St. Mary's Academy
2022 Summer Assignment
AP Chemistry

AP Chemistry 2022-23
Summer Assignment

Due: First Day of School

Assessment: Second Day of School

Section 1: Naming

Knowing how chemical compounds are named will be an expected skill on Day 1. This includes covalent compounds, ionic compounds (with and without transition metals), polyatomic ions, acids/bases, etc.

Polyatomic Ions - Must be Memorized

Name	Formula
Ammonium	NH_4^+
Acetate	CH_3COO^-
Carbonate	CO_3^{2-}
Chlorate	ClO_3^-
Chlorite	ClO_2^-
Chromate	CrO_4^{2-}
Cyanide	CN^-
Bicarbonate	HCO_3^-
Hydroxide	OH^-
Nitrate	NO_3^-
Nitrite	NO_2^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Phosphate	PO_4^{3-}
Phosphite	PO_3^{3-}
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

For each of the following, provide the corresponding name or chemical formula

Name	Formula
$NaHCO_3$	
NaF	
$MgCl_2$	
N_2O	
$Pb(NO_3)_4$	
H_3PO_3	
$AgNO_3$	
Na_3N	
$Hg(NO_3)_2$	
HCN	
$HClO_4$	
Br_2I_4	
	Pentaphosphorus Octafluoride
	Ammonium Sulfate
	Nitric Acid
	Barium Sulfate
	Phosphorous Acid
	Iron (II) Sulfide
	Sodium Hydroxide
	Nitrogen Pentaoxide
	Magnesium Carbonate
	Phosphoric Acid
	Iron (III) Chloride

Section 2: Conversions using moles, grams, and particles

Conversions using Avogadro's number and especially molar mass will be essential knowledge for AP Chemistry.

1. How many molecules are in 4.23 moles of $CaCO_3$?

2. How many atoms are in 1.14 moles of $NaOH$?

3. How many molecules are in 7.02 x 10^{24} molecules of $BaCl_2$?

4. How many grams are in 6.71 moles of NaN_3?

5. How many moles are in 912 grams of CO_2?

6. How many moles are in 1.43 kg of $NaHCO_3$?

7. How many molecules are in 12.4 grams of $NaCl$?

8. How many atoms are in 2.13 grams of $CaCO_3$?

9. How many liters does 13.2 grams of oxygen gas take up?

Section 3: Periodic Trends

In Honors Chemistry, we spent a lot of time discussing periodic trends. This will be very important this year, as it informs our understanding of bonding and intermolecular forces, which are a substantial part of the AP Exam.

1.   In 3-4 sentences, describe atomic size and its trends on the periodic table (down a group and across a period).

2. List C, F, N, and O in order of increasing atomic radius. _____

3. List P, Se, As, and S in order of increasing atomic radius. _____

4. List Br, I, F, and Cl in order of increasing atomic radius. _____

5.   In 3-4 sentences, describe ionization energy and its trends on the periodic table (down a group and across a period).

6. List Mg, Sr, Ba, and Ca in order of increasing ionization energy. _____

7. List Li, Na, Be, and Mg in order of increasing ionization energy. _____

8. List Ca, K, Cl, and S in order of increasing ionization energy. _____

9.   In 3-4 sentences, describe electronegativity and its trends on the periodic table (down a group and across a period).

10. List F, S, O, and Cl in order of increasing electronegativity. _____

11. List Si, F, P, and O in order of increasing electronegativity. _____

12. List Rb, Na, K, and Cs in order of increasing electronegativity. _____

Section 4: Lewis Structures

Lewis structures are one of the primary ways in which we depict molecules. These structures will become increasingly complex in AP Chemistry, as we discuss resonance structures and formal charge. With that being said, it will be important to enter the class knowing how to draw basic Lewis structures (including expanded/limited octets and charged species).
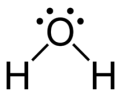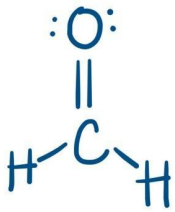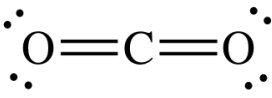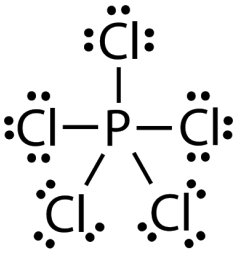
For each of the following, draw the Lewis structure

