AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.3 STRUCTURE AND BONDING OF CARBON

SCORE	PERCENTAGE
/225	%

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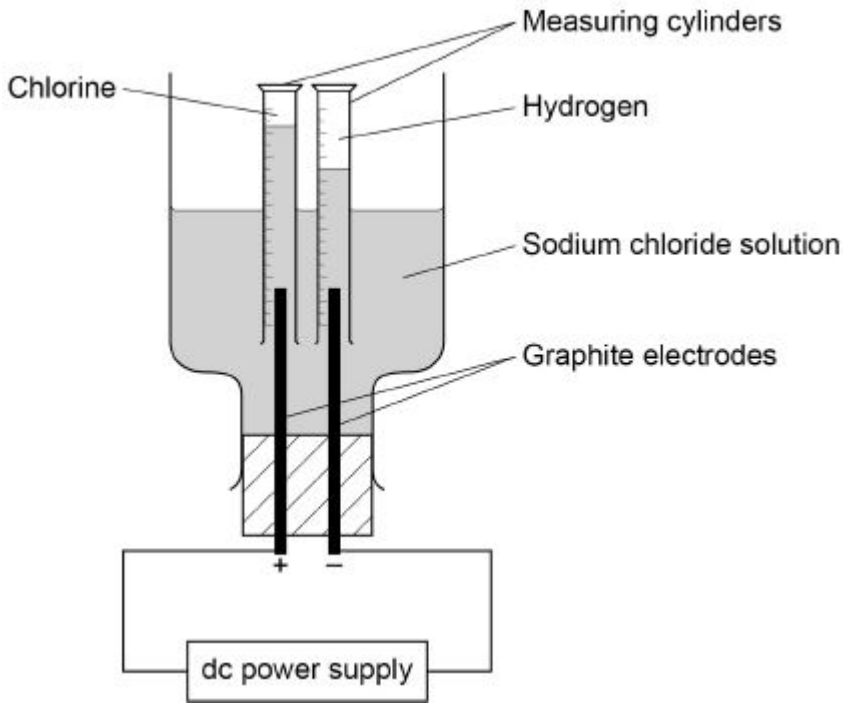
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Q1.

A student investigated the electrolysis of sodium chloride solution.

Figure 1 shows the apparatus.

Figure 1

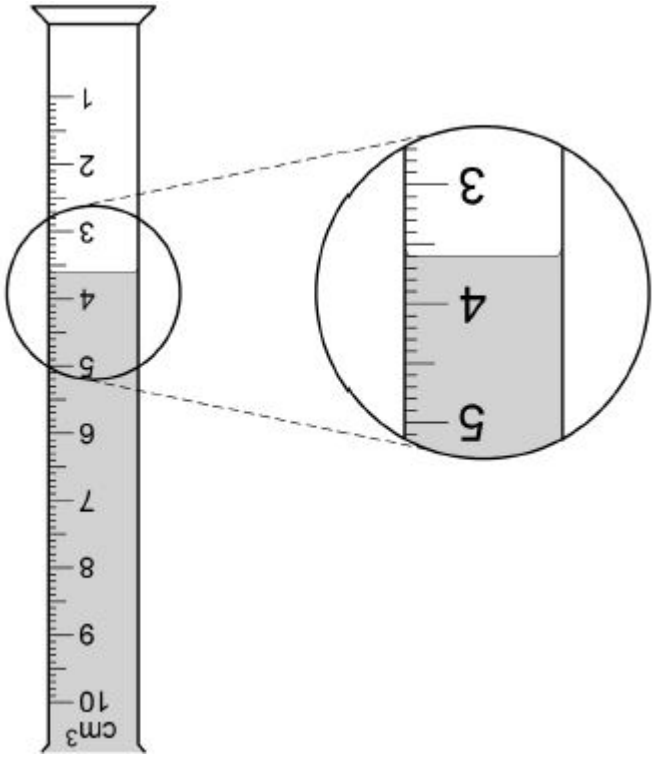


The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.

(a) **Figure 2** shows the volume of hydrogen gas collected in the measuring cylinder after 8 minutes.

Figure 2

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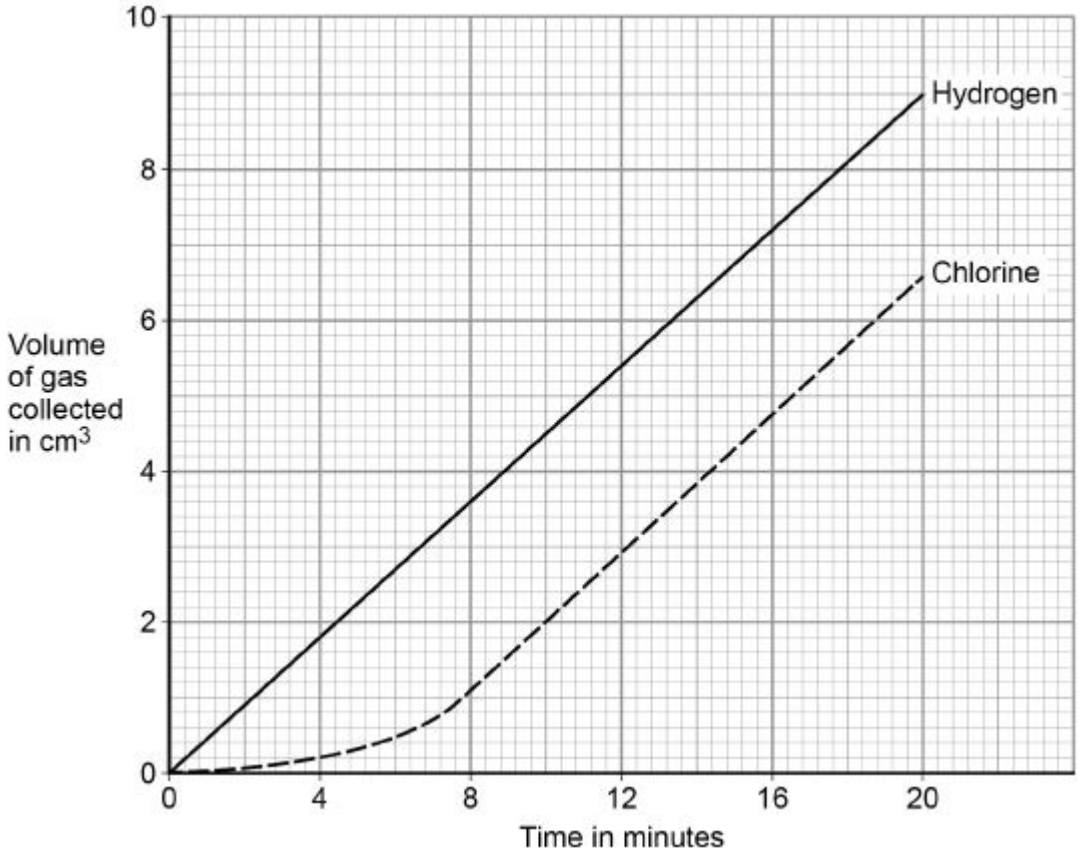
What is the volume of hydrogen gas collected?

Volume = _____ cm^3

(1)

Figure 3 shows the results of the investigation.

Figure 3



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(b) Which of the lines on **Figure 3** show that the volume of gas collected is directly proportional to the time?

Tick **one** box.

- Both lines ☐
- Chlorine line only ☐
- Hydrogen line only ☐
- Neither line ☐

(1)

(c) Which of the lines on **Figure 3** show a positive correlation between the volume of gas collected and time?

Tick **one** box.

- Both lines ☐
- Chlorine line only ☐
- Hydrogen line only ☐
- Neither line ☐

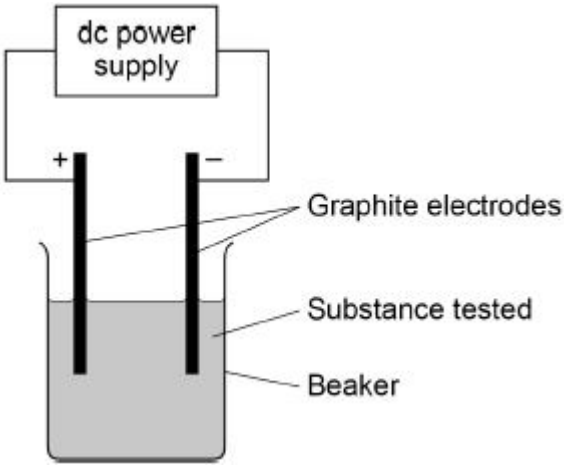
(1)

A teacher demonstrates the electrolysis of different substances using graphite electrodes.

Figure 4 shows the apparatus used.

Figure 4

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(d) Why can graphite conduct electricity?

Tick **one** box.

Graphite exists in layers of atoms. ☐

Graphite has a giant structure. ☐

Graphite has a high melting point. ☐

Graphite has delocalised electrons. ☐

(1)

(e) The teacher demonstrates the electrolysis of:

- molten zinc chloride
- potassium bromide solution.

Complete the table below to predict the products.

