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	Easy

Time allowed: 40

Score: /32

Percentage: /100

Question 1a

a)
State what is meant by the term delocalisation of electrons.

[1]

[1 mark]

Question 1b

b)
Delocalisation is common in some types of organic molecule.

i)
Identify whether ethanoic acid, CH_3COOH, has delocalised π electrons.

[1]

ii)
Identify where the ethanoate ion, CH_3COO^-, has delocalised electrons.

[1]

iii)
Give a reason for your choices.

[1]

[3 marks]

Question 1c

c)
Draw two resonance structures for the ethanoate ion, CH_3COO^-.

[2]

[2 marks]

Question 1d

d)
Deduce the bond order of the C-O bonds in the ethanoate ion.

[1]

[1 mark]

Question 2a

a)
Benzene, C_6H_6, has two resonance structures. Draw skeletal formulae of these two structures.

[1]

[1 mark]

Question 2b

b)
Benzene is commonly drawn in the following manner:

Explain what this represents and why this is a useful way to draw benzene.

[2]

[2 marks]

Question 2c

c)
Some of the sigma bonds in benzene are formed from hybrid orbitals. The type of hybridisation present is sp^2.
State which orbitals hybridise to form sp^2 orbitals.

[2]

[2 marks]

Question 2d

d)
The sp^2 hybridized orbitals form sigma bonds in the benzene molecule. The delocalised electrons from pi bonds.

i)
Deduce the number of sigma (σ) bonds in benzene.

[1]

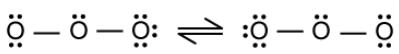
ii)
Deduce the number of pi (π) bonds in benzene.

[1]

[2 marks]

Question 3a

a)
Ozone, O_3, forms two resonance structures, shown below:



i)
Allocate formal charges to the oxygen atoms in the left-hand diagram.

[1]

ii)
Deduce the bond order for the O-O bond in ozone.

[1]

[2 marks]

Question 3b

b)
The bond order of oxygen, O_2, molecules is 2.

i)
State which bonds are easier to break, those in oxygen or those in ozone.

[1]

ii)
Compare the wavelengths of light needed to break the bonds in oxygen and ozone respectively

[1]

[2 marks]

Question 3c

c)
Ozone, O_3, can react to form oxygen, O_2. Write an equation to show the overall equation for this depletion.

[1]

[1 mark]

Question 3d

d)
A number of species can catalyse the depletion of ozone, O_3.
Write the molecular formulae for two catalysts of ozone depletion.

[2]

[2 marks]

Question 4a

a)
Methane contains sp^3 hybridised orbitals.

i)
Explain the formation of sp^3 hybridised orbitals.

[2]

ii)
How many sp^3 hybridised orbitals are present in methane?

[1]

[3 marks]

Question 4b

b)
Ethyne, C_2H_2, is another hydrocarbon, in this case containing sp hybrid orbitals.

i)
Explain the formation of the sp hybrid orbitals in ethyne

[2]

ii)
Deduce the number of sp hybrid orbitals in a molecule of ethyne.

[1]

iii)
State if these sp hybrid bonds form sigma (σ) or pi (π) (bonds)

[1]

[4 marks]

Question 4c

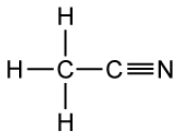
c)
Explain, using the concept of hybridisation, how the triple bond in ethyne, C_2H_2, forms.

[2]

[2 marks]

Question 4d

d)
Ethanenitrile, CH_3CN, is an organic molecule with a tetrahedral molecular geometry around one carbon and a linear molecular geometry around the other carbon. The structure is shown below:



i)
Identify how many sp^3 hybrid orbitals are present in this molecule.

[1]

ii)
Identify how many sp hybrid orbitals are present in this molecule.

[1]

[2 marks]