# ERNEST RIGHETTI HIGH SCHOOL SCIENCE DEPARTMENT

## AP Chemistry – Policies & Summer Assignment 2024-25

Instructor: Mr. Scott Davis  Email: **sdavis@righetti.us**

**KEEP THIS PAPER!**

Join the REMIND APCHEM2023-24 group: Text **@rhsap25** to either 81010 or (512) 337-4858
Through Remind, you will be able to communicate with me over the summer and beyond and I will be able to send reminders and updated information.

AP Summer Assignment/Help: **https://scottdavis.wixsite.com/sciencedavis/apsummerassignmenthelp**

Dear AP Students & Parents,

Welcome to AP Chemistry! This is a College Board approved course offered to **juniors & seniors** who wish to continue their studies in chemistry and prepare for taking the spring Advanced Placement Exam in chemistry. A student in AP Chemistry should have successfully completed a year of high school general chemistry with a B grade or better and be enrolled in or completed Algebra II. The content covered in AP Chem coincides with a college level chemistry class. As an AP student, you are expected to show initiative, work independently and collaboratively when appropriate, become a willing problem solver, and submit quality work at all times. This two semester class is a second year of chemistry, but in order to adequately prepare for this course and the AP exam, you will need to review and complete the following problems in this packet. You are expected to remember the concepts covered in your first year of chemistry (CES or equivalent). The AP Chemistry exam is **very difficult**. Study guides are a good thing to invest in.

**WHAT YOU WILL NEED TO DO BEFORE THE FIRST DAY OF SCHOOL NEXT AUGUST:**

1. **You and your parent** need to **sign the attached stub** and **return it to me via screenshot to the remind or by email before June 5.** This is your statement of agreement that you are committing to put forth the effort and responsibility to do your best and take responsibility for the content of this AP class. Your parent is pledging that they will support you in your endeavor to succeed and understands that this is a college level course.
2. **Before leaving for summer break, go to the library and check out a book.** That said, it is also expected that you continue to use online resources that I provide and that you can search up online to answer questions and complete assignments I give to you via the remind & website. I don't know how much we will use the book in class but it is a good resource.
3. **Complete all assigned problems** from the website above. You are expected to answer all verbal questions in complete sentences and show your work for all mathematical calculations. Your answers should a) tell the answers in a way that also provides the questions, b) be thorough and complete, & c) should have appropriate units and labels. **ALL PROBLEMS FROM THESE PAGES ARE DUE AT THE BEGINNING OF THE SCHOOL YEAR IN AUGUST!! DON'T WAIT UNTIL AUGUST TO BEGIN THEM! BE A SELF STARTER & TAKE INITIATIVE!** ☺
4. You are responsible to maintain your memorization of CES concepts including review problems as well as the **list of memorized ions, the strong acids & bases, and familiarize yourself with the solubility rules (attached).**
5. Use the REMIND to ask questions from me, but in the summer, be prepared for me to take a day + to respond. ☺
6. **BRING YOUR COMPLETED WORK TO SCHOOL THE FIRST WEEK SO YOU MAY EARN CREDIT AND BE PREPARED TO KEEP ON GOING! GOOD LUCK! YOU CAN DO IT!** ☺

## SOLUBILITY RULES

*Always soluble:*

alkali metal ions ($Li^+$, $Na^+$, $K^+$, $Rb^+$, $Cs^+$), $NH_4^+$,
$NO_3^-$, $ClO_3^-$, $ClO_4^-$, $C_2H_3O_2^-$, $HCO_3^-$

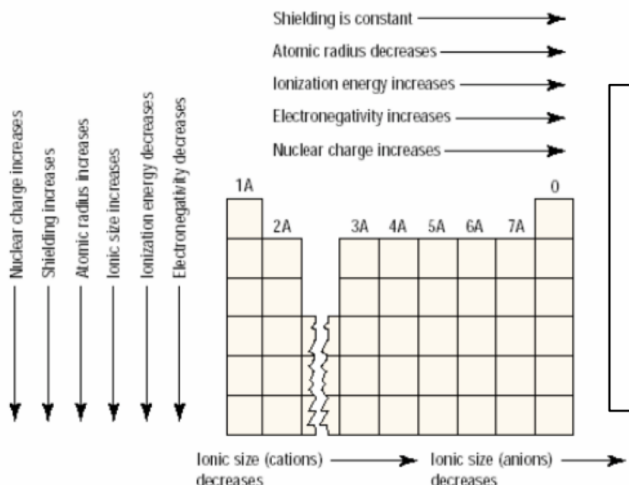
*Generally soluble:* (mnemonics)

