AP Chemistry **Name:**

Ch.1 – Matter, Measurement, and Problem Solving Date:

1.1 Atoms and Molecules

1.2 The Scientific Approach to Knowledge

1. Classify each statement as an observation, a low, or a theory. Justify your answers.
    a. Chlorine is a highly reactive gas.

    b. If elements are listed in order of increasing mass of their atoms, their chemical reactivity follows a repeating pattern.

    c. Neon is an inert (or nonreactive) gas.

    d. The reactivity of elements depends on the arrangement of their electrons.

1.3 The Classification of Matter

1. Classify each substance as a pure substance or a mixture. If it is a pure substance, classify it as an element or a compound. If it is a mixture, classify it as homogeneous or heterogeneous.
    a. Wine

    b. Beef stew

    c. Iron

    d. Carbon monoxide

1.4 Physical and Chemical Changes and Physical and Chemical Properties

1. Identify the following changes as physical or chemical changes
    a. Baking soda reacts with vinegar to produce carbon dioxide. _____

    b. The copper sheath on the Statue of Liberty turns green. _____

    c. Addition of salt melts ice on the highway. _____

    d. Steam condenses on the windowpane. _____

    e. Epoxy resin cures and hardens. _____

    f. Sugar dissolves in a cup of coffee. _____

    g. Natural gas burns in a furnace. _____

2. Which of the following physical properties are extensive?
   a. heat capacity
   b. viscosity
   c. melting point
   d. conductivity
   e. specific heat capacity
   f. density

1.5 Energy: A Fundamental Part of Physical and Chemical Change

1.6 The Units of Measurement

1. Convert 25°C to K.

2. Convert 350. K to °C.

3. Calculate the density of lead if a 10. kg block has a volume of 885 cm^3.

4. What is the volume of a 100. g bar of aluminum if its density is 2.70 $g \cdot cm^{-3}$?

5. Calculate the mass of 100. cm^3 of uranium (density 19.07 $g \cdot cm^{-3}$).

6. Acetone (nail polish remover) has a density of 0.7857 g/cm^3.
   a. What is the mass, in g, of 28.56 mL of acetone?

   b. What is the volume, in mL, of 6.54 g of acetone?

7. A 12.3 g block of an unknown metal is immersed in water in a graduated cylinder. The level of water in the cylinder rose. The level of water in the cylinder rose exactly the same distance when 17.4 grams of aluminum (density 2.70 $g \cdot cm^{-3}$) was added to the same cylinder. What is the unknown metal's density?

8. Use prefix multipliers to express each measurement without any exponents.
   a. 38.8×10^5 g
   b. 55.2×10^{-10} s
   c. 23.4×10^{11} m
   d. 87.9×10^{-7} L

9. Use scientific notation to express each quantity with only base units (no multipliers).
   a. 35 μL
   b. 225 Mm
   c. 133 Tg
   d. 1.5 cg

1.7 The Reliability of a Measurement

1. Write the following numbers in scientific notation with the correct number of significant figure
   a. 1,327
   b. 0.00562
   c. 2.76
   d. 0.166
   e. 0.09911

2. Measurements of the boiling point of a liquid were taken by two laboratory technicians (A and B). The actual boiling point was 92.3. Which technician achieved the most **accurate** result and which technician was the most **precise**? Explain your answer.

A: 92.0 92.1 92.4 92.2
B: 91.9 92.5 92.6 92.0

3. Evaluate the following expressions. Express the answers in scientific notation with the correct number of significant figures and the correct units.
   a. 0.0045 in + 1.0098 in + 0.987 in + 23.08 in
   b. $(3.45\ cm^3 \times 2.70\ g \cdot cm^{-3}) + (7.433\ cm^3 \times 1.677\ g \cdot cm^{-3})$
   c. 2.703 g/(1.376 cm x 2.45 cm x 3.78 cm)

1.8 Solving Chemical Problems

1. Convert each of the following. Show all work.
   a. 1342 mL into L
   b. 3.26×10^{-6} km into mm

c. 8,768 mg into g

d. 400 cm^3 into m^3

e. 3600 sq. in. into sq. ft.

f. 521 m into km

2. If one pound is 453.59 grams, how many grams are there in one ounce? How many ounces are there in one kilogram? (There are 16 ounces in a pound)

3. A sample of gold alloy contains 5.6% silver by mass. How many grams of silver are there in 1 kilogram of the alloy?

Review questions: on a separate sheet of paper, write or type your answers to the following review questions. Your answers must be in complete sentences.

Chapter 1 review questions: 8, 9, 11, 18, 19, 25, 32

AP Chemistry **Name:**

Ch. 2 – Atoms and Elements

Date:

2.1 Imaging and Moving Individual Atoms

2.2 Early Ideas about the Building Blocks of Matter

2.3 Modern Atomic Theory and the Laws that Led to It

1. Two samples of sodium chloride were decomposed into their constituent elements. One sample produced 6.98 g of sodium and 10.7 g of chlorine, and the other sample produced 11.2 g of sodium and 17.3 g of chlorine. Are these results consistent with the law of definite proportions? Explain your answer.

2. Sulfur and fluorine form several different compounds including sulfur hexafluoride and sulfur tetrafluoride. Decomposition of a sample of sulfur hexafluoride produces 4.45 g of fluorine and 1.25 g of sulfur, while decomposition of a sample of sulfur tetrafluoride produces 4.43 g of fluorine and 1.87 g of sulfur. Calculate the mass of fluorine per gram of sulfur for each sample and show that these results are consistent with the laws of multiple proportions.

