
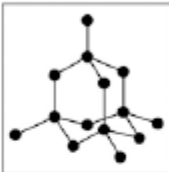
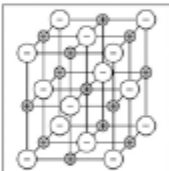
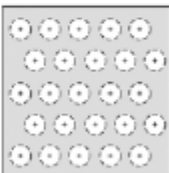
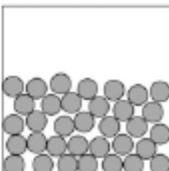


Bonding

Q1.

This question is about different substances and their structures.

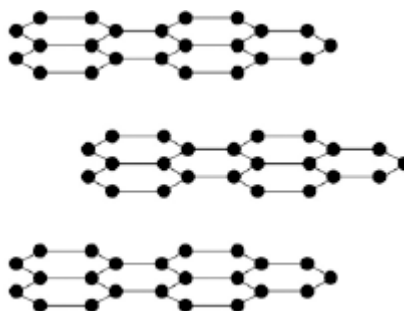
(a) Draw **one** line from each statement to the diagram which shows the structure.

Statement	Structure
The substance is a gas	
The substance is a liquid	
The substance is ionic	
The substance is a solid metal	
	

(4)

(b) **Figure 1** shows the structure of an element.

Figure 1



What is the name of this element?

Tick **one** box.

Carbon

Chloride

Nitrogen

Xenon

(1)

(c) Why does this element conduct electricity?

Tick **one** box.

It has delocalised electrons

It contains hexagonal rings

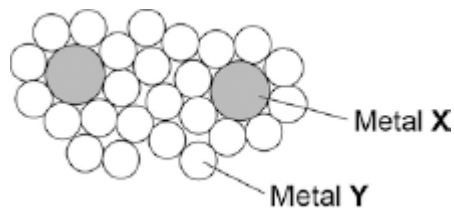
It has weak forces between the layers

It has ionic bonds

(1)

(d) **Figure 2** shows the structure of an alloy.

Figure 2



Explain why this alloy is harder than the pure metal Y.

(2)

(e) What percentage of the atoms in the alloys are atoms of X?

(2)

(f) What type of substance is an alloy?

Tick **one** box.

Compound

Element

Mixture

(1)

(Total 11 marks)

Q2.

The figure below shows magnesium burning in air.



© Charles D Winters/Science Photo Library

(a) Look at the figure above.

How can you tell that a chemical reaction is taking place?

(1)

(b) Name the product from the reaction of magnesium in the figure.

(1)

(c) The magnesium needed heating before it would react.

What conclusion can you draw from this?

Tick **one** box.

The reaction is reversible

The reaction has a high activation energy

The reaction is exothermic

Magnesium has a high melting point

(1)

(d) A sample of the product from the reaction in the figure above was added to water and shaken.

Universal indicator was added.

The universal indicator turned blue.

What is the pH value of the solution?

Tick **one** box.

1

4

7

9

(1)

(e) Why are nanoparticles effective in very small quantities?

Tick **one** box.

They are elements

They are highly reactive

They have a low melting point

They have a high surface area to volume ratio

(1)

(f) Give **one** advantage of using nanoparticles in sun creams.

(1)

(g) Give **one** disadvantage of using nanoparticles in sun creams.

(1)

(h) A coarse particle has a diameter of 1×10^{-6} m.
A nanoparticle has a diameter of 1.6×10^{-9} m.

Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

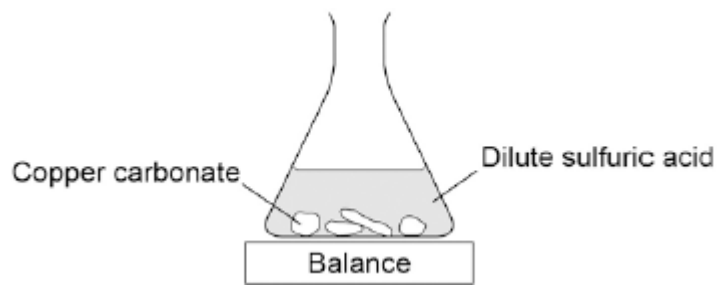
(2)

(Total 9 marks)

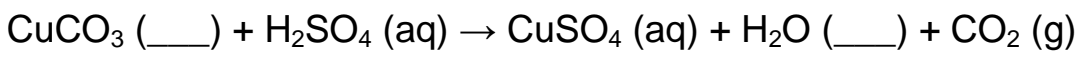
Q3.

A student investigated the reaction of copper carbonate with dilute sulfuric acid.

The student used the apparatus shown in the figure below.



(a) Complete the state symbols in the equation.



(2)

(b) Why did the balance reading decrease during the reaction?

Tick **one** box.

The copper carbonate broke down.

A salt was produced in the reaction.

A gas was lost from the flask.



Water was produced in the reaction.



(1)

- (c) Describe a safe method for making pure crystals of copper sulfate from copper carbonate and dilute sulfuric acid. Use the information in the figure above to help you.

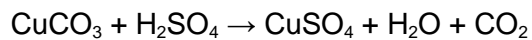
In your method you should name all of the apparatus you will use.

(6)

- (d) The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

The equation for the reaction of copper carbonate and sulfuric acid is:



Relative formula masses : $\text{CuCO}_3 = 123.5$; $\text{H}_2\text{SO}_4 = 98.0$; $\text{CuSO}_4 = 159.5$

Calculate the percentage atom economy for making copper sulfate from copper carbonate.

Atom economy = _____ %

(3)

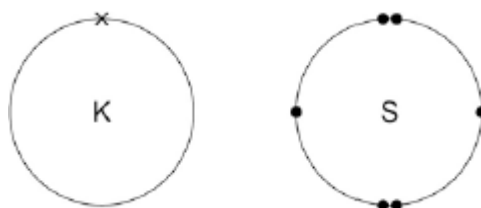
- (e) Give **one** reason why is it important for the percentage atom economy of a reaction to be as high as possible.

(1)
(Total 13 marks)

Q4.

Figure 1 shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

Figure 1



- (a) Potassium forms an ionic compound with sulfur.

Describe what happens when **two** atoms of potassium react with **one** atom of sulfur.

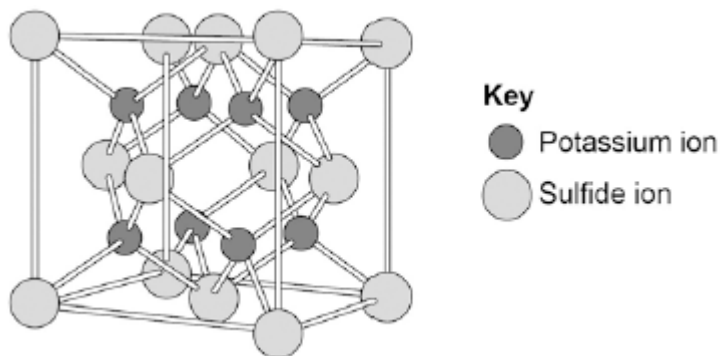
Give your answer in terms of electron transfer.

Give the formulae of the ions formed.

(5)

- (b) The structure of potassium sulfide can be represented using the ball and stick model in **Figure 2**.

Figure 2



The ball and stick model is **not** a true representation of the structure of potassium sulfide.

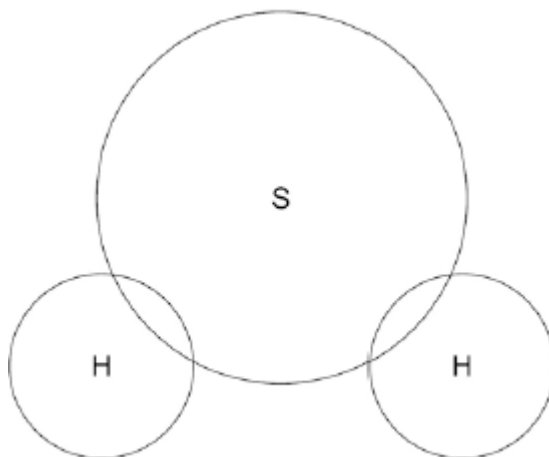
Give **one** reason why.

(1)

- (c) Sulfur can also form covalent bonds.

Complete the dot and cross diagram to show the covalent bonding in a molecule of hydrogen sulfide.

Show the outer shell electrons only.



(2)

- (d) Calculate the relative formula mass (M_r) of aluminium sulfate $\text{Al}_2(\text{SO}_4)_3$

Relative atomic masses (A_r): oxygen = 16; aluminium = 27; sulfur = 32

Relative formula mass = _____

(2)

- (e) Covalent compounds such as hydrogen sulfide have low melting points and do **not** conduct electricity when molten.

Draw **one** line from each property to the explanation of the property.

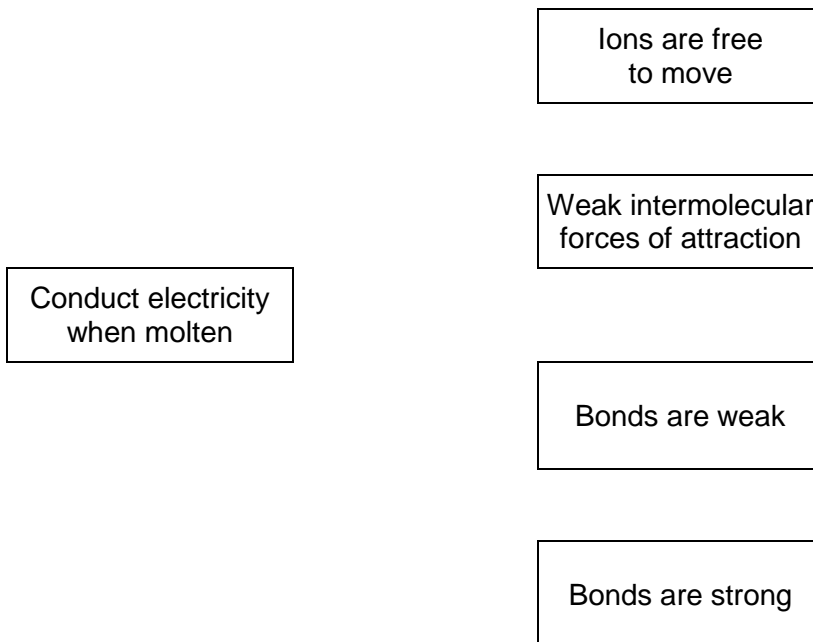
Property	Explanation of property
	Electrons are free to move
	There are no charged particles free to move
Low melting point	Ions are free to move
	Weak intermolecular forces of attraction
Does not conduct electricity when molten	Bonds are weak
	Bonds are strong

(2)

- (f) Ionic compounds such as potassium sulfide have high boiling points and conduct electricity when dissolved in water.

Draw **one** line from each property to the explanation of the property.

Property	Explanation of property
	Electrons are free to move
	There are no charged particles free to move
High boiling point	



(2)
(Total 14 marks)

Q5.

This question is about halogens and their compounds.

The table below shows the boiling points and properties of some of the elements in Group 7 of the periodic table.

Element	Boiling point in °C	Colour in aqueous solution
Fluorine	-188	colourless
Chlorine	-35	pale green
Bromine	X	orange
Iodine	184	brown

(a) Why does iodine have a higher boiling point than chlorine?

Tick **one** box.

- | | |
|--|--------------------------|
| Iodine is ionic and chlorine is covalent | <input type="checkbox"/> |
| Iodine is less reactive than chlorine | <input type="checkbox"/> |
| The covalent bonds between iodine atoms are stronger | <input type="checkbox"/> |
| The forces between iodine molecules are stronger | <input type="checkbox"/> |

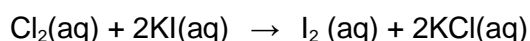
(1)

(b) Predict the boiling point of bromine.

(1)

- (c) A redox reaction takes place when aqueous chlorine is added to potassium iodide solution.

The equation for this reaction is:



Look at table above.

