AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 2)

SCORE	PERCENTAGE
/298	%

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Q1.

This question is about elements and the periodic table.

(a) Newlands and Mendeleev both produced early versions of the periodic table.

(i) Complete the sentence.

In their periodic tables, Newlands and Mendeleev arranged the elements in order of _____ .

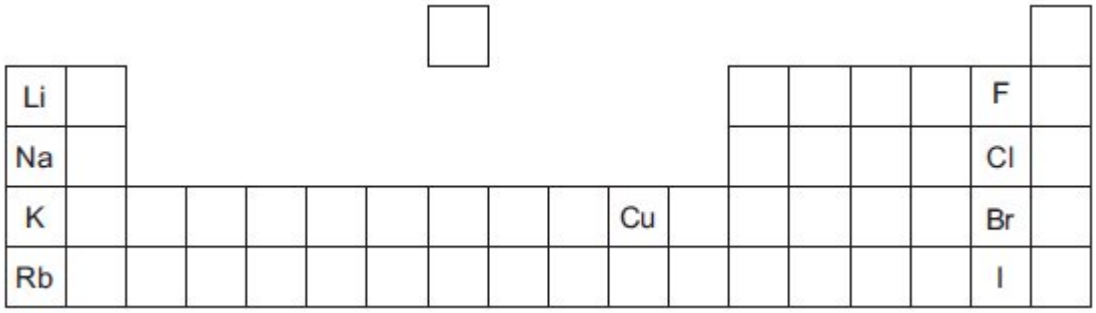
(1)

(ii) Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

_____

(1)

(b) The diagram below shows the position of nine elements in the modern periodic table.



(i) Which **one** of the nine elements shown in the diagram above has the lowest boiling point?

_____

(1)

(ii) Copper and potassium have different melting points and boiling points.
Give **one other** difference between the properties of copper and potassium.

_____

_____

(1)

(iii) Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

_____

_____

_____

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_____

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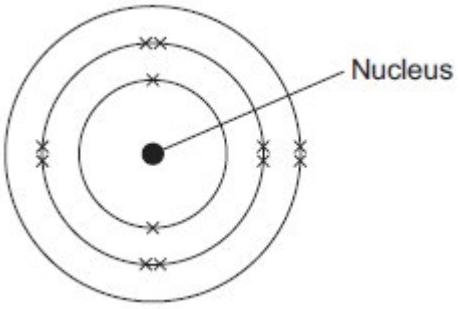
(4)

(Total 8 marks)

Q2.

This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



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

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

The nucleus contains protons and _____ .

The particles with the smallest relative mass that move around the nucleus are called _____ .

Atoms of magnesium are neutral because they contain the same number of electrons and _____ .

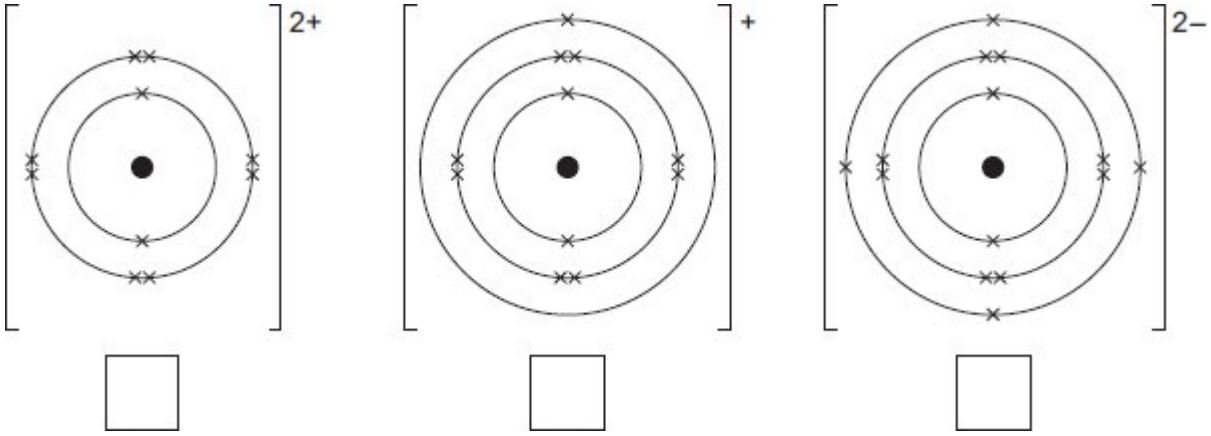
(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

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Tick (✓) **one** box.



(1)

(b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.

$$Mg(s) + 2\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

(i) State **two** observations that could be made during the reaction.

1. _____

_____

2. _____

_____

(2)

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

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

(6)

(Total 12 marks)

Q3.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

(a) (i) Which of these particles has a positive charge?

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

(1)

(ii) Which of these particles does **not** have an electrical charge?

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

(1)

(b) How are the elements in the periodic table arranged?

Tick (✓) **one** box.

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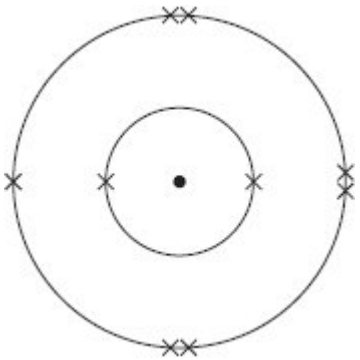
In order of increasing atomic number ☐

In order of increasing mass number ☐

In order of increasing reactivity ☐

(1)

(c) The diagram shows the arrangement of the electrons in an atom of fluorine.



(i) How many protons are in an atom of fluorine?

Tick (✓) **one** box.

2 ☐

7 ☐

9 ☐

(1)

(ii) The boiling point of fluorine is −188 °C.

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

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Solid ☐

Liquid ☐

Gas ☐

(1)

(d) Fluorine reacts with copper to form an ionic compound.

(i) Explain, in terms of electrons and electronic structure, what happens to a fluorine atom when it reacts with copper.

Use the figure above to help you to answer this question.

_____

_____

_____

_____

_____

(2)

(ii) Describe a chemical test which would show that a solution contains copper(II) ions.

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

Q4.

This question is about metals.

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

Tick (✓) **one** box.

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aluminium ☐

gold ☐

magnesium ☐

(1)

(b) Complete the sentence.

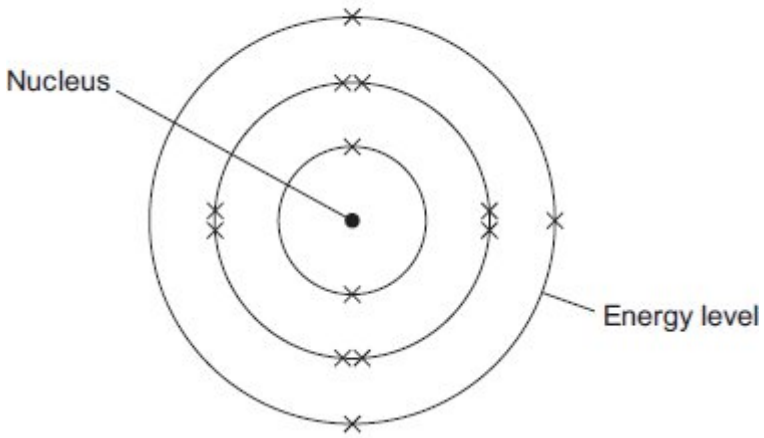
Aluminium is an element because aluminium is made of

only one type of _____ .

(1)

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

Figure 1



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

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

The nucleus of an aluminium atom contains _____ and

_____ .

(2)

(ii) Complete the sentence.

In the periodic table, aluminium is in Group _____ .

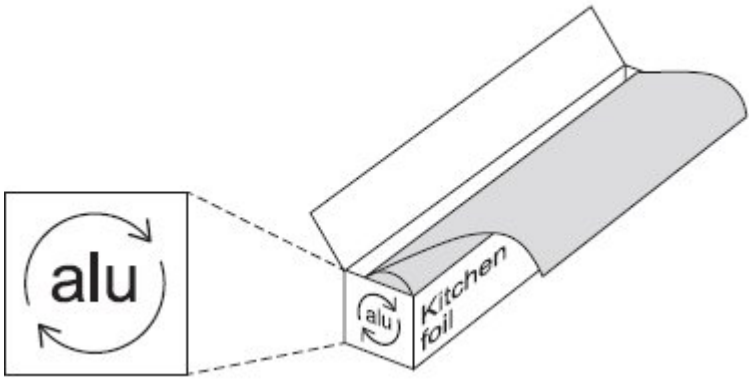
(1)

(d) Aluminium is used for kitchen foil.

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

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Figure 2



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

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

_____ .

(1)

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

_____

_____

_____

_____

(2)

(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)

(Total 10 marks)

Q5.

This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of _____

(1)

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(ii) The mass number of an atom is the number of _____

_____

(1)

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

_____

_____

_____

_____

(2)

(c) Explain why fluorine and chlorine are in the same group of the periodic table.

Give the electronic structures of fluorine and chlorine in your explanation.

_____

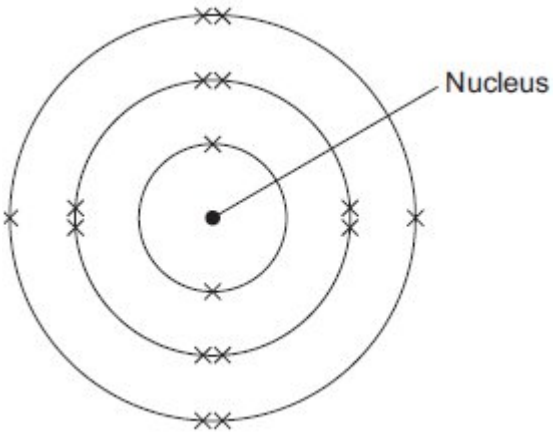
_____

_____

_____

(2)

(d) The diagram shows the electronic structure of an atom of a non-metal.



