AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.2 HOW BONDING AND STRUCTURE ARE RELATED TO THE PROPERTIES OF SUBSTANCES (PACK 2)

SCORE	PERCENTAGE
/231	%

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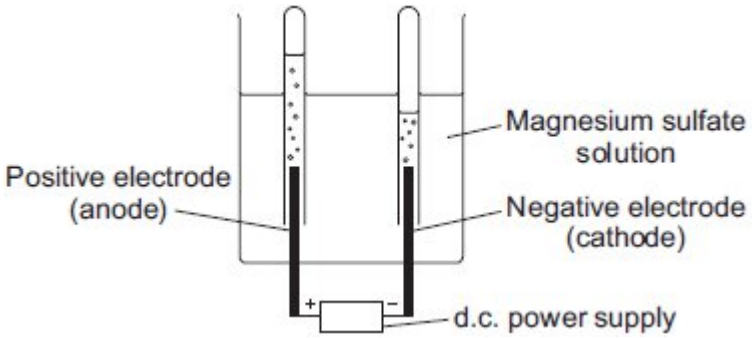
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Q1.

Diagram 1 shows the apparatus used to electrolyse magnesium sulfate solution.

Diagram 1



Gases were given off at both electrodes.

(a) The gas collected at the anode was oxygen.

Draw **one** line from the test for oxygen to the correct result.

Test	Result
	The splint relights
Place a glowing splint in the tube of the gas	The splint goes out
	There is a squeaky pop

(1)

(b) (i) The gas collected at the cathode was hydrogen.

Describe how to test the gas to show that it is hydrogen.

Test _____

_____

Result _____

_____

(2)

(ii) Why is hydrogen, and **not** magnesium, produced at the cathode?

_____

_____

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(1)

(c) A student wanted to use electrolysis to silver plate a metal spoon.

(i) Give **one** reason why metal spoons are sometimes silver plated.

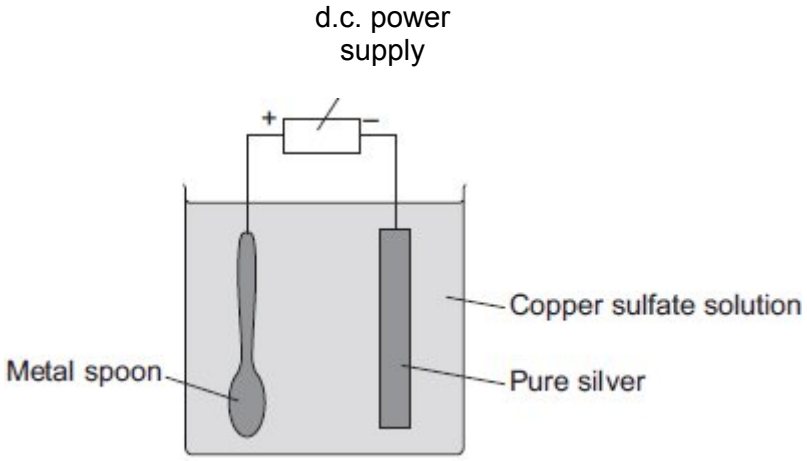
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_____

(1)

(ii) **Diagram 2** shows the apparatus the student used. The student did **not** set the apparatus up correctly.

Diagram 2



The student found that the metal spoon eroded and a thin layer of copper formed on the pure silver electrode.

Suggest **two** changes that the student must make to his apparatus to be able to silver plate the metal spoon. Give a reason for each change.

_____

_____

_____

_____

_____

_____

_____

(4)

(iii) Why is it difficult to electroplate plastic spoons?

_____

_____

(1)

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(Total 10 marks)

Q2.

A student was investigating a magnesium salt, **X**.

The student found that **X**:

- has a high melting point
- does not conduct electricity
- dissolves in water and the solution conducts electricity.

(a) (i) What is the type of bonding in magnesium salt **X**?

_____

(1)

(ii) Explain why solid **X** does **not** conduct electricity but a solution of **X** does conduct electricity.

_____

_____

_____

_____

(2)

(b) The student dissolved **X** in water.

The student added dilute nitric acid and silver nitrate solution to the solution of **X**.

A white precipitate was formed.

Salt **X** contains chloride ions.

Explain why a white precipitate was formed.

_____

_____

_____

_____

(2)

(c) The student dissolved **X** in water.

The student added a few drops of sodium hydroxide solution to the solution of **X**.

A white precipitate was formed.

(i) Salt **X** contains magnesium ions.

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Name **two** other metal ions that would give a white precipitate when a few drops of sodium hydroxide solution are added.

1. _____

2. _____

(2)

(ii) Describe the **two** further tests the student would have to do to show that salt **X** contains magnesium ions, and **not** the two metal ions you identified in part **(c) (i)**.

Give the expected results of each test.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

Q3.

Glass is made from silicon dioxide.



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

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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.

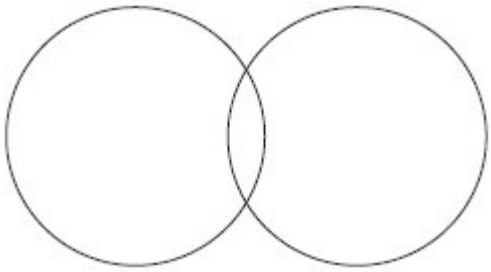
Give the formula of sodium oxide.

_____

(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.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q4.

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?

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)

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(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

_____

_____

_____

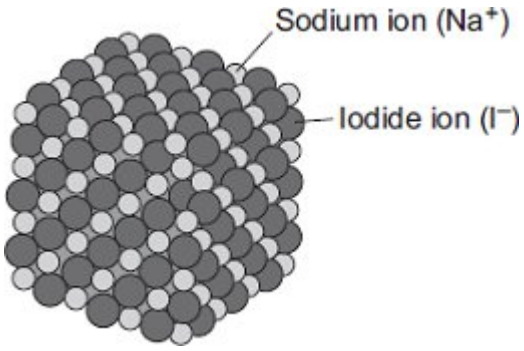
_____

_____

_____

(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.

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

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(1)

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

Explain why.

_____

_____

_____

_____

(2)

(Total 11 marks)

Q5.

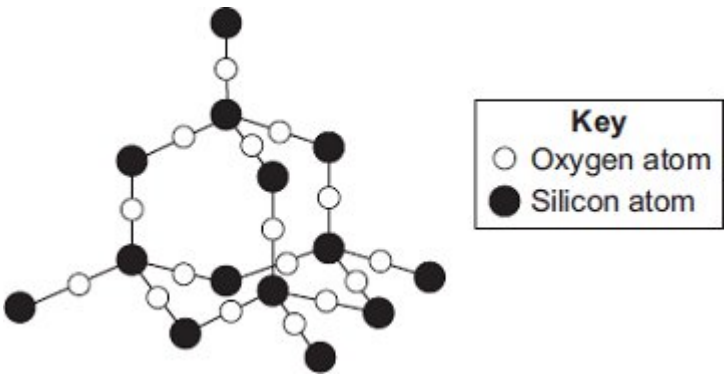
Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.



© Oleksiy Mark/iStock

The diagram shows a small part of the structure of silicon dioxide.



Explain why silicon dioxide is a suitable material for lining furnaces.

