

Q1. The drawing shows a container of a compound called magnesium chloride.



(i) How many elements are joined together to form magnesium chloride?

.....

(1)

(ii) Magnesium chloride is an ionic compound. What are the names of its ions?

..... ions and ions

(1)

(iii) How many **negative** ions are there in the formula for magnesium chloride?

.....

(1)

(iv) Complete the sentence.

Ions are atoms, or groups of atoms, which have lost or gained

.....

(1)

(v) Suggest **three** properties which magnesium chloride has because it is an ionic compound.

Property 1

.....

Property 2

.....

Property 3

.....

(3)

(Total 7 marks)

- Q2.** (a) Every chemical element has a chemical symbol. Choose the correct chemical symbols from the box and complete the **three** spaces in the table.

C	Co	Cu	Fe	I	Ir	Zn	Zr
----------	-----------	-----------	-----------	----------	-----------	-----------	-----------

Name of element	Chemical symbol
Copper
Iron
Zinc

(3)

- (b) Give **one** use for each of the following metals. You should give a different use for each metal.

Copper

.....

Iron

.....

Zinc

.....

(3)

- (c) Give **four** physical properties which metals usually have.

1.

.....

2.

.....

3.

.....

4.

.....

(4)

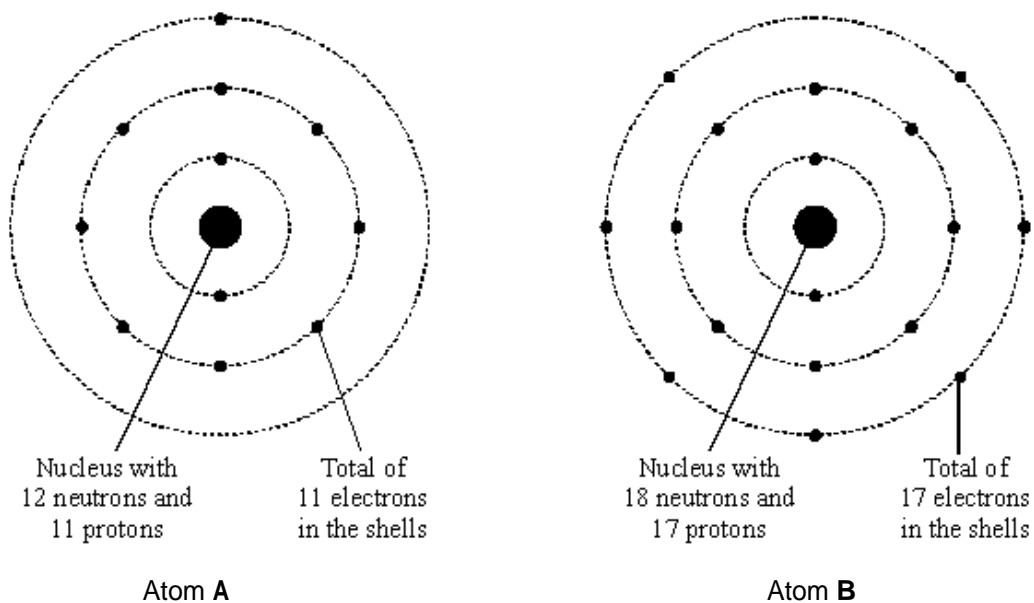
- (d) Metals usually form ionic compounds. Give **one** property of an ionic compound.

.....

.....

(1)

(e) The diagrams show **two** different atoms, atom **A** and atom **B**.



(i) Complete the following sentence.

For these two atoms to become ions one would
be transferred from atom to atom

(1)

(ii) Atom **A** and atom **B** are from different elements. How can you tell this from their nuclei?

.....
.....

(1)

(Total 13 marks)

- Q3.** (a) Read the article about the use of nanoparticles in sun creams.

Sun creams

Many sun creams use nanoparticles. These sun creams are very good at absorbing radiation, especially ultraviolet radiation. Owing to the particle size, the sun creams spread more easily, cover better and save money because you use less. The new sun creams are also transparent, unlike traditional sun creams which are white. The use of nanoparticles is so successful that they are now used in more than 300 sun cream products.

Some sun creams contain nanoparticles of titanium oxide. Normal-sized particles of titanium oxide are safe to put on the skin.

It is thought that nanoparticles can pass through the skin and travel around the body more easily than normal-sized particles. It is also thought that nanoparticles might be toxic to some types of cell, such as skin, bone, brain and liver cells.

- (i) How is the size of nanoparticles different from normal-sized particles of titanium oxide?

.....

(1)

- (ii) Suggest how the size of nanoparticles might help them to enter the body more easily.

.....

.....

(1)

- (b) Give **two** advantages of using nanoparticles in sun creams.

1

.....

2

.....

(2)

- (c) Why might nanoparticles be dangerous inside the body?

.....

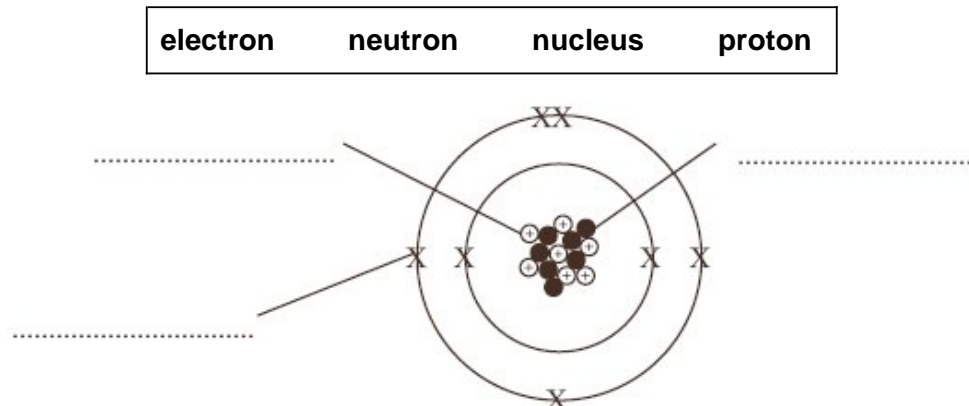
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(1)

(Total 5 marks)

Q4. (a) The diagram represents an atom of nitrogen.

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



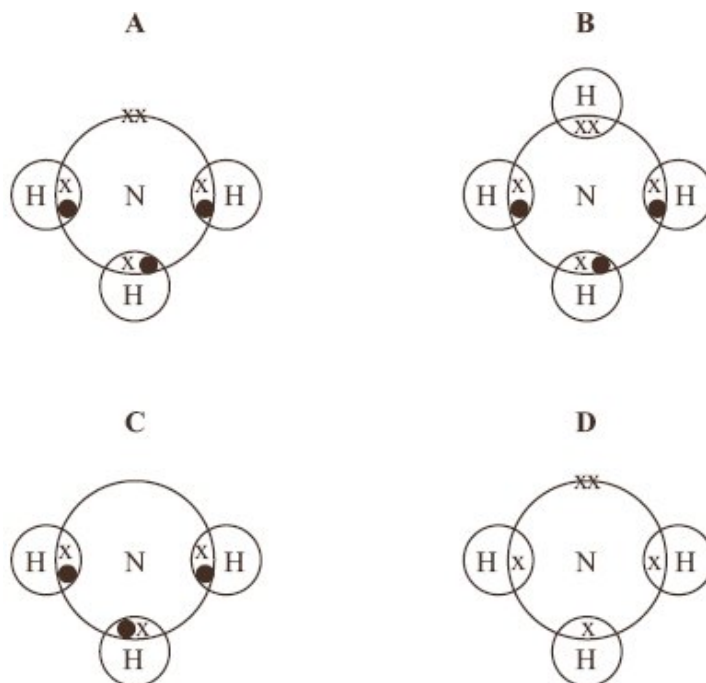
(2)

(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 .



