

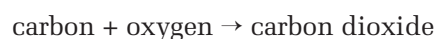
ACTIVITY 7.1

SKILLS

- > Literacy
- > Processing and analysing data and information

Compounds and equations

When two or more elements chemically join together, a compound is formed. The name of the compound usually comes from putting together the names of the elements that make up the compound. Simple word equations can be used to show the formation of a compound. For instance, carbon and oxygen can combine to form carbon dioxide:



Naming rules for compounds

- For **metal-non-metal** compounds (ionic compounds) the name of the metal appears first (or element with the lower group number); the name of the non-metals appears second, and its ending is changed to *ide*.
- **Special groups:** these special groups act together in a compound and have the following name stem:
 - SO_4 is sulfate
 - ClO_3 is chlorate
 - NO_3 is nitrate
 - PO_4 is phosphate
 - OH is hydroxide
 - NH_4 is ammonium
 - MnO_4 is permanganate
- For **non-metal-non-metal** compounds (molecular compounds), the elements are written in order of increasing group number (e.g. NO not ON), except for H. The number of atoms in the molecule is indicated by using a prefix: *mono* = 1, *di* = 2, *tri* = 3, *tetra* = 4. (The exception to this rule is for the first atom: if the first atom is 'mono' then no prefix is needed.)

1 Name the following ionic compounds and molecular compounds. (The first one is done for you.)

a NaF is sodium fluoride

c CaO is _____

b LiCl is _____

d MgI_2 is _____

e BeF_2 is _____f NaOH is _____g KClO_3 is _____h CuSO_4 is _____i FeO is _____j $\text{Pb}(\text{NO}_3)_2$ is _____k K_2SO_4 is _____l $(\text{NH}_4)_3\text{PO}_4$ is _____m CO_2 is _____n CO is _____o NO_2 is _____p HCl is _____ or _____q PF_3 is _____r NH_3 is _____ or _____s SO_2 is _____t CCl_4 is _____u H_2O is _____ or _____v N_2O_3 is _____

- 2 Complete the word equations below showing elements combining to form compounds. Assume that when more than one non-metal is combining, a special group is involved.

a K, Br: potassium + bromine \rightarrow _____b Na, O: _____ + _____ \rightarrow sodium oxidec _____, _____: calcium + sulfur \rightarrow _____d Al, N, O: aluminium + nitrogen + oxygen \rightarrow _____e Cu, S, O: _____ + _____ + _____ \rightarrow copper sulfatef _____, _____, _____: magnesium + oxygen + hydrogen \rightarrow _____g Ba, O, H: _____ + _____ + _____ \rightarrow barium hydroxideh _____, _____, _____: silver + phosphorus + oxygen \rightarrow _____

ACTIVITY 7.2

SKILLS

- > Planning and conducting
- > Processing and analysing data and information

Experiment: Combustion of fuels

Aim

To examine how a combustion reaction occurs.

Equipment

- Spirit burner
- Methylated spirits
- Kerosene
- Heatproof mat
- 250 mL beaker
- Water
- Temperature probe and data logger (or thermometer)
- Matches
- Watch or stopwatch

Diagram

Set up the equipment as shown in Figure 7.1 and label Figure 7.1.

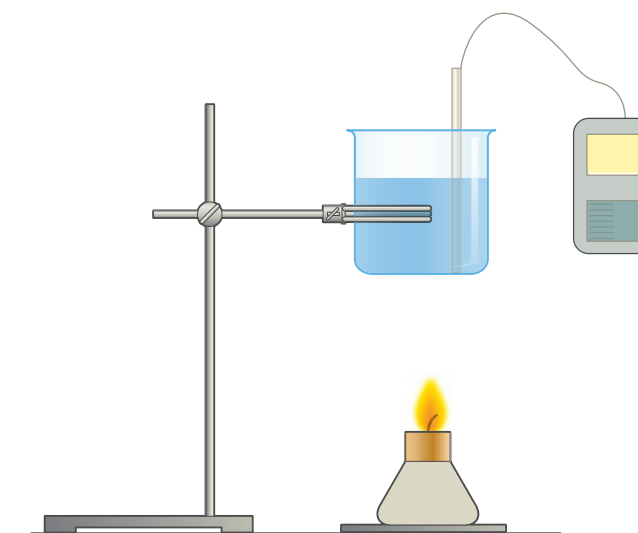


Fig 7.1

Method

- 1

Place a spirit burner containing methylated spirits onto a heatproof mat.
- 2

Set up a 250 mL beaker containing 100 mL of water and a temperature probe and data logger (or thermometer). The beaker should be 10 cm above the wick of the burner.
- 3