2.4 The Discovery of the Electron

1. To illustrate Robert Millikan's determination of the charge on an electron, suppose that you were given the task of determining the mass of a single jelly bean given the following experimental data. Various scoops of jelly beans were weighed and the following masses determined. The number of jelly beans in each scoop was not known.

Masses (in grams) of ten different scoops:

4.96	8.68	13.64	7.44	21.08	16.12	9.92	19.84	6.20	12.40

2.5 The Structure of the Atom

2.6 Subatomic Particles: Protons, Neutrons, and Electrons in Atoms

1. How many **protons** are found in ^{12}C? ^{13}C? $^{13}C^{-1}$?

2. How many **neutrons** are found in ^{12}C? ^{13}C? $^{13}C^{-1}$?

3. How many **electrons** are found in ^{12}C? ^{13}C? $^{13}C^{-1}$?

4. What do all carbon atoms (and ions) have in common?

5. How is the charge on an ion determined?

6. Where is most of the mass of an atom, within the nucleus or outside of the nucleus? Explain your reasoning.

7. Complete the following table:

Isotope	Atomic Number Z	Mass Number A	Number of electrons
^{31}P	15		
^{18}O			8
	19	39	18
$^{58}Ni^{2+}$		58	

8. Give the mass number of each of the following atoms:
   a. an iron atom with 30 neutrons _____
   b. an americium atom with 148 neutrons _____
   c. a tungsten atom with 110 neutrons _____

9. Give the complete symbol ($^{A}_{Z}X$) for each of the following atoms:
   a. nitrogen with 8 neutrons _____
   b. zinc with 34 neutrons _____
   c. xenon with 75 neutrons _____

10. How many electrons, protons, and neutrons are there in an atom of:
    a. carbon-13 electrons _____ protons _____ neutrons _____
    b. copper-63 electrons _____ protons _____ neutrons _____
    c. bismuth-205 electrons _____ protons _____ neutrons _____

11. Fill in the blanks in the table (one column per element).

Symbol	^{65}Cu	^{85}Kr		
Number of protons			78	
Number of neutrons			117	46
Number of electrons in the neutral atom				36
Name of element				

12. Radioactive americium-241 is used in household smoke detectors and in bone mineral analysis. Give the number of electrons, protons, and neutrons in an atom of americium-241.

13. Copper has two stable isotopes, and, with masses of 62.939598 amu and 64.927793 amu, respectively. Calculate the percent abundances of these isotopes of copper.

14. Which of the following atoms are isotopes of the same element? Identify the elements of these isotopes and describe the number of protons and neutrons in the nucleus of them all.
$^{15}_{7}X$ $^{12}_{6}X$ $^{13}_{7}X$ $^{18}_{8}X$ $^{14}_{7}X$ $^{14}_{6}X$ $^{16}_{8}X$ $^{13}_{6}X$ $^{17}_{8}X$

15. Which of the following are isotopes of element X, with atomic number of 9?
$^{21}_{9}X$ $^{19}_{9}X$ $^{20}_{9}X$ $^{18}_{9}X$ $^{21}_{8}X$ $^{9}_{19}X$

2.7 Finding Patterns: The Periodic Law and the Periodic Table

1. Match the following

a. Sodium _____ Alkali metal

b. Chlorine _____ Alkaline earth metal

c. Nickel _____ Transition metal

d. Argon _____ Actinide

e. Calcium _____ Halogen

f. Uranium _____ Noble gas

g. Oxygen _____ Chalcogen (group 6A)

2. Write the names of the following elements:

a. N _____ d. P _____

b. Ca _____ e. Cr _____

c. K _____ f. V _____

3. Write the symbols for the following elements

a. Silicon _____ d. Sodium _____

b. Chlorine _____ e. Silver _____

c. Iron _____ f. Sulfur _____

2.8 Atomic Mass: The Average Mass of an Element's Atoms

1. Verify that the atomic mass of magnesium is 24.31 amu, given the following information:
Magnesium-24, mass = 23.985042 amu; percent abundance = 78.99%
Magnesium-25, mass = 24.985837 amu; percent abundance = 10.00%
Magnesium-26, mass = 25.982593 amu; percent abundance = 11.01%

2. There are three naturally occurring isotopes of neon:
neon-20 mass 19.9924 amu abundance 90.84%
neon-21 mass 20.9940 amu abundance 0.260%
neon-22 mass 21.9914 amu abundance 8.90%
   a. Without calculation, what is the **approximate** atomic mass of neon? _____
   b. Calculate the actual atomic mass.

3. Uranium has an atomic mass equal to 238.0289. It consists of two isotopes: uranium-235 with an isotopic mass of 235.044 amu and uranium-238 with an isotopic mass of 238.051. Calculate the % abundance of the uranium-235 isotope.

2.9 Molar Mass: Counting Atoms by Weighing Them

1. Calculate the molar mass of each substance. Give answers to two decimal places

H_2SO_4	**Cl_2**	**$Ca(OH)_2$**	**$HC_2H_3O_2$**
CO_2	**N_2O**	**NaOCl**	**Al_2S_3**

2. How many moles are there in 8.3×10^8 atoms of Zn?

3. How many atoms of Ag are contained in 73,000 grams?

4. What would be the mass of 47,000,000 atoms of O?

5. What would be the mass of 1 atom of Fe?

6. How many moles are there in 352 grams of N?

7. What is the mass of 3.98×10^{24} H molecules?

Review questions: on a separate sheet of paper, write or type your answers to the following review questions. Your answers must be in complete sentences.

