

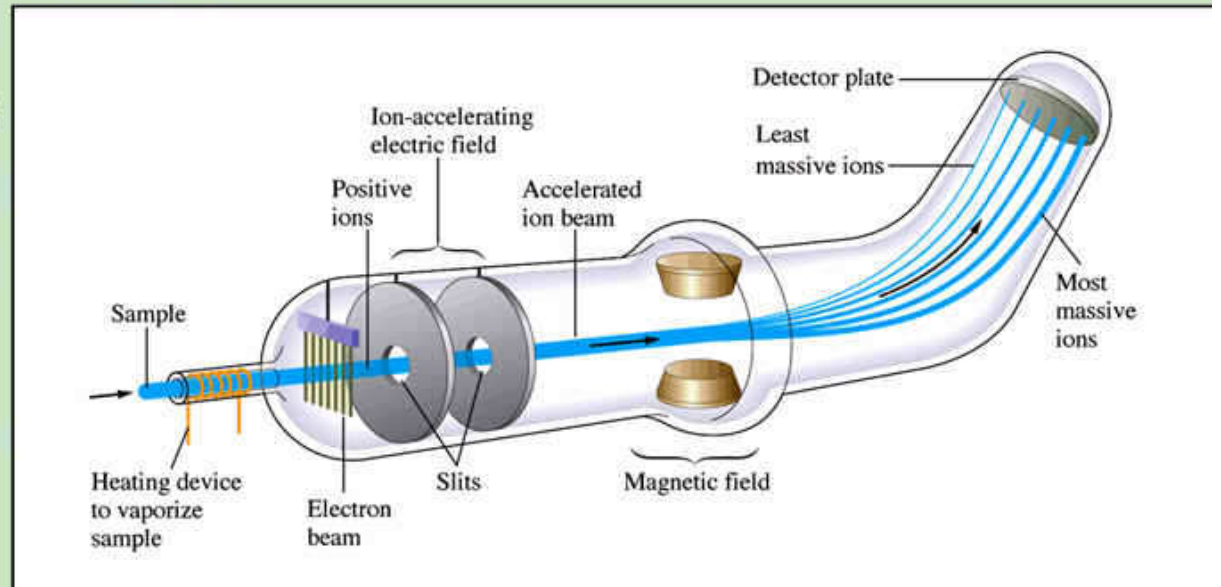
Chapter 3 problems:

21, 23, 25, 35, 37, 39, 41, 43, 45, 53, 59, 62, 65, 66, 69, 73, 75, 77-80, 91, 92, 94, 102, 103, 105, 111, 112, 114, 117, 122, 124, 125

