AP Chemistry Summer Work

Greetings and Happy Summer!

I know that the last thing that makes for a lazy and happy summer is summer homework, but there's just no way around this. Still, I want you to enjoy the summer months as best you can and know that I'm limiting what I ask you to do a minimum.

Ok, so this is what I was told to tell you (by a former student)… she said " Tell your classes they can get frustrated with homework and labs all they want but if they want to go to college and become anything they HAVE to do homework and labs. There are almost 2000 Gen Chem freshmen at UGA and they ALL need chemistry for their major. Tutoring, here at UGA isn't just for 'not smart' kids. If you want an 'A' you have to go the extra mile, if you want it (the grade) you got to make the effort."

Why do I tell you this? I assume you are NOT taking AP Chemistry because you love my personality. I assume you are taking it because you are planning on a career that will require you to have additional chemistry classes in college. To that end, AP Chemistry is about knowing chemistry well enough to be able to take one concept and apply it to another. It is about BEING PREPARED for the next level of Chemistry; it is about discovering that the topics from 1st year Chemistry that you though were difficult…are a piece of cake

Like many college-level courses, you need to prepare for tests like there are NO other grades to help you earn what you deem to be a decent grade. If you have given a topic its due focus and IF you still don't understand – you know I'm here to help.

In the past, I stressed that I am NOT about making this course so hard that you all ruin your GPA's and all that has done is make students think they will get credit whether they work or not. I need you to understand that AP Chemistry has an AP Test at the end of the course. Our collective (and individual) goal for the year is to pass the test. That means I have to let you know when you aren't upholding your part of the bargain. Sadly, for many of you, the only message you are willing to hear is GRADE.

I have Lee County email addresses for most of you. I have invited everyone to join the AP Chemistry Google Classroom so that we can communicate throughout the summer, wherever you are. If I don't have your email address – you REALLY DO NEED TO SEND IT TO ME!!! ASAP!

GOOGLE CLASSROOM CODE FOR 2017/2018 – sccjbk

TWO PARTS TO THE SUMMER WORK

Part I: Go to the AP Central site http://apcentral.collegeboard.com to familiarize yourself as much as possible with the AP Chemistry course (**this shouldn't take more than 15-20 minutes**).

Starting at the AP Central homepage (and in any order) please:

- ✓ read about the actual AP Chemistry course (click on the green link AP COURSES AND EXAMS in the upper left part of the page). Then click on AP Chemistry to read about the course. Go into the course overview and please print it (2 pages).
- ✓ find (on the right side) find a link for AP Exam Dates under Explore AP. Once on this page, (on the left side) you "should" find a lot of information (in a blue box) about the exams. Please browse through the information (includes: 2018 exam dates, helping students prepare, on exam day, scores, etc.).

Part 2 Review of 1st year chemistry concepts (**memorizing things that chemists "just know" & problems**)

I included a checklist (that follows this letter). Use it to see where you need to focus your time.

NOTE: We may spend 2-3 days covering questions over part 2. We will have a quick test over the summer work (including memorization) sometime the first week. The reason why you have summer work is because we don't have time to review everything you learned in 1st year chemistry. In fact, the majority of the review of first year concepts won't happen until we are in serious review mode for the test.

OK, so… I'm sure there will be **a few of you who will procrastinate** and **try to do ALL of this the very last night** – that's **not a good idea**. You might be able to cram well enough to do ok on the first tests, but you won't remember it long enough for it to help you for the rest of the year.

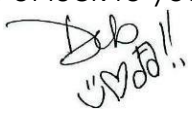
I WILL SAY THAT I HONESTLY BELIEVE IT IS PROBABLY BEST TO WAIT UNTIL THE 2nd HALF OF THE SUMMER… but please do NOT wait until the last day. My goal is to keep you from struggling every time that these formulas are used in lecture, homework, quizzes, tests and labs.

The summer work is due the first day of school. I will look at it over the weekend and then will return it so we can go over any material that needs to be reviewed. **The summer work will not be accepted late and I will not accept electronic submissions – even if you choose to NOT come the first day of school, the summer work is still due the first day of school!**

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 call or email me and I will get back to you quickly.

I would "like to think" that this summer I will do a better job of developing an AP Chemistry website than I did before. HOWEVER, like you, I do intend on trying to relax a bit this summer. If you would, please email me baltenbergerde@lee.k12.ga.us) with AP Chemistry in the subject line so that I have your working email address.

