**AP Chemistry Summer Assignment**

Congratulations on taking AP Chemistry! This class is challenging, but it is my hope that you will leave the course knowing you have tried your best and learned something new about the world around you. We will spend a significant amount of time in hands-on practice, both through laboratory experiments and service-learning activities during the summer and school year.

To that end, I ask that you join the Remind group by texting the message @apchem202 to 81010. This will keep you up-to-date on what we will be doing this summer and allows you to contact me or your classmates during the school year.

I also have a website, ***benzonichem.weebly.com***, that will have links on the AP Chemistry page to videos and review activities to help with the summer assignment. Please make use of them.

Some topics and skills to be very comfortable with before you enter AP Chemistry in the fall:

**Chemistry-specific skills**

Naming and writing formulas of compounds

Balancing equations

Types of reactions (incl. predicting products)

Net ionic equations

Stoichiometry

% composition, empirical & molecular formulas

Solubility rules

Gas laws

Lewis dot structures & molecular geometry

Electronegativity

**Math skills**

Logarithms

Significant figures

Rearranging formulas

Identifying given & unknown in a problem

Organization of information in a problem

Reading graphs

Estimation

**PART 1: SKILLS PRACTICE**

Please complete the following questions from the book. The answers to all the questions are in the back. Utilize the study guide I have provided to you to help solve these problems. As an aside, I would outline the ***first five*** chapters in the book so that you have some background knowledge before you begin work. I will post PowerPoints and helpful worksheets in the Weebly site under the *Unit 1 – Chemical Foundations* tab.

Chapter 1 (p33): 25 – 33 odds, 53 - 63 odds

Chapter 2 (p75): 31 – 57 odds, 59 – 71 odds

Chapter 3 (p123): 21, 23, 27 – 51 odds, 53 – 73 odds, 75, 77, 79, 85 – 95 odds

Chapter 4 (p181): 29 – 35 odds, 45, 47

**PART 2: COMMON IONS**

This part of the summer assignment for AP Chemistry is quite simple (but not easy). You need to master the formulas, charges, and names of the common ions. On the first day of the school year, you will be given a quiz on these ions. You will be asked to:

* write the names of these ions when given the formula and charge
* write the formula and charge when given the names

I have included several resources in this packet. First, there is a list of the ions that you must know on the first day. This list also has, on the back, some suggestions for making the process of memorization easier. For instance, many of you will remember that most of the monatomic ions have charges that are directly related to their placement on the periodic table. There are naming patterns that greatly simplify the learning of the polyatomic ions as well.

Also included is a copy of the periodic table used in AP Chemistry. Notice that this *is not* the table used in first year chemistry. The AP table is the same that the College Board allows you to use on the AP Chemistry test. Notice that it has the symbols of the elements but *not* the written names. You need to take that fact into consideration when studying for the afore-mentioned quiz!

I have included a sheet of flashcards for the polyatomic ions that you must learn. I strongly suggest that you cut them out and begin memorizing them immediately. Use the hints on the common ions sheet to help you reduce the amount of memorizing that you must do. Do not let the fact that there are no flashcards for monatomic ions suggest to you that the monatomic ions are not important. They are every bit as important as the polyatomic ions. If you have trouble identifying the charge of monatomic ions (or the naming system) then I suggest that you make yourself some flashcards for those as well.

Doubtless, there will be some students who will procrastinate and try to do all of this studying just before the start of school. Those students may even cram well enough to do well on the initial quiz. However, they will quickly forget the ions, and struggle every time that these formulas are used in lecture, homework, quizzes, tests and labs. All research on human memory shows us that frequent, short periods of study, spread over long periods of time will produce much greater retention than long periods of study of a short period of time. I could wait and throw these at you on the first day of school, but I don’t think that would be fair to you. Use every modality possible as you try to learn these – speak them, write them, visualize them.

**PART 3: SIGNIFICANT FIGURES IN CALCULATIONS**

Unless you have been exposed to significant figure rules in another course, this topic will take a bit of study. I have attached a two-sided page with explanations of the rules, and examples of problem solving in addition, subtraction, multiplication and division.

There are some excellent videos and practice activities produced by Khan Academy for this subject. I will have links on the AP Chemistry page of my website to those videos and practice activities, as well as to some review activities.

I look forward to seeing you all at the beginning of the next school year. If you need to contact me during the summer, you can email me at rachel.benzoni@ops.org and I will get back to you quickly. Best of luck to you all!

