AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.1.7

Electronic structure

Past-paper questions

Tier	**Foundation**
Question groups	**32**
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.

4.1.1.7 Electronic structure

Question 01

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*.

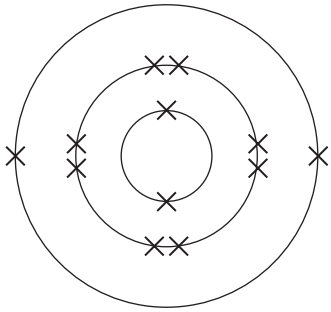
Complete the following sentence using the correct words from the box.

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.



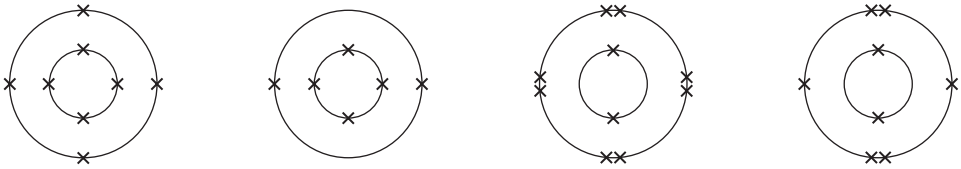
Magnesium atom

Question 01 · 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?

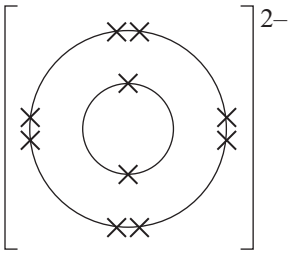


A **B** **C** **D**

Diagram .....

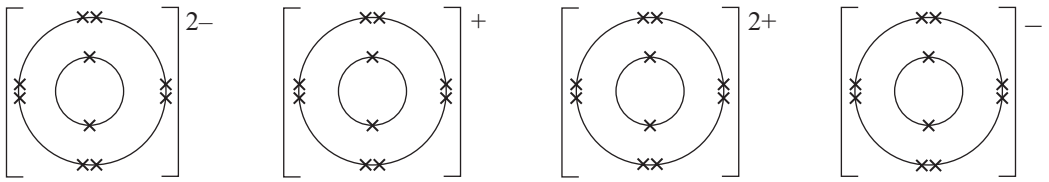
(1 mark)

(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

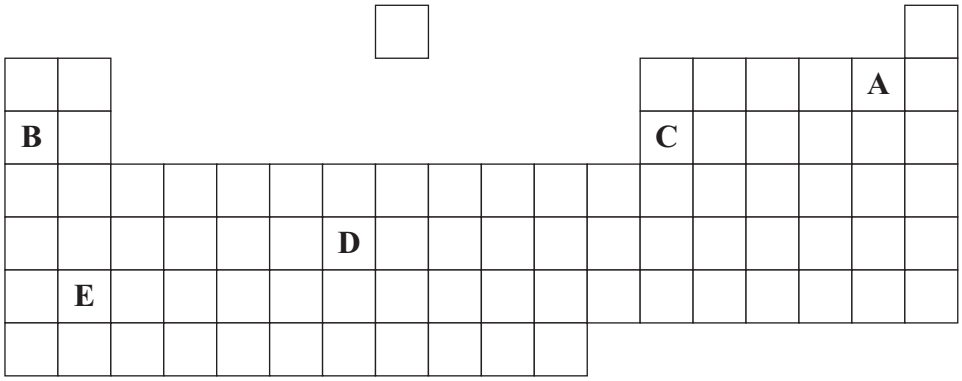
4.1.1.7 Electronic structure

Question 02

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)

4.1.1.7 Electronic structure

Question 02 · 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

4.1.1.7 Electronic structure

Question 03

June 2008 | CHY2F | Original Q7 | Legacy

7 Toothpastes often contain fluoride ions to help protect teeth from attack by bacteria.



Some toothpastes contain tin(II) fluoride.

This compound has the formula SnF_2.

7 (a) Calculate the relative formula mass (M_r) of SnF_2.
Relative atomic masses: F = 19; Sn = 119

.....

.....

.....

.....

Relative formula mass (M_r) = ...
(2 marks)

7 (b) Calculate the percentage by mass of fluorine in SnF_2.

.....

.....

.....

.....

Percentage by mass of fluorine = ... %
(2 marks)

4.1.1.7 Electronic structure

Question 03 · continued

for mark

7 (c) A tube of toothpaste contains 1.2 g of SnF_2.

Calculate the mass of fluorine in this tube of toothpaste.

.....

.....

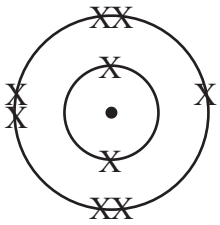
.....

.....

Mass of fluorine = ... g

(1 mark)

7 (d) The diagram represents the electron arrangement of a fluorine atom.



Explain how a fluorine atom can change into a fluoride ion, F^-.

.....

.....

.....

.....

(2 marks)

7

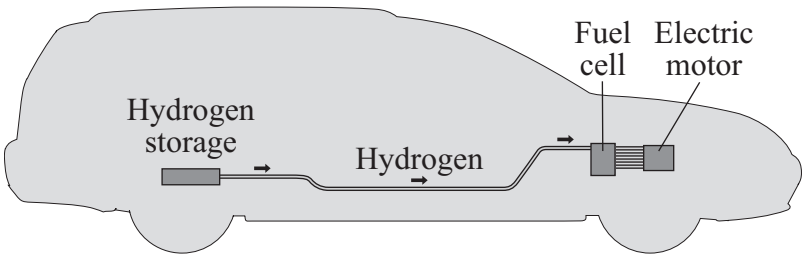
4.1.1.7 Electronic structure

Question 04

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.

4.1.1.7 Electronic structure

Question 04 · 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

4.1.1.7 Electronic structure

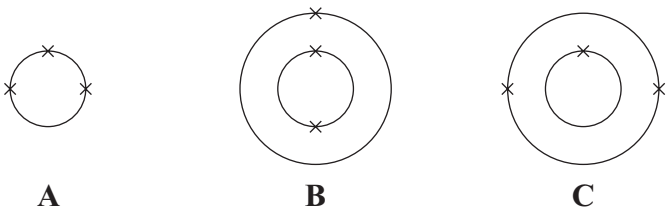
Question 04 · continued

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 ☐

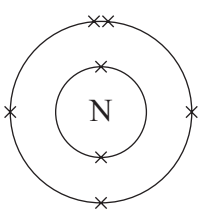
(1 mark)

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

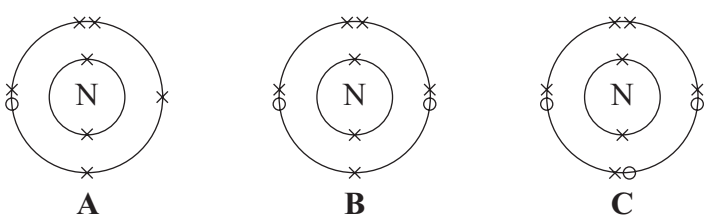
Statement	Tick (✓)
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(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)

4.1.1.7 Electronic structure

Question 04 · continued June 2009 | CHY2F | Original Q6 | Legacy

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

4.1.1.7 Electronic structure

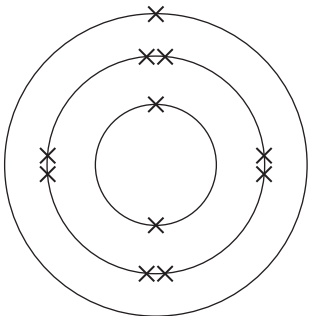
Question 05

7 Sodium chloride is a raw material.

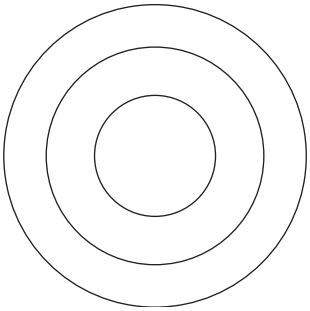
7 (a) The electronic structure of a sodium atom is shown below.

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?

.....

.....

.....

.....

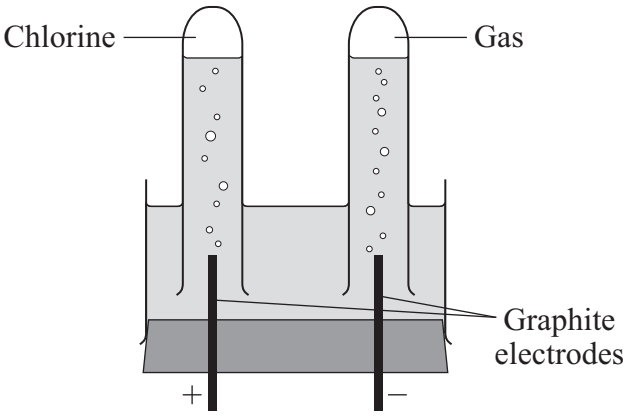
(2 marks)

4.1.1.7 Electronic structure

Question 05 · 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

4.1.1.7 Electronic structure

Question 05 · 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

4.1.1.7 Electronic structure

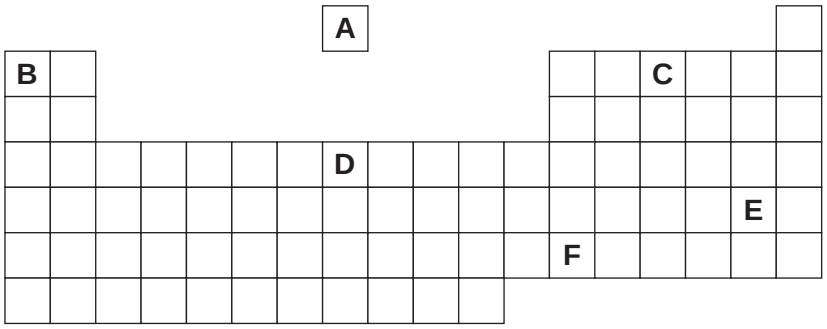
Question 06

June 2010 | CHY3F | Original Q3 | Legacy

3 (a) Use the periodic table on the Data Sheet to help you answer these questions.

Part of the periodic table is shown below.

The letters are **not** the symbols of the elements.



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

Which letter, **A**, **B**, **C**, **D**, **E** or **F**, represents

3 (a) (i) hydrogen Letter ☐

(1 mark)

3 (a) (ii) a Group 3 element Letter ☐

(1 mark)

3 (a) (iii) a halogen Letter ☐

(1 mark)

3 (a) (iv) the element with atomic (proton) number of 7 Letter ☐

(1 mark)

3 (a) (v) an element with one electron in its outer shell? Letter ☐

(1 mark)

4.1.1.7 Electronic structure

Question 06 · continued

3 (b) The table shows the melting points of the Group 1 metals arranged in alphabetical order.