Best of luck to you all,



Mrs. Dr. B

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Please note that I check both emails throughout the summer – however I may not check them daily. Be patient please – it is my vacation time also and I plan on spending a good deal of time enjoying my family!

ALSO… FYI – while I require the composition notebook for problems, a three-ring notebook is probably a great place to keep your "notes".
I would like to suggest that you might want to get a carbonless lab notebook. These are available from numerous sites online. I can suggest Hayden McNeil which has several different types of student lab notebooks (with 50 or 100 sets of pages). I have included the link below.

www.Hmpublishing.com

Chemistry Top Bound 50 pages	- ISBN 978-1-930882-50-8	$10.95 (constructed like a steno pad – w/o spiral wires)
Chemistry Spiral Bound 50 pages	- ISBN 978-1-930882-23-2	$11.95
Chemistry Top-page Perforated 50 pages	- ISBN 978-1-930882-18-8	$11.95 (spiral notebook w/ wires at top instead of sides)

Why keep a lab notebook?

"The laboratory notebook is a permanent, documented, and primary record of laboratory observations. Therefore, a student's notebook will be a bound journal with pages numbered in advance and never torn out. This notebook contains a carbonless duplicate copy so that when you write you will produce an original and a copy. The original remains in the book as a permanently bound record and the copy is to be turned in for grading." *derived with permission from Dartmouth College, Department of Chemistry; www.dartmouth.edu/~chemlab/*

Also, many colleges require proof of what laboratory activities you have encountered in order to receive credit for introductory chemistry courses. Because you create a copy when you write in the notebook, when you turn in the copy that is graded, the laboratory notebook will give you a mark free record of these activities should you need them.

Summer Work – check list

MOST of this can be checked off by going through the attached resources & references… other things are checked off by completing the accompanying problem sets

Measurement and Matter

- ☐ Relate and apply basic SI units to the appropriate type of measurement
- ☐ Relate metric prefixes & their values to the appropriate BASE unit
- ☐ Utilize dimensional analysis to convert between various measurements
- ☐ Convert between standard and scientific notation and be able to utilize scientific notation in multiplication/division and addition/subtraction
- ☐ Calculate experimental error from reported data sets; classify examples of experimental error into random error and/or systematic error
- ☐ Determine the number of significant figures that are required when measuring, the number of significant figures in reported numbers, and how to calculate using significant figures
- ☐ Know how to do percent problems
- ☐ Distinguish between a substance and a mixture
- ☐ Describe the difference between elements & atoms and between elements & compounds
- ☐ Distinguish between a homogeneous and heterogeneous mixture
- ☐ Know the density formula and be able to use it to calculate density, mass and volume
- ☐ Know the relationship between Fahrenheit, Celsius and Kelvin; convert from one to the other
- ☐ Classify changes that occur in reactions as being either physical or chemical in order to determine if a "reaction" occurs
- ☐ Be able to distinguish between 3 states of matter and understand which processes are exothermic and which are endothermic.
- ☐ Know the names of the processes by which matter changes states

Atoms, Elements, Molecules, and Compounds

- ☐ Describe the relationship between # of protons, neutrons, and electrons in atoms of various elements
- ☐ Know what isotopes are and how atomic mass is calculated using naturally occurring isotopes
- ☐ Describe the relationship between the atomic mass shown on the periodic table and molar mass
- ☐ Know the locations of Alkali Metals, Alkaline Earth Metals, mixed group elements, Halogens, and Noble Gases/inert gases
- ☐ Distinguish between atoms and ions (and how do differentiate between them using proper nomenclature) and between cations and anions
- ☐ Determine (based on placement on the periodic table) the most likely charge of ions in the s and p blocks
- ☐ Distinguish between the terms chemical formula, empirical formula, molecular formula, and structural formula
- ☐ Write formulas and name ionic compounds (binary, stock system, polyatomic ionic)
- ☐ Write and name nonmetal (molecular) compounds (mono-, di-, tri-, etc.)

