

7: Covalent bonding – Topic questions

Paper 3

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

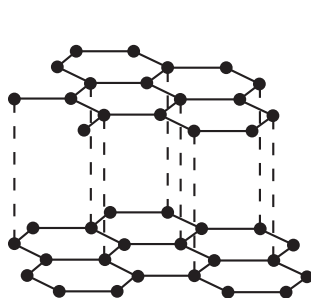
Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2014	November	31
3	2014	November	33
7	2016	November	33

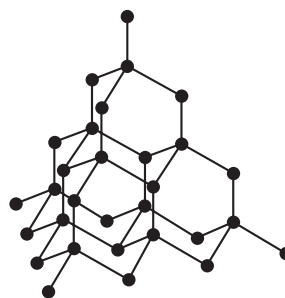
The mark scheme for each question is provided at the end of the document.

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

- 2 Two macromolecular forms of carbon are graphite and diamond. The structures of graphite and diamond are given below.



graphite



diamond

- (a) Explain in terms of its structure why graphite is soft and is a good conductor of electricity.

.....
.....
.....
.....
..... [3]

- (b) State **two** uses of graphite which depend on the above properties.

It is soft
.....
It is a good conductor of electricity
..... [2]

- (c) Silicon(IV) oxide also has a macromolecular structure.

- (i) Describe the macromolecular structure of silicon(IV) oxide.

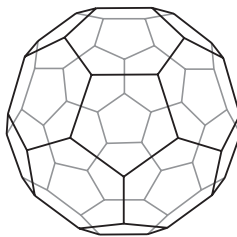
.....
..... [1]

- (ii) Predict **two** physical properties which diamond and silicon(IV) oxide have in common.

.....
..... [2]

[Total: 8]

- 3 In 1985 the fullerenes were discovered. They are solid forms of the element carbon. The structure of the C_{60} fullerene is given below.



- (a) (i) In the C_{60} fullerene, how many other carbon atoms is each carbon atom bonded to?

..... [1]

- (ii) Another fullerene has a relative molecular mass of 840.
How many carbon atoms are there in one molecule of this fullerene?

..... [1]

- (b) Fullerenes are soluble in liquid hydrocarbons such as octane. The other solid forms of carbon are insoluble.
Describe how you could obtain crystals of fullerenes from soot which is a mixture of fullerenes and other solid forms of carbon.

.....
.....
.....
..... [3]

- (c) A mixture of a fullerene and potassium is an excellent conductor of electricity.

- (i) Which other form of solid carbon is a good conductor of electricity?

..... [1]

- (ii) Explain why metals, such as potassium, are good conductors of electricity.

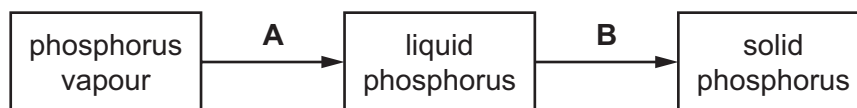
.....
..... [2]

- (iii) The mixture of fullerene and potassium has to be stored out of contact with air. There are substances in unpolluted air which will react with potassium.
Name **two** potassium compounds which could be formed when potassium is exposed to air.

..... [2]

[Total: 10]

- 7 The diagram shows the changes of state when phosphorus is cooled slowly to room temperature.



- (a) Give the names of the changes of state labelled **A** and **B**.

A

B [2]

- (b) Describe the arrangement and motion of the particles in solid phosphorus.

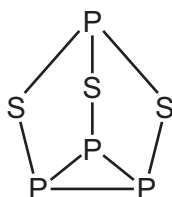
arrangement

motion [2]

- (c) Is phosphorus(V) oxide an acidic oxide or basic oxide?
Explain your answer.

..... [1]

- (d) Phosphorus sulfide is a covalent molecule.



Question	Answer	Marks
2 (a)	soft because weak forces between layers / sheets / rows	1
	layers can slip / slide	1
	good conductor because electrons can move / mobile	1
2 (b)	it is soft: pencils OR lubricant OR polish	1
	good conductor: electrodes OR brushes (in electric motors)	1
2 (c) (i)	Every silicon atom is bonded / attached to 4 oxygen atoms or every oxygen bonded / attached to two silicon atoms	1
2 (c) (ii)	any two from: <ul style="list-style-type: none"> • high melting point / boiling point • hard • colourless crystals / shiny • poor / non-conductor of electricity / insulator • insoluble in water 	2
		Total: 8
3 (a) (i)	3	1
3 (a) (ii)	70	1
3 (b)	add octane (or other liquid hydrocarbon) (to soot)	1
	COND (on addition of any solvent) filter (to remove insoluble forms of carbon)	1
	(allow to) evaporate OR heat OR warm OR leave in sun (to get crystals of fullerene)	1
3 (c) (i)	graphite	1
3 (c) (ii)	delocalised electrons / free electrons / sea of electrons	1
	COND (on electrons) move / mobile / electrons flow	1
3 (c) (iii)	any two from: <ul style="list-style-type: none"> • potassium oxide • potassium hydroxide • potassium carbonate • potassium hydrogencarbonate (bicarbonate) 	2
		Total: 10

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Question	Answer	Marks
7 (a)	A condensation / condensing / condense	1
	B freezing / solidification	1
7 (b)	<i>arrangement:</i> regular	1
	<i>motion:</i> (only) vibrating / not moving (from place to place)	1
7 (c)	acidic because phosphorus is a non-metal / phosphorus is on the right-hand side of the Periodic Table	1
7 (d)	any two from:	2
	<ul style="list-style-type: none"> • does not conduct electricity / heat • has a low melting point / boiling point • insoluble in water / soluble in organic solvents 	
7 (e)	sulfur dioxide is produced	1
	harmful effect of sulfur dioxide, e.g. acid rain / names effect of acid rain, e.g. corrodes metals / death of trees / kills organisms in lakes / irritation to lungs (or eyes / skin / nose / throat)	1
		Total: 9