AP Chemistry Summer Work 2019 – 2020

I am excited to meet each of you and begin the long, tough, pressure-filled, and rewarding journey that is AP Chem!

Here is a list of your "to-dos" that need to be completed before you return in the fall. Pay close attention to the due dates as they are different for each assignment.

1. **Join the AP Chem Google Classroom page**. Follow the instructions below to access the rest of your assignments and other information:
    a. Log in to your Gibbons Google account in Google Chrome
    b. Go to classroom.google.com
    c. Click **+** and enter the code: rz5qv in the box and click **Join**.

2. **Mental Math for AP Practice**. This should be completed before you return in the fall.
   Instructions: Work through the pages within this practice packet. THESE SHOULD BE DONE WITHOUT A CALCULATOR. You are not allowed to use your calculator during the multiple-choice section of the AP Chemistry Exam. This means that the questions that are math based (yes, even the ones that involve stoichiometry and pH math) can be done in your head. Often this involves moving decimals, working in fractions, and estimating certain values, all of which are addressed in this assignment.

3. Write an **introduction letter** to your AP Chemistry teacher. This must be completed by June 23rd.
   Instructions: Please write a letter to me giving me some more information about yourself and why you chose to take AP Chem. Please address the following points but feel free to also include some other information if you would like!
    - Why are you taking AP Chemistry? What goals do you have for this class next year (and your future)?
    - What are your worries or fears when you think about this class and your school year next year?
    - What was your greatest struggle in your previous chemistry class? How did you work through it?
    - What are some other activities and interests that you have outside of class? (this can be through Gibbons or otherwise)
    - Tell me something interesting about yourself.

4. **Unit 0: AP Chemistry Preamble:** these are periodic assignments that you will need to complete throughout the summer to keep certain chemistry skills fresh in your brain.
   Instructions: The purpose of this summer assignment is to help you remember first year chemistry topics. All of these problems you learned how to do in chemistry honors/CP chemistry. You may use your calculator on this assignment.
    a. Place your answers in each week's assignment found on Google Classroom.
    b. Be sure your answers are numbered consecutively as they are on the original assignment sheets. There are 125 problems total and some have multiple letter sub points.
    c. Keep ALL your work so that you can show it to me next August during the first week of class.
    d. When you submit your answers, write me a note at the end of your assignment to let me know what problem gave you the most difficulty (or to ask a question on the assignment).
    e. A printed copy of each assignment (and all corresponding work) is due on the first day back in August.

5. Check out the document on the back of this page. It includes information that I am going to expect you to have memorized throughout the year. Please go ahead and commit the polyatomic ions and the strong acids to memory as soon as possible.

As always, please let me know if you have any questions. I hope you have a great summer and see you in August!

Ms. Kratzke (Quigley) ☺

Stuff worth memorizing….

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 four 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	$HC_2H_3O_2$

AP Chem Summer Work ↓

Mental Arithmetic: Background and Research

MENTAL MATH

The Importance of Mental Math

Data from two sources indicate that "arithmetic fluency" (effortless, immediate, accurate recall of simple arithmetic facts) is crucial for success in quantitative science courses. Empirically, studies by Wagner, Sasser, and DiBiase (JCE 2002), Cooper and Pearson (J. Sci. Ed. Tech. 2012), and Leopold and Edgar (JCE 2008) all found that a highest predictor of success in general chemistry among the multiple variables studied was a test of simplified math calculations with no calculators allowed.

Cognitive science also cites the importance of mental math in learning to solve scientific calculations. Findings include:

- Students able to do simple mental math quickly can better understand quantitative examples and proportional reasoning encountered during class and in texts.
- If students have *not* mastered their times tables, explanations based on doubles, halves, squares, and "simple whole number ratios" for them may not be simple.
- Having to remember a calculator answer, even for the brief transfer to paper where a problem is being solved, stores data in one of the 3-5 slots in novel working memory (WM). That storage may bump out of WM an element needed for problem solving.
- If answers to simple problems can be recalled fluently, more room is available in WM for constructing links to context cues: A process that builds conceptual understanding.

