

Writing formulae and balancing equations

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to write formulae from ion charges, add state symbols, balance symbol equations and write ionic equations with spectator ions. They suit GCSE and IGCSE students, O Level, WAEC and KCSE learners, NGSS high school chemistry and Class 9-10 students.

Work from easiest to hardest and recount the atoms after every change.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-7

Problem 1 Formulae from ions (easy)

Nkechi uses the ion table to write formulae.

1. Write the formula of sodium chloride.
2. Write the formula of magnesium oxide.
3. Write the formula of calcium chloride.

Problem 2 State symbols (easy)

Zinc metal reacts with hydrochloric acid solution to form zinc chloride solution and hydrogen gas. The balanced equation is $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$.

1. State what (aq) means.
2. Rewrite the equation with state symbols.

Problem 3 Counting atoms (easy)

Count the atoms of each element.

1. $2\text{H}_2\text{SO}_4$
2. $3\text{Mg}(\text{NO}_3)_2$
3. $\text{Al}_2(\text{SO}_4)_3$

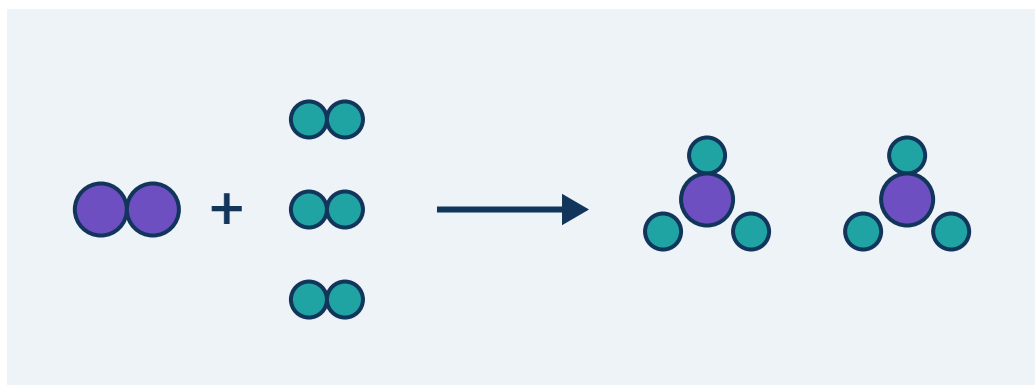
Problem 4 Balance the simple ones (easy)

Balance each equation.

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

Problem 5 Reading particles (easy)

The diagram shows nitrogen (violet) and hydrogen (teal) forming ammonia.



Ammonia is made from nitrogen and hydrogen.

1. Count the nitrogen atoms and hydrogen atoms on each side.
2. Write the balanced symbol equation.

Problem 6 Word equation to symbols (easy)

When calcium carbonate is heated strongly it breaks down to calcium oxide and carbon dioxide gas.

1. Write the formulae of the three substances.
2. Write the equation with state symbols.

Problem 7 The wrong subscript (easy)

Ikenna balances $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$ by writing $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$.

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

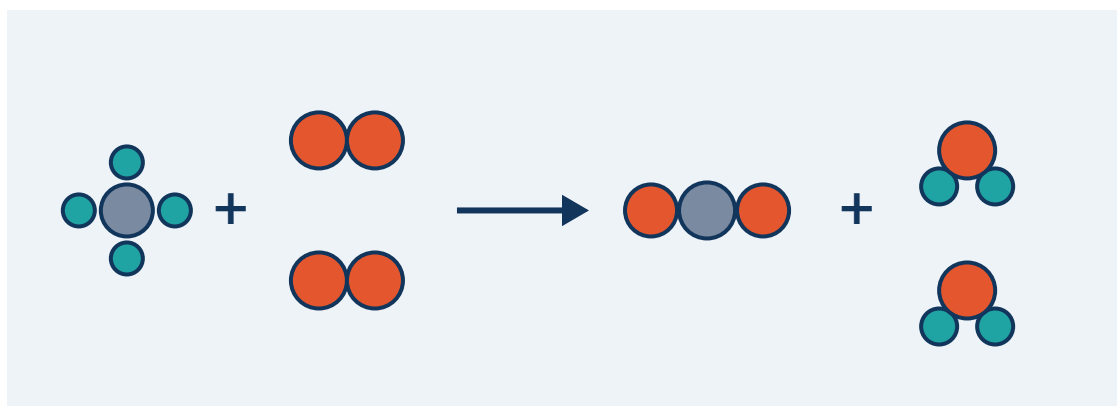
Problem 8 Formulae with brackets (medium)

Write the formula of each compound.

1. Calcium hydroxide
2. Aluminium nitrate
3. Ammonium sulfate
4. Iron(III) oxide
5. Copper(II) nitrate

Problem 9 Burning fuels (medium)

The diagram shows methane burning in oxygen.



Methane burns in oxygen.

1. Write the balanced equation for methane burning.
2. Balance $\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$.
3. Balance $\text{C}_2\text{H}_5\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$.

Problem 10 Balance the metals (medium)

Balance each equation.

