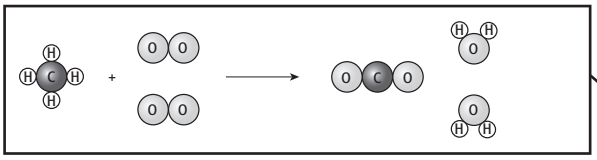
Answers to worksheet questions

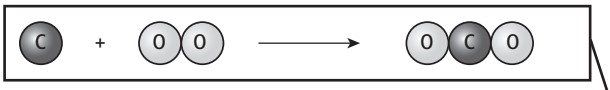
Chapter 4

Worksheet 4.1

1 a A

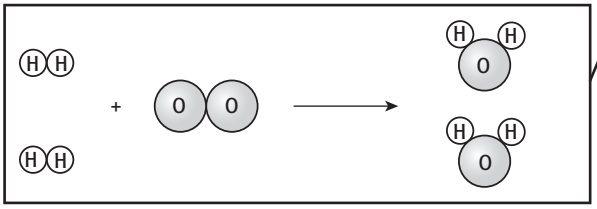


B

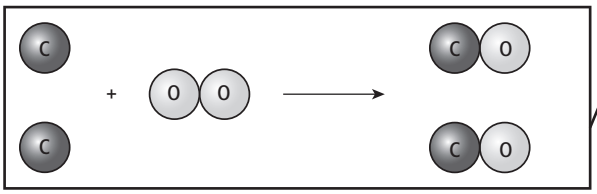


C

D



E



hydrogen burning with oxygen

methane burning with oxygen

carbon burning with limited oxygen

sulfur burning with oxygen

carbon burning with oxygen

b i D
ii E
iii C
iv B
v A

2

Number of atoms in reactants
C = *1*
O = *4*
H = *4*

Number of atoms in products
C = *1*
O = *4*
H = *4*

Worksheet 4.2

1 **a** $HCl + NaOH \rightarrow NaCl + H_2O$

b **i** $2Na + 2H_2O \rightarrow 2NaOH + H_2$

These are the atoms/molecules that should be drawn on the diagram:

left-hand pan (reactants): two Na atoms and two water molecules

right-hand pan (products): two NaOH 'formula units' and one hydrogen molecule

ii sodium + water → sodium hydroxide + hydrogen

2 **a** **i** sodium + bromine → sodium bromide

ii $2Na + Cl_2 \rightarrow 2NaCl$

b **i** calcium + oxygen → calcium oxide

ii $2Mg + O_2 \rightarrow 2MgO$

c **i** potassium + oxygen → potassium oxide

ii $4Na + O_2 \rightarrow 2Na_2O$

3 **a** **i** $CaO + 2HCl \rightarrow CaCl_2 + H_2O$

ii calcium oxide + hydrochloric acid → calcium chloride + water

b **i** $2K + 2H_2O \rightarrow 2KOH + H_2$

ii potassium + water → potassium hydroxide + hydrogen

c **i** $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

ii calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

d **i** $Mg + 2HCl \rightarrow MgCl_2 + H_2$

ii magnesium + hydrochloric acid → magnesium chloride + hydrogen

Worksheet 4.3

1 **a** iron(III) oxide + aluminium → aluminium oxide + iron

b $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

c **i** because iron(III) oxide is losing oxygen and aluminium is gaining it

ii iron(III) oxide

iii aluminium

d because the reaction is so exothermic that the iron produced is molten

2 **a** **i**, **ii** and **iv**

b **iii**

c **v**

d $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$

$CO_2(g) + Ca(OH)_2(aq) \rightarrow CaCO_3(s) + H_2O(l)$

3 **a** **i** $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

ii $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

b chlorine

c magnesium

d the definition in terms of electron transfer: oxidation is the loss of electrons and reduction is the gain of electrons

e $2Br^- + Cl_2 \rightarrow 2Cl^- + Br_2$ and $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$

Worksheet 4.4

The electrolysis of sodium chloride solution is useful in defining the changes taking place at the electrodes during the process.

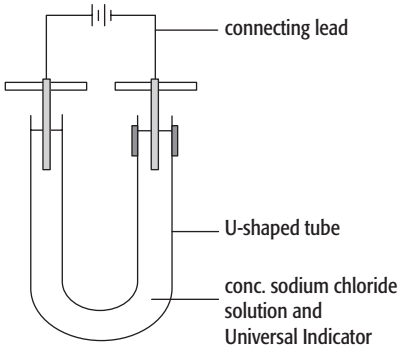
This demonstration requires:

- U-shaped tube
- clamp and stand
- two graphite electrodes
- two electrode holders
- two leads
- power pack
- 100 cm^3 beaker
- conc. sodium chloride solution
- spatula
- Universal Indicator
- stirring rod
- distilled water
- eye protection

Safety

The products in this reaction are far more hazardous than the reactants. Wear eye protection when carrying out the experiment and particularly when clearing up.

