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 $Fe + O_2 \rightarrow FeO$
Step 4 $2Fe + O_2 \rightarrow 2FeO$

Chemical formula help

Acids	**Alkalis (Bases)**
Acetic acid, CH_3COOH, produces acetate salts, CH_3COO^- Hydrochloric acid, HCl, produces chloride salts, Cl^- Nitric acid, HNO_3, produces nitrate salts, NO_3^- Sulfuric acid, H_2SO_4, produces sulfate salts, SO_4^{2-}	Ammonia NH_3 Potassium hydroxide, KOH Sodium hydroxide, NaOH

Cations (positive ions)	**Anions** (negative ions)
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+}	bromide Br^-, carbonate CO_3^{2-}, chloride Cl^-, hydroxide OH^-, nitrate NO_3^-, phosphate PO_4^{3-} and sulfate SO_4^{2-}

Diatomic molecules: Bromine Br_2, chlorine Cl_2, hydrogen H_2, nitrogen N_2 and oxygen O_2

Valencies or Combining Powers of Elements

Element	**1**	**2**	**3**
Metal	Lithium Li, potassium K, sodium Na Silver Ag	Barium Ba, calcium Ca, magnesium Mg Copper Cu, iron(II) Fe, mercury Hg, zinc Zn Lead Pb	Aluminium Al Iron(III) Fe
Non-metal	Hydrogen H Bromine Br, chlorine Cl	Oxygen O, sulfur S	Nitrogen 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, 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(H_2O).

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 (CH_4) produces carbon dioxide and water. Note: In a combustion reaction a fuel reacts with oxygen.

27. The combustion of ethanol, (C_2H_5OH) produces carbon dioxide and water

28. The combustion of glucose, ($C_6H_{12}O_6$) 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 ($C_6H_{12}O_6$) to produce ethanol(C_2H_5OH) and carbon dioxide gas.

32. In the process of photosynthesis, plants use carbon dioxide and water to make glucose($C_6H_{12}O_6$) and oxygen.

33. A solution of silver nitrate reacts with a solution of potassium phosphate to produces a yellow precipitate of silver phosphate and a solution of potassium nitrate.

34. Sodium hydrogen carbonate, $NaHCO_3$ and acetic acid react to produce carbon dioxide, water and sodium acetate, CH_3COONa

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(NO_2) combines with water to produce a mixture of nitric acid and nitrous acid (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(NO) combines with oxygen to produce brown nitrogen dioxide(NO_2).

Balancing Chemical Equations Answers

1. Magnesium + oxygen → magnesium oxide

$2Mg + O_2 \rightarrow 2MgO$

2. Aluminum + oxygen → aluminium oxide

$4Al + 3O_2 \rightarrow 2Al_2O_3$

3. Hydrochloric acid + magnesium → magnesium chloride + hydrogen

$2HCl + Mg \rightarrow MgCl_2 + H_2$

4. Sulfuric acid + zinc → zinc sulfate + hydrogen

$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

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

$H_2SO_4 + Ca \rightarrow CaSO_4 + H_2O + CO_2$

6. Mercury(II) oxide → mercury + oxygen

$2HgO \rightarrow Hg + O_2$

7. Carbon carbonate → copper oxide + carbon dioxide

$CuCO_3 \rightarrow CuO + CO_2$

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

$CuO + 2HCl \rightarrow CuCl_2 + H_2O$

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

$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

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

$AgNO_3 + NaCl \rightarrow AgCl(s) + NaNO_3$ where (s) = solid or precipitate

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

$KOH + HCl \rightarrow KCl + H_2O$

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

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

13. Chlorine + potassium bromide → potassium chloride + bromine

$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

14. Aluminum + bromine → aluminum bromide

$2Al + 3Br_2 \rightarrow 2AlBr_3$

15. Sodium + water → sodium hydroxide + hydrogen

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

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

$Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$

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

$Ca(OH)_2 + CO_2 \rightarrow H_2O + CaCO_3$

18. Calcium carbonate → calcium oxide + carbon dioxide

$CaCO_3 \rightarrow CaO + CO_2$

19. Copper oxide + carbon → copper + carbon monoxide

$CuO + C \rightarrow Cu + CO$

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

$2HCl + Na_2S \rightarrow H_2S + 2NaCl$

21. Copper sulfate + sodium hydroxide → copper hydroxide + sodium sulfate

$CuSO_4 + 2NaOH \rightarrow Cu(OH)_2(s) + Na_2SO_4$

22. Calcium hydroxide → copper oxide + water

$Cu(OH)_2 \rightarrow CuO + H_2O$

23. Copper oxide + hydrogen → copper + water

$CuO + H_2 \rightarrow Cu + H_2O$

24. Sodium hydroxide + ammonium chloride → sodium chloride + ammonia + water

$NaOH + NH_4Cl \rightarrow NaCl + NH_3 + H_2O$

25. Sodium iodide + lead nitrate

$2NaI + Pb(NO_3)_2 \rightarrow 2NaNO_3 + PbI_2(s)$

26. Methane + oxygen → carbon dioxide + water

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

27. Ethanol + oxygen → carbon dioxide + water

$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

28. Glucose + oxygen → carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

29. Barium hydroxide + sulfuric acid → barium sulfate + water

$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O$

30. Mercury(II) nitrate + potassium iodide → mercury iodide + potassium nitrate

$Hg(NO_3)_2 + 2KI \rightarrow HgI_2(s) + 2KNO_3$

31. Glucose → ethanol + carbon dioxide

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

32. Carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

33. Silver nitrate + potassium phosphate → silver phosphate + potassium nitrate

$3AgNO_3 + K_3PO_4 \rightarrow Ag_3PO_4 + 3KNO_3$

34. Sodium hydrogen carbonate + acetic acid → sodium acetate + carbon dioxide + water

$NaHCO_3 + CH_3COOH \rightarrow CH_3COONa + CO_2 + H_2O$

35. Nitrogen + hydrogen → ammonia

$N_2 + 3H_2 \rightarrow 2NH_3$

36. Calcium carbonate + sodium chloride → sodium carbonate + calcium chloride

$CaCO_3 + 2NaCl \rightarrow Na_2CO_3 + CaCl_2$

37. Nitrogen dioxide + water → nitric acid + nitrous acid

$NO_2 + 2H_2O \rightarrow HNO_3 + HNO_2$

38. Sodium oxide + water → sodium hydroxide

$Na_2O + H_2O \rightarrow 2NaOH$

39. Lithium hydroxide + carbon dioxide → lithium carbonate + water

$2LiOH + CO_2 \rightarrow Li_2CO_3 + H_2O$

40. Nitrogen monoxide + oxygen → nitrogen dioxide

$2NO + O_2 \rightarrow 2NO_2$