What is the colour of the final solution in this reaction?

Tick **one** box.

Brown

Orange

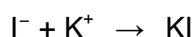
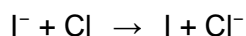
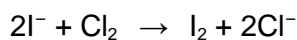
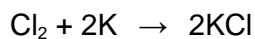
Pale green

Colourless

(1)

- (d) What is the ionic equation for the reaction of chlorine with potassium iodide?

Tick **one** box.



(1)

- (e) Why does potassium iodide solution conduct electricity?

Tick **one** box.

It contains a metal

It contains electrons which can move

It contains ions which can move

It contains water

(1)

- (f) What are the products of electrolysis of potassium iodide solution?

Tick **one** box.

Product at cathode	Product at anode	
--------------------	------------------	--

hydrogen	iodine	<input type="checkbox"/>
----------	--------	--------------------------

hydrogen	oxygen	<input type="checkbox"/>
----------	--------	--------------------------

potassium	iodine	<input type="checkbox"/>
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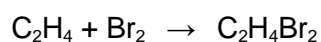
potassium	oxygen	<input type="checkbox"/>
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(1)
(Total 6 marks)

Q6.

This question is about the reaction of ethene and bromine.

The equation for the reaction is:

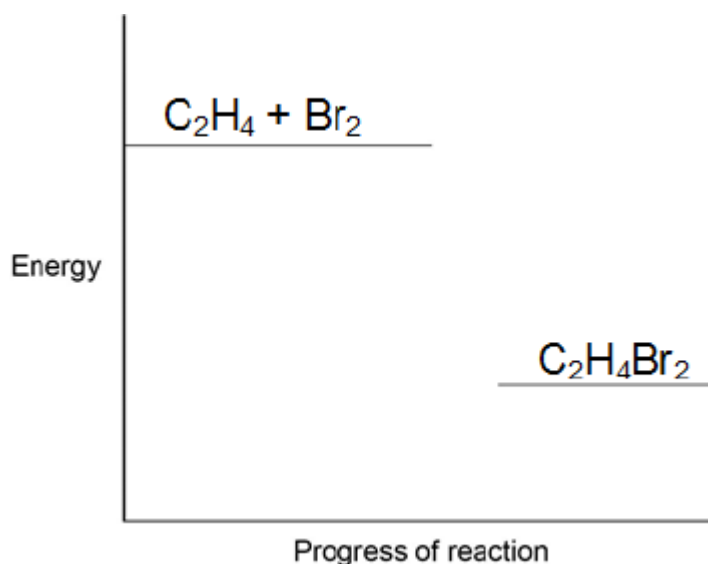


(a) Complete the reaction profile in **Figure 1**.

Draw labelled arrows to show:

- The energy given out (ΔH)
- The activation energy.

Figure 1



(3)

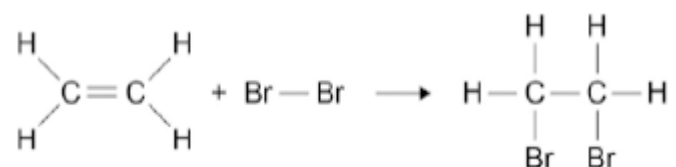
(b) When ethene reacts with bromine, energy is required to break covalent bonds in the molecules.

Explain how a covalent bond holds two atoms together.

(2)

- (c) **Figure 2** shows the displayed formulae for the reaction of ethene with bromine.

Figure 2



The bond enthalpies and the overall energy change are shown in the table below.

	C=C	C-H	C-C	C-Br	Overall energy change
Energy in kJ / mole	612	412	348	276	-95

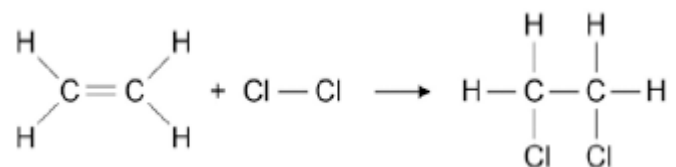
Use the information in the table above and **Figure 2** to calculate the bond energy for the Br-Br bond.

Bond energy _____ kJ / mole

(3)

- (d) **Figure 3** shows the reaction between ethene and chlorine and is similar to the reaction between ethene and bromine.

Figure 3



“The more energy levels (shells) of electrons an atom has, the weaker the covalent bonds that it forms.”

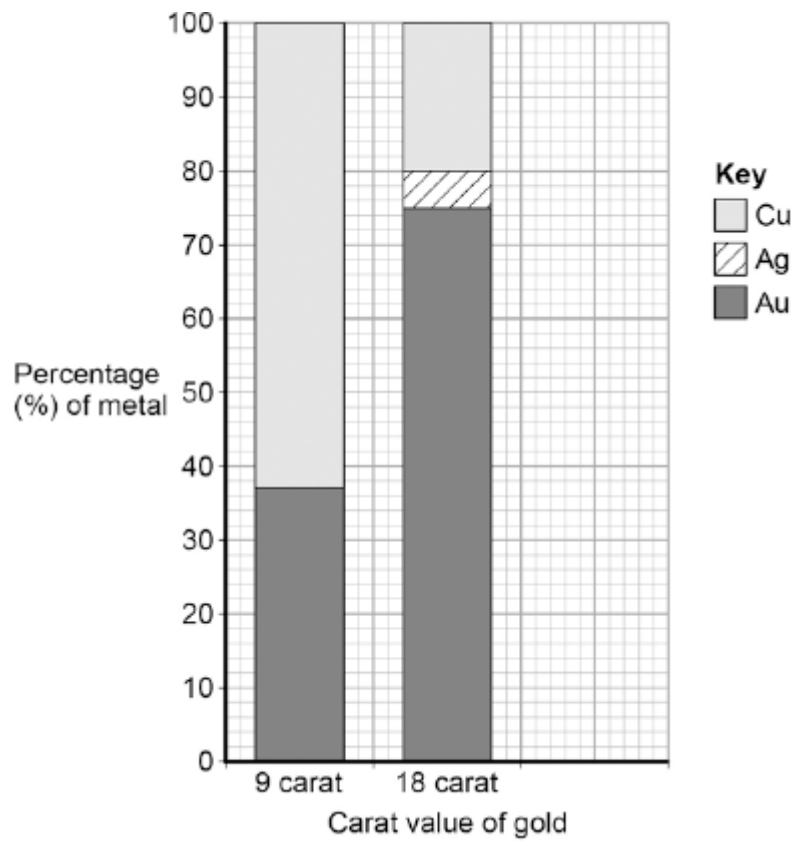
Use the above statement to predict and explain how the overall energy change for the reaction of ethene with chlorine will differ from the overall energy change for the reaction of ethene with bromine.

(6)
(Total 14 marks)

Q7.

Gold is mixed with other metals to make jewellery.

The figure below shows the composition of different carat values of gold.



(a) What is the percentage of gold in 12 carat gold?

Tick **one** box.

12 % 30 % 50 % 80 %

(1)

(b) Give the percentage of silver in 18 carat gold.

Use the figure above to answer this question.

Percentage = _____ %

(1)

(c) Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

1. _____

2. _____

(2)

(Total 4 marks)

Q8.

The table below gives information about four alcohols.

Alcohol	Formula	Melting point in °C	Boiling point in °C
Methanol	CH ₃ OH	-94	65
Ethanol	CH ₃ CH ₂ OH	-118	78
Propanol	CH ₃ CH ₂ CH ₂ OH	-129	97
Butanol	CH ₃ CH ₂ CH ₂ CH ₂ OH	-89	118

(a) Which alcohol in the table is liquid over the greatest temperature range?

(1)

(b) Which statement is correct?

Tick **one** box.

A molecule of ethanol has 5 hydrogen atoms

Butanol has the highest boiling point

Methanol has the largest molecules

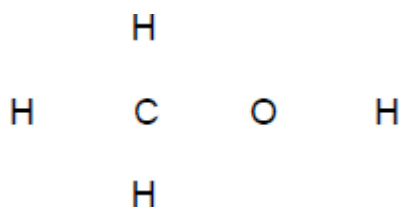
Propanol has the highest melting point

(1)

(c) A molecule of methanol has five single covalent bonds.

Draw the missing bonds in **Figure 1** to complete the displayed formula for methanol.

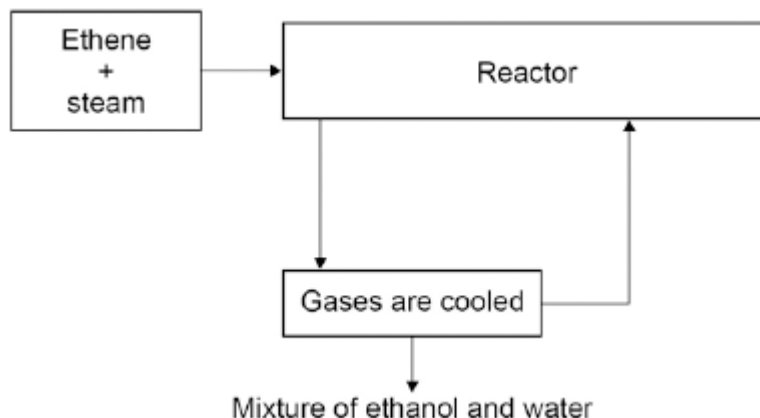
Figure 1



(1)

(d) Figure 2 shows a flow diagram of the process to produce ethanol.

Figure 2



Complete the word equation for the reaction to produce ethanol.



(1)

(e) What happens to the unreacted ethene?

(1)

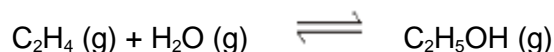
(f) Wine contains ethanol.
A bottle of wine was left open in air.
After a few days, the wine tasted of vinegar.
Vinegar is a solution of ethanoic acid in water.

Explain how oxidation causes the wine to taste of vinegar after a few days.

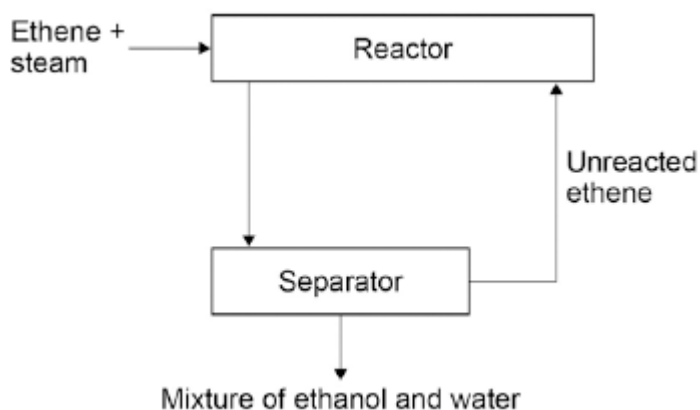
Q9.

In industry ethanol is produced by the reaction of ethene and steam at 300°C and 60 atmospheres pressure using a catalyst.

The equation for the reaction is:



The figure below shows a flow diagram of the process.



- (a) Why does the mixture from the separator contain ethanol and water?

(1)

- (b) The forward reaction is exothermic.

Use Le Chatelier's Principle to predict the effect of increasing temperature on the amount of ethanol produced at equilibrium.

Give a reason for your prediction.

(2)

- (c) Explain how increasing the pressure of the reactants will affect the amount of ethanol produced at equilibrium.

Q10.

Metals are extracted from ores in the Earth's crust.

(a) Why is copper used in the manufacture of computers?

Tick (✓) **one** box.

Because it has a high density.

