Q1. As the world population increases there is a greater demand for fertilisers.

(a) Explain what fertilisers are used for.

.....

.....

.....

.....

(2)

(b) The amount of nitrogen in a fertiliser is important.

(i) How many nitrogen atoms are there in the formula, NH_4NO_3?

.....

(1)

(ii) Work out the relative formula mass of ammonium nitrate, NH_4NO_3.

Relative atomic masses: H 1; N 14; O 16.

.....

.....

Relative formula mass of ammonium nitrate = ...

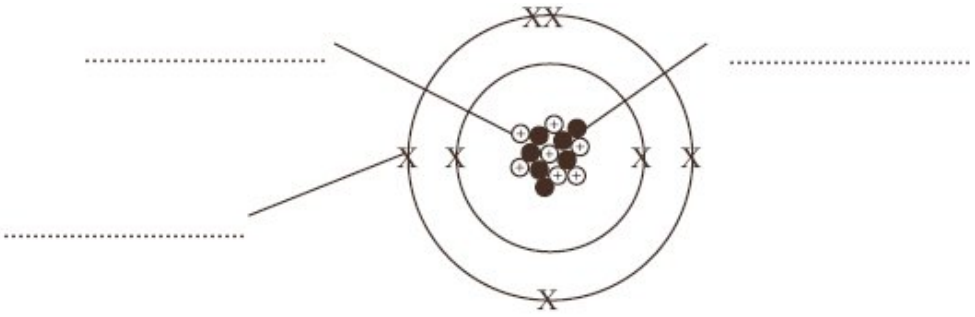
(1)

(Total 4 marks)

Q2. (a) The diagram represents an atom of nitrogen.

(i) Use words from the box to label the diagram.

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



(2)

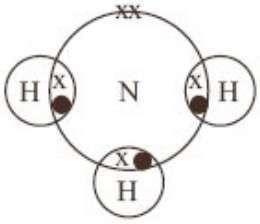
(ii) Draw a ring around the mass number of this atom.

5 **7** **14** **21**

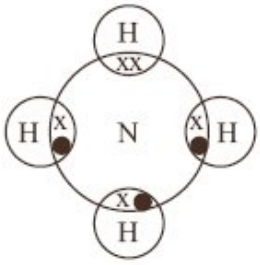
(1)

(b) Nitrogen can react with hydrogen to make ammonia, NH_3 .

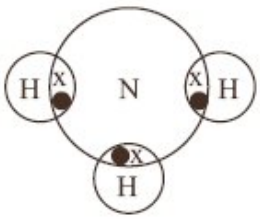
A



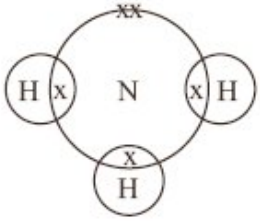
B



C



D



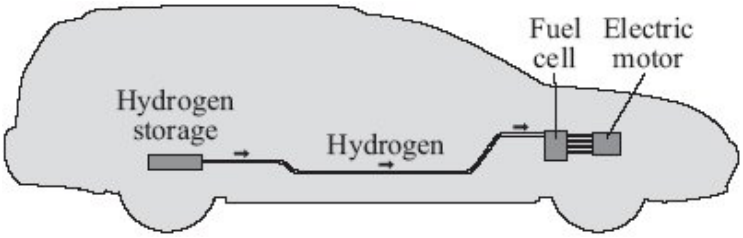
Which diagram, **A**, **B**, **C** or **D**, best represents an ammonia molecule? ☐

(1)

(Total 4 marks)

Q3. 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.

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

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

1 .....

.....

2 .....

.....

(2)

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

State why.

.....

.....

(1)

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

.....

.....

(1)

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

(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.

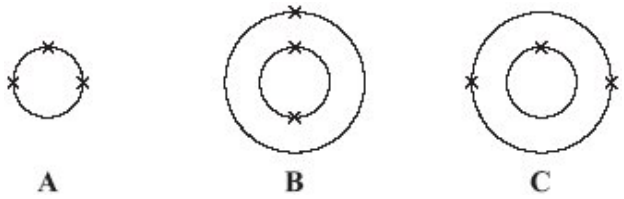


Diagram ☐

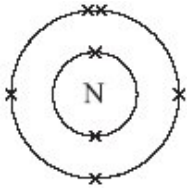
(1)

(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)

(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.

