

# GCSE Chemistry

## Worksheet: Conservation of mass and balanced equations

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>30 min</b> | TOTAL<br><b>28 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** Conservation of mass and balanced equations

**NAME** \_\_\_\_\_

**CLASS** \_\_\_\_\_

**DATE** \_\_\_\_\_

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Symbol equations use numbers written in front of formulae and small numbers written within formulae.

0 1 . 1

How many oxygen atoms are shown in  $3\text{Ca}(\text{NO}_3)_2$ ?

.....

.....

.....

.....  
[1 mark]

0 1 . 2

How many atoms in total are shown in the formula  $\text{Al}_2(\text{SO}_4)_3$ ?

.....

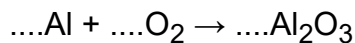
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.....  
[1 mark]

0 1 . 3

Balance the equation for the reaction of aluminium with oxygen.



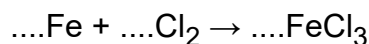
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[1 mark]

0 1 . 4

Balance the equation for the reaction of iron with chlorine.



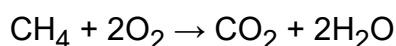
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[1 mark]

0 2

Methane burns completely in air:



0 2 . 1

Which statement about the total mass of the products is correct?

Tick (✓) **one** box.

It is greater than the total mass of the reactants.

☐

It is less than the total mass of the reactants.

☐

It is equal to the total mass of the reactants.

☐

It depends on how quickly the methane burns.

☐

[1 mark]

0 2 . 2

How many hydrogen atoms are shown on the right-hand side of the equation?

.....

.....

.....

[1 mark]

0 2 . 3

0.64 g of methane burns completely in oxygen. The products are 1.76 g of carbon dioxide and 1.44 g of water.  
Calculate the mass of oxygen that reacted.

.....

.....

.....

.....

Mass of oxygen = ..... g

[2 marks]

0 2 . 4

Explain why the total mass of the products equals the total mass of the reactants.

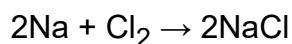
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[1 mark]

0 3

Sodium reacts with chlorine to produce sodium chloride.



0 3 . 1

Complete the sentence.

Tick (✓) **one** box.

The total mass of the products of a chemical reaction is ...

less than the total mass of the reactants.

equal to the total mass of the reactants.

greater than the total mass of the reactants.

half of the total mass of the reactants.

☐

☐

☐

☐

[1 mark]

0 3 . 2

How many chlorine atoms are shown on the left-hand side of the equation?

.....

.....

.....

.....

**[1 mark]**

0 3 . 3

A teacher reacted 2.30 g of sodium with 3.55 g of chlorine in a fume cupboard.  
All of the sodium and all of the chlorine reacted.  
Calculate the mass of sodium chloride produced.

.....

.....

.....

Mass of sodium chloride = ..... g

**[1 mark]**

0 3 . 4

Explain why the mass of sodium chloride produced is equal to the total mass of the sodium and chlorine that reacted.

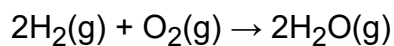
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**[1 mark]**

0 4

Hydrogen burns in oxygen:



A student says:

‘Three molecules react to make only two molecules, so the total mass of the products must be less than the total mass of the reactants.’

Relative atomic masses ( $A_r$ ): H = 1, O = 16

0 4 . 1

Evaluate the student’s statement.

Use the equation and relative formula masses in your answer.

.....

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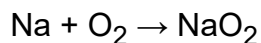
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.....

[6 marks]

0 5

A student was asked to write a balanced symbol equation for the reaction between sodium and oxygen to form sodium oxide. The student wrote:



0 5 . 1

The student's equation has the same number of atoms of each element on both sides, but it is still wrong.

Explain why.

.....

.....

.....

.....

[2 marks]

0 5 . 2

Write the correct balanced symbol equation for the reaction between sodium and oxygen.

.....

.....

[1 mark]

0 5 . 3

Explain why changing a small number within a formula (a subscript) is not allowed when balancing an equation.

.....

.....

[1 mark]

0 6

Word equations can be written as balanced symbol equations.

0 6 . 1

Lithium reacts with water to produce lithium hydroxide (LiOH) and hydrogen.  
Write a balanced symbol equation for this reaction.

.....

.....

.....

.....

[2 marks]

0 6 . 2

Calcium carbonate (CaCO<sub>3</sub>) decomposes when heated to produce calcium oxide (CaO) and carbon dioxide.  
Write a balanced symbol equation for this reaction.

.....

.....

[1 mark]

0 6 . 3

Nitrogen reacts with hydrogen to produce ammonia (NH<sub>3</sub>).  
Write a balanced symbol equation for this reaction.

.....

.....

.....

.....