Group 1 metal		
Name	**Symbol**	**Melting point in °C**
Caesium	Cs	29
Francium	Fr	27
Lithium	Li	180
Potassium	K	64
Rubidium	Rb	39
Sodium	Na	98

3 (b) (i) Arrange these metals in order of increasing melting point. Three have been done for you.

Fr Cs Li

Lowest ⟶ Highest

(1 mark)

3 (b) (ii) Use the periodic table on the Data Sheet **and** your answer in part (b)(i) above to complete this sentence about how the melting points change.

Going down Group 1, the melting points ..... .

(1 mark)

3 (c) The transition metals are a block of elements between Groups 2 and 3 of the periodic table. Transition metals have different properties to Group 1 metals.

Put ticks (✓) next to the **three** correct statements about transition metals in the table below.

Statement	(✓)
They are harder than Group 1 metals	
They have lower densities than Group 1 metals	
They have higher melting points than Group 1 metals	
They are more reactive with water than Group 1 metals	
They often form coloured compounds but Group 1 compounds are usually white	

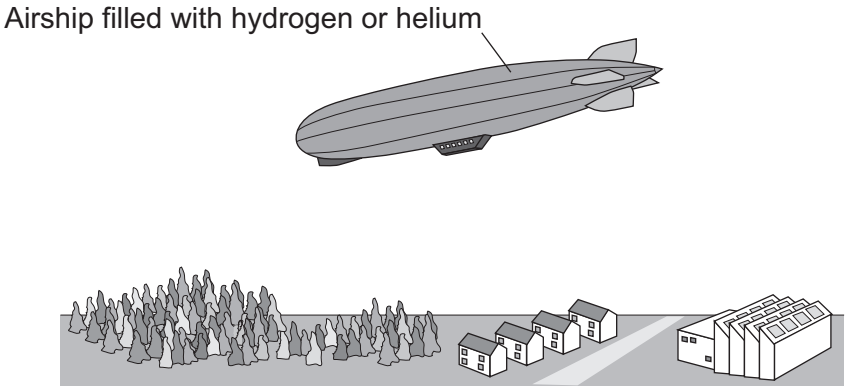
(3 marks)

10

4.1.1.7 Electronic structure

Question 07

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)

4.1.1.7 Electronic structure

Question 07 · 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.

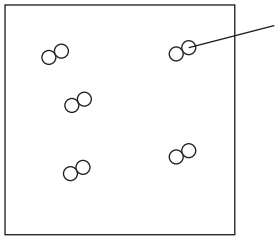
Helium is now used in airships because it is

- 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.

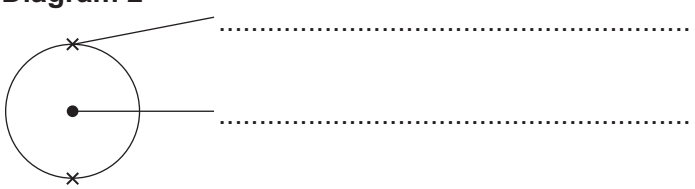
(1 mark)

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

4.1.1.7 Electronic structure

Question 08

7 Calamine lotion is used to treat itching. The main ingredients are two metal oxides.



7 (a) One of the metal oxides has a relative formula mass (M_r) of 81.

The formula of this metal oxide is MO.
(M is **not** the correct symbol for the metal.)

The relative atomic mass (A_r) of oxygen is 16.

7 (a) (i) Calculate the relative atomic mass (A_r) of metal M.

.....

.....

.....

Relative atomic mass (A_r) = ...
(2 marks)

7 (a) (ii) Use your answer to part (a)(i) and the periodic table on the Data Sheet to name metal M.

The name of metal M is ..... .
(1 mark)

4.1.1.7 Electronic structure

Question 08 · continued

7 (b) The other metal oxide is iron(III) oxide.

This contains iron(III) ions (Fe^{3+}) and oxide ions (O^{2-}).

7 (b) (i) Explain in terms of electrons how an iron atom (Fe) can change into an iron(III) ion (Fe^{3+}).

.....

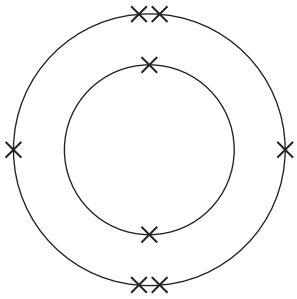
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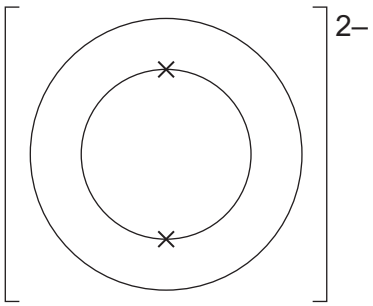
.....

(2 marks)

7 (b) (ii) The diagram below represents the electronic structure of an oxygen atom (O).



Complete the diagram below to show the electronic structure of an oxide ion (O^{2-}).



(1 mark)

6

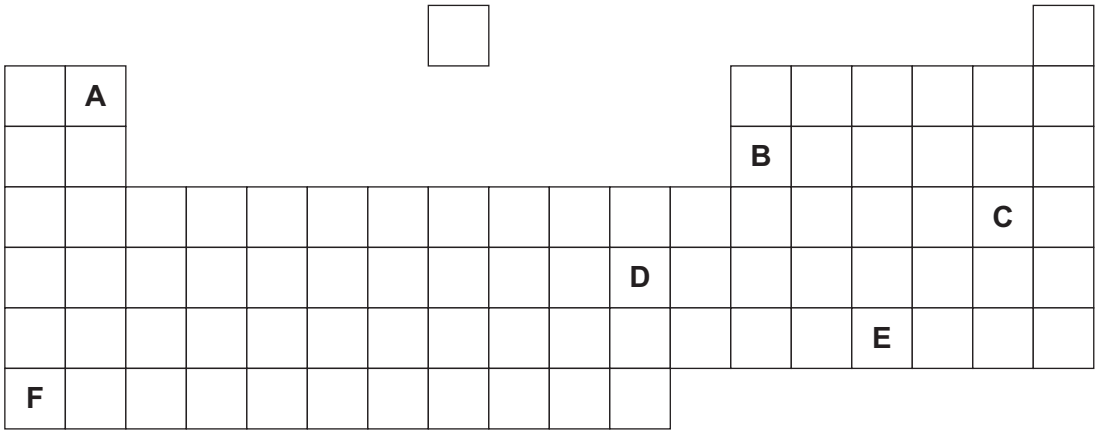
4.1.1.7 Electronic structure

Question 09

January 2011 | CHY3F | Original Q1 | Legacy

1 The periodic table on the Data Sheet may help you to answer these questions.

1 (a) Part of the periodic table is shown below.



The letters are **not** the symbols of the elements.

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

Which letter, **A**, **B**, **C**, **D**, **E** or **F**, represents

1 (a) (i) aluminium ☐ *(1 mark)*

1 (a) (ii) a Group 5 element ☐ *(1 mark)*

1 (a) (iii) an alkali metal ☐ *(1 mark)*

1 (a) (iv) the element with atomic (proton) number of 47 ☐ *(1 mark)*

1 (a) (v) an element with seven electrons in its outer shell? ☐ *(1 mark)*

4.1.1.7 Electronic structure

Question 09 · continued

1 (b) The table shows the boiling points of the Group 7 elements.

The elements are arranged **in alphabetical order**.

Group 7 element		
Name	**Symbol**	**Boiling point in °C**
Astatine	At	337
Bromine		58
Chlorine	Cl	–34
Fluorine	F	–188
Iodine	I	184

1 (b) (i) The symbol for bromine is missing from the table.

What is the symbol for bromine? Symbol = ...

(1 mark)

1 (b) (ii) Arrange these elements in order of **decreasing** boiling point. The first one and the last one have been done for you.

At .... F

Highest boiling point ⟶ Lowest boiling point

(1 mark)

1 (c) The table shows some statements about Group 7 elements.

Tick (✓) the **two** correct statements.

	Tick (✓)
They are halogens.	
They are metals.	
They become less reactive down Group 7.	
They are compounds.	

(2 marks)

9

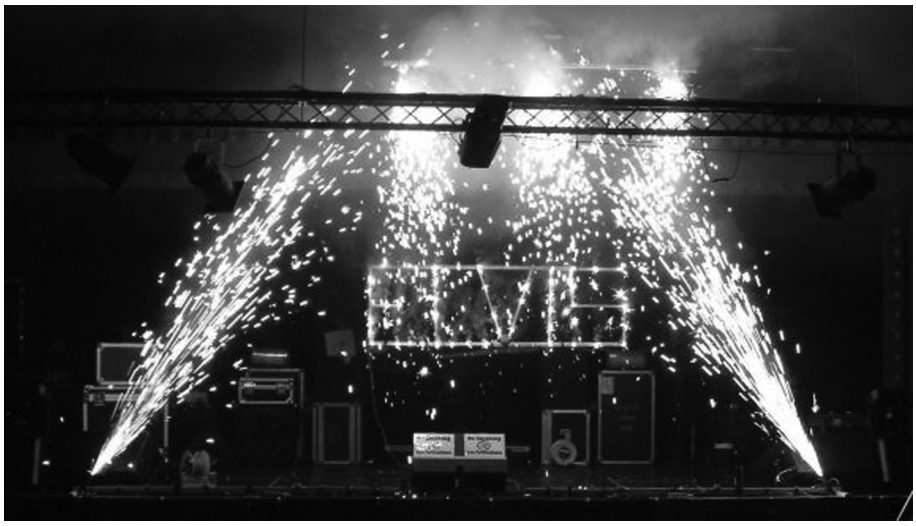
4.1.1.7 Electronic structure

Question 10

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)

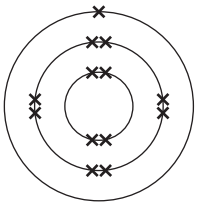
4.1.1.7 Electronic structure

Question 10 · continued

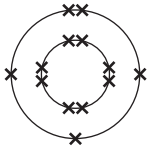
5 (d) An aluminium atom has 13 electrons.