Choose answers from the box.

chlorine	**bromine**	**hydrogen**	**oxygen**	**potassium**	**zinc**

Substance electrolysed	**Product at cathode (negative electrode)**	**Product at anode (positive electrode)**
Molten zinc chloride		
Potassium bromide solution		

(4)

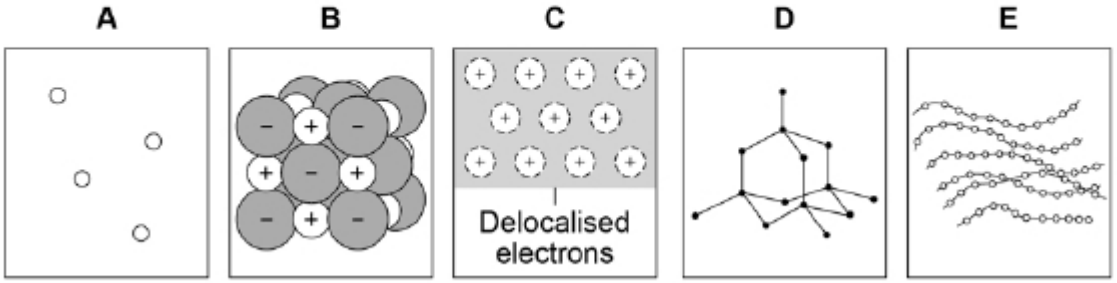
(Total 8 marks)

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Q2.

Figure 1 shows the structure of five substances.

Figure 1



(a) Which diagram shows a gas?

Tick (✔) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(b) Which diagram shows the structure of diamond?

Tick (✔) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(c) Which diagram shows a metallic structure?

Tick (✔) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(d) Which diagram shows a polymer?

Tick (✔) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(e) A chlorine atom has 7 electrons in the outer shell.

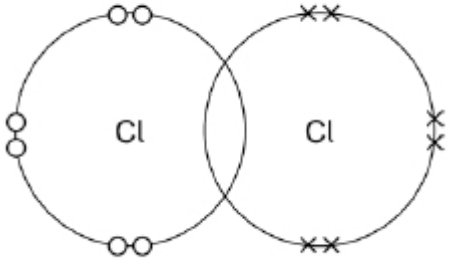
Two chlorine atoms covalently bond to form a chlorine molecule, Cl_2

Figure 2 is a dot and cross diagram showing the outer shells and some electrons in a chlorine molecule.

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Complete the dot and cross diagram.
Show only the electrons in the outer shell.

Figure 2



(1)

(f) What is the reason for chlorine's low boiling point?

Tick (✔) **one** box.

Strong covalent bonds ☐

Strong forces between molecules ☐

Weak covalent bonds ☐

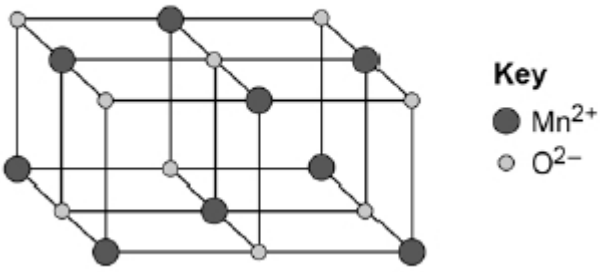
Weak forces between molecules ☐

(1)

Figure 3 represents the structure of manganese oxide.

Manganese oxide is an ionic compound.

Figure 3



(g) Determine the empirical formula of manganese oxide.

Use **Figure 3**.

_____

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_____

Empirical formula = _____

(1)

(h) Why does manganese oxide conduct electricity as a liquid?

Tick (✔) **one** box.

Atoms move around in the liquid	☐
Electrons move around in the liquid	☐
Ions move around in the liquid	☐
Molecules move around in the liquid	☐

(1)

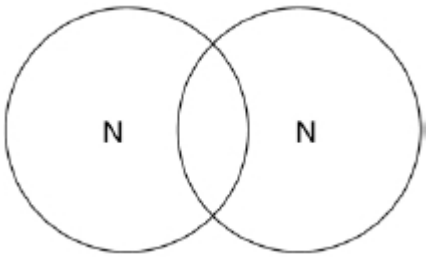
(Total 8 marks)

Q3.

This question is about structure and bonding.

(a) Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule, N_2

Show only the electrons in the outer shell.



(2)

(b) Explain why nitrogen is a gas at room temperature.

Answer in terms of nitrogen's structure.

_____

_____

_____

_____

_____

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_____

(3)

(c) Graphite and fullerenes are forms of carbon.

Graphite is soft and is a good conductor of electricity.

Explain why graphite has these properties.

Answer in terms of structure and bonding.

_____

_____

_____

_____

_____

_____

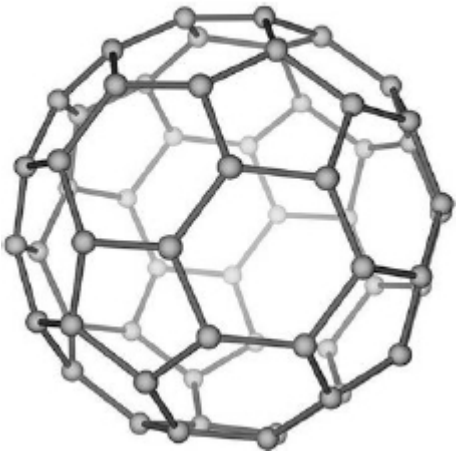
_____

_____

(4)

(d) **Figure 1** shows a model of a Buckminsterfullerene molecule.

Figure 1



A lubricant is a substance that allows materials to move over each other easily.

Suggest why Buckminsterfullerene is a good lubricant.

Use **Figure 1**.

_____

_____

_____

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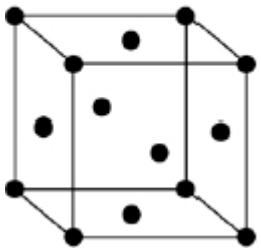
_____

(2)

Silver can form cubic nanocrystals.

Figure 2 represents a silver nanocrystal.

Figure 2



(e) A silver nanocrystal is a cube of side 20 nm

Calculate the surface area to volume ratio of the nanocrystal.

_____

_____

_____

_____

_____

Surface area to volume ratio = _____

(3)

(f) Silver nanoparticles are sometimes used in socks to prevent foot odour.

Suggest why it is cheaper to use nanoparticles of silver rather than coarse particles of silver.

_____

_____

_____

_____

(2)

(Total 16 marks)

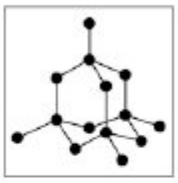
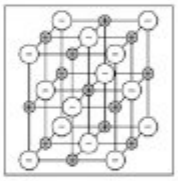
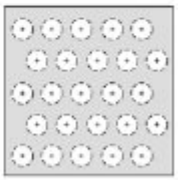
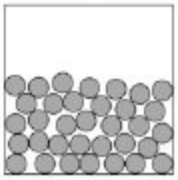
Q4.

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**

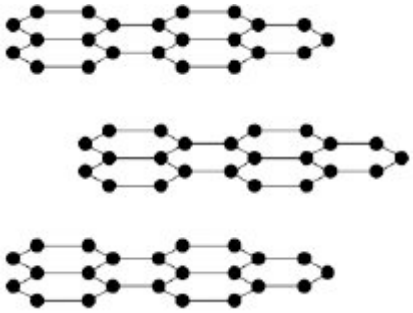
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The substance is a gas	
The substance is a liquid	
The substance is ionic	
The substance is a solid metal	
	

(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 ☐

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(1)

(c) Why does this element conduct electricity?

Tick **one** box.

It has delocalised electrons ☐

It contains hexagonal rings ☐

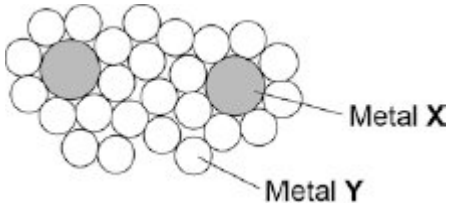
It has weak forces between the layers ☐

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 ☐

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Element ☐

Mixture ☐

(1)

(Total 11 marks)

Q5.

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



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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.

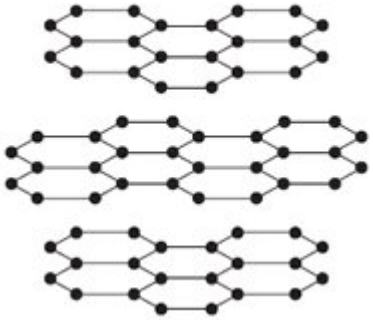
(1)

(b) Graphite is made of carbon atoms.

Figure 2 shows the structure of graphite.

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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)

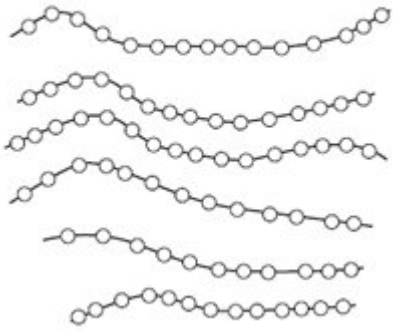
(c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

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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. _____

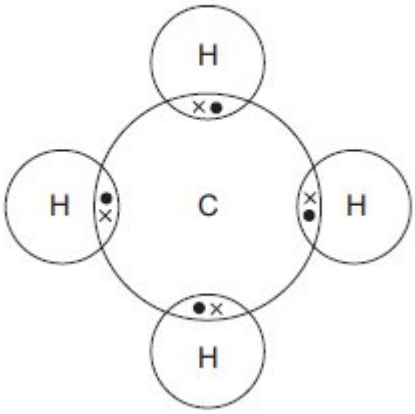
2. _____

(2)

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

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Figure 4



(i) What is the formula for methane?

