**AP Chemistry Summer Project 2019**

You will need a binder (2” recommended) for this course to hold note packets, labs and course work. **There will be a test over this material the first week of school.** The summer project should be review for you, but it’s **really important** that you push yourself to be good at the concepts within these assignments, because these are the basis for everything else next year. You’re awesome for taking the class, so you should be equally awesome at the basics of Chemistry. ☺

Check out the following texts from Mrs. Hamik:

- **Chemistry AP Edition**, ninth edition by Zumdahl and Zumdahl
- **The Ultimate Chemical Equations Handbook**, second edition by Smith and Hague

Chemistry AP Editions (TEXTBOOK) Assignment:

- **Read Chapter one**, take notes in the space provided on the corresponding notes packet.
  - Answer these End-of-Chapter Questions: #29, 32-33, 37, 39, 43, 47-48, 52, 55, 71-73, 79, 81, 87-88. These should be kept in your binder by chapter.
  - **Please note**: you can check your answers to the blue numbers in the back of the book – this is for EVERY CHAPTER. Do attempt the problems first. 😄

- **Read Chapter two**, take notes in the space provided on the corresponding notes packet.
  - Answer the following questions #18, 19, 26-29, 35, 36, 40, 42, 55, 58, 59, 67, 69. These should be kept in your binder by chapter. (Naming was cut here because it’s IN THE HANDBOOK!!)

Ultimate **Chemical Equations Handbook** Assignment:

- Read Chapters 1-4, 7-10 (pages 1-21, 39-67)
- Answer the questions associated with each chapter (not all, see below), ON SEPARATE PAPER, **DO NOT WRITE IN THE BOOK**. Thanks! Keep these answers in your binder or notebook organized by chapter. Problems to do:
  - Ch 1 through Ch 4: all questions naming and formulas
  - Ch 7: only exercise 7-1 (#1-10) balancing eqns
  - Ch 8: all (#1-10) single replacement rxns
  - Ch 9: only exercise 9-1 (#1-10) double replacement rxns
  - Ch 10: complete ionic equations: exercise 10-1 (#1, 2, 6, 7, 8), exercise 10-3, exercise 10-4, net ionic equations: exercise 10-7 (#1, 2, 6, 7, 8), exercise 10-9, exercise 10-10

**Summer Assistance:**

- You are welcome and **encouraged** to ask questions.
- Email questions to me at Ashley.Hamik@ops.org. I may not check daily, but I will check often over the summer break.
- I use text reminders from remind.com throughout the school year. I **will** send out reminders about the summer project, **sign up now**!
  - **Text to 81010, “@chemMVPs19”,** and you should be signed up.
  - You can also sign up for the same messages via email, let me know if you need that option.
- There may be a date or two prior to the start of school that will be available to a study session (at a Public Library, or a café with Wifi). I will remind-text information on this as school approaches.

*The summer project is due the first class day of school.*

*There will be a test over this material within the first full week of school.*
Dear AP Chem Student,

Do your summer project, and do it well! Don’t wait until the last week to do it; it is very long, (but not necessarily hard). It is a great review of the stuff that should not be forgotten, or you will have to play catch up quickly when class starts. **Review mole ratios, significant figures, conversions and units for sure.** Also, review everything you learned about the periodic table, because there are not cheat sheets in this course.

**This class is manageable.** I played sports and participated in a club, while earning a high B, low A each semester. It comes down to if you are willing to do all of your homework assignments. Everything on the AP test will be covered in class, and review sessions, so show up. As a motivation, extra credit is given second semester so do it and you will see your grade increase on each test.

There will come a time when you question why you ever signed up for this class. **Push through it!** I’m not going to lie when I say the class will become really hard. However, it gets easier as the year progresses. This class if nothing else will prepare you for your future. You have to go through school by challenging yourself once in a while, but it is worth it.

You will feel accomplished by the end!

- S. S.