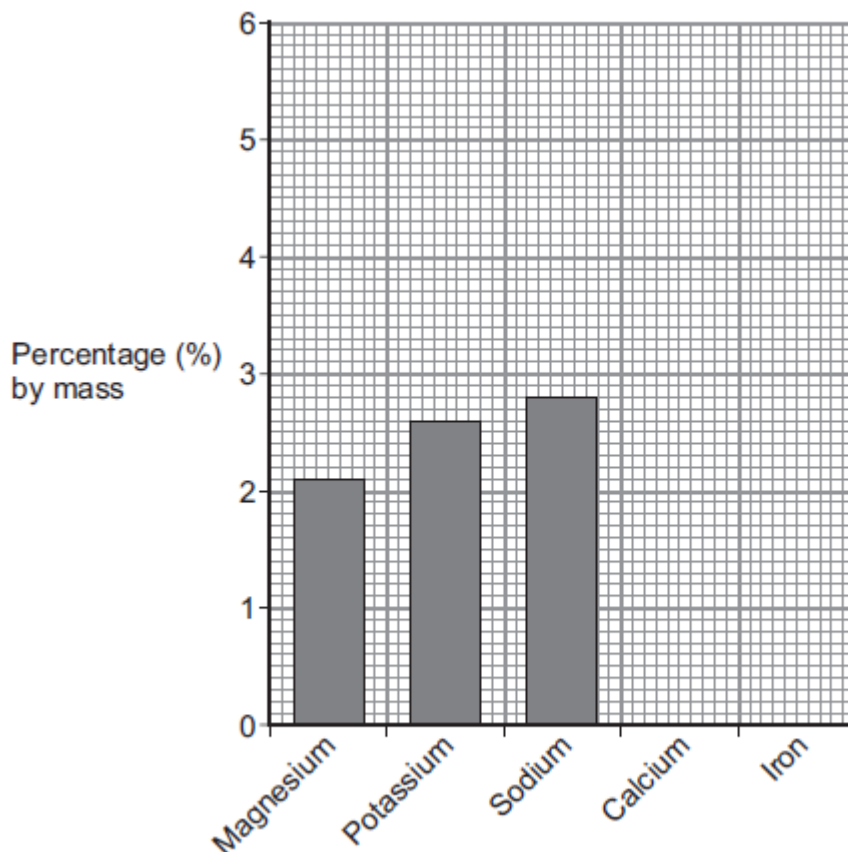
Because it does not react with water.

Because it is a good conductor of electricity.

(1)

(b) **Figure 1** shows the percentage (%) by mass of some metals in the Earth's crust.

Figure 1



(i) What is the percentage by mass of magnesium in the Earth's crust?

_____ %

(1)

(ii) On **Figure 1** draw the bars for:

- calcium at 3.6% by mass
- iron at 5.0% by mass.

(2)

(c) An ore of zinc contains zinc carbonate.

The equation for the reaction when zinc carbonate is heated is:



(i) What is the name of this type of reaction?

Tick (✓) **one** box.

corrosion	<input type="checkbox"/>
decomposition	<input type="checkbox"/>
electrolysis	<input type="checkbox"/>

(1)

(ii) Which substance in the equation is a gas at room temperature (20 °C)?

Tick (✓) **one** box.

zinc carbonate	<input type="checkbox"/>
zinc oxide	<input type="checkbox"/>
carbon dioxide	<input type="checkbox"/>

(1)

(iii) Complete the table below to show the number of atoms of carbon and oxygen in the formula of zinc carbonate.

Element	Number of atoms in the formula ZnCO ₃
zinc, Zn	1
carbon, C	
oxygen, O	

(2)

(iv) When 125 g zinc carbonate is heated, 81 g zinc oxide is produced.

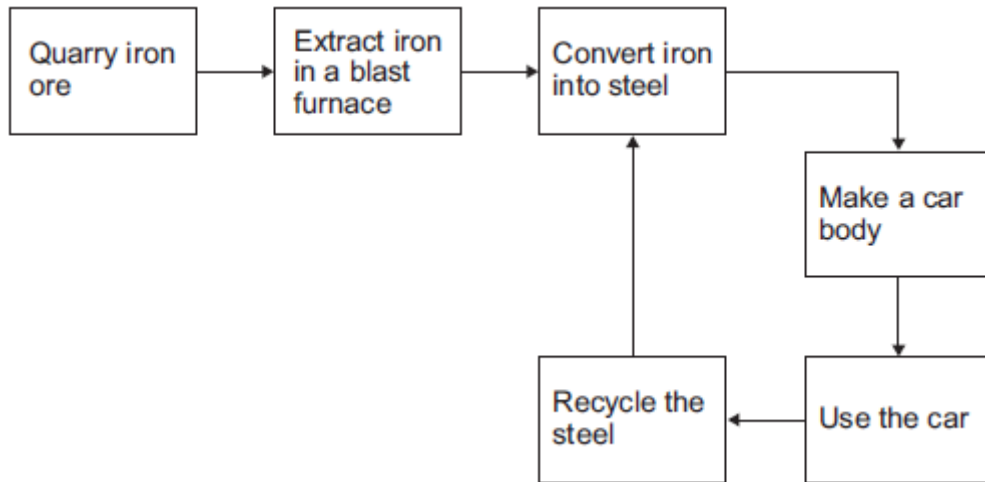
Calculate the mass of carbon dioxide produced.

Mass of carbon dioxide = _____g

(1)

(d) **Figure 2** shows a simple life cycle of a car body.

Figure 2



(i) What is **one** reason why iron from the blast furnace is converted into steel?

Tick (✓) **one** box.

To make the iron pure.

To make the iron more brittle.

To make alloys for specific uses.

(1)

(ii) Apart from cost, give **three different** reasons why steel should be recycled.

1. _____

2. _____

3. _____

(3)

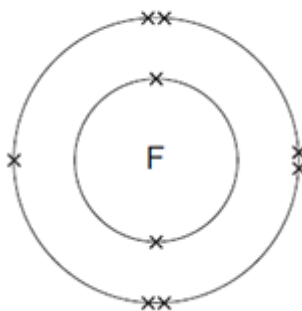
(Total 13 marks)

Q11.

This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



- (i) In which group of the periodic table is fluorine?

Group _____

(1)

- (ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

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

alkalis	alloys	isotopes
----------------	---------------	-----------------

Atoms of fluorine with different numbers of neutrons are called _____ .

(1)

- (b) Sodium reacts with fluorine to produce sodium fluoride.

- (i) Complete the word equation for this reaction.

sodium + _____ → _____

(1)

- (ii) Complete the sentence.

Substances in which atoms of two or more different elements are chemically combined are called _____ .

(1)

- (iii) The relative formula mass (M_r) of sodium fluoride is 42.

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

ion	mole	molecule
-----	------	----------

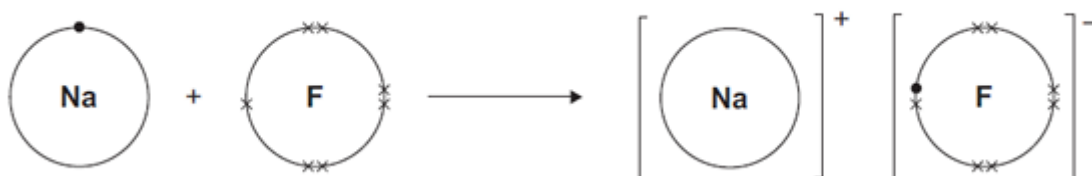
The relative formula mass (M_r), in grams, of sodium fluoride is one _____ of the substance.

(1)

- (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

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

Figure 2



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

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

(4)

- (v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✓) **two** boxes.

Dissolve in water

Gas at room temperature

High melting point

Low boiling point



(2)
(Total 13 marks)

Q12.

This question is about substances containing carbon atoms.

- (a) Diamond is made of carbon atoms.
- (i) Diamond is used for tips of drills.

Figure 1 shows a drill.

Figure 1



© Kershawj/iStock

Give **one** reason why diamond is used for tips of drills.

(1)

- (ii) Diamond nanoparticles can be made.

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

hundred	million	thousand
---------	---------	----------

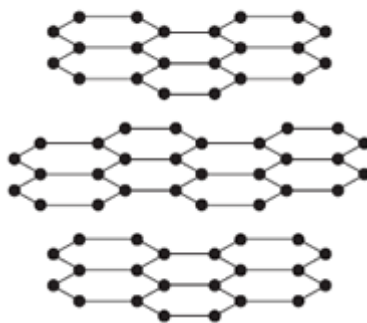
Nanoparticles contain a few _____ atoms.

(1)

- (b) Graphite is made of carbon atoms.

Figure 2 shows the structure of graphite.

Figure 2



(i) What type of bonding does graphite have?

Tick (✓) **one** box.

Covalent

Ionic

Metallic

(1)

(ii) How many carbon atoms does each carbon atom bond to in graphite?

Tick (✓) **one** box.

1

2

3

4

(1)

(iii) What is a property of graphite?

Tick (✓) **one** box.

Dissolves in water

Has a low melting point

Soft and slippery

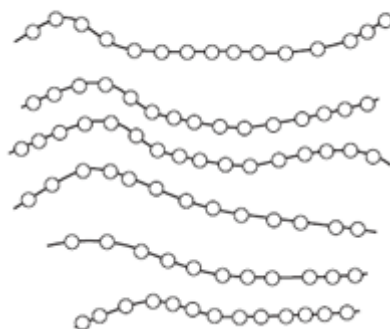
(1)

(c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 3 shows the structure of a thermosoftening polymer.

Figure 3



- (i) Complete the sentence.

Between the polymer chains in a thermosoftening polymer there are no _____ .

(1)

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

condense	dissolve	melt
----------	----------	------

Heating would cause a thermosoftening polymer to

_____ .

(1)

- (iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction.

Suggest **two** conditions that could be changed.

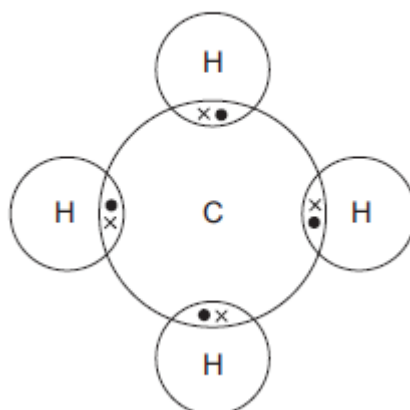
1. _____

2. _____

(2)

- (d) **Figure 4** shows how the atoms are bonded in methane.

Figure 4



(i) What is the formula for methane?

Tick (✓) **one** box.

C₄H

CH₄

C₄H₄

(1)

(ii) Methane has a low boiling point.

What does methane consist of?

Tick (✓) **one** box.

Charged ions

A giant lattice

Small molecules

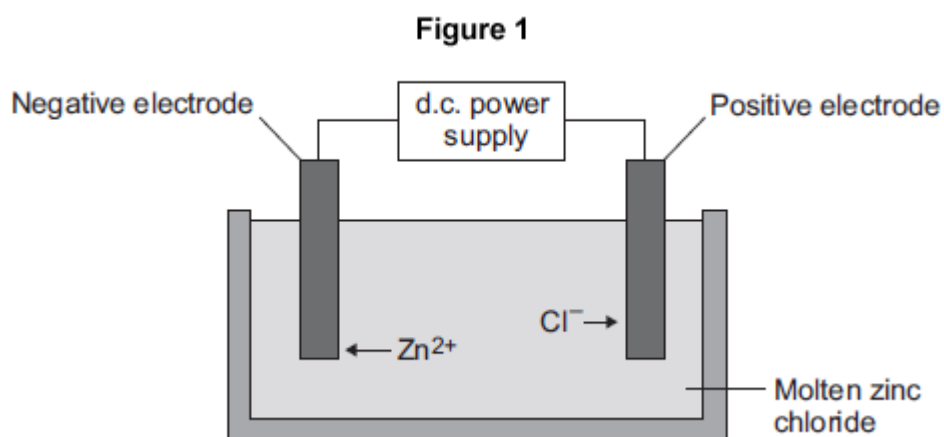
(1)

(Total 11 marks)

Q13.

This question is about zinc.

Figure 1 shows the electrolysis of molten zinc chloride.



(a) Zinc chloride is an ionic substance.
Complete the sentence.

When zinc chloride is molten, it will conduct _____.

(1)

(b) Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

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

(1)

(ii) Explain why zinc ions move towards the negative electrode.

