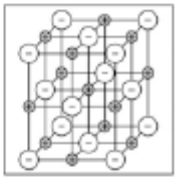
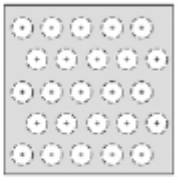
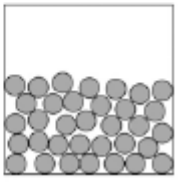
Q1. This question is about different substances and their structures.

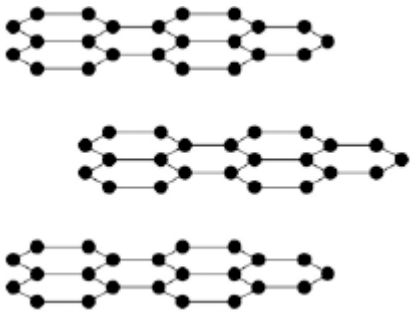
(a) Draw **one** line from each statement to the diagram which shows the structure.

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 ☐

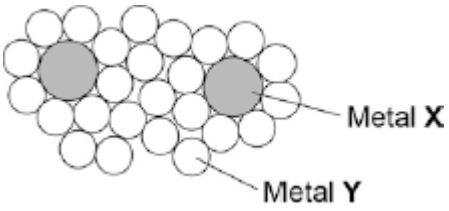
It has weak forces between the layers ☐

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. 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 ☐

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. ☐

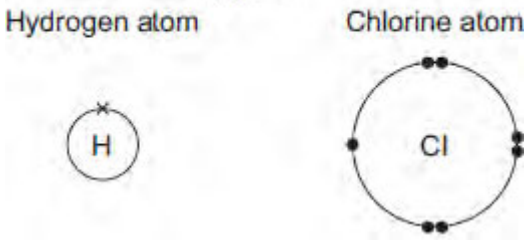
Hydrogen ions move faster than sodium ions. ☐

(1)

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

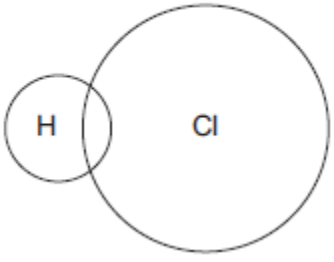
The diagrams in **Figure 1** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

Figure 1



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

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. ☐

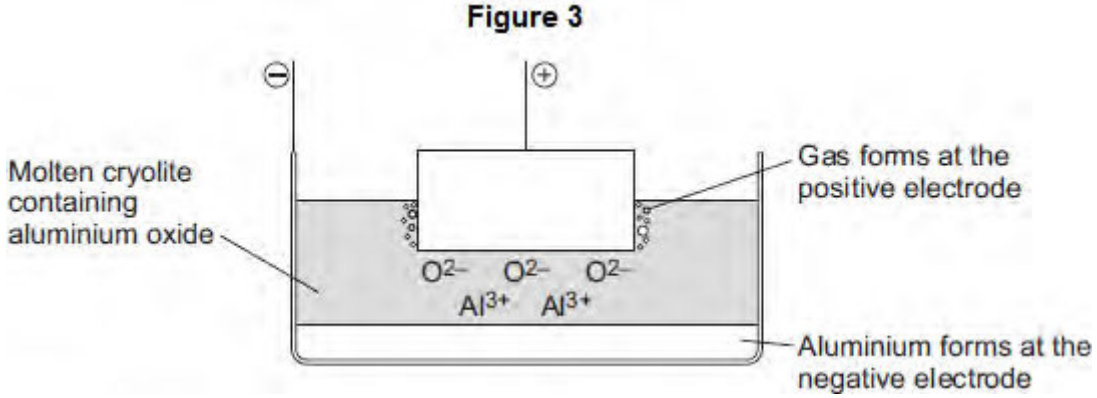
Hydrogen chloride does not conduct electricity. ☐