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar ☐

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O ☐

S ☐

Si ☐

(1)

(e) When elements react, their atoms join with other atoms to form compounds.

Complete the sentences.

(i) Compounds formed when non-metals react with metals consist of particles called _____ .

(1)

(ii) Compounds formed from only non-metals consist of particles called _____ .

(1)

(Total 9 marks)

Q6.

This question is about carbon and gases in the air.

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

Complete the table by writing the relative mass of a neutron and an electron.

Name of particle	**Relative mass**
proton	1
neutron	
electron	

(2)

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

Tick (✓) **one** box.

The atomic number ☐

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The mass number ☐

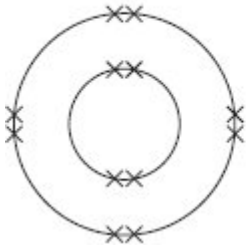
One mole of the atom ☐

(1)

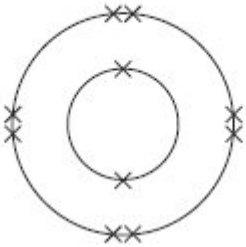
(c) An atom of carbon has six electrons.

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

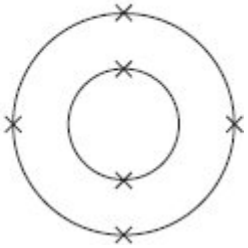
Structure A



Structure B



Structure C



The carbon atom is structure ☐

(1)

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

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

_____

(1)

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

_____

(1)

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

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

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

_____

_____

M_r of carbon monoxide = _____

(1)

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

_____

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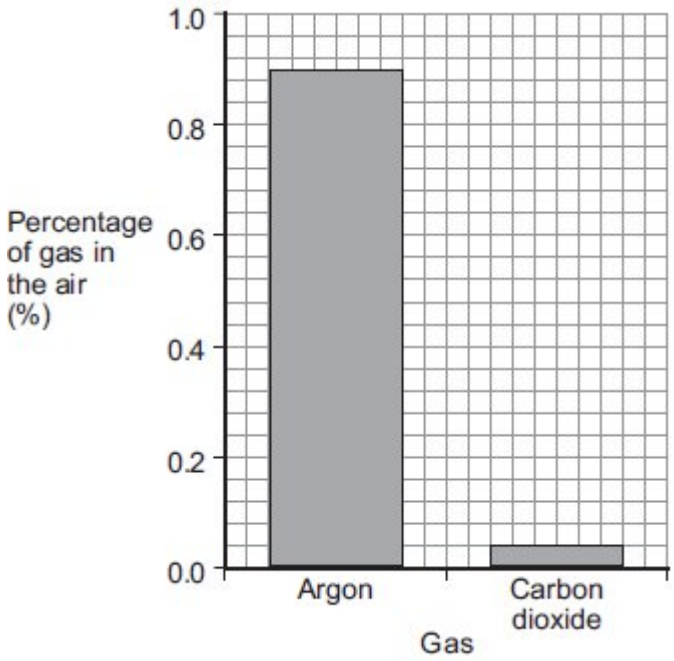
_____

Percentage by mass of carbon in carbon monoxide = _____%

(1)

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

(i) The graph shows the percentage of argon and the percentage of carbon dioxide in the air.



What is the percentage of argon in the air?

Percentage of argon = _____ %

(1)

(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)

(Total 10 marks)

Q7.

This question is about atoms and isotopes.

(a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol $^{7}_{3}Li$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.

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_____

_____

_____

_____

_____

_____

(3)

(b) Amounts of substances can be described in different ways.

Complete the sentences.

One mole of a substance is the relative formula mass in

_____

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of

_____

(2)

(c) Two isotopes of oxygen are $^{18}_{8}O$ and $^{16}_{8}O$

Describe the similarities and differences between the isotopes $^{18}_{8}O$ and $^{16}_{8}O$

You should refer to the numbers of sub-atomic particles in each isotope.

_____

_____

_____

_____

_____

_____

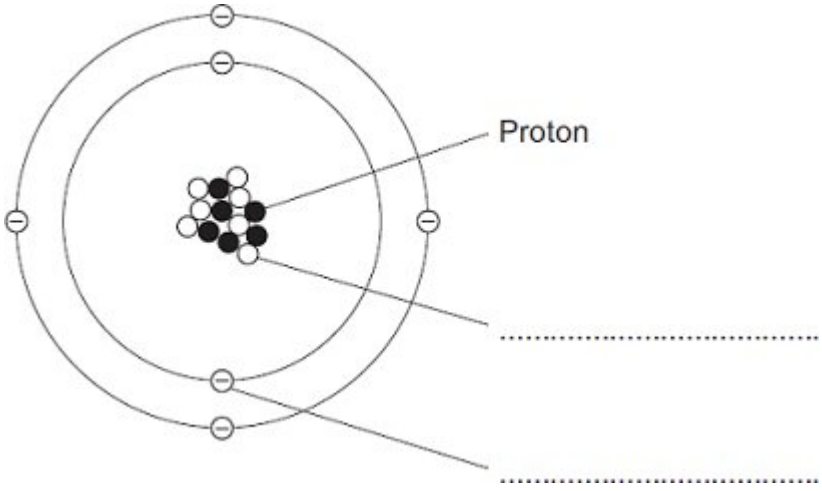
(3)

(Total 8 marks)

Q8.

The diagram shows a carbon atom.

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(a) (i) A proton is labelled.

Use the correct answer from the box to label each of the other sub-atomic particles.

electron	ion	molecule	neutron

(2)

(ii) The atom of carbon is represented as:

$$^{13}_{6}C$$

What is the mass number of this carbon atom?

Draw a ring around the correct answer.

6 13 19

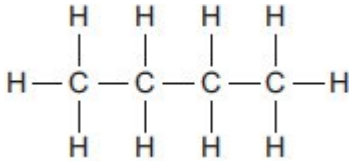
(1)

(iii) Complete the sentence.

Atoms of carbon have no overall electrical charge because the number of protons is the same as the number of _____ .

(1)

(b) Butane is represented as:



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

bond	compound	helium	hydrogen	mixture	oxygen

Butane is a _____ .

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Butane contains atoms of carbon and _____ .

Each line between the atoms in butane represents a chemical

_____ .

(3)

(ii) Which is the correct formula for butane?

Tick (✔) **one** box.

C_4H_4 ☐

C_4H_8 ☐

C_4H_{10} ☐

(1)

(Total 8 marks)

Q9.

Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide, SO_2

(a) Why is it important that sulfur dioxide is **not** released into the atmosphere?

Tick (✔) **one** box.

Sulfur dioxide causes acid rain. ☐

Sulfur dioxide causes global dimming. ☐

Sulfur dioxide causes global warming. ☐

(1)

(b) Sulfur dioxide dissolves in water.

What colour is universal indicator in a solution of sulfur dioxide?
Give a reason for your answer.

_____

_____

_____

_____

(2)

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(c) Sulfur dioxide is a gas at room temperature.

The bonding in sulfur dioxide is covalent.

Explain, in terms of its structure and bonding, why sulfur dioxide has a low boiling point.

_____

_____

_____

_____

_____

_____

(3)

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

Sulfur dioxide is produced when fossil fuels are burned.

It is important that sulfur dioxide is not released into the atmosphere.

Three of the methods used to remove sulfur dioxide from gases produced when fossil fuels are burned are:

- wet gas desulfurisation (**W**)
- dry gas desulfurisation (**D**)
- seawater gas desulfurisation (**S**).

Information about the three methods is given in the bar chart and in **Table 1** and **Table 2**.

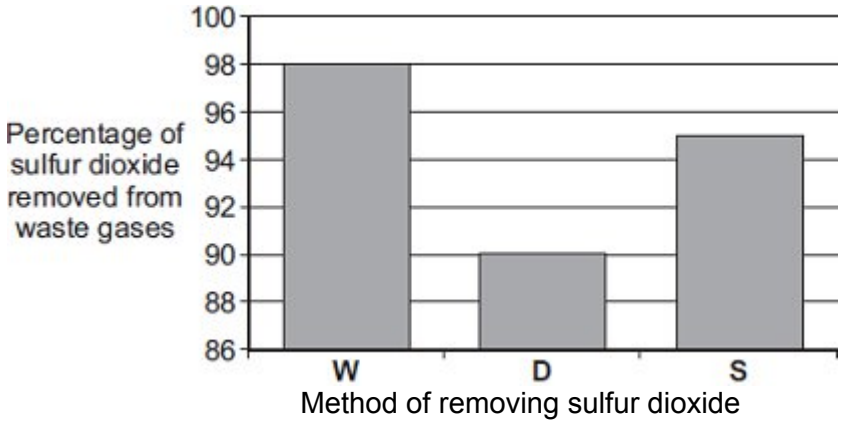


Table 1

Method	Material used	How material is obtained

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W	Calcium carbonate, $CaCO_3$	Quarrying
D	Calcium oxide, CaO	Thermal decomposition of calcium carbonate: $CaCO_3 \longrightarrow CaO + CO_2$
S	Seawater	From the sea

Table 2

Method	What is done with waste material
W	Solid waste is sold for use in buildings. Carbon dioxide is released into the atmosphere.
D	Solid waste is sent to landfill.
S	Liquid waste is returned to the sea.

Evaluate the three methods of removing sulfur dioxide from waste gases.

Compare the three methods and give a justified conclusion.