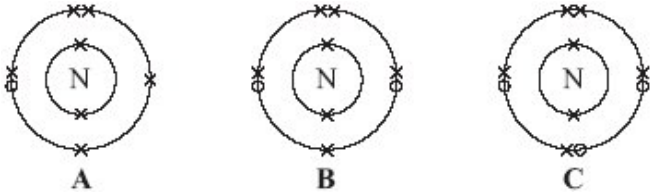


Diagram ☐

(1)

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

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

What does the symbol $\rightleftharpoons$ mean?

Draw a ring around your answer.

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

(1)

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

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

much larger
a little larger
much smaller

than normal sized particles of lithium nitride.

(1)

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

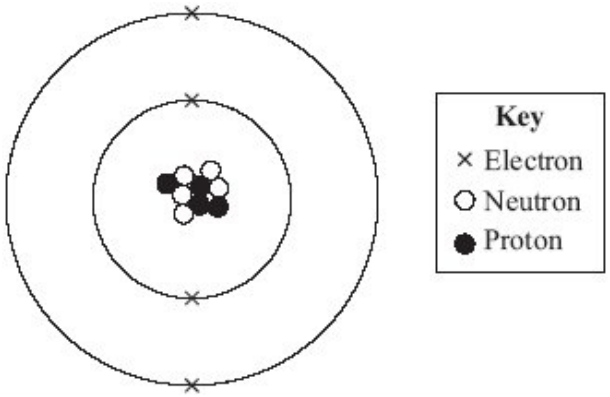
density
mass
surface area

than normal sized particles of lithium nitride.

(1)

(Total 10 marks)

Q4. The diagram represents an atom of beryllium.



Use a number from the box to complete each sentence.

4	7	9	12

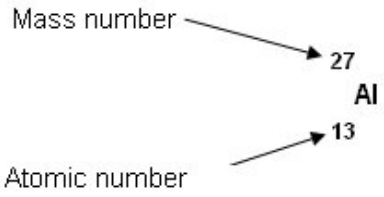
(a) The atomic number (proton number) of this atom is ☐.

(1)

(b) The mass number of this atom is ☐.

(1)
(Total 2 marks)

Q5. (a) An atom of aluminium can be represented as shown below.



In this atom of aluminium the number of protons is ..... and

the number of neutrons is .....

(2)

(b) Which statement in the table below describes the mass of an electron?

Tick (✓) **one** box.

Statement	Tick (✓)
Electrons have a very small mass compared to protons.	
Electrons have about the same mass as protons.	
Electrons are much heavier than protons.	
Electrons have about the same mass as neutrons.	

(1)

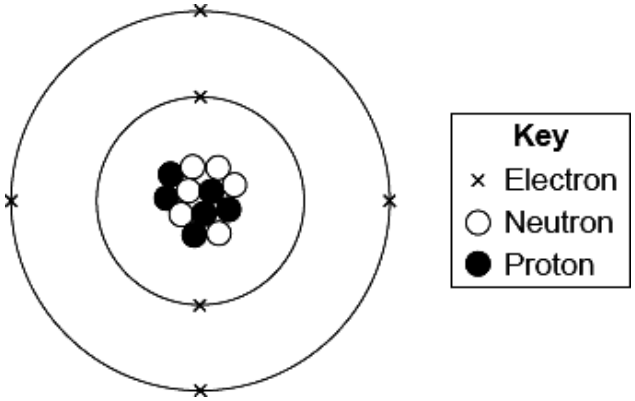
(c) Which method is used to extract aluminium from aluminium oxide?

Tick (✓) **one** box.

Method	Tick (✓)
Heating aluminium oxide.	
Heating aluminium oxide with carbon.	
Electrolysis of molten aluminium oxide.	
Heating aluminium oxide with copper.	