Note the starting temperature of the water in the beaker.
- 4

Light a match well away from the methylated spirits. Carefully bring the match to the wick of the spirit burner and light the wick.
- 5

Time the burn for 60 seconds (1 minute).
- 6

Note the finish temperature of the water in the beaker and then put out the flame by putting the steel cap over the wick.
- 7

Repeat steps 1–6 using kerosene as the fuel.

WARNING

Flame hazard. Wear safety glasses and lab coat. Keep flammables away.

Always wear leather topped school shoes as protection for objects that are dropped.

Hazards

Write out some hazards in this experiment and address each one.

Flame hazard

Fragile glass hazard

Results

Fuel	Before reaction	After reaction
Methylated spirits	Temperature = Observations:	Temperature = Observations:
Kerosene	Temperature = Observations:	Temperature = Observations:

Conclusion

Write a conclusion to this experiment.

Questions

- 1

Industrial methylated spirits is mainly ethanol. The combustion of the fuel ethanol (C₂H₅OH) is shown by the chemical equation below. Use this to write out the word equation underneath. Circle the products.

C₂H₅OH

+

3O₂

→

2CO₂

+

3H₂O

+

→

+
- 2

Write out the word equation for the combustion of kerosene (C₁₂H₂₆).
- 3

Identify the reactants and products that could be observed directly during this reaction.

4 Energy is also involved in a combustion reaction. Which side of the equation should energy go on? Justify your answer.

5 Contrast the combustion of ethanol and the combustion of kerosene by writing out the similarities and differences.

6 Use your textbook and the results here to explain whether or not there is any pollution produced by combustion.

7 Figure 7.2 shows a fire triangle. Explain what the diagram shows about combustion.

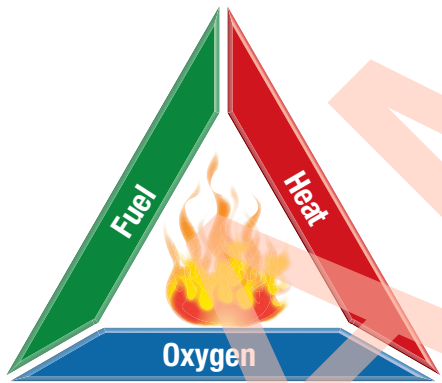


Fig 7.2

8 Write out the definition of ‘flashpoint’. Explain why fuels do not ignite immediately in air, even before a match gets near them.

