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 $\rightarrow$ Iron(II) oxide
Step 2 & 3 Fe + O$_2$ $\rightarrow$ FeO
Step 4 2Fe + O$_2$ $\rightarrow$ 2FeO

Chemical formula help

<table>
<thead>
<tr>
<th>Acids</th>
<th>Alkalis (Bases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid, CH$_3$COOH, produces acetate salts, CH$_3$COO$^-$</td>
<td>Ammonia NH$_3$</td>
</tr>
<tr>
<td>Hydrochloric acid, HCl, produces chloride salts, Cl$^-$</td>
<td>Potassium hydroxide, KOH</td>
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<tr>
<td>Nitric acid, HNO$_3$, produces nitrate salts, NO$_3^-$</td>
<td>Sodium hydroxide, NaOH</td>
</tr>
<tr>
<td>Sulfuric acid, H$_2$SO$_4$, produces sulfate salts, SO$_4^{2-}$</td>
<td></td>
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</tbody>
</table>

Cations (positive ions)

<table>
<thead>
<tr>
<th>Anions (negative ions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum Al$^{3+}$, ammonium NH$_4^+$, barium Ba$^{2+}$, calcium Ca$^{2+}$, copper Cu$^{2+}$, iron(II) Fe$^{2+}$, iron(III) Fe$^{3+}$, lead Pb$^{2+}$, lithium Li$^+$, magnesium Mg$^{2+}$, mercury Hg$^{2+}$, sodium Na$^+$, potassium K$^+$, silver Ag$^+$, zinc Zn$^{2+}$</td>
</tr>
</tbody>
</table>

Diatomic molecules: Bromine Br$_2$, chlorine Cl$_2$, hydrogen H$_2$, nitrogen N$_2$ and oxygen O$_2$

Valencies or Combining Powers of Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>Lithium Li, potassium K, sodium Na, Silver Ag</td>
<td>Barium Ba, calcium Ca, magnesium Mg, Copper Cu, iron(II) Fe, mercury Hg, zinc Zn, Lead Pb</td>
<td>Aluminium Al, Iron(III) Fe</td>
</tr>
<tr>
<td>Non-metal</td>
<td>Hydrogen H, Bromine Br, chlorine Cl</td>
<td>Oxygen O, sulfur S</td>
<td>Nitrogen N</td>
</tr>
</tbody>
</table>
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, 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 (H₂O).

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 (CH₄) produces carbon dioxide and water. Note: In a combustion reaction a fuel reacts with oxygen.

27. The combustion of ethanol, (C₂H₅OH) produces carbon dioxide and water

28. The combustion of glucose, (C₆H₁₂O₆) 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 (C₆H₁₂O₆) to produce ethanol(C₂H₅OH) and carbon dioxide gas.

32. In the process of photosynthesis, plants use carbon dioxide and water to make glucose(C₆H₁₂O₆) 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, NaHCO₃ and acetic acid react to produce carbon dioxide, water and sodium acetate, CH₃COONa

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(NO₂) combines with water to produce a mixture of nitric acid and nitrous acid (HNO₂).

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(NO) combines with oxygen to produce brown nitrogen dioxide(NO₂).
Balancing Chemical Equations Answers

1. Magnesium + oxygen → magnesium oxide
   \[ 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \]

2. Aluminum + oxygen → aluminium oxide
   \[ 4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3 \]

3. Hydrochloric acid + magnesium → magnesium chloride + hydrogen
   \[ 2\text{HCl} + \text{Mg} \rightarrow \text{MgCl}_2 + \text{H}_2 \]

4. Sulfuric acid + zinc → zinc sulfate + hydrogen
   \[ \text{H}_2\text{SO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{H}_2 \]

5. Sulfuric acid + calcium → calcium sulfate + water + carbon dioxide
   \[ \text{H}_2\text{SO}_4 + \text{Ca} \rightarrow \text{CaSO}_4 + \text{H}_2\text{O} + \text{CO}_2 \]

6. Mercury(II) oxide → mercury + oxygen
   \[ 2\text{HgO} \rightarrow \text{Hg} + \text{O}_2 \]

7. Carbon carbonate → copper oxide + carbon dioxide
   \[ \text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2 \]

8. Copper oxide + hydrochloric acid → copper(II) chloride + water
   \[ \text{CuO} + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} \]

9. Copper + silver nitrate → copper(II) nitrate + silver
   \[ \text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu(NO}_3)_2 + 2\text{Ag} \]