(1)
(Total 4 marks)

Q6. The diagram represents a carbon atom.



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

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

6 **12** **18**

(1)

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

6 **12** **18**

(1)

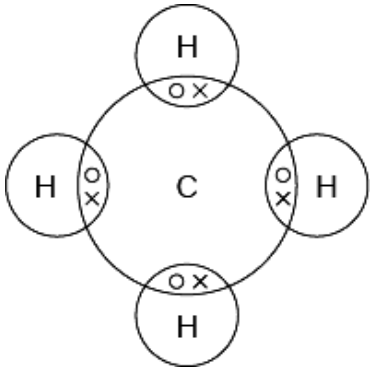
(c) A different carbon atom has 6 protons and 8 neutrons.

Draw a ring around the symbol that represents this atom.

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

(1)

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



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

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

(1)

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

compound **element** **mixture**

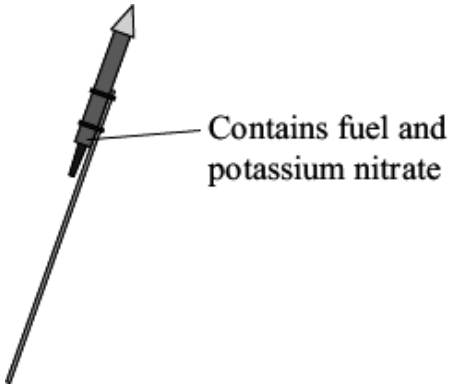
(1)

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

covalent **ionic** **metallic**

(1)
(Total 9 marks)

Q7. Firework rockets contain fuel and potassium nitrate.



The potassium nitrate provides oxygen for the fuel to react.

(a) The table shows how a student worked out the relative formula mass (M_r) of potassium nitrate.

Some of the numbers are missing.

Relative atomic masses (A_r): N = 14; O = 16; K = 39.

Name of atom (symbol)	**Number of atoms**	A_r	**Mass**
potassium (K)	1	39	39
nitrogen (N)	1	14	14
oxygen (O)		16	
The M_r of potassium nitrate =			101

(i) The mass of oxygen is not shown in the table.

Draw a ring around the correct mass of oxygen.

16 **32** **48**

(1)

(ii) Draw a ring around the number of oxygen atoms in the formula of potassium nitrate.

1 **2** **3**

(1)

(b) When the fuel reacts with the oxygen an *exothermic* reaction takes place.

What does *exothermic* mean?

.....

.....

.....

.....

(2)

(c) The fuel contains carbon. Carbon reacts with oxygen to make carbon dioxide.

Which **two** statements in the table explain why carbon dioxide is a gas at room temperature?

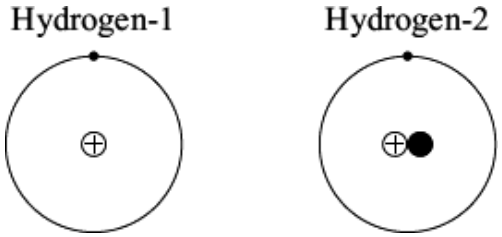
Tick (✓) the **two** statements.

Statement	**Tick (✓)**
It has a giant structure	
It has a low boiling point.	
It is made of small molecules.	
It is made of ions.	

(2)
(Total 6 marks)

Q8. Two isotopes of hydrogen are hydrogen-1 ($^{1}_{1}H$) and hydrogen-2 ($^{2}_{1}H$).

The diagrams represent atoms of hydrogen-1 and hydrogen-2.



(a) Use the correct words from the box to complete the sentences.

electrons	**neutrons**	**protons**

(i) The positive particles, ⊕ , in the nucleus of atoms are called

..... .

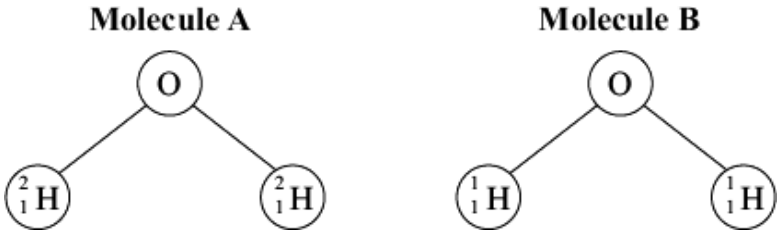
(1)

(ii) The particles with no charge, ● , in the nucleus of atoms are called

..... .

