Bernabei

# ***Worksheet: Science 9 Enriched: Six Types of Chemical Reaction***

*NAME(s):* _____;_____

*Fill in the blanks using the correct type of reaction, and give an example of a chemical equation representing that type of reaction (refer to the photocopied booklet from the BC Science 10 textbook* ***Table 6.1, page 265*** *for a summary of the different types of reactions. Refer to* ***section 6.1*** *for examples)*

1) A(n) _____ reaction is one in which oxygen bonds with another element to form carbon dioxide, water, and heat.

*EXAMPLE of this type of reaction (balanced chemical equation):*

_____ + _____ → _____ + _____

2) A(n) _____ reaction takes place when an element switches places with one of the elements in a chemical compound.

*EXAMPLE of this type of reaction (balanced chemical equation):*

_____ + _____ → _____ + _____

3) A(n) _____ reaction is one where a complex molecule breaks down to form two or more less complicated molecules.

*EXAMPLE of this type of reaction (balanced chemical equation):*

_____ + _____ → _____ + _____

4) A(n) _____ reaction is one where the cations of two ionic compounds switch places.

*EXAMPLE of this type of reaction (balanced chemical equation):*

_____ + _____ → _____ + _____

5) A(n) _____ reaction is when two or more simple molecules join to form a more complicated molecule.

*EXAMPLE of this type of reaction (balanced chemical equation):*

_____ + _____ → _____ + _____

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*For the following questions (i) balance the equation; (ii) indicate what type of reaction the equation shows; (iii) Write the word equation*

6) ____ $LiOH$ + ____ $H_2SO_4$ → ____ $Li_2SO_4$ + ____ $H_2O$

Type of reaction: _____

Word equation: _____

7) ____ $C_5H_{12}$ + ____ $O_2$ → ____ $CO_2$ + ____ $H_2O$

Type of reaction: _____

Word equation: _____

8) ____ $Fe$ + ____ $Ni(OH)_2$ → ____ $Ni$ + ____ $Fe(OH)_3$

Type of reaction: _____

Word equation: _____

9) ____ $NaHCO_3$ → ____ $NaOH$ + ____ $CO_2$

Type of reaction: _____

Word equation: _____

10) ____ $Pb(C_2H_3O_2)_2$ + ____ $NaBr$ → ____ $PbBr_2$ + ____ $NaC_2H_3O_2$

Type of reaction: _____

Word equation: _____

Name Date

Section 6.1 Summary

# Types of Chemical Reactions

*Textbook pages 256–271*

## Before You Read

Many chemical reactions occur in daily life. In the lines below, describe one chemical reaction you have observed.

## How are chemical reactions classified?

Chemical reactions can be classified as one of six main types: synthesis, decomposition, single replacement, double replacement, neutralization (acid-base), or combustion. You can identify each type of reaction by examining the reactants. This makes it possible to classify a reaction and then predict the identity of the products.

## What is a synthesis (combination) reaction?

In a **synthesis** (combination) reaction, two or more reactants (A and B) combine to produce a single product (AB).

element + element → compound
A + B → AB

(The letters A and B represent elements.)

hydrogen + oxygen → water

## What is a decomposition reaction?

In a **decomposition** reaction a compound is broken down into smaller compounds or separate elements. A decomposition reaction is the reverse of a synthesis reaction.

compound → element + element
AB → A + B

calcium chlorate → calcium chloride + oxygen

**Make Flash Cards**

Create flash cards to help you learn the different reactions. Write the name of the reaction on the front of the card and an example on the back.

**Reading Check**

How many products are there in a synthesis reaction?


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## What is a single replacement reaction?

In a **single replacement** reaction, a reactive element (a metal or a non-metal) and a compound react to produce another element and another compound. In other words, one of the elements in the compound is replaced by another element. The element that is replaced could be a metal or a non-metal.

element + compound → element + compound
A + BC → B + AC where A is a metal OR
A + BC → C + BA where A is a non-metal

aluminum + lead(II) nitrate → aluminum nitrate + lead

## What is a double replacement reaction?

A **double replacement** reaction usually involves two ionic solutions that react to produce two other ionic compounds. One of the compounds forms a **precipitate**, which is an insoluble solid that forms from a solution. The precipitate floats in the solution, then settles and sinks to the bottom. The other compound may also form a precipitate, or it may remain dissolved in solution.

ionic solution + ionic solution → ionic solution + ionic solid
AB(aq) + CD(aq) → AD(aq) + CB(s)

iron(II) chloride + lithium phosphate
→ iron(II) phosphate + lithium chloride

## What is a neutralization (acid-base) reaction?

When an acid and a base are combined, they will neutralize each other. In a neutralization (acid-base) reaction, an acid and a base react to form a salt and water.

acid + base → salt + water
$HX + MOH \rightarrow MX + H_2O$

(X represents a negative ion. M represents a positive ion.)

sulphuric acid + sodium hydroxide
→ sodium sulphate + water ✔

✔ ***Reading Check***

What is another name for a neutralization reaction?