ACTIVITY 7.3

Materials chemistry

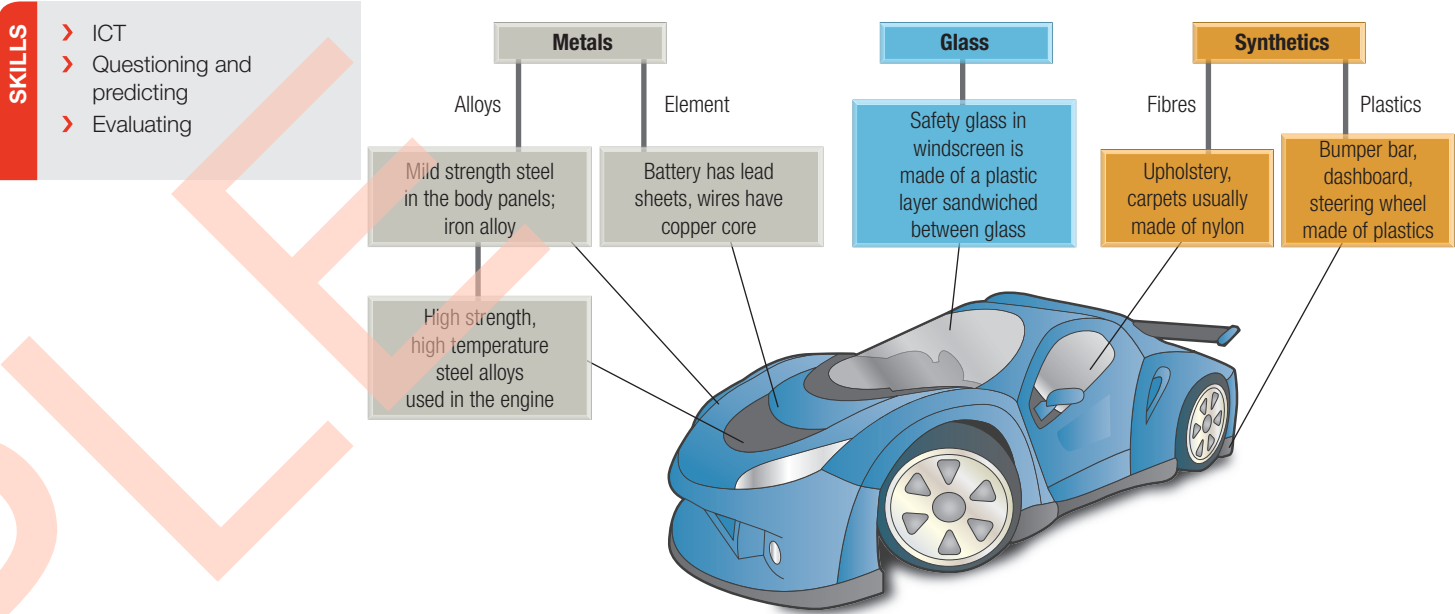


Fig 7.3

1 Examine the diagram of a car in Figure 7.3. Complete the table below to show the materials used and the useful properties.

Part	Made of what?	Useful properties
Tyres		Rubber outside – soft, gives grip, waterproof Steel wire inside – strong and stretchable (ductile)

2 Why would a glass–plastic sandwich be used instead of just glass for the windscreen?

3 Use the Internet or your textbook to find the chemical formula of the following:

- a Iron _____
- b Steel _____
- c Rubber _____
- d Plastic (polypropylene) _____
- e Glass _____

4 Describe how rubber was discovered and developed over time.

5 Explain why car tyres are a matrix of rubber, synthetic materials and steel instead of just rubber.

6 Discuss the benefits of funding scientific research into new materials.

7 Discuss the drawbacks associated with funding scientific research into new materials.

ACTIVITY 7.4

Chemical reactions compendium

SKILLS

- > Critical and creative thinking
- > Processing and analysing data and information
- > Evaluating

1 Write each word next to its matching sentence.

compound molecule ion element

- a Made up of two or more bonded non-metal atoms: _____
- b Made up of non-metal atoms bonded with metal atoms: _____
- c A particle with a charge: _____
- d A pure substance made of one type of atom: _____

2 List two signs that a chemical reaction has taken place.

3 Is a precipitate a gas, a liquid or a solid? _____

4 In every corrosion reaction, what does a metal react with?

5 What product besides water is produced during combustion of any fuel?

6 What happens to water molecules in decomposition by electrolysis?

- 7 If AB is a compound that is put into solution with another compound XY, what are the two possible product compounds?

- 8 Complete the following general reaction equations.

a acid + base \rightarrow _____ + _____

b acid + metal \rightarrow _____ + _____

c acid + carbonate \rightarrow _____ + _____ + _____

d acid + active metal \rightarrow _____ + _____

- 9 How is complete combustion similar to, and different from, incomplete combustion?

- 10 Describe the law of conservation of mass.

- 11 An incomplete electron shell diagram of the $^{16}_8\text{O}$ atom is shown in Figure 7.4.

a Identify the number of protons: _____

b Identify the number of neutrons: _____

c Identify the number of electrons: _____

d Draw the electrons on the shells in the diagram.

e Label the nucleus, shells and locations of protons, neutrons and electrons on the diagram.

