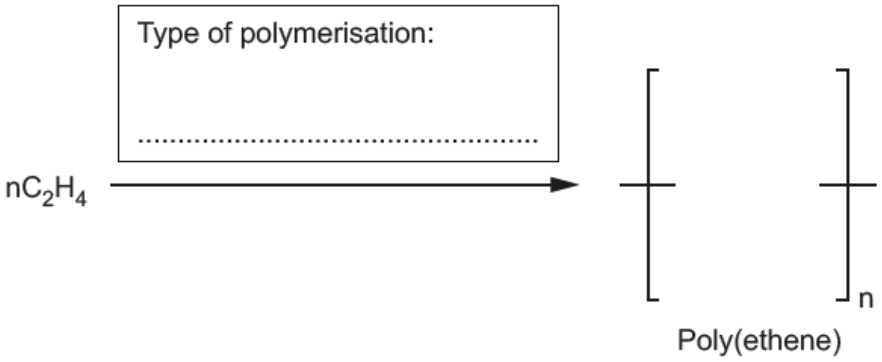
Material choices – 2021/20 GCSE 21st Chemistry B

1. Nov/2020/Paper_J258/01/No.3

Plastic bags are made of poly(ethene).

Poly(ethene) is made by polymerisation of ethene.

(a) Complete the diagram to show the polymerisation of ethene, C_2H_4.



[2]

(b) Ethene, C_2H_4, is made by cracking molecules such as decane, $C_{10}H_{22}$.

Complete the symbol equation for this reaction.

$C_{10}H_{22} \rightarrow C_2H_4 +$ ..... **[1]**

(c) The table shows the energy required to make 1000 poly(ethene) bags and transport them to shops:

	Energy per 1000 bags (kJ)
Energy required to make the raw materials	279000
Energy required to process the raw materials to make the bags	220000
Energy required to transport the bags	11000

(i) Calculate the total energy required **per bag**.

Use data from the table.

Total energy required per bag = ... kJ **[2]**

(ii) Calculate the percentage of the energy in the table required to make the raw materials for 1000 bags.

Give your answer to **2** significant figures.

Percentage = ... % **[3]**

(d) Some plastic materials are described as 'biodegradable'.

What does 'biodegradable' mean?

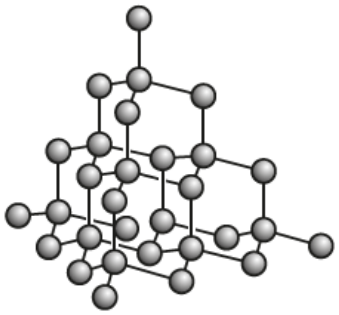
.....

..... **[1]**

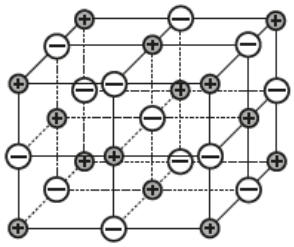
2. Nov/2020/Paper_J258/01/No.5(d)

(d) **Fig. 5.3** shows models of four types of giant structure.

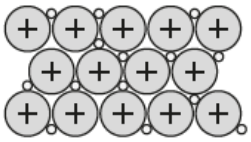
A



B



C



D

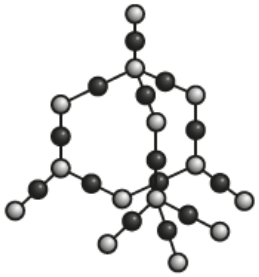


Fig. 5.3

(i) Which **two** structures are compounds?

Put a (ring) around the **two** correct answers.

A **B** **C** **D**

[2]

(ii) Which structure conducts electricity when it is solid?

Put a (ring) around the **one** correct answer.

A **B** **C** **D**

[1]

(iii) Which **two** structures contain ions?

Put a (ring) around the **two** correct answers.

A **B** **C** **D**

[2]

3. Nov/2021/Paper_J258/02/No.5

Aluminium is extracted from molten aluminium oxide by electrolysis.

(a) Explain why molten aluminium oxide conducts electricity but solid aluminium oxide does not.

.....

.....

.....

..... **[2]**

(b) **Fig. 3.1** shows the tank used to electrolyse aluminium oxide.

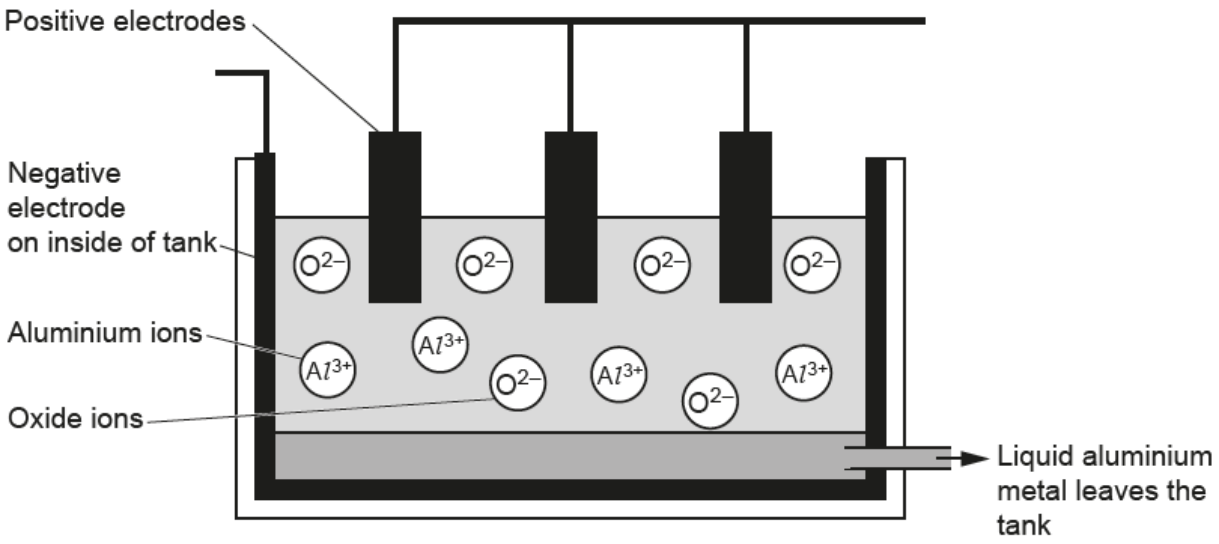


Fig. 3.1

(i) Give the name of the product formed at each electrode in **Fig. 3.1**.

