# AP Chemistry Summer Assignment 2020

Welcome to AP Chemistry! This course covers a lot of challenging concepts at a fast pace. We will be getting started right away and will not spend much time reviewing concepts you already know. This assignment is meant to be a *review*. If this assignment is very challenging for you and you do not feel like you have learned a majority of the concepts, then this course may not be for you. I am assuming that you have learned these skills and feel confident solving these types of problems. We will spend the first few weeks of the year going into some of the assigned chapters in more depth, so if you have some questions while you are doing the summer assignment, you will have a chance to ask. Your textbook is a great resource to utilize when you have a question about a concept. Looking forward to a wonderful year!

## Textbook

Chemistry (AP Edition), 9th or 10th Edition          *Make sure you get the AP Edition!*

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## Objectives

1. To review basic concepts you learned when you took Honors Chemistry
2. To practice math skills which you will need for AP Chemistry
3. To hit the ground running when we return in the fall

## Assignment Details

1. Purchase the textbook (*make sure it is the AP Edition!)*
2. Read Unit 1 Syllabus
3. Read and review chapters 1 - 4 (Unit 1)
   a. Time Management - *DO ONE CHAPTER A WEEK*
4. Complete **flashcards** for chapters 1 - 4; see unit 1 syllabus for key terms
5. Complete **AP multiple choice** for chapters 1 - 4; found at the end of each chapter in the textbook. Outlined in the unit 1 syllabus.
6. Complete the *AP Chemistry Summer Assignment Worksheet*
   a. Includes a *math* assignment - 23 questions
   b. Includes a *chemistry* assignment - 56 questions
7. The summer assignment worksheet will be collected on the **first** day of school.
8. Review and begin to memorize *AP Chemistry Memorization Assignment*
9. *DO NOT* leave all of this to the last minute - this will take a while to complete

**AP Chemistry Summer Math Assignment**

Supply the answers in the blanks. **No calculators please! The multiple choice section of the AP exam does not allow calculators and you need the practice doing mental math without one.**

1. $1.62 \times 10^6 + 1.9 \times 10^5 = $ _____

2. $1.62 \times 10^6 - 1.9 \times 10^5 = $ _____

3. $3.72 \times 10^{-8} + 0.211 \times 10^{-7} = $ _____

4. $3.72 \times 10^{-8} - 0.211 \times 10^{-7} = $ _____

5. $(2.3 \times 10^4)(3.1 \times 10^4) = $ _____

6. square root of $9.0 \times 10^{-8} = $ _____

7. cube root of $8.0 \times 10^{-9} = $ _____

8. approximate square root of $3.2 = $ _____

9. $\dfrac{(2.6x10^{-8})}{(0.52x10^{-9})} = $ _____

10. $10^x = 2$ and $\log 2 = 0.30$;  $x = $ _____

11. $x = $ _____ if $x^2/0.10 = 4.0 \times 10^{-9}$

12. $x = $ _____ if $xy = 16$ and $y^2 = 225$

13. $\dfrac{(2.4x10^{-8})(0.25x10^{-2})}{(1.5x10^{-4})} = $

14. $\log (1.0 \times 10^4) = $ _____

15. $\log (1.0 \times 10^{-4})$ _____

16. log $(2.3 \times 10^{-5})$ = _____

17. approximate value of x if $(x + 0.1)(x) = 2.0 \times 10^{-8}$

18. $x + y = 3$ and $x - y = 9$; $x =$ _____

19. $(0.001)(0.001) =$ _____

20. $3.42/342 =$ _____

21. If a megabuck is one million dollars and a kilobuck is one thousand dollars, how many kilobucks is 342 dollars?

22. A ten cm candle is being burned at both ends. One end burns at the rate of one cm per hour; the other end burns at one-half cm per hour. How far from the center of the candle will the burning ends meet?

23. A wooden cube three cm on edge is placed inside a cube box that is six cm on edge. How much free space is in the box?

**Complete the following list of chemistry problems. They cover concepts you learned in first year chemistry. If you get stuck, feel free to read through the appropriate section of your textbook. Show all work on this copy.**

1. Give an example of a homogeneous mixture and a heterogeneous mixture.

2. Do the following statements describe chemical or physical properties?
   a. Oxygen gas supports combustion.

   b. Fertilizers help to increase agricultural production.

   c. Water boils below $100^{o}C$ on top of a mountain.

   d. Lead is denser than aluminum.

   e. Uranium is a radioactive element.