Tick (✔) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

(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)

Q6.

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.

_____

_____

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_____

_____

_____

(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)

Q7.

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.

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Bleach ☐

Fertiliser ☐

Soap ☐

(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. ☐

Hydrogen is less reactive than sodium. ☐

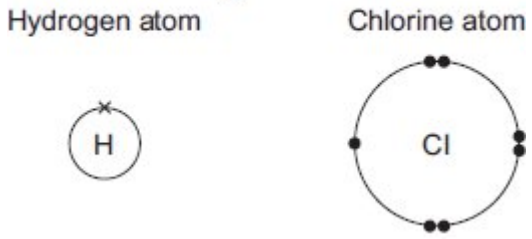
Hydrogen ions move faster than sodium ions. ☐

(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.

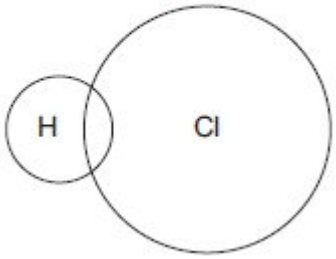
Figure 1



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

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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. ☐

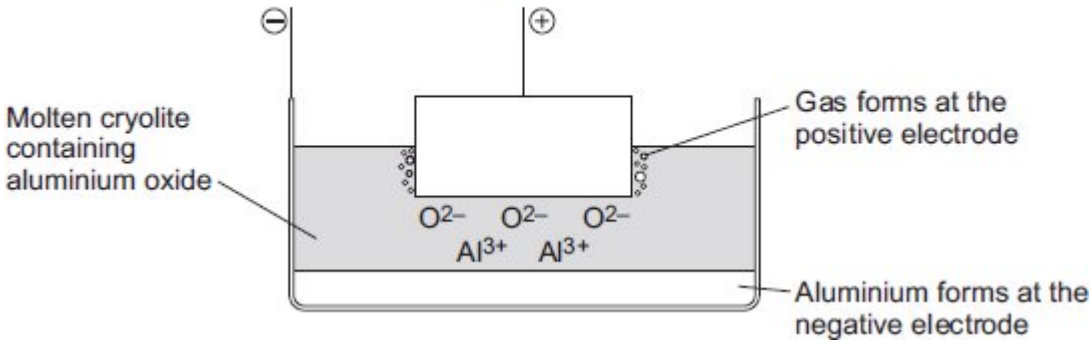
Hydrogen chloride has a giant structure. ☐

(2)

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

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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 ☐

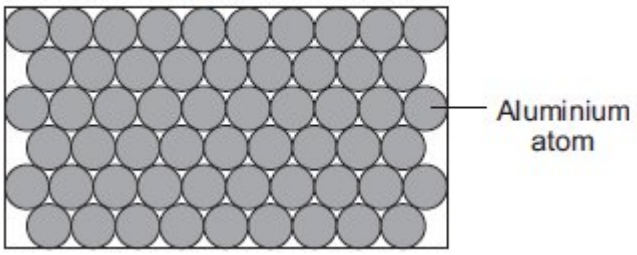
Reduction ☐

(1)

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

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Figure 4



Complete the sentence.

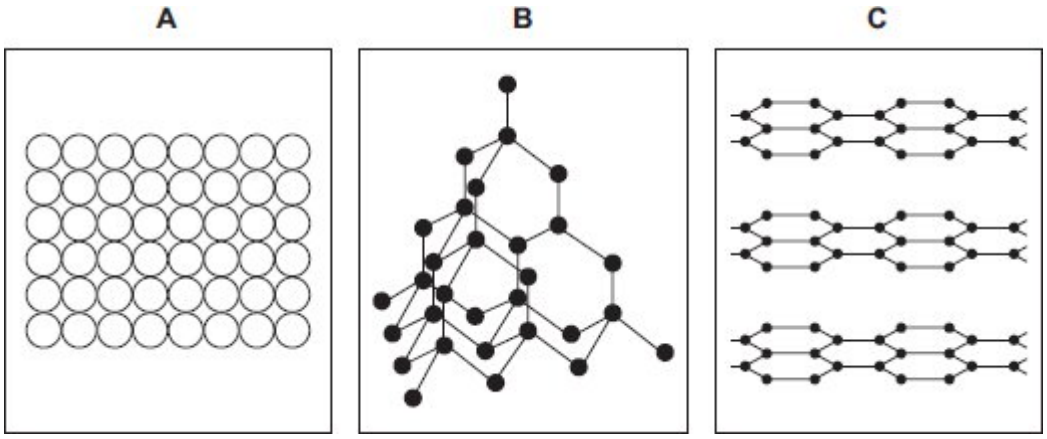
Metals can be bent and shaped because the layers of atoms can _____

_____

(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)

Q8.

The article gives some information about graphene.

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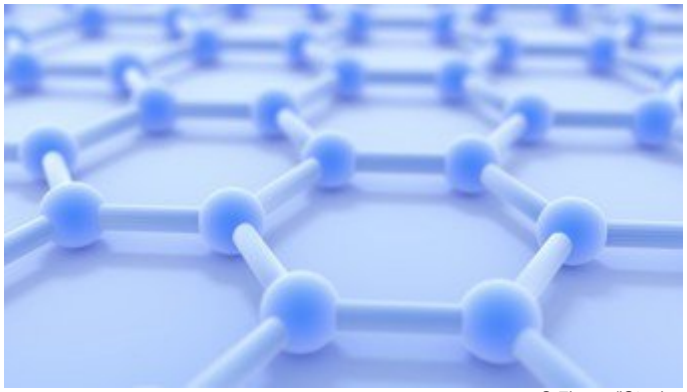
Nanotunes!

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.



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(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)

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

Explain why graphite is a lubricant.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q9.

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)

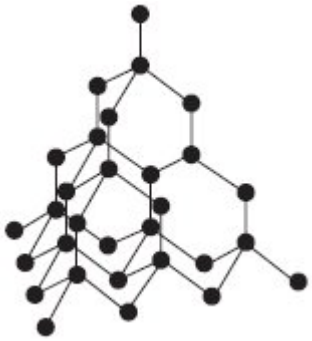
(b) Diamonds are used for the cutting end of drill bits.

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.

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(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)

(Total 7 marks)

Q10.

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

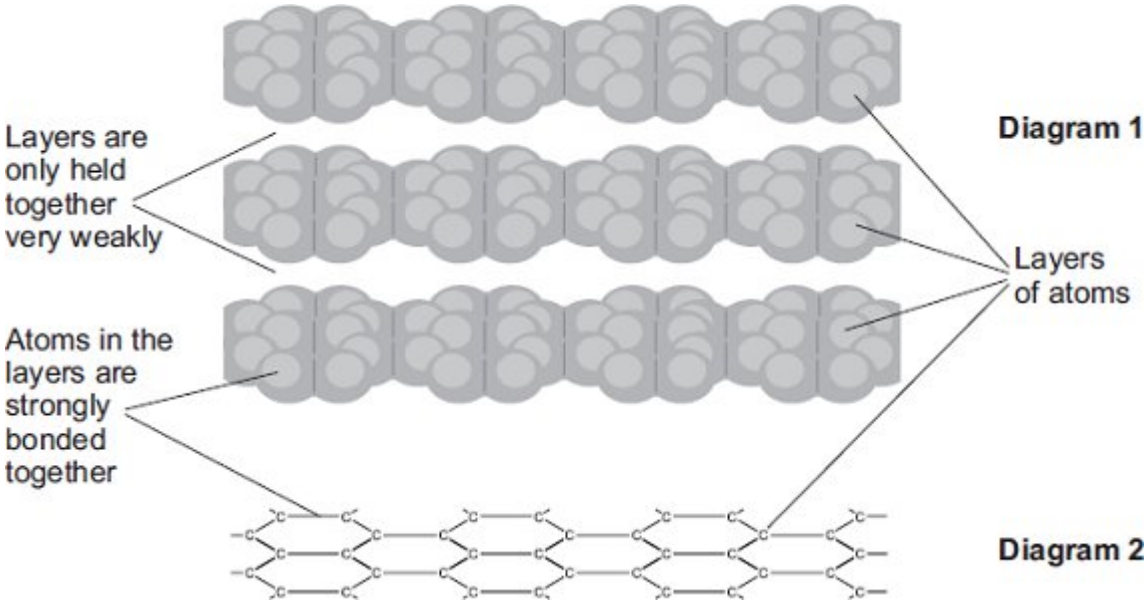


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The pencil contains graphite. Graphite rubs off the pencil onto the paper.

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)

Q11.

Oil rigs are used to drill for crude oil.



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© 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.

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_____

(4)

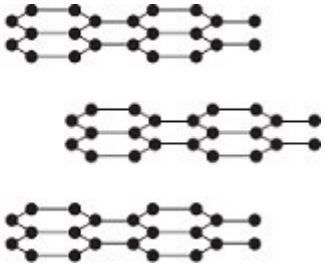
(Total 11 marks)

Q12.