Product at positive electrode .....

Product at negative electrode .....

[2]

(ii) The temperature inside the tank is 900 °C. The aluminium metal leaves the tank as a liquid.

What does this tell you about aluminium metal?

Tick (✓) **one** box.

The boiling point of aluminium metal is below 900 °C. ☐

The melting point of aluminium metal is above 900 °C. ☐

The melting point of aluminium metal is below 900 °C. ☐

[1]

(c) Aluminium metal is used to make electrical cables.

Fig. 3.2 shows the bonding in a metal.

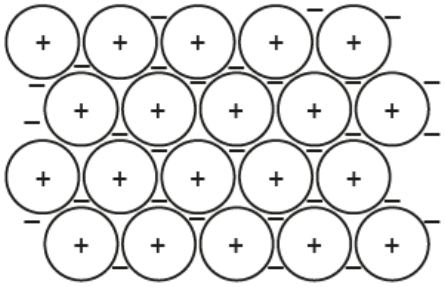


Fig. 3.2

(i) What does (+) in **Fig. 3.2** represent?

Tick (✓) **one** box.

A metal ion ☐

A molecule ☐

A neutron ☐

A proton ☐

[1]

(ii) Describe what happens when a metal conducts electricity.

.....

..... **[2]**

(d) Aluminium, copper and silver are all metals with high electrical conductivity.

The table shows information about each metal.

Metal	Electrical conductivity (MS/m)	Density (g/cm^3)	Price (£/kg)
Copper	58	9.0	5
Silver	63	10.5	370
Aluminium	35	2.7	1

(i) Give **two** reasons why copper is a better choice than silver or aluminium for most electrical wiring.

Use the table to help.

1. .....

.....

2. .....

.....

[2]

(ii) Aluminium is used to make overhead power cables.

Give **one** advantage and **one** disadvantage of using aluminium rather than copper for overhead power cables.

Advantage

.....

.....

Disadvantage

.....

.....

[2]

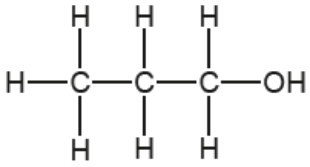
4. Nov/2020/Paper_J258/01/No.1(a)

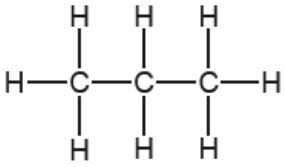
Drinking cups can be made from poly(propene) or aluminium.

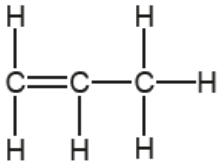
(a) Poly(propene) is made from propene. Propene has the structural formula $CH_3CH=CH_2$.

(i) Which is the correct displayed formula for propene?

Put a (ring) around the correct answer.







[1]

(ii) Complete **Fig. 1.1** to show the repeating unit of poly(propene).

Use **one** term from the list.

H **CH_3** **C_3H_6**

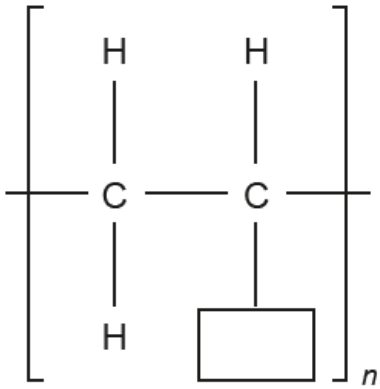


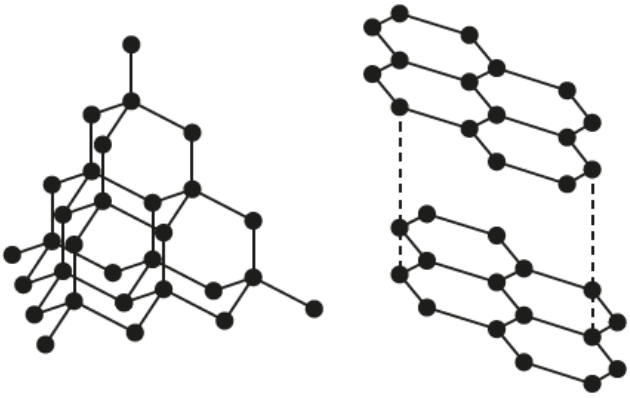
Fig. 1.1

[1]

5. Nov/2020/Paper_J258/01/No.4

Diamond and graphite are allotropes of carbon. They are both giant structures.

Fig. 4.1 shows models of diamond and graphite:



Diamond **Graphite**

Fig. 4.1

(a) (i) What do the black dots in **Fig. 4.1** represent?

..... **[1]**

(ii) Name the type of bond that is represented by the solid black lines in **Fig. 4.1**.

..... **[1]**

(b) **Fig. 4.2** shows a model of sodium chloride, which has a giant ionic lattice structure.

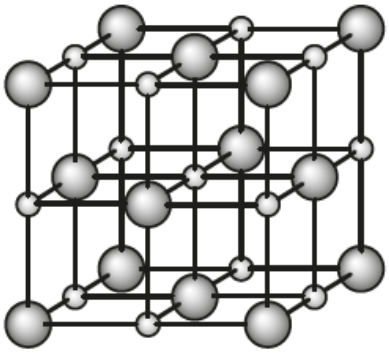


Fig. 4.2

Describe **one** similarity and **one** difference between the properties of sodium chloride and graphite.

Similarity .....

.....

Difference .....

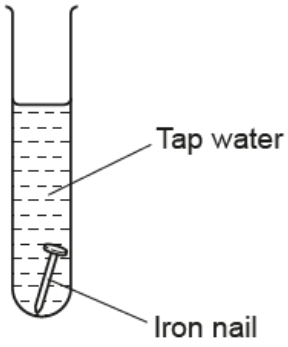
.....

