

HONORS CHEMISTRY SUMMER WORK 2010

May 2010

All entering students of Honors Chemistry must be familiar with the following skills and content before the start of the school year. Read the given examples carefully and do all the problems as you go along. You should show work neatly for all problems. You may consult textbooks and other sources. The packet will be collected at the first period of class and graded. You will also be given quizzes on the elements (Part V) and polyatomic ions (Part VI) in the beginning weeks of September.

Part I. Basic Math Skills

- A. Rounding
- B. Number Line
- C. Scientific Notation
- D. Clear Presentation of Work
- E. Multiplying fractions using the calculator
- F. Scientific Notation on the Calculator
- G. Areas of rectangles and volumes of rectangular blocks
- H. Exponents
- I. Proportion - Cross multiplication
- J. Simple Algebra problems
- K. Literal equations in Algebra
- L. Complex fractions
- M. Units in Measurement

Part II. Technical Writing Skills

Part III. Collecting Data and Drawing Conclusions

Part IV. Logical Thinking Skills

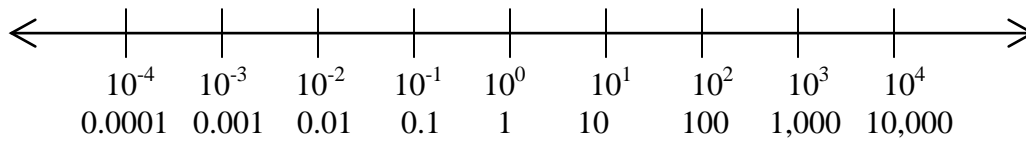
Part V. Selected Elements of the Periodic Table

Part VI. Polyatomic Ions – Names and Formulas

C. Scientific Notation

When you have a number that is very large or very small, you can express that number in scientific notation. In scientific notation, a number is rewritten as the product of two numbers: a coefficient and 10 raised to a power.

The larger a number is, the larger the power of 10 needed to represent it. Positive exponents of 10 result in numbers greater than 1 (large numbers). The smaller a number is, the smaller the power of 10 is needed to represent it. Negative exponents of 10 result in numbers less than 1 (decimals).



For example: The number 60,200 is equivalent to $6.02 \times 10,000$
Therefore it can be written in scientific notation as 6.02×10^4 .

In summary: $60,200 = 6.02 \times 10,000 = 6.02 \times 10^4$

For example: The number 0.0072 is equivalent to 7.2×0.001
Therefore it can be written in scientific notation as 7.2×10^{-3} .

In summary: $0.0072 = 7.2 \times 0.001 = 7.2 \times 10^{-3}$

Another way that you may have learned before to determine what power of 10 is used in scientific notation is to count how many places the decimal is moved. Even if you are familiar with that method, learn the concept explained above.

4. Write out the following numbers currently shown in scientific notation.

(a) 4.2×10^{-2}

(b) 6.2×10^5

5. Circle the greater number in each pair below:

(a) 7×10^2 or 7×10^6

(b) 1×10^3 or 1×10^{-3}

(c) 4×10^{-5} or 4×10^{-8}

(d) 6×10^{-8} or 2×10^{-4}

D. Clear Presentation of Work

Since written communication is important, you must present mathematical work clearly. Work horizontally (as if you write a phrase or a sentence), and work downwards. Make sure that you have proper equal signs, if needed. Use parenthesis instead of “x” to indicate multiplication.

e.g. $(2.5)(4.6)(6.7)$ This means 2.5 multiply 4.6 multiply 6.7
 $= 77.05$ (we will talk about significant figures later)

e.g. $5V=20$
 $V = 4$

e.g. Write formula or equation $PV=nRT$
Substitute correct values,
for example, if $P=3.40$, $V=2.55$, $R=0.0821$, and $T=298$, then write
 $(3.40)(2.55)=n(0.0821)(298)$
Solve for the unknown $n = 0.354$

6. If $PV = nRT$ and $P = 1.2$, $V = 3.4$, $n = 5.6$, $R = 8.31$, Calculate T .

7. If $M_1V_1 = M_2V_2$ and $M_1 = 6.2$, $M_2 = 1.3$, and $V_2 = 200$, calculate V_1 .

8. If you want to multiply 13 by 24 and then divide by 2, set up the expression in one step and then evaluate.

9. Add 50 to 273, then multiply by 4, then divide by 2.3. Set up the expression in one step and then evaluate.

E. Multiplying fractions using the calculator

The parentheses are often used to indicate multiplication. Get into the habit of using parentheses instead of “x” to indicate multiplication.