[2 marks]

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**END OF QUESTIONS**

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

## GCSE Chemistry · Worksheet: Conservation of mass and balanced equations · 28 marks

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### Question 1 (4 marks)

01.1 [1 mark]

**Answer:** 18

- 18 (1)
- 

01.2 [1 mark]

**Answer:** 17

- 17 (1)
- 

01.3 [1 mark]

**Answer:**  $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$

- $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$  (1)

**Notes:** Allow correct multiples.

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01.4 [1 mark]

**Answer:**  $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$

- $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$  (1)

**Notes:** Allow correct multiples.

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## Question 2 (5 marks)

02.1 [1 mark]

**Correct:** It is equal to the total mass of the reactants.

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02.2 [1 mark]

**Answer:** 4

- 4 (1)
- 

02.3 [2 marks]

**Answer:** 2.56 g

- $1.76 + 1.44 - 0.64$  (1)
  - 2.56 (g) (1)
- 

02.4 [1 mark]

- no atoms are lost or made in a chemical reaction / atoms are only rearranged (1)
- 

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## Question 3 (4 marks)

03.1 [1 mark]

**Correct:** equal to the total mass of the reactants.

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03.2 [1 mark]

**Answer:** 2

- 2 (1)
- 

03.3 [1 mark]

**Answer:** 5.85 g

- 5.85 (g) (1)
- 

03.4 [1 mark]

- no atoms are lost or made during a chemical reaction (1)

**Notes:** Allow 'atoms are not created or destroyed, only rearranged'. Do not accept 'mass is conserved' on its own.

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## Question 4 (6 marks)

### 04.1 [6 marks]

**Answer:** The statement is wrong. No atoms are made or lost in a reaction: there are 4 H atoms and 2 O atoms on each side, only regrouped into fewer, larger molecules. Reactants:  $(2 \times 2) + 32 = 36$ ; products:  $2 \times 18 = 36$ , so the total mass is the same.

### Levels of response

- **Level 3 (5–6)** A detailed, coherent answer. Relevant points are accurate, linked in a logical sequence and use correct scientific terms.
- **Level 2 (3–4)** Several relevant points with some linking, but the answer has gaps, errors or lacks detail.
- **Level 1 (1–2)** Simple statements making one or two relevant points, with little or no linking.
- **No marks (0)** Nothing relevant or worthy of credit.

### Indicative content

- the student is wrong: the total mass of the products equals the total mass of the reactants
- the law of conservation of mass: no atoms are lost or made during a chemical reaction; the atoms are only rearranged into new substances
- atom count:  $2\text{H}_2$  contains 4 H atoms and  $\text{O}_2$  contains 2 O atoms;  $2\text{H}_2\text{O}$  also contains 4 H atoms and 2 O atoms
- the number in front of a formula multiplies the whole formula, and the subscript shows the number of atoms of that element in one molecule ( $2\text{H}_2\text{O}$  is 2 molecules, each with 2 H atoms and 1 O atom)
- the number of molecules can change because the atoms are regrouped into molecules that contain different numbers of atoms (each water molecule has 3 atoms; each hydrogen or oxygen molecule has 2)
- total  $M_r$  of reactants =  $(2 \times 2) + 32 = 36$ ; total  $M_r$  of products =  $2 \times 18 = 36$ , so the masses are equal

**Notes:** Allow the mass argument in grams, e.g.  $4\text{ g} + 32\text{ g} = 36\text{ g}$ .

Level 3 (5–6 marks): a clear judgement that the statement is wrong, supported by conservation of mass (atoms are not made or lost), an atom count on both sides and the relative formula mass calculation ( $36 = 36$ ).

Level 2 (3–4 marks): states that mass is conserved, supported by either a correct atom count or a correct mass calculation, but does not explain why the number of molecules can change.

Level 1 (1–2 marks): simple statements, e.g. 'mass is always conserved' or 'the equation is balanced', with no supporting evidence.

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## Question 5 (4 marks)

### 05.1 [2 marks]

- the formula of sodium oxide is wrong: it should be  $\text{Na}_2\text{O}$  (not  $\text{NaO}_2$ ) (1)
- sodium ions are  $\text{Na}^+$  and oxide ions are  $\text{O}^{2-}$ , so two sodium ions are needed for each oxide ion (1)

**Notes:** Do not accept 'the equation is not balanced'.

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### 05.2 [1 mark]

**Answer:**  $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$

- $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$  (1)
- 

### 05.3 [1 mark]

- changing a subscript changes the substance / gives the formula of a different compound (that is not the one in the reaction) (1)
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## Question 6 (5 marks)

### 06.1 [2 marks]

**Answer:**  $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$

- correct formulae:  $\text{Li} + \text{H}_2\text{O} \rightarrow \text{LiOH} + \text{H}_2$  (1)
- correctly balanced:  $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$  (1)

**Notes:** Allow multiples. Ignore state symbols. The balancing mark depends on correct formulae.

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### 06.2 [1 mark]

**Answer:**  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

- $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$  (1)
- 

### 06.3 [2 marks]

**Answer:**  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

- correct formulae:  $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$  (1)
- correctly balanced:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$  (1)

**Notes:** Allow  $\rightleftharpoons$  instead of  $\rightarrow$ . Do not accept N or H as formulae for the elements.

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