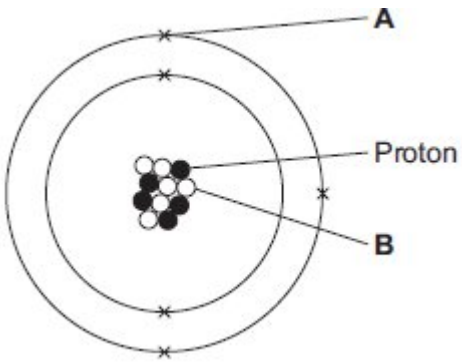
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(6)
(Total 12 marks)

Q10.

(a) **Figure 1** shows an atom of element **G**.

Figure 1



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

(i) Label **A** shows

an electron **an ion** **a nucleus**

(1)

(ii) The particle labelled **B** is

an isotope **a molecule** **a neutron**

(1)

(iii) The mass number of element **G** is

5 **6** **11**

(1)

(iv) Use the periodic table to identify element **G**.

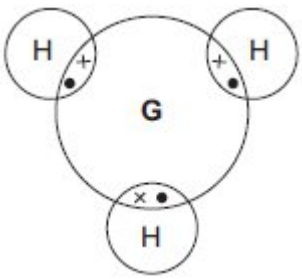
Element **G** is

boron **carbon** **sodium**

(1)

(b) **Figure 2** shows a compound of **G** and hydrogen.

Figure 2



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

(i) The formula of the compound in **Figure 2** is

GH_3 **G_3H** **3HG**

(1)

(ii) The type of bonding shown in **Figure 2** is

covalent **ionic** **metallic**

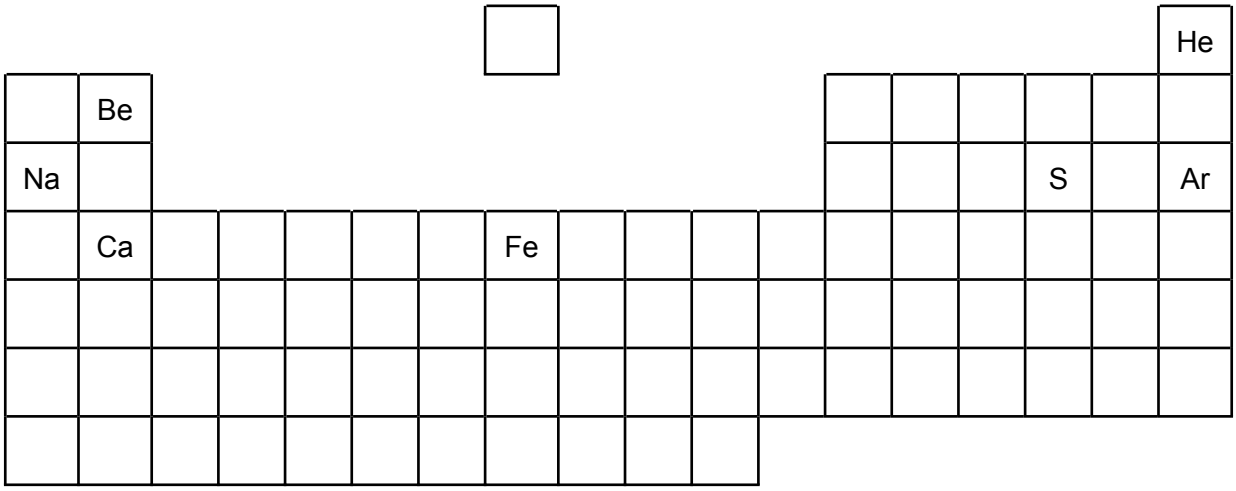
(1)

(Total 6 marks)

Q11.

(a) The symbols for seven different elements are shown in **Figure 1**.

Figure 1



Choose the correct symbol from **Figure 1** to answer each question.

You may use each symbol once, more than once or not at all.

Write the symbol that represents:

(i) a Group 1 element

_____

(1)

(ii) a transition metal

_____

(1)

(iii) an element with electrons in the same number of energy levels as an atom of argon (Ar)

_____

(1)

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(iv) an element which forms an oxide that dissolves in water to form an acidic solution

_____

(1)

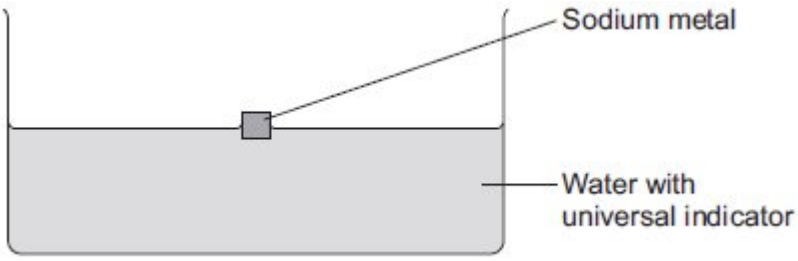
(v) an element that forms a chloride with the formula XCl

_____

(1)

(b) A teacher put a cube of sodium metal into water containing universal indicator, as shown in **Figure 2**.

Figure 2



The equation for the reaction is:

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH\ (aq) + H_2(g)$$

sodium + water → sodium hydroxide + hydrogen

(i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(ii) Name the ion that made the universal indicator turn purple.

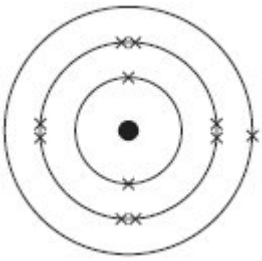
_____

(1)

(c) **Figure 3** represents the electronic structure of a sodium atom.

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Figure 3



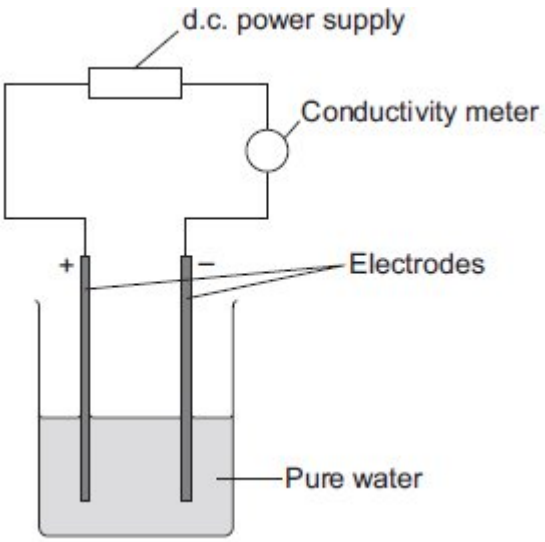
In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)
(Total 11 marks)

Q12.

A student investigated the conductivity of different concentrations of sodium chloride solution.
The student set the apparatus up as shown in **Figure 1**.

Figure 1



The student measured the conductivity of the pure water with a conductivity meter.

The reading on the conductivity meter was zero.

(a) The student:

- added sodium chloride solution one drop at a time
- stirred the solution
- recorded the reading on the conductivity meter.

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The student's results are shown in the table below.

Number of drops of sodium chloride solution added	Relative conductivity of solution
0	0
1	100
2	120
3	310
4	400
5	510
6	590
7	710
8	800

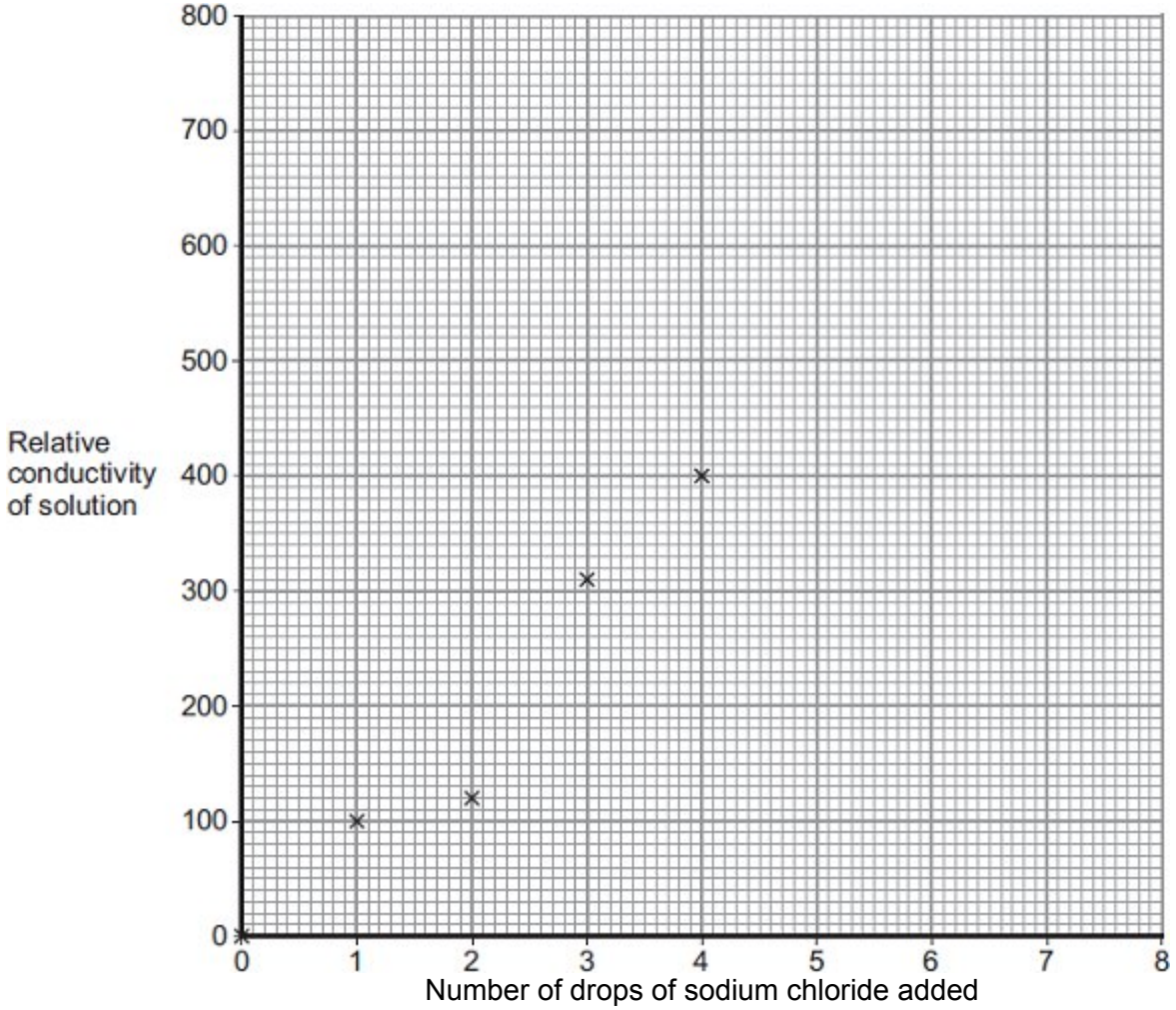
(i) The student plotted the results on the grid shown in **Figure 2**.

