AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.1.2

Ionic bonding

Past-paper questions

Tier	**Foundation**
Question groups	**30**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

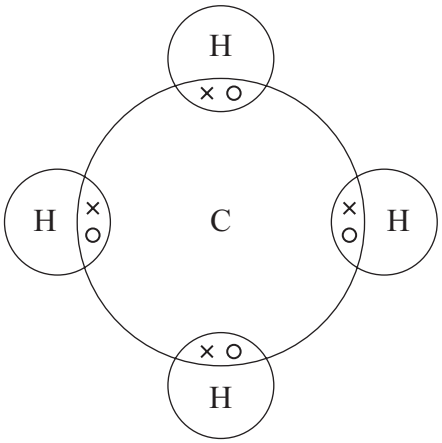
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.2.1.2 Ionic bonding

Question 01

January 2008 | CHY2F | Original Q1 | Legacy

1 The diagram represents a particle of methane.



(a) What is the formula of methane? .....

(1 mark)

(b) Choose a word from the box to answer the question.

atom	ion	molecule

Which of the words best describes the methane particle shown in the diagram?

.....

(1 mark)

(c) Choose a word from the box to answer the question.

covalent	ionic	metallic

What is the type of bonding shown in the diagram?

.....

(1 mark)

3

4.2.1.2 Ionic bonding

Question 02

January 2008 | CHY2F | Original Q3 | Legacy

3 Distress flares are used to attract attention in an emergency.



Flares often contain magnesium. Magnesium burns to form magnesium oxide.

(a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

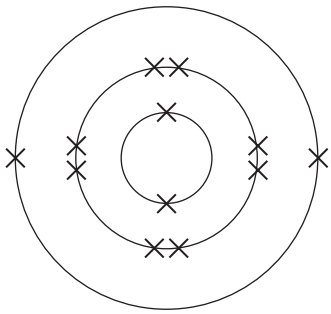
Complete the following sentence using the correct words from the box.

gives out heat	**stores heat**	**takes in heat**

An *exothermic* reaction is one which ..... .

(1 mark)

(b) The diagram shows the electronic structure of a magnesium atom.
The atomic (proton) number of magnesium is 12.



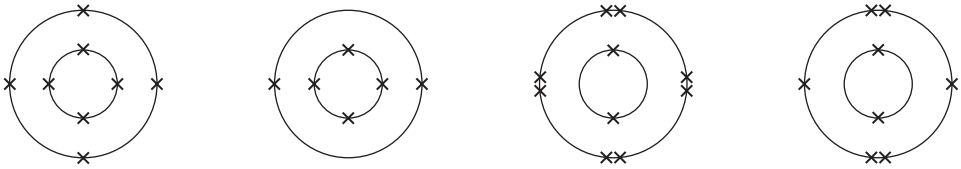
Magnesium atom

Question 02 · continued

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The atomic (proton) number of oxygen is 8.

Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?

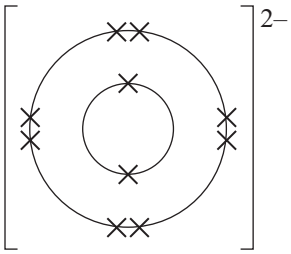


A **B** **C** **D**

Diagram .....

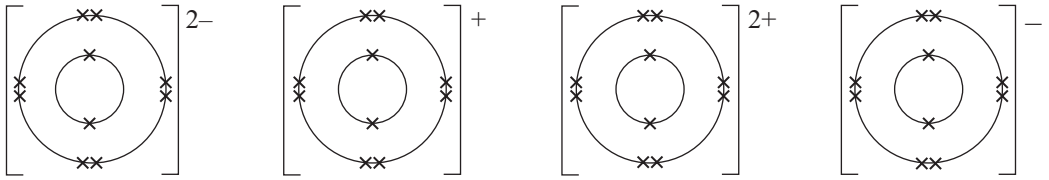
(1 mark)

(c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen. The diagram shows the electronic structure of an oxide ion.



Oxide ion

Which diagram, **J**, **K**, **L** or **M**, shows the electronic structure of a magnesium ion?



J **K** **L** **M**

Diagram .....

(1 mark)

(d) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Draw a ring around the name of the salt formed when magnesium oxide reacts with hydrochloric acid.

magnesium chloride **magnesium hydroxide** **magnesium sulfate**

(1 mark)

4

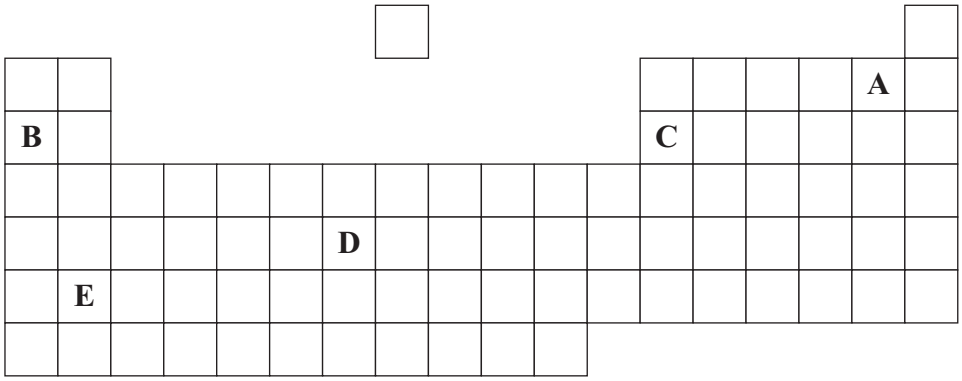
4.2.1.2 Ionic bonding

Question 03

January 2008 | CHY3F | Original Q1 | Legacy

1 (a) The periodic table on the Data Sheet may help you to answer this question.

Part of the periodic table is shown below.



Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A** to **E**, represents:

(i) sodium Letter .....

(1 mark)

(ii) a non-metal Letter .....

(1 mark)

(iii) a Group 2 element Letter .....

(1 mark)

(iv) a transition element? Letter .....

(1 mark)

4.2.1.2 Ionic bonding

Question 03 · continued

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(b) Complete these sentences by drawing a ring around the correct answer.

(i) Attempts to classify the elements into a periodic table were made

by [Arrhenius and Dalton / Brønsted and Lowry / Mendeleev and Newlands] .

(1 mark)

(ii) They arranged the elements in order of their [atomic weight / melting point / reactivity] .

(1 mark)

(iii) They put elements in the same Group if they had similar [boiling points / chemical reactions / electrical conductivities] .

(1 mark)

(iv) We now know that elements in the same Group have the same number of

[electrons / neutrons / protons] in their outer shell (energy level).

(1 mark)

8

4.2.1.2 Ionic bonding

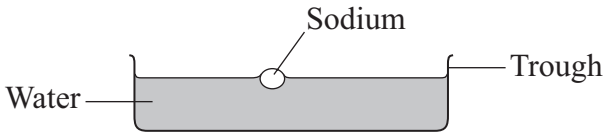
Question 04

June 2008 | CHY3F | Original Q2 | Legacy

2 (a) Read a student's report about the reaction between sodium and water.

The reaction between sodium and water

A small piece of sodium was added to some water in a trough.



The sodium floated and started to react.

The sodium moved along the surface of the water and melted to give a ball of molten metal.

The ball became smaller and smaller until it had all gone.

A gas was given off and a colourless solution was left.

The word equation for this reaction is:

sodium + water → sodium hydroxide + hydrogen

Use the information from the student's report to answer these questions.

2 (a) (i) Which information shows that sodium has a low density?

.....

(1 mark)

2 (a) (ii) Which information shows that the reaction is exothermic?

.....

(1 mark)

2 (a) (iii) Name the gas given off.

.....

(1 mark)

2 (b) The periodic table on the Data Sheet may help you to answer these questions.

2 (b) (i) Sodium is in Group 1.

Name a Group 1 element that is more reactive than sodium.

.....

(1 mark)

4.2.1.2 Ionic bonding

Question 04 · continued

for mark

2 (b) (ii) Here are some statements about Group 1 elements.
Only **two** of these statements are correct.
Put a tick (✓) next to the **two** correct statements.

Statement	(✓)
They are halogens	
They are metals	
They form covalent compounds	
They form ions with a +1 charge	

(2 marks)

2 (c) Dimitri Mendeleev put forward his periodic table in 1869.

Complete these sentences by drawing a ring around the correct answer.

2 (c) (i) Mendeleev arranged the elements in order of their [atomic weight / density / reactivity] .

(1 mark)

2 (c) (ii) The table is called a periodic table because elements with [identical / the same / similar] properties occur at regular intervals.

(1 mark)

2 (c) (iii) The vertical columns are known as [groups / periods / rows] .

(1 mark)

2 (d) How did Mendeleev overcome the problem of undiscovered elements when he designed his table?

.....

(1 mark)

10

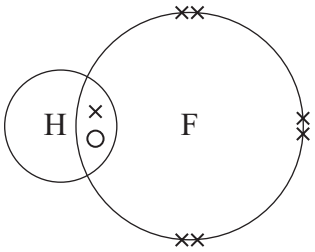
4.2.1.2 Ionic bonding

Question 05

June 2009 | CHY2F | Original Q4 | Legacy

4 This question is about fluorine and some of its compounds.

4 (a) The diagram represents a molecule of hydrogen fluoride.



Draw a ring around the type of bonding that holds the hydrogen and fluorine atoms together in this molecule.

covalent **ionic** **metallic**

(1 mark)

4 (b) Fluorine is made in industry by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.

4 (b) (i) Use **one** word from the box to complete the sentence.

gas	**liquid**	**solid**

To allow electrolysis to take place the mixture of potassium fluoride and hydrogen fluoride must be ..... . *(1 mark)*

4.2.1.2 Ionic bonding

Question 05 · continued

for mark

4 (b) (ii) The mixture of potassium fluoride and hydrogen fluoride contains fluoride ions (F^-), hydrogen ions (H^+) and potassium ions (K^+).

Use **one** word from the box to complete the sentence.

fluorine	**hydrogen**	**potassium**

During electrolysis the element formed at the **positive** electrode is

..... . *(1 mark)*

4 (c) Fluoride ions are sometimes added to drinking water. It is thought that these ions help to reduce tooth decay.

4 (c) (i) Tick (✓) **one** question that **cannot** be answered by scientific investigation alone.

Question	Tick (✓)
Do fluoride ions in drinking water reduce tooth decay?	
Are fluoride ions in drinking water harmful to health?	
Should fluoride ions be added to drinking water?	

(1 mark)

4 (c) (ii) Explain why you have chosen this question.

.....

.....