- ☐ Relate the definition of mole, Avogadro's Number, and mass through stoichiometry
- ☐ Calculate the molar mass of a substance (grams/mol or $g \cdot mol^{-1}$)
- ☐ Calculate % composition when given formula or the mass of each element of a compound
- ☐ Be able to find the molecular and empirical formulas and differentiate between the two
- ☐ Know how to determine empirical and molecular formula using stoichiometry (mass percent)
- ☐ Define hydrated compounds
- ☐ Know how to determine the formula of a hydrated compound from experimental data
- ☐ Be able to name binary acids according to the following rule
  - ide $\rightarrow$ hydro ic acid
- ☐ Be able to name and/or write the formula of oxy acids according to their anion.
  - ate $\rightarrow$ ic acid; ite $\rightarrow$ ous acid

Chemical Equations and Stoichiometry

- ☐ Identify examples of all of the basic types of reactions
  - synthesis, decomposition, single- and double displacement, acid/base, combustion
- ☐ Distinguish between the products and reactants in a chemical equation
- ☐ Be able to write combustion equations
- ☐ Know when to label the substances solid (s), gas (g), liquid (l), or aqueous (aq)
- ☐ Identify the 4 signs that a chemical reaction occurs
- ☐ Use solubility rules to determine if a double displacement reaction occurs when given two ionic compounds
- ☐ Apply the Law of Conservation of Matter when balancing equations
- ☐ Utilize molar mass and molar ratio (♥ of EVERY stoichiometry problem) to do basic stoichiometry problems
- ☐ Describe what determines if a reactant is limiting or in excess
- ☐ Solve problems involving Limiting Reactants
- ☐ Given the actual yield, know how to find the theoretical yield and the percent yield

Properties of Aqueous Solutions

- ☐ Distinguish between the **solute**, **solvent**, and **solution**. Give examples
- ☐ Describe the differences between unsaturated, saturated, and supersaturated
- ☐ Use the formula for Molarity to calculate Molarity of a solution, # moles of solute or volume of solution
- ☐ Describe how to **make a solution** correctly. Know what a **volumetric flask** is.
- ☐ Describe how dilutions are made and use the generic formula to do a simple dilution problem
- ☐ Describe the nature (distinguishing properties) of acids and bases
- ☐ Differentiate between the three different models of acids & bases (what does each produce, donate, and/or accept)
- ☐ Identify the defining property that distinguishes between strong & weak acids and/or bases

Assigned problems

The assigned problems need to be worked in a composition notebook. You will find the problems on a separate PDF.
Work MUST be shown & must be organized so that I can follow your procedures. Work AND answers must be legible (ON Lines, not between them) AND answers MUST include units of measurement where appropriate (preferably using sig fig rules).

Also, please know that being able to solve problems and explain results is a major part of AP Chemistry. Do you know what the LEAST important part of a problem is? Amazingly, it's the answer.

	Assigned Problems & Exercises (see PDF of pages)
Topics 1,2 & 3 – **Measurement**	1.34, 1.41 (include ± error in this measurement), 1.82
Topic 4 - **Significant Figures and Calculations**	1.37a,b,d,e; 1.39a,d; 1.40b, 1.61a,d
Topic 5 - **Dimensional Analysis**	1.49b,d; 1.76
Topics 6 & 7 – **Temperature & Density**	1.25a,c,d; 1.29a,b,c; 1.68
Topic 8 - **Classification of Matter**	1.15, 1.22
Topic 9 - **Fundamental Laws of Chemistry**	(see 1.22 in topic 8), 2.10, 2.12
Topic 10 - **Atomic Structure**	2.2, 2.8, 2.24b,e; 2.27a,c; 2.32, 2.35a, 2.89, 2.92b,c,d,e (challenge question)
Topic 11 - **Molecules and Ions**	2.4,
Topic 12 - **Periodic Table**	7.11a,b; 7.24a, 7.28a, 7.42a,b,c;
Topic 13 - **Naming Simple Ionic & Covalent Compounds**	2.54a,b,c; 2.60a,d,e,f; 2.64a,b,e; 2.68a,b,d,g; 2.74a,c,e,f;
Topics 14 – **Reactions, Writing, & Balancing Equations**	3.2, 3.14d,e; 4.22a,b,c; 4.56a,c,d
Topics15 & 16 - **The Mole Concept** **Percent Composition** **Empirical & Molecular Formulas**	3.22 c,d; 3.30, 3.36a,b,c; 3.24b,d; 2.44a,b,d; 3.44a,b,c; 3.50a,b;
Topic 17 - **Reaction Stoichiometry**	3.62a,b,c; 3.66a,b;
Topic 18 - **Limiting Reactants & Percent Yield**	3.74a,b,c; 3.78a,b; 3.82a,b

Resources

NOTE: none of the material that follows HAS to be read, watched, etc. – HOWEVER, if you struggle with any of the topics, I will suggest (strongly) that you utilize what I have provided for you.

