

**Q1.** The table below shows the electronegativity values of some elements.

	H	C	N	O
Electronegativity	2.1	2.5	3.0	3.5

(a) State the meaning of the term *electronegativity*.

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(2)

(b) State the strongest type of intermolecular force in the following compounds.

Methane (CH<sub>4</sub>) .....

Ammonia (NH<sub>3</sub>) .....

(2)

(c) Use the values in the table to explain how the strongest type of intermolecular force arises between two molecules of ammonia.

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(3)

(d) Phosphorus is in the same group of the Periodic Table as nitrogen.  
A molecule of PH<sub>3</sub> reacts with an H<sup>+</sup> ion to form a PH<sub>4</sub><sup>+</sup> ion.  
Name the type of bond formed when PH<sub>3</sub> reacts with H<sup>+</sup> and explain how this bond is formed.

Type of bond .....

Explanation .....

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(3)

- (e) Arsenic is in the same group as nitrogen. It forms the compound  $\text{AsH}_3$ . Draw the shape of an  $\text{AsH}_3$  molecule, including any lone pairs of electrons. Name the shape made by its atoms.

Shape

Name of shape .....

(2)

- (f) The boiling point of  $\text{AsH}_3$  is  $-62.5\text{ }^\circ\text{C}$  and the boiling point of  $\text{NH}_3$  is  $-33.0\text{ }^\circ\text{C}$ . Suggest why the boiling point of  $\text{AsH}_3$  is lower than that of  $\text{NH}_3$ .

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(1)

- (g) Balance the following equation which shows how  $\text{AsH}_3$  can be made.



(1)

(Total 14 marks)

- Q2.** (a) Name the strongest type of intermolecular force between hydrogen fluoride molecules and draw a diagram to illustrate how two molecules of HF are attracted to

each other.

In your diagram show all lone pairs of electrons and any partial charges. Explain the origin of these charges.

Suggest why this strong intermolecular force is not present between HI molecules.

(7)

- (b) Crystals of sodium chloride and of diamond both have giant structures. Their melting points are 1074 K and 3827 K, respectively. State the type of structure present in each case and explain why the melting point of diamond is so high.

(4)

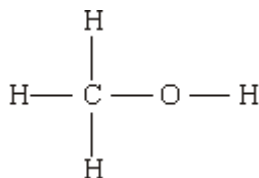
(Total 11 marks)

**Q3.** Which one of the following statements is **not** correct?

- A** The first ionisation energy of iron is greater than its second ionisation energy.
- B** The magnitude of the lattice enthalpy of magnesium oxide is greater than that of barium oxide.
- C** The oxidation state of iron in  $[\text{Fe}(\text{CN})_6]^{3-}$  is greater than the oxidation state of copper in  $[\text{CuCl}_2]^-$
- D** The boiling point of  $\text{C}_3\text{H}_8$  is lower than that of  $\text{CH}_3\text{CH}_2\text{OH}$

(Total 1 mark)

**Q4.** (a) Methanol has the structure



Explain why the O–H bond in a methanol molecule is polar.

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(2)

- (b) The boiling point of methanol is +65 °C; the boiling point of oxygen is –183 °C. Methanol and oxygen each have an  $M_r$  value of 32. Explain, in terms of the intermolecular forces present in each case, why the boiling point of methanol is much higher than that of oxygen.

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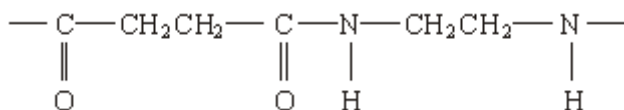
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(3)  
(Total 5 marks)

- Q5.** (a) The structure below shows the repeating unit of a polymer.



By considering the functional group formed during polymerisation, name this type of polymer and the type of polymerisation involved in its formation.

Type of polymer .....

Type of polymerisation .....

(2)

- (b) Draw the structure of the species present in solid aminoethanoic acid,  $\text{H}_2\text{NCH}_2\text{COOH}$

(1)

- (c) Explain why the melting point of aminoethanoic acid is much higher than that of hydroxyethanoic acid, HOCH<sub>2</sub>COOH

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(2)  
(Total 5 marks)

**Q6.** The table below shows the electronegativity values of some elements.

	Fluorine	Chlorine	Bromine	Iodine	Carbon	Hydrogen
Electronegativity	4.0	3.0	2.8	2.5	2.5	2.1

- (a) Define the term *electronegativity*.

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(2)

- (b) The table below shows the boiling points of fluorine, fluoromethane (CH<sub>3</sub>F) and hydrogen fluoride.

	F-F	<pre>       F               C      /   \     H  H  H           </pre>	H-F
Boiling point/K	85	194	293

- (i) Name the strongest type of intermolecular force present in:

Liquid F<sub>2</sub>.....

Liquid  $\text{CH}_3\text{F}$  .....

Liquid  $\text{HF}$  .....

(ii) Explain how the strongest type of intermolecular force in liquid  $\text{HF}$  arises.

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(6)

(c) The table below shows the boiling points of some other hydrogen halides.

	$\text{HCl}$	$\text{HBr}$	$\text{HI}$
Boiling point / K	188	206	238

(i) Explain the trend in the boiling points of the hydrogen halides from  $\text{HCl}$  to  $\text{HI}$ .

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(ii) Give **one** reason why the boiling point of  $\text{HF}$  is higher than that of all the other hydrogen halides.

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(3)

(Total 11 marks)

**Q7.** The elements phosphorus, sulfur, chlorine and argon are in the p block of the Periodic Table.

(a) State why these elements are classified as p block elements.

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(1)

(b) State the trend in atomic radius from phosphorus to chlorine and explain the trend.

*Trend* .....

*Explanation* .....

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(3)

(c) In terms of structure and bonding, explain why sulfur has a higher melting point than phosphorus.

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(3)

(d) In terms of atomic structure, explain why the van der Waals' forces in liquid argon are very weak.

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(2)

(Total 9 marks)