(1 mark)

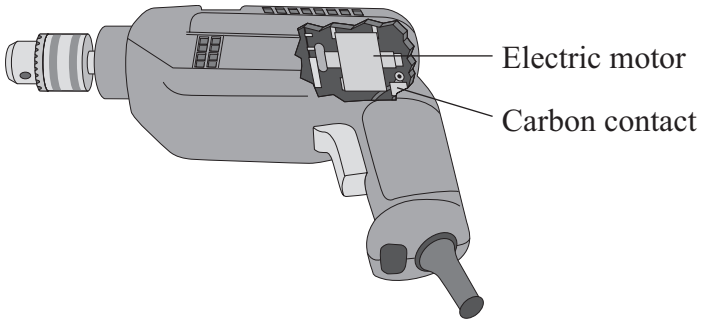
5

4.2.1.2 Ionic bonding

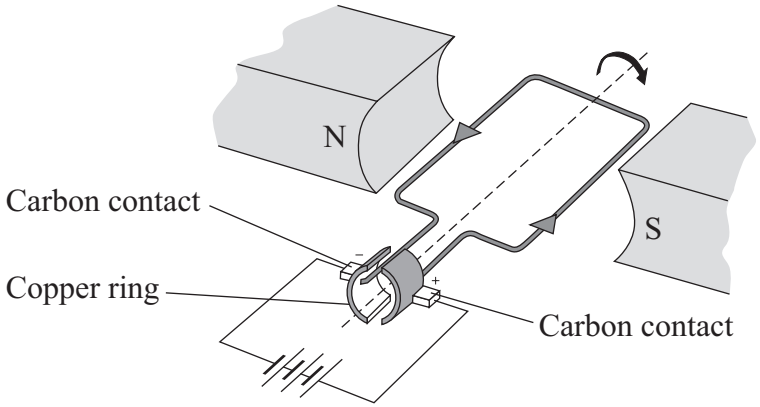
Question 06

June 2009 | CHY2F | Original Q5 | Legacy

5 This drill contains an electric motor.



The diagram below shows the main parts of an electric motor.



The carbon contacts are made of graphite. Springs push the contacts against the copper ring. The carbon contacts conduct electricity to the copper ring. The copper ring rotates rapidly but does not stick or become worn because the graphite is soft and slippery.

5 (a) Using this information give **two** properties that make graphite suitable for making the carbon contacts.

1 .....

.....

2 .....

.....

(2 marks)

4.2.1.2 Ionic bonding

Question 06 · continued

for mark

5 (b) (i) Draw a ring around the correct word in each box to complete the sentence.

Each carbon atom in graphite is joined to

two three four	other carbon atoms by	covalent ionic metallic	bonds.

(2 marks)

5 (b) (ii) Tick (✓) the statement which explains why graphite is soft and slippery.

Statement	Tick (✓)
It is made of layers of atoms.	
It is made of small molecules.	
It is an ionic compound.	

(1 mark)

5

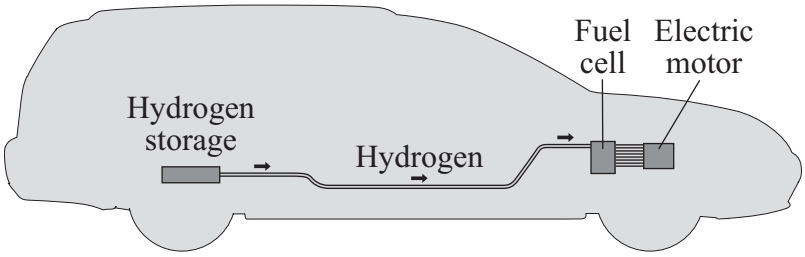
4.2.1.2 Ionic bonding

Question 07

June 2009 | CHY2F | Original Q6 | Legacy

6 Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. On combustion it reacts with oxygen from the air to release a large amount of energy. The only product of combustion is water which does not cause pollution. Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. Hydrogen stored in lithium nitride will not explode.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

4.2.1.2 Ionic bonding

Question 07 · continued

for mark

6 (a) Use information from the article to help you to answer these questions.

6 (a) (i) Give **two** reasons why hydrogen is an excellent fuel.

1 .....

.....

2 .....

.....

(2 marks)

6 (a) (ii) Hydrogen stored in lithium nitride is safer in an accident than a cylinder full of hydrogen gas.

State why.

.....

.....

(1 mark)

6 (a) (iii) What is the advantage of using 'nanosized' particles of lithium nitride instead of normal sized particles for storing hydrogen?

.....

.....

(1 mark)

Question 6 continues on the next page

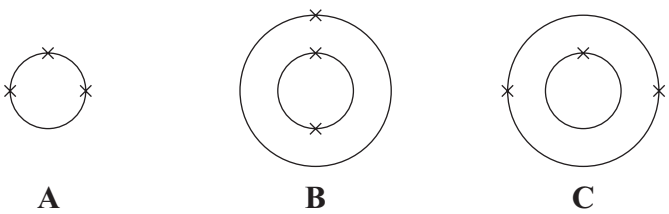
Question 07 · continued

for mark

6 (b) Lithium nitride is an ionic compound that contains lithium ions (Li^+) and nitride ions (N^{3-}).

6 (b) (i) The periodic table on the Data Sheet may help you to answer this question.

Which diagram, **A**, **B** or **C**, represents the electronic structure of a lithium atom?
Write your answer in the box.



A **B** **C**

Diagram ☐

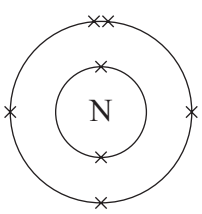
(1 mark)

6 (b) (ii) Tick (✓) the statement which describes how a lithium atom (Li) changes into a lithium ion (Li^+).

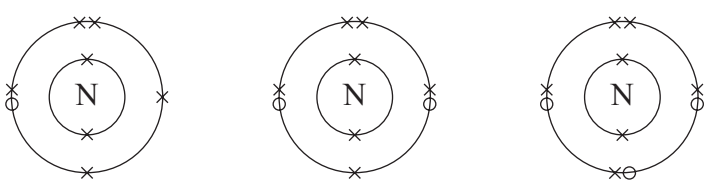
Statement	Tick (✓)
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(1 mark)

6 (b) (iii) The diagram shows the electronic structure of a nitrogen atom.



Which diagram, **A**, **B** or **C**, represents the electronic structure of a nitride ion (N^{3-})?
Write your answer in the box.



A **B** **C**

Diagram ☐

(1 mark)

4.2.1.2 Ionic bonding

Question 07 · continued

for mark

6 (c) The equation for the reaction of lithium nitride with hydrogen is:

$$Li_3N + 2H_2 \rightleftharpoons LiNH_2 + 2LiH$$

What does the $\rightleftharpoons$ symbol mean?

Draw a ring around your answer.

reversible reaction **endothermic reaction** **neutralisation**

(1 mark)

6 (d) Draw a ring around the correct answer in each box to complete the sentences.

6 (d) (i) 'Nanosized' particles of lithium nitride will be

much larger
a little larger
much smaller

than normal sized particles of lithium nitride. *(1 mark)*

6 (d) (ii) One of the reasons why 'nanosized' particles have different properties from normal sized particles is that they have a greater

density
mass
surface area

than normal sized particles of lithium nitride. *(1 mark)*

10

4.2.1.2 Ionic bonding

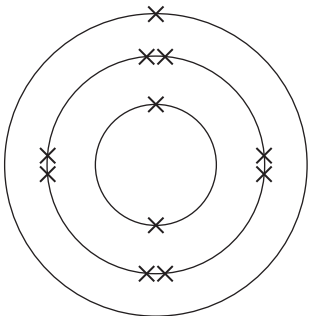
Question 08

7 Sodium chloride is a raw material.

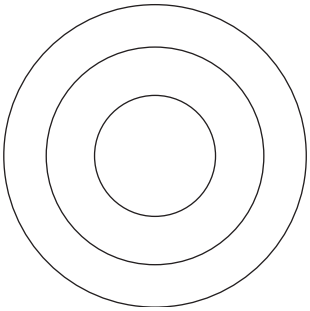
7 (a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

Sodium atom



Chlorine atom



(1 mark)

7 (b) When sodium and chlorine react to form sodium chloride they form sodium ions (Na^+) and chloride ions (Cl^-).

How does a sodium atom change into a sodium ion?

.....

.....

.....

.....

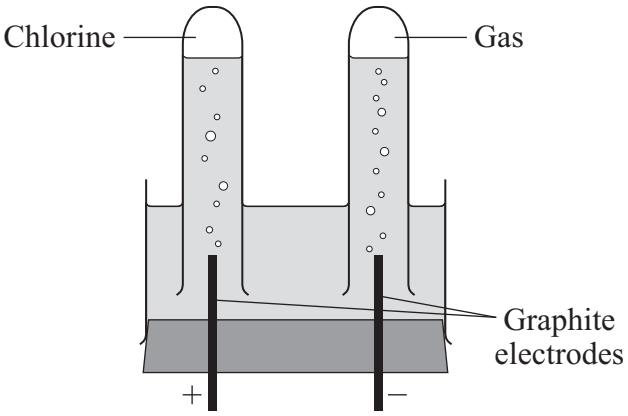
(2 marks)

4.2.1.2 Ionic bonding

Question 08 · continued

for mark

7 (c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions (Na^+), chloride ions (Cl^-), hydrogen ions (H^+) and hydroxide ions (OH^-).

7 (c) (i) Why do chloride ions move to the positive electrode?

.....

(1 mark)

7 (c) (ii) Name the gas formed at the negative electrode.

.....

(1 mark)

Question 7 continues on the next page

4.2.1.2 Ionic bonding

Question 08 · continued

for mark

7 (d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

> Local people have been protesting outside a paper factory. They say:
> 'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'
>
> The company replied:
> 'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

7 (d) (i) Why are some local people worried about the use of chlorine compounds?

.....

.....

(1 mark)

7 (d) (ii) Why might other local people want the company to continue to use chlorine compounds?

.....

.....

(1 mark)

7 (d) (iii) It is decided to have an enquiry.
Why should this be done by independent scientists?

.....

.....

(1 mark)

8

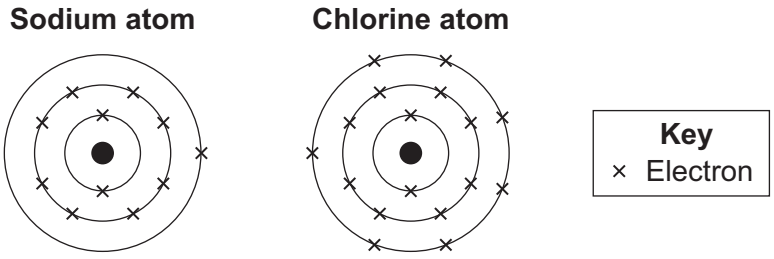
4.2.1.2 Ionic bonding

Question 09

June 2010 | CHY1AP | Original Q3 | Legacy

QUESTION THREE

This question is about a sodium atom and a chlorine atom.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A bonds

B electrons

C elements

D nuclei

In the diagrams, ● represents . . . **1** . . . .

