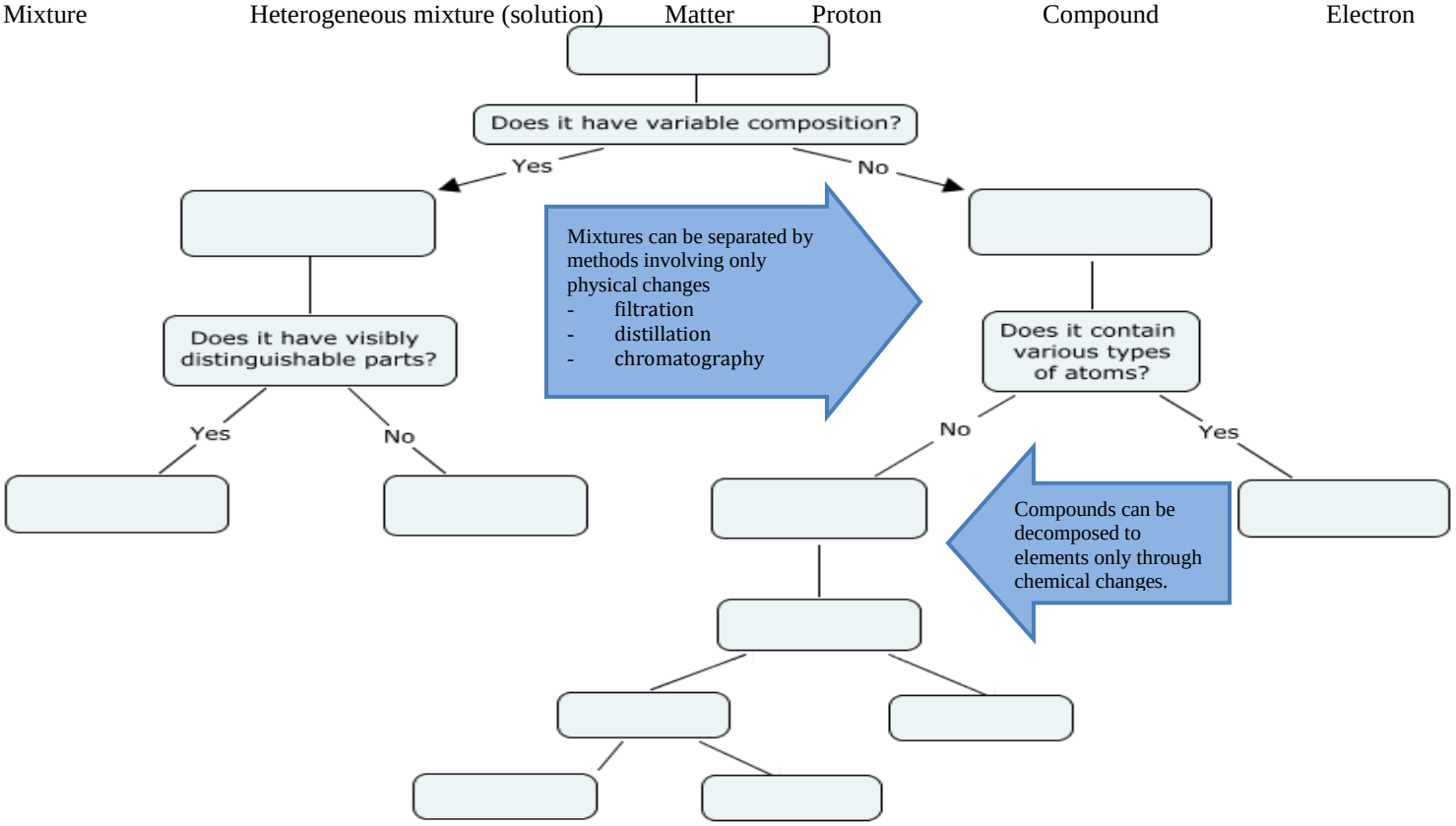
AP Chemistry Summer Assignment

Name: _____

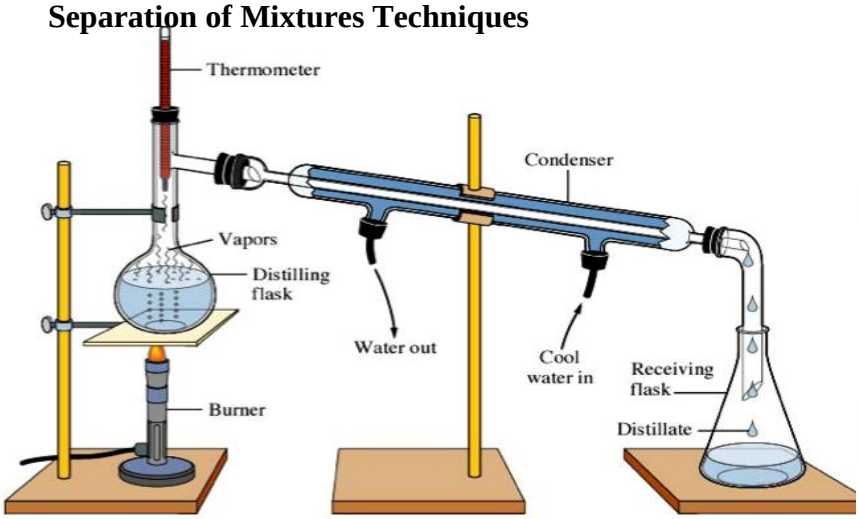
Classification of Matter

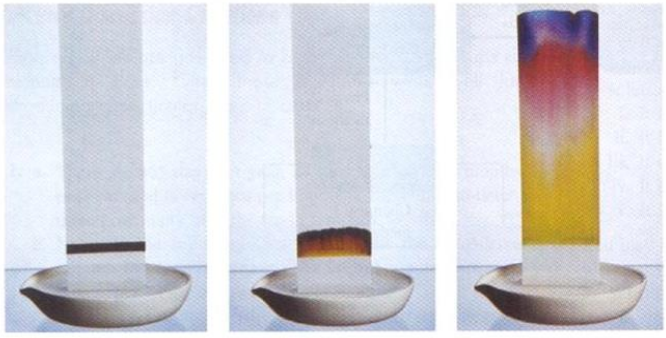
Place the following words in the flow chart below:

Element	Homogeneous Mixture (solution)	Atom	Neutron	Pure Substance	Nucleus
Mixture	Heterogeneous mixture (solution)	Matter	Proton	Compound	Electron



Separation of Mixtures Techniques





Distillation

What **physical property** would allow you to separate a mixture containing water, isopropyl alcohol, and salt using the above distillation apparatus? _____

What would be left over in the distilling flask? _____

Paper chromatograph of ink.

(a) A line of the mixture to be separate is placed at one end of a sheet of porous paper.
(b) The paper acts as a wick to draw up the liquid.
(c) The component with the strongest attraction for the liquid travels farther than those that cling to the paper.

Density

$$\textbf{Density} = \frac{\text{mass}}{\text{volume}}$$

mass units: grams volume units: mL or cm^3 (1 mL = 1 cm^3)

1. A chemist, trying to identify the main component of a compact disc cleaning fluid, finds that 25.00 cm^3 of the substance has a mass of 19.625 g at 20°C. The following are the names and densities of the compounds that might be the main component.

Compound	Density $\left(\frac{g}{cm^3}\right)$ at 20°C
Chloroform	1.492
Diethyl ether	0.714
Ethanol	0.789
Isopropyl alcohol	0.785
Toluene	0.867

Which of these compounds is the most likely to be the main component of the compact disc cleaner?

2. A student has a cube of aluminum that measures 4 cm wide on each side. What is the volume of this cube? (Volume = length x width x height)

