

## AP Chemistry Summer Assignment

Future AP Chemistry Student,

Welcome to AP Chemistry. I am eagerly anticipating a great year of Chemistry. In order to ensure the best start for everyone next fall, I have prepared a **summer assignment** that reviews **basic chemistry concepts**. There is a multitude of tremendous chemistry resources available via the Internet. With the ready access to hundreds of websites either in your home or at the local library, I am confident that you will have sufficient resources to prepare adequately for the fall semester. The reference text book as part of AP course is “Chemistry” by Zumdahl/Zumdahl.

Much of the material in this summer packet will be familiar to you. It will be important for everyone to come to class **the first day** prepared. While I review, extensive remediation is not an option as we work towards our goal of being 100% prepared for the AP Exam in **early May**. There will be a test covering the basic concepts included in the summer packet during the **first or second week** of school.

You may contact me by email: ([stewaC01@wsdmi.org](mailto:stewaC01@wsdmi.org)) this summer. I will do my best to answer your questions **ASAP**.

I hope you are looking forward to an **exciting year** of chemistry. You are all certainly **fine** students, and with **plenty** of motivation and hard work you should find AP Chemistry a successful and rewarding experience.

Finally, I recommend that you spread out the summer assignment. Please do not try to complete it all in the final week of the summer. Chemistry takes time to **process** and **grasp** at a level necessary for success in AP Chemistry. Remember, AP Chemistry is an **equivalent course to Introductory Chemistry** in college. Taking a college level course **in high school is difficult, requires dedication**, and is a **great investment** in your education so prepare yourself and arrive ready to learn.

Important information:

- The **course grade** will mainly depend on your **performance on tests**. **Do not** expect **any grade curves**. You will be **given opportunities** which you **must** strive to perform well and **achieve** the **desired** grade.
- Over the summer, purchase a **Barron’s AP Chemistry** book (this will be an important resource during the semester).
- For the first day of school, you need to get a **spiral-bound graphing** notebook (available at Staples) and a **3-ring binder**.

Have a **great summer** and **enjoy** the chemistry.

Mr. Stewart

**The following assignment is to be completed on lined paper and submitted on the first day of school. YOU MUST SHOW WORK FOR ALL PROBLEMS.** Questions cover topics from general chemistry to basic Mole concepts. Certain topics will be reviewed during regular school year.

- Write the **most common guidelines** to determine significant figures (digits) with an example?
- Use **conversion factors** to convert the following:
  - 515 m = \_\_\_ miles.
  - 200 in = \_\_\_ meters
  - 325 days = \_\_\_\_\_ seconds.
  - 20 gallons = \_\_\_\_\_ ml
- Classify each of the following as units of mass, volume, length, density, energy, or pressure.  
a. mg      b. mL      c. cm<sup>3</sup>      d. mm      e. kg/m<sup>3</sup>      f. kJ      g. atm      h. cal.
- Some laboratory experiments are performed at 55°C. Express this temperature in:
  - K
- A cylinder rod formed from silicon is 21.3 cm long and has a mass of 5.00 kg. The density of silicon is 2.33 g/cm<sup>3</sup>. What is the diameter of the cylinder? (the volume of cylinder is given by  $\pi r^2 h$ , where r is the radius and h is the length)
- How many **significant figures** are in each of the following?
  - 1.92 mm
  - 0.030100 kJ
  - $6.022 \times 10^{23}$  atoms
  - 460.00 L
  - 0.00036 cm<sup>3</sup>
  - 100
  - 1001
  - 0.001
  - 0.0101
- Record the following in correct **scientific notation**:
  - 350,000,000 cal
  - 0.0000721 mol
  - 0.0000000809 Å
  - 765,400,000,000 atoms
- Calculate the following to the **correct number** of significant figures.
  - $1.27 \text{ g} / 5.296 \text{ cm}^3$
  - $12.235 \text{ g} / 1.01 \text{ L}$
  - $12.2 \text{ g} + 0.38 \text{ g}$
  - $17.3 \text{ g} + 2.785 \text{ g}$
  - $2.1 \times 3.21$
  - $200.1 \times 120$
  - $17.6 + 2.838 + 2.3 + 110.77$
- Give the **chemical symbols** for the following elements:
  - Carbon
  - sulfur
  - Titanium
  - Nitrogen
  - Helium
  - Krypton
  - Fluorine
  - Scandium
  - Arsenic
- Write the name for each of the elements symbols:
  - Na
  - Au
  - Ag
  - Sn
  - Fe
  - Hg
  - K