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

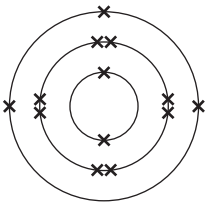
A



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)

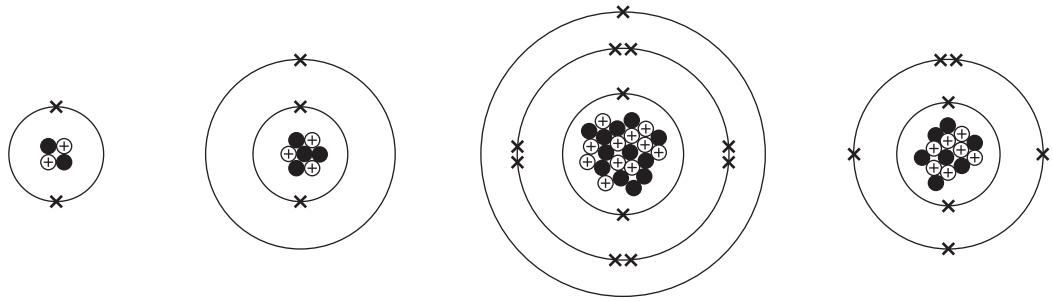
8

4.1.1.7 Electronic structure

Question 11

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)

4.1.1.7 Electronic structure

Question 11 · 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

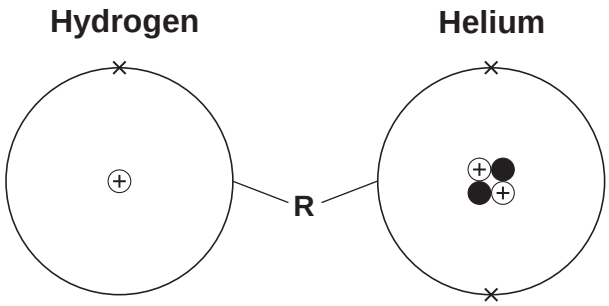
Turn over for the next question

4.1.1.7 Electronic structure

Question 12

January 2013 | CH1FP | Original Q1 | Legacy

1 The Sun is mainly hydrogen and helium.
The diagrams show an atom of hydrogen and an atom of helium.



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

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

molecule.

nucleus.

shell.

(1 mark)

1 (a) (ii) The circle (labelled **R**) around the centre of each atom is called

a bond.

an electrical charge.

an energy level (shell).

(1 mark)

4.1.1.7 Electronic structure

Question 12 · continued

1 (b) Use the diagrams on page 2 to help you to answer these questions.

Draw **one** line from each question to its correct answer.

Question	Answer
How many protons are there in the hydrogen atom?	1
How many electrons are there in the helium atom?	2
What is the mass number of the helium atom?	3
	4

(3 marks)

1 (c) The Sun is 73% hydrogen and 25% helium. The rest is other elements.

What is the percentage of other elements in the Sun? ..... %

(1 mark)

1 (d) One of the other elements in the Sun is neon.
Neon is in the same group of the periodic table as helium.

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

1 (d) (i) How many protons are there in a neon atom?

.....

(1 mark)

1 (d) (ii) Which group of the periodic table are helium and neon in?

.....

(1 mark)

8

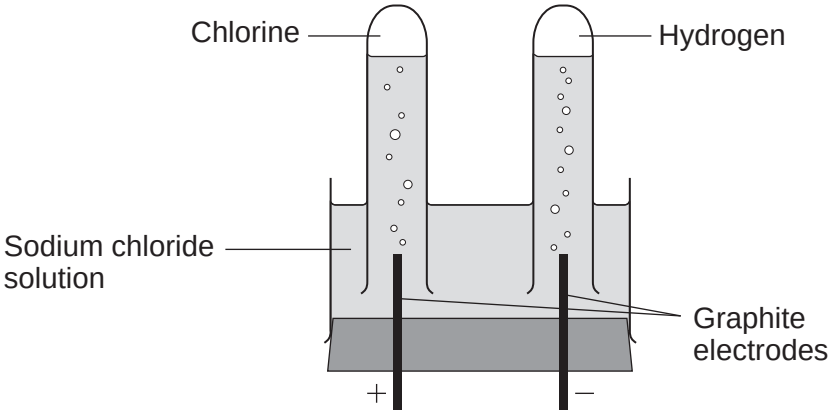
4.1.1.7 Electronic structure

Question 13

January 2013 | CH2FP | Original Q8 | Legacy

8 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



8 (a) One of the products of the electrolysis of sodium chloride solution is hydrogen.

8 (a) (i) Why do hydrogen ions move to the negative electrode?

.....

.....

(1 mark)

8 (a) (ii) How does a hydrogen ion change into a hydrogen atom?

.....

.....

(1 mark)

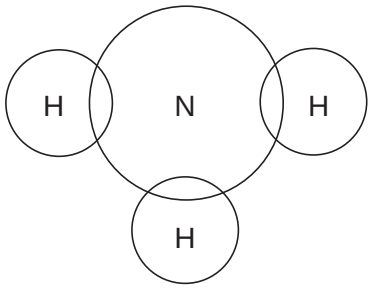
Question 13 · continued

8 (b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.



(2 marks)

8 (c) The table shows the ions in sodium chloride solution.

Positive ions	Negative ions
hydrogen	chloride
sodium	hydroxide

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

8 (c) (i) Which ion makes the waste alkaline?

.....

(1 mark)

8 (c) (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 8 continues on the next page

4.1.1.7 Electronic structure

Question 13 · continued

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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	Membrane cell
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

.....

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4.1.1.7 Electronic structure

Question 14

June 2014 | CH2FP | Original Q4 | Legacy

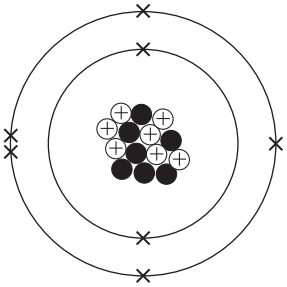
4 Fertilisers contain elements that plants need.

AQAGROW
Plant Fertiliser

Contains:
- Nitrogen
- Phosphorus
- Potassium

4 (a) **Figure 5** represents a nitrogen atom.

Figure 5



Complete each sentence.

4 (a) (i) The mass number of this nitrogen atom is ..... .

[1 mark]

4 (a) (ii) Atoms of nitrogen with different numbers of neutrons are called ..... .

[1 mark]

4 (a) (iii) Compared with a proton, the mass of an electron is ..... .

[1 mark]

4.1.1.7 Electronic structure

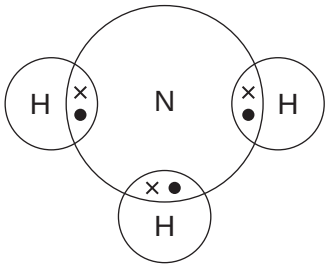
Question 14 · continued

4 (b) Fertilisers can be made from ammonia.

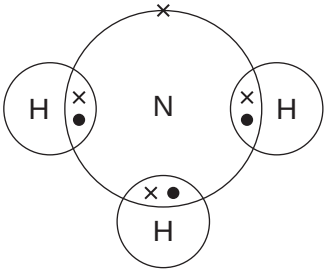
4 (b) (i) Which diagram, **A**, **B**, or **C**, represents the electronic structure of an ammonia molecule?

[1 mark]

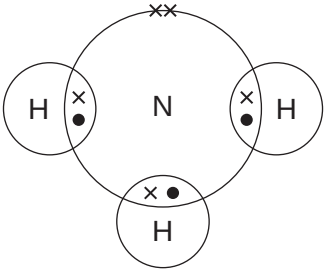
A



B



C



The electronic structure of an ammonia molecule is shown in diagram ☐

4 (b) (ii) What is the correct formula of ammonia?

Draw a ring around the correct answer.

[1 mark]

N_3H NH_3 NH^3

Question 4 continues on the next page

4.1.1.7 Electronic structure

Question 14 · continued

4 (c) A student made ammonium nitrate by reacting ammonia solution with an acid.

4 (c) (i) Name the acid used to make ammonium nitrate.

[1 mark]

.....

4 (c) (ii) Complete the sentence.

[1 mark]

The student added a few drops of ....., which changed colour when the ammonia solution had neutralised the acid.

4 (c) (iii) The student added charcoal and filtered the mixture.

This produced a colourless solution of ammonium nitrate.

How is solid ammonium nitrate obtained from the solution?

[1 mark]

.....

4 (c) (iv) A farmer put ammonium nitrate fertiliser onto a field of grass.

Suggest what would happen to the grass.

[1 mark]

.....

.....

Question 14 · continued

4 (d) Some fertilisers contain potassium chloride.

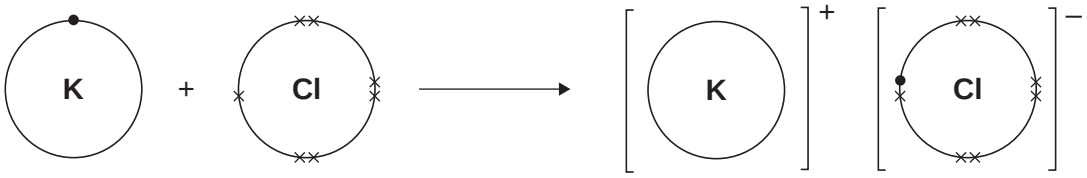
Potassium reacts with chlorine to produce potassium chloride.

Figure 6 shows how this happens.

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

Only the outer shell is shown.

Figure 6



Use **Figure 6** to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with chlorine to produce potassium chloride.

[4 marks]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

13

4.1.1.7 Electronic structure

Question 15

June 2015 | CH1FP | Original Q1 | Legacy

1 This question is about metals.

1 (a) Which unreactive metal is found in the Earth as the metal itself?

[1 mark]

Tick (✓) **one** box.

aluminium ☐

gold ☐

magnesium ☐

1 (b) Complete the sentence.

[1 mark]

Aluminium is an element because aluminium is made of

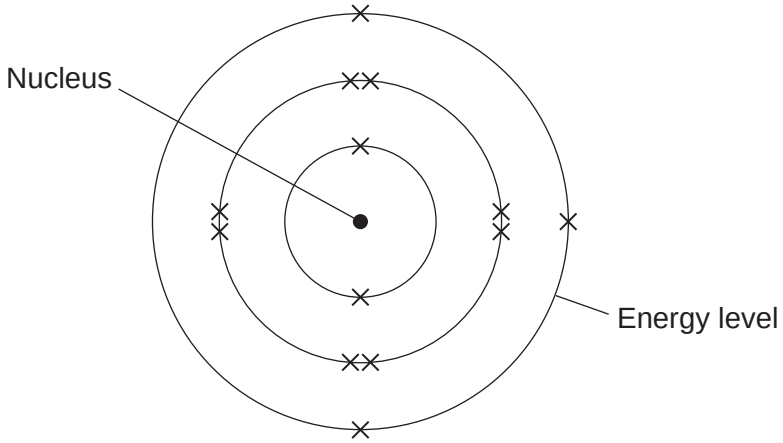
only one type of ..... .

4.1.1.7 Electronic structure

Question 15 · continued

1 (c) **Figure 1** shows the electronic structure of an aluminium atom.

Figure 1



1 (c) (i) Use the correct words from the box to complete the sentence.

[2 marks]

electrons	**ions**	**protons**	**neutrons**	**shells**

The nucleus of an aluminium atom contains ..... and ..... .

1 (c) (ii) Complete the sentence.

[1 mark]

In the periodic table, aluminium is in Group ..... .

