Q1.

This question is about structure and bonding.

(a) Define electronegativity.

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(1)

(b) Explain why the C–Cl bond is polar.

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(2)

(c) Although the C–Cl bond is polar, CCl_4 is a non-polar molecule.

Explain why.

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(2)

(d) There are van der Waals forces between non-polar molecules.
Explain what causes these forces.

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(3)

Barium reacts with oxygen to form barium oxide.

Barium oxide has a high melting point and an ionic lattice structure similar to that of sodium chloride.

(e) Draw a 3D diagram to show how the particles are arranged in a barium oxide lattice.

You should draw eight particles.

(2)

(Total 10 marks)

Q2.

SF_6 and SF_3^+ have different shapes and different bond angles.

Deduce the shape of SF_6 and the shape of SF_3^+

State the bond angle in SF_6 and the bond angle in SF_3^+

Justify the bond angles by referring to electron pairs.

(Total 6 marks)

Q3.

This question is about the shapes of molecules.

Discuss the difference between the shapes of CF_4 and XeF_4 In your answer you should:

- name the shape of each molecule
- explain the shape of each molecule
- explain the bond angle(s) in each molecule.

(Total 6 marks)

Q4.

This question is about intermolecular forces in some organic compounds.

The table below gives some information about three organic compounds.

Compound	dichloromethane	tetrachloromethane	propan-1-ol
Boiling point / °C	40	77	97
Polarity of molecules	polar	non-polar	polar

(a) State why the C–Cl bonds in dichloromethane and tetrachloromethane are polar.

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_____

(1)

(b) Suggest why tetrachloromethane molecules are non-polar.

_____

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(1)

(c) Explain why tetrachloromethane has a higher boiling point than dichloromethane.

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(2)

(d) Propan-1-ol has a higher boiling point than the other two compounds because of hydrogen bonding.

Describe the hydrogen bonding in propan-1-ol.

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(2)

(Total 6 marks)

Q5.

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.

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

The student:

- places a large beaker on a balance
- pours 500 cm^3 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

(a) Calculate ΔH_{vap} for water.

[1 kW = 1 kJ s^{-1}]

ΔH_{vap} _____ kJ mol^{-1}

(3)

The table below shows some data about three compounds that all contain the same number of electrons.

Compound	CH_3CH_2OH	$CH_3CH_2NH_2$	CH_3OCH_3
Boiling point / K	352	290	248

(b) All three compounds in the table above 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)

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

(3)

(Total 10 marks)

Q6.

This question is about shapes of molecules.

Complete the table below by drawing the shapes of both the AsF_5 and KrF_2 molecules, showing all lone pairs of electrons that influence the shape.

Deduce the bond angle(s) in AsF_5

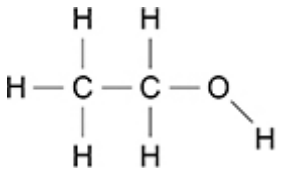
	AsF_5	**KrF_2**
Diagram of shape		
Bond angle(s)		

(Total 3 marks)

Q7.

This question is about intermolecular forces.

(a) Complete the diagram to show how one molecule of ammonia can form a hydrogen bond with one molecule of ethanol.
Include all lone pairs of electrons and partial charges on atoms involved in the hydrogen bond.



(3)

The table below shows the electronegativity values of atoms of some elements.

Atom	H	C	N	O	Br
Electronegativity	2.1	2.5	3.0	3.5	2.8

(b) Define the term electronegativity.

_____

_____

_____

(1)

(c) Deduce the **two** atoms from the table above that will form the most polar bond.

_____

(1)

(d) The C–Br bond is polar.

Explain why CBr_4 is **not** a polar molecule.

_____

_____

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_____

(2)

(e) Suggest, in terms of the intermolecular forces for each compound, why CBr_4 has a higher boiling point than $CHBr_3$

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(3)

(Total 10 marks)