_____

_____

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## What is a combustion reaction?

**Combustion** is the rapid reaction of a compound or element with oxygen to form an oxide and produce heat. For example, organic compounds, such as methane, combust with oxygen to form carbon dioxide (the oxide of carbon) and water (the oxide of hydrogen).

hydrocarbon + oxygen → carbon dioxide + water

$C_XH_Y + O_2 \rightarrow CO_2 + H_2O$

(The subscripts X and Y represent integers.)

$C_2H_6O_3 + O_2 \rightarrow CO_2 + H_2O$

The summary chart below compares the six types of chemical reactions.

| Reaction Type | Reactants and Products | Notes on the Reactants |
|---|---|---|
| Synthesis (combination) | A + B → AB | • Two elements combine |
| Decomposition | AB → A + B | • One reactant only |
| Single replacement<br>If A is a metal<br>If A is a non-metal | <br>A + BC → B + AC<br>A + BC → C + BA | • One element and one compound |
| Double replacement | AB + CD → AD + CB | • Two compounds react. |
| Neutralization (acid-base) | HX + MOH → MX + $H_2O$ | • Acid plus base |
| Combustion | $C_XH_Y + O_2 \rightarrow CO_2 + H_2O$ | • Organic compound with oxygen |



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*Use with textbook pages 256–267.*

# Classifying chemical reactions

**Classify** each of the following reactions as synthesis (S), decomposition (D), single replacement (SR), double replacement (DR), neutralization (N), or combustion (C). Place the correct letter representing the reaction type in the space provided. Then **balance** the chemical equation by placing the correct coefficients in the equation.

_____ 1. ___ $N_2$ + ___ $F_2$ → ___ $NF_3$

_____ 2. ___ $KClO_3$ → ___ $KCl$ + ___ $O_2$

_____ 3. ___ $C_{12}H_{22}O_{11}$ + ___ $O_2$ → ___ $CO_2$ + ___ $H_2O$

_____ 4. ___ $CuSO_4$ + ___ $Fe$ → ___ $Fe_2(SO_4)_3$ + ___ $Cu$

_____ 5. ___ $MgF_2$ + ___ $Li_2CO_3$ → ___ $MgCO_3$ + ___ $LiF$

_____ 6. ___ $H_3PO_4$ + ___ $NH_4OH$ → ___ $H_2O$ + ___ $(NH_4)_3PO_4$

_____ 7. ___ $NaF$ + ___ $Br_2$ → ___ $NaBr$ + ___ $F_2$

_____ 8. ___ $CH_3OH$ + ___ $O_2$ → ___ $CO_2$ + ___ $H_2O$

_____ 9. ___ $ZnCl_2$ → ___ $Zn$ + ___ $Cl_2$

_____ 10. ___ $RbNO_3$ + ___ $BeF_2$ → ___ $Be(NO_3)_2$ + ___ $RbF$

_____ 11. ___ $S_8$ + ___ $H_2$ → ___ $H_2S$

_____ 12. ___ $LiCl$ + ___ $Br_2$ → ___ $LiBr$ + ___ $Cl_2$

_____ 13. ___ $H_2SO_4$ + ___ $KOH$ → ___ $H_2O$ + ___ $K_2SO_4$

_____ 14. ___ $C_{10}H_8$ + ___ $O_2$ → ___ $CO_2$ + ___ $H_2O$

_____ 15. ___ $HI$ → ___ $H_2$ + ___ $I_2$

_____ 16. ___ $HCl$ + ___ $Al$ → ___ $H_2$ + ___ $AlCl_3$

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_____ 17. ____ $P$ + ____ $Cl_2$ → ____ $PCl_3$