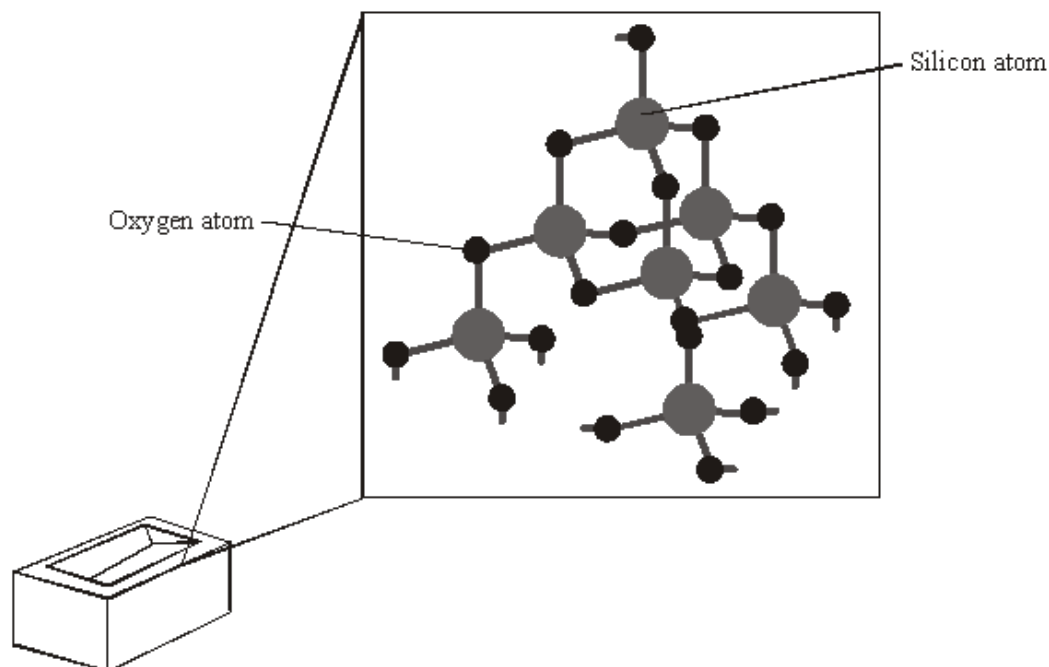
Which diagram, **A**, **B**, **C** or **D**, best represents an ammonia molecule?

(1)

(Total 4 marks)

Q5. Bricks made from silica (silicon dioxide) are used to line furnaces that operate at high temperatures.

Part of the structure of silica is shown in the diagram.



Use words from the box to complete the sentences.

covalent	giant	low	small
four	high	six	weak

One reason for using silica to make bricks for high-temperature furnaces is that silica has a melting point.

Silica has this property because it is a structure in which each silicon atom is joined to oxygen atoms by bonds.

(Total 4 marks)

Q6. 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*.

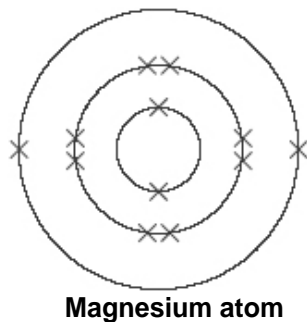
Complete the following sentence using the correct words from the box.

gives out heat	stores heat	takes in heat
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An *exothermic* reaction is one which

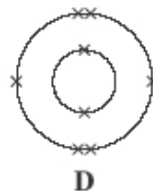
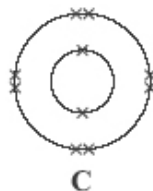
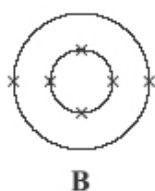
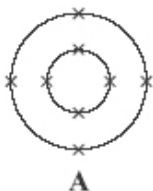
(1)

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



The atomic (proton) number of oxygen is 8.

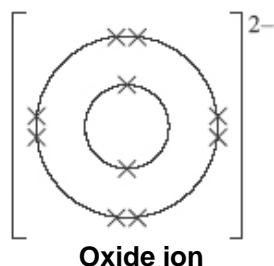
Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?



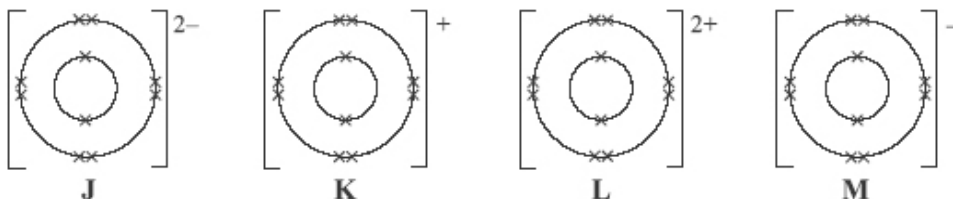
Diagram

(1)

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



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



Diagram

(1)

- (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

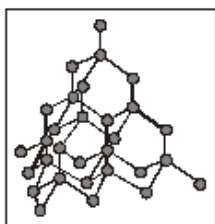
(1)

(Total 4 marks)

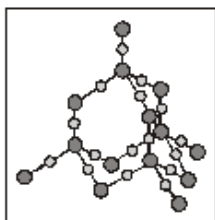
Q7. This question is about giant structures. Diamond, graphite and silicon dioxide all have giant structures.

(a) The diagrams show the structures of these three substances.

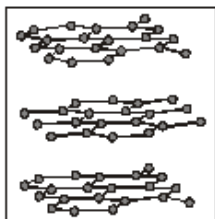
Draw a line from each structure to its name.



Silicon dioxide



Graphite



Diamond

(2)

(b) Complete the sentences using words from the box.

covalent	four	hard	ionic
shiny	soft	three	two

(i) Diamond, graphite and silicon dioxide have high melting points because all the atoms in their structures are joined by strong bonds.

(1)

(ii) In diamond each atom is joined to other atoms.

(1)

(iii) Diamond can be used to make cutting tools because it has a rigid structure which makes it very

(1)

(iv) In graphite each atom is joined to other atoms.

(1)

(v) Graphite can be used to make pencils because it has a structure which makes it

(1)

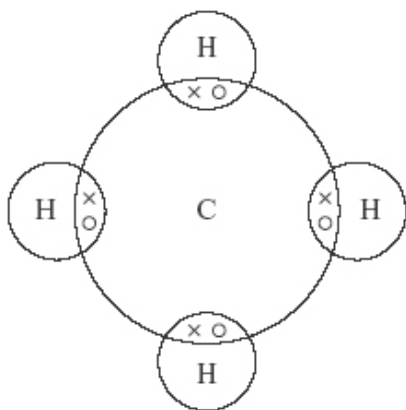
- (c) When a diamond is heated to a high temperature and then placed in pure oxygen it burns. Carbon dioxide is the only product.

Name the element in diamond.

(1)

(Total 8 marks)

Q8. The diagram represents a particle of methane.



- (a) What is the formula of methane?

(1)

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

atom	ion	molecule
------	-----	----------

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

.....

(1)

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

covalent	ionic	metallic
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What is the type of bonding shown in the diagram?

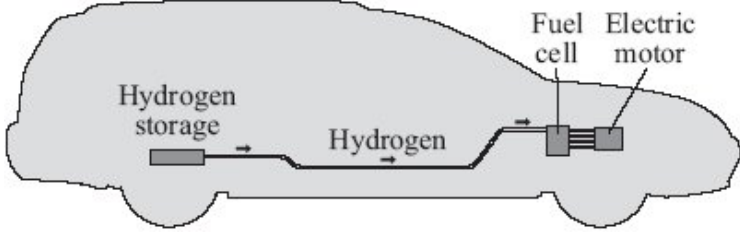
.....

(1)

(Total 3 marks)

Q9. 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?

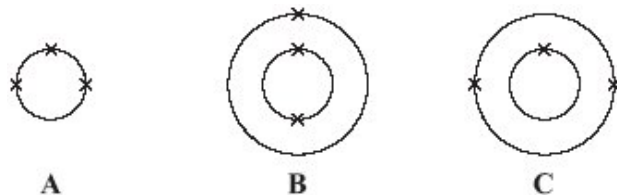
-
-

(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

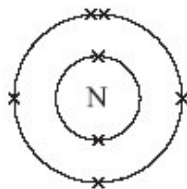
(1)

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

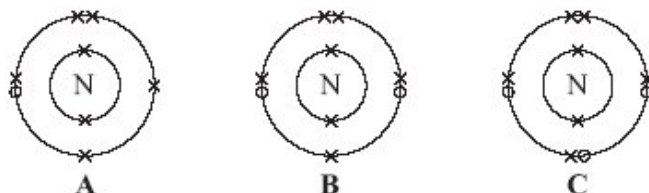
Statement	Tick (✓)
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(1)

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



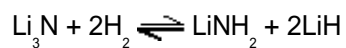
Which diagram, **A**, **B** or **C**, represents the electronic structure of a nitride ion (N^{3-})?
Write your answer in the box.