| | |
|---|---|
| $Cl^-$, $Br^-$, $I^-$ | Soluble except $Ag^+$, $Pb^{2+}$, $Hg_2^{2+}$ (AP/H) |
| $F^-$ | Soluble except $Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$, $Pb^{2+}$, $Mg^{2+}$ (CBS-PM) |
| $SO_4^{2-}$ | Soluble except $Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$, $Pb^{2+}$ (CBS/PBS) |

*Generally insoluble:*

| | |
|---|---|
| $O^{2-}$, $OH^-$ | Insoluble except alkali metal ions and $NH_4^+$<br>$Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$ (CBS) somewhat soluble |
| $CO_3^{2-}$, $PO_4^{3-}$, $S^{2-}$, $SO_3^{2-}$, $C_2O_4^{2-}$, $CrO_4^{2-}$ | Insoluble except alkali metals and $NH_4^+$ |

## PERIODIC TRENDS/PERIODICITY



Memorization: Do what you can to memorize ions form this list…these are VERY common & used on the exam:

Reminder: ~ous ending on an ion means the "smaller" charge and ~ic ending means the larger one.
Ex: ferrous = $Fe^{2+}$ and ferric = $Fe^{3+}$

## IONS LIST

| | | | | | |
|---|---|---|---|---|---|
| acetate | $C_2H_3O_2^-$ | ferric | $Fe^{3+}$ (yellow) | oxalate | $C_2O_4^{2-}$ |
| aluminum | $Al^{3+}$ | ferrous | $Fe^{2+}$ (green) | oxide | $O^{2-}$ |
| ammonium | $NH_4^+$ | fluoride | $F^-$ | perbromate | $BrO_4^-$ |
| barium | $Ba^{2+}$ | hydrogen | $H^+$ | perchlorate | $ClO_4^-$ |
| bicarbonate | $HCO_3^-$ | hydronium | $H_3O^+$ | periodate | $IO_4^-$ |
| bisulfate | $HSO_4^-$ | hydroxide | $OH^-$ | permanganate | $MnO_4^-$ *(purple)* |
| bisulfide | $HS^-$ | hypobromite | $BrO^-$ | peroxide | $O_2^{2-}$ |
| bisulfite | $HSO_3^-$ | hypochlorite | $ClO^-$ | phosphate | $PO_4^{3-}$ |
| bromate | $BrO_3^-$ | hypoiodite | $IO^-$ | phosphide | $P^{3-}$ |
| bromide | $Br^-$ | iodate | $IO_3^-$ | phosphite | $PO_3^{3-}$ |
| bromite | $BrO_2^-$ | iodide | $I^-$ | potassium | $K^+$ |
| calcium | $Ca^{2+}$ | iodite | $IO_2^-$ | silver | $Ag^+$ |
| carbonate | $CO_3^{2-}$ | lead | $Pb^{2+}$ | sodium | $Na^+$ |
| chlorate | $ClO_3^-$ | lithium | $Li^+$ | stannic | $Sn^{4+}$ |
| chloride | $Cl^-$ | magnesium | $Mg^{2+}$ | stannous | $Sn^{2+}$ |
| chlorite | $ClO_2^-$ | manganese | $Mn^{2+}$ | strontium | $Sr^{2+}$ |
| chromate | $CrO_4^{2-}$ (yellow) | mercuric | $Hg^{2+}$ | sulfate | $SO_4^{2-}$ |
| chromium | $Cr^{3+}$ | mercurous | $Hg_2^{2+}$ | sulfide | $S^{2-}$ |
| cupric | $Cu^{2+}$ (blue) | nickel | $Ni^{2+}$ (green) | sulfite | $SO_3^{2-}$ |
| cuprous | $Cu^+$ (green) | nitrate | $NO_3^-$ | thiocyanate | $SCN^-$ |
| cyanide | $CN^-$ | nitride | $N^{3-}$ | thiosulfate | $S_2O_3^{2-}$ |
| dichromate | $Cr_2O_7^{2-}$ (orange) | nitrite | $NO_2^-$ | zinc | $Zn^{2+}$ |

