

Nat 5: Unit 1 Chemical Changes and Structure

Key Area: Formulae and Reacting Quantities

Lesson 17: Percentage Composition

Learning Outcomes

By the end of the lesson you should ...

1. Recognise that mathematical skills will be helpful in Chemistry.
2. Be able to calculate percentages.
3. Carry out calculations using the relationship information in the data booklet involving percentage by mass.

Success Criteria

You will have been successful in this lesson if you:

1. Complete all self checks evaluating and correcting any errors made.
2. Understand how to use the percentage by mass equation.
3. Complete Homework and return to your teacher for correction in the usual way by Fri 26 Feb.

If you have any questions about the content of this lesson, you should ask your **class teacher** either through your class MS team or via email. MS Teams will be monitored throughout the week by a chemistry teacher. If you need help or clarification with either the task or the content of the lesson, just ask.

Links to Prior Knowledge:

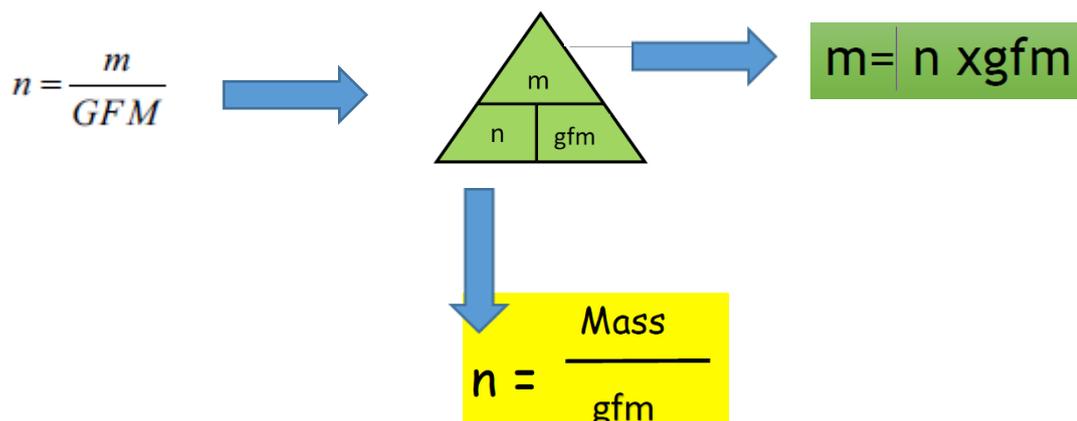
It is essential that you have completed **lesson 16**

*You may wish to have a copy of the data booklet handy for this lesson.
Download from the SQA website - [ChemistryDataBookletSQPN5.pdf \(sqa.org.uk\)](https://www.sqa.org.uk/ChemistryDataBookletSQPN5.pdf)*

Chemistry and Maths

Throughout the Nat 5 Chemistry course you will be asked to use numeracy skills that you have previously learned in maths. You did this last week when you used 1 of the relationships from **Page 3 of the Chemistry Data Booklet** (remember you will always get a copy of this for all tests).

You used your maths skills to put the relationship into a triangle so you could calculate mass or number of moles.



You are now going to use your numeracy skills to calculate percentages and apply this same working to chemical compounds.

Calculating Percentage by mass

The data below shows the nutrition value for a yoghurt



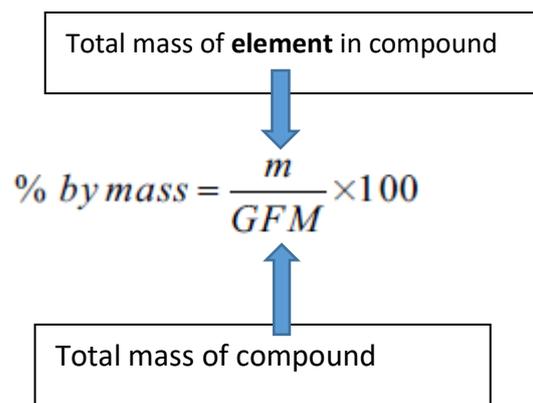
Total mass of yoghurt

| | |
|--------------------|-----------------|
| Energy | 585kJ (139kcal) |
| Fat | 4.9g |
| of which saturates | 3.1g |
| Carbohydrate | 19.4g |
| of which sugars | 16.7g |
| Protein | 3.7g |
| Salt | 0.16g |