Pages 1&2: links to videos that cover topic areas that correlate to the assigned problems
Rules for naming acids and ionic compounds
Rules for writing formulas
Page 3: polyatomic ions
Page 4: tips for learning ions
Page 5: Solubility Rules
Rules for determining oxidation numbers
Common charges for the most commonly used Transition metals
Page 6: AP Periodic Table
Pages 7: Math and other basic information
Page 8: Periodic trends

Video Resources (correlated to the assigned problems)

YOU ARE NOT REQUIRED TO WATCH ANY OF THE VIDEOS BELOW. They are simply presented as resources for you to use IF you feel less than confident.

Adapted from Mr. Craig Ontl, AP Chemistry Teacher at Lincoln High School, Wisconsin Rapids, WI 54494

Topics 1,2 & 3 - **Measurement** (Units, Accuracy & Precision, and error)

Accuracy and Precision (Part 1) - Tyler Dewitt (https://www.youtube.com/watch?v=5APhVxCEPFs)
Accuracy and Precision (Part 2) - Tyler Dewitt (https://www.youtube.com/watch?v=3G5IWRDfgTw)
Error & Percent Error - Tyler Dewitt (https://www.youtube.com/watch?v=h--PfS3E9Ao)
Lecture: Units & Uncertainty - Prof. Chuck Wight (https://www.youtube.com/watch?v=i5rvvlTl2rY)

Topic 4 - **Significant Figures and Calculations**

Tyler Dewitt has 10 videos over the topic of SigFigs. Here's a link to all of them (grouped together) – (https://www.youtube.com/watch?v=5UjwJ9PIUvE&list=PL3hPm0ZdYhyy0PQUQ1ka94hxVQPdYGS9m)
Significant digits & calculations – Chem Team (http://www.chemteam.info/SigFigs/SigFigs.html)

Topic 5 - **Dimensional Analysis**

Converting w/ Dimensional Analysis - Tyler Dewitt (https://www.youtube.com/watch?v=7N0lRJLwpPI)
Dimensional Analysis/Factor Label Method – ChemSoln (https://www.youtube.com/watch?v=DsTg1CeWchc)
Summary of Unit Conversions & SigFigs: Crash Course (https://www.youtube.com/watch?v=hQpQ0hxVNTg)

Topics 6 & 7 – **Temperature & Density**

Temperature and Density – Brandon Chemistry (https://youtu.be/ae2ek0JD6H8)

Topic 8 - **Classification of Matter**

Classification Of Matter – Play Chemistry (https://www.youtube.com/watch?v=XL8xZYbbgh4)
Physical vs Chemical Properties: Explained – ChemAcademy (https://www.youtube.com/watch?v=Z5L2NOMEWT0)

Topic 9 - **Fundamental Laws of Chemistry**

Fundamental Laws of Chemistry: Crash Course (https://www.youtube.com/watch?v=QiiyvzZBKT8)
How Can You See An Atom? - Reactions (ACS) (https://www.youtube.com/watch?v=ipzFnGRfsfE)

Topic 10 - **Atomic Structure**

The History of Atomic Chemistry: Crash Course (https://www.youtube.com/watch?v=thnDxFdkzZs)
Atomic #, Mass #, & Net Charge – Tyler Dewitt (https://www.youtube.com/watch?v=dRfrvpVdKGM)
What's the Difference - Mass# & Atomic#? – Tyler Dewitt (https://www.youtube.com/watch?v=m15DWkkGe_0)
How to Calculate Relative Atomic Mass - Mr. Causey's Chemistry (https://www.youtube.com/watch?v=DgLje5aMAKg)
How to Calculate Atomic Mass Practice Problems - by Tyler DeWitt (https://www.youtube.com/watch?v=ULRsJYhQmlo)
How to Calculate Isotope Abundance – Tyler Dewitt (https://www.youtube.com/watch?v=6CfSyGd5Ry4)

Topic 11 - **Molecules and Ions**

Ions: Explained - Chem Academy (https://www.youtube.com/watch?v=ME16VVASTq0)
What's the Difference between an Atom and a Molecule? – Tyler Dewitt (https://www.youtube.com/watch?v=RbbOBPfH_uk)