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You should know that this class requires time & effort, but if you work hard you will be fine. The real way to succeed in this class is to do the homework. If you practice & know what you’re doing, you’ll be fine. This class helps you prepare for hard classes in the future, & the amount you learn in here is completely worth the hours spent taking notes & doing homework. If you do not do your work, you will not get a good grade. This is not an easy to pass class, you really have to put effort into it.

- M. G.

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You should know the basic stuff to Chem. Especially stoichiometry because that follows you throughout the whole year. Study last year Chem! Doing my homework was necessary for success because the class sometimes go by so quickly you HAVE to take it home and do it yourself! Stick with it because when you finally get to the AP test and you understand everything, you feel extremely proud of yourself! You will also feel very smart and you get a lot from this class! Have fun!!!

- R. K.

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You should know what an atom, mole, and molecule are. Because if you don’t, it’s hard. For necessary success, the homework is your friend for math, and for conceptual understanding say it out loud even if you seem stupid. Stick with AP CHEM because when you take the AP test it’s a big satisfactory moment to do it, even if it’s not a 5, it’s your best work.

- V. D.
If you are coming into AP Chemistry, do not blow off the summer packets because these basic ideas will follow you the whole year and will be a part of the AP Test in some way. I would also recommend you stay consistent with doing the homework problems you will be assigned because there is much more math this year than any one of you will think, and a large majority of it is very confusing especially when you have to do many conversions, keep track of significant figures, know which constants/units to use, or which equations to use. I would recommend looking over old tests, quizzes, packets throughout the year so that you do not have to try and cram a week before the test, because there is too much to know. You will eventually learn the six big ideas throughout the year, and these are the absolute majority of the AP test. You do not get a calculator on the AP multiple choice, so you do not get a calculator on the multiple choice section of any test this year. With this being said, there is still math on these so you need to be good at mental math. If you want to be successful, you need to do all of your homework, use the quizzes to help you for the tests, and try hard on the lab write ups because these are great grade boosters. Do not hold off studying until a night or two before the test because it will come back to haunt you. Lastly, it will be hard to stay focused when you have class here every day of the week, and notes will be from when class starts right up to the bell, so pay attention, do not chatter or sleep during notes, and stay off your phones. I will be honest; this class will be the hardest science class, or probably any class you have ever taken, but you will be proud of yourself once you have finished. Do not be one of those people who drops out at semester.

YOU SHOULD MAKE QUIZLETS, ACTUALLY DO YOUR HOMEWORK, AND MAKE A GROUP CHAT TO HELP EACH OTHER. EVERYONE IS STRUGGLING TOGETHER, AND IT’S EASIER TO HELP OTHERS THAN IGNORING THEM. CARE IN JANUARY AND FEBRUARY, EVEN IF YOU’RE IN A SLUMP. IT’LL SAVE YOU LATER. THE LABS AREN’T AS BAD AS THEY SEEM. DO THEM. THEY’RE GOOD GRADE BOOSTERS. 

- T.S.

And finally, this is the best kind of feedback I could hope for!

- J. S.
Objective: Establish a foundation of mathematic processes.

Chapter 1
Chemical Foundations

READ the Chapter: Annotate & fill in notes. Is there a picture? Note what makes it relevant (look at the captions in the book).

1.1 Chemistry: An Overview & 1.2 The Scientific Method

- Read & jot down the key concepts.
  - What are the 3 basic steps in the scientific method?
- Make sure you know the nuances of the vocabulary in 1.2
- For the rest of the packet, mark the starts of each section, 1.3, 1.4, etc...

Units of Measurement

- English system vs. *Metric System*

  Metric Prefixes:
  T _ _ G _ _ M _ _ k h D (base) d c m _ _ µ _ _ n _ _ p _ _ f

  *Complete list in table 1.2 (p.10)
SI system (see Table 1.1) – based on which measurement system?
- 7 “base” units
  - Can manipulate these 7 to get all others
- Volume is derived from length
  (Volume’s base unit is L)
  \[ V = l \cdot w \cdot h \]
  \[ = (1m)^3 = 1m^3 \]
  \[ = (10dm)^3 = 1000dm^3 \]

NOTE: 1dm³ = 1000cm³ = 1L

1cm³ = 1mL

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Uncertainty in Measurement

What’s each graduation (line) worth on this buret?

