Properties of Materials – 2022 GCSE Gateway Chemistry Combined Science A

1. June/2022/Paper_ J250/03/No.11(c)

(c) The table shows the melting point and boiling point of pure nitrogen dioxide.

Melting point (°C)	Boiling point (°C)
–9	21

(i) Which state symbol shows the physical state of nitrogen dioxide at –2 °C?

Tick (✓) **one** box.

g ☐

l ☐

s ☐

[1]

(ii) A scientist measures the melting point of a sample of nitrogen dioxide.

The result shows that the sample of nitrogen dioxide is impure.

Which temperature could be the melting point of the impure nitrogen dioxide?

Tick (✓) **one** box.

–11 °C ☐

–9 °C ☐

23 °C ☐

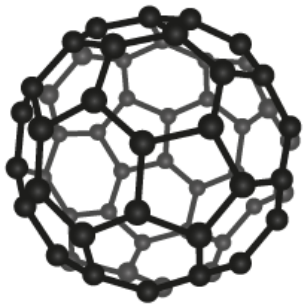
[1]

2. June/2022/Paper_ J250/03/No.15

Fullerenes are allotropes of carbon that have many uses.

Fig. 15.1 shows a molecule of a fullerene.

Fig. 15.1



(a) (i) Which group of allotropes contain this fullerene?

Tick **one** (✓) box.

Inorganic ☐

Organic ☐

Physical ☐

[1]

(ii) What is the approximate size of a molecule of this fullerene?

Tick **one** (✓) box.

1×10^{-15} m ☐

1×10^{-10} m ☐

1×10^{-5} m ☐

[1]

(b) The carbon atoms in fullerenes are joined by covalent bonds.

(i) Explain how two atoms of carbon form a covalent bond.

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.....

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

(ii) How many covalent bonds does one atom of carbon form in a molecule of fullerene, as shown in **Fig. 15.1**?

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

(c) The model used to show the molecule of fullerene in **Fig. 15.1** has limitations.

The table shows some statements about the model.

Which statements about this model are **true**, and which are **false**?

Tick (✓) **one** box in each row.

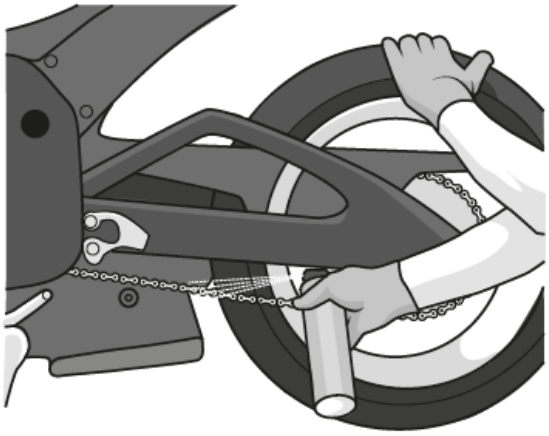
	True	False
It shows the length of the covalent bonds.		
It shows the size of the carbon atoms.		
It shows the three-dimensional shape of the molecule.		

[2]

(d) Fullerenes can be used as lubricants. Lubricants reduce the friction between moving parts.

Fig. 15.2 shows a lubricant being sprayed onto the chain of a motorbike.

Fig. 15.2



(i) Explain why fullerenes can be used as lubricants.

Use ideas about the structure and bonding of the fullerene shown in **Fig. 15.1** in your answer.

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

(ii) A lubricant may need to be used at high temperatures.

Explain why fullerenes can be used at high temperatures.

Use ideas about the structure and bonding of the fullerene shown in **Fig. 15.1** in your answer.

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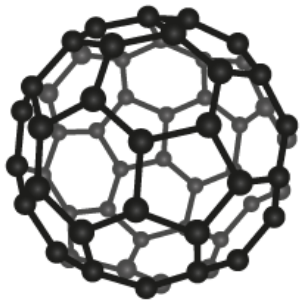
..... **[3]**

3. June/2022/Paper_ J250/09/No.11

Fullerenes are allotropes of carbon that have many uses.

Fig. 11.1 shows a molecule of a fullerene.

Fig. 11.1



(a) (i) Which group of allotropes contain this fullerene?

Tick **one** (✓) box.

Inorganic ☐

Organic ☐

Physical ☐

[1]

(ii) What is the approximate size of a molecule of this fullerene?

Tick **one** (✓) box.

1×10^{-15} m ☐

1×10^{-10} m ☐

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The table shows some statements about the model.

Which statements about this model are **true**, and which are **false**?

Tick **one** (✓) box in each row.

	True	**False**
It shows the length of the covalent bonds.		
It shows the size of the carbon atoms.		
It shows the three-dimensional shape of the molecule.		

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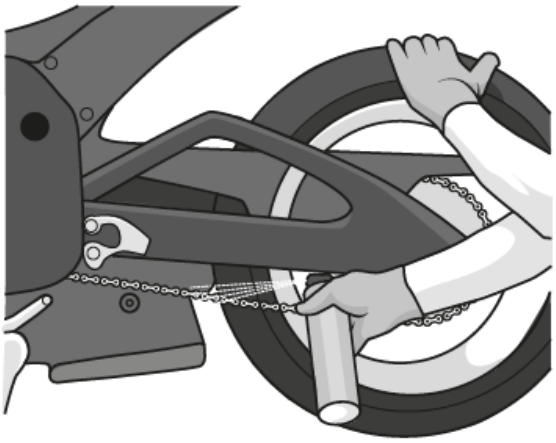

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