Topic 12 - **Periodic Table**

The Periodic Table - Crash Course (https://www.youtube.com/watch?v=0RRVV4Diomg)
A Tour of the Periodic Table – Bozeman Science (https://www.youtube.com/watch?v=fLSfgNxoVGk)
The Periodic Table: Atomic Radius, Ionization Energy, & Electronegativity – Professor Dave (https://www.youtube.com/watch?v=hePb00CqvP0)

Topic 13 - **Naming Simple Ionic and Covalent Compounds**

How To Speak Chemistrian -Crash Course (https://www.youtube.com/watch?v=mlRhLicNo8Q)
Type I Binary Ionic Compounds - Naming and Writing Formulas – Chem Academy (https://www.youtube.com/watch?v=RvwlbRNgmDA)
Type II Binary Ionic Compounds - Naming and Writing Formulas – Chem Academy

(https://www.youtube.com/watch?v=wDllOi_tEPs)
Type III Binary Compounds - Naming and Writing Formulas – Chem Academy
(https://www.youtube.com/watch?v=lDJhYT-CPIE)

Topics 14 – **Reactions, Writing, and Balancing Equations**

Major Types of Chemical Reactions -Tyler Dewitt (https://www.youtube.com/watch?v=aMU1RaRulSo)
Double Displacement Reactions (predicting if reactions occur)-GetChemistryHelp
(https://www.youtube.com/watch?v=_oixjNeKtxs)
Activity Series & Single Replacement Rxns – KMT Chemistry
(https://www.youtube.com/watch?v=5MlRtHFstTo&t=3s)

Topics15 & 16 - **The Mole Concept** and **Percent Composition, Empirical and Molecular Formulas**

Introduction to Moles - Tyler Dewitt (https://www.youtube.com/watch?v=wI56mHUDJgQ&t=2s)
Converting Between Moles, Atoms, & Molecules - Tyler Dewitt
(https://www.youtube.com/watch?v=HMAOrGpkTsQ)
How to Calculate Molar Mass - Tyler Dewitt (https://www.youtube.com/watch?v=Qflq48Foh2w)
Moles, Molecules & Atoms Conversion - moballer12 (https://www.youtube.com/watch?v=9DL4-m8lMr8)
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Percent Composition by Mass - Tyler Dewitt (https://www.youtube.com/watch?v=lywmGCflUIA)
Common Percent Comp Mistakes – Tyler Dewitt (https://www.youtube.com/watch?v=lh1endFwo80&t=68s)
Intro: Empirical & Molecular Formula - Tyler Dewitt (https://www.youtube.com/watch?v=wnRaBWvhYKY)
Calculating Molecular Formula from Empirical Formula - Tyler Dewitt
(https://www.youtube.com/watch?v=J_MtVs0aBdU&t=18s)

Topic 17 - **Reaction Stoichiometry**

Reaction Stoichiometry - Bozeman Science (https://www.youtube.com/watch?v=LQq203gyftA)
Mole to Mole Stoichiometry – Nancy Foote (https://www.youtube.com/watch?v=80a47D1x5Hs)
Mass to Mass Stoichiometry Example - Nancy Foote (https://www.youtube.com/watch?v=bZ9xDZlmXVQ)

Topic 18 - **Limiting Reactants and Percent Yield**

Intro. to Limiting & Excess Reactant - Tyler Dewitt (https://www.youtube.com/watch?v=nZOVR8EMwRU)
Limiting Reactant Practice Problem - Tyler Dewitt (https://www.youtube.com/watch?v=Mlu_v8rE1TY)
Limiting Reactant Practice Problem (Adv) - Tyler Dewitt (https://www.youtube.com/watch?v=N0dTXcoHI-I)

Rules for Writing Formulas and Naming Ionic Compounds

1. Write element symbols
2. The cation is always written first (in name and in formula)
3. Change the ending of the anion to -ide
4. Balance charges (charges should equal zero) using # valence electrons & least common multiple

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Rules for Naming Acids

Binary Acids – consisting of hydrogen plus an anion consisting of only one element.

Hydro + **stem of the anion** + suffix (**-ic**) and followed by the word **acid**.

HCl = hydro chlor ic acid
hydrochloric acid

Oxyacids – consisting of hydrogen plus an anion that is "usually either a "ite" or "ate" polyatomic ion.

a. When the anion is an "–ite", the acid name is the stem of the anion with the suffix ***–ous***, followed by the word acid.

stem of the anion + suffix (**-ous**) and followed by the word **acid**

$HClO_2$ = chlor ous acid
chlorous acid

b. When the anion is an "–ate", the acid name is the stem of the anion with the suffix ***–ic***, followed by the word acid.