Cognitive experts emphasize that to learn quantitative relationships efficiently and effectively, students need to have more than "moderate" skills in mental math: They need *fluency*. The most efficient process to develop fluency is "spaced *overlearning*:" Practice to achieve fast, 100% accurate recall repeated for several days, accompanied by problem-solving that applies mental math to calculations with simple numbers.

Student Background

From 1990 to 2010, before the importance of math fluency was identified by cognitive research, K-12 math standards in most US states required calculator use on 3rd grade state math tests and de-emphasized "mental math." As one result, the math fluency of the current student generation varies *widely* depending on the policies of states and districts that were in place during their early schooling.

Cognitive research does *not* suggest avoiding calculators to solve *complex* problems. What is recommended is to require the use of mental math often enough that it is ready when needed to understand simple quantitative relationships (estimating to check calculator answers, handling exponentials, balancing equations, looking for half-lives in kinetics data, etc.).

Mental Arithmetic Quiz

Directions: Do NOT open this to view the inside until you are told to do so. This is a timed quiz. It tests how well you can do *arithmetic automatically* -- withOUT a calculator.

Nearly always in chemistry, you need to work carefully and check your work. But, on *this* one quiz, work quickly to get as many problems right as you can. If you cannot answer a question within **2-4** seconds, ***skip*** to the next question.

Your instructor will tell you the time limit and when to open to the quiz on the page inside.

↳ MAX 3 minutes!

Arithmetic Timed Quiz

Answer each *quickly* in the box provided. *Skip* questions you can*not* answer quickly.

1. **Multiplication.** Fill in the boxes below.

8 x 9 =	
4 x 3 =	
7 x 5 =	
8 x 6 =	
6 x 4 =	
9 x 4 =	

8 x 4 =	
6 x 6 =	
7 x 9 =	
5 x 3 =	
7 x 7 =	
6 x 5 =	

9 x 5 =	
5 x 4 =	
8 x 8 =	
5 x 7 =	
5 x 8 =	
6 x 3 =	

3 x 9 =	
8 x 3 =	
5 x 5 =	
7 x 8 =	
7 x 4 =	
9 x 6 =	

2. **Addition:**

8 + 9 =	
4 + 13 =	
4 + 45 =	

8 + 4 =	
16 + 6 =	
7 + 59 =	

9 + 5 =	
25 + 4 =	
8 + 88 =	

3 + 9 =	
8 + 33 =	
5 + 64 =	

3. **Subtraction:**

18 – 9 =	
24 – 13 =	
54 – 45 =	

8 – 4 =	
16 – 6 =	
67 – 5 =	

9 – 5 =	
25 – 4 =	
88 – 18 =	

13 – 9 =	
28 – 3 =	
25 – 13 =	

4. **Division:**

18 / 9 =	
42 / 7 =	
96 / 8 =	

32 / 4 =	
54 / 6 =	
56 / 7 =	

45 / 5 =	
72 /12 =	
12 / 24 =	

63 / 9 =	
27 / 3 =	
3 / 12 =	

STOP HERE

Mental Math Review Exercises - Multiplication

This worksheet contains fifty multiplication exercises in five sets of 10 problems. There are also suggestions to help you gain speed and accuracy with your mental multiplication. You can practice this worksheet several times, but you should also create more calculations for yourself. You should not use a calculator on this worksheet; however, it can be very helpful to rewrite the numbers in a different way to help you "see" the calculation more clearly.

Warm-up Exercises

Basic multiplication drills are very good. Without using a calculator, multiply each of the numbers up to 20 by each of the single digit numbers (1 through 9). For example:

3 x 13	4 x 13	5 x 13	6 x 13	7 x 13	8 x 13	9 x 13

Especially important are the multiplication "tables" using the numbers 15, 25, and 75.