Chapter 2 review questions: 5, 12, 20, 21, 22, 23

AP Chemistry **Name:**

Ch. 3 – Molecules, Compounds, and Chemical Equations Date:

3.1 Hydrogen, Oxygen, and Water
3.2 Chemical Bonds
3.3 Representing Compounds: Chemical Formulas and Molecular Models

1. The structural formula for acetic acid is CH_3CO_2H.

   a. What is its empirical formula? _____

   b. What is its molecular formula? _____

2. Determine the number of each type of atom in each formula.

   a. $Ca(NO_2)_2$

   b. $CuSO_4$

   c. $Al(NO_3)_3$

   d. $Mg(HCO_3)_2$

3. Identify the elements that have *molecules* as their basic units.

   a. Hydrogen b. Lead c. Iodine d. Oxygen

4. Classify each compound as ionic or molecular

   a. CF_2Cl_2 _____

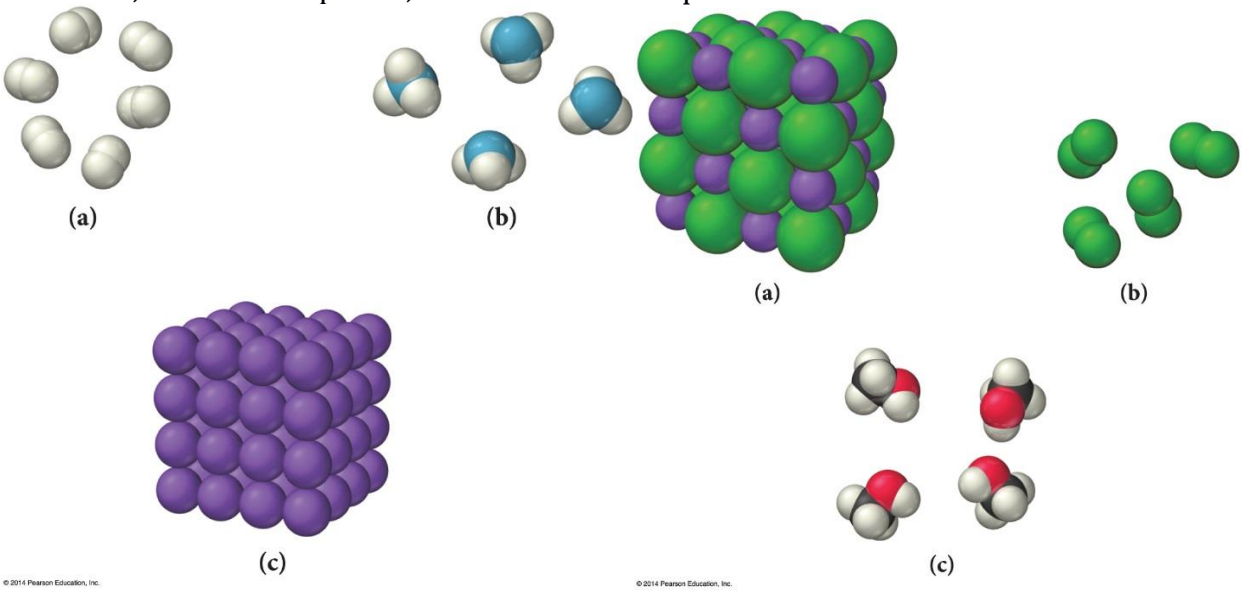
   b. CCl_4 _____

   c. PtO_2 _____

   d. SO_3 _____

3.4 An Atomic-Level View of Elements and Compounds

1. Based on the molecular views, classify each substance as an atomic element, a molecular element, an ionic compound, or a molecular compound.



3.5 Ionic Compounds: Formulas and Names
3.6 Molecular Compounds: Formulas and Names
3.7 Summary of Inorganic Nomenclature

Note that sections 3.5-3.7 are grouped together

1. Name the polyatomic ions.

a. $CH_3CO_2^-$ _____

b. $H_2PO_4^-$ _____

c. SO_3^{2-} _____

d. HCO_3^- _____

e. $Cr_2O_7^{2-}$ _____

f. ClO_4^- _____

2. What are the formulas of the polyatomic ions?

a. Phosphate _____

b. Nitrite _____

c. Sulfate _____

d. Cyanide _____

e. Bisulfite _____

f. Chlorite _____

3. Writing Ionic Formulas

	Cl^-	NO_3^-	S^{2-}	CO_3^{2-}	N^{3-}	PO_4^{3-}	OH^-
Na^+							
NH_4^+							
Sn^{2+}							
Hg_2^{2+}							
Al^{3+}							
Sn^{4+}							

4. Naming Ionic Compounds

Cation	**Anion**	**Formula**	**Name**
Cu^{2+}	OH^-		
Ba^{2+}	SO_4^{2-}		
NH_4^+	$Cr_2O_7^{2-}$		
Ag^+	$C_2H_3O_2^-$		
Fe^{3+}	S^{2-}		