11. Label each of the following as either a **physical process** or a **chemical process**.
- corrosion of aluminum metal.
  - Melting of ice.
  - Pulverizing an aspirin.
  - Digesting a candy bar.
  - Explosion of nitroglycerin.
  - Milk turning sour.
  - Burning of paper.
  - Forming of frost on a cold night.
  - Bleaching of hair with hydrogen peroxide.
  - A copper wire is hammered flat.
12. Calculate the mass of O<sub>2</sub> produced if 3.450 g potassium chlorate is completely decomposed by heating in presence of a catalyst ( Manganese dioxide). KCl is also produced. **IMPORTANT**
13. Write the formula of the following compounds? (Use **criss- cross** method)  
**IMPORTANT**
- Calcium sulfate.
  - Ammonium Phosphate
  - Lithium Nitrite
  - potassium perchlorate.
  - Barium Oxide
  - Zinc sulfide.
  - Sodium Perbromate
  - Calcium Iodide
  - Aluminum Carbonate.
14. Convert **6.75 atm** to: (Using **factor-labeling** method)
- mm Hg
  - kilopascals
15. Define the words: **atomic number, atomic mass, mass number, molecular formula, structural formula, empirical formula, isotopes, cation, anion, and metalloid.**
16. Determine **number of protons and neutrons** in each of the following.
- K<sub>19</sub><sup>39</sup>
  - <sup>23</sup><sub>11</sub>Na.
  - <sup>208</sup><sub>82</sub>Pb
  - <sup>33</sup><sub>15</sub>P
17. 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?
18. What is the empirical formula of a compound that contains 53.73% Fe and 46.27% of S ?
19. Determine the number of molecules present in 4.56 mol of nitrogen (N<sub>2</sub>).
20. List the following as diatomic molecule, molecular compound, ionic compound or element.
- F<sub>2</sub>
  - Cl<sub>2</sub>
  - C
  - NaCl
  - KF
  - CO<sub>2</sub>
  - H<sub>2</sub>
  - Ag
  - Rust (Fe<sub>2</sub>O<sub>3</sub>)
  - MgO
  - O<sub>2</sub>
  - I<sub>2</sub>
  - CO
  - K<sub>2</sub>CO<sub>3</sub>
21. State the contribution of the following chemist in one line.
- Democritus
  - Mendeleev
  - J.J Thompson
  - Millikan

22. What is the difference between a. Chlorine and Chloride? b. Sodium atom and sodium ion. IMPORTANT
23. How many grams of methane (CH<sub>4</sub>) are present in 5.6 moles of methane gas? ( USE factor labeling method)
24. Calculate the **mass in grams** of each of the following: IMPORTANT
- $6.02 \times 10^{23}$  atoms of Mg.
  - $3.01 \times 10^{23}$  Formula units of CaCl<sub>2</sub>.
  - $12.4 \times 10^{15}$  atoms of neon.
25. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:
- Mass of crucible, cover, and contents before heating 23.4 g.
  - mass of empty crucible and cover 18.82 g.
  - mass of crucible, cover, and contents after heating to constant mass 20.94 g.
- Calculate the experimental percent of water in the compound.
26. How do you distinguish:
- An element from a compound.
  - An element from a mixture.
  - A true solution from a heterogeneous mixture.
27. An **extensive property** is one that depends on the amount of the sample. Which of the following properties are extensive?
- a. volume b. density c. temperature d. energy e. melting point. F. pressure
28. Name the types of **general inorganic reactions** with example of each?
29. Define Acid, base and salt? Give some examples of each.
30. What mass of copper is required to replace silver from 4.00g of silver nitrate dissolved in water? IMPORTANT
- $$\text{Cu(s)} + \text{AgNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{Ag.}$$
31. Write the chemical formulas for the following compounds:
- Calcium Carbonate
  - Ammonium Phosphate
  - Sodium Chloride
  - Sodium Oxide
  - Calcium Sulfate
  - Sodium Nitrite
  - Magnesium Acetate
  - Potassium cyanide
  - Zinc(II) Nitrate
  - Iron(III) Phosphate
  - Nickel (II) Fluoride
32. 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 ?
33. 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?
34. Mercury has an atomic mass of 200.59 amu. Calculate the
- Mass of  $3.0 \times 10^{10}$  atoms.
  - Number of atoms in one nanogram of Mercury.
35. Calculate the molar masses ( g/ mol) of
- Ammonia ( NH<sub>3</sub>)
  - Baking soda ( NaHCO<sub>3</sub>)
  - Osmium Metal (Os)