(1)

(b) The diagrams show two different types of water molecule.



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

Molecule **A** is | heavier than / lighter than / the same mass as | molecule **B**.

Explain your answer.

.....

.....

(2)

(Total 4 marks)

Q9. (a) A magnesium atom contains 12 protons (●),12 neutrons (o) and 12 electrons (x).

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

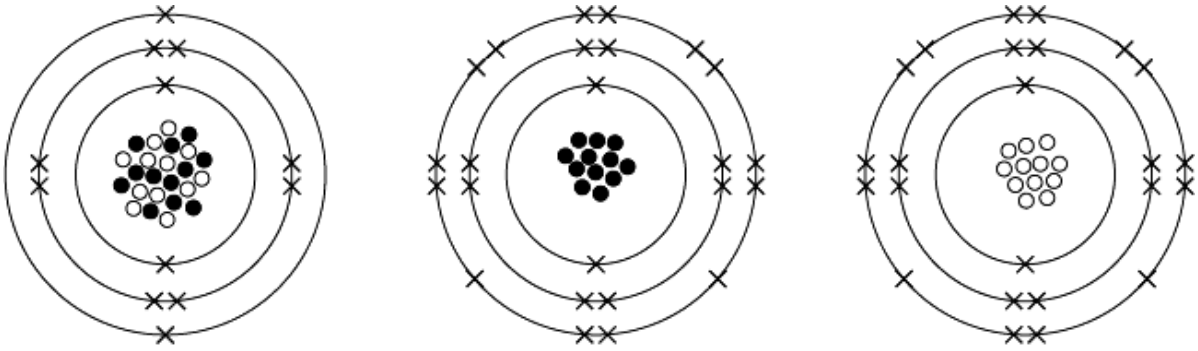
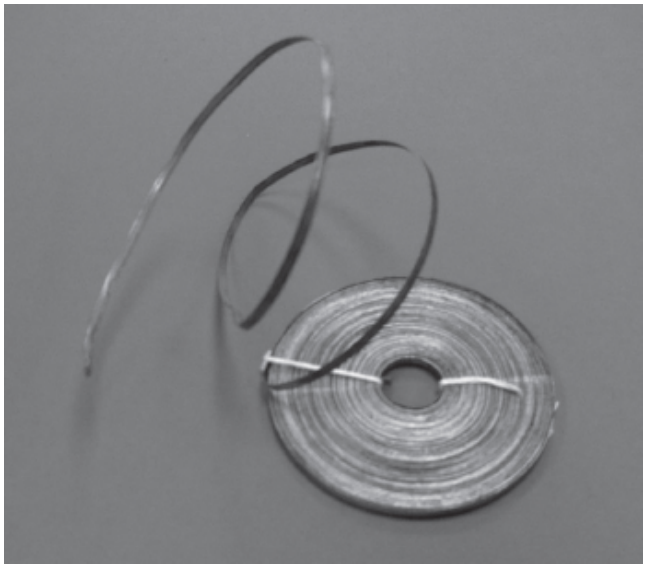


Diagram A **Diagram B** **Diagram C**

This magnesium atom is **Diagram** ☐

(1)

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



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

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

(2)

(c) Magnesium sulfate is a salt of magnesium.