3 x 15	4 x 15	5 x 15	6 x15	7 x 15	8 x 15	9 x 15
3 x 25	4 x 25	5 x 25	6 x 25	7 x 25	8 x 25	9 x 25
3 x 75	4 x 75	5 x 75	6 x 75	7 x 75	8 x 75	9 x 75

Distribution

Rearranging multiplication problems often simplifies the process when using "big" numbers. Look at the following examples for inspiration:

$15 \times 75 = (10 + 5) \times 75 = (10 \times 75) + (5 \times 75) = 750 + 375 = 1125$

$9 \times 14 = (10 - 1) \times 14 = (10 \times 14) - (1 \times 14) = 140 - 14 = 126$

$7 \times 18 = (10 - 3) \times 18 = (10 \times 18) - (3 \times 18) = 180 - 54 = 126$

(continued on the next page)

Fractions

Converting decimal numbers to fractions can make it easier to complete math operations with the numbers. For example, the number 0.30 is the fraction $\frac{3}{10}$. When you mentally multiply a number by 0.3, complete the operation in two steps:

- First, multiply the number by 3,
- Then, divide by 10.

For example: Multiply the number 1.5 by 0.30.

$$0.30 \times 1.5 = \frac{3}{10} \times 1.5$$

1. 3 x 1.5 = 4.5
2. 4.5 / 10 = 0.45

The final answer is 0.45

Set 1 – Use the skill shown above to perform these calculations *without a calculator.*

1.	0.1 x 2.0 =	5.	0.9 x 3.0 =	8.	0.4 x 1.5 =
2.	0.2 x 4.0 =	6.	0.1 x 4.5 =	9.	0.3 x 7 =
3.	0.4 x 4.0 =	7.	0.2 x 2.5 =	10.	0.9 x 6 =
4.	0.3 x 3.0 =				

(continued on the next page)

When multiplying two fractions, multiply the numerators by each other and the denominators by each other. Complete this in two steps:

- multiply the numerators by each other and put that answer in the numerator of the answer, then
- multiply the denominators by each other and put that answer in the denominator of the answer.

Study this example: $\frac{2}{3} \times \frac{3}{8}$

- first, multiply 2 and 3 and put 6 in the numerator of the answer. $\frac{2}{3} \times \frac{3}{8} = \frac{6}{\quad}$
- Then, multiply 3 and 8 and put 24 in the denominator of the answer. $\frac{2}{3} \times \frac{3}{8} = \frac{6}{24}$

  Notice that the answer can be simplified to a decimal number. $\frac{6}{24} = \frac{1}{4} = 0.25$

Here is another example:

Often, you will find yourself multiplying numbers such as 0.3 x 0.4

This operation can be re-written as $\frac{3}{10} \times \frac{4}{10} = \frac{12}{100} = 0.12$

Another way to see this operation is just like those on the previous page.

- First, multiply 3 x 4.
- Then, divide the answer by 10, twice.

Set 2 – Use the skill shown above to perform these calculations *without a calculator.*

1.	0.1 x 0.6 =	5.	0.9 x 0.4 =	8.	0.4 x 0.3 =
2.	0.2 x 0.5 =	6.	0.1 x 0.2 =	9.	0.3 x 0.8 =
3.	0.4 x 0.5 =	7.	0.2 x 0.2 =	10.	0.9 x 0.9 =
4.	0.3 x 0.2 =				

Scientific Notation

With small or large numbers, it is usually useful to rewrite the number in scientific notation before using it in math operations.

Look at this example: 0.6 x 0.09

One way to perform the calculation is to use fractions.

$$\frac{6}{10} \times \frac{9}{100} = \frac{54}{1000} = 0.054$$

Another way is to rewrite the numbers in scientific notation. Remember the rules for multiplying numbers in scientific notation.

