Structure + Bonding Carbon

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.2 Bonding Structure + Props Matter
Sub-Topic	Structure + Bonding Carbon
Difficulty Level	Bronze Level
Booklet	Question Paper 1

Time Allowed: **57 minutes**

Score: **/56**

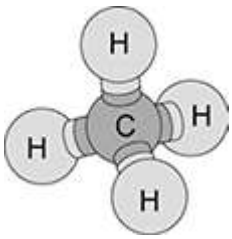
Percentage: **/100**

Grade Boundaries:

Q1. There are several different forms of carbon and many different carbon compounds.

(a) **Figure 1** shows a 3D model of a molecule of methane (CH_4).

Figure 1



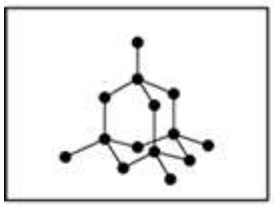
Draw the 2D structure of a methane molecule.

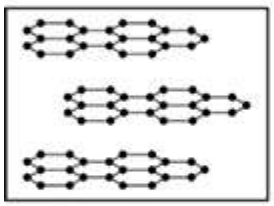
(1)

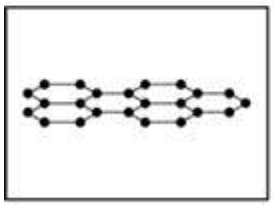
(b) Different forms of carbon have different bonding and structure.

Draw **one** line from the form of carbon to the bonding and structure.

Form of carbon	**Bonding and structure**







	Each carbon atom is bonded to three other carbon atoms in a single layer
	Each carbon atom is bonded to four other carbon atoms
	Layers of carbon atoms with no covalent bonds between the layers
	Carbon ions held together by strong electrostatic forces
	Pairs of carbon atoms with no covalent bonds between the molecules

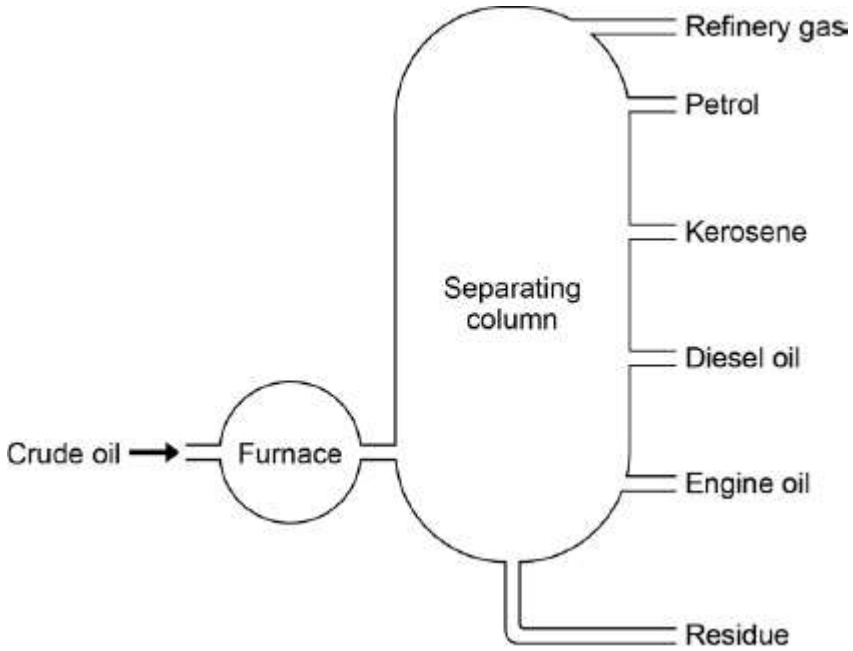
(3)

(c) Crude oil is a mixture of many different carbon compounds.

Crude oil can be separated into useful fractions by fractional distillation.

Figure 2 shows a column used to separate crude oil.

Figure 2



Complete the sentences.

Use words from the box.

condense	**evaporate**	**freeze**

Crude oil is heated so that most of the compounds .....

At different temperatures the compounds cool and .....

(2)

(d) Which fraction is the most **viscous**?

Tick **one** box.

