

Bonding Part2

Q1.

Kelp is a seaweed.

Kelp can be burned to give out energy.



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

Reactions which give out energy are

endothermic.
exothermic.
reversible.

(1)

- (b) Which **two** of the following questions **cannot** be answered by scientific experiments alone?

Tick (✓) **two** boxes.

Question	Tick (✓)
How much carbon dioxide is produced when 100 g of kelp is burned?	
Does kelp give out more heat energy than coal when burned?	
Should people use kelp instead of oil as an energy source?	
Will kelp be more popular than coal in the next 10 years?	

(2)

- (c) Potassium iodide can be produced from kelp.

(1)
(Total 9 marks)

Q2.

Thermosoftening polymers can be used to make plastic bottles and food packaging.

- (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

(1)

- (b) The reaction to produce the polymers uses a catalyst.

Why are catalysts used in chemical reactions?

(1)

- (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

- (i) Name the instrument used to identify the compounds.

(1)

- (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

(1)

- (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

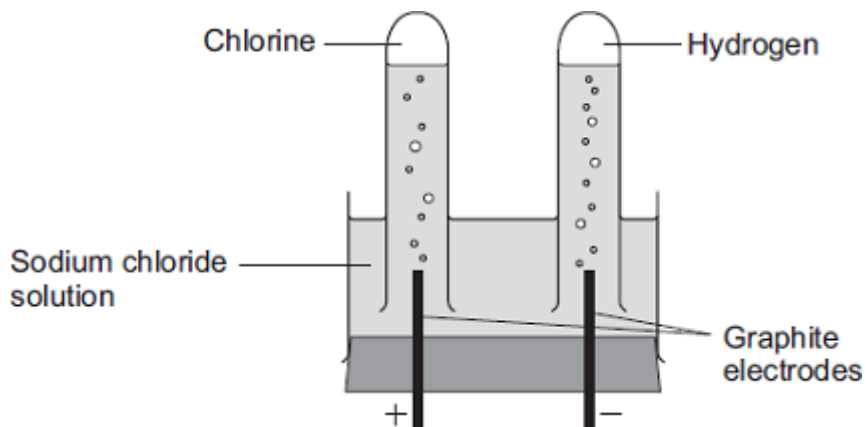
Suggest **two** conditions which could be changed when poly(ethene) is made.

(2)
(Total 6 marks)

Q3.

The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



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

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

(1)

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

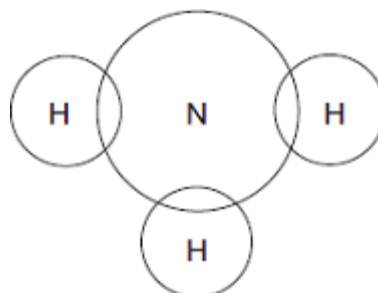
(1)

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

Complete the diagram to show the bonding in ammonia.

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

Show only outer shell electrons.



(2)

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

Positive ions	Negative ions
hydrogen	chloride

sodium	hydroxide
--------	-----------

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

- (i) Which ion makes the waste alkaline?

(1)

- (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

(1)

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

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

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

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

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

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

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

(1)

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

Give **two** reasons why.

(2)

- (c) Sodium iodide can be produced from kelp.

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

(1)

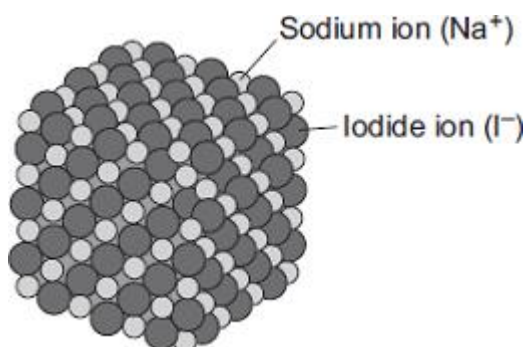
- (ii) Sodium iodide contains sodium ions (Na^+) and iodide ions (I^-).

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

You may use a diagram in your answer

(3)

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



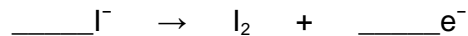
Solid sodium iodide does not conduct electricity.

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.



(1)

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

Explain why.

(2)

(Total 11 marks)

Q5.

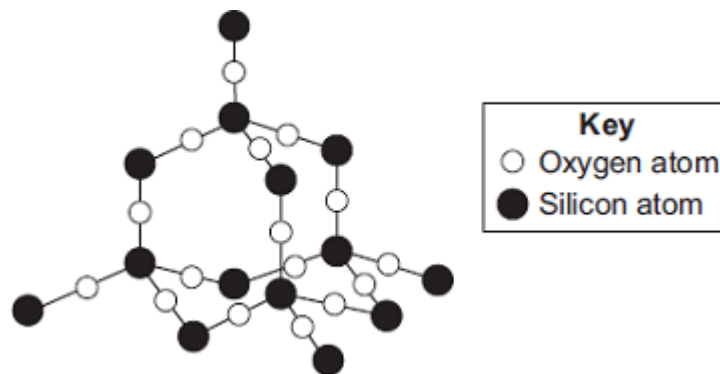
Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.



© Oleksiy Mark/iStock

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

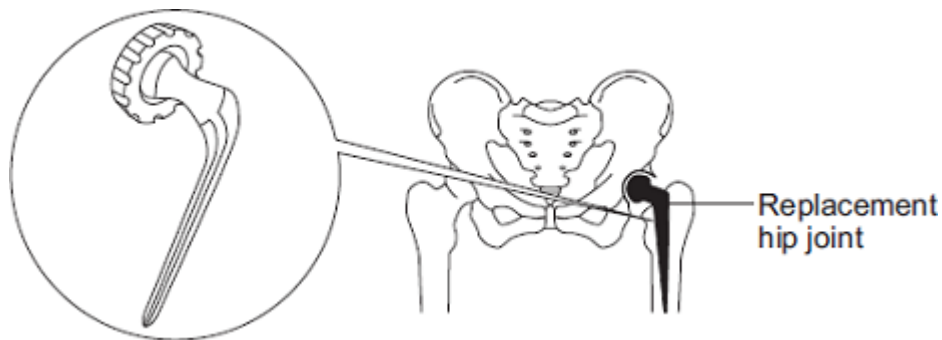


Explain why silicon dioxide is a suitable material for lining furnaces.

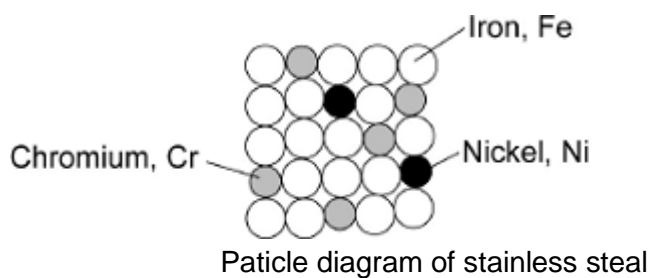
(Total 4 marks)

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.



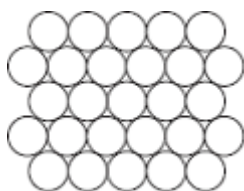
- (a) Use the diagram to complete the percentages of metals in this stainless steel.

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*.



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

(1)

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

Suggest why.

- (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.

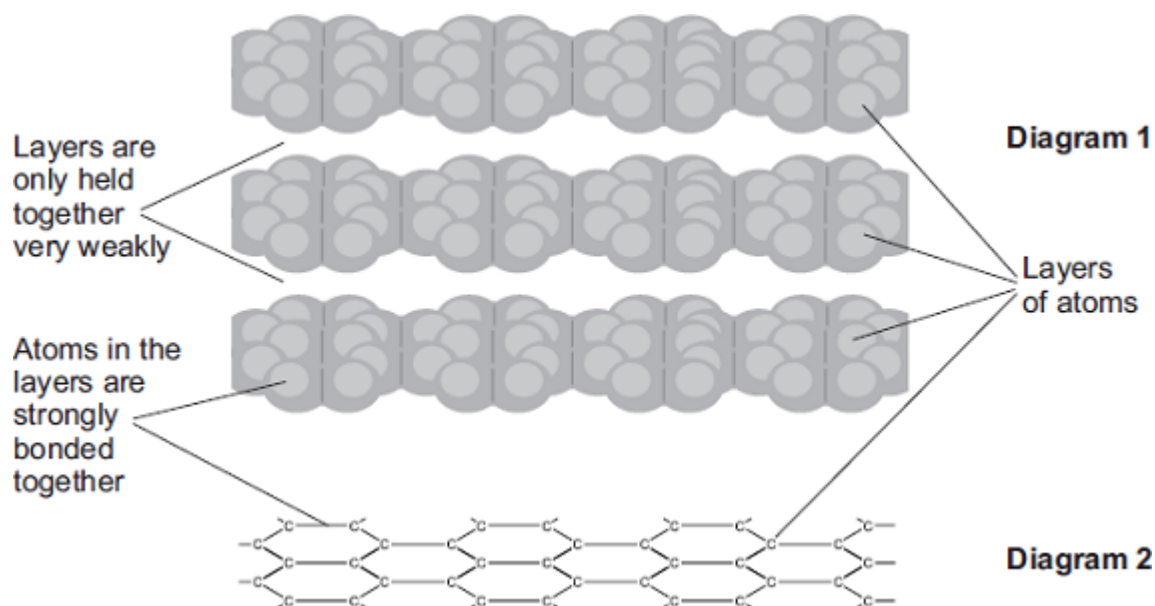
The picture shows a student filling in a multiple choice answer sheet using a pencil.