Sodium and chlorine are . . . **2** . . . .

When sodium and chlorine react, the chlorine atoms take . . . **3** . . . from the sodium atoms.

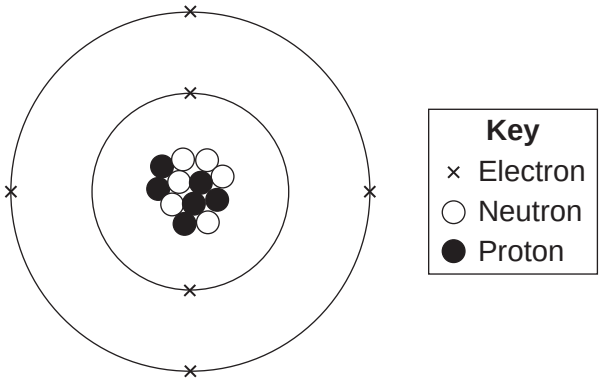
The sodium and chlorine atoms are then held together by . . . **4** . . . .

4.2.1.2 Ionic bonding

Question 10

June 2010 | CHY2F | Original Q2 | Legacy

2 The diagram represents a carbon atom.



2 (a) Use words from the box to answer the questions.

electron	**neutron**	**nucleus**	**proton**

2 (a) (i) What is the name of the central part of the atom?

.....

(1 mark)

2 (a) (ii) What is the name of the particle with no charge?

.....

(1 mark)

2 (a) (iii) What is the name of the particle with a negative charge?

.....

(1 mark)

2 (b) Use the diagram above to help you to answer these questions.

2 (b) (i) Draw a ring around the atomic (proton) number of this carbon atom.

6 **12** **18**

(1 mark)

2 (b) (ii) Draw a ring around the mass number of this carbon atom.

6 **12** **18**

(1 mark)

4.2.1.2 Ionic bonding

Question 10 · continued

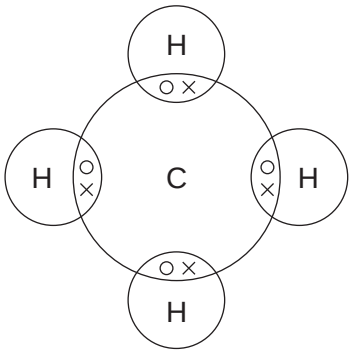
2 (c) A different carbon atom has 6 protons and 8 neutrons.

Draw a ring around the symbol that represents this atom.

$^{8}_{6}C$ $^{14}_{6}C$ $^{14}_{8}C$

(1 mark)

2 (d) The diagram shows the bonding in a methane molecule.



2 (d) (i) Draw a ring around the chemical formula of a methane molecule.

CH_4 **CH^4** **C_4H**

(1 mark)

2 (d) (ii) Draw a ring around the word that describes methane.

compound **element** **mixture**

(1 mark)

2 (d) (iii) Draw a ring around the type of bonding in a methane molecule.

covalent **ionic** **metallic**

(1 mark)

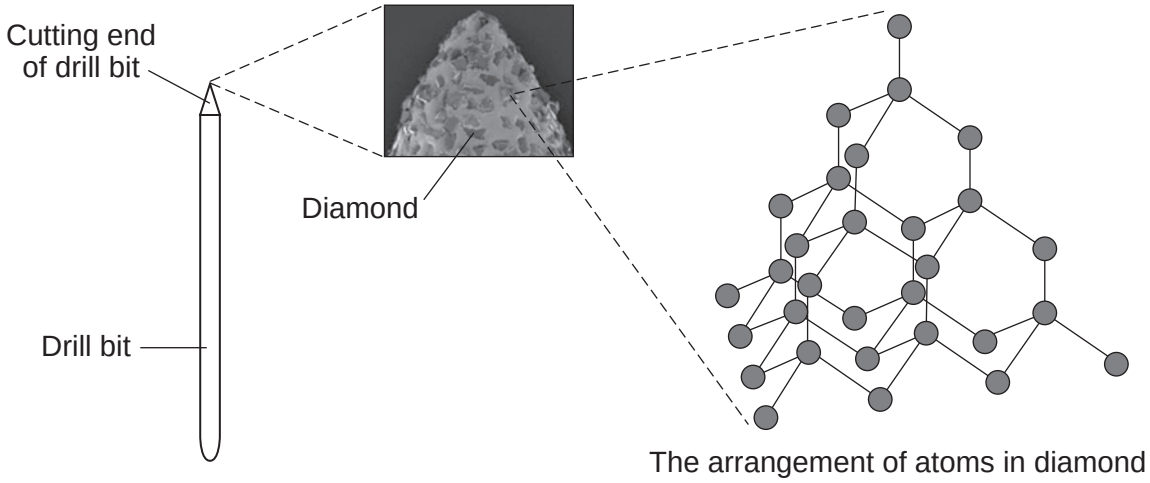
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4.2.1.2 Ionic bonding

Question 11

June 2010 | CHY2F | Original Q4 | Legacy

4 A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



The arrangement of atoms in diamond

Draw a ring around the correct word in each box.

4 (a) Diamond is made from [carbon / nitrogen / oxygen] atoms.

(1 mark)

4 (b) Diamond has a giant structure in which [none / some / all] of the atoms are joined together.

(1 mark)

4 (c) The atoms in diamond are joined together by [covalent / ionic / metallic] bonds.

(1 mark)

4.2.1.2 Ionic bonding

Question 11 · continued

4 (d) In diamond each atom is joined to [two / three / four] other atoms.

(1 mark)

4 (e) Diamond is suitable for the cutting end of a drill bit because it is [hard. / shiny. / soft.]

(1 mark)

5

Turn over for the next question

4.2.1.2 Ionic bonding

Question 12

June 2010 | CHY2F | Original Q5 | Legacy

5 This question is about lead iodide and magnesium iodide.

5 (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a solid.

lead ions in solution + iodide ions in solution → lead iodide solid

5 (a) (i) Draw a ring around the name given to this type of reaction.

electrolysis **neutralisation** **precipitation**

(1 mark)

5 (a) (ii) Tick (✓) the method used to separate solid lead iodide from the solution.

Method	Tick (✓)
distillation	
evaporation	
filtration	

(1 mark)

5 (a) (iii) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you to:

draw a ring around a soluble compound which contains lead ions

lead bromide **lead chloride** **lead nitrate**

draw a ring around a soluble compound which contains iodide ions.

lead iodide **silver iodide** **sodium iodide**

(2 marks)

4.2.1.2 Ionic bonding

Question 12 · continued

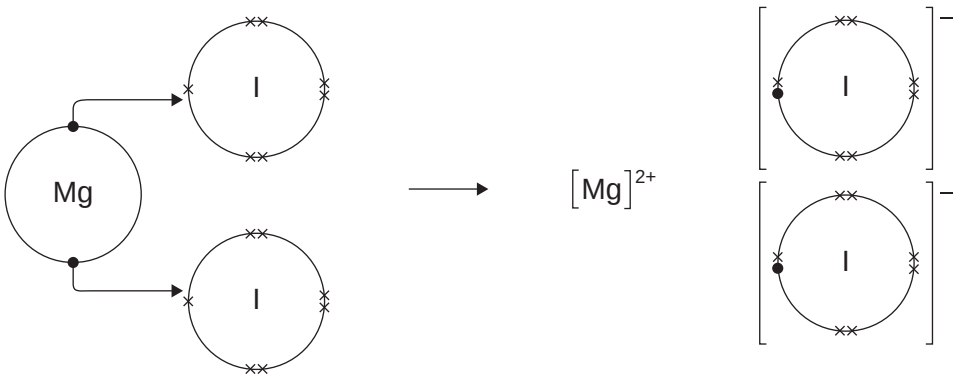
5 (b) Magnesium iodide can be made by reacting magnesium with iodine.

magnesium + iodine → magnesium iodide

The diagram shows how this takes place.

Only the outer electrons are shown.

The dots (•) and crosses (×) are used to represent electrons.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

.....

.....

.....

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.....

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(4 marks)

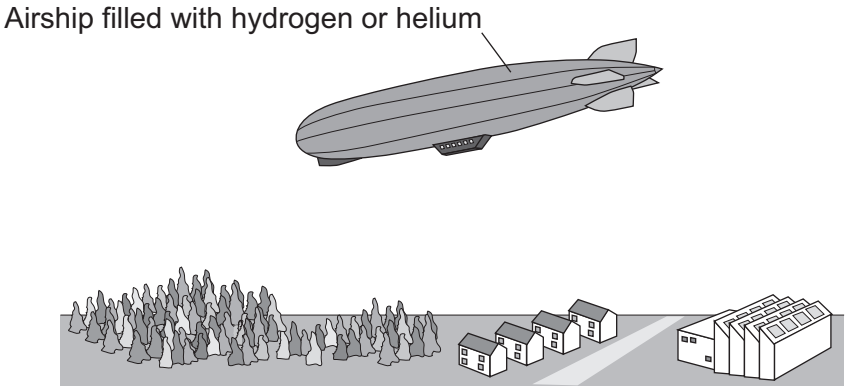
8

4.2.1.2 Ionic bonding

Question 13

January 2011 | CHY1F | Original Q1 | Legacy

1 Hydrogen and helium have both been used in airships.



1 (a) Tick (✓) the property which both hydrogen and helium have that makes an airship float in air.

Property	Tick (✓)
Colourless	
Less dense than air	
More dense than air	

(1 mark)

1 (b) (i) Hydrogen is no longer used in airships because it burns in oxygen.

The chemical equation for this reaction is shown.

$$2H_2 + O_2 \rightarrow 2H_2O$$

Complete the word equation for this reaction.

hydrogen + oxygen → .....

(1 mark)

4.2.1.2 Ionic bonding

Question 13 · continued

1 (b) (ii) Helium is safer than hydrogen because it does **not** burn in oxygen.

Draw a ring around the correct answer to complete the sentence.

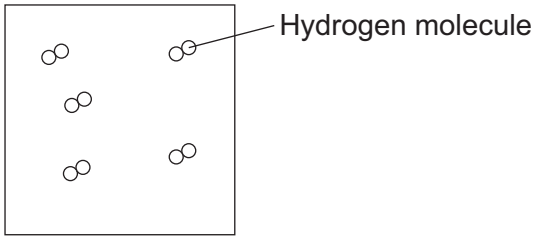
Helium is now used in airships because it is

- a fuel.
- already in the air.
- unreactive.

(1 mark)

1 (c) **Diagram 1** represents hydrogen molecules.

Diagram 1



Draw a ring around the correct answer to complete the sentence.

Each hydrogen molecule is made up of two hydrogen

- atoms.
- compounds.
- elements.

