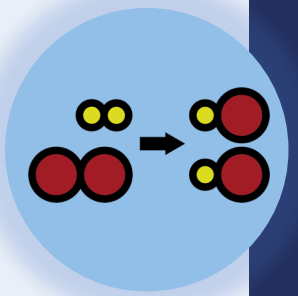
# Relative Formula Mass

**Answer the questions below.**

1. State the chemical symbol for potassium.
   **K**
2. List the elements in $Zn(OH)_2$.
   **Zinc, oxygen, hydrogen**
3. Where on the periodic table are non-metals found?
   **On the right-hand side**
4. List 2 elements that are in group 1 of the Periodic Table
   **Lithium, sodium, potassium, rubidium, caesium, francium**
5. How many atoms are there in $Zn(OH)_2$?
   **5**

Do Now



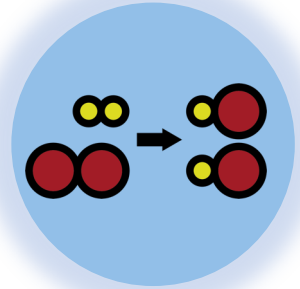
# Relative Formula Mass

## C3.2.2

Science
Mastery



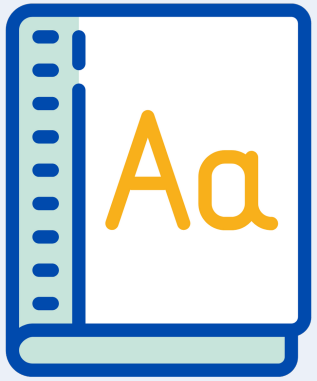
C3.2.1 Prior Knowledge Review
➢ **C3.2.2 Relative Formula Mass**
C3.2.3 Percentage by Mass
C3.2.4 Conservation of Mass
C3.2.5 Balancing Equations
C3.2.6 Uncertainty
C3.2.7 Introducing Concentration
C3.2.8 Concentration Calculations
C3.2.9 Soluble Salts
C3.2.10 Making Soluble Salts
C3.2.11 Making Soluble Salts 2



**Following this lesson, students will be able to:**

- Recall that relative atomic mass can be written as $\mathbf{A_r}$ and relative formula mass can be written as $\mathbf{M_r}$.
- State the relative atomic mass of an element
- Calculate the relative formula mass for a compound.

**Key Words:**




**relative atomic mass**

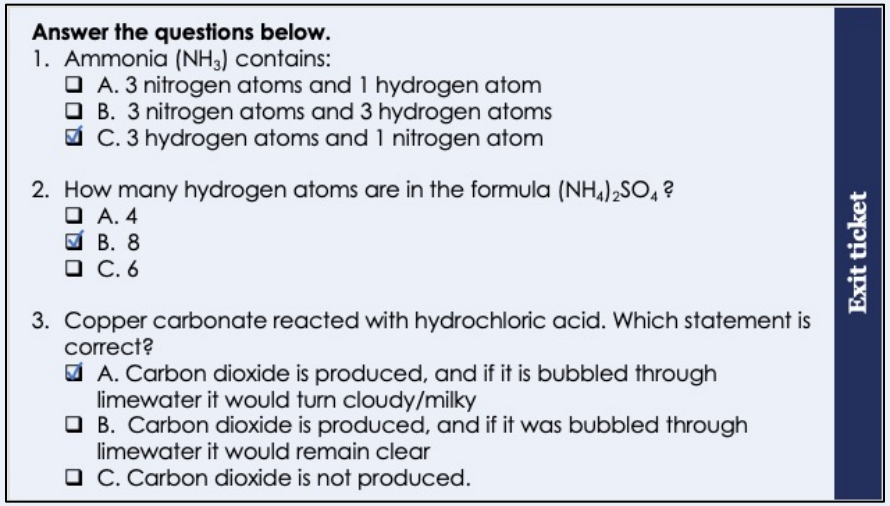
**relative** | **relative formula mass**