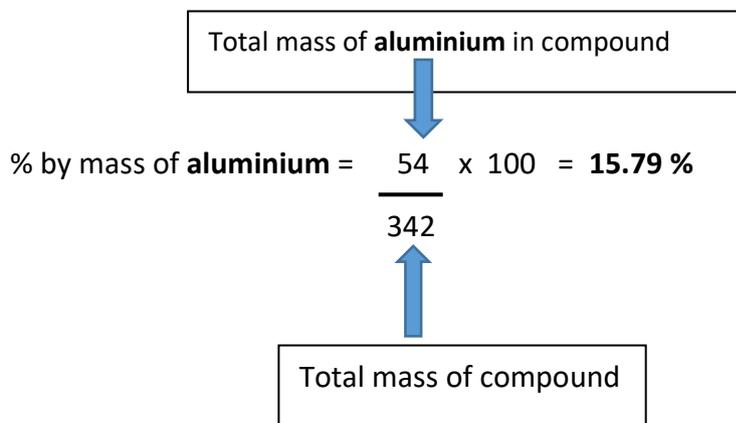
Total mass of sugar

Once you have calculated the GFM, you use the following relationship from **page 3 of the data booklet**:

$$\% \text{ by mass} = \frac{m}{GFM} \times 100$$



Therefore the percentage by mass of **Aluminium** in $\text{Al}_2(\text{SO}_4)_3$ would be calculated as follows:

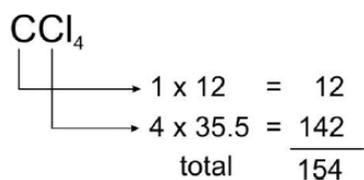


Example 1

Calculate the percentage by mass of

- a. **carbon** in carbon chloride (CCl_4)

Step 1: calculate the GFM



Step 2: insert values into equation

$$\% \text{ by mass} = \frac{m}{\text{GFM}} \times 100$$

$$\% \text{ by mass of carbon} = \frac{12}{154} \times 100 = \mathbf{7.79\%}$$

- b. **chlorine** in carbon chloride (CCl_4)

Careful!!

Common **mistake** is to use 1 mole of chlorine (35.5)

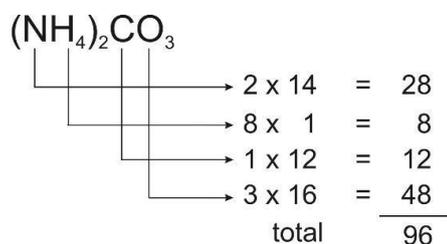
$$\% \text{ by mass of chlorine} = \frac{142}{154} \times 100 = \mathbf{92.21\%}$$

Example 2

Calculate the percentage by mass of

- a. **nitrogen** in ammonium carbonate $(\text{NH}_4)_2\text{CO}_3$

Step 1: calculate the GFM



Step 2: insert values into equation

$$\% \text{ by mass} = \frac{m}{GFM} \times 100$$

$$\% \text{ by mass of nitrogen} = \frac{28}{96} \times 100 = \mathbf{29.17\%}$$

- b. **oxygen** in ammonium carbonate $(\text{NH}_4)_2\text{CO}_3$

$$\% \text{ by mass of oxygen} = \frac{48}{96} \times 100 = \mathbf{50\%}$$

Practice makes Perfect

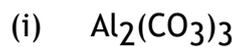
Once you have read and fully understand the previous information please attempt the following self checks in your jotter.

Self Check 12

1. Calculate the percentage mass of **each element** in the following compounds



2. Calculate the percentage mass of **each element** in the following compounds



Self Check 13

1. An important fertiliser has the formula Na_3PO_4 .
Calculate the percentage mass of phosphorus in the fertiliser.
2. A plant needs a fertiliser with a high percentage of potassium. Two possible fertilisers are potassium sulphate (K_2SO_4) and potassium nitrate (KNO_3).
Show by calculation, that potassium sulphate contains the highest percentage mass of potassium.
3. Both Urea (CON_2H_4) and ammonium nitrate (NH_4NO_3) contain nitrogen.
Show, by calculation, which compound has the highest percentage mass of nitrogen.

Homework 7(on next page) to be completed for Fri 26

Homework Week 7

Please complete and submit to your teacher in the usual way

Calculations involving the Mole Triangle:

show your working clearly.

1. Calculate the masses of the following:

- (a) 0.2 moles of $\text{Ca}(\text{OH})_2$ (b) 0.125 moles of CuS
(c) 4 moles of sodium chloride (d) 2 moles of Silicon oxide

2. Calculate the number of moles in each of the following:

- (a) 50g of $\text{Al}_2(\text{SO}_3)_3$ (b) 10.3g of $(\text{NH}_4)_3\text{PO}_4$
(c) 28g of magnesium hydroxide (d) 83.5g of calcium fluoride

Calculations involving percentage by mass:

show your working clearly.

3. Calculate the percentage by mass of aluminium in aluminium sulfate, $\text{Al}_2(\text{SO}_4)_3$.

4. Iron can be extracted from its ore haematite, Fe_2O_3 , in a blast furnace. Calculate the percentage by mass of iron in haematite.

5. Calculate the percentage mass of silicon in andalusite, Al_2SiO_3 .

6. Calculate the percentage mass of sodium in sodium phosphate, Na_3PO_4