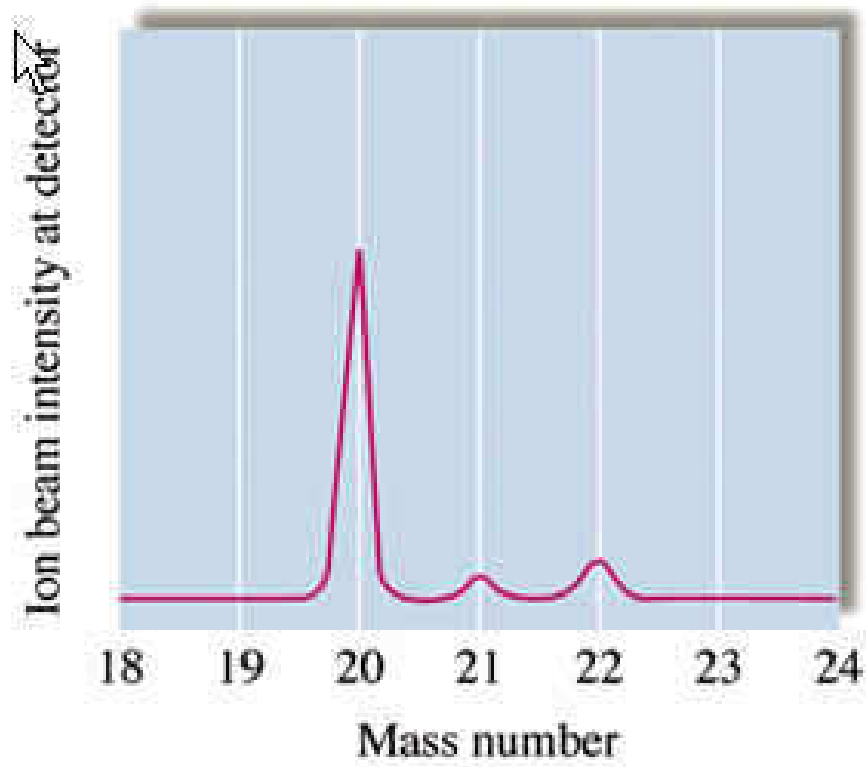
Chapter 3 - Stoichiometry

By definition, and agreement around the world, 1 atom of Carbon-12 weighs 12 atomic mass units (amu's). All other element weights are relative to this weight.

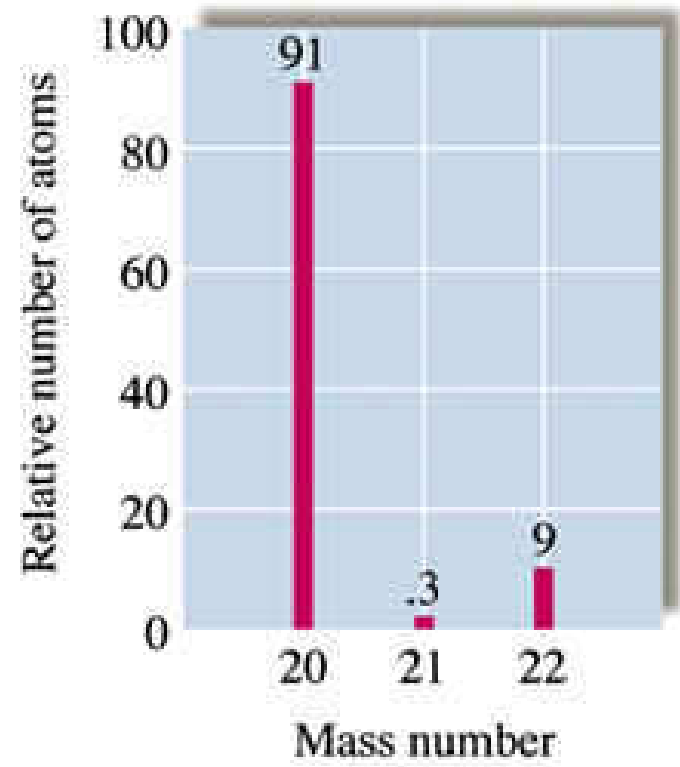
$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ grams}$$



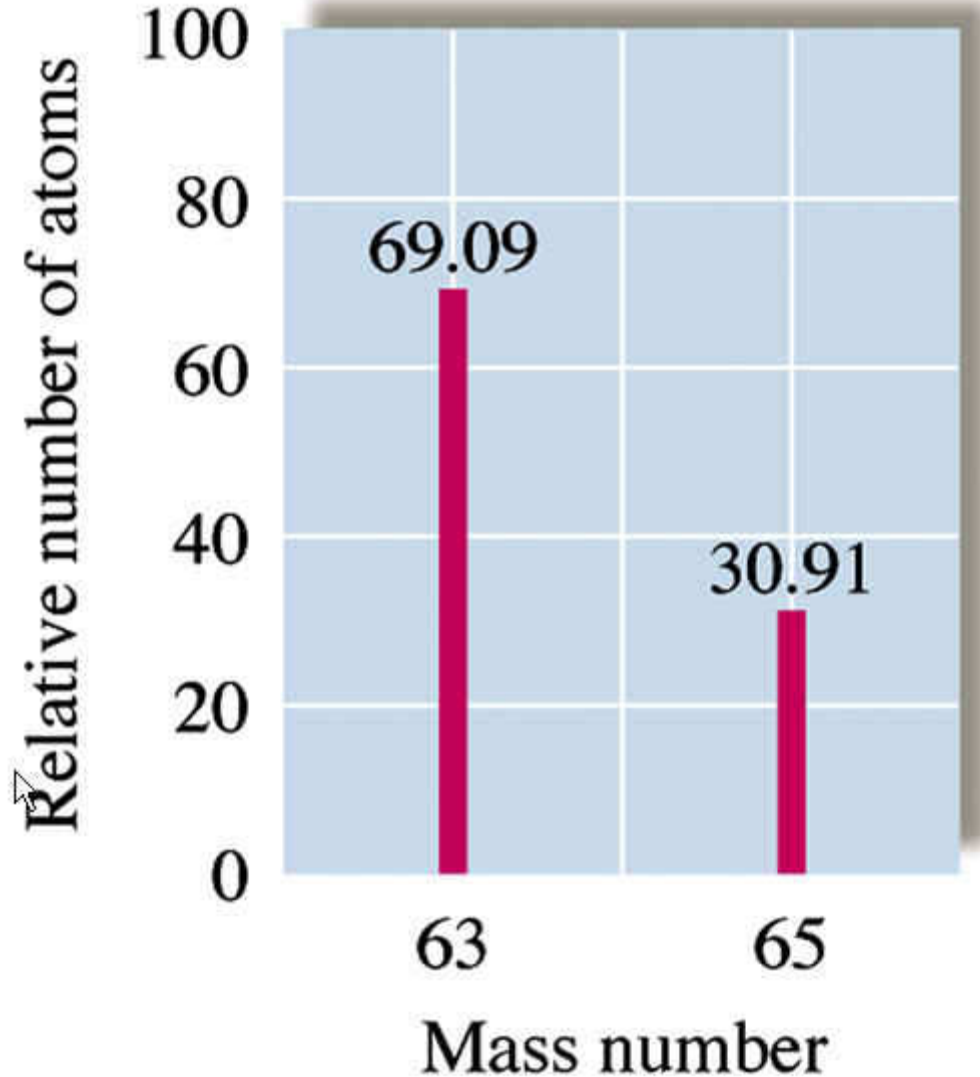
Mass Spectrometer – method of determining mass of particles.