Lesson Objectives

# 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.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



**Answer the questions below.**

1. Ammonia ($NH_3$) contains:
   - ☐ A. 3 nitrogen atoms and 1 hydrogen atom
   - ☐ B. 3 nitrogen atoms and 3 hydrogen atoms
   - ☑ C. 3 hydrogen atoms and 1 nitrogen atom

2. How many hydrogen atoms are in the formula $(NH_4)_2SO_4$ ?
   - ☐ A. 4
   - ☑ B. 8
   - ☐ C. 6

3. Copper carbonate reacted with hydrochloric acid. Which statement is correct?
   - ☑ A. Carbon dioxide is produced, and if it is bubbled through limewater it would turn cloudy/milky
   - ☐ B. Carbon dioxide is produced, and if it was bubbled through limewater it would remain clear
   - ☐ C. Carbon dioxide is not produced.

Exit ticket

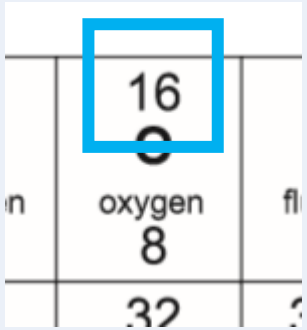
Fix-it

## Relative Atomic Mass

**Relative** means compared to something else

Atoms are very small and have very little mass. So instead of using their actual mass in kg, their **relative** masses are used. This is the **relative atomic mass** or $\mathbf{A_r}$.

The relative atomic mass of an **element** can be found in the **periodic table**.




**Use a periodic table to find the $A_r$ of carbon.** 12

The **relative atomic mass** ($\mathbf{A_r}$) is the average mass of the atoms of an element compared to the mass of carbon-12.

**State the relative atomic mass ($A_r$) for the following elements.**

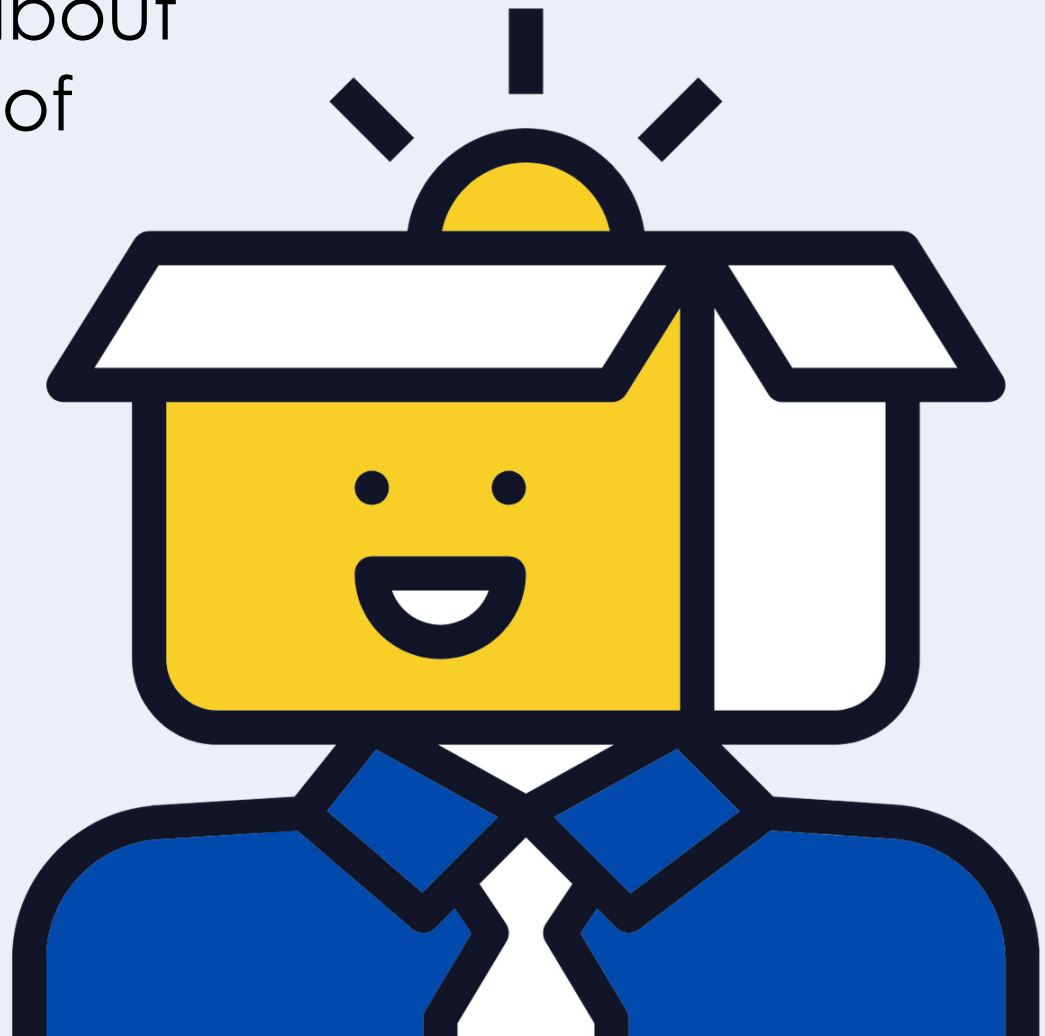
1. Potassium **39**
2. Iron **56**
3. Neon **20**
4. Hydrogen **1**
5. Gold **197**
6. Sulfur **32**
7. Helium **4**
8. Magnesium **24**
9. Carbon **12**

