

Bonding

11 questions · 20 marks

Answer all questions. The marks available are shown against each part. Every question is taken unaltered from a past paper; the source is noted beneath it. In Section A, choose the best answer and write its letter in the box.

Section A · Multiple choice

10 questions · 10 marks

1. Which substance does **not** have any bond angles of 120° ? [1 mark] 1 mark

- | | |
|---------------------|-----------------------|
| A benzene | ☐ |
| B boron trifluoride | ☐ |
| C cyclohexane | ☐ |
| D graphite | ☐ |

Answer

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2. Which species has a lone pair of electrons on the central atom? [1 mark] 1 mark

- | | |
|----------------------|-----------------------|
| A CO_2 | ☐ |
| B SO_2 | ☐ |
| C PCl_6^- | ☐ |
| D SO_4^{2-} | ☐ |

Answer

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3. What happens when water is vaporised? [1 mark]

1 mark

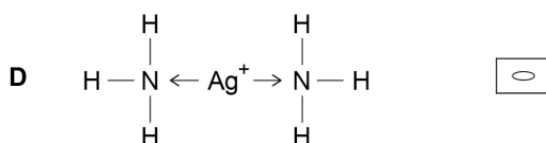
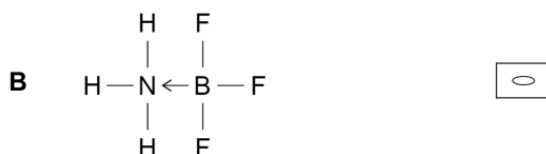
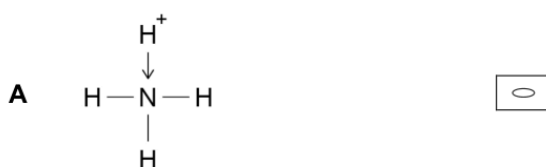
- A Covalent bonds break within molecules. ☐
- B Intermolecular forces are overcome. ☐
- C The enthalpy of the molecules decreases. ☐
- D The disorder of the molecules decreases. ☐

Answer

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4. Which diagram shows the formation of a dative covalent bond? [1 mark]

1 mark



Answer

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5. Which substance contains delocalised electrons?

[1 mark]

1 mark

A cyclohexane

☐

B graphite

☐

C iodine

☐

D sodium chloride

☐

Answer

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6. Which statement about $(\text{CH}_3)_2\text{CHCH}_2\text{COOH}$ is correct?

[1 mark]

1 mark

A In aqueous solution it reacts with magnesium to form carbon dioxide.

☐

B It can form hydrogen bonds.

☐

C It has optical isomers.

☐

D It has the IUPAC name 2-methylbutanoic acid.

☐

Answer

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7. What is the formula of ammonium ethanedioate?

[1 mark]

1 mark

A $\text{NH}_4(\text{C}_2\text{O}_4)_2$

☐

B $(\text{NH}_4)_2\text{C}_2\text{O}_4$

☐

C $\text{NH}_4\text{C}_2\text{O}_4$

☐

D $(\text{NH}_4)_2(\text{C}_2\text{O}_4)_3$

☐

Answer

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8. Which molecule has a permanent dipole?

[1 mark]

1 mark

A BF_3

☐

B NH_3

☐

C SiCl_4

☐

D SO_3

☐

Answer

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9. In which molecule are all the atoms in the same plane?

[1 mark]

1 mark

A CH_3CHO

☐

B CH_3NH_2

☐

C $\text{C}_6\text{H}_5\text{Cl}$

☐

D $\text{C}_6\text{H}_5\text{CH}_3$

☐

Answer

— AQA 7405/3 Chemistry · 2021 · Paper 3, Question 15

10. In which substance do covalent bonds break when it melts?

[1 mark]

1 mark

A hexane

☐

B ice

☐

C iodine

☐

D silicon dioxide

☐

Answer

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Section B · Structured questions

1 question · 10 marks

11. The molar enthalpy of vaporisation (ΔH_{vap}) of a liquid is the enthalpy change when one mole of liquid is converted to vapour at the boiling point of the liquid. 10 marks

A student does an experiment to determine ΔH_{vap} for water.

The student:

- places a large beaker on a balance
- pours 500 cm³ of water into the beaker
- uses a 2.4 kW heater to raise the temperature of the water to 100 °C
- records the mass of the beaker and hot water
- uses the 2.4 kW heater to boil the water for 100 s
- records the mass of the beaker and remaining water.

The loss in mass is 103 g

1

Calculate ΔH_{vap} for water.

[1 kW = 1 kJ s⁻¹]

[3 marks]

ΔH_{vap} kJ mol⁻¹

Table 2 shows some data about three compounds that all contain the same number of electrons.

Table 2

Compound	CH ₃ CH ₂ OH	CH ₃ CH ₂ NH ₂	CH ₃ OCH ₃
Boiling point / K	352	290	248

2

All three compounds in **Table 2** are polar.

Ethanol is the most polar and ethylamine is the least polar.

Explain why all three molecules are polar and why ethylamine is the least polar. In your answer refer to the shapes around, and relative electronegativities of, the most electronegative atoms.

[4 marks]

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3

Explain the trend in the boiling points of the three compounds.
Refer to the intermolecular forces in all three compounds in your answer.

[3 marks]

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