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 ☐

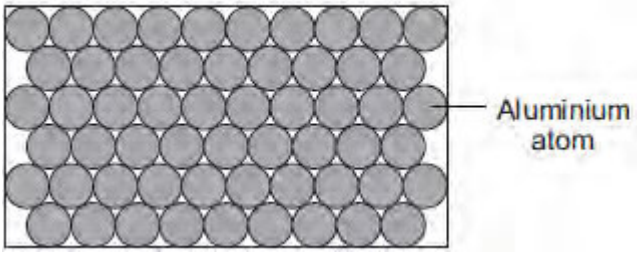
Oxidation ☐

Reduction ☐

(1)

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

Figure 4



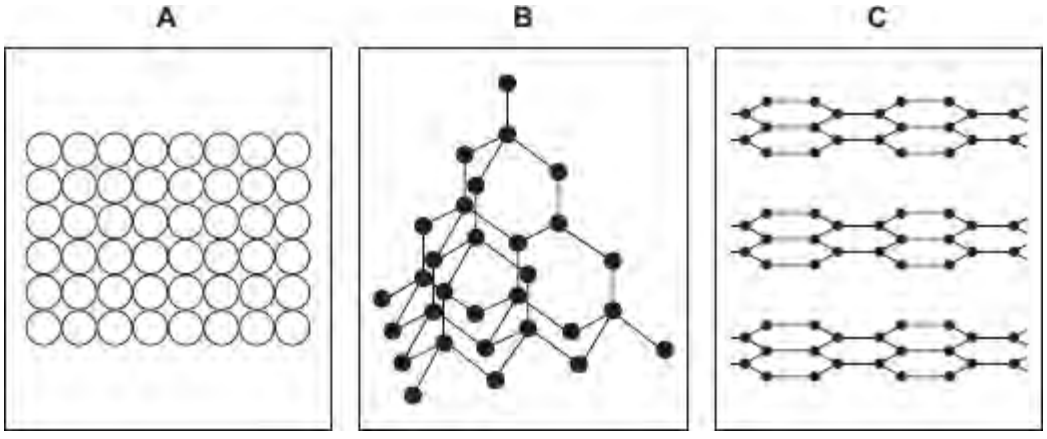
Complete the sentence.

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)

Q3. 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

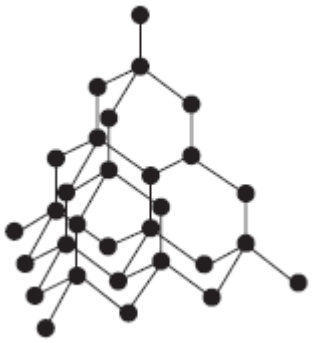
(1)

(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)

[covalent]

Diamond has a giant | ionic / metallic | structure.

(1)

(iv)

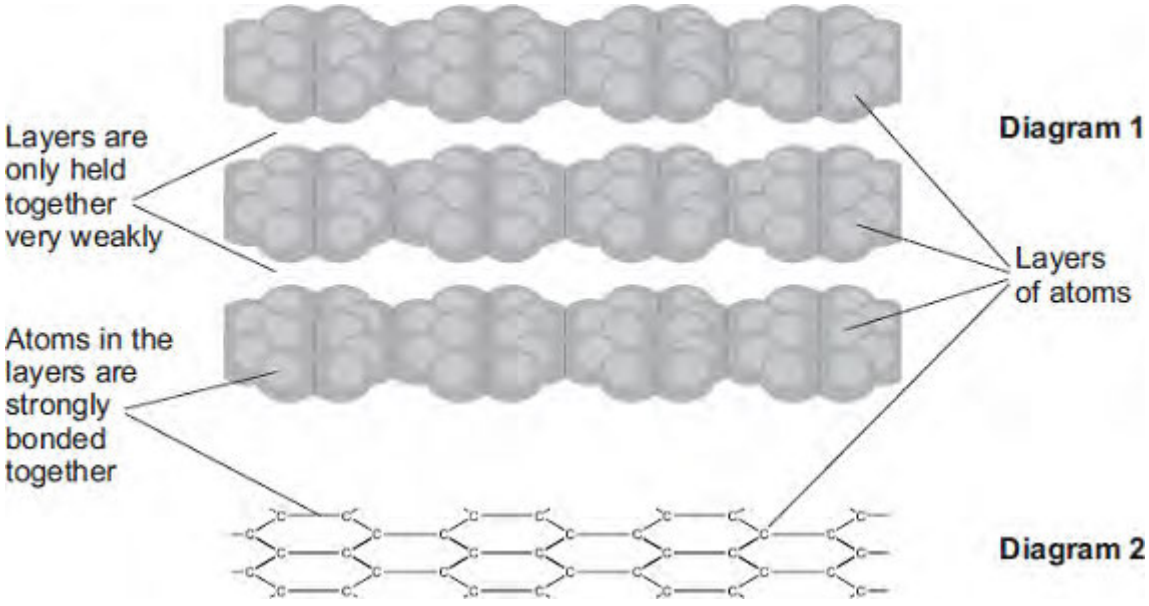
In diamond | all / none / some | of the atoms are bonded together.

