How Bond + Structure Relate to Props

Question Paper 1

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

Time Allowed: **60 minutes**

Score: **/57**

Percentage: **/100**

Grade Boundaries:

Q1. The three states of matter are solid, liquid and gas.

(a) Lithium reacts with water to produce lithium hydroxide solution and hydrogen.

Use the correct state symbols from the box to complete the chemical equation.

aq	g
l	s

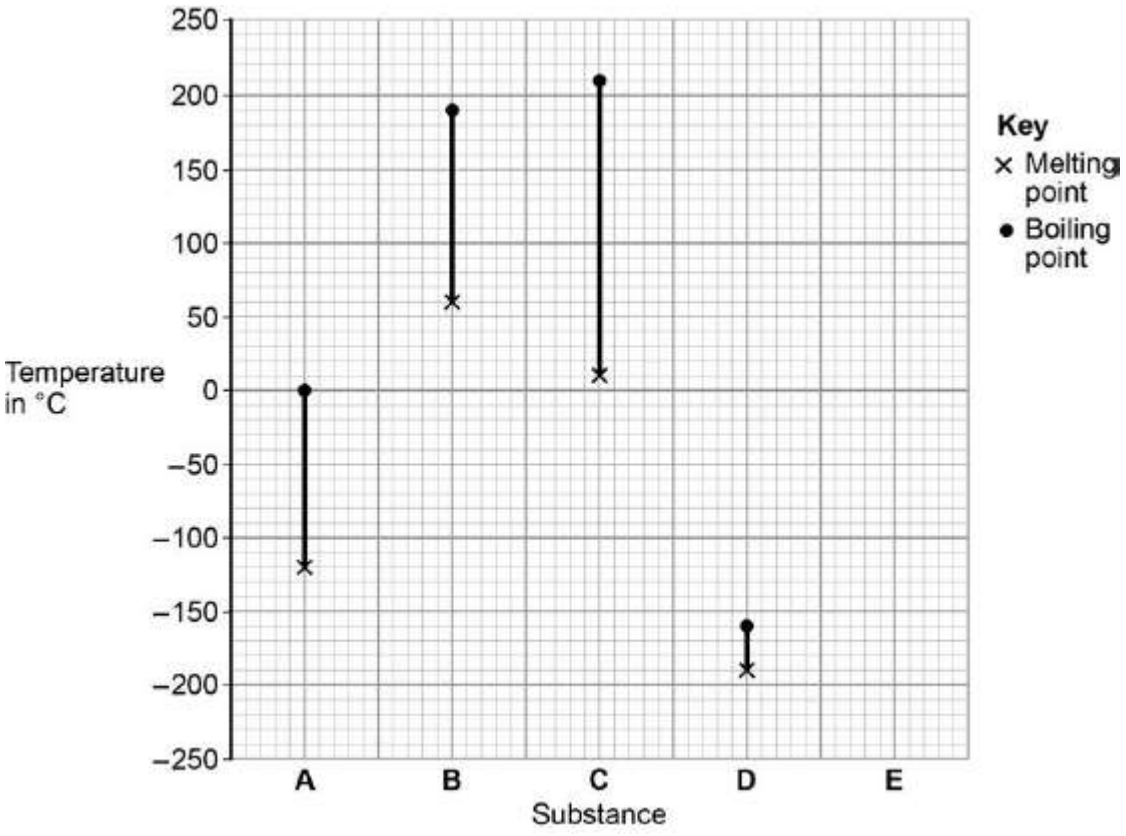
$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(.....) + H_2(.....)$

lithium + water → lithium hydroxide + hydrogen

(2)

(b) **Figure 1** shows the melting points and the boiling points of four substances, **A**, **B**, **C** and **D**.

Figure 1



Which substance is liquid over the greatest temperature range?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(c) Which **two** substances are gases at 50 °C?

Tick **one** box.

A and **B** ☐

B and **C** ☐

C and **D** ☐

A and **D** ☐

(1)

(d) A different substance, **E**, has:

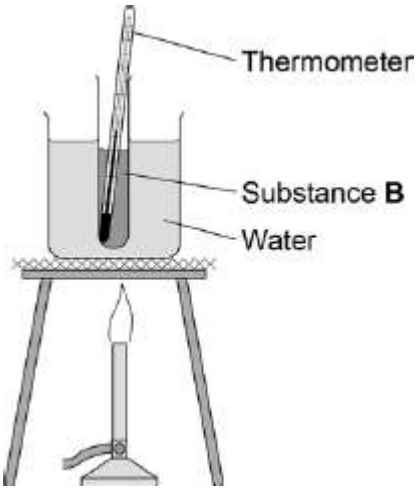
- a melting point of −50 °C
- a boiling point of +120 °C

Plot these two values on **Figure 1**.

