

Intermolecular Forces

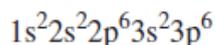
Molecules are attracted to each other by weak intermolecular forces. There are three types of intermolecular force;

- Van der Waal's forces
- Dipole-dipole forces
- Hydrogen bonding

For each group of molecules below, identify the strongest type of intermolecular force present in each molecule (1 mark) and then use this information to order the molecules according to their boiling point, from lowest to highest (1 mark).

| | | |
|----------------------|--------------------|------------------|
| 1. CH ₄ | SiH ₄ | SnH ₄ |
| 2. NH ₃ | PH ₃ | AsH ₃ |
| 3. HF | HCl | HBr |
| 4. CH ₃ F | CH ₃ Cl | CH ₄ |
| 5. HF | H ₂ O | NH ₃ |

- (a) A Period 3 element, E, forms an ion E^{2-} which has the electron arrangement shown below.



Give the electron arrangement of an atom of element E and identify this element.

Electron arrangement of an atom of E

Identity of E

(2 marks)

- (b) There is a trend in the electronegativity of the Period 3 elements Na to Cl

- (i) Define the term *electronegativity*.

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- (ii) State and explain the trend in the electronegativity of the Period 3 elements Na to Cl

Trend

Explanation

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(5 marks)

- (c) Some electronegativity values are given below.

| | H | F | Cl | Br | I |
|-------------------------|-----|-----|-----|-----|-----|
| Electronegativity value | 2.1 | 4.0 | 3.0 | 2.8 | 2.5 |

- (i) Explain why the covalent bond in HF is polar.

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- (ii) State and explain the trend in polarity of the covalent bonds in the hydrogen halides HF, HCl, HBr and HI

Trend

Explanation

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(3 marks)

(d) The boiling points of some hydrogen halides are shown in the table below.

| Hydrogen halide | HF | HCl | HBr | HI |
|-------------------|-----|-----|-----|-----|
| Boiling point / K | 293 | 188 | 206 | 238 |

Explain, in terms of the intermolecular forces present, why

(i) the boiling point of HF is much higher than those of the other hydrogen halides.

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(ii) the boiling points increase from HCl to HI

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(6 marks)

(e) Chloride ions are polarised by cations.

(i) State the meaning of the term *polarised* as applied to a Cl^- ion.

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(ii) State a feature of a cation that would cause the Cl^- ion to be polarised strongly.

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(2 marks)