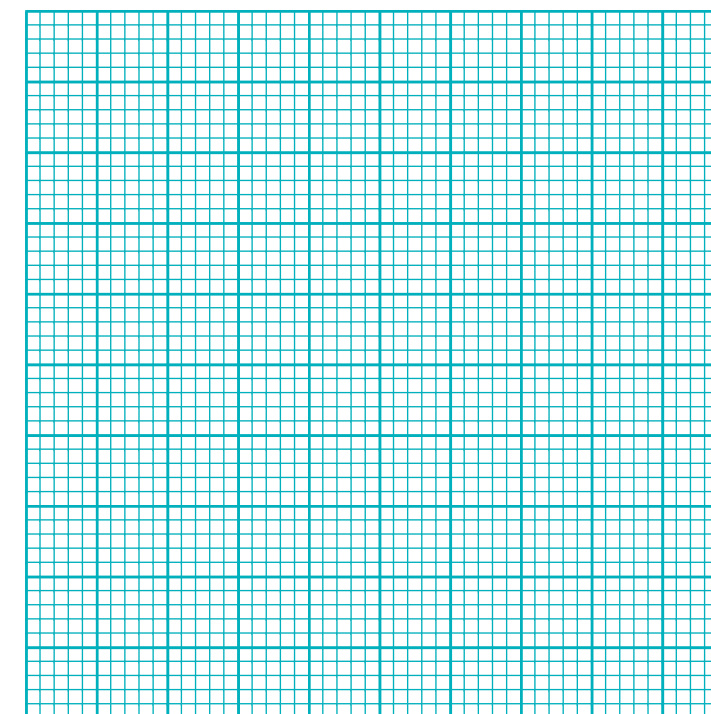


Fig 7.4

- 12 A student wishes to measure how much mass a nail gains when rusting in different volumes of salty water.

Volume of salt water (mL)	Mass gain from rust (g)
2	2.4
4	4.5
6	6.1
8	6.8
10	7.5
12	8.2

- a Plot a graph of the results and draw a line of best fit.



- b What is the dependent variable?

- c What is the independent variable?

4 Construct a single-page information sheet with the following sections:

- Heading
- The chemicals involved
- Effects on the environment
- Positive and negative issues associated with the topic
- Impacts on society
- Pictures

5 Each individual member in the group must write a conclusion. Write yours here.

6 As a group, present your findings to the class.

ACTIVITY 7.6

SKILLS

- › Questioning and predicting
- › Planning and conducting

Experiment: Reaction rate

In this task, you will carry out an experiment using different concentrations of reactants to determine the effect of concentration on reaction rate.

Hydrochloric acid reacts with magnesium metal, producing hydrogen gas. Bubbles of hydrogen gas are evident as the reaction occurs.

Equipment

- Dropper bottles of hydrochloric acid (0.5 M, 1.0 M, 2.0M) (Note: 'M' refers to the concentration of the solution)
- Distilled water
- Strips of magnesium, about 2 cm long
- 4 test tubes
- Test tube rack
- 4 thermometers, -10 – 110 °C
- 10-mL measuring cylinder

WARNING
Acid hazard. Wear safety glasses and lab coat. Wash hands with water.

