

Percentage by Mass

Answer the questions below.

1. State the relative atomic mass of Argon.

40

2. State the symbol for relative atomic mass.

A_r

3. Calculate the relative formula mass of NaCl

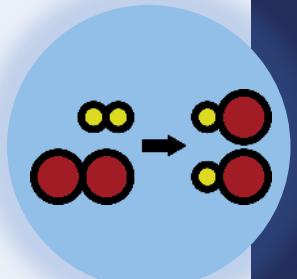
58.5

4. State the number of protons, neutrons and electrons in an atom of lithium.

3 protons, 4 neutrons, 3 electrons

5. What are isotopes?

Isotopes are atoms of the same element with different mass numbers due to different numbers of neutrons in the nucleus



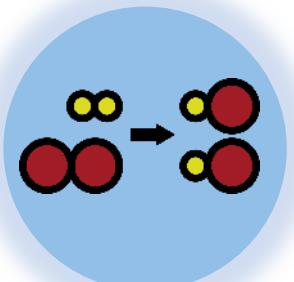
Percentage by Mass

C3.2.3

Science
Mastery

- C3.2.1 Prior Knowledge Review
- C3.2.2 Relative Formula Mass
- **C3.2.3 Percentage by Mass**
- C3.2.4 Conservation of Mass
- C3.2.5 Balancing Equations
- C3.2.6 Uncertainty
- C3.2.7 Introducing Concentration

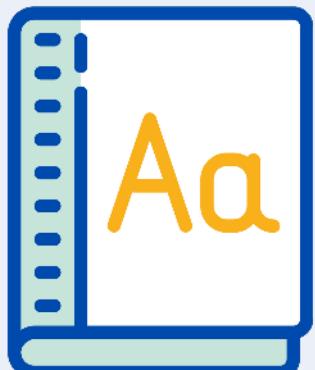
- C3.2.8 Concentration Calculations
- C3.2.9 Soluble Salts
- C3.2.10 Making Soluble Salts
- C3.2.11 Making Soluble Salts 2



Following this lesson, students will be able to:

- Recall that relative atomic mass can be written as A_r and relative formula mass can be written as M_r .
- Calculate relative atomic mass and relative formula mass.
- Calculate the percentage by mass of an element in a compound.

Key Words:



relative atomic mass

relative formula mass

conservation of mass

percentage

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

The teacher should customise this slide as needed, to facilitate

- **reteach, explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
- **practice** answering specific questions or of key skills.
- **redrafting** or **improving** previous work.

Choose the correct option for the following questions.

1. The relative formula mass for NH_3 is... (A_r : N = 14; H = 1)
 A. 17
 B. 15
 C. 45
2. The relative formula mass for Fe_2O_3 is...
 A. 384
 B. 160
 C. 76
3. Complete the sentence. The relative formula mass is
 A. The sum of the atomic mass of protons and electrons in a compound
 B. The sum of the relative atomic masses of the elements in a compound
 C. The sum of the relative atomic masses in an element

Percentages and Fractions practice

Match up the pairs of calculations that have the same value.
There will be one left over. Suggest some possible calculations
that it could be paired with.

1.

60% of 80

48

2.

25% of 80

20

3.

$\frac{3}{5}$ of 80

48

4.

37.5% of 80

30

5.

$\frac{1}{4}$ of 240

60

6.

75% of 60

45

7.

75% of 80

60

8.

250% of 8

20

9.