© Cihan Ta?k?n/iStock

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 the diagrams to help you explain why graphite can rub off the pencil onto the paper.

(2)

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

covalent

ionic

metallic

(1)


(Total 3 marks)

Q8.

Read the article and then answer the questions.

Nanotennis!

Tennis balls contain air under pressure, which gives them their bounce. Normal tennis balls are changed at regular intervals during tennis matches because they slowly lose some of the air. This means that a large number of balls are needed for a tennis tournament.



© Feng Yu/iStock

'Nanocoated' tennis balls have a 'nanosize' layer of butyl rubber. This layer slows down the escape of air so that the ball does not lose its pressure as quickly. The 'nanocoated' tennis balls last much longer and do not need to be replaced as often.

(a) Tick (✓) the best description of a 'nanosize' layer.

Description	Tick (✓)
A layer one atom thick.	<input type="checkbox"/>
A layer a few hundred atoms thick.	<input type="checkbox"/>

A layer millions of atoms thick.	
----------------------------------	--

(1)

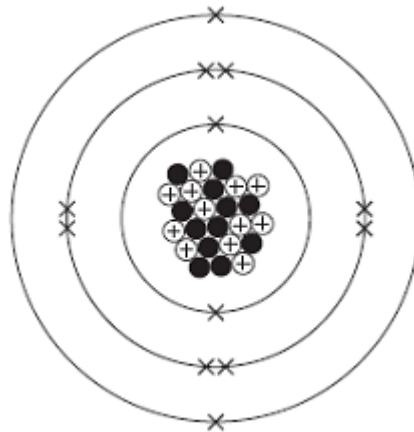
- (b) Suggest **two** ways in which using 'nanocoated' tennis balls would be good for the environment.

(2)

(Total 3 marks)

Q9.

The diagram represents a magnesium atom.



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

electron	neutron	nucleus	proton
-----------------	----------------	----------------	---------------

- (i) What is the name of the central part of the atom? _____ (1)

- (ii) What is the name of the particle with no charge? _____ (1)

- (iii) What is the name of the particle with a negative charge? _____ (1)

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

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

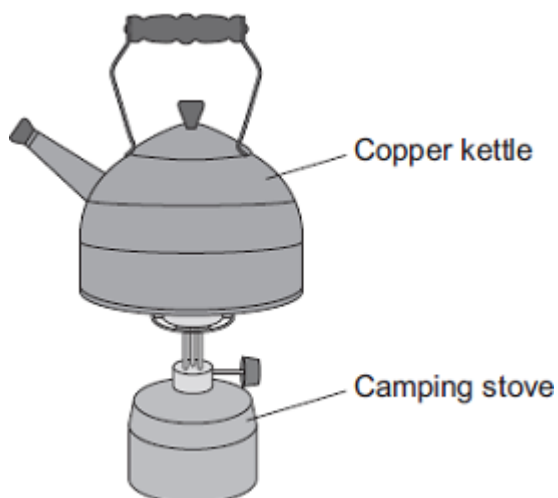
12

24

36

(1)

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



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

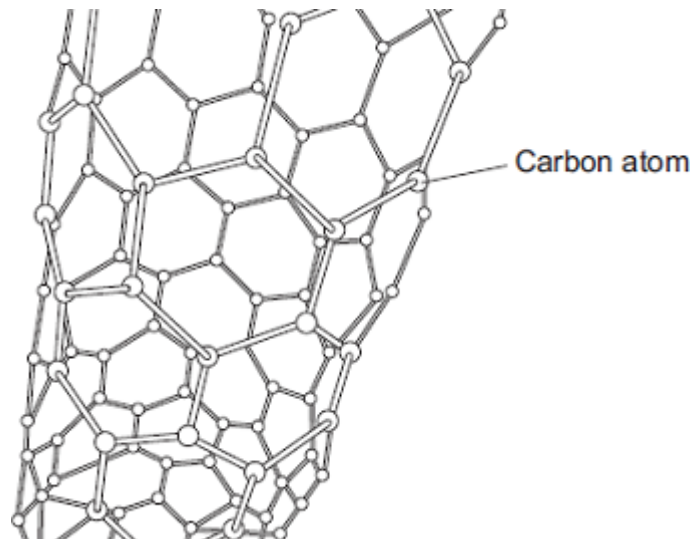
Your answer should describe the structure and bonding of a metal.

(4)

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

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

The diagram shows the structure of a carbon nanotube.



- (i) What does the term 'nano' tell you about the carbon nanotubes?

(1)

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

Explain why the carbon nanotube can conduct electricity.

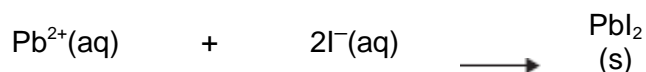
(2)

(Total 7 marks)

Q11.

This question is about some compounds made from 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.



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 name:

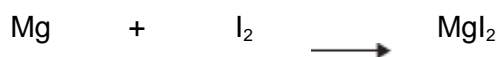
(i) A soluble compound which contains lead ions _____

(1)

(ii) A soluble compound which contains iodide ions

(1)

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

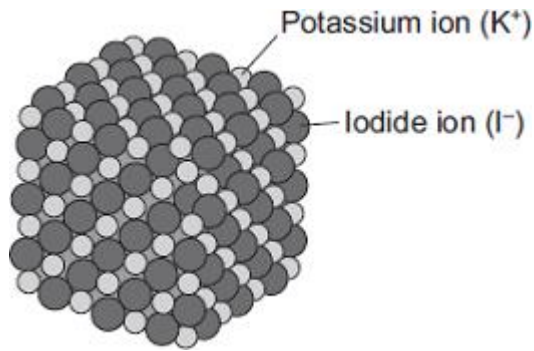


Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^-).

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

(4)

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



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

(3)

(Total 9 marks)

Q12.

Nanoparticles have many uses.

(a) (i) Tick (✓) **one** use of nanoparticles.

In the extraction of iron

In suntan creams

In the test for oxygen

(1)

(ii) How is the size of nanoparticles different from normal-sized particles?

Draw a ring around the correct answer.

much smaller

same size

much larger

(1)

(b) Very small amounts of cerium oxide nanoparticles can be added to diesel fuel.

The cerium oxide is a catalyst.

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

Only a very small amount of cerium oxide nanoparticles is needed because

the nanoparticles

are elements.

are very reactive.

have a high surface area to volume ratio.

(1)

(ii) Explain how a catalyst increases the rate of a reaction.

(2)

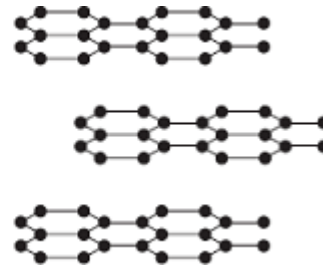
(Total 5 marks)

Q13.

The diagrams show the structures of diamond and graphite.



Diamond



Graphite

(a) Diamond and graphite both contain the same element.

What is the name of this element? _____

(1)

(b) Use the diagrams above and your knowledge of structure and bonding to explain why:

(i) graphite is very soft

(2)

(ii) diamond is very hard

(2)

(iii) graphite conducts electricity.

(2)

(Total 7 marks)

Q14.

This question is about lithium and sodium.

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

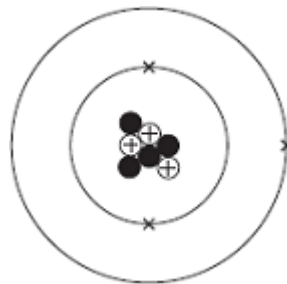
In which group of the periodic table are lithium and sodium?

Group

(1)

(b) A lithium atom can be represented as ${}^7_3\text{Li}$

The diagram represents the lithium atom.



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

What is the name of these particles?

(1)

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

What is the name of these particles?

