

# Covalent Bonding

## Question Paper

<b>Level</b>	A Level
<b>Subject</b>	Chemistry
<b>Exam Board</b>	Edexcel
<b>Topic</b>	Bonding & Structure
<b>Sub Topic</b>	Covalent Bonding
<b>Booklet</b>	Question Paper
<b>Paper Type</b>	Open-Response

**Time Allowed:** 45 minutes

**Score:** /37

**Percentage:** /100

**Grade Boundaries:**

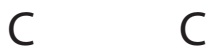
A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 This question is about isomers of  $C_4H_8$ .

- (a) (i) Alkenes contain a carbon-carbon double bond, which consists of a  $\sigma$  bond and a  $\pi$  bond.

Show, and clearly label, the  $\sigma$  and  $\pi$  bonds on the diagram below.

(2)



- \*(ii) Explain why the  $\sigma$  bond is stronger than the  $\pi$  bond.

(2)

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- (b) (i) Draw the structural formula of *E*-but-2-ene.

(1)

- (ii) Explain why but-1-ene does not exhibit *E-Z* isomerism.

(1)

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(iii) Describe the result of the test for the presence of a C=C bond in *E*-but-2-ene using bromine water. Give the displayed formula of the organic product.

(2)

Test result .....

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Displayed formula of organic product:

(c) Another test for C=C bonds is the reaction with acidified potassium manganate(VII).

Describe the result of this test using **but-1-ene** and give the displayed formula of the organic product.

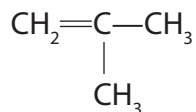
(2)

Test result .....

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Displayed formula of organic product:

(d) Another isomer of  $C_4H_8$  has the structure shown below.



(i) Name this isomer.

(1)

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(ii) This isomer forms an addition polymer. Show the structure of this polymer by drawing **two** repeat units.

(1)

(e) 'Polybutene' is the name used by cosmetic companies for a mixture of poly(but-1-ene) and poly(but-2-ene).

An American "eco-cosmetics" company says that though 'polybutene' is considered a safe ingredient in lip gloss, it is non-sustainable to use it.

Suggest **one** reason to justify this statement.

(1)

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(Total for Question = 13 marks)

2 (a) Explain how the atoms are held together by the covalent bond in a molecule of hydrogen.

(1)

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(b) Draw the dot and cross diagrams for

(i) methane, CH<sub>4</sub>

(1)

(ii) ethene, CH<sub>2</sub>=CH<sub>2</sub>

(1)

(iii) nitrogen, N<sub>2</sub>

(1)

(iv) the ammonium ion, NH<sub>4</sub><sup>+</sup>

(1)

(c) Silicon exists in a giant covalent lattice.

(i) The electrical conductivity of pure silicon is very low. Explain why this is so in terms of the bonding.

(2)

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(ii) Explain the high melting temperature of silicon in terms of the bonding.

(2)

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**(Total for Question = 9 marks)**

3 This question is about the properties of ions and ionic compounds.

(a) Solid calcium carbonate,  $\text{CaCO}_3$ , has a giant ionic structure.

(i) Draw a diagram (using dots or crosses) for a calcium **ion**. Show **ALL** the electrons and the charge on the ion.

(2)

(ii) Complete the electronic configuration for a calcium **ion**.

(1)

$1s^2$

(iii) Would you expect a calcium ion to be bigger, smaller or the same size as a calcium atom? Give TWO reasons to explain your answer.

(2)

(iv) Explain why ionic compounds have relatively high melting temperatures.

(2)

(b) Changes in the concentration of ions in a solution can be estimated by measuring the electrical conductivity of the solution.

(i) Explain why solutions of ions are able to conduct electricity.

(1)

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(ii) Suggest why aqueous solutions of calcium chloride,  $\text{CaCl}_2(\text{aq})$ , and barium chloride,  $\text{BaCl}_2(\text{aq})$ , of the same molar concentration, have different electrical conductivities.

(1)

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(iii) 1 kg of a solution contains 0.100 mol of calcium ions,  $\text{Ca}^{2+}$ .

What is the concentration of the calcium ions by mass in parts per million (ppm)?

[Assume the relative atomic mass of calcium is 40.]

(2)

.....ppm



- \***(c)** Some buildings are made from limestone, which is mainly calcium carbonate. Gases in the atmosphere such as sulfur dioxide,  $\text{SO}_2$ , and nitrogen dioxide,  $\text{NO}_2$ , can be responsible for damaging these buildings.

Describe how these gases come to be present in the atmosphere and explain how they can damage a limestone building.

**(3)**

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- (d)** The lattice energy of calcium chloride,  $\text{CaCl}_2$ , is  $-2258 \text{ kJ mol}^{-1}$  based on an experimental Born-Haber cycle and  $-2223 \text{ kJ mol}^{-1}$  based on theoretical calculations.

Would you expect its bonding to match the ionic model? Justify your answer.

**(1)**

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**(Total for Question = 15 marks)**