3. Does each of the following describe a physical change or a chemical change?
   a. The helium gas inside a balloon tends to leak out after a few hours.

   b. A flashlight beam slowly gets dimmer and finally goes out.

   c. Frozen orange juice is reconstituted by adding water to it.

   d. The growth of plants depends on the sun's energy in a process called photosynthesis.

   e. A spoonful of table salt dissolves in a bowl of soup.

4. Give the names of the elements represented by the chemical symbols:
   a. Li
   b. F
   c. P
   d. Cu
   e. As
   f. Zn
   g. Cl
   h. Pt
   i. Mg
   j. U
   k. Al
   l. Si
   m. Ne

5. Give the chemical symbols for the following elements:
   a. potassium

   b. tin

   c. chromium

   d. boron

   e. barium

   f. plutonium

   g. sulfur

   h. argon

   i. mercury

6. Classify each of the following substances as an element or compound:
   a. hydrogen

   b. water

   c. gold

   d. sugar

7. Classify each of the following as an element, compound, homogeneous mixture, or heterogeneous mixture:
   a. seawater

   b. helium gas

   c. sodium chloride (table salt)

   d. a bottle of soft drink

   e. milk shake
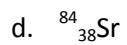
   f. air in a bottle

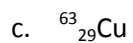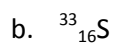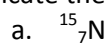   g. concrete

8. Name the SI base units that are important in chemistry.  Give the SI units for expressing the following:
   a. length

   b. volume

   c. mass

   d. time

   e. energy

   f. temperature

9. Write the numbers represented by the following prefixes:
   a. mega

   b. kilo

   c. deci

   d. centi

   e. milli

   f. micro

   g. nano

   h. pico

10. What units do chemists usually use for liquids and solids?  For gas density?  Explain the differences.

11. Bromine is a reddish-brown liquid.  Calculate the density of bromine (in g/mL) if 586 g of the substance occupies 188 mL.

12. a. Normally the human body can endure a temperature of 105°F for only short periods of time without permanent damage to the brain or other vital organs. What is this temperature in °C?

b. Ethylene glycol is a liquid organic compound that is used as an antifreeze in car radiators. It freezes at -11.5°C. Calculate the freezing point temperature in degrees Fahrenheit.

c. The temperature on the surface of the sun is about 6300°C. What is this temperature in degrees Fahrenheit?

d. The ignition temperature of paper is 451°F. What is the temperature in degrees Celsius?

13. Convert the following temperatures to Kelvin:
   a. 113°C, the melting point of sulfur

   b. 37°C, the normal body temperature

   c. 357°C, the boiling point of mercury

14. Convert the following temperature to degrees Celsius:
   a. 77 K, the boiling point of liquid nitrogen

   b. 4.2 K, the boiling point of liquid helium

   c. 601 K, the melting point of lead

15. What is the number of significant figures in each of the following measurements?
   a. 4867 mi
   b. 56 mL
   c. 60,104 ton
   d. 2900 g
   e. 40.2 g/cm$^3$

16. Carry out the following calculations as if they were calculations of experimental results, and express each answer in the correct units with the correct number of significant figures.
    a. 5.6792 m + 0.6 m + 4.33 m

    b. 3.70 g – 2.9133 g

    c. 4.51 cm x 3.6666 cm

17. Carry out the following conversions (you must use conversion factors):
    a. 22.6 m to dm

    b. 25.4 mg to kg

    c. 556 mL to L

    d. 10.6 kg/m$^3$ to g/cm$^3$

18. The average speed of helium at 25$^O$C is 1255 m/s.  Convert this speed to miles per hour (mph) using conversion factors.

19. Describe the contributions of the following scientists to our knowledge of atomic structure:
    a. JJ Thomson

    b. RA Millikan

    c. Ernest Rutherford

    d. James Chadwick

20. Describe the experimental basis for believing that the nucleus occupies a very small fraction of the volume of the atom.