What’s the volume of the liquid?

Measurement ALWAYS has some degree of uncertainty. What does that uncertainty depend on?

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All measurements are obtained with a measuring device & are read by people

- A measurement ALWAYS has some degree of uncertainty
  - A measurement includes all the known digits and (how many?) uncertain digits.

- The certain & the uncertain digits together make up the significant figures of a measurement.
Precision =

Accuracy =

Types of Error
- Random Error =
- Systematic Error =

What are some examples of each?

Significant Figures – how to count?
- All non-zero numbers are significant
  Ex: 155.2 has 4 SF
- Leading Zeros: Zeros that precede all the nonzero digits are not significant (called a placeholder, makes the # smaller)
  Ex: 0.0034 has 2 SF
- Captive Zeros: Zeros that are sandwiched between two significant digits are significant
  Ex: 1.3002 has 5 SF
- Trailing Zeros: Zeros at the right end of a number are significant only if the number contains a decimal point.
  Ex: 9.600 has 4 SF, Ex: 96.200 has 3 SF
  Ex: 100 has 3 SF, Ex: 0.0004010 has 4 SF
Sig Fig EXCEPTIONS:

- **Exact Numbers**
  - Numbers not obtained with a measuring device (Ex: 8 apples, \(2\pi r\)) or are definitions (Ex: 1 in = 2.54 cm)
  - Assume they have an infinite number of SF

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Example A

How many SF in each of the following? (Underline/highlight them for each.)

- a) 12
- b) 1098
- c) 2001
- d) 2.001 \(\times 10^3\)
- e) 0.000101
- f) 1.01 \(\times 10^{-5}\)
- g) 1000.
- h) 22.04030

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Example B

Which of the following are exact numbers?

- a) The elevation of Breckenridge is 9600 ft
- b) There are 12 eggs in a dozen
- c) One yard is equal to 0.9144 m
- d) The announced attendance at a football game was 52,806 (based on ticket sales)
- e) In 1983, 1759 Ph.D.’s in chemistry were awarded in the U.S.
SF in Mathematical Operations

**Addition & Subtraction**
Answer has the same number of decimal places as the least precise measurement in the calculation

Why? Because of the uncertainty of the tools used to measure – if you're adding together 11 cm (± 1 cm) plus 2.87 cm (± 0.01 cm), you cannot know the hundredths place for sure when the uncertainty on the first instrument is ±1 cm!

**Multiplication & Division**
Answer has the same number of significant figures as the least precise measurement in the calculation

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Unit Conversions and Significant Figures

- **Crash Course Chemistry #2** (11:23)
- [Watch this video!](https://www.youtube.com/watch?v=XYZ123) - it's searchable on YouTube

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Example C
Perform the following operations & express the result to the correct number of SF

a) \( 97.381 + 4.2502 + 0.99195 = \)

b) \( 171.5 + 72.915 - 8.23 = \)

c) \( (0.102 \times 0.0821 \times 273) / 1.01 = \)

d) \( 0.14 \times (6.022 \times 10^{23}) = \)
Rules for Rounding with SF

- In a series of calculations, carry all extra digits to the final answer, THEN round.
  
  *See textbook disclaimer

- When rounding, (fill in…)
  - If < 5, preceding digit _________________
  - If ≥ 5, preceding digit _________________
  - Use only the first number to the _______ of the last significant figure.
    - Do not round sequentially!
    - Ex. Suppose 4.348 needs to be rounded to 2 SF:
      - rounds to =43
        (4 not high enough; do not round the 4 because of the 8, 8 is insignificant)

Example D

- Round each of the following to 3 SF and write your answer in scientific notation
  - a) 312.54
  - b) 0.0031254
  - c) 31,254,000
  - d) 0.31254
  - e) 31.254 x 10^{-3}

Example E

- Science fiction often uses nautical analogies to describe space travel. If the starship U.S.S. Enterprise is traveling at a warp factor 1.71, what is its speed in knots?

