Things to Know for AP SkyviewChem

Things to Memorize

The following should be memorized. Not like you memorized the capital of Michigan or Turkey but the way you've memorized your birthday. Instantaneous recall is the standard you want to achieve. Don't dwell on anyone's opinion about the value of memorization, just do it. These things will not be the answers to AP questions but will lead you to the answers.

1. Ions – See the list below with the ions to memorize.
2. Solubility Rules – These are for ionic compounds and are not just about dissolving but about dissociating into ions. Chemically the difference in these two is shown by sugar and salt. $C_6H_{12}O_{6(s)} \rightarrow C_6H_{12}O_{6(aq)}$ while $NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$.
3. Common acids and bases – know which acids and bases are strong and which are considered weak
4. Assigning Oxidation States – This is the **imaginary** charge an atom has in a compound.
5. Oxidation and Reduction – know your strong oxidizing agents and strong reducing agents and the products which form from these reactions
6. Intermolecular Forces – know the different types and strengths
7. Organic Chemistry – know how to name simple organic compounds (ie ethane) and the main functional groups
8. Colors – know the colors of certain elements they are dissolved as ions. We will see some of these colors throughout the year in lab, and you can look them up on line.

Procedures to Practice

This short list of little skills is needed to solve problems.

1. Common Ions

Positive ions (cations)

+1 Charge

ammonium (NH_4^+)
copper (I) or cuprous (Cu^+)
hydrogen ($H^{+)}$ "proton"
hydronium ion (H_3O^+)
silver (Ag_+)
Group 1 (Li^+, Na^+, K_+, Rb^+, Cs^+, Fr^+)

+2 Charge

cadmium (Cd^{2+})
chromium (II) or chromous (Cr^{2+})
cobalt(II) or cobaltous (Co^{2+})
copper(II) or cupric (Cu^{2+})
iron(II) or ferrous (Fe^{2+})
lead(II) or plumbous (Pb^{2+})
manganese(II) or manganous (Mn^{2+})

Negative ions (anions)

-1 Charge

acetate ($C_2H_3O_2^-$)
cyanide (CN^{-1})
dihydrogen phosphate ($H_2PO_4^-$)
hydrogen carbonate or bicarbonate(HCO_3^-)
hydrogen sulfate or bisulfate (HSO_4^-)
hydroxide (OH^-)
nitrate (NO_3^-), nitrite (NO_2^-)
perchlorate (ClO_4^-), chlorate (ClO_3^-), chlorite (ClO_2^-), hypochlorite (ClO^-)
permanganate (MnO_4^-)
Group 17, Halogens (F^-, Cl^-, Br^-, I^-)
thiocyanate (SCN^-)

Mercury(I) or mercurous ($Hg2^{2+}$)
Mercury(II) or mercuric (Hg^{2+})
nickel (Ni^{2+})
tin(II) or stannous (Sn^{2+})
zinc (Zn^{2+})
Group 2, Alkaline Earth Metals
(Be^{2+},Mg^{2+},Ca^{2+},Sr^{2+},Ba^{2+},Ra^{2+})

-2 charge

carbonate (CO_3^{2-})
Chromate (CrO_4^{2-})
dichromate($Cr_2O_7^{2-}$)
Hydrogen phosphate (HPO_4^{2-})
oxalate ($C_2O_4^{2-}$)

oxide (O^{2-})
peroxide (O_2^{2-})
sulfate (SO_4^{2-})
sulfite (SO_3^{2-})
sulfide (S^{2-})

thiosulfate ($S_2O_3^{2-}$)

+3 Charge

aluminum (Al^{3+})

iron(III) or ferric (Fe^{3+})

chromium(III) or chromic (Cr^{3+})

-3 Charge

Arsenate (AsO_4^{3-})

Phosphite (PO_3^{3-})

phosphate (PO_4^{3-})

Group 15, pnictogen - nitride (N^{3-}), phosphide (P^{3-})

+4 Charge

lead(IV) or plumbic (Pb^{4+})

tin(IV) or stannic (Sn^{4+})

Summary of metal cations with more than one possible charge:

Cu^{+}, Cu^{2+}; Hg_2^{2+}, Hg^{2+}; Co^{2+}, Co^{3+}, Cr^{2+}, Cr^{3+}; Fe^{2+}, Fe^{3+}; Mn^{2+}, Mn^{3+}; Pb^{2+}, Pb^{4+}; Sn^{2+}, Sn^{4+}

Manganese and some other metals can form several ions with different charges. Know the ones listed.

2. Solubility Rules

1. All common compounds of Group 1 and ammonium ions are soluble.
2. All nitrates, acetates, and chlorates are soluble.
3. All binary compounds of the halogens (other than F) are soluble, **except** those of Ag, Hg(I), and Pb.
4. All sulfates are soluble, **except** those of barium, strontium, calcium, lead.
5. Sulfides and hydroxide are insoluble **except** for Ca, Ba, Sr, ammonium and the alkali metals.
6. Except for rule 1, carbonates, oxides, silicates, and phosphates are insoluble.