(2)

(iii) What type of reaction occurs when the zinc ions gain electrons?

Tick (✓) **one** box.

Neutralisation

Oxidation

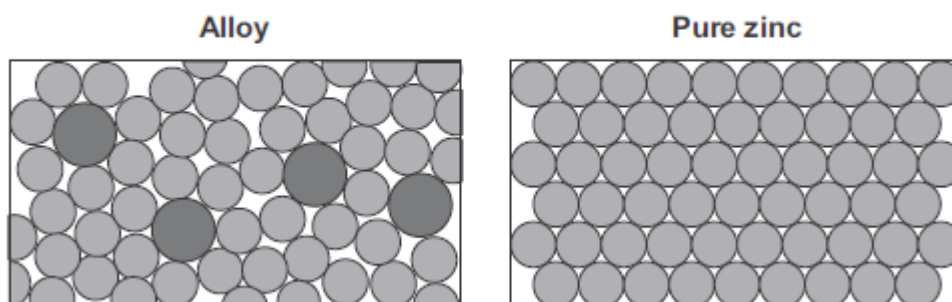
Reduction

(1)

(c) Zinc is mixed with copper to make an alloy.

(i) **Figure 2** shows the particles in the alloy and in pure zinc.

Figure 2



Use **Figure 2** to explain why the alloy is harder than pure zinc.

(2)

(ii) Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

(1)
(Total 8 marks)

Q14.

This question is about atoms, molecules and nanoparticles.

(a) Different atoms have different numbers of sub-atomic particles.

(i) An oxygen atom can be represented as $^{16}_8\text{O}$

Explain why the mass number of this atom is 16.

You should refer to the numbers of sub-atomic particles in the nucleus of the atom.

(2)

(ii) Explain why $^{12}_6\text{C}$ and $^{14}_6\text{C}$ are isotopes of carbon.

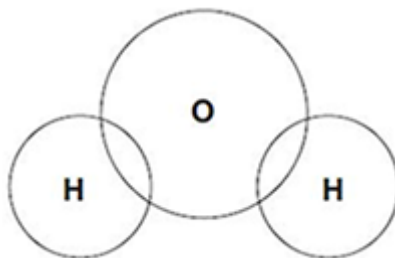
You should refer to the numbers of sub-atomic particles in the nucleus of each isotope.

(3)

(b) Hydrogen atoms and oxygen atoms chemically combine to produce water molecules.

(i) Complete the figure below to show the arrangement of the outer shell electrons of the hydrogen and oxygen atoms in a molecule of water.

Use dots (•) or crosses (×) to represent the electrons.



(2)

(ii) Name the type of bonding in a molecule of water.

(1)

(iii) Why does pure water **not** conduct electricity?

(1)

(c) Nanoparticles of cobalt oxide can be used as catalysts in the production of hydrogen from water.

(i) How does the size of a nanoparticle compare with the size of an atom?

(1)

(ii) Suggest **one** reason why 1 g of cobalt oxide nanoparticles is a better catalyst than 1g of cobalt oxide powder.

(1)

(Total 11 marks)

Q15.

This question is about magnesium and magnesium chloride.

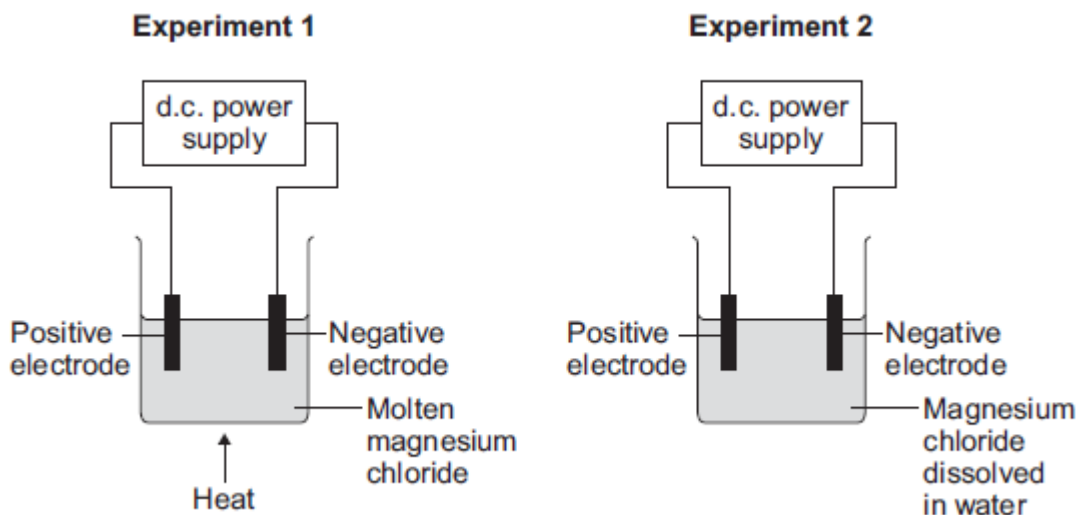
(a) Magnesium chloride contains magnesium ions (Mg^{2+}) and chloride ions (Cl^-).

Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.

(4)

(b) Magnesium chloride can be electrolysed.

The diagram below shows two experiments for electrolysing magnesium chloride.



(i) Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

(2)

(ii) Explain how magnesium is produced at the negative electrode in **Experiment 1**.

(3)

(iii) In **Experiment 2** a gas is produced at the negative electrode. Name the gas produced at the negative electrode.

(1)

- (iv) Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

(1)

- (v) Complete and balance the half equation for the reaction at the positive electrode.



(1)

- (c) Magnesium is a metal.

Explain why metals can be bent and shaped.

(2)

(Total 14 marks)

Q16.

This question is about the properties and uses of materials.

Use your knowledge of structure and bonding to answer the questions.

- (a) Explain how copper conducts electricity.

(2)

- (b) Explain why diamond is hard.

(2)

- (c) Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

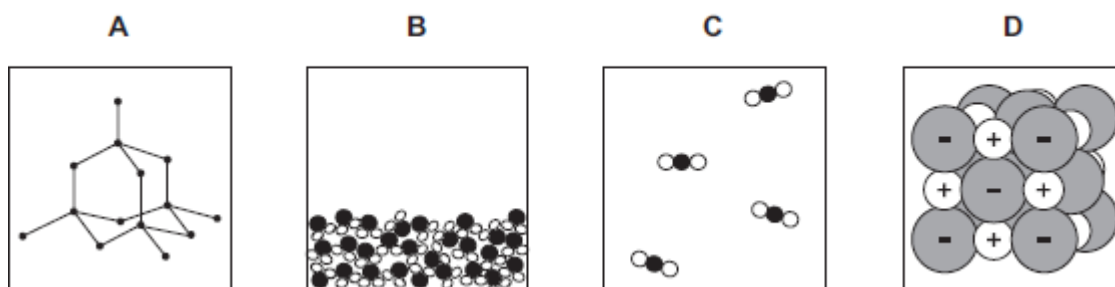
(2)

(Total 6 marks)

Q17.

The structures of four substances, **A**, **B**, **C** and **D**, are represented in **Figure 1**.

Figure 1



- (a) Use the correct letter, **A**, **B**, **C** or **D**, to answer each question.

- (i) Which substance is a gas?

(1)

- (ii) Which substance is a liquid?

(1)

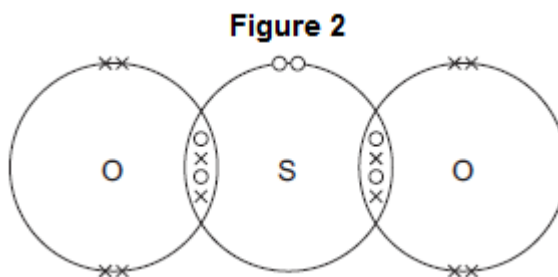
- (iii) Which substance is an element?

(1)

- (iv) Which substance is made of ions?

(1)

(b) **Figure 2** shows the bonding in substance **C**.



(i) What is the formula of substance **C**?

Draw a ring around the correct answer.

SO₂ **SO²** **S₂O**

(1)

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

delocalised	shared	transferred
--------------------	---------------	--------------------

When a sulfur atom and an oxygen atom bond to produce substance **C**, electrons are _____

(1)

(iii) What is the type of bonding in substance **C**?

Draw a ring around the correct answer.

covalent **ionic** **metallic**

(1)

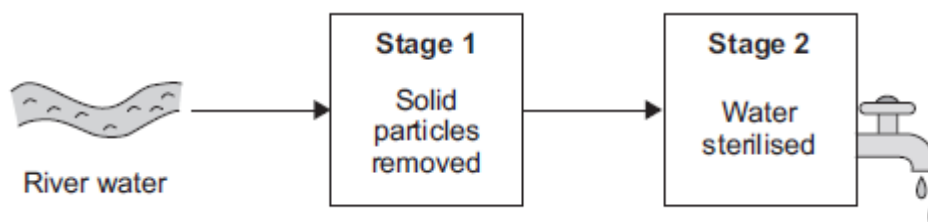
(Total 7 marks)

Q18.

This question is about water.

River water needs to be treated before it is safe to drink.

(a) The diagram shows two stages of the treatment of river water.



(i) What is the name of the process used to remove solid particles in **Stage 1**?

Tick (✓) **one** box.

- Crystallisation
- Fermentation
- Filtration

(1)

(ii) What is added in **Stage 2** to sterilise the water?

Tick (✓) **one** box.

- Chlorine
- Fluoride
- Potassium

(1)

(b) Toxic substances in river water are removed by adding very small amounts of iron oxide nanoparticles.

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

(1)

(ii) Nanoparticles are needed in only very small amounts.

Suggest why.

(1)

(c) In certain areas of the UK, tap water contains aluminium ions.

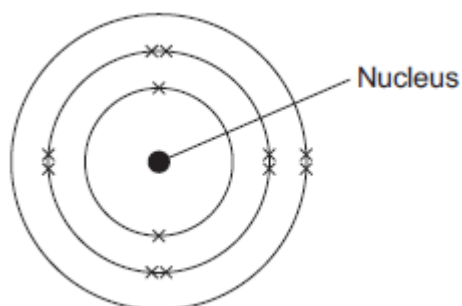
What would you **see** when sodium hydroxide solution is added drop by drop to tap water containing aluminium ions?

(2)
(Total 6 marks)

Q19.

This question is about magnesium.

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



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

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

The nucleus contains protons and _____

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

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

(3)

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

Which diagram shows a magnesium ion?

Tick (✓) **one** box.

 <input type="checkbox"/>	 <input type="checkbox"/>	 <input type="checkbox"/>
------------------------------	------------------------------	------------------------------

(1)

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



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

1. _____

2. _____

(2)

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

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

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

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

(6)

(Total 12 marks)

Q20.

This question is about copper.

- (a) Copper can be extracted by smelting copper-rich ores in a furnace.

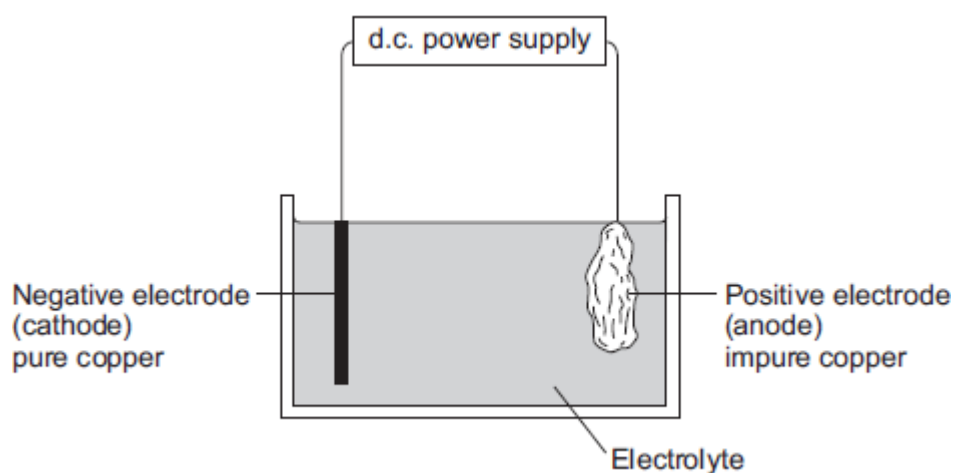
The equation for one of the reactions in the smelting process is:



Explain why there would be an environmental problem if sulfur dioxide gas escaped into the atmosphere.