Miss Benzoni

Advanced Placement Chemistry, Northwest High Magnet School

**Common Ions and Their Charges**

A mastery of the common ions, their formulas and their charges, is essential to success in

AP Chemistry. You are expected to know all of these ions on the first day of class, when I will give you a quiz on them. You will always be allowed a periodic table, which makes identifying the ions on the left “automatic.” For tips on learning these ions, see the opposite side of this page.

|  |  |  |
| --- | --- | --- |
| **From the table:**  |                          | **Ions to Memorize**  |
| **Cations**  | **Name**  | **Cations**  | **Name**  |
| H+  | Hydrogen  | Ag+  | Silver  |
| Li+  | Lithium  | Zn2+  | Zinc  |
| Na+  | Sodium  | Hg22+  | Mercury(I)  |
| K+  | Potassium  | NH4+  | Ammonium  |
| Cs+  | Cesium  |   |   |
| Be2+  | Beryllium  | **Anions**  | **Name**  |
| Mg2+  | Magnesium  | NO21-  | Nitrite  |
| Ca2+  | Calcium  | NO31-  | Nitrate  |
| Ba2+  | Barium  | SO32-  | Sulfite  |
| Sr2+  | Strontium  | SO42-  | Sulfate  |
| Al3+  | Aluminum  | HSO41-  | Hydrogen sulfate (bisulfate)  |
|   |   | OH1-  | Hydroxide  |
| **Anions**  | **Name**  | CN1-  | Cyanide  |
| H-  | Hydride  | PO43-  | Phosphate  |
| F-  | Fluoride  | HPO42-  | Hydrogen phosphate  |
| Cl-  | Chloride  | H2PO41-  | Dihydrogen phosphate  |
| Br-  | Bromide  | SCN1-  | Thiocyanate  |
| I-  | Iodide  | CO32-  | Carbonate  |
| O2-  | Oxide  | HCO31-  | Hydrogen carbonate (bicarbonate)  |
| S2-  | Sulfide  | ClO1-  | Hypochlorite  |
| Se2-  | Selenide  | ClO21-  | Chlorite  |
| N3-  | Nitride  | ClO31- | Chlorate  |
| P3-  | Phosphide  | ClO41-  | Perchlorate  |
| As3-  | Arsenide  | BrO1- | Hypobromite  |
|  |  | BrO21-  | Bromite  |
| **Type II Cations**  | **Name**  | BrO31-  | Bromate  |
| Fe3+  | Iron(III)  | BrO41-  | Perbromate  |
| Fe2+  | Iron(II)  | IO1-  | Hypoiodite  |
| Cu2+  | Copper(II)  | IO21-  | iodite  |
| Cu+  | Copper(I)  | IO31- | iodate  |
| Co3+  | Cobalt(III)  | IO41- | Periodate  |
| Co2+  | Cobalt(II)  | C2H3O21-  | Acetate  |
| Sn4+  | Tin(IV)  | MnO4-  | Permanganate  |
| Sn2+  | Tin(II)  | Cr2O72-  | Dichromate  |
| Pb4+  | Lead(IV)  | CrO42-  | Chromate  |
| Pb2+  | Lead(II)  | O22-  | Peroxide  |
| Hg2+  | Mercury(II)  | C2O42-  | Oxalate  |
|   |   | NH21- | Amide  |
|   |   | BO33-  | Borate  |
|   |   | S2O32-  | Thiosulfate  |

***Tips for Learning the Ions***

## “From the Table”

These are ions can be organized into two groups.

1. Their place on the table suggests the charge on the ion, since the neutral atom gains or loses a predictable number of electrons in order to obtain a noble gas configuration. This was a focus in first year chemistry, so if you are unsure what this means, get help BEFORE the start of the year.
	1. All Group 1 Elements (alkali metals) lose one electron to form an ion with a 1+ charge
	2. All Group 2 Elements (alkaline earth metals) lose two electrons to form an ion with a 2+ charge
	3. Group 13 metals like aluminum lose three electrons to form an ion with a 3+ charge
	4. All Group 17 Elements (halogens) gain one electron to form an ion with a 1- charge
	5. All Group 16 nonmetals gain two electrons to form an ion with a 2- charge
	6. All Group 15 nonmetals gain three electrons to form an ion with a 3- charge

Notice that cations keep their name (sodium ion, calcium ion) while anions get an “-ide” ending (chloride ion, oxide ion).