(1)

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

3	4	7
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The mass number of this atom of lithium is

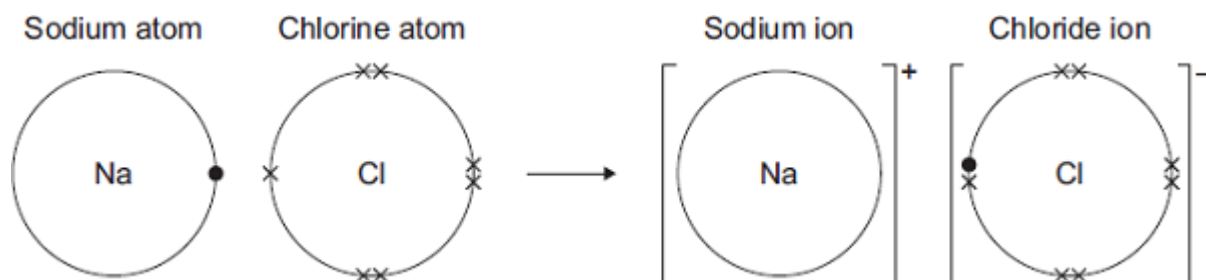
(1)

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



The diagram shows how the reaction happens.

Only the outer electrons are shown.



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

(i) A sodium atom changes into a sodium ion by

gaining
losing
sharing

an electron.

(1)

(ii) A sodium ion has

a negative
no
a positive

charge.

(1)

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

strong

covalent
electrostatic
magnetic

forces.

(1)

(d) Sodium chloride is an ionic compound.

Tick (✓) **two** properties of ionic compounds.

Property	Tick (✓)
Do not dissolve in water	
High melting points	
Low boiling points	
Strong bonds	

(2)

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

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

Relative formula mass = _____

(1)

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

The relative formula mass of a substance, in grams,

is one

ion
isotope
mole

of the substance.

(1)

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

What are nanoparticles?

(1)

(Total 12 marks)

Q15.

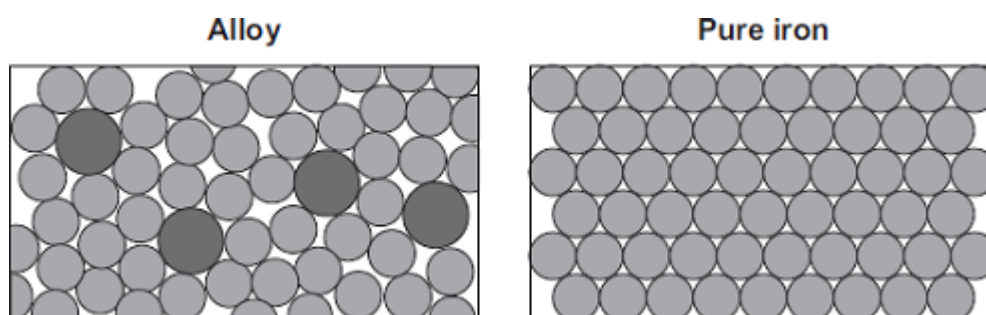
Oil rigs are used to drill for crude oil.



© Digital Vision/Photodisc

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

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



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

(2)

(b) Drill heads contain diamonds.

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

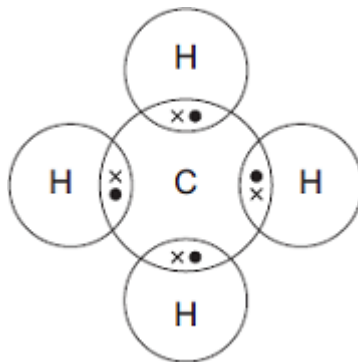
Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2)

(c) Methane gas is often found where crude oil is found.

The diagram shows how atoms bond in methane.

Only the outer electrons are shown.



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

Methane is

a compound.
an element.
a mixture.

(1)

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

The formula of methane is

C_4H_4
C_4H
CH_4

(1)

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

(1)

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

(2)

(Total 9 marks)

Q16.

Humphrey Davy was a professor of chemistry.

In 1807 Humphrey Davy did an electrolysis experiment to produce potassium.

- (a) (i) Humphrey Davy was the first person to produce potassium.

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

Humphrey Davy's experiment to produce this new element was quickly

accepted by other scientists because he

had a lot of money.
had a lot of staff to help.
was well qualified.

(1)

(ii) Other scientists were able to repeat Davy's experiment.

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

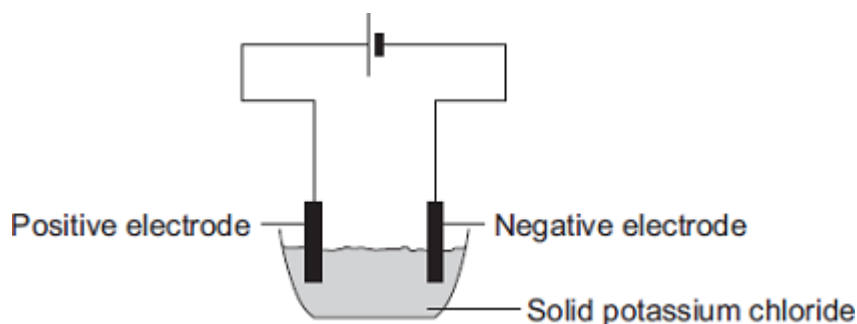
Being able to repeat Davy's experiment is important because

other scientists can

check the results of the experiment.
see if the experiment is safe.
take the credit for the discovery.

(1)

(b) A student tried to electrolyse potassium chloride.



Potassium chloride contains potassium ions (K^+) and chloride ions (Cl^-).

(i) The student found that solid potassium chloride does not conduct electricity.

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

are too big **cannot move** **have no charge**

Solid potassium chloride does not conduct electricity because

the ions _____ .

(1)

(ii) What could the student do to the potassium chloride to make it conduct electricity?

(1)

(iii) During electrolysis why do potassium ions move to the negative electrode?

(1)

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

When the potassium ions reach the negative electrode

they turn into potassium

atoms.
electrodes.
molecules.

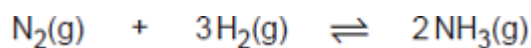
(1)

(Total 6 marks)

Q17.

Ammonia is produced from nitrogen and hydrogen.

The equation for this reaction is:



- (a) (i) A company wants to make 6.8 tonnes of ammonia.

Calculate the mass of nitrogen needed.

Relative atomic masses (A_r): H = 1; N = 14

Mass of nitrogen = _____ tonnes

(3)

- (ii) The company expected to make 6.8 tonnes of ammonia.

The yield of ammonia was only 4.2 tonnes.

Calculate the percentage yield of ammonia.

Percentage yield of ammonia = _____ %

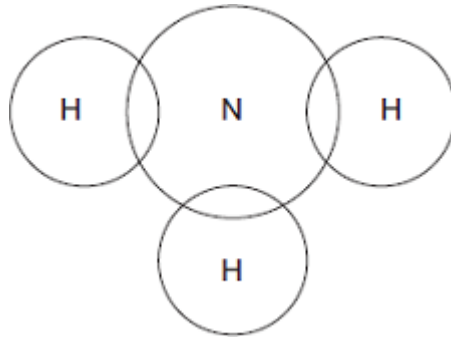
(2)

- (iii) Use the equation above to explain why the percentage yield of ammonia was less than expected.

(1)

- (b) Complete the diagram to show the arrangement of the outer shell electrons of the nitrogen and hydrogen atoms in ammonia.

Use dots (•) and crosses (x) to represent the electrons.



(2)

- (c) Ammonia dissolves in water to produce an alkaline solution.

- (i) Which ion makes ammonia solution alkaline?

(1)

- (ii) Name the type of reaction between aqueous ammonia solution and an acid.

(1)

- (iii) Name the acid needed to produce ammonium nitrate.

(1)

- (iv) The reaction of ammonia with sulfuric acid produces ammonium sulfate.

Use the formulae of the ions on the Chemistry Data Sheet.

Write the formula of ammonium sulfate.

(1)

(Total 12 marks)

Q18.

Oil rigs are used to drill for crude oil.



© Digital Vision/Photodisc

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

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)

Q19.