(1)
(Total 7 marks)

Q4. The picture shows a student filling in a multiple choice answer sheet using a pencil.

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.

.....

.....

.....

.....

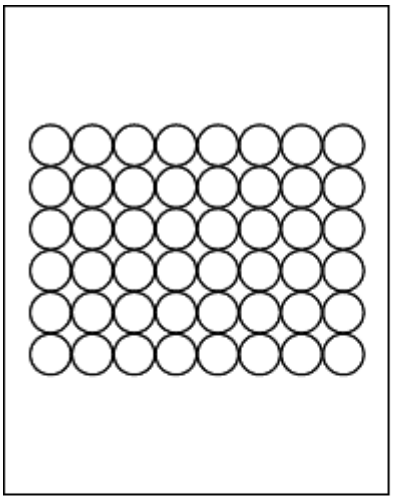
(2)

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

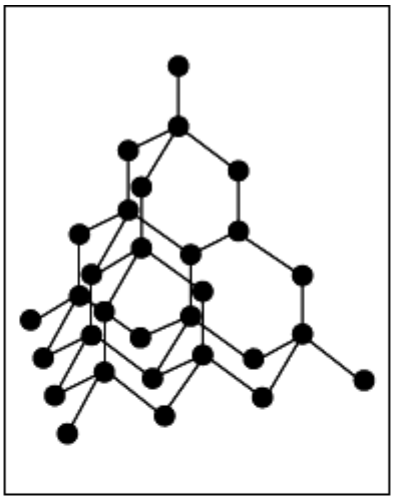
covalent **ionic** **metallic**

(1)
(Total 3 marks)

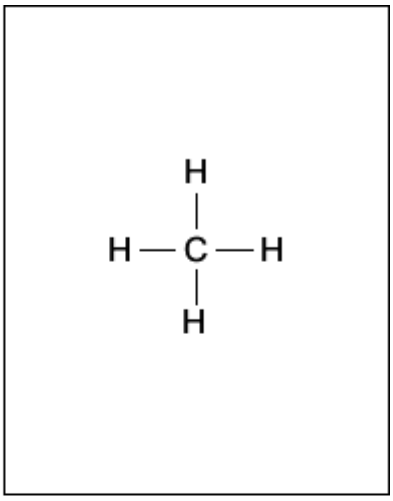
Q5. The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