Plot the four remaining results.

Draw a line of best fit, ignoring the anomalous result.

Figure 2

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(3)

(ii) One of the points is anomalous.

Suggest **one** error that the student may have made to cause the anomalous result.

_____

_____

(1)

(iii) The student wanted to compare the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable he should keep constant when measuring the conductivity of the two solutions.

_____

(1)

(b) (i) Explain, in terms of bonding, why pure water does **not** conduct electricity.

_____

_____

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_____

_____

(2)

(ii) Explain why sodium chloride solution conducts electricity.

_____

_____

_____

_____

(2)

(iii) After he had added sodium chloride solution, the student noticed bubbles of gas at the negative electrode.

Complete the sentence.

The gas produced at the negative electrode is _____

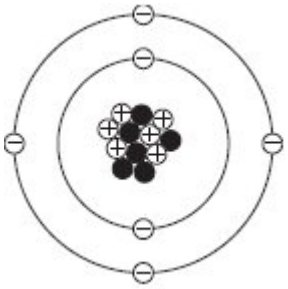
(1)

(Total 10 marks)

Q13.

Fossil fuels contain carbon.

(a) The figure below represents a carbon atom.



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

(i) The name of the particle with a positive charge is

an electron.
a neutron.
a proton.

(1)

(ii) The centre of the atom is called the

energy level.
molecule.
nucleus.

(1)

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

Use the correct number from the box to complete each sentence.

4	6	8	10	12

The mass number of this carbon atom is ☐

In the periodic table, carbon is in Group ☐

(b) Coal is a fossil fuel.

A piece of coal contains:

- 80% carbon
- 9% oxygen
- 1% sulfur
- 5% hydrogen.

The rest of the coal is other elements.

(i) What is the percentage of other elements in this piece of coal?

_____ %

(1)

(ii) Coal burns in air to produce carbon dioxide, sulfur dioxide and water.

Draw **one** line from each product to the type of pollution caused by each product.

Product	Type of pollution
Carbon dioxide	Acid rain
Sulfur dioxide	Global dimming
Water	Global warming
	No pollution

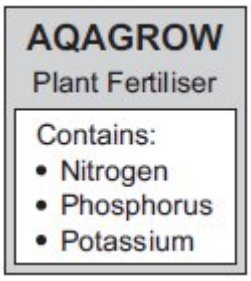
(3)

(Total 8 marks)

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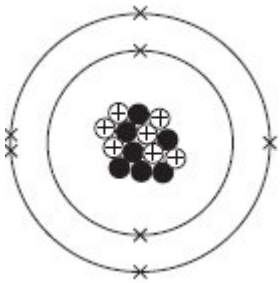
Q14.

Fertilisers contain elements that plants need.



(a) **Figure 1** represents a nitrogen atom.

Figure 1



Complete each sentence.

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

(1)

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

_____ .

(1)

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

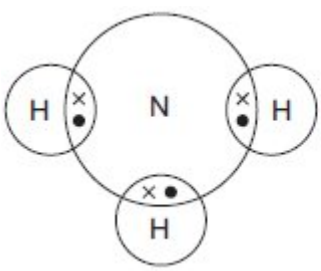
_____ .

(1)

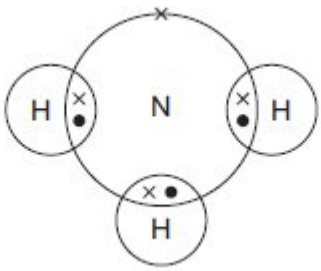
(b) Fertilisers can be made from ammonia.

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

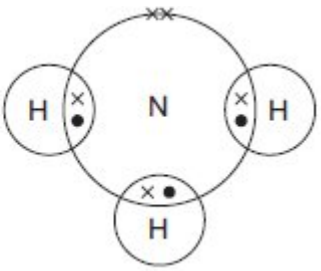
A



B



C



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(1)

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

(ii) What is the correct formula of ammonia?

Draw a ring around the correct answer.

N_3H **NH_3** **NH^3**

(1)

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

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

_____

(1)

(ii) Complete the sentence.

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

(1)

(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)

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

Suggest what would happen to the grass.

_____

_____

(1)

(d) Some fertilisers contain potassium chloride.

Potassium reacts with chlorine to produce potassium chloride.

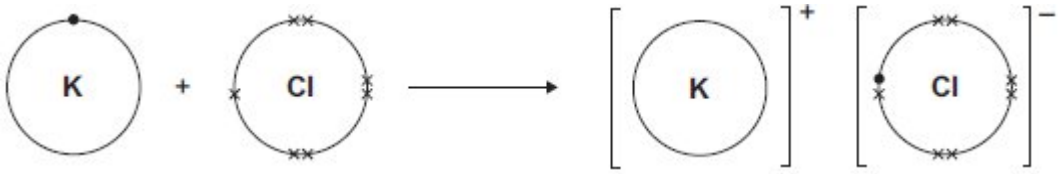
Figure 2 shows how this happens.

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

Only the outer shell is shown.

Figure 2

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

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

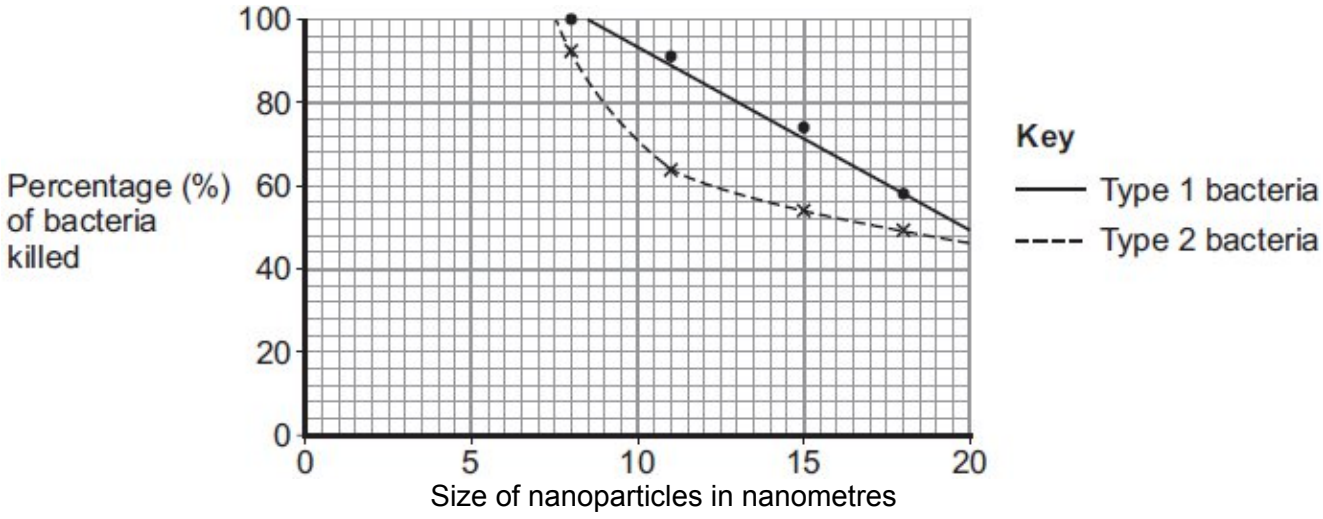
(4)

(Total 13 marks)

Q15.

Magnesium oxide nanoparticles can kill bacteria.

The figure below shows the percentage of bacteria killed by different sized nanoparticles.



(a) (i) Give **two** conclusions that can be made from the figure above.

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_____

_____

_____

_____

_____

_____

(2)

(ii) Points are plotted for only some sizes of nanoparticles.

Would collecting and plotting data for more sizes of nanoparticles improve the conclusions?

Give a reason for your answer.

_____

_____

(1)

(b) Magnesium oxide contains magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Describe, as fully as you can, what happens when magnesium atoms react with oxygen atoms to produce magnesium oxide.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q16.

Glass is made from silicon dioxide.

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

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

_____

_____

(1)

(b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

(i) Sodium oxide contains Na^+ ions and O^{2-} ions.

