

# AP Chemistry Summer Assignment

## Chapters to be covered at home: 1-3

Your summer assignment includes a number of topics that should be a review of honors chemistry. Please take notes on chapters 1-3 in a notebook that you will continue to use when you return in September. While taking notes it is strongly suggested that you read the "Sample Exercise" and do the "Practice Exercises" which will enhance your understanding of what you are reading. If you follow this practice throughout the year you will be more successful in the course and in your understanding of chemistry.

All completed problems should be **neatly** written out, all set-ups included, and handed in on the first day of class, **NO** exceptions. Notes will also be checked at this time. Upon your return in September, I will help you with any minor problems you may have had over the summer and on the following class period you will have a major comprehensive exam to assess your understanding of the summer material. The comprehensive exam **WILL NOT** be scaled, as these topics are all things you have covered previously in honors chemistry.

This will be a very fast paced course in order to ensure the completion of all of the topics for the AP Exam in May.

Please feel free to contact me over the summer with questions: [mgjordano@north-reading.k12.ma.us](mailto:mgjordano@north-reading.k12.ma.us)

## Topics to have mastered by September:

1. Dimensional Analysis
2. All Nomenclature (Naming and Formula writing)
3. Lewis Structures
4. Polyatomic Ion List
5. Strong Acids
6. All Gas Laws
7. All Chemistry Basics (atoms, ions, isotopes, atomic number, mass number, avg. atomic mass etc.)
8. 5 Chemical reaction and balancing
9. % Composition, Empirical and Molecular Formulas
10. Limiting Reactant, and % Yield
11. Sig. Figs
12. Periodic Table (location of metals, nonmetals, metalloids, charges, valence electrons, etc.)
13. Properties of elements

## Polyatomic Ions to know (formulas and names)

Ammonium  
Cyanide  
Hydroxide  
Nitrate

Nitrite  
Chlorate  
Perchlorate  
Permanganate

Carbonate  
Bicarbonate  
Sulfate  
Sulfite

Chromate  
Dichromate  
Phosphate  
Phosphite

**Practice Problems: Show all work for credit.**

**USE SIGNIFICANT DIGITS in problems.**

1. Write the **most common guidelines** for both addition/subtraction and multiplication/division to determine significant figures (digits) with an example of each.

2. Use **dimensional analysis** to convert the following:

a. 200 meters = \_\_\_\_ miles.

b. 650 in = \_\_\_\_ meters

c. 4 years= \_\_\_\_ seconds.

d. 200 liters = \_\_\_\_ ml

3. Classify each of the following as units of mass, volume, length, density, energy, or pressure.

a. Kg \_\_\_\_\_

b. Liter \_\_\_\_\_

c.  $m^3$  \_\_\_\_\_

d. mm \_\_\_\_\_

e.  $kg/m^3$  \_\_\_\_\_

f. Joule \_\_\_\_\_

g. atm \_\_\_\_\_

h. cal \_\_\_\_\_

i. Torr \_\_\_\_\_

j. g/ml \_\_\_\_\_

4. Most laboratory experiments are performed at room temperature at  $65^\circ\text{C}$ . Express this temperature in:

a.  $^\circ\text{F}$

b. K

5. A substance has a length of 46.0 mm on each side and has a mass of 3.00 kg. What is the density of the cube?

6. How many significant figures are in each of the following?

- |                                 |       |                          |       |
|---------------------------------|-------|--------------------------|-------|
| a. 1.9200 mm                    | _____ | g. 1001                  | _____ |
| b. 0.0301001 kJ                 | _____ | h. 0.001345              | _____ |
| c. $6.022 \times 10^{23}$ atoms | _____ | i. 0.0101                | _____ |
| d. 460.000 L                    | _____ | j. $3.02 \times 10^4$    | _____ |
| e. 0.000036 cm <sup>3</sup>     | _____ | k. $3.21 \times 10^{-2}$ | _____ |
| f. 10000                        | _____ |                          |       |

7. Record the following in correct scientific notation:

- |                      |       |
|----------------------|-------|
| a. 4050,000,000 cal  | _____ |
| b. 0.000123 mol      | _____ |
| c. 0.00345 Å         | _____ |
| d. 700,000,000 atoms | _____ |