e.g. $(2.5)(4.6)(6.7)$ means 2.5 is multiplied by 4.6, which is then multiplied by 6.7

For a fraction, multiply the value above the fraction line and divide the value below the fraction line.

e.g.
$$\left(\frac{1.2}{2.3}\right)\left(\frac{3.4}{4.5}\right)\left(\frac{5.6}{6.7}\right)$$
$$= 0.33$$

(a) I suggest you solve the problem above by looking at one pair of parentheses at a time. So on your calculator, press: $1.2 \div 2.3 \times 3.4 \div 4.5 \times 5.6 \div 6.7$

(b) It is also correct to multiply all the numbers above the fraction line first, then divide by all the numbers below the fraction line; so on your calculator, press:

$$1.2 \times 3.4 \times 5.6 \div 2.3 \div 4.5 \div 6.7$$

(c) Or, press: $1.2 \times 3.4 \times 5.6 \div (2.3 \times 4.5 \times 6.7)$

The method (a) above is recommended in science since the fraction can be very large with numbers, symbols, and/or words, and the many fractions may occupy more than one line, so working with one fraction at a time will be less confusing. For example,

$$(35.6 \text{ g NH}_3) \left(\frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3}\right) \left(\frac{3 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3}\right) \left(\frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}}\right)$$

= 28.3 g H₂O Note that some units have cancelled out.

For the above problem, on your calculator, work with one fraction at a time, so press

$$35.6 \times 1 \div 17.0 \times 3 \div 4 \times 18.0 \div 1$$

Of course, you don't have to worry about multiplying or dividing by 1, so you can press: $35.6 \div 17.0 \times 3 \div 4 \times 18.0$

10. Use Method (a) above and your calculator to evaluate the following expressions. For multiplication and division problems only, **Honors Chem. students** should learn not to write intermediate numbers from multiplying or dividing part of the setup. So, punch numbers into calculator and write only the answer.

(i)
$$\left(\frac{8.09}{3.44}\right)\left(\frac{3.23}{4.50}\right)\left(\frac{8.55}{6.73}\right)$$

(ii)
$$\left(\frac{70.2}{3.11}\right)\left(\frac{5.90}{4.23}\right)\left(\frac{2.35}{4.43}\right)\left(\frac{4.25}{6.77}\right)\left(\frac{10.23}{3.76}\right)$$

F. Scientific Notation on the Calculator

Another common chemistry calculation involves using numbers in scientific notation. To put a number in scientific notation into your calculator, there are two options.

(a) 6.02×10^{23} can be put into your calculator as $(6.02 \times 10 \wedge 23)$

(b) 6.02×10^{23} can be put into your calculator as $6.02 \text{ E } 23$

You can use either one of the above methods. To enter E on your calculator, press 2nd key followed by a comma (located above the 7 on TI calculators). E is equivalent to $\times 10^\wedge$ and by using it instead of $\times 10^\wedge$ in your calculations, you eliminate having to worry about having parenthesis around numbers in scientific notation used in calculations.

Here is an example that involves both multiplying many fractions as well as using numbers in scientific notation:

$$\left(\frac{29.2 \text{ g H}_2\text{O}}{1} \right) \left(\frac{1 \text{ mol H}_2\text{O}}{18 \text{ g H}_2\text{O}} \right) \left(\frac{1 \text{ mol O}_2}{2 \text{ mol H}_2\text{O}} \right) \left(\frac{6.02 \times 10^{23} \text{ molecules O}_2}{1 \text{ mol O}_2} \right) = 4.88 \times 10^{23} \text{ molecules O}_2$$

In your calculator, you would enter this as:

$$(29.2 \div 18 \div 2 * 6.02 \text{ E } 23) = 4.88 \text{ E } 23 \quad (\text{which is } 4.88 \times 10^{23})$$

When dividing by scientific notation numbers, use parentheses, or treat each part of the notation separately. For example, to calculate $\frac{4.25}{3.42 \times 10^6}$ using your calculator,

enter: $4.25 \div 3.42 \text{ E } 6$

or $4.25 \div (3.42 \times 10^6)$

or $4.25 \div 3.42 \div 10^6$ Use the \div sign for anything below the division line.

