

Balancing equations and conserving atoms

Grade 8 science (Year 9 · Class 8) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to read chemical equations, count atoms on both sides, balance equations with coefficients and use conservation of mass. They begin with simple recall and end with multi-step reasoning using data.

They match standards MS-PS1-2 and MS-PS1-5 and suit Year 9, KS3 and Class 8 students.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-2, MS-PS1-5

Problem 1 Reactants and products (easy)

Word equation: copper + oxygen → copper oxide.

1. Identify the reactants.
2. Identify the product.
3. State whether a new substance has formed.

Problem 2 Signs of reaction (easy)

Maria in Lisbon observes six events: (a) a tablet fizzes in water, (b) ice melts, (c) sugar dissolves in tea, (d) a nail turns orange-brown, (e) a match head burns, (f) a puddle dries.

1. Identify the events that show a chemical reaction.
2. State one sign of reaction seen in each.

Problem 3 Counting atoms (easy)

Look at the equation $\text{H}_2 + \text{Cl}_2 \rightarrow 2 \text{HCl}$.

1. Count the H and Cl atoms on the left.
2. Count the H and Cl atoms on the right.
3. State whether it is balanced.

Problem 4 Balanced or not (easy)

Decide whether each equation is balanced.

- (i) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
- (ii) $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$
- (iii) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

Problem 5 Coefficient or subscript (easy)

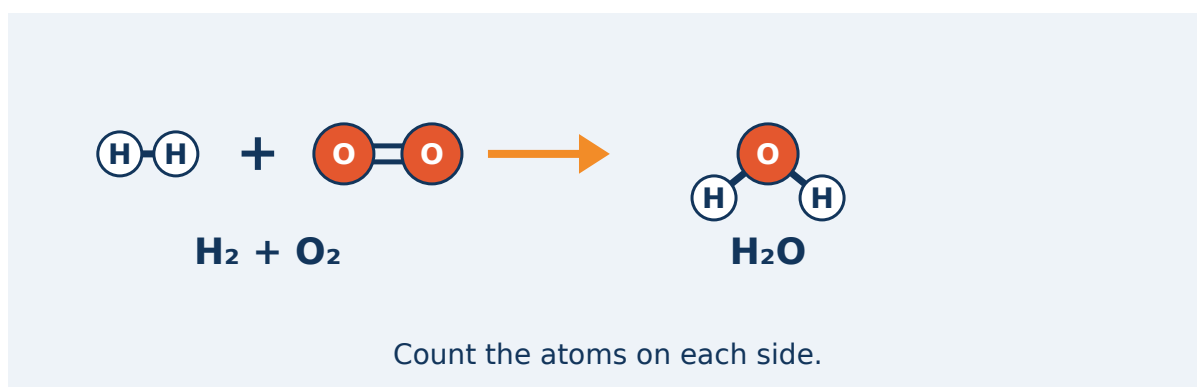
A student wants to balance $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$.

1. State which kind of number may be changed when balancing.
2. Explain why writing H_2O_2 is not allowed.

Problem 6 Balance with a picture (easy)

Look at the model equation.

1. Count the atoms of each element on each side.
2. Write the balanced equation.



The unbalanced equation for Problem 6.

Problem 7 Balance three (easy)

Balance each equation.

1. $\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$
2. $\text{H}_2 + \text{Cl}_2 \rightarrow \text{HCl}$
3. $\text{Ca} + \text{O}_2 \rightarrow \text{CaO}$

Problem 8 Aluminium cooking pot (medium)

Aluminium reacts with oxygen to form a protective layer: $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$.

1. Count the atoms on each side before balancing.
2. Balance the equation.
3. Check by recounting.

Problem 9 Zinc in acid (medium)

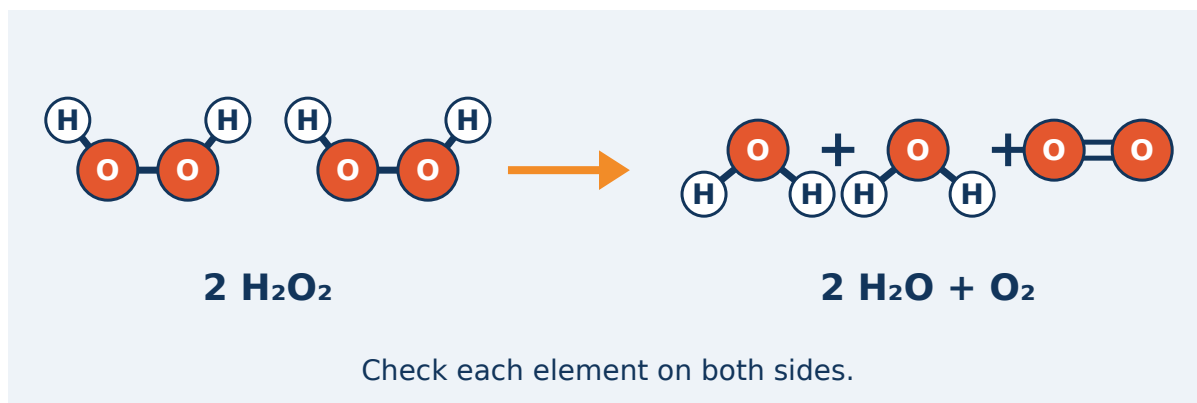
Zinc reacts with hydrochloric acid in a school lab: $\text{Zn} + \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$.