8. Calculate the following to the correct number of significant figures.

- |   |                               |
|---|-------------------------------|
| a. $1.270 \text{ g} / 5.296 \text{ cm}^3$ | e. $2.1 \times 3.2102$        |
| b. $12.235 \text{ g} / 1.010 \text{ L}$   | f. $200.1 \times 120$         |
| c. $12 \text{ g} + 0.38 \text{ g}$        | g. $17.6 + 2.838 + 2.3 + 200$ |
| d. $170\text{g} + 2.785 \text{ g}$        |                               |

9. Write the Latin names for each of the elements symbols:

- |       |       |       |       |
|-------|-------|-------|-------|
| a. Na | _____ | e. Fe | _____ |
| b. Au | _____ | f. Hg | _____ |
| c. Ag | _____ | g. K  | _____ |
| d. Sn | _____ | h. Pb | _____ |

10. A solid white substance A is heated strongly in the absence of air. It decomposes to form a new white substance B and a gas C. The gas has exactly the same properties as the product obtained when carbon is burned in an excess of oxygen. Based on these observations, can we determine whether solids A and B and the gas C are elements or compounds? Explain your conclusions for each substance.

11. Label each of the following as either a **physical process** or a **chemical process**.

a. Corrosion of aluminum metal.

\_\_\_\_\_

b. Melting of ice.

\_\_\_\_\_

c. Pulverizing an aspirin.

\_\_\_\_\_

d. Digesting a candy bar.

\_\_\_\_\_

e. Explosion of nitroglycerin.

\_\_\_\_\_

f. Milk turning sour.

\_\_\_\_\_

g. Burning of paper.

\_\_\_\_\_

h. Forming of frost on a cold night.

\_\_\_\_\_

i. Bleaching hair with  $\text{H}_2\text{O}_2$ .

\_\_\_\_\_

j. A copper wire is hammered flat.

\_\_\_\_\_

12. You may notice when water boils, you can see bubbles that rise to the surface of the water.

a. What is inside these bubbles?

b. Is the boiling of water a chemical or physical change? Explain

13. Dalton assumed that all atoms of the same element were identical in all their properties. Explain why this assumption is not valid.

14. Why do we call  $\text{Ba}(\text{NO}_3)_2$  barium nitrate, but we call  $\text{Fe}(\text{NO}_3)_2$  iron(II) nitrate?

15. Calculate the mass of  $\text{O}_2$  produced if 3.450 g potassium chlorate is completely decomposed by heating in presence of a catalyst (Manganese dioxide).

16. Write the formula of the following compounds?

a. Calcium sulfate

\_\_\_\_\_

b. Ammonium Phosphate

\_\_\_\_\_

c. Lithium Nitrite

\_\_\_\_\_

d. potassium perchlorate

\_\_\_\_\_

e. Barium Oxide

\_\_\_\_\_

f. Zinc sulfide

\_\_\_\_\_

g. Sodium bromate

\_\_\_\_\_

h. Calcium Iodide

\_\_\_\_\_

i. Aluminum Carbonate

\_\_\_\_\_

17. Convert 6.75 atm to:

a. torr Hg

b. kilo pascals

c. mm of Hg

18. Define the words: atomic number, atomic mass, mass number, molecular formula, structural formula, empirical formula, isotopes, cation, anion, metalloid, and allotrope.

19. Determine number of protons and neutrons in each of the following.

a.  $K_{19}^{39}$

b.  $^{23}_{11}\text{Na}$ .

c.  $^{208}_{82}\text{Pb}$

d.  $^{33}_{15}\text{P}$

20. White gold is an alloy that typically contains 45.0% by mass gold and the remainder is platinum. If 154 g of gold are available, how many grams of platinum are required to combine with the gold to form this alloy?

