Answers Chemical Reaction 1

Year 9 Science Chapter 5

p102

1 A **chemical reaction** is a process in which one or more substances, **the reactants**, are transformed into one or more different substances, **the products**.

2 A chemical equation describes what happens in a chemical reaction. The equation shows the **reactants** on the left hand side, the **products** on the right hand side, and the chemical formulas of the substances.

3 X and Y are the reactants. XY is the product.

4 The chemical formula of methane is CH_4

5 The chemical formula of carbon dioxide is CO_2

6 One atom of carbon and two atoms of oxygen in a molecule of carbon dioxide (CO_2)

7 One atom of carbon and four atoms of hydrogen in a molecule of methane (CH_4)

8 The reactants (CH_4 and CO_2) have four atoms of hydrogen. The products (CO_2 and $2H_2O$) have four (2x2) atoms of hydrogen. The number of hydrogen atoms are the same.

p103

1 **a)** $NaCl$ **b)** $ZnCl_2$ **c)** $CuSO_4$

2 **a)** $C + O_2 \rightarrow CO_2$ **b)** $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ **c)** $CaCO_3 \rightarrow CaO + CO_2$

3 **a)**

$C + O_2 \rightarrow CO_2$	
C = 1	C = 1
O = 2	O = 2

b)

$H_2 + Cl_2 \rightarrow 2HCl$	
H = 2	H = 2
Cl = 2	Cl = 2

c)

$CaCO_3 \rightarrow CaO + CO_2$	
Ca = 1	Ca = 1
C = 1	C = 1
O = 3	O = 3

d)

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$	
Zn =1	Zn = 1
Cu = 1	Cu =1
S = 1	S = 1
O = 4	O = 4

e)

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$	
H = 4	H = 4
S = 1	S = 1
O = 6	O = 6
Na = 2	Na = 2

f)

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	
C = 3	C = 3
H = 8	H = 8
O = 10	O = 10

g)

$C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$	
C = 12	C = 12
H = 22	H = 22
O = 35	O = 35

p104

1

$Zn + HCl \rightarrow ZnCl_2 + H_2$	
Zn = 1	Zn = 1
H = 1	H = 2
Cl = 1	Cl = 2

Not balanced for H or Cl

2

$N_2 + 3H_2 \rightarrow 2NH_3$	
N = 2	N = 2
H = 6	H = 6

Balanced equation

3

$Al + Br_2 \rightarrow AlBr_3$	
Al = 1	Al = 1
Br = 2	Br = 3

Not balanced for Br

4

$H_2 + O_2 \rightarrow H_2O$	
H = 2	H = 2
O = 2	O = 1

Not balanced for O

5

$2S + 3O_2 \rightarrow SO_2$	
S = 2	S = 1
O = 6	O = 2

Not balanced for S or O

6

$C_2H_6 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	
C = 2	C = 3
H = 6	H = 8
O = 10	O = 10

Not balanced for C or H

7

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	
C = 3	C = 3
H = 8	H = 8
O = 10	O = 10

Balanced equation

8

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$	
C = 5	C = 5
H = 12	H = 12
O = 16	O = 16

Balanced equation

p104

9 $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$

C = 12	C = 12
H = 22	H = 22
O = 35	O = 35

Balanced equation

10 $CO_2 + 2H_2O \rightarrow 3O_2 + C_6H_{12}O_6$

C = 1	C = 6
O = 4	O = 12
H = 4	H = 12

Not balanced for C, O or H

11 $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Ca = 1	Ca= 1
O = 4	O = 4
H = 2	H = 2
C = 1	C = 1

Balanced equation

12 $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$

N = 4	N = 4
H = 12	H = 12
O = 6	O = 6

Balanced equation

13 $K_2CO_3 + BaCl_2 \rightarrow KCl + BaCO_3$

K = 2	K = 1
C = 1	C = 1
O = 3	O = 3
Ba = 1	Ba = 1
Cl = 2	Cl = 1

Not balanced for K or Cl

14 $Fe_2O_3 + 3C \rightarrow 3CO + 2Fe$

Fe = 2	Fe = 2
O = 3	O = 3
C = 3	C = 3

Balanced equation

15 $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

H = 4	H = 4
S = 1	S = 1
O = 6	O = 6
Na = 2	Na = 2

Balanced equation

16 $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$

Mg = 1	Mg = 1
O = 6	O = 6
H = 4	H = 4
S = 1	S = 1

Balanced equation

p105

1 $2Cu + O_2 \rightarrow 2CuO$ **2** $2H_2 + O_2 \rightarrow 2H_2O$ **3** $2H_2O \rightarrow 2H_2 + O_2$ **4** $8Fe + S_8 \rightarrow 8FeS$