1. Metals that can form more than one ion will have their positive charge denoted by a roman numeral in parenthesis immediately next to the name of the

## Polyatomic Anions

Most of the work on memorization occurs with these ions, but there are a number of patterns that can greatly reduce the amount of memorizing that one must do.

1. “ate” anions have one more oxygen then the “ite” ion, but the same charge. If you memorize the “ate” ions, then you should be able to derive the formula for the “ite” ion and vice-versa.
	1. sulfate is SO42-, so sulfite has the same charge but one less oxygen (SO32-)
	2. nitrate is NO3-, so nitrite has the same charge but one less oxygen (NO2-)

1. If you know that a sufate ion is SO42- then to get the formula for hydrogen sulfate ion, you add a hydrogen ion to the front of the formula. Since a hydrogen ion has a 1+ charge, the net charge on the new ion is less negative by one.
	1. Example:

PO43- 🡪 HPO42- 🡪 H2PO41-

 phosphate hydrogen phosphate dihydrogen phosphate

1. Learn the hypochlorite 🡪 chlorite 🡪 chlorate 🡪perchlorate series, and you also know the series containing iodite/iodate as well as bromite/bromate.
	1. The relationship between the “ite” and “ate” ion is predictable, as always. Learn one and you know the other.
	2. The prefix “hypo” means “under” or “too little” (think “hypodermic”, “hypothermic” or

“hypoglycemia”)

* + 1. Hypochlorite is “under” chlorite, meaning it has one less oxygen
	1. The prefix “hyper” means “above” or “too much” (think “hyperkinetic”)
		1. the prefix “per” is derived from “hyper” so perchlorate (hyperchlorate) has one more oxygen than chlorate.
	2. Notice how this sequence increases in oxygen while retaining the same charge:

 ClO- 🡪 ClO2- 🡪 ClO3- 🡪 ClO4-

 hypochlorite chlorite chlorate perchlorate

## Significant Figures in Measurement and Calculations

A successful chemistry student habitually labels all numbers, because the unit is important. Also of great importance is the number itself. Any number used in a calculation should contain only figures that are considered reliable; otherwise, time and effort are wasted. Figures that are considered reliable are called *significant figures*. Chemical calculations involve numbers representing actual measurements. In a measurement, significant figures in a number consist of:

**Figures (digits) definitely known + One estimated figure (digit)**

### Recording Measurements

When one reads an instrument (ruler, thermometer, graduate, buret, barometer, balance), he expresses the reading as one which is reasonably reliable. For example, in the accompanying illustration, note the reading marked *A*. This reading is definitely beyond the 7 cm mark and also beyond the 0.8 cm mark. We read the 7.8 with certainty. We further *estimate* that the reading is five-tenths the distance from the 7.8 mark to the 7.9 mark.

So, we estimate the length as 0.05 cm more than 7.8 cm. All of these have meaning and are therefore significant. We express the reading as 7.85 cm, accurate to three significant figures. All of these figures, *7.85*, can be used in calculations. In reading B we see that 9.2 cm is definitely known. We can include one estimated digit in our reading, and we estimate the next digit to be zero. Our reading is reported as 9.20 cm. It is accurate to three significant figures.

### Rules for Zeros

If a zero represents a measured quantity, it is a significant figure. If it merely locates the decimal point, it is not a significant figure.

* **Zero Within a Number**. In reading the measurement 9.04 cm, the zero represents a measured quantity, just as 9 and 4, and is, therefore, a significant number. A zero between any of the other digits in a number is a significant figure.
* **Zero at the Front of a Number**. In reading the measurement 0.46 cm, the zero does not represent a measured quantity, but merely locates the decimal point. It is not a significant figure. Also, in the measurement 0.07 kg, the zeros are used merely to locate the decimal point and are, therefore, not significant. Zeros at the first (left) of a number are not significant figures.
* **Zero at the End of a Number**. In reading the measurement 11.30 cm, the zero is an estimate and represents a measured quantity. It is therefore significant. Another way to look at this: The zero is not needed as a placeholder, and yet it was included by the person recording the measurement. It must have been recorded as a part of the measurement, making it significant. Zeros to the right of the decimal point, and at the end of the number, are significant figures.
* **Zeros at the End of a Whole Number**. Zeros at the end of a whole number may or may not be significant. If a distance is reported as 1600 feet, one assumes two sig figs. Reporting measurements in scientific notation removes all doubt, since all numbers written in scientific notation are considered significant.