Engine oil ☐

Diesel oil ☐

Kerosene ☐

Petrol ☐

(1)

(e) Which fraction is the most **flammable**?

Tick **one** box.

Diesel oil ☐

Kerosene ☐

Petrol ☐

Refinery gas ☐

(1)

(f) Why does kerosene separate out of the mixture before diesel oil?

.....

.....

(1)
(Total 9 marks)

Q2. Hydrocarbons are used to make useful products.

(a) What are the elements in hydrocarbons?

Tick **one** box.

Carbon and hydrogen only ☐

Carbon, hydrogen and oxygen ☐

Carbon and nitrogen only ☐

Carbon, nitrogen and oxygen ☐

(1)

(b) **Table 1** gives some information about four hydrocarbons.

Table 1

Hydrocarbon	Melting point in °C	Boiling point in °C
Methane	–183	–162
Ethene	–169	–104
Octane	–57	+126
Decane	–30	+174

What are two correct statements about the four compounds?

Tick **two** boxes.

Methane has the lowest boiling point and decane has the highest melting point ☐

Methane and decane are both gases at 20 °C ☐

Ethene and octane are both alkanes ☐

Decane and ethene are both liquids at 0 °C ☐

Octane is liquid over a larger temperature range than methane ☐

(2)

(c) Ethene can be produced from long-chain hydrocarbons by cracking.

Give the conditions needed for cracking.

.....

.....

.....

.....

(2)

(d) Poly(ethene) is a polymer made from ethene. Poly(ethene) is used to make plastic bags.

Table 2 is from a life cycle assessment comparing paper bags and plastic bags.

Table 2

	Paper bag	**Plastic bag**
Raw material	Wood (renewable)	Oil or gas (non-renewable)
Energy used to make in MJ	1.7	1.5
Solid waste produced in g	50	14
Carbon dioxide produced in kg	0.23	0.53

Evaluate which type of bag is more environmentally friendly.

Use data from **Table 2** and your own knowledge to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 11 marks)

Q3. 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. ☐

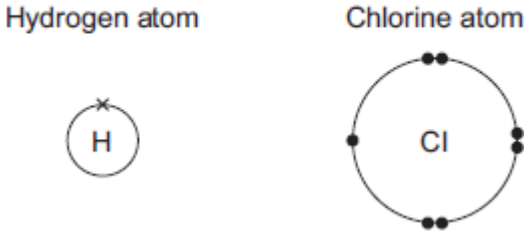
Hydrogen ions move faster than sodium ions. ☐

(1)

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

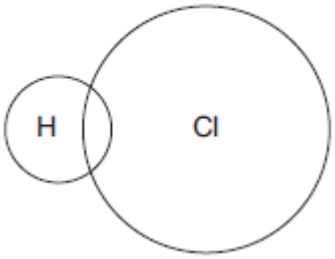
The diagrams in **Figure 1** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

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. ☐

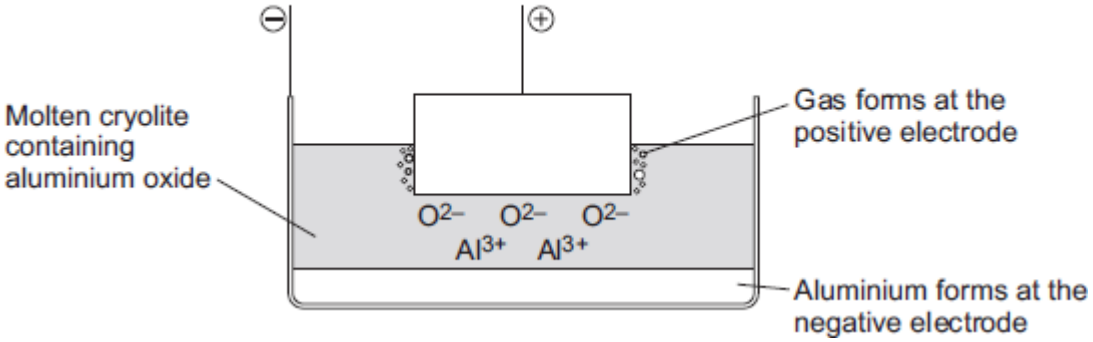
Hydrogen chloride does not conduct electricity. ☐