[2]

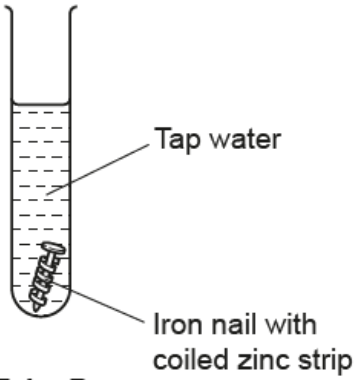
6. Nov/2020/Paper_J258/01/No.6

Iron is an important metal in the construction industry. The main disadvantage of iron is that it rusts.

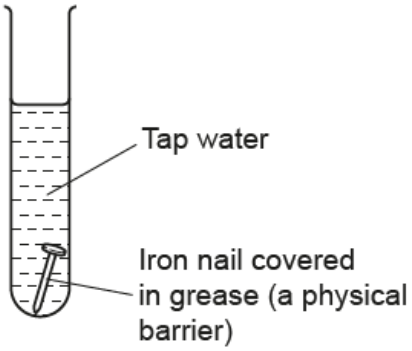
Mia investigates the rusting of iron, using iron nails. She has three test tubes, **Tube A**, **Tube B** and **Tube C**.



Tube A



Tube B



Tube C

(a) (i) The iron nail in **Tube B** rusts much more slowly than the iron nail in **Tube A**.

Explain why.

.....

..... **[2]**

(ii) Mia compares **Tube A** with **Tube C**.

Complete the sentence using **one** of the phrases below.

faster than **more slowly than** **at the same rate as**

The iron nail in **Tube C** rusts .....the iron nail in **Tube A**.
[1]

(iii) Explain your answer to **(a)(ii)**.

.....

..... **[1]**

(b) Mia collects the rust. She dissolves the rust in hydrochloric acid and adds some sodium hydroxide solution.

She sees a brown precipitate.

What is the name of this brown precipitate?

Tick (✓) **one** box.

Iron(III) chloride ☐

Iron(II) hydroxide ☐

Iron(III) hydroxide ☐

Sodium chloride ☐

[1]

(c) Mia now reacts an iron nail with hydrochloric acid.

Write a **word** equation for this reaction.

..... **[2]**

7. Nov/2020/Paper_J258/02/No.1

Fig. 1.1 shows the dot and cross diagrams for some molecules.

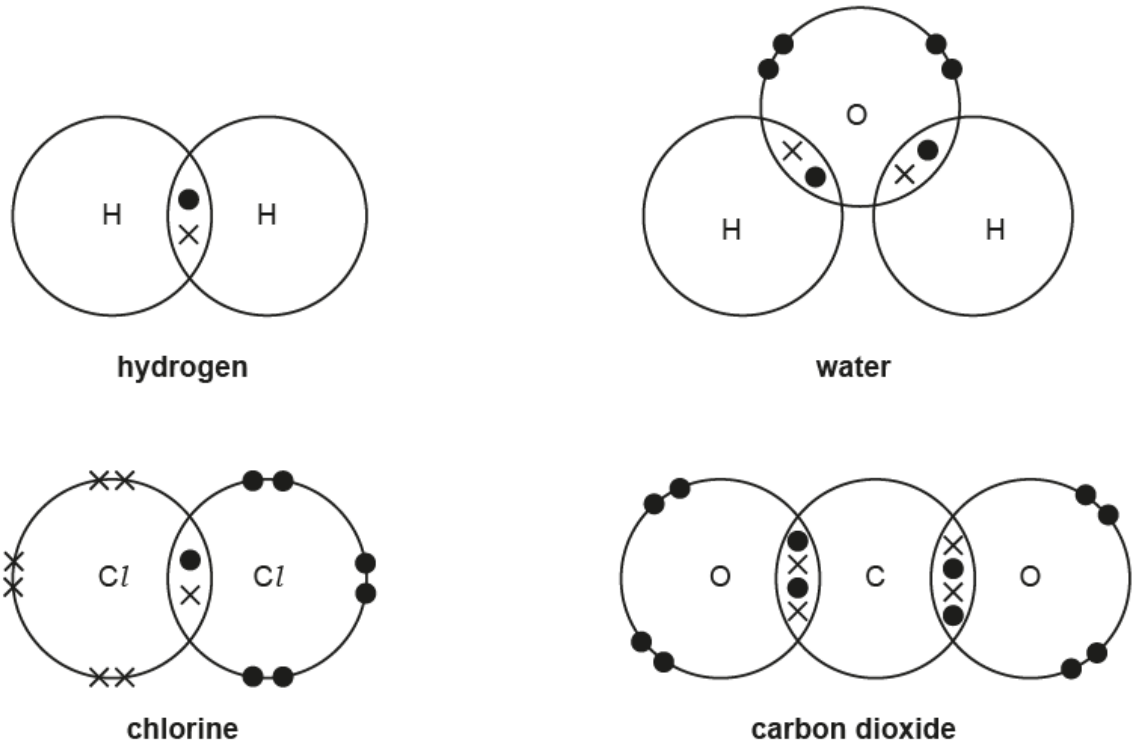


Fig. 1.1

(a) Which molecules are elements and which are compounds?

Tick (✓) **one** box in each row.

	Element (✓)	Compound (✓)
carbon dioxide		
chlorine		
hydrogen		
water		

[2]

(b) How do the dot and cross diagrams in **Fig. 1.1** show that all of these molecules are simple covalent?

Tick (✓) **two** boxes.

- They are all gases. ☐
- They bond by sharing electrons. ☐
- They contain only a few atoms. ☐
- They have electrons in their outer shells. ☐

[2]

(c) How does the dot and cross diagram in **Fig. 1.1** show that carbon dioxide has double bonds?

.....

.....

.....

..... **[2]**

(d) Using **Fig. 1.1**, complete the table to show how many bonds each atom forms.