5 $2Fe + 3Cl_2 \rightarrow 2FeCl_3$ **6** $2NaCl \rightarrow 2Na + Cl_2$ **7** $3Ca + N_2 \rightarrow Ca_3N_2$ **8** $H_2 + Br_2 \rightarrow 2HBr$

9 $4Al + 3O_2 \rightarrow 2Al_2O_3$ **10** $Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$ **11** $2AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2Ag$

12 $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$ **13** $Fe_2O_3 + 3C \rightarrow 3CO + 2Fe$

14 $Fe_2O_3 + 3CO \rightarrow 3CO_2 + 2Fe$ **15** $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

16 $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

p107

1 A combination reaction occurs when two or more substances combine chemically to produce one product. X + Y ➔ XY is a combination reaction.

2 X and Y are the reactants. XY is the product.

3 **a)** and **e)** are the combination reactions (producing one product).

4 $2Mg + O_2 \rightarrow 2MgO$ **5** $CaO + H_2O \rightarrow Ca(OH)_2$

p109

1 A decomposition reaction occurs when a compound is chemically broken down into simpler substances. XY ➔ X + Y is a decomposition reaction.

2 XY is the reactant. X and Y are the products.

3 **a)** and **d)** are the decomposition reactions (a compound broken down into simpler substances).

4 I would expect glucose to be broken down to carbon and water: $C_6H_{12}O_6 \rightarrow C + H_2O$

p111

1 A single replacement reaction occurs when an element in a compound is replaced by another element. $XY + Z \rightarrow XZ + Y$ is a single replacement reaction.

2 XY and Z are the reactants. XZ and Y are the products.

3 **a)** and **c)** are single replacement reactions.

4 $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ The Al replaces the Fe in the Fe_2O_3 A single replacement.

p113

1 A double replacement reaction occurs two compounds swap elements to produce two new compounds. $AB + CD \rightarrow AD + CB$ is a double replacement reaction.

2 AB and CD are the reactants. AD and CB are the products.

3 $HCl + NaOH \rightarrow NaCl + H_2O$

4 **a)** $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$ **b)** $2HNO_3 + Mg(OH)_2 \rightarrow Mg(NO_3)_2 + 2H_2O$

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

p115

1 Reactions that produce energy are called **exothermic** reactions. The burning of fossil fuels such as coal, oil, and gas produce heat. These are **exothermic** reactions. A reaction that produces heat, **exothermic**, will warm the surroundings.

2 Reactions that absorb energy are called **endothermic** reactions. Many decomposition reactions absorb heat in breaking the compound into smaller compounds. These are **endothermic** reactions. A reaction that absorbs heat, **endothermic**, will cool the surroundings.

3 **a)** The temperature in an exothermic reaction increases.

b) The temperature in an endothermic reaction decreases.

4 **a)** exothermic **b)** neither (more information is needed such as room temperature- is temperature gained or lost to the surroundings, and time between measurements) **c)** exothermic **d)** endothermic