36. Convert the following to moles
- 3.86 grams of Carbon dioxide.
  - $6.0 \times 10^5$ g of Hydrazine ( $\text{N}_2\text{H}_4$ ), a rocket propellant.
37. The molecular formula of morphine, a pain-killing narcotic, is  $\text{C}_{17}\text{H}_{19}\text{NO}_3$ .
- What is the molar mass?
  - What fraction of atoms in morphine is accounted for by carbon?
  - Which element contributes least to the molar mass?
38. Complete the list of ionic compounds ( name or formula)
- Cupric Hydroxide
  - Strontium Chromate
  - Ammonium Perchlorate
  - $\text{NaHCO}_3$
  - $\text{Fe}_2(\text{CO}_3)_3$
  - Sodium Hydroxide.
  - Potassium Chloride.
39. 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? IMPORTANT
40. Determine the **molar mass** for the following:
- $\text{N}_2\text{O}_5$
  - $\text{CuSO}_4$
  - $\text{Ca}(\text{HCO}_3)_2$
  - $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$
41. Calculate the percentage by mass of the following compounds: IMPORTANT
- $\text{SO}_3$
  - $\text{CH}_3\text{COOCH}_3$
  - Ammonium Nitrate.
42. Determine the empirical formula of the compounds with the following compositions by mass:
- 10.4 % C, 27.8% S , 61.7 % Cl
  - 21.7 % C, 9.6 % O, and 68.7 % F
43. 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?
44. 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?
45. What is the molecular formula of each of the following compounds?
- empirical formula  $\text{CH}_2$  , molar mass =84g/mol.
  - Empirical formula  $\text{NH}_2\text{Cl}$ , Molar mass = 51.5 g/ Mol

46. Determine the empirical and molecular formula of each of the following substances:
- 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.
  - 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.
47. Write balanced chemical equations for the reactions of **sodium** with the following nonmetals to form ionic solids.
- Nitrogen
  - Oxygen
  - Sulfur
  - Bromine
48. Write a **balanced equation** for the following: **IMPORTANT**
- Reaction of boron trifluoride gas with water to give liquid hydrogen fluoride and solid boric acid, (H<sub>3</sub>BO<sub>3</sub>).
  - Reaction of magnesium oxide with Iron to form Iron (III) Oxide and Magnesium.
  - The decomposition of dinitrogen oxide gas to its elements.
  - The reaction of calcium carbide solid with water to form calcium hydroxide and acetylene (C<sub>2</sub>H<sub>2</sub>) gas.
  - The reaction of solid calcium cyan amide (CaCN<sub>2</sub>) with water to form calcium carbonate and ammonia gas.
  - Ethane burns in air (Oxygen).
  - Hydrogen reacts with oxygen to form Water.
  - Nitrogen gas reacts with Hydrogen to form Ammonia.
  - Hydrogen reacts with Iodine gas to form Hydrogen Iodide.
  - Sodium reacts with Iodine gas to form Sodium Iodide.
  - Sodium Oxide reacts with water to form sodium hydroxide and hydrogen.
  - Carbon dioxide combines with water to form carbonic acid.
  - Magnesium and nitrogen gas combine to form magnesium nitride.
  - Conc. Hydrochloric acid reacts with Conc. Sodium hydroxide to form sodium chloride and water.

49. DEFINE limiting reagent, theoretical yield, and actual yield? **IMPORTANT**

50. 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?

51. WHEN benzene (C<sub>6</sub>H<sub>6</sub>) reacts with bromine (Br<sub>2</sub>) bromobenzene (C<sub>6</sub>H<sub>5</sub>Br) is obtained:



- What is the theoretical yield of bromobenzene in this reaction when 30.0g of benzene reacts with 65.0 g of bromine?
- If the actual yield of bromobenzene was 56.7 g what was the percentage yield?