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.

_____

_____

_____

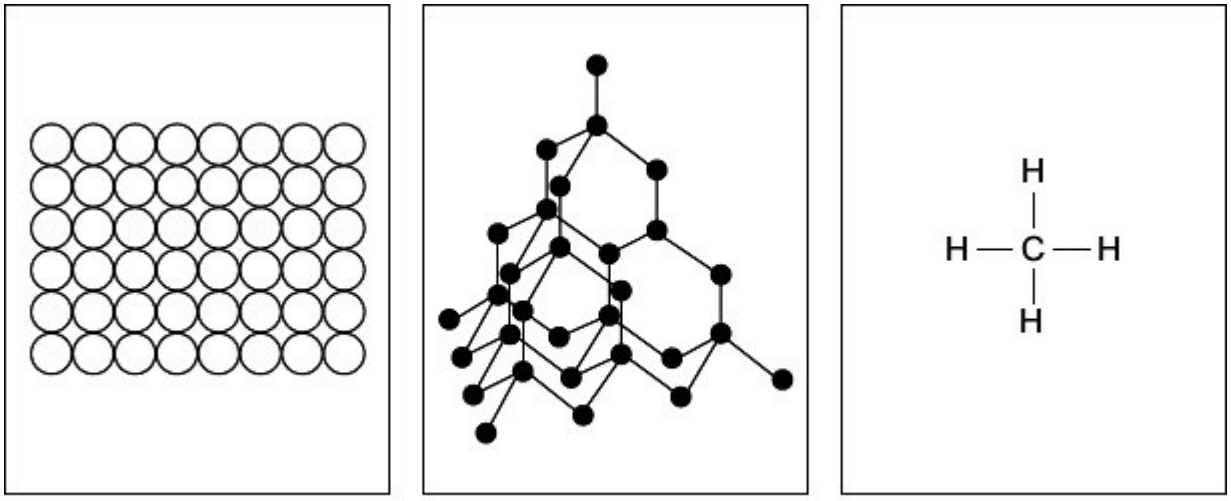
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(2)

(Total 7 marks)

Q13.

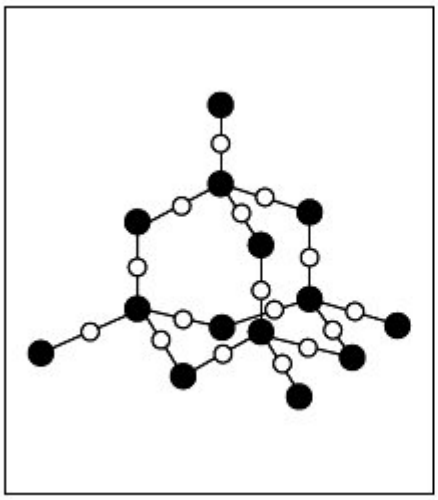
The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



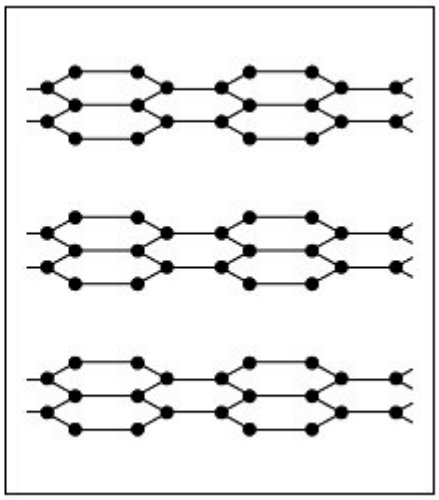
A

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.

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(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)

Q14.

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.

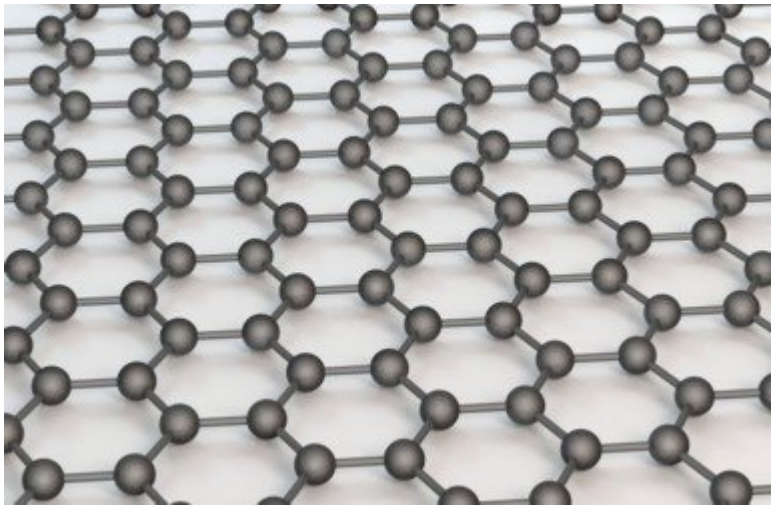
The properties of graphene include:

- 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.



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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)

Q15.

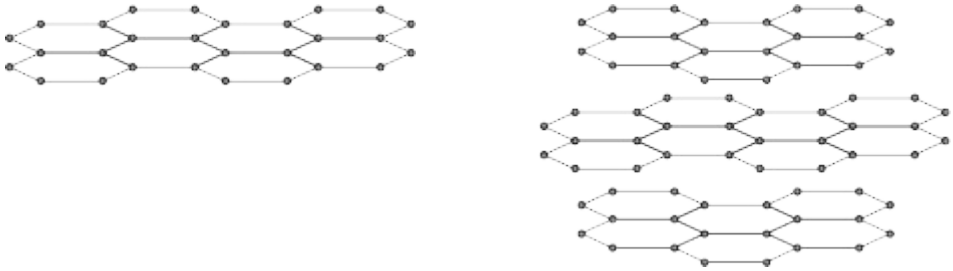
Read the information

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.

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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)

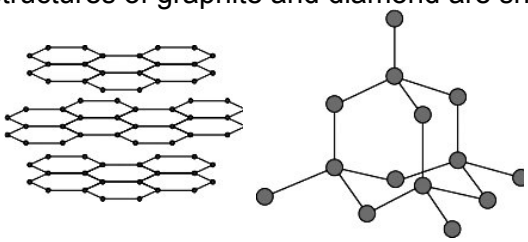
(Total 5 marks)

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Q16.

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.



Graphite **Diamond**

(a) Graphite is softer than diamond.

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

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

Explain why.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

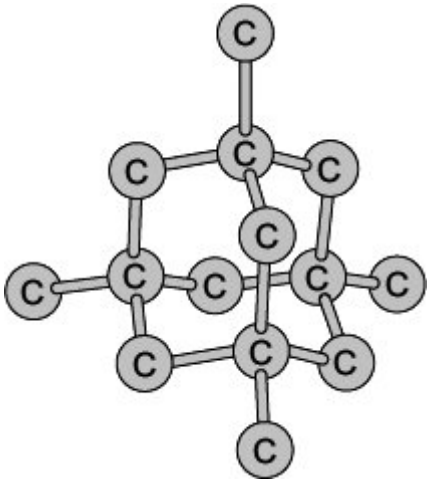
Q17.

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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.

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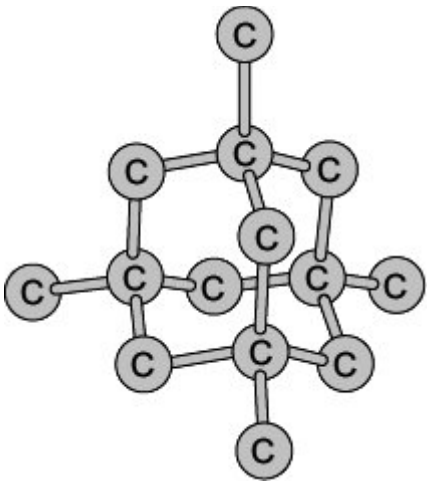
Nanoparticles of diamond are

very small.
large.
very large.

(1)
(Total 4 marks)

Q18.

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.

_____

_____

_____

_____

_____

_____

_____

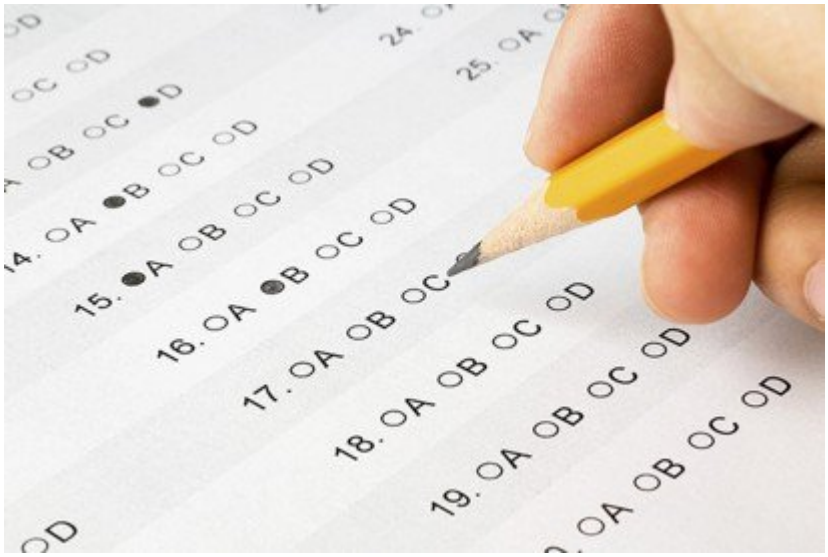
_____

(3)
(Total 3 marks)

Q19.