**Acids & Bases were generally not discussed in general chemistry yet…but there are only a few to KNOW THE NAMES/FORMULAS for…the STRONG ACIDS & STRONG BASES here:**

| 6 Strong Acids | 6 Strong Bases |
|---|---|
| $HClO_4$ – perchloric acid | LiOH – lithium hydroxide |
| HCl – hydrochloric acid | NaOH – sodium hydroxide |
| HBr- hydrobromic acid | KOH – potassium hydroxide |
| HI – hydroiodic acid | $Ca(OH)_2$ – calcium hydroxide |
| $HNO_3$ – nitric acid | $Sr(OH)_2$ – strontium hydroxide |
| $H_2SO_4$ – sulfuric acid | $Ba(OH)_2$ – barium hydroxide |

## SQUARE of EQUALITY

These things are ratios for Stoichiometry calculations.

1 mol = $6.022 \times 10^{23}$ rp,fu,atoms,particles

II □ II

$g_{(from\ the\ pt)}$ = 22.4 L $_{(for\ gases\ at\ STP)}$

## Other things to remember from general chemistry:

**BINARY FORMULA NAMING:**
Ionic compounds: **metal (**charge as Rom. numeral if has many**) anion**
Molecule: (di,etc if more than 1)**1st element mono**,etc **2nd element**
*Prefixes: mono, di,tri,tetra,penta,hexa,hepta,octa,nona,deca…*

**Stoichiometry:** (shown for gramsa →gramsB…use any or part)
$\frac{g_a}{|g_{a\ pt}} \frac{|1 mol_a|}{|Y\ mol_a|} \frac{X\ mol_B|}{1\ mol_B} \frac{g_{B\ pt}}{}$. Assuming X & Y are coefficients of the bal. rxn.

**Molarity** = mol/Liters and is the unit of concentration
$M_1V_1 = M_2V_2$

**%Yield** = actually got / theoretical x 100
**%Composition** = mass of all of 1 type of atom / mass of molecule x100
**Limiting Reagent:** check stoich to determine which one will be used up in the reaction…that is the LR to use for all calculations.
**Specific Heat:** $Q = m_{ass} \bullet Cp \bullet \Delta T$ $Heat_{lost} = Heat_{gained}$

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## AP Chemistry – Policies & Summer Assignment 2024-25

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AP CHEMISTRY COURSE POLICIES 2023-2024 – Mr. Scott Davis - Room 112 – sdavis@smjuhsd.org

**REQUIRED MATERIALS –**

◆Text: Jespersen & Hyslop, *Chemistry: The Molecular Nature of Matter, 7th ed.* – Wiley & Sons, 2013. Bring when asked. ◆Scientific calculator (mandatory) ◆A quadrille composition book for laboratory reports ◆Computer/tablet for some laboratory data processing. You may be asked to use logger pro. We will be able to download it to your tablet later. ◆Pens/Pencils/Notes/notebook, etc… ⃠☎ Your cell phone should be off & away during class time.

**COURSE INFORMATION –**

AP Chemistry is a rigorous year-long college level laboratory science course designed to familiarize the student with the principles of matter and its changes and to help prepare the student for further studies in high school and post high school science. By signing up for AP Chemistry, you are expected to take the College Board's AP Chemistry Exam in May. Because of the AP status, this course counts for a bump in g.p.a. points.

**GRADING & OTHER INFORMATION –**

Grades are usually based upon Chapter tests & quizzes (~45%), laboratory reports (~25%), homework (~15%), and the final exam (~15%). Grades may be calculated using weighted averages. A final may be given at the end of the semester and will be comprehensive. Your work should be done as neatly and legible as possible to earn maximum scores. Class grades are assigned based upon the district scale: 90-A 80-B 70-C 60-D and below 60% is failing. Your grade should be an accurate reflection of your mastery of the chemical concepts and is therefore not subject to negotiations at any time. Stay current with your studies and spend the appropriate amount of time on chemistry and your grade will show it.

**Tests** – Tests will be given at the completion of a chapter/concept. They are always announced in class ahead of time. Announced and unannounced quizzes may be given periodically. You must have a scientific calculator separate from your cellular device as cell phone usage during a test or quiz will result in a zero on the exam. Talking while any students are engaged in quiz/test taking will result in a loss of points. Academic integrity among an AP student is not only expected and encouraged, but is a requirement. Those whose academic integrity doesn't meet standard may fail.