_____

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_____

_____

_____

_____

_____

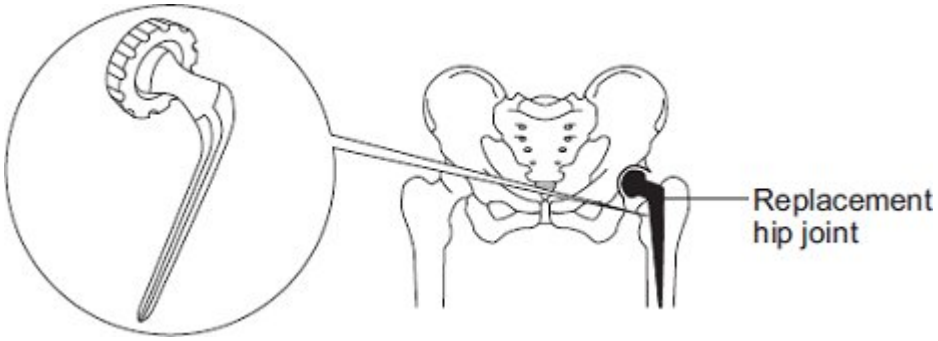
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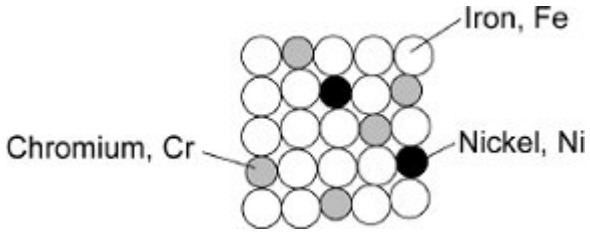
(Total 4 marks)

Q6.

The hip joint sometimes has to be replaced.
Early replacement hip joints were made from stainless steel.



Stainless steel is an alloy of iron, chromium and nickel.
The diagram below represents the particles in stainless steel.



Paticle diagram of stainless steal

(a) Use the diagram to complete the percentages of metals in this stainless steel.

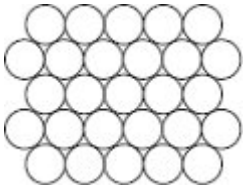
The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	
Nickel, Ni	

(2)

(b) Pure iron is a soft, metallic *element*.

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(i) Why is iron described as an *element*?

_____

_____

(1)

(ii) Pure iron would **not** be suitable for a replacement hip joint.

Suggest why.

_____

_____

(1)

(iii) The three metals in stainless steel have different sized atoms.
Stainless steel is harder than pure iron.

Explain why.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q7.

Oil rigs are used to drill for crude oil.



© Digital Vision/Photodisc

(a) Drill heads are made from steel. Steel is an alloy.

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Explain why alloys are harder than pure metals.

(3)

(b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

(4)

(c) Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

(4)

(Total 11 marks)

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Q8.

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 $^{1}_{1}H$

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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.

_____

_____

_____

_____

_____

_____

_____

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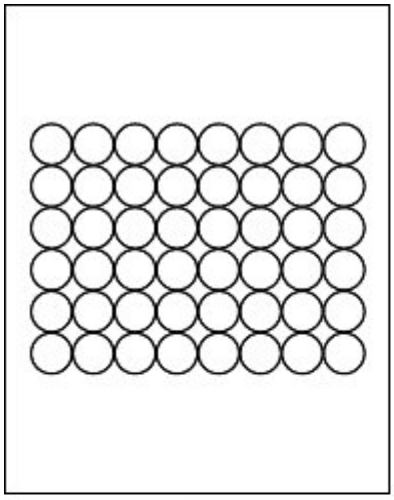
(3)

(Total 8 marks)

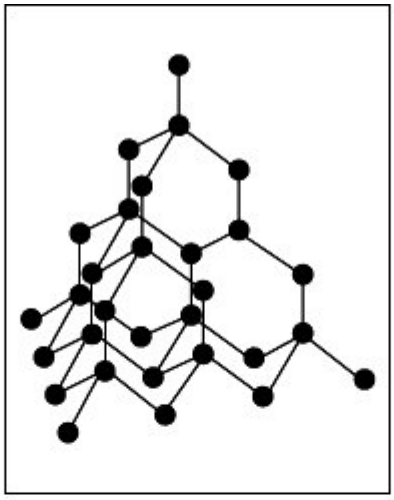
Q9.

The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.

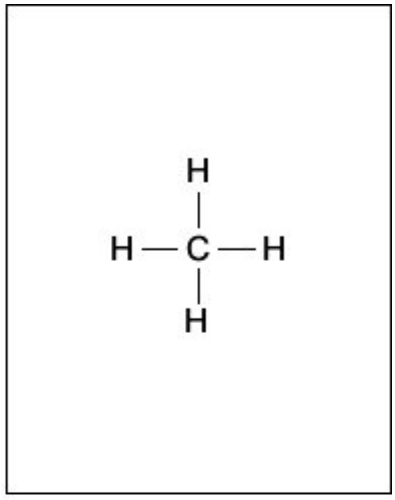
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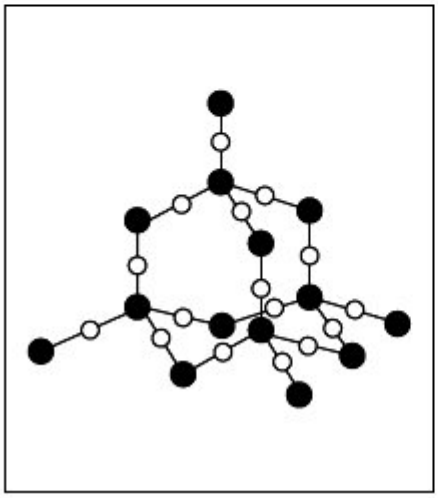
A



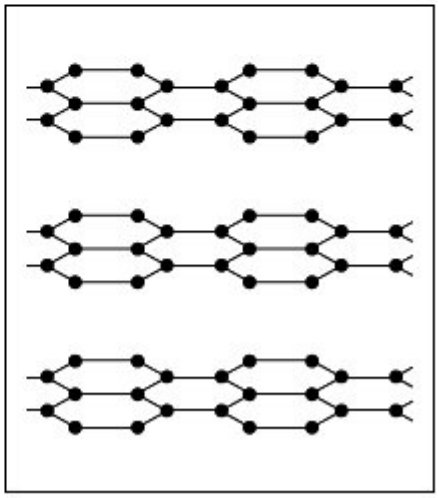
B



C



D



E

(a) Give **one** substance, **A**, **B**, **C**, **D** or **E**, that:

(i) has a very low boiling point

(1)

(ii) is a compound

(1)

(iii) is a metal.

(1)

(b) Draw a ring around the type of bonding holding the atoms together in substance **C**.

covalent **ionic** **metallic**

(1)

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(c) Explain why substance **E** is soft and slippery.

_____

_____

_____

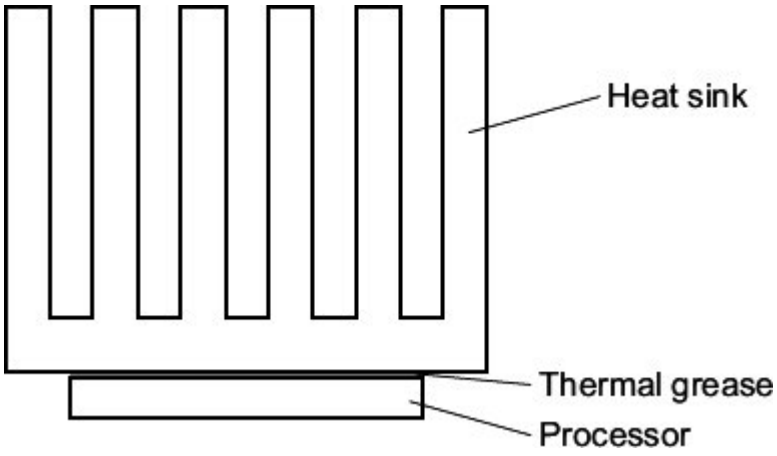
_____

(2)

(Total 6 marks)

Q10.