SiF_4	NH_3	SO_3^{2-}	CO_2
ClO_3^-	N_2	H_2O	XeF_4
HCN	BF_3	NO_2^-	SF_6
BrF_5	C_2H_4	CH_2O	PO_4^{3-}
ClO_4^-	ClF_3	C_2H_6	PCl_5

Section 5: Intermolecular Forces, VSEPR Shapes, and Polarity

These three interrelated topics are ones that we learned in Honors Chemistry, and are a large part of the AP Exam.

For each given Lewis structure, identify the shape, whether it is polar or nonpolar, and the dominant IMF (LDF, Dip-Dip, H-Bonding).

Structure	Shape	Polarity	IMF
H—O—H (with lone pairs on O)			
O=C with H and H (formaldehyde)			
O=C=O			
Cl—P—Cl with Cl above and Cl, Cl below			
F—C—F with F above and F below			

Section 6: Ideal Gases

Knowing how to use the ideal gas law not only reinforces the concepts of gas behavior, but is also a good algebraic exercise.

1. 14.2 moles of an ideal gas at STP will take up how much volume?

2. What is the pressure of an ideal gas in atm if 19.8 moles of the gas takes up 1.3 L at 300 K?

3.   How many molecules of ideal oxygen gas are present if the pressure of 13.4 L of the gas is 785 torr and the temperature of the gas is 35 degrees Celsius?

4.   How many grams of Argon gas are present if the pressure of 6.62 L of the gas is 912 torr and the temperature of the gas is 58 degrees Celsius?

5.   What is the temperature of 76.2 grams of fluorine gas if the pressure is 1.34 atm and the volume is 189 mL?

6.   What is the pressure in mmHg of 1.45 moles of Krypton gas if the volume is 5.46 L and the temperature is 1200 K?

Section 7: Stoichiometry
Using balanced equations in order to determine chemical quantities will be important in AP Chemistry. For each of the following problems, you will have to balance the equation yourself.

1.   Potassium nitrate reacts with carbonic acid in a double replacement reaction. If 2.4 moles of carbonic acid reacts with excess potassium nitrate, how many moles of potassium carbonate can form?

2. $SeCl_6$ reacts with oxygen gas to form SeO_2 and chlorine gas. If 6.79 moles of $SeCl_6$ reacts with excess oxygen, how many grams of chlorine gas can be formed?

3.   Aluminum metal reacts with HCl in a single replacement reaction. If 75.2 grams of aluminum metal reacts with excess HCl, how many grams of aluminum chloride can be formed?

4.   45.6 grams of Mercury (II) Hydroxide reactions with 50.6 grams of Phosphoric Acid in a double replacement reaction. Determine the limiting reactant.

5.   192.7 grams of calcium chloride reacts with 178.0 grams of sodium phosphate in a double replacement reaction. Determine the limiting reactant and calculate how many grams of NaCl can form.

Section 8: Molarity and Solutions
This concept is used extensively in AP Chemistry, especially with kinetics and equilibrium.

1. What is the molarity of a solution that has 2.6 moles of solute dissolved in 0.56 L of solution?

2. Calculate the molarity of a KCl solution if 23.4 grams of KCl is dissolved to make 3.67 L of aqueous solution.

3. Calculate the volume of a NaBr solution if 321 grams of NaBr is used to prepare a 7.2 M solution.

4. How many grams of potassium nitrate are required to prepare 512 mL of a 3.0 M potassium nitrate solution?

5. What is the molarity of a sodium acetate solution ($NaC_2H_3O_2$) if 902 grams of sodium acetate is dissolved in 6.2 L of water?

