

7: Covalent bonding – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	November	43
3	2016	March	42
4	2016	November	43

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

- 1 (a) Complete the table.

particle	charge	relative mass
proton	+1	
neutron		1
electron		

[2]

- (b) The following are isotopes of carbon.



- (i) In terms of numbers of protons, neutrons and electrons, how are these **three** isotopes the same and how are they different?

They are the same because

.....

They are different because

.....

[3]

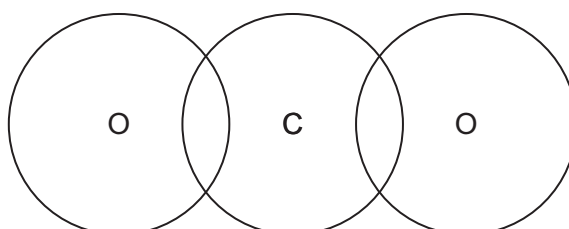
- (ii) Why do all isotopes of carbon have the same chemical properties?

..... [1]

- (c) Name **two** forms of the element carbon which have giant covalent structures.

..... and [1]

- (d) Complete the diagram to show the electron arrangement in a carbon dioxide molecule.
Show the outer shell electrons only.



[2]

[Total: 9]

3 Carbon dioxide and silicon(IV) oxide are oxides of Group IV elements.

(a) Complete the following table.

	carbon dioxide	silicon(IV) oxide
formula		SiO ₂
melting point/°C	–56	1610
physical state at 25 °C	gas	
conduction of electricity	non-conductor	
structure		macromolecular

[4]

(b) (i) Name the type of bonds that exist between the atoms in silicon(IV) oxide.

..... [1]

(ii) Explain why silicon(IV) oxide has a very high melting point.

.....
..... [1]

(iii) Explain, in terms of attractive forces between particles, why carbon dioxide has a very low melting point.

.....
..... [1]

(iv) Explain, in terms of particles, why carbon dioxide is a non-conductor of electricity.

.....
..... [1]

(c) Suggest a chemical equation for the reaction between sodium hydroxide solution and carbon dioxide.

..... [2]

(d) (i) Name the type of chemical reaction in which carbon dioxide is produced from fossil fuels.

..... [1]

(ii) Name the chemical process in which green plants convert carbon dioxide into carbohydrates.

..... [1]

(iii) Name the chemical process in which living things produce carbon dioxide.

..... [1]

[Total: 13]

4 Silicon(IV) oxide and sodium chloride have different types of bonding and structure.

(a) Name the type of bonding present in

silicon(IV) oxide,

sodium chloride.

[2]

(b) Name the type of structure present in silicon(IV) oxide.

..... [1]

(c) (i) Silicon(IV) oxide has a high melting point. Explain why.

.....

..... [2]

(ii) Silicon(IV) oxide is a poor conductor of electricity. Explain why.

..... [1]

(d) Solid sodium chloride does not conduct electricity. However, it conducts electricity when molten.

Explain why solid sodium chloride does **not** conduct electricity, whereas molten sodium chloride does conduct electricity.

.....

.....

.....

..... [3]

(e) A **concentrated** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

(i) Name the products formed at the electrodes.

product at the positive electrode (anode)

product at the negative electrode (cathode)

[2]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

..... [1]

(f) A **dilute** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

Name the main product formed at the positive electrode.

..... [1]

(g) Molten sodium chloride is electrolysed using carbon electrodes.

(i) Name the product formed at the negative electrode.

..... [1]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

..... [1]

(iii) Chlorine is produced at the positive electrode.

Give the test for chlorine.

test

result [2]

[Total: 17]

Question	Answer	Marks
1 (a)	proton	+1
	neutron	0
	electron	-1
		$1/1840$
1 (b) (i)	(same) number of protons and electrons / 6 protons and six electrons (different) neutron (number) / 6, 7 and 8 neutrons	2 1
1 (b) (ii)	same <u>number</u> of electrons / electron configuration	1
1 (c)	diamond <i>and</i> graphite	1
1 (d)	two double bonds with no extra electrons on the carbon atoms both oxygen atoms with four non-bonding electrons	1 1
		Total: 9

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Question	Answer	Marks										
3 (a)	<table><tr><td>CO₂;</td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td>solid;</td></tr><tr><td></td><td>poor conductor / non-conductor;</td></tr><tr><td>simple molecular / simple (covalent);</td><td></td></tr></table>	CO ₂ ;					solid;		poor conductor / non-conductor;	simple molecular / simple (covalent);		4
	CO ₂ ;											
		solid;										
		poor conductor / non-conductor;										
simple molecular / simple (covalent);												
3 (b) (i)	covalent;	1										
3 (b) (ii)	all bonds are (very) strong or bonds; OR bonds need a lot of energy or heat to break; OR (there are) no weak bonds / no (weak) intermolecular forces;	1										
	3 (b) (iii)		weak forces between molecules; OR weak intermolecular forces or weak van der Waals' forces; OR low amount of energy needed to break intermolecular / van der Waals' forces;	1								
3 (b) (iv)	no (moving) ions / no mobile or moving electrons / all electrons used in bonding / made of uncharged molecules;	1										
3 (c)	2NaOH + CO ₂ → Na ₂ CO ₃ + H ₂ O OR NaOH + CO ₂ → NaHCO ₃ formula of Na ₂ CO ₃ / NaHCO ₃ ; whole equation correct;	2										
3 (d) (i)	(complete) combustion / burning;	1										
3 (d) (ii)	photosynthesis;	1										
3 (d) (iii)	respiration;	1										
Total: 13												

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Question	Answer	Marks
4 (a)	<i>silicon(IV) oxide</i> : covalent	1
	<i>sodium chloride</i> : ionic / electrovalent	1
4 (b)	giant molecular / macromolecular / giant covalent / giant atomic	1
4 (c) (i)	M1 (covalent) bonds are strong	2
	M2 a lot of heat or energy is needed to break / weaken / overcome bonds	
	OR there are no <u>weak bonds</u>	
	OR there are <u>no intermolecular forces</u>	
	OR covalent bonds are the <u>only bonds</u>	
4 (c) (ii)	OR strong bonds are the <u>only bonds</u>	1
	(it has) no moving ions / no moving electrons / all electrons are used in bonding / no moving charged particles	
	(sodium chloride contains) ions / is ionic	
	in the solid ions are not moving / they are in fixed positions	
	ions can move when molten	
4 (e) (i)	<i>product at the positive electrode</i> : chlorine	1
	<i>product at the negative electrode</i> : hydrogen	1
4 (e) (ii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	1
	OR $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$	
4 (f)	oxygen	1
4 (g) (i)	sodium	1
4 (g) (ii)	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$	1
4 (g) (iii)	<i>test</i> : (damp blue) litmus	1
	<i>result</i> : bleached / removes colour / (turns) white	1
		Total: 17