21. Determine the number of molecules present in 4.56 mol of nitrogen ( $N_2$ ).

22. List the following as diatomic molecule, molecular compound, ionic compound, Atomic element.

a.  $F_2$  \_\_\_\_\_

b.  $Cl_2$  \_\_\_\_\_

c. C \_\_\_\_\_

d. NaCl \_\_\_\_\_

e. KF \_\_\_\_\_

f.  $CO_2$  \_\_\_\_\_

g.  $H_2$  \_\_\_\_\_

h. Ag \_\_\_\_\_

i. Rust \_\_\_\_\_

j. MgO \_\_\_\_\_

k.  $O_2$  \_\_\_\_\_

l.  $I_2$  \_\_\_\_\_

m. CO \_\_\_\_\_

n.  $K_2CO_3$  \_\_\_\_\_

23. What is the difference between:

a. Chlorine and Chloride?

b. Sodium atom and sodium ion.

24. How many grams of methane ( $CH_4$ ) are present in 5.6 moles of methane gas?

25. Calculate the mass in grams of each of the following:

a.  $6.02 \times 10^{23}$  atoms of Mg.

b.  $3.01 \times 10^{23}$  Formula units of  $CaCl_2$ .

c.  $12.4 \times 10^{15}$  atoms of neon.

26. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:

1. Mass of crucible, cover, and contents before heating 23.4 g.
2. mass of empty crucible and cover 18.82 g.
3. mass of crucible, cover, and contents after heating to constant mass 20.94 g.

Calculate the experimental percent of water in the compound.

27. How do you distinguish:

- a. An element from a compound.
- b. An element from a mixture.
- c. A true solution from a heterogeneous mixture.
- d. Distillation from filtration.

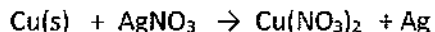
28. An **extensive property** is one that depends on the amount of the sample. Circle the properties that are extensive?

- a. volume   b. density   c. temperature   d. energy   e. melting point   f. pressure

29. A hydrated compound has an analysis of 18.29% Ca, 32.37% Cl, and 49.34% water. What is its formula?

30. Name the 5 types of **general inorganic reactions** with example of each?

31. What mass of copper is required to replace silver from 4.00g of silver nitrate dissolved in water?



32. Write the chemical formulas for the following compounds:

a. Calcium Carbonate \_\_\_\_\_

b. Ammonium Phosphate \_\_\_\_\_

c. Sodium Chloride \_\_\_\_\_

d. Sodium Oxide \_\_\_\_\_

e. Calcium Sulfate \_\_\_\_\_

f. Sodium Nitrite \_\_\_\_\_

g. Magnesium Acetate \_\_\_\_\_

h. Potassium cyanide \_\_\_\_\_

i. Zinc(II) Nitrate \_\_\_\_\_

j. Iron(III) Phosphate \_\_\_\_\_

k. Nickel (II) Fluoride \_\_\_\_\_

33. Define

a. Law of conservation of mass.

b. Law of multiple proportion.

34. Strontium consists of four isotopes with masses and their percent abundance of 83.9134 amu ( 0.5%), 85.9094 amu (9.9%) , 86.9089 amu (7.0 %) , and 87.9056 amu (82.6 %). Calculate the atomic mass of Sr ?

35. Nitrogen has two isotopes, N-14 and N-15, with atomic masses of 14.00031 amu and 15.001 amu, respectively. What is the percent abundance of N-15?

36. Write the number of protons and electrons?

a.  $\text{P}_4$  molecule

b. a  $\text{PCl}_5$  molecule

c. a  $\text{P}^{3-}$  ion

d.  $\text{P}^{5+}$  ion

37. Mercury has an atomic mass of 200.59 amu. Calculate the

a. Mass of  $3.0 \times 10^{10}$  atoms.

b. Number of atoms in one nanogram of Mercury.

38. Calculate the molar masses (g/ mol) of

a. Ammonia (  $\text{NH}_3$  )

b. Baking soda (  $\text{NaHCO}_3$  )

c. Osmium Metal (Os)

39. Convert the following to moles

a. 3.86 grams of Carbon dioxide.

b.  $6.0 \times 10^5$  g of Hydrazine ( $\text{N}_2\text{H}_4$ ), a rocket propellant.

40. The molecular formula of morphine, a pain-killing narcotic, is  $\text{C}_{17}\text{H}_{19}\text{NO}_3$ .

a. What is the molar mass?

b. What fraction of atoms in morphine is accounted for by carbon?

c. Which element contributes least to the molar mass?