Atom	Number of bonds
hydrogen	.....
oxygen	2
carbon	.....
chlorine	.....

[2]

(e) Argon is a gas. The arrangement of electrons in the outer shell of argon is shown in **Fig. 1.2**.

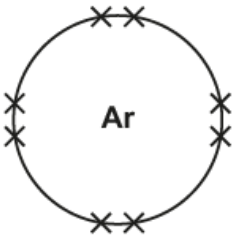


Fig. 1.2

Explain **how** and **why** argon is different to the simple covalent molecules shown in **Fig. 1.1**.

.....

.....

.....

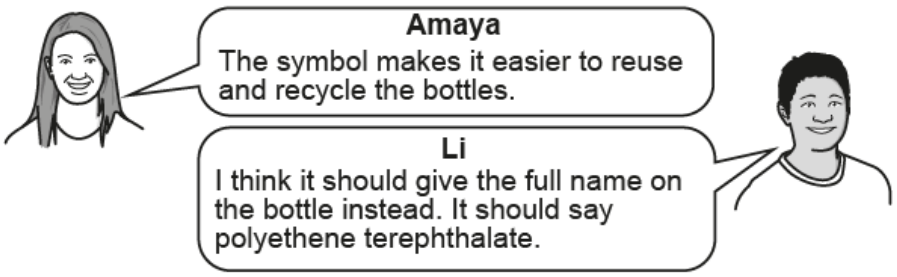
..... **[2]**

8. Nov/2020/Paper_J258/02/No.5

Mixed plastic waste contains drinks bottles made from a polymer known as PET (polyethene terephthalate).

Bottles made from PET have this symbol on the bottle.

(a) Amaya and Li discuss the PET symbol.



Do you agree with each person's comments?

Give **one** reason for each of your answers.

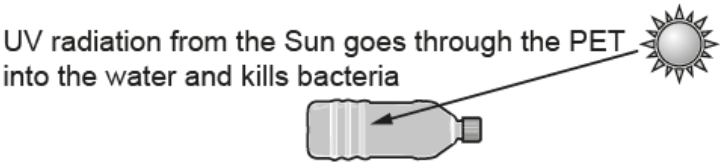
Amaya .....

.....

Li .....

..... **[2]**

(b) In some countries, waste PET bottles are used to treat water to make it safe for drinking. They are washed and dried first, and then filled with water and left in the Sun.



(i) If glass bottles are used instead of PET bottles, the bacteria are not killed.

Suggest why bacteria in water in a glass bottle are not killed.

..... **[1]**

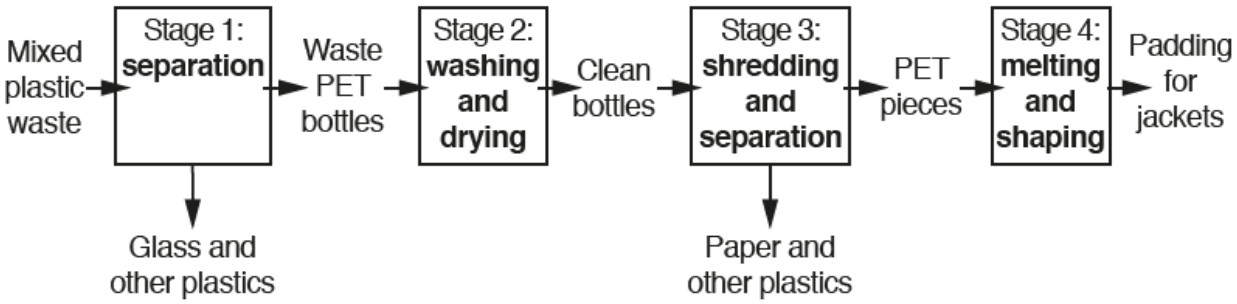
(ii) In the UK, bacteria in drinking water are killed by adding a substance to the water.

Name this substance.

..... **[1]**

(c) Waste PET bottles can also be processed to be remade into polymers for new products.

The flowchart shows how mixed plastic waste is processed to produce padding for jackets.



(i) Which stage of the flowchart produces pure PET?

Stage ..... **[1]**

(ii) Waste PET bottles that are used to treat water are removed from the process before the end.

After which stage should bottles that are used to treat water be removed?

Stage ..... **[1]**

(d) Using waste PET bottles to treat water or to make padding for jackets are two examples of ways to reduce mixed plastic waste.

Explain the difference between **reusing** and **recycling** PET bottles, using these two examples.

.....

.....

.....

..... **[2]**

(e) Waste PET bottles used to treat water and to make padding for jackets have different Life Cycle Assessments.

Give **two** reasons why their Life Cycle Assessments are different.

1. .....

.....

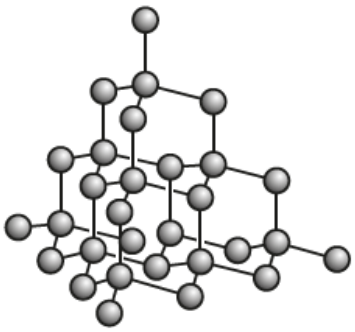
2. .....

..... **[2]**

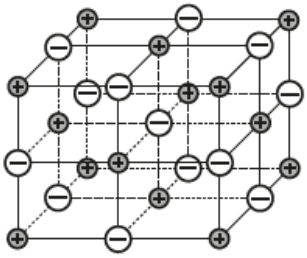
9. Nov/2021/Paper_J258/03/No.6(d)

(d) **Fig. 6.3** shows models of four types of giant structure.

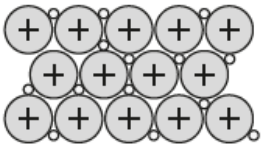
A



B



C



D

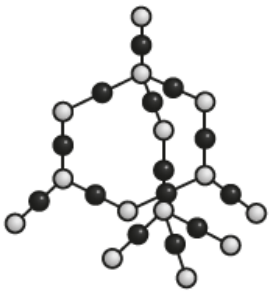


Fig. 6.3

(i) Which **two** structures contain covalent bonds?