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.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

(1)

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(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.

_____

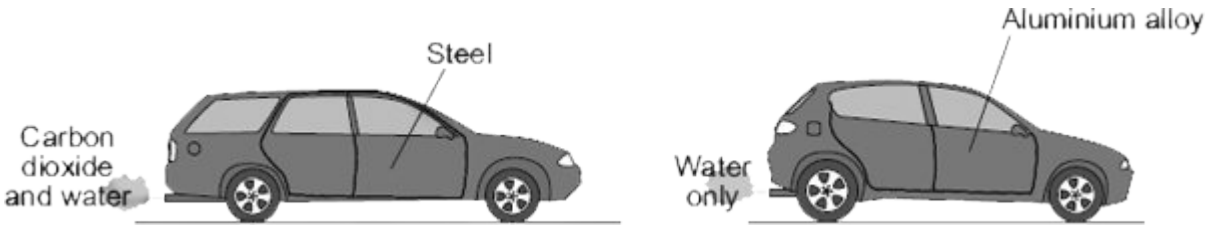
_____

(1)

(Total 6 marks)

Q11.

The picture shows two different cars.



(a) Some properties of aluminium are given below.

Tick (✓) **two** reasons why aluminium is better than steel for car bodies.

Reason	Tick (✓)
Aluminium is not a transition metal.	
Aluminium has a low density.	
Aluminium is expensive to extract.	
aluminium is resistant to corrosion.	

(2)

(b) Each car body is made from an *alloy*.

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(i) What is an *alloy*?

_____

_____

(1)

(ii) An alloy is used to make a car body. A pure metal is **not** used to make a car body.

Suggest why.

_____

_____

(1)

(c) The car with a steel body uses petrol for fuel.

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

(i) Petrol is made from

air.
crude oil.
metal ores.

(1)

(ii) Petrol is a mixture of

carbonates
hydrocarbons
polymers

including C_8H_{18}

(1)

(iii) In the car engine petrol reacts with

argon
nitrogen
oxygen

to produce carbon dioxide and water.

(1)

(d) Look at the substances coming out of each car's exhaust.

(i) Suggest the name of the fuel used in the car with the aluminium alloy body.

Name of fuel _____ .

(1)

(ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

_____

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_____

(1)

(Total 9 marks)

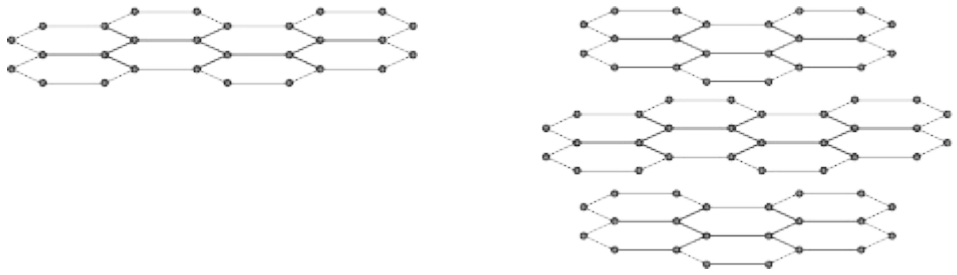
Q12.

Read the information

Graphene

Scientists have made a new substance called graphene.
The bonding and structure of graphene are similar to graphite.

Graphene is made of a single layer of the same atoms as graphite.



Graphene **Graphite**

Use the information above and your knowledge of graphite to answer the questions.

(a) This part of the question is about graphene.

Choose the correct answer to complete each sentence.

(i)

ionic	**covalent**	**metallic**

The bonds between the atoms in graphene are _____

(1)

(ii)

chromium	**carbon**	**chlorine**

Graphene is made of _____ atoms.

(1)

(iii)

2	**3**	**4**

In graphene each atom bonds to _____ other atoms.

(1)

(b) This part of the question is about graphite.

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Graphite is used in pencils.

Explain why. Use the diagrams to help you.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q13.

This question is about gold (Au).

(a) An atom of gold is represented as:

$$^{197}_{79}Au$$

How many neutrons are in this atom of gold? _____

(1)

(b) Gold ions are used as a catalyst.

How does a gold atom (Au) become a gold ion (Au^{3+})?

_____

_____

_____

_____

(2)

(c) A gold catalyst can be used when carbon monoxide reacts with oxygen to make carbon dioxide.

(i) Complete and balance the equation for this reaction.

__ CO + _____ → ___ CO_2

(2)

(ii) Carbon dioxide has a very low boiling point.

Explain why.

_____

_____

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_____

_____

_____

_____

(3)

(d) Gold is used as a catalyst in industrial processes. Gold is rare and increasingly expensive.

Suggest **three** reasons why gold is still used in industrial processes.

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q14.

Stage smoke is used for special effects at pop concerts.



By Sam Cockman [CC BY 2.0], via Flickr

Ammonium chloride can be used to make stage smoke.
Ammonium chloride is a white solid.
When heated, ammonium chloride produces white smoke which can be blown onto the stage.

The equation shows what happens when ammonium chloride is heated and cooled.

$$NH_4Cl(s) \underset{\text{cooled}}{\overset{\text{heated}}{\rightleftharpoons}} NH_3(g) + HCl(g)$$

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ammonium chloride (white)	ammonia (colourless)	hydrogen chloride (colourless)

(a) The sentences explain how the smoke is made.

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

Use the information and the equation to help you.

When heated, ammonium chloride makes two colourless | solids. / liquids. / gases. |

These are blown into the air where they cool and make a | colourless / black / white | solid / liquid / gas |

which is | ammonia. / ammonium chloride. / hydrogen chloride. |

(4)

(b) Complete the sentence.

The symbol $\rightleftharpoons$ means that the reaction is _____

(1)

(Total 5 marks)

Q15.

High quality connectors are used to connect a satellite box to a television.
The connectors should conduct electricity very well and should not corrode.



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

The connectors on this scart lead are coated with gold.

(a) Gold is a typical metal.

(i) Describe the structure and bonding of gold.

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_____

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Why is gold a good conductor of electricity?

_____

_____

(1)

(b) The surface of some metals, such as iron, corrode when exposed to the air.

Suggest why this reduces the electrical conductivity of the metal.

_____

_____

_____

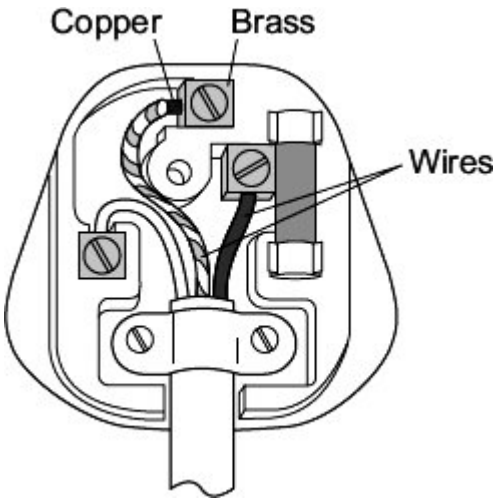
_____

(2)

(Total 6 marks)

Q16.

