum is added to a solution of silver nitrate.
2. A piece of solid bismuth is heated strongly in oxygen.
3. Solid ammonium carbonate is heated.
4. Glucose is burned completely in air.
5. Sodium hydroxide is added to a solution of magnesium nitrate.
6. Concentrated hydrochloric acid is added to solid manganese (II) sulfide.
7. Water is added to solid magnesium nitride.
8. A solid sample of magnesium carbonated is heated strongly.
9. A piece of nickel metal is immersed in a solution of copper (II) sulfate.
10. Liquid bromine is shaken with a sodium iodide solution.
11. Solutions of cobalt (II) nitrate and sodium hydroxide are mixed.
12. Carbon dioxide gas is passed over hot, solid sodium oxide.
13. Lithium metal is burned in nitrogen.
14. Aluminum metal is added to a solution of copper (II) chloride.
15. Manganese (II) nitrate and copper (II) chloride solutions are mixed.
16. Hydrogen gas is passed over hot copper (II) oxide.
17. Small chunks of sodium are added to water.
18. Hydrogen sulfide gas is bubbled through potassium hydroxide solution.
19. Lead foil is immersed in silver nitrate solution.
20. Hydrogen peroxide decomposes when exposed to sunlight.

Notes: Problem Solving and Logical Thinking

Problem solving skills will be necessary in order to be successful in this class. In order to begin developing your logical thinking skills, try to solve the logic problems that are included in this packet.

*****A quiz over the polyatomic ions and solubility rules will be given during the first two weeks of your return to school in August.**

Logic Problem #1

Lab Assistants

Dr Beaker is supervising four students. All the students, named Beryl, Selena, Al and Mo, will produce a compound of a different color; black, white, red or green. One student is working in the organic lab, one in the inorganic lab, one in the physical lab and one in the analytical lab. The building has four floors labeled 1, 2, 3 and 4, and each lab is situated on a different floor.

1. Mo works on an odd numbered floor.
2. The student who made the white compound works in the physical lab.
3. Al works one floor above Mo.
4. The black compound was made on the floor above the white one by Selena, who is an analytical chemist.
5. Beryl works on the floor which is immediately above the organic chemist and immediate below the analytical chemist.
6. The organic chemist has to use the stairs to get to their lab.
7. Al made the green compound and is meeting the inorganic chemist after work.

Can you help Dr Beaker decide which student is in which lab, on which floor and what the color of their compound should be?

Logic Problem #2

Rock Collections

Nearly all of the children in Ms. Simon's second grade class have rock collections. When one child asked if she could bring hers in for "show and tell," Ms. Simon told the class it would be all right to bring up to 12 rocks each, but each collection must be kept in a glass jar so they could be seen without being scattered. "That way," she explained, "they won't get lost or mixed up." The next day, four of the children each brought in a dozen rocks for "show and tell." From the following clues, determine how many of each of the four colors mentioned below each child had.

1. Altogether, 12 white rocks, 12 red rocks, and 12 green rocks were brought in.
2. Each child had at least one of each color; no one had more than 6 of any one color.
3. Cory had more red rocks than green rocks.
4. Lucy had twice as many red rocks as white rocks.
5. Terry, who had the same number of white and green rocks, had more red rocks than anyone else.
6. Jody had three times as many white rocks as black rocks.
7. Lucy had twice as many green rocks as Terry and three times as many green rocks as Cory.

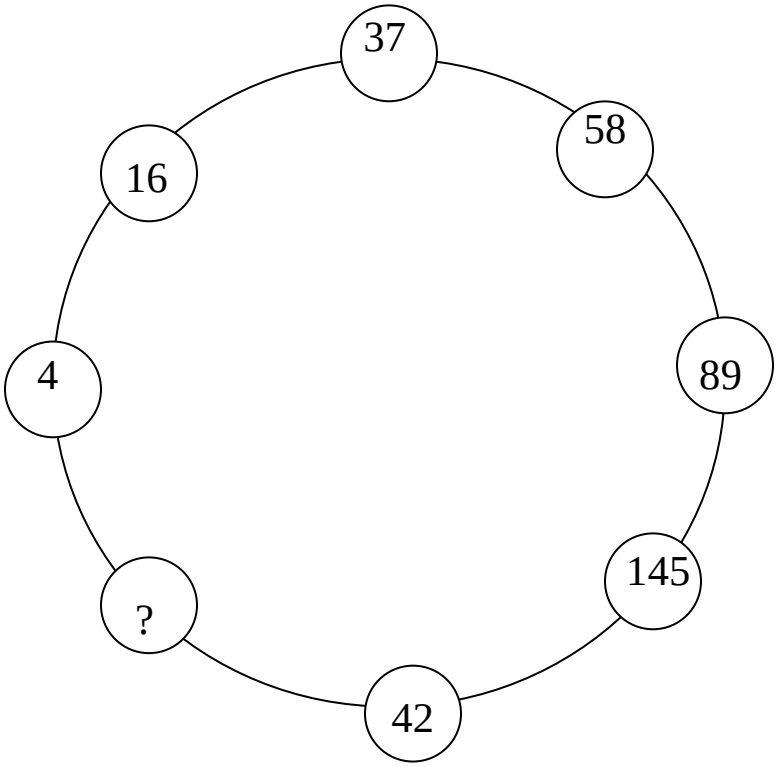
Child	Black	Green	Red	White

Logic Problem #3

Magic Circle

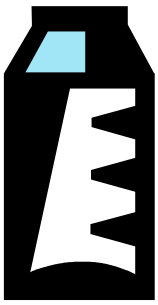
By Nobuyuki Yoshigahara

Eight numbers are placed in the diagram shown below. Do you see a pattern in going from one number to the next as you follow the arrows? Describe the pattern and identify the missing number.