(2)

(e) **Figure 2** shows the apparatus a student used to determine the melting point and the boiling point of substance **B** in **Figure 1**.

Figure 2



Explain why the student could not use this apparatus to determine the boiling point of substance **B**.

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.....

.....

.....

(2)

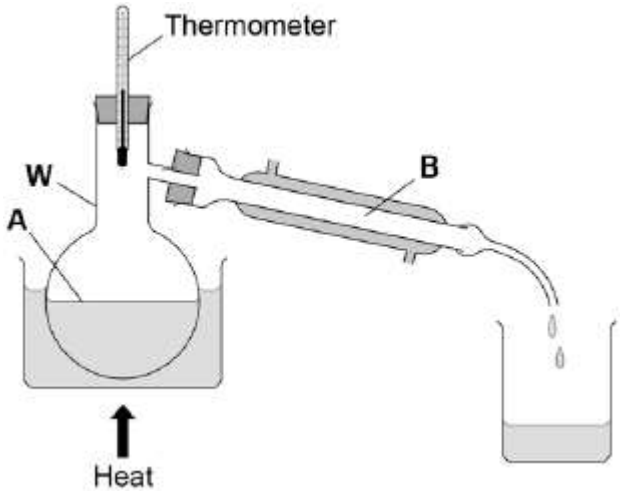
(f) Suggest **one** reason why the student could not use this apparatus to determine the exact melting point of substance **B**.

.....

.....

(1)
(Total 9 marks)

Q2. The apparatus in the figure below is used to separate a mixture of liquids in a fuel.



(a) What is apparatus **W** on above the figure above?

Tick **one** box.

- Beaker ☐
- Boiling Tube ☐
- Flask ☐
- Jug ☐

(1)

(b) What is the name of this method of separation?

Tick **one** box.

- Crystallisation ☐
- Electrolysis ☐
- Filtration ☐

Distillation ☐

(1)

(c) Name the changes of state taking place at **A** and **B** in the figure above.

Use words from the box.

boiling	**condensing**	**freezing**	**melting**

Change of state at **A**: .....

Change of state at **B**: .....

(2)

(d) **Table 1** shows the boiling points of the hydrocarbons in the fuel.

Table 1

Hydrocarbon	Boiling point in °C
Pentane	36
Hexane	69
Heptane	98
Octane	125

Which hydrocarbon will be the last to collect in the beaker?

Tick **one** box.

Pentane ☐

Hexane ☐

Heptane ☐

Octane ☐

(1)

(e) The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

Tick **one** box.

Catalyst ☐

Formulation ☐

Polymer ☐

Solvent ☐

(1)

(f) Describe how this fuel is different from crude oil.

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(2)

(g) A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	Trial 2	Trial 3	Trial 4

Melting point in °C	35	48	37	37

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

.....

.....

Mean melting point = ... °C

(2)

(Total 10 marks)

Q3. 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.

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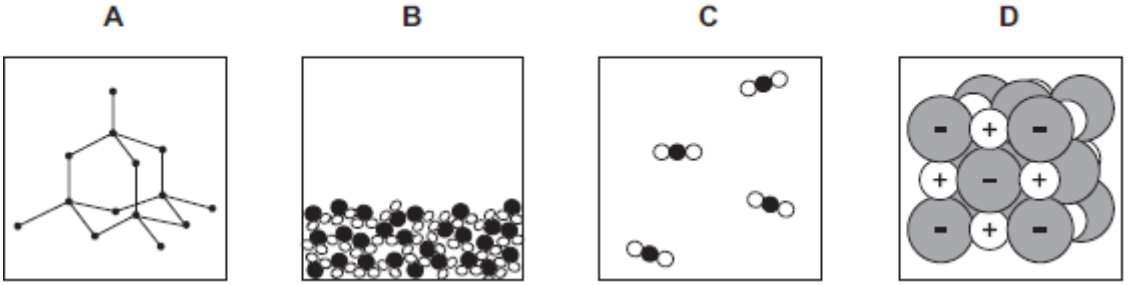
(6)
(Total 11 marks)

Q4. 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? ☐

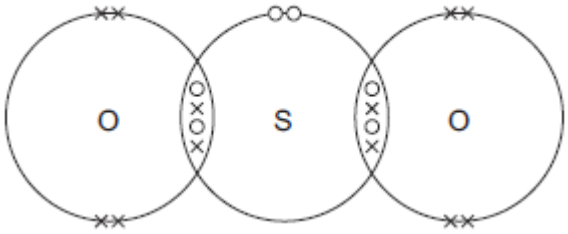
(1)

(iv) Which substance is made of ions? ☐

(1)

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

Figure 2



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

Draw a ring around the correct answer.