Procedure

1 Set up your experiment as shown in Figure 7.5.

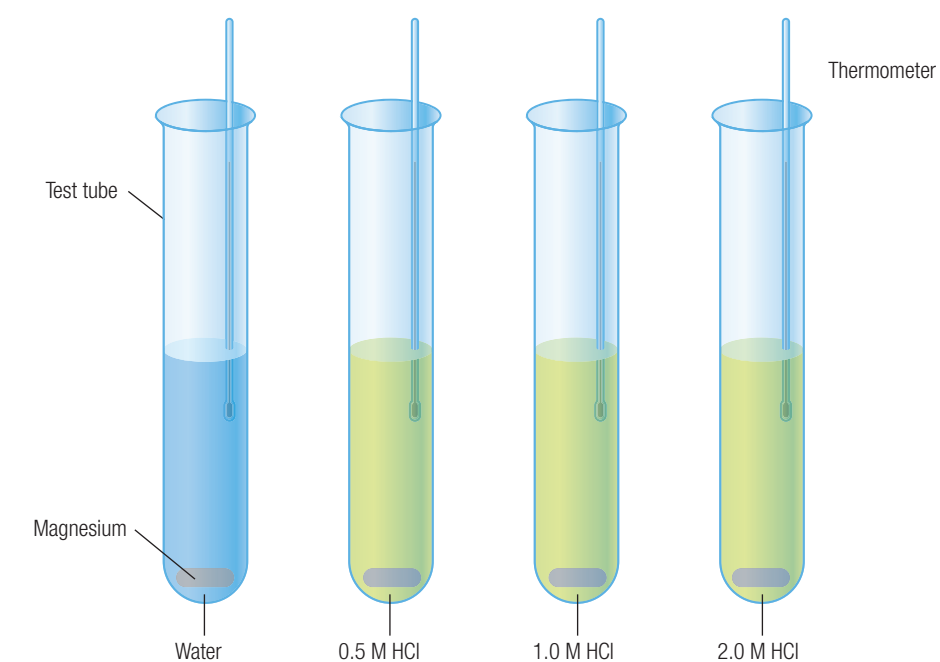


Fig 7.5

2 Write a suitable hypothesis for this experiment.

3 Write an aim for this experiment.

4 Write out a suitable method for this experiment.

5 Write out a list of observations.

6 Identify the independent variable in this experiment.

7 Is there any evidence that this reaction is exothermic? Comment.

8 Describe any trend or pattern in the results. Then discuss why this may occur.

9 Define what a catalyst is and link this to this experiment.

ACTIVITY 7.7 Review: Using chemistry

SKILLS

- > Literacy
- > Processing and analysing data and information

- When two or more different types of atom chemically combine, what do they produce?
 - an element
 - a compound
 - a mixture
 - a solution
- How many electrons are there in $^{16}_8\text{O}$?
 - 4
 - 6
 - 8
 - 16
- What is put on the left-hand side of a chemical reaction?
 - products
 - catalyst
 - reactants
 - insoluble chemicals
- The number of electrons in a neutral atom is equal to the:
 - atomic number
 - mass number
 - density
 - number of neutrons
- What compound forms when lithium (+1) combines with oxygen (−2)?
 - LiO
 - Li_2O
 - LiO_2
 - Li^+O^{2-}
- How many hydrogen atoms are there in a molecule of $\text{C}_2\text{H}_6\text{O}$?
 - one
 - two
 - six
 - eight
- What type of change occurs when iron and oxygen chemically combine to produce rust?
 - physical change
 - change of state
 - semiconductor
 - chemical change
- Two solutions react to produce an insoluble substance. What do we call that substance?
 - solute
 - precipitate
 - solvent
 - nitrate
- The compound HCl is commonly known as:
 - hydrogen carbon iodide
 - hydrogen iodide
 - hydrochloric acid
 - hydrogen carbonate
- What do we call a substance that speeds up a reaction?
 - catalyst
 - heat
 - exothermic
 - reactant

11 Complete the following table.

Name		calcium ion	sodium chloride	
Chemical formula	O^{2-}			NaOH
Element or compound?				

12 Complete the following word equations showing the formation of compounds.

- magnesium + _____ → magnesium sulfide
- calcium + fluorine → _____
- _____ + _____ → copper oxide
- sodium + oxygen + hydrogen → _____

13 Answer the following using the appropriate word(s).

- The gas produced when acid reacts with magnesium metal.

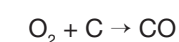
- A name of the reaction between an acid and a base.

- The general name for a change that produces new chemicals.

- The least reactive group of elements in the periodic table.

- A substance that changes colour to show how acidic a solution is.

14 Write the word equation that represents the following reaction:



- 15 Identify the element that has the electron configuration 2, 7 and explain whether or not this is stable.

- 16 Complete the following table showing different reaction types.

Reactants	Products	Reaction type
Acid + metal		Acid/metal
Fuel + oxygen	Carbon dioxide + water	
Acid + carbonate		Acid/carbonate
Metal + oxygen		

- 17 Some students wish to investigate how acid affects the rusting of a nail. They put different amounts of acid into test tubes of water, with a nail in each, and measure the length of rust extending along the nail after a few days.

Amount of acid added (mL)	0	2	4	6	8	10
Length of rust along nail (mm)	5	8	16	22	30	30

- a What is the dependent variable?
- b List two variables that need to be controlled to make this a fair test.

- c What type of reaction is this classified as?

- d Describe what the result shows.