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 ☐

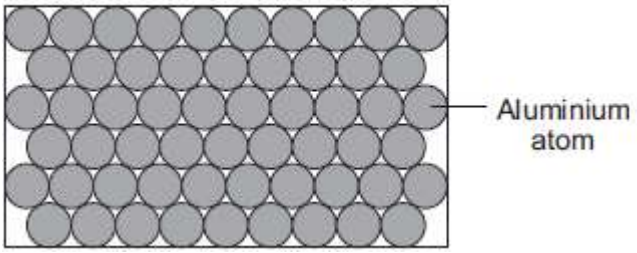
Oxidation ☐

Reduction ☐

(1)

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

Figure 4



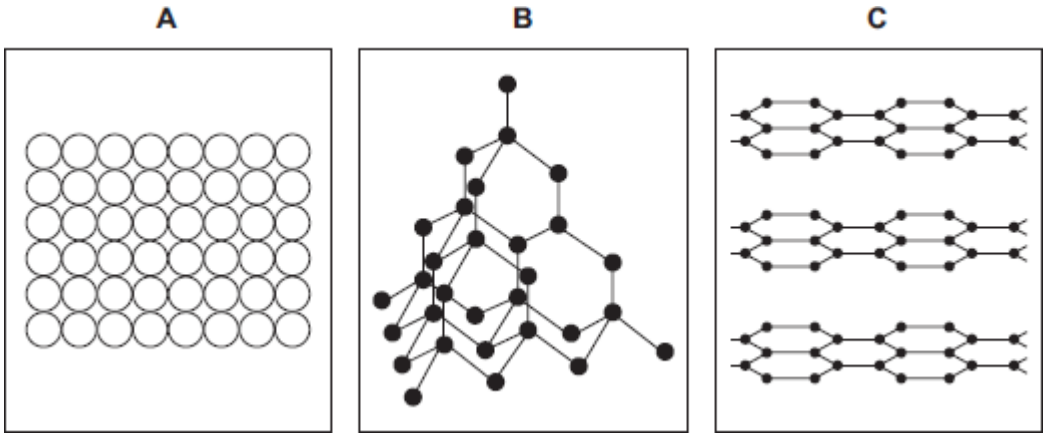
Complete the sentence.

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

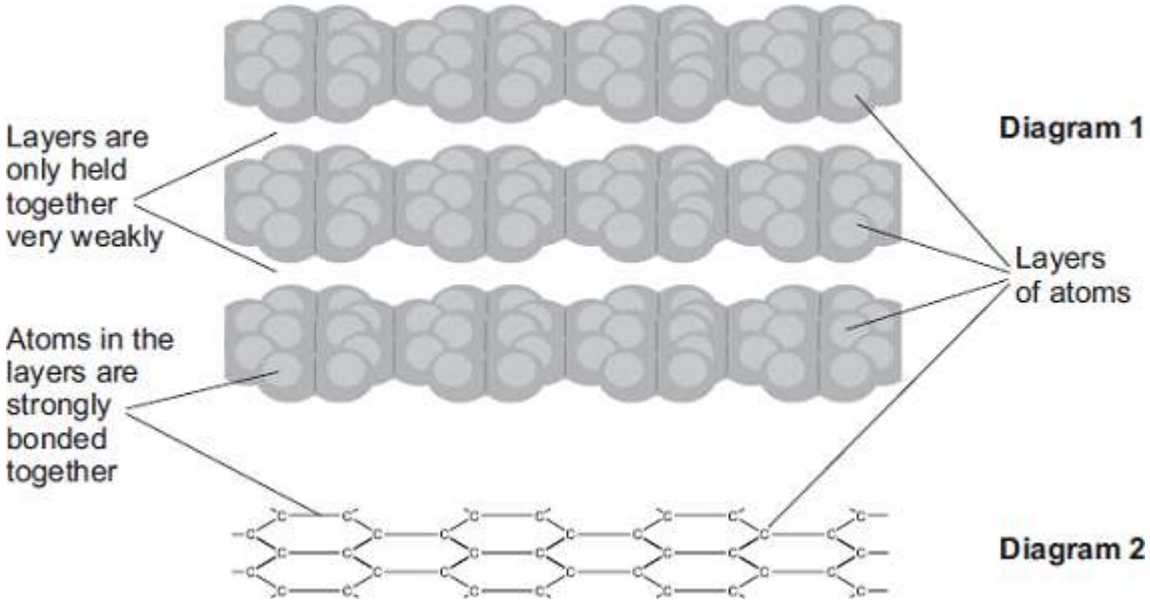
graphite has ..... .