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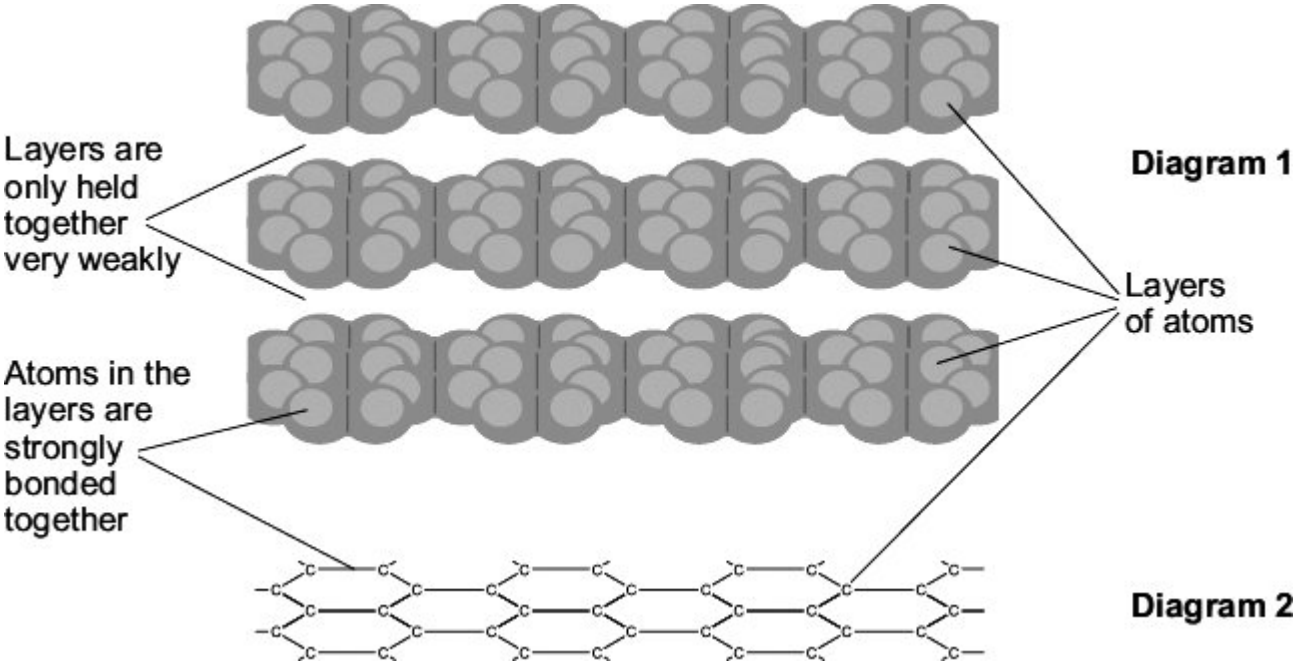
The picture shows a student using a pencil to complete a multiple choice answer sheet.



By albertogp123 [CC BY 2.0] , via Flickr

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

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



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

_____

(1)

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

_____

_____

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_____

_____

(2)

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

covalent **ionic** **metallic**

(1)

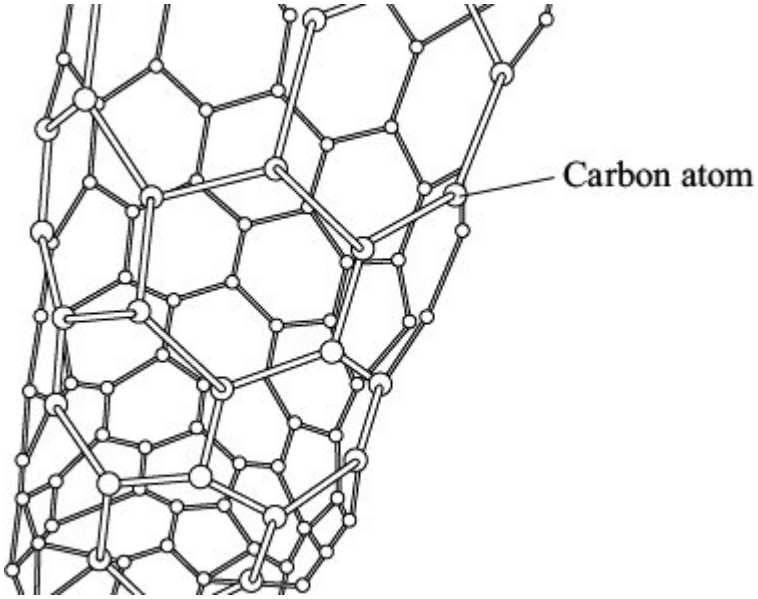
(Total 4 marks)

Q20.

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

Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



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

Tick (✓) the correct answer in the table.

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

(1)

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

(i) Carbon nanotubes are similar to graphite because each carbon atom is joined to [two / three / four] other carbon atoms.

(1)

(ii) The carbon atoms are joined by [covalent / ionic / metallic] bonds.

(1)

(iii) Carbon nanotubes are very strong because the [atoms / bonds / electrons] are hard to break.

(1)

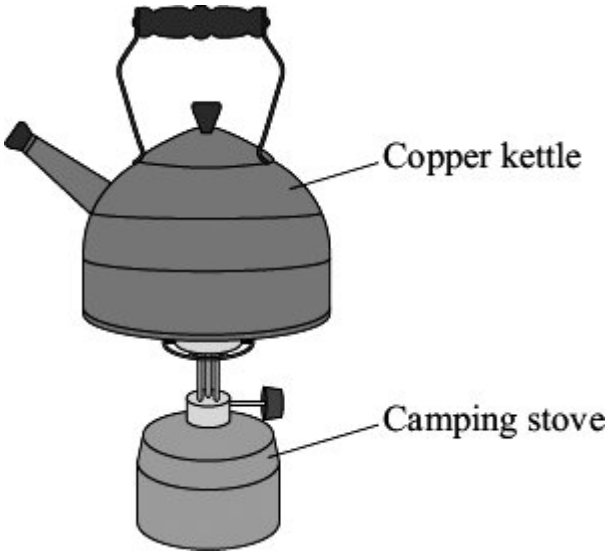
(Total 4 marks)

Q21.

The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

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



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(a) Explain why copper, like many other metals, has a high melting point.
You should describe the structure and bonding of a metal in your answer.

_____

_____

_____

_____

_____

_____

_____

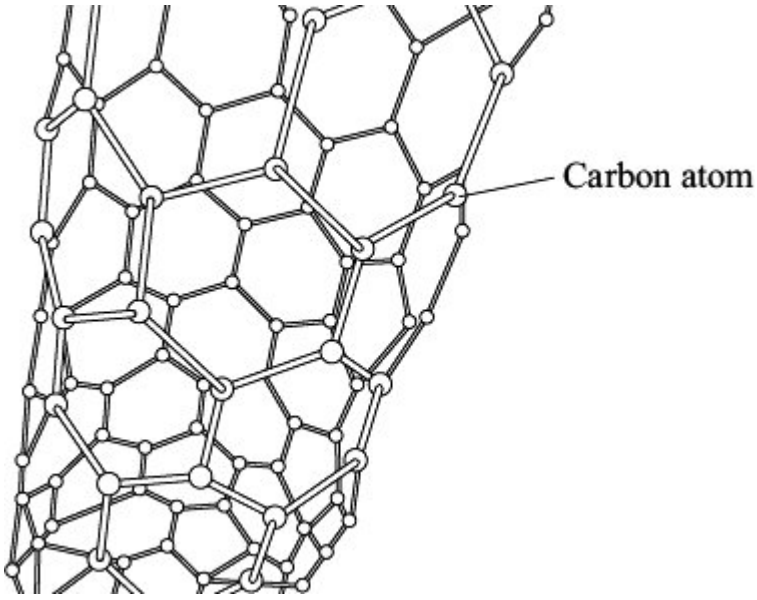
_____

(4)

(b) An aeroplane contains many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by lighter carbon nanotubes.

The diagram shows the structure of a carbon nanotube.



(i) What does the term ‘nano’ tell you about the carbon nanotubes?

_____

_____

(1)

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

Explain why the carbon nanotube can conduct electricity.

