Periodicity Answers

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
2	a		Cross between the Na cross and the Mg cross	1	
2	b		$Al(g) \rightarrow Al^+(g) + e–$ $Al(g) - e– \rightarrow Al^+(g)$ $Al(g) + e– \rightarrow Al^+(g) + 2e–$	2	One mark for state symbols consequential on getting equation correct. Electron does not have to have the – sign on it Ignore (g) if put as state symbol with e^- but penalise state symbol mark if other state symbols on e^-
2	c		2^{nd} / second / 2 / II	1	Only
2	d		Paired electrons <u>in (3)p orbital</u> repel	1 1	Penalise wrong number If paired electrons repel allow M2
2	e		Neon/ Ne $1s^22s^22p^6$ / $[He]2s^22p^6$	1 1	No consequential marking from wrong element Allow capital s and p Allow subscript numbers
2	f		Decreases Atomic radius increases/ electron removed further from nucleus or nuclear charge/ electron in higher energy level/ Atoms get larger/ more shells As group is descended more shielding	1 1 1	CE if wrong Accept more repulsion between more electrons for M2 Mark is for distance from nucleus Must be comparative answers from M2 and M3 CE M2 and M3 if mention molecules Not more sub-shells

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		$2s^2 2p^6 3s^1$	1	$1s^2$ can be rewritten Allow $2s^2 2p_x^2 2p_y^2 2p_z^2 3s^1$ Allow subscripts and capitals
1	(b)	(i)	Energy/enthalpy (needed) to remove one mole of electrons from one mole of atoms/compounds/molecules/elements ***OR*** Energy to form one mole of positive ions from one mole of atoms ***OR*** Energy/enthalpy to remove one electron from one atom In the gaseous state (to form 1 mol of gaseous ions)	1 1	Energy given out loses M1 M2 is dependent on a reasonable attempt at M1 Energy needed for this change $X(g) \rightarrow X^+(g) + e^{(-)}$ = 2 marks This equation alone scores one mark
1	(b)	(ii)	$Mg^+(g) \rightarrow Mg^{2+}(g) + e^{(-)}$ $Mg^+(g) + e^{(-)} \rightarrow Mg^{2+}(g) + 2e^{(-)}$ $Mg^+(g) - e^{(-)} \rightarrow Mg^{2+}(g)$	1	Do not penalise MG Not equation with X
1	(b)	(iii)	Electron being removed from a positive ion (therefore need more energy)/ electron being removed is closer to the nucleus/Mg^+ smaller (than Mg)/Mg^+ more positive than Mg	1	Allow from a + particle/ species Not electron from a higher energy level/or higher sub-level More protons = 0
1	(b)	(iv)	Range from 5000 to 9000 kJ mol^{-1}	1	
1	(c)		Increase Bigger nuclear <u>charge</u> (from Na to Cl)/more <u>protons</u> electron (taken) from same (sub)shell/ similar or same shielding/ electron closer to the nucleus/smaller atomic radius	1 1 1	If decrease CE = 0/3 If blank mark on QWC If no shielding = 0 Smaller ionic radius = 0

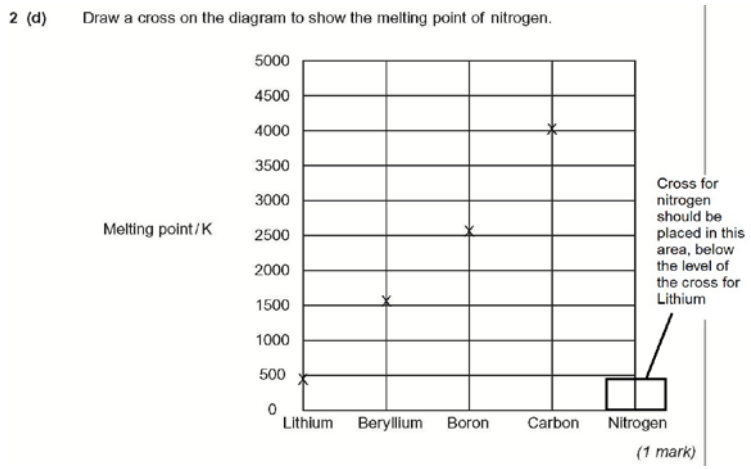
1	(d)		Lower Two/pair of electrons in (3)p orbital or implied repel (each other)	1 1 1	If not lower CE = 0/3 If blank mark on Allow does not increase Not 2p M3 dependent upon a reasonable attempt at M2
1	(e)		Boron/B or oxygen/O/ O_2	1	

Question	Marking Guidance	Mark	Comments
5(a)	$Li(g) \rightarrow Li^+(g) + e^-(g)$ $Li(g) - e^-(g) \rightarrow Li^+(g)$ $Li(g) + e^-(g) \rightarrow Li^+(g) + 2e^-$	1	One mark for balanced equation with state symbols Charge and state on electron need not be shown
5(b)	Increases Increasing nuclear charge / increasing no of protons Same or similar shielding / same no of shells / electron (taken) from same (sub)shell / electron closer to the nucleus / smaller atomic radius	1 1 1	If trend wrong then CE = 0/3 for 5(b). If blank mark on. Ignore effective with regard to nuclear charge
5(c)	Lower Paired electrons in a (4) p orbital (Paired electrons) repel	1 1 1	If not lower then CE = 0/3 If incorrect p orbital then M2 = 0 If shared pair of electrons M2 + M3 = 0
5(d)	Kr is a bigger atom / has more shells / more shielding in Kr / electron removed further from nucleus/ electron removed from a higher (principal or main) energy level	1	CE if molecule mentioned Must be comparative answer QWC
5(e)	2 / two / II	1	
5(f)	Arsenic / As	1	

