

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	high melting point – strong covalent bonds does not conduct electricity – there are no charged particles free to move		1 1	AO1 4.2.2.6
01.2	C		1	AO1 4.2.2.6
01.3	oxygen: small molecule silicon: giant covalent structure		1 1	AO2 4.2.26 4.1.2.3
02.1	1 P atom and 3 H atoms are drawn with 1 shell each P atoms has 3 dots and 5 crosses each H atom shares 1 dot and 1 cross with P atom	the diagram shows cl should be the central p surrounded by 3 Hs – with no lone pairs on any of the Hs	2	AO2 4.2.1.4
02.2	intermolecular		1	AO2 4.2.2.4
02.3	gas		1	AO2 4.2.2.1
02.4	as radius of central atom increases, boiling point increases because strength of intermolecular forces increases with increasing size of molecule/because there are more electrons		1 1	AO3 4.2.2.4
03.1	there are no gaps/sticks between electrons		1	AO1 4.2.1.4
03.2	some of its electrons are free to move		1	AO1 4.2.3.2

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03.3	$\frac{0.24}{1.99 \times 10^{-23}}$ $= 1.21 \times 10^{22}$	one mark given for correct number of significant figures	1 1+1	AO2
04	<b>Level 3:</b> A detailed and coherent comparison is given, demonstrating a sound knowledge of the differences in properties and the reasons for them.		5-6	AO1 4.2.3.1 4.2.3.2
	<b>Level 2:</b> A correct description is given of the properties of each allotrope. Some reasons are given, but are not clearly articulated / not clearly linked to the property.		3-4	
	<b>Level 1:</b> Some correct points are made about each structure. Comparisons and reasons are not included.		1-2	
	<b>No relevant content.</b>		0	
	<b>Indicative content:</b>			
	<ul style="list-style-type: none"> <li>graphite conducts electricity but diamond does not</li> <li>because graphite includes delocalised electrons, but diamond does not.</li> <li>graphite is soft but diamond is hard</li> <li>because the layers in the structure of graphite can slide over each other, but there are no such layers in diamond/diamond has lots of strong bonds</li> <li>both have high melting and boiling points</li> <li>because both include strong covalent bonds between their atoms.</li> </ul>			
05.1	Z		1	AO2 4.2.3.2

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05.2	2 Cl atoms are drawn with 1 shell each one Cl atom has 7 crosses and 1 dot, the other 7 dots and 1 cross Cl atoms share 1 dot and 1 cross		2	AO2 4.2.1.4
05.3	2 O atoms are drawn with 1 shell each one O atom has 6 crosses and 2 dots, the other 6 dots and 2 crosses O atoms share 2 dots and 2 crosses	allow one mark if only one shared pair of electrons (single bond) but a total of eight electrons around each atom	2	AO2 4.2.1.4
05.4	Y chlorine has a higher melting point because it has more electrons/stronger intermolecular forces		1 1	AO3 4.2.2.4
06.1	low melting point because of small molecules does not conduct electricity because does not include charged particles that are free to move	accept soluble in water with correct explanation of hydrogen bonding ignore the name of the compound/ethanol	1 1 1 1	AO1 x 2 AO2 x 2 4.2.2.4
06.2	C <sub>2</sub> H <sub>5</sub> OH	allow elements in any order e.g. H <sub>6</sub> OC <sub>2</sub>	1	AO2 4.2.1.4
06.3	there are six hydrogen atoms, $6 \times 6.02 \times 10^{23} = 3.61 \times 10^{24}$ atoms		1	AO2
06.4	liquid		1	AO2 4.2.2.1

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07.1	R		1	AO3 4.2.3.3
07.2	high (tensile) strength		1	AO1 4.2.2.3
07.3	electronics – because of electricity conduction reinforcing composite materials – because of high tensile strength	both the use and reason required for each mark	1 1	AO1 4.2.2.3
08.1	$C_6H_{14}$		1	AO2 4.2.1.4
08.2	1 C atom and 4 H atoms are drawn with 1 shell each C atom has 4 dots and 4 crosses, each H atom has 1 dot and 1 cross which it shares with the C atom		2	AO1 4.2.1.4
08.3	1 C atom and 4 H atoms are shown with letters each H atom is connect to the C atom by -		1	AO1 4.2.1.4
8.4	<b>Level 3:</b> A detailed and coherent comparison is given, demonstrating a sound understanding of the properties of liquids and gases.		5-6	AO1 x 4 AO3 x 2 4.2.2.1
	<b>Level 2:</b> Correct comparisons are made, showing some understanding of the properties of liquids and gases. The answer is not clearly articulated.		3-4	
	<b>Level 1:</b> Some correct points are made about the properties of liquids and/or gases.		1-2	
	<b>No relevant content.</b>		0	

