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Phone: +442081445350

www.chemistryonlinetuition.com

Emil:asherrana@chemistryonlinetuition.com

CHEMISTRY

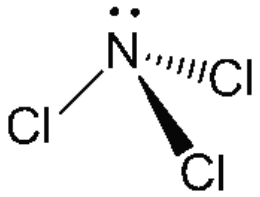
BONDING

Level & Board	AQA (A-LEVEL)
TOPIC:	BONDING
PAPER TYPE:	SOLUTION -1
TOTAL QUESTIONS	10
TOTAL MARKS	33

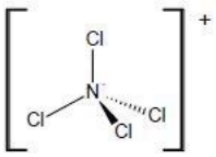
Bonding

1.

NCl_3
Name of Shape: Trigonal pyramidal
Lone pair: one Lone pair of electrons on N atom.
Bond angle: 107° (less than 109.5 due to repulsion of Lone pair)



NCl_4^+
Name of shape of NCl_4^+: tetrahedral
Bond angle in NCl_4^+: 109.5°



In NCl_4^+ the nitrogen atom is bonded to four chlorine atoms with no lone pairs.
Bond angle is 109.5° because the tetrahedral geometry has four regions of electron density, resulting in bond angles that are close to the angle of 109.5° keeping the electrons at maximum distance to minimize repulsion.

(Total 5 marks)

2. **(B)**

(Total 1 mark)

3.

(a)

The difference in boiling points between pentan-2-ol and pent-1-ene is due to intermolecular forces present in each compound.
Pentan-2-ol contains a hydroxyl group (-OH), which gives hydrogen bonding interactions.
Pent-1-ene is an alkene, which do not have functional group that can form hydrogen bonds. It only have weaker intermolecular forces like London dispersion forces.
Hydrogen bonds are stronger than other intermolecular forces like London dispersion forces.
The presence of hydrogen bonding in pentan-2-ol leads to stronger intermolecular attractions between its molecules compared to pent-1-ene.

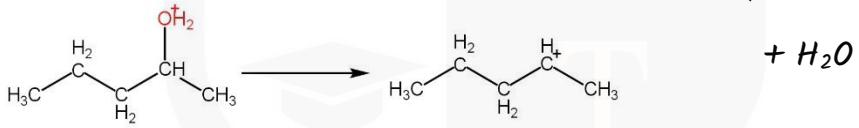
(3)

(b)

The mechanism for the dehydration of pentan-2-ol to form pent-1-ene involves the following steps:

- **Protonation**: The sulfuric acid donates a proton (H^+) to the oxygen atom of the alcohol group in pentan-2-ol, forming a protonated alcohol intermediate.
  This step occurs because the sulfuric acid is a strong acid and easily donates protons.

- **Water Elimination**: The protonated alcohol intermediate loses a water molecule (elimination of a water molecule).
  The loss of water forms a carbocation intermediate, pent-2-yl carbocation.



- **Deprotonation**: In the final step, a water molecule or another molecule of alcohol acts as a base and removes a proton from the pent-2-yl carbocation, resulting in the formation of pent-1-ene.

This series of steps results in the production of pent-1-ene from pentan-2-ol through the dehydration reaction.

(5)

4. (C)

(Total 1 mark)

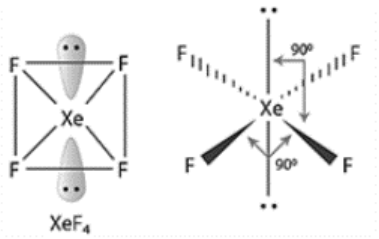
5.

Shape:

XeF_4 :

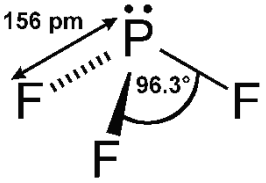
- XeF_4 has Square Planar geometry.