Diagram



Method

- 75 cm^3 of distilled water are placed in a beaker and two heaped spatulas of sodium chloride added.
- Stir until the salt dissolves then add several drops of Universal Indicator solution. Add sufficient indicator to colour the water green throughout.
- Pour this solution into the U-shaped tube and clamp it.
- Wash the graphite electrodes carefully and then fix them so there is about 3 cm of electrode in each side of the U-shaped tube.
- Attach the connecting leads to the electrodes and connect them to a power pack set to 10 V.
- Turn on the power and observe closely what happens. A piece of white paper held behind the U-shaped test tube can help the class to see any colour changes that occur.
- Continue the experiment for about five minutes, turning off the power as soon as you notice any change at the positive electrode or smell a bleachy, swimming pool smell.

The students should record all their observations. Make sure that it is clear which is the positive and which the negative electrode.

Explaining the observations

1 giant ionic; ionic bonding

2 The ions are released from the lattice structure and are able to move about through the solution.

3 Na^+, H^+, Cl^- and OH^-

4 Chlorine gas is produced, because the gas is pale green and smells of swimming pools.

5 $2Cl^- - 2e^- \rightarrow Cl_2$ or $2Cl^- \rightarrow Cl_2 + 2e^-$

6 Na^+ and H^+ ions

7 hydrogen gas

8 $2H^+ + 2e^- \rightarrow H_2$

9 Na^+ and OH^- ions. They form sodium hydroxide, NaOH.

10 because hydrogen ions are discharged here, leaving an excess of OH^- ions which turn the Universal Indicator purple

Using the products

The three products are hydrogen, chlorine and sodium hydroxide.
Uses:

- hydrogen: making hydrogen chloride and hydrochloric acid, making margarine, for fuel cells
- chlorine: water treatment, making PVC, making hydrogen chloride and hydrochloric acid
- sodium hydroxide: making soaps and detergents, making paper

Worksheet 4.5

1 **a** photochemical: a reaction brought about by light

precipitation: a reaction involving the sudden formation of a solid on mixing two solutions

redox: a reaction in which electrons are transferred. Br^- ions lose electrons/are oxidised; Ag^+ ions gain electrons/are reduced

b the silver bromide precipitate is pale yellow and then turns grey/darkens

c photosynthesis / the reaction between chlorine and methane

2 **a** bromide ion

b No, it is insoluble.

3 **a** Silver iodide is yellow and it would darken or go grey in the light.

b $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$

Worksheet 4.6

Oxidation is the ***loss*** of electrons.
Reduction is the ***gain*** of electrons.

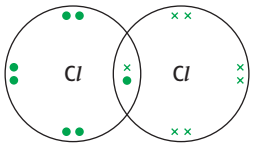
1 I = iodine, H = hydrogen, N = nitrogen, Br = bromine, O = oxygen, Cl = chlorine, F = fluorine

2 molecules made of two atoms

3 oxygen, O_3, ozone (or trioxygen)

4 covalent bonding

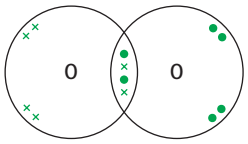
Cl_2



chlorine molecule

Cl–Cl
displayed formula

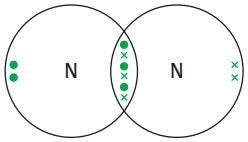
O_2



oxygen, O_2

O=O
displayed formula

N_2



nitrogen, N_2

N≡N
displayed formula

Worksheet 4.7

Oxidation

1 combustion: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

methane + oxygen → carbon dioxide + water

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

glucose + oxygen → carbon dioxide + water

3 rusting: $4Fe + 3O_2 + 2xH_2O \rightarrow 2Fe_2O_3.xH_2O$

4 excluding air by: storage in sealed airtight containers (e.g. bottles, jars, tins) / covering or encasing (e.g. in plastic film or wax or with oil) / addition of antioxidant preservatives / keep in a refrigerator to lower temperature

wine → vinegar: ethanol + oxygen → ***ethanoic*** acid + ***water***

Reduction

1 $2CuO + C \rightarrow 2Cu + CO_2$

2 carbon dioxide + water → glucose + oxygen

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

Worksheet 4.8

1 precipitation

2 reduction

3 endothermic

4 reversible

5 decomposition

6 oxidation

7 displacement

8 combustion