(1)
(Total 14 marks)

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.

.....

.....

.....

.....

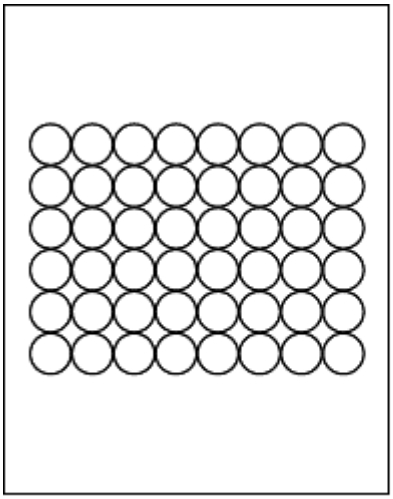
(2)

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

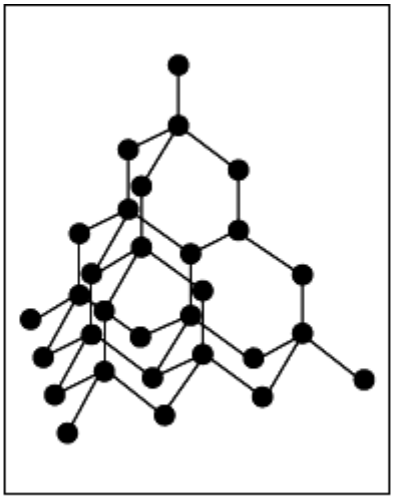
covalent **ionic** **metallic**

(1)
(Total 3 marks)

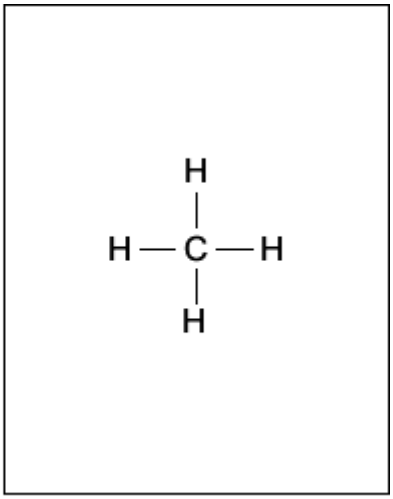
Q5. The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



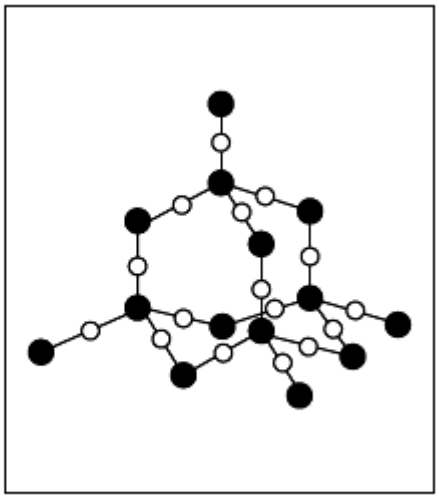
A



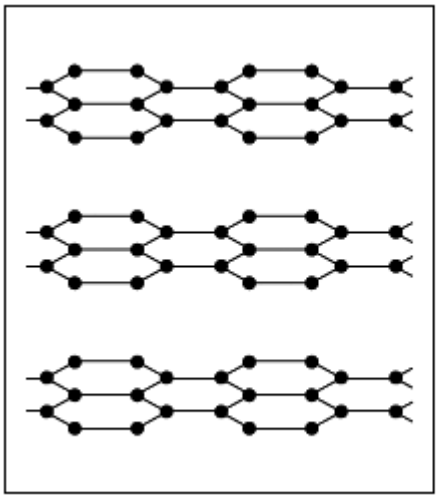
B



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.

.....