_____ 18. ____ $C_6H_6$ + ____ $O_2$ → ____ $CO_2$ + ____ $H_2O$

_____ 19. ____ $K_2SO_4$ + ____ $BaCl_2$ → ____ $BaSO_4$ + ____ $KCl$

_____ 20. ____ $H_3PO_4$ + ____ $Ca(OH)_2$ → ____ $H_2O$ + ____ $Ca_3(PO_4)_2$

_____ 21. ____ $NF_3$ → ____ $N_2$ + ____ $F_2$

_____ 22. ____ $Al$ + ____ $N_2$ → ____ $AlN$

_____ 23. ____ $HF$ + ____ $Fe(OH)_3$ → ____ $H_2O$ + ____ $FeF_3$

_____ 24. ____ $GaF_3$ + ____ $Cs$ → ____ $CsF$ + ____ $Ga$

_____ 25. ____ $Ca(NO_3)_2$ + ____ $Na_3PO_4$ → ____ $Ca_3(PO_4)_2$ + ____ $NaNO_3$

_____ 26. ____ $HCl$ + ____ $Al(OH)_3$ → ____ $AlCl_3$ + ____ $H_2O$

_____ 27. ____ $C_5H_{12}$ + ____ $O_2$ → ____ $CO_2$ + ____ $H_2O$

_____ 28. ____ $H_2O_2$ → ____ $H_2O$ + ____ $O_2$

_____ 29. ____ $NH_4HCO_3$ + ____ $NaCl$ → ____ $NaHCO_3$ + ____ $NH_4Cl$

_____ 30. ____ $Na$ + ____ $O_2$ → ____ $Na_2O$


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*Use with textbook pages 256–267.*

# Types of chemical reactions—Word equations

**Classify** each of the following chemical reactions as synthesis (S), decomposition (D), single replacement (SR), double replacement (DR), or neutralization (N). Then **write a balanced equation** for each word equation.

_____ 1. magnesium + sulphur → magnesium sulphide

_____ 2. potassium hydroxide + sulphuric acid → water + potassium sulphate

_____ 3. chlorine + potassium iodide → potassium chloride + iodide

_____ 4. aluminum chloride + sodium hydroxide → aluminum hydroxide + sodium chloride

_____ 5. lead(II) oxide → lead + oxygen

_____ 6. magnesium + silver nitrate → silver + magnesium nitrate

_____ 7. cadmium(II) nitrate + ammonium sulphide → cadmium(II) sulphide + ammonium nitrate

_____ 8. tin(IV) hydroxide + hydrogen bromide → water + tin(IV) bromide

_____ 9. sodium + oxygen → sodium oxide

_____ 10. sodium nitride → sodium + nitrogen

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_____ 11. calcium hydroxide + phosphoric acid → water + calcium phosphate

_____ 12. barium chloride + sodium carbonate → barium carbonate + sodium chloride

_____ 13. zinc + nickel(II) nitrate → zinc nitrate + nickel

_____ 14. antimony + iodine → antimony(III) iodide

_____ 15. carbon dioxide → carbon + oxygen

_____ 16. iron(III) sulphate + lead → lead(II) sulphate + iron

_____ 17. barium nitrate + ammonium carbonate → ammonium nitrate + barium carbonate

_____ 18. zinc hydroxide + hydrochloric acid → water + zinc chloride

_____ 19. ammonium carbonate + magnesium chloride → ammonium chloride + magnesium carbonate

_____ 20. rubidium hydroxide + sulphuric acid → water + rubidium sulphate


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*Use with textbook pages 256–267.*

# Predicting the products

**1.** For each of the following:

I. predict the products

II. classify the reaction as synthesis (S), decomposition (D), single replacement (SR), double replacement (DR), neutralization (N), or combustion (C)

III. write a balanced equation

_____ (a) $H_2O \rightarrow$

_____ (b) $H_2 + Cl_2 \rightarrow$

_____ (c) $NaI + F_2 \rightarrow$

_____ (d) $AgNO_3 + Na_3PO_4 \rightarrow$

_____ (e) $Ba(OH)_2 + H_2SO_4 \rightarrow$

_____ (f) $P_4 + Cl_2 \rightarrow$

_____ (g) $CH_3OH + O_2 \rightarrow$

_____ (h) $Sr(OH)_2 + H_3PO_4 \rightarrow$

_____ (i) $FeI_2 \rightarrow$

_____ (j) $CuCl_2 + Fe \rightarrow$

_____ (k) $Cr_2(SO_4)_3 + K_2CO_3 \rightarrow$

_____ (l) $C_2H_5OH + O_2 \rightarrow$

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_____ (m) $H_2$ + $F_2$ →

_____ (n) $Ag_2O$ →

_____ (o) $Cl_2$ + KI →

**2.** For each of the following:

I. complete the word equation by predicting the products

II. classify the reaction as synthesis (S), decomposition (D), single replacement (SR), double replacement (DR), or neutralization (N)

III. write a balanced equation for each word equation

_____ (a) sodium + chlorine →

_____ (b) gallium fluoride + cesium →

_____ (c) calcium hydroxide + nitric acid →

_____ (d) barium chloride + silver nitrate →

_____ (e) cobalt(II) bromide →

_____ (f) copper(II) iodide + bromine →

_____ (g) phosphoric acid + magnesium hydroxide →

_____ (h) zinc + iodine →

_____ (i) beryllium chloride →

_____ (j) iron(III) sulphate + calcium hydroxide →


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*Use with textbook pages 256–267.*

