

## Balancing Chemical Equations Worksheet

### Student Instructions

1. Identify the reactants and products and write a word equation.
2. Write the correct chemical formula for each of the reactants and the products.
3. Check to see whether there are the same NUMBERS and TYPES of atoms on both sides of the equation. i.e. The Law of Conservation of Matter.
4. Balance each chemical equation by placing whole numbers in front of the chemical formula.

eg. The burning of steel wool(iron) in air.

Step 1. Iron + Oxygen → Iron(II) oxide

Step 2 & 3  $\text{Fe} + \text{O}_2 \rightarrow \text{FeO}$

Step 4  $2\text{Fe} + \text{O}_2 \rightarrow 2\text{FeO}$

### Chemical formula help

Acids	Alkalis (Bases)
Acetic acid, $\text{CH}_3\text{COOH}$ , produces acetate salts, $\text{CH}_3\text{COO}^-$ Hydrochloric acid, $\text{HCl}$ , produces chloride salts, $\text{Cl}^-$ Nitric acid, $\text{HNO}_3$ , produces nitrate salts, $\text{NO}_3^-$ Sulfuric acid, $\text{H}_2\text{SO}_4$ , produces sulfate salts, $\text{SO}_4^{2-}$	Ammonia $\text{NH}_3$ Potassium hydroxide, $\text{KOH}$ Sodium hydroxide, $\text{NaOH}$

Cations (positive ions)	Anions (negative ions)
aluminum $\text{Al}^{3+}$ , ammonium $\text{NH}_4^+$ , barium $\text{Ba}^{2+}$ , calcium $\text{Ca}^{2+}$ , copper $\text{Cu}^{2+}$ , iron(II) $\text{Fe}^{2+}$ , iron(III) $\text{Fe}^{3+}$ , lead $\text{Pb}^{2+}$ , lithium $\text{Li}^+$ , magnesium $\text{Mg}^{2+}$ , mercury $\text{Hg}^{2+}$ , sodium $\text{Na}^+$ , potassium $\text{K}^+$ , silver $\text{Ag}^+$ , zinc $\text{Zn}^{2+}$	bromide $\text{Br}^-$ , carbonate $\text{CO}_3^{2-}$ , chloride $\text{Cl}^-$ , hydroxide $\text{OH}^-$ , nitrate $\text{NO}_3^-$ , phosphate $\text{PO}_4^{3-}$ and sulfate $\text{SO}_4^{2-}$

**Diatomic molecules:** Bromine  $\text{Br}_2$ , chlorine  $\text{Cl}_2$ , hydrogen  $\text{H}_2$ , nitrogen  $\text{N}_2$  and oxygen  $\text{O}_2$

### Valencies or Combining Powers of Elements

Element	1	2	3
Metal	Lithium $\text{Li}$ , potassium $\text{K}$ , sodium $\text{Na}$ Silver $\text{Ag}$	Barium $\text{Ba}$ , calcium $\text{Ca}$ , magnesium $\text{Mg}$ Copper $\text{Cu}$ , iron(II) $\text{Fe}$ , mercury $\text{Hg}$ , zinc $\text{Zn}$ Lead $\text{Pb}$	Aluminium $\text{Al}$ Iron(III) $\text{Fe}$
Non-metal	Hydrogen $\text{H}$ Bromine $\text{Br}$ , chlorine $\text{Cl}$	Oxygen $\text{O}$ , sulfur $\text{S}$	Nitrogen $\text{N}$

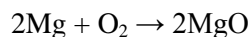
**Write balanced equations for the following reactions**

