

Question			Expected Answers	Marks	Additional Guidance
1	a	i	(atoms of the) same element OR same atomic no. OR no. of protons AND with different numbers of neutrons OR different masses ✓	1	IGNORE 'same number of electrons' DO NOT ALLOW 'different numbers of electrons' DO NOT ALLOW 'different relative atomic masses' DO NOT ALLOW 'elements with different numbers of neutrons' without mention of same protons OR same atomic number
		ii	same (number of) electrons (in the outer shell) OR same electron configuration OR structure ✓	1	DO NOT ALLOW different number of protons IGNORE 'same number of protons' IGNORE 'they are both carbon' OR 'they are both the same element'
		iii	mass of the isotope compared to 1/12th OR mass of the atom compared to 1/12th ✓ (the mass of a) carbon-12 OR ^{12}C (atom) ✓	2	IGNORE reference to average OR weighted mean (i.e. correct definition of relative atomic mass will score both marks) ALLOW mass of a mole of the isotope/atom with 1/12th the mass of a mole OR 12 g of ✓ carbon-12 ✓ ALLOW 2 marks for: ' mass of the isotope OR mass of the atom compared to ^{12}C atom given a mass of 12.0' i.e. 'given a mass of 12' communicates the same idea as 1/12th.'

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			<p>ALLOW 12C OR C12</p> <p>ALLOW FOR 2 MARKS: $\frac{\text{mass of the isotope}}{\text{mass of 1/12th mass of carbon - 12}}$ i.e. fraction is equivalent to 'compared to'</p> <p>ALLOW 1 MARK FOR a mix of mass of atom and mass of mole of atoms, i.e.: 'mass of the isotope/mass of an atom compared with 1/12th the mass of a mole OR 12 g of carbon-12.'</p>
b	<p>giant covalent (lattice) ✓</p> <p>layers ✓</p> <p>Each of the three properties below must be linked to explanation <i>good conductor</i> - because it has mobile electrons OR delocalised electrons OR electrons can move ✓</p> <p><i>high melting / boiling point</i> - because strong OR covalent bonds have to be broken ✓</p> <p>soft - because there are van der Waals' forces OR</p>	5	<p>Use annotations with ticks, crosses etc. for this part.</p> <p>All five marking points are independent</p> <p>ALLOW giant atomic OR giant molecular OR macromolecular</p> <p>ALLOW planes OR sheets Allow diagram showing at least two layers</p> <p>Electron(s) must be spelt correctly ONCE</p> <p>DO NOT ALLOW 'strong ionic bonds' OR strong metallic bonds.</p>

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			intermolecular forces OR weak bonds OR weak forces between the layers OR <i>soft</i> - because layers can slide ✓		
	c	i	0.0268 OR 0.027 OR 0.02675 mol ✓	1	NO OTHER ACCEPTABLE ANSWER
		ii	1.61×10^{22} ✓	1	ALLOW 1.6×10^{22} up to calculator value ALLOW ECF answer to (i) $\times 6.02 \times 10^{23}$ ALLOW any value for N_A in the range: $6.0 \times 10^{23} - 6.1 \times 10^{23}$
			Total	11	

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2	a	i	white precipitate OR white solid ✓	1	DO NOT ALLOW goes white / cloudy / milky / off-white DO NOT ALLOW creamy white precipitate ALLOW milky white precipitate
		ii	$\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$ Balanced equation correct ✓ ALL state symbols correct ✓	2	ALLOW 2 marks $\text{AgNO}_3(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{NO}_3^-(\text{aq})$ (equation mark and state symbol mark) ALLOW 1 mark for: $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$ (state symbol mark) ALLOW 1 mark for the state symbols for THESE balanced equation ONLY: $\text{Ag}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}_2(\text{s})$ $\text{Ag}(\text{aq}) + \text{Cl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$
		iii	(precipitate) dissolves OR disappears OR goes colourless OR goes clear ✓	1	ALLOW forms a solution
	b	i	removes or kills bacteria OR kills germs OR kills micro-organisms OR make it safe to drink OR sterilises water ✓	1	ALLOW to make water potable IGNORE virus DO NOT ALLOW 'purifies water' DO NOT ALLOW 'antiseptic'
		ii	it is toxic OR poisonous OR could form chlorinated hydrocarbons ✓	1	ALLOW forms carcinogens OR forms toxins DO NOT ALLOW harmful DO NOT ALLOW 'it causes cancer' (chlorine is not a carcinogen) DO NOT ALLOW 'irritates lungs'
	c	i	Cl_2 is 0 AND HCl is -1 AND HClO is (+)1 ✓	1	ALLOW 1- ALLOW 1+