Question	Marking Guidance	Mark	Comments
5(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
5(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 then 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

5(c)	Regular arrangement of minimum of 6 particles in minimum of 2 rows + charge in each one (of 6) Rows/planes/sheets/layers (of atoms/ions) can slide (owtte) over one another	1 1 1	Ignore e- Do not allow ring arrangements OR structures bonded with electrons Allow +, (1+, 2+ or 3+) in ions/or in words M3 independent If ionic bonding/molecules/IMF/vdw/covalent, penalise M3 Ignore layers of electrons sliding

5(d)	Bigger charge (3+ compared to 1+) ***OR*** smaller atom/ion in Al / more protons/bigger nuclear charge More free /delocalised electrons (in Al)/bigger sea of electrons in Al Stronger metallic bonding/ stronger (electrostatic) attraction between the (+) ions or nuclei and the (delocalised) electrons (or implied)	1 1 1	CE = 0 if molecules, ionic, covalent, IMF (Allow Al^{2+}) Accept 2 or 3 delocalised electrons compared to 1 in Na Must be implied that the electrons are the delocalised ones not the electrons in the shells. Accept converse arguments

Question	Marking Guidance	Mark	Comments
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	1	Allow giant covalent (molecule) = 2
	Covalent bonds in the structure	1	
	Strong (covalent) bonds must be broken or overcome / (covalent) bonds need a lot of energy to break	1	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

Question	Marking Guidance	Mark	Comments
6(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.
6(b)	<u>Increase</u>	1	
	Oxygen / O	1	If not oxygen, then cannot score M2, M3 and M4
	<u>Paired</u> electrons in a (2)<u>p</u> orbital	1	If paired electrons in incorrect p orbital, lose M3 but can award M4
	(Paired electrons in a p orbital) repel	1	
6(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.
6(d)	(More energy to) remove an electron from a (more) positive ion / cation	1	Allow electron closer to the nucleus in the positive ion.
6(e)	Lithium / lithium / Li	1	If formula given, upper and lower case letters must be as shown.

Question	Marking Guidance	Mark	Comments
2(a)(i)	Higher than P	1	
2(a)(ii)	$1s^2\ 2s^2 2p^6 3s^1$	1	Allow any order
2(a)(iii)	$Al^+(g) + e^{(-)} \longrightarrow Al^{2+}(g) + 2e^{(-)}$ ***OR*** $Al^+(g) \longrightarrow Al^{2+}(g) + e^{(-)}$ ***OR*** $Al^+(g) - e^{(-)} \longrightarrow Al^{2+}(g)$	1	
2(a)(iv)	Electron in Si (removed from) (3)p orbital / electron (removed) from higher energy orbital or sub-shell / electron in silicon is more shielded	1	Accept converse arguments relating to Al Penalise incorrect p-orbital
2(b)	Sodium / Na Electron (removed) from the 2nd shell / 2p (orbital)	1 1	Allow Na^+ M2 is dependent on M1 Allow electron from shell nearer the nucleus (so more attraction)
2(c)	Silicon / Si	1	Not SI
2(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

Question	Marking Guidance	Mark	Comments
1(a)	Silicon / Si	1	If not silicon then CE = 0/3
	covalent (bonds)	1	M3 dependent on correct M2
	Strong or many of the (covalent) bonds need to be broken / needs a lot of energy to break the (covalent) bonds	1	Ignore hard to break
1(b)	Argon / Ar	1	If not argon then CE = 0/3. But if Kr chosen, lose M1 and allow M2+M3
	Large(st) number of protons / large(st) nuclear charge	1	Ignore smallest atomic radius
	Same amount of shielding / same number of shells / same number of energy levels	1	Allow similar shielding
1(c)	Chlorine / Cl	1	Not Cl_2, Not C**L, not** Cl^2

Question	Marking Guidance	Mark	Comments
5(a)	General increase	1	If not increase then CE
	Greater nuclear charge / more protons	1	
	Same shielding / electrons added to same shell	1	allow similar
	Stronger attraction (from nucleus) for outer electron(s)	1	Allow electron in outer shell
5(b)			CE if not Al or S
	Aluminium / Al (lower than Mg)	1	
	(outer) electron in (3)p orbital / sub-shell (level)	1	If 2p or 4p orbital lose M2 and M3
	(3p) higher in energy	1	allow more shielded or weaker nuclear attraction
	or		M3 is dependent on M2
	Sulfur / S (lower than P)		
	(outer) electrons in (3)p orbital begin to pair		If 2p or 4p orbital lose M2 and M3 allow 2 electrons in (3)p
	repel		M3 is dependent on M2
5(c)	Sulfur / S	1	CE if not S
	Large jump after 6^{th} or between 6^{th} and 7^{th}	1	Do not allow M2 if atom/ion is removed

5(d)	Silicon Giant covalent structure / macromolecule Covalent (bonds) Many / strong (covalent bonds) or (covalent bonds) need lots of energy to break	1 1 1 1	CE if not Si Giant covalent scores M2 and M3 CE for M2-M4 if molecules / metallic / ionic / IMFs mentioned