(2)

- (b) The impure copper produced by smelting is purified by electrolysis, as shown below.



Copper atoms are oxidised at the positive electrode to Cu^{2+} ions, as shown in the half equation.



- (i) How does the half equation show that copper atoms are oxidised?

(1)

- (ii) The Cu^{2+} ions are attracted to the negative electrode, where they are reduced to produce copper atoms.

Write a balanced half equation for the reaction at the negative electrode.

(1)

- (iii) Suggest a suitable electrolyte for the electrolysis.

(1)

- (c) Copper metal is used in electrical appliances.

Describe the bonding in a metal, and explain why metals conduct electricity.

(4)

- (d) Soil near copper mines is often contaminated with low percentages of copper compounds.

Phytomining is a new way to extract copper compounds from soil.

Describe how copper compounds are extracted by phytomining.

(3)

- (e) A compound in a copper ore has the following percentage composition by mass:

55.6% copper, 16.4% iron, 28.0% sulfur.

Calculate the empirical formula of the compound.

Relative atomic masses (A_r): S = 32; Fe = 56; Cu = 63.5

You must show all of your working.

Empirical formula = _____

(4)
(Total 16 marks)

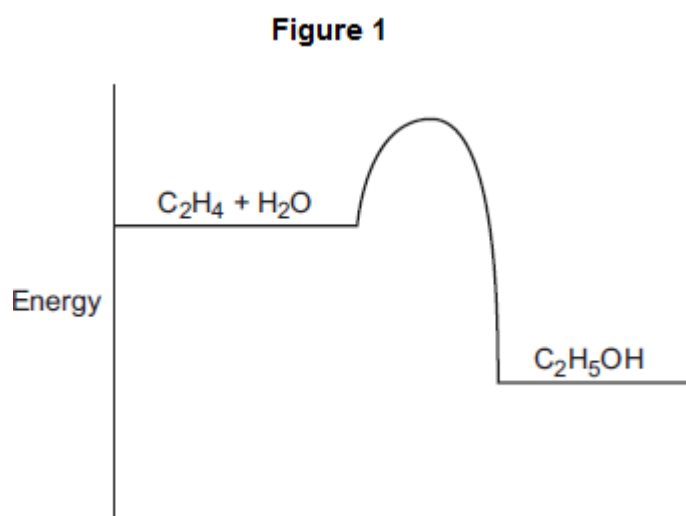
Q21.

This question is about ethanol.

- (a) Ethanol is produced by the reaction of ethene and steam:



- (i) **Figure 1** shows the energy level diagram for the reaction.



How does the energy level diagram show that the reaction is exothermic?

(1)

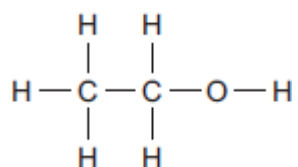
- (ii) A catalyst is used for the reaction.

Explain how a catalyst increases the rate of the reaction.

(2)

- (b) **Figure 2** shows the displayed structure of ethanol.

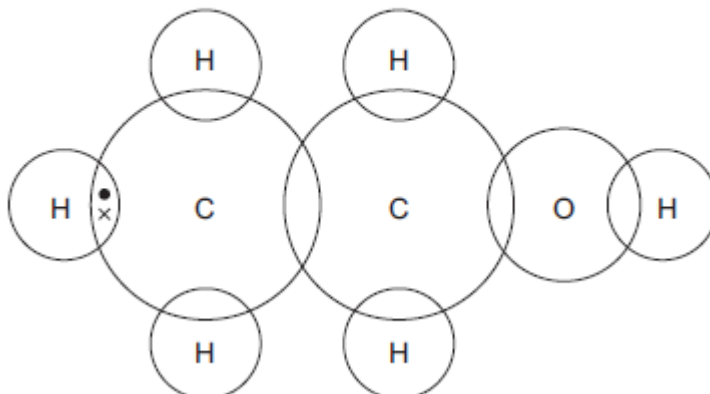
Figure 2



Complete the dot and cross diagram in **Figure 3** to show the bonding in ethanol.

Show the outer shell electrons only.

Figure 3

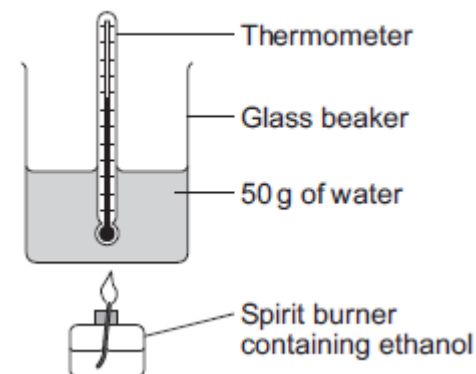


(2)

- (c) A student burned some ethanol.

Figure 4 shows the apparatus the student used.

Figure 4



- (i) The student recorded the temperature of the water before and after heating. His results are shown in **Table 1**.

Table 1

Temperature before heating	20.7 °C
Temperature after heating	35.1 °C

Calculate the energy used to heat the water.

Use the equation $Q = m \times c \times \Delta T$

The specific heat capacity of water = $4.2 \text{ J / g / }^\circ\text{C}$

Energy used = _____ J

(3)

- (ii) **Table 2** shows the mass of the spirit burner before the ethanol was burned and after the ethanol was burned.

Table 2

Mass of spirit burner before ethanol was burned	72.80 g
Mass of spirit burner after ethanol was burned	72.10 g

Calculate the number of moles of ethanol ($\text{C}_2\text{H}_5\text{OH}$) that were burned.

Relative atomic masses (A_r): H = 1; C = 12; O = 16

Number of moles burned = _____

(3)

- (iii) Calculate the energy released in joules per mole.

You should assume that all the energy from the ethanol burning was used to heat the water.

Energy = _____ J / mole

(1)

- (d) The names, structures and boiling points of ethanol and two other alcohols are shown in **Table 3**.

Table 3

Name	Methanol	Ethanol	Propanol
Structure	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{O}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$
Boiling point in °C	65	78	97

Use your knowledge of structure and bonding to suggest why the boiling points increase as the number of carbon atoms increases.

(3)
(Total 15 marks)

Q22.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

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

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

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

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

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

Tick (✓) **one** box.

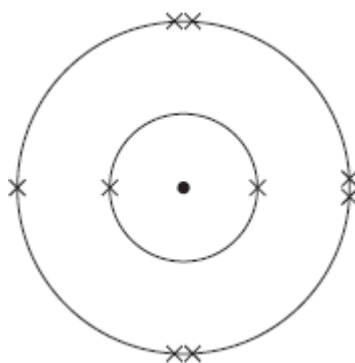
In order of increasing atomic number

In order of increasing mass number

In order of increasing reactivity

(1)

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



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

Tick (✓) **one** box.

2

7

9

(1)

(ii) The boiling point of fluorine is $-188\text{ }^{\circ}\text{C}$.

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

Solid

Liquid

Gas

(1)

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

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

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

(2)

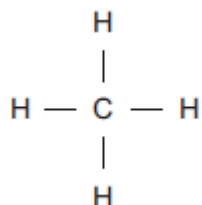
(ii) Describe a chemical test which would show that a solution contains copper(II) ions.

(2)
(Total 9 marks)

Q23.

Methane (CH₄) is used as a fuel.

- (a) The displayed structure of methane is:



Draw a ring around a part of the displayed structure that represents a covalent bond.

(1)

- (b) Why is methane a compound?

Tick (✓) **one** box.

Methane contains atoms of two elements, combined chemically.

Methane is not in the periodic table.

Methane is a mixture of two different elements.

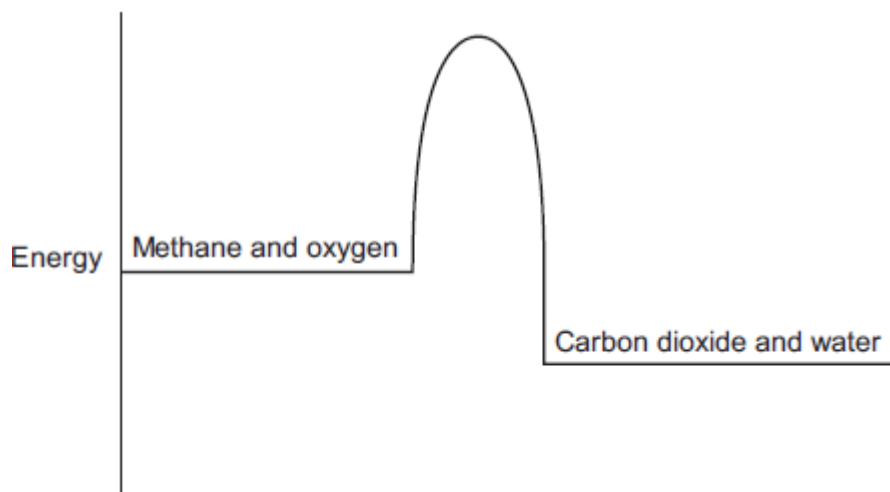
(1)

- (c) Methane burns in oxygen.

- (i) The diagram below shows the energy level diagram for the complete combustion of methane.

Draw and label arrows on the diagram to show:

- the activation energy
- the enthalpy change, ΔH .



(2)

- (ii) Complete and balance the symbol equation for the complete combustion of methane.



(2)

- (iii) Explain why the **incomplete** combustion of methane is dangerous.

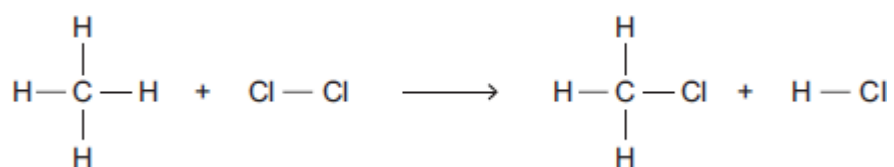
(2)

- (iv) Explain why, in terms of the energy involved in bond breaking and bond making, the combustion of methane is exothermic.

(3)

- (d) Methane reacts with chlorine in the presence of sunlight.

The equation for this reaction is:



Some bond dissociation energies are given in the table.

Bond	Bond dissociation energy in kJ per mole
C-H	413
C-Cl	327
Cl-Cl	243
H-Cl	432

- (i) Show that the enthalpy change, ΔH , for this reaction is -103 kJ per mole.

(3)

- (ii) Methane also reacts with bromine in the presence of sunlight.



This reaction is less exothermic than the reaction between methane and chlorine.

The enthalpy change, ΔH , is -45 kJ per mole.

What is a possible reason for this?

Tick (✓) **one** box.

CH_3Br has a lower boiling point than CH_3Cl

The C-Br bond is weaker than the C-Cl bond.

The H-Cl bond is weaker than the H-Br bond.

Chlorine is more reactive than bromine.

(1)
(Total 15 marks)

Q24.

This question is about salts.

- (a) Salt (sodium chloride) is added to many types of food.

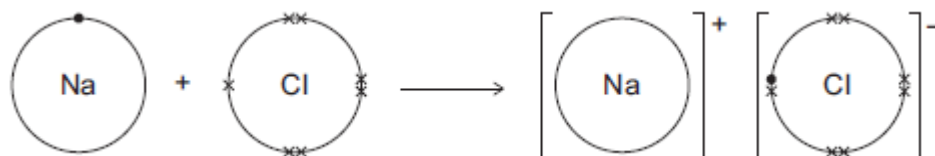
Sodium chloride is produced by reacting sodium with chlorine.



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

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

Only the outer electrons are shown.



Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

(3)

- (b) Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

- (i) Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

Tick (✓) **one** box.

Have no overall electric charge

Have high boiling points

Have giant covalent structures

(1)

(ii) Which one of the following questions cannot be answered by science alone?

Tick (✓) **one** box.

How much sodium chloride is in food?

What harm does a lack of iodine do?

Should iodine be added to salt in food?

Give **one** reason why this question cannot be answered by science alone.

(2)

(c) A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

(i) Name the acid used.

(1)

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

an acid	an alkali	a salt
----------------	------------------	---------------

Ammonia solution (ammonium hydroxide) is _____ .

(1)

(iii) The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

The solution added is an _____ .

(1)

(d) Farmers buy solid ammonium nitrate in poly(ethene) sacks.

(i) How is solid ammonium nitrate made from a solution of ammonium nitrate?

Tick (✓) **one** box.

Crystallisation

Decomposition

Electrolysis

(1)

(ii) Why do farmers use ammonium nitrate on their fields?

(1)

(iii) The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

(1)

(Total 12 marks)

Q25.

This question is about electrolysis.

(a) Metal spoons can be coated with silver.
This is called electroplating.

Suggest **one** reason why spoons are electroplated.

(1)

(b) When sodium chloride solution is electrolysed the products are hydrogen and chlorine.

(i) What is made from chlorine?

Tick (✓) **one** box.

Bleach	<input type="checkbox"/>
Fertiliser	<input type="checkbox"/>
Soap	<input type="checkbox"/>

(1)

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

Why is hydrogen produced at the negative electrode and **not** sodium?

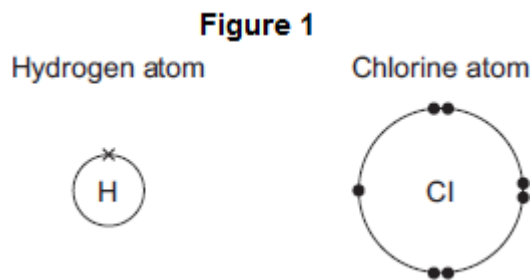
Tick (✓) **one** box.

Hydrogen is a gas.	<input type="checkbox"/>
Hydrogen is less reactive than sodium.	<input type="checkbox"/>
Hydrogen ions move faster than sodium ions.	<input type="checkbox"/>

(1)

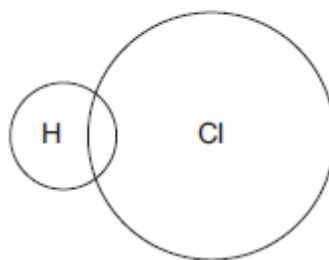
- (iii) Hydrogen and chlorine can be used to produce hydrogen chloride.

The diagrams in **Figure 1** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.



Complete **Figure 2** to show how the outer electrons are arranged in a molecule of hydrogen chloride (HCl).

Figure 2



(1)

(iv) What is the type of bond in a molecule of hydrogen chloride?

Tick (✓) **one** box.

Covalent

Ionic

Metallic

(1)

(v) Why is hydrogen chloride a gas at room temperature (20 °C)?

Tick (✓) **two** boxes.

Hydrogen chloride has a low boiling point.

Hydrogen chloride has a high melting point.

Hydrogen chloride is made of simple molecules.

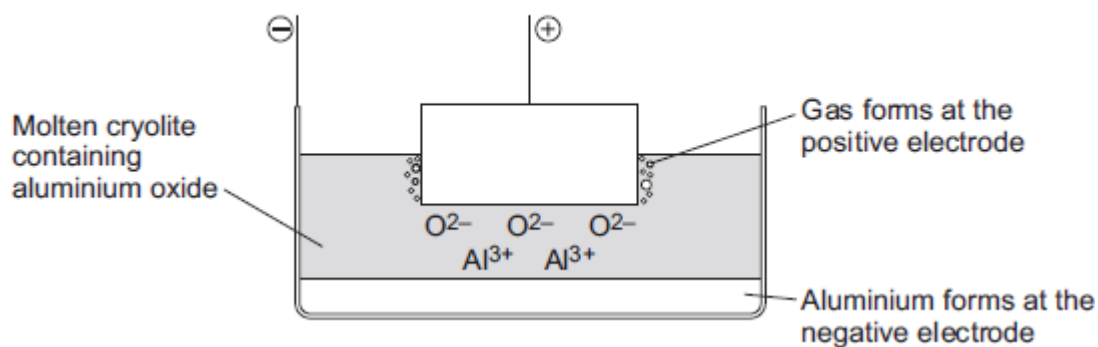
Hydrogen chloride does not conduct electricity.

Hydrogen chloride has a giant structure.

(2)

(c) Aluminium is produced by electrolysis of a molten mixture of aluminium oxide and cryolite.
This is shown in **Figure 3**.

Figure 3



- (i) Name a gas produced at the positive electrode.

(1)

- (ii) Aluminium ions move to the negative electrode.

Explain why.

(2)

- (iii) At the negative electrode, the aluminium ions gain electrons to produce aluminium.

What is this type of reaction called?

Tick (✓) **one** box.

Combustion

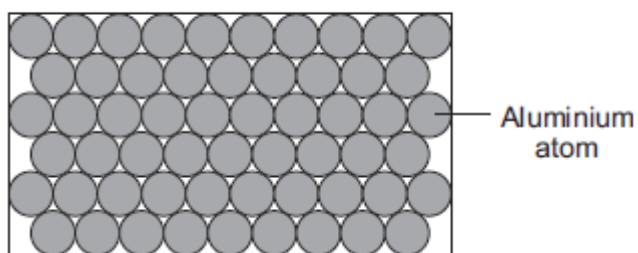
Oxidation

Reduction

(1)

- (iv) Aluminium has layers of atoms, as shown in **Figure 4**.

Figure 4



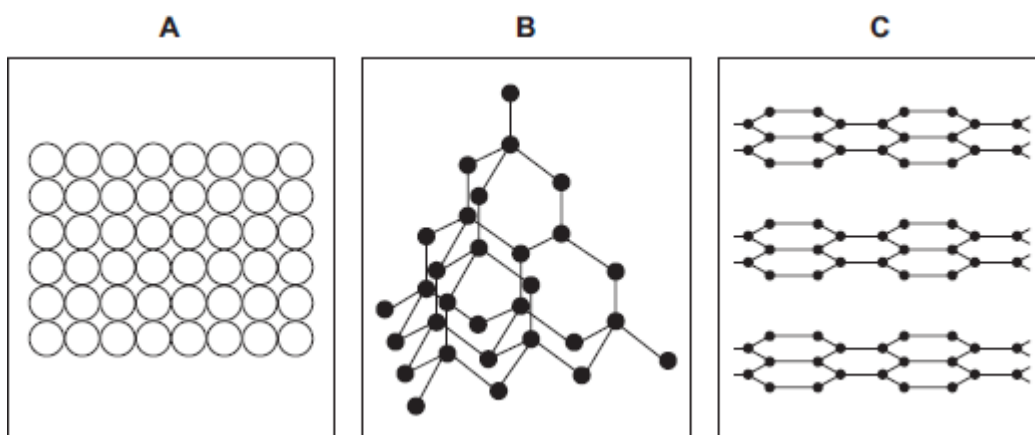
Complete the sentence.

Metals can be bent and shaped because the layers of atoms can ____

(1)

(d) Electrodes used in the production of aluminium are made from graphite.

(i) Which diagram, **A**, **B** or **C**, shows the structure of graphite?



The structure of graphite is shown in diagram



(1)

(ii) The temperature for the electrolysis is 950 °C.

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

cross links **a giant ionic lattice** **strong covalent bonds**

The graphite does not melt at 950 °C because

graphite has _____.

(1)

(Total 14 marks)

Q26.

This question is about metals and alloys.

(a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a

metal.

(4)

(b) Describe how the structure of an alloy is different from the structure of a pure metal.

(2)

(c) Alloys are used to make dental braces and coins.

(i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

(1)

(ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

(1)

(iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

Aluminium is manufactured by the electrolysis of a molten mixture of cryolite and

(1)

- (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

(1)

- (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

(1)

(Total 11 marks)

Q27.

This question is about compounds.

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

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from the table to answer these questions.

- (i) Name a soluble compound that contains silver ions.

(1)

- (ii) Name a soluble compound that contains carbonate ions.

(1)

- (b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

(1)

- (c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

(i) State how solid lead nitrate can be obtained from lead nitrate solution.

(1)

(ii) Balance the equation for the reaction.



(1)

(iii) Give the total number of atoms in the formula $\text{Pb}(\text{NO}_3)_2$

(1)

(d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (A_r): O = 16; Pb = 207

You must show your working to gain full marks.

Empirical formula = _____

(4)

(Total 10 marks)

Q28.

This question is about sodium chloride and iodine.

(a) Describe the structure and bonding in sodium chloride.

(4)

- (b) When sodium chloride solution is electrolysed, one product is chlorine.
Name the **two** other products from the electrolysis of sodium chloride solution.

(2)

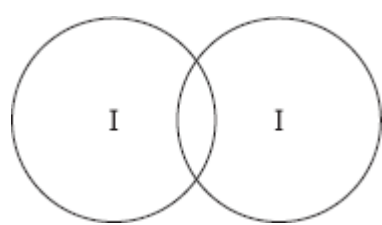
- (c) Many people do not have enough iodine in their diet.
Sodium chloride is added to many types of food. Some scientists recommend that sodium chloride should have a compound of iodine added.

Give **one** ethical reason why a compound of iodine should **not** be added to sodium chloride used in food.

(1)

- (d) The bonding in iodine is similar to the bonding in chlorine.
(i) Complete the diagram below to show the bonding in iodine.

Show the outer electrons only.



(2)

- (ii) Explain why iodine has a low melting point.

(3)

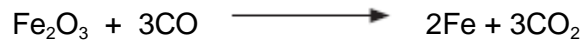
- (iii) Explain, in terms of particles, why liquid iodine does not conduct electricity.

(2)
(Total 14 marks)

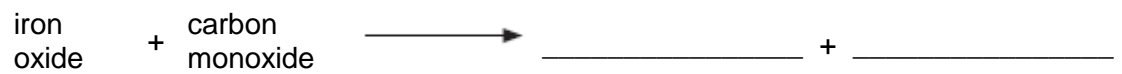
Q29.

Iron is extracted from iron oxide in the blast furnace.

(a) The equation for one of the reactions in the blast furnace is:



(i) Complete the word equation for this reaction.



(2)

(ii) Oxygen is removed from iron oxide in the blast furnace.

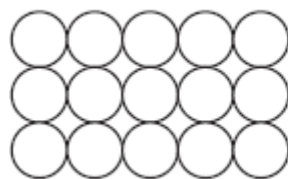
Draw a ring around the correct answer to complete the sentence.

The iron oxide is

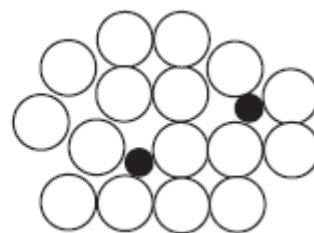
neutralised.
oxidised.
reduced.

(1)

(b) The diagrams represent pure iron and iron from the blast furnace.



Pure iron



Iron from the blast furnace

(i) Draw **one** line from each statement to the correct explanation.

Statement

Explanation

Pure iron is an element because

it is made of one sort of atom only.

it contains two elements not chemically combined.

Iron from the blast furnace is a mixture because

every atom has the same number of neutrons.

it contains two elements chemically combined.

(2)

(ii) Explain why iron from the blast furnace is harder than pure iron.

