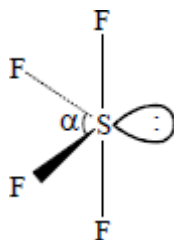


Q1. Which one of the following is the most likely value for the bond angle α shown in the diagram of SF_4 below?



- A 118°
- B 101°
- C 90°
- D 88°

(Total 1 mark)

Q2. Which one of the following has a shape which is **not** influenced by a lone pair of electrons?

- A CH_3OH
- B H_2F^+
- C BF_3
- D NF_3

(Total 1 mark)

Q3. Which one of the following molecules or ions is pyramidal in shape?

- A BF_3
- B CH_3^+
- C CH_3^-
- D SF_3^-

(Total 1 mark)

Q4. Lithium hydride, LiH, is an ionic compound containing the hydride ion, H⁻. The reaction between LiH and aluminium chloride, AlCl₃, produces the ionic compound LiAlH₄.

(a) Balance the equation below which represents the reaction between LiH and AlCl₃.



(b) Give the electronic configuration of the hydride ion, H⁻.

..... (1)

(c) Predict the shape of the AlH_4^- ion. Explain why it has this shape.

Shape

Explanation

.....
.....

(3)

(d) A bond in AlH_4^- can be represented by H → Al

Name this type of bond and explain how it is formed.

Type of bond

Explanation

.....
.....

(3)

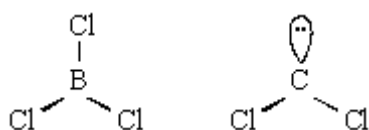
(Total 8 marks)

Q5. Which one of the following ions has three lone pairs of electrons around the central atom?

- A BF_2^-
- B NH_2^-
- C ClF_2^-
- D PF_6^-

(Total 1 mark)

Q6. (a) The shape of the molecule BCl_3 and that of the unstable molecule CCl_2 are shown below.



(i) Why is each bond angle exactly 120° in BCl_3 ?

.....
.....

(ii) Predict the bond angle in CCl_2 and explain why this angle is different from that in BCl_3 .

Predicted bond angle

Explanation

.....

(5)

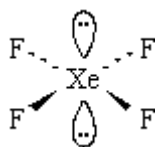
(b) Give the name which describes the shape of molecules having bond angles of $109^\circ 28'$.
Give an example of one such molecule.

Name of shape

Example

(2)

(c) The shape of the XeF_4 molecule is shown below.



(i) State the bond angle in XeF_4 .

.....

(ii) Suggest why the lone pairs of electrons are opposite each other in this molecule.

.....

.....

(iii) Name the shape of this molecule, given that the shape describes the positions of the Xe and F atoms only.

.....

(4)

(d) Draw a sketch of the NF_3 molecule. Indicate in your sketch any lone pairs of electrons on nitrogen.

(2)

(Total 13 marks)

Q7. (a) Both HF and HCl are molecules having a polar covalent bond. Their boiling points are 293 K and 188 K respectively.

(i) State which property of the atoms involved causes a bond to be polar.

.....
.....

(ii) Explain, in terms of the intermolecular forces present in each compound, why HF has a higher boiling point than HCl.

.....
.....
.....
.....
.....

(4)

(b) When aluminium chloride reacts with chloride ions, as shown by the equation below, a co-ordinate bond is formed.



Explain how this co-ordinate bond is formed.

.....
.....
.....

(2)

(c) Draw the shape of the PCl_5 molecule and of the PCl_4^+ ion. State the value(s) of the

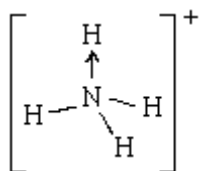
bond angles.



Bond angle(s) Bond angle(s)

(4)
(Total 10 marks)

- Q8.** (a) An ammonium ion, made by the reaction between an ammonia molecule and a hydrogen ion, can be represented as shown in the diagram below.



- (i) Name the type of bond represented in the diagram by N—H
.....
- (ii) Name the type of bond represented in the diagram by N→H
.....
- (iii) In terms of electrons, explain why an arrow is used to represent this N→H bond.
.....

.....

(iv) In terms of electron pairs, explain why the bond angles in the NH_4^+ ion are all $109^\circ 28'$

.....
.....
.....
.....

(7)

(b) Define the term *electronegativity*.

.....
.....

(2)

(c) A bond between nitrogen and hydrogen can be represented as $\overset{\delta-}{\text{N}}-\overset{\delta+}{\text{H}}$

(i) In this representation, what is the meaning of the symbol $\delta+$?

.....

(ii) From this bond representation, what can be deduced about the electronegativity of hydrogen relative to that of nitrogen?

.....
.....

(2)

(Total 11 marks)

- Q9.** (a) Predict the shapes of the SF_6 molecule and the AlCl_4^- ion. Draw diagrams of these species to show their three-dimensional shapes. Name the shapes and suggest values for the bond angles. Explain your reasoning.

(8)

- (b) Perfume is a mixture of fragrant compounds dissolved in a volatile solvent.

When applied to the skin the solvent evaporates, causing the skin to cool for a short time. After a while, the fragrance may be detected some distance away. Explain these observations.

(4)

(Total 12 marks)