5. Write the number that corresponds with each prefix.

mono	di	tri	tetra	penta	hexa	hepta	octa	nona	deca

6. Writing Formulas of Binary Nonmetal Compounds

Name	Formula	Name	Formula
nitrogen trifluoride		phosphorus trichloride	
nitrogen monoxide		phosphorus pentachloride	
nitrogen dioxide		sulfur hexafluoride	
dinitrogen tetroxide		disulfur decafluoride	
dinitrogen monoxide		xenon tetrafluoride	

7. Naming Binary Nonmetal Compounds

Name	Formula	Name	Formula
	CCl_4		HBr
	P_4O_{10}		N_2F_4
	ClF_3		XeF_3
	BCl_3		PI_3
	SF_4		SCl_2

8. Practice for Both Types of Compounds

Formula	Name
HCl	
PCl_5	
K_2S	
$NiSO_4$	
ClF_3	
OF_2	
$Al(OH)_3$	
NCl_3	
$(NH_4)_3PO_4$	
S_2Cl_2	

Formula	Name
	carbon dioxide
	ammonium carbonate
	sulfur dichloride
	calcium iodide
	boron trifluoride
	phosphorus triiodide
	magnesium perchlorate
	potassium permanganate
	aluminum phosphate
	dioxygen difluoride

9. Write the ions present in the following salts and predict their formulas:

	Cation (+)	Anion (-)	Formula
potassium bromide	K^+	Br^-	KBr
calcium carbonate			
magnesium iodide			

	Cation (+)	Anion (-)	Formula
lithium oxide			
aluminum sulfate			
ammonium chlorate			
beryllium phosphate			

10. Name the following ionic salts

a. $(NH_4)_2SO_4$ _____

b. $KHCO_3$ _____

c. $Ca(NO_3)_2$ _____

d. $Co_2(SO_4)_3$ _____

e. $NiSO_4$ _____

f. $AlPO_4$ _____

11. Name the following binary compounds of the nonmetals

a. CS_2 _____

b. SF_6 _____

c. IF_5 _____

d. N_2H_4 _____

e. PCl_5 _____

f. Cl_2O_7 _____

g. $SiCl_4$ _____

h. GeH_4 _____

i. P_4O_{10} _____

j. S_4N_4 _____

k. OF_2 _____

l. IF_7 _____

12. What are the formulas for the following binary compounds?

a. silicon dioxide _____

b. boron trifluoride _____

c. xenon tetroxide _____

d. dinitrogen pentoxide _____

e. bromine trifluroide _____

f. carbon tetrachloride _____

g. phosphine _____

h. silicon carbide _____

i. disulfur dichloride _____

j. hydrogen selenide _____

3.8 Formula Mass and the Mole Concept for Compounds

Show all work and include units in your final answer.

1. How many moles are present in 128 grams of sulfur dioxide?

2. What is the mass of 3 moles of oxygen molecules?

3. If 5 moles of a metallic element have a mass of 200 grams, which element is it?

4. What is the molar mass of methane CH_4?

5. What is the mass of 9 moles of fluorine molecules?

6. 102 grams of a gas contains 6 moles. What is its molar mass?

7. How many grams are there in one mole of benzene C_6H_6?

8. How many moles of nitrogen atoms are there in 6 moles of TNT ($CH_3C_6H_2(NO_2)_3$)?

9. What is the molar mass of TNT?

3.9 Composition of Compounds

Determine the percent composition of each element below:

1. H_2SO_4	H	S	O
2. $Ca(OH)_2$	Ca	O	H
3. $HC_2H_3O_2$	H	C	O
4. CO_2	C	O	
5. N_2O	N	O	
6. NaOCl	Na	O	Cl
7. Al_2S_3	Al	S	

3.10 Determining a Chemical Formula from Experimental Data

1. Cupric chloride, $CuCl_2$, when heated to 100°C is dehydrated. If 0.235 g of $CuCl_2 \cdot x\ H_2O$ gives 0.185 g of $CuCl_2$ on heating, what is the value of *x*?

2. The "alum" used in cooking is potassium aluminum sulfate hydrate, $KAl(SO_4)_2 \cdot x\ H_2O$. To find the value of *x*, you can heat a sample of the compound to drive off all of the water and leave only $KAl(SO_4)_2$. Assume you heat 4.74 g of the hydrated compound and that the sample loses 2.16 g of water. What is the value of *x*?

3. If "Epsom salt," $MgSO_4 \cdot x\ H_2O$ is heated to 250□C, all the water of hydration is lost. On heating a 1.687-g sample of the hydrate, 0.824 g of $MgSO_4$ remains. What is the formula of Epsom salt?

4. When $CaSO_4 \cdot x\ H_2O$ is heated, all of the water is driven off. If 34.0 g of $CaSO_4$ (molar mass = 136) is formed from 43.0 g of $CaSO_4 \cdot x\ H_2O$, what is the value of x?

5. The hydrocarbons ethylene (molar mass 28 g/mol), cyclobutane (molar mass 56 g/mol), pentene (molar mass 70 g/mol), and cyclohexane (molar mass 84 g/mol), all have the same empirical formula. What is it? Write the molecular formulas for these four compounds.

6. A compound was analyzed and found to contain 76.57% carbon, 6.43% hydrogen, and 17.00% oxygen by mass. Calculate the empirical formula of the compound. If the molar mass of the compound is 94.11g/mol, what is the molecular formula of the compound?

7. A compound was analyzed and found to contain 53.30% carbon, 11.19% hydrogen, and 35.51% oxygen by mass. Calculate the empirical formula of the compound. If the molar mass of the compound is 90.12 g/mol, what is the molecular formula of the compound?

