4.2 Resonance, Shapes & Giant Structures

Question Paper

Course	DP IB Chemistry
Section	4. Chemical Bonding & Structure
Topic	4.2 Resonance, Shapes & Giant Structures
Difficulty	Hard

Time allowed: 60

Score: /49

Percentage: /100

Question 1a

a)
A simple amide is $HCONH_2$.
Draw the Lewis (electron dot) structure for this molecule.

[2]

[2 marks]

Question 1b

b)
Predict and explain the bond angle around the C and N atoms.

[6]

[6 marks]

Question 1c

c)
Predict the molecular geometry and the electron domain geometry around the C and N in $HCONH_2$.

[4]

[4 marks]

Question 1d

d)
State, with a reason, whether $HCONH_2$ is a polar molecule.

[3]

[3 marks]

Question 2a

a)
Tetrafluoroethene, C_2F_4, and tetrafluorohydrazine, N_2F_4, are fluorides of adjacent elements in the Periodic Table.
Draw the Lewis (electron dot) structures for C_2F_4 and N_2F_4 showing all valance electrons.

[2]

[2 marks]

Question 2b

b)
Predict and explain the F-C-F bond angle in tetrafluoroethene and the F-N-F bond angle in tetrafluorohydrazine.

[5]

[5 marks]

Question 2c

c)
Tetrafluorohydrazine is a polar molecule but tetrafluoroethene is not.
Explain the difference in molecular polarity.

[4]

[4 marks]

Question 3a

a)
Draw the Lewis (electron dot) structure of the carbonate ion, CO_3^{2-}.

[3]

[3 marks]

Question 3b

b)
Deduce the number of possible resonance structures for the carbonate ion, CO_3^{2-}, and draw two of them.

[3]

[3 marks]

Question 3c

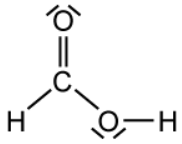
c)
Discuss how the bonding in the carbonate ion, CO_3^{2-}, evidences the presence of the resonance structures.

[3]

[3 marks]

Question 3d

d)
Organic molecules can also show resonance. The methanoate ion, $HCOO^-$, shows similar resonance forms to the carbonate ion, CO_3^{2-}.
The corresponding organic acid, methanoic acid, also has resonance structures.



Draw another resonance structure of methanoic acid.

[2]

[2 marks]

Question 4a

a)
Some of the physical and structural properties of diamond and graphite are shown below:

Property	Diamond	Graphite
Melting Point at 1 atmosphere / K	4200	4300
Density / g cm^{-3}	3.51	2.26
Average bond length / nm	0.155	0.142
Delocalisation	No	Yes
Hybridisation	sp^3	sp^2
Electron mobility $cm^2 V^{-1} s^{-1}$	1000 - 2000	15000 - 200000

Suggest why the melting point of graphite is higher than that of diamond, using the information in the table.

[2]

[2 marks]

Question 4b

b)
Predict the bond order in both diamond and graphite.

[2]

[2 marks]

Question 4c

c)
Graphene has the structure of a single layer of graphite.
Suggest, giving a reason, the electron mobility of graphene compared to graphite.

[2]

[2 marks]

Question 4d

d)
Graphite is a layered giant structure, containing London dispersion forces between the layers, whereas diamond has covalent bonds across all planes.
Describe and explain, based on structure and bonding, the differences expected when each of graphite and diamond are moved across a paper surface.

[6]

[6 marks]