SO_2 **SO^2** **S_2O**

(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)

Q5. 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. ☐

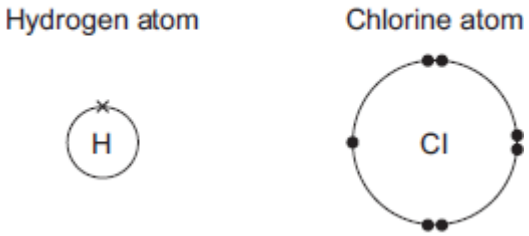
Hydrogen ions move faster than sodium ions. ☐

(1)

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

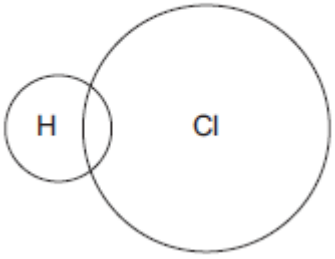
The diagrams in **Figure 1** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

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. ☐

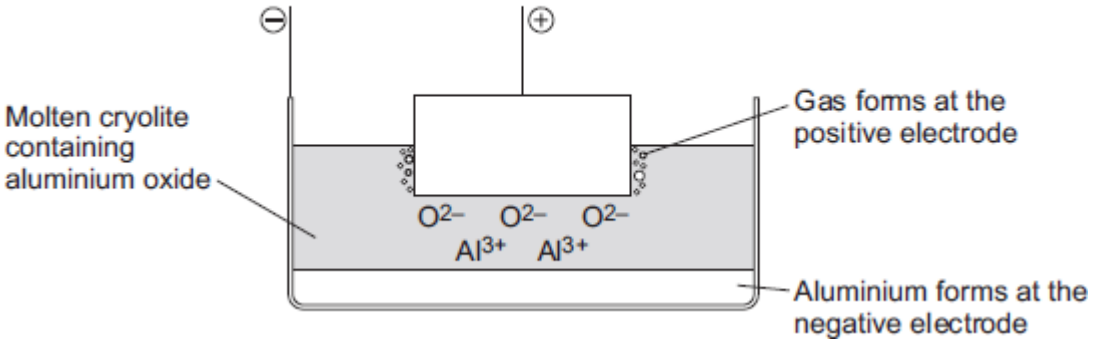
Hydrogen chloride does not conduct electricity. ☐

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 ☐

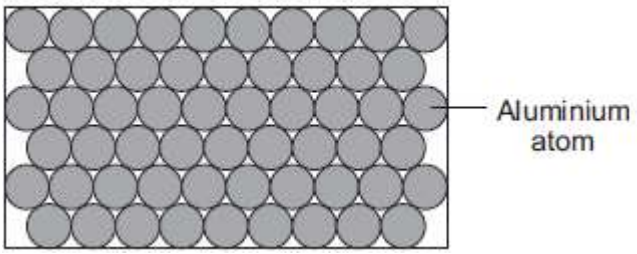
Oxidation ☐

Reduction ☐

(1)

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

Figure 4



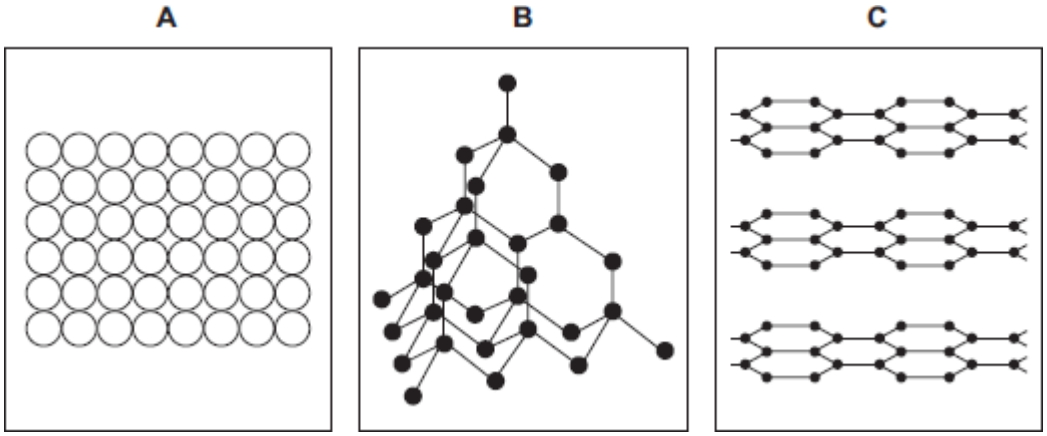
Complete the sentence.