1. Magnesium ribbon burns in air to produce a white powder. A synthesis reaction.
2. Aluminum reacts with oxygen to produce a compound.
3. Hydrochloric acid and magnesium react to produce hydrogen gas and a magnesium salt
4. Sulfuric acid and zinc react to produce hydrogen gas and a zinc salt.
5. The action of sulfuric acid on calcium carbonate produces water, a calcium salt and a gas that turns limewater milky.
6. The heating of mercury(II) oxide,  $\text{HgO}$ , causes it to decompose into its elements. This is an example of a decomposition reaction.
7. The heating of copper carbonate produces carbon dioxide gas and copper oxide.
8. Copper oxide reacts with hydrochloric acid to produce a green solution of copper(II) chloride and water.
9. A strip of copper metal when placed in a solution of silver nitrate produces metallic silver and a copper salt.
10. When a solution of silver nitrate comes into contact with a solution of sodium chloride a white precipitate of silver chloride and a solution of sodium nitrate are produced.
11. Potassium hydroxide can be used to neutralise a solution of hydrochloric acid. It produces a potassium salt and water.
12. Sodium hydroxide can be used to neutralise a solution of sulfuric acid. It produces a salt plus water.
13. Chlorine gas and potassium bromide react to produce potassium chloride and bromine.
14. Aluminum and bromine combine violently to produce a single compound.
15. Sodium reacts violently with water to produce a solution of sodium hydroxide and hydrogen gas.
16. Iron(III) oxide when heated in hydrogen produces iron and water.
17. Limewater (calcium hydroxide) reacts with carbon dioxide to produce water and a precipitate of calcium carbonate.
18. Limestone (calcium carbonate) when strongly heated decomposes into carbon dioxide and quicklime (calcium oxide).
19. Copper oxide and carbon when heated together produce the copper metal and carbon monoxide gas.
20. Hydrochloric acid and sodium sulfide produce hydrogen sulfide gas and a salt.

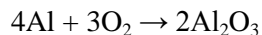
21. Copper sulfate and sodium hydroxide when mixed together produce a precipitate of copper hydroxide and a solution of sodium sulfate.
22. Copper hydroxide when heated produces black copper oxide and steam( $\text{H}_2\text{O}$ ).
23. Copper oxide when heated in the presence of hydrogen gas produces copper metal and water.
24. Sodium hydroxide reacts with a solution of ammonium chloride to produce ammonia gas, salt and water.
25. A mixture of sodium iodide and lead nitrate produces a solution of sodium nitrate and a precipitate.
26. The complete combustion of methane ( $\text{CH}_4$ ) produces carbon dioxide and water. Note: In a combustion reaction a fuel reacts with oxygen.
27. The combustion of ethanol, ( $\text{C}_2\text{H}_5\text{OH}$ ) produces carbon dioxide and water
28. The combustion of glucose, ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) produces carbon dioxide and water
29. Barium hydroxide reacts with sulfuric acid to produce a white precipitate and water
30. A solution of mercury(II) nitrate reacts with a solution of potassium iodide to produce a bright orange mercury(II) iodide precipitate and a solution of potassium nitrate.
31. In the process of fermentation, yeast breakdown glucose molecules ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) to produce ethanol( $\text{C}_2\text{H}_5\text{OH}$ ) and carbon dioxide gas.
32. In the process of photosynthesis, plants use carbon dioxide and water to make glucose( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and oxygen.
33. A solution of silver nitrate reacts with a solution of potassium phosphate to produce a yellow precipitate of silver phosphate and a solution of potassium nitrate.
34. Sodium hydrogen carbonate,  $\text{NaHCO}_3$  and acetic acid react to produce carbon dioxide, water and sodium acetate,  $\text{CH}_3\text{COONa}$
35. In the Haber process nitrogen and hydrogen combine to produce ammonia
36. In the Solvay process calcium carbonate and sodium chloride are used to produce calcium chloride and sodium carbonate via an indirect pathway.
37. Brown nitrogen dioxide gas( $\text{NO}_2$ ) combines with water to produce a mixture of nitric acid and nitrous acid ( $\text{HNO}_2$ ).
38. Sodium oxide dissolves in water to produce a strong alkali solution
39. Lithium hydroxide is used in space missions to remove carbon dioxide from the air. Lithium carbonate and water are produced.
40. Colourless nitrogen monoxide( $\text{NO}$ ) combines with oxygen to produce brown nitrogen dioxide( $\text{NO}_2$ ).

## Balancing Chemical Equations Answers

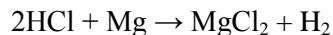
1. Magnesium + oxygen → magnesium oxide



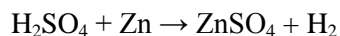
2. Aluminum + oxygen → aluminium oxide



3. Hydrochloric acid + magnesium → magnesium chloride + hydrogen



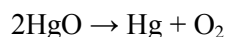
4. Sulfuric acid + zinc → zinc sulfate + hydrogen



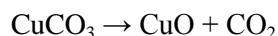
5. Sulfuric acid + calcium → calcium sulfate + water + carbon dioxide



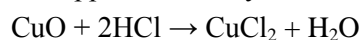
6. Mercury(II) oxide → mercury + oxygen



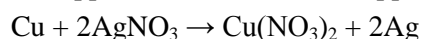
7. Carbon carbonate → copper oxide + carbon dioxide