Diagram

(1)

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



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

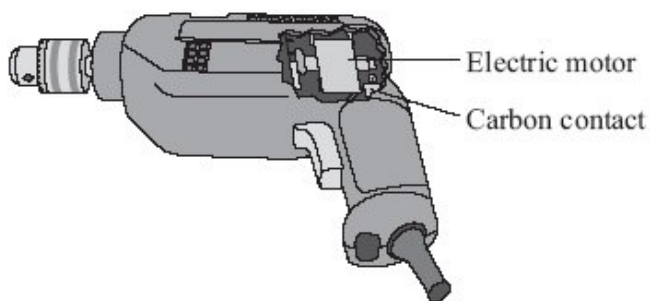
density
mass
surface area

than normal sized particles of lithium nitride.

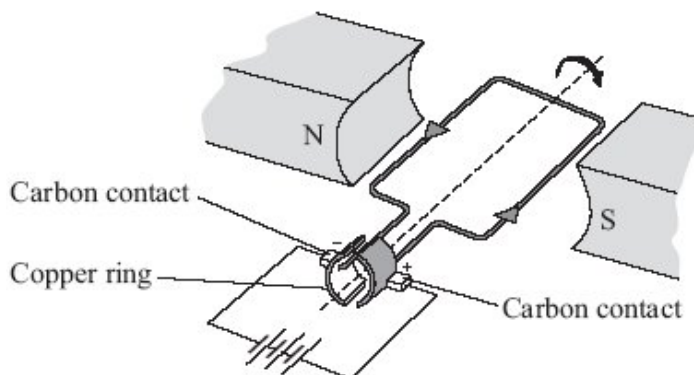
(1)

(Total 10 marks)

Q10. This drill contains an electric motor.



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



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

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

- 1
-
- 2
-

(2)

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

Each carbon atom in graphite is joined to

two
three
four

other carbon atoms by

covalent
ionic
metallic

bonds.

(2)

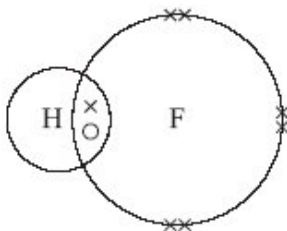
- (ii) Tick (✓) the statement which explains why graphite is soft and slippery.

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

(1)
(Total 5 marks)

Q11. This question is about fluorine and some of its compounds.

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



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

covalent

ionic

metallic

(1)

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

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

gas	liquid	solid
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To allow electrolysis to take place the mixture of potassium fluoride and hydrogen fluoride must be

(1)

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

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

fluorine	hydrogen	potassium
-----------------	-----------------	------------------

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

.....

(1)

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

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

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

(1)

(ii) Explain why you have chosen this question.

.....

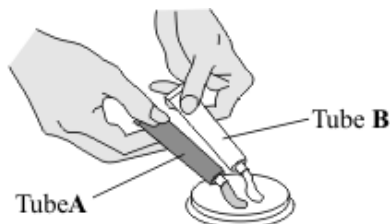
.....

(1)

(Total 5 marks)

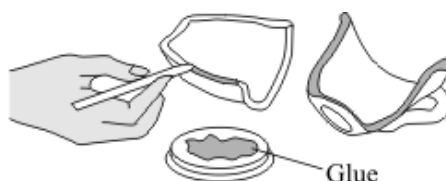
Q12. The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

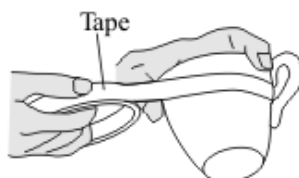


Step 2 Mix the liquids to make the glue.

Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Assemble the pieces to be joined and then hold them together with tape.



Step 4 Leave the glue to set.

(a) When liquids **A** and **B** are mixed a chemical reaction takes place.

(i) This reaction is exothermic.

Complete the sentence below using a word or phrase from the box.

decrease	increase	stay the same
-----------------	-----------------	----------------------

During the reaction the temperature of the mixture will

(1)

(ii) When the glue sets it forms a giant covalent structure.

Draw a ring around **one** property that you would expect the set glue to have.

good conductor of electricity **low melting point** **high melting point**

(1)

(b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in °C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

(i) Complete the sentences below using words or phrases from the box.

decrease	increase	stay the same
-----------------	-----------------	----------------------

When the temperature is increased the time taken for the glue to set

.....

When the temperature is increased the rate of the setting reaction

.....

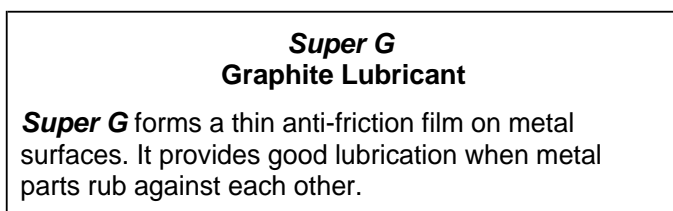
(2)

- (ii) Put a tick (✓) next to the **two** reasons why an increase in temperature affects the rate of reaction.

Reason	(✓)
It gives the particles more energy.	
It increases the concentration of the particles.	
It increases the surface area of the particles.	
It makes the particles move faster.	

(2)
(Total 6 marks)

Q13. This label was on a container of graphite lubricant.



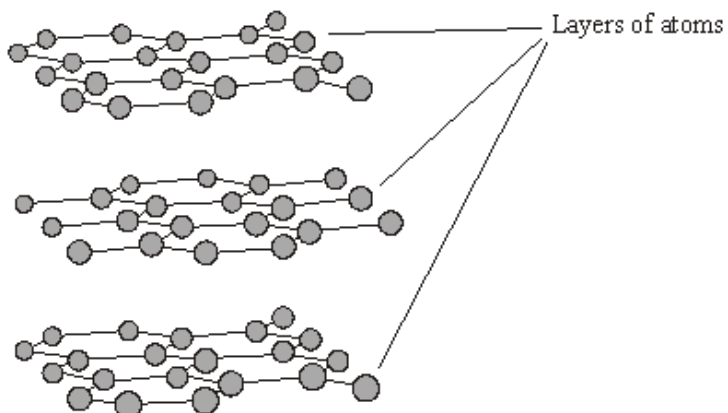
- (a) Give **one** reason why a lubricant is used when metal parts rub against each other.

.....

.....

(1)

- (b) The diagram shows the arrangement of atoms in graphite.



- (i) Draw a ring around the type of atoms in graphite.

aluminium

carbon

silicon

(1)

- (ii) Graphite is a good lubricant because it is slippery. Use the diagram to explain why graphite is slippery.

.....

.....

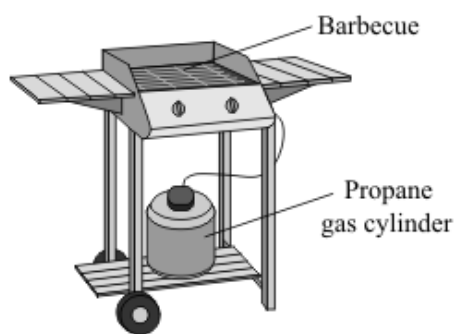
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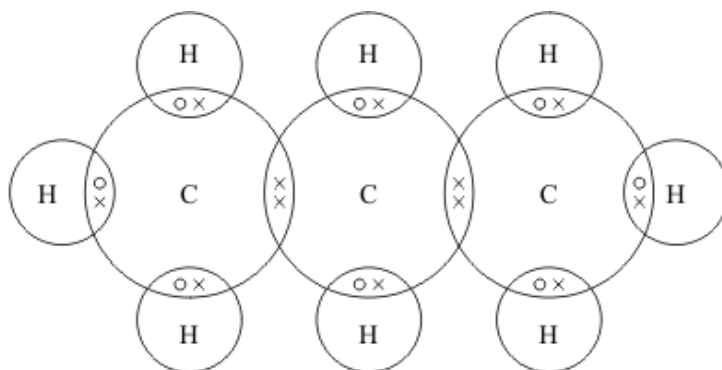
.....

(2)
(Total 4 marks)

- Q14.** This barbecue burns propane gas.



The diagram represents a propane molecule.



- (a) What is the formula of propane?

(1)

- (b) (i) Draw a ring around the name of the particle represented by the symbols ○ and × in the diagram.

electron

neutron

proton

(1)

- (ii) Draw a ring around the type of bonding that holds the atoms together in a propane molecule.

covalent

ionic

metallic

(1)

- (c) Under high pressure in the cylinder propane is a liquid.
Liquid propane evaporates easily to form a gas when the tap on the cylinder is opened.