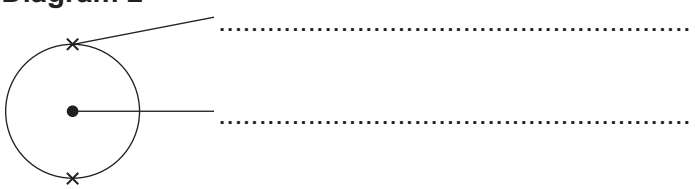
(1 mark)

1 (d) **Diagram 2** shows the parts of a helium atom.

Use words from the box to label **diagram 2**.

bond	**electron**	**nucleus**

Diagram 2



(2 marks)

6

4.2.1.2 Ionic bonding

Question 14

January 2011 | CHY2F | Original Q3 | Legacy

3 (a) A magnesium atom contains 12 protons (●),12 neutrons (o) and 12 electrons (×).

Which diagram, **A**, **B** or **C**, represents this magnesium atom?

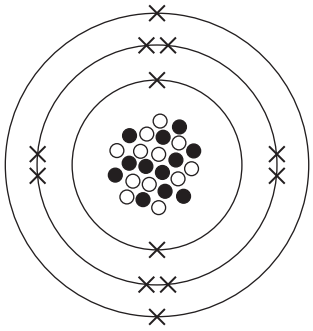


Diagram A

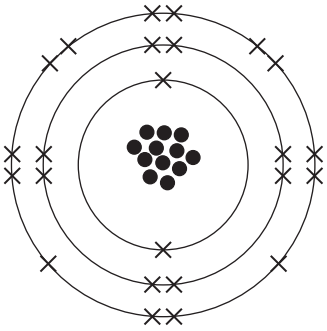


Diagram B

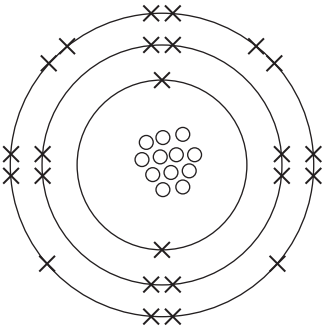
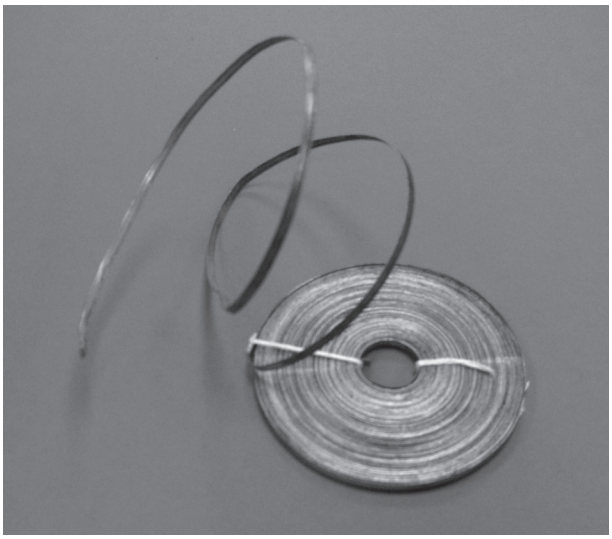


Diagram C

This magnesium atom is **Diagram** ☐ .

(1 mark)

3 (b) Magnesium metal is shaped to make magnesium ribbon.



Tick (✓) **two** reasons which explain why metals can be shaped.

Reason why	Tick (✓)
The atoms are all joined by covalent bonds.	
The atoms can slide over each other.	
The atoms are large.	
The atoms are in layers.	

(2 marks)

4.2.1.2 Ionic bonding

Question 14 · continued

3 (c) Magnesium sulfate is a salt of magnesium.

It can be prepared by the reaction of magnesium metal with an acid. The equation for the reaction of magnesium with this acid is:

Mg(s)	+	H_2SO_4(aq)	→	$MgSO_4$(aq)	+	H_2(g)
magnesium		acid		magnesium sulfate solution		hydrogen

3 (c) (i) Draw a ring around the name of the acid used in this reaction.

hydrochloric **nitric** **sulfuric**

(1 mark)

3 (c) (ii) Use the equation to help you to answer this question.

Tick (✓) **two** things that happen when this reaction takes place.

	Tick (✓)
Bubbles are produced.	
The magnesium disappears.	
A solid is formed.	
Water is formed.	

(2 marks)

3 (c) (iii) Draw a ring around a method to get solid magnesium sulfate from magnesium sulfate solution.

crystallisation **electrolysis** **oxidation**

(1 mark)

7

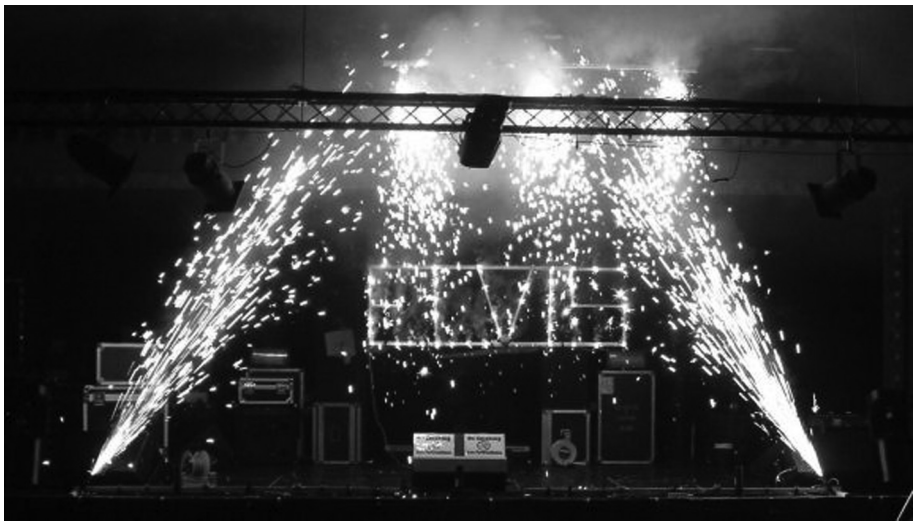
4.2.1.2 Ionic bonding

Question 15

June 2011 | CHY2F | Original Q5 | Legacy

5 Read the information in the box.

Flash powder is used to produce special effects at pop concerts.



Flash powder contains aluminium. The powder burns with a bright white flame and gives out lots of heat and light. It also produces white smoke.

The flash powder is placed on stage in a special container. At the bottom of the container there is a thin piece of wire. When the flash is needed, electricity is passed through the wire. The wire gets hot and starts the aluminium burning.

5 (a) When aluminium burns the reaction is exothermic.

Give **one** piece of information from the box which shows that the reaction is exothermic.

.....

(1 mark)

5 (b) The hot wire provides energy to start the aluminium burning.

Draw a ring around the name given to the energy needed to start a chemical reaction.

activation energy **potential energy** **solar energy**

(1 mark)

5 (c) When aluminium burns it reacts with oxygen to make aluminium oxide.

Complete the word equation for this reaction.

aluminium + ... → .....

(1 mark)

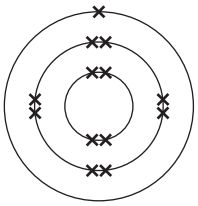
4.2.1.2 Ionic bonding

Question 15 · continued

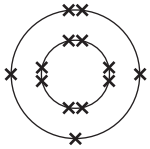
5 (d) An aluminium atom has 13 electrons.

Which diagram, **A, B** or **C**, represents the electronic structure of an aluminium atom?

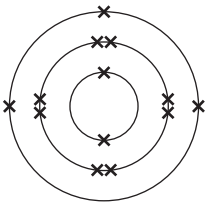
A



B



C



The electronic structure of an aluminium atom is diagram ☐

(1 mark)

5 (e) The white smoke produced is aluminium oxide.

Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

Draw a ring around the correct word in each box to complete each sentence.

5 (e) (i) Electrons have [a negative / no / a positive] charge.

(1 mark)

5 (e) (ii) When an aluminium atom (Al) turns into an aluminium ion (Al^{3+})

it [gains / loses / shares] three electrons.

(1 mark)

5 (e) (iii) When an oxygen atom (O) turns into an oxide ion (O^{2-})

it [gains / loses / shares] [one / two / three] electrons.

(2 marks)

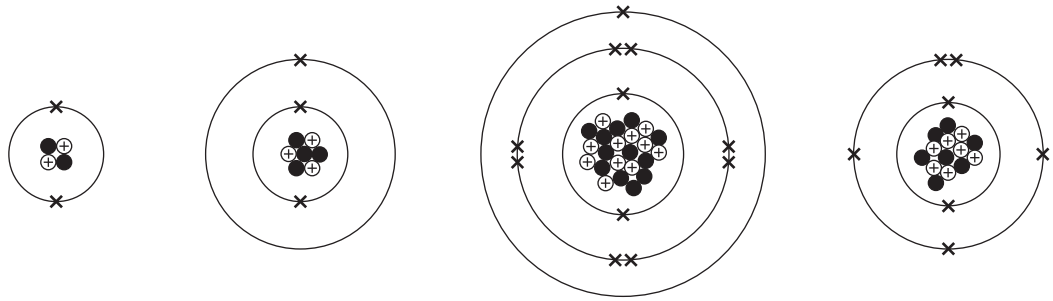
8

4.2.1.2 Ionic bonding

Question 16

June 2012 | CH1FP | Original Q1 | Legacy

1 The diagrams show the sub-atomic particles in four different atoms.



Atom A **Atom B** **Atom C** **Atom D**

Use the Chemistry Data Sheet to help you to answer these questions.

1 (a) Draw a ring around the correct answer to complete each sentence.

1 (a) (i) The centre of each atom is called the

energy level.
molecule.
nucleus.

(1 mark)

1 (a) (ii) The centre of each atom contains neutrons and

bonds.
electrons.
protons.

(1 mark)

1 (b) Complete the sentence.

There is no overall electrical charge on each atom because the

number of ..... is equal to the number of ..... .

(1 mark)

4.2.1.2 Ionic bonding

Question 16 · continued

1 (c) What is the name of the element represented by atom **D**? .....
(1 mark)

1 (d) Which **two** of the atoms, **A**, **B**, **C** and **D**, are in the same group of the periodic table?

Give a reason for your answer.

Atom ☐ and atom ☐

Reason .....