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



© Tristan3D/Shutterstock

- (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 ${}^2_1\text{H}$ and ${}^1_1\text{H}$

Describe the similarities and the differences in the isotopes ${}^2_1\text{H}$ and ${}^1_1\text{H}$

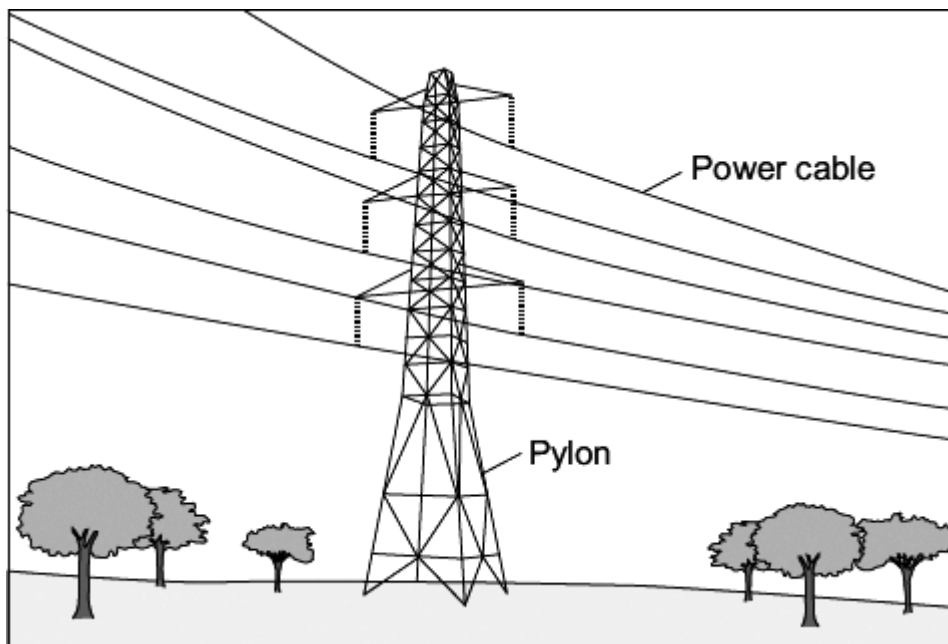
You should refer to the sub-atomic particles in each isotope.

(3)

(Total 8 marks)

Q20.

Metals are used in the manufacture of pylons and overhead power cables.



(a) Suggest **one** reason why iron (steel) is used to make pylons.

(1)

(b) The table shows some of the properties of two metals.

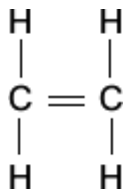
Metal	Density in g per cm ³	Melting point in °C	Percentage(%) relative electrical conductivity	Percentage(%) abundance in Earth's crust
copper	8.92	1083	100	0.007
aluminium	2.70	660	60	8.1

Use the information in the table to suggest why aluminium and **not** copper is used to conduct electricity in overhead power cables.

(2)

(c) A polymer can be used to cover and insulate power cables.

The polymer is made from the alkene:



Draw a ring around the correct answer to complete each of the sentences.

(i) The chemical formula of this alkene is

CH
CH ₄
C ₂ H ₄

(1)

(ii) The two lines between the carbon atoms are called a

double bond.
nucleus.
single bond.

(1)

(iii) The name of the polymer formed when many of these alkene molecules join

together is

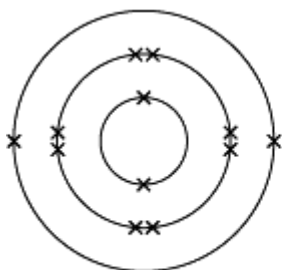
poly(ethene).
poly(ethenol).
poly(propene).

(1)

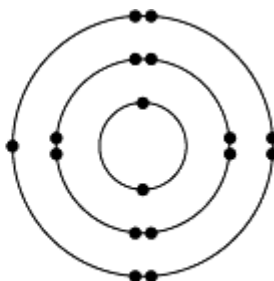
(Total 6 marks)

Q21.

The diagrams represent the electronic structure of a magnesium atom and a chlorine atom.



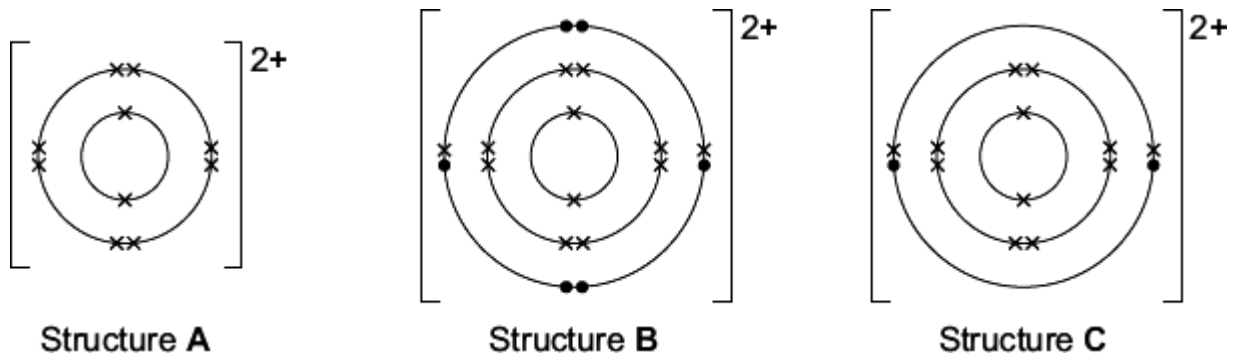
Magnesium atom



Chlorine atom

Magnesium reacts with chlorine to make the ionic compound called magnesium chloride. This contains magnesium ions, Mg²⁺, and chloride ions, Cl⁻

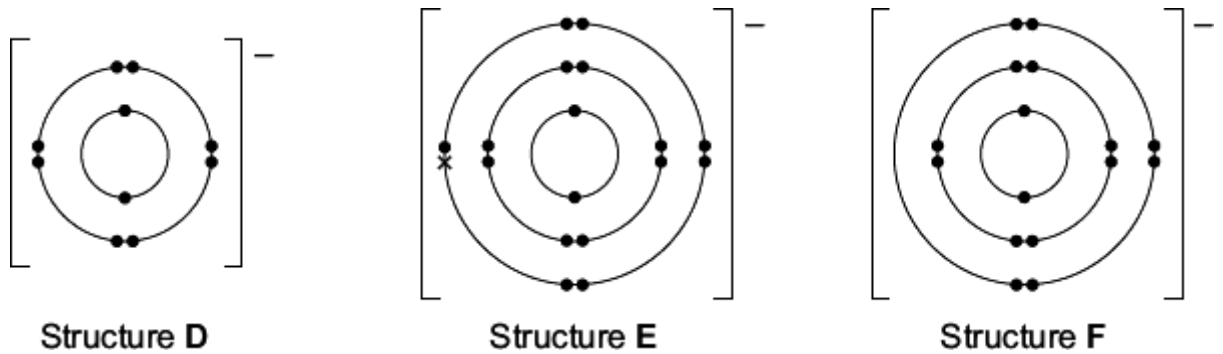
(a) (i) Which structure, **A**, **B** or **C**, represents a magnesium ion?



The magnesium ion is Structure

(1)

(ii) Which structure, D, E or F, represents a chloride ion?



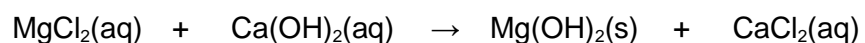
The chloride ion is Structure

(1)

(b) Magnesium metal can be extracted from sea water.
Sea water contains magnesium chloride, MgCl_2

(i) Calcium hydroxide, Ca(OH)_2 , is added to the sea water.
Magnesium hydroxide, Mg(OH)_2 , is produced as a solid.

This is the equation for the reaction:



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

Magnesium hydroxide forms as a solid because it is

soluble
insoluble
dissolved

in water.

This type of reaction is called

- precipitation.
- neutralisation.
- thermal decomposition.

(2)

(ii) How is the solid magnesium hydroxide separated from the solution?

(1)

(iii) An acid is then added to the solid magnesium hydroxide to make magnesium chloride.

Draw a ring around the name of this acid.

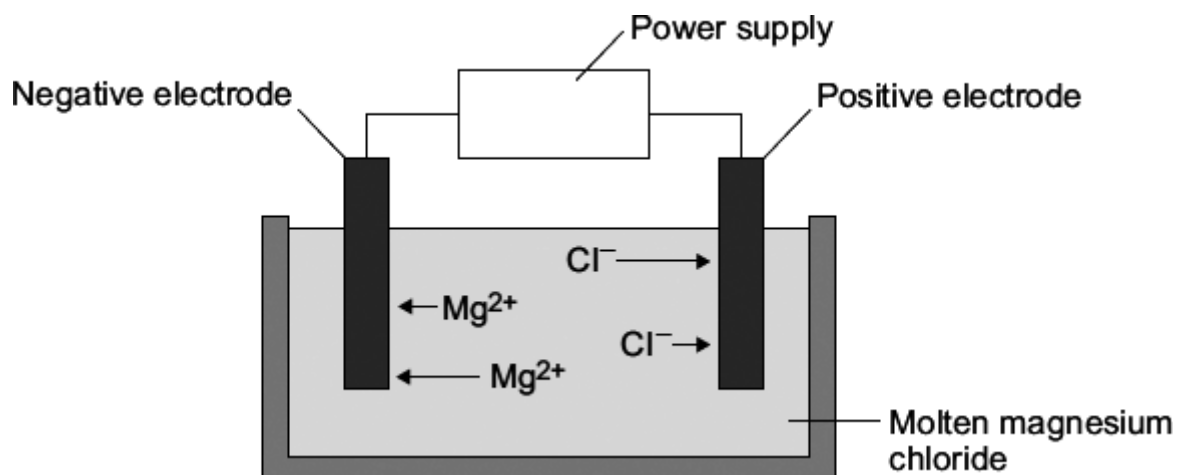
nitric acid

hydrochloric acid

sulfuric acid

(1)

(c) Electrolysis is used to extract magnesium metal from magnesium chloride.