Question 1 continues on the next page

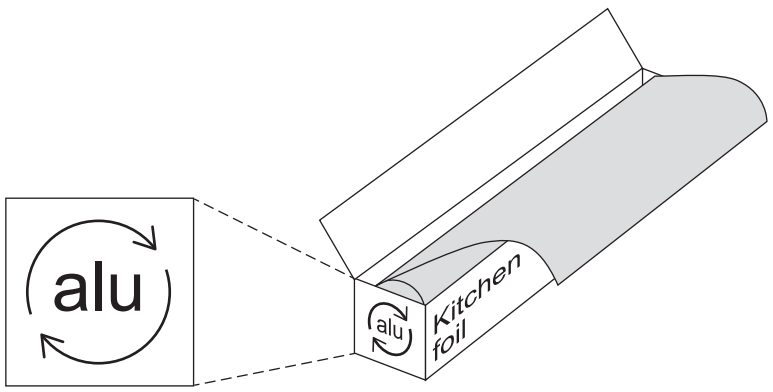
4.1.1.7 Electronic structure

Question 15 · continued

1 (d) Aluminium is used for kitchen foil.

Figure 2 shows a symbol on a box of kitchen foil.

Figure 2



The symbol means that aluminium can be recycled. It does not show the correct chemical symbol for aluminium.

1 (d) (i) What is the correct chemical symbol for aluminium? ..... .

[1 mark]

1 (d) (ii) Give **two** reasons why aluminium should be recycled.

[2 marks]

.....

.....

.....

.....

1 (e) Aluminium has a low density, conducts electricity and is resistant to corrosion.

Which **one** of these properties makes aluminium suitable to use as kitchen foil?
Give a reason for your answer.

[2 marks]

.....

.....

.....

.....

10

4.1.1.7 Electronic structure

Question 16

June 2015 | CH2FP | Original Q1 | Legacy

1 This question is about carbon and gases in the air.

1 (a) Carbon atoms have protons, neutrons and electrons.

Complete **Table 1** by writing the relative mass of a neutron and an electron.

[2 marks]

Table 1

Name of particle	Relative mass
proton	1
neutron	
electron	

1 (b) What is the total number of protons and neutrons in an atom called?

[1 mark]

Tick (✓) **one** box.

The atomic number ☐

The mass number ☐

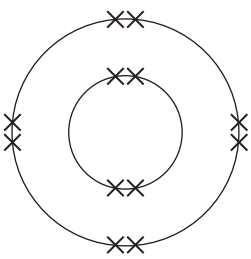
One mole of the atom ☐

1 (c) An atom of carbon has six electrons.

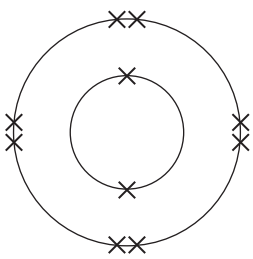
Which structure, **A**, **B** or **C**, represents the electronic structure of the carbon atom?

[1 mark]

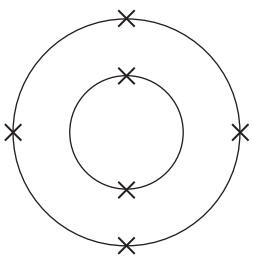
Structure A



Structure B



Structure C



The carbon atom is structure ☐.

4.1.1.7 Electronic structure

Question 16 · continued

1 (d) Carbon reacts with oxygen to produce carbon dioxide (CO_2).

1 (d) (i) How many different elements are in one molecule of carbon dioxide?

[1 mark]

.....

1 (d) (ii) What is the total number of atoms in one molecule of carbon dioxide?

[1 mark]

.....

1 (e) Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

1 (e) (i) Calculate the relative formula mass (M_r) of carbon monoxide.

Relative atomic masses (A_r): C = 12; O = 16

[1 mark]

.....

.....

M_r of carbon monoxide = ...

1 (e) (ii) Calculate the percentage by mass of carbon in carbon monoxide.

[1 mark]

.....

.....

Percentage by mass of carbon in carbon monoxide = ...%

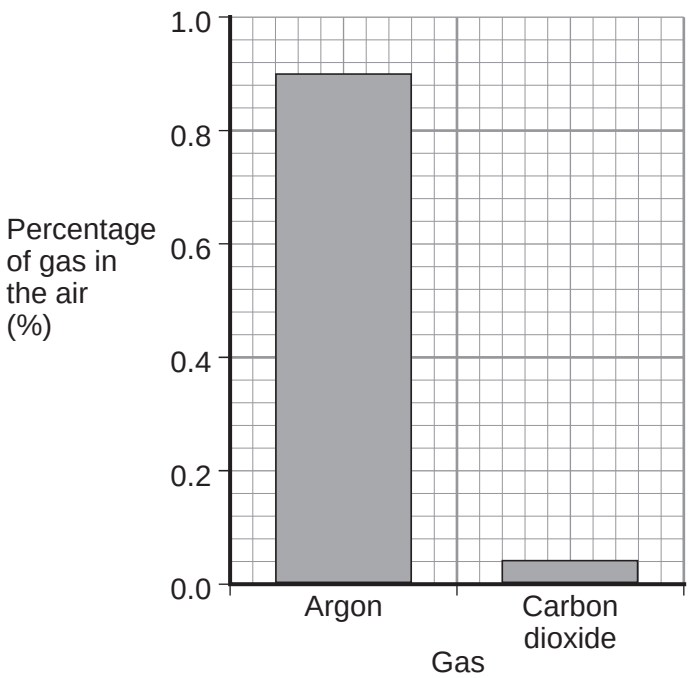
Question 1 continues on the next page

Question 16 · continued

1 (f) Carbon dioxide is one of the gases in the air.

1 (f) (i) **Figure 1** shows the percentage of argon and the percentage of carbon dioxide in the air.

Figure 1



What is the percentage of argon in the air?

[1 mark]

Percentage of argon = ... %

1 (f) (ii) An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

[1 mark]

.....

.....

10

4.1.1.7 Electronic structure

Question 17

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. ☐

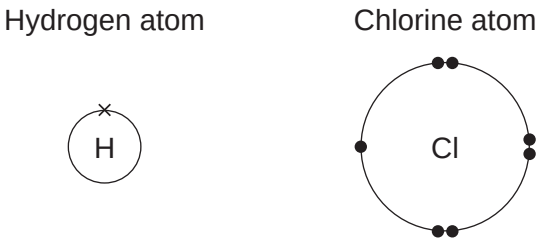
4.1.1.7 Electronic structure

Question 17 · 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.

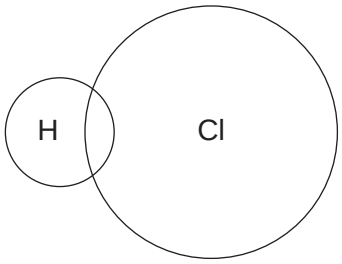
Figure 4



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

Question 17 · 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. ☐

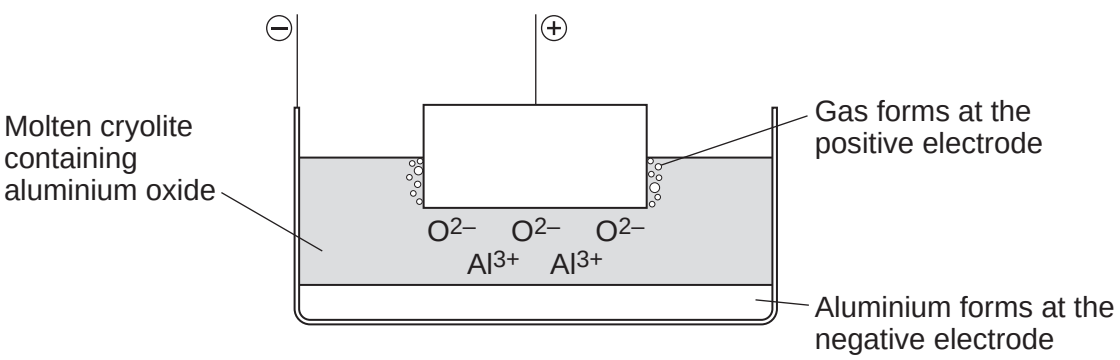
Hydrogen chloride is made of simple molecules. ☐

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]

.....

Question 17 · 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.

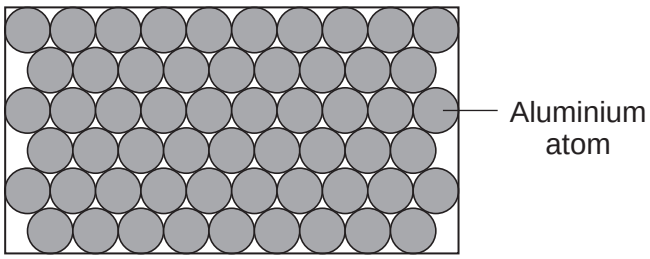
Combustion ☐

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

4.1.1.7 Electronic structure

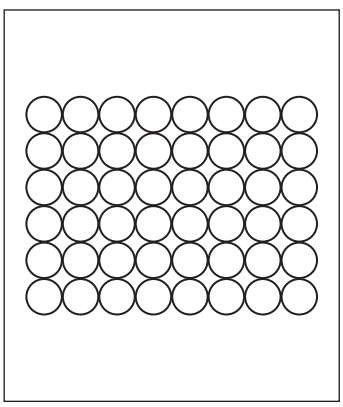
Question 17 · continued

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

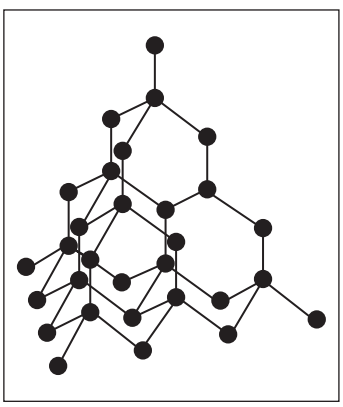
4 (d) (i) Which diagram, **A**, **B** or **C**, shows the structure of graphite?

[1 mark]

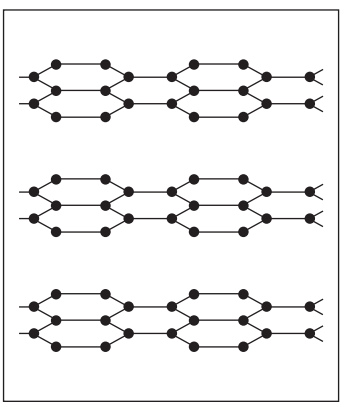
A



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

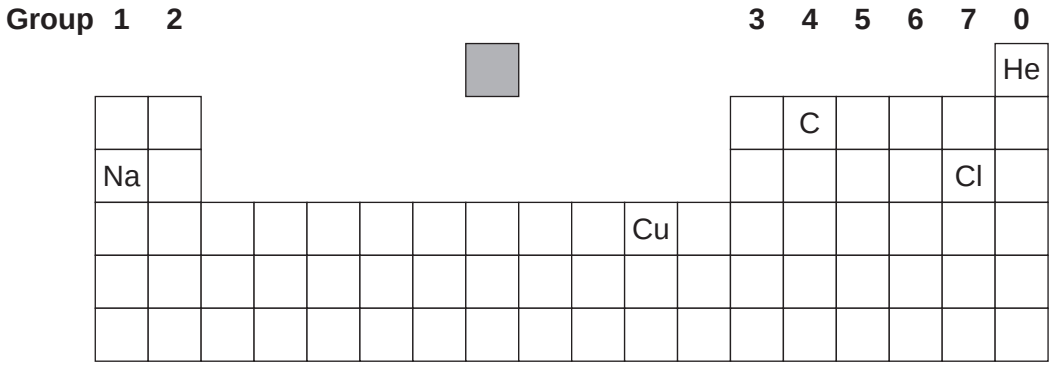
4.1.1.7 Electronic structure

Question 18

June 2015 | CH3FP | Original Q2 | Legacy

2 **Figure 2** shows the chemical symbols of five elements in the periodic table.

