

Summer Assignment

Welcome to AP Chemistry!

AP Chemistry comprises the following nine units:

- | | |
|--|--|
| 1. Atomic Structure and Properties | 6. Thermochemistry |
| 2. Compound Structure and Properties | 7. Equilibrium |
| 3. Properties of Substances and Mixtures | 8. Acids and Bases |
| 4. Chemical Reactions | 9. Thermodynamics and Electrochemistry |
| 5. Kinetics | |

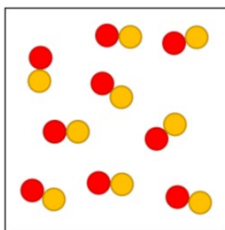
Much of the first four units have been covered in your first year chemistry class. Consequently, we will move through those units more quickly than the later units.

If you are new to me, there may be concepts included in this assignment that were not covered in your first year chemistry class. Note the material you did not cover this year, and we will sort through it in August.

Please come visit me in room 003 during the last couple weeks of school. I will have a paper copy of this assignment for you, and if you like having a reference in hard copy, you can check out the textbook that we will use next year.

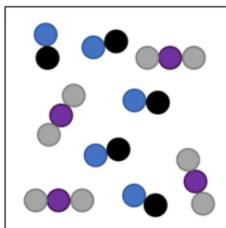
Please complete this assignment *before* our first class meeting. Do not wait until the day before school starts. Perhaps a page a day starting at the beginning of August is a good goal. I will collect it on our first day of class, and late points will be deducted if it is turned in late.

- A chemist mixes sodium with water and witnesses a violent reaction between metal and water. This is best classified as
 - an observation
 - a hypothesis
 - a law
 - a theory
- This image represents a particulate view of a sample of matter. Classify the sample according to its composition.



- | | |
|------------------------|--------------------------|
| a. element | c. compound |
| b. homogeneous mixture | d. heterogeneous mixture |

3. Classify the sample according to its composition.



- a. element
b. homogeneous mixture
c. compound
d. heterogeneous mixture
4. Which of the following statements about separation techniques is true?
- a. Filtration can be used to separate a homogenous mixture of two liquids.
b. Chromatography is a god technique for separating a mixture of two solids.
c. Separation techniques involve separating molecules into atoms.
d. Distillation is a technique that depends on the differences in the tendencies of substances to form gases.
5. Which property of rubbing alcohol is a chemical property?
- a. density (0.786 g/cm^3)
b. flammability
c. boiling point $(82.5 \text{ }^\circ\text{C})$
d. melting point $(-89 \text{ }^\circ\text{C})$
6. Express the quantity $3.32 \times 10^{-4} \text{ m}$ in mm . There are 1000 mm in 1 m. Use dimensional analysis.
7. What is the mass of a 1.75 L sample of a liquid that has a density of 0.921 g/mL ?
(1000 mL = 1 L)
8. Which of the following quantities are *inexact* numbers?
- a. the number of μg in a g .
b. the number of square yards in a square mile.
c. the height of a building.
d. the density of aluminum.
e. the number of seconds in a day.
f. the number of calories in 1 Joule.

9. Perform the following calculation to the correct number of significant figures.

$$\frac{4.3998 \times 0.00553}{2.002}$$

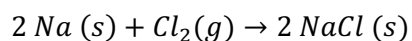
10. Perform the following calculation to the correct number of significant figures.

$$\frac{8.01 - 7.50}{3.002}$$

11. A solid metal sphere has a radius of 3.53 cm and a mass of 1.796 kg . What is the density (in g/cm^3) of the metal in the sphere? The volume of a sphere is $V = \frac{4}{3}\pi r^3$.
12. A commercial Boeing 757 airliner has a typical cruising speed of 528 miles per hour. What is this speed in meters/second? $1 \text{ mile} = 1.609 \text{ km}$
13. Which of the following factors determines the size of an atom?
- the volume of the nucleus
 - the volume of space occupied by the electrons of the atom
 - the volume of a single electron, multiplied by the number of electrons in the atom
 - the total nuclear charge
 - the total mass of the electrons surrounding the nucleus
14. A student has 1.0 g samples of each of the following compounds NaCl , KBr , and KCl . List the samples in order of increasing numbers of moles in the sample.
15. Given 10. g samples each of LiF , LiCl , LiBr , and LiI , place the samples in order of least to greatest number of lithium atoms.

16. Determine the number of protons and neutrons in an isotope of iron-58.
17. An isotope of an element contains 82 protons and 122 neutrons. What is the isotope symbol for this species? (e.g., ${}^A_ZX$)
18. Determine the number of electrons in the Cr^{3+} ion.
19. Which pair of elements would be most similar in their chemical properties?
- | | |
|-------------|-------------|
| a. K and Fe | c. O and Si |
| b. Ne and N | d. Br and I |
20. A naturally occurring sample of an element contains only two isotopes. The first isotope has a mass of 68 amu and a natural abundance of 60.11%. The second isotope has a mass of 71 amu. Find the average atomic mass of the element.
21. Determine the number of atoms in 1.85 mL of mercury. The density of mercury is 13.5 g/cm^3 .
22. Balance the following equations and indicate what type of reaction it is (synthesis, decomposition, single replacement, double replacement, or combustion).
- a. $\text{___}KNO_3 \rightarrow \text{___}KNO_2 + \text{___}O_2$
- b. $\text{___}AgNO_3 + \text{___}K_2SO_4 \rightarrow \text{___}Ag_2SO_4 + \text{___}KNO_3$
- c. $\text{___}CH_3NH_2 + \text{___}O_2 \rightarrow \text{___}CO_2 + \text{___}H_2O + \text{___}N_2$
- d. $\text{___}N_2O_5 + \text{___}H_2O \rightarrow \text{___}HNO_3$
- e. $\text{___}Na + \text{___}Zn(NO_3)_2 \rightarrow \text{___}Zn + \text{___}NaNO_3$

23. Determine the mass of sodium chloride produced when 10.0 g of sodium react with 10.0 g of chlorine gas according to the following equation.