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_____

_____

_____

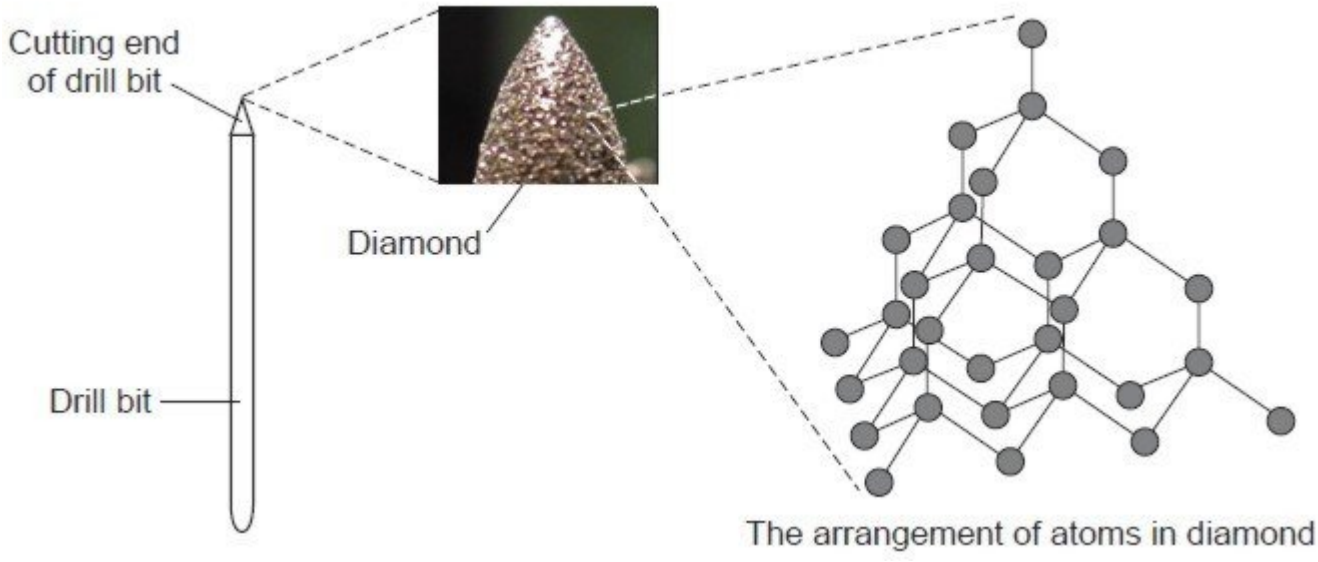
_____

(2)

(Total 7 marks)

Q22.

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



By Wanderlinse [CC By 2.0], via Flickr

Draw a ring around the correct word in each box.

(a) Diamond is made from | carbon / nitrogen / oxygen | atoms .

(1)

(b) Diamond has a giant structure in which | none / some / all | of the atoms are joined together.

(1)

(c) The atoms in diamond are joined together by | covalent / ionic | bonds.

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metallic

(1)

(d) In diamond each atom is joined to

two
three
four

other atoms.

(1)

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

hard.
shiny.
soft

(1)

(Total 5 marks)

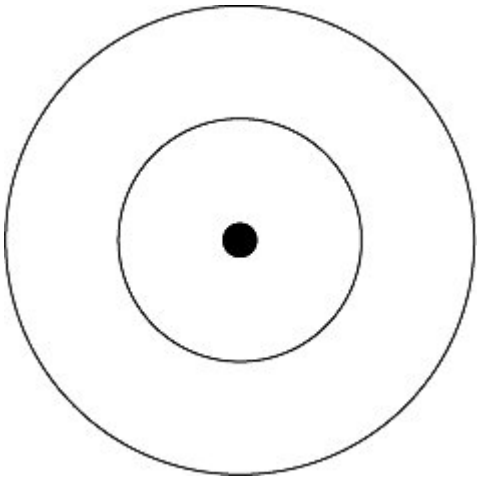
Q23.

Pure carbon can exist in two forms, diamond and graphite.

(a) Complete the diagram to show the electronic structure of a carbon atom.

A carbon atom has 6 electrons.

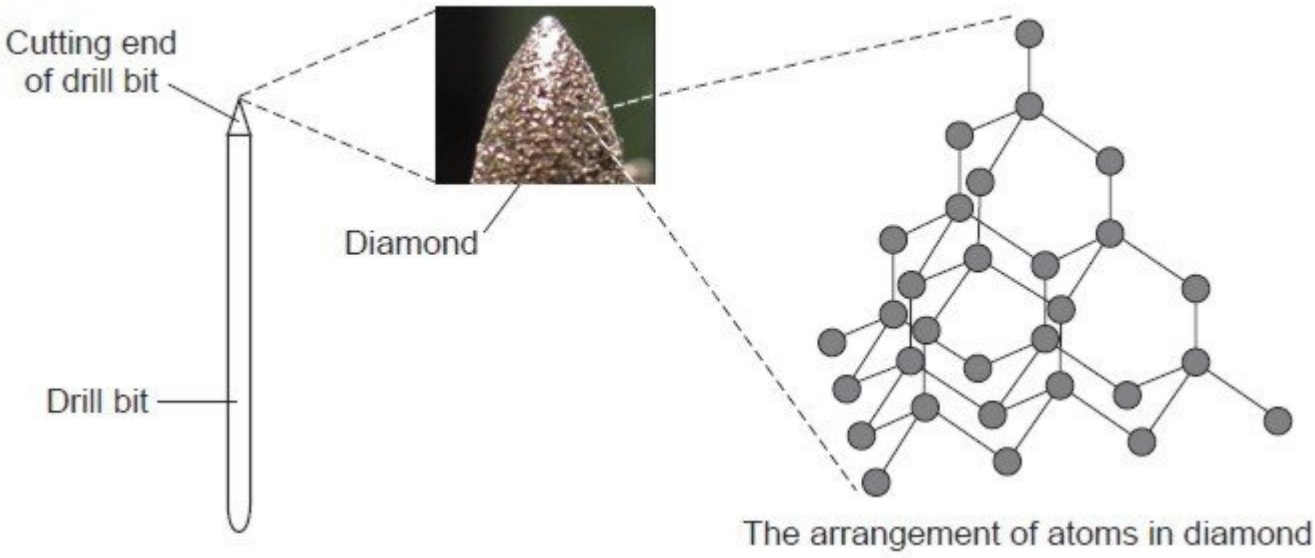
Show the electrons as crosses (x).



(1)

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

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By Wanderlinse [CC By 2.0], via Flickr

(i) What property of diamond makes it suitable for use on the cutting end of a drill bit?

_____

(1)

(ii) Explain, as fully as you can, why diamond has this property. Use your knowledge of the structure and bonding of diamond and the information shown opposite to help you to answer this question.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Explain why graphite is a good conductor of electricity and why diamond does **not** conduct electricity.

_____

_____

_____

_____

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_____

_____

_____

_____

(3)

(Total 8 marks)

Q24.

This label was on a container of graphite lubricant.

> ***Super G***
> **Graphite Lubricant**
>
> ***Super G*** forms a thin anti-friction film on metal surfaces. It provides good lubrication when metal parts rub against each other.

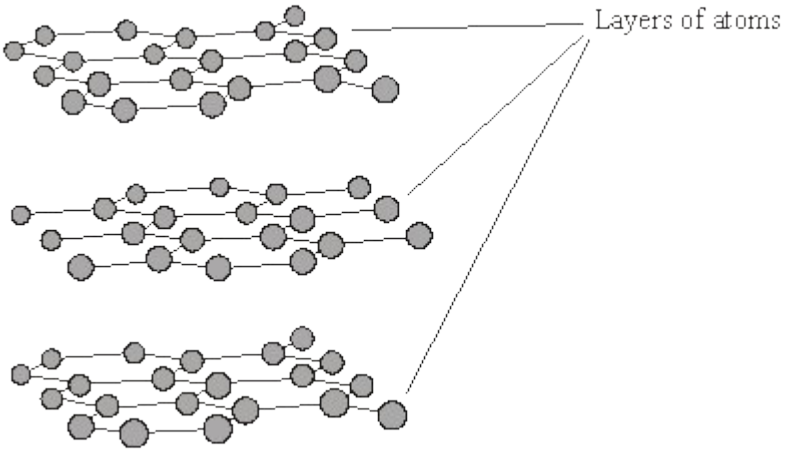
(a) Give **one** reason why a lubricant is used when metal parts rub against each other.

_____

_____

(1)

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



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

aluminium **carbon** **silicon**

(1)

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

_____

_____

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_____

_____

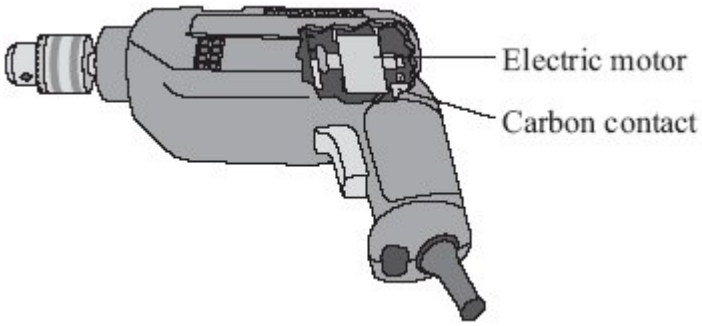
_____

(2)

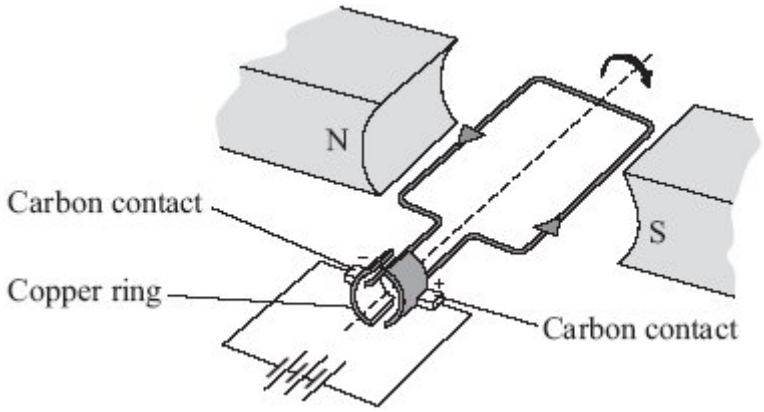
(Total 4 marks)

Q25.