**You'll need your Periodic Table for this!**

Check for understanding

## Think outside the box!

Why do you think we **use relative atomic masses** when talking about the mass of elements, instead of grams or kilograms?



Talk Task

# Relative Formula Mass

For compounds (different elements combined together chemically) we can calculate the **relative formula mass** or **$M_r$**.

This is calculated by adding up the relative atomic masses of the all the atoms in the **formula.**

$CO_2$ contains 1 carbon atom and 2 oxygen atoms.
$A_r$: C = 12
O = 16

**To calculate the $M_r$:**
**$M_r$ of $CO_2$ = 12 + (2 x 16) = 44**

The **relative formula mass** (**$M_r$**) is the sum of the relative atomic masses of the elements in a compound.

## Calculating the relative formula mass ($M_r$)

1. Calculate the $M_r$ for the following compounds.
   ($A_r$: H = 1; C = 12; N = 14; O = 16; K = 39)
   a. $NH_3$ **14 + (1 x 3) = 17**
   b. $O_2$ **16 x 2 = 32**
   c. $H_2O$ **(1 x 2) + 16 = 18**
   d. KOH **39 + 16 + 1 = 56**

2. Use your understanding of the conservation of mass to find the $M_r$ of CaO. ($M_r$: $CaCO_3$ = 100; $CO_2$ = 44)

**$CaCO_3$ → CaO + $CO_2$**

**100 ? 44**

**100 – 44 = 56**

**100 = 56 + 44**

Check for understanding

# Calculating relative formula mass

**A student has written the following to work out the relative formula mass for $(NH_4)_2SO_4$.**

**With your partner, discuss**

- **Why hasn't student done this calculation correctly?**
- **What should the answer be?**

N - nitrogen
H - hydrogen
S - sulfur
O – oxygen

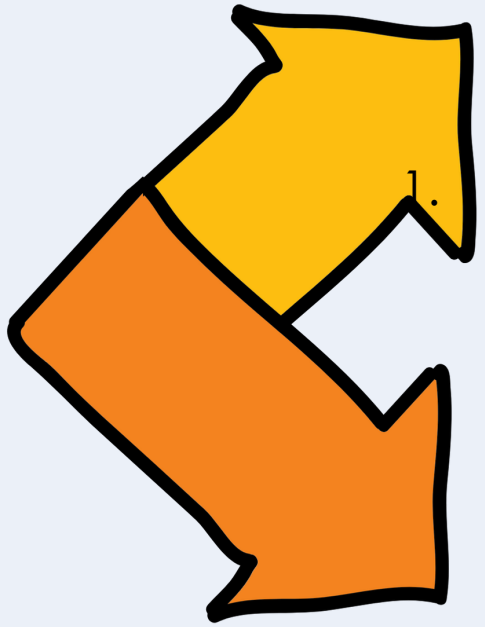
N – nitrogen x 1
H – hydrogen x 4
S – sulfur x 1
O – oxygen x 4