- First, multiply the numbers
- Then, add the exponents on the tens

$(6 \times 10^{-1}) \times (9 \times 10^{-2}) = (6 \times 9) \times (10^{-1} \times 10^{-2}) = 54 \times 10^{-3} = 5.4 \times 10^{-2} = 0.054$

The final answer might appear as a decimal number (standard notation), or it might be shown in scientific notation. Practice rewriting numbers in scientific notation. Also, practice converting numbers back to standard notation.

Set 3 – Use the skill shown above to perform these calculations *without a calculator.*

1.	0.4 x 0.06 =	5.	0.6 x 0.06 =	8.	0.4 x 0.12 =
2.	0.3 x 0.09 =	6.	0.2 x 0.15 =	9.	0.2 x 0.75 =
3.	0.7 x 0.02 =	7.	0.3 x 0.25 =	10.	0.5 x 0.1s6 =
4.	0.5 x 0.08 =				

Chemistry Calculations using Molarity

Use the math skills on the previous pages to solve these mental math calculations. The questions mimic the multiple-choice questions on the AP Chemistry exam. Notice that the molar mass, or formula mass, of a compound is usually supplied to you. Remember, all of these calculations can be completed without a calculator. However, in questions 6 through 10 you may need to estimate the final answer.

Set 4

1. Calculate the number of moles of HCl in 100.0 mL of 0.500 M solution.
2. Calculate the number of moles of Cu^{2+} in 400.0 mL of 0.300 M $CuSO_4$ solution.
3. Calculate the number of moles of Na^{1+} in 300.0 mL of 0.30 M Na_2CO_3 solution.
4. Calculate the number of moles of KOH in 200 mL of 0.300 M solution.
5. Calculate the number of moles of Ag^{1+} and NO_3^{1-} present in 900 mL of 6.0 M $AgNO_3$.
6. Calculate the number of grams of HCl needed to make 100.0 mL of a 0.20 M solution. The molar mass of HCl is 36.46 g mol^{-1}.
7. Calculate the mass of copper (II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$, present in 200.0 mL of 2.5 M solution. The formula weight of copper sulfate is 250 g mol^{-1}.
8. Calculate the mass of solute needed to make 200 mL of a 0.20 M Na_2CO_3 solution (106 g mol^{-1}).
9. The molar mass of KOH is 56.1 g mol^{-1}. Calculate the number of grams of the compound present in 400 mL of a 1.5 M solution.
10. Calculate the mass of silver nitrate, $AgNO_3$, in 500 mL of a 0.5 M solution (molar mass 170 g mol^{-1}).

Continued on the next page

More Chemistry Calculations using Molarity

Use all the math skills on the previous pages to solve these mental math calculations.

Set 5

1. Calculate the number of moles of HCl in 80.0 mL of 0.500 M solution.
2. Calculate the number of moles of Cu^{2+} in 250.0 mL of 0.300 M $CuSO_4$ solution.
3. Calculate the number of moles of Na^{1+} in 200.0 mL of 0.75 M Na_2CO_3 solution.
4. Calculate the number of moles of KOH in 160.0 mL of 0.500 M solution.
5. Calculate the number of moles of Ag^{1+} and NO_3^{1-} present in 500 mL of 0.15 M $AgNO_3$.
6. Calculate the number of grams of HCl needed to make 200.0 mL of a 0.15 M solution. The molar mass of HCl is 36.46 g mol^{-1}.
7. Calculate the mass of copper (II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$, present in 50.0 mL of 0.20 M solution. The formula weight of copper sulfate is 250 g mol^{-1}.
8. Calculate the mass of solute needed to make 250 mL of a 0.40 M Na_2CO_3 solution (106 g mol^{-1}).
9. The molar mass of KOH is 56.1 g mol^{-1}. Calculate the number of grams of the compound present in 50.0 mL of a 0.40 M solution.
10. Calculate the mass of silver nitrate, $AgNO_3$, in 60.0 mL of a 0.50 M solution (molar mass 170 g mol^{-1}).