(i) What must be done to solid magnesium chloride to allow it to conduct electricity?

(1)

(ii) Why do the magnesium ions move to the negative electrode?

(1)

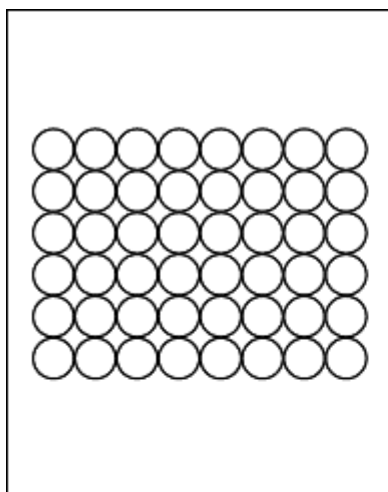
(iii) Name the product formed at the positive electrode.

(1)

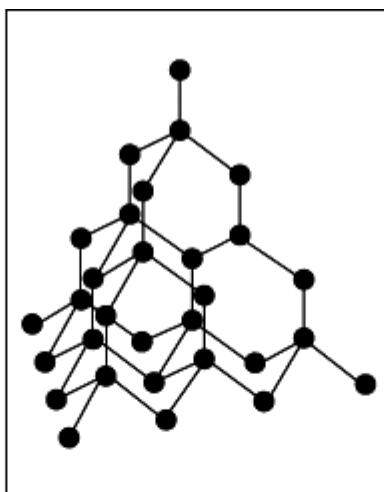
(Total 9 marks)

Q22.

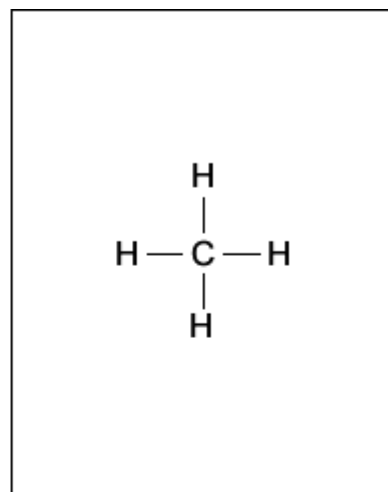
The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



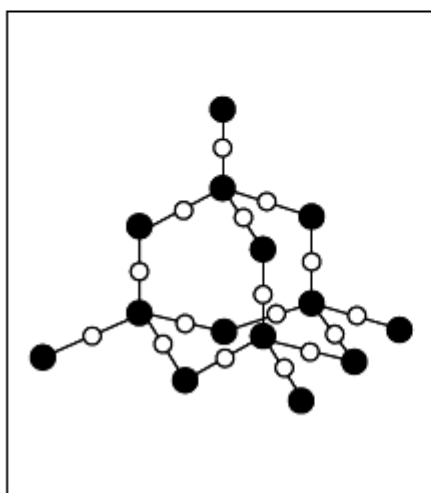
A



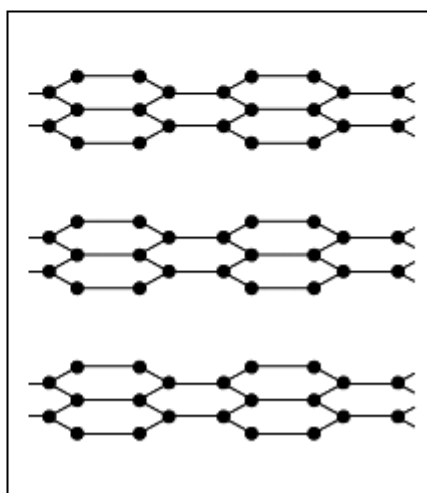
B



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)

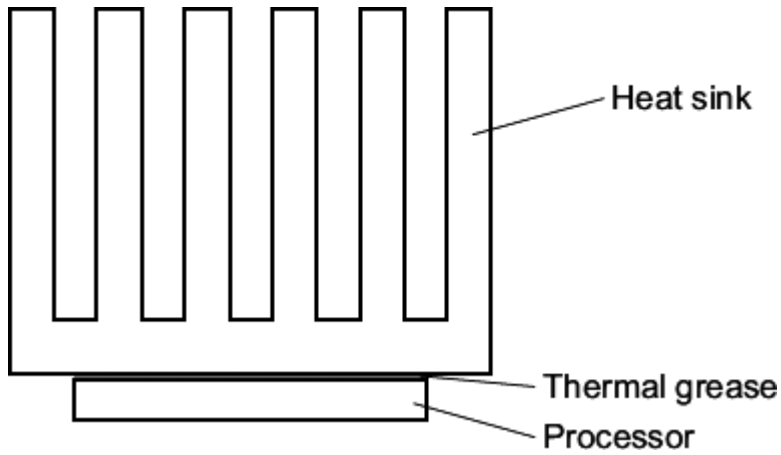
(c) Explain why substance **E** is soft and slippery.

(2)

(Total 6 marks)

Q23.

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)

- (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)

Q24.

Scientists have recently developed a method to produce large sheets of a substance called graphene.

Graphene is made from carbon and is a single layer of graphite just one atom thick.

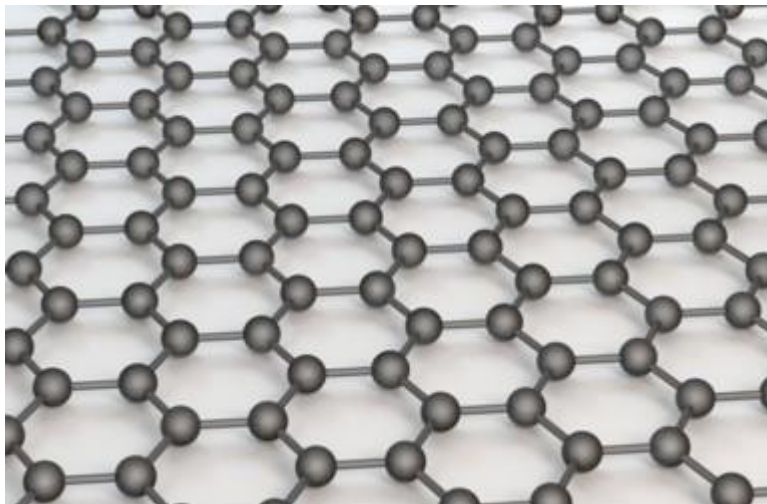
The properties of graphene include:

- it conducts electricity
- it is transparent since it is only one atom thick
- it is strong and durable.



These properties make it suitable to overlay a monitor screen to make it a touchscreen.

The photograph below shows the structure of graphene.



Photographs supplied by iStockphoto/Thinkstock

Use your knowledge of the bonding in graphite and the photograph of the structure to help you to explain, as fully as you can:

- (a) (i) why graphene is strong;

(3)

- (ii) why graphene conducts electricity.

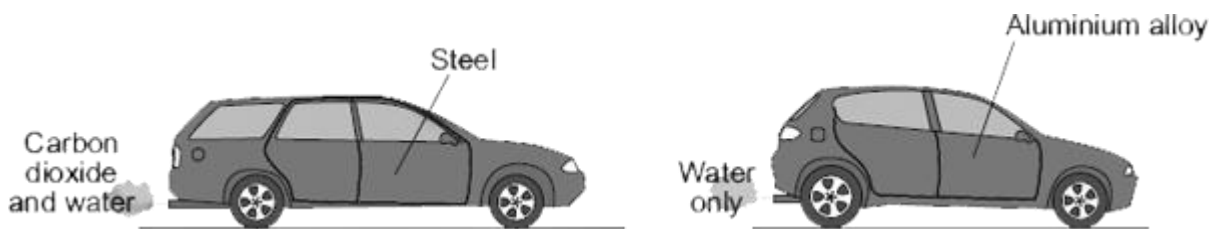
(2)

- (b) Suggest why a sheet of graphite which has a large number of carbon layers would not be suitable for the touchscreen.

(1)

(Total 6 marks)

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*.

(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.

carbonates

(1)

(ii) Petrol is a mixture of

hydrocarbons
polymers

 including C₈H₁₈

(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)

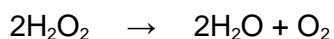
(ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

(1)

(Total 9 marks)

Q26.

