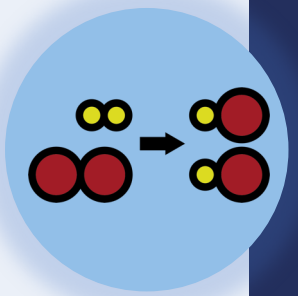
Relative Formula Mass

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

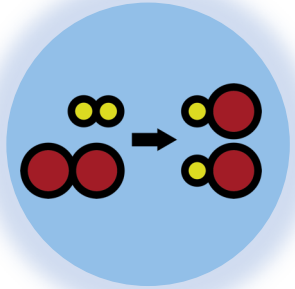
Do Now



Relative Formula Mass

C3.2.2

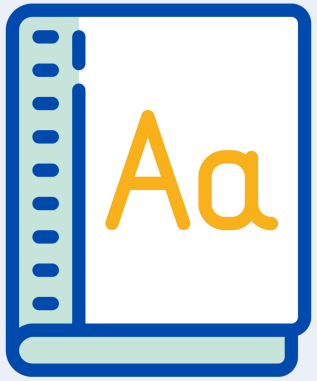
Science
Mastery



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

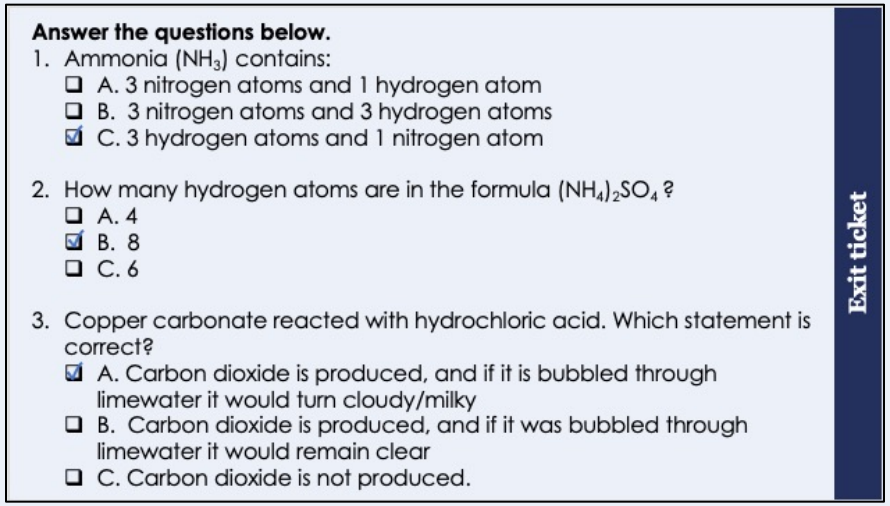
relative | **relative formula mass**

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

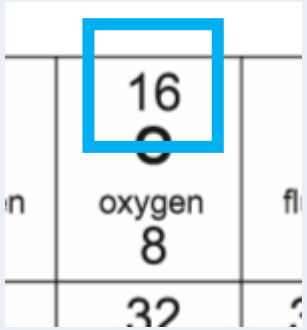
Fix-it

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.

