Holy Trinity School

A Level Chemistry Bridging Work

Moles

A mole is the amount of a substance that contains 6.02 x 10^{23} particles.

The mass of 1 mole of any substance is the relative formula mass (Mr) in grams.

Examples:

One mole of carbon contains 6.02 x 10^{23} particles and has a mass of 12.0g.

Two moles of copper contains 12.04 x 10^{23} particles, and has a mass of 127g.

One mole of water contains 6.02 x 10^{23} particles and has a mass of 18g.

The amount in moles of a substance can be found by using the formula:

$$amount\ in\ moles\ of\ a\ substance = \frac{mass\ of\ a\ substance}{relative\ formula\ mass}$$

Activity 1

Fill in the table:

Substance	**Mass of substance**	**Amount/moles**	**Number of particles**
Helium			18.12 x 10^{23}
Chlorine	14.2		
Methane		4	
Sulfuric acid	4.905		

Space for working out.

Empirical Formula

If you measure the mass of each reactant used in a reaction, you can work out the ratio of atoms of each reactant in the product. This is known as the empirical formula. This may give you the actual chemical formula, or the actual chemical formula may be a multiple of this. For example, hydrogen peroxide is H_2O_2 but would have the empirical formula HO.

Use the following to find an empirical formula:

1. Write down the reacting masses
2. Find the amount in moles of each element
3. Find the ratio of moles of each element

Worked example:

A compound contains 2.232g of iron, 1.284g of sulfur and 1.920g of oxygen. What is the empirical formula?

Element	**Iron**	**Sulfur**	**Oxygen**
Step 1 **Mass divided by relative atomic mass**	2.232/55.8	1.284/32.1	1.920/16.0
Step 2 **Amount in moles**	0.040	0.040	0.120
Step 3 **divide by the smallest value**	0.040/0.040	0.040/0.040	0.120/0.040
Step 4 **Ratio is...**	1	1	2

Therefore, the empirical formula is $FeSO_4$.

If the question gives the percentage of each element instead of mass, replace mass with the percentage of an element present and follow the same process.

Activity 2

Work out the following empirical formulas:

1. The smell of pineapple is caused by ethyl butanoate. A sample is known to contain only 0.180g of carbon, 0.030g of hydrogen and 0.080g of oxygen. What is the empirical formula of ethyl butanoate?

2. Find the empirical formula of a compound containing 0.0578g of titanium, 0.288g of carbon, 0.012g of hydrogen and 0.384g of oxygen.

3. 300g of a substance are analysed and found to contain only carbon, hydrogen and oxygen. The sample contains 145.9g of carbon and 24.32g of hydrogen. What is the empirical formula of the compound?

4. Another 300g sample is known to contain only carbon, hydrogen and oxygen. The percentage of carbon is found to be exactly the same as the percentage of

oxygen. The percentage of hydrogen is known to be 5.99%. What is the empirical formula of the compound?