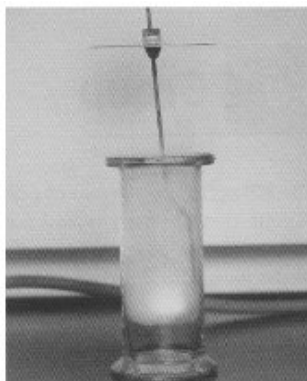
Draw a ring around the correct answer in each box to explain why propane evaporates easily.

Propane has a	high low	boiling point because it consists of	large small	molecules.
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(1)

(Total 4 marks)

- Q15.** The picture shows sodium reacting with chlorine. The reaction forms sodium chloride.



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

compound	element	hydrocarbon	mixture
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Which word best describes:

- (i) sodium

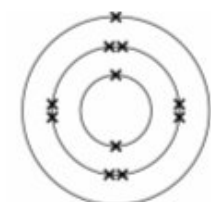
(1)

- (ii) sodium chloride?

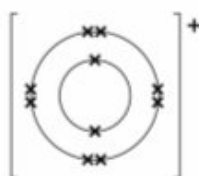
(1)

- (b) When sodium reacts with chlorine the sodium atoms change into sodium ions.

The diagrams below represent a sodium atom and a sodium ion.



Sodium atom (Na)



Sodium ion (Na⁺)

Use the diagrams to help you explain how a sodium atom turns into a sodium ion.

.....

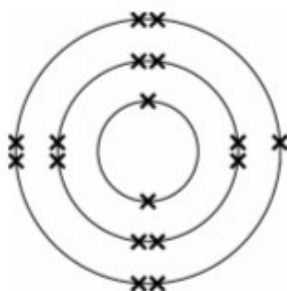
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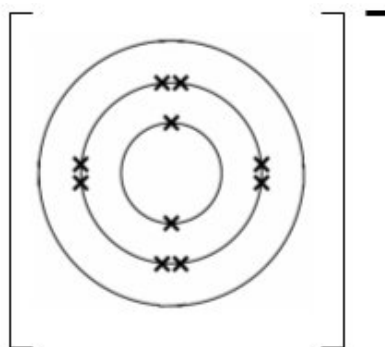
(2)

- (c) (i) The diagram below represents a chlorine atom.



When chlorine reacts with sodium the chlorine forms negative chloride ions.

Complete the diagram below to show the outer electrons in a chloride ion (Cl^-).



(1)

- (ii) Chloride ions are strongly attracted to sodium ions in sodium chloride.

Explain why.

.....

.....

(1)

(Total 6 marks)

Q16. Read the information in the box and then answer the questions.

Sun Creams

Sun creams contain titanium oxide. This compound absorbs harmful radiation.

Traditional sun creams contain normal-sized particles of titanium oxide. Normal-sized particles of titanium oxide are known to be safe to put on the skin.

Many new sun creams contain nano-sized particles of titanium oxide.

Experiments suggest that nano-sized particles might pass through the pores of the skin more easily than normal-sized particles.

- (a) Explain why nano-sized particles might pass more easily through the pores of the skin than normal sized particles.

.....
.....

(1)

- (b) Using these sun creams is beneficial because they absorb harmful radiation.

Suggest **one** possible risk of using these sun creams.

.....
.....

(1)

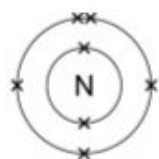
(Total 2 marks)

- Q17.** (a) Ammonia has the formula NH_3 . It is made from nitrogen and hydrogen.

How many atoms are in an ammonia molecule?

(1)

- (b) The diagrams show the electron arrangement in nitrogen and hydrogen.

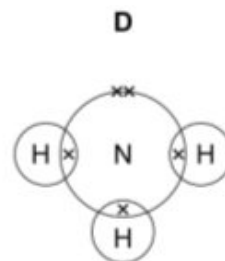
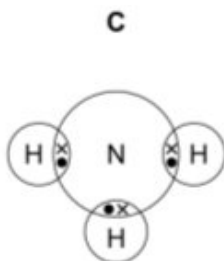
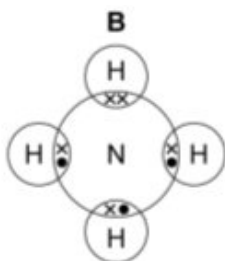
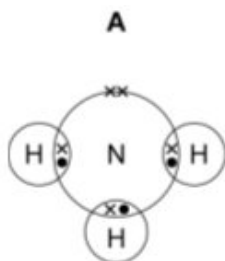


Nitrogen



Hydrogen

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



Write your answer in the box.

Diagram

(1)

- (c) Ammonia dissolves in water to form a solution with a pH of 10.

What does this pH value tell you about ammonia solution?

.....

(1)

- (d) In industry a large amount of ammonia is neutralised by an acid to make ammonium nitrate.

- (i) What type of substance is ammonium nitrate?

Tick (✓) **one** box.

acid

☐

alkali

☐

base

☐

salt

☐

(1)

(ii) Which acid is added to ammonia to make ammonium nitrate?

Tick (✓) **one** box.

hydrochloric

☐

citric

☐

nitric

☐

sulfuric

☐

(1)

(iii) Draw a ring around the main use of ammonium nitrate.

fertiliser

lubricating oil

medicine

plastic

(1)

(e) Instant cold packs are used to treat sports injuries.



One type of cold pack has a plastic bag containing water. Inside the bag is a smaller bag containing ammonium nitrate.

The outer bag is squeezed so that the inner bag bursts. The ammonium nitrate dissolves in the water. This process is endothermic.

Explain why the bag becomes cold.

.....

.....

.....

.....

(2)
(Total 8 marks)

Q18. The diagram shows how the atoms are joined in part of a diamond.



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

(i) Diamond has a high melting point because

some
a few
all

of the atoms are

joined by strong bonds.

(1)

(ii) Each atom is joined
to

one
two
four

other atoms.

(1)

(iii) The bonds are

covalent.
ionic.
metallic.

(1)

(iv) Diamond is used in cutting tools because it is

hard.
soft.
shiny.

(1)

(b) Diamond is made of carbon.

Name a gas produced when carbon reacts with oxygen.

.....

(1)

(Total 5 marks)

Q19. This picture shows a sword. The sword is about 3400 years old. It is made of an alloy called bronze.



Photograph © O.Louis Mazzatenta / Getty Images

Bronze is made from copper and tin.

Bronze made better swords than pure copper. This is because bronze is harder than pure copper.

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

An alloy is a mixture of

metals.
molecules.
non-metals.

(1)

- (b) Pure copper can be quite easily bent out of shape.

Which **two** statements in the table explain why copper can be bent?

Tick (✓) **two** boxes.

Statements	Tick (✓)
Copper atoms are arranged in layers.	
Copper atoms are joined by strong covalent bonds.	
Copper atoms can slide over each other.	
Copper is made of small molecules.	

(2)

- (c) Which **one** statement in the table explains why bronze is harder than pure copper?

Tick (✓) **one** box.

Statements	Tick (✓)
Copper and tin atoms are the same size.	
The layers of atoms are distorted in bronze.	
The copper and tin atoms are joined by strong covalent bonds in bronze.	

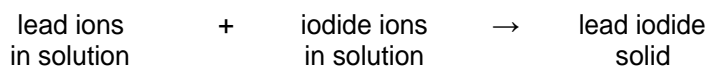
(1)

(Total 4 marks)

Q20. This question is about lead iodide and magnesium iodide.

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

Lead iodide is formed as a solid.



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

electrolysis

neutralisation

precipitation

(1)

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

Method	Tick (✓)
distillation	
evaporation	
filtration	

(1)

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

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

Use the table to help you to:

draw a ring around a soluble compound which contains lead ions

lead bromide

lead chloride

lead nitrate

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

lead iodide

silver iodide

sodium iodide

(2)

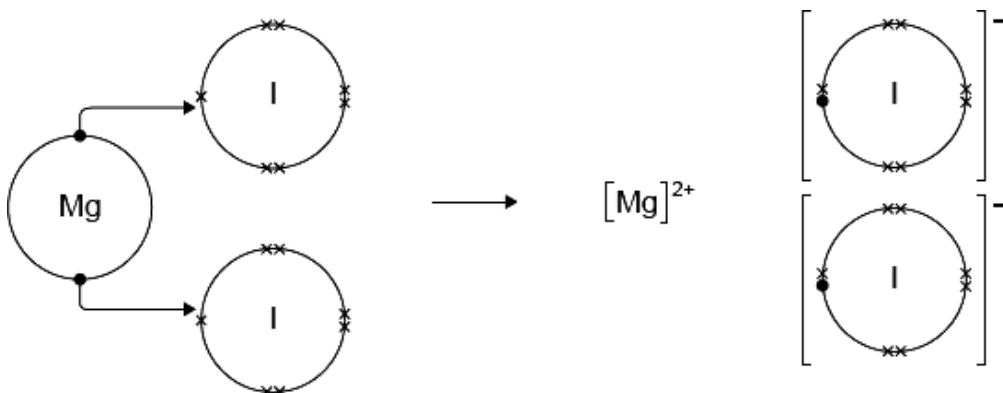
- (b) Magnesium iodide can be made by reacting magnesium with iodine.