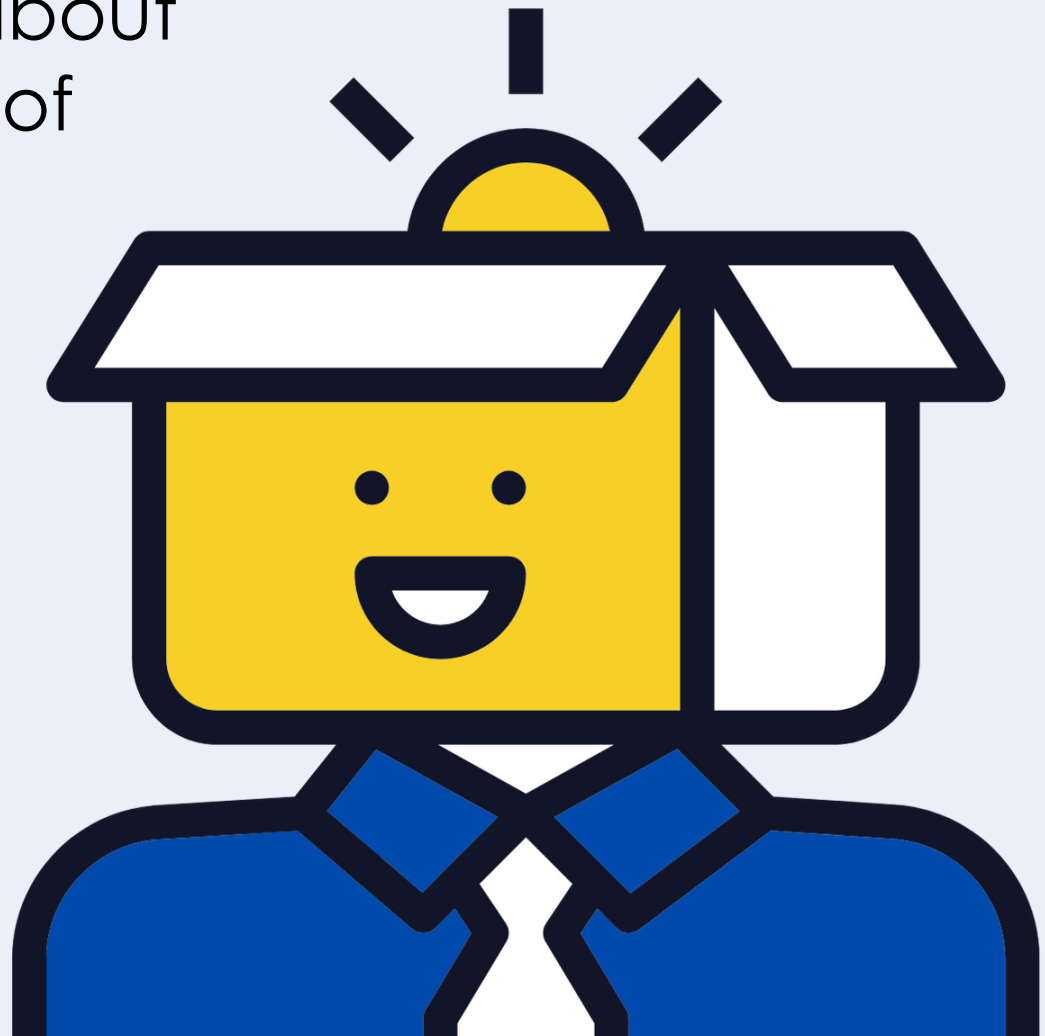
1. Potassium **39**
2. Iron **56**
3. Neon **20**
4. Hydrogen **1**
5. Gold **197**
6. Sulfur **32**
7. Helium **4**
8. Magnesium **24**
9. Carbon **12**

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

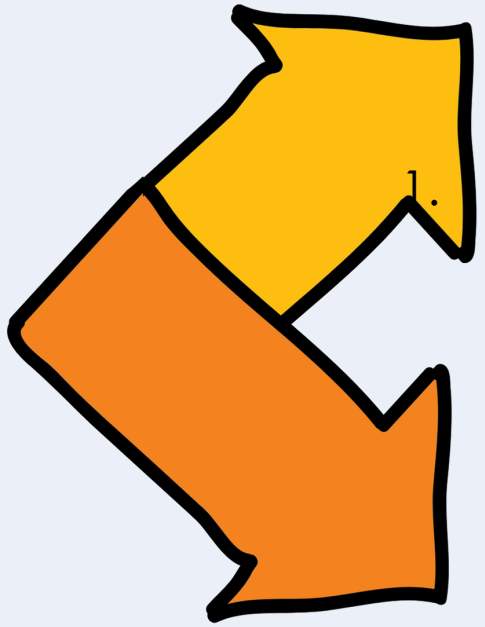
N – nitrogen x 1
H – hydrogen x 4
S – sulfur x 1
O – oxygen x 4

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!