Put a (ring) around the **two** correct answers.

A **B** **C** **D**

[2]

(ii) Which structure only conducts electricity when it is molten?

Put a (ring) around the **one** correct answer.

A **B** **C** **D**

[1]

10. Nov/2021/Paper_J258/03/No.8

Plastic bags are made of poly(ethene).

(a) (i) Poly(ethene) is made by polymerising ethene, C_2H_4.

Draw the structure of the repeating unit of poly(ethene).

[2]

(ii) What **type** of polymer is poly(ethene)?

..... **[1]**

(b) (i) Ethene, C_2H_4, is made by cracking molecules such as decane, $C_{10}H_{22}$.
One other product is made in the reaction.

Write a balanced symbol equation for the cracking of decane.

..... **[2]**

(ii) Ethene is an alkene.

Describe a laboratory test for an alkene **and** the expected result for ethene.

Test .....

.....

Result .....

.....
[2]

(c) **Table 8.1** shows the energy required to make 1000 poly(ethene) bags and transport them to shops:

	Energy per 1000 bags (kJ)
Energy required to make the raw materials	279 000
Energy required in processing the raw materials to make bags	220 000
Energy required to transport the bags	11 000

Table 8.1

(i) Calculate the percentage of the energy in the table required to transport the bags.

Give your answer to **1** decimal place.

Percentage = ... % **[3]**

(ii) Sarah estimates the cost of recycling waste bags into new bags.

Table 8.2 shows her estimates:

	Energy per 1000 bags (kJ)
Processing	220 000
Transport	11 000

Table 8.2

Suggest why Sarah's estimates may be inaccurate.

Use data from **Table 8.1** and **Table 8.2** to support your answer.

.....

.....

..... **[2]**

(d) Poly(ethene) is described as 'non-biodegradable'.

Define '**non-biodegradable**'.

.....

..... **[1]**

11. Nov/2021/Paper_J258/04/No.5

Table 5.1 and **Table 5.2** show information about the structures and uses of diamond and graphene.

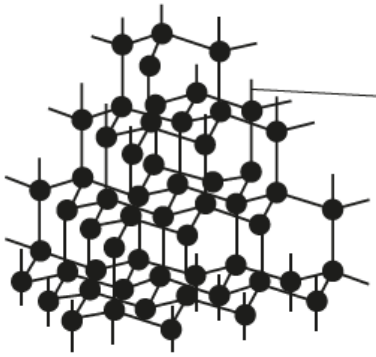
	Diamond
Structure: Giant covalent	 Many carbon atoms. Each carbon atom is bonded to four others with covalent bonds in a 3-dimensional lattice.
Uses	Tips of high speed drilling machinery.

Table 5.1

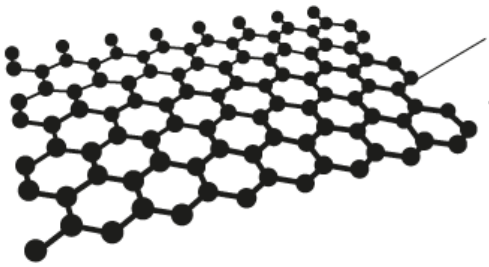
	Graphene
Structure: Nanoparticle	 Each sheet contains a single layer of carbon atoms bonded together with covalent bonds. Structure contains delocalised electrons.
Uses	Making micro-scale electronic components and batteries.

Table 5.2

(a)* Discuss the similarities and differences between the properties of diamond and graphene in terms of their structures and explain why they have different uses.

Use information from **Table 5.1** and **Table 5.2** in your answer.

.....

.....

.....

.....

.....

.....

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.....

.....

.....

.....

..... **[6]**

(b) New types of batteries that contain nanoparticles of graphene have been available for less than 10 years.

Some people are concerned about the health effects of using new products that contain nanoparticles.

(i) Why are people concerned about the health effects of nanoparticles?

.....

.....

.....

..... **[2]**

(ii) Life cycle assessments are done to evaluate the sustainability of making new products.

Suggest **two** factors that are important to consider in evaluating the sustainability of graphene batteries.

1. .....

.....

2. .....

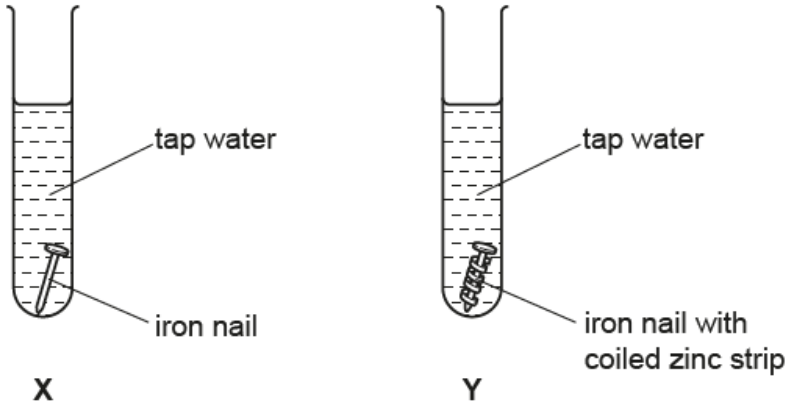
.....

[2]

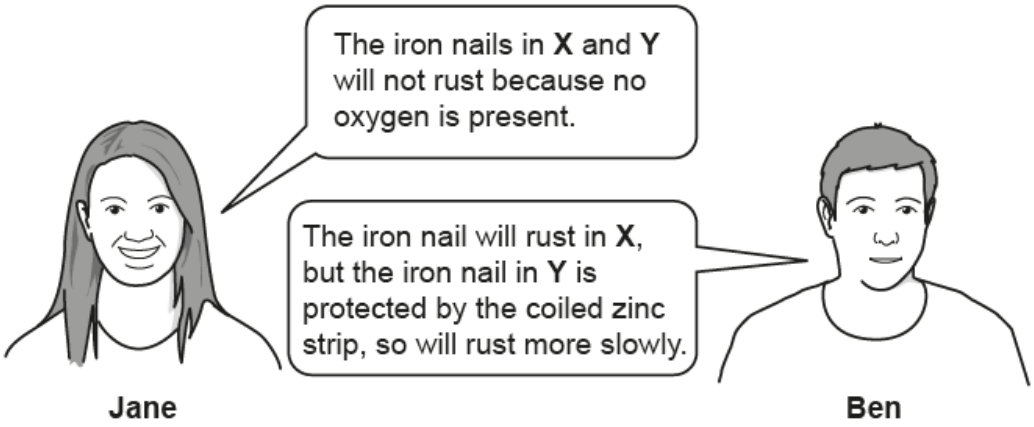
12. Nov/2020/Paper_J258/03/No.6

Iron is an important metal in the construction industry. The main disadvantage of iron is that it rusts.