21. Indicate the number of protons, neutrons, and electrons in each of the following species:
   a. $^{15}_{7}N$

   b. $^{33}_{16}S$

   c. $^{63}_{29}Cu$

   d. $^{84}_{38}Sr$

   e. $^{130}_{56}Ba$

   f. $^{186}_{74}W$

   g. $^{202}_{80}Hg$
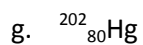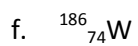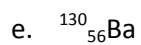
22. Define, with two examples, the following terms:
   a. alkali metals

   b. alkaline earth metals

   c. halogens

   d. noble gases

23. Elements whose name ends with –ium are usually metals. Sodium is one example. Identify a nonmetal whose name ends with –ium.

24. Explain why the chemical formula HCl can represent two different chemical systems.

25. Name the following compounds:
   a. $KClO$

   b. $Ag_2CO_3$

   c. $HNO_2$

   d. $KMnO_4$

   e. $CsClO_3$

   f. $KNH_4SO_4$

   g. $FeO$

   h. $Fe_2O_3$

   i. $TiCl_4$

   j. $NaH$

   k. $Li_3N$

   l. $Na_2O$

   m. $Na_2O_2$


26. Write the formulas for the following compounds:
   a. rubidium nitrite

   b. potassium sulfide

   c. sodium hydrogen sulfide

   d. magnesium phosphate

   e. calcium hydrogen phosphate

   f. potassium dihydrogen phosphate

   g. iodine heptafluoride

   h. ammonium sulfate

   i. silver perchlorate

   j. boron trichloride

27. Write the formulas for the following compounds:
    a. copper (I) cyanide

    b. strontium chlorite

    c. perbromic acid

    d. hydroiodic acid

    e. disodium ammonium phosphate

    f. lead (II) carbonate

    g. tin (II) fluoride

    h. tetraphosphorous decasulfide

    i. mercury (II) oxide

    j. mercury (I) iodide

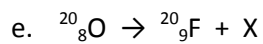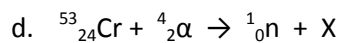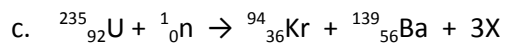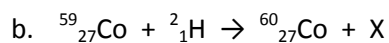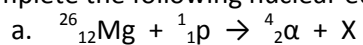    k. selenium hexafluoride


28. Write the formula of the common ion derived from each of the following:
    a. Li

    b. S

    c. I

    d. N

    e. Al

    f. Cs

    g. Mg
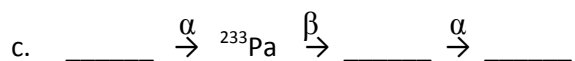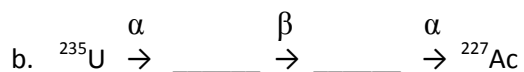
29. Fill in the blanks in the following table:

| Cation | Anion | Formula | Name |
|---|---|---|---|
|  |  |  | Magnesium bicarbonate |
|  |  | $SrCl_2$ |  |
| $Fe^{3+}$ | $NO_2^-$ |  |  |
|  |  |  | Manganese (II) chlorate |
|  |  | $SnBr_4$ |  |
| $Co^{2+}$ | $PO_4^{3-}$ |  |  |
| $Hg_2^{2+}$ | $I^-$ |  |  |
|  |  | $Cu_2CO_3$ |  |
|  |  |  | Lithium nitride |
| $Al^{3+}$ | $S^{2-}$ |  |  |

30. Complete the following nuclear equations and identify X in each case:
   a. $^{26}_{12}Mg + {}^{1}_{1}p \rightarrow {}^{4}_{2}\alpha + X$

   b. $^{59}_{27}Co + {}^{2}_{1}H \rightarrow {}^{60}_{27}Co + X$

   c. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{94}_{36}Kr + {}^{139}_{56}Ba + 3X$

   d. $^{53}_{24}Cr + {}^{4}_{2}\alpha \rightarrow {}^{1}_{0}n + X$
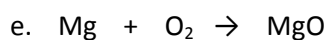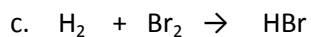
   e. $^{20}_{8}O \rightarrow {}^{20}_{9}F + X$