(a) The symbol equation for the decomposition of hydrogen peroxide is:

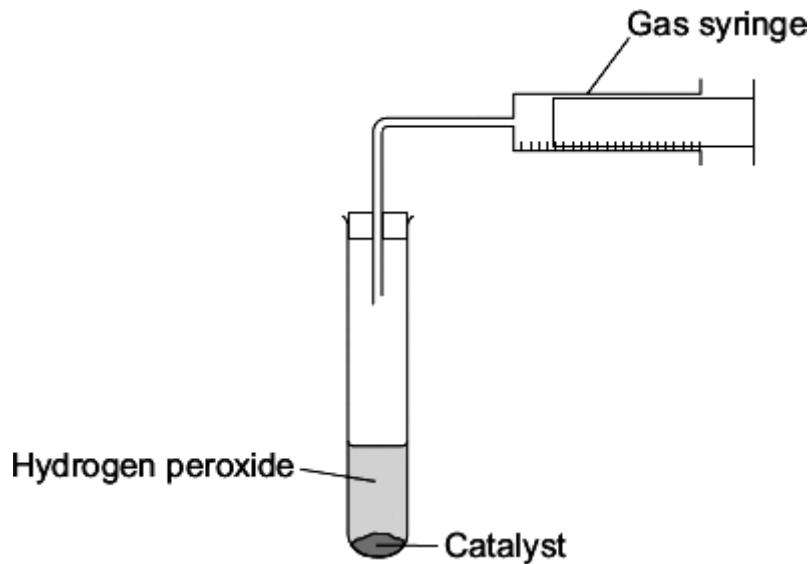


Complete the word equation for the decomposition of hydrogen peroxide.

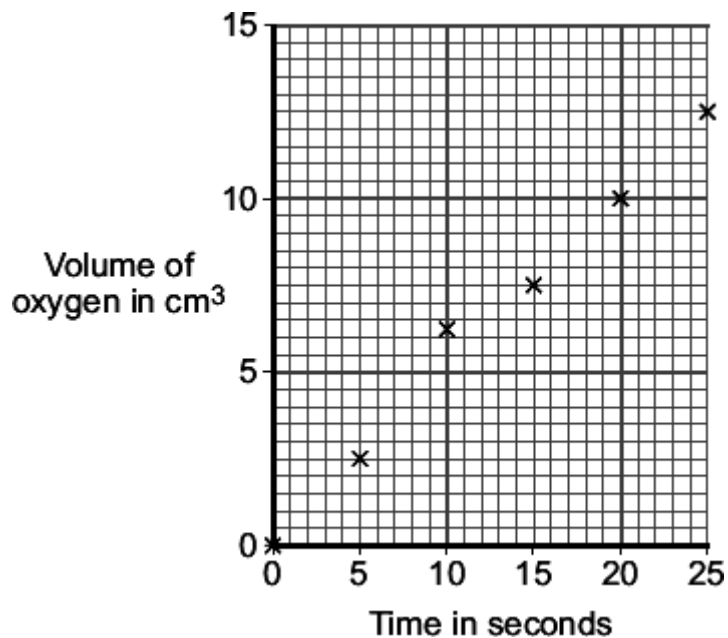
Hydrogen peroxide → _____ + _____

(1)

(b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



(i) Draw a straight line of best fit to complete the graph.



(1)

(ii) Draw a circle around the anomalous point on the graph.

(1)

(iii) What is the volume of oxygen given off after 15 seconds?

_____ cm³

(1)

(iv) How did the volume of oxygen change between 0 and 25 seconds?

(1)

(c) The student wanted to make the reaction faster.

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

higher.

(i) To make the reaction faster, the temperature should be

lower.
the
same.

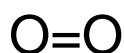
(1)

(ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.
more
concentrated.
the same.

(1)

(d) The diagram represents the bonding in oxygen.



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

(i) When two oxygen atoms bond, the atoms

share
transfer
delocalise

electrons.

(1)

(ii) The oxygen atoms are joined by

ionic
metallic
covalent

bonds.

(1)

(iii) Oxygen is made of

simple
molecules.
a giant lattice.
macromolecules.

(1)

(e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

Statement	Tick (✓)
Water has a boiling point of 100 °C.	

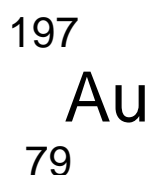
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2)
(Total 12 marks)

Q27.

Gold and gold ions are used as catalysts.

- (a) An atom of gold is represented as:



Complete the sentences.

The atomic number of gold is _____

The number of electrons in an atom of gold is _____

(2)

- (b) Scientists have found that gold nanoparticles are very good catalysts.

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

A gold nanoparticle contains a few

hundred
thousand
million

 atoms.

(1)

- (c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.



- (i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion are called _____

(1)

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

one.

The number of these particles lost when a gold atom becomes a gold ion is

two.

three.

(1)

(d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

(1)

(e) Chloroethene can react to make a thermosoftening polymer.

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

When heated, a thermosoftening polymer will

dissolve.

melt.

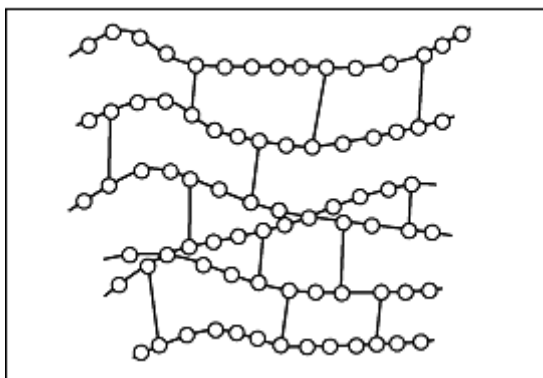
solidify.

(1)

(ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

(1)

(Total 8 marks)

Q28.

Read the information

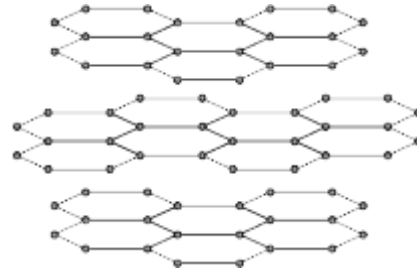
Graphene

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.

Graphite is used in pencils.

Explain why. Use the diagrams to help you.

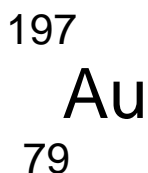
(2)

(Total 5 marks)

Q29.

This question is about gold (Au).

- (a) An atom of gold is represented as:



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 (Au³⁺)?

(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.



(2)

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

Explain why.

(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)

Q30.

This question is about calcium hydroxide.

Ancient artworks and monuments can be protected from acid rain if the surface is sprayed with calcium hydroxide nanoparticles.



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

- (a) Calcium hydroxide has the formula $\text{Ca}(\text{OH})_2$

Why are there two hydroxide ions for each calcium ion in the formula?

(1)

- (b) The calcium hydroxide is used in the form of *nanoparticles*.

What are *nanoparticles*?

(1)

- (c) A student added water to calcium oxide to make calcium hydroxide.

The equation for the reaction is shown below.



Calculate the maximum mass of calcium hydroxide which could be made from 2.00 g of calcium oxide.

Relative atomic masses (A_r): H = 1; O = 16; Ca = 40.

Maximum mass of calcium hydroxide = _____ g

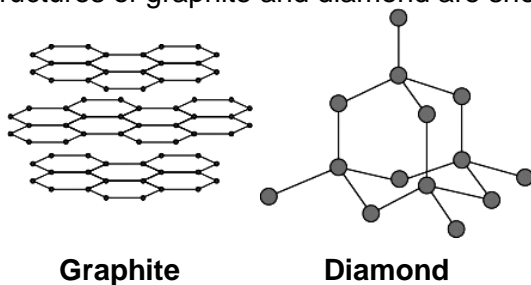
(3)

(Total 5 marks)

Q31.

Graphite and diamond are different forms of the element carbon.
Graphite and diamond have different properties.

The structures of graphite and diamond are shown below.



- (a) Graphite is softer than diamond.

Explain why.

(4)

- (b) Graphite conducts electricity, but diamond does not.

Explain why.

(3)

(Total 7 marks)

Q32.

Stage smoke is used for special effects at pop concerts.



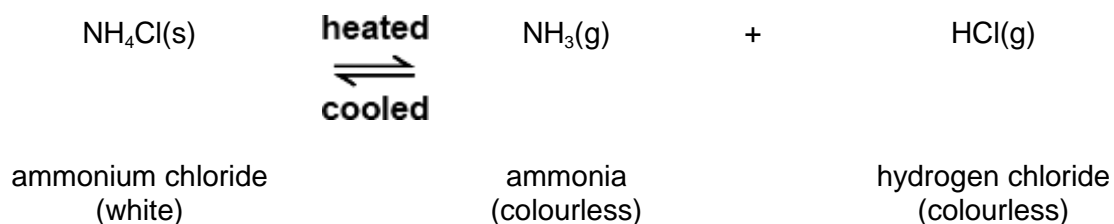
By Sam Cockman [CC BY 2.0], via Flickr

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.