Figure 2



2 (a) Choose the correct chemical symbol from **Figure 2** to complete each sentence.

2 (a) (i) The element that is an alkali metal is ..... .

[1 mark]

2 (a) (ii) The element that is a transition metal is ..... .

[1 mark]

2 (a) (iii) The element in Group 4 is ..... .

[1 mark]

2 (a) (iv) The element with a full outer energy level (shell) of electrons is ..... .

[1 mark]

2 (b) Which other element goes in the shaded box in **Figure 2**? .....

[1 mark]

5

4.1.1.7 Electronic structure

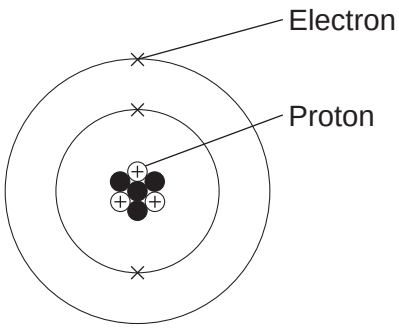
Question 19

June 2016 | CH1FP | Original Q1 | Legacy

1 There are eight elements in the second row (lithium to neon) of the periodic table.

1 (a) **Figure 1** shows a lithium atom.

Figure 1



1 (a) (i) What is the mass number of the lithium atom in **Figure 1**?

[1 mark]

Tick (✓) **one** box.

3 ☐

4 ☐

7 ☐

1 (a) (ii) What is the charge of an electron?

[1 mark]

Tick (✓) **one** box.

–1 ☐

0 ☐

+1 ☐

4.1.1.7 Electronic structure

Question 19 · continued

June 2016 | CH1FP | Original Q1 | Legacy

1 (a) (iii) Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

[1 mark]

Tick (✓) **one** box.

ions ☐

molecules ☐

neutrons ☐

1 (b) What is **always** different for atoms of different elements?

[1 mark]

Tick (✓) **one** box.

number of neutrons ☐

number of protons ☐

number of shells ☐

Question 1 continues on the next page

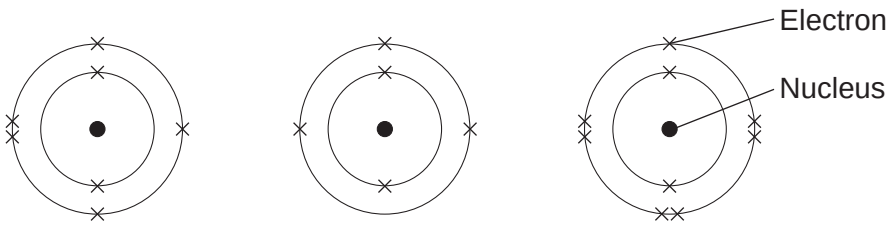
4.1.1.7 Electronic structure

Question 19 · continued

1 (c) **Figure 2** shows the electron arrangements of three different atoms, **X**, **Y** and **Z**.

These atoms are from elements in the second row (lithium to neon) of the periodic table.

Figure 2



Atom X **Atom Y** **Atom Z**

Which atom is from an element in Group 3 of the periodic table?

[1 mark]

Tick (✓) **one** box.

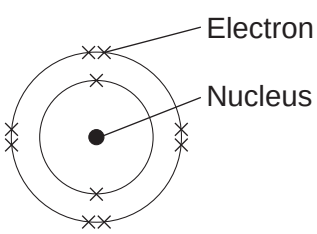
Atom X ☐

Atom Y ☐

Atom Z ☐

1 (d) **Figure 3** shows the electron arrangement of a different atom from an element in the second row of the periodic table.

Figure 3



1 (d) (i) Give the chemical symbol of this element.

[1 mark]

_____

1 (d) (ii) Why is this element unreactive?

[1 mark]

_____

_____

7

4.1.1.7 Electronic structure

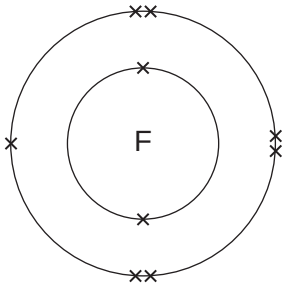
Question 20

June 2016 | CH2FP | Original Q1 | Legacy

1 This question is about fluorine.

1 (a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



1 (a) (i) In which group of the periodic table is fluorine?

[1 mark]

Group _____

1 (a) (ii) Complete **Table 1** to show the particles in an atom and their relative masses.

[2 marks]

Table 1

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

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

[1 mark]

alkalis	**alloys**	**isotopes**

Atoms of fluorine with different numbers of neutrons are called _____ .

4.1.1.7 Electronic structure

Question 20 · continued

1 (b) Sodium reacts with fluorine to produce sodium fluoride.

1 (b) (i) Complete the word equation for this reaction.

[1 mark]

sodium + _____ ⟶ _____

1 (b) (ii) Complete the sentence.

[1 mark]

Substances in which atoms of two or more different elements are chemically combined are called _____ .

1 (b) (iii) The relative formula mass (M_r) of sodium fluoride is 42.

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

[1 mark]

ion	mole	molecule

The relative formula mass (M_r), in grams, of sodium fluoride is one _____ of the substance.

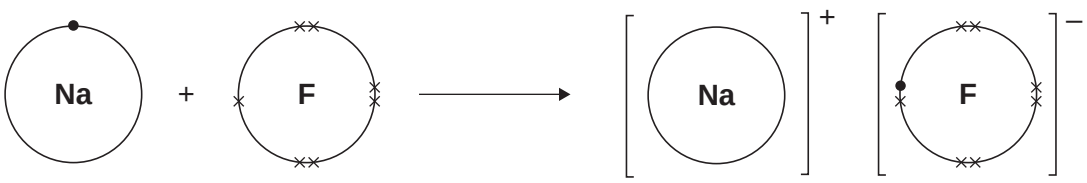
Question 1 continues on the next page

Question 20 · continued

1 (b) (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

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

Figure 2



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

[4 marks]

4.1.1.7 Electronic structure

Question 20 · continued

1 (b) (v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

[2 marks]

Tick (✓) **two** boxes.

- Dissolve in water ☐
- Gas at room temperature ☐
- High melting point ☐
- Low boiling point ☐

13

Turn over for the next question

4.1.1.7 Electronic structure

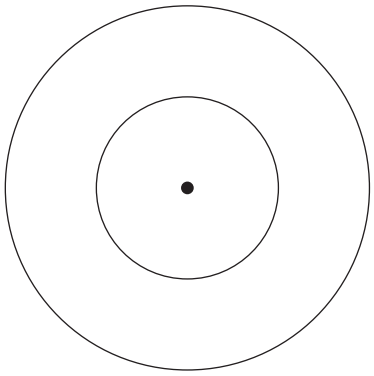
Question 21

June 2017 | CH1FP | Original Q6 | Legacy

6 This question is about compounds of carbon.

6 (a) **Figure 7** shows an atom with two energy levels (shells).

Figure 7



6 (a) (i) A carbon atom has six electrons.

Complete **Figure 7** to show the electronic structure of a carbon atom.

Use **x** to represent an electron.

[1 mark]

6 (a) (ii) Complete the following description about the central part of this carbon atom.

[3 marks]

The central part is made up of six neutrons that have no electrical charge and _____

_____

_____

_____

_____

6 (b) Crude oil is a mixture of compounds. These compounds are mainly hydrocarbons.

What does the term hydrocarbon mean?

[1 mark]

_____

_____

Question 21 · continued

6 (c) Alkanes and alkenes are hydrocarbons.

Table 2 shows the boiling points of some alkanes and alkenes.

Table 2

Alkanes

Name	Formula	Boiling point in °C
Ethane	C_2H_6	−88
Propane	C_3H_8	−42
Butane	C_4H_{10}	0
Pentane	C_5H_{12}	+36
Hexane	C_6H_{14}	+69

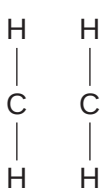
Alkenes

Name	Formula	Boiling point in °C
Ethene	C_2H_4	−104
Propene	C_3H_6	−48
Butene	C_4H_8	−6
Pentene	C_5H_{10}	+30
Hexene	C_6H_{12}	+64

6 (c) (i) Complete the displayed structure of ethane and the displayed structure of ethene.

[2 marks]

Ethane



Ethene



6 (c) (ii) Describe the relationship between the number of carbon atoms in an alkane molecule and the boiling point of the alkane molecule.

[1 mark]

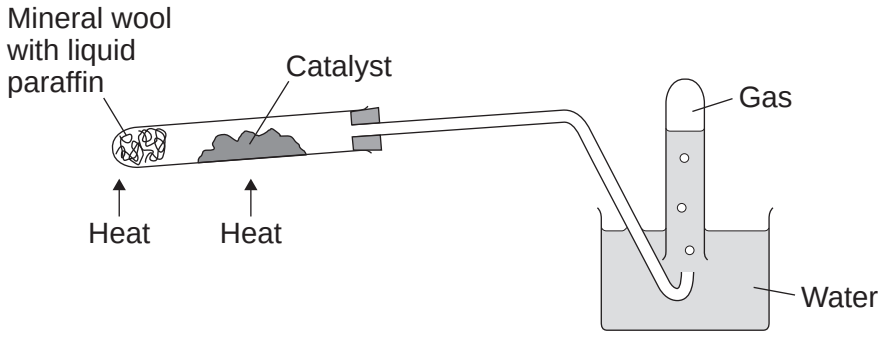
Question 21 · continued

6 (c) (iii) Use the information in **Table 2** to compare the boiling points of alkanes with the boiling points of alkenes.

[2 marks]

6 (d) A student used the apparatus in **Figure 8** to investigate what happens when liquid paraffin is heated to a high temperature.

Figure 8



Liquid paraffin contains alkanes.

Describe what happens to the alkane molecules in this investigation.

[3 marks]

13

4.1.1.7 Electronic structure

Question 22

June 2017 | CH2FP | Original Q3 | Legacy

3 This question is about oxygen and substances containing oxygen.

3 (a) Oxygen is a gas at room temperature.

3 (a) (i) What type of bonding holds the atoms together in oxygen?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

3 (a) (ii) Which **two** statements about oxygen are true?

[2 marks]

Tick (✓) **two** boxes.

