

**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<sub>2</sub>O?

	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 <sub>2</sub>						
H <sub>2</sub> O						
O <sub>2</sub>						
NH <sub>3</sub>						
CH <sub>4</sub>						

**A Simple Roadmap**

1) How many grams are in 3.75 moles of  $\text{H}_2\text{O}$ ?

2) How many moles are in 100.0 g of  $\text{H}_2\text{O}$ ?

3) How many grams are in 1.00 moles of  $\text{NaCl}$ ?

4) How many moles are in 32.10 g of  $\text{CH}_4$ ?

5) How many grams are in 3.33 moles of  $\text{NH}_3$ ?

6) How many molecules are in 200.0 g of  $\text{Cr}_2\text{S}_3$ ?

**More Mole Practice**

1) How many grams are in 4.50 moles of  $\text{PCl}_3$ ?

2) How many moles are in 4.50 g  $\text{PCl}_5$ ?

3) How many grams are in 3.00 moles of  $\text{SF}_6$ ?

4) How many moles are in 200.0 g of  $\text{Cr}_2\text{S}_3$ ?

5) How many moles are in  $6.022 \times 10^{22}$  molecules of  $\text{NH}_3$ ?

6) How many molecules are in 3.75 moles of  $\text{H}_2\text{O}$ ?

7) How many grams are in  $3.011 \times 10^{23}$  molecules of  $\text{HF}$ ?

8) How many molecules are in 22.00 g of  $\text{CO}_2$ ?

9) How many hydrogen atoms are in 8.025 g of  $\text{CH}_4$ ?

10) How many oxygen atoms are in 20.00 g of  $\text{SO}_3$ ?

**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  $\text{KMnO}_4$ ?

**Formula Problems**

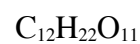
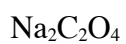
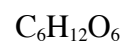
## Percentage Composition

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<sub>2</sub>O.

## Empirical Formula

What are the empirical formulas of the following compounds:?



## 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<sub>2</sub>O      180 g/mole

CH<sub>2</sub>O      60.06 g/mole

C<sub>3</sub>H<sub>4</sub>O<sub>3</sub>      88 g/mole

HO      34.02 g/mole

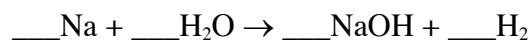
**Roadmap Problems**

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

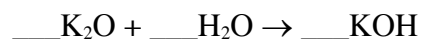
Molecules B ----- Moles B ----- Mass B ----- Volume B

## Mole Ratios

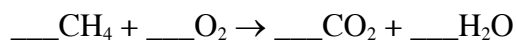
Our first reaction:

1) How many moles of NaOH are produced by 1.00 moles of H<sub>2</sub>O?2) How many moles of H<sub>2</sub> are produced by 1.75 moles of Na?

Our second reaction

3) How many grams of KOH are produced by 10.00 g of K<sub>2</sub>O?4) How many grams of H<sub>2</sub>O are needed to completely react with 75.00 g of K<sub>2</sub>O in the same reaction as number 3?

The next reaction:



5) How many grams of  $\text{CO}_2$  are produced by the burning of 32.0 g of  $\text{CH}_4$ ?

6) How many grams of  $\text{H}_2\text{O}$  are produced by the burning of 16.00 g of  $\text{O}_2$ ?

And finally:



7) How many grams of  $\text{O}_2$  are produced by the decomposition of 100. g of  $\text{KClO}_3$ ?

8) How many grams of  $\text{KCl}$  are produced by the decomposition of 100.0 g of  $\text{KClO}_3$ ?

Now you try:



9) How many grams of  $\text{O}_2$  are produced by the decomposition of 100. g of  $\text{HgO}$ ?

10) How many grams of  $\text{Hg}$  are produced by the decomposition of 100.0 g of  $\text{HgO}$ ?

**Limiting & Excess Reactants****Post Lab Discussion**

Why is HCl the excess reactant?

Why is NaHCO<sub>3</sub> the limiting reactant?

If your lab went perfectly, how much NaCl should you have made?  
[for 3.00 g NaHCO<sub>3</sub>; 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  $\text{H}_2$  and 10.00 g of  $\text{O}_2$  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  $\text{O}_2$  are mixed and a reaction occurs.

a) How many grams of  $\text{Na}_2\text{O}$  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  $\text{Cl}_2$  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  $\text{O}_2$  what is the percent yield?

**Excess Reactant Post Lab**

## Sample Data

Mass of beaker and 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:

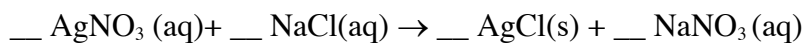
5) Volume of HCl used:

6) Moles of HCl used:

7) Excess reactant:

A little enrichment! Working with solutions!

1) One very common precipitation reaction is:



a) What mass of AgCl can be made by reacting 50.0 mL of 0.050 M AgNO<sub>3</sub>?

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?