_____

When the student massed the cube on a scale they found that the cube of aluminum had a mass of 165 g. What is the density of this aluminum cube?

_____

The accepted value for the density of aluminum is 2.70 g/cm^3. Calculate the percent error for your calculated density.

When you calculate results that are aiming for known values, the percent error formula is useful tool for determining the precision of your calculations. The formula is given by:

$$\textbf{Percent Error} = \frac{|\textbf{Experimental Value} - \textbf{Theoretical Value}|}{\textbf{Theoretical Value}} \times 100\%$$

The experimental value is your calculated value, and the theoretical value is the known value. A percentage very close to zero means you are very close to your targeted value, which is good. It is always necessary to understand the cause of the error, such as whether it is due to the imprecision of your equipment, your own estimations, or a mistake in your experiment.

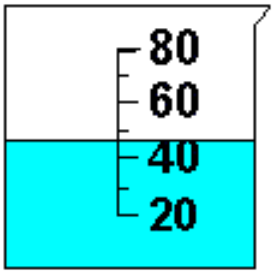
Percent error for Al _____%

Significant Figures

There are two kinds of numbers in the world**:**

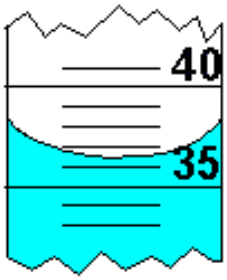
- **exact:**
  - Examples: There are exactly 12 eggs in a dozen.
    Most people have exactly 10 fingers and 10 toes.
- **inexact numbers:**
  - Example: Any measurement.
    If I quickly measure the width of a piece of notebook paper, I might get 220 mm (2 significant figures). If I am more precise, I might get 216 mm (3 significant figures). An even more precise measurement would be 215.6 mm (4 significant figures).