11. Use one of the methods above to calculate the following, without having to show intermediate work:

(i) $\frac{(2.96 \times 10^5)(4.3 \times 10^2)}{(8.58 \times 10^3)}$

(iii) $\frac{(6.67 \times 10^{-11})(423)(570)}{(640 \times 10^{-6})^2}$

14. Evaluate the following expressions:

(i) $(5^3)(5^{10})$

(ii) $(-5a^4)^3$

(iii) $\frac{6^{24}}{6^3}$

(iv) $\frac{10^{-23}}{10^{-11}}$

(v) $\frac{10^{23}}{10^{-2}}$

(vi) $\left(\frac{5^{13}}{5^{-22}}\right)\left(\frac{5^{-4}}{5^6}\right)$

I. Proportion - Cross multiplication & cross division

$$D = \frac{M}{V}$$

e.g. If $D = 3.42$ g/mL and $V = 12.2$ mL, then upon substitution,

$$3.42 = \frac{M}{12.2} \quad \text{same as} \quad \frac{3.42}{1} = \frac{M}{12.2}$$
$$M = 41.7 \text{ g}$$

The idea is to put the unknown on one side and everything else on the other side of the equal sign. Cross multiply 3.42 and 12.2. This is the same as multiplying 12.2 on both sides and then canceling. Honors Chemistry students must learn to show this without any more intermediate work, i.e. press 3.42×12.2 on calculator:

$$3.42 = \frac{M}{12.2}$$

$$M = 41.7 \text{ g}$$

e.g. If $D = 3.42 \text{ g/mL}$ and $M = 45.6 \text{ g}$, then upon substitution,

$$3.42 = \frac{45.6}{V}$$

$V = 13.3 \text{ g}$ i.e., put V on one side and bring 3.42 down to denominator, so press $45.6 \div 3.42$ on calculator (with no intermediate work for Honors Chem. students)

15. If $M = \frac{n}{V}$ and $M = 2.1$ and $V = 3.8$, calculate n .

16. If $M = \frac{n}{V}$ and $M = 2.1$ and $n = 5.5$, calculate V .

J. Simple Algebra problems

e.g. $PV=nRT$ If $P=3.40$, $V=2.55$, $R=0.0821$, and $T=298$, then write
 $(3.40)(2.55) = n(0.0821)(298)$
 $n = 0.354$

Honors Chem. students should not show any more intermediate steps, just envision putting the unknown, n , on one side and everything else on the other side using cross-multiplying or cross-dividing. Press $3.40 \times 2.55 \div 0.0821 \div 298$ on your calculator, or $3.40 \times 2.55 \div (0.0821 \times 298)$.

17. Multiply the following numbers: 2.03, 5.78, 9.00

18. Solve for x if $7.8x = 209$

K. Literal equations in Algebra

Express one variable in terms of other variables, without numbers.

e.g. For the expression, $PV = nRT$

(a) express P in terms of the other variables: $P = \frac{nRT}{V}$

(b) express T in terms of the other variables: $T = \frac{PV}{nR}$

(c) express n in terms of the other variables: $n = \frac{PV}{RT}$

19. If $M_1V_1 = M_2V_2$, express

(i) V_2 in terms of the other variables.

(ii) M_1 in terms of the other variables.

20. If $M = \frac{n}{V}$, express

(i) n in terms of the other variables

(ii) V in terms of the other variables

L. Complex fractions

The fraction line is a division line. Since $\frac{A}{B}$ means $A \div B$,

$$\begin{aligned} & \frac{\frac{C}{D}}{\frac{E}{F}} \\ &= \frac{C}{D} \div \frac{E}{F} \\ &= \frac{C}{D} \times \frac{F}{E} \end{aligned}$$

Do the same for units.

21. Evaluate the following expressions

(i)
$$\frac{\frac{8.566}{2.35}}{\frac{15.90}{9.33}}$$

(ii)
$$\frac{\frac{3.56}{2.00}}{\frac{4.44}{9.33}}$$

M. Units in Measurement

Learn the common unit conversions:

$$1 \text{ kg} = 1000 \text{ g}$$

$$1 \text{ g} = 10 \text{ dg}$$

$$1 \text{ g} = 100 \text{ cg}$$

$$1 \text{ g} = 1000 \text{ mg}$$

$$1 \text{ g} = 1,000,000 = 10^6 \mu\text{g} \text{ [a million]}$$

$$1 \text{ g} = 1,000,000,000 = 10^9 \text{ ng} \text{ [a billion]}$$

$$1 \text{ km} = 1000 \text{ m}$$

$$1 \text{ m} = 10 \text{ dm}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$1 \text{ m} = 1000 \text{ mm}$$

$$1 \text{ m} = 1,000,000 = 10^6 \mu\text{m} \text{ [a million]}$$

$$1 \text{ m} = 1,000,000,000 = 10^9 \text{ nm} \text{ [a billion]}$$

Convert the following:

22. $1 \text{ kg} = \underline{\hspace{2cm}} \text{ mg}$

23. $1 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

24. $1 \text{ g} = \underline{\hspace{2cm}} \text{ mg}$

25. $23 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

26. $15.3 \text{ g} = \underline{\hspace{2cm}} \text{ cg}$

27. $0.25 \text{ m} = \underline{\hspace{2cm}} \text{ mm}$

Part II. Technical Writing Skills

The ability to write clearly and concisely is an asset in any profession. Scientists communicate what they have done in an experiment through technical reports. In this type of report, you not only present your data and draw conclusions about it, but also explain your methods, describe the equipment you used, and give some background on the problem.

This type of report is different from those that you may write for an English or History class. Technical reports are about conveying scientific information in a clear and to-the-point manner. They involve using formal, impersonal language and conveying information in a complete but brief manner. When writing technically, you should **write in the passive voice and not use any personal pronouns** (I, you, he/she/it, the experimenter, one, the scientist, etc). In using the passive voice and avoiding personal pronouns, it implies that you are unbiased in reporting your scientific findings. Passive voice shifts the focus from the actor (the person who performed the action) to the action (what was done).

For example:

Active Voice = “The girl poured the liquid into the beaker.”

Passive Voice = “The liquid was poured into the beaker.”

In the active voice sentence, the focus is on the girl (the actor) and what she is doing. In the passive voice sentence, the focus is on the pouring (the action). Often times when you turn active voice into passive voice, it is easy to remove any personal pronouns at the same time (because you are shifting the focus off of the person doing the action).

Turn the following sentences from the active voice into the passive voice and remove any personal pronouns:

