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.

i) Explain why NH_3 obeys octet rule but BF_3 does not.
ii) 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.

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

[8 marks]

(c) Aluminium and sodium are metals.

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

[4 marks]

2019 / 2020

3 (a) Explain each of the following statements.

i) Upon reaction with fluorine, oxygen forms only OF_2 whereas sulphur forms SF_2, SF_4 and SF_6 molecules.

ii) The shape of a PF_5 molecule differs from that of an IF_5 molecule.

iii) Of the three possible resonances, structures for OCN^- BELOW, III is the best structure.

$[O{=}C{=}N]^-$ I $[O{\equiv}C{-}N]^-$ II $[O{-}C{\equiv}N]^-$ III

[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,

(a) draw **three (3)** possible structures of phosgene.
[3 marks]

(b) determine the most plausible structure and give your reason.
[5 marks]

(c) determine the hybrid orbital for the central atom of the most plausible structure.
[4 marks]

(d) 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

A. molecular size
B. molecular shape
C. molecular polarity
D. molecular formula

14. Determine which molecule has dipole moment, $\mu = 0$

A. CS_2
B. SO_2
C. NO
D. H_2O

15. Choose the most plausible Lewis structure for CNO^-.

A. $[C{=}N{=}O]^-$

B. $[C{\equiv}N{-}O]^-$

C. $[C{-}N{\equiv}O]^-$

D. $[C{=}N{-}O]^-$

16. Choose the molecule with linear shape

A. O_3
B. H_2S
C. SCl_2
D. XeF_2

17. Arrange the following compounds in the order of increasing boiling point.

HF, HCl, Cl_2

18. The hybridisation of the central atom in the following molecules is sp^3 **except**

A. NH_3
B. H_2O
C. ClF_3
D. CH_3Cl

19. Deduce which of the following species has a see-saw shape.

A. $SiCl_4$
B. SF_4
C. XeF_4
D. CH_4

2022 / 2023

3 (a) Selenium dioxide, SeO_2 , is a colourless solid and one of the most available forms of selenium.

i) Draw the Lewis structure of SeO_2.
ii) Based on VSEPR theory, predict the molecular geometry of SeO_2.
iii) Determine hybridisation on the central atom.
iv) 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 ga

(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, $CH_3CH_2CH_2CH_2CH_3$ 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 $CH_3CH_2CH_2CH_2CH_3$.

[9 marks]