

EMPIRICAL FORMULAE

We are learning to:

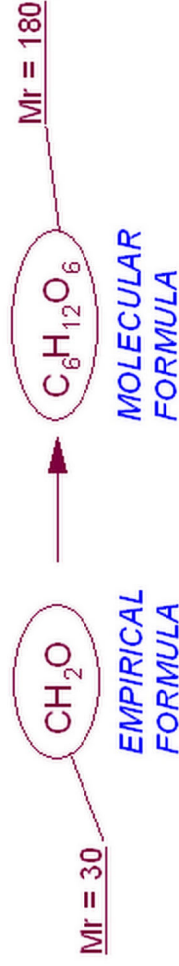
* Calculate simplest ratio of atoms in a compound

(**EMPIRICAL FORMULA**)

- using actual mass
- using % mass

* Work out molecular formula

- using relative formula mass



WHAT'S THE PROBLEM?

mass of Mg = 30g

mass of O = 20g

ratio Mg : O

3 : 2

by mass

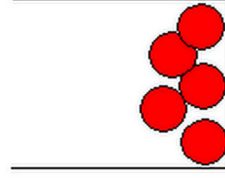


✗ number of atoms

because the Mg and O atoms have different masses

IMAGINE...

snooker balls



mass 500g

mass of
each ball

100g

number
of balls

5

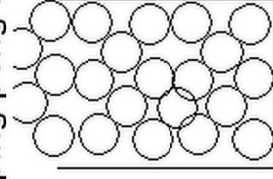
ratio

1

:

4

ping pong balls



80g

4g

20

Mr!

BACK TO MAGNESIUM OXIDE...

	Magnesium	Oxygen
mass	30g	20g
Mr	24	16
amount in mol	$30/24$ = 1.25	$20/16$ = 1.25
ratio	1	1

Empirical formula **MgO**

Calculating Empirical Formulae

A compound contained 4.6g Na, 2.8g N, 9.6g O.
Find the empirical formula. (Na = 23; N = 14; O=16)

	Sodium	Nitrogen	Oxygen
mass	4.6g	2.8g	9.6g
amount in mol	$4.6/23 = 0.2$	$2.8/14 = 0.2$	$9.6/16 = 0.6$
ratio	1	: 1	: 3

Empirical formula NaNO₃

Which one of these equations is correct?

A $Mr = mol \times mass$

B $mass = mol \times Mr$

C $mol = mass \times Mr$

Calculating Empirical Formulae using % mass

Find the empirical formula of a compound containing 85.7% C, 14.3% H by mass. (H = 1; C = 12)
% apply to any amount, so choose 100g

	C	H
mass	85.7g	14.3g
amount in mol	$85.7/12 = 7.14$	$14.3/1 = 14.3$
ratio	1	: 2

Empirical formula CH₂

What data do you need to know to work out the empirical formula?

atomic number of each element

mass of each element

Mr of each element

type of bonding of compound

Put these steps in order
for working out empirical formula:

work out amount
of each element
in mol...

ensure you
have Mr of
each element

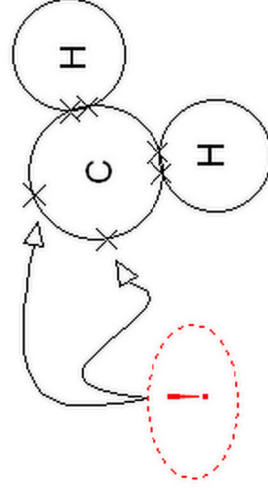
ensure you have
masses of each
element

...by dividing the
mass by the Mr

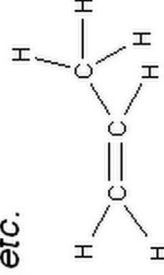
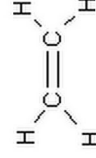
work out simplest ratio of elements

Converting Empirical Formulae to Molecular Formulae

Could you have a molecule CH_2 ?



but you could have C_2H_4 , C_3H_6 etc.



Converting Empirical Formulae to Molecular Formulae

relative formula mass

Unknown compound has Mr = 56

Empirical formula, CH_2 , Mr = 14

How many multiples of 14 are in 56?

$$56 / 14 = 4$$

need 4 CH_2 units

MOLECULAR FORMULA = C_4H_8

What is the empirical and molecular formula of a compound which has 40% C, 6.7% H and 53.3% O by mass, and a relative formula mass of 180? (C = 12; H = 1; O = 16)

	C	H	O
% mass	40	6.7	53.3
mol	$40/12$ $= 3.33$	$6.7/1$ $= 6.7$	$53.3/16$ $= 3.34$
ratio	1	2	1

Empirical formula CH_2O

need 6 of these units to make 180

Molecular formula $\text{C}_6\text{H}_{12}\text{O}_6$

Mr = 30