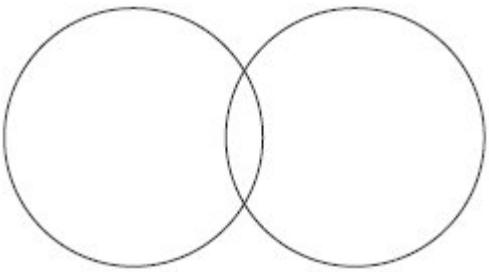
Give the formula of sodium oxide.

_____

(1)

(ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).



(2)

(c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

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_____

_____

_____

_____

_____

_____

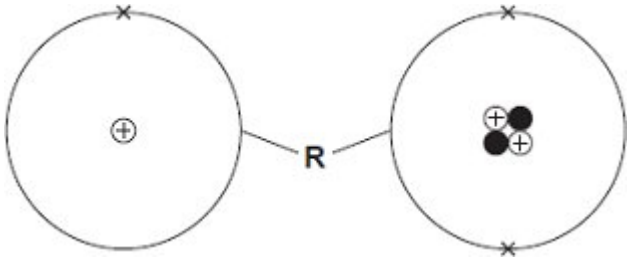
(3)

(Total 7 marks)

Q17.

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

Hydrogen **Helium**



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

(i) The centre of each atom is called the

molecule.
nucleus.
shell.

(1)

(ii) The circle (labelled **R**) around the centre of each atom

is called

a bond.
an electrical charge.
an energy level (shell).

(1)

(b) Use the diagrams in part (a) to help you to answer these questions.

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

Question	**Answer**

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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)

(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)

(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.

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

_____

(1)

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

_____

(1)

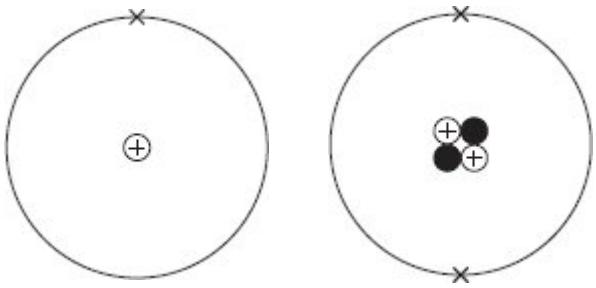
(Total 8 marks)

Q18.

The Sun produces helium atoms from hydrogen atoms by nuclear fusion reactions.

Hydrogen **Helium**

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(a) Describe the differences in the atomic structures of a hydrogen atom and a helium atom.

_____

_____

_____

_____

_____

_____

_____

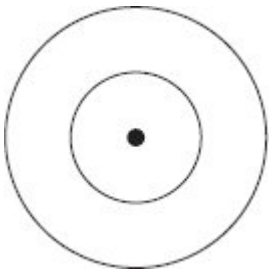
_____

(3)

(b) The Sun consists of 73% hydrogen and 25% helium.
The rest is other elements.
One of the other elements in the Sun is neon.

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

(i) Complete the diagram to show the electronic structure of a neon atom.



(1)

(ii) Why is neon in the same group of the periodic table as helium?

_____

_____

_____

(1)

(Total 5 marks)

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Q19.

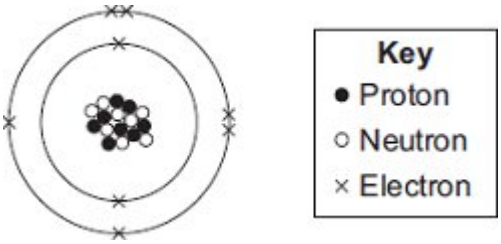
This question is about atoms and molecules.

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

Name of particle	Relative mass
Proton	_____
Neutron	1
Electron	_____

(2)

(b) The diagram shows an oxygen atom.



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)

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

Oxygen atoms with different numbers of neutrons are called

isotopes.
molecules.
polymers.

(1)

(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)

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

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

a compound	an element	a mixture

Water is _____ .

(1)

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

H – O – H **O – H – H** **O – H – O**

(1)

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

covalent **ionic** **metallic**

(1)

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

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

(1)

(Total 10 marks)

Q20.

Kelp is a seaweed.

Kelp can be used in foods and as a renewable energy source.



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(a) Scientific experiments, on their own, **cannot** fully answer one of the following questions. Which one?

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Tick (✓) **one** box.

Questions	Tick (✓)
How much carbon dioxide is produced when 100 g of kelp is burned?	
Does kelp give out more heat energy than coal?	
Will kelp last longer than coal as an energy source?	
Which fuel, kelp or coal, produces the most ash when burned?	

(1)

(b) Scientists cannot answer the question 'should people use kelp instead of coal as an energy source?'

Give **two** reasons why.

_____

_____

_____

_____

(2)

(c) Sodium iodide can be produced from kelp.

(i) How many electrons are in the outer shell of an iodine atom?

(1)

(ii) Sodium iodide contains sodium ions (Na^+) and iodide ions (I^-).

Describe, as fully as you can, what happens when sodium atoms react with iodine atoms to produce sodium iodide.

You may use a diagram in your answer

_____

_____

_____

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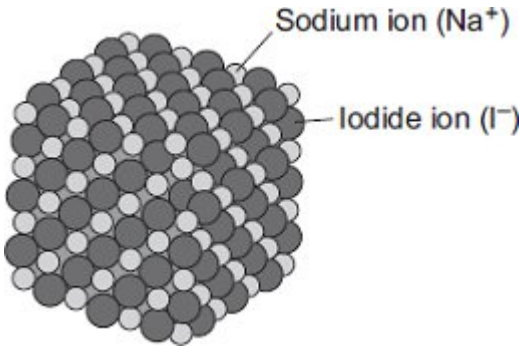
_____

_____

_____

(3)

(iii) The diagram shows the structure of sodium iodide.



Solid sodium iodide does not conduct electricity.

Why does sodium iodide solution conduct electricity?

_____

_____

(1)

(iv) When sodium iodide solution is electrolysed, iodine is formed at the positive electrode.

Complete and balance the half equation for the formation of iodine.

$$_____I^- \rightarrow I_2 + _____e^-$$

(1)

(v) What is formed at the negative electrode when sodium iodide solution is electrolysed?

Explain why.

_____

_____

_____

_____

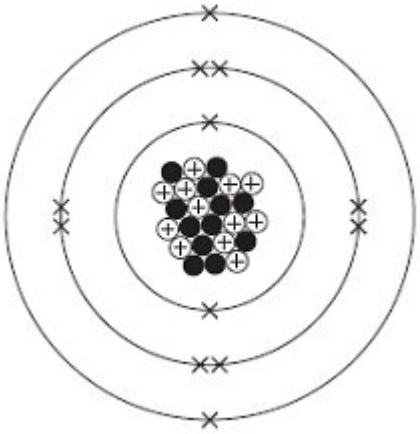
(2)

(Total 11 marks)

Q21.

The diagram represents a magnesium atom.

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

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

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

(1)

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

(1)

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

(1)

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

(i) Draw a ring around the atomic (proton) number of this magnesium atom.

12 **24** **36**

(1)

(ii) Draw a ring around the mass number of this magnesium atom.

12 **24** **36**

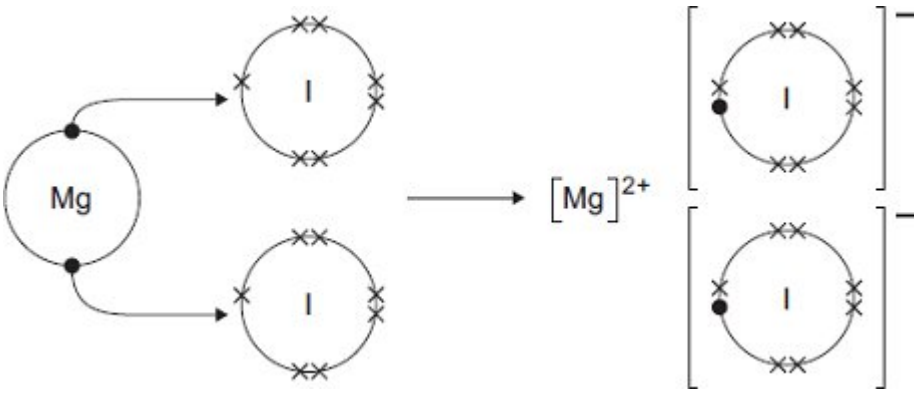
(1)

(c) The diagram shows how magnesium and iodine atoms form magnesium iodide.

Only the outer electrons are shown.

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

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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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

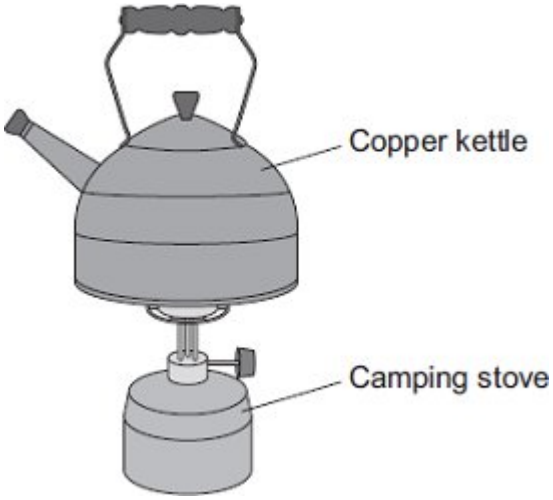
Q22.

The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

- it has a high melting point
- it is a very good conductor of heat.

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(a) Explain why copper, like many other metals, has a high melting point.

Your answer should describe the structure and bonding of a metal.