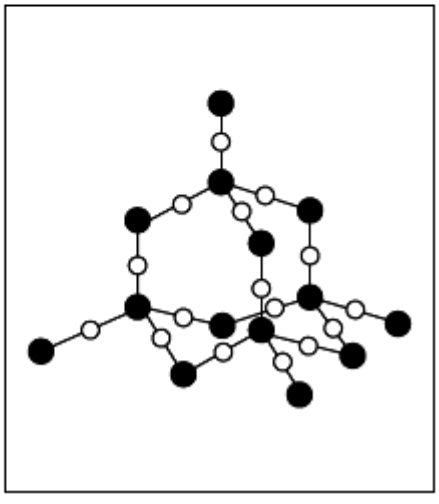
A



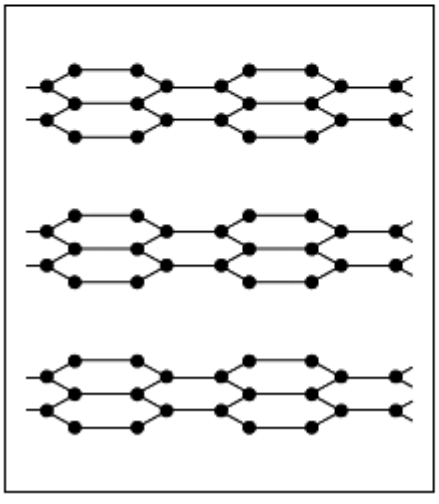
B



C



D



E

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

(i) has a very low boiling point

(1)

(ii) is a compound

(1)

(iii) is a metal. ☐

(1)

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

covalent **ionic** **metallic**

(1)

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

.....

.....

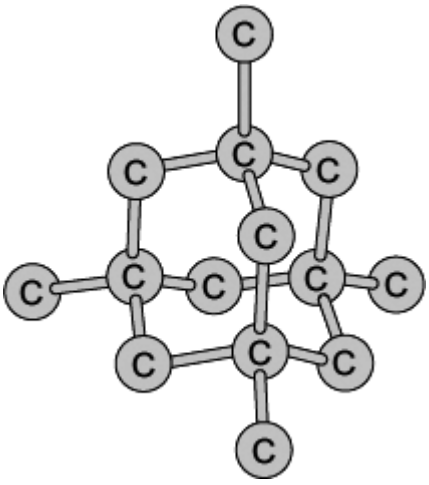
.....

.....

(2)
(Total 6 marks)

Q6. Liquids containing nanoparticles of diamond are used as abrasives.Nanoparticles of diamond can be used to grind down surfaces to give them a very smooth polished finish.

Abrasive liquid containing nanoparticles of diamond



Model of part of the diamond structure

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

calcium **carbon** **chromium** **cobalt**

(1)

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

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

It has strong ionic bonds.	

(2)

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

Nanoparticles of diamond are

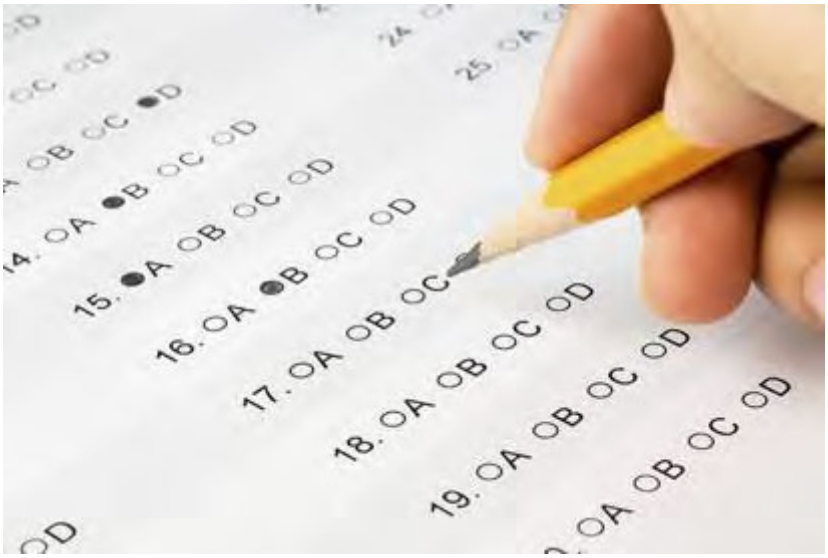
very small.

large.

very large.