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.

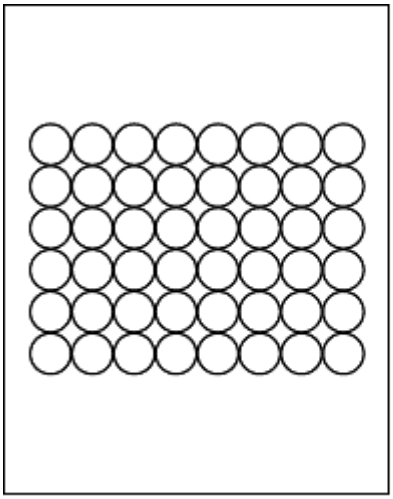
cross links	**a giant ionic lattice**	**strong covalent bonds**

The graphite does not melt at 950 °C because

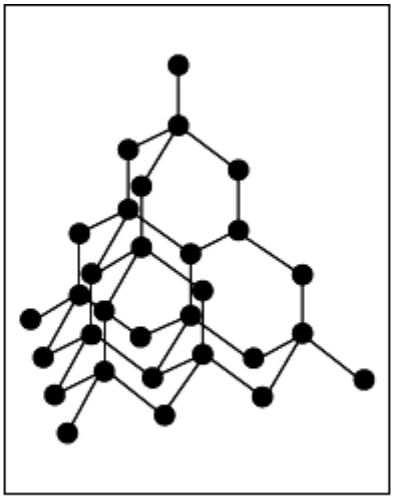
graphite has ..... .

(1)
(Total 14 marks)

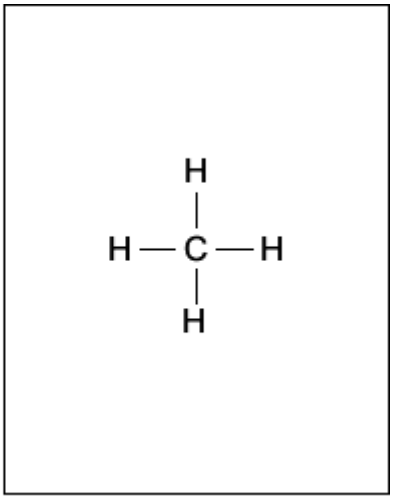
Q6. The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



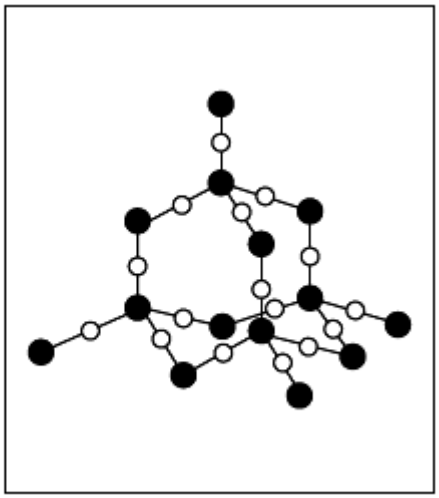
A



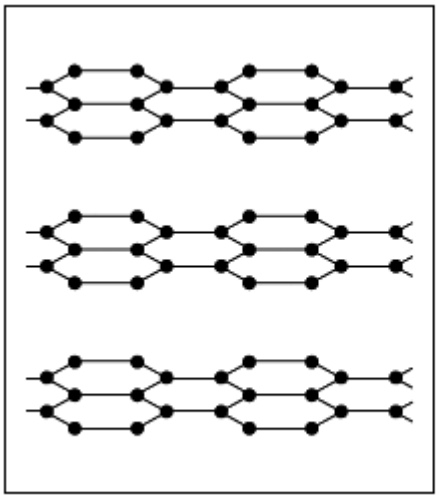
B



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.

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(2)
(Total 6 marks)