_____

_____

_____

_____

_____

_____

_____

_____

_____

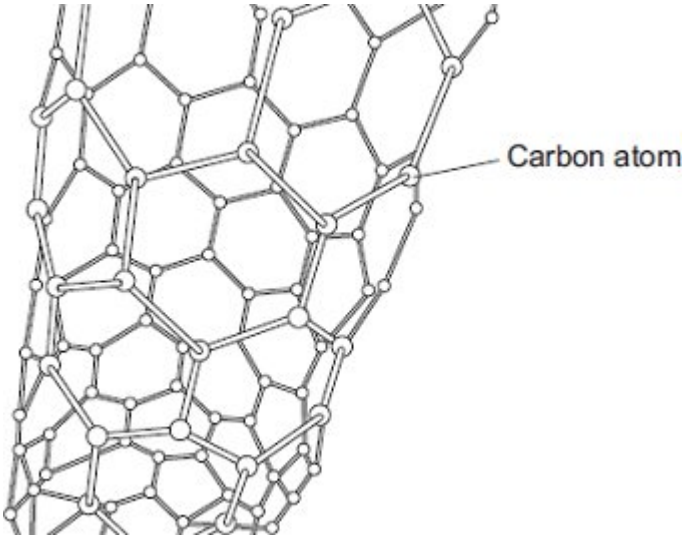
(4)

(b) Aeroplanes contain many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by carbon nanotubes which are less dense than copper.

The diagram shows the structure of a carbon nanotube.

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(i) What does the term ‘nano’ tell you about the carbon nanotubes?

_____

_____

(1)

(ii) Like graphite, each carbon atom in the carbon nanotube is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q23.

(a) Which sub-atomic particles are present in the nucleus of an atom?

_____ and _____

(2)

(b) There are two isotopes of the element chlorine:

$^{35}_{17}Cl$ $^{37}_{17}Cl$

Describe, in terms of sub-atomic particles, **one** similarity and **one** difference between atoms of the two isotopes of chlorine.

Similarity _____

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_____

Difference _____

_____

(2)

(c) Chlorine reacts with hydrogen to produce hydrogen chloride.

(i) The table shows the values of some bond dissociation energies.

Bond	**H—H**	**Cl—Cl**	**H—Cl**
Dissociation energy in kJ per mole	436	242	431

Use the values in the table to calculate the enthalpy change (ΔH) for the reaction.

$$H_2(g) + Cl_2(g) \longrightarrow 2\ HCl(g)$$

_____

_____

_____

_____

_____

Enthalpy change (ΔH) = _____ kJ per mole

(3)

(ii) Hydrogen also reacts with fluorine.

$H_2(g) + F_2(g) \longrightarrow 2\ HF(g)$ $\Delta H = -538$ kJ per mole

Draw an energy level diagram for this reaction.

Include on your diagram labels to show:

- the reactants and the products
- the overall enthalpy change (ΔH)
- the activation energy.

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(3)
(Total 10 marks)

Q24.

Magnesium burns in oxygen.



By Kingsway School [CC BY 2.0],
via Flickr

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

The word equation for magnesium burning is:

magnesium + oxygen ⟶ magnesium oxide

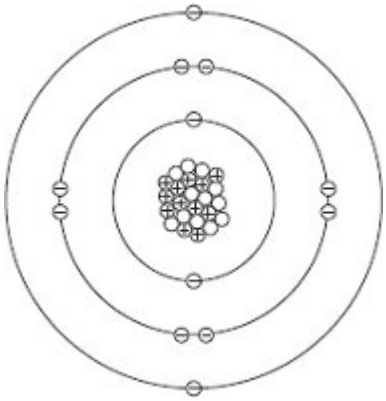
Draw **one** line from each substance to its correct description.

Substance	Description
magnesium	compound
magnesium oxide	metal
oxygen	mixture
	non-metal

(3)

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(b) The diagram represents a magnesium atom.



Complete the table to show the name of each particle and the charge of each particle in the magnesium atom.

Name of particle	Charge
proton	+1
neutron	_____
_____	−1

(2)

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

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

(i) In a magnesium atom, the protons and neutrons are in the

core.
nucleus.
shell.

(1)

(ii) The number of protons in a magnesium atom is the

atomic number
mass number.
group number.

(1)

(iii) The sum of the protons and neutrons in a magnesium atom is the

atomic number.
mass number.
group number.

(1)

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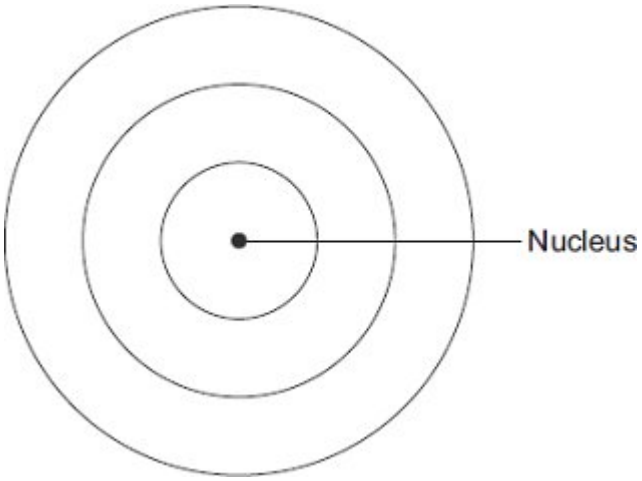
(Total 8 marks)

Q25.

Aluminium has many uses.

(a) An aluminium atom has 13 electrons.

(i) Draw the electronic structure of an aluminium atom.



(1)

(ii) Name the **two** sub-atomic particles in the nucleus of an aluminium atom.

_____ and _____

(1)

(iii) Why is there no overall electrical charge on an aluminium atom?

_____

_____

(1)

(b) Rail tracks are made from steel.

Molten iron is used to weld rail tracks.

The reaction of aluminium with iron oxide is used to produce molten iron.

(i) Balance the chemical equation for the reaction.

$$____Al + Fe_2O_3 \longrightarrow ____Fe + Al_2O_3$$

(1)

(ii) Why does aluminium react with iron oxide?

_____

_____

(1)

(Total 5 marks)

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Q26.

This question is about lithium and sodium.

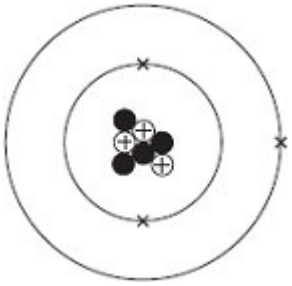
(a) Use the Chemistry Data Sheet to help you to answer this question.

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

(1)

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

The diagram represents the lithium atom.



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

What is the name of these particles?

_____

(1)

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

What is the name of these particles?

_____

(1)

(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)

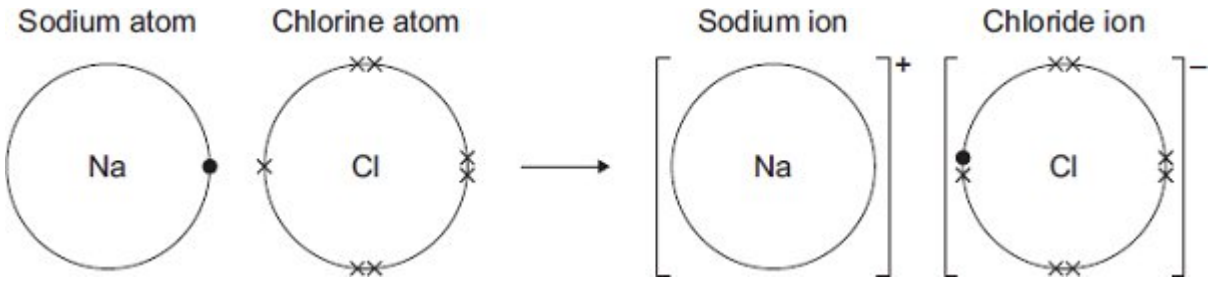
(c) Sodium reacts with chlorine to produce sodium chloride.

sodium + chlorine ⟶ sodium chloride

The diagram shows how the reaction happens.

Only the outer electrons are shown.

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

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

(1)

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

(1)

(iii) The ions in sodium chloride are held together by

strong [covalent / electrostatic / magnetic] forces.

(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)

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

Calculate the relative formula mass of sodium chloride.

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Relative atomic masses: Na = 23; Cl = 35.5

_____

_____

Relative formula mass = _____

(1)

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

The relative formula mass of a substance, in grams,

is one	ion isotope mole	of the substance.

(1)

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

What are nanoparticles?

_____

_____

(1)

(Total 12 marks)

Q27.

Oil rigs are used to drill for crude oil.

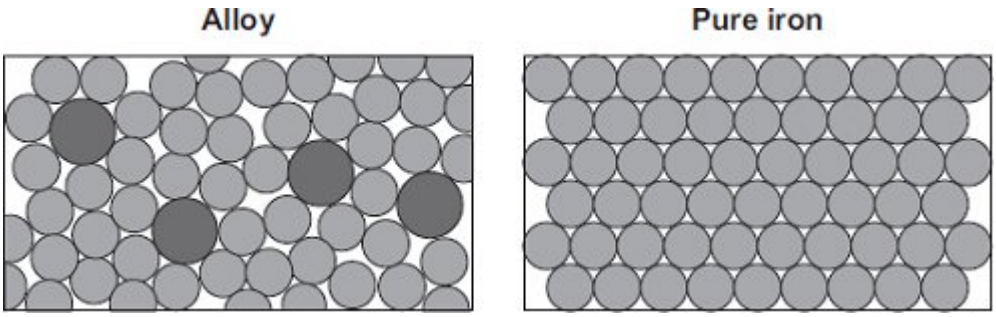


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(a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.

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Use the diagrams to explain why the alloy is harder than pure iron.

