What is a mole?

What is Avogadro's Number?

Why Do We Call It a Mole?

How big is it?

Peas

Pennies

Why do we choose Avogadro's number to be that particular number?

Why Do We Use Moles in Chemistry?

Particles have many names…

Molar Mass has many names…

How Do We Calculate Molar Mass?

What is the Mass of One Mole of H_2O?

	Mass of 1 Mole	Mass of 2 Moles	Mass of 3 Moles	Mass of 0.5 Moles	Molecules in 1 Mole	Molecules in 2 Moles
H_2						
H_2O						
O_2						
NH_3						
CH_4						

A Simple Roadmap

1) How many grams are in 3.75 moles of H_2O?

2) How many moles are in 100.0 g of H_2O?

3) How many grams are in 1.00 moles of NaCl?

4) How many moles are in 32.10 g of CH_4?

5) How many grams are in 3.33 moles of NH_3?

6) How many molecules are in 200.0 g of Cr_2S_3?

More Mole Practice

1) How many grams are in 4.50 moles of PCl_3?

2) How many moles are in 4.50 g PCl_5?

3) How many grams are in 3.00 moles of SF_6?

4) How many moles are in 200.0 g of Cr_2S_3?

5) How many moles are in 6.022×10^{22} molecules of NH_3?

6) How many molecules are in 3.75 moles of H_2O?

7) How many grams are in 3.011×10^{23} molecules of HF?

8) How many molecules are in 22.00 g of CO_2?

9) How many hydrogen atoms are in 8.025 g of CH_4?

10) How many oxygen atoms are in 20.00 g of SO_3?

Molarity

Do all chemicals come as a solid?

What property can you measure for a liquid?

What is the difference between solute, solvent, and solution?

In a solution of NaCl in water what is really present?

What was density?

What is molarity?

How do we calculate it?

What about this word molar?

What do you do if your liquid comes as a concentrate?

How do you physically prepare a solution?

1) What is the molarity when 2.50 moles of NaCl are added to enough water to make 1.00 L of solution?

2) What is the molarity when 5.61 g of KOH is dissolved in enough water to make 500.0 mL's?

3) How many grams of HF are needed to make 1.00 L of 2.50 M HF?

4) If I need exactly 2.00 moles of HCl what volume of 1.50 M HCl do I need?

5) If HCl concentrate is 12.1 M, how many mL's of it are needed to make 250 mL of 2.00M HCl?

6. How do you prepare 100 mL of 0.200 M $KMnO_4$?
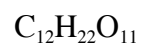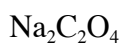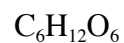
Formula Problems
Percentage Composition

Let's look at NaCl. It has two ions one of Na and one of Cl. Is it 50% Na and 50%Cl?

Now what about water, H_2O.

Empirical Formula

What are the empirical formulas of the following compounds:?

N_2O_4 N_2O_5 $C_6H_{12}O_6$

$Na_2C_2O_4$ PH_3 $C_{12}H_{22}O_{11}$

Four Step Process

1)

2)

3)

4)

Washing Soda contains 43.38% Na, 11.33% C, and 45.29% O. What is its empirical formula?

The numbers are not always clean and tidy! Aluminum sulfide is 35.95% Aluminum and 64.05% Sulfur what is its empirical formula

Molecular Formula

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

CH_2O 180 g/mole CH_2O 60.06 g/mole

$C_3H_4O_3$ 88 g/mole HO 34.02 g/mole
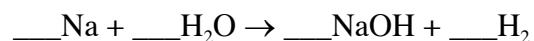
Roadmap Problems

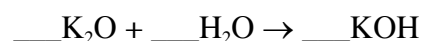Molecules A -------- Moles A -------- Mass A -------- Volume A

Molecules B -------- Moles B --------- Mass B --------- Volume B

Mole Ratios

Our first reaction:
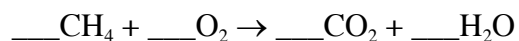
$$\_\_\_Na + \_\_\_H_2O \rightarrow \_\_\_NaOH + \_\_\_H_2$$

1) How many moles of NaOH are produced by 1.00 moles of H_2O?