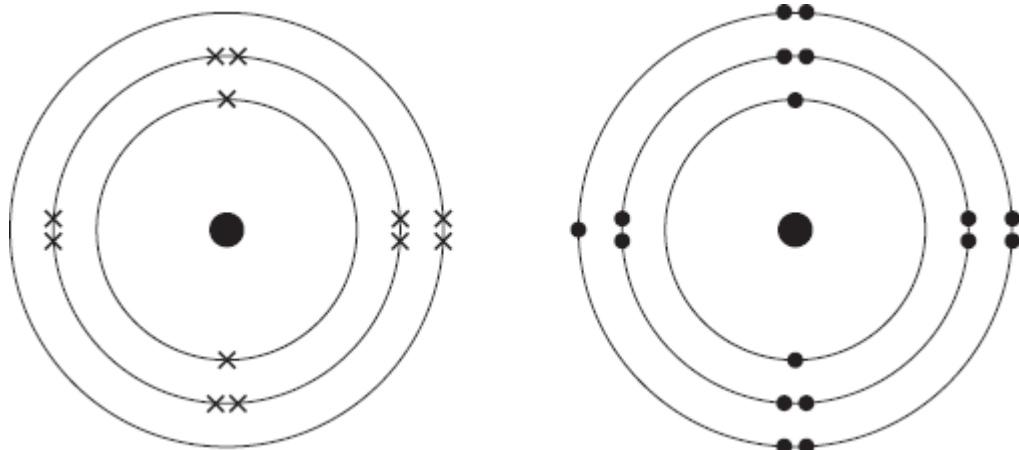
Use the diagrams on page 4 to help you.

(2)

(Total 7 marks)

Q30.

(a) The diagram shows an atom of magnesium and an atom of chlorine.



Magnesium

Chlorine

Describe, in terms of electrons, how magnesium atoms and chlorine atoms change into ions to produce magnesium chloride (MgCl_2).

(4)

(b) Calculate the relative formula mass (M_r) of magnesium chloride (MgCl_2).

Relative atomic masses (A_r): magnesium = 24; chlorine = 35.5

Relative formula mass (M_r) = _____

(2)

(Total 6 marks)

Q31.

The article gives some information about graphene.



Carbon can be made into nano-thin, strong sheets called graphene.

A graphene sheet is a single layer of graphite.

Graphene conducts electricity and is used in loudspeakers.

The picture shows the structure of graphene.



(a) Use the picture and your knowledge of bonding in graphite to:

(i) explain why graphene is strong;

(3)

(ii) explain why graphene can conduct electricity.

(2)

(b) Graphite is made up of layers of graphene.

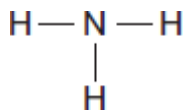
Explain why graphite is a lubricant.

(2)

(Total 7 marks)

Q32.

- (a) A particle of ammonia is represented by the formula NH_3 or as:



- (i) How many different elements are there in a particle of ammonia?

(1)

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

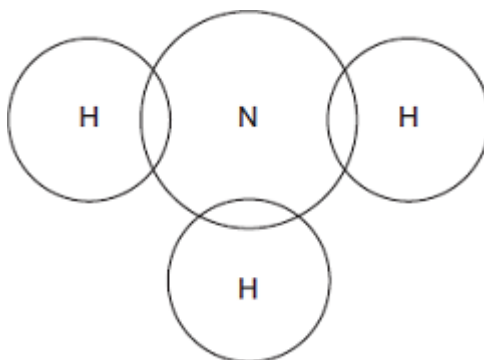
A particle of ammonia is called

an atom.
an ion.
a molecule.

(1)

- (iii) Complete the dot and cross bonding diagram for ammonia.

Show **only** electrons in the outer energy level of each atom.

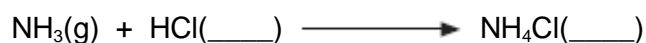


(2)

- (b) Ammonia gas reacts with hydrogen chloride gas to produce a white solid.

The formula of the white solid is NH_4Cl

- (i) Complete the equation by adding the correct state symbols.



(1)

- (ii) The white solid has the formula NH_4Cl

Complete the name of the white solid.

Ammonium _____

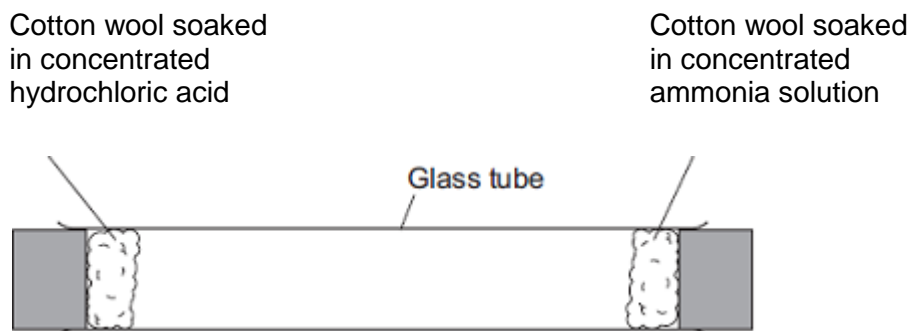
(1)

- (c) Concentrated ammonia solution gives off ammonia gas.

Concentrated hydrochloric acid gives off hydrogen chloride gas.

Apparatus was set up as shown in **Diagram 1**.

Diagram 1



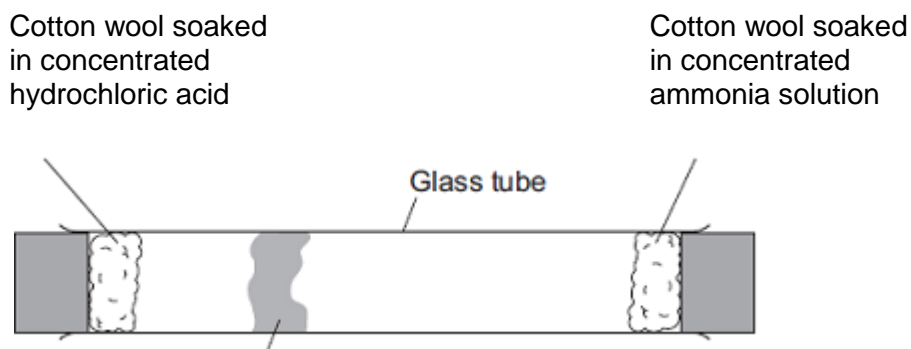
- (i) Concentrated hydrochloric acid is corrosive.

Give **one** safety precaution you should take when using concentrated hydrochloric acid.

(1)

- (ii) After 3 minutes a white solid was seen in the glass tube, as shown in **Diagram 2**.

Diagram 2



Suggest why the white solid is seen nearer the concentrated hydrochloric acid than the concentrated ammonia.

(1)

- (iii) The experiment was repeated at a higher temperature.

Explain why the white solid was produced in less than 3 minutes.

(2)
(Total 10 marks)

Q33.

Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide, SO₂

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

Tick (✓) **one** box.

Sulfur dioxide causes acid rain.

Sulfur dioxide causes global dimming.

Sulfur dioxide causes global warming.

(1)

(b) Sulfur dioxide dissolves in water.

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

(2)

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

The bonding in sulfur dioxide is covalent.

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

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

Sulfur dioxide is produced when fossil fuels are burned.

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

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

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

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

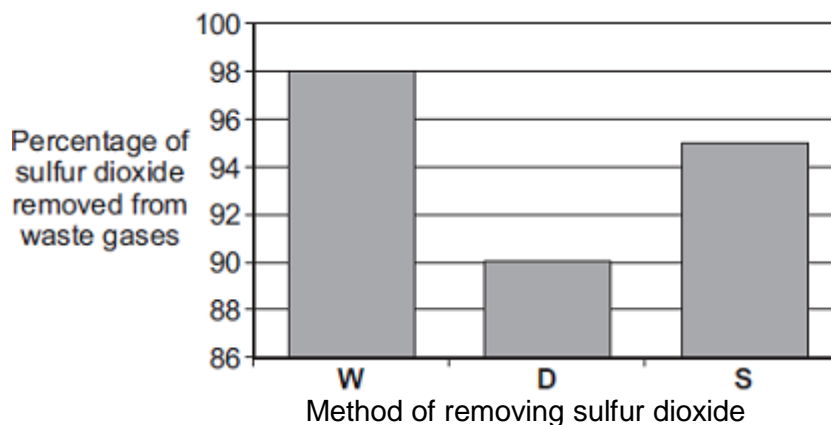


Table 1

Method	Material used	How material is obtained
W	Calcium carbonate, CaCO ₃	Quarrying
D	Calcium oxide, CaO	Thermal decomposition of calcium carbonate: CaCO ₃ → CaO + CO ₂
S	Seawater	From the sea

Table 2

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

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

Compare the three methods and give a justified conclusion.

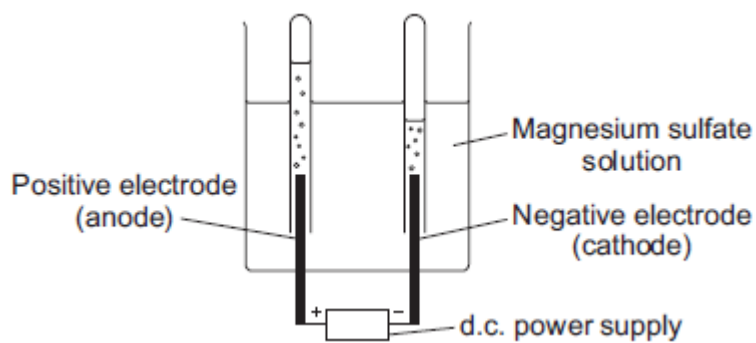
(6)

(Total 12 marks)

Q34.

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?

(1)

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

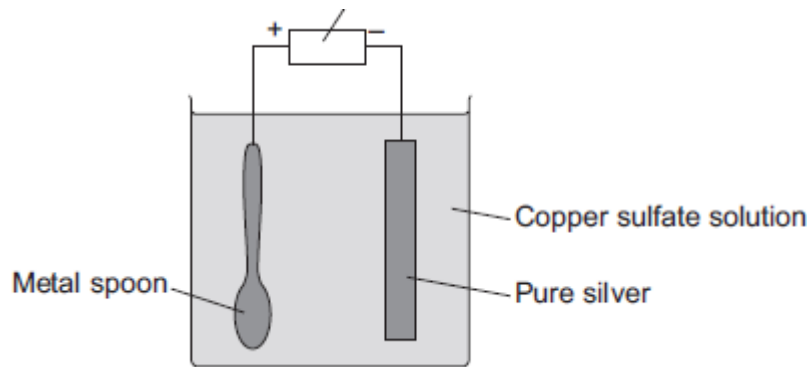
- (i) Give **one** reason why metal spoons are sometimes silver plated.

(1)

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

Diagram 2

d.c. power
supply



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)

(Total 10 marks)

Q35.

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.

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.

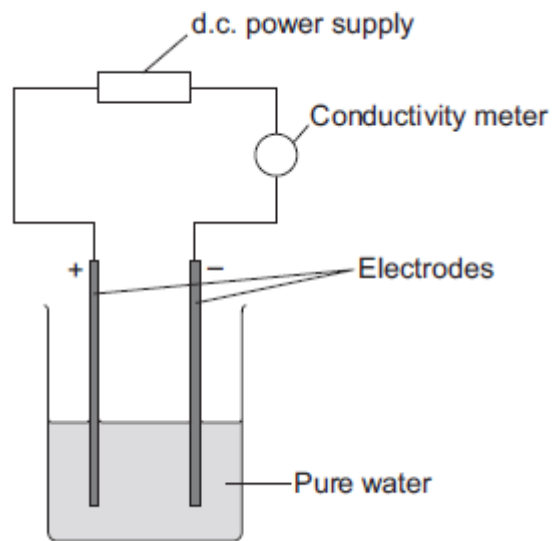
(4)
(Total 11 marks)

Q36.

A student investigated the conductivity of different concentrations of sodium chloride solution.

The student set the apparatus up as shown in **Figure 1**.

Figure 1



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

The reading on the conductivity meter was zero.

