Example: You need 1.75 moles of iron. What mass of iron do you need to weigh out on the balance?

Fe: Atomic weight of 55.85 amu

So, $55.85\ g\ Fe = mol\ Fe$

$$1.75\ mol\ Fe \times \frac{55.85\ g\ Fe}{mol\ Fe} = \boxed{97.7\ g\ Fe}$$

WHAT ABOUT COMPOUNDS? FORMULA WEIGHT

Example: 25.0 g of WATER contain how many MOLES of water molecules?

(H_2O)

H_2O

H : $2 \times 1.008 = 2.016$

O : $1 \times 16.00 = 16.00$

18.016 ← FORMULA WEIGHT of water

Formula weight = mass of one mole of either an element OR a compound!

$18.016\ g\ H_2O = mol\ H_2O$

$$25.0\ g\ H_2O \times \frac{mol\ H_2O}{18.016\ g\ H_2O} = 1.39\ mol\ H_2O$$

Formula weight goes by several names:

- For atoms, it's the same thing as ATOMIC WEIGHT
- For molecules, it's called MOLECULAR WEIGHT
- Also called "MOLAR MASS"

Example: How many grams of ammonium carbonate do we need to weigh out to get 3.65 moles of ammonium carbonate?

First, find the FORMULA of ammonium carbonate

$NH_4^+ \quad CO_3^{2-}$

NH_4^+

$(NH_4)_2CO_3$

Second, find the FORMULA WEIGHT

N : 2 x 14.01

H : 8 x 1.008

C : 1 x 12.01

O : 3 x 16.00

96.094 g $(NH_4)_2CO_3$ = mol $(NH_4)_2CO_3$

Finally, use the formula weight to convert moles to mass...

$$3.65 \text{ mol } (NH_4)_2CO_3 \times \frac{96.094 \text{ g } (NH_4)_2CO_3}{\text{mol } (NH_4)_2CO_3} = \boxed{351 \text{ g } (NH_4)_2CO_3}$$

PERCENTAGE COMPOSITION

- sometimes called "percent composition" or "percent composition by mass"
- the percentage of each element in a compound, expressed in terms of mass

Example: Find the percentage composition of ammonium nitrate.

NH_4^+ NO_3^-

NH_4NO_3:

N: $2 \times 14.01 = 28.02$

H: $4 \times 1.008 = 4.032$

O: $3 \times 16.00 = 48.00$

80.052 g NH_4NO_3 = mol NH_4NO_3

$$\%\,N = \frac{28.02\ g\ N}{80.052\ g\ total} \times 100\% = 35.00\ \%\ N$$

$$\%\,H = \frac{4.032\ g\ H}{80.052\ g\ total} \times 100\% = 5.04\ \%\ H$$

$$\%\,O = \frac{48.00\ g\ O}{80.052\ g\ total} \times 100\% = 59.96\ \%\ O$$

The percentages should sum to approximately 100% (within roundoff error)

A few more examples...

↙ Use FORMULA WEIGHT when relating mass and moles ↙

You have a 250.g bottle of silver(I) chloride (AgCl). How many moles of AgCl do you have?

AgCl: Ag - 1 x 107.9
Cl - 1 x 35.45
143.35 g AgCl = mol AgCl

$$250.\text{ g AgCl} \times \frac{\text{mol AgCl}}{143.35\text{ g AgCl}} = \boxed{1.74\text{ mol AgCl}}$$

How many grams of NaOH are present in a 1.50 mole sample of NaOH?

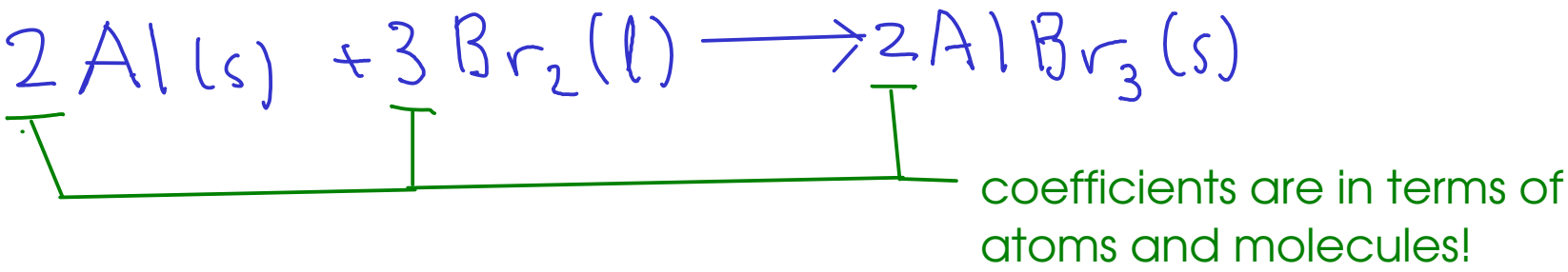
NaOH: Na - 1 x 22.99
O - 1 x 16.00
H - 1 x 1.008
39.998 g NaOH = mol NaOH

$$1.50\text{ mol NaOH} \times \frac{39.998\text{ g NaOH}}{\text{mol NaOH}} = \boxed{60.0\text{ g NaOH}}$$

CHEMICAL CALCULATIONS CONTINUED: REACTIONS

- Chemical reactions proceed on an ATOMIC basis, NOT a mass basis!

- To calculate with chemical reactions (i.e. use chemical equations), we need everything in terms of ATOMS ... which means MOLES of atoms



2 atoms Al = 3 molecules Br_2 = 2 formula units $AlBr_3$

2 mol Al = 3 mol Br_2 = 2 mol $AlBr_3$ *

- To do chemical calculations, we need to:

① - Relate the amount of substance we know (mass or volume) to a number of moles

② - Relate the moles of one substance to the moles of another using the equation

③ - Convert the moles of the new substance to mass or volume as desired