6. How many grams of potassium sulfate are in 4.32 L of concentrated 9.0 M potassium sulfate solution?

7. If I have 100. mL of a 12.0 M stock solution of concentrated HCl, what is the concentration of the solution if I dilute it to 1.58 L?

Section 9: Thermodynamics
Thermodynamics studies the exchange of heat in chemical reactions. There are two AP Units dedicated to thermodynamics.

1. Define endothermic reaction and exothermic reaction.

2. How many joules (J) are needed to melt 45 grams of ice? (Heat of Fusion = 334 J/g)

3.   How many kilojoules (kJ) are released when 5.00 grams of water vapor is converted to liquid? (Heat of Vaporization = 2260 J/g)

4.   How many Joules (J) are required to heat 12 grams of liquid water from 25 degrees Celsius to 34 degrees Celsius? (Specific Heat of Water = 4.184 J/g-C

5.   Calculate the standard heat of reaction for the following
reaction: $CH_4(g) + Cl_2(g) \rightarrow C(s, \text{diamond}) + 4HCl(g)$

•$\Delta H_f°(CH_4(g)) = -74.86$ kJ/mol

•$\Delta H_f°(C(s, \text{diamond})) = 1.9$ kJ/mol

•$\Delta H_f°(HCl(g)) = -92.3$ kJ/mol

Section 10: Acids and Bases (Strong)

Useful Info
pH + pOH = 14
pH = -log[H$^+$]
pOH = -log[OH$^-$]
[H$^+$] = 10^{-pH}
[OH$^-$] = 10^{-pOH}
[H$^+$][OH$^-$] = 1.0 x 10^{-14}

1. What is the pH of a 0.0235 M HCl solution?

2. What is the pOH of a 0.0235 M HCl solution?

3. What is the pH of a 6.50 x 10^{-3} M KOH solution?

4. What is the pOH is a 6.50 x 10^{-3} M KOH solution?

5. What is the concentration of H$^+$ ions in an HBr solution that has a pH of 3.22?

6. What is the concentration of OH$^-$ ions in an HBr solution that has a pH of 3.22?

7. What is the concentration of H$^+$ ions in an NaOH solution that has a pH of 12.4?

8. What is the concentration of OH$^-$ ions in an NaOH solution that has a pH of 12.4?

Section 11: Lab

We will be doing lab experiments for every unit in AP Chemistry. Some lab techniques we are already familiar with, while some will be new. Going into the year, it will be important to have a basic understanding of the lab equipment that we will be using.

For each lab instrument, draw a sketch of the instrument and briefly explain its function.

Instrument	Sketch	Function
Balance		
Erlenmeyer Flask		
Beaker		
Stirring Rod		
Graduated Cylinder		
Filter Paper		

Buret		
Pipet		
Chromatography Paper		
Bunsen Burner		
Ring Stand		
Crucible		

Video Resources

Section 1

https://www.youtube.com/watch?v=ptAw20kem90

https://www.youtube.com/watch?v=US9XscmIfxE

https://www.youtube.com/watch?v=3agUL7-ezXk

Section 2

https://www.youtube.com/watch?v=irYPta9G_sw

https://www.youtube.com/watch?v=CzvueA3iw0A

Section 3

https://www.youtube.com/watch?v=0tP6bV89log

Section 4

https://www.youtube.com/watch?v=p7Fsb21B2Xg

Section 5

https://www.youtube.com/watch?v=QdwzMPwPA3I&t=1375s

Section 6

https://www.youtube.com/watch?v=iaZ96KaQ44c

Section 7

https://www.youtube.com/watch?v=7Cfq0ilw7ps

Section 8

https://www.youtube.com/watch?v=o_iETsDSvkg

https://www.youtube.com/watch?v=FPidlCmymVg

Section 9

https://www.youtube.com/watch?v=WU7TfO-iaK8

Section 10

https://www.youtube.com/watch?v=OEW4-Sfyvik