Bonding, shape and intermolecular forces

AQA 7404 and 7405 · AS and A level

Answer on your own paper. Show your working where needed.

1. Bonding in three substances

Name the bonding in solid sodium fluoride, in a fluorine molecule and in solid sodium. Describe the attraction involved in each.

2. Formation of ammonium

Ammonia reacts with H^+ to form NH_4^+. State the direction of the arrow used to represent the new bond. Give the shape and approximate H-N-H bond angle of the ion.

3. Methane, ammonia and water

Rank the bond angles in CH_4, NH_3 and H_2O from largest to smallest. Give approximate angles and explain the trend.

4. Carbon dioxide and water

Which of CO_2 and H_2O has a permanent molecular dipole? Explain your answer by comparing their bonds and shapes.

5. Electrical conductivity

Explain why solid magnesium conducts electricity. Magnesium chloride conducts when molten. Predict whether it conducts when solid and identify what carries charge in the molten salt.

6. Two forms of carbon

Graphite conducts electricity along its layers. Pure diamond does not conduct. Explain these observations using the way carbon atoms are bonded in each structure.

7. Two compounds of formula C_2H_6O

Ethanol has structural formula CH_3CH_2OH. Methoxymethane is CH_3OCH_3. Predict which compound has the higher boiling point and explain your choice.

8. Two isomers of C_5H_{12}

Pentane, $CH_3CH_2CH_2CH_2CH_3$, and 2,2-dimethylpropane, $C(CH_3)_4$, have the same molecular formula. Predict which has the higher boiling point. Explain how the shapes affect the intermolecular forces.

9. Extra challenge · One bond is replaced

In a model of gaseous PCl_5, phosphorus forms five bonds and has no lone pair. Draw its shape. Give the smallest bond angle and show which bonds make that angle.

A second model replaces just one axial P-Cl bond with a P-F bond. Keep the original bond directions and treat the P-F bond dipole as larger. Predict whether each molecule has a permanent dipole. Explain using the directions of the bond dipoles.

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