

Section AAnswer **all** questions in the spaces provided.**1** Fluorine forms compounds with many other elements.**1 (a)** Fluorine reacts with bromine to form liquid bromine trifluoride (BrF_3).
State the type of bond between Br and F in BrF_3 and state how this bond is formed.

Type of bond

How bond is formed

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(2 marks)**1 (b)** Two molecules of BrF_3 react to form ions as shown by the following equation.**1 (b) (i)** Draw the shape of BrF_3 and predict its bond angle.
Include any lone pairs of electrons that influence the shape.Shape of BrF_3 Bond angle
(2 marks)**1 (b) (ii)** Draw the shape of BrF_4^- and predict its bond angle.
Include any lone pairs of electrons that influence the shape.Shape of BrF_4^- Bond angle
(2 marks)

- 1 (c)** BrF_4^- ions are also formed when potassium fluoride dissolves in liquid BrF_3 to form KBrF_4 .
Explain, in terms of bonding, why KBrF_4 has a high melting point.

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(3 marks)

(Extra space)

- 1 (d)** Fluorine reacts with hydrogen to form hydrogen fluoride (HF).

- 1 (d) (i)** State the strongest type of intermolecular force between hydrogen fluoride molecules.

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(1 mark)

- 1 (d) (ii)** Draw a diagram to show how two molecules of hydrogen fluoride are attracted to each other by the type of intermolecular force that you stated in part **(d) (i)**. Include all partial charges and all lone pairs of electrons in your diagram.

(3 marks)

- 1 (e)** The boiling points of fluorine and hydrogen fluoride are -188°C and 19.5°C respectively. Explain, in terms of bonding, why the boiling point of fluorine is very low.

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(2 marks)

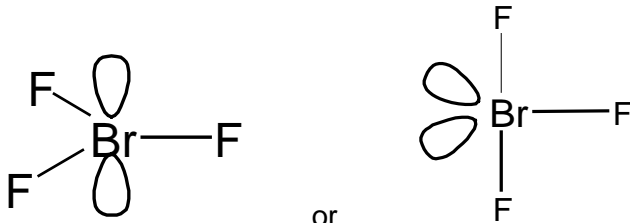
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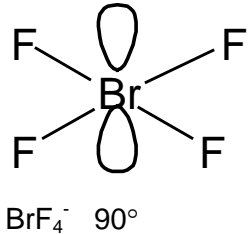
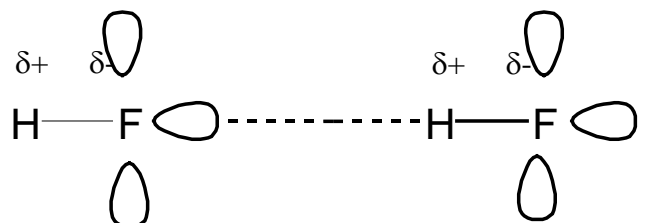
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Turn over ►



Question	Marking Guidance	Mark	Comments
1(a)	Covalent Shared <u>pair</u> (s) of electrons / one electron from Br and one electron from F	1 1	If not covalent CE = 0/2 If dative covalent CE = 0/2 If blank mark on Ignore polar If number of pairs of electrons specified, must be 3 Not 2 electrons from 1 atom Not shared pair between ions/molecules
1(b)(i)	 <p>BrF₃ if trigonal planar shown = 120° or if T shape shown 84 - 90°</p>	1 1	BrF ₃ should have 3 bp and 2 lp and correct atoms for the mark Penalise FI Allow 84 - 90° or 120° and ignore 180° Irrespective of shape drawn

1(b)(ii)	 <p>BrF₄⁻ 90°</p>	1	BrF ₄ ⁻ should have 4 bp and 2 lp and all atoms for the mark (ignore sign) Allow FI
1(c)	<p>Ionic or (forces of) attraction between ions / bonds between ions</p> <p>Strong (electrostatic) attraction / strong bonds / lots of energy needed to break bonds</p> <p>Between K⁺ and BrF₄⁻ ions/oppositely charged ions / + and - ions</p>	1 1 1	<p>If molecules, IMF, metallic, CE =0</p> <p>If covalent bonds mentioned, 0/3, unless specified <u>within</u> the BrF₄⁻ ion and not broken</p> <p>Ignore atoms</p> <p>If ions mentioned they must be correct</p> <p>Strong bonds between + and - ions =3/3</p>
1(d)(i)	Hydrogen <u>bonds</u> /hydrogen <u>bonding</u> /H <u>bonds</u> /H <u>bonding</u>	1	Not just hydrogen
1(d)(ii)		3	<p>One mark for 4 partial charges</p> <p>One mark for 6 lone pairs</p> <p>One mark for H bond from the <u>lone pair to the Hδ+</u></p> <p>Allow FI</p> <p>If more than 2 molecules are shown they must all be correct. Treat any errors as contradictions within each marking point.</p> <p>CE = 0/3 if incorrect molecules shown.</p>

1(e)	vdw / van der Waals forces between molecules IMF are weak / need little energy to break IMF / easy to overcome IMF	1 1	QoL Not vdw between HF molecules, CE = 0/2 vdw between atoms, CE = 0/2 If covalent, ionic, metallic, CE=0/2
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