41. Complete the list ionic compounds (name or formula)

a. Cupric Hydroxide

\_\_\_\_\_

b. Strontium Chromate

\_\_\_\_\_

c. Ammonium Per chlorate

\_\_\_\_\_

d.  $\text{NaHCO}_3$

\_\_\_\_\_

e.  $\text{Fe}_2(\text{CO}_3)_3$

\_\_\_\_\_

f. Sodium Hydroxide

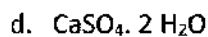
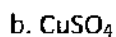
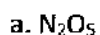
\_\_\_\_\_

g. Potassium Chloride

\_\_\_\_\_

42. The hormone, thyroxine is secreted by the thyroid gland, and has the formula:  $\text{C}_{15}\text{H}_{17}\text{NO}_4\text{I}_4$ . How many milligrams of Iodine can be extracted from 15.0 Grams of thyroxine?

43. Determine the **formula weight** for the following:



44. Calculate the percentage by mass of OXYGEN in the following compounds:

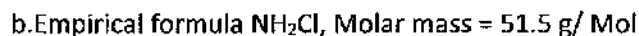
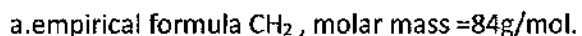


45. Arsenic reacts with chlorine to form a chloride. If 1.587 g of arsenic reacts with 3.755 g of chlorine, what is the simplest formula of the chloride?

46. Vanillin, a flavoring agent, is made up of carbon, hydrogen, and Oxygen atoms. When a sample of Vanillin weighing 2.500g burns in Oxygen, 5.79 g of carbon dioxide and 1.18 g of water are obtained. What is the empirical formula of Vanillin?

47. Washing soda is a hydrate of sodium carbonate. Its formula is  $\text{Na}_2\text{CO}_3 \cdot x \text{H}_2\text{O}$ . A 2.714 g Sample of washing soda is heated until a constant mass of 1.006 g of  $\text{Na}_2\text{CO}_3$  is reached. What is x?

48. What is the molecular formula of each of the following compounds?



49. Determine the empirical and molecular formula of each of the following substances:

- a. Ibuprofen, a headache remedy contains 75.6 % C, 8.80 % H, and 15.5 % O by mass and has a molar mass about 206 g/mol.
- b. Epinephrine (adrenaline) a hormone secreted into the bloodstream in times of danger or stress contains 59% C, 7.1% H, 26.2% O, and 7.7% N by mass, its MW is about 180 amu.

50. Write balanced chemical equations for the reactions of sodium with the following nonmetals to form ionic solids.

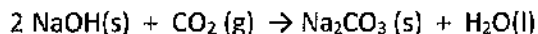
- a. Nitrogen
- b. Oxygen
- c. Sulfur
- d. Bromine

51. Write a balanced equation for the following (include states):

- a. The rxn of boron trifluoride gas with water to give liquid hydrogen fluoride and solid boric acid, ( $\text{H}_3\text{BO}_3$ ).
- b. The reaction of magnesium Oxide with Iron to form Iron (III) Oxide and Magnesium.
- c. The decomposition of dinitrogen Oxide gas to its elements.
- d. The reaction of Calcium Carbide solid with water to form calcium hydroxide and acetylene ( $\text{C}_2\text{H}_2$ ) gas.
- e. The rxn of solid calcium cyan amide ( $\text{CaCN}_2$ ) with water to form calcium carbonate and ammonia gas.

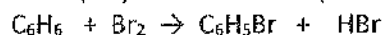
- f. Ethane burns in air (Oxygen).
- g. Hydrogen reacts with oxygen to form Water.
- h. Nitrogen gas reacts with Hydrogen to form Ammonia.
- i. Hydrogen reacts with Iodine gas to form Hydrogen Iodide.
- j. Sodium reacts with Iodine gas to form Sodium Iodide.
- k. Sodium Oxide reacts with water to form sodium hydroxide and hydrogen.
- l. Carbon dioxide combines with water to form carbonic acid.
- m. Magnesium and nitrogen gas combine to form magnesium nitride.
- n. Conc. Hydrochloric acid reacts with Conc. Sodium hydroxide to form sodium chloride and water.

