

2018 / 2019

- 3 (a) Ammonia, NH_3 and boron trifluoride, BF_3 are covalent compounds. NH_3 and BF_3 react to form H_3NBF_3 molecule.

- Explain why NH_3 obeys octet rule but BF_3 does not.
- Show the formation of H_3NBF_3 molecule using Lewis dot symbol and label the bond formed.

[5 marks]

- (b) Oxygen difluoride, OF_2 is a strongly oxidising colourless gas.

- Determine the molecular geometry of this molecule.
- Explain whether OF_2 is a polar and non-polar molecule.

[8 marks]

- (c) Aluminium and sodium are metals.

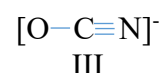
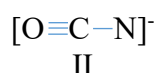
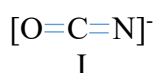
- Explain the formation of metallic bond in sodium using the electron sea model.
- Why aluminium has higher boiling point than sodium?

[4 marks]

2019 / 2020

- 3 (a) Explain each of the following statements.

- Upon reaction with fluorine, oxygen forms only OF_2 whereas sulphur forms SF_2 , SF_4 and SF_6 molecules.
- The shape of a PF_5 molecule differs from that of an IF_5 molecule.
- Of the three possible resonances, structures for OCN^- BELOW, III is the best structure.



[10 marks]

- (b) Illustrate the hybridisation of the central atom in SF_4 using orbital diagrams.

Show and label the overlapping of orbitals in the molecule. [7 marks]

- (c) Explain the difference in melting point between elements in group 1 and group 17.

[5 marks]

2020 / 2021

- 3 Phosgene, COCl_2 , is a chemical used in the production of plastics and pesticides. Given that chlorine cannot be the central atom,
- draw **three (3)** possible structures of phosgene. [3 marks]
 - determine the most plausible structure and give your reason. [5 marks]
 - determine the hybrid orbital for the central atom of the most plausible structure. [4 marks]
 - name the molecular shape and draw the overlapping orbitals of COCl_2 . [5 marks]

2021 / 2022

13. Boiling points of Br_2 and I_2 are at 58.8°C and 184.3°C respectively. The difference in the boiling points of these molecules is due to
- molecular size
 - molecular shape
 - molecular polarity
 - molecular formula
14. Determine which molecule has dipole moment, $\mu = 0$
- CS_2
 - SO_2
 - NO
 - H_2O
15. Choose the most plausible Lewis structure for CNO^- .
- $[\text{C}=\text{N}=\text{O}]^-$
 - $[\text{C}\equiv\text{N}-\text{O}]^-$
 - $[\text{C}-\text{N}\equiv\text{O}]^-$
 - $[\text{C}=\text{N}-\text{O}]^-$

16. Choose the molecule with linear shape
- O_3
 - H_2S
 - SCl_2
 - XeF_2
17. Arrange the following compounds in the order of increasing boiling point.
- $\text{HF}, \text{HCl}, \text{Cl}_2$
18. The hybridisation of the central atom in the following molecules is sp^3 **except**
- NH_3
 - H_2O
 - ClF_3
 - CH_3Cl
19. Deduce which of the following species has a see-saw shape.
- SiCl_4
 - SF_4
 - XeF_4
 - CH_4

2022 / 2023

- 3 (a) Selenium dioxide, SeO_2 , is a colourless solid and one of the most available forms of selenium.
- Draw the Lewis structure of SeO_2 .
 - Based on VSEPR theory, predict the molecular geometry of SeO_2 .
 - Determine hybridisation on the central atom.
 - Explain whether SeO_2 is polar or non-polar. [7 marks]
- (b) Calcium is a silvery-white soft metal that tarnishes easily in the air. By using the electron sea model, illustrate the formation of metallic bonds in calcium. Explain the electrical conductivity exhibited by calcium. [5 marks]
- (c) Aluminium conducts electricity but aluminium chloride does not. Explain. [5 marks]

2023 / 2024

- 3 (a) AlCl_3 and NO_2 are two examples of chemical species that violate the octet rule.
- (i) Draw the Lewis structure for AlCl_3 and NO_2
 - (ii) Draw the molecular structure when two AlCl_3 molecules combine to form Al_2Cl_6 .
 - (iii) Draw the molecular structure when two NO_2 molecules combine to form N_2O_4 .
 - (iv) Explain the difference in the bond formation for Al_2Cl_6 and N_2O_4 . [8 marks]
- (b) Predict the shape and bond angle in XeF_4 molecule by using the VSEPR theory. [3 marks]
- (c) Methyl imine, CH_2NH , is the simplest imine and a stable colourless gas
- (i) Show the hybridisation of the C and N in CH_2NH molecule
 - (ii) Sketch the overlapping orbitals in CH_2NH and label the bonds. [6 marks]

2024 / 2025

- 3 (a) Boron trifluoride, BF_3 and iodine trifluoride, IF_3 are simple covalent molecules
- (i) Draw the Lewis structures for both molecules.
 - (ii) Predict the molecular shapes for both molecules based on Valence Shell Electron Pair Repulsion theory.
 - (iii) Differentiate the polarity of both molecules. [8 marks]
- (b) Methanol, CH_3OH and pentane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ are colourless, volatile and flammable liquids.
- (i) Illustrate the hybridisation process of carbon and oxygen in CH_3OH .
 - (ii) Draw and label the overlapping orbitals in CH_3OH .
 - (iii) Compare the boiling points of CH_3OH and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$. [9 marks]