14.2 Further Aspects of Bonding

Question Paper

Course	DP IB Chemistry
Section	14. Chemical Bonding & Structure (HL only)
Topic	14.2 Further Aspects of Bonding
Difficulty	Medium

Time allowed: 70

Score: /54

Percentage: /100

Question 1a

a)
Harmful UV radiation from the Sun is absorbed by the ozone layer.

Explain how the bonding in O_2 and O_3 affects the wavelengths of UV light they absorb

[3 marks]

Question 1b

b)
The chemical balance of the stratosphere is disrupted by the presence of chlorofluorocarbons (CFCs) and other ozone-depleting compounds.

Describe, using equations, how CFCs contribute to ozone depletion using dichlorodifluoromethane and explain the initial step by reference to the bonds in the CFC.

[4 marks]

Question 1c

c)
Although the use of harmful CFCs is being phased out, suggest why these compounds are expected to remain in the atmosphere for the next 80 – 100 years.

[2 marks]

Question 1d

d)
Formulate two equations to show how nitrogen(II) oxide, NO, catalyses the destruction of ozone.

[2 marks]

Question 2a

a)
Cyclohexane C_6H_{12} has a puckered, non-planar shape whereas benzene C_6H_6 is planar.

Explain this difference by making reference to the C-C-C bond angles and the type of hybridisation of carbon in each molecule.

[4 marks]

Question 2b

b)
Urea, $CO(NH_2)_2$, is present in solution in animal urine.

What is the hybridisation of C and N in the molecule, and what are the approximate bond angles?

[4 marks]

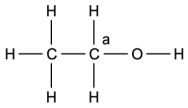
Question 2c

c)
Describe the hybridisation of the carbon atom in methane and explain how the concept of hybridisation can be used to explain the shape of the methane molecule

[4 marks]

Question 2d

d)
A molecule of ethanol is shown below.



Deduce the hybridisation of the carbon atom marked in the diagram below.

[1 mark]

Question 3a

a)
Carbonation is the process of increasing the concentration of carbonate ions in water to produce carbonated drinks.

Identify the hybridisation of the central carbon atom.

[1 mark]

Question 3b

b)
Explain, with the use of diagrams, how there are three valid structures for the carbonate ion.

[3 marks]

Question 3c

c)
Describe the distribution of pi (π) electrons and explain how this can account for the structure and stability of the carbonate ion, CO_3^{2-}.

[3 marks]

Question 3d

d)
Identify and explain the bond order of the carbonate ion.

[2 marks]

Question 4a

a)

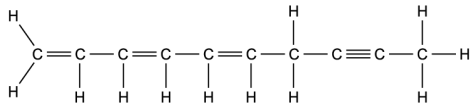
Explain how the concept of hybridisation can be used to explain the triple bond present in propyne.

[3 marks]

Question 4b

b)

Consider the molecule below which contains both sigma and pi bonds.



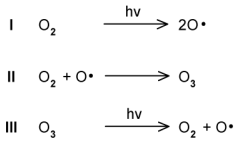
How many carbon atoms exhibit sp^2 hybridisation in this molecule.

[1 mark]

Question 4c

c)

The concentration of ozone in the upper atmosphere is maintained by the following three reactions, **I**, **II** and **III**



Explain which reaction requires the most energy

[4 marks]

Question 4d

d)
Deduce the hybridisation shown by the nitrogen atoms in NF_4^+, N_2H_2 and N_2H_4.

	NF_4^+	N_2H_2	N_2H_4
Hybridisation			

[3 marks]

Question 5a

a)
Sea spray is generated by the breaking of waves and releases bromine into the atmosphere.

Write two balanced equations to show how a bromine radical could cause the destruction of ozone.

[2 marks]

Question 5b

b)
Explain why ozone can be dissociated by light with a longer wavelength than required to decompose oxygen.

[3 marks]

Question 5c

c)
The two oxygen-oxygen bonds in ozone are in fact of equal length. Deduce why this is the case and how the length of these would compare to oxygen-oxygen bond lengths in hydrogen peroxide, H_2O_2, and in the oxygen molecule, O_2

[2 marks]

Question 5d

d)
One CFC, Freon-13 (chlorotrifluoromethane), which can be used as a refrigerant, has been phased out by the Montreal Protocol.

Describe, using equations, the mechanism of the catalysis of ozone depletion by this particular CFC.

[3 marks]