.....
(2 marks)

6

Turn over for the next question

4.2.1.2 Ionic bonding

Question 17

June 2012 | CH2FP | Original Q1 | Legacy

1 (a) The symbol equation for the decomposition of hydrogen peroxide is:

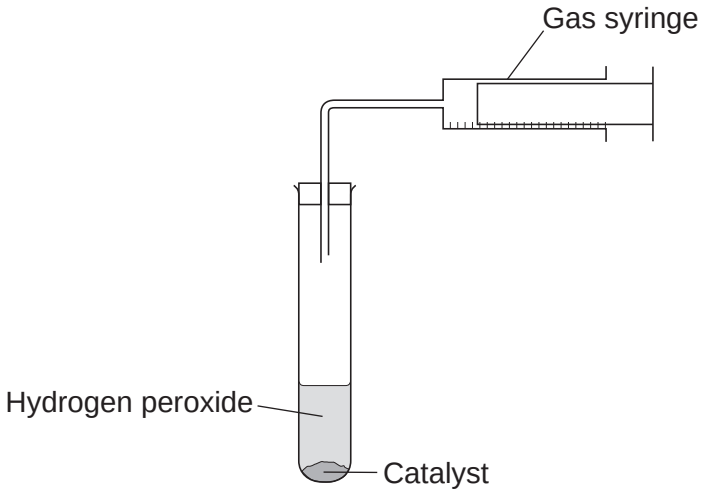
$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

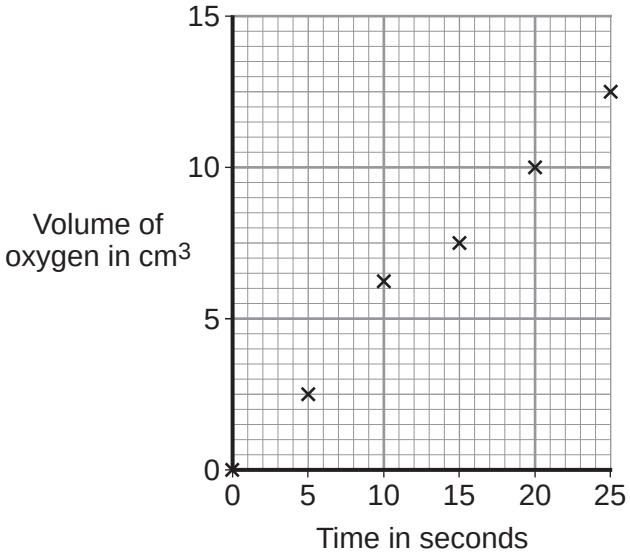
Hydrogen peroxide → ..... + ...

(1 mark)

1 (b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



1 (b) (i) Draw a straight line of best fit to complete the graph.



(1 mark)

4.2.1.2 Ionic bonding

Question 17 · continued

1 (b) (ii) Draw a circle around the anomalous point on the graph.

(1 mark)

1 (b) (iii) What is the volume of oxygen given off after 15 seconds? ..... cm^3

(1 mark)

1 (b) (iv) How did the volume of oxygen change between 0 and 25 seconds?

.....

(1 mark)

1 (c) The student wanted to make the reaction faster.

Draw a ring around the correct answer to complete each sentence.

1 (c) (i) To make the reaction faster, the temperature should be

higher.

lower.

the same.

(1 mark)

1 (c) (ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

(1 mark)

Question 1 continues on the next page

4.2.1.2 Ionic bonding

Question 17 · continued

1 (d) The diagram represents the bonding in oxygen.

O=O

Draw a ring around the correct answer to complete each sentence.

1 (d) (i) When two oxygen atoms bond, the atoms [share / transfer / delocalise] electrons.

(1 mark)

1 (d) (ii) The oxygen atoms are joined by [ionic / metallic / covalent] bonds.

(1 mark)

1 (d) (iii) Oxygen is made of [simple molecules. / a giant lattice. / macromolecules.]

(1 mark)

1 (e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

Statement	Tick (✓)
Water has a boiling point of 100 °C.	
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2 marks)

12

4.2.1.2 Ionic bonding

Question 18

January 2013 | CH2FP | Original Q1 | Legacy

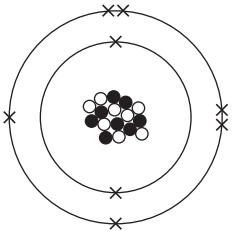
1 This question is about atoms and molecules.

1 (a) Complete the table to show the relative masses of the particles in atoms.

Name of particle	Relative mass
Proton	.....
Neutron	1
Electron	.....

(2 marks)

1 (b) The diagram shows an oxygen atom.



Key
- ● Proton
- ○ Neutron
- × Electron

Use the correct number to complete each sentence.

8	**16**	**18**	**24**

The atomic (proton) number of the oxygen atom shown above is ..... .

The mass number of the oxygen atom shown above is ..... .

(2 marks)

1 (c) (i) Draw a ring around the correct answer to complete the sentence.

Oxygen atoms with different numbers of neutrons are called

isotopes.

molecules.

polymers.

(1 mark)

4.2.1.2 Ionic bonding

Question 18 · continued

1 (c) (ii) An oxygen atom with a different number of neutrons has 10 neutrons.

Draw a ring around the symbol which represents this atom.

$^{16}_{8}O$ $^{18}_{10}O$ $^{18}_{8}O$

(1 mark)

1 (d) A water molecule contains hydrogen and oxygen atoms.

1 (d) (i) Use the correct answer to complete the sentence.

a compound	an element	a mixture

Water is ..... .

(1 mark)

1 (d) (ii) Draw a ring around the correct structure of a water molecule.

H — O — H **O — H — H** **O — H — O**

(1 mark)

1 (d) (iii) Draw a ring around the type of bonding in a water molecule.

covalent **ionic** **metallic**

(1 mark)

1 (d) (iv) Draw a ring around the correct answer to complete the sentence.

The bonds in a water molecule are formed by [gaining / losing / sharing] electrons.

(1 mark)

10

4.2.1.2 Ionic bonding

Question 19

June 2013 | CH2FP | Original Q1 | Legacy

1 This question is about lithium and sodium.

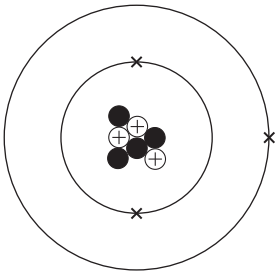
1 (a) Use the Chemistry Data Sheet to help you to answer this question.

In which group of the periodic table are lithium and sodium? Group ☐

(1 mark)

1 (b) A lithium atom can be represented as $^{7}_{3}Li$

The diagram represents the lithium atom.



1 (b) (i) Some particles in the nucleus have a positive charge.

What is the name of these particles? .....

(1 mark)

1 (b) (ii) Some particles in the nucleus have no charge.

What is the name of these particles? .....

(1 mark)

1 (b) (iii) Use the correct answer from the box to complete the sentence.

3	4	7

The mass number of this atom of lithium is ☐

(1 mark)

Question 1 continues on the next page

4.2.1.2 Ionic bonding

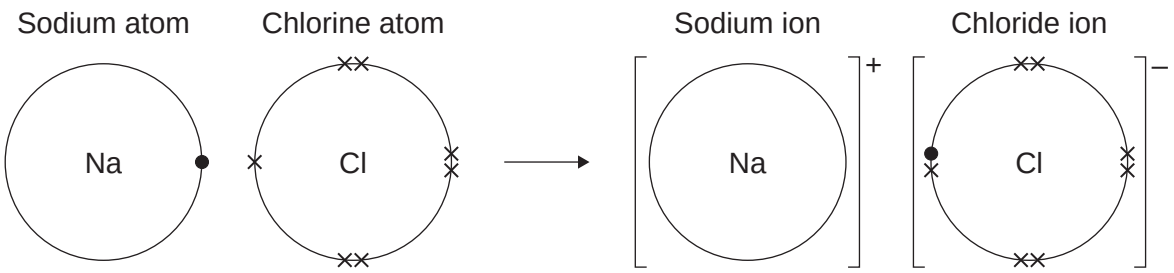
Question 19 · continued

1 (c) Sodium reacts with chlorine to produce sodium chloride.

sodium + chlorine ⟶ sodium chloride

The diagram shows how the reaction happens.

Only the outer electrons are shown.



Draw a ring around the correct answer to complete each sentence.

1 (c) (i) A sodium atom changes into a sodium ion by [gaining / losing / sharing] an electron.

(1 mark)

1 (c) (ii) A sodium ion has [a negative / no / a positive] charge.

(1 mark)

1 (c) (iii) The ions in sodium chloride are held together by strong [covalent / electrostatic / magnetic] forces.

(1 mark)

4.2.1.2 Ionic bonding

Question 19 · continued

1 (d) Sodium chloride is an ionic compound.

Tick (✓) **two** properties of ionic compounds.

Property	Tick (✓)
Do **not** dissolve in water	
High melting points	
Low boiling points	
Strong bonds	

(2 marks)

1 (e) (i) The formula of sodium chloride is NaCl

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

.....

.....

Relative formula mass = ...

(1 mark)

1 (e) (ii) Draw a ring around the correct answer to complete the sentence.

The relative formula mass of a substance, in grams, is one ion / isotope / mole of the substance.

(1 mark)

1 (f) Nanoparticles of sodium chloride (salt) are used to flavour crisps.

What are nanoparticles?

.....

.....

(1 mark)

12

4.2.1.2 Ionic bonding

Question 20

June 2014 | CH2FP | Original Q7 | Legacy

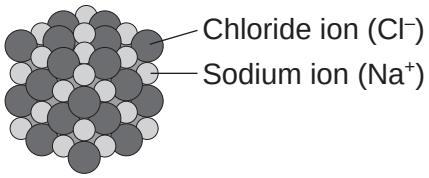
7 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine

Cl — Cl

Sodium chloride



Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

[6 marks]

.....

.....

.....

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.....

.....

Extra space .....

.....

.....

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.....

6

4.2.1.2 Ionic bonding

Question 21

2 This question is about salts.

2 (a) Salt (sodium chloride) is added to many types of food.

Sodium chloride is produced by reacting sodium with chlorine.

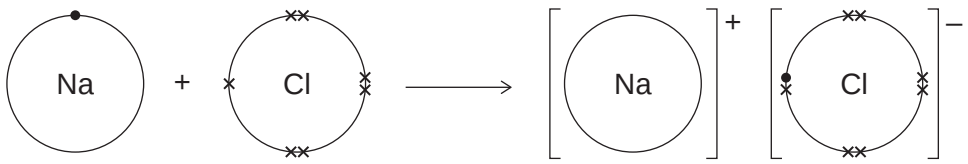
sodium + chlorine ⟶ sodium chloride

Figure 2 shows what happens to atoms of sodium and chlorine in this reaction.

The dots (•) and crosses (×) represent electrons.

Only the outer electrons are shown.

Figure 2



Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

[3 marks]

.....

.....

.....

.....

.....

.....

Question 2 continues on the next page

4.2.1.2 Ionic bonding

Question 21 · continued

2 (b) Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

2 (b) (i) Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

[1 mark]

Tick (✓) **one** box.

Have no overall electric charge ☐

Have high boiling points ☐

Have giant covalent structures ☐

2 (b) (ii) Which one of the following questions cannot be answered by science alone?

[2 marks]

Tick (✓) **one** box.

How much sodium chloride is in food? ☐

What harm does a lack of iodine do? ☐

Should iodine be added to salt in food? ☐

Give **one** reason why this question cannot be answered by science alone.

