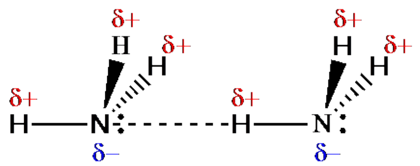
7 Periodicity
Answers to practice questions

Question number	Answer	Marks	Guidance
1 (a) (i)	$Mg^{2+}(g) \rightarrow Mg^{3+}(g) + e^{-}$	B1	
1 (a) (ii)	2p	B1	
1 (b)	There is a large increase between 5th and 6th ionisation energies, marking electron loss from the next closest shell. The element must have 5 electrons in its outer shell - Element is P	B1 B1 B1	
1 (c)	5th ionisation energy as the 5th electron is being removed	B1	
2 (a)	Na Mg Al	B1	
2 (b)	Al Si P	B1	
2 (c)	Si P S	B1	
2 (d)	Na Mg Al: giant metallic lattice P, S, Cl: simple molecular lattice	B1 B1	
3 (a)	Graphite has a giant covalent lattice and iodine has a simple molecular lattice On melting, covalent bonds are broken in graphite London forces are broken between iodine molecules Covalent bonds are much stronger Covalent bonds require more energy input to break and graphite has a much higher melting point	B1 B1 B1 B1 B0	
3 (b)	Graphite contains delocalised electrons between its layers The delocalised electrons can move allowing graphite to conduct Iodine can no mobile charge carriers and cannot conduct	B1 B1 B1	
4 (a)	The energy required to remove one electron from each atom in one mole of gaseous atoms	B1 B1 B1	

4 (b)	Across Period 3, nuclear charge increases Electrons are added to the same shell and attraction between nucleus and outer electrons increases	B1 B1 B1	
4 (c)	In B, electron is removed from a 2p orbital rather than 2s orbital in Be. The 2p sub-shell is at higher energy and its electron is easier to remove	B2	
4 (d)	In O, one of the 2p orbitals contains paired electrons whereas in N, all three orbitals are singly occupied The paired electrons in O repel and electron is easier to remove	B1 B1	
4 (e)	Down a group, electrons are added to a new shell, further from the nucleus There are more inner shells between the outer electrons and the nucleus, increasing the shielding Attraction between nucleus and outer electrons decreases	B1 B1 B1	
4 (f) (i)	$N^{3+}(g) \rightarrow N^{4+}(g) + e^{-}$	B1	
4 (f) (ii)	As each electron is removed the remaining electrons are attracted more to the nucleus	B1	
5 (a) (i)	$O^{+}(g) \rightarrow O^{2+}(g) + e^{-}$	B2	
5 (a) (ii)	Large difference between 6th and 7th ionisation energies marks a different shell closer to nucleus	B1 B1	
5 (b) (i)	$1s^{2}2s^{2}2p^{6}3s^{2}3p^{1}$	B1	
5 (b) (ii)	1 mark for sharp rise between ionisation 3 and ionisation 4 1 mark for sharp rise between ionisation 11 and ionisation 12 1 mark for increase for all ionisation energies	B1 x 3	

6 (a)	Giant metallic lattice has mobile electrons. The giant ionic lattice has no mobile ions as all ions are fixed in position. When molten, the ionic lattice collapses and the ions are now able to move and conduct electricity	B1 B1 B1	**IGNORE** 'free electrons' for 'mobile electrons' **DO NOT ALLOW** references to incorrect bonding **ALLOW** 'ions are fixed in place' **IGNORE** 'no mobile electrons' for solid ionic **IGNORE** 'no mobile charge carriers' for solid ionic **IGNORE** 'delocalised ions' **OR** 'free ions' for 'mobile ions' **DO NOT ALLOW** any mention of electrons moving **IGNORE** 'aqueous ionic compounds have mobile ions'
6 (b) (i)	 1 mark for dipole shown on two NH_3 molecules 1 mark for hydrogen bond shown between H on one molecule and lone pair on other molecule	B1 x 2	There must be 3H atoms bonded to one N atom **DO NOT ALLOW** any Hδ- OR Nδ+ **ALLOW** 2-D NH_3 molecules **IGNORE** lone pair(s) for first marking point All H-bonds drawn must hit the lone pair H-bond does not need to be labelled but must be different from covalent bond **DO NOT ALLOW** more than one lone pair on N for second marking point **ALLOW** a pair of molecules with two 'correct' hydrogen bonds forming a 'dimer'
6 (b) (ii)	A H_2O can form more H-bonds per molecule because O has two lone pairs in H_2O against one lone pair for N in NH_3. O is more electronegative that N and will attract more making stronger hydrogen bon	B1 B1	**ALLOW** 'more' for 'stronger' **OR** Ice has twice as many hydrogen bonds as ammonia **ALLOW** ice has stronger intermolecular forces than ammonia **OR** bigger permanent dipole than ammonia **DO NOT ALLOW** comparisons between different types of force **DO NOT ALLOW** reference to van der Waals' **IGNORE** 'more energy needed'

			ALLOW O has more lone pairs

<table>
<tr><td>6 (c)</td><td>SiO_2 has a giant covalent lattice structure.