(1)
(Total 4 marks)

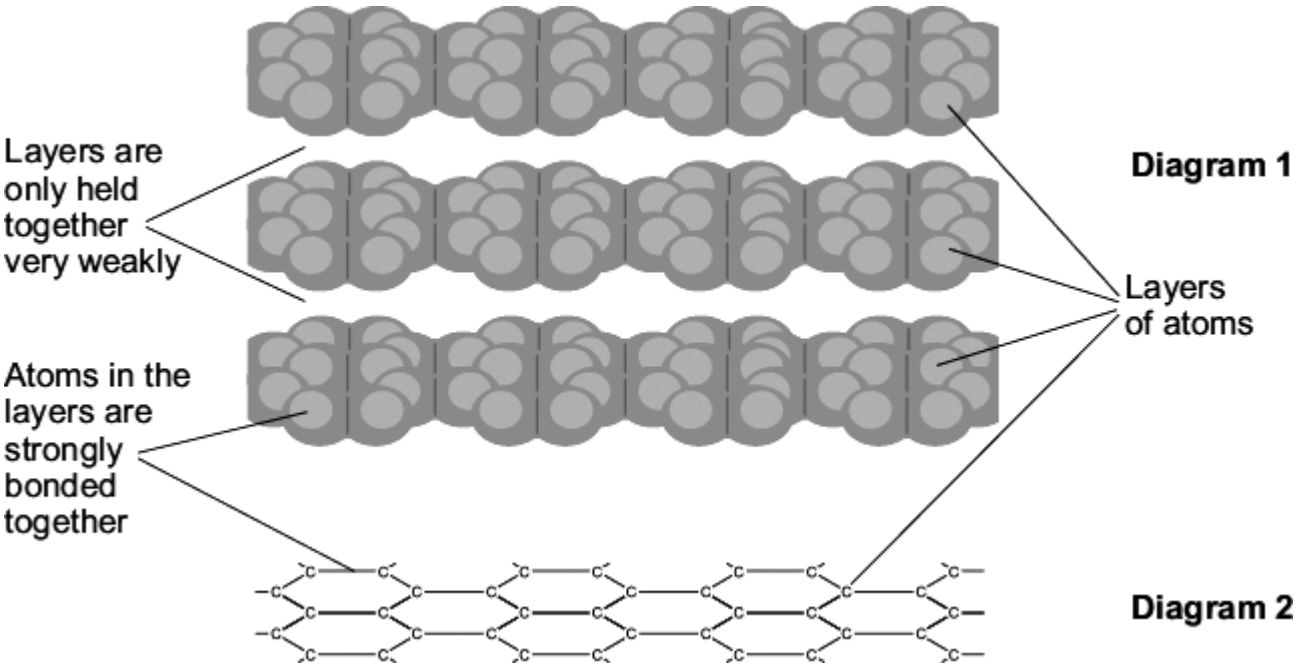
Q7. The picture shows a student using a pencil to complete a multiple choice answer sheet.



By albertogp123 [CC BY 2.0] , via Flickr

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

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



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

.....

(1)

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

.....

.....

.....

.....

(2)