**Laboratories –** Laboratories are an integral part of AP Chemistry and may be worth up to 50 points each. Each student must complete his/her own laboratory in order to reach the course objectives and the College Board's requirements for AP. The laboratory format will be provided at the start of the school year, but each student must have a quadrille bound composition book for labs. **Lab safety is always number one in a chemistry class, and as such, there is to be no messing around or inventing an unauthorized procedure.** Removal from a lab will cost major class points and seriously inhibit earning a good grade. Be safe and be on task.☺

**Homework –** Homework is assigned many nights and is due the next day before the tardy bell rings unless otherwise instructed. Homework that involves mathematical calculations may be done in pencil, but must have work shown completely…even if a calculator is used to determine a final answer. Questions/concept review problems should be written in a complete sentence that not only provides the answer but indicates the question as well. If you are having difficulty with homework, attempt all of it and be prepared to submit your attempts and then ask questions during class or make arrangements to get help. Nightly homework assignments should be posted on the website.

**Make-ups –** Absences in AP Chemistry are very detrimental. ***Parents, please do your best*** to not schedule appointments or absences for your child during the AP Chem hour. If you are absent, it is your responsibility to make arrangements with the instructor to make up laboratories and work. If you know in advance you will be gone, please inform your lab partners and the instructor so pre-absence work may be given. It is a good idea to exchange cell phone numbers with your lab partners with whom you may catch up on what happened in class when you were gone. **TEST MAKE-UPS** happen on a designated date within the grading period. There may be ONE make-up test for each of the 6 week grading periods which will cover all material from the entire grading period. This grade will replace a zero on any missing tests or may improve a lowest score as a retake on tests taken in that 6 week period. Only excused absences are eligible for replacement of a zero grade.

**Originality of work – Academic integrity again is important**. Only work which reflects the author's actions are acceptable in AP Chem. Cheating, etc… will result in a loss of points and potentially further disciplinary action.

**Citizenship/Participation Grade –** Students should adhere to all classroom, laboratory, safety, and school policies. Any student falling short of this may be warned or removed from class with further corrective action to follow. Refer to school handbooks and discipline policies. Be on time, be ready, and be enthusiastic about your education! ☺

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**Notebooks/Notes –** All students should maintain a notebook with notes and a place for handouts. Notebooks may be collected for grading this year, so organization is important and maintaining work is critical. Daily review of notes and problems will help master the content before the exams. Keep all AP work and assignments until August of 2025 after you have received both your ERHS grades and your AP scores.

**Classroom Expectations –** Enter the room quietly and ready to turn in homework and begin the lesson. Be in your seat quiet and ready before the bell rings. Say good bye to outside class friends before coming in to the room, even during the passing periods. Be in your seat, prepared, with positive attitude and a willing ness to TRY before the tardy bell rings. At the conclusion of the period, the instructor will excuse you, not the ringing of the bell. Please be in your seats demonstrating readiness for dismissal. During laboratories, appropriate lab safety clothing and shoes as well as other safety apparatus must be worn at all times. Labs are a time for investigation, not socialization, so please remain focused on the task at hand. Remember that while lab duties are often shared, each student must maintain his/her own lab report and original work. **Help maintain a distraction-free working/learning environment by not talking during them.** Be ready to respond to questions appropriately.

Your personal belongings including work for other classes, make up, cell phones, and food should remain away during class time. **Chemistry classrooms have vapors and precipitates that are not good to come into contact with food. PLEASE CONSUME AND LEAVE YOUR UN-PACKAGED FOOD outside of chemistry class!☺** Help keep the classroom and laboratory safe and clean and only write on your personal belongings. Laboratory materials may become the financial responsibility of the student when checked out for use. Be careful with the equipment!

**AP EXAM-** The object of this course is to help prepare students to take the College Board's Advanced Placement Exam in Chemistry in May of the academic year. The exam is 3 hours & 15 minutes long and contains 60 multiple choice questions worth 50% of the score and 7 free response (3 long answer and 4 short answer) questions that are combined worth 50% of the score. An overall score is assigned 1-5. Scores of 3-5 are considered passing by colleges and universities which will assign unit credits for such scores. Students will be given periodic table resources, formula sheets, and may use an approved scientific calculator on the free response portion only. Check out the college board's website for information about the test. ***It is expected that as a student who has signed up for this AP class, you are planning to take the exam.*** The district has funded AP exams in the past couple of years, but plan to pay until word is announced that the fee is covered. The chemisty exam is notoriously hard and we will do our best to prepare but individual preparation work and personal study time is important to be really prepared for the exam.