N – 1 x 7 = 7
H – 4 x 1 = 4
S – 1 x 16 = 16
O – 4 x 8 = 32

7 + 4 + 16 + 32 = 59

Talk Task

# What is the difference between these two terms?



$A_r$

1. What is the relative molecular mass of Magnesium Chloride, MgCl2?

$M_r$

Talk Task

# Drill

1. What letters denote relative atomic mass?
2. What is the definition for relative atomic mass?
3. What is Mr?
4. What is the difference between $A_r$ and Ar?
5. What is the relative atomic mas of Aluminium, Al?
6. What is the relative molecular mass of sodium Chloride, NaCl?
7. How many atoms of each element are present in $Mg(OH)_2$?
8. What is the relative molecular mass of $Mg(OH)_2$?
9. How many atoms of each element are present in $Ca_3(PO_4)_2$?
10. What is the relative molecular mass of $Ca_3(PO_4)_2$?

Check for understanding

# Drill answers

1. $A_r$
2. The average mass of the atoms of an element compared to the mass of carbon 12
3. Relative formula mass
4. $A_r$ is relative atomic mass and Ar is the symbol for argon
5. 27
6. 23 + 35.5 = 58.5
7. Mg = 1, O = 2, H = 2
8. 24 + (16 x 2) + (2x1) =58
9. Ca = 3, P =2 O=8
10. (40x3) +(31x2)+(16x8)= 120+62+128 = 310

Check for understanding

# I: Calculating relative formula mass

## Magnesium nitrate, $Mg(NO_3)_2$

Mg is Magnesium, 24
N is Nitrogen, 14
O is Oxygen, 16

Magnesium: 1
Nitrogen: 2
Oxygen: 6

Magnesium: 24 x 1 = 24
Nitrogen: 14 x 2 = 28
Oxygen: 16 x 6 = 96

24 + 28 + 96 = <u>148</u>

**Steps:**

1. Write out the **elements** and their **relative atomic masses**
2. Use the formula to write the **number of atoms** of each element
3. Calculate the **mass of the atoms** of each element (Relative atomic mass x number of atoms)
4. **Add up the total mass** of the elements (this is your $M_r$)

Activity

## We: Calculating relative formula mass

# Calcium carbonate, $CaCO_3$

Ca is Calcium, 40
C is Carbon, 12
O is Oxygen, 16

Calcium: 1
Carbon: 1
Oxygen: 3

Calcium: 40 x 1 = 40
Carbon: 12 x 1 = 12
Oxygen: 16 x 3 = 48

40 + 12 + 48 = <u>100</u>

**Steps:**

1. Write out the **elements** and their **relative atomic masses**
2. Use the formula to write the **number of atoms** of each element
3. Calculate the **mass of the atoms** of each element (Relative atomic mass x number of atoms)
4. **Add up the total mass** of the elements (this is your $M_r$)

Activity

## You: Calculating relative formula mass

# Calcium phosphate, $Ca_3(PO_4)_2$

Ca is Calcium, 40
P is Phosphate, 31
O is Oxygen, 16

Calcium: 3
Phosphate : 2
Oxygen: 8

Calcium: 40 x 3 = 120
Phosphate : 31 x 2 = 62
Oxygen: 16 x 8 = 128

120 +62+128 = 310

**Steps:**

1. Write out the **elements** and their **relative atomic masses**
2. Use the formula to write the **number of atoms** of each element
3. Calculate the **mass of the atoms** of each element (Relative atomic mass x number of atoms)
4. **Add up the total mass** of the elements (this is your $M_r$)

Activity

**Answer the questions below.**

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

Exit ticket

Feedback

| Lesson C3.2.2 | |
|---|---|
| What was good about this lesson? | What can we do to improve this lesson? |
| | |

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!