Significant figures are critical when reporting scientific data because they give the reader an idea of how well you could actually measure/report your data. In any measurement, the number of significant figures is critical. The number of significant figures is the number of digits believed to be correct by the person doing the measuring and always includes *one* ***estimated*** *digit*.



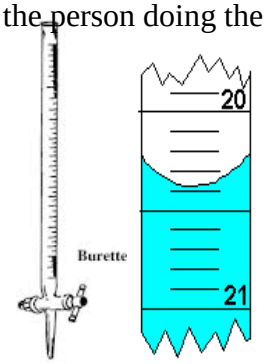
Beaker

The first digit is definitely a 4 because the liquid line is between 40 and 50.
The second digit is an **estimate**… 4**6**? 4**7**? 4**8**?
This measurement has 2 significant figures.



Graduated cylinder

Graduated cylinder has more gradations (lines) so we can get more significant figures.
Now we know it is 36 and we can **estimate** the last digit 36.**4**? 36.**5**? 36.**6**?
This measurement has 3 significant figures.



Buret

Buret has even more gradations so it will give you the most accurate measurement.
We know 20.3 and can estimate the last digit.
20.3**7**? 20.3**8**? 20.3**9**?
This measurement has 4 sig figs.

Rules for Significant Figures (sig figs)

A. Determining the Number of Significant Figures

1. All non zero numbers are *significant* (meaning they count as sig figs).
2. Zeros located between non-zero digits are *significant* (they count).
3. Zeros to left of the first nonzero digit are *insignificant* (they **don't** count); they are only placeholders!
4. Trailing zeros (zeros at the end) are *significant* only if the number contains a decimal point. If the number does not contain a decimal point, trailing zeros are *insignificant* (they **don't** count).

Reminders about Rounding:
If the first digit to be dropped is **greater than or equal to 5**, increase the last reported digit by one (round up). If the first digit to be dropped is **less than 5**, keep the remaining digits the same.

Round to 3 significant figures: 32107 m = _____ 2.4572 m = _____

923.26 m = _____ 123456 m =_____

B. Rules for Addition/Subtraction Calculations

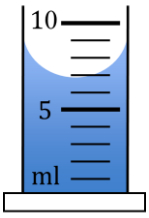
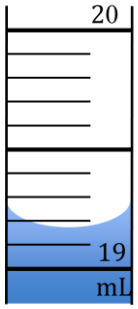
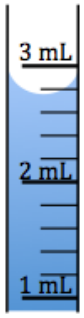
Round your calculated sum/difference to the same number of decimal places as that of the least precise measurement (the value with the fewest of decimal places, also called the limiting term).

C. Rules for Multiplication/Division Calculations

The calculated product/quotient should have the same number of significant figures as the measurement with the lowest number of significant figures (limiting term).

Reporting Measurements Correctly: Assignment

1. Report the volume shown using the correct significant figures and units.

	volume:		volume:		volume:
	# of sig figs		# of sig figs		# of sig figs

2. Mary runs a 10 km race in 1.322 hours. She hires a coach and trains for a month. She then runs the same 10 km in 1.204 hours. Assume that her times were reported correctly, using the same timer. Did the new coach help? Did her time improve significantly?

   What if her new time had been 1.319 hours?

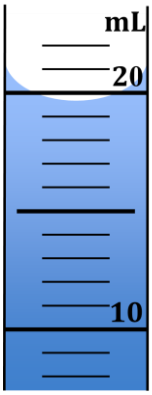
3. A group of chemistry students was given the following procedure, and asked to record their measurements in a data table. Some of the students took pictures of their measurements just in case...

Procedure

1. You have about 2 grams of aluminum foil. Record the exact mass in your data table, and place the foil in a 100 mL beaker.
2. Add about 20 mL of 2 M $CuCl_2$ to the beaker. Record the exact volume in your data table.

Measuring the mass of the aluminum foil:

Measuring the volume of the $CuCl_2$ solution.



The students' data table is shown below. Identify their mistakes, and write the correct measurements in the table to the right.