Logic Problem #4

4 quarts

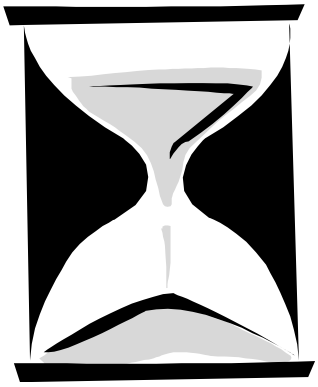


2 ½ quarts

1 ½ quarts

A milk pitcher contains 4 quarts of milk. The milk needs to be divided equally between two friends. The only containers available are two empty bottles, one of them which holds 2 ½ quarts and the other which holds 1 ½ quarts. Using the pitcher and both bottles, explain how the milk can be divided equally between the two friends.

Logic Problem #5



Microcentury Minutes

You have just one microcentury available to watch the latest episode of *Jeopardy* on TV. Is that long enough to see the whole program?

In order to receive credit, you must solve the problem using the Factor Label Method and show all of your work.

Logic Problem #6

When astronauts landed on the moon, they left mirrors on the surface to help scientists conduct experiments and measure distances. On a particular day, an astronomer sends a pulse of light to the moon, where it reflects from a mirror and returns to the Earth 2.562 seconds after it is sent. Given that light travels through space at a speed of 3.00×10^8 m/s, calculate the distance from the Earth's surface to the moon's surface in miles.

The problem must be solved using dimensional analysis (factor-label method) and the answer must include the correct number of significant digits.

Use the following equalities in determining the solution to the problem.

1 inch = 2.54 cm
1760 yards = 1 mile

Are you ready for the challenge of AP Chemistry?

The following problems are based on the concepts covered in Honors Chemistry; however, the difficulty level is representative of what you will see in AP Chemistry. Try to solve them and see if you are ready for the challenge. Good Luck!

1. If you put 8.21 gallons of gas in your car and it cost you a total of $17.25, what is the cost of gas per liter in Canadian dollars? Assume 0.82 dollar U.S. = 1.00 dollar Canadian. (Solve using the Factor Label Method)

2. Using the information given below, answer the following questions. In an ion with an unknown charge, the total mass of all electrons was determined to be 2.55×10^{-26}g , while the total mass of its protons was 5.34×10^{-23} g. What is the identity and charge on this ion? What is the symbol and mass number of a neutral atom whose total mass of its electrons is 3.92×10^{-26}g, while its neutrons have a mass of 9.35×10^{-23} g?
   mass of electron = 9.11×10^{-31}kg
   mass of proton = 1.67×10^{-27}kg
   mass of neutron = 1.67×10^{-27}kg

3. A binary compound is known to contain a cation with 51 protons and 48 electrons. The anion contains one-third the number of protons as the cation. The number of electrons in the anion is equal to the number of protons plus 1. What is the formula of this compound? What is the name of this compound?

4. A compound contains only carbon, hydrogen, and oxygen. Combustion of 10.68 mg of the compound yields 16.01 mg CO_2 and 4.37 mg H_2O. The molar mass of the compound is 176.1 g/mol. What are the empirical and molecular formulas of the compound?

5. A given sample of a xenon fluoride compound contains molecules of the type XeF_n, where n is some whole number. Given that 9.03×10^{20} molecules of XeF_n weighs 0.368 g, determine the value of n in the formula and identify the geometric shape of the molecule.

6. An ionic compound MX_3 is prepared according to the following unbalanced chemical equation. $M + X_2 \rightarrow MX_3$
   A 0.105 g sample of X_2 contains 8.92×10^{20} molecules. The compound MX_3 consists of 54.47% X by mass. What are the identities of M and X, and what is the correct name for MX_3? Starting with 1.00 g each of M and X_2, what mass of MX_3 can be prepared?

7. A 20.0 L stainless steel container was charged with 2.00 atm of hydrogen gas and 3.00 atm of oxygen gas. A spark ignited the mixture, producing water. What is the pressure in the tank at 25°C? at 125°C?

8. A chemist weighed out 5.14 g of a mixture containing unknown amounts of BaO (s) and CaO (s) and placed the sample in a 1.50 L flask containing CO_2 (g) at 30.0° C and 750. torr. After the reaction to form $BaCO_3$ (s) and $CaCO_3$ (s) was completed, the pressure of CO_2 (g) remaining was 230. torr. Calculate the mass percentages of CaO (s) and BaO (s) in the mixture.