.....

.....

2 (c) A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

2 (c) (i) Name the acid used.

[1 mark]

.....

4.2.1.2 Ionic bonding

Question 21 · continued

2 (c) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

an acid	**an alkali**	**a salt**

Ammonia solution (ammonium hydroxide) is ..... .

2 (c) (iii) The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

[1 mark]

The solution added is an ..... .

2 (d) Farmers buy solid ammonium nitrate in poly(ethene) sacks.

2 (d) (i) How is solid ammonium nitrate made from a solution of ammonium nitrate?

[1 mark]

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

2 (d) (ii) Why do farmers use ammonium nitrate on their fields?

[1 mark]

.....

.....

2 (d) (iii) The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

[1 mark]

.....

.....

12

4.2.1.2 Ionic bonding

Question 22

June 2015 | CH2FP | Original Q4 | Legacy

4 This question is about electrolysis.

4 (a) Metal spoons can be coated with silver.
This is called electroplating.

Suggest **one** reason why spoons are electroplated.

[1 mark]

.....

.....

4 (b) When sodium chloride solution is electrolysed the products are hydrogen and chlorine.

4 (b) (i) What is made from chlorine?

[1 mark]

Tick (✓) **one** box.

Bleach ☐

Fertiliser ☐

Soap ☐

4 (b) (ii) Sodium chloride solution contains two types of positive ions, hydrogen ions (H^+) and sodium ions (Na^+).

Why is hydrogen produced at the negative electrode and **not** sodium?

[1 mark]

Tick (✓) **one** box.

Hydrogen is a gas. ☐

Hydrogen is less reactive than sodium. ☐

Hydrogen ions move faster than sodium ions. ☐

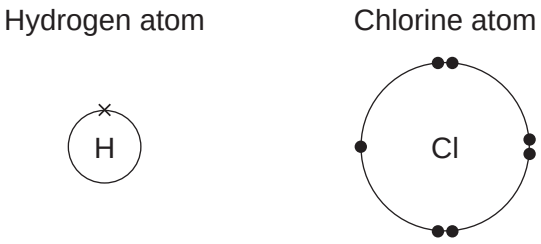
4.2.1.2 Ionic bonding

Question 22 · continued

4 (b) (iii) Hydrogen and chlorine can be used to produce hydrogen chloride.

The diagrams in **Figure 4** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

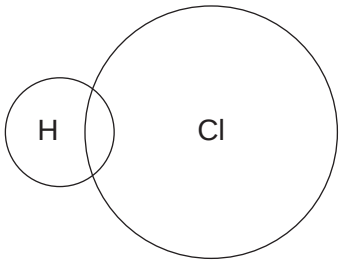
Figure 4



Complete **Figure 5** to show how the outer electrons are arranged in a molecule of hydrogen chloride (HCl).

[1 mark]

Figure 5



4 (b) (iv) What is the type of bond in a molecule of hydrogen chloride?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

Question 4 continues on the next page

4.2.1.2 Ionic bonding

Question 22 · continued

4 (b) (v) Why is hydrogen chloride a gas at room temperature (20 °C)?

[2 marks]

Tick (✓) **two** boxes.

Hydrogen chloride has a low boiling point. ☐

Hydrogen chloride has a high melting point. ☐

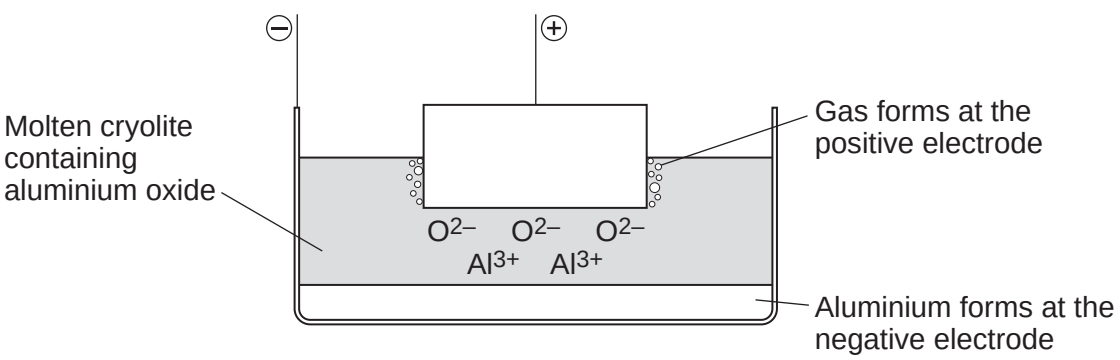
Hydrogen chloride is made of simple molecules. ☐

Hydrogen chloride does not conduct electricity. ☐

Hydrogen chloride has a giant structure. ☐

4 (c) Aluminium is produced by electrolysis of a molten mixture of aluminium oxide and cryolite.
This is shown in **Figure 6**.

Figure 6



4 (c) (i) Name a gas produced at the positive electrode.

[1 mark]

.....

4.2.1.2 Ionic bonding

Question 22 · continued

4 (c) (ii) Aluminium ions move to the negative electrode.

Explain why.

[2 marks]

.....

.....

.....

.....

4 (c) (iii) At the negative electrode, the aluminium ions gain electrons to produce aluminium.

What is this type of reaction called?

[1 mark]

Tick (✓) **one** box.

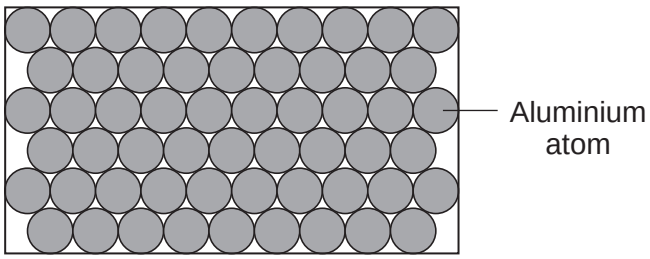
Combustion ☐

Oxidation ☐

Reduction ☐

4 (c) (iv) Aluminium has layers of atoms, as shown in **Figure 7**.

Figure 7



Complete the sentence.

[1 mark]

Metals can be bent and shaped because the layers of atoms can ..... .

Question 4 continues on the next page

4.2.1.2 Ionic bonding

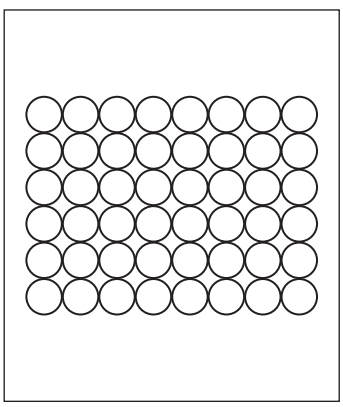
Question 22 · continued

4 (d) Electrodes used in the production of aluminium are made from graphite.

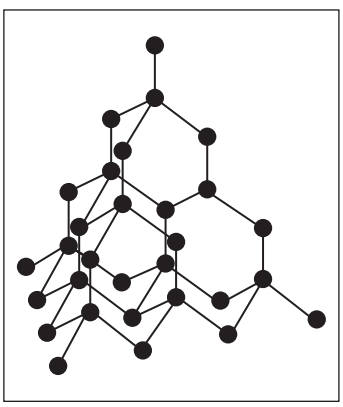
4 (d) (i) Which diagram, **A**, **B** or **C**, shows the structure of graphite?

[1 mark]

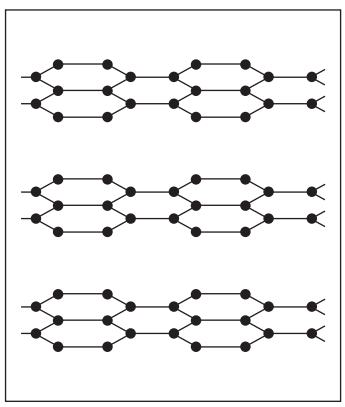
A



B



C



The structure of graphite is shown in diagram ☐.

4 (d) (ii) The temperature for the electrolysis is 950 °C.

Use the correct answer from the box to complete the sentence.

[1 mark]

cross links	**a giant ionic lattice**	**strong covalent bonds**

The graphite does not melt at 950 °C because

graphite has ..... .

14

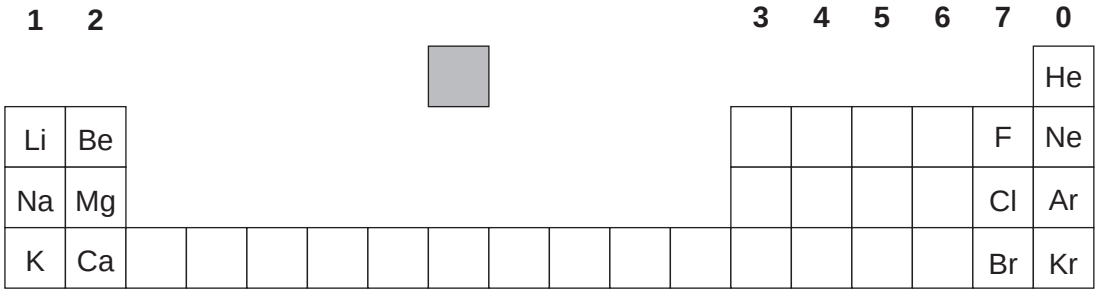
4.2.1.2 Ionic bonding

Question 23

2 Use the Chemistry Data Sheet to help you answer this question.

Figure 2 shows part of the periodic table.

Figure 2



2 (a) Give the name of the element that should be in the shaded box.

[1 mark]

2 (b) How many different elements are there in the complete periodic table?

[1 mark]

Tick (✓) **one** box.

About 36 ☐

About 100 ☐

About 500 ☐

4.2.1.2 Ionic bonding

Question 23 · continued

2 (c) What are **two** reasons why lithium, sodium and potassium are in the same group of the periodic table?

[2 marks]

Tick (✓) **two** boxes.

- Low melting points ☐
- Same number of electrons in the outer shell ☐
- Similar atomic (proton) numbers ☐
- Similar chemical reactions ☐
- Two electrons in the innermost shell ☐

2 (d) Complete each sentence.

[2 marks]

The elements in Group 0 are called _____ gases.

The elements in the central block are known as _____ metals.

2 (e) Use the correct word from the box to complete each sentence.

[2 marks]

alloys	ions	molecules	polymers	protons

Atoms of fluorine gain electrons to form fluoride _____ .

Atoms of fluorine share electrons to form fluorine _____ .

8

4.2.1.2 Ionic bonding

Question 24

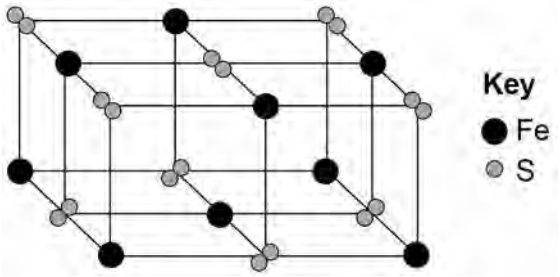
June 2018 | 8462/1F | Original Q9

0 9 This question is about metals and metal compounds.