Data		mistake(s)
Mass of Aluminum	**2.1**	
Volume of $CuCl_2$	**20 mL**	

Corrected Data Table	
Mass of Aluminum	
Volume of $CuCl_2$	

Identifying and Using Significant Figures: Assignment

Report the number of significant figures for each of the following measurements

1.) 54 g _____ 4.) 4.00 g _____ 7.) 0.041 g _____

2.) 45678 g _____ 5.) 400 g _____ 8.) 0.00010 g _____

3.) 4.03 g _____ 6.) 400. g _____ 9.) 190909090 g _____

Underline the measurement in each of the expressions that is the limiting term. Calculate the indicated sum or difference, and round to the correct decimal point. Write the answer with the correct units and number of significant figures, then indicate the number of significant figures you reported.

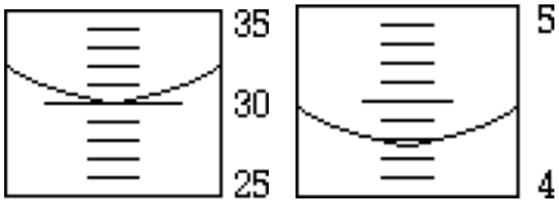
10.) 55.43 g + 44.333 g + 5.31 g + 9.2 g = _____ # of sig figs _____

11.) 3.461728 mL + 14.91 mL + 0.980001 mL + 5.2631 mL = _____ # of sig figs _____

12.) 23.1 cm + 4.77 cm + 125.39 cm + 3.581 cm = _____ # of sig figs _____

13.) 22.101 kg - 0.9307 kg = _____ # of sig figs _____

14.) Record the volume in each of the graduated cylinders pictured below. Determine the volume of the solution that would result from adding the two volumes together. Use the correct units and significant figures to report your answer.



Volume 1 + Volume 2 = Total Volume

_____mL + _____mL = _____mL

Underline the measurement in each of the expressions that is the limiting term. Calculate the indicated product or quotient, and round to the correct number of significant figures.

14.) 343.4 g ÷ 34.337 mL = _____ # of sig figs _____

15.) 1.3 cm × 5.724 cm = _____ # of sig figs _____

16.) 6305 mL ÷ 0.010 mL = _____ # of sig figs _____

17.) 12.5 m × 75 m = _____ # of sig figs _____

Nomenclature

Rules for Naming Covalent Compounds
(nonmetal + nonmetal)

A. Use pre-fixes to identify the number of each type of element
B. If the 1st element has only 1 atom – DO NOT USE MONO!

Rules for Naming Ionic Compounds
(metal +nonmetal)

A. Balance Charges (charges should net zero)
B. Cation is always written first (in name and in formula)
C. Change the ending of the anion to –ide (unless polyatomic ion, then named as given)

Name these binary compounds of two nonmetals.

IF_7_____ XeF_2 _____ SF_6_____

N_2O_5_____ N_2O_4_____ PCl_3_____

Name these binary compounds with a fixed charge metal.

$AlCl_3$ _____ BaI_2_____ Na_2S _____

MgO_____ $SrBr_2$ _____ Al_2O_3_____

Name these binary compounds of cations with variable charge (use roman numerals).

$CuCl_2$ _____ SnO_____ Cu_2S_____

Fe_2O_3_____ $PbCl_4$_____ CoP_____

Name these compounds with polyatomic ions.

$Fe(NO_3)_3$_____ $Ca(ClO_3)_2$_____ NH_4NO_2_____

NaOH_____ KNO_2_____ $Cu_2Cr_2O_7$ _____

Cu_2SO_4_____ $NaHCO_3$_____ NH_4CH_3COO_____

Naming Acids

If the formula has hydrogen written first, then this usually indicates that the hydrogen is an H^+ cation and that the compound is an acid.

Rules for Naming an Acid

A. When the name of the anion ends in *–ide* (nonmetal off of the periodic table), the acid name begins with the prefix *hydro-*, the stem of the anion has the suffix *–ic* and it is followed by the word *acid*.

-ide becomes hydro _____ic Acid

Example: Cl^- is the Chloride ion so HCl = hydrochloric acid

HCl _____ H_2S _____

HI _____ HF _____

B. When the anion name ends in *–ite* (common polyatomic ion ending), the acid name is the stem of the anion with the suffix *–ous*, followed by the word acid.

-ite becomes _____ous Acid

Example: ClO_2^- is the Chlorite ion so $HClO_2$. = Chlorous acid.

C. When the anion name ends in *–ate* (common polyatomic ion ending), the acid name is the stem of the anion with the suffix *–ic*, followed by the word acid.

-ate becomes _____ic Acid

Example: ClO_3^- is the Chlorate ion so $HClO_3$ = Chloric acid.

I like to remember these rules as "I **ate something and it was **ic**ky" and "R**ite** **ous**" (*yea… its spelled wrong…*)

HNO_3, which contains the polyatomic ion nitrate, is called nitric acid.