$HClO_3$ = chlor ic acid
chloric acid

NOTE: hypochlorite has hypochlor- as the stem and perchlorate has perchlor- as the stem!

AP Chemistry

The Polyatomic Ions to know like the back of your hands

Name	Formula and charge
ammonium	NH_4^{+1}
mercury (I)	Hg_2^{+2}
hydronium	H_3O^{+1}
nitrite	NO_2^{-1}
nitrate	NO_3^{-1}
sulfite	SO_3^{-2}
sulfate	SO_4^{-2}
hydroxide	OH^{-1}
cyanide	CN^{-1}
phosphite	PO_3^{-3}
phosphate	PO_4^{-3}
hydrogen phosphate	HPO_4^{-2}
dihydrogen phosphate	$H_2PO_4^{-1}$
thiocyanate	NCS^{-1}/SCN^{-1}
carbonate	CO_3^{-2}
hydrogen carbonate (bicarbonate)	HCO_3^{-1}
hypochlorite	ClO^{-1}
chlorite	ClO_2^{-1}
chlorate	ClO_3^{-1}
perchlorate	ClO_4^{-1}
hypobromite	BrO^{-1}
bromite	BrO_2^{-1}
bromate	BrO_3^{-1}
perbromate	BrO_4^{-1}
hypoiodite	IO^{-1}
iodite	IO_2^{-1}
iodate	IO_3^{-1}
periodate	IO_4^{-1}
acetate	$C_2H_3O_2^{-}$
permanganate	MnO_4^{-1}
dichromate	$Cr_2O_7^{-2}$
chromate	CrO_4^{-2}
oxylate	$C_2O_4^{-2}$
peroxide	O_2^{-1}
thiosulfate	$S_2O_3^{-1}$

Tips for Learning Ions

Ion can be organized into two groups.

1. Where an element is found on the periodic 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.
   a. All Group 1 Elements (alkali metals) lose one electron to form an ion with a $^{1+}$ charge
   b. All Group 2 Elements (alkaline earth metals) lose two electrons to form an ion with a $^{2+}$ charge
   c. Group 13 metals like aluminum lose three electrons to form an ion with a $^{3+}$ charge
   d. All Group 17 Elements (halogens) gain one electron to form an ion with a $^{1-}$ charge
   e. All Group 16 nonmetals gain two electrons to form an ion with a $^{2-}$ charge
   f. All Group 15 nonmetals gain three electrons to form an ion with a $^{3-}$ charge

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

2. 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 element (these are mostly transition metals found in the d block of the periodic table (groups 3-12)

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.

   Nick the **C**amel, is a **Br**at. He **ate** a 1 **I**nch **Cr**ispy **Cl**am for **S**upper in **P**hoenix.

   All of these are the "-ate" polyatomic anions
   Bolded letter represents the "base" element
   # of consonants in the word = number of oxygen atoms in the polyatomic
   # vowels in the word = charge (negative) for the polyatomic

   So… based on the above, sulfate comes from **S**upper. 4 consonants = 4 oxygen atoms, and there are 2 vowel (2- charge)… sulfate = SO_4^{2-}. And we know that sulfite has the same charge but one less oxygen so it is SO_3^{2-}.

2. If you know that a sulfate ion is SO_4^{2-} 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.
   a. Example: PO_4^{3-} → HPO_4^{2-} → $H_2PO_4^-$
      phosphate — hydrogen phosphate — dihydrogen phosphate

3. Learn the hypochlorite → chlorite → chlorate → perchlorate series, and you also know the series containing iodite/iodate as well as bromite/bromate.
   a. The relationship between the "ite" and "ate" ion is predictable, as always. Learn one and you know the other.
   b. The prefix "hypo" means "under" or "too little" (think "hypodermic", "hypothermic" or "hypoglycemia")
      i. Hypochlorite is "under" chlorite, meaning it has one less oxygen
   c. The prefix "hyper" means "above" or "too much" (think "hyperkinetic")
      i. the prefix "per" is derived from "hyper" so perchlorate (hyperchlorate) has one more oxygen than chlorate.
   d. Notice how this sequence increases in oxygen while retaining the same charge:
      ClO^- → ClO_2^- → ClO_3^- → ClO_4^-
      hypochlorite — chlorite — chlorate — perchlorate