Oxygen consists of a giant lattice. ☐

Oxygen consists of small molecules. ☐

Oxygen conducts electricity. ☐

Oxygen is an alloy. ☐

Oxygen has a low boiling point. ☐

Question 3 continues on the next page

Question 22 · continued

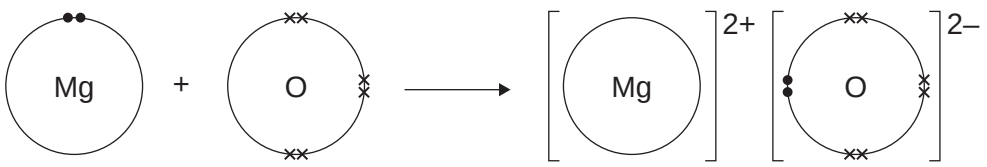
3 (b) Magnesium oxide is produced when magnesium reacts with oxygen.

3 (b) (i) **Figure 6** shows what happens to the electrons in the outer shells when a magnesium atom reacts with an oxygen atom.

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

Only the outer electrons are shown.

Figure 6



Describe, in terms of electrons, what happens when a magnesium atom reacts with an oxygen atom to produce magnesium oxide.

[4 marks]

4.1.1.7 Electronic structure

Question 22 · continued

3 (b) (ii) Nanoparticles of magnesium oxide can be made.

Which **two** statements about nanoparticles are true?

[2 marks]

Tick (✓) **two** boxes.

Nanoparticles are very small atoms. ☐

Nanoparticles can return to their original shape after being deformed. ☐

Nanoparticles contain a few hundred atoms. ☐

Nanoparticles contain millions of molecules. ☐

Nanoparticles have a high surface area to volume ratio. ☐

3 (c) Silicon dioxide has a very high melting point.

Silicon dioxide does not conduct electricity when molten.

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

[1 mark]

giant covalent	giant ionic	metallic

The structure of silicon dioxide is _____ .

10

4.1.1.7 Electronic structure

Question 23

June 2017 | CH2FP | Original Q4 | Legacy

4 This question is about sodium chloride.

4 (a) Calculate the relative formula mass (M_r) of sodium chloride (NaCl).

Relative atomic masses (A_r): Na = 23; Cl = 35.5

[1 mark]

Relative formula mass (M_r) = _____

4 (b) A student reacted hydrochloric acid and sodium hydroxide solution to produce sodium chloride and another product.

Use the correct answer from the box to complete the word equation for the reaction.

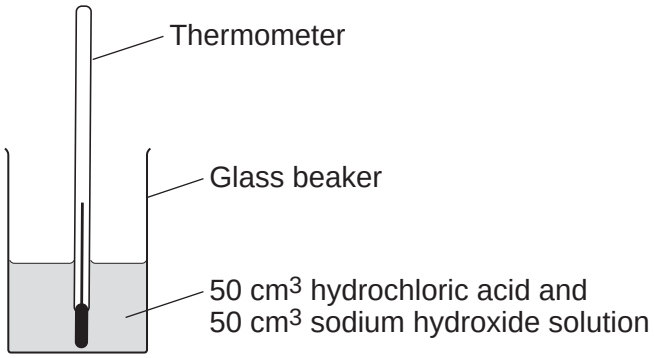
[1 mark]

chlorine	**hydrogen**	**oxygen**	**water**

hydrochloric acid + sodium hydroxide ⟶ sodium chloride + _____

4 (c) **Figure 7** shows the apparatus the student used to measure the temperature change in the reaction between hydrochloric acid and sodium hydroxide solution.

Figure 7



The student:

- measured 50 cm^3 hydrochloric acid into a glass beaker
- measured the temperature of the hydrochloric acid
- added 50 cm^3 of sodium hydroxide solution
- measured the highest temperature of the solution
- repeated the experiment with insulation around the glass beaker.

Question 23 · continued

4 (c) (i) Suggest **one** reason why the insulation around the glass beaker gives more accurate results.

[1 mark]

_____

_____

4 (c) (ii) The student did the investigation using the insulation three times.

Table 2 shows the results.

Table 2

Experiment number	Temperature of acid before reaction in °C	Highest temperature of solution in °C	Temperature change in °C
1	20	33	13
2	20	34	14
3	19	32	

Calculate the temperature change in **Experiment 3**.

Write your answer in **Table 2**.

[1 mark]

4 (c) (iii) How does **Table 2** show that the results are repeatable?

[1 mark]

_____

_____

4 (c) (iv) Complete the sentence.

[1 mark]

The temperature increase shows that the reaction between hydrochloric acid and sodium hydroxide is _____ .

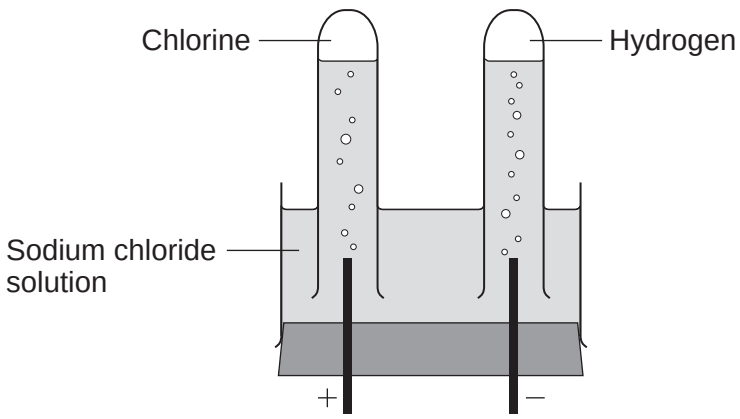
Question 4 continues on the next page

4.1.1.7 Electronic structure

Question 23 · continued

4 (d) A student investigated the electrolysis of sodium chloride solution, as shown in **Figure 8**.

Figure 8



4 (d) (i) State, in terms of ions, why sodium chloride solution conducts electricity.

[1 mark]

_____

_____

4 (d) (ii) Chlorine is produced at the positive electrode.

Why are chloride ions attracted to the positive electrode?

[1 mark]

_____

_____

4 (d) (iii) When sodium chloride solution is electrolysed, sodium hydroxide is also produced.

What can be manufactured from sodium hydroxide?

[1 mark]

Tick (✓) **one** box.

Alloys ☐

Poly(ethene) ☐

Soap ☐

4.1.1.7 Electronic structure

Question 23 · continued

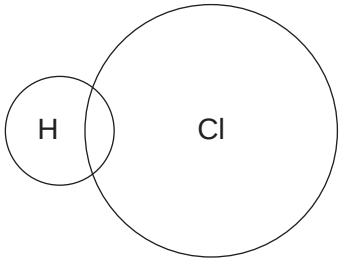
4 (d) (iv) The products chlorine and hydrogen react to form hydrogen chloride.

Hydrogen atoms have one electron in their outer shell. Chlorine atoms have seven electrons in their outer shell.

Complete **Figure 9** to show how the outer electrons are arranged in a molecule of hydrogen chloride (HCl).

[2 marks]

Figure 9



4 (d) (v) Which calculation shows the percentage of hydrogen in hydrogen chloride?

Relative atomic masses (A_r): H = 1; Cl = 35.5

Relative formula mass (M_r): HCl = 36.5

[1 mark]

Tick (✓) **one** box.

$\frac{35.5}{36.5} \times 100$ ☐

$\frac{1}{35.5} \times 100$ ☐

$\frac{1}{36.5} \times 100$ ☐

$\frac{1}{72.0} \times 100$ ☐

12

4.1.1.7 Electronic structure

Question 24

June 2017 | CH3FP | Original Q1 | Legacy

1 This question is about elements and compounds.

1 (a) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

densities	numbers	weights

The elements in the modern periodic table are arranged in order of their atomic _____ .

1 (a) (ii) Use the correct answer from the box to complete the sentence.

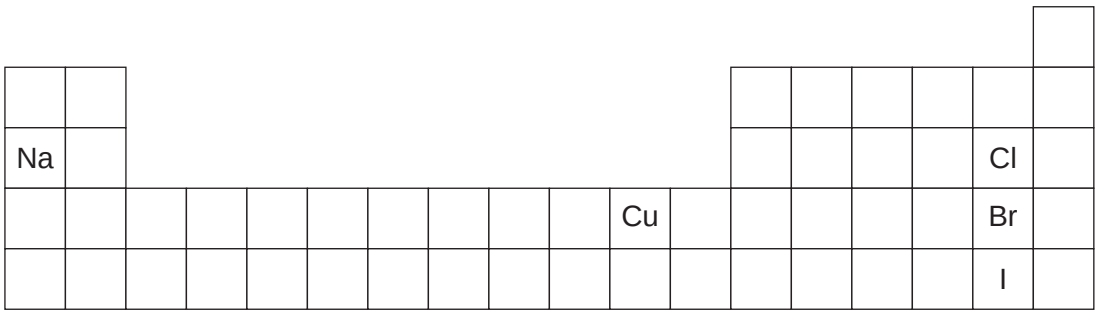
[1 mark]

electrons	neutrons	protons

The outer shells of atoms of elements in the same group have the same number of _____ .

1 (b) **Figure 1** shows the position of five elements in the modern periodic table.

Figure 1



1 (b) (i) Which **one** of the elements in **Figure 1** is a gas at room temperature?

[1 mark]

_____

4.1.1.7 Electronic structure

Question 24 · continued

1 (b) (ii) Which **one** of the elements in **Figure 1** is a transition metal?

[1 mark]

_____

1 (b) (iii) Complete the sentence.

[1 mark]

In the modern periodic table, bromine (Br) is in Group _____ .

1 (c) Bromine reacts with sodium iodide to produce iodine.

The word equation for the reaction is:

bromine + sodium iodide ⟶ iodine + sodium bromide

1 (c) (i) What type of reaction is this?

[1 mark]

Tick (✓) **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

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

Which halogen would react with sodium chloride solution to produce chlorine?

[1 mark]

Tick (✓) **one** box.

Bromine ☐

Fluorine ☐

Iodine ☐

Question 1 continues on the next page

4.1.1.7 Electronic structure

Question 24 · continued

1 (d) Silver nitrate in the presence of dilute nitric acid is used to test for iodide ions.

What colour precipitate is produced?

[1 mark]

Tick (✓) **one** box.

Cream ☐

White ☐

Yellow ☐

4.1.1.7 Electronic structure

Question 24 · continued

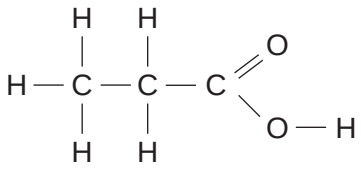
1 (e) Propanoic acid is a compound containing carbon atoms.

1 (e) (i) **Figure 2** shows the displayed structure of propanoic acid.

Draw a ring around the functional group of propanoic acid in **Figure 2**.

[1 mark]

Figure 2



1 (e) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

carbon dioxide	hydrogen	oxygen

Propanoic acid reacts with carbonates to produce _____ .

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

[1 mark]

alkalis	esters	fuels

Propanoic acid reacts with alcohols to produce pleasant smelling compounds called _____ .