$33\frac{1}{3}\%$ of 90

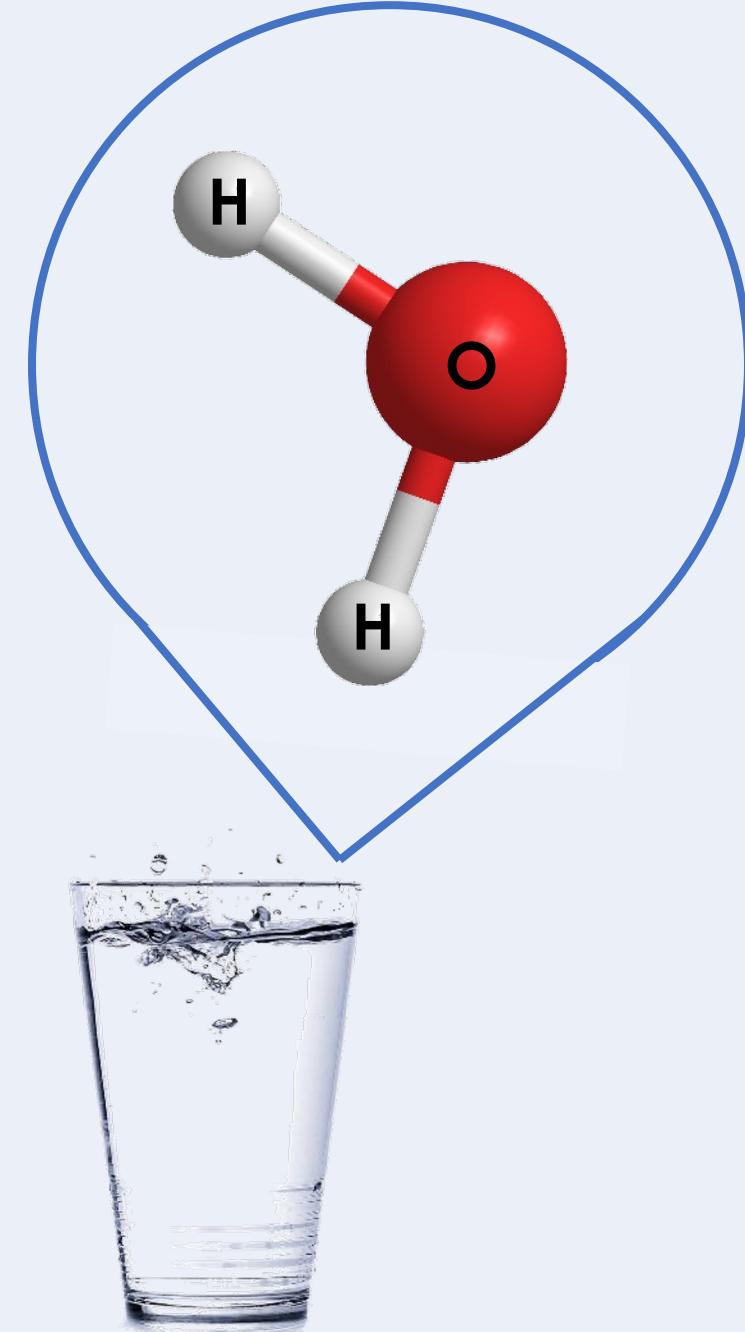
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Percentage by mass

Water has the chemical formula H_2O .

Think about the mass of a water molecule.

What **percentage** of that mass do you think comes from hydrogen?



Percentage by mass

Percentage by mass is used to calculate the percentage by mass of an **element** within a **compound**

$$\% \text{ by mass} = \frac{A_r \times \text{number of atoms in a compound}}{M_r \text{ of the compound}} \times 100$$

What is the Percentage by mass of ~~by~~ oxygen in water (H_2O)?

1. A_r of ~~by~~ oxygen = 16

Number of ~~by~~ oxygen atoms = 2

2. M_r of $\text{H}_2\text{O} = 18$

3. $\frac{16}{18} = 0.888$

4. $0.888 \times 100 = \underline{\underline{88.8\%}}$

Steps:

1. Find the A_r and count the **number of each type of atom**.
2. Find the M_r
3. **Divide the sum of the relative atomic masses** of all atoms you are investigating **by the relative formula mass**
4. **Multiply by 100**

Percentage by mass

The chemical octyl acetate smells like oranges.

It has the formula $C_{10}H_{20}O_2$.

Calculate the percentage by mass of oxygen in octyl acetate.

1. A_r of oxygen = 16

Number of oxygen atoms = 2

2. M_r of $C_{10}H_{20}O_2$ = 172

3. $\frac{32}{172} = 0.186$

4. $0.186 \times 100 = \underline{18.6\%}$

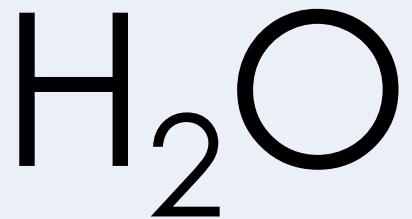
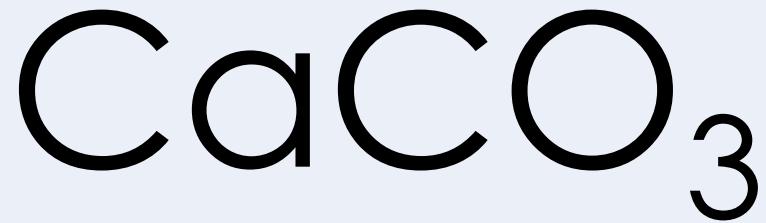
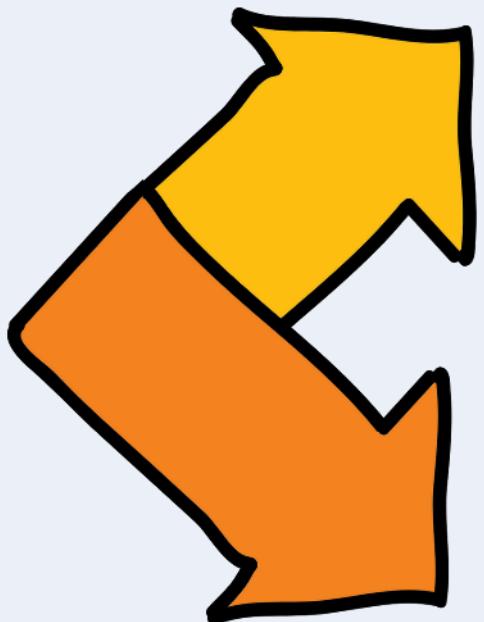


What is the percentage by mass of carbon in CO₂?