The diagram shows how this takes place.

Only the outer electrons are shown.

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



Use the diagram to help you to answer this question.

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

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

.....

.....

.....

.....

.....

.....

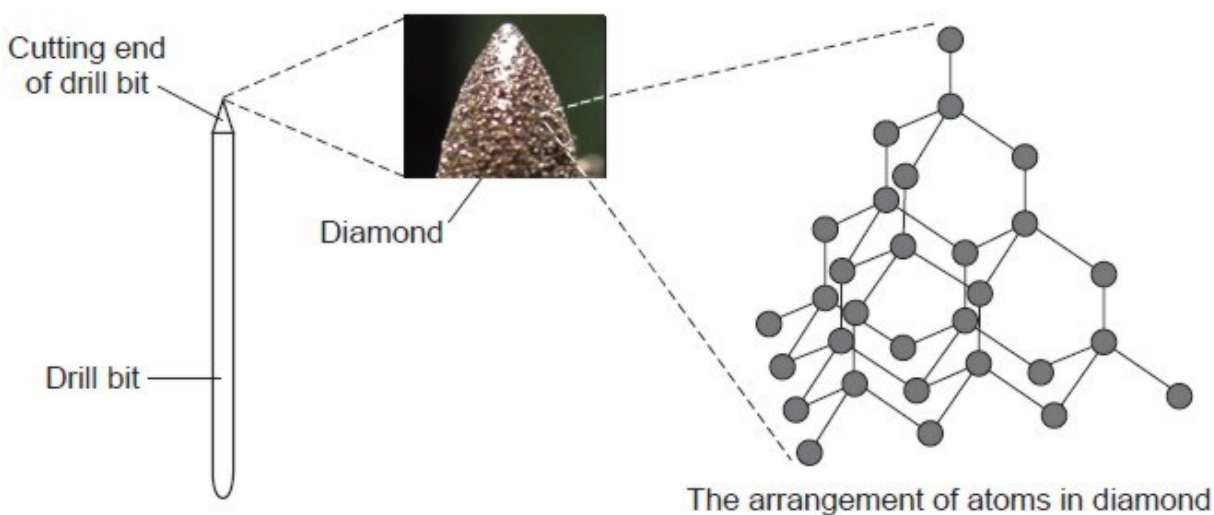
.....

.....

.....

(4)
(Total 8 marks)

Q21. A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



By Wanderlinse [CC By 2.0], via Flickr

Draw a ring around the correct word in each box.

(a) Diamond is made from

carbon
nitrogen
oxygen

atoms.

(1)

(b) Diamond has a giant structure in which

none
some
all

of the atoms are joined together.

(1)

(c) The atoms in diamond are joined together by

covalent
ionic
metallic

bonds.

(1)

(d) In diamond each atom is joined to

two
three
four

other atoms.

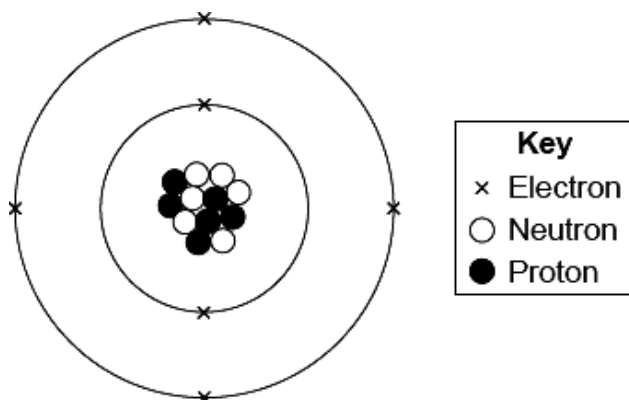
(1)

(e) Diamond is suitable for the cutting end of a drill bit because it is

hard.
shiny.
soft

(1)
(Total 5 marks)

Q22. 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.

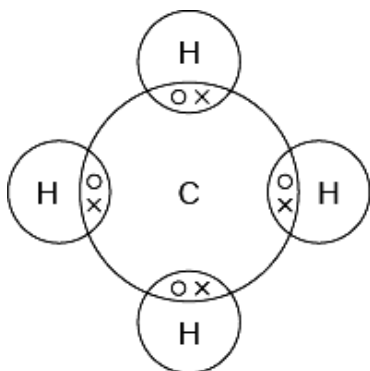
${}^8_6\text{C}$

${}^{14}_6\text{C}$

${}^{14}_8\text{C}$

(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

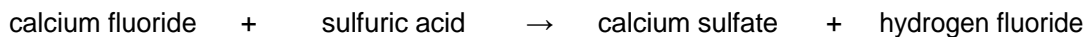
metallic

(1)

(Total 9 marks)

Q23. Hydrogen fluoride is used to make hydrofluoric acid.

- (a) A company makes hydrogen fluoride by reacting solid calcium fluoride with sulfuric acid. The reaction takes place in a rotating kiln.



The company want this reaction to take place quickly.

- (i) Rotating the kiln makes the reaction take place faster.

Suggest why.

.....
.....

(1)

- (ii) Draw a ring around the correct word in each box.

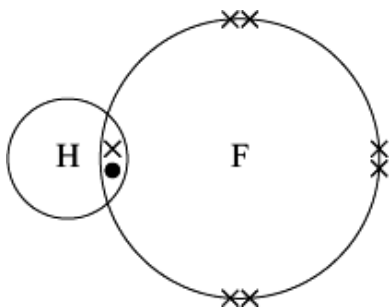
To make the reaction take place **faster**:

the temperature should be	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">higher lower</div>	so that the particles have	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">less more</div>	energy
the solid calcium fluoride should be	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">powder lumps</div>	to give a	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">small big</div>	surface area
the sulfuric acid solution should be	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">dilute concentrated</div>	to give	<div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;">less more</div>	collisions

between the particles each second.

(3)

- (b) The diagram represents a molecule of hydrogen fluoride.



The hydrogen and fluorine atoms are joined by a covalent bond.

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

electrons	neutrons	protons
------------------	-----------------	----------------

In a covalent bond the atoms share

(1)

- (c) Hydrogen fluoride is dissolved in water to make an acidic solution of hydrofluoric acid.

Draw a ring around the symbol of the ion that makes the solution acidic.

H⁺

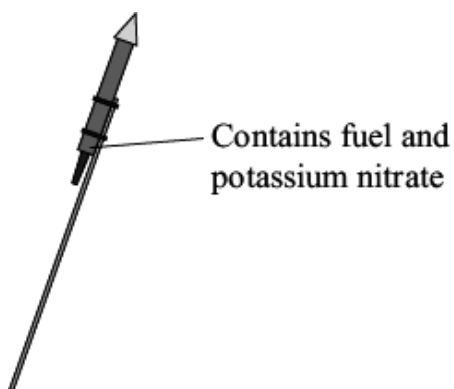
OH⁻

F⁻

(1)

(Total 6 marks)

Q24. 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.

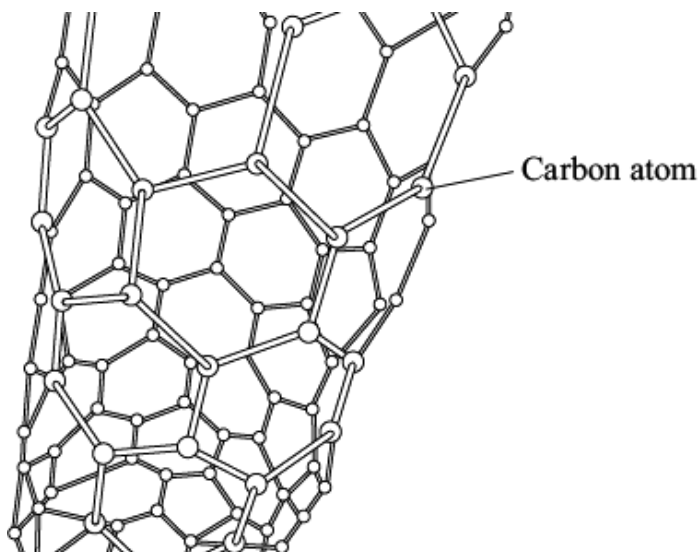
Statement	Tick (✓)
It has a giant structure	
It has a low boiling point.	
It is made of small molecules.	
It is made of ions.	

