

Balancing equations and conserving atoms

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

Each answer shows the atom counts or the method first, and then the result in bold. Always recount your own balanced equation as a final check.

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

Problem 1 Reactants and products

1. The reactants are **copper and oxygen**.
2. The product is **copper oxide**.
3. Yes, copper oxide is a new substance, so a chemical reaction has happened.

Problem 2 Signs of reaction

1. Chemical changes: (a), (d) and (e).
2. (a) a gas is formed (fizzing); (d) a colour change as rust forms; (e) heat and light given out.

Events a, d and e.

Problem 3 Counting atoms

1. Left: H 2, Cl 2.
2. Right: $2 \times 1 \text{ H} = 2$, $2 \times 1 \text{ Cl} = 2$.
3. The counts are equal: **it is balanced**.

Problem 4 Balanced or not

- (i) Left O 2, right O 1: **not balanced**.
(ii) Na 2/2, Cl 2/2: **balanced**.
(iii) C 1/1, O 2/2: **balanced**.

Problem 5 Coefficient or subscript

1. Only the **coefficient**, the big number in front of a formula.
2. H_2O_2 is a different substance (hydrogen peroxide), so the equation would no longer describe the reaction of making water.

Problem 6 Balance with a picture

1. Left: H 2, O 2. Right: H 2, O 1.
2. Make the oxygen even: 2 H_2O gives O 2 and H 4, so use 2 H_2 : **$2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$** .

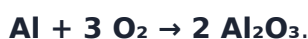
Problem 7 Balance three

Check: 1 Na 2/2, Cl 2/2; 2 H 2/2, Cl 2/2; 3 Ca 2/2, O 2/2.

Problem 8 Aluminium cooking pot

1. Left: Al 1, O 2. Right: Al 2, O 3.

2. The least common multiple of 2 and 3 is 6 oxygen atoms: 3 O₂ and 2 Al₂O₃, giving 4 Al: **4**



3. Left Al 4, O 6; right Al 4, O 6.

Problem 9 Zinc in acid

1. Left: Zn 1, H 1, Cl 1. Right: Zn 1, Cl 2, H 2.

2. Put 2 before HCl: **Zn + 2 HCl → ZnCl₂ + H₂.**

3. Hydrogen, H₂, is the gas.

Problem 10 Hydrogen peroxide

1. Left: 2 × 2 = 4 H and 2 × 2 = 4 O. Right: 2 × 2 = 4 H, and O is 2 + 2 = 4.

2. Equal on both sides, so **balanced**.

3. **Oxygen gas**, O₂.

Problem 11 Baking soda in the oven

1. Mass lost in total = 16.8 – 10.6 = 6.2 g. CO₂ = 6.2 – 1.8 = **4.4 g**.

2. The **conservation of mass**: mass of products equals mass of reactants.

Problem 12 Open and closed flasks

1. 120.0 – 119.1 = **0.9 g**.

2. Nothing can leave a sealed flask, so the total mass stays the same.

3. The gas that escaped from the open flask carries the missing 0.9 g; atoms are conserved.

Problem 13 Spot the error

1. He changed a subscript, which creates the wrong substance (MgO₂ does not describe magnesium oxide).

2. Change only coefficients: **2 Mg + O₂ → 2 MgO**.

Problem 14 Word to symbol

1. $2 \text{ K} + \text{Cl}_2 \rightarrow 2 \text{ KCl}$
2. $2 \text{ Zn} + \text{O}_2 \rightarrow 2 \text{ ZnO}$
3. $2 \times 2 = 4 \text{ atoms.}$

Problem 15 Check by tabulating

1. Left: K 2, Cl 2, O $2 \times 3 = 6$. Right: K 2, Cl 2, O $3 \times 2 = 6$.
2. All three match: **balanced**.

Problem 16 Metals and chlorine

1. $2 \text{ Fe} + 3 \text{ Cl}_2 \rightarrow 2 \text{ FeCl}_3$ (Fe 2/2, Cl 6/6).
2. $2 \text{ Al} + 3 \text{ Cl}_2 \rightarrow 2 \text{ AlCl}_3$ (Al 2/2, Cl 6/6).
3. $4 \text{ Na} + \text{O}_2 \rightarrow 2 \text{ Na}_2\text{O}$ (Na 4/4, O 2/2).

Problem 17 Acids and metals

1. $\text{Mg} + 2 \text{ HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ (H 2/2, Cl 2/2).
2. $2 \text{ Al} + 6 \text{ HCl} \rightarrow 2 \text{ AlCl}_3 + 3 \text{ H}_2$ (Al 2/2, H 6/6, Cl 6/6).
3. $\text{Ca(OH)}_2 + 2 \text{ HCl} \rightarrow \text{CaCl}_2 + 2 \text{ H}_2\text{O}$ (H 4/4, O 2/2, Cl 2/2).

Problem 18 Fertiliser from air

1. $28 + 6 = 34 \text{ g}$ on each side.
2. $140 \div 28 = 5$, so $5 \times 34 = 170 \text{ g of ammonia.}$
3. $5 \times 6 = 30 \text{ g of hydrogen.}$

Problem 19 Analysing sealed-flask data

1. Trial 1: -0.02 g ; trial 2: $+0.02 \text{ g}$; trial 3: -0.02 g ; trial 4: -1.30 g .
2. Trials 1, 2 and 3 agree within $\pm 0.05 \text{ g}$.
3. A leak let gas escape from the flask. Percentage lost = $1.30 \div 55.40 \times 100 = 2.3 \%$.

Problem 20 Welding railway tracks

1. Fe 2/2, O 3/3, Al needs 2 on the left: $\text{Fe}_2\text{O}_3 + 2 \text{ Al} \rightarrow \text{Al}_2\text{O}_3 + 2 \text{ Fe.}$
2. $160 + 54 = 214 \text{ g}$; $102 + 112 = 214 \text{ g}$.
3. 80 g is half of 160 g , so iron = **56 g**.