$SiCl_4$ has a simple molecular lattice structure.

For melting, strong covalent bonds are broken in SiO_2.

Weak London forces are broken in $SiCl_4$

More energy is required to break stronger forces in SiO_2 than $SiCl_4$</td><td>B1

B1

B1

B1

B1</td><td>ALLOW macromolecular OR giant atomic
ALLOW SiO_2 is a ‘giant structure with covalent bonds’
ALLOW even if reference to ‘covalent’ only appears later in answer.
DO NOT ALLOW any reference to ‘ionic’ OR ‘intermolecular’ OR ‘metallic’
Quality of Written Communication - Covalent OR macromolecular OR atomic spelt correctly ONCE and used in context of the first marking point

ALLOW simple covalent
DO NOT ALLOW any reference to ‘giant’ OR ‘ionic’ OR ‘metallic’

If neither of the 1st 2 marks have been awarded, ALLOW 1 mark for SiO_2 is giant AND $SiCl_4$ is simple OR molecular

ALLOW induced dipoles
DO NOT ALLOW permanent dipoles

ALLOW alternative words to broken e.g. overcome

ALLOW incorrect forces in $SiCl_4$ OR SiO_2 for this mark</td></tr>
<tr><td>7 (a) (i)</td><td><table>
<tr><td></td><td>Na</td><td>Mg</td><td>Al</td><td>Si</td><td>P</td><td>S</td><td>Cl</td></tr>
<tr><td>melting point /ºC</td><td>98</td><td>639</td><td>660</td><td>1410</td><td>44</td><td>113</td><td>–101</td></tr>
<tr><td>structure</td><td>M</td><td>M</td><td>M</td><td>C</td><td>S</td><td>S</td><td>S</td></tr>
<tr><td>bonds/forces broken on boiling</td><td>MB</td><td>MB</td><td>MB</td><td>CB</td><td>LF</td><td>LF</td><td>LF</td></tr>
</table>
1 mark for each correct type, M, C and S</td><td>B1 x 3</td><td></td></tr>
</table>

<table>
<tr><td>7 (a) (ii)</td><td>
<table>
<tr><td></td><td>Na</td><td>Mg</td><td>Al</td><td>Si</td><td>P</td><td>S</td><td>Cl</td></tr>
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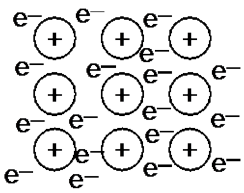
</table>
1 mark only for all correct (final row)</td><td>B1</td><td></td></tr>
<tr><td>7 (b)</td><td>Attraction between positive ions and delocalised electrons

+ = positive ion</td><td>B1
B1</td><td></td></tr>
<tr><td>7 (c)</td><td>The number of delocalised electrons and the ionic charge increase
The attraction increases, making the metallic bonding stronger which requires more energy to break</td><td>B1
B1</td><td></td></tr>
<tr><td>7 (d)</td><td>For melting weak London forces are broken between P_4 molecules
In silicon, strong covalent bonds are broken
Much more energy is required to break stronger forces</td><td>B1
B1
B1</td><td></td></tr>
<tr><td>7 (e)</td><td>Sulfur exists as S_8 and chlorine as Cl_2 molecules.
London forces are stronger between S_8 molecules as they have more electrons than Cl_2 molecules</td><td>B1
B1</td><td></td></tr>
<tr><td>8 (a) (i)</td><td>Sodium: giant metallic lattice
containing positive Na^+ ions and delocalised electrons</td><td>B1
B1</td><td></td></tr>
<tr><td>8 (a) (ii)</td><td>Sodium chloride: giant ionic lattice
containing oppositely charged Na^+ and Cl^- ions</td><td>B1
B1</td><td></td></tr>
<tr><td>8 (a) (iii)</td><td>Chlorine: Simple molecular lattice
containing Cl_2 molecules</td><td>B1
B1</td><td></td></tr>
</table>

8 (b)	Sodium has mobile electrons which conduct. Sodium chloride has no mobile ions as all ions are fixed in position. Chlorine cannot conduct as there are no charged particles in the structure	B1 B1 B1	
8 (c)	When molten, the ionic lattice in NaCl collapses and the ions are now able to move and conduct electricity	B1	