(2)
(Total 6 marks)

Q25. Lightweight handlebars for bicycles are made from materials containing carbon nanotubes.

Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



(a) What does the term 'nano' tell you about the diameter of carbon nanotubes?

Tick (✓) the correct answer in the table.

Answer	Tick (✓)
The diameter of the tube is very small.	
The diameter of the tube is large.	
The diameter of the tube is very large	

(1)

(b) Look at the diagram and then draw a ring around the correct word to complete each sentence.

(i) Carbon nanotubes are similar to graphite because each carbon atom is joined to

two
three
four

other carbon atoms.

(1)

(ii) The carbon atoms are joined by

covalent
ionic
metallic

bonds.

(1)

(iii) Carbon nanotubes are very strong because the

atoms
bonds
electrons

are hard to break.

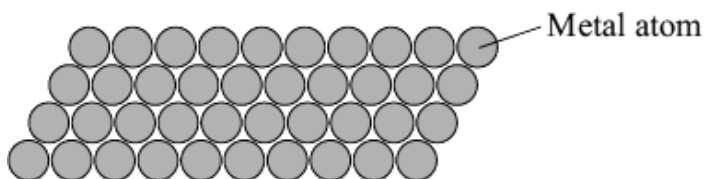
(1)

(Total 4 marks)

Q26. Metal is bent and shaped to make a car body.



The diagram below represents how atoms are arranged in a metal.



Which **two** statements in the table best explain why the metal can be bent and shaped?

Tick (✓) the **two** statements.

Statement	Tick (✓)
The atoms are in layers.	
The metal is shiny.	
The atoms can slide over each other.	
All the atoms are linked by strong covalent bonds.	

(2)
(Total 2 marks)

Q27. 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.

By russelljsmith [CC BY 2.0], via Flickr

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

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

.....

(1)

- (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)

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

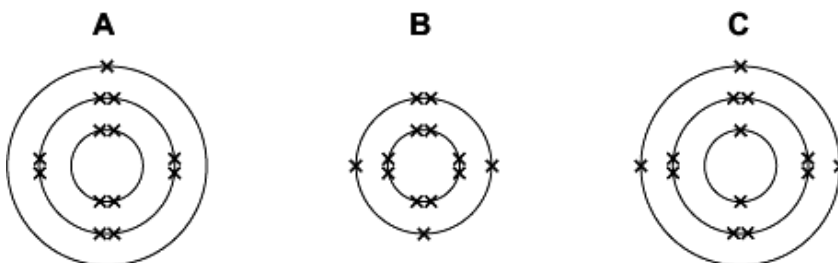
Complete the word equation for this reaction.

aluminium + →

(1)

- (d) An aluminium atom has 13 electrons.

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



The electronic structure of an aluminium atom is diagram

(1)

- (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.

- (i) Electrons have

a negative
no
a positive

charge.

(1)

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

it

gains
loses
shares

three electrons.

(1)

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

it

gains
loses
shares

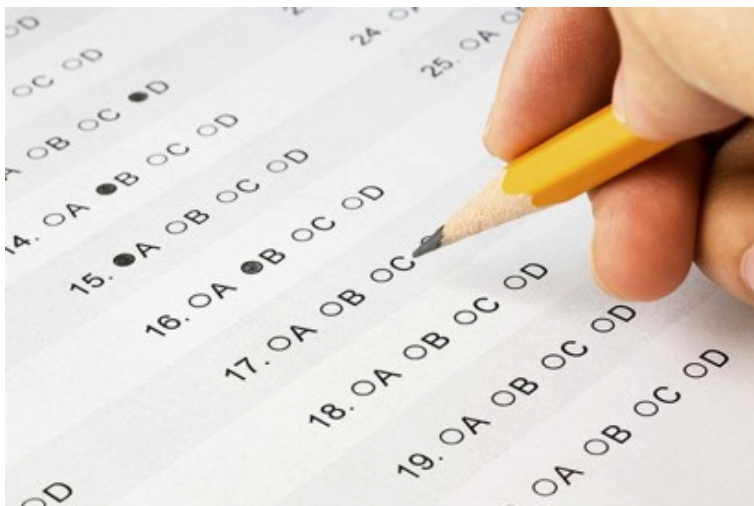
one
two
three

electrons.

(2)

(Total 8 marks)

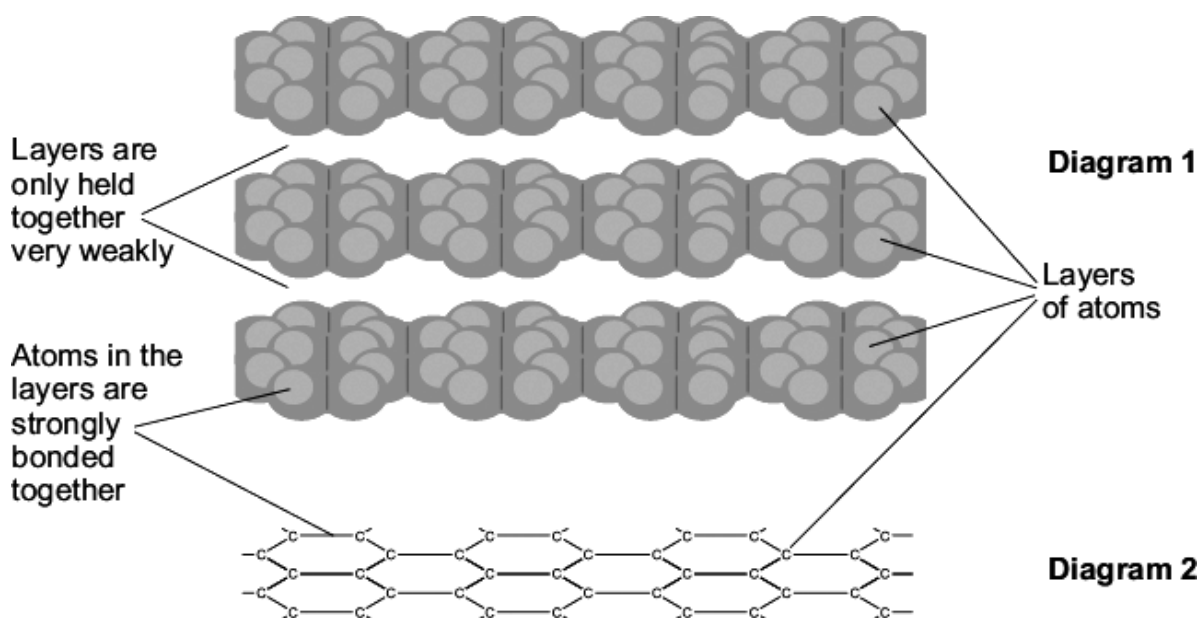
Q28. The picture shows a student using a pencil to complete a multiple choice answer sheet.



By albertogp123 [CC BY 2.0] , via Flickr

The pencil contains graphite. Graphite rubs off the pencil onto the paper.

Diagrams 1 and 2 show how the atoms are arranged in graphite.



- (a) Use **Diagram 2** and your Data Sheet to help you to name the element from which graphite is made.

.....

(1)

- (b) Use **Diagram 1** to help you explain why graphite can rub off the pencil onto the paper.

.....
.....
.....
.....

(2)

(c) Draw a ring around the type of bond which holds the atoms together in each layer.

covalent

ionic

metallic

(1)
(Total 4 marks)

Q29. Welding blankets are placed under metals being welded. They protect the area under the welding from hot sparks or molten metal.



Welding blanket

Some welding blankets are made from silicon dioxide.

(a) The table lists some properties of materials.

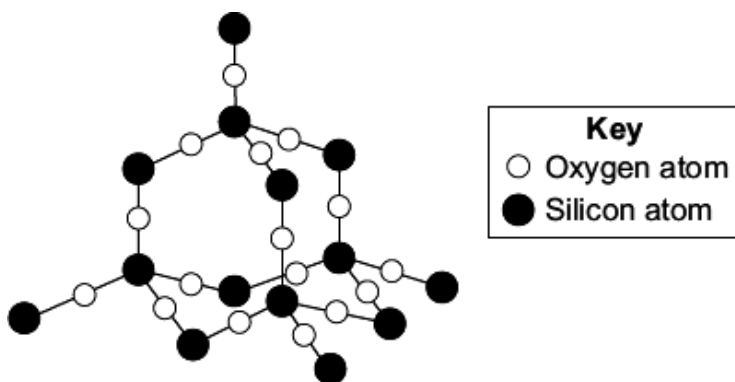
Two of these are properties of materials used to make welding blankets.