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

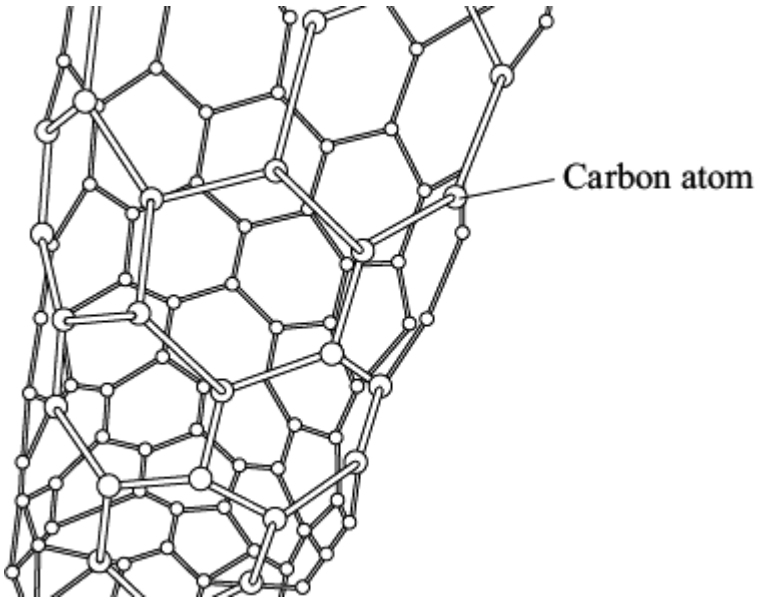
covalent **ionic** **metallic**

(1)
(Total 4 marks)

Q8. Lightweight handlebars for bicycles are made from materials containing carbon nanotubes.

Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



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

Tick (✓) the correct answer in the table.

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

(1)

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

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

two
three
four

other carbon atoms.

(1)

(ii) The carbon atoms are joined by

covalent
ionic
metallic

bonds.

(1)

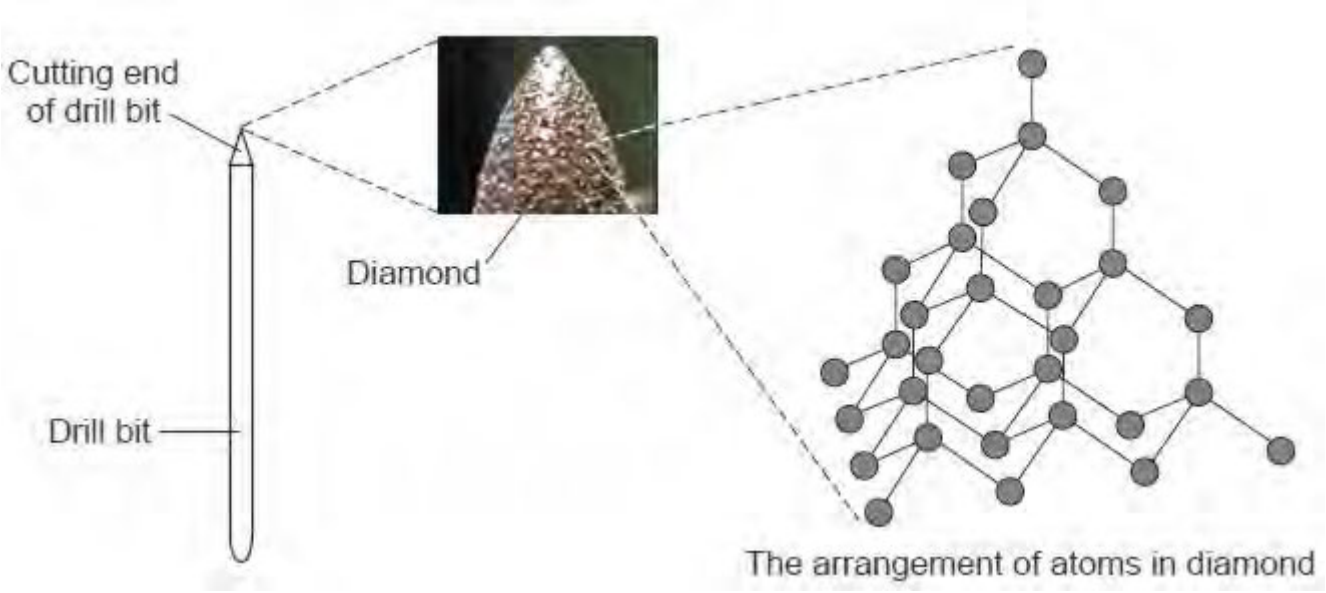
(iii) Carbon nanotubes are very strong because the

atoms
bonds
electrons

are hard to break.

(1)
(Total 4 marks)

Q9. 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)

covalent

(c) The atoms in diamond are joined together by

ionic
metallic

bonds.

(1)

(d) In diamond each atom is joined to

two
three
four

other atoms.

(1)

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

hard.
shiny.
soft

(1)
(Total 5 marks)