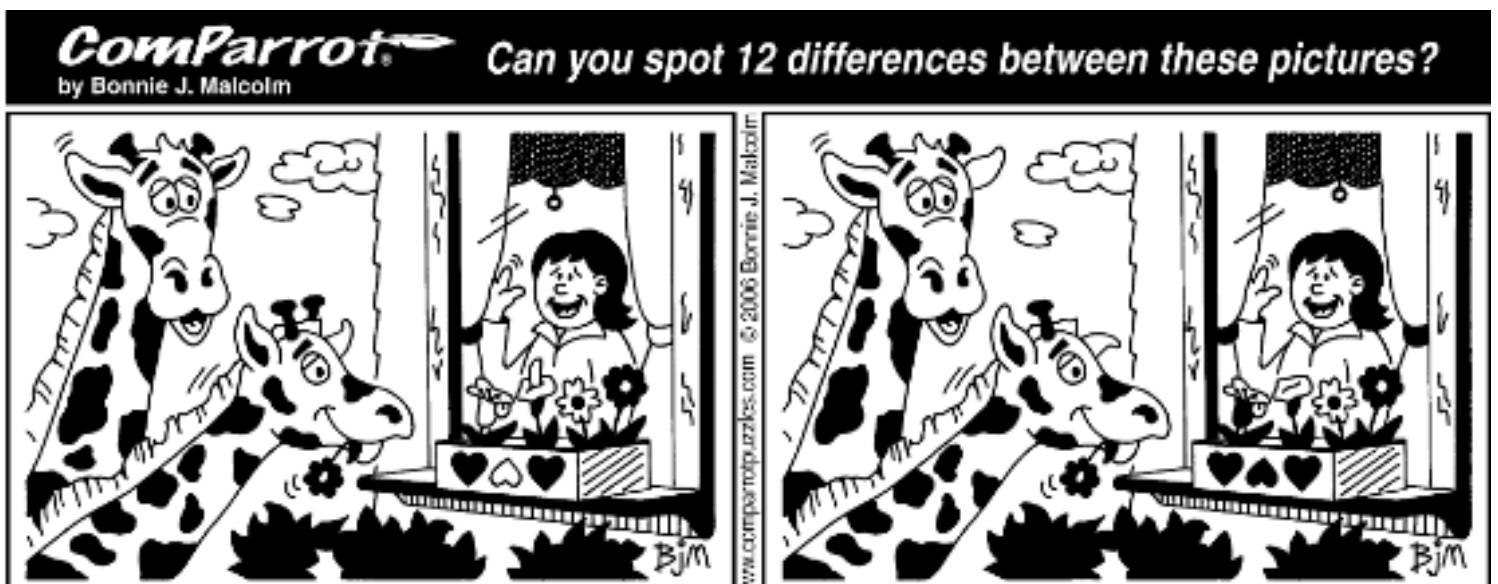
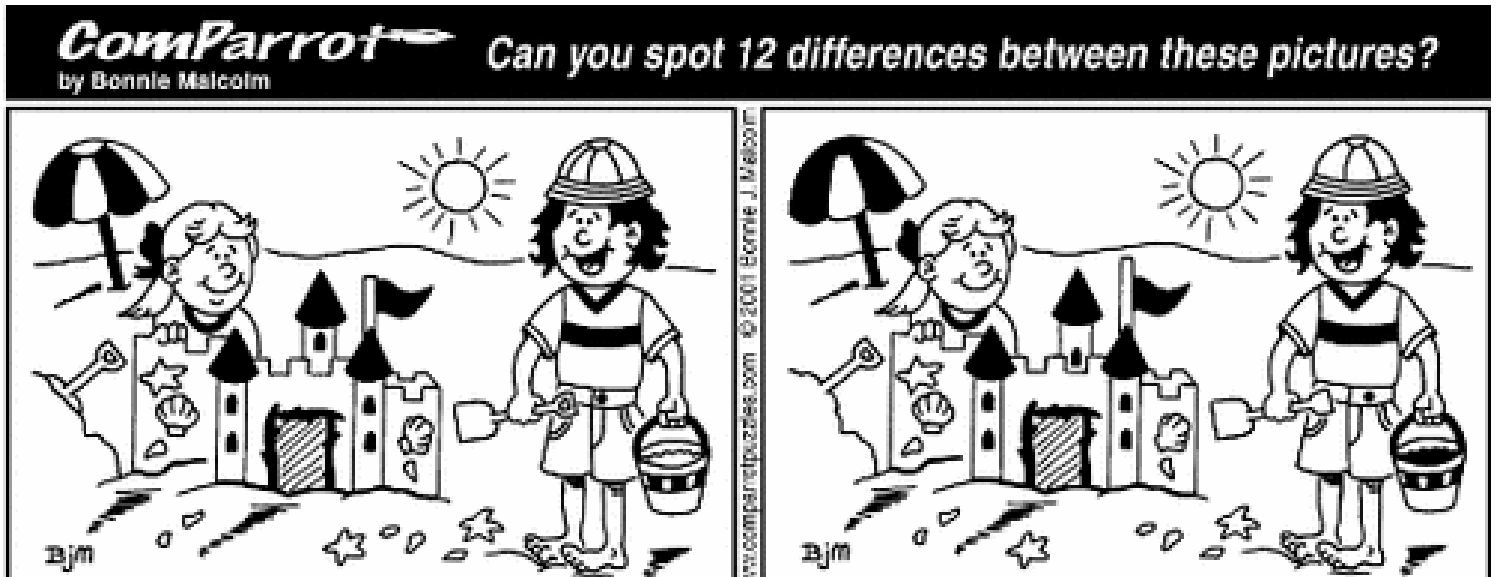
1. I dropped the phone on the floor.
2. Sue observed the beaker for signs that a chemical reaction had occurred.
3. The experimenter tipped over the beaker, spilling some of the liquid.
4. One should wash their equipment at the end of lab.

Part III. Collecting Data and Drawing Conclusions

Observations

To observe is to gather information using your five senses. In science, making good observations are essential. You must have a keen awareness of all that is around you and be able to identify the differences between what you started with and what you end up with. Observations are part of the data that you collect during lab just as you would collect measurements.

Below are two sets of two pictures. Using a color other than black, circle the 12 differences between the picture on the left and the picture on the right.



Inferences

To infer is to speculate or conclude from reasoning. Inferences are explanations for the observations that you have made. They are often based on your past experiences or prior knowledge.

Example:

Observation = The grass in front of the school is wet.

Inferences = It rained. The sprinkler was on. Fitz was just there. ☺

All of these inferences could possibly explain why the grass was wet. They incorporate the observation you made with your senses with your prior experiences.