11

4.1.1.7 Electronic structure

Question 25

June 2018 | 8462/1F | Original Q2

0 2 The halogens are elements in Group 7.

0 2 . 1 Bromine is in Group 7.

Give the number of electrons in the outer shell of a bromine atom.

[1 mark]

0 2 . 2 Bromine reacts with hydrogen. The gas hydrogen bromide is produced.

What is the structure of hydrogen bromide?

[1 mark]

Tick **one** box.

- Giant covalent ☐
- Ionic lattice ☐
- Metallic structure ☐
- Small molecule ☐

0 2 . 3 What is the formula for fluorine gas?

[1 mark]

Tick **one** box.

- F ☐
- F_2 ☐
- F^2 ☐
- 2F ☐

4.1.1.7 Electronic structure

Question 25 · continued

A student mixes solutions of halogens with solutions of their salts.

Table 1 shows the student's observations.

Table 1

	Potassium chloride (colourless)	Potassium bromide (colourless)	Potassium iodide (colourless)
Chlorine (colourless)		Solution turns orange	Solution turns brown
Bromine (orange)	No change		Solution turns brown
Iodine (brown)	No change	No change	

0 2 . 4 Explain how the reactivity of the halogens changes going down Group 7.

Use the results in **Table 1**.

[3 marks]

Question 2 continues on the next page

4.1.1.7 Electronic structure

Question 25 · continued

A company uses chlorine to produce titanium chloride from titanium dioxide.

0 2 . 5 What is the relative formula mass (M_r) of titanium dioxide, TiO_2?

Relative atomic masses (A_r): O = 16 Ti = 48

[1 mark]

Tick **one** box.

64 ☐

80 ☐

128 ☐

768 ☐

0 2 . 6 The company calculates that 500 g of titanium dioxide should produce 1.2 kg of titanium chloride.

However, the company finds that 500 g of titanium dioxide only produces 900 g of titanium chloride.

Calculate the percentage yield.

[2 marks]

Percentage yield = _____ %

9

4.1.1.7 Electronic structure

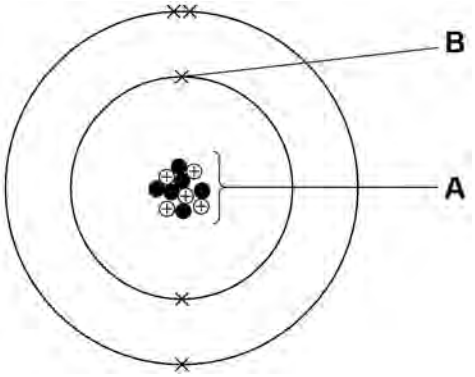
Question 26

June 2019 | 8462/1F | Original Q1

0 1 This question is about atomic structure.

Figure 1 represents an atom of element **Z**.

Figure 1



0 1 . 1 Name the parts of the atom labelled **A** and **B**.

Choose answers from the box.

[2 marks]

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

A _____

B _____

4.1.1.7 Electronic structure

Question 26 · continued

0 1 . 2 Which particle has the lowest mass?

Choose the answer from the box.

[1 mark]

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

0 1 . 3 Which group of the periodic table contains element **Z**?

Use **Figure 1**.

[1 mark]

Group _____

0 1 . 4 Give the atomic number and the mass number of element **Z**.

Use **Figure 1**.

Choose answers from the box.

[2 marks]

1	**5**	**6**	**11**	**16**

Atomic number _____

Mass number _____

Question 1 continues on the next page

4.1.1.7 Electronic structure

Question 26 · continued

Bromine has two different types of atom.

The atoms have a different number of neutrons but the same number of protons.

0 1 . 5 What is the name for this type of atom?

[1 mark]

Tick (✓) **one** box.

Compound ☐

Ion ☐

Isotope ☐

Molecule ☐

0 1 . 6 The different types of bromine atom can be represented as $^{79}_{35}Br$ and $^{81}_{35}Br$

The relative atomic mass (A_r) of bromine is 80

Which statement is true about the number of each type of atom in bromine?

[1 mark]

Tick (✓) **one** box.

There are fewer $^{79}_{35}Br$ atoms than $^{81}_{35}Br$ atoms. ☐

There are more $^{79}_{35}Br$ atoms than $^{81}_{35}Br$ atoms. ☐

There are the same number of $^{79}_{35}Br$ atoms and $^{81}_{35}Br$ atoms. ☐

8

4.1.1.7 Electronic structure

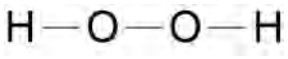
Question 27

June 2019 | 8462/1F | Original Q2

0 2 This question is about compounds of oxygen and hydrogen.

Figure 2 represents the structure of hydrogen peroxide.

Figure 2



0 2 . 1 What is the correct formula of hydrogen peroxide?

[1 mark]

Tick (✓) **one** box.

- H2O2 ☐
- HO_2 ☐
- H^2O^2 ☐
- H_2O_2 ☐

0 2 . 2 Which type of bonding is shown in **Figure 2**?

[1 mark]

Tick (✓) **one** box.

- Covalent ☐
- Ionic ☐
- Metallic ☐

0 2 . 3 Hydrogen peroxide decomposes in the presence of a catalyst.

Which elements are often used as catalysts?

[1 mark]

Tick (✓) **one** box.

Alkali metals ☐

Halogens ☐

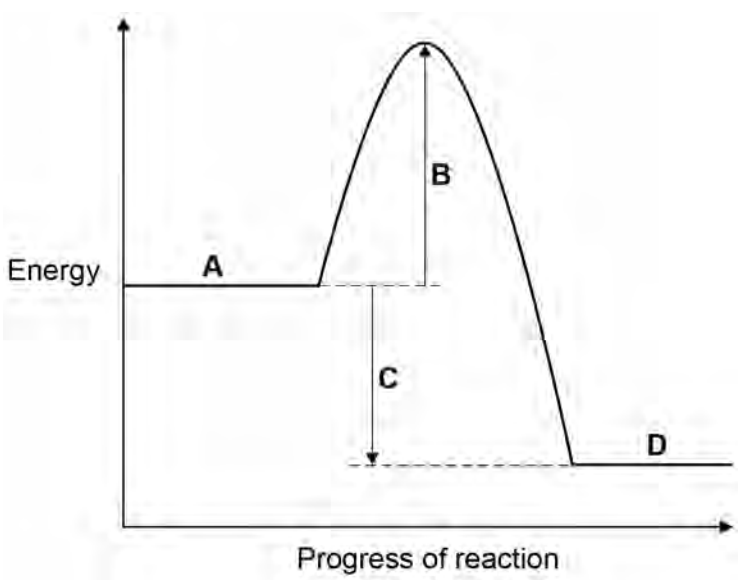
Transition metals ☐

Figure 3 shows the reaction profile for the decomposition of hydrogen peroxide.

The word equation for this reaction is:

hydrogen peroxide → water + oxygen

Figure 3



Question 27 · continued

Labels **A**, **B**, **C** and **D** each represent a different part of the reaction profile.

Use **Figure 3** to answer Questions **02.4** and **02.5**

0 2 . 4 Which label shows the activation energy?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 5 Which label shows the energy of hydrogen peroxide?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 6 The decomposition of hydrogen peroxide gives out energy to the surroundings.

What type of reaction is this?

[1 mark]

Tick (✓) **one** box.

Displacement ☐

Endothermic ☐

Exothermic ☐

Neutralisation ☐

Question 2 continues on the next page

4.1.1.7 Electronic structure

Question 27 · continued

0 2 . 7 Hydrogen and oxygen form water.

A hydrogen atom contains one electron.

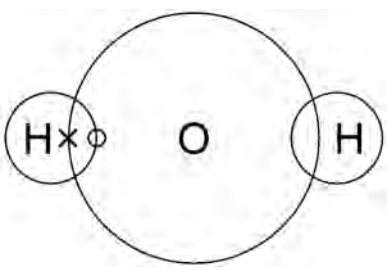
An oxygen atom contains six electrons in the outer shell.

Complete **Figure 4** to show a dot and cross diagram for a water molecule.

Show the outer electrons only.

[2 marks]

Figure 4



8

4.1.1.7 Electronic structure

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 ☐

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]

4.1.1.7 Electronic structure

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.

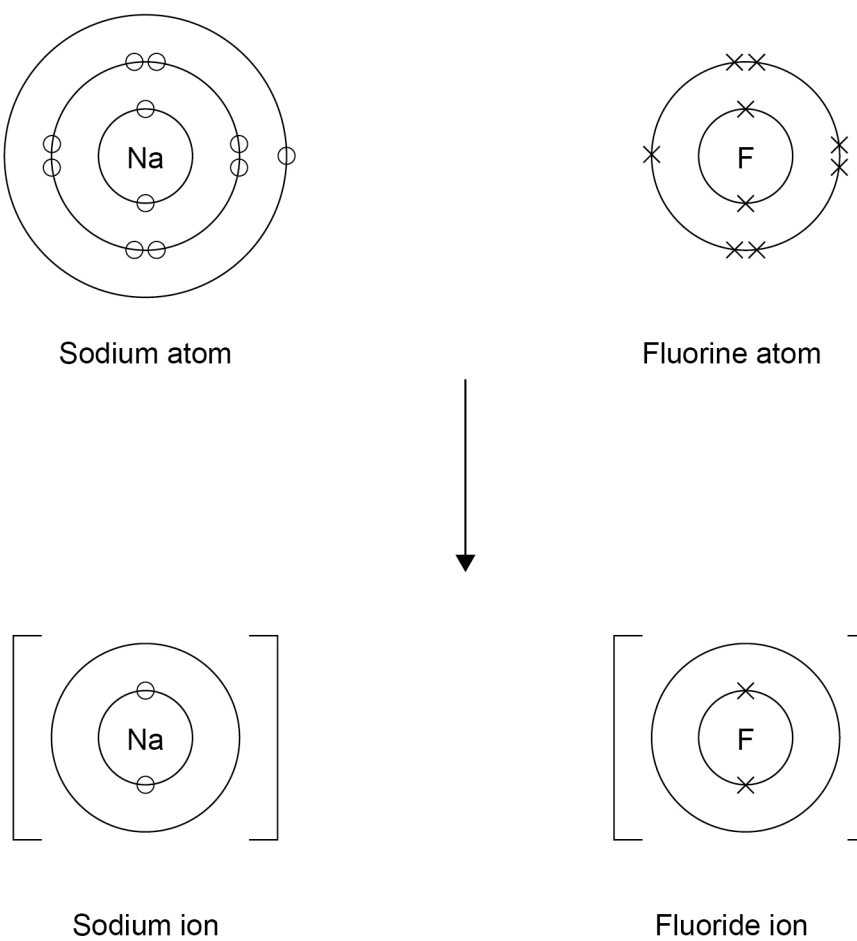
Complete **Figure 5** to show what happens when a sodium atom and a fluorine atom react to produce sodium fluoride.