# Types of chemical reactions

**Match each Chemical Equation to a Reaction Type below. Each Reaction Type may be used only once.**

**Chemical Equation**

1. _____ $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$
2. _____ $16\ Al + 3\ S_8 \rightarrow 8\ Al_2S_3$
3. _____ $LiOH + HNO_3 \rightarrow H_2O + LiNO_3$
4. _____ $2\ C_6H_{14} + 19\ O_2 \rightarrow 14\ H_2O + 12\ CO_2$
5. _____ $2\ AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2\ Ag$
6. _____ $Pb(NO_3)_2 + K_2CrO_4 \rightarrow PbCrO_4 + 2\ KNO_3$

**Reaction Type**

**A.** synthesis
**B.** combustion
**C.** neutralization
**D.** decomposition
**E.** single replacement
**F.** double replacement

7. What type of chemical reaction involves two smaller molecules reacting to produce one larger molecule?

   **A.** synthesis

   **B.** combustion

   **C.** decomposition

   **D.** single replacement

8. Carbon dioxide gas can be broken down into solid carbon and oxygen gas. What type of reaction is this?

   **A.** synthesis **C.** neutralization

   **B.** combustion **D.** decomposition

**Use the following word equation to answer question 9.**

**potassium chlorate → oxygen + potassium chloride**

9. What type of reaction is represented by the word equation?

   **A.** synthesis

   **B.** decomposition

   **C.** single replacement

   **D.** double replacement

10. Which of the following represents a single replacement reaction?

| | |
|---|---|
| I. | $Sn + 2\ AgNO_3 \rightarrow Sn(NO_3)_2 + 2\ Ag$ |
| II. | gold(II) cyanide + zinc → gold + zinc cyanide |
| III. | Magnesium iodide reacts with bromine gas to produce magnesium bromide and iodine. |

   **A.** I and II only **C.** II and III only

   **B.** I and III only **D.** I, II, and III

11. Which set of ordered coefficients balances the following equation?

$$Fe + O_2 \rightarrow Fe_2O_3$$

   **A.** 2, 1, 1 **C.** 4, 2, 3

   **B.** 2, 2, 2 **D.** 4, 3, 2

12. What coefficient is needed for water in order to balance the following equation?

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$

   **A.** 2 **C.** 4

   **B.** 3 **D.** 6

13. Hydrochloric acid can be used to neutralize barium hydroxide. What is the formula for the salt produced by this neutralization?

   **A.** $BaCl_2$ **C.** $Ba(ClO_2)_2$

   **B.** $Ba(ClO)_2$ **D.** $Ba(ClO_3)_2$

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**14.** Which reactants form the salt $MgSO_4$ in a neutralization reaction?

**A.** $SO_2$ and $MgO_2$

**B.** $H_2S$ and MgOH

**C.** $H_2O$ and $Mg(OH)_2$

**D.** $H_2SO_4$ and $Mg(OH)_2$

**15.** Given the incomplete equation of a chemical reaction: $C_9H_6O_4 + O_2 \rightarrow$

Which of the following are the products formed from this reaction?

| | |
|---|---|
| I. | $H_2$ |
| II. | $H_2O$ |
| III. | $CO_2$ |

**A.** I and II only

**B.** I and III only

**C.** II and III only

**D.** I, II, and III

**16.** Given the incomplete equation of a chemical reaction:

barium chloride + ammonium carbonate $\rightarrow$

Which of the following are the products formed from this reaction?

| | |
|---|---|
| I. | $H_2O$ |
| II. | $NH_4Cl$ |
| III. | $BaCO_3$ |

**A.** I and II only

**B.** I and III only

**C.** II and III only

**D.** I, II, and III

**Use the following chemical reaction to answer question 17.**

$$2\,HNO_3 + Be(OH)_2 \rightarrow Be(NO_3)_2 + 2\,H_2O$$

**17.** Which of the following statements is true?

| | |
|---|---|
| I. | $HNO_3$ is an acid. |
| II. | $Be(NO_3)_2$ is a base. |
| III. | This is a neutralization reaction. |
| IV. | The products of this reaction are a salt and water. |

**A.** I, II, and III only

**B.** I, II, and IV only

**C.** I, III, and IV only

**D.** II, III, and IV only

**18.** Sodium nitrate is produced as a result of mixing a solution of cadmium(II) nitrate with a solution of sodium sulphide. What is the other compound formed from this reaction?

**A.** CdS

**B.** $CdSO_4$

**C.** $NaS_2$

**D.** $CdNO_4$


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