Note: You can apply the solubility rules to predict whether the product of a double replacement reaction will be a precipitate or not. If the compound is soluble, it will dissociate into free ions in solution. If the compound is insoluble, it will be a precipitate. Example: When $AgNO_3$(aq) and NaCl(aq) are mixed, the products will be AgCl and $NaNO_3$. AgCl is insoluble (rule 3) and will precipitate out. $NaNO_3$ is soluble and will remain in solution (rules 1 &2).

3. Acids and Bases

Common Acids

sulfuric acid - H_2SO_4(aq)

phosphoric acid – H_3PO_4(aq)

Carbonic acid – H_2CO_3(aq)

Sulfuric Acid - H_2SO_4(aq)

Acetic acid (ethanoic acid) $HC_2H_3O_2$(aq) or CH_3COOH(aq)

7 Strong Acids

hydrochloric acid - HCl(aq)

hydrobromic acid – HBr(aq)

Hydroiodic acid - HI(aq)

nitric acid – HNO_3(aq)

Chloric acid - $HClO_3$(aq)

Chlorous acid - $HClO_4$(aq)

Common Bases

aqueous ammonia – NH_3(aq)

7 Strong Bases

1A metal hydroxides (NaOH, LiOH…)

$Ca(OH)_2$(aq)

$Sr(OH)_2$(aq)

$Ba(OH)_2$(aq)

Note: Strong acids and bases are those that dissociate completely in water.

Example: HCl(aq) → $^{+}$(aq) + Cl^{-}(aq)

$Ca(OH)_2$(aq) → Ca^{2+}(aq) + $2OH^{-}$(aq)

Weak acids and bases do not dissociate completely, and will be present as the compound in water.

Example: $HC_2H_3O_2$(aq) → H^{+}(aq) + $C_2H_3O_2^{-}$(aq)

NH_3(aq) → NH_4^{+}(aq) + OH^{-}(aq)

4. Rules for Assigning Oxidation Numbers

1. The oxidation number of any element in its free state (uncombined with other elements) is zero. e.g., Fe in a bar of iron is zero. O_2 and N_2 in the Earth's atmosphere both have oxidation numbers of zero. When an element has equal numbers of protons and electrons, its overall charge is zero.
2. The oxidation number of alkali metals **in a compound** is always 1+, e.g., LiCl, Na_3P, K_2S, etc.
3. The oxidation number of alkaline **earth** metals **in a compound** is always 2+, e.g., $MgCl_2$, CaF_2, SrO, etc.
4. Fluorine is always assigned a value of 1- **in a compound**, e.g., NaF
5. The oxidation number of oxygen is almost always 2- in a compound. Exceptions to this rule would be peroxides, O_2^{2-} where the oxidation number of **each** oxygen is 1-, and super peroxides, O_2^{-} where the oxidation number of each oxygen is ½-. Neither peroxides nor superperoxides are common. Peroxides are only known to form compounds with the elements in the first two columns of the periodic table, e.g., H_2O_2, Na_2O_2, CaO_2, etc. Potassium, rubidium, and cesium are the only elements that form superperoxides, e.g., KO_2.
6. In covalent compounds (with nonmetals), hydrogen is assigned an oxidation number of 1+, e.g., HCl, H_2O, NH_3, CH_4. The exception to this rule is when hydrogen combines with a metal to form a hydride. Under these conditions, which are rare, hydrogen is assigned an oxidation number of 1-, e.g., NaH.
7. In metallic halides the halogen (F, Cl, Br, I,) always has an oxidation number equal to 1-.
8. Sulfide, selenide, telluride are always 2- in binary salts.
9. Nitrides, phosphides, and arsenides are always 3- in binary salts.
10. All other oxidation numbers are assigned so that the sum of the oxidation numbers of each element equals the net charge on the molecule or polyatomic ion. In neutral compounds, the sum of the positive and negative charges must equal zero.

5. Oxidation and Reduction

Loss **o**f **e**lectrons, **G**ain is **r**eduction. (LEO goes GRRRRRR!!!!)

Strong Oxidizing agents

MnO_4^- in acid solution → Mn^{2+} + H_2O
MnO_4^- in neutral or basic solution → MnO_2
$Cr_2O_7^{2-}$ in acid solution → Cr^{3+} + H_2O
$Cr_2O_7^{2-}$ in basic solution → CrO_4^{2-} + H_2O
H_2SO_4 (concentrated) → SO_2 + H_2O
Free halogens (Cl_2) → Halide ions (Cl^-)

Strong Reducing Agents

Halide ions (Cl^-) → Free halogens (Cl_2)
Free metals (Mg) → Metal ions (Mg^{2+})
"-ite" ions (SO_3^{2-}) → "-ate" ions (SO_4^{2-})
HNO_3 (concentrated) → NO_2 + H_2O
H_2O_2 in acid solution → H_2O

Study Suggestion: You may not completely understand this right now, but it will make sense later in the year. For now, learn the oxidizing and reducing agents in bold and the products formed when they react. Predicting products is very important in AP chem!

