Molarity

How do we measure amounts in solutions?

What is molarity?

What forms can the equation take?

What about making solutions from solutions?

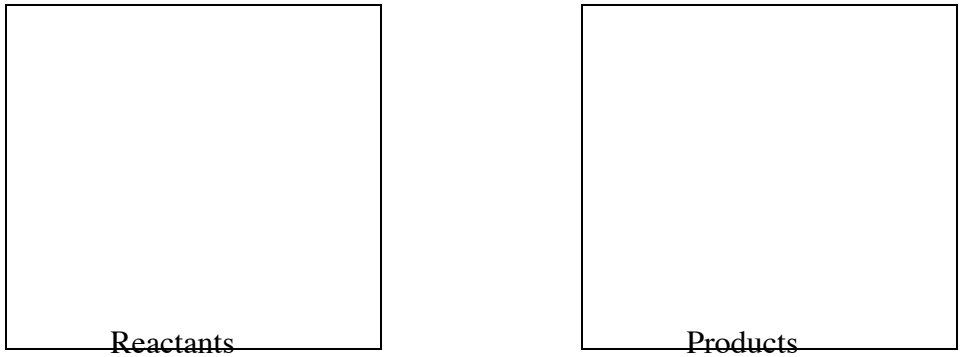
1) What is the molarity of 20.00 g of NaOH in 1.50 L of solution?

2) How many grams of KOH are needed to make 2.00 L of 0.75 M solution?

3) What is the molarity of nitrate ions in a solution that has 25.0g of $Ca(NO_3)_2$ in 2.00 L?

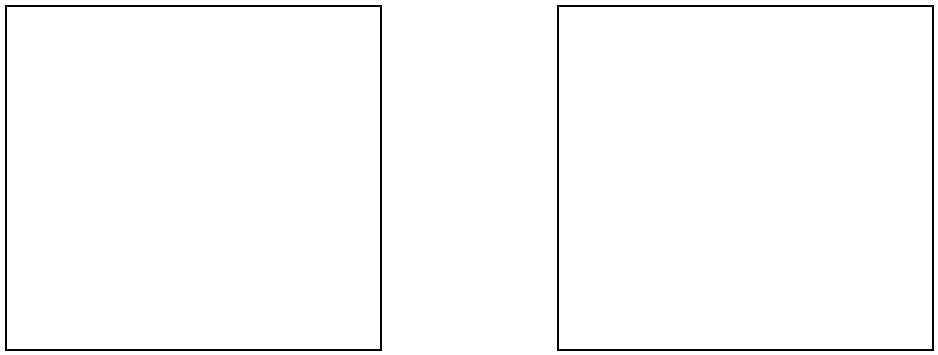
Particulate Diagrams
Write the equation for the formation of HCl from hydrogen gas and chlorine gas.

Draw the reactants in the boxes on the left and the products in the boxes on the right.



Write the equation for the formation of ammonia gas from hydrogen and nitrogen gasses.

Five molecules of nitrogen react with five molecules of hydrogen. Draw an accurate diagram of the reactants and products in the boxes below.



There is not a perfectly balanced number of atoms on each side.
Identify the limiting and excess reactants in this scenario. Justify your answer.

The Roadmap

Molecules of A -------- Moles of A -------- Mass of A -------- Liquid Volume of A

Balanced Chemical Equation

Molecules of B -------- Moles of B --------- Mass of B -------- Liquid Volume of B

Mass A to Mass B

1) For the reaction:

$$\_\_Na + \_\_H_2O \leftrightarrows \_\_H_2 + \_\_NaOH$$

10.00 g of Na reacts with excess water. How many grams of NaOH can be produced?

2) For the reaction:

$$\_\_Pb(NO_3)_2 + \_\_NaCl \leftrightarrows + \_\_PbCl_2 + \_\_NaNO_3$$

What mass of $PbCl_2$ can be formed from the reaction of 50.0 mL of 0.250 M NaCl with excess lead (II) nitrate?

Percent Yields

3) A 1.00 g sample of Ammonium Chloride (NH_4Cl) is decomposed. 0.25 g of ammonia are produced. What is the percent yield?

Reaction:

Conversion:

Final Answer

4) Consider 100.0 g of CaC_2 reacted with excess water to produce $Ca(OH)_2$ and C_2H_2. What is the percent yield if 28.3 g of C_2H_2 is produced?

Reaction:

Conversion:

Final Answer

5) If 10.00 g $CaCO_3$ decomposes with a 80.0% yield how much CaO is produced?

Reaction:

Conversion:

Final Answer

Excess Reactants

6) Consider 100.0 g of CCl_4 mixed with 30.00 g of HF. What mass of CCl_2F_2 can be produced? How much excess reactant is left over?

