CHEMISTRY ONLINE
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CHEMISTRY

BONDING

Level & Board	AQA (A-LEVEL)
TOPIC:	BONDING
PAPER TYPE:	SOLUTION -2
TOTAL QUESTIONS	10
TOTAL MARKS	35

Bonding

1.

(a)

Electronegativity is ability to attract and hold bond pair of electrons in a Covalent bond.

Atoms with higher electronegativity values tend to attract electrons more strongly, while atoms with lower electronegativity values tend to lose electrons or share them less equally in a bond. Flurine has electronegativity of 4.0

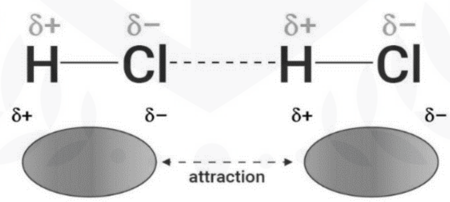
Electronegativity generally increases across a period in the periodic table from left to right and decreases down a group.

(1)

(b)

Permanent dipole-dipole forces in hydrogen chloride HCl molecules due to the difference in electronegativity between hydrogen and chlorine atoms within the molecule.

In an HCl molecule, chlorine is more electronegative than hydrogen. As a result, the shared pair of electrons in the covalent bond between hydrogen and chlorine is more attracted toward the chlorine atom, creating a partial negative charge (δ^-) on the chlorine and a partial positive charge (δ^+) on the hydrogen.



(2)

(c)

Molecule	Name of Shape	Tick (✓) if Molecule Has a Permanent Dipole
CH_3Cl	Tetrahedral(Distorted)	✓
PH_3	Trigonal Pyramidal	✓
$BeCl_2$	Linear	✗
SiH_4	Tetrahedral	✗

(4)

2. (A)

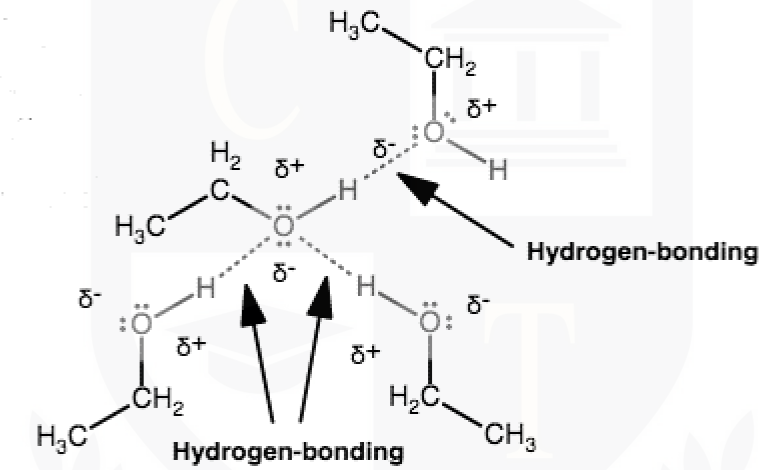
(Total 1 mark)

3. (A)

(Total 1 mark)

4.

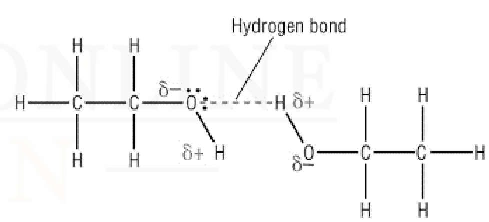
(a)



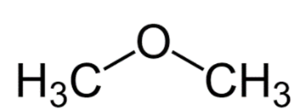
(3)

(b)

- ***Ethanol:***
  - *Ethanol molecules can form hydrogen bonds due to the presence of the hydroxyl (-OH) functional group.*
  - *These hydrogen bonds result in stronger attractions between ethanol molecules, requiring more energy to break these bonds and transition the liquid molecules into a vapor phase. Therefore, ethanol has a higher boiling point of 78°C due to the presence of hydrogen bonding.*



- ***Methoxymethane (Dimethyl ether):***
  - *Methoxymethane has no hydrogen bonding.*
  - *So, it experiences weaker intermolecular forces.*
  - *The main intermolecular forces present in it are van der Waals forces, which are comparatively weaker than hydrogen bonding.*

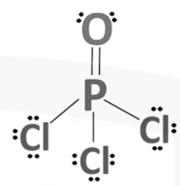


So, methoxymethane has a lower boiling point of -24°C compared to ethanol.