Solubility Rules

1. All compounds containing alkali metal cations and the ammonium ion are soluble.
2. All compounds containing NO_3^-, ClO_4^-, ClO_3^-, and $C_2H_3O_2^-$ anions are soluble.
3. All chlorides, bromides, and iodides are soluble except those containing Ag^+, Pb^{2+}, or Hg^{2+}.
4. All sulfates are soluble except those containing Hg^{2+}, Pb^{2+}, Sr^{2+}, Ca^{2+}, or Ba^{2+}.
5. All hydroxides are insoluble except compounds of the alkali metals, Ca^{2+}, Sr^{2+}, and Ba^{2+}.
6. All compounds containing PO_4^{3-}, S^{2-}, CO_3^{2-}, and SO_3^{2-} ions are insoluble except those that also contain alkali metals or NH_4^+.

Rules for Determining Oxidation Number

Oxidation Number: A number assigned to an atom in a molecular compound or molecular ion that indicates the general distribution of electrons among the bonded atoms.

1. The oxidation # of any uncombined element is O.
2. The oxidation # of a monatomic ion equal the charge on the ion.
3. The more electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.
4. The oxidation # of fluorine in a compound is always −1
5. Oxygen has an oxidation # of −2. When combined with fluorine = +2; in a peroxide= −1.
6. The oxidation state of hydrogen in most of its compounds is+1. When combined with a metal = −1.
7. In compounds, the elements of groups 1 & 2 as well as aluminum have oxidation # of +1, +2, and +3, respectively
8. The sum of the oxidation # of all atoms in a neutral compound is O.
9. The sum of the oxidation # of all atoms in a polyatomic ion equals the charge of the ion.

Variable Valences for Most Commonly Used Transition Metals

Name	Symbol	Charge	Stock Name
Chromium	Cr	+2 +3	Chromium (II) Chromium (III)
Manganese	Mn	+2 +3	Manganese (II) Manganese (III)
Iron	Fe	+2 +3	Iron (II) Iron (III)
Cobalt	Co	+2 +3	Cobalt (II) Cobalt (III)
Copper	Cu	+1 +2	Copper (I) Copper (II)
Lead	Pb	+2 +4	Lead (II) Lead (IV)
Mercury	Hg	+1 +2	Mercury (I) Mercury (II)
Tin	Sn	+2 +4	Tin (II) Tin (IV)
Gold	Au	+1 +3	Gold (I) Gold (III)
Silver	Ag	+1 +2(rarely)	Silver Silver (II)
Bismuth	Bi	+3 +5	Bismuth (III) Bismuth (V)
Antimony	Sb	+3 +5	Antimony (III) Antimony (V)
Cadmium	Cd	+2	Cadmium
Zinc	Zn	+2	Zinc

INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.179
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.938	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **§** (269)	111 **§** (272)	112 **§** (277)	§Not yet named					

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

GO ON TO THE NEXT PAGE.

Significant Figures (rules) – **a different way of remembering the "real rules"**

If the decimal is PRESENT
Start at the Pacific.

Come to the first real digit
and count all remaining digits

Ex.
a. 32.02 _____
b. 0.00235 _____

If the decimal is NOT PRESENT
Start at the Atlantic.

Come to the first real digit and
count all remaining digits

Ex.
a. 42500 _____
b. 620350 _____

Accuracy & Precision

Accuracy refers to the closeness of measurements to the correct or accepted value of the quantity measured. **examples:** baseball pitcher throwing strikes; basketball going in the hoop; lab data is the correct answer

Precision refers to the closeness of a set of measurements of the same quantity made in the same way. **examples:** baseball pitcher throwing strikes in the same location or keeps throwing balls in the same location; basketball shots are all net every time or basketball shots are missed by bouncing of the rim in the same location; lab data give the same results over and over (possibly right or wrong)

Percentage Error

Percentage error is a way for scientists to express how far off a laboratory value is from the commonly accepted value.