The diagram shows an electric plug.



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

Copper is used for the wires because it

conducts electricity.
conducts heat.
is shiny.

(1)

(ii) Brass is an *alloy* of copper and zinc.

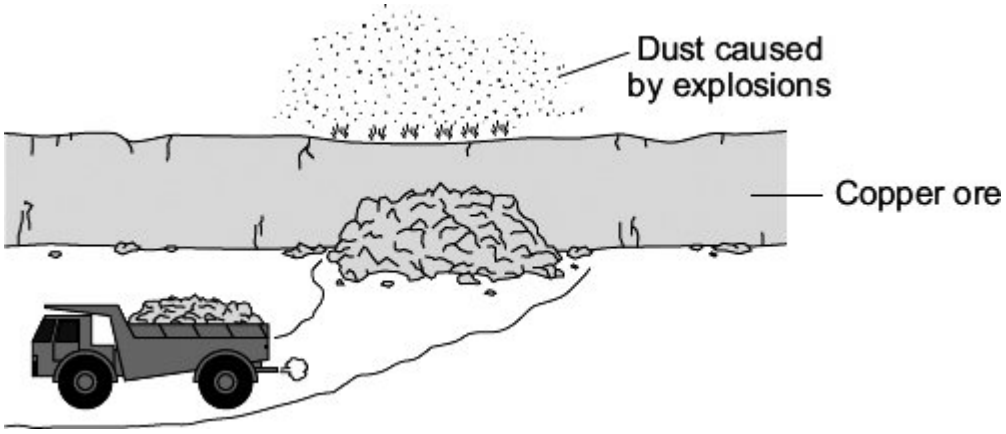
What is an *alloy*?

_____

_____

(1)

(b) Open-cast mines are used to obtain copper ore.



Suggest **two** reasons why people would **not** like to live near an open-cast mine.

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q17.

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

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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. _____

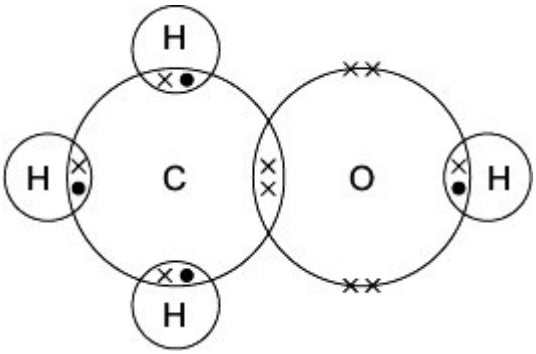
_____

2. _____

_____

(2)

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



Draw a ring around:

(i) the formula of methanol

CH_4O **CH^4O** **CHO_4**

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(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)

Q18.

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



Some welding blankets are made from silicon dioxide.

(a) The table lists some properties of materials.

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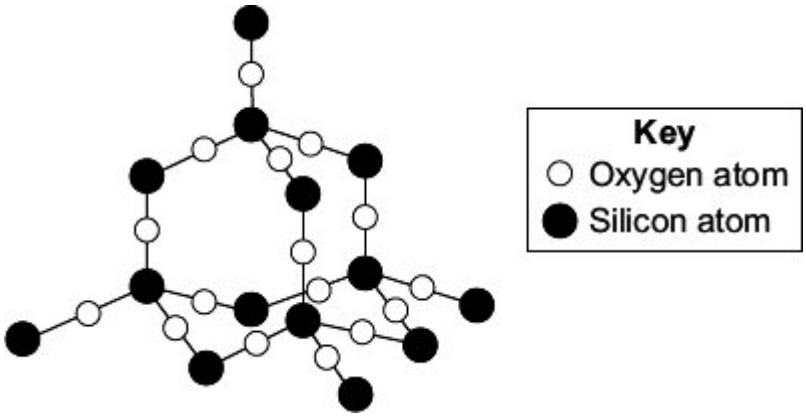
Two of these are properties of materials used to make welding blankets.

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)

covalent.

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(iii) The bonds between the atoms are

ionic.
metallic.

(1)

(iv) These bonds are

easily broken.
very strong.
weak.

(1)
(Total 6 marks)

Q19.

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

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

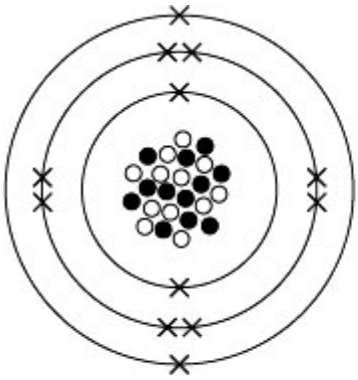


Diagram A

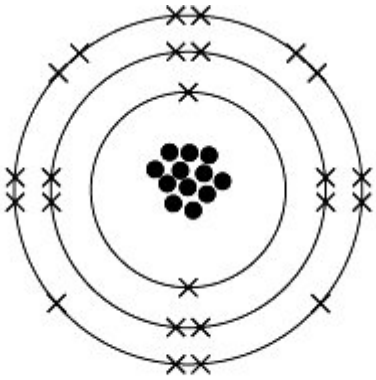


Diagram B

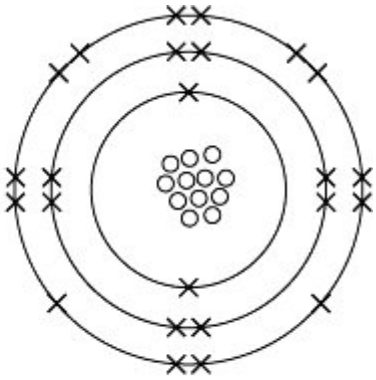


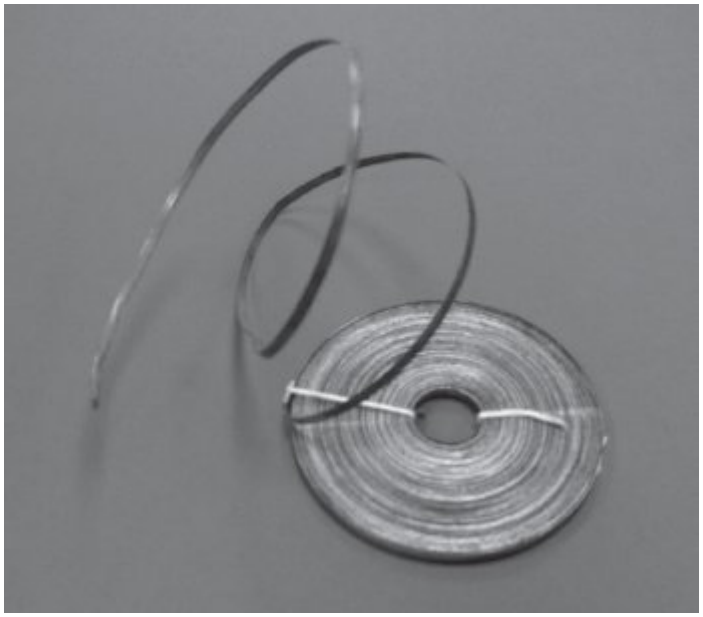
Diagram C

This magnesium atom is **Diagram** ☐

(1)

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

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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 (✓)

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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.

