AP Chemistry
Summer Review
Pope High School

Dear AP Chemistry Students,
We are looking forward to the school year and the work we're going to do together.
This packet is meant to refresh or help instruct you on several things you will want to have firmly in mind for the start of school. We recommend that you review your Honors Chemistry notes and start looking at this material several weeks before school starts in the fall. If you have never had Chemistry before; online tutorials I like: Tyler DeWitt, The Organic Chemist, Khan Academy. There is a free textbook resource called OpenStax that has a Chemistry textbook you can use online.
Good luck and have a wonderful and productive summer!
I'm looking forward to a fantastic year in AP Chemistry!

Sincerely,

Chris Smith

Polyatomic Ions (most you learned in Honors Chemistry, but the ones you didn't are bolded)

-1	-2	-3
$C_2H_3O_2^-$ acetate	SO_4^{2-} sulfate	PO_4^{3-} phosphate
NO_3^- nitrate	SO_3^{2-} sulfite	**AsO_4^{3-} arsenate**
NO_2^- nitrite	CO_3^{2-} carbonate	**AsO_3^{3-} arsenite**
CN^- cyanide	**$C_2O_4^{2-}$ oxalate**	
OCN^- cyanate	**CrO_4^{2-} chromate**	
SCN^- thiocyanate	**$Cr_2O_7^{2-}$ dichromate**	
MnO_4^- permanganate	**$S_2O_3^{2-}$ thiosulfate**	
OH^- hydroxide	O_2^{2-} peroxide	
HSO_4^- bisulfate	**SeO_4^{2-} selenate**	
HCO_3^- bicarbonate	**HPO_4^{2-} hydrogen phosphate**	+1
O_2^- superoxide		NH_4^+ ammonium
$H_2PO_4^-$ dihydrogen phosphate		
ClO_4^- perchlorate *		
ClO_3^- chlorate *		
ClO_2^- chlorite *		
ClO^- hypochlorite *		

*** Br, I, and F may be substituted**

Strong Acids (for all practical purposes, all others are weak acids): HCl, HBr, HI, H_2SO_4, HNO_3, $HClO_3$, $HClO_4$

Strong Bases (for all practical purposes all others are weak):
Group I hydroxides and Group II hydroxides (except $Be(OH)_2$ and $Mg(OH)_2$)

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except **Ag^+, Hg_2^{2+}, *Pb^{2+}**
I^-	soluble	except **Ag^+, Hg_2^{2+}, *Pb^{2+}**
SO_4^{2-}	soluble	except **Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+**
CO_3^{2-}	insoluble	except **Group IA and NH_4^+**
PO_4^{3-}	insoluble	except **Group IA and NH_4^+**
OH^-	insoluble	except **Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}**
S^{2-}	insoluble	except **Group IA, IIA and NH_4^+**
Na^+	soluble	none
K^+	soluble	none
NH_4^+	soluble	none

Special Reactions

Metal

metal + acid → salt + H_2

metal oxide + H_2O→ metal hydroxide

metal oxide + CO_2 → metal carbonate

metal chloride + O_2 → metal chlorate

Nonmetal

nonmetal + H_2O → oxy-acid

$SO_3 + H_2O \rightarrow H_2SO_4$

$SO_2 + H_2O \rightarrow H_2SO_3$

$N_2O_5 + H_2O \rightarrow 2\ HNO_3$

$N_2O_3 + H_2O \rightarrow 2\ HNO_2$

$P_2O_5 + 3H_2O \rightarrow 2\ H_3PO_4$

$P_2O_3 + 3H_2O \rightarrow 2\ H_3PO_3$

I. Nomenclature:

Formula	Name
1. P_4O_{10}	_____
2. CaF_2	_____
3. P_2S_3	_____
4. _____	Carbon monoxide
5. _____	Sodium hydride
6. _____	Aluminum selenide
7. _____	Xenon hexafluoride
8. _____	dinitrogen monoxide
9. $KClO_3$	_____
10. $Pb(OH)_3$	_____

11. $Ca(MnO4)_2$ _____

12. N_2O_4 _____

13. $Ti(HPO4)_2$ _____

14. _____ Manganese (VII) oxide
15. _____ Francium dichromate
16. _____ Copper (II) dihydrogen phosphate
17. _____ Silver chromate
18. _____ Ammonium oxalate
19. $(NH_4)_2SO_3$ _____
20. $Ni_3(PO_4)_2$ _____
21. $Fe(IO_2)_3$ _____
22. $NaBrO_2$ _____
23. H_3PO_3 _____
24. _____ Tartaric acid
25. _____ Hydrotellluric acid
26. _____ Mercury (I) nitrate
27. _____ Vanadium (V) oxide
28. _____ tetraphosphorous decaoxide

II. Use dimensional analysis to convert the following: Must show your work

1. 515 m = ___ miles.
2. 200 in = _____ meters
3. 325 days = _____ seconds.
4. 20 gallons = _____ ml
5. 3 meters into centimeters
6. 10 kilometers into meters
7. 15,050 milligrams into grams
8. 3,264 milliliters into liters
9 . 9,674,444 grams into kilograms
10. A cylinder rod formed from silicon is 16.8 cm long and has a mass of 2.17 kg. The density of silicon is 2.33 g/cm3. What is the diameter of the cylinder? (the volume of cylinder is given by Πr^2h, where r is the radius and h is the length)