8. Combustion analysis of naphthalene, a hydrocarbon used in mothballs, produced 8.80 g carbon dioxide and 1.44 g water. Calculate the empirical formula for naphthalene

9. Tartaric acid is the white, pwdery substance that coats tart candies such as Sour Patch Kids. Combustion analysis of a 12.02 g sample of tartaric acid (which contains only C, H, and O) produced 14.08 g of carbon dioxide and 4.32 grams of water. Determine the empirical formula of tartaric acid.

3.11 Writing and Balancing Chemical Equations

1. Balance the following equations:
   a. $\_C_4H_6(g) + \_O_2(g) \rightarrow \_CO_2(g) + \_H_2O(l)$

   b. $\_NH_3(g) + \_O_2(g) \rightarrow \_NO_2(g) + \_H_2O(l)$

   c. $\_PCl_3(l) + \_H_2O(l) \rightarrow \_H_3PO_3(aq) + \_HCl(aq)$

   d. $\_Ca_3P_2(s) + \_H_2O(l) \rightarrow \_Ca(OH)_2(aq) + \_PH_3(g)$

   e. $\_C_4H_8(OH)_2(l) + \_O_2(g) \rightarrow \_CO_2(g) + \_H_2O(l)$

   f. $\_NH_3(g) + \_NO(g) \rightarrow \_N_2(g) + \_H_2O(l)$

   g. $\_KClO_3(s) \rightarrow \_KCl(s) + \_O_2(g)$

   h. $\_Ca(OH)_2(s) + \_H_3PO_4(aq) \rightarrow \_Ca_3(PO_4)_2(s) + \_H_2O(l)$

   i. $\_C_3H_8(g) + \_O_2(g) \rightarrow \_CO_2(g) + \_H_2O(l)$

   j. $\_N_2O(g) + \_O_2(g) \rightarrow \_NO_2(g)$

   k. $\_Al_4C_3(s) + \_H_2O(l) \rightarrow \_Al(OH)_3(aq) + \_CH_4(g)$

   l. $\_CS_2(l) + \_Cl_2(g) \rightarrow \_CCl_4(l) + \_S_2Cl_2(l)$

   m. $\_C_2H_5OH(l) + \_PCl_3(l) \rightarrow \_C_2H_5Cl(l) + \_H_3PO_3(l)$

   n. $\_ZnS(s) + \_O_2(g) \rightarrow \_ZnO(s) + \_SO_2(g)$

2. When asked to balance the equation $C_2H_6(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$ the following suggestions were made:
   a. $C_2H_6(g) + 5O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$
   b. $C_2H_6(g) + 5O(g) \rightarrow 2CO(g) + 3H_2O(l)$
   c. $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$

   Which answer is correct and what is wrong with each of the others?

3. Write balanced chemical equations for the following reactions
   a. The decomposition of ammonium nitrate to nitrogen gas, oxygen gas, and water vapor.

   b. The reaction of sodium bicarbonate with sulfuric acid to produce sodium sulfate, water, and carbon dioxide.

c. The treatment of phosphorus pentachloride with water to produce phosphoric acid and hydrogen chloride.

3.12 Organic Compounds

Review questions: on a separate sheet of paper, write or type your answers to the following review questions. Your answers must be in complete sentences.

Chapter 3 review questions: 2, 5, 8, 15, 17

AP Chemistry **Name:**

Ch. 4 – Chemical Quantities and Aqueous Reactions Date:

4.1 Climate Change and the Combustion of Fossil Fuels

4.2 Reaction Stoichiometry: How Much Carbon Dioxide?

1. If the maximum amount of product possible is formed in the following reactions, what mass of the specified product would you obtain?
   a. 10 grams of sodium chloride is treated with excess silver nitrate
   $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$
   How much silver chloride is precipitated?

   b. 12 grams copper metal is treated with excess dilute nitric acid:
   $3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$
   How much nitric oxide gas (NO) is produced?

   c. 60 grams propane gas is burned in excess oxygen:
   $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$
   How much water is produced?

4.3 Limiting Reactant, Theoretical Yield, and Percent Yield

1. Hydrazine reacts with dinitrogen tetroxide according to the equation:
   $2N_2H_4(g) + N_2O_4(g) \rightarrow 3N_2(g) + 4H_2O(g)$ 50.0 grams of hydrazine is mixed with 100.0 grams of dinitrogen tetroxide. How much nitrogen gas was produced?

2. Sodium metal reacts vigorously with water to produce a solution of sodium hydroxide and hydrogen gas:
   $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$ What mass of hydrogen gas can be produced when 10 grams of sodium is added to 15 grams of water?

3. Nitrous oxide reacts with oxygen to produce nitrogen dioxide according to the equation: $2N_2O(g) + 3O_2(g) \rightarrow 4NO_2(g)$ What mass of nitrogen dioxide can be made from 42 grams of nitrous oxide and 42 grams of oxygen?

4. If only 75 grams of nitrogen dioxide was produced in the reaction described in the previous question, what was the percent yield?