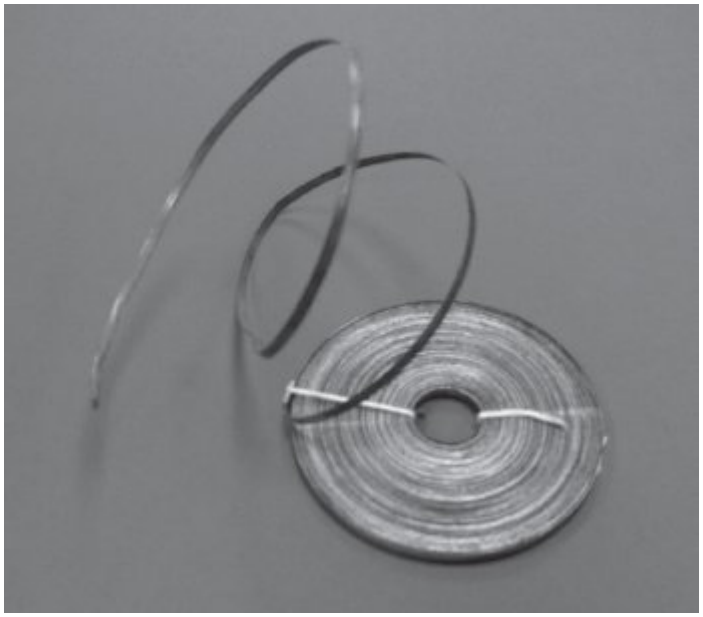
crystallisation **electrolysis** **oxidation**

(1)

(Total 7 marks)

Q20.

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



Explain why metals can be shaped.

_____

_____

_____

_____

_____

(2)

(b) Magnesium sulfate is a salt of magnesium.

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

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

(i) Name the acid used to make magnesium sulfate.

_____ acid

(1)

(ii) Use the equation to help you to describe what you would **observe** when magnesium reacts with the acid.

_____

_____

_____

_____

_____

(2)

(iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

_____

_____

(1)

(Total 6 marks)

Q21.

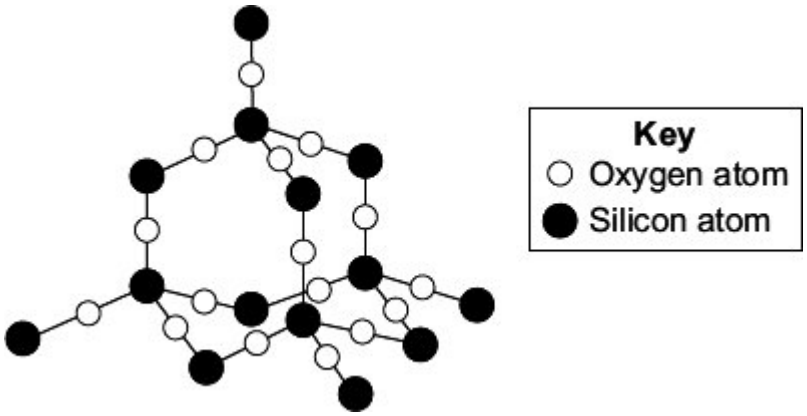
Welding blankets are placed under metals being welded. They protect the area under the welding.

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Some welding blankets are made from silicon dioxide which does not melt when hit by sparks or molten metal.

The diagram shows a small part of the structure of silicon dioxide.



Describe the structure and bonding in silicon dioxide **and** explain why it is a suitable material for making welding blankets.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 3 marks)

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Q22.

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*.

What is the meaning of *exothermic*?

_____

_____

(1)

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

What is the name given to the heat energy needed to start a chemical reaction?

_____ energy

(1)

(c) The white smoke produced is aluminium oxide.

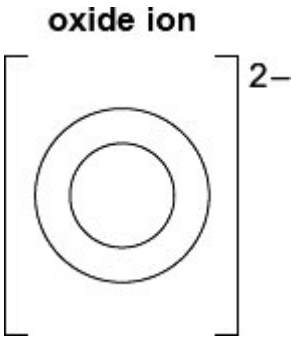
Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

(i) Complete the diagram to show the electronic structure of an oxide ion.

The atomic number of oxygen = 8

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Use crosses (x) to represent the electrons.



(1)

(ii) The bonding in aluminium oxide is ionic.

What causes the aluminium ions and oxide ions to be held together strongly?

_____

_____

(1)

(Total 4 marks)

Q23.

Lead compounds have been used for thousands of years as colours in paint.



Johannes Vermeer [Public domain], via Wikimedia Commons

(a) A sample of a red oxide used in paint was found to contain 6.21 g of lead and 0.64 g of oxygen.

Calculate the empirical (simplest) formula of this compound.

You **must** show all your working to gain full marks.

Relative atomic masses: O = 16; Pb = 207.

_____

_____

_____

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_____

_____

_____

_____

_____

_____

_____

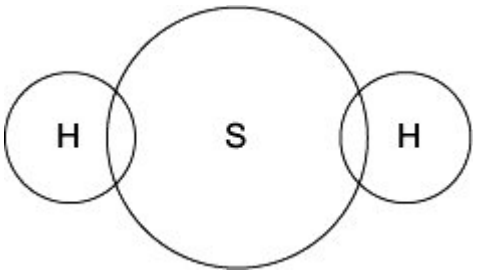
(4)

(b) A problem with lead compounds is that they slowly react with hydrogen sulfide in the air. This produces lead sulfide which is black.

(i) Hydrogen sulfide has the formula H_2S. The bonding in a molecule of hydrogen sulfide can be represented as:

H–S–H

Complete the diagram below to show the arrangement of the outer electrons of the hydrogen and sulfur atoms in hydrogen sulfide.
Use dots (●) and crosses (x) to represent the electrons.
You need only show the outer shell electrons.
(Atomic numbers: H = 1; S = 16.)



(1)

(ii) Hydrogen sulfide has a low boiling point.

Explain why.

_____

_____

_____

_____

(2)

(iii) Lead white is also used in paint. The white colour slowly darkens when lead sulfide is produced.

The painting can be restored with hydrogen peroxide. This converts the black lead sulfide into white lead sulfate.

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Balance the equation for the reaction between lead sulfide and hydrogen peroxide (H_2O_2).

$$PbS(s) + _____H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$$

(1)

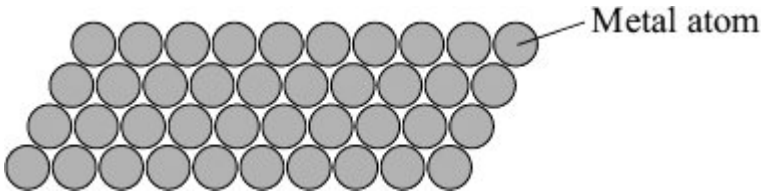
(Total 8 marks)

Q24.

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.	

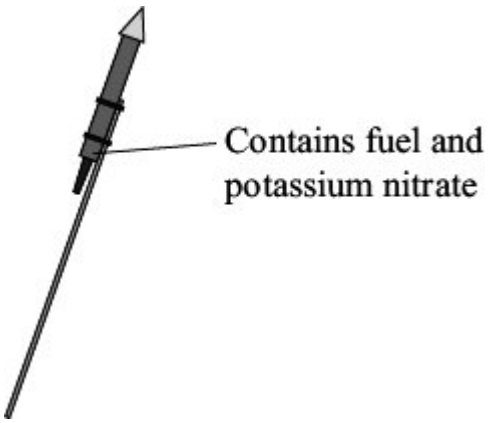
(2)

(Total 2 marks)

Q25.