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

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

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

hydrochloric **nitric** **sulfuric**

(1)

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

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

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

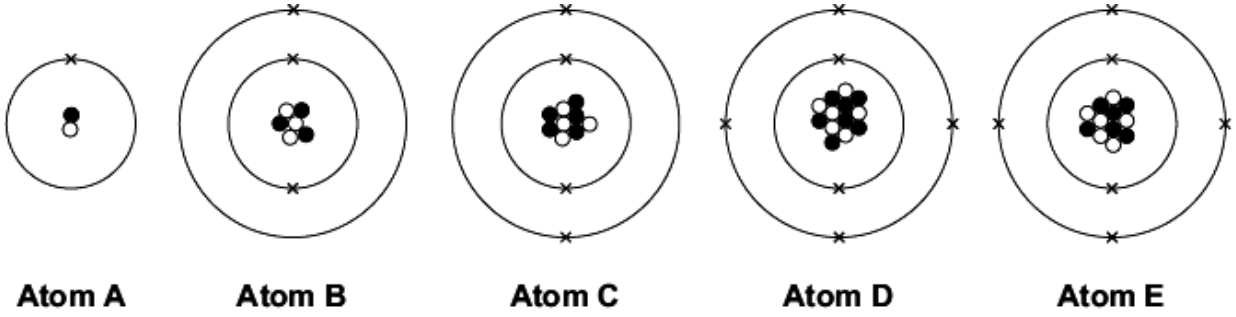
(2)

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

crystallisation **electrolysis** **oxidation**

(1)
(Total 7 marks)

Q10. The diagrams show five different atoms, **A**, **B**, **C**, **D** and **E**.



Key
○ represents a proton
● represents a neutron
× represents an electron

(a) Which atom, **A**, **B**, **C**, **D** or **E**:

(i) has an atomic number (proton number) of 3 **Atom** ☐

(1)

(ii) has a mass number of 2 **Atom** ☐

(1)

(iii) is in Group 2 of the periodic table? **Atom** ☐

(1)

(b) Which **two** atoms from **A**, **B**, **C**, **D** and **E** are isotopes of the same element?

Atom ☐ and **Atom** ☐

(1)

(c) Which particle in an atom has a negative charge? .....

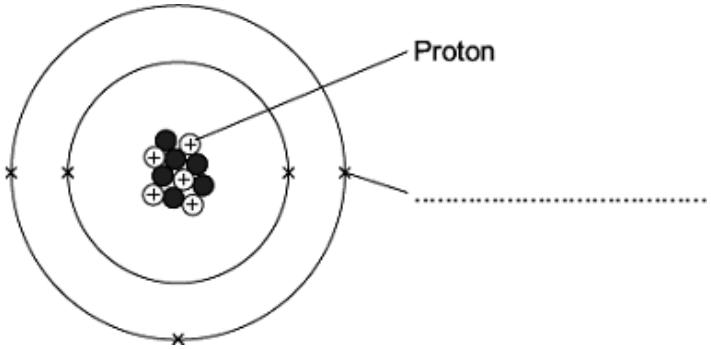
(1)

(Total 5 marks)

Q11. 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 ..... .

(1)

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

5 **11** **16**

(1)

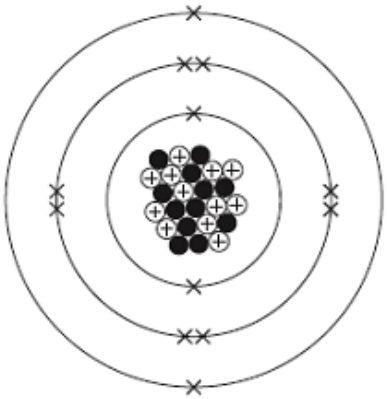
(ii) Another atom of this element has a different mass number.

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)

Q12. The diagram represents a magnesium atom.



(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.

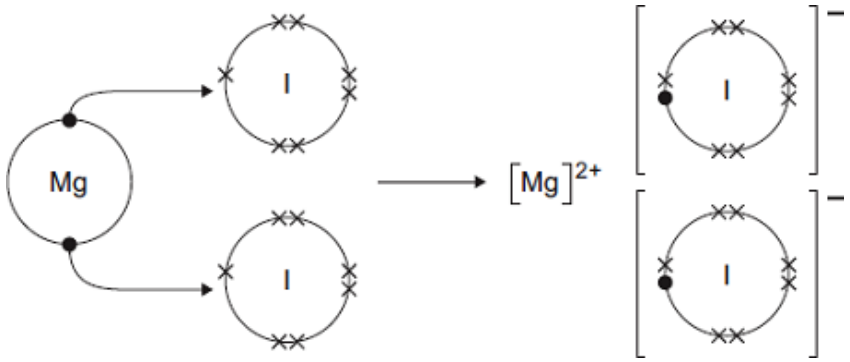
12 **24** **36**

(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.