5. Freddie flask has 4.5 g of sodium hydroxide and 3.45×10^{23} molecules of hydrogen chloride and wants to predict how much sodium chloride he can make according to:

$$\_\_HCl + \_\_NaOH \rightarrow \_\_ NaCl + \_\_\_H_2O$$

6. How many moles of H_2O form when 16.9 grams of N_2 gas form according to the following equation? $3\ CuO + 2\ NH_3 \rightarrow 3\ Cu + 3\ H_2O + 1\ N_2$

7. What mass of HF must react to form 23.5 grams of H_2O according to the following equation?

$$\_\_SiO_2 + \_\_HF \text{ ---> } \_\_H_2O + \_\_SiF_4?$$

8. How many moles of Pb are formed when 38.2 grams of PbO react according to the following equation? $\_\_PbS + \_\_PbO$ ---> $\_\_Pb + \_\_\_SO_2$?

9. How many moles of NaCl form when 7.4 moles of NaClO react according to the following equation?

$$3\ NaClO \rightarrow 2\ NaCl + 1\ NaClO_3?$$

10. What is the limiting reactant for the following reaction if I have 10. grams of $Pb(SO_4)_2$ and 5.0 grams of $LiNO_3$

$$\_\_\_Pb(SO_4)_2 + \_\_\_LiNO_3 \rightarrow \_\_\_Pb(NO_3)_4 + \_\_\_ Li_2SO_4$$

Review questions: on a separate sheet of paper, write or type your answers to the following review questions. Your answers must be in complete sentences.

Chapter 4 review questions: 1, 2, 3

AP Chemistry

Reference: Significant Figures

The **significant figures** are the digits in a number which represent the accuracy of that number. All non-zero digits in a number are significant. But zeros may be just "place holders". The following two examples show the use of place holders in numbers.

.085 This number has an accuracy of **two significant figures**. In this number the "8" and "5" are measured digits and are therefore significant. The zero is just a place holder that shows the position of the decimal point; it is not a significant figure.

400 This number has an accuracy of **one significant figure**. Trailing zeros are often only place holders. In this number the zeros are there to show that the "4" is in the hundreds column. Since no decimal point is shown, the zeros have not been measured and are not significant.

Rules for Determining Significant Figures

1. **All non-zero digits** are significant.
2. **Zeros to the left of non-zero digits** are NEVER significant.
3. **Zeros between non-zero digits** are ALWAYS significant.
4. **Zeros to the right of non-zero digits** are significant ONLY if a decimal point is shown.

*Notice that the terms left, between and right refer to the placement of the zeros in relationship with non-zero numbers NOT in relationship with the decimal point.

The following examples illustrate the rules shown above as they apply to zeros:

rule 2		rule 3		rule 4	
number	**sig figs**	**number**	**sig figs**	**number**	**sig figs**
007	1	408	3	600	1
.025	2	7.002	4	8,500	2
0.09	1	30.7	3	30.0	3
.0081	2	50,009	5	46,000.	5

AP Chemistry

Reference: Significant Figure Math

When Adding or Subtracting	When Multiplying or Dividing
The answer must be rounded off to **the same column** (ones, tenths, hundredths, etc.) as the least precise measurement used in the calculation.	The answer must be rounded off to **the same number of significant figures** as the least accurate measurement used in the calculation.

Example 1.6 Significant Figures in Calculations

Perform each calculation to the correct number of significant figures.

a. $1.10 \times 0.5120 \times 4.0015 \div 3.4555$

b.
$$\begin{array}{r} 0.355 \\ +105.1 \\ -100.5820 \\ \hline \end{array}$$

c. $4.562 \times 3.99870 \div (452.6755 - 452.33)$

d. $(14.84 \times 0.55) - 8.02$

Solution

a. Round the intermediate result (in blue) to three significant figures to reflect the three significant figures in the least precisely known quantity (1.10).

$$\begin{aligned} &1.10 \times 0.5120 \times 4.0015 \div 3.4555 \\ &= 0.65219 \\ &= 0.652 \end{aligned}$$

b. Round the intermediate answer (in blue) to one decimal place to reflect the quantity with the fewest decimal places (105.1). Notice that 105.1 is *not* the quantity with the fewest significant figures, but it has the fewest decimal places and therefore determines the number of decimal places in the answer.

$$\begin{array}{r} 0.355 \\ +105.1 \\ -100.5820 \\ \hline 4.8730 \end{array} = 4.9$$

c. Mark the intermediate result to two decimal places to reflect the number of decimal places in the quantity within the parentheses having the fewest number of decimal places (452.33). Round the final answer to two significant figures to reflect the two significant figures in the least precisely known quantity (0.3455).

$$\begin{aligned} &4.562 \times 3.99870 \div (452.6755 - 452.33) \\ &= 4.562 \times 3.99870 \div 0.3455 \\ &= 52.79904 \\ &= 53 \end{aligned}$$

2 places of the decimal

d. Mark the intermediate result to two significant figures to reflect the number of significant figures in the quantity within the parentheses having the fewest number of significant figures (0.55). Round the final answer to one decimal place to reflect the one decimal place in the least precisely known quantity (8.162).

$$\begin{aligned} &(14.84 \times 0.55) - 8.02 = 8.162 - 8.02 \\ &= 0.142 \\ &= 0.1 \end{aligned}$$