LABORATORY SAFETY – Students will receive a laboratory safety contract in the beginning of the year that outlines proper chemistry lab safety procedures and equipment. Students and parents will be asked to acknowledge receipt and understanding of those guidelines. In general…LAB SAFETY IS ALWAYS NUMBER ONE!

Please fill out and return the portion below to the instructor before **June 5**. Keep the above for your notebook.
DO YOUR SUMMER ASSIGNMENT AND BE READY WITH IT THE FIRST DAYS OF SCHOOL! ☺

Cut along the dotted line and return the stub to your instructor before June 5 or sign and submit a picture of your filled out form via Remind or email!

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**As a student of AP Chemistry, I have read the expectations and am committing now to follow through with my studies. I acknowledge my responsibility to complete my summer assignment and work to make a positive contribution to my studies in chemistry. I will make every effort to learn and prepare chemistry for the AP exam.**

**STUDENT NAME:**_____ **Student Signature**_____

**As a parent of an AP student,** I recognize the importance of my child's academics in this course and will support my child as much as possible including encouragement, help, and materials needed for their success. I understand the policies presented in this packet and will remind my child to work on his/her summer assignments.

PARENT NAME:_____ CIRCLE ONE PLEASE father/mother Parent Signature_____

2 Versions of the Periodic Table: The one you used in RHS Chemistry:

| 1 | | | | | | | | | | | | | | | | | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydrogen 1 1 H 1.00794 | 2 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | Helium 2 He 4.002602 |
| Lithium 3 1 Li 6.941 | Beryllium 4 2 Be 9.01218 | | | | | | | | | | | Boron 5 3 B 10.811 | Carbon 6 4,2 C 12.0107 | Nitrogen 7 N 14.00674 | Oxygen 8 O 15.9994 | Fluorine 9 F 18.9984 | Neon 10 Ne 20.1797 |
| Sodium 11 1 Na 22.98977 | Magnesium 12 2 Mg 24.305 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Aluminum 13 3 Al 26.981538 | Silicon 14 4 Si 28.0855 | Phosphorus 15 P 30.97376 | Sulfur 16 S 32.065 | Chlorine 17 Cl 35.453 | Argon 18 Ar 39.984 |
| Potassium 19 1 K 39.0983 | Calcium 20 2 Ca 40.08 | Scandium 21 3 Sc 44.9559 | Titanium 22 4,3 Ti 47.88 | Vanadium 23 5-2 V 50.9415 | Chromium 24 6,3,2 Cr 51.9961 | Manganese 25 7,6,4 Mn 54.93805 | Iron 26 2,3 Fe 55.845 | Cobalt 27 2,3 Co 58.9332 | Nickel 28 2,3 Ni 58.6934 | Copper 29 2,1 Cu 63.546 | Zinc 30 2 Zn 65.409 | Gallium 31 3 Ga 69.723 | Germanium 32 4 Ge 72.64 | Arsenic 33 3,5 As 74.9216 | Selenium 34 Se 78.96 | Bromine 35 Br 79.904 | Krypton 36 Kr 83.798 |
| Rubidium 37 1 Rb 85.4678 | Strontium 38 2 Sr 87.62 | Yttrium 39 3 Y 88.9059 | Zirconium 40 4 Zr 91.22 | Niobium 41 5,3 Nb 92.90638 | Molybdenum 42 6-2 Mo 95.94 | Technetium 43 7 Tc [98] | Ruthenium 44 2,3,4 Ru 101.07 | Rhodium 45 2,3,4 Rh 102.9055 | Palladium 46 2,4 Pd 106.42 | Silver 47 1 Ag 107.8682 | Cadmium 48 2 Cd 112.411 | Indium 49 3 In 114.818 | Tin 50 4,2 Sn 118.710 | Antimony 51 3,5 Sb 121.760 | Tellurium 52 -2,4,6 Te 127.60 | Iodine 53 I 126.9045 | Xenon 54 Xe 131.293 |
| Cesium 55 1 Cs 132.9054 | Barium 56 2 Ba 137.33 | 57 - 71 | Hafnium 72 4 Hf 178.49 | Tantalum 73 5 Ta 180.9479 | Tungsten 74 6-2 W 183.84 | Rhenium 75 7,6,4 Re 186.207 | Osmium 76 2,3,4 Os 190.23 | Iridium 77 2,3,4 Ir 192.217 | Platinum 78 2,4 Pt 195.078 | Gold 79 3,1 Au 196.96655 | Mercury 80 2,1 Hg 200.59 | Thallium 81 3,1 Tl 204.3833 | Lead 82 4,2 Pb 207.2 | Bismuth 83 3,5 Bi 208.980 | Polonium 84 4,2 Po [209] | Astatine 85 At [210] | Radon 86 Rn [222] |
| Francium 87 1 Fr [223] | Radium 88 2 Ra 226.0254 | 89-103 | Rutherfordium 104 4,3 Rf [261] | Dubnium 105 5,4 Db [262] | Seaborgium 106 6,5,4 Sg [266] | Bohrium 107 7-3 Bh [264] | Hassium 108 8-1 Hs [269] | Meitnerium 109 6-1 Mt [268] | Darmstadtium 110 6-1 Ds [271] | Roentgenium 111 3,1 Rg [272] | Copernicium 112 4,3 Cn [277] | Nihonium 113 1 Nh [286] | Flerovium 114 2 Fl [289] | Moscovium 115 3,1 Mc [289] | Livermorium 116 4,2 Lv [293] | Tennessine 117 ? Ts [293] | Oganesson 118 Og [294] |