1 600 feet 1.6 x103 feet Two significant figures

1 600 feet 1.60 x 103 feet Three significant figures

1 600 feet 1.600 x 103 feet Four significant figures

**Sample Problem #1**: Underline the significant figures in the following numbers.

1. 0.0420 cm answer = 0.0420 cm (e) 2 403 ft. answer = 2 403 ft.
2. 5.320 in. answer = 5.320 in. (f) 80.5300 m answer = 80.5300 m
3. 10 lb. answer = 10 lb. (g) 200. g answer = 200 g
4. 0.020 ml answer = 0.020 ml (h) 2.4 x 103 kg answer = 2.4 x 103 kg

### Rounding Off Numbers

In reporting a numerical answer, one needs to know how to "round off" a number to include the correct number of significant figures. Even in a series of operations leading to the final answer, one must "round off" numbers. The rules are well accepted rules:

1. If the figure to be dropped is less than 5, simply eliminate it.
2. If the figure to be dropped is greater than 5, eliminate it & raise the preceding figure by 1.
3. If the figure is 5, followed by nonzero digits, raise the preceding figure by 1
4. If the figure is 5, not followed by nonzero digit(s), & preceded by an odd digit, raise the preceding digit by 1
5. If the figure is 5, not followed by nonzero digit(s), & the preceding significant digit is even, the preceding digit remains unchanged

**Sample Problem #2**: Round off the following to three significant figures.

(a) 3.478 m answer = 3.48 m (c) 5.333 g answer = 5.33 g

(b) 4.8055 cm answer = 4.81 cm (d) 7.999 in. answer = 8.00 in.

### Multiplication

In multiplying two numbers, when you wish to determine the number of significant figures you should have in your answer (the product), you should inspect the numbers multiplied and find which has the least number of significant figures. This is the number of significant figures you should have in your answer (the product). Thus the answer to 0.024 x 1244 would be rounded off to contain two significant figures since the factor with the lesser number of significant figures (0.024) has only *two* such figures.

**Sample Problem #3**: Find the area of a rectangle 2.1 cm by 3.24 cm.

Solution: Area = 2.1 cm x 3.24 cm = 6.804 cm2

We note that 2.1 contains two significant figures, while 3.24 contains three significant figures. Our product should contain no more than *two* significant figures. Therefore, our answer would be recorded as 6.8 cm2

**Sample Problem #4**: Find the volume of a rectangular solid 10.2 cm x 8.24 cm x 1.8 cm

Solution: Volume = 10.2 cm x 8.24 cm x 1.8 cm = 151.2864 cm3

We observe that the factor having the least number of significant figures is 1.8 cm. It contains two significant figures. Therefore, the answer is rounded off to 150 cm3.

### Division

In dividing two numbers, the answer (quotient) should contain the same number of significant figures as are contained in the number (divisor or dividend) with the least number of significant figures. Thus the answer to 528 ÷ 0.14 would be rounded off to contain *two* significant figures. The answer to 0.340 ÷ 3242 would be rounded off to contain three significant figures.

**Sample Problem #5**: Calculate 20.45 ÷ 2.4

Solution: 20.45 ÷ 2.4 = 8.52083

We note that the 2.4 has fewer significant figures than the 20.45. It has only *two* significant figures. Therefore, our answer should have no more than two significant figures and should be reported as 8.5.

### Addition and Subtraction

In adding (or subtracting), set down the numbers, being sure to keep like decimal places under each other, and add (or subtract). Next, note which column contains the first estimated figure. This column determines the last decimal place of the answer. After the answer is obtained, it should be rounded off in this column. In other words, round to the least number of decimal places in you data.

**Sample Problem #6**: Add 42.56 g + 39.460 g + 4.1g Solution: 42.56 g

 39.460 g

 4.1 g

 Sum = 86.120 g

Since the number 4.1 only extends to the first decimal place, the answer must be rounded to the first decimal place, yielding the answer 86.1 g.

### Average Readings

The average of a number of successive readings will have the same number of decimal places that are in their sum.

 **Sample Problem #7**: A graduated cylinder was weighed three times and the recorded weighings were 12.523 g, 12.497 g, 12.515 g. Calculate the average weight.

 Solution:

12.523 g

12.497 g

12.515 g

37.535 g

In order to find the average, the sum is divided by 3 to give an answer of 12.51167. Since each number extends to three decimal places, the final answer is rounded to three decimal places, yielding a final answer of 12.512 g. Notice that the divisor of 3 does not affect the rounding of the final answer. This is because 3 is an exact number - known to an infinite number of decimal places.