- (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)

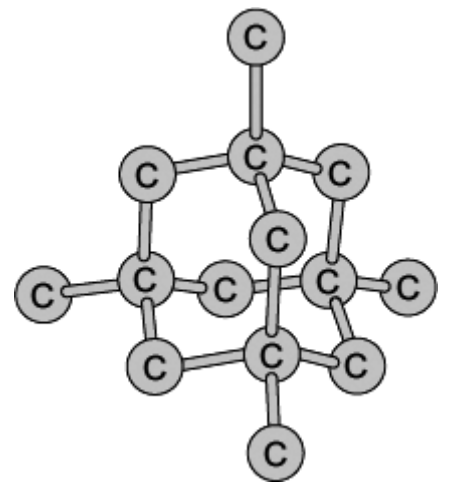
(Total 5 marks)

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

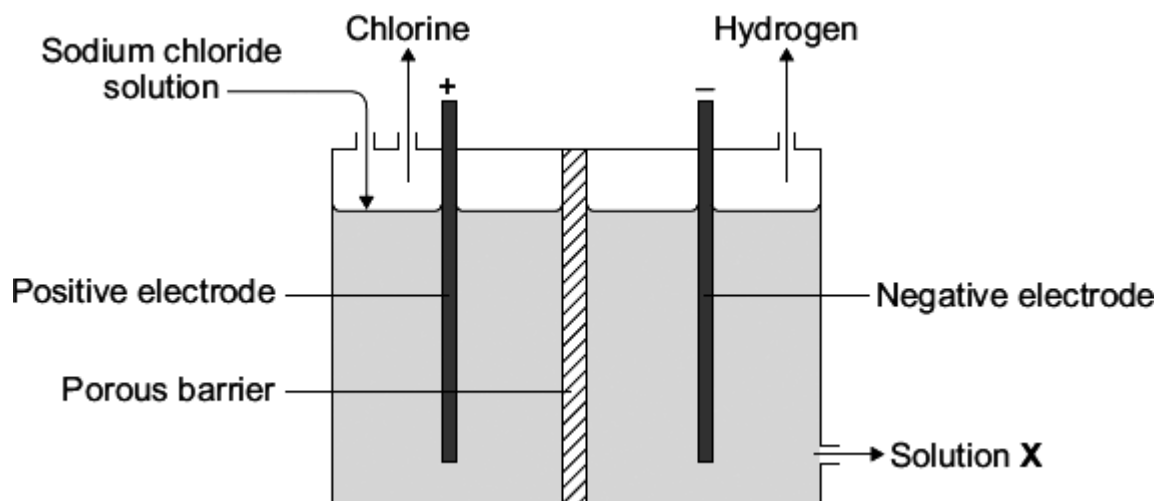
- very small.
- large.
- very large.

(1)

(Total 4 marks)

Q34.

The electrolysis of sodium chloride solution is an industrial process.



(a) Why do chloride ions move to the positive electrode?

(1)

(b) Sodium chloride solution contains two types of positive ions, sodium ions (Na^+) and hydrogen ions (H^+).

Tick (✓) the reason why hydrogen is produced at the negative electrode and **not** sodium.

Reason	Tick (✓)
Hydrogen is a gas.	
Hydrogen is less reactive than sodium.	
Hydrogen is a non-metal.	
Hydrogen ions travel faster than sodium ions.	

(1)

(c) Solution **X** is alkaline.

Which ion makes solution **X** alkaline?

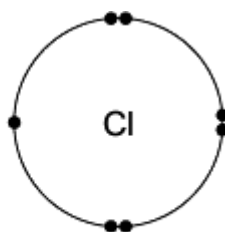
(1)

(d) Electrolysis of sodium chloride solution produces hydrogen and chlorine. The hydrogen and chlorine can be used to make hydrogen chloride.

(i) The diagrams show how the outer electrons are arranged in atoms of hydrogen and chlorine.

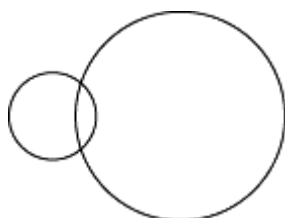


Hydrogen atom



Chlorine atom

Complete the diagram to show how the electrons are arranged in a molecule of hydrogen chloride (HCl).



(1)

- (ii) Name the type of bond between the hydrogen and the chlorine atoms in a molecule of hydrogen chloride.

(1)

- (iii) Some hydrogen chloride was bubbled into water. This made a solution with a pH of 1.

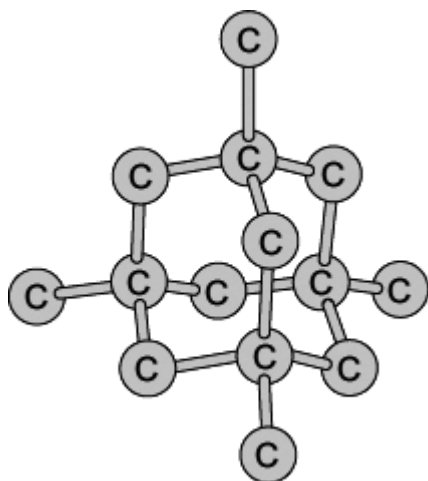
Which ion gave the solution a pH of 1?

(1)

(Total 6 marks)

Q35.

Diamonds are used as abrasives.



Model of part of the diamond structure

Diamonds are very hard.
Explain why.

A good answer will include information on the structure and bonding in diamonds.

(3)

Q36.

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.

(3)

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

(1)

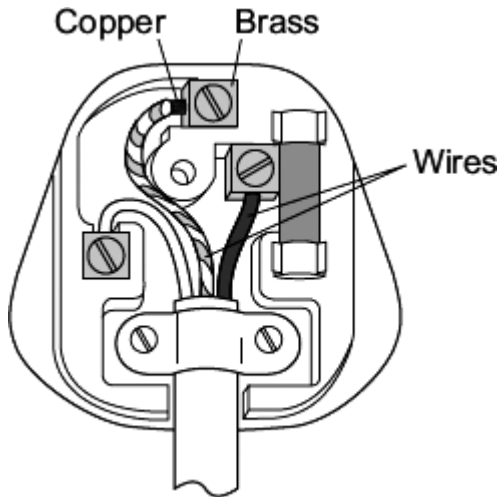
(b) The surface of some metals, such as iron, corrode when exposed to the air.

Suggest why this reduces the electrical conductivity of the metal.

(2)

Q37.

The diagram shows an electric plug.



- (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.

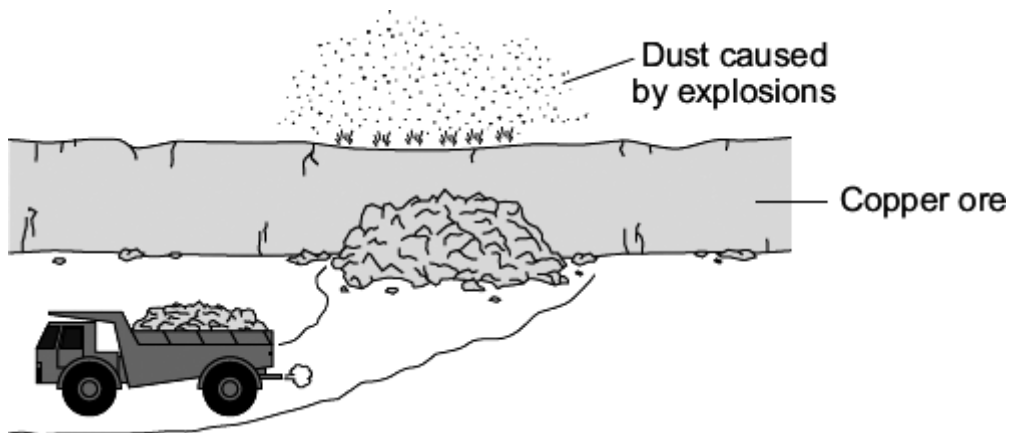
(1)

- (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)

Q38.

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.

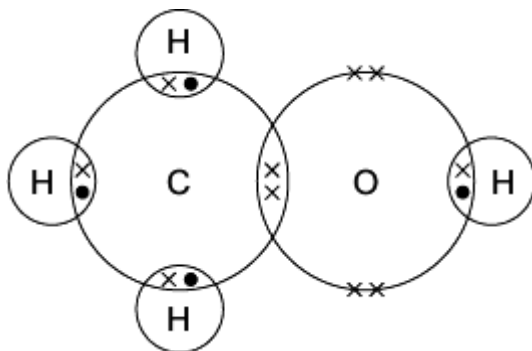
Give **two** reasons why.

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)

Q39.