_____

_____

_____

_____

(2)

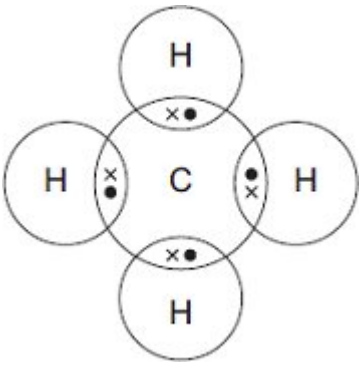
(b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2)

(c) Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.



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

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Methane is

a compound.
an element.
a mixture.

(1)

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

The formula of methane is

C_4H_4
C_4H
CH_4

(1)

(iii) Name the type of bond between the carbon and hydrogen atoms in methane.

_____

(1)

(d) Explain why methane is a gas at 20°C.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q28.

Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



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(a) The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) The atmosphere on Venus contains droplets of sulfuric acid solution.

(i) Suggest a pH value for sulfuric acid solution.

pH = _____

(1)

(ii) Name the ion which makes sulfuric acid solution acidic.

_____

(1)

(c) The atmosphere of Venus contains the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

Describe the similarities and the differences in the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

You should refer to the sub-atomic particles in each isotope.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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(Total 8 marks)

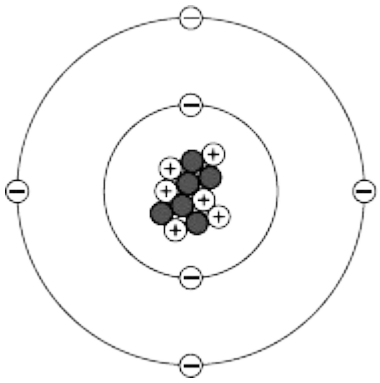
Q29.

The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

(a) Diamond is a form of carbon. The diagram represents a carbon atom.



Complete the table to show the name and charge of each type of particle in the carbon atom.

Name of particle	Charge
proton	
neutron	0
	-1

(2)

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

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

Gold and carbon are

compounds.

elements.

mixtures.

(1)

(ii) Complete the sentence.

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Gold and carbon have different properties because gold is a metal and carbon is a _____

(1)

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

Pure gold is not used to make the ring because pure gold is too

hard.

reactive.

soft.

The gold ring is made by mixing pure gold with other metals to form

a compound.

an atom.

an alloy.

(2)

(d) The data in the table shows some information about the three metals in the gold ring.

Name of metal	Atomic number	Percentage (%) of metal
gold	79	
silver	47	16
copper	29	9

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

Question	Answer
What is the percentage of gold in this ring?	29
How many electrons are there in a copper atom?	61
How many neutrons are in an atom of silver with a mass	75

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number of 108?

79

(3)

(Total 9 marks)

Q30.

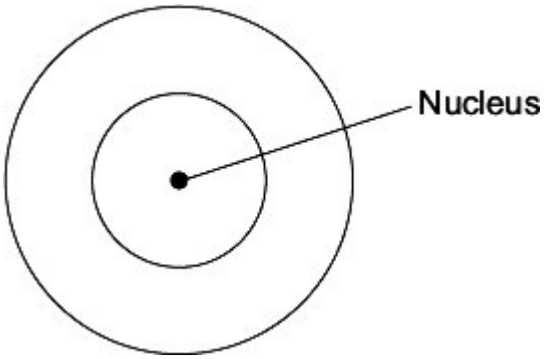
The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

(a) Diamond is a form of carbon. A carbon atom has six electrons.

Draw the electronic structure of a carbon atom.



(1)

(b) A gold atom has an atomic number of 79 and a mass number of 197.

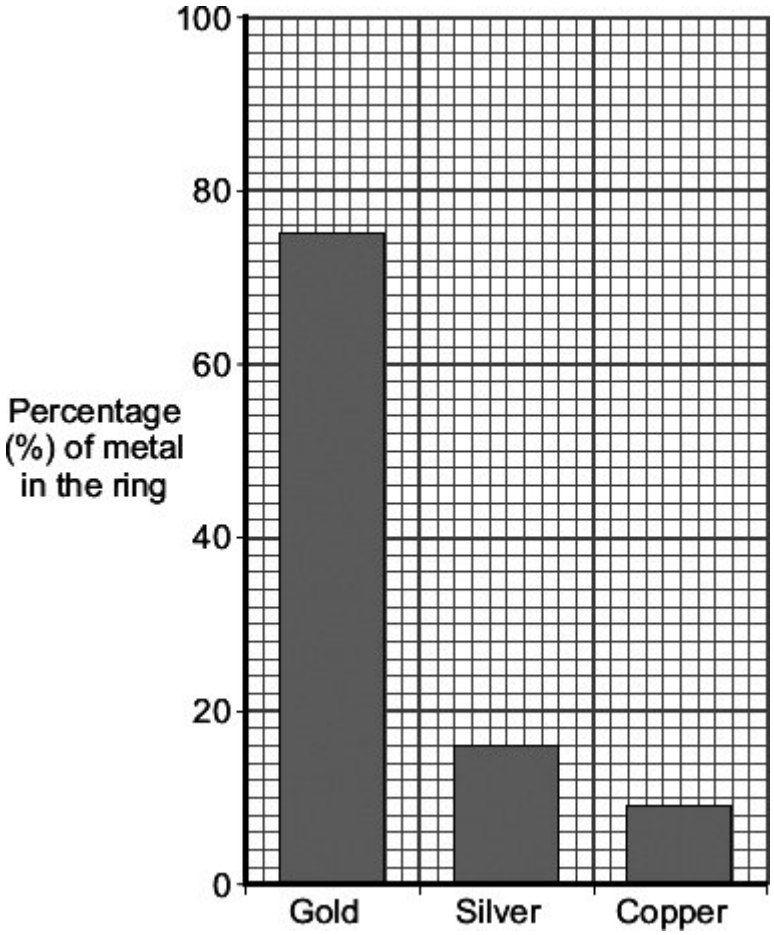
Complete the table to show the name and number of each sub-atomic particle in this gold atom.

Name	Number
Proton	79
Electron	_____
_____	_____

(3)

(c) The bar chart shows the composition of this gold ring.

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(i) Give the percentage of the other two metals in this gold ring.

Silver is _____ % and copper is _____ %

(1)

(ii) This gold ring is not made from 100% gold.

Give **two** reasons why.

1. _____

_____

_____

2. _____

_____

_____

(2)

(Total 7 marks)

Q31.

This question is about atoms and molecules.

(a) In the diagrams below:

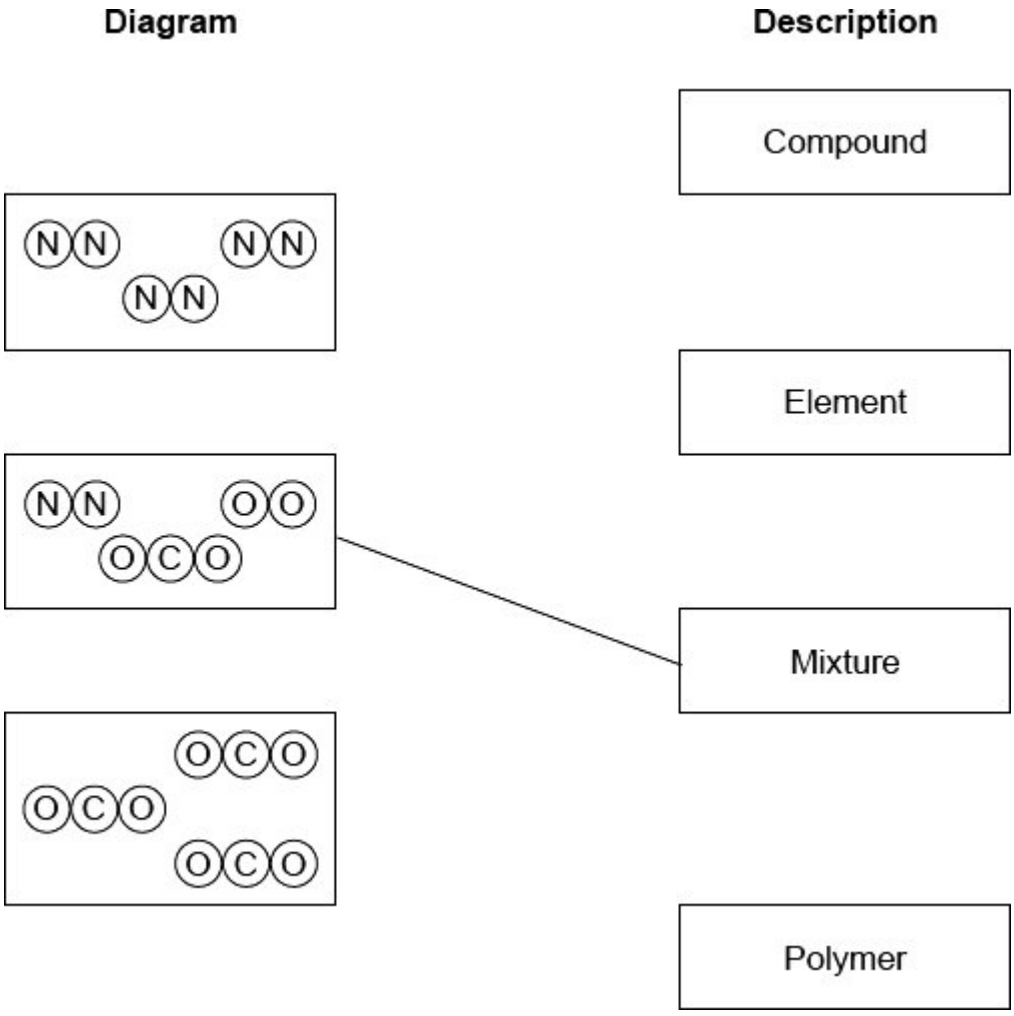
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(N) is a nitrogen atom

(O) is an oxygen atom

(C) is a carbon atom.