1. $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$
2. $\text{Al} + \text{HCl} \rightarrow \text{AlCl}_3 + \text{H}_2$
3. $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$

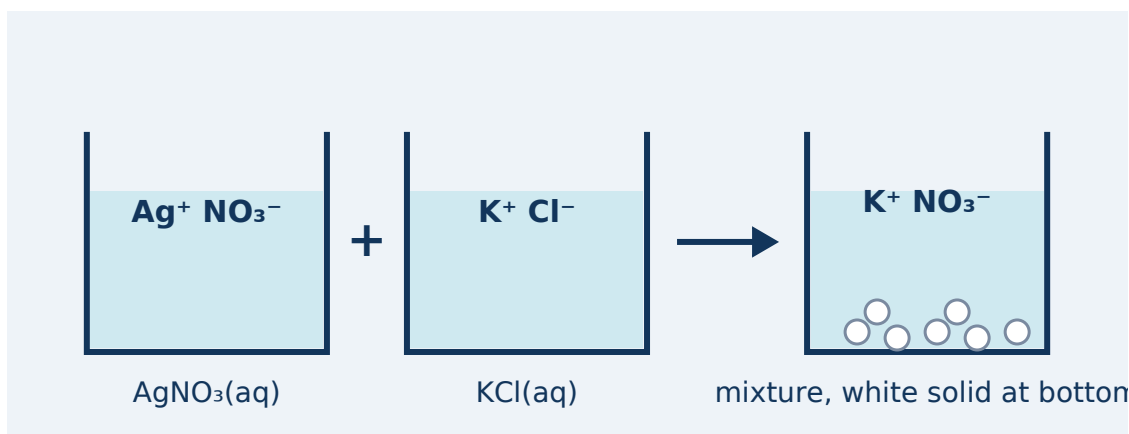
Problem 11 Neutralisation equations (medium)

Write a balanced equation with state symbols for each reaction.

1. Sulfuric acid solution reacts with sodium hydroxide solution to form sodium sulfate solution and water.
2. Hydrochloric acid solution reacts with calcium hydroxide solution to form calcium chloride solution and water.

Problem 12 A precipitate forms (medium)

Siddharth mixes silver nitrate solution and potassium chloride solution. A white solid forms.



Mixing two solutions.

1. Write the full balanced equation with state symbols.
2. Name the spectator ions.
3. Write the ionic equation.

Problem 13 Which formulae are wrong? (medium)

Hyun-woo wrote these formulae: NaO, MgCl, Al₂O₃, CaNO₃, K₂SO₄.

1. Identify the formulae that are wrong.
2. Write the correct formula for each of them.
3. Explain the mistake in NaO.

Problem 14 Conservation of mass (medium)

Mei burns 4.8 g of magnesium ribbon in air in the equation $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. It combines with 3.2 g of oxygen.

1. Calculate the mass of magnesium oxide formed.
2. State the law you used.
3. Explain why the white ash weighs more than the ribbon.

Problem 15 Zinc in copper sulfate (medium)

Aarav puts a zinc strip in blue copper(II) sulfate solution. Zinc dissolves and brown copper forms. The equation is $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{Cu(s)}$.

1. Write the equation using the ions in solution.
2. State the spectator ion.
3. Write the ionic equation and check the charges.

Problem 16 Harder balancing (hard)

Balance each equation.

1. $\text{C}_4\text{H}_{10} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
2. $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$
3. $\text{Ca(OH)}_2 + \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{H}_2\text{O}$

Problem 17 Three precipitations (hard)

Write the ionic equation for each precipitation reaction.

1. $\text{BaCl}_2\text{(aq)} + \text{Na}_2\text{SO}_4\text{(aq)} \rightarrow \text{BaSO}_4\text{(s)} + 2\text{NaCl(aq)}$
2. $\text{Mg(NO}_3)_2\text{(aq)} + 2\text{NaOH(aq)} \rightarrow \text{Mg(OH)}_2\text{(s)} + 2\text{NaNO}_3\text{(aq)}$
3. For each, name the spectator ions and check that the charge balances.

Problem 18 Deduce the ion charge (hard)

Use the formula to work out the charge on the metal ion.

1. Iron compound Fe₂O₃ (oxide ion is O²⁻).

2. Iron compound FeO.
3. Compound $M_3(PO_4)_2$ (phosphate is PO_4^{3-}).
4. Write the formula of the compound containing Fe^{3+} and CO_3^{2-} .

Problem 19 A displacement reaction (hard)

Solid aluminium reacts with aqueous copper(II) chloride to form aqueous aluminium chloride and solid copper.

1. Write the formulae and the balanced equation with state symbols.
2. Write the ionic equation.
3. Show that the charge is balanced.

Problem 20 Heating limestone (hard)

Ravi heats 10.0 g of calcium carbonate in an open crucible. The solid residue of calcium oxide has a mass of 5.6 g.

1. Write the balanced equation.
2. Calculate the mass of carbon dioxide released.
3. Calculate the percentage of the original mass that was lost.
4. Explain why the crucible gets lighter although mass is conserved.