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	ii	It has been both oxidised and reduced OR Its oxidation state has increased and decreased ✓ it has been oxidised (from 0) to +1 AND it has been reduced (from 0) to -1 ✓ (These two points together subsume the first marking point)	2	ALLOW 'chlorine' OR 'it' DO NOT ALLOW chlorIDE IF CORRECT OXIDATION STATES IN (i), ALLOW 2 marks for: it is oxidised to form HClO it is reduced to form HCl
	iii	$\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaClO} + \text{NaCl} + \text{H}_2\text{O}$ ✓	1	IGNORE state symbols
d	i	$2\text{ClO}_2 \rightarrow \text{Cl}_2 + 2\text{O}_2$ OR $\text{ClO}_2 \rightarrow \frac{1}{2}\text{Cl}_2 + \text{O}_2$ ✓	1	IGNORE state symbols
	ii	divides each % by correct A_r : i. $\frac{1.20}{1.0} : \frac{42.0}{35.5} : \frac{56.8}{16.0}$ OR 1.20, 1.18, 3.55 ✓ HClO_3 ✓	2	ALLOW 1 mark for empirical formula of HCl_2O_6 (use of atomic numbers) ALLOW 1 mark for empirical formula of $\text{H}_3\text{Cl}_3\text{O}$ (upside-down expression) ALLOW ECF for use of incorrect A_r values to get empirical formula but only if no over-rounding ALLOW 2 marks for correct answer of HClO_3
	iii	the oxidation number of chlorine ✓	1	ALLOW 'the oxidation state of chlorine OR oxidation number of chlorine is 5' DO NOT ALLOW 'it' instead of 'chlorine' DO NOT ALLOW 'the oxidation state OR number of chlorIDE is 5'
		Total	14	

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3	(a)	(i)	<p><i>Nuclear charge mark</i> (Across the period) number of protons increases OR greater nuclear charge ✓</p> <p>Quality of written communication – nuclear OR proton(s) OR nucleus spelled correctly ONCE for the first marking point</p> <p><i>Distance / shielding mark</i> (Outermost) electrons are in the same shell OR (Outermost) electrons experience the same shielding OR Atomic radius decreases ✓</p> <p><i>Nuclear attraction (to electron) mark</i> Greater nuclear attraction (on outermost electrons) OR (outer) electrons are attracted more strongly (to the nucleus) ✓</p>	3	<p>FULL ANNOTATIONS WITH TICKS, CROSSES, CON, etc MUST BE USED</p> <p>Comparison should be used for each mark</p> <p>IGNORE atomic number increases, but ALLOW proton number increases IGNORE nucleus gets bigger IGNORE ‘effective nuclear charge increases’ DO NOT ALLOW ‘charge’ increases without reference to nuclear</p> <p>ALLOW shielding is similar BUT IGNORE ‘there is shielding’ DO NOT ALLOW sub-shells OR orbitals</p> <p>ALLOW greater nuclear pull for greater nuclear attraction DO NOT ALLOW use of greater nuclear charge for greater nuclear attraction for third mark</p>
		(ii)	(Diamond and graphite form) gaseous atoms (of carbon when they are ionised) ✓	1	ALLOW the atoms are in the gaseous state

Question		Answer			Marks	Guidance
	(b)		Lithium	Carbon (diamond)	Fluorine	<p>ALLOW shared pair of electrons for covalent (bond)</p> <p>ALLOW vdw for van der Waals'</p> <p>ALLOW temporary–induced or instantaneous–induced for van der Waals'</p> <p>ALLOW Positive ions for Li⁺ ions</p> <p>IGNORE 'Lithium ions' but ALLOW 'Positive lithium ions'</p> <p>DO NOT ALLOW Li²⁺</p> <p>IGNORE C and IGNORE F₂</p> <p>IGNORE diagrams but ALLOW names of particles if seen as a label on a diagram</p> <p>DO NOT ALLOW implication that covalent bonds are broken in fluorine for the <i>particles</i> mark of fluorine as this implies the particles are atoms</p>
		Structure	Giant	Giant ✓	Simple	
		Force or bond overcome on melting	Metallic bond	Covalent (bond) ✓	van der Waals' (forces) OR induced dipoles ✓	
		Particles between which the force or bond is acting	Li ⁺ ions and (delocalised) electrons ✓	Atoms ✓	Molecules ✓	
Total					10	