Reaction:

Conversion for first reactant:

Conversion for second reactant:

Work backwards for the excess:

7) What mass of excess remains in a reaction mixture that consists of 1.54 g of $Cr(NO_3)_3$ dissolved in 120.0 mL of 0.100 M H_2S?

Reaction:

Conversion for first reactant:

Conversion for second reactant:

Work backwards for the excess:

Now you practice!

8) A volume of 3.42 mL of 0.500M $AgNO_3$ is reacted with 2.50 g of copper (II) chloride. How many grams of the excess reactant is left over? (Answer 2.39 g $CuCl_2$)

9) Phosphorus is P_4 and it reacts with oxygen gas to make P_4O_{10}. How much of the excess reactant remains if 3.75 g of P_4 is mixed with 6.55 g of O_2? (Answer 1.71 g O_2)

10) Calculate the % yield when 5.23 g of $ZnCl_2$ is mixed with 35.0 mL of 0.325 M $AgNO_3$ and 1.35 g of AgCl is formed. (Answer 82.8%)

11) HCN and Water are produced by the reaction of ammonia, oxygen gas and methane(CH_4). If you mix 35.00 grams of methane and 35.00 grams of ammonia with excess oxygen and you get 53.22 g of HCN what is the percent yield? (Answer 95.86%)

Formula Problems

Remember empirical versus molecular formulas.

Chemical formulas are based on what type of ratios?

Determine the molecular formulas from the empirical formula of the following compounds based on their molecular weights:

CH	78.13g/mole	HCO_2	90.00 g/mole
CH_2Cl	99 g/mole	CH_2O	180 g/mole

Percent by Mass

Find the percent by mass of Carbon in CH_4.

Find the percent by mass of Hydrogen in PH_3.

How do you determine an empirical formula?

1)

2)

3)

4)

Using the percent by mass data find the empirical formula of dichloroethane.
Carbon 24.27%, Hydrogen 4.07%, Chlorine 71.65%.

What is the molecular formula for this compound if it has a molar mass of 98.96 grams per mole?

A compound that contains only nitrogen and oxygen is 30.4% nitrogen by mass. The molar mass of the compound is 92 g/mole. What is the molecular formula of this compound?

A compound is found to be 40.92% Carbon, 4.58% Hydrogen, and 54.50 % Oxygen. What is the empirical and molecular formula for it if it has a molar mass of 176 g/mole?

Combustion Problems

What happens when something burns?

How do we collect the products?

1) Napthalene has a molar mass of 128.18 g/mole. Combustion of a 3.000 g sample of it produces 10.30 g of CO_2 and 1.686 g of H_2O. What is the molecular formula?

2) The combustion of 1.000g of acetic acid (MW= 60.06 g/mole) produces 1.465 g of CO_2 and 0.6000 g of water. If acetic acid contains carbon, hydrogen and oxygen what is it's molecular formula?

3) An organic compound contains only carbon, hydrogen, and oxygen. Combustion of 2.000 g of it produces 3.822 g of CO_2 and 2.346 g of H_2O. What is the molecular formula of the compound? The molar mass is 46.08 g/mole.

4) A compound contains carbon, hydrogen, oxygen, and nitrogen. When 5.000 g of the compound is combusted 9.065 g of CO_2 and 2.319 g of H_2O are formed. In a separate experiment 4.000 g of the compound is combusted to produce 1.404 g of NH_3. What is the molecular formula of the compound it has a molar mass of 194 g/mole?

Gravimetric Analysis

Let's imagine a lab where we dissolve a solid that contains Barium Carbonate in acid. It produces some CO_2 and some barium ions in solution. We can figure out the percentage of barium in the original sample.

Barium is insoluble with sulfate ion.

What is now in the beaker?

Filtration (weigh the paper first)

Wash it, dry it

Mass of Barium Carbonate Sample	9.743 g
Mass of dry filter paper	1.372 g
Mass of filter paper and precipitate after first drying	2.789 g
Mass of filter paper and precipitate after second drying	2.651 g
Mass of filter paper and precipitate after third drying	2.652 g
Mass percent of Barium in original sample	

1) What would happen to the percent of barium if the filter paper was not totally dried?

2) What would happen to the mass percent of barium if both products were insoluble?

The Hydrate Lab

What is a hydrate?

What is a crucible?

		Trial One
	Formula of anhydrous salt	$SrCl_2$
1	Mass of empty crucible and cover	29.00 g
2	Mass of crucible, cover and hydrate	32.55 g
3	Mass after Heating	31.11 g
4	Molar mass of the anhydrous salt	
5	Mass of water lost	
6	Mass of anhydrous salt	
7	Moles Anhydrous Salt	
8	Moles Water	
9	Ratio Water:Salt	
10	Formula	

1) What would happen to the formula if some of the dry solid is spilled before weighing?

2) What would happen to the formula if not all the water was driven off?