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.

.....

.....

.....

.....

.....

.....

.....

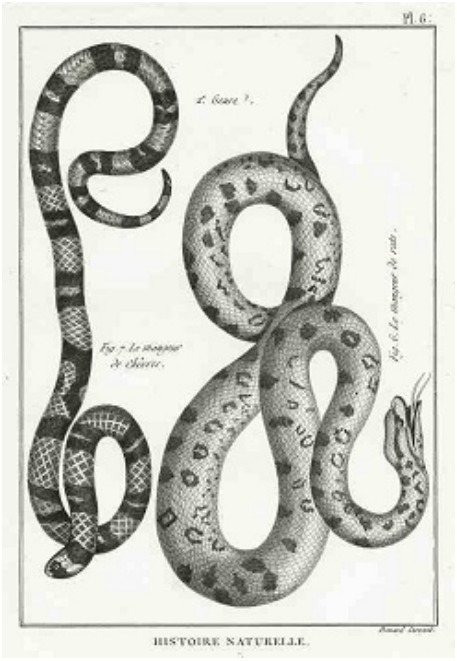
.....

.....

.....

(4)
(Total 9 marks)

Q13. Printed pictures can be made using etchings.



© Eduardo Jose Bernardino/iStock

An etching can be made when a sheet of brass reacts with iron chloride solution.

(a) Brass is a mixture of two metals, copper and zinc.

(i) A mixture of two metals is called ..... .

(1)

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

Copper and zinc atoms are different sizes.

This makes brass

harder
more flexible
softer

than the pure metals.

(1)

(b) Iron chloride has the formula $FeCl_3$

Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

(i) Calculate the relative formula mass (M_r) of iron chloride ($FeCl_3$).

.....

.....

.....

Relative formula mass (M_r) of iron chloride = ...

(2)

(ii) Calculate the percentage of iron in iron chloride ($FeCl_3$).

.....

.....

.....

Percentage of iron in iron chloride = ...%

(2)

(Total 6 marks)

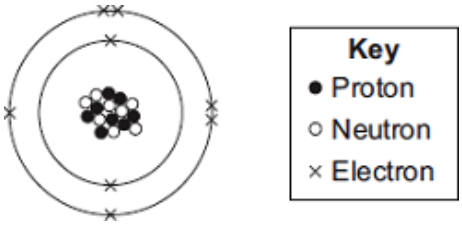
Q14. This question is about atoms and molecules.

(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.

(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)

Q15. This question is about lithium and sodium.

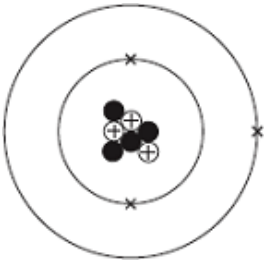
(a) Use the Chemistry Data Sheet to help you to answer this question.

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 ☐

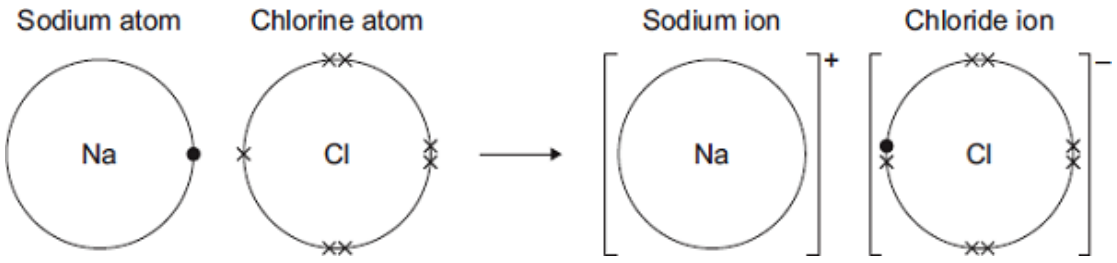
(1)

(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.



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.

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)