9. Tris(pentafluorophenyl)borane, commonly known by its acronym BARF, is frequently used to initiate polymerization of ethylene or propylene in the presence of a catalytic transition metal compound. It is composed solely of C, F, and B; it is 42.23% C by mass and 55.66% F by mass.
   a) What is the empirical formula of BARF?
   b) A 2.251 g sample of BARF dissolved in 347.0 mL of solution produces a 0.01267 M solution. What is the molecular formula of BARF?

10. An unknown compound contains only C, H, and O. Combustion analysis of the compound gives mass percentages of 31.57% C and 5.30% H. The molar mass is determined by freezing point depression of an aqueous solution. A freezing point of -5.20°C is recorded for a solution made by dissolving 10.56 g of the compound in 25.0 g water. Determine its empirical formula, molar mass, and molecular formula of the compound. Assume that the compound is a non-electrolyte. (K_f of water is 1.86 °C · kg/mol)

***If you could not solve these problems, please do not let it discourage you from taking the course. You each have come highly recommended and are capable of doing well and achieving much success in the class. I simply wanted to give you a sneak preview of the problem-solving that will be taking place in the class on a daily basis. I am excited about your willingness to take on this challenge and am looking forward to a great year!

Common Polyatomic Ions

Anions		
1-	**2-**	**3-**
Acetate, CH_3COO^-	Carbide, C_2^{2-}	Aluminate, AlO_3^{3-}
Amide, NH_2^-	Carbonate, CO_3^{2-}	Arsenate. AsO_4^{3-}
Azide, N_3^-	Chromate, CrO_4^{2-}	Borate, BO_3^{3-}
Benzoate, $C_6H_5COO^-$	Dichromate, $Cr_2O_7^{2-}$	Citrate, $C_6H_5O_7^{3-}$
Chlorate, ClO_3^-	Imide, NH^{2-}	Phosphate, PO_4^{3-}
Chlorite, ClO_2^-	Manganate, MnO_4^{2-}	Phosphite, PO_3^{3-}
Cyanate, OCN^-	Metasilicate, SiO_3^{2-}	
Cyanide, CN^-	Monohydrogen phosphate, HPO_4^{2-}	
Dihydrogen phosphate, $H_2PO_4^-$	Oxalate, $C_2O_4^{2-}$	
Formate, $HCOO^-$	Peroxide, O_2^{2-}	**4-**
Hydrogen carbonate (bicarbonate), HCO_3^-	Peroxydisulfate, $S_2O_8^{2-}$	Orthosiliscate, SiO_4^{4-}
Hydrogen sulfate (bisulfate), HSO_4^-	Phthalate, $C_8H_4O_4^{2-}$	Pyrophosphate, $P_2O_7^{4-}$
Hydrogen sulfide (bisulfide), HS^-	Polysulfide, S_x^{2-}	
Hydroxide, OH^-	Selenate, SeO_4^{2-}	
Hypochlorite, ClO^-	Sulfate, SO_4^{2-}	**5-**
Iodate, IO_3^-	Sulfite, SO_3^{2-}	Tripolyphosphate, $P_3O_{10}^{5-}$
Nitrate, NO_3^-	Tartrate, $C_4H_4O_6^{2-}$	
Nitrite, NO_2^-	Tellurate, TeO_4^{2-}	**Cations**
Perchlorate, ClO_4^-	Tetraborate, $B_4O_7^{2-}$	**1+**
Permanganate, MnO_4^-	Thiosulfate, $S_2O_3^{2-}$	Ammonium, NH_4^+
Thiocyanate, SCN^-	Tungstate, WO_4^{2-}	Hydronium, H_3O^+
Triiodide, I_3^-	Zinvate, ZnO_2^{2-}	
Vanadate, VO_3^-		

TABLE 8.3 Solubility rules for ionic compounds

NH_4^+	All common salts of ammonium ion are soluble.
Na^+, K^+	All common salts of sodium and potassium are soluble.
NO_3^-	All nitrates are soluble.
$C_2H_3O_2^-$	All acetates are soluble except iron(III) acetate, $Fe(C_2H_3O_2)_3$.
Cl^-, Br^-, I^-	All chlorides, bromides, and iodides are soluble except those of Ag^+, Hg^+, and Pb^{2+}. $PbCl_2$ and $PbBr_2$ are slightly soluble in hot water.
SO_4^{2-}	All sulfates are soluble except $CaSO_4$, $BaSO_4$, $PbSO_4$, and Ag_2SO_4.
PO_4^{3-}, CO_3^{2-}	Only alkali metal and NH_4^+ phosphates and carbonates are soluble.
S^{2-}	Only alkali metal and NH_4^+ sulfides are soluble.
OH^-	Only alkali metal and NH_4^+ hydroxides are soluble. Ca^{2+}, Ba^{2+}, and Sr^{2+} hydroxides are slightly soluble.

This is an abbreviated list. A more complete list will be given out when you return in August.

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)