Firework rockets contain fuel and potassium nitrate.

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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?

_____

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_____

_____

_____

(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)

Q26.

(a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

	Hydrogen-1	**Hydrogen-2**
Atomic number	1	1
Mass number	1	2

An atom of hydrogen-1 is represented as: $^{1}_{1}\mathrm{H}$

Show how an atom of hydrogen-2 is represented.

(1)

(b) (i) Calculate the relative formula mass (M_r) of water, H_2O

Relative atomic masses: H = 1; O = 16.

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_____

_____

Relative formula mass (M_r) = _____

(1)

(ii) Simple molecules like water have low boiling points.

Explain why, in terms of molecules.

_____

_____

_____

_____

(2)

(c) Molecules of heavy water contain two atoms of hydrogen-2 instead of two atoms of hydrogen-1.

Explain why a molecule of heavy water has more mass than a normal water molecule.
You should refer to the particles in the nucleus of the two different hydrogen atoms in your answer.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

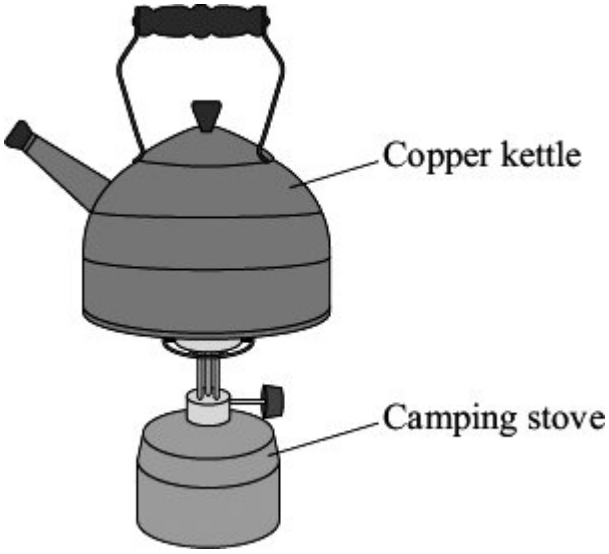
Q27.

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.
You should describe the structure and bonding of a metal in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

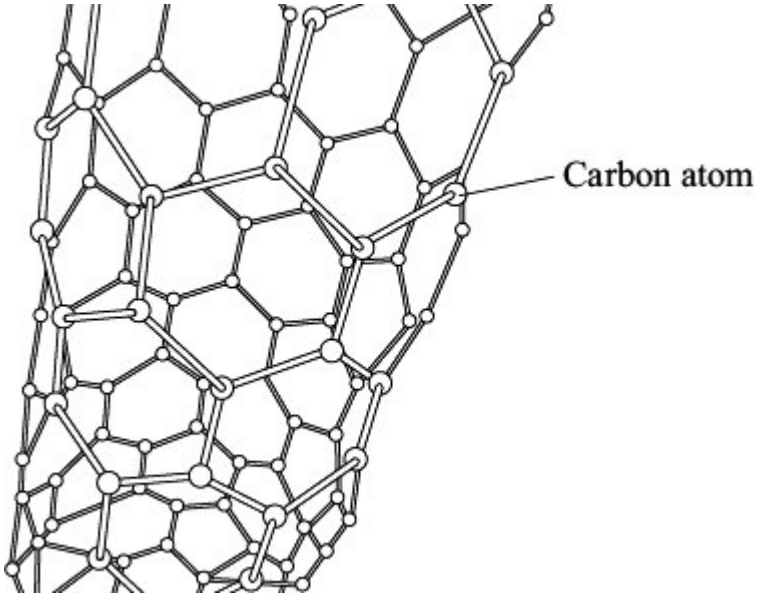
(4)

(b) An aeroplane contains 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 lighter carbon nanotubes.

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 is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q28.

This question is about some compounds of iodine.

(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 precipitate.

$Pb^{2+}(aq) + 2I^{-}(aq) \rightarrow PbI_2(s)$

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

Soluble compounds	Insoluble compounds
all sodium and potassium salts	

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all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you name:

a soluble compound which contains lead ions _____

a soluble compound which contains iodide ions _____

(2)

(ii) Suggest a method of separating the lead iodide from the solution.

_____

(1)

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

$Mg + I_2 \rightarrow MgI_2$

Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^-).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

_____

_____

_____

_____

_____

_____

_____

_____

_____

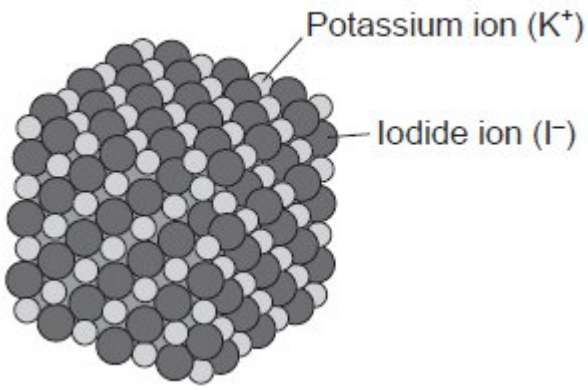
_____

_____

(4)

(c) The diagram shows the structure of potassium iodide.

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Explain why a high temperature is needed to melt potassium iodide.

_____

_____

_____

_____

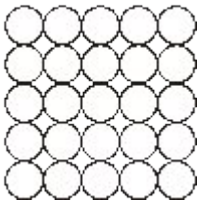
(2)

(Total 9 marks)

Q29.

Iron is the main structural metal used in the world.

(a) The diagram represents the particles in iron, Fe.



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

Iron is described as an element because all the

atoms
compounds
metals

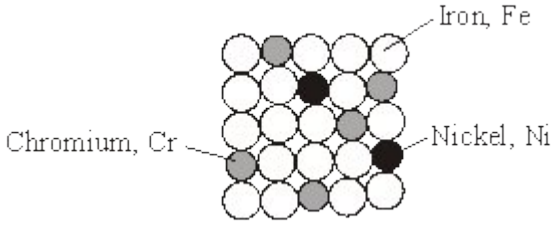
are the same.

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.

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Use the correct words from the box to complete the sentences about alloys.

metal	mixture	molecule	polymer	smart	structure

Stainless steel is an alloy because it is a _____ of iron, chromium and nickel.

An alloy is made up of more than one type of _____ .

Stainless steel alloys are harder than iron because the different sized atoms added change the _____ .

An alloy that can return to its original shape after being deformed is called a _____ alloy.

(4)

(c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

(i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1. _____

_____

2. _____

_____

(2)

(ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

_____

_____

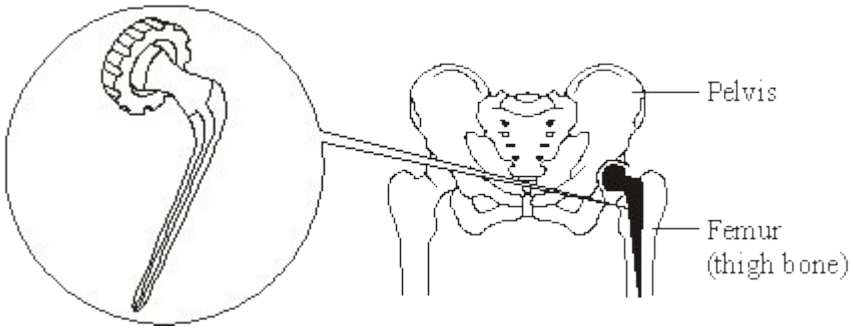
(1)

(Total 8 marks)

Q30.