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

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

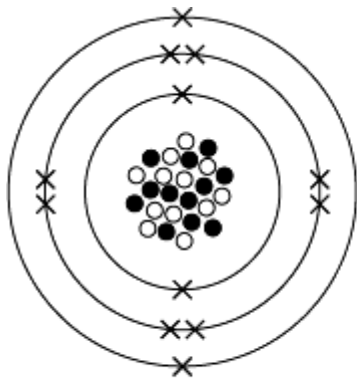


Diagram A

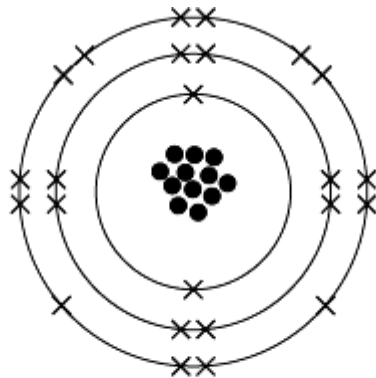


Diagram B

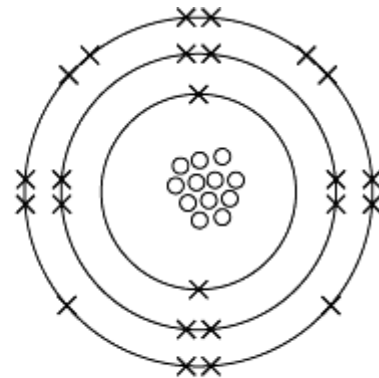
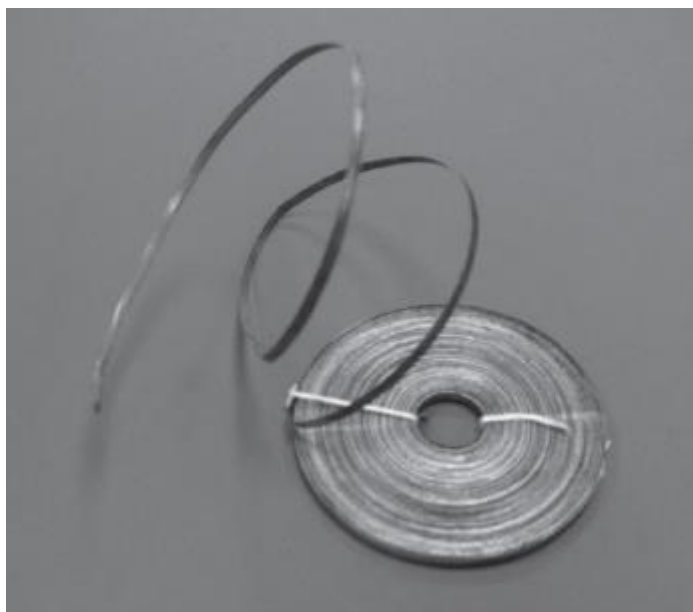


Diagram C

This magnesium atom is **Diagram**

(1)

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



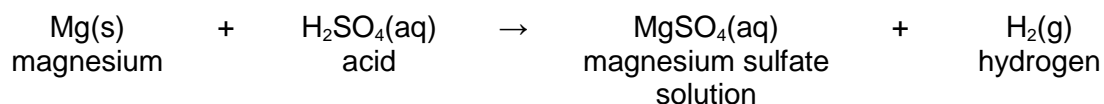
Tick (✓) **two** reasons which explain why metals can be shaped.

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)

Q40.

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.

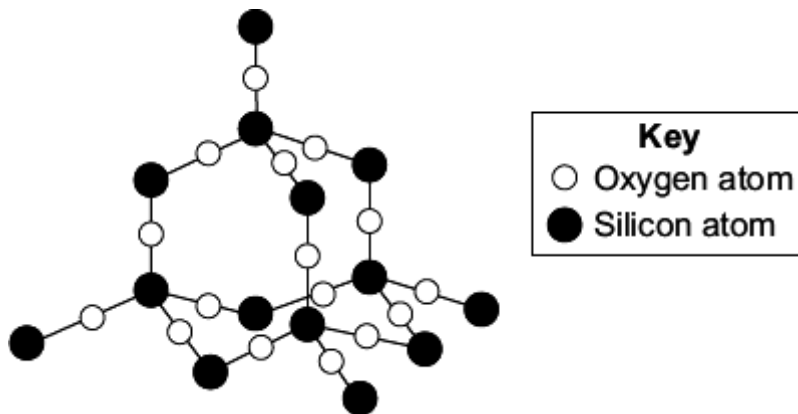
Two of these are properties of materials used to make welding blankets.

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)

Q41.

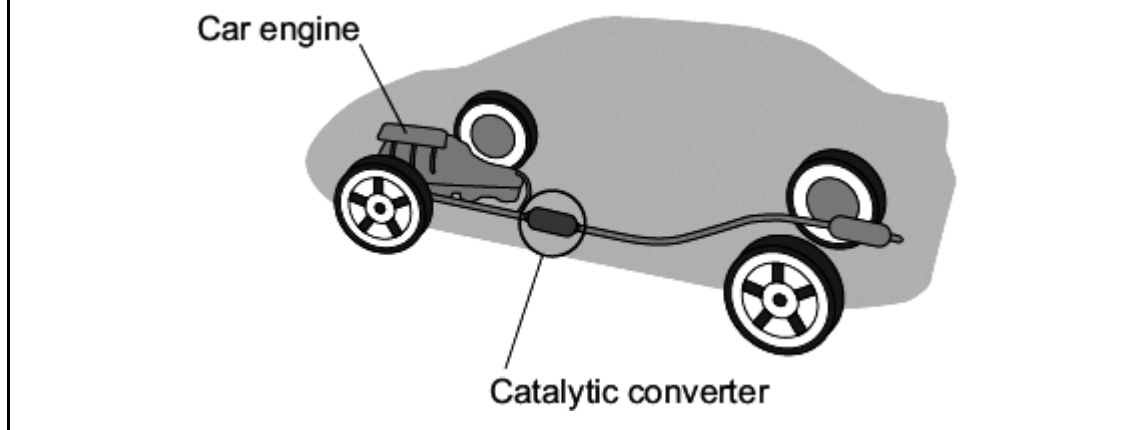
Read the information about car engines.

Burning petrol in air is an exothermic reaction. This reaction is used in car engines.

When petrol burns it produces harmful substances such as nitrogen oxides and

carbon monoxide.

A catalytic converter stops these harmful substances being released into the air.



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

(i) The exothermic reaction makes the temperature

of the engine

decrease.

increase.

stay the same.

(1)

(ii) This is because during

exothermic reactions

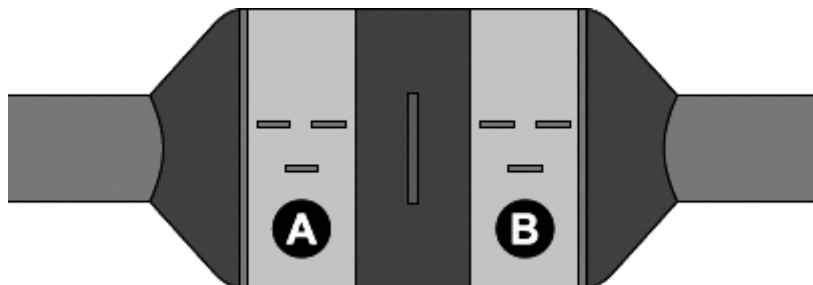
energy is taken in from the surroundings.

energy is given out to the surroundings.

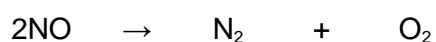
there is no energy change.

(1)

(b) The diagram shows a catalytic converter which removes harmful substances. The catalytic converter has two parts, **A** and **B**, which contain different catalysts.



(i) The equation for the reaction that takes place in part **A** is:

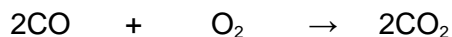


Which **one** of the substances shown in the equation is a compound?

Give the formula of this compound.

(1)

- (ii) The equation for the reaction that takes place in part **B** is:



Why is it important to stop carbon monoxide (CO) from being released into the air?

(1)

- (c) The table lists some statements about catalysts. Only **two** statements are correct.

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

Statement	Tick (✓)
A catalyst can speed up a chemical reaction.	
A catalyst is used up in a chemical reaction.	
Different reactions need different catalysts.	
A catalyst does not change the rate of a chemical reaction.	

(2)

- (d) Modern catalytic converters contain nanosized particles of catalyst. Less catalyst is needed when nanosized catalyst particles are used.

- (i) Complete the sentence.

The size of nanosized particles is _____ than normal sized particles.

(1)

- (ii) The catalysts contain platinum.

Suggest why a manufacturer of catalytic converters would want to use less catalyst.

(1)

(Total 8 marks)