The formula is: $\%\ \text{error} = \left| \frac{\text{accepted value - experimental}}{\text{value accepted value}} \right| \times 10$

Atomic Structure

Atomic # (z) = # of protons

1. Identifies (ID's) an element – UNIQUE for each element
2. Elements in order on the periodic table by atomic #
3. Because atoms must be neutral; (z) also = # e^-

Mass # - total # of p^+ and n^o

Ions = Charged Atoms

charge occurs from gaining or losing e^-

Isotopes and Average Atomic Mass

Isotope = (nuclide)

2 ways to represent isotopes:

hyphen notation *or* *nuclear symbol* mass #

Uranium-235 (element ↓, mass # ↓) or $^{235}_{92}U$ (mass # ↑, atomic # ↓) → element symbol

Isotopes & Average Atomic Mass

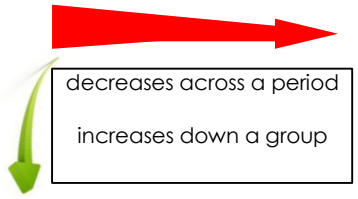
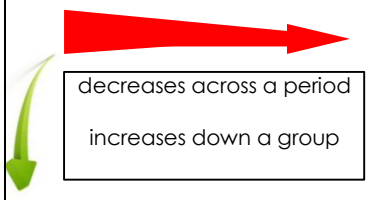
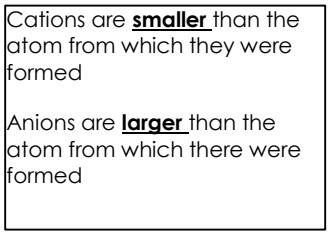
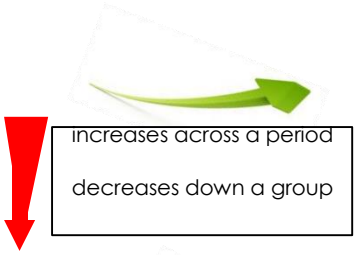
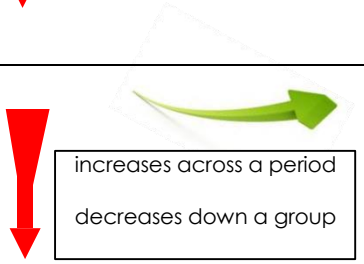
Most elements are commonly found as a mixture of two or more isotopes. All the isotopes of any given element have the same atomic number, but they have different atomic masses because they differ in the number of neutrons found in the nucleus.

The average atomic mass is the weighted average of all of the commonly occurring isotopes of an element

Example: A sample of cesium is 75% ^{133}Cs, 20% ^{132}Cs and 5% ^{134}Cs. What is its average atomic mass?

Answer: .75 x 133 = 99.75
.20 x 132 = 26.4
.05 x 134 = 6.7
Total = 132.85 amu = average atomic mass

Periodic Trends & Properties

Term	Definition	Trend on Periodic Table	Why?
Atomic Radius	The radius of an atom from the center of the nucleus to the outer most portion of the electron cloud (remember, the electron cloud accounts for MOST of the volume of an atom)		**Across:** electrons added to the same energy level experience increasing attraction to the nucleus due (Effective Nuclear Charge) to successive addition of protons **Down:** each period on the table adds a new energy level that extends the electron cloud out
Ionization Energy	The energy required to remove an electron from an atom: $Na + 496\ kJ \rightarrow Na^+ + e^-$ Ionization energy increases for each successive electron removed from a atom: $Na^+ + 4562\ kJ \rightarrow Na^{+2} + e^-$		**Across**: electrons are harder to remove from small atoms because (ENC) causes them to be held closer to the nucleus **Down**: electrons are easier to remove from larger atoms because they are farther from the nucleus
Ionic Radius	The radius of an ion from the center of the nucleus to the outer most portion of the electron cloud (AFTER an electron has been gained or removed) ***Cation*** – positively charged ion, formed when an atom loses one or more electrons ***Anion*** – negatively charged ion, formed when an atom gains one or more electrons		**Cations** – losing electrons decreases the size of the electron cloud because ENC coming from the nucleus (it doesn't change) but it pulls more strongly on the remaining electrons **Anions** – gaining electrons increases the size of the electron cloud because ENC coming from the nucleus (it doesn't change) but it pulls on the remaining electrons with less force
Electronegativity	The ability of an atom IN A MOLECULE to attract the shared electrons towards itself & away from the other atom		**Across**: as the atomic radius of an atom decreases, shared electrons can come in closer to the atom; proximity increases the ability of the protons to attract electrons **Down**: each period on the table add a new energy level that extends the electron cloud out farther from the nucleus; thereby decreasing the ability of the protons to attract shared electrons
Electron affinity	The change in energy associated with the addition of an electron to a gaseous atom		**Across**: as the atomic ratio of an atom decreases, loose electrons can come in closer to the atom where they are attracted to atom **Down**: each period on the table add a new energy level that extends the electron cloud out farther from the nucleus; the ability of the atom to attract electrons decreases