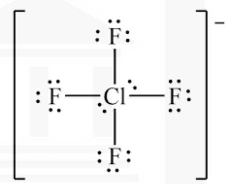
(3)

(c)

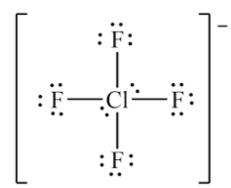
Shape of the $POCl_3$ molecule



Shape of the ClF_4^-



The ClF_4^- ion has a square planar molecular geometry due to its structure, with the four fluorine atoms and two lone pairs arranged around the central chlorine atom.
The lone pairs tend to repel more strongly than bonded pairs, resulting in a distortion from the ideal 90° and 180° angles in a perfect square planar structure.
Due to the repulsion between the lone pairs and the bonding pairs, the Cl-F-Cl bond angles in ClF_4^- are almost 90°.



(5)

5. (D)

(Total 1 mark)

6. (D)

(Total 1 mark)

7.

(a)

A fluoride ion is larger than a sodium ion because a fluoride ion has less proton than a sodium ion.

Sodium ion (Na^+):

Na^+ has lost one electron compared to its neutral state (Na), leading to increase effective nuclear charge on remaining electrons this decreases the electron cloud's size.

This reduction in the electron cloud results in a smaller ionic radius for the sodium ion.

Fluoride ion (F^-):

F^- has gained one electron compared to its neutral state (F). The additional electron increases the electron-electron repulsions within the electron cloud, causing it to expand.

This expansion of the electron cloud results in a larger ionic radius for the fluoride ion compared to the neutral fluorine atom.

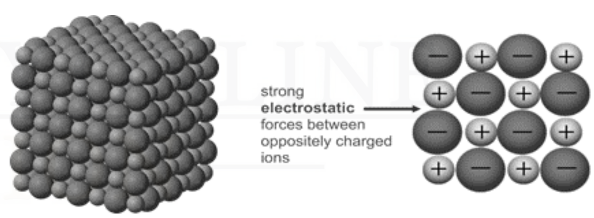
(2)

(b)

The high melting point (993 °C) of sodium fluoride is due to its strong ionic bonding and crystal structure.

Sodium fluoride consists of sodium cations (Na^+) and fluoride anions (F^-) held together by ionic bonds i.e. strong electrostatic forces.

To melt sodium fluoride, the ionic bonds need to be overcome, which requires a significant input of energy to break the strong attractions between the positively and negatively charged ions within the crystal lattice.



(2)

(c)

Bond type: Dative covalent bond / coordinate covalent bond

Explanation:

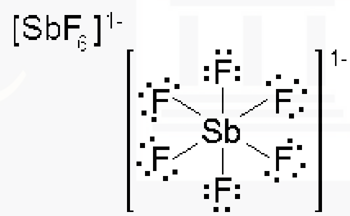
The hydrogen fluoride molecule (HF) having a lone pair of electrons on the fluorine atom.

The proton (H^+) accepts an electron pair.
The fluorine atom in HF donates its electron pair to the proton (H^+), creating a shared pair of electrons between the hydrogen ion and the fluorine atom.
So, creating a dative covalent bond where both electrons in the bond come from the fluorine atom, leading to the formation of the H_2F^+ ion.

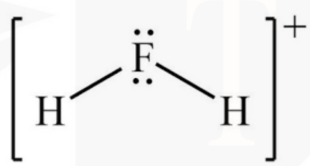
(2)

(d)

SbF_6^-
Shape : octahedral



H_2F^+
Shape : bent or v-shaped



(4)

8. (C)

(Total 1 mark)

9. (B)

(Total 1 mark)

10. (A)

(Total 1 mark)

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