2) How many moles of H_2 are produced by 1.75 moles of Na?

Our second reaction

$$\_\_\_K_2O + \_\_\_H_2O \rightarrow \_\_\_KOH$$

3) How many grams of KOH are produced by 10.00 g of K_2O?

4) How many grams of H_2O are needed to completely react with 75.00 g of K_2O in the same reaction as number 3?

The next reaction:

$$\_\_\_CH_4 + \_\_\_O_2 \rightarrow \_\_\_CO_2 + \_\_\_H_2O$$

5) How many grams of CO_2 are produced by the burning of 32.0 g of CH_4?

6) How many grams of H_2O are produced by the burning of 16.00 g of O_2?

And finally:

$$\_\_\_KClO_3 \rightarrow \_\_\_O_2 + \_\_\_KCl$$

7) How many grams of O_2 are produced by the decomposition of 100. g of $KClO_3$?

8) How many grams of KCl are produced by the decomposition of 100.0 g of $KClO_3$?

Now you try:

$$\_\_\_HgO \rightarrow \_\_\_O_2 + \_\_\_Hg$$

9) How many grams of O_2 are produced by the decomposition of 100. g of HgO?

10) How many grams of Hg are produced by the decomposition of 100.0 g of HgO?

Limiting & Excess Reactants   Post Lab Discussion

Why is HCl the excess reactant?

Why is $NaHCO_3$ the limiting reactant?

If your lab went perfectly, how much NaCl should you have made?
[for 3.00 g $NaHCO_3$; 2.09 g NaCl should be produced.]

Why didn't you get that amount of NaCl?

Making Bicycles
Each completed bicycle needs one frame and two wheels:

20 frames, how many bikes could you make?

30 wheels, how many bikes could you make?

Which one is the limiting reactant?

Which one is in excess?

How many are left over?

Time for some examples from Chemistry:

1) 10.00 g of H_2 and 10.00 g of O_2 are mixed and a reaction occurs.

a) How many grams of water are produced?

b) Which reactant is the limiting reactant?

c) How much of the excess reactant is left over?

2) 10.00 g of Na and 10.00 g of O_2 are mixed and a reaction occurs.

a) How many grams of Na_2O are produced?

b) Which reactant is the limiting reactant?

c) How much of the excess reactant is left over?

Percent Yield

Making Cookies: why is it that when the recipe says it will yield 24 cookies you seem to get only 12? What percentage of the expected yield did you get?

Theoretical yield versus actual yield

What is the formula for percent yield?

What can affect the percent yield of a reaction?

Is a yield greater than 100% ever going to happen?

1) Fred and Wilma mix 12.5 g of Cu with excess Cl_2 and manage to produce 25.4 g of copper(II) chloride. What was their percentage yield?

2) If 500.g mercury oxide decomposes to produce 35.0 g of O_2 what is the percent yield?

Excess Reactant Post Lab

Sample Data

Mass of beral pipet	0.99 g
Mass of pipet and water	5.98 g
Mass of beaker	110.23 g
Mass of beaker and zinc	110.72 g
Mass of pipet and 1-M HCl	5.99 g

Reaction:

Calculations:
1) Mass of water used:
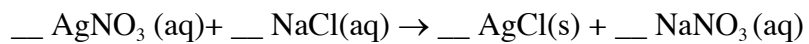
2) Volume of pipet:

3) Mass of Zn:

4) Moles of Zn:

5) Volume of HCl used:

6) Moles of HCl used:

7)Excess reactant:

A little enrichment! Working with solutions!

1) One very common precipitation reaction is:

$$\_\_ AgNO_3 \text{ (aq)} + \_\_ NaCl\text{(aq)} \rightarrow \_\_ AgCl\text{(s)} + \_\_ NaNO_3 \text{(aq)}$$

a) What mass of AgCl can be made by reacting 50.0 mL of 0.050 M $AgNO_3$?

b) What mass of AgCl can be made by reacting 50.0 mL of 0.10 M NaCl?

c) Which is the limiting reactant?

d) Which is the excess reactant?

e) What mass of excess reactant remains after the reaction?

f) What mass of limiting reactant remains after the reaction?