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

$$4 \text{NH}_3 (\text{g}) + 6 \text{NO} (\text{g}) \longrightarrow 5 \text{N}_2 (\text{g}) + 6 \text{H}_2\text{O} (\text{l})$$

Fill in the blanks below:

- a. 12.3 mol of NO reacts with \_\_\_\_\_ mol of ammonia.
  - b. 5.87 mol NO yields \_\_\_\_\_ mol nitrogen.
53. Chlorine and Fluorine react to form gaseous chlorine trifluoride. You start with 1.75 mol of chlorine and 3.68 mol of fluorine.
- a. Write the balanced equation for the reaction.
  - b. What is the limiting reactant?
54. To prevent a condition called the “bends”, deep sea divers breathe a mixture containing, in mole percent, 10.0% O<sub>2</sub>, 10.0% N<sub>2</sub>, 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?
55. When Hydrogen sulfide gas, H<sub>2</sub>S, reacts with oxygen, Sulfur dioxide gas and steam are produced.
- a. Write the balanced chemical equation for this reaction.
  - b. 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.
56. Which of the following statements are always true? Never true? Not always true?
- a. A compound with the molecular formula C<sub>6</sub>H<sub>6</sub> has the same simplest formula.
  - b. The mass percent of copper in CuO is less than in Cu<sub>2</sub>O.
  - c. The limiting reactant is the one present in the smallest number of grams.
  - d. Since C<sub>3</sub>H<sub>6</sub>O<sub>3</sub> and C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> reduce to the same formula, they represent the same compound.
57. A sample of carbon dioxide gas, CO<sub>2</sub> (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 IMPORTANT
- a. increased to 1.25 atm
  - b. decrease to 0.350 atm
58. A nitrogen sample at 30°C has a volume of 1.75L. If the pressure and the amount of gas remain unchanged, determine the volume when:
- a. The Celsius temperature is doubled
59. On a warm day, an amusement park balloon is filled with 47.8 g He. The temperature is 33°C and the pressure in the balloon is 2.25 atm. Calculate the volume of the balloon. IMPORTANT
64. Define the terms: Exothermic, endothermic reactions?

65. What is a solute and solvent? Define Molarity, Molality. IMPORTANT
66. Calculate the molarity of a solution that contains 0.0345 mol  $\text{NH}_4\text{Cl}$  in exactly 400 ml of solution?
67. Calculate the molarity of a solution that contains 20.0 grams of sodium hydroxide in 200ml? IMPORTANT
68. How many grams of solute are present in 50.0 ml of 0.360 M sodium chloride?
69. The compound adrenaline contains 56.7 % C, 6.56 % H, 28.37% O and 8.28 % N by mass. What is the empirical formula for adrenaline?
70. 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.

- a. What mass of DDT is formed?
  - b. Which reactant is limiting? Which is in excess?
  - c. What mass of excess reactant is left over?
  - d. If the actual yield of DDT is 200.0 g, what is the percent yield?
- 71.) Calculate the pH of a solution that has a  $[\text{H}^+]$  of  $3.22 \times 10^{-3} \text{ M}$ .
- 72.) What is the pH of a solution that has a  $[\text{OH}^-]$  of  $5.57 \times 10^{-8} \text{ M}$ ?
- 73.) The pH of solution is 5.33. What is the hydronium ion concentration?

# Write formulas for the following

(next page)

**You MUST know the charges of the monatomic cations and anions.**

**You Must know the charges of the polyatomic ions. (use your Chemistry-R charge sheet).**

## Common monoatomic ions

I) Name ( Ion)

Symbol( Ion)

- 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 |
|-------------------------|---------|
| a) Acetate              |         |
| c) Carbonate            |         |
| e) Chlorite             |         |
| g) Cyanide              |         |
| i) Dihydrogen Phosphate |         |
| k) Hydrogen Carbonate   |         |
| m) Hydrogen Sulfite     |         |
| o) Hydroxide            |         |
| q) Nitrite              |         |

- | Name                    | Formula |
|-------------------------|---------|
| b) Ammonium             |         |
| d) Chlorate             |         |
| f) Chromate             |         |
| h) Dichromate           |         |
| j) Dihydrogen Phosphate |         |
| l) Hydrogen Sulfate     |         |
| n) Hypochlorite         |         |
| p) Nitrate              |         |
| r) Oxalate              |         |

- s) Perchlorate
- u) Peroxide
- w) Sulfate
- y) Thiosulfate

- t) Permanganate
- v) Phosphate
- x) Sulfite

Common Acids

Hydrochloric Acid  
 Carbonic acid  
 Nitrous acid  
 Nitric Acid  
 Chlorous Acid

Formula

Common Acids

Phosphoric acid  
 Sulfurous Acid  
 Sulfuric Acid  
 Hypochlorous Acid  
 Chloric Acid

Formula

Perchloric acid