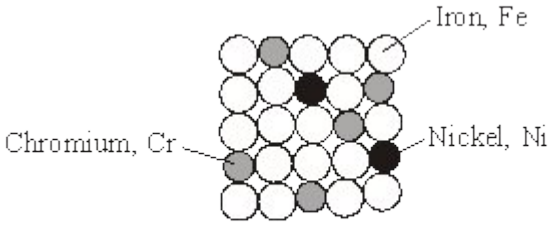
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The hip joint between the femur and pelvis sometimes has to be replaced.
Early hip replacement joints were made from stainless steel.



Stainless steel is an alloy of iron, chromium and nickel.

The diagram below represents the particles in stainless steel.



Particle diagram of stainless steel

(a) Use the particle diagram to complete the percentages of metals in this stainless steel.

The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	
Nickel, Ni	

(2)

(b) Pure iron is a relatively soft, metallic element.

(i) Why is iron described as an *element*?

_____

_____

(1)

(ii) Suggest why pure iron would **not** be suitable for a hip replacement joint.

_____

_____

(1)

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(iii) Use the particle diagram to help you to explain why stainless steel is harder than pure iron.

_____

_____

_____

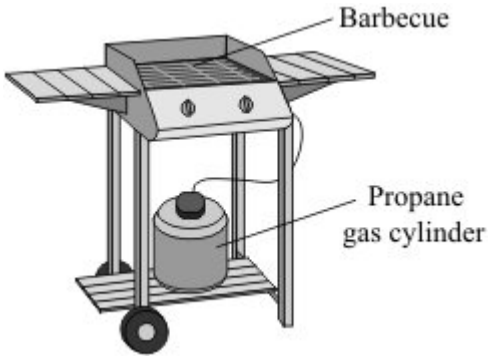
_____

(2)

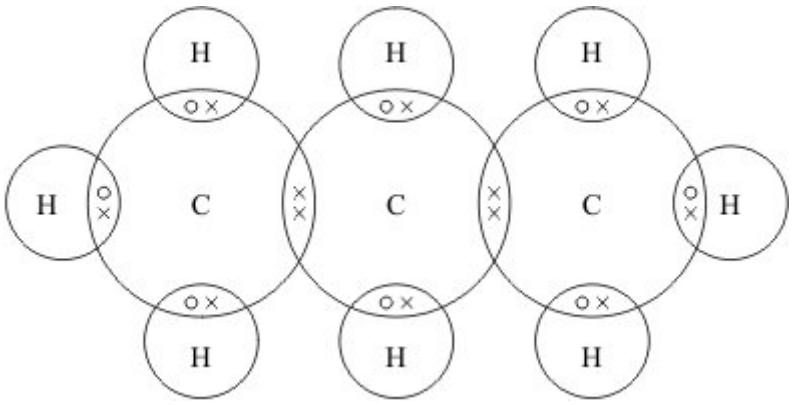
(Total 6 marks)

Q31.

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.

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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.

(1)

(Total 4 marks)

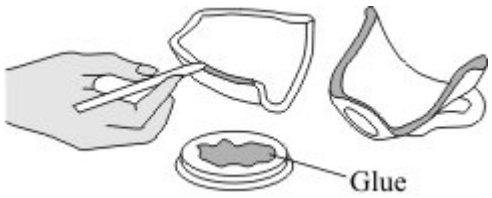
Q32.

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

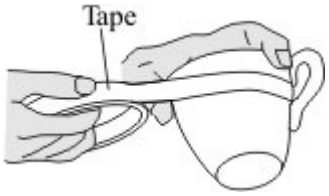
Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.



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.

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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.	

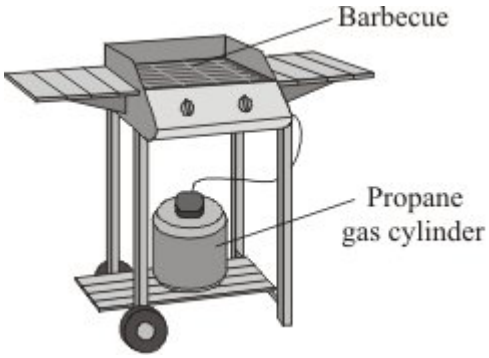
(2)

(Total 6 marks)

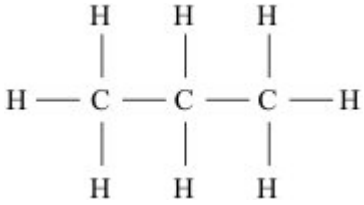
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Q33.

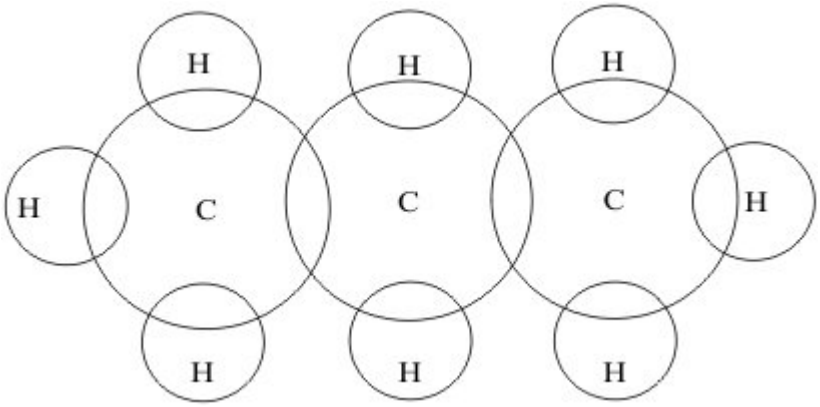
This barbecue burns propane gas.



The structure of propane is shown below.



(a) Complete the diagram to show how the outer energy level (shell) electrons of hydrogen and carbon are arranged in a molecule of propane.