8. Copper oxide + hydrochloric acid → copper(II) chloride + water



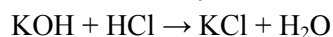
9. Copper + silver nitrate → copper(II) nitrate + silver



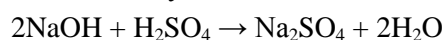
10. Silver nitrate + sodium chloride → silver chloride + sodium nitrate



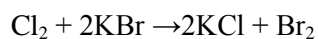
11. Potassium hydroxide + hydrochloric acid → potassium chloride + water



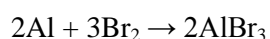
12. Sodium hydroxide + sulfuric acid → sodium sulfate + water



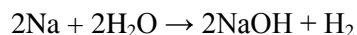
13. Chlorine + potassium bromide → potassium chloride + bromine



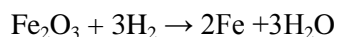
14. Aluminum + bromine → aluminum bromide



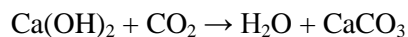
15. Sodium + water → sodium hydroxide + hydrogen



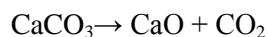
16. Iron(III) oxide + hydrogen → iron + water



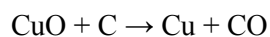
17. Calcium hydroxide + carbon dioxide → water + calcium carbonate



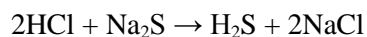
18. Calcium carbonate → calcium oxide + carbon dioxide



19. Copper oxide + carbon → copper + carbon monoxide



20. Hydrochloric acid + sodium sulfide → hydrogen sulfide + sodium chloride



21. Copper sulfate + sodium hydroxide → copper hydroxide + sodium sulfate  
 $\text{CuSO}_4 + 2\text{NaOH} \rightarrow \text{Cu}(\text{OH})_2(\text{s}) + \text{Na}_2\text{SO}_4$
22. Calcium hydroxide → copper oxide + water  
 $\text{Cu}(\text{OH})_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$
23. Copper oxide + hydrogen → copper + water  
 $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$
24. Sodium hydroxide + ammonium chloride → sodium chloride + ammonia + water  
 $\text{NaOH} + \text{NH}_4\text{Cl} \rightarrow \text{NaCl} + \text{NH}_3 + \text{H}_2\text{O}$
25. Sodium iodide + lead nitrate  
 $2\text{NaI} + \text{Pb}(\text{NO}_3)_2 \rightarrow 2\text{NaNO}_3 + \text{PbI}_2(\text{s})$
26. Methane + oxygen → carbon dioxide + water  
 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
27. Ethanol + oxygen → carbon dioxide + water  
 $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
28. Glucose + oxygen → carbon dioxide + water  
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
29. Barium hydroxide + sulfuric acid → barium sulfate + water  
 $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{H}_2\text{O}$
30. Mercury(II) nitrate + potassium iodide → mercury iodide + potassium nitrate  
 $\text{Hg}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{HgI}_2(\text{s}) + 2\text{KNO}_3$
31. Glucose → ethanol + carbon dioxide  
 $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
32. Carbon dioxide + water → glucose + oxygen  
 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
33. Silver nitrate + potassium phosphate → silver phosphate + potassium nitrate  
 $3\text{AgNO}_3 + \text{K}_3\text{PO}_4 \rightarrow \text{Ag}_3\text{PO}_4 + 3\text{KNO}_3$
34. Sodium hydrogen carbonate + acetic acid → sodium acetate + carbon dioxide + water  
 $\text{NaHCO}_3 + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{CO}_2 + \text{H}_2\text{O}$
35. Nitrogen + hydrogen → ammonia  
 $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
36. Calcium carbonate + sodium chloride → sodium carbonate + calcium chloride  
 $\text{CaCO}_3 + 2\text{NaCl} \rightarrow \text{Na}_2\text{CO}_3 + \text{CaCl}_2$
37. Nitrogen dioxide + water → nitric acid + nitrous acid  
 $\text{NO}_2 + 2\text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$
38. Sodium oxide + water → sodium hydroxide  
 $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$
39. Lithium hydroxide + carbon dioxide → lithium carbonate + water  
 $2\text{LiOH} + \text{CO}_2 \rightarrow \text{Li}_2\text{CO}_3 + \text{H}_2\text{O}$
40. Nitrogen monoxide + oxygen → nitrogen dioxide  
 $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$