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

Property	Tick (✓)
High melting point	
Reacts with sparks	
Not flammable	
Low boiling point	

(2)

- (b) Silicon dioxide has a giant structure. The diagram shows a small part of this structure.



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

- (i) Silicon dioxide has a high melting point because

a few
some
all

of the atoms are joined

to other atoms.

(1)

- (ii) Each oxygen atom is joined to

two
three
four

silicon atoms.

(1)

- (iii) The bonds between the atoms are

covalent.
ionic.
metallic.

(1)

- (iv) These bonds are

easily broken.
very strong.
weak.

(1)

(Total 6 marks)

Q30. (a) A magnesium atom contains 12 protons (●), 12 neutrons (○) and 12 electrons (x).

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

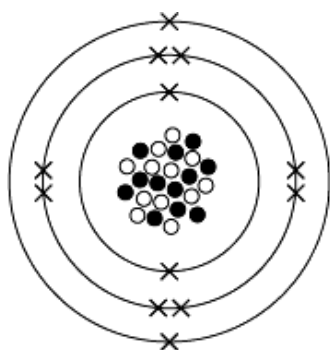


Diagram A

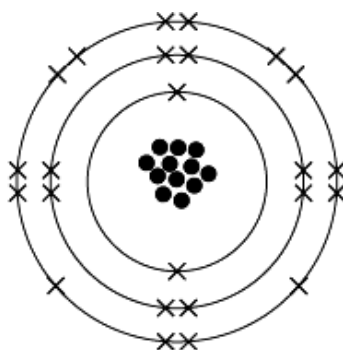


Diagram B

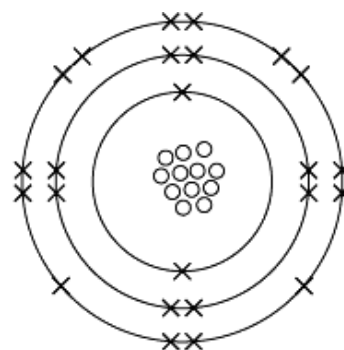
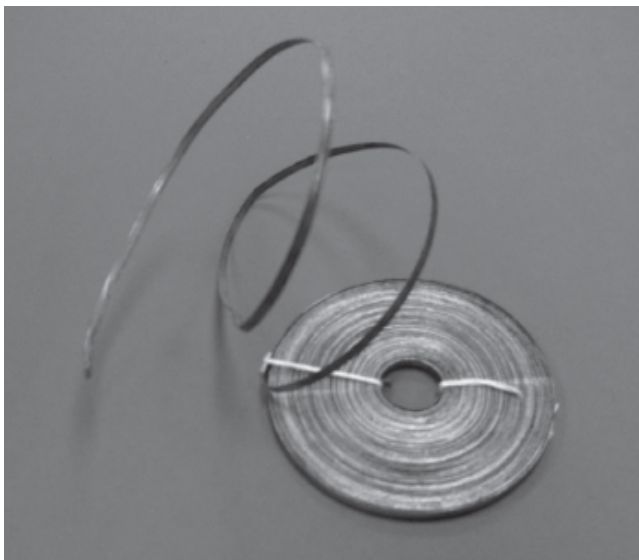


Diagram C

This magnesium atom is **Diagram**

(1)

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



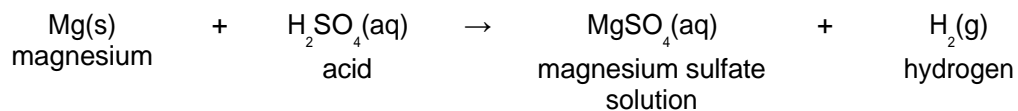
Tick (✓) **two** reasons which explain why metals can be shaped.

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:



- (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)

- Q31.** The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.



By Bertramz (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

I use different coloured dyes dissolved in methanol.
I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time.
The bowl dries more quickly if I use methanol instead of water.

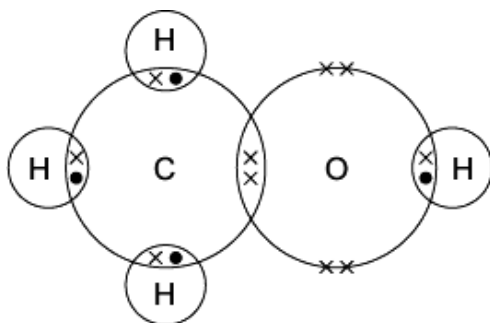
- (a) The artist uses methanol instead of water.

Give **two** reasons why.

- 1
-
- 2
-

(2)

- (b) The diagram shows how the atoms are bonded in methanol.



Draw a ring around:

- (i) the formula of methanol



(1)

- (ii) the type of bonding in methanol.

covalent

ionic

metallic

(1)

- (c) Methanol has a low boiling point.

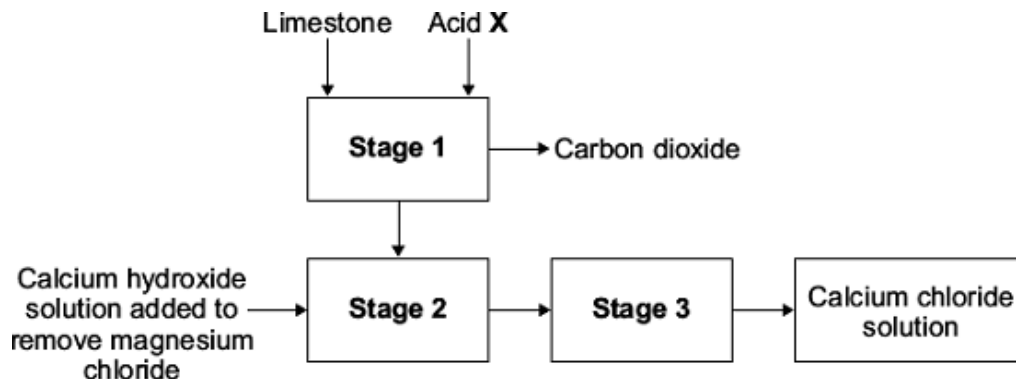
Tick (✓) the reason why.

Reason why	Tick (✓)
It has a giant covalent structure.	
It is made of small molecules.	
It has a giant metallic structure.	

(1)

(Total 5 marks)

- Q32.** (a) Calcium chloride is made from limestone. Limestone contains mainly calcium carbonate and a small amount of magnesium carbonate.



- (i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Draw a ring around the name of acid **X**.

hydrochloric

nitric

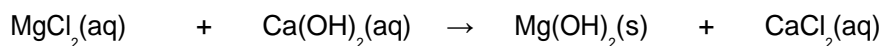
sulfuric

(1)

- (ii) **Stage 1** produces a concentrated solution of calcium chloride. The solution also contains magnesium chloride.

Calcium hydroxide solution is added in **stage 2** to remove the magnesium chloride.

The equation for this reaction is:



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

In **stage 2** a precipitate is made because magnesium hydroxide is

dissolved

insoluble

in water.

soluble

In **stage 3** the solid magnesium hydroxide can be separated from the calcium chloride

solution using

chromatography.

electrolysis.

filtration.

(2)

- (iii) What method can be used to change the calcium chloride solution into solid calcium chloride?

Draw a ring around your answer.

crystallisation

electrolysis

reduction

(1)

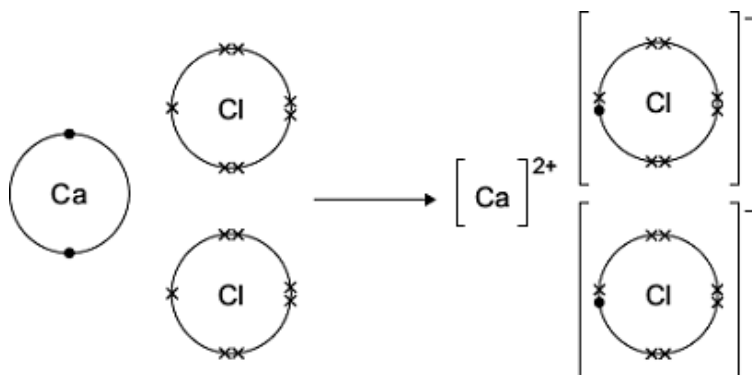
- (b) Calcium chloride can also be made by reacting calcium with chlorine:



The diagram shows what happens to atoms of calcium and chlorine in this reaction.