10. Silver nitrate + sodium chloride → silver chloride + sodium nitrate
    \[ \text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl}(s) + \text{NaNO}_3 \text{ where } (s) = \text{solid or precipitate} \]

11. Potassium hydroxide + hydrochloric acid → potassium chloride + water
    \[ \text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O} \]

12. Sodium hydroxide + sulfuric acid → sodium sulfate + water
    \[ 2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} \]

13. Chlorine + potassium bromide → potassium chloride + bromine
    \[ \text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2 \]

14. Aluminum + bromine → aluminum bromide
    \[ 2\text{Al} + 3\text{Br}_2 \rightarrow 2\text{AlBr}_3 \]

15. Sodium + water → sodium hydroxide + hydrogen
    \[ 2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 \]

16. Iron(III) oxide + hydrogen → iron + water
    \[ \text{Fe}_2\text{O}_3 + 3\text{H}_2 \rightarrow 2\text{Fe} + 3\text{H}_2\text{O} \]

17. Calcium hydroxide + carbon dioxide → water + calcium carbonate
    \[ \text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{H}_2\text{O} + \text{CaCO}_3 \]

18. Calcium carbonate → calcium oxide + carbon dioxide
    \[ \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \]

19. Copper oxide + carbon → copper + carbon monoxide
    \[ \text{CuO} + \text{C} \rightarrow \text{Cu} + \text{CO} \]

20. Hydrochloric acid + sodium sulfide → hydrogen sulfide + sodium chloride
    \[ 2\text{HCl} + \text{Na}_2\text{S} \rightarrow \text{H}_2\text{S} + 2\text{NaCl} \]
21. Copper sulfate + sodium hydroxide → copper hydroxide + sodium sulfate
CuSO₄ + 2NaOH → Cu(OH)₂(s) + Na₂SO₄

22. Calcium hydroxide → copper oxide + water
Cu(OH)₂ → CuO + H₂O

23. Copper oxide + hydrogen → copper + water
CuO + H₂ → Cu + H₂O

24. Sodium hydroxide + ammonium chloride → sodium chloride + ammonia + water
NaOH + NH₄Cl → NaCl + NH₃ + H₂O

25. Sodium iodide + lead nitrate
2NaI + Pb(NO₃)₂ → 2NaNO₃ + PbI₂(s)

26. Methane + oxygen → carbon dioxide + water
CH₄ + 2O₂ → CO₂ + 2H₂O

27. Ethanol + oxygen → carbon dioxide + water
C₂H₅OH + 3O₂ → 2CO₂ + 3H₂O

28. Glucose + oxygen → carbon dioxide + water
C₆H₁₂O₆ + 6O₂ → 6CO₂ + 6H₂O

29. Barium hydroxide + sulfuric acid → barium sulfate + water
Ba(OH)₂ + H₂SO₄ → BaSO₄ + H₂O

30. Mercury(II) nitrate + potassium iodide → mercury iodide + potassium nitrate
Hg(NO₃)₂ + 2KI → HgI₂(s) + 2KNO₃

31. Glucose → ethanol + carbon dioxide
C₆H₁₂O₆ → 2C₂H₅OH + 2CO₂

32. Carbon dioxide + water → glucose + oxygen
6CO₂ + 6H₂O → C₆H₁₂O₆ + 6O₂

33. Silver nitrate + potassium phosphate → silver phosphate + potassium nitrate
3AgNO₃ + K₃PO₄ → Ag₃PO₄ + 3KNO₃

34. Sodium hydrogen carbonate + acetic acid → sodium acetate + carbon dioxide + water
NaHCO₃ + CH₃COOH → CH₃COONa + CO₂ + H₂O

35. Nitrogen + hydrogen → ammonia
N₂ + 3H₂ → 2NH₃

36. Calcium carbonate + sodium chloride → sodium carbonate + calcium chloride
CaCO₃ + 2NaCl → Na₂CO₃ + CaCl₂

37. Nitrogen dioxide + water → nitric acid + nitrous acid
NO₂ + H₂O → HNO₃ + HNO₂

38. Sodium oxide + water → sodium hydroxide
Na₂O + H₂O → 2NaOH

39. Lithium hydroxide + carbon dioxide → lithium carbonate + water
2LiOH + CO₂ → Li₂CO₃ + H₂O

40. Nitrogen monoxide + oxygen → nitrogen dioxide
2NO + O₂ → 2NO₂