AP Chemistry

Reference: The Nuclear Atom Schematic

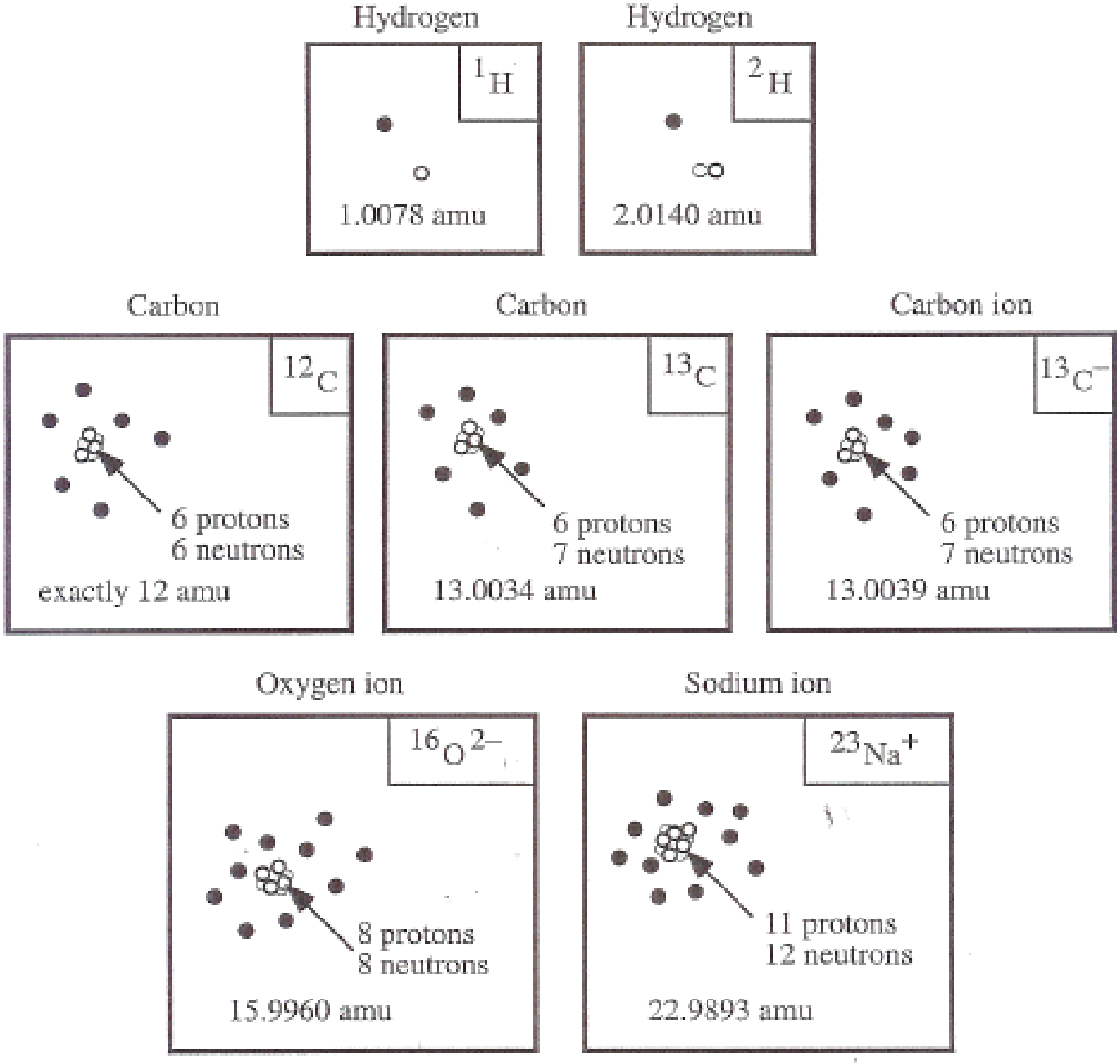
The Nuclear Atom

(What Is an Atom?)

Model: Schematic Diagrams for Various Atoms.

- ● electron (–)
- ⊙ proton (+)
- ○ neutron (no charge)

$1 \text{ amu} = 1.6606 \times 10^{-24} \text{ g}$



^{1}H and ^{2}H are <u>isotopes</u> of hydrogen.

^{12}C and ^{13}C are <u>isotopes</u> of carbon.

The <u>nucleus</u> of an atom contains the protons and the neutrons.

AP Chemistry

Reference: Writing Formulas and Naming Compounds

Introduction

Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds (H_2O, NH_3, CH_4, etc.) simply have ***common names*** that must be memorized.

The two types of compounds we will focus on first are ***ionic compounds*** (formed from positive and negative ions) and ***binary nonmetal compounds*** (molecular compounds). Later we will add ***acids***. So… you must recognize the ***type*** of compound before you try to name it. [Note: + ion = "cation" and – ion = "anion".]

	Ionic	**Binary Nonmetal**
Formula	positive ion before negative ion ex: NaCl $(NH_4)_2SO_4$ Al_2S_3	usually the less electronegative atom is first ex: CO CO_2 N_2O
Naming	Name of cation + name of anion sodium chloride ammonium sulfate aluminum sulfide	Indicate the number (mono, di, tri) and kind of atoms. First element is simply name of element. Second element name ends with "ide" carbon monoxide carbon dioxide dinitrogen monoxide