p116

1 $2Mg + O_2 \rightarrow 2MgO$

Mg = 2 Mg = 2
O = 2 O = 2
Mass is conserved

b) $CaCO_3 \rightarrow CaO + CO_2$

Ca = 1 Ca = 1
C = 1 C = 1
O = 3 O = 3
Mass is conserved

c) $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

C = 4 C = 4
H = 4 H = 4
O = 10 O = 10
Mass is conserved

p117

1 The number of atoms in the reactants is equal to the number of atoms in the products.

2 **a)** $2Zn + O_2 \rightarrow 2ZnO$

Zn = 2 Zn = 2
O = 2 O = 2
Mass is conserved

b) $2H_2O_2 \rightarrow 2H_2O + O_2$

H = 4 H = 4
O = 4 O = 4
Mass is conserved

c) $SnO_2 + 2H_2 \rightarrow Sn + 2H_2O$

Sn = 1 Sn = 1
O = 2 O = 2
H = 4 H = 4
Mass is conserved

3 **a)** $C + O_2 \rightarrow CO_2$

12 grams + 32 grams ➔ 44 grams
44 grams of CO_2 will be produced

b) $C + O_2 \rightarrow CO_2$

6 tonnes + 16 tonnes ➔ 22 tonnes
16 tonnes of oxygen would be needed

p118

1 Ores are metal compounds, usually oxides, carbonates, and/or sulphides of the metal, mixed with sandy impurities.

2 Iron (Fe) is extracted from iron oxide (Fe_2O_3) by heating at high temperatures, in a blast furnace, with carbon. $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$

3 Aluminium (Al) is extracted from pure aluminium oxide (Al_2O_3) by electrolysis at high temperature (1000°C). $2Al_2O_3 \rightarrow 4Al + 3O_2$

4 Single replacement reaction. $Cu_2S + O_2 \rightarrow Cu + SO_2$

p119

1 **Respiration** is the release of energy from glucose, or other carbohydrates. This energy is used for cell growth and repair.

2 **Respiration** $C_6H_{12}O_6 + O_2 \rightarrow H_2O + CO_2 + Energy$
glucose + oxygen ➔ water + carbon dioxide + energy

3 Respiration provides the energy for life

4 All living organisms use respiration to provide energy

5 $C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + Energy$

p122

1 A **chemical reaction** is a process in which one or more substances, **the reactants**, are transformed into one or more different substances, **the products**.

2 A chemical equation describes what happens in a chemical reaction. The equation shows the **reactants** on the left hand side, the **products** on the right hand side, and the chemical formulas of the substances.

3 X and Y are the reactants. XY is the product.

4 **a)** $C + O_2 \rightarrow CO_2$ **b)** $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ **c)** $CaCO_3 \rightarrow CaO + CO_2$

5 **a)** $C + O_2 \rightarrow CO_2$

C = 1	C = 1
O = 2	O = 2

b) $H_2 + Cl_2 \rightarrow 2HCl$

H = 2	H = 2
Cl = 2	Cl = 2

c) $CaCO_3 \rightarrow CaO + CO_2$

Ca = 1	Ca = 1
C = 1	C = 1
O = 3	O = 3

d) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Zn =1	Zn = 1
Cu = 1	Cu =1
S = 1	S = 1
O = 4	O = 4

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

H = 4	H = 4
S = 1	S = 1
O = 6	O = 6
Na = 2	Na = 2

f) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

C = 3	C = 3
H = 8	H = 8
O = 10	O = 10

g) $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$

C = 12	C = 12
H = 22	H = 22
O = 35	O = 35

p123

1 $Zn + HCl \rightarrow ZnCl_2 + H_2$

Zn = 1	Zn = 1
H = 1	H = 2
Cl = 1	Cl = 2

Not balanced for H or Cl

2 $H_2 + O_2 \rightarrow H_2O$

H = 2	H = 2
O = 2	O = 1

Not balanced for O

3 $2S + 3O_2 \rightarrow SO_2$

S = 2	S = 1
O = 6	O = 2

Not balanced for S or O

4 $C_2H_6 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

C = 2	C = 3
H = 6	H = 8
O = 10	O = 10

Not balanced for C or H

5 $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

C = 3	C = 3
H = 8	H = 8
O = 10	O = 10

Balanced equation

6 $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

C = 5	C = 5
H = 12	H = 12
O = 16	O = 16

Balanced equation

7 $CO_2 + 2H_2O \rightarrow 3O_2 + C_6H_{12}O_6$

C = 1	C = 6
O = 4	O = 12
H = 4	H = 12

Not balanced for C, O, or H

8 $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Ca = 1	Ca = 1
O = 4	O = 4
H = 2	H = 2