6. Determining an Intermolecular Forces (IMF's) form Lewis electron dot structures (LEDS)

Know how to draw a LEDS to determine molecular polarity that leads to the correct IMF and how it impacts physical properties such as boiling point and vapor pressure.

IMF's = Forces ***between*** molecules that create condensed states (s) and (l).

Strongest

- **Network Covalent** Directional covalent bonds C (graphite, diamond) Si, SiO_2(sand)
- **Ionic (electrostatic attraction)** Forces between adjacent ions ($Na^+ \rightarrow Cl^-$)
- **Metallic** Forces between metal nuclei (Cu, Ag)
- **Hydrogen bonding** Forces between adjacent molecules with H & F, O, N or Cl. (H_2O, NH_3)
- **Dipole-dipole** Forces between adjacent polar molecules (CO, NF_3)
- **London Dispersion Force** Forces between adjacent nonpolar molecules (CO_2, Cl_2)

Weakest

7. Organic Chemistry

Organic chemistry is the study of carbon based compounds. The nomenclature of organic compounds is based on the number of carbon atoms present in the molecule (prefix) and the presence of functional groups (ending).

C_nH_{2n+2}-ane C_nH_{2n}-ene C_nH_{2n-2}-yne

Functional Groups:

-ol	-oic acid
-al	Benzene
-one	C_6H_6

Prefix Number of C

meth- 1	hex- 6
eth- 2	hept- 7
prop- 3	oct- 8
but- 4	non- 9
pent- 5	dec- 10

Examples → CH_4 – one carbon atom "meth-" & C_nH_{2n+2} … "methane"
C_2H_5OH - two carbon atoms "eth-" & an alcohol (-OH) … "ethanol"
$C_3H_7NH_2$ - three carbon atoms "prop-" & an amine ($-NH_2$) … "propylamine"

8. Colors:

Colors of some aqueous ions

Co^{2+} pink	Fe^{3+} brown/yellow
Cu^{2+} blue green	CrO_4^{2-} orange
Fe^{2+} olive green	$Cr_2O_7^{2-}$ yellow
Ni^{2+} bright green	

9. Types of chemical reactions

Be able to predict the products for single replacement, double replacement, synthesis, decomposition, and combustion reaction patterns. Using your solubility rules determine if ionic compounds or (s) or (aq). Balance the equation and be able to write a NET ionic reaction for DR reactions that form solids, gases or liquids.

REFERENCE LAST YEARS NOTEBOOK.

10. Stoichiometry

Molar Mass: calculate.
All year long we will use the official AP Chemistry Periodic Table for this and will report our molar mass to the hundredths place (X.XX). You will be given one and a copy of the official Periodic. You can print another if needed from the College Board website for AP Chemistry.
Use the complete atomic mass from the periodic table. Only round the final answer to the hundredths place.
Example: $Ca(NO_3)_2$
$Ca(NO_3)_2$ is 1 x Ca + 2 x N + 6 x O = molar mass
1 x 40.08 + 2 x 14.007 + 6 x 16.00 = 164.094 which rounds to 164.09 g/mol of $Ca(NO_3)_2$

Calculate "how much":

- Reactant is needed, product is made, and reactant is left over.
- LR and ER problems.
- REFERENCE LAST YEARS NOTEBOOK.

11. Nomenclature for Ionic vs. Molecular compounds

- REFERENCE LAST YEARS NOTEBOOK.

12. Solutions

- Molarity
- How to prepare from molarity and grams
- How to prepare from a stock solution (dilution problems)

13. Be able to solve problems with Claim, Evidence, and Reason (CER)

Things to PRACTICE for AP SkyviewChem

Please check out a "Tro – Chemistry, a molecular approach" text book from the Skyview library.

Use your notebook form Mrs. Grant or Mrs. McKinney's Chemistry 1 course.

Study:

- **Chapters 1-4**. Please focus on last year's content.
    - Topics to **ignore** for now
        - Ch.2
            - Mass spectrometer
        - Ch.3
            - Organic compounds
        - Ch. 4
            - Redox reactions.
- **Chapter 6. ONLY** "q" equations from year one.
- **Chapter 9-11.** Please focus on last year's content.
    - Topics to **ignore** for now
        i. Ch. 9
            1. Bond energies and lengths.
            2. Bonding in metals
        ii. Ch. 10
            1. Molecular orbital theory
            2. Valence bond theory.
        iii. Ch. 11
            1. Crystalline solids

PRACTICE:

At the end of each of the above chapters there is a "Self Assessment Quiz". The answers are stated but the work is not shown. Please take each quiz for chapters 1-4, 6 (q equations only), and 9-11 and ignore the topics listed above if a problem is given on them.

Do this on separate Sheet of paper or in last year's chemistry notebook. SHOW ALL WORK when necessary.

1st Week of School, 2018/19: A summer review quiz on the above topics will be given.