  - Useful info:
    - Warp 1.71 = 5.00 times the speed of light
    - speed of light = 3.00 x 10^8 m/s
    - 1 knot = 2000yd/hr, exactly
Learning to Solve Problems Systematically

- We will be doing this ALL YEAR!
- WHAT are your three questions to constantly ask with each problem?
- The answer for #3 is to look at units, units, UNITS!!

Objective: Establish a foundation of mathematical processes.

Dimensional Analysis

- Method of converting from one system of units to another
  - Make sure to read through the examples & UNDERSTAND THEM.
- See Appendix 6 for conversion factors

$$\begin{align*}
90 \text{ miles} &\quad 5280 \text{ feet} \\
1 \text{ hour} &\quad 3600 \text{ sec} = 1.3 \times 10^2 \text{ ft/sec}
\end{align*}$$

Temperature

Which unit(s) will we use most often?

<table>
<thead>
<tr>
<th>Fill in the table</th>
<th>Freezing Point of Water</th>
<th>Boiling Point of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fahrenheit, °F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celsius, °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelvin, K</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conversions:

$$\begin{align*}
T_F &= \frac{9}{5} T_C + 32 \\
T_K &= T_C + 273.15 \\
T_C &= \frac{5}{9} (T_F - 32) \\
T_C &= T_K - 273.15
\end{align*}$$
Objective: Establish a foundation of mathematical processes.

*Notice that the size of a Celsius degree is the SAME SIZE as a Kelvin degree*

Density

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

Units: g/cm$^3$ or g/mL

- Density is HUGE in chemistry!! We'll be using it a lot to find mass and/or volume of mixtures of solutions in the solutions unit.

- What do Chemists use density for?

Classification of Matter

- Matter is...
  - States of Matter
  - Mixtures vs. Pure Substances
Matter Flow Chart – copy Fig. 1.14
Also note the definition for each term

Separation of Mixtures

- **Distillation**
  - Separation based on boiling point
  
  *Describe how this works ➔*

More Separation of Mixtures…

- **Filtration** =

- **Chromatography**
  - Includes a mobile phase (liquid or gas) & stationary phase (solid)
  - Separation based on…
Objective: Establish a foundation of mathematical processes.

Paper Chromatography

Black line

Black/brown-ish

Blue

Red blend

Yellow

Answers to Examples:

- Example A: 2, 4, 4, 3, 4, 7
- Example B: b, c, & e
- Example C: 102.623, 236.2, 2.26, 8.4 x 10^2
- Example D: 3.13 x 10^4, 3.13 x 10^-4, 3.13 x 10^7, 3.13 x 10^-1, 3.13 x 10^-2
- Example E: 2.95 x 10^9 knots

Remember to do the End of Chapter problems!
Questions: # 29, 32-33, 37, 39, 43, 47-48, 52, 55, 71-73, 79, 81, 87-88
Chapter 2
Atoms, Molecules, and Ions

READ the Chapter: Annotate & fill in notes. Is there a picture? Note what makes it relevant (look at the captions in the book).

Mark the start of each section, 2.1, 2.2, etc…

Fundamental Chemical Laws

- Law of _______________________
  -mass is neither created or destroyed
- Law of _______________________
  -Every compound has the same proportion of elements by mass
  -Ex: CuCO₃ is always 5.3 parts Cu to 4 parts O to 1 part C (by mass)

Fundamental Chemical Laws, Cont’d

- Law of _______________________
  -When two elements make many compounds (Ex: CO and CO₂), the ratios of the masses of the second element that combine with 1g of the first element are small whole numbers.
Illustrating the Law of Multiple Proportions

<table>
<thead>
<tr>
<th>Mass of nitrogen that combines with 1.0000g oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound A 1.750 g</td>
</tr>
<tr>
<td>Compound B 0.8750 g</td>
</tr>
<tr>
<td>Compound C 0.4375 g</td>
</tr>
</tbody>
</table>