0 9 . 1 Iron pyrites is an ionic compound.

Figure 12 shows a structure for iron pyrites.

Figure 12



Determine the formula of iron pyrites.

Use **Figure 12**.

[1 mark]

_____

0 9 . 2 An atom of iron is represented as $^{56}_{26}Fe$

Give the number of protons, neutrons and electrons in this atom of iron.

[3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 9 . 3 Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.

[2 marks]

1 _____

_____

2 _____

_____

4.2.1.2 Ionic bonding

Question 24 · continued

Nickel is extracted from nickel oxide by reduction with carbon.

0 9 . 4 Explain why carbon can be used to extract nickel from nickel oxide.

[2 marks]

0 9 . 5 An equation for the reaction is:

$$NiO + C \rightarrow Ni + CO$$

Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

Relative formula mass (M_r): NiO = 75

Give your answer to 3 significant figures.

[3 marks]

Percentage atom economy = _____ %

11

4.2.1.2 Ionic bonding

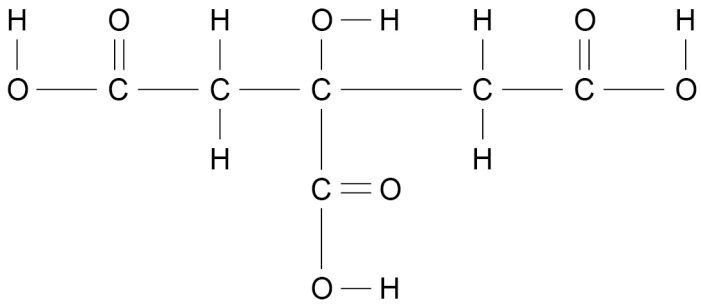
Question 25

November 2020 | 8462/1F | Original Q6

0 6 This question is about citric acid.

Figure 7 represents one molecule of citric acid.

Figure 7



0 6 . 1 Complete the molecular formula of citric acid.

Use **Figure 7**.

[1 mark]

C_6H __ O __

0 6 . 2 What type of bonding is shown in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

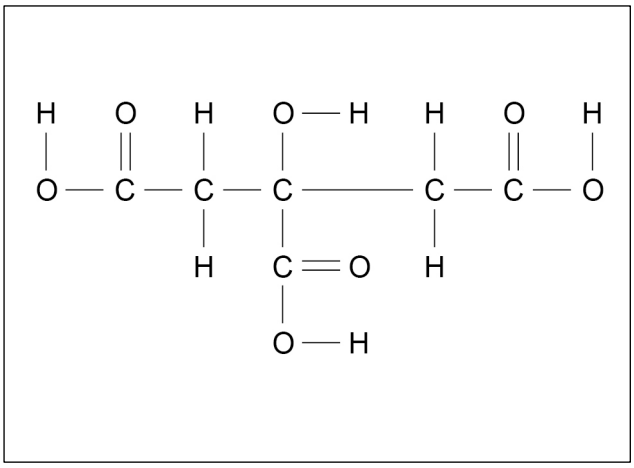
4.2.1.2 Ionic bonding

Question 25 · continued

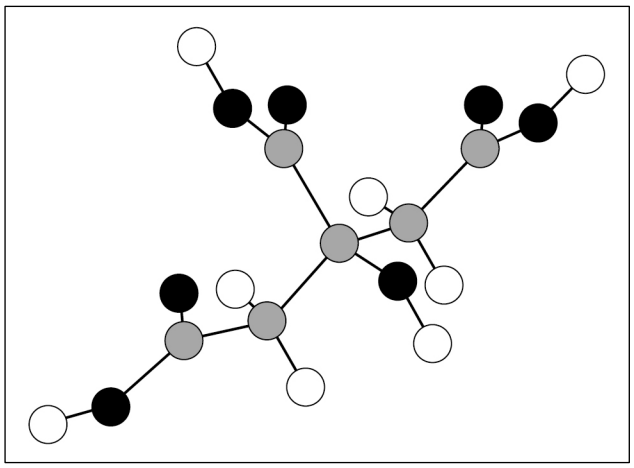
0 6 . 3 **Figure 8** shows two representations of one molecule of citric acid, **A** and **B**.

Figure 8

A



B



Give **two** advantages of representation **A** compared with representation **B**.

[2 marks]

Advantages of **A**:

1 _____

_____

2 _____

_____

Question 25 · continued

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

Citric acid is a solid.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.
2. Measure the temperature of the sodium hydrogencarbonate solution.
3. Add 0.25 g of citric acid to the cup.
4. Stir the solution.
5. Measure the temperature of the solution.
6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

Table 4 shows some of the student's results.

Table 4

Mass of citric acid added in g	Temperature of solution in °C
0.00	22.6
0.25	22.2
0.50	21.8
0.75	21.4
1.00	21.0
1.25	20.6

0 6 . 4 How do the results in **Table 4** show that the reaction is endothermic?

[1 mark]

Question 25 · continued

0 6 . 5 Three of the student's results are plotted on **Figure 9**.

A line of best fit for these points is drawn.

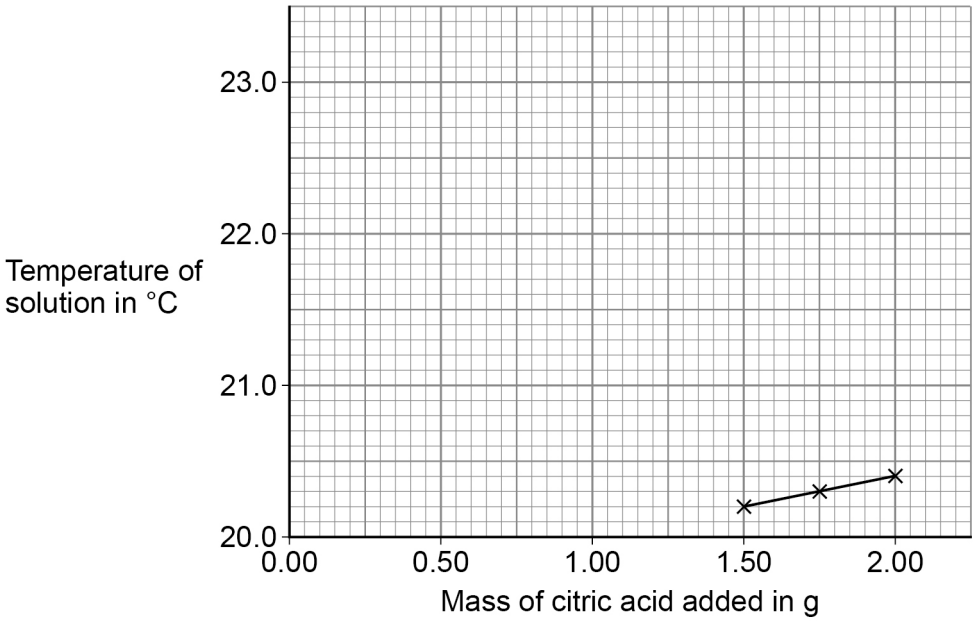
Complete **Figure 9**.

You should:

- plot the data from **Table 4** on **Figure 9**
- draw a line of best fit through the points you have plotted
- extend your line of best fit to meet the line of best fit already drawn on **Figure 9**.

[4 marks]

Figure 9



0 6 . 6 Determine the overall temperature change for the reaction.

Use **Figure 9**.

[2 marks]

Overall temperature change = _____ °C

4.2.1.2 Ionic bonding

Question 25 · continued

November 2020 | 8462/1F | Original Q6

0 6 . 7 What is the dependent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Mass of citric acid ☐

Temperature of solution ☐

Volume of solution ☐

12

4.2.1.2 Ionic bonding

Question 26

November 2020 | 8462/1F | Original Q8

0 8 This question is about structure and bonding.

0 8 . 1 Which **two** substances have intermolecular forces between particles?

[2 marks]

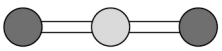
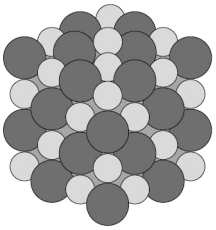
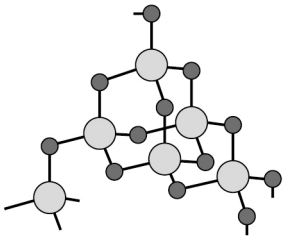
Tick (✓) **two** boxes.

- Diamond ☐
- Magnesium ☐
- Poly(ethene) ☐
- Sodium chloride ☐
- Water ☐

0 8 . 2 **Table 5** shows the structures of three compounds.

Table 5

Diagrams not to scale

Compound	Structure
Carbon dioxide	
Magnesium oxide	
Silicon dioxide	

4.2.1.2 Ionic bonding

Question 26 · continued

Compare the structure and bonding of the three compounds:

- carbon dioxide
- magnesium oxide
- silicon dioxide.

[6 marks]

8

4.2.1.2 Ionic bonding

Question 27

November 2020 | 8462/2F | Original Q10

1 0 This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

1 0 . 1 Draw **one** line from each hydrocarbon to the formula of that hydrocarbon.

[2 marks]

Hydrocarbon	Formula
	C_6H_8
Hexane	C_6H_{10}
	C_6H_{12}
Hexene	C_6H_{14}
	C_6H_{16}

1 0 . 2 Bromine water is added to hexane and to hexene.

What would be observed when bromine water is added to hexane and to hexene?

[2 marks]

Hexane _____

_____

Hexene _____

_____

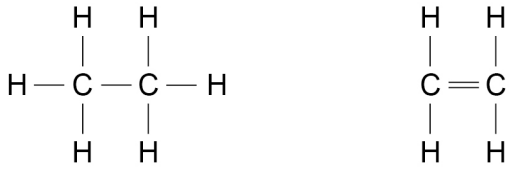
4.2.1.2 Ionic bonding

Question 27 · continued

1 0 . 3 Ethane is an alkane and ethene is an alkene.

Figure 8 shows the displayed structural formulae of ethane and of ethene.

Figure 8



Ethane **Ethene**

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

10

4.2.1.2 Ionic bonding

Question 28

November 2021 | 8462/1F | Original Q3

0 3 This question is about Group 1 elements.

0 3 . 1 Complete **Table 2** to show the electronic structure of a potassium atom.

[1 mark]

Table 2

Atom	Number of electrons	Electronic structure
Sodium	11	2,8,1
Potassium	19	

0 3 . 2 Why do Group 1 elements have similar chemical properties?

[1 mark]

Tick (✓) **one** box.

- They have the same number of electron shells. ☐
- They have the same number of outer shell electrons. ☐
- They have two electrons in the first shell. ☐

0 3 . 3 What is the type of bonding in sodium?

