

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	Medium

Time allowed: 80

Score: /61

Percentage: /100

on la
Draw the structure of silicon dioxide and state the type of bonding present. [2 marks]
on 1b
Describe the similarities and differences you would expect in the properties of silicon and diamond. [3 marks]
on 1c
The boiling point of diamond is 3550 °C, but for carbon dioxide it is -78.5 °C. Both are covalent substances. Explain this difference with reference to structure and bonding.
[4 marks]

Question 1d

d)	Silicon dioxide has a similar name to carbon dioxide, but its boiling point is 2230 °C.
	Briefly outline the reason for this difference.

[2 marks]

Question 2a

a) In 1996 the Nobel prize in Chemistry was awarded for the discovery of a new carbon allotrope, known as fullerenes.

Outline the structure of buckminsterfullerene.

[2 marks]

Question 2b

b) Like carbon dioxide, graphite is also a covalent substance, but it is a solid at room temperature. Graphite has a melting point of around 3600 °C.

Describe the structure and bonding of graphite and explain why it has such a high melting point.

[5 marks]

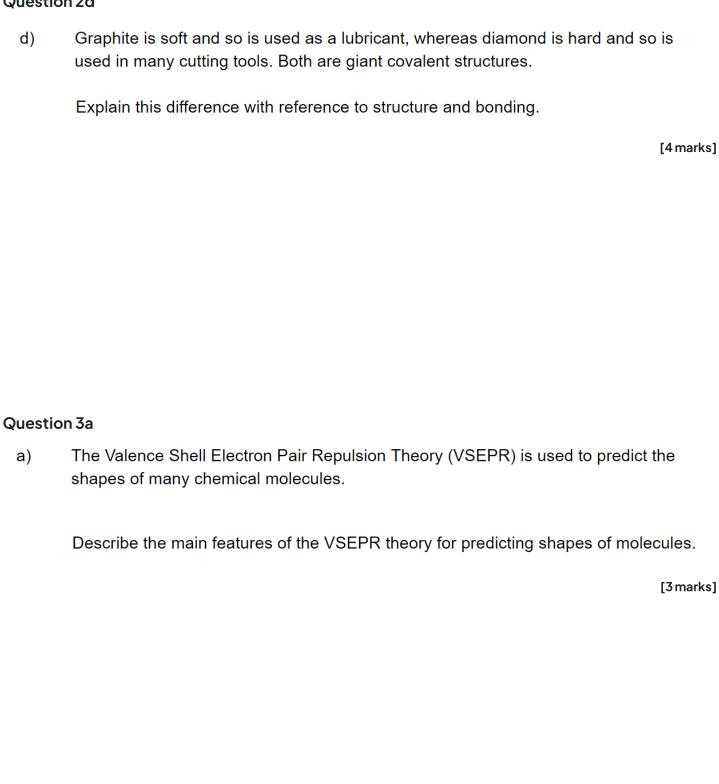
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Question 2c

- Graphite is made purely of carbon, a non-metal, yet it conducts electricity.
 Diamond, which is also made purely of carbon, cannot conduct electricity.
- (i) Explain this difference in electrical conductivity between graphite and diamond.
- (ii) Give one other difference in the properties of graphite and diamond.

[4 marks]

Question 2d



Question 3b

State and explain the bond angle F-O-F in OF₂. b)

[3 marks]

Question 3c

c) Deduce whether each of the three molecules oxygen difluoride, OF₂, phosphorus trifluoride, PF₃, and boron trichloride, BC*I*₃, are polar or non-polar. Give a reason in each case.

[3 marks]

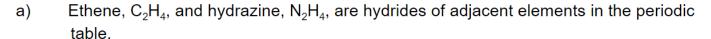
Question 3d

- d) Predict and explain the shapes and bond angles of the following molecules:
- (i) BF₃
- (ii) NBr₃

[4 marks]

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Question 4a



State and explain the H—C—H bond angle in ethene and the H—N—H bond angle in hydrazine.

[5 marks]

Question 4b

b) Hydrazine can be oxidised to form diimide, which is a useful compound used in organic synthesis.

Deduce the molecular geometry of diimide, N₂H₂, and estimate its H–N–N bond angle.

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[2 marks]

Question 4c

c) Explain whether ethene and hydrazine are polar or non-polar.

[4 marks]

Question 4d

d) Hydrazine forms a cation with an ethane-like structure called hydrazinediium, $N_2H_6^{2+}$. Predict the value of the H–N–H bond angle in $N_2H_6^{2+}$.

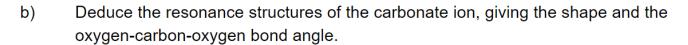
[1 mark]

Question 5a

- a) Draw the resonance structures for the following ions:
- (i) Methanoate, HCOO-.
- (ii) Nitrate(III), NO₂⁻.

[2 marks]

Question 5b



[3 marks]

Question 5c

c) In December 2010, researchers in Sweden announced the synthesis of N,N-dinitronitramide, N(NO₂)₃. They speculated that this compound, more commonly called trinitramide, may have significant potential as an environmentally friendly rocket fuel oxidant.

Deduce the N-N-N bond angle in trinitramide and explain your reasoning.

[3 marks]



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Question 5d

d) Predict, with an explanation, the polarity of the trinitramide molecule.

[2 marks]