III. How many significant figures are in each of the following?

1. 1.92 mm
2. 0.030100 kJ
3. 6.022 $x10^{23}$ atoms
4. 460.00 L
5. 0.00036 cm3
6. 100
7. 1001
8. 0.001
9. 0.0101

Calculate the following to the correct number of significant figures.
10. 1.27 g / 5.296 cm3
11. 12.235 g / 1.01 L
12. 12.2 g + 0.38 g
13. 17.3 g + 2.785 g
14. 2.1 x 3.21
15. 200.1 x 120
16. 17.6 + 2.838 + 2.3 + 110.77

IV. Record the following in correct scientific notation:
1. 350,000,000 cal
2. 0.0000721 mol
3. 0.0000000809 Å
4. 765,400,000,000 atoms

V. Reactions
In each of the equations below, the reactants are written correctly. You must write the correct products and then balance the equation. Identify the type of chemical reaction before writing the products.

1. $CaCO_3 \rightarrow$
2. $Al + O_2 \rightarrow$
3. $Fe + CuSO_4 \rightarrow$
4. $C_6H_{12} + O_2 \rightarrow$
5. $Zn + H_2SO_4 \rightarrow$
6. $Cl_2 + MgI_2 \rightarrow$
7. $NaOH \rightarrow$
8. $Fe + HCl \rightarrow$
9. $NaOH + H_3PO_4 \rightarrow$
10. $(NH_4)_2SO_4 + Ca(OH)_2 \rightarrow$
11. $AgNO_3 + K_2SO_4 \rightarrow$
12. $Mg(OH)_2 + H_3PO_4 \rightarrow$
13. $Na + H_2O \rightarrow$
14. $KClO_3 \rightarrow$
15. $Al_2(SO_4)_3 + Ca_3(PO_4)_2 \rightarrow$
16. $SO_2 + H_2O \rightarrow$
17. $(NH_4)_3PO_4 + Ba(OH)_2 \rightarrow$
18. $Ca(OH)_2 + HNO_3 \rightarrow$
19. $C_3H_8 + O_2 \rightarrow$
20. $Li + S \rightarrow$
21. Solid sodium bicarbonate is mixed with copper (II) nitrate.
22. Magnesium oxide is heated.
23. Acetic acid is added to a solution of ammonia.
24. Iron (III) chloride is mixed with silver sulfite.
25. A solid piece of aluminum is put into a solution of nickel (II) chloride.
26. A solution of lithium chloride is added to a solution of lead (IV) nitrite.

27. Sulfuric acid is added to a solution of aluminum hydroxide.
28. Cadmium nitrate is added to sodium sulfide.
29. Chromium (III) sulfate is added to ammonium carbonate.
30. Methane combusts in air.

VI. Electron Structure and Periodicity
1. Draw the orbital notation for nickel.
2. How many unpaired electrons are in arsenic?
3. Write the electron configuration for palladium.
4. How many valence electrons are in mercury?
5. Write the noble gas electron configuration for uranium.
6. Write the noble gas electron configuration for lead.
7. Which is more electronegative, sulfur or chlorine, and why?
8. Which has a larger atomic radius, potassium or bromine, and why?
9. Which has the smaller ionization energy, nitrogen or phosphorus, and why?
10. Write the noble gas electron configuration for copper.
11. Given the data below determine the average atomic mass

Isotope	% Abundance	Isotopic Mass
a. Sb-121	57.25%	120.9038 amu
Sb-123	42.75%	122.0041 amu

VII. Mole Concept Sample Problems
1. Convert each of the following to moles.

a. 12.64 g $NaOH$	b. 3.00 x 10^{24} atoms Au	c. 40.0 L of Ne gas
d. 800. g $CaBr_2$	e. 3.011 x 10^{22} molecules H_2O	f. 6.78 L of Ar gas

2. Given 0.250 moles of Sulfur trioxide determine
(i) the mass (ii) the number of atoms (iii) the volume at STP

VIII. Bonding
Draw the Lewis Structures of
1. $SeCl_2$
2. Nitrate
3. OF_2
4. BF_3
5. Sulfate
6. Ammonium
7. CO_2
8. CH_3NH_2
9. $HCOOH$
10. HCN

IX.Stoichiometry

1. 30.5 g of sodium metal reacts with a solution of excess lithium bromide. How many grams of lithium metal are produced?
2. How many molecules are in 100 L of Carbon dioxide at STP?
3. Propane, C_3H_8, undergoes combustion. How many grams of propane are needed to produce 45.9 g of water?
4. How many moles are in 3.02 x 10^{26} molecules of water?
5. Find the empirical and molecular formulas for a compound containing 11.66 g iron and 5.01 g oxygen if the molar mass of the compound is 320 g/mol.
6. A solution of 3.50 g of sodium phosphate is mixed with a solution containing 6.40 g of barium nitrate. How many grams of barium phosphate can be formed?
7. Find the empirical and molecular formulas for a compound containing 5.28 g of tin and 3.37 g of fluorine if the molar mass of the compound is 584.1 g/mol.
8. Octane, C_8H_{18}, undergoes combustion. How many grams of oxygen are needed to burn 10.0 g of octane?
9. Sodium azide, NaN_3, decomposes into its elements. How many grams of sodium azide are required to form 34.8 g of nitrogen gas?
10. Ammonia reacts with oxygen gas to form nitrogen monoxide and water. How many grams of nitrogen monoxide are formed when 1.50 g of ammonia react with 2.75 g of oxygen gas?