HNO_2, which contains the polyatomic ion nitrite, is called nitrous acid.

Name the following acids using the correct naming rule.

$HClO_4$_____ H_2SO_4 _____

H_3PO_4 _____ HNO_2 _____

$H_2C_2O_4$ _____ H_2CO_3 _____

HBr _____ H_2CrO_4 _____

$HC_2H_3O_2$_____ HCl _____

Write the chemical formulas. *For ionic compounds and acids make sure the formulas are charge balanced!*

tin(IV) phosphide _____	sulfuric acid _____	dichromic acid _____
copper(II) cyanide _____	sulfurous acid _____	zinc fluoride _____
magnesium hydroxide _____	hydrosulfuric acid _____	gallium arsenide _____
sodium peroxide _____	phosphorous pentabromide _____	copper(I) oxide _____
dihydrogen monoxide _____	potassium nitride _____	sodium nitrate _____
cobalt(II) chromate _____	chromium(III) carbonate _____	nitrogen trihydride _____

Composition

Complete the following problems showing all work.

1. A 0.941 gram piece of magnesium metal is heated and reacts with oxygen. The resulting magnesium oxide weighed 1.560 grams. Determine the percent composition of each element in the compound.

2. Determine the empirical formula given the following data for each compound:
   a. Fe = 63.53%, S = 36.47%

   b. Fe = 46.55%, S = 53.45%

3. A compound contains 21.6% sodium, 33.0% chlorine, 45.1% oxygen. Determine the empirical formula of the compound.

Solubility Rules
Review solubility rules and identify each of the following compounds as soluble or insoluble in water.

Na_2CO_3	_____	AgI	_____	Li_2O	_____
$CoCO_3$	_____	$Ni(NO_3)_2$	_____	$Mn(C_2H_3O_2)_2$	_____
$Pb(NO_3)_2$	_____	KI	_____	$Cr(OH)_3$	_____
K_2S	_____	FeS	_____	$AgClO_3$	_____
$BaSO_4$	_____	$PbCl_2$	_____	$Sn(SO_3)_4$	_____
$(NH_4)_2S$	_____	$CuSO_4$	_____	FeF_2	_____

Write out the balanced chemical equation for each of the following double replacement reactions. Predict whether each of these double replacement reactions will give a precipitate or not based on the solubility of the products. If yes, identify the precipitate.

silver nitrate and potassium chloride

magnesium nitrate and sodium carbonate

strontium bromide and potassium sulfate

cobalt (III) bromide and potassium sulfide

ammonium hydroxide and copper (II) acetate

lithium chlorate and chromium (III) fluoride

Balancing Equations
Balance the following equations with the lowest whole number coefficients.

____S_8	+	____ O_2	→	____ SO_3				
____$C_{10}H_{16}$	+	____ Cl_2	→	____ C	+	____ HCl		
____Fe	+	____ O_2	→	____ Fe_2O_3				
____$C_7H_6O_2$	+	____ O_2	→	____CO_2	+	____ H_2O		
		____$KClO_3$	→	____ KCl	+	____ O_2		
		____H_3AsO_4	→	____As_2O_5	+	____ H_2O		
____V_2O_5	+	____ HCl	→	____$VOCl_3$	+	____ H_2O		
____$Hg(OH)_2$	+	____ H_3PO_4	→	____ $Hg_3(PO_4)_2$	+	____ H_2O		

Stoichiometry and Limiting Reagents

1. Given the equation below, what mass of water would be needed to react with 10.0g of sodium oxide?

   $$Na_2O + H_2O \rightarrow 2NaOH$$

2. $2NaClO_3 \rightarrow 2NaCl + 3O_2$
   What mass of sodium chloride is formed along with 45.0g of oxygen gas?

3. $4NH_3 + 5O_2 \rightarrow 4NO + 6\ H_2O$
   What mass of water will be produced when 100.0g of ammonia is reacted with excess oxygen?

4. If the reaction in #3 is done with 25.0g of each reactant, which would be the limiting reagent?

5. $Na_2S + 2AgNO_3 \rightarrow Ag_2S + 2NaNO_3$
   a. If the above reaction is carried out with 50.0g of sodium sulfide and 35.0g of silver nitrate, which is the limiting reagent?

   b. What mass of the excess reactant remains?

   c. What mass of silver sulfide would precipitate?

6. $6NaOH + 2Al \rightarrow 2Na_3AlO_3 + 3H_2$
   What volume of hydrogen gas (measured at STP) would result from reacting 75.0g of sodium hydroxide with 50.0g of aluminum?