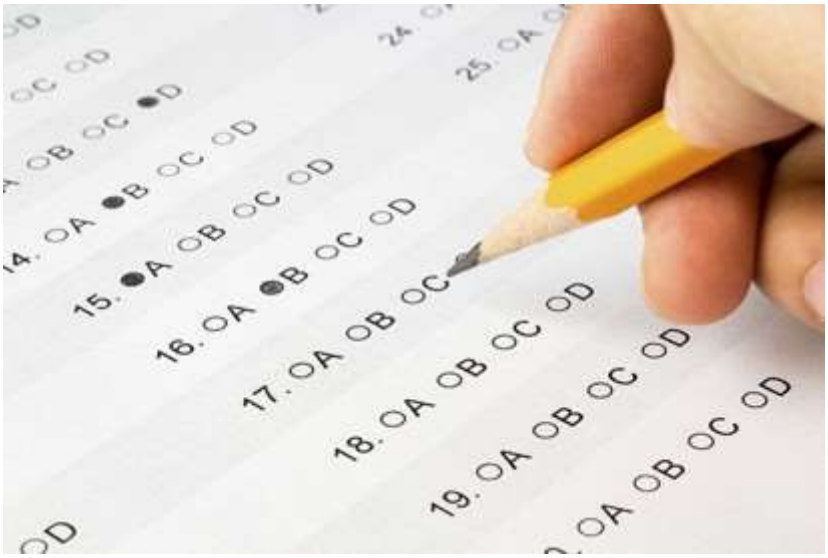
.....

.....

.....

(2)
(Total 6 marks)

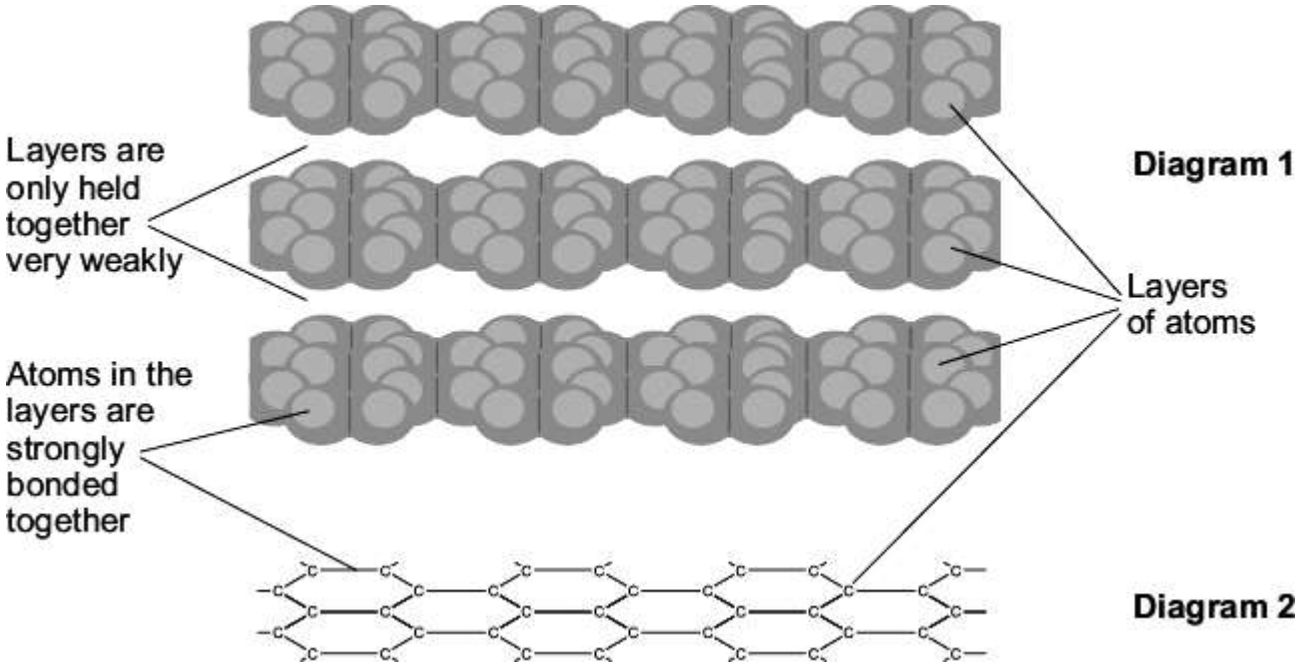
Q6. The picture shows a student using a pencil to complete a multiple choice answer sheet.