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

Only the outer electrons are shown.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when calcium reacts with chlorine to make calcium chloride.

.....

.....

.....

.....

.....

.....

.....

.....

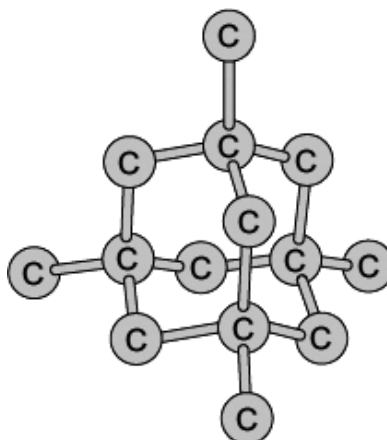
(4)

(Total 8 marks)

- Q33.** Liquids containing nanoparticles of diamond are used as abrasives.
Nanoparticles of diamond can be used to grind down surfaces to give them a very smooth polished finish.



Abrasive liquid containing nanoparticles of diamond



Model of part of the diamond structure

- (a) Diamond is made of one element.
Draw a ring around the name of this element.

calcium

carbon

chromium

cobalt

(1)

- (b) Tick (✓) **two** statements in the table which explain why diamond is hard.

Statement	Tick (✓)
It is made of layers.	
It has weak covalent bonds.	
Each atom is joined to four other atoms.	
It has a giant structure.	
It has strong ionic bonds.	

(2)

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

Nanoparticles of diamond are

very small.

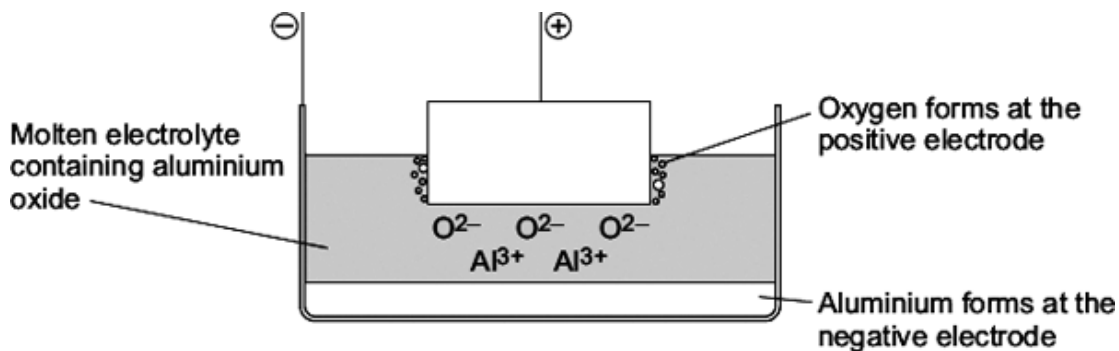
large.

very large.

(1)

(Total 4 marks)

Q34. The diagram represents an electrolysis cell for extracting aluminium.
The current will only flow when the electrolyte is molten.



(a) The electrolyte is aluminium oxide mixed with another substance.

(i) What is the name of the other substance in the electrolyte?

Draw a ring around the correct answer.

cryolite

rock salt

limestone

(1)

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

This other substance is added to

condense the aluminium oxide.

lower the melting point of the aluminium oxide.

raise the boiling point of the aluminium oxide.

(1)

- (b) (i) Oxide ions (O^{2-}) move to the positive electrode.

Explain why.

.....

.....

.....

.....

(2)

- (ii) Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.



Complete the sentence.

The name of the element which reacts with oxygen is

(1)

- (iii) The positive electrode gets smaller.

Suggest why.

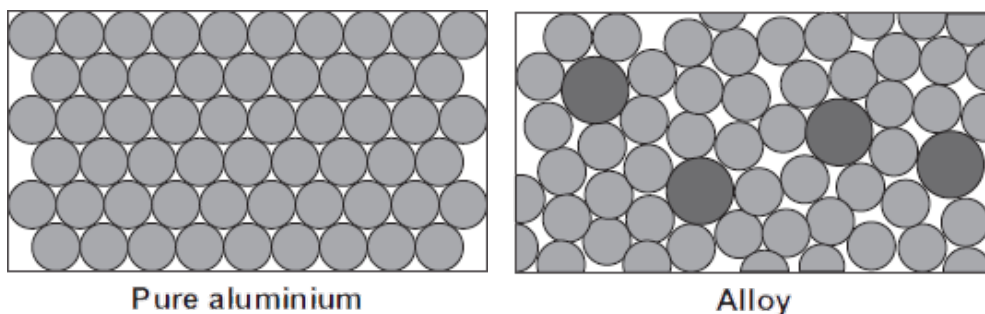
.....

.....

(1)

- (c) Aluminium is used in an alloy with magnesium to make drinks cans.

The diagrams show the arrangement of atoms in pure aluminium and in the alloy.



The alloy is harder than pure aluminium.

Explain why. Use the diagrams to help you.

.....

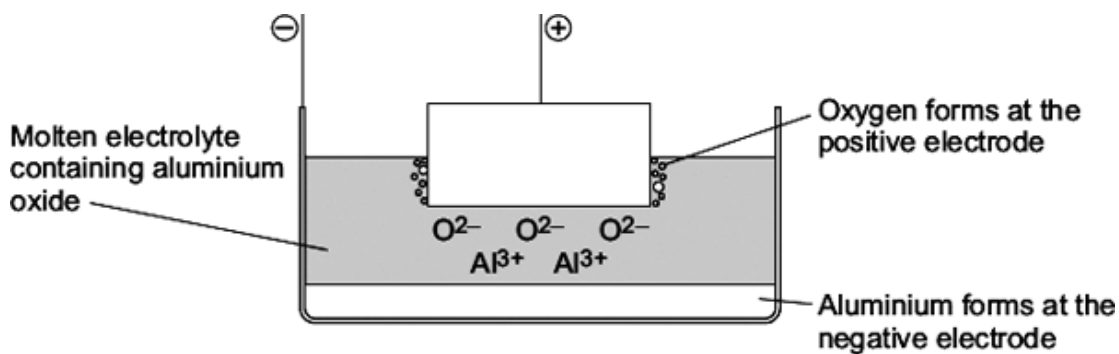
.....

.....

.....

(2)
(Total 8 marks)

- Q35.** The diagram represents an electrolysis cell for extracting aluminium.
The current will only flow when the electrolyte is molten.



- (a) The electrolyte is aluminium oxide mixed with another substance.
- (i) What is the name of the other substance in the electrolyte?
- Draw a ring around the correct answer.

cryolite

rock salt

limestone

(1)

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

This other substance is added to

condense the aluminium oxide.

lower the melting point of the aluminium oxide.

raise the boiling point of the aluminium oxide.

(1)

- (b) (i) Oxide ions (O^{2-}) move to the positive electrode.

Explain why.

.....

.....

.....

.....

(2)

- (ii) Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.



Complete the sentence.

The name of the element which reacts with oxygen is

(1)

- (iii) The positive electrode gets smaller.

Suggest why.

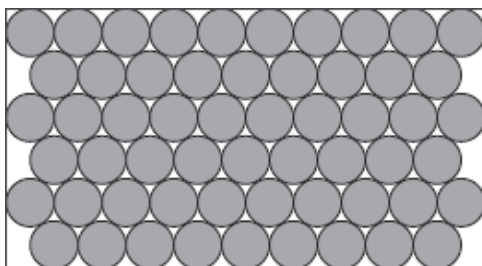
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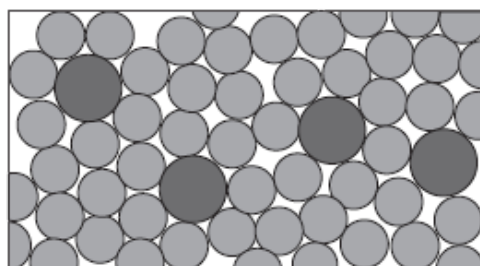
(1)

- (c) Aluminium is used in an alloy with magnesium to make drinks cans.

The diagrams show the arrangement of atoms in pure aluminium and in the alloy.



Pure aluminium



Alloy

The alloy is harder than pure aluminium.

Explain why. Use the diagrams to help you.

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(2)
(Total 8 marks)