For one of the sets of pictures above, choose 4 of the 12 observations you made and infer what may have happened.

3. For the following puzzle, carefully read each of the clues and fill in the table (to draw conclusions by eliminating impossibilities). Some clues may not help you the first time you read them through and you may have to come back to them.

Last Friday two women (Mrs. Chow and Mrs. Mastiff) and two men (Mr. Shepherd and Mr. Basset) took their poodles to the Poodle Parlor for a complete grooming. Each has a miniature poodle of a different color - apricot, chocolate, silver, or white (one of whom is named Zsa-Zsa). From the clues, determine the owner of each dog, the color of each poodle, and its name.

1. Mrs. Chow doesn't own the silver poodle.
2. The apricot poodles isn't the one that belongs to Mr. Basset.
3. The white poodle is named Mickey.
4. Mrs. Mastiff and Mr. Basset are the owners of the chocolate poodle and Fifi, in some order.
5. The silver poodle is named Pepi LaPue.

OWNER'S NAME	POODLE COLOR	POODLE'S NAME

Part V. Selected Elements of the Periodic Table

Everything is made up of elements, which are organized in the Periodic Table. Each element has a name as well as a 1 or 2-letter symbol. The first letter of the symbol must be in upper case and the second letter must be in lower case. Below is a list of elements and their symbols that you need to memorize by the 1st week of classes. Making flash cards (with the name on one side and the symbol on the other) is a great way to learn these. Also getting familiar with the position of the element in the Periodic Table will be helpful in shortening homework time in the future.

ELEMENTS LIST

Symbol	Name	Symbol	Name	Symbol	Name
1st Row in Periodic Table		4th Row		Additional Elements (scattered)	
H	hydrogen	K	potassium	Rb	rubidium
He	helium	Ca	calcium	Sr	strontium
2nd Row		Ti	titanium	Ag	silver
Li	lithium	Cr	chromium	Cd	cadmium
Be	beryllium	Mn	manganese	Sn	tin
B	boron	Fe	iron	I	iodine
C	carbon	Co	cobalt	Xe	xenon
N	nitrogen	Ni	nickel	Cs	cesium
O	oxygen	Cu	copper	Ba	barium
F	fluorine	Zn	zinc	La	lanthanum
Ne	neon	Ga	gallium	Pt	platinum
3rd Row		As	arsenic	Au	gold
Na	sodium	Se	selenium	Zn	mercury
Mg	magnesium	Br	bromine	Pb	lead
Al	aluminum	Kr	krypton	Rn	radon
Si	silicon			Ra	radium
P	phosphorus			Ac	actinium
S	sulfur				
Cl	chlorine				
Ar	argon				



Acrobat Document

Periodic Table

Part VI. Polyatomic Ions – Names and Formulas

Copied below from Table 9.3, page 257 of your textbook, is a list of the “Common Polyatomic Ions” you need to learn. You should make index cards with formula on one side and name on the other side. In order to learn them, you need to know how to read them correctly. For example, H_2PO_4^- is read as H2PO4 minus, and there should be a little pause between the “4” and the “minus” because there is one minus charge and not four minus charges in the superscript. Pay attention to upper case and lower case letters in the formulas, and the position of the numbers and charges (i.e., subscripts versus superscripts). One letter or one number will make a difference, so pay attention to all the details. This task will take some time to accomplish but Honors Chemistry will move at a rapid pace, so it is better to get started.

Table 9.3	
Common Polyatomic Ions	
Formula	Name
Charge = 1-	
H_2PO_4^-	Dihydrogen phosphate
$\text{C}_2\text{H}_3\text{O}_2^-$	Acetate
HSO_3^-	Hydrogen sulfite
HSO_4^-	Hydrogen sulfate
HCO_3^-	Hydrogen carbonate
NO_2^-	Nitrite
NO_3^-	Nitrate
CN^-	Cyanide
OH^-	Hydroxide
MnO_4^-	Permanganate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
Charge = 2-	
HPO_4^{2-}	Hydrogen phosphate
$\text{C}_2\text{O}_4^{2-}$	Oxalate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
CO_3^{2-}	Carbonate
CrO_4^{2-}	Chromate
$\text{Cr}_2\text{O}_7^{2-}$	Dichromate
SiO_3^{2-}	Silicate
Charge = 3-	
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate
Charge = 1+	
NH_4^+	Ammonium