(b)



(c)



Problem: Determine the average mass of Copper.

Problem: 98.99% of carbon is C-12, the remaining 1.11% is C-13 (which weighs 13.003355 amu). What is the average mass of Carbon?

The Mole: 1 mole = the number of C-12 atoms in exactly 12 grams of C-12, which is:

6.02×10^{23} atoms (Avogadro's Number)

More broadly: 6.02×10^{23} atoms of any element equals its atomic mass.



Problem: Determine the number of moles and atoms in 10.0 g Aluminum

Molar Mass (Molar Weight, Molecular Mass, Molecular Weight) – Mass (in grams) of 1 mole of a molecule.

What is the molar mass of methane, CH_4 ?

Problem: You own 10.0 grams of CaCO_3 .

How many moles CaCO_3 ?

How many “molecules” of CaCO_3 ?

How many atoms of O?

Problem: A new element is discovered, and has 2 isotopes. Determine the relative abundance (%) of each isotope if the average mass of the 2 isotopes is 35.4575 g/mole, and the mass of 1 isotope is 34.9688 g/mole, and the other isotope is 36.9659 g/mole.

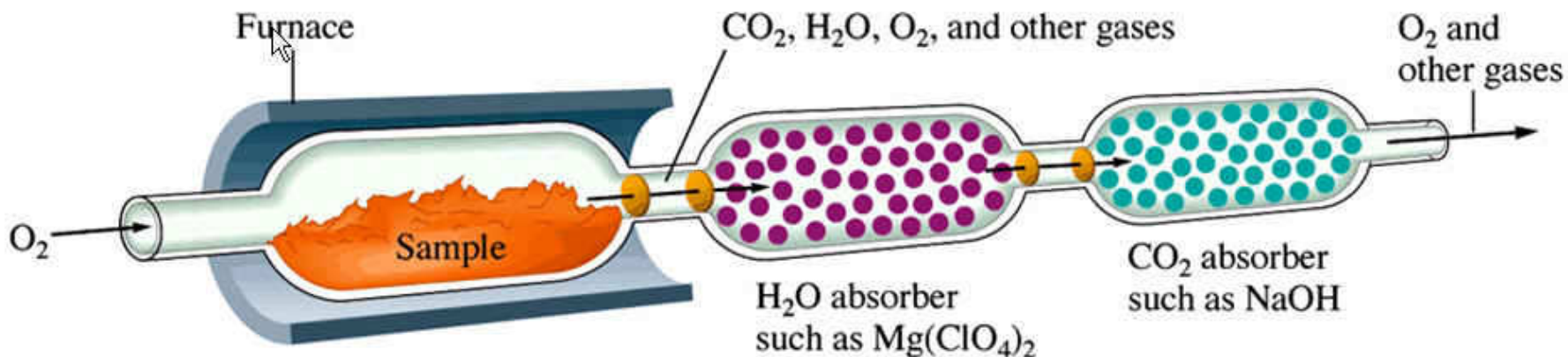
Percent composition:

Calculate the % N (by mass) in ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$

**Which has more Nitrogen by mass, 100 pounds of ammonium phosphate,
Or 100 pounds of ammonia, NH_3 ?**

Empirical Formula – The lowest, whole number ratio of atoms in a molecule.