[1 mark]

Tick (✓) **one** box.

- Covalent ☐
- Ionic ☐
- Metallic ☐

4.2.1.2 Ionic bonding

Question 28 · continued

Table 3 shows observations made when lithium, potassium and rubidium react with water.

Table 3

Element	Observations
Lithium	Bubbles slowly Floats Moves slowly
Sodium	1 _____ 2 _____
Potassium	Bubbles very quickly Melts into a ball Floats Moves very quickly Flame
Rubidium	Sinks Melts into a ball Explodes with a flame

0 3 . 4 Give **two** observations you could make when sodium reacts with water.

Write your answers in **Table 3**.

[2 marks]

4.2.1.2 Ionic bonding

Question 28 · continued

0 3 . 5 How does the reactivity of the elements change going down Group 1?

[1 mark]

0 3 . 6 Give **two** ways in which the observations in **Table 3** show the change in reactivity going down Group 1.

[2 marks]

1

2

0 3 . 7 Which gas is produced when Group 1 elements react with water?

[1 mark]

Tick (✓) **one** box.

- Carbon dioxide ☐
- Hydrogen ☐
- Nitrogen ☐
- Oxygen ☐

Question 28 · continued

0 3 . 8 Sodium fluoride is an ionic compound.

Figure 5 shows dot and cross diagrams for a sodium atom and a fluorine atom.

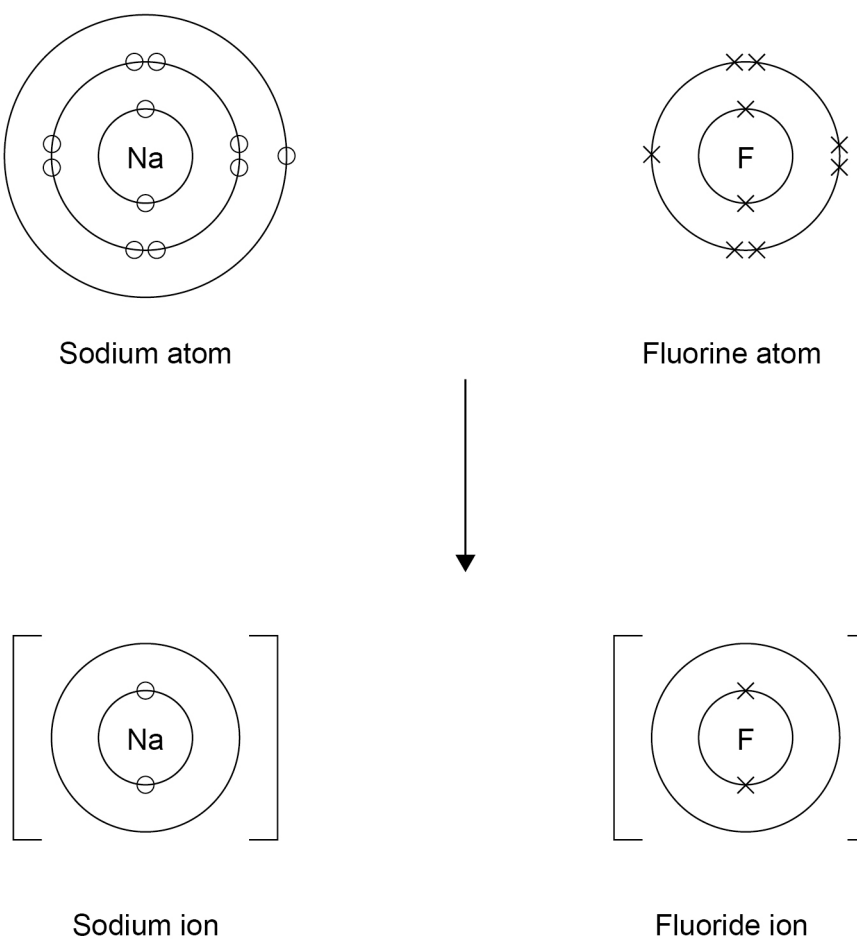
Complete **Figure 5** to show what happens when a sodium atom and a fluorine atom react to produce sodium fluoride.

You should:

- complete the electronic structures of the sodium ion and the fluoride ion
- give the charges on the sodium ion and the fluoride ion.

[3 marks]

Figure 5



12

4.2.1.2 Ionic bonding

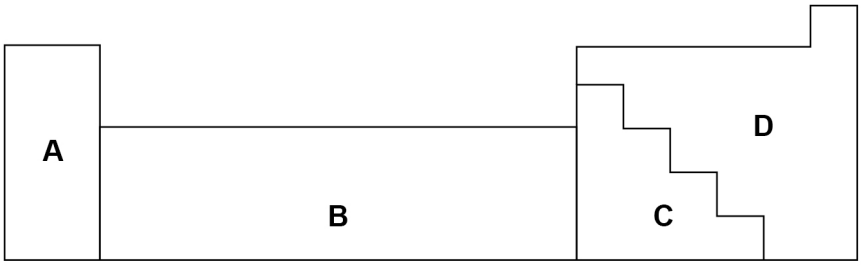
Question 29

June 2022 | 8462/1F | Original Q9

0 9 This question is about metals and non-metals.

Figure 15 shows an outline of part of the periodic table.

Figure 15



0 9 . 1 Element **Q** is a dull solid with a melting point of 44 °C.

Element **Q** does not conduct electricity.

Which section of the periodic table in **Figure 15** is most likely to contain element **Q**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 9 . 2 Element **R** forms ions of formula R^{2+} and R^{3+}

Which section of the periodic table in **Figure 15** is most likely to contain element **R**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 9 . 3 Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

1 _____

_____

2 _____

_____

4.2.1.2 Ionic bonding

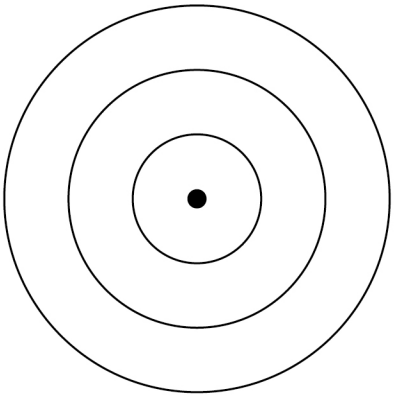
Question 29 · continued

0 9 . 4 Complete **Figure 16** to show the electronic structure of an aluminium atom.

Use the periodic table.

[1 mark]

Figure 16



0 9 . 5 Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

[3 marks]

0 9 . 6 Name the type of bonding in compounds formed between metals and non-metals.

[1 mark]

4.2.1.2 Ionic bonding

Question 29 · continued

0 9 . 7 Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

[4 marks]

13

4.2.1.2 Ionic bonding

Question 30

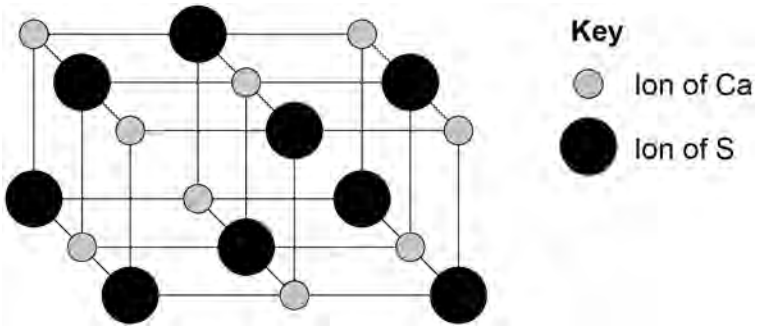
June 2025 | 8462/1F | Original Q9

0 9 This question is about structure and bonding.

Calcium sulfide is an ionic compound.

Figure 13 represents the structure of calcium sulfide.

Figure 13



0 9 . 1 Determine the empirical formula of calcium sulfide.

[1 mark]

Empirical formula _____

Question 9 continues on the next page

4.2.1.2 Ionic bonding

Question 30 · continued

0 9 . 2 Calcium is in Group 2 of the periodic table.

Sulfur is in Group 6 of the periodic table.

Describe what happens when a calcium atom reacts with a sulfur atom.

Answer in terms of electrons and ions.

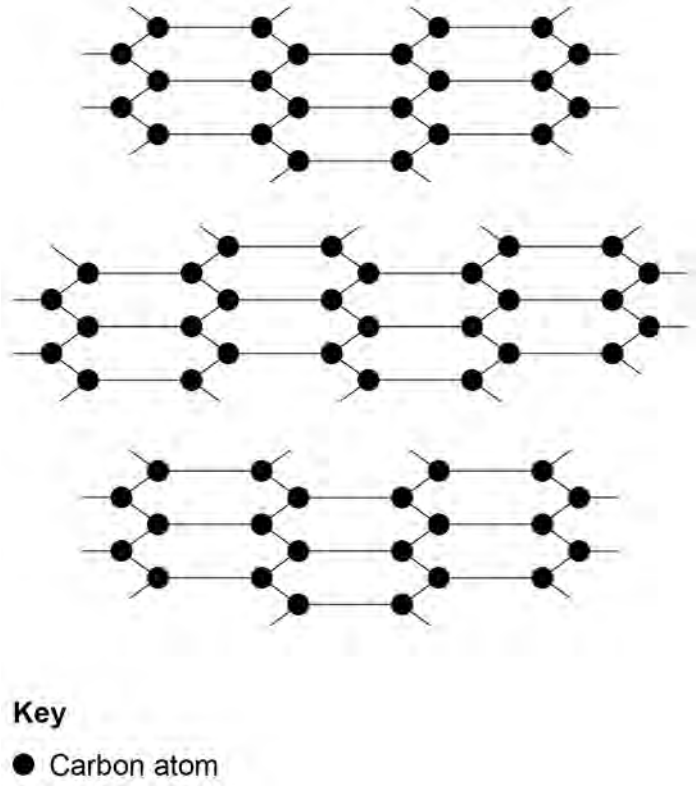
[4 marks]

4.2.1.2 Ionic bonding

Question 30 · continued

Figure 14 shows the structure of graphite.

Figure 14



0 9 . 3 Describe the structure and bonding of graphite.

[4 marks]

Extra space

4.2.1.2 Ionic bonding

Question 30 · continued

0 9 . 4 Substances that consist of small molecules do **not** conduct electricity.

Give **one** reason why.

[1 mark]

0 9 . 5 Methane consists of small molecules.

Poly(ethene) is a polymer.

Why does poly(ethene) have a higher melting point than methane?

[1 mark]

Tick (✓) **one** box.

- Poly(ethene) has more covalent bonds to break than methane. ☐
- Poly(ethene) has no intermolecular forces to overcome. ☐
- Poly(ethene) has stronger covalent bonds to break than methane. ☐
- Poly(ethene) has stronger intermolecular forces to overcome than methane. ☐

11