Draw **one** line from each diagram to its correct description.
One line has been done for you.

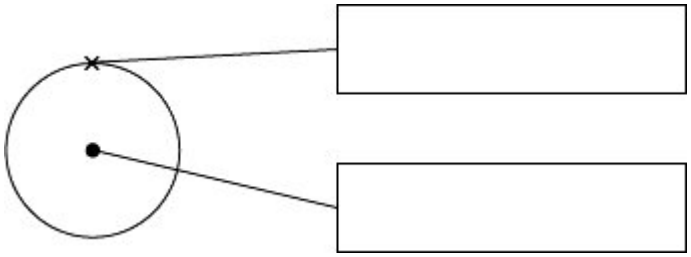


(2)

(b) The diagram below shows a hydrogen atom.
Use words from the box to write the correct labels on the diagram.

alloy	**electron**	**group**	**nucleus**

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(2)

(c) This chemical equation represents the reaction of hydrogen burning.

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

Complete the sentence to describe what is happening in this chemical reaction.

Hydrogen reacts with _____

_____

_____

_____

(2)

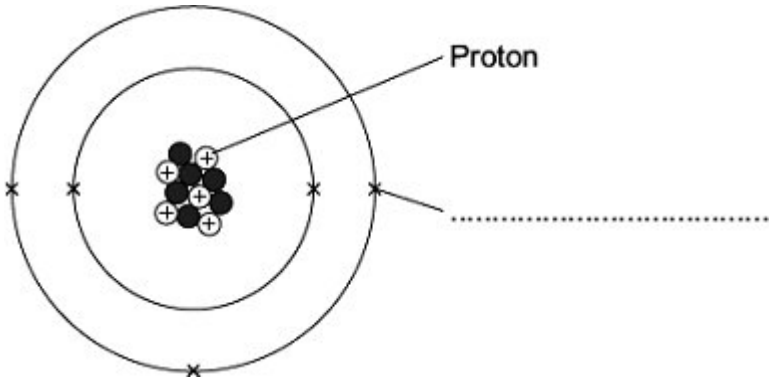
(Total 6 marks)

Q32.

The diagram represents an atom of an element.

(a) Choose **one** word from the box to complete the label on the diagram.

electron	**neutron**	**nucleus**



(1)

(b) (i) What is the atomic (proton) number of this atom? _____

(1)

(ii) Name the element.

Use the periodic table on the Data Sheet to help you answer this question.

The name of the element is _____ .

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(1)

(c) (i) Draw a ring around the mass number of this atom.

5 **11** **16**

(1)

(ii) Another atom of this element has a different mass number.

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

Atoms of the same element with different numbers of

electrons
neutrons
protons

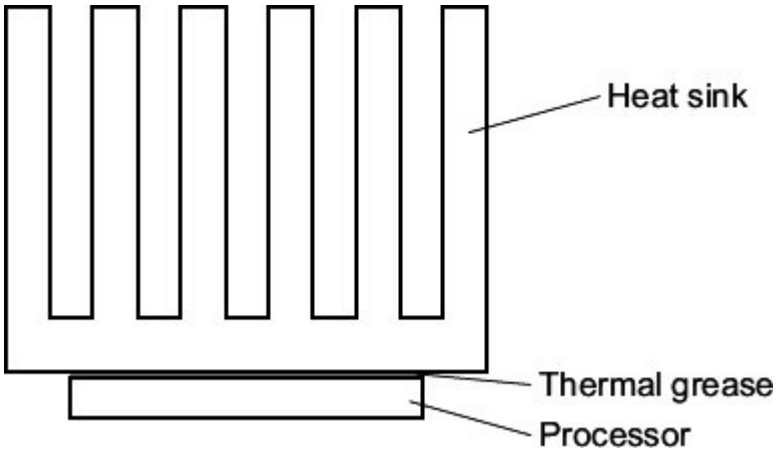
are called isotopes.

(1)

(Total 5 marks)

Q33.

The diagram shows how a heat sink is placed on top of a processor in a computer.
The heat sink is a large piece of metal which conducts heat away from the processor.
If the processor gets too hot it may be damaged.



(a) (i) Describe the structure of a metal.

_____

_____

_____

_____

_____

_____

_____

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_____

(3)

(ii) Why are metals very good conductors of heat?

_____

_____

(1)

(b) When viewed under a microscope, it can be seen that the surfaces of the processor and the heat sink that are in contact are not flat.
There are lots of tiny gaps between the two surfaces.
The gaps contain air, which does not conduct heat very well.
Thermal grease is used to fill the gaps between the processor and the heat sink to improve the transfer of heat from the processor to the heat sink.

One type of thermal grease contains nanosized particles of silver.
The manufacturer claims that the nanosized particles help to transfer heat better than normal sized particles.

(i) How are nanosized particles different from normal sized particles?

_____

_____

(1)

(ii) Suggest **one** reason why nanosized particles of silver might help to transfer heat better than normal sized particles.

_____

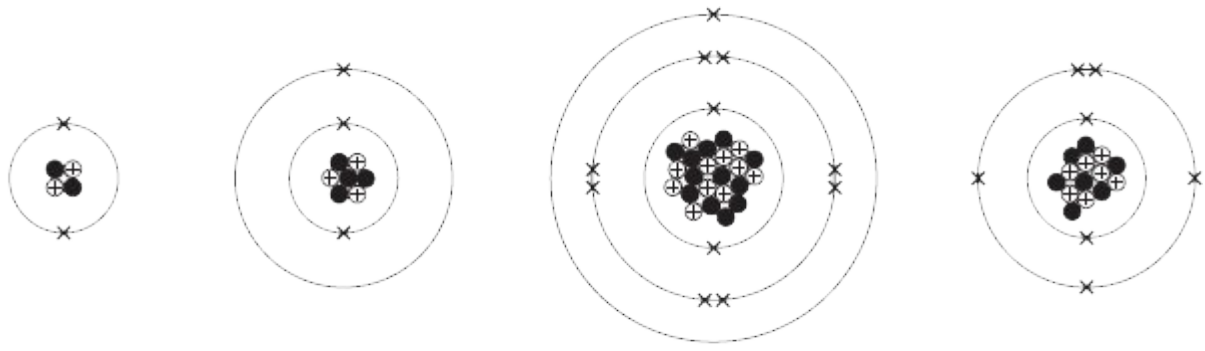
_____

(1)

(Total 6 marks)

Q34.

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.

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

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(i) The centre of each atom is called the

energy level.
molecule.
nucleus.

(1)

(ii) The centre of each atom contains neutrons and

bonds.
electrons.
protons.

(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)

(c) What is the name of the element represented by atom **D**? _____

(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)

(Total 6 marks)

Q35.

Ethanol (C_2H_5OH) can be made from ethene or from sugar.

(a) Complete the table which shows the number of atoms of each element in the formula of ethanol.

Use the Chemistry Data Sheet to help you to complete the table.

Element	Symbol	Number of atoms in the formula C_2H_5OH
Carbon	C	2
Hydrogen	H	_____

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_____	O	1

(2)

(b) Ethene (C_2H_4) is produced when hydrocarbons are cracked.

(i) Tick (✓) **two** conditions needed to crack a hydrocarbon.

Condition	Tick (✓)
The presence of an emulsifier.	
Heating the hydrocarbon to a high temperature.	
Adding oxygen to the hydrocarbon.	
The presence of a catalyst.	

(2)

(ii) Draw the missing bonds to complete the displayed structure of ethene.

H H

C C

H H

(1)

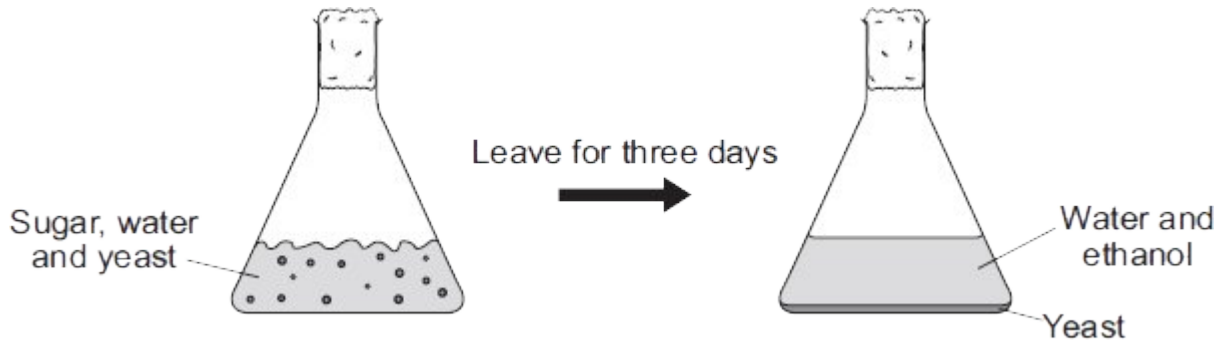
(iii) Name the substance added to ethene (C_2H_4) to produce ethanol (C_2H_5OH).

_____

(1)

(c) The diagram shows how a solution of ethanol is made from sugar dissolved in water.

The boiling point of ethanol is 78°C and the boiling point of water is 100°C.



(i) Name the gas produced during this reaction.

_____

(1)

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(ii) What are the main steps needed to obtain pure ethanol from the mixture produced after three days?

_____

_____

_____

_____

(2)

(Total 9 marks)

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