31. Fill in the blanks in the following radioactive decay series:

   a. $^{232}Th \xrightarrow{\alpha} \underline{\hspace{1cm}} \xrightarrow{\beta} \underline{\hspace{1cm}} \xrightarrow{\beta} {}^{228}Th$

   b. $^{235}U \xrightarrow{\alpha} \underline{\hspace{1cm}} \xrightarrow{\beta} \underline{\hspace{1cm}} \xrightarrow{\alpha} {}^{227}Ac$

   c. $\underline{\hspace{1cm}} \xrightarrow{\alpha} {}^{233}Pa \xrightarrow{\beta} \underline{\hspace{1cm}} \xrightarrow{\alpha} \underline{\hspace{1cm}}$

32. How many moles of cobalt (Co) atoms are there in $6.00 \times 10^9$ cobalt atoms?

33. How many moles of calcium (Ca) atoms are in 77.4 g of calcium?

34. How many atoms are present in 3.14 g of copper (Cu)?

35. Calculate the molar mass of each of the following substances:
    a. $NO_2$

    b. $SO_3$

    c. $C_6H_6$

    d. $NaI$

    e. $K_2SO_4$

    f. $Ca_3(PO_4)_2$

36. How many molecules of ethane ($C_2H_6$) are present in 0.334 g of $C_2H_6$?

37. What are the empirical formulas of the compounds with the following compositions?
    a. 40.1% C, 6.6% H, 53.3% O

    b. 18.4% C, 21.5% N, 60.1% K

38. The anticaking agent added to Morton salt is calcium silicate, $CaSiO_3$. This compound can absorb up to 2.5 times its mass of water and still remain a free flowing powder. Calculate the percent composition of $CaSiO_3$

39. The empirical formula of a compound is CH. If the molar mass of this compound is about 78 g, what is the molecular formula?

40. Balance the following equations:
    a. C + O$_2$ → CO

    b. CO + O$_2$ → CO$_2$

    c. H$_2$ + Br$_2$ → HBr

    d. K + H$_2$O → KOH + H$_2$

    e. Mg + O$_2$ → MgO

    f. O$_3$ → O$_2$
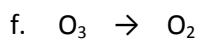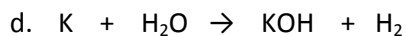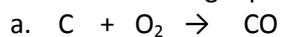
41. Ammonia is a principal nitrogen fertilizer. It is prepared by the reaction between nitrogen and hydrogen.

$$3 H_2 \text{ (g)} + N_2 \text{ (g)} \rightarrow 2 NH_3 \text{ (g)}$$
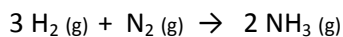
In a particular reaction, 6.0 moles of NH$_3$ were produced. How many moles of H$_2$ and how many moles of N$_2$ were reacted to produce this amount of NH$_3$?

42. When baking soda (sodium bicarbonate or sodium hydrogen carbonate, NaHCO$_3$) is heated, it releases carbon dioxide gas, which is responsible for the rising of dough in cookies, rolls and donuts.
    a. Write the balanced equation for the decomposition of the compound (one of the products is Na$_2$CO$_3$).

    b. Calculate the mass of NaHCO$_3$ required to produce 20.5 g of CO$_2$.

43. When potassium cyanide (KCN) reacts with acids, a deadly poisonous gas, hydrogen cyanide, HCN, is produced.  Here is the equation:

$$KCN_{(aq)} + HCl_{(aq)} \rightarrow KCl_{(aq)} + HCN_{(g)}$$
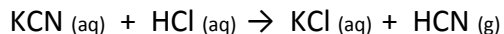
If a sample of 0.140 g of KCN is treated with excess HCl, calculate the amount of HCN formed, in grams.