This drill contains an electric motor.



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



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

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

_____

_____

_____

_____

(2)

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

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Each carbon atom in graphite is joined to

two three four	other carbon atoms by	covalent ionic metallic	bonds.

(2)

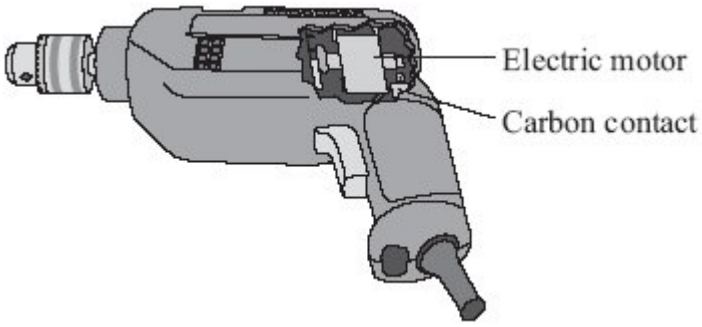
(ii) Tick (✓) the statement which explains why graphite is soft and slippery.

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

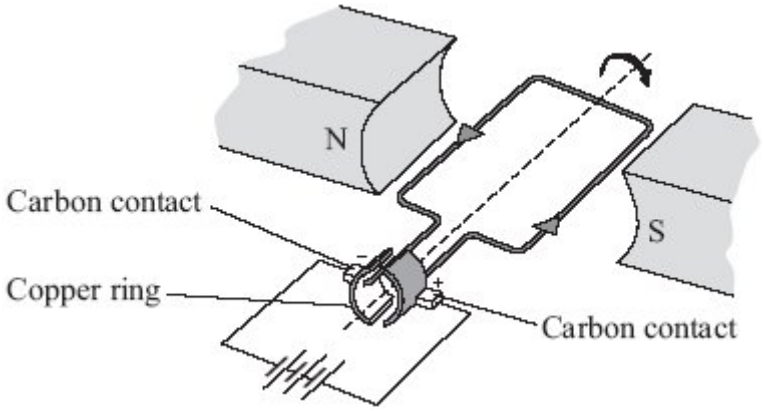
(1)
(Total 5 marks)

Q26.

This drill contains an electric motor.



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



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

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Graphite has properties which are ideal for making the contacts in an electric motor.

Explain, in terms of structure and bonding, why graphite has these properties.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 5 marks)

Q27.

The *electrolysis* of sodium chloride solution produces useful substances.

(a) Explain the meaning of *electrolysis*.

_____

_____

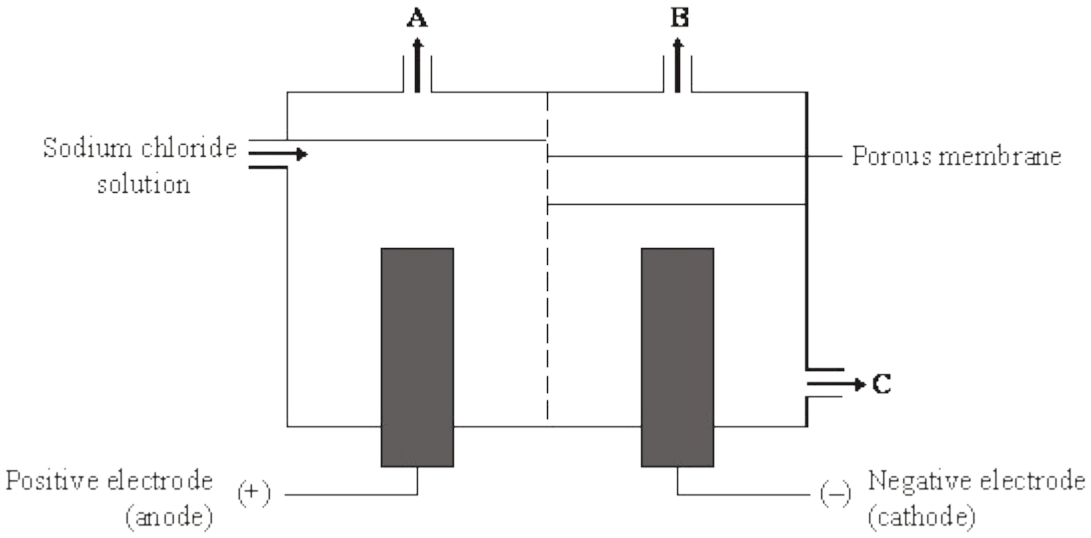
_____

_____

(2)

(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.

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The electrolysis produces two gases, chlorine and Gas **A.**

Name Gas **A** _____

(1)

(c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q28.

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

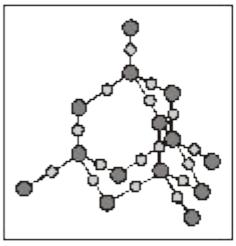
(a) The diagrams show the structures of these three substances.

Draw a line from each structure to its name.

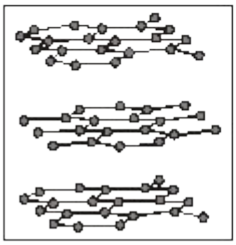
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Silicon dioxide



Graphite



Diamond

(2)

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

covalent	**four**	**hard**	**ionic**
shiny	**soft**	**three**	**two**

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

(1)

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

(1)

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

(1)

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

(1)

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

(1)

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

Name the element in diamond. _____

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(1)

(Total 8 marks)

Q29.

Silicon is an important element used in the electronics industry.

(a) Silicon can be made by heating a mixture of sand (silicon dioxide) with magnesium powder.

The equation for this reaction is shown below.

$$SiO_2\ (s) + 2Mg\ (s) \rightarrow 2MgO\ (s) + Si\ (s)$$

Calculate the mass of silicon dioxide needed to make 1 g of silicon.

Relative atomic masses: O = 16; Si = 28

_____

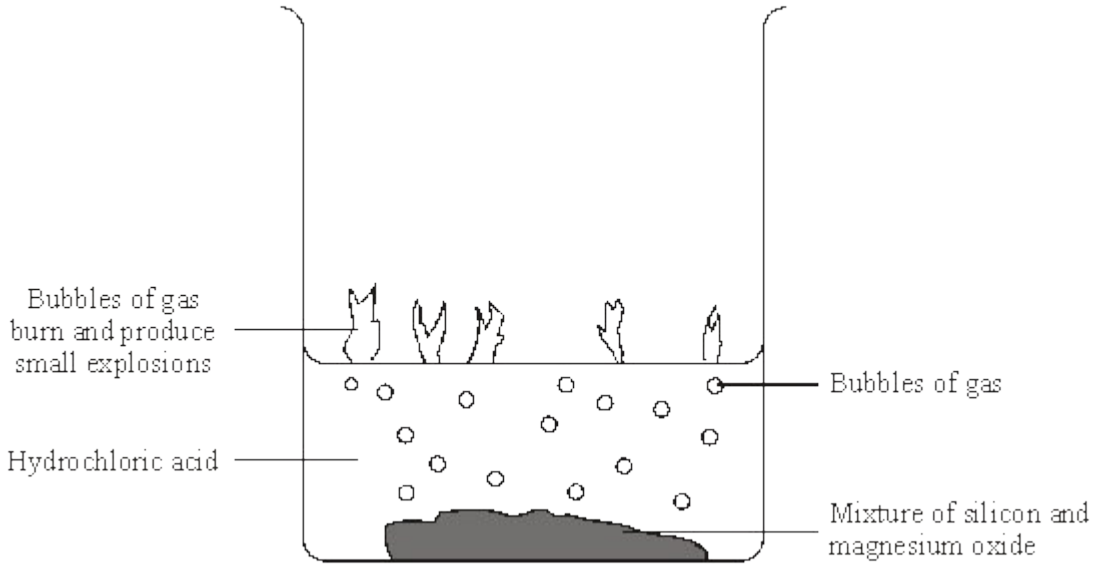
_____

_____

Mass = _____g

(3)

(b) The resulting mixture of magnesium oxide and silicon is added to a beaker containing hydrochloric acid. The silicon is then filtered from the solution.



(i) The magnesium oxide reacts with the hydrochloric acid and forms magnesium chloride ($MgCl_2$) solution and water.

magnesium oxide + hydrochloric acid → magnesium chloride solution + water

Write a balanced symbol equation for this reaction, including state symbols.

_____

(2)

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(ii) The gases produced are a mixture of several silicon hydrides.

One of the gases produced in the reaction is the silicon hydride with the formula SiH_4. The structure of this molecule is similar to methane, CH_4.

Draw a diagram to show the bonding in a molecule of SiH_4. Represent the electrons as dots and crosses and only show the outer shell (energy level) electrons.

(1)

(iii) A sample of a different silicon hydride was found to contain 1.4 g of silicon and 0.15 g of hydrogen.