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	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• in both atoms, the electrons are arranged in shells/energy levels</li> <li>• methane is a gas at room temperature</li> <li>• but hexane is in the liquid state.</li> <li>• both substances can be poured</li> <li>• both substances have no fixed shape / hexane takes the shape of the bottom of its container and methane takes the shape of the bottom of its container</li> <li>• hexane has a greater density than methane (at room temperature)</li> </ul>			
08.5	hexane has stronger forces between its particles than methane so more energy is required to separate the particles in hexane than in methane		1 1	AO2 4.2.2.1
09.1	${}^{14}_7\text{N}$		1	AO2 4.1.1.5
09.2	E ${}^{14}_7\text{N}$		1 1	AO2
09.3	${}^{24}_{12}\text{Mg}^{2+}$		1 1	AO2 4.1.1.5
09.4	Mg and ${}^{25}_{12}\text{Mg}^{2+}$ mass = 25, atomic number = 12		1 1	AO2 4.1.1.5

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10.1	1 C atom and 2 O atoms are drawn with 1 shell each C atom has 4 crosses and 4 dots each O atom has 6 crosses and 2 dots and shares 2 dots and 2 crosses with the C atom		2	AO2 4.2.1.4
10.2	silicon dioxide has a higher boiling point/ $\text{CO}_2$ has lower sublimation point boiling silicon dioxide involves breaking strong covalent bonds but subliming carbon dioxide involves breaking weak intermolecular forces		1 1 1	AO1 4.2.2.4 4.2.2.6
11.1	bond strengths decrease as number of electron energy levels/shells increase/as you go down the group because the bonding electrons are less attracted to the nucleus		1 1	AO3 4.2.2.4

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11.2	2 N atoms are drawn with 1 shell each 1 N atom has 5 crosses and 3 dots, the other N atom has 5 dots and 3 crosses N atoms share 3 dots and 3 crosses		1	AO2 4.2.1.4
	2 O atoms are drawn with 1 shell each 1 O atom has 6 crosses and 2 dots, the other O atom has 6 dots and 2 crosses O atoms share 2 crosses and 2 dots		1	
	2 H atoms are drawn with 1 shell each both H atoms have 1 dot and 1 cross which they share		1	
	triple bond is strong than double bond, double bond is stronger than single bond		1	

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12.1	mass = $7 \times 1.7 \times 10^{-27}$ kg mass = $1.19 \times 10^{-26}$ kg $\text{volume} = \frac{4}{3} \pi \times (1 \times 10^{-14})^3$ volume = $4.19 \times 10^{-42}$ m <sup>3</sup> $\text{density} = \frac{\text{mass}}{\text{volume}}$ $\text{density} = \frac{1.9 \times 10^{-26}}{4.19 \times 10^{-42}}$ density = $3 \times 10^{15}$ kg/m <sup>3</sup> to one significant figure		1  1  1 1	AO2
12.2	all matter is spread evenly throughout the nucleus		1	AO3
12.3	no because the mass of an atom is concentrated in the nucleus / the density of an atom is not the same throughout the atom	accept an explanation that relates to question <b>12.2</b> if the assumption given in question <b>12.2</b> was valid	1 1	AO3
12.4	assumes that there are no forces between the spheres whereas forces between the particles affect the physical properties of the substance <b>or</b> assumes spheres are solid whereas most of an atom is empty space, with a solid nucleus <b>or</b> assumes atoms do not contain subatomic particles / electrons, neutrons, protons whereas atoms do contain subatomic particles		1 1  <b>or</b> 1 1  <b>or</b> 1 1	AO1 4.2.2.1