

4.2 Resonance, Shapes & Giant Structures

Question Paper

Course	DPIB Chemistry
Section	4. Chemical Bonding & Structure
Topic	4.2 Resonance, Shapes & Giant Structures
Difficulty	Easy

Time allowed: 70
Score: /51
Percentage: /100

Question 1a

a)

Yellow phosphorus reacts with chlorine to form phosphorus trichloride, PCl_3 .

i)

Draw the Lewis (electron dot) structure of phosphorus trichloride.

[1]

ii)

Predict the Cl-P-Cl bond angle and molecular geometry of the phosphorus trichloride molecule.

[2]

[3 marks]**Question 1b**

b)

Phosphorus trichloride, PCl_3 , can form a co-ordinate bond with a hydrogen ion to form HPCl_3^+ .

i)

Draw the Lewis (electron dot) structure of HPCl_3^+ .

[2]

ii)

Predict the bond angle and molecular geometry of HPCl_3^+ .

[2]

[4 marks]

Question 1c

c)

BCl_3 has three electron domains in a trigonal planar structure.

BCl_3 is not a polar molecule, but PCl_3 is.

Explain this difference using section 8 of the Data booklet.

[4]**[4 marks]****Question 1d**

d)

PCl_4^+ has the same electron domain geometry as HPCl_3^+ .

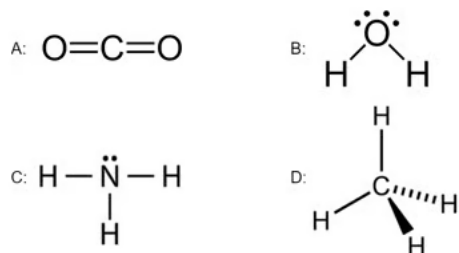
Explain why PCl_4^+ is not a polar molecule.

[2]**[2 marks]**

Question 2a

a)

This question is about the geometry of a number of common molecules.



i) Which molecule(s) has/ have tetrahedral structures with respect to the electron domain geometry? [1]

ii) What is the molecular geometry of CO_2 ? [1]

iii) Draw the 3D representation of ammonia, NH_3 . [1]

[3 marks]

Question 2b

b)

Estimate the H-O-H bond angle in water, H_2O , using VSEPR theory.
Explain your answer.

[3]

[3 marks]

Question 2c

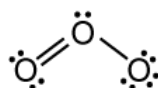
c)
Suggest a way in which the bond angle in ammonia / NH_3 could become 109.5° and explain your answer.

[3]

[3 marks]

Question 2d

d)
Ozone, O_3 , is another simple molecule which has the following structure:



i)
Estimate the O-O-O bond angle in ozone using VSEPR theory.

[1]

ii)
Explain why the actual bond lengths present in ozone are equal.

[2]

[3 marks]

Question 3a

a)

Carbon has three naturally occurring allotropes; diamond, graphite and buckminsterfullerene, C₆₀.

State how many atoms each carbon is directly bonded to in each of the allotropes, explaining any differences.

[4]

[4 marks]

Question 3b

b)

Describe the differences in the structures of the three allotropes of carbon.

[3]

[3 marks]

Question 3c

c)

Describe and explain the differences in electrical conductivity between the three allotropes of carbon.

[4]

[4 marks]

Question 3d

d)

Graphene can be made from graphite.

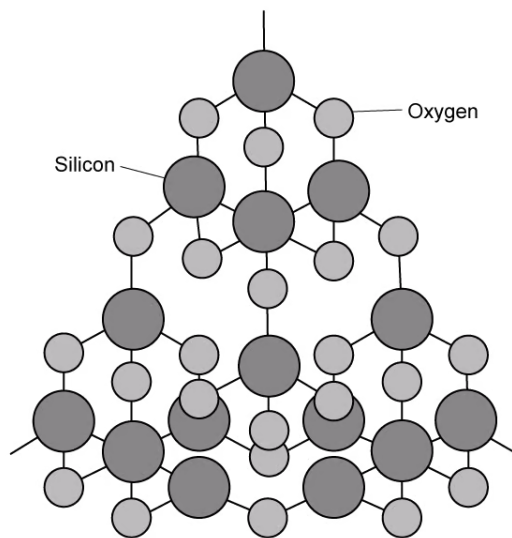
Describe a similarity and difference between these two structures.

[2]

[2 marks]

Question 4a

a)
Silicon and carbon are in the same group of the Periodic Table. They both form covalent bonds.



Both silicon and carbon form dioxides, but silicon dioxide has a melting point of 1710 °C whilst carbon dioxide has a melting point of -78 °C.

Explain this difference with reference to the structure and bonding present in each dioxide.

[4]

[4 marks]

Question 4b

b)

How many oxygen atoms are bonded to each carbon and to each silicon?

Explain how this links to the formula of each compound.

[3]

[3 marks]**Question 4c**

c)

Predict the O-C-O and O-Si-O bond angles respectively in CO₂ and in SiO₂.

[2]

[2 marks]**Question 4d**

d)

Predict and explain the solubility of both SiO₂ and CO₂ in water.

[4]

[4 marks]