44. Fermentation is a complex chemical process of wine making in which glucose is converted into ethanol and carbon dioxide:
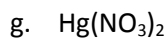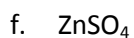
$$\underset{\text{glucose}}{C_6H_{12}O_6} \rightarrow 2 \underset{\text{ethanol}}{C_2H_5OH} + 2 CO_2$$
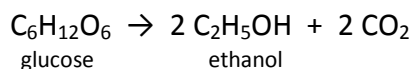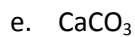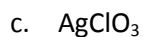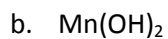
Starting with 500.4 g of glucose, what is the maximum amount of ethanol in grams and in liters that can be obtained by the process? (Density of ethanol is 0.789 g/mL)

45. Nitric oxide (NO) reacts with oxygen to form nitrogen dioxide ($NO_2$), a dark brown gas.

$$2 NO_{(g)} + O_{2(g)} \rightarrow 2 NO_{2(g)}$$
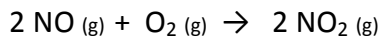
In one experiment, 0.886 mole of NO is mixed with 0.503 mole of $O_2$.  Calculate which of these two reactants is the limiting reactant.  Also calculate the number of moles of $NO_2$ produced.

46. Characterize the following compounds as soluble or insoluble in water:
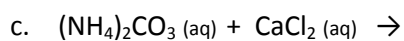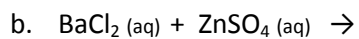    a. $Ca_3(PO_4)_2$

    b. $Mn(OH)_2$

    c. $AgClO_3$

    d. $K_2S$

    e. $CaCO_3$

    f. $ZnSO_4$

    g. $Hg(NO_3)_2$

    h. $HgSO_4$

    i. $NH_4ClO_4$
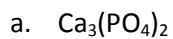

47. Write the net ionic equations for the following reactions:
    a. $AgNO_{3\ (aq)} + Na_2SO_{4\ (aq)} \rightarrow$




    b. $BaCl_{2\ (aq)} + ZnSO_{4\ (aq)} \rightarrow$




    c. $(NH_4)_2CO_{3\ (aq)} + CaCl_{2\ (aq)} \rightarrow$
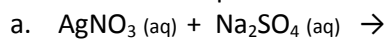



48. Give Arrhenius's and Bronsted's definitions of an acid and a base. Why are Bronsted's definitions more useful in describing acid-base properties?

49. Identify each of the following species as a Bronsted acid, base, or both:
   a.  $HI$

   b.  $CH_3COO^-$

   c.  $H_2PO_4^-$

   d.  $HSO_4^-$

   e.  $NH_4^+$

   f.  $ClO_2^-$

50. Predict the outcomes of the reactions represented by the following equations by using the activity series, and balance the equations:
   a.  $Cu_{(s)} + HCl_{(aq)} \rightarrow$

   b.  $I_{2\,(s)} + NaBr_{(aq)} \rightarrow$

   c.  $Mg_{(s)} + CuSO_{4\,(aq)} \rightarrow$

   d.  $Cl_{2\,(g)} + KBr_{(aq)} \rightarrow$

51. How many moles of $MgCl_2$ are present in 60.0 mL of 0.100 M $MgCl_2$ solution?

52. How many grams of KOH are present in 35.0 mL of a 5.50 M solution?

53. Calculate the molarity of each of the following solutions:
   a.  29.0 g of ethanol ($C_2H_5OH$) in 545 mL of solution.

   b.  15.4 g of sucrose ($C_{12}H_{22}O_{11}$) in 74.0 mL of solution.

   c.  9.00 g of sodium chloride (NaCl) in 86.4 mL of solution.

54. A sample of nitrogen gas kept in a container of volume 2.3 L and a temperature of 32$^\circ$C exerts a pressure of 4.7 atm. Calculate the number of moles of gas present. (Note: The AP curriculum tends to present pressures in atm rather than kPa. As a result, the value for R will be 0.0821 L·atm/mol·K instead of 8.31 L·kPa/mol·K)

55. Given that 6.9 moles of carbon monoxide gas are present in a container with volume 30.4 L, what is the pressure of the gas (in atm) if the temperature is 62$^\circ$C?

56. Methane, the principal component of natural gas, is used for heating and cooking. The combustion process is:

$$CH_4 \text{ (g)} + 2\ O_2 \text{ (g)} \rightarrow CO_2 \text{ (g)} + 2\ H_2O \text{ (g)}$$
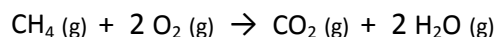
If 15.0 moles of $CH_4$ are reacted, what is the volume of $CO_2$ in liters produced at 23.0$^\circ$C and 0.985 atm?