Jane and Ben investigate the rusting of iron nails using two test tubes, **X** and **Y**.



(a) Jane and Ben discuss the investigation:



Do you agree with each person's comments?

Give **one** reason for each of your answers.

Jane .....

.....

Ben .....

.....

[2]

(b) When iron rusts, an iron(III) cation is made.

$Fe \longrightarrow Fe^{3+} + 3e^-$

(i) What is being oxidised in this reaction?

Put a ring around the correct formula.

Fe **Fe^{3+}** **$3e^-$**

[1]

(ii) Give **one** reason for your answer to **(b)(i)**.

.....

..... **[1]**

(c) Jane collects the rust. She dissolves the rust in hydrochloric acid and adds some sodium hydroxide solution.

She sees a brown precipitate.

What is the name of this brown precipitate?

Tick (✓) **one** box.

Iron(III) chloride ☐

Iron(II) hydroxide ☐

Iron(III) hydroxide ☐

Sodium chloride ☐

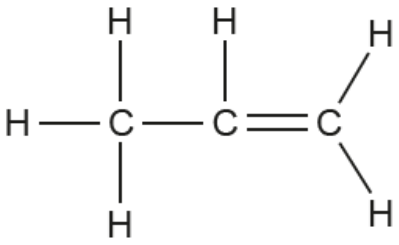
[1]

13. Nov/2020/Paper_J258/03/No.7

Drinking cups can be made from poly(propene) or aluminium.

(a) Poly(propene) is made from propene.

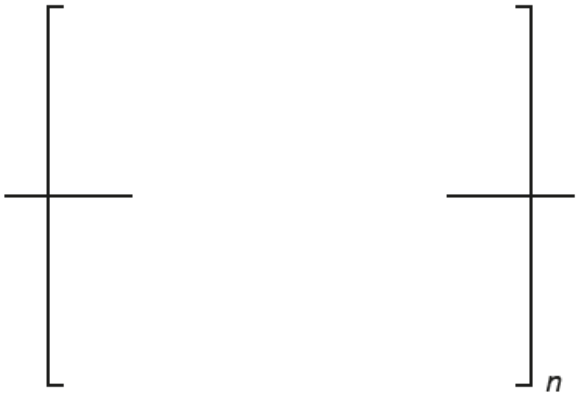
The displayed formula for propene is shown below:



(i) What is the empirical formula of propene?

..... **[1]**

(ii) Draw the structure for a repeating unit of poly(propene).

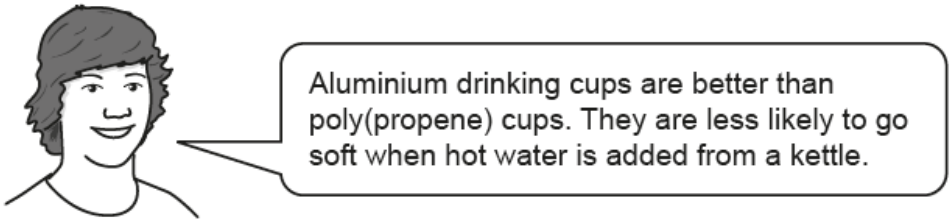


[2]

(b) Aluminium melts at 660 °C. Poly(propene) melts at 130 °C.

Hot water from a kettle has a temperature of between 90 °C and 100 °C.

James says,



James

Do you agree with James?

Yes ☐

No ☐

Explain your answer.

.....

..... **[1]**

(c) Which statements about polymers are **true**, and which are **false**?

Tick (✓) **one** box in each row.

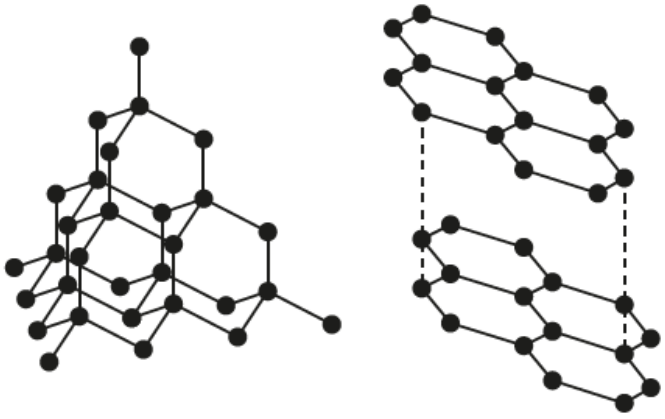
	True	**False**
When monomers form condensation polymers, a small molecule is also formed.		
DNA is a polymer formed from nucleotides.		
To make a condensation polymer, each monomer needs only one functional group.		

[3]

14. Nov/2020/Paper_J258/03/No.8

Diamond and graphite are allotropes of carbon.

Models of diamond and graphite are shown in **Fig. 8.1**:



Diamond **Graphite**

Fig. 8.1

(a) Graphite can mark paper but diamond **cannot**.

Explain why.

Use ideas about intermolecular forces and bonding in your answer.

.....

.....

.....

.....

.....

..... **[3]**

(b) **Fig. 8.2** shows a model of sodium chloride:

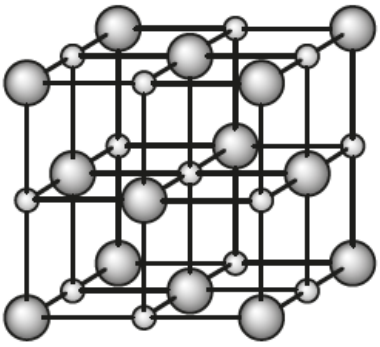


Fig. 8.2

What type of structure does sodium chloride have?

