# 14.1 More Structures & Shapes

## Question Paper

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|---|---|
| Course | DP IB Chemistry |
| Section | 14. Chemical Bonding & Structure (HL only) |
| Topic | 14.1 More Structures & Shapes |
| Difficulty | Easy |

**Time allowed:** 40

**Score:** /31

**Percentage:** /100

## Question 1a

a)
Two types of covalent bond are sigma and pi bonds.

i)
Describe how a sigma (σ) bond is formed

[1]

ii)
Describe how a pi (π) bond is formed

[1]

**[2 marks]**

## Question 1b

b)
Describe the difference in the location of the electron dense regions in sigma (σ) and pi (π) bonds.

[2]

**[2 marks]**

## Question 1c

c)
Deduce the number of sigma (σ) and pi (π) bonds in methane, $CH_4$.

[2]

**[2 marks]**

## Question 1d

d)
Deduce the number of sigma (σ) and pi (π) bonds in oxygen, $O_2$.

[2]

**[2 marks]**

## Question 2a

a)
Sulfur can form bonds with six fluorine atoms to form sulfur hexafluoride, $SF_6$.

i)
How many electrons are in the outer shell of the sulfur in $SF_6$?

[1]

ii)
State the minimum and maximum numbers of electrons possible in the outer shell of sulfur.

[1]

**[2 marks]**

## Question 2b

b)
Sulfur has no lone pairs when bonded to fluorines in $SF_6$. Predict the molecular geometry of sulfur hexafluoride, $SF_6$.

[1]

**[1 mark]**

## Question 2c

c)
State the F-S-F bond angles in $SF_6$.

[1]

**[1 mark]**

## Question 2d

d)
Phosphorus pentafluoride, $PF_5$, is also a molecule with an expanded octet around the central atom.

i)
Draw a Lewis (electron dot) structure for $PF_5$

[1]

ii)
Predict the molecular geometry of $PF_5$

[1]

iii)
State the F-P-F bond angle(s)

[1]

**[3 marks]**

## Question 3a

a)
Although noble gases do not normally react, a few compounds are possible. One is xenon tetrafluoride.
Draw the Lewis structure (electron dot) for $XeF_4$.

[2]

**[2 marks]**

## Question 3b

b)
Predict the molecular geometry and electron domain geometry for the $XeF_4$ molecule.

[2]

**[2 marks]**

## Question 3c

c)
Predict and explain the F-Xe-F bond angle in $XeF_4$

[2]

**[2 marks]**

## Question 3d

d)
The formal charge on an atom can be calculated by the following:

**FC = (Number of valence electrons) – ½(Number of bonding electrons) – (Number of non-bonding electrons)**

Calculate the formal charge on the xenon and the fluorines in xenon tetrafluoride, $XeF_4$.

[2]

**[2 marks]**

## Question 4a

a)
Draw a Lewis (electron dot) structure for carbon dioxide, $CO_2$.

[2]

**[2 marks]**

## Question 4b

b)

Predict the molecular geometry and the O-C-O bond angle in carbon dioxide, $CO_2$.

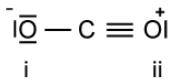
[2]

**[2 marks]**

## Question 4c

c)

An alternative way to draw the carbon dioxide molecule is:




Identify the formal charge on each of the oxygen atoms.

[2]

**[2 marks]**

## Question 4d

d)

State which of the Lewis structures, that from part a) or part c), is preferable and explain your choice.

[2]

**[2 marks]**