52. Sodium hydroxide reacts with carbon dioxide as follows:



Which reagent is the limiting reactant when 1.85 mol of sodium hydroxide and 1.00 mol carbon dioxide are allowed to react? How many moles of sodium carbonate can be produced? How many moles of the excess reactant remain after the completion of the reaction?

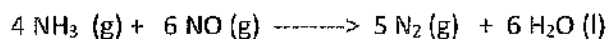
53. WHEN benzene ( $C_6H_6$ ) reacts with bromine ( $Br_2$ ) bromobenzene( $C_6H_5Br$ ) is obtained:



a. What is the theoretical yield of bromobenzene in this reaction when 30.0g of benzene reacts with 65.0 g of bromine?

c. If the actual yield of bromobenzene was 56.7 g what was the percentage yield?

54. One way to remove Nitrogen Oxide (NO) from smokestack emissions is to react it with ammonia:



a. 12.3 mol of NO reacts with \_\_\_\_\_ mol of ammonia.

b. 5.87 mol NO yields \_\_\_\_\_ mol nitrogen.

55. To prevent a condition called the "bends", deep sea divers breathe a mixture containing, in mole percent, 10.0%  $O_2$ , 10.0%  $N_2$ , and 80.0% He.

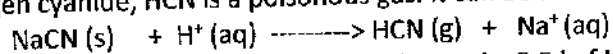
a. Calculate the molar mass of this mixture.

b. What is the ratio of the density of this gas to that of pure Oxygen?

56. A 2.0g sample of  $SX_6$  (g) has a volume of  $329.5 \text{ cm}^3$  at 1.00 atm and  $20^\circ\text{C}$ . Identify the element 'X'. Name the compound.

57. When Hydrogen sulfide gas,  $\text{H}_2\text{S}$ , reacts with oxygen, Sulfur dioxide gas and steam are produced.
- Write the balanced chemical equation for this reaction.
  - How many liters of sulfur dioxide would be produced from 4.0 l of Oxygen? Assume 100% yield and that all gases are measured at the same temperature and pressure.

58. Hydrogen cyanide, HCN is a poisonous gas. It can be formed by the reaction:



What mass of sodium cyanide is required to make 8.5 l of Hydrogen Cynaide at  $22^\circ\text{C}$  and 751 mm Hg?

59. A gaseous mixture contains 5.78 g of methane, 2.15 g of neon, and 6.8 g of sulfur dioxide. What pressure is exerted by the mixture inside a 75.0 L cylinder at  $85^\circ\text{C}$  and 751 mm Hg?

60. A sample of Methane gas is at  $50^\circ\text{C}$  and 20 atm. Would you expect it to behave more ideally or less ideally if:
- The pressure was reduced to 1 atm.
  - The temperature were reduced to  $-50^\circ\text{C}$ ?

61. Define solubility. Familiarize yourself with the solubility rules. Especially the rule and exceptions for halogens.

62. Name the following:

- $\text{CO}_2$  \_\_\_\_\_
- $\text{P}_4\text{S}_{10}$  \_\_\_\_\_
- $\text{NI}_3$  \_\_\_\_\_
- $\text{PCl}_5$  \_\_\_\_\_
- $\text{CCl}_4$  \_\_\_\_\_
- $\text{SF}_6$  \_\_\_\_\_

g.  $\text{CH}_4$  \_\_\_\_\_

h.  $\text{C}_2\text{H}_6$  \_\_\_\_\_

i.  $\text{C}_3\text{H}_8$  \_\_\_\_\_

63. Which of the following statements are always true? Never true? Not always true?

a. A compound with the molecular formula  $\text{C}_6\text{H}_6$  has the same simplest formula.

b. The mass percent of copper in  $\text{CuO}$  is less than in  $\text{Cu}_2\text{O}$ .

c. The limiting reactant is the one present in the smallest number of grams.

d. Since  $\text{C}_3\text{H}_6\text{O}_3$  and  $\text{C}_6\text{H}_{12}\text{O}_6$  reduce to the same formula, they represent the same compound.

64. A bedroom 11 ft x 12 ft x 8.0 ft contains 35.41 kg of air at  $25^\circ\text{C}$ . Express the volume of the room in liters, the amount of air in moles (molar mass of air is 29.0 g/mol) and the temperature in Kelvin.