Balanced equation

9 $Fe_2O_3 + 3C \rightarrow 3CO + 2Fe$

Fe = 2	Fe = 2
O = 3	O = 3
C = 3	C = 3

Balanced equation

10 $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

H = 4	H = 4
S = 1	S = 1
O = 6	O = 6
Na = 2	Na = 2

Balanced equation

11 $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$

Mg = 1	Mg = 1
O = 6	O = 6
H = 4	H = 4
S = 1	S = 1

Balanced equation

p123

12 $Cu + O_2 \rightarrow 2CuO$ **13** $2H_2 + O_2 \rightarrow 2H_2O$ **14** $2H_2O \rightarrow 2H_2 + O_2$

15 $2NaCl \rightarrow 2Na + Cl_2$ **16** $4Al + 3O_2 \rightarrow 2Al_2O_3$ **17** $2AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2Ag$

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p124

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4 I would expect glucose to be broken down to carbon and water: $C_6H_{12}O_6 \rightarrow C + H_2O$

5 A combination reaction occurs when two or more substances combine chemically to produce one product. X + Y ➔ XY is a combination reaction.

6 X and Y are the reactants. XY is the product.

7 **a)** and **e)** are the combination reactions (producing one product).

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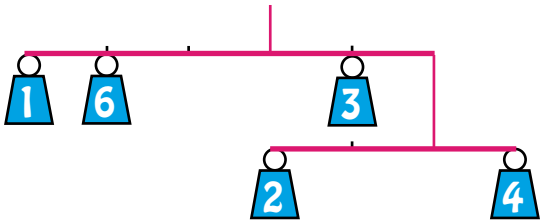
p125

1



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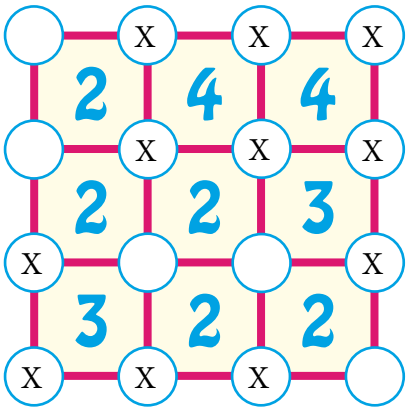

3 keg + nails = 100 pounds
keg + 0.5nails = 54 pounds
0.5nails = 100 - 54 pounds
0.5nails = 46 pounds
nails = 92 pounds
Thus keg = 8 pounds

p126

1 A single replacement reaction occurs when an element in a compound is replaced by another element. XY + Z ➔ XZ + Y is a single replacement reaction.

2 XY and Z are the reactants. XZ and Y are the products.

3 **a)** and **c)** are single replacement reactions.

4 $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ The Al replaces the Fe in the Fe_2O_3 A single replacement.

5 A double replacement reaction occurs two compounds swap elements to produce two new compounds. AB + CD ➔ AD + CB is a double replacement reaction.

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7 $HCl + NaOH \rightarrow NaCl + H_2O$

8 **a)** $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$ **b)** $2HNO_3 + Mg(OH)_2 \rightarrow Mg(NO_3)_2 + 2H_2O$
c) $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

p127

1 Reactions 2 and 4 are exothermic **2** Reaction 3 is endothermic **3** b) between 290°C and 450°C

4 a) Ag_2CO_3

p128

1 **a)** Reactants are $NaHCO_3$ and $C_6H_8O_7$ **b)** Products are $C_6H_5Na_3O_7$, CO_2 , and H_2O **c)** The cool feeling is evidence of an endothermic reaction **d)** The fizzy feeling is probably caused by the CO_2 gas **e)** Yes

2 **a)** No - because some of the mass (CO2) has escaped. **b)** Completely seal the beaker before and after.

3 **a)** 12 + 32 = 44 grams (assuming all of the C combines with the O_2) **b)** 16 tonnes of oxygen

4 **a)** double replacement **b)** decomposition **c)** combination **d)** single replacement

5 **a)** $2Zn + O_2 \rightarrow 2ZnO$ **b)** $4Al + 3O_2 \rightarrow 2Al_2O_3$ **c)** $4Na + O_2 \rightarrow 2Na_2O$

6 **a)** yes **b)** yes **c)** no **d)** yes **e)** no **f)** no