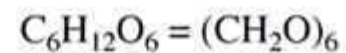
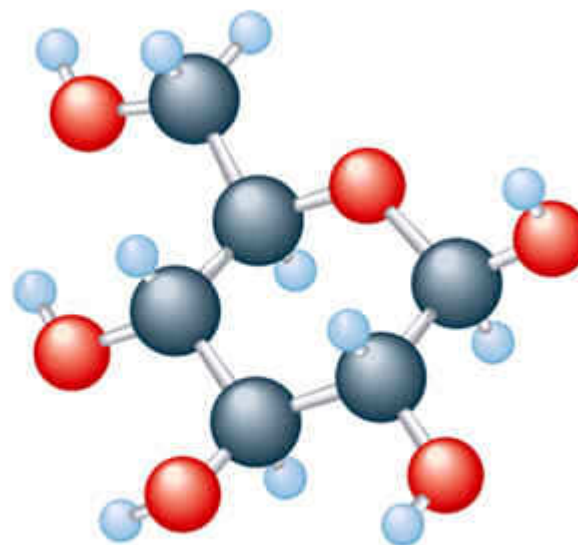
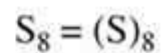
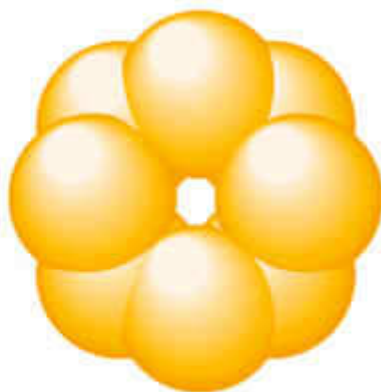
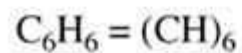
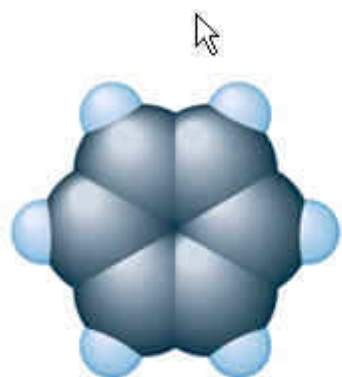
Combustion Analyzer



A substance that weighs 0.1156 g and contains C,H, and N is burned, and 0.1638 g CO_2 and 0.1676 g H_2O are produced.

- a) Determine the percent by weight of each element**
- b) Determine the empirical formula of the original substance.**

To determine the molecular formula, you must know the molecular weight of a substance.



Regarding the previous problem: The molecular weight of the substance is 93 g/mole. Determine the molecular formula.

Chemical Equation – use to represent a chemical reaction.

Reactants → products

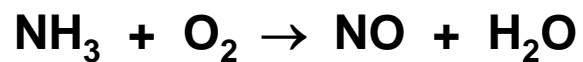
(s)

(l)

(g)

(aq)

Problem: Balance the following equation:



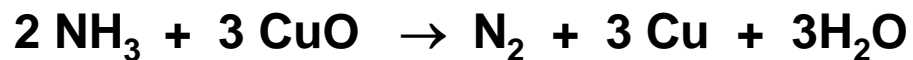
What do the coefficients mean?

Stoichiometry



What mass (grams) CO_2 will be removed by 1.0 kg LiOH?

Limiting and Excess Reactants



A sample contains:

18.1 g NH_3

90.4 g CuO

Which reactant is limiting?

Which reactant is excess?

How many grams of the excess reactant are left over?

How many grams of each product will form?

Regarding the previous problem...

If 8.5 g of N₂ is measured after the reaction takes place, determine the:

a) Theoretical yield (amount of product predicted based on stoichiometry)

b) Actual yield (amount of product produced in a lab)

c) % yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$