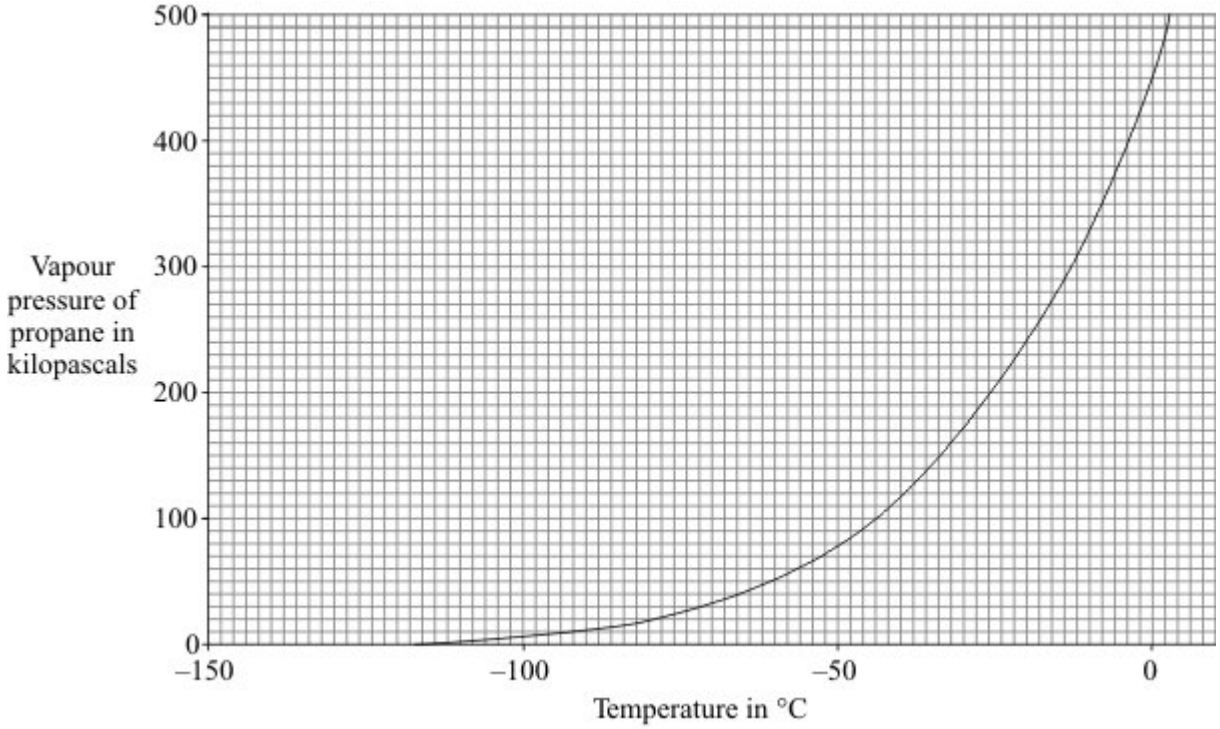


(1)

(b) The graph shows how the vapour pressure of propane changes with temperature.

The vapour pressure of a liquid is the pressure of the vapour above the liquid.

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(i) Describe, as fully as you can, how the vapour pressure of propane changes with temperature.

_____

_____

_____

_____

_____

(2)

(ii) The boiling point of a liquid is the temperature at which its vapour pressure is equal to the air pressure above the liquid.

Use the graph to find the boiling point of propane when the air pressure is 100 kilopascals.

Boiling point _____ °C

(1)

(c) Explain, in terms of molecules, why propane has a low boiling point.

_____

_____

_____

_____

_____

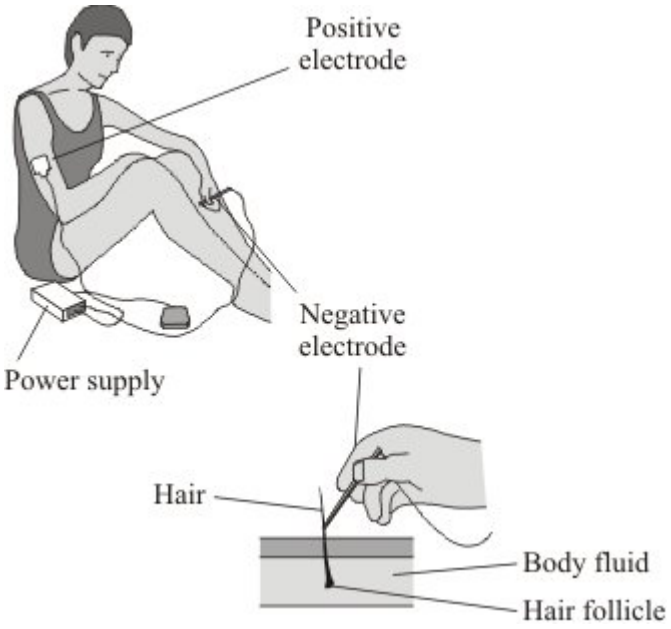
(2)

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(Total 6 marks)

Q34.

Electrolysis can be used to remove unwanted hair from the skin.



The hair is first coated with a layer of gel containing ions in solution.

The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair. Electricity flows through the gel and causes electrolysis of the body fluid around the hair follicle.

(a) Metal wires conduct electricity to the electrodes.

Explain how metals conduct electricity.

_____

_____

_____

_____

(2)

(b) Explain why the gel containing ions in solution can conduct electricity.

_____

_____

(1)

(c) The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

This solution contains hydrogen ions that move to the negative electrode.

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(i) The half equation represents the reaction at the negative electrode.

$2H^+ + 2e^- \rightarrow H_2$

Explain why this reaction is a reduction.

_____

_____

(1)

(ii) As a result of the electrolysis of sodium chloride solution, an alkali forms which kills the hair follicle.

What is the name of this alkali? _____

(1)

(iii) Complete the half equation for the reaction at the positive electrode.

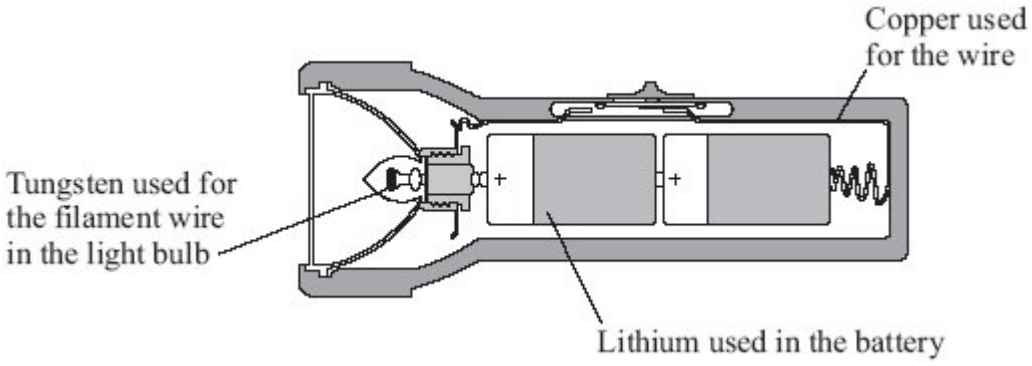
$Cl^- \rightarrow Cl_2$

(1)

(Total 6 marks)

Q35.

The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

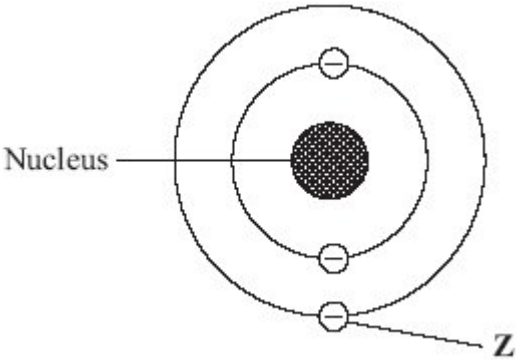


(a) Why is copper used for the wire?

_____

(1)

(b) The diagram shows the structure of an atom of lithium.



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Name the particle labelled **Z**.

_____

(1)

(c) The table shows some properties of the metals used in the electrical circuit.

Metal	Melting point in °C	Boiling point in °C	Reaction with oxygen
Copper	1083	2582	Reacts **slowly** to form a thin oxide layer on surface
Lithium	179	1317	Reacts **rapidly** to form oxide
Tungsten	3370	5930	Reacts **only** when very hot to form oxide

(i) Use information from the table to suggest the order of reactivity for copper, lithium and tungsten.

most reactive _____

_____

least reactive _____

(2)

(ii) The filament wire glows because it gets very hot.

Use information from the table to suggest **one** reason why tungsten is used for the filament wire in the light bulb.

_____

_____

(1)

(d) The gas used in the light bulb is argon.

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

Argon is used in the light bulb because it is

dense.
solid.
unreactive.

.

(1)

(Total 6 marks)

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