- There are three possible ratios (A:B, B:C, and A:C).
- All 3 ratios give small whole numbers
  - A:B = 1.750/0.8750 = 2:1
  - B:C = 0.8750/0.4375 = 2:1
  - A:C = 1.750/0.4375 = 4:1

The Fundamental Laws

- Crash Course Chemistry #3 (10:58)
- !!Watch this video!! - it's searchable on YouTube

Dalton’s Atomic Theory (1808)

1. Each element is made of ___________
2. Atoms of a given element are ___________
3. Compounds are formed when ___________ ___________ combine
4. Chemical reactions involve the ___________ of atoms. The atoms themselves ___________ changed.

- Read & Describe how we figured out absolute formulas for compounds; two scientist’s contributions
Early Experiments to Characterize the Atom

**The Electron** - discovered by J.J. Thompson with a _______ ______ Tube (late 19th century)
- Partially evacuated tube with metal electrodes on either end
- High voltage was applied to the tube

How does it work?

Thompson’s work, cont’d
- When the voltage was applied, a “ray” or “cathode ray” was produced at the negative electrode (cathode)
- An electric field was applied, and the cathode ray was repelled by the negative pole of the applied electric field

J.J. Thompson’s Conclusions
- Thompson postulated the “ray” was….(fill in!)
  - now called ____________
  - ____________ are negatively charged with a charge to mass ratio of ____________ C/g
- All atoms contain ____________
- Knew atoms were neutral, so assumed atoms also had positive charge (Plum Pudding Model)
J.J. Thompson’s Plum Pudding Model

- Knew atoms were neutral, so assumed atoms also had ___________ ___________

Early Experiments to Characterize the Atom, Cont’d

The Electron, cont’d

Robert Millikan & Oil Drop Experiment (1909)
- Determined…

- With this value & the charge-to-mass ratio from Thompson, he calculated the mass of an electron to be $9.11 \times 10^{-31}$ kg

Q: How did the Oil Drop Exp. Work?

- Atomizer to produce oil droplets
- Oil spray
- Microscope
- Electrically charged plates
- X rays produce charges on the oil drops
Radioactivity

- 3 types of emission:
  - \( \alpha \) (Helium nucleus)
  - \( \beta \) (High-speed electron)
  - \( \gamma \) (High-energy "light")
- Now known to be more types of radiation

The Nuclear Atom

- Ernest Rutherford & the Gold Foil Experiment
  - What was supposed to happen? What actually happened? See next slide…

Gold Foil Experiment, cont’d

- If Thompson’s model were true, then…
  - But that’s not what happened. Some alpha particles…
    - but many particles…
- Conclusion: The atom has a small, positively charged nucleus
The Nucleus & Atoms

- Crash Course Chemistry #1 (10:11)
- Watch this video! - it's searchable on YouTube

Objective: Establish a foundation of mathematical processes.

Modern View of Atomic Structure

- Current model of the atom
  - Mass & charge of subatomic particles – fill in

<table>
<thead>
<tr>
<th>Particle</th>
<th>Mass</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron</td>
<td>9.11 x 10^{-31} kg</td>
<td>1^-</td>
</tr>
<tr>
<td>Proton</td>
<td>1.67 x 10^{-27} kg</td>
<td>1^+</td>
</tr>
<tr>
<td>Neutron</td>
<td>1.67 x 10^{-27} kg</td>
<td>none</td>
</tr>
</tbody>
</table>

Modern View of Atomic Structure, cont’d

- Isotopes = Atoms with same # of ________, different # of ________.
Modern View of Atomic Structure, cont’d

- **Atomic Number**, \( Z = 6 \) \( ^6 \text{C} \)
  Equal to the number of protons

- **Mass Number**, \( A = 12 \) \( ^{12} \text{C} \)
  Equal to the sum of protons and neutrons

Together, they make up **Atomic Notation**: \( \frac{A}{Z} X \)

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**Example A** Complete the following table:

<table>
<thead>
<tr>
<th>Symbol</th>
<th># of p</th>
<th># of n</th>
<th># of e</th>
<th>Net charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33</td>
<td>42</td>
<td></td>
<td>3+</td>
</tr>
<tr>
<td>( ^{126}_{52} \text{Te}^2- )</td>
<td>16</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>123</td>
<td></td>
<td>1+</td>
</tr>
<tr>
<td>( ^{195}_{78} \text{Pt} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Molecules and Ions**

- Two MAJOR types of chemical bonds – *Describe each!*
  1. Covalent
  2. Ionic

  3. another bond type: Metallic (*look up, not addressed here in the book*)
What types of bonding are displayed in each?

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**The Periodic Table**

- Crash Course Chemistry #4 (11:21)
- !!Watch this video!! - it’s searchable on YouTube

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**An Introduction to the Periodic Table:**

**TYPES OF ELEMENTS:**

- **Metals**
  - Tend to lose electrons
  - Malleable, ductile, good conductors, luster
  - More metallic character as you move down a family

- **Non-metals**
  - Tend to gain electrons
  - Often covalently bonded
  - More non-metallic character as you move up a family

- **Metalloids**
  - Share properties of metals and non-metals
  - All elements on the “zig-zag” except Al
Periodic Basics:

Label the following: metals, nonmetals, metalloids, and the families from Fig 2.19.

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Covalent Bonding

- Result of sharing of e⁻ between atoms
- Called “molecules”
- Nm + Nm (multiple nonmetals together)
- Ways to represent:
  - Chemical formula (Ex: CO₂)
  - Structural formula (O=C=O)
  - Space-filling/Ball-and-stick model

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Ionic Bonding

- Result of attraction between oppositely charged ions
- M + Nm or any polyatomic ion
- Cation & anion
- Called “ionic solids”, “crystals” or a “salt”
- Polyatomic ions (see Table 2.5 for common polyatomics ➔ Memorizing these names/ions will make your AP life infinitely better!)
Naming Simple Compounds

- Naming Ionic compounds
  - Cation first, anion second
  - Cation takes its own name
    - If cation can form multiple ions, use roman numeral to indicate charge
    - Old system: “-ic” vs. “-ous” suffixes
  - Anion gets “-ide” ending
    - If the anion is a polyatomic ion, its name does not change

Common Charges of Ions

Naming Simple Compounds, cont’d

- Naming Covalent compounds
  - First element keeps its name
  - Second element picks up –ide ending
  - When in doubt, least electronegative element is written first
  - Use prefixes to identify number of atoms of each element
    - “mono” is never used on the first element
    - Q: What are the prefixes? Record at right…
Formulas from Names

- For ionics, use "criss-cross" method*
  - "works most of the time – be sure to check the charge on the anion. OVERALL CHARGE = ZERO
  - Example: Co$_2$O$_3$ = cobalt (III) oxide, b/c O$^{2-}$
  - PbBr$_2$ = lead (II) bromide, b/c Br$^{-1}$
  - PbS$_2$ = lead (IV) sulfide, b/c S$^{2-}$
- For covalents, look at prefixes
  - Example: dinitrogen tetroxide = N$_2$O$_4$

**Acids/Rules for Naming**

- Acid = molecule with one or more H$^+$ ions attached to an anion
- Two systems of naming:
  - If anion does not contain oxygen, use prefix "hydro-" and suffix "-ic".
  - If anion contains oxygen, use suffix "-ic" or "-ous"
    - If anion ends in "-ate", use suffix "-ic"
    - If anion ends in "-ite", use suffix "-ous"

*** CHAPTER 4 IN "Chem Equations Handbook"***

Practice for Chapter 2…

- CRACK OPEN that Chemical Equations Handbook! Chapters 1 – 4 will help you SO MUCH in this upcoming year!

Answers to Example A, left → right across each row:

- As: 30
- S: 80
- Te: 80
- 78, 117, 78, 0

Don’t forget the end-of-Chapter Problems from the summer assignment sheet!