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

4.1.1.7 Electronic structure

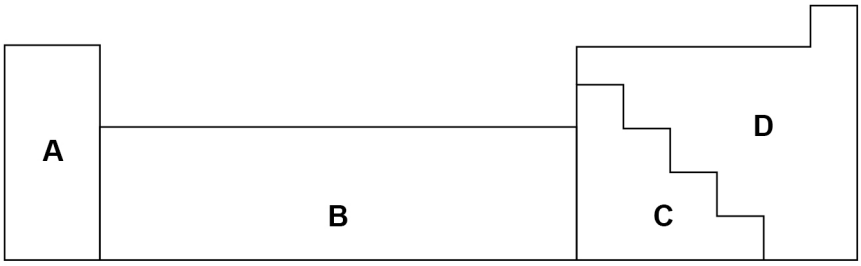
Question 29

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 _____

_____

4.1.1.7 Electronic structure

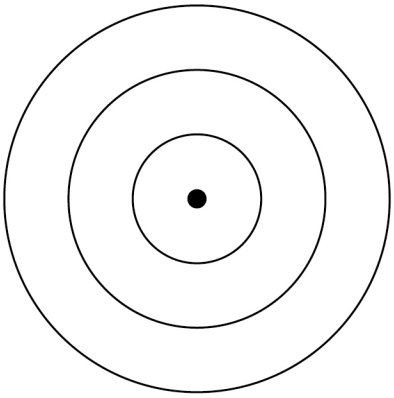
Question 29 · continued

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]

4.1.1.7 Electronic structure

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

4.1.1.7 Electronic structure

Question 30

June 2023 | 8462/1F | Original Q9

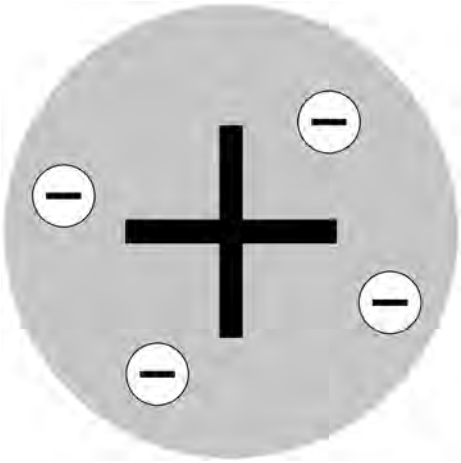
0 9 Discoveries in chemistry led to a better understanding of atomic structure.

0 9 . 1 Atoms were originally thought to be tiny spheres that could not be divided.

The plum pudding model of the atom was then developed.

Figure 10 represents the plum pudding model of the atom.

Figure 10



Describe the plum pudding model of the atom.

[2 marks]

0 9 . 2 Atoms contain electrons, neutrons and protons.

Write these three particles in order of their discovery.

[1 mark]

Earliest _____

_____

Latest _____

Very few atoms of the element tennessine (Ts) have ever been identified.

The atomic number of tennessine is 117

0 9 . 3 Predict the number of outer shell electrons in an atom of tennessine.

Give **one** reason for your answer.

Use the periodic table.

[2 marks]

Number of outer shell electrons _____

Reason _____

_____

0 9 . 4 Tennessine was first identified by a small group of scientists in 2010.

Suggest **one** reason why tennessine was **not** accepted as a new element by other scientists until 2015.

[1 mark]

_____

_____

Question 9 continues on the next page

0 9 . 5 The discovery of isotopes explained why some relative atomic masses are not whole numbers.

Element **R** has two isotopes.

Table 5 shows the mass numbers and percentage abundances of the isotopes of element **R**.

Table 5

Mass number	Percentage abundance (%)
6	7.6
7	92.4

Calculate the relative atomic mass (A_r) of element **R**.

Give your answer to 1 decimal place.

[3 marks]

Relative atomic mass (1 decimal place) = _____

9

4.1.1.7 Electronic structure

Question 31

June 2024 | 8462/1F | Original Q9

0 9 This question is about the periodic table.

Sodium and potassium are in Group 1 of the periodic table.

0 9 . 1 Give **one** similarity and **one** difference between the electronic structures of sodium and potassium.

[2 marks]

Similarity _____

_____

Difference _____

_____

Group 1 elements react with water.

0 9 . 2 Give **two** observations made when potassium reacts with water.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 3 Potassium hydroxide solution is produced when potassium reacts with water.

What is the colour of universal indicator when added to potassium hydroxide solution?

Give **one** reason for your answer.

[2 marks]

Colour of universal indicator _____

Reason _____

_____

Question 31 · continued

Table 4 shows the densities of some of the elements in Group 0 of the periodic table.

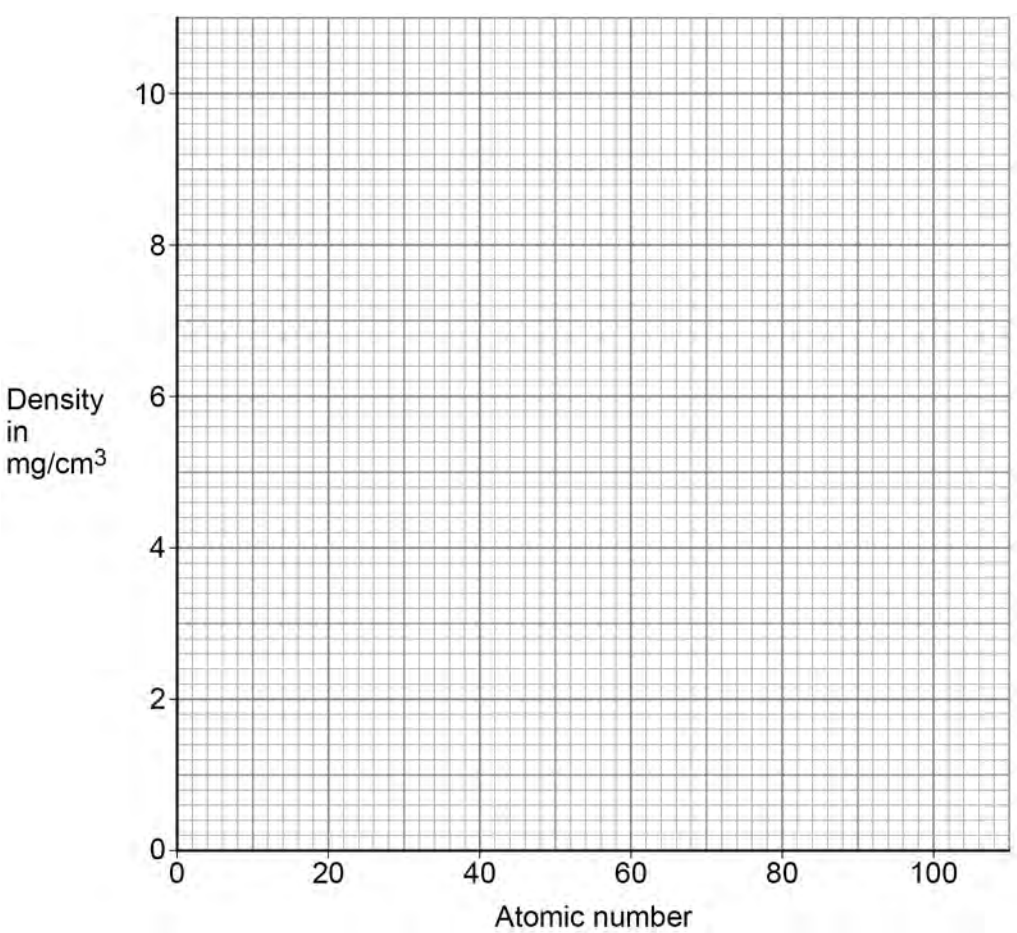
Table 4

Element	Atomic number	Density in mg/cm^3
Helium	2	0.2
Neon	10	0.8
Argon	18	1.6
Krypton	36	**X**
Xenon	54	5.4
Radon	86	9.1

0 9 . 4 Plot the data from **Table 4** on **Figure 15**.

[2 marks]

Figure 15



4.1.1.7 Electronic structure

Question 31 · continued

0 9 . 5 Estimate the density (**X**) of krypton.

Use **Figure 15** and **Table 4**.

[1 mark]

Density = _____ mg/cm^3

0 9 . 6 The elements in Group 7 are called the halogens.

A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Which combination of solutions will produce a reaction when mixed?

[1 mark]

Tick (✓) **one** box.

- Chlorine and potassium fluoride ☐
- Chlorine and potassium bromide ☐
- Bromine and potassium fluoride ☐
- Bromine and potassium chloride ☐

0 9 . 7 Which of the following describes the trends going down Group 7?

[1 mark]

Tick (✓) **one** box.

- Relative molecular mass decreases and boiling point decreases. ☐
- Relative molecular mass decreases and boiling point increases. ☐
- Relative molecular mass increases and boiling point decreases. ☐
- Relative molecular mass increases and boiling point increases. ☐

11

4.1.1.7 Electronic structure

Question 32

June 2025 | 8462/1F | Original Q8

0 8 This question is about elements in the periodic table.

0 8 . 1 Describe where the non-metallic elements are found in the periodic table.

[1 mark]

0 8 . 2 Gallium (Ga) is a metallic element in Group 3.

Which of these properties of gallium is **not** typical of most metals?

[1 mark]

Tick (✓) **one** box.

- A boiling point above 1000 °C ☐
- A melting point below 100 °C ☐
- Conducts electricity when solid ☐
- Forms positive ions ☐

4.1.1.7 Electronic structure

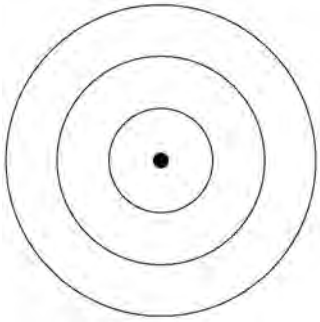
Question 32 · continued

0 8 . 3 A sodium atom can be represented as $^{23}_{11}Na$

Complete **Figure 12** to show the electronic structure of a sodium atom.

[1 mark]

Figure 12



0 8 . 4 Mendeleev created an early periodic table.

Mendeleev placed most of the elements in order of atomic weight.

Tellurium and iodine were not placed in order of atomic weight.

Why did Mendeleev **not** place tellurium and iodine in order of atomic weight?

[1 mark]

0 8 . 5 Argon is an element in Group 0 of the periodic table.

Explain why argon is unreactive.

[2 marks]

Question 32 · continued

An element **X** consists of two isotopes.

0 8 . 6 What is meant by 'isotopes'?

Answer in terms of subatomic particles.

[2 marks]

0 8 . 7 **Table 5** shows the mass numbers and percentage abundances of the isotopes of **X**.

Table 5

Mass number	Percentage abundance (%)
113	4
115	96

Which is the closest estimate to the relative atomic mass of **X**?

[1 mark]

Tick (✓) **one** box.

~113 ☐ ~114 ☐ ~115 ☐

9