Calculate the formula of this silicon hydride. You must show all your working to gain full marks.

Relative atomic masses: H = 1; Si = 28

_____

_____

_____

_____

_____

_____

_____

(4)

(iv) The silicon hydrides react immediately they come into contact with oxygen in the air. They burst into flames with a small explosion and give out energy.

Which letter, **A** to **H**, best describes this reaction?

Energy involved in breaking and forming bonds	Activation energy	Rate of reaction	Letter
		fast	**A**

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The energy released from forming new bonds is greater than the energy needed to break existing bonds	high	slow	**B**
	low	fast	**C**
		slow	**D**
The energy needed to break existing bonds is greater than the energy released from forming new bonds	high	fast	**E**
		slow	**F**
	low	fast	**G**
		slow	**H**

Letter _____

(1)

(c) The structure of silicon is similar to the structure of diamond.

Describe the structure of silicon and explain why it has a high melting point. You may draw a diagram if this helps.

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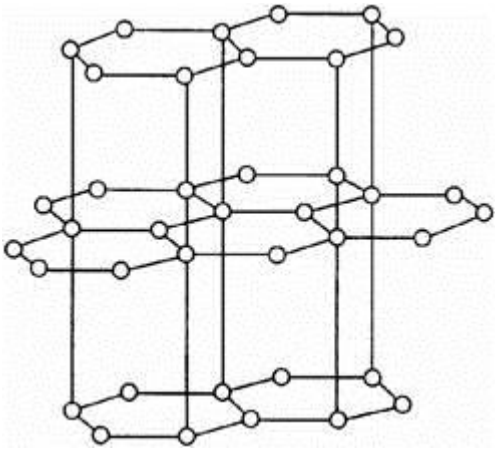
(4)

(Total 15 marks)

Q30.

The diagram represents the structure of graphite.

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Use your knowledge and understanding of the structure of graphite to explain why graphite can be used:

(a) in the 'leads' of pencils;

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(b) as an electrical conductor.

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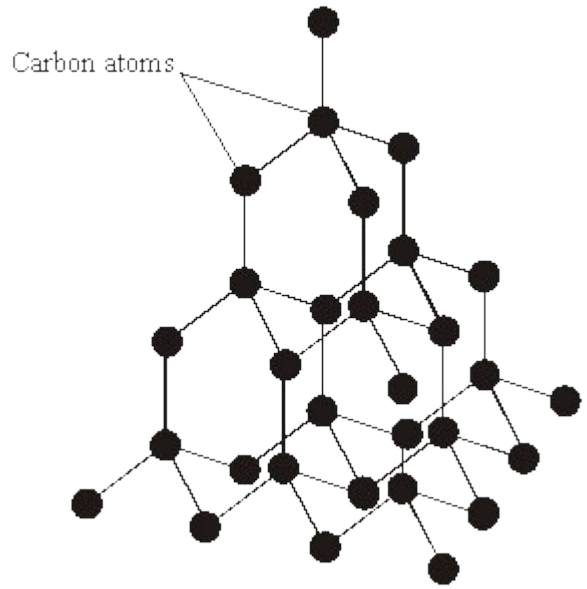
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(Total 5 marks)

Q31.

The diagram shows the structure of diamond.

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(a) *To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words*.

Explain, as fully as you can, why diamond has a high melting point.

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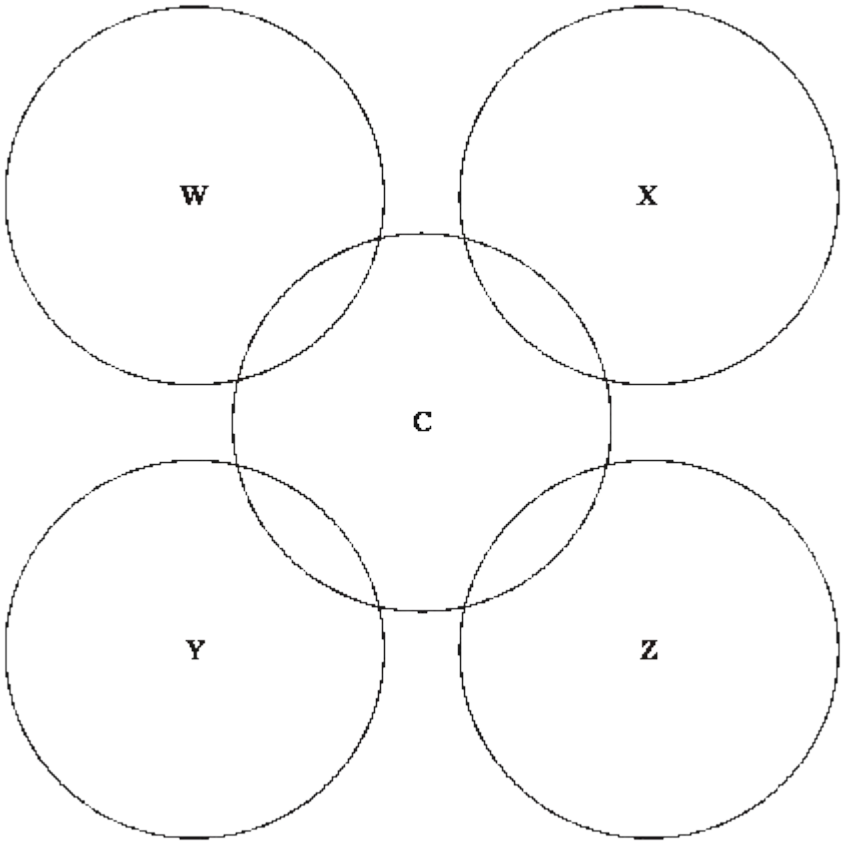
(3)

(b) The diagram below shows the outer electron shells of five carbon atoms in the giant lattice of diamond.

Carbon atom **C** forms bonds with each of the carbon atoms **W**, **X**, **Y** and **Z**.

Draw the positions of all the electrons in the outer shells of each of carbon atoms **C**, **W**, **X**, **Y** and **Z**.

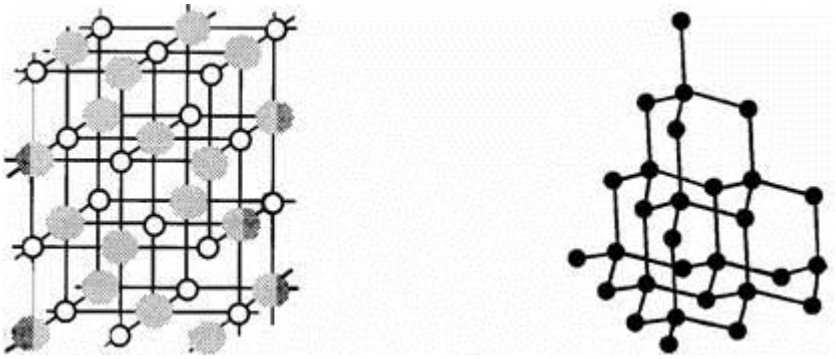
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(3)
(Total 6 marks)

Q32.

The diagrams show the giant structures of sodium chloride and diamond.



sodium chloride (melting point 801°C) diamond (melting point 4800°C)

(a) The equation shows how sodium choride could be formed.

Balance the equation.

$$Na + Cl_2 \rightarrow Na\,Cl$$

(1)

(b) By reference to the detailed structure of sodium chloride explain fully why:

(i) sodium chloride has a quite high melting point,

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(1)

(ii) solid sodium chloride melts when it is heated strongly,

_____

_____

(2)

(iii) molten sodium chloride will conduct electricity.

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(1)

(c) By reference to the detailed structure of diamond, explain why the melting point of diamond, is higher than that of sodium chloride.

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(2)

(Total 7 marks)

Q33.

(a) Copper is a metal.
Explain how it conducts electricity.

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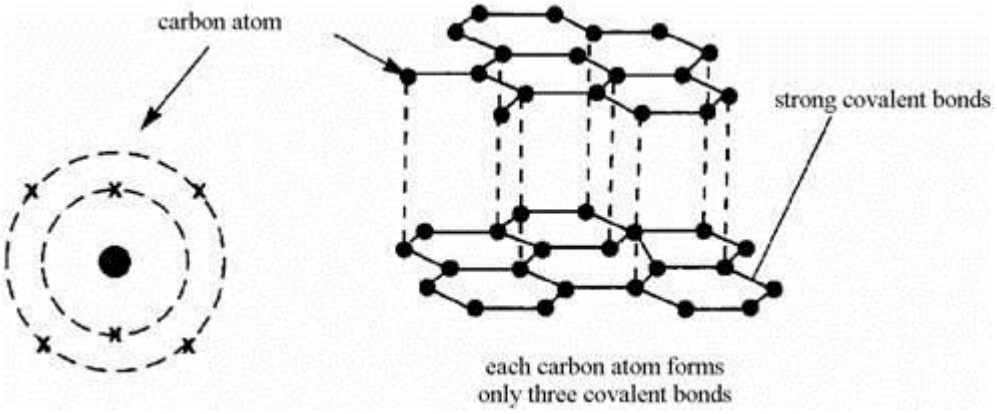
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(2)

(b) Graphite is a non-metal.

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Use the information to explain why graphite conducts electricity.

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(3)

(Total 5 marks)

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