65. A sample of carbon dioxide gas,  $\text{CO}_2$  (g), occupies a volume of 5.75 L at 0.890 atm. If the temperature and the number of moles remain constant, calculate the volume when the pressure

a. increased to 1.25 atm

b. decrease to 0.350 atm

66. A nitrogen sample at  $30^\circ\text{C}$  has a volume of 1.75 L. If the pressure and the amount of gas remain unchanged, determine the volume when the Celsius temperature is doubled.

67. An open flask contains 0.200 mol of air. Atmospheric pressure is 745 mmHg and room temperature is  $68^\circ\text{F}$ . How many moles are present in the flask when the pressure is 1.10 atm and the temperature is  $33^\circ\text{C}$ ?

68. On a warm day, an amusement park balloon is filled with 47.8 g He. The temperature is  $33^\circ\text{C}$  and the pressure in the balloon is 2.25 atm. Calculate the volume of the balloon.

69. A drum use to transport crude oil has a volume of 162 L. How many water molecules, as steam, are required to fill the drum at 1.00 atm and 100°C? What volume of liquid water (density of water is 1.0 g/cm<sup>3</sup>) is required to produce that amount of steam?
70. Calculate the densities of the following gases at 27°C and 763 mmHg
- a. Carbon monoxide
  - b. Chlorine
71. What is it the difference between a strong electrolyte and a weak electrolyte?
72. What is an **Activity series** of metal? How does it help us in studying properties of elements?
73. A volatile liquid (one that evaporates) is put into a jar and the jar is then sealed. Does the mass of the sealed jar and its contents change upon the vaporization of the liquid? Explain.
74. Define the terms: Exothermic, endothermic reactions?

75. DDT, an insecticide harmful to fish, birds, and humans, is produced by the following reaction:



If 1142 g of chlorobenzene is reacted with 485 g of chloral.

- What mass of DDT is formed?
- Which reactant is limiting? Which is in excess?
- What mass of excess reactant is left over?
- If the actual yield of DDT is 200.0 g, what is the percent yield?

76. A 2.25 g sample of scandium metal is reacted with excess hydrochloric acid to produce 0.1502 g hydrogen gas. What is the formula of the scandium chloride produced in the reaction?

77. Differentiate between what happens when the following are dissolved in water.

- Polar solute Vs non polar solute.
- KF Vs  $\text{CO}_2$
- RbCl vs AgCl

**AP CHEMISTRY (Common mono, di & polyatomic ions.)**

Ion Name	Ion Symbol
a) Sodium	
b) Potassium	
c) Cesium	
d) Beryllium	
e) Calcium	
f) Strontium	
g) Barium	
h) Gallium	
i) Aluminum	
j) Nitrogen	
k) Arsenic	
l) Bismuth	

m) Oxygen
n) Fluorine
o) Chlorine
p) Bromine
q) Iodine

#### Common ions of transition elements

Ion Name	Ion
a) Chromium(III)	
b) Manganese(II)	
c) Iron(II) or Ferrous	
d) Iron(III) or Ferric	
e) Cobalt(II)	
f) Nickel(II) or nickel	
g) Copper(II) or Cupric	
h) Zinc	
i) Silver	
j) Cadmium	
k) Mercury(II) or mercuric	

#### Common Polyatomic Ions

Name	Formula	Name	Formula
a) Acetate		b) Ammonium	
c) Carbonate		d) Chlorate	
e) Chlorite		f) Chromate	
g) Cyanide		h) Dichromate	
i) Dihydrogen Phosphate		j) Dihydrogen Phosphate	
k) Hydrogen Carbonate		l) Hydrogen Sulfate	
m) Hydrogen Sulfite		n) Hypochlorite	
o) Hydroxide		p) Nitrate	
q) Nitrite		r) Oxalate	
s) Perchlorate		t) Permanganate	
u) Peroxide		v) Phosphate	
w) Sulfate		x) Sulfite	
y) Thiosulfate		z) Phosphite	

Common Acids	Formula	Common Acids	Formula
Hydrochloric Acid		Phosphoric acid	
Carbonic acid		Sulfurous Acid	
Nitrous acid		Sulfuric Acid	
Nitric Acid		Hypochlorous Acid	
Chlorous Acid		Chloric Acid	