24. Determine the percent yield of water produced when 68.3 g of hydrogen gas react with 85.4 g of oxygen gas and 86.4 g of water are collected.

25. Methane, CH_4 , is the gas commonly found in labs to fuel Bunsen burners.

a. How many moles of methane are in a 7.21 g sample?

b. How many molecules of methane are in the sample?

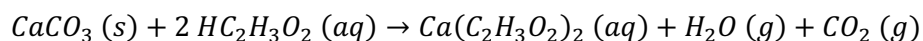
c. How many atoms of hydrogen are in the sample?

26. Which has a greater mass, 0.25 mol of CO or 1.5×10^{23} molecules of CO ?

27. Two sample of a compound containing elements A and B are decomposed. The first sample produces 15 g of A and 35 g of B. The second sample produces 25 g of A. What is the mass of B in the second sample?

28. *You may find the next two questions challenging. Please try your best ... avoid AI please.*

The main component of eggshells is calcium carbonate, $CaCO_3$. If you react eggshells with acetic acid, $HC_2H_3O_2$, the following reaction takes place:



If 4.421 g of $CO_2 (g)$ were produced from 10.57 g of eggshells, what percentage by mass of the eggshells was calcium carbonate?

29. A 31.203 g sample of brass was analyzed. Brass is an alloy (solid mixture) of copper and zinc. The zinc in the alloy reacted with 35.123 g of hydrochloric acid, HCl , which was in excess. After all the zinc reacted, the mass of the solution was 36.306 g.
- What mass of hydrogen gas was produced?
 - What mass of zinc reacted?
 - What the percentage of zinc (by mass) in the alloy?

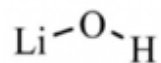
30. Write the ground state electron configuration for
- chlorine
 - aluminum ion, Al^{3+}
 - sulfide ion, S^{2-}
31. Rank the following from smallest to largest atomic/ionic radius.
- S, S^{2-}
 - Mg, Mg^{2+}
 - Cl, Ar, K
 - Be, Mg, Ca
32. Based on the successive ionization energies for the element "X," predict the formula of the product that X forms when it reacts with chlorine.
- | Ionization energy | Energy (kJ/mol) |
|-------------------|-----------------|
| 1st | 577 |
| 2nd | 1820 |
| 3rd | 2740 |
| 4th | 11,600 |
| 5th | 14,841 |
33. The first ionization energy for potassium, K , is 419 kJ/mol ; the second ionization energy for calcium, Ca , is 1145 kJ/mol . Why are the ionization energies so different even though K^+ and Ca^{2+} are isoelectronic?

34. Use the table to answer the following questions.

Element	Electronegativity
Si	1.8
H	2.1
C	2.5
S	2.5
O	3.0
Cl	3.0
F	4.0

- a. Select three sets of two elements that would form polar covalent bonds. Place them in order from least polar to most polar.
- b. Select three sets of two elements that would form nonpolar covalent bonds.

35. Is the bond/attraction between $Li - O$ the same as between $H - O$?

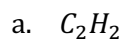
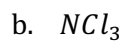
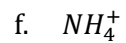
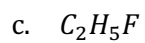
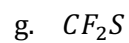
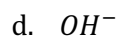


Describe both the $Li - O$ and $H - O$ bonds/attractions using correct terms.

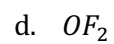
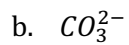
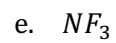
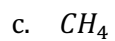
36. Based on locations on the periodic table, rank the following in terms of increasing metal character.

Ba Ca Ge Se Ne Cu Ga

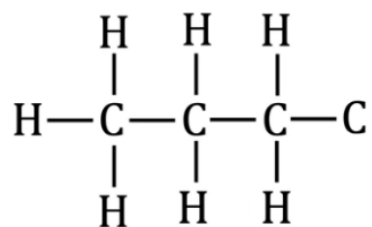
37. Draw the Lewis diagrams for the following compounds.



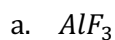
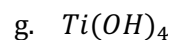
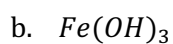
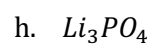
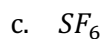
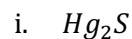
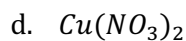
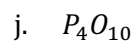
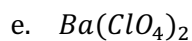
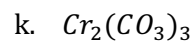
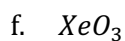
38. Draw the Lewis structure, predict the molecular geometry (VSEPR shape), and give bond angles for the following molecules or ions.



39. The incomplete Lewis diagram of butyric acid, $C_4H_8O_2$, is below. Complete the diagram including all lone pairs of electrons.



40. Name the following compounds.



41. Write the formulas for the following compounds.

a. copper (I) oxide

g. manganese (III) dichromate

b. potassium peroxide

h. zinc nitrate

c. ammonium oxalate

i. sodium hypobromite

d. dinitrogen tetroxide

j. tetraphosphorus hexasulfide

e. iron (III) carbonate

k. aluminum hydroxide

f. hydrogen cyanide

42. Perform each of the following operations.

a. Convert 0.0054 to standard scientific notation.

b. $(5.0 \times 10^{-2}) + (4.7 \times 10^{-3})$

c. $(5.98 \times 10^{12})(2.77 \times 10^{-5})$

d. $\sqrt[4]{1.75 \times 10^{-12}}$