You should include the type of bonding in your answer.

..... **[1]**

(c) Complete the table to explain how graphite and sodium chloride conduct electricity.

	Graphite	**Sodium chloride**
Conducts electricity when:	solid	either molten or .....
Particles responsible for conduction of electricity:	.....	.....

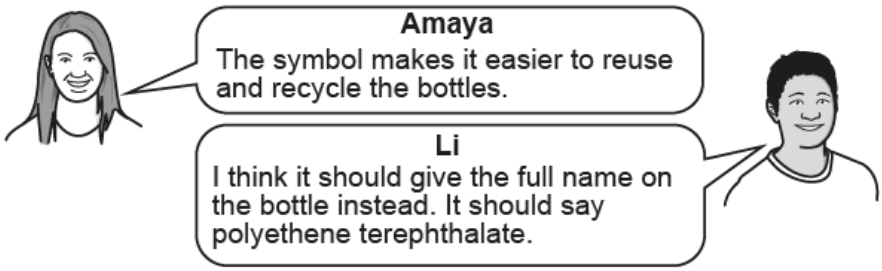
[3]

15. Nov/2020/Paper_J258/04/No.1

Mixed plastic waste contains drinks bottles made from a polymer known as PET (polyethene terephthalate).

Bottles made from PET have this symbol on the bottle.

(a) Amaya and Li discuss the PET symbol.



Do you agree with each person's comments?

Give **one** reason for each of your answers.

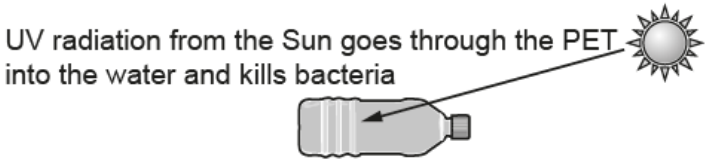
Amaya .....

.....

Li .....

..... **[2]**

(b) In some countries, waste PET bottles are used to treat water to make it safe for drinking. They are washed and dried first, and then filled with water and left in the Sun.



(i) If glass bottles are used instead of PET bottles, the bacteria are not killed.

Suggest why bacteria in water in a glass bottle are not killed.

..... **[1]**

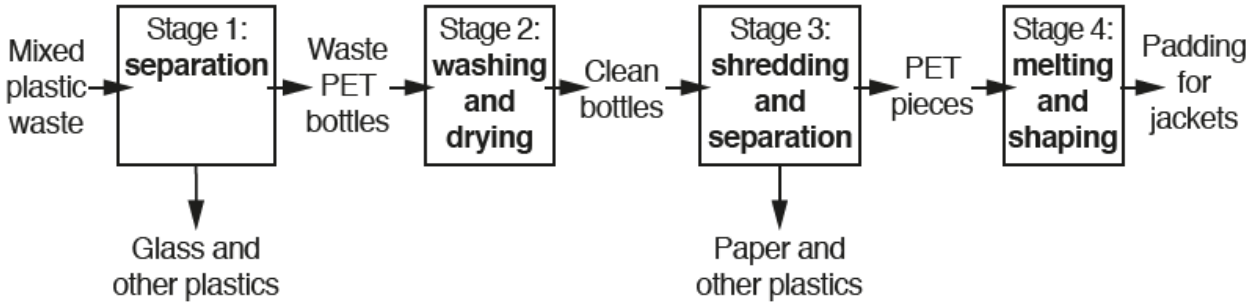
(ii) In the UK, bacteria in drinking water are killed by adding a substance to the water.

Name this substance.

..... **[1]**

(c) Waste PET bottles can also be processed to be remade into polymers for new products.

The flowchart shows how mixed plastic waste is processed to produce padding for jackets.



(i) Which stage of the flowchart produces pure PET?

Stage ..... **[1]**

(ii) Waste PET bottles that are used to treat water are removed from the process before the end.

After which stage should bottles that are used to treat water be removed?

Stage ..... **[1]**

(d) Using waste PET bottles to treat water or to make padding for jackets are two examples of ways to reduce mixed plastic waste.

Explain the difference between **reusing** and **recycling** PET bottles using these two examples.

.....

.....

.....

..... **[2]**

(e) Waste PET bottles used to treat water and to make padding for jackets have different Life Cycle Assessments.

Give **two** reasons why their Life Cycle Assessments are different.

1. .....

.....

2. .....

.....

[2]

16. Nov/2020/Paper_J258/03/No.5

Sodium oxide, Na_2O and magnesium oxide, MgO, are both oxides with ionic bonds. When ionic bonds form, electrons pass from one atom to another to form ions.

Fig. 5.1 and **Fig. 5.2** show the arrangement of electrons in the **atoms** and **ions** for each oxide.