1. Count the atoms of each element on each side.
2. Balance the equation.
3. State which product is a gas.

Problem 10 Hydrogen peroxide (medium)

Hydrogen peroxide solution used on a cut breaks down, producing bubbles: $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$.

1. Count the H and O atoms on each side of the picture.
2. State whether the equation is balanced.
3. Identify the gas that makes the bubbles.



Hydrogen peroxide breaking down (Problem 10).

Problem 11 Baking soda in the oven (medium)

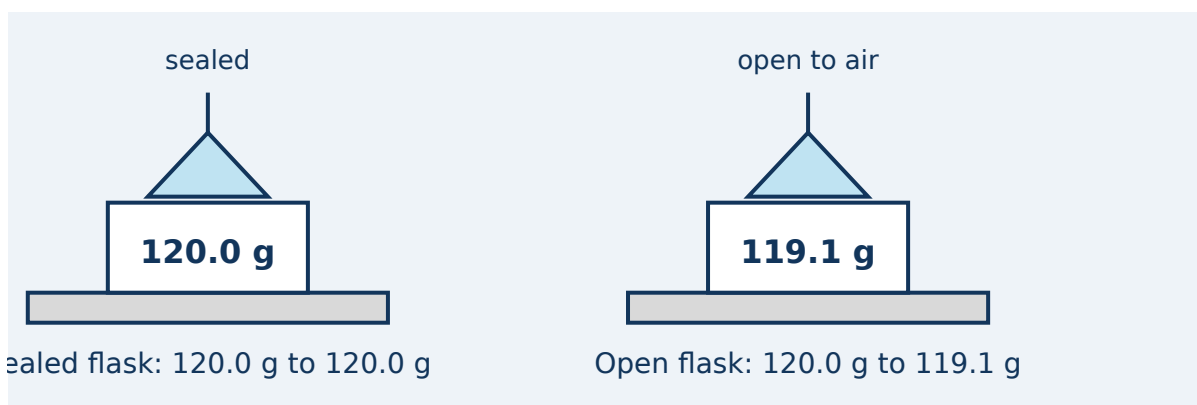
Sodium hydrogencarbonate breaks down on heating: $2 \text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$. A cook in Nairobi heats 16.8 g and 10.6 g of solid Na_2CO_3 remains. 1.8 g of water leaves as steam.

1. Calculate the mass of CO_2 released.
2. State the law you used.

Problem 12 Open and closed flasks (medium)

Look at the two balances.

1. Calculate the mass lost in the open flask.
2. Explain why the sealed flask shows no change.
3. Explain why the mass is not really destroyed.



The flasks in Problem 12.

Problem 13 Spot the error (medium)

Jun in Seoul balances $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$ by writing $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}_2$.

1. Explain what is wrong.
2. Write the correct balanced equation.

Problem 14 Word to symbol (medium)

Write a balanced symbol equation for each word equation.

1. potassium + chlorine $\rightarrow$ potassium chloride (KCl)
2. zinc + oxygen $\rightarrow$ zinc oxide (ZnO)
3. State the total number of atoms in 2 KCl.

Problem 15 Check by tabulating (medium)

A teacher gives the equation $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$.

1. Make a list of K, Cl and O atoms on each side.
2. State whether the equation is balanced.

Problem 16 Metals and chlorine (hard)

Balance each equation.

1. $\text{Fe} + \text{Cl}_2 \rightarrow \text{FeCl}_3$
2. $\text{Al} + \text{Cl}_2 \rightarrow \text{AlCl}_3$
3. $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$

Problem 17 Acids and metals (hard)

Balance each equation.

1. $\text{Mg} + \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
2. $\text{Al} + \text{HCl} \rightarrow \text{AlCl}_3 + \text{H}_2$
3. $\text{Ca(OH)}_2 + \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$

Problem 18 Fertiliser from air (hard)

Ammonia is made from nitrogen and hydrogen: $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$. In this reaction 28 g of nitrogen reacts with 6 g of hydrogen to give 34 g of ammonia.

1. Show that mass is conserved.
2. Calculate the mass of ammonia from 140 g of nitrogen.
3. Calculate the mass of hydrogen needed.

Problem 19 Analysing sealed-flask data (hard)

Four trials of a reaction in sealed flasks gave these masses.

Trial	Mass before (g)	Mass after (g)
1	52.30	52.28
2	48.15	48.17
3	60.02	60.00
4	55.40	54.10

1. Calculate the difference in each trial.
2. Identify which trials agree with conservation of mass within ± 0.05 g.
3. Suggest a reason for trial 4 and calculate the percentage lost.

Problem 20 Welding railway tracks (hard)

Rail workers in Pune use a reaction of iron(III) oxide with aluminium: $\text{Fe}_2\text{O}_3 + \text{Al} \rightarrow \text{Al}_2\text{O}_3 + \text{Fe}$. In the balanced reaction, 160 g Fe_2O_3 reacts with 54 g Al to give 102 g Al_2O_3 and 112 g Fe.

1. Balance the equation.
2. Show that mass is conserved.
3. Calculate the mass of iron from 80 g of Fe_2O_3 .