(a) The student:

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

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

Number of drops of sodium chloride solution added	Relative conductivity of solution
0	0
1	100
2	120
3	310

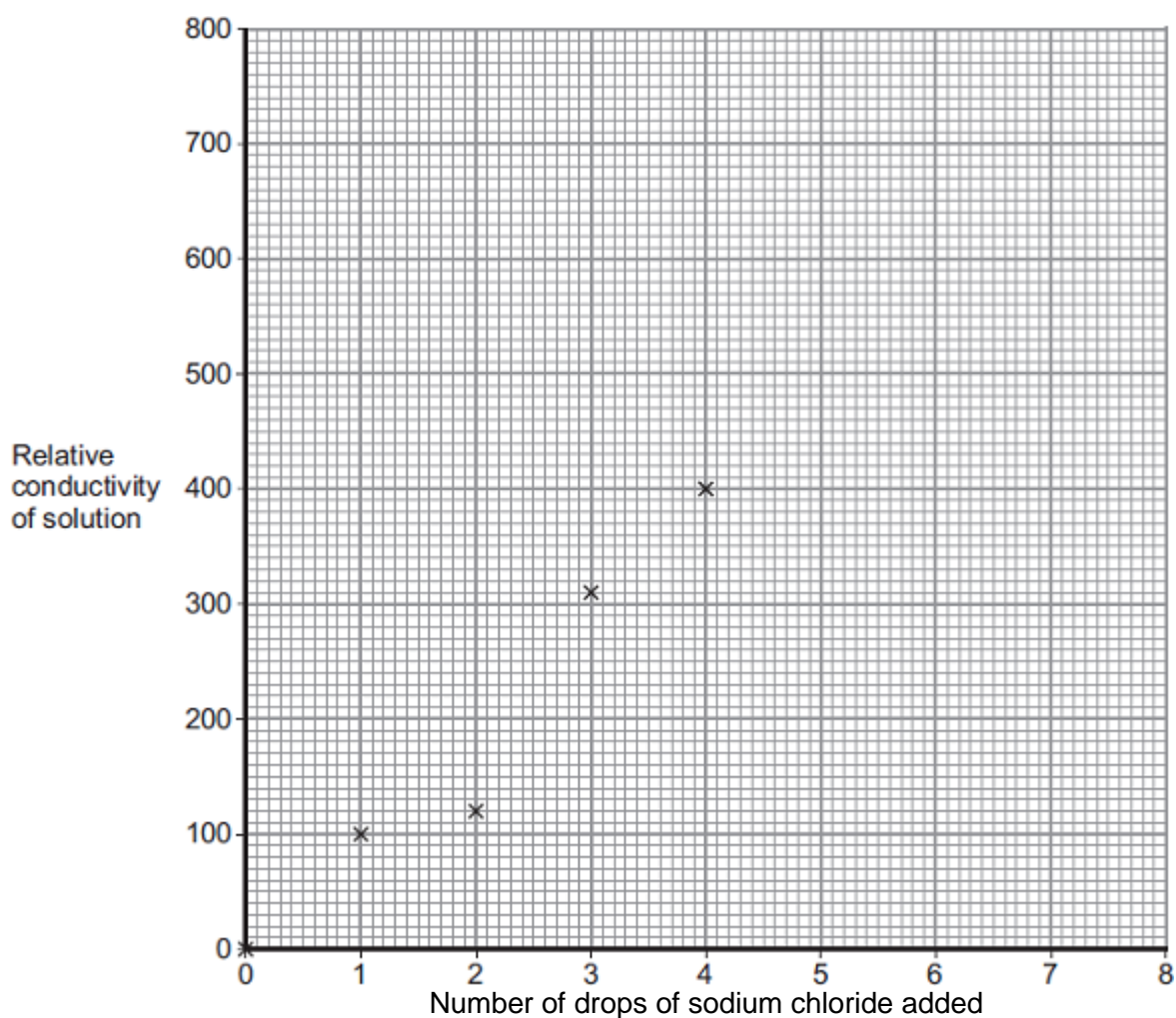
4	400
5	510
6	590
7	710
8	800

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

Plot the four remaining results.

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

Figure 2



(3)

(ii) One of the points is anomalous.

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

(1)

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

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

(1)

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

(2)

- (ii) Explain why sodium chloride solution conducts electricity.

(2)

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

Complete the sentence.

The gas produced at the negative electrode is _____

(1)

(Total 10 marks)

Q37.

This question is about diamonds.

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

- (a) Diamonds are found in meteorites.
- (i) Meteorites get very hot when they pass through the Earth's atmosphere, but the diamonds do not melt.

Diamond has a

high
low
very low

 melting point.

(1)

(ii) Most diamonds found in meteorites are nanodiamonds.

A nanodiamond contains a few

hundred
thousand
million.

atoms

(1)

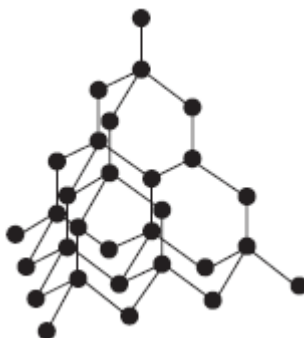
(b) Diamonds are used for the cutting end of drill bits.

Diamonds can be used for drill bits because they are

hard.
shiny.
soft.

(1)

(c) The figure below shows the arrangement of atoms in diamond.



(i) Diamond is made from

carbon
nitrogen
oxygen

atoms.

(1)

(ii) Each atom in diamond is bonded to

three
four
five

other atoms.

(1)

(iii) Diamond has a giant

covalent
ionic
metallic

structure.

(1)

(iv) In diamond

all
none
some

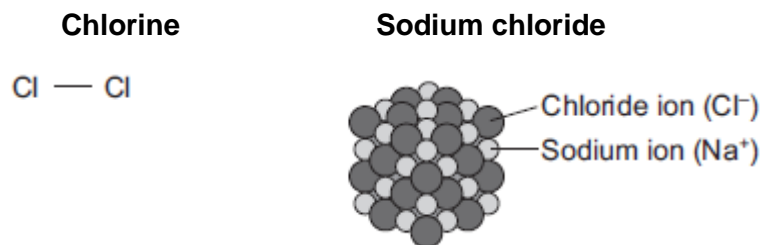
of the atoms are bonded together.

(1)

Q38.

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

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

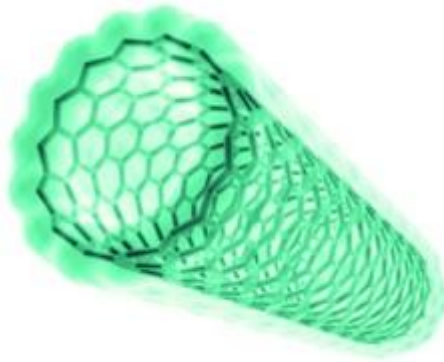


Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

Extra space

Q39.

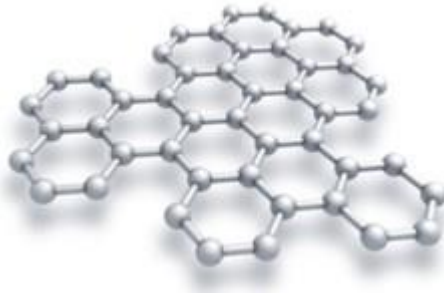
Carbon atoms are used to make nanotubes.



© Denis Nikolenko/Hemera/Thinkstock

Carbon atoms in a nanotube are bonded like a single layer of graphite.

The figure below shows the structure of a single layer of graphite.



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- (a) Suggest why carbon nanotubes are used as lubricants.

(2)

- (b) Explain why graphite can conduct electricity.

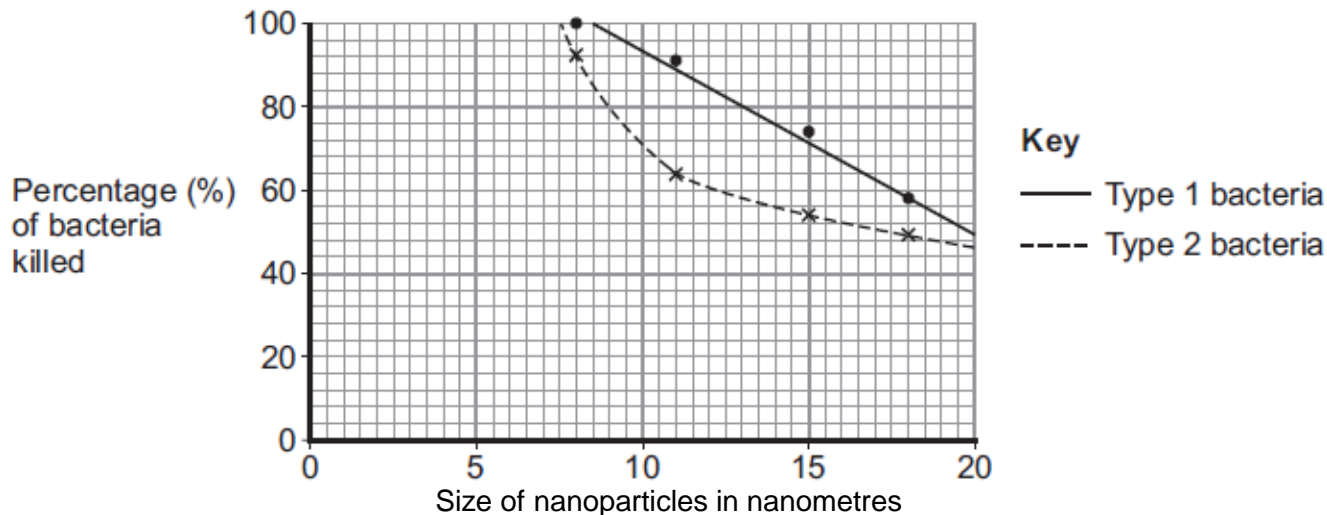
(2)

(Total 4 marks)

Q40.

Magnesium oxide nanoparticles can kill bacteria.

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



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

(2)

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

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

Give a reason for your answer.

(1)

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

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

(4)
(Total 7 marks)

Q41.

Glass is made from silicon dioxide.



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

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

Suggest why.

(1)

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

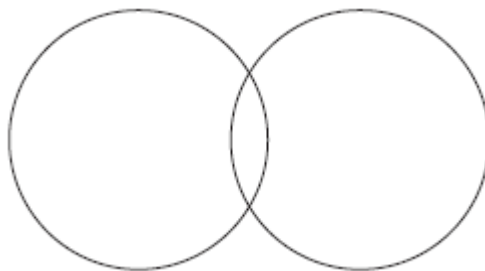
- (i) Sodium oxide contains Na^+ ions and O^{2-} ions.

Give the formula of sodium oxide.

(1)

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

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



(2)

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

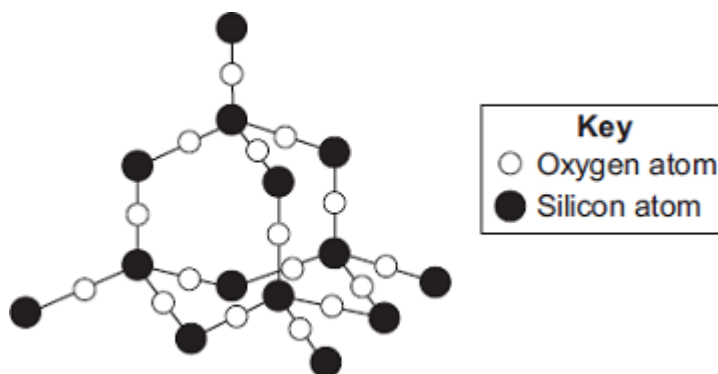
Describe the structure of a metal.

(3)

(Total 7 marks)

Q42.

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



(a) Use the diagram above to answer the question.

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

In silicon dioxide, each silicon atom is bonded with

- | |
|-------|
| two |
| three |
| four |

oxygen atoms.

ionic.

The bonds in silicon dioxide are

covalent.
metallic.

(2)

(b)



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Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

(1)

(c) Nanowires can be made from silicon dioxide.

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

The word 'nano' means the wires are very

brittle.

thick.

thin.

(1)

(Total 4 marks)