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.

.....

.....

.....

.....

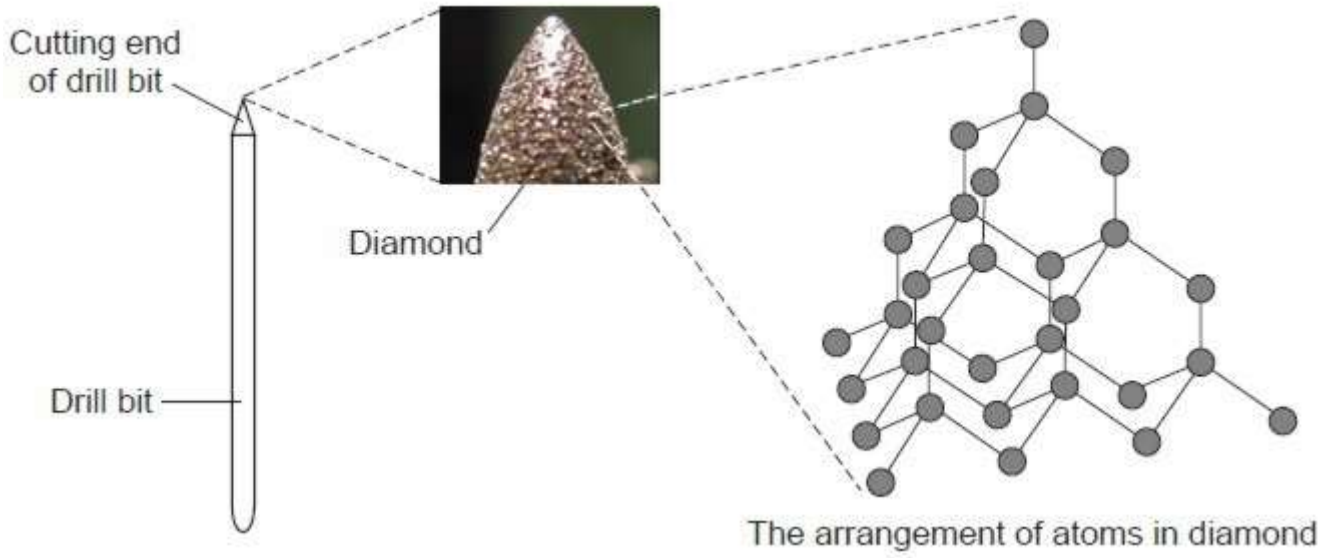
(2)

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

covalent **ionic** **metallic**

(1)
(Total 4 marks)

Q7. 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 / 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)

Q8. 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.

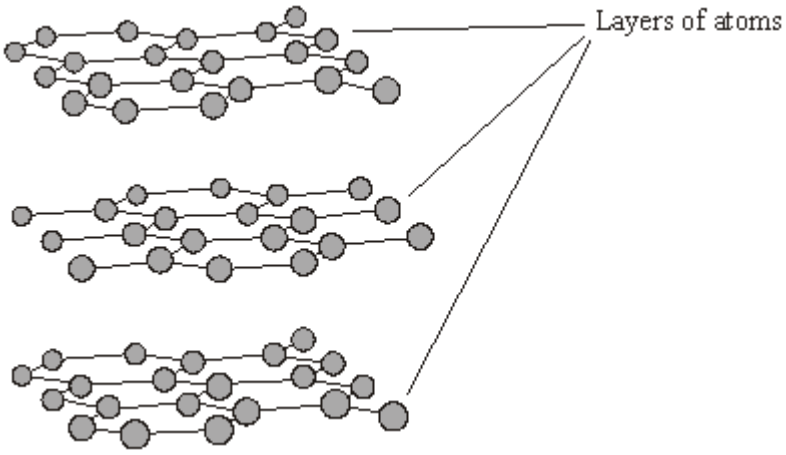
(a) Give **one** reason why a lubricant is used when metal parts rub against each other.

.....

.....

(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.

.....

.....

.....

.....

.....

(2)

(Total 4 marks)