- Xenon (Xe) is the central atom surrounded by four fluorine (F) atoms. It has two lone pairs of electrons in addition to the four bonding pairs.
- The presence of the lone pairs influences the molecular geometry to be Square Planar, where the lone pairs are placed in the two remaining positions opposite each other.



PF_3 :

- PF_3 molecule has a trigonal pyramidal shape.
- Phosphorus (P) is the central atom with three fluorine (F) atoms attached and one lone pair of electrons.
- The presence of the lone pair causes distortion in the molecular shape, resulting in a trigonal pyramidal geometry.

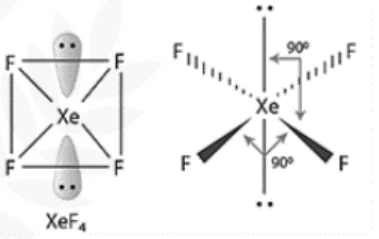


Effect of Shape on Melting Points:

XeF_4: (117 °C)

XeF_4 has symmetrical, Square Planar shape due to bonding and lone pair arrangement around xenon.

So, it has stronger van der Waals forces due to symmetrical structure and larger xenon and fluorine atoms.

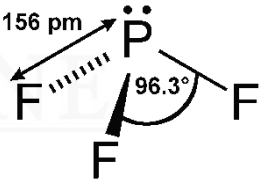


PF_3: (-151.5 °C)

In PF_3 Trigonal pyramidal shape due to lone pair, causes asymmetry.

Although PF_3 has Lone pair and has Weaker van der Waals forces but compared to XeF_4 has smaller, less polarizable atoms.

That is why it has weaker van der Waals forces compared to XeF_4.



So XeF_4 having a higher melting point due to stronger intermolecular forces resulting from its symmetrical Square Planar shape and larger, more polarizable atoms.

That is why it has higher melting point due to stronger intermolecular forces requiring more energy to overcome.

(Total 6 marks)

6. (A)

(Total 1 mark)

7. (D)

(Total 1 mark)

8. (C)

(Total 1 mark)

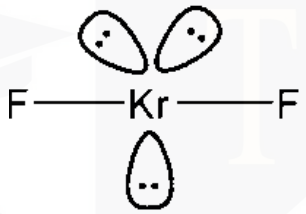
9. (B)

(Total 1 mark)

10.

(a)

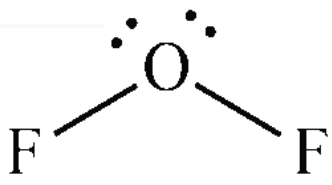
Shape: Linear
Bond angle: 180°
Lone pair : 3



(3)

(b)

Bond angle: 103°
Explanation:
In oxygen difluoride (OF_2), the presence of two lone pairs of electrons on the oxygen atom effects the bond angle. As Lone pairs repel more than bond pairs so, the two lone pairs repel the bonding pairs more strongly than the bonding pairs repel each other.



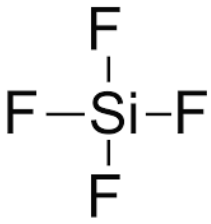
This increased repulsion between the lone pairs and the bonding pairs causes the bonding pairs to be pushed closer together. As a result, the bond angle in OF_2 is less than the ideal 120° for a trigonal planar arrangement and is approximately 103°.

(2)

(c)

Silicon tetrafluoride (SiF_4) have van der Waals forces, such as London dispersion forces, as its intermolecular force due to temporary electron dispersions. With a symmetrical tetrahedral structure, SiF_4 do not have a net dipole.

So, SiF_4 has only weak London dispersion forces arising from temporary dipoles for intermolecular attractions in the compound.



(3)

I am Sorry !!!!!

DR. ASHAR RANA

M.B.B.S / MS. CHEMISTRY

CHEMISTRY ONLINE TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

CONTACT INFORMATION FOR
CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com

Address: 210-Old Brompton Road, London SW5 OBS, UK