Elements with hollow letters are created.
Shaded are liquid at room temperature.

Key: Element Name, Atomic Number, Oxidation #s, Symbol, Atomic Weight

| Lanthanum 57 3 La 138.9055 | Cerium 58 3,4 Ce 140.116 | Praseodymium 59 3,4 Pr 140.90765 | Neodymium 60 3 Nd 144.24 | Promethium 61 3 Pm [145] | Samarium 62 3,2 Sm 150.36 | Europium 63 3,2 Eu 151.964 | Gadolinium 64 3 Gd 157.25 | Terbium 65 3,4 Tb 158.9253 | Dysprosium 66 3 Dy 162.50 | Holmium 67 3 Ho 164.930 | Erbium 68 3 Er 167.259 | Thulium 69 3,2 Tm 168.934 | Ytterbium 70 3,2 Yb 173.04 | Lutetium 71 3 Lu 174.967 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Actinium 89 3 Ac [227] | Thorium 90 4 Th 232.038 | Protactinium 91 5,4 Pa 231.0359 | Uranium 92 6-3 U 238.0289 | Neptunium 93 6-3 Np [237] | Plutonium 94 6-3 Pu [244] | Americium 95 6-3 Am [243] | Curium 96 3 Cm [247] | Berkelium 97 4,3 Bk [247] | Californium 98 3 Cf [251] | Einsteinium 99 Es [252] | Fermium 100 Fm [257] | Mendelevium 101 Md [258] | Nobelium 102 No [259] | Lawrencium 103 Lr [262] |

The one you will use for the AP Chemistry Exam & all of our class exams:

# PERIODIC TABLE OF THE ELEMENTS

| 1 H 1.008 | | | | | | | | | | | | | | | | | 2 He 4.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 Li 6.94 | 4 Be 9.01 | | | | | | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 |
| 11 Na 22.99 | 12 Mg 24.30 | | | | | | | | | | | 13 Al 26.98 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.06 | 17 Cl 35.45 | 18 Ar 39.95 |
| 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 54.94 | 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 (266) | 107 Bh (264) | 108 Hs (277) | 109 Mt (268) | 110 Ds (271) | 111 Rg (272) | | | | | | | |

| | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lanthanide Series | Ce 140.12 | Pr 140.91 | Nd 144.24 | Pm (145) | Sm 150.4 | Eu 151.97 | Gd 157.25 | Tb 158.93 | Dy 162.50 | Ho 164.93 | Er 167.26 | Tm 168.93 | Yb 173.04 | Lu 174.97 |
| | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |
| †Actinide Series | Th 232.04 | Pa 231.04 | U 238.03 | Np (237) | Pu (244) | Am (243) | Cm (247) | Bk (247) | Cf (251) | Es (252) | Fm (257) | Md (258) | No (259) | Lr (262) |