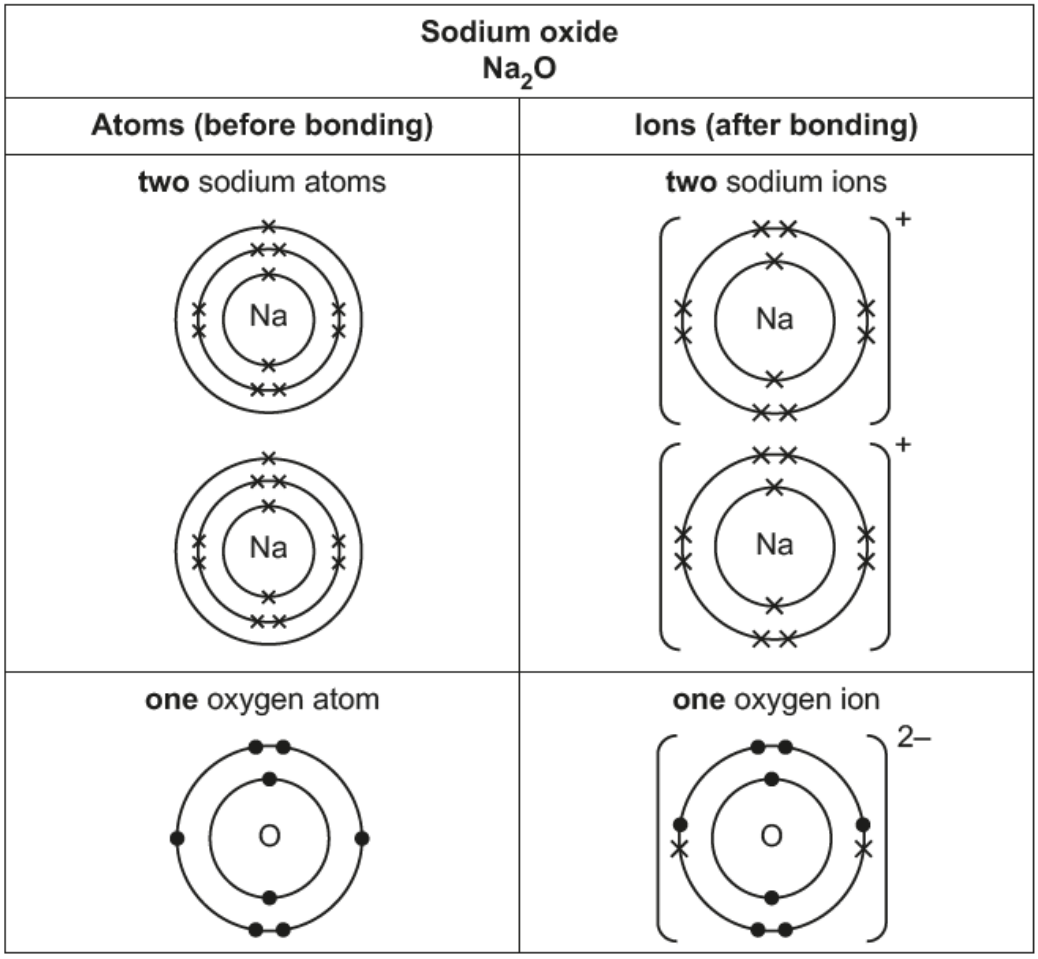


Fig. 5.1

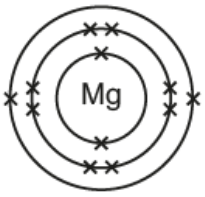
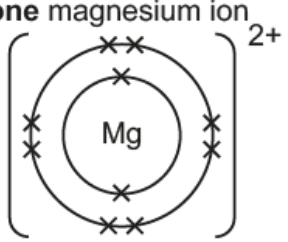
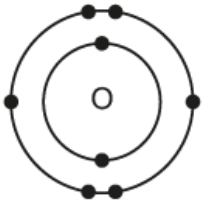
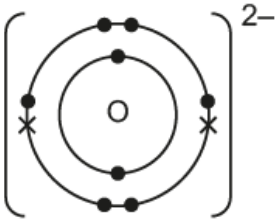
<table>
<tr><th colspan="2">Magnesium oxide
MgO</th></tr>
<tr><th>Atoms (before bonding)</th><th>Ions (after bonding)</th></tr>
<tr><td>one magnesium atom
 
</td><td>one magnesium ion
 
</td></tr>
<tr><td>one oxygen atom
 
</td><td>one oxygen ion
 
</td></tr>
</table>

Fig. 5.2

(a)* **Describe** and **explain** how ionic bonds in sodium oxide (**Fig. 5.1**) and magnesium oxide (**Fig. 5.2**) form, and explain why the two oxides have different formulae.

Use ideas about electrons and electron shells in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

(b) Sodium oxide and magnesium oxide are both ionic compounds.

Which statements about **both** sodium oxide **and** magnesium oxide are correct?

Tick (✓) **two** boxes.

Their boiling points are $>$ 100 °C. ☐

They conduct electricity when molten. ☐

They have very low melting points. ☐

They have weak intermolecular forces between their particles. ☐

They react with dilute acids to give a salt, water and carbon dioxide. ☐

[2]

17. Nov/2020/Paper_J258/03/No.7(a)

Calcium nitrate, $Ca(NO_3)_2$, and ammonium nitrate, NH_4NO_3, are ionic compounds which are used to make fertilisers.

(a) **Fig. 7.1** shows how the ions are arranged in a solid, ionic compound.

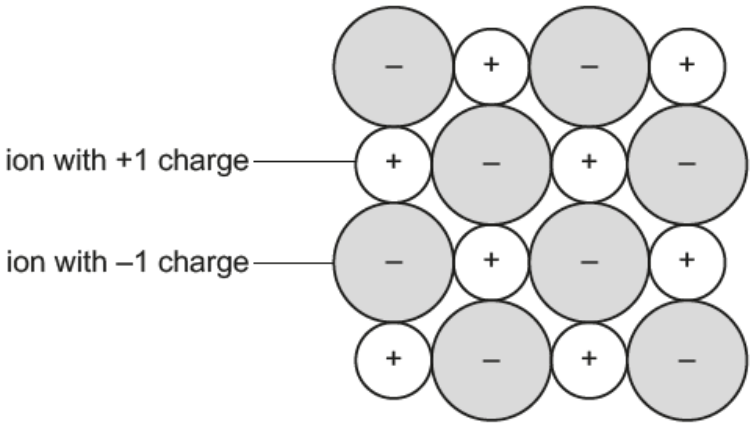


Fig. 7.1

(i) Give **two** reasons why **Fig. 7.1** is a better representation for the ions in solid ammonium nitrate, NH_4NO_3, than the ions in solid calcium nitrate, $Ca(NO_3)_2$.

1. .....

.....

2. .....

.....

[2]

(ii) In **Fig. 7.1** the ions are shown far larger than they actually are.

Suggest **two other** reasons why **Fig. 7.1** does not accurately represent a solid ionic compound.

1. .....

.....

2. .....

.....

[2]