- A. $\frac{12}{16} \times 100 = 75\%$
- B. $\frac{24}{32} \times 100 = 75\%$
- C. $\frac{12}{32} \times 100 = 37.5\%$
- D. $\frac{12}{44} \times 100 = 27.3\%$

1. A_r of carbon = 12
Number of carbon atoms = 1
2. M_r of CO₂ = 44
3. $\frac{12}{44} = 0.2727$
4. $0.2727 \times 100 = \underline{27.3\%}$

Which of these compounds contain a greater percentage of oxygen?



Drill

1. What is A_r ?
2. What is M_r ?
3. What is the definition for percentage by mass?
4. What is the equation for calculating percentage by mass?
5. How many atoms of oxygen are present in sulfuric acid, H_2SO_4 ?
6. What is the sum of all the atomic mass of oxygen in H_2SO_4 ?
7. What is the relative formula mass of H_2SO_4 ?
8. Using questions 6 and 7 calculate the percentage of oxygen in H_2SO_4 .

Drill answers

1. Relative atomic mass
2. Relative formula mass
3. Percentage of an element in a compound
4.
$$\% \text{ by mass} = \frac{A_r \times \text{number of atoms in a compound}}{M_r \text{ of the compound}} \times 100$$
5. 4 atoms of oxygen
6. Mr of the O in H_2SO_4 : $4 \times 16 = 64$
7. Mr of in H_2SO_4 : $(2 \times \text{H}) + (\text{S}) + (4 \times \text{O}) = (2 \times 1) + (32) + (4 \times 16) = 2 + 32 + 64 = 98$
8.
$$\begin{aligned} \% \text{ by mass} &= \frac{64}{98} \times 100 \\ &= 65\% \end{aligned}$$

I: Worked example

Calculate the percentage of carbon in CH₄.

(A_r: C = 12, H = 1)

1. Use the A_r of C

Count the number of carbon atoms

2. Find the M_r of CH₄

3. Use the equation % by mass = $\frac{A_r \times \text{number of atoms in a compound}}{M_r \text{ of the compound}} \times 100$

4. Calculate using a calculator

1. A_r of carbon = 12

Number of carbon atoms = 1

2. M_r of CH₄ = 16

3. $\frac{12}{16} = 0.75$

4. $0.75 \times 100 = \underline{75\%}$

We: Worked example

Calculate the percentage of carbon in C_2H_6 .

(A_r : C = 12, H = 1)

1. Use the A_r of C

Count the number of carbon atoms

2. Find the M_r of C_2H_6

3. Use the equation % by mass =
$$\frac{A_r \times \text{number of atoms in a compound}}{M_r \text{ of the compound}} \times 100$$

4. Calculate using a calculator

1. A_r of carbon = 12

Number of carbon atoms = 2

2. M_r of C_2H_6 = 30

3.
$$\frac{(12 \times 2)}{30} = 0.8$$

4. $0.8 \times 100 = \underline{\underline{80\%}}$

You: Worked example

Calculate the percentage of Oxygen in Mg(OH)_2 .

(A_r : C = 12, H = 1)

1. Use the A_r of C

Count the number of carbon atoms

2. Find the M_r of Mg(OH)_2

3. Use the equation % by mass =
$$\frac{A_r \times \text{number of atoms in a compound}}{M_r \text{ of the compound}} \times 100$$

4. Calculate using a calculator

1. A_r of oxygen = 16

Number of oxygen atoms = 2

2. M_r of Mg(OH)_2 = 58

3. $\frac{(16 \times 2)}{58} = 0.55$

4. $0.55 \times 100 = \underline{\underline{55\%}}$

Answer the questions below.

1. What is the relative formula mass for NH_3 ? (A_r : N = 14; H = 1)
 A. 17
 B. 15
 C. 45
2. Calculate the percentage by mass of carbon in C_2H_4 .
 A. 28%
 B. 85.7%
 C. 42.8%
3. Calculate the percentage by mass of carbon in carbon monoxide (CO).
 A. 18%
 B. 43%
 C. 0.43%

Lesson C3.2.3

What was good about this lesson?

What can we do to improve this lesson?

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Thank you!