AP Chemistry

Reference: Ions to Memorize

note that there is some overlap on this chart with the other one, but they are not identical. You are responsible for ALL ions listed

aluminum	Al^{3+}	strontium	Sr^{2+}
ammonium	NH_4^+	stannous	Sn^{2+}
barium	Ba^{2+}	stannic	Sn^{4+}
calcium	Ca^{2+}	zinc	Zn^{2+}
cuprous	Cu^+	acetate	$C_2H_3O_2^-$ or CH_3COO^-
cupric	Cu^{2+}	bromide	Br^-
ferrous	Fe^{2+}	carbonate	CO_3^{2-}
ferric	Fe^{3+}	chlorate	ClO_3^-
hydrogen	H^+	chloride	Cl^-
hydronium	H_3O^+	chromate	CrO_4^{2-}
lead	Pb^{2+}	dichromate	$Cr_2O_7^{2-}$
lithium	Li^+	fluoride	F^-
magnesium	Mg^{2+}	hydroxide	OH^-
manganese	Mn^{2+}	iodide	I^-
mercurous	Hg_2^{2+}	nitrate	NO_3^-
mercuric	Hg^{2+}	oxide	O^{2-}
nickel	Ni^{2+}	permanganate	MnO_4^-
potassium	K^+	phosphate	PO_4^{3-}
silver	Ag^+	sulfate	SO_4^{2-}
sodium	Na^+	sulfide	S^{2-}

AP Chemistry

Reference: Ions to Memorize

note that there is some overlap on this chart with the other one, but they are not identical. You are responsible for ALL ions listed

P^{3-} phosphide	**O_2^{2-}** peroxide	**CN^-** cyanide
PO_3^{3-} phosphite	**C^{4-}** carbide	**SCN^-** thiocyanate
PO_4^{3-} phosphate	**SiO_3^{2-}** silicate	**$C_2O_4^{2-}$** oxalate
	IO_3^- iodate	**$C_2H_3O_2^-$** acetate
HPO_4^{2-} monohydrogen phosphate	**H^-** hydride	**CrO_4^{2-}** chromate
$H_2PO_4^-$ dihydrogen phosphate	**OH^-** hydroxide	**$Cr_2O_7^{2-}$** dichromate
N^{3-} nitride	**As^{3-}** arsenide	**CO_3^{2-}** carbonate
NO_3^- nitrate	**Br^-** bromide	**HCO_3^-** hydrogen carbonate (bicarbonate)
NO_2^- nitrite	**F^-** fluoride	
MnO_4^- permanganate	**I^-** Iodide	**NH_4^+** ammonium
S^{2-} sulfide	**O^{2-}** oxide	Cations (other than group 1A, 2A) that are normally written without roman numeral charge designators
HS^- hydrogen sulfide (bisulfide)	**Se^{2-}** selenide	
SO_4^{2-} Sulfate	**Te^{2-}** telluride	
SO_3^{2-} Sulfite	**Cl^-** chloride	**Al^{3+}** Aluminum
HSO_4^- hydrogen sulfate (bisulfate)	**ClO_4^-** perchlorate	**C_4^+** carbon
HSO_3^- hydrogen sulfite (bisulfite)	**ClO_3^-** chlorate	**Ga^{3+}** gallium
$S_2O_3^{2-}$ thiosulfate	**ClO_2^-** chlorite	**Si^{4+}** silicon
	ClO^- hypochlorite	**Ag^+** silver

AP Chemistry

Reference: Mole Conversions

1. Given moles, find grams. Example: How many grams are in 2.3 moles of water?

$$given\ moles\ * \frac{molar\ mass\ (in\ grams, from\ periodic\ table)}{1\ mole\ of\ substance} = grams$$

2. Given moles, find atoms of a pure substance. Example: How many atoms are in 5.6 moles of carbon?

$$given\ moles * \frac{6.022\ x\ 10^{23}\ atoms}{1\ mole} = atoms$$

3. Given moles, find molecules of a compound. Example: how many molecules are in 3.4 moles of water?

$$given\ moles * \frac{6.022\ x\ 10^{23}\ molecules}{1\ mole} = molecules$$

4. Given moles, find atoms of a compound. Example: how many atoms are in 3.4 moles of water?

$$given\ moles * \frac{6.022\ x\ 10^{23}\ molecules}{1\ mole} * \frac{number\ of\ atoms\ (eg: 3\ for\ H_2O)}{1\ molecule} = atoms$$

5. Given grams, find moles. Example: How many moles are in 45.6 grams of calcium chloride?

$$given\ grams * \frac{1\ mole\ of\ substance}{molar\ mass\ (in\ grams, from\ periodic\ table)} = moles$$

6. Given grams, find atoms (of a pure substance) or molecules (of a compound). Example: how many atoms are in 75.6 grams of sodium? How many molecules are in 65.4 grams of sodium chloride?

$$given\ grams * \frac{1\ mole\ of\ substance}{molar\ mass\ (in\ grams)} * \frac{6.022\ x\ 10^{23}\ atoms\ or\ molecules}{1\ mole} = atoms\ or\ molecules$$

7. Given atoms (of a pure substance) or molecules (of a compound) find moles. Example: how many moles are in 5.45 x 10^{23} carbon atoms? How many moles are in 3.78 x 10^{23} water molecules?

$$Given\ atoms\ or\ molecules * \frac{1\ mole}{6.022\ x\ 10^{23}\ atoms\ or\ molecules} = moles$$

8. Given atoms (of a pure substance) or molecules (of a compound), find grams. Example: what is the mass of 4.56 x 10^{23} carbon atoms? What is the mass of 3.45 x 10^{24} water molecules?

$$Given\ atoms\ or\ molecules * \frac{1\ mole}{6.022\ x\ 10^{23}\ atoms\ or\ molecules} * \frac{molar\ mass\ (in\ grams)}{1\ moles} = grams$$