**Solubility Rules - memorize the simple rules below**

| ALWAYS SOUBLE IF IN A COMPOUND | EXCEPT WITH |
|---|---|
| Alkali ions, $NH_4^+$, | No Exceptions |
| $NO_3^-$, $C_2H_3O_2^-$, $ClO_4^-$, $ClO_3^-$ | No Exceptions |
| $Cl^-$, $Br^-$, $I^-$ | $Pb^{2+}$, $Ag^+$ |
| $SO_4^{2-}$ | $Pb^{2+}$, $Ag^+$, $Hg_2^{2+}$  $Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$ |

If a substance does not fit one of the three rules above, assume it is INSOLUBLE and should be written as a *molecule* (not ionized). This isn't perfect, but will cover most situations, unless you are given other information in the question to help you know soluble or not.

**Polyatomic Ions - Memorize the shaded ions (and learn the pattern so you know their companions)**

By learning the four shaded "-ate" ions below, **and** knowing that one less oxygen (same charge) turns the name to −*ite*, **and** two less oxygens (if possible) turns the name to *hypo*−xxx−ite **and** one more oxygen (if possible) turns the name to *hypo*−xxx−ite will make learning all eighteen ions in the chart below as easy as learning just four.

### *Seven Strong Acids*
*memorize them*
*(assume all other acids are weak)*

| | |
|---|---|
| HCl | hydrochloric acid |
| HBr | hydrobromic acid |
| HI | hydroiodic acid |
| $HNO_3$ | nitric acid |
| $H_2SO_4$ | sulfuric acid |
| $HClO_3$ | chloric acid |
| $HClO_4$ | perchloric acid |

| hypo- (2 less O) | -ite (1 less O) | -ate | per- (1 more O) |
|---|---|---|---|
| | nitrite   $NO_2^-$ | nitrate    $NO_3^-$ | |
| | sulfite   $SO_3^{2-}$ | sulfate   $SO_4^{2-}$ | |
| | phosphite  $PO_3^{3-}$ | phosphate   $PO_4^{3-}$ | |
| hypochlorite  $ClO^-$ | chlorite  $ClO_2^-$ | chlorate  $ClO_3^-$ | perchlorate  $ClO_4^-$ |
| hypobromite  $BrO^-$ | bromite   $BrO_2^-$ | bromate  $BrO_3^-$ | perbromate  $BrO_4^-$ |
| hypoiodite  $IO^-$ | iodite   $IO_2^-$ | iodate  $IO_3^-$ | periodate  $IO_4^-$ |

**and don't forget**

| |
|---|
| ammonium    $NH_4^+$ |

### Odd Companions or No Companion

| | |
|---|---|
| hydroxide    $OH^-$ | |
| cyanide    $CN^-$ | |
| acetate    $C_2H_3O_2^-$ | |
| carbonate    $CO_3^{2-}$ | bicarbonate    $HCO_3^-$ |
| permanganate   $MnO_4^-$ *purple color* | |

### No kidding…..

Practice your times tables.

Go to www.tablestest.com
or www.timestables.me.uk/
or some other times & division practice site.

The multiple choice section of the AP Exam and thus our class exams does not allow calculators, thus you must get good at your times tables.

You will use a calculator on Free Response (problem type) questions.

## Naming Acids - Learn the pattern, don't just memorize the names

Does the anion contain oxygen?

**if NO**
hydro-(anion root)-ic

| | |
|---|---|
| HF | hydrofluoric |
| HCl | hydrochloric |
| HBr | hydrobromic |
| HI | hydroiodic |
| $H_2S$ | hydrosulfuric |
| HCN | hydrocyanic |

if **YES**
check the ending of the root

-ite
(anion root)-ous

| | |
|---|---|
| nitrous | $HNO_2$ |
| sulfurous | $H_2SO_3$ |
| phosphorus | $H_3PO_3$ |
| chlorous | $HClO_2$ |
| bromous | $HBrO_2$ |

-ate
(anion root)-ic

| | |
|---|---|
| nitric | $HNO_3$ |
| sulfuric | $H_2SO_4$ |
| phosphoric | $H_3PO_4$ |
| chloric | $HClO_3$ |
| bromic | $HBrO_3$ |
| carbonic | $H_2CO_3$ |
| acetic | $HC_2H_3O_2$ |