

Question number	Answer	Marks	Guidance
1 (a)	Macromolecular/giant covalent/ giant molecular / giant atomic	1	If IMF/H-bonds/Ionic/metallic CE =0/3 covalent bond between molecules CE = 0/3 If giant unqualified M1 = 0 but mark on
	Many/strong covalent bonds	1	M2 and M3 can only be scored if covalent mentioned in answer Ignore metalloid and carbon Ignore bp
	Bonds must be broken/overcome	1	Ignore numbers of bonds and references to energy
1 (b)	(Simple) <u>molecular</u>	1	QoL Do not allow simple covalent for M1 Giant covalent/ionic/metallic, CE = 0 If breaking covalent bonds CE= 0/3
	S bigger <u>molecule</u> (than P) or S ₈ and P ₄ references	1	QoL Allow more electrons in sulfur <u>molecule</u> or S ₈ Do not allow S is bigger than P Allow S <u>molecule</u> has a bigger M _r Do not allow contradictions
	So more/ stronger <u>van der Waals</u> forces (to be broken or overcome)	1	Not just more energy to break
1 (c)	Regular arrangement of minimum of 6 particles in minimum of 2 rows	1	Ignore e- Do not allow ring arrangements OR structures bonded with electrons
	+ charge in each one (of 6)	1	Allow +, (1+, 2+ or 3+) in ions/or in words
	<u>Rows/planes/sheets/layers</u> (of atoms/ions) can slide (owtte) over one another	1	M3 independent If ionic bonding/molecules/IMF/vdw/covalent, penalise M3 Ignore layers of electrons sliding
1 (d)	Bigger charge (3+ compared to 1+) OR smaller atom / ion in Al / more protons/bigger nuclear charge	1	CE = 0 if molecules, ionic, covalent, IMF (Allow Al ²⁺)
	More free /delocalised electrons (in Al) / bigger sea of electrons in Al	1	Accept 2 or 3 delocalised electrons compared to 1 in Na

	Stronger metallic bonding / stronger (electrostatic) attraction between the (+) ions or nuclei and the (delocalised) electrons (or implied)	1	Must be implied that the electrons are the delocalised ones not the electrons in the shells. Accept converse arguments
2 (a)	Lithium / Li	1	Penalise obvious capital I (second letter).
2 (b) (i)	Increase / gets bigger	1	Ignore exceptions to trend here even if wrong
2 (b) (ii)	Boron / B Electron removed from (2)p orbital /sub-shell / (2)p electrons removed Which is higher in energy (so more easily lost) / more shielded (so more easily lost) / further from nucleus	1 1 1	If not Boron, CE = 0/3 If p orbital specified it must be 2p
2 (c)	C / Carbon	1	
2 (d)	Below Li 	1	The cross should be placed on the diagram, on the column for nitrogen, below the level of the cross printed on the diagram for Lithium.
2 (e)	Macromolecular / giant molecular / giant atomic <u>Covalent</u> bonds in the structure <u>Strong (covalent) bonds must be broken or overcome / (covalent) bonds need a lot of energy to break</u>	1 1 1	Allow giant covalent (molecule) = 2 Ignore weakening / loosening bonds If ionic / metallic/molecular/ dipole dipole/ H bonds/ bonds between molecules, CE = 0/3 Ignore van der Waals forces Ignore hard to break

3 (a) (i)	Higher than P	1	
3 (a) (ii)	$1s^2 2s^2 2p^6 3s^1$	1	Allow any order
3 (a) (iii)	$Al^+(g) + e^{(-)} \rightarrow Al^{2+}(g) + 2e^{(-)}$ OR $Al^+(g) \rightarrow Al^{2+}(g) + e^{(-)}$ OR $Al^+(g) - e^{(-)} \rightarrow Al^{2+}(g)$	1	
3 (a) (iv)	<u>Electron</u> in Si (removed from) (3)p orbital / electron (removed) from higher energy orbital or sub-shell / <u>electron</u> in silicon is more shielded	1	Accept converse arguments relating to Al Penalise incorrect p-orbital
3 (b)	Sodium / Na	1	Allow Na^+
	<u>Electron</u> (removed) from the 2 nd shell / 2p (orbital)	1	M2 is dependent on M1 Allow electron from <u>shell</u> nearer the nucleus (so more attraction)
3 (c)	Silicon / Si	1	Not Si
3 (d)	Heat or energy needed to overcome the attraction between the (negative) electron and the (positive) nucleus or protons Or words to that effect eg electron promoted to higher energy level (infinity) so energy must be supplied	1	Not breaking bonds QoL
4 (a)	Carbon / C	1	If M1 incorrect, CE = 0/3
	Fewest protons / smallest nuclear charge / least attraction between protons (in the nucleus) and electrons / weakest nuclear attraction to electrons	1	Allow comparative answers. Allow converse answers for M2
	Similar shielding	1	Allow same shielding.
4 (b)	<u>Increase</u>	1	
	<u>Oxygen</u> / O	1	If not oxygen, then cannot score M2, M3 and M4
	Paired electrons in a (2)p orbital	1	If paired electrons in incorrect p orbital, lose M3 but can award M4
	(Paired electrons in a p orbital) repel	1	

4 (c)	$C(g) \rightarrow C^+(g) + e^{(-)}$ OR $C(g) + e^{(-)} \rightarrow C^+(g) + 2e^{(-)}$ OR $C(g) - e^{(-)} \rightarrow C^+(g)$	1	Ignore state symbols for electron
4 (d)	(More energy to) remove an electron from a (more) positive ion / cation	1	Allow electron closer to the nucleus in the positive ion.
4 (e)	Lithium / lithuim / Li	1	If formula given, upper and lower case letters must be as shown.