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.'

Question			Expected Answers	Marks	Additional Guidance
					ALLOW 12C **OR** C12 **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' **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.'
	b		giant covalent (lattice) ✓ layers ✓ **Each of the three properties below must be linked to explanation** *good conductor* - because it has mobile electrons **OR** delocalised electrons **OR** electrons can move ✓ *high melting / boiling point* - because strong **OR** covalent bonds have to be broken ✓ *soft* - because there are van der Waals' forces **OR**	**5**	**Use annotations with ticks, crosses etc. for this part.** **All five marking points are independent** **ALLOW** giant atomic **OR** giant molecular **OR** macromolecular **ALLOW** planes **OR** sheets Allow diagram showing at least two layers **Electron(s) must be spelt correctly ONCE** **DO NOT ALLOW** 'strong ionic bonds' **OR** strong metallic bonds.

Question			Expected Answers	Marks	Additional Guidance
			intermolecular forces **OR** weak bonds **OR** weak forces between the layers **OR** *soft* - 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)** × 6.02×10^{23} **ALLOW** any value for N_A in the range: $6.0 \times 10^{23} – 6.1 \times 10^{23}$
			Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
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	$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ Balanced equation correct ✓ **ALL** state symbols correct ✓	2	**ALLOW 2 marks** $AgNO_3(aq) + Cl^-(aq) \longrightarrow AgCl(s) + NO_3^-(aq)$ **(equation mark and state symbol mark)** **ALLOW 1 mark for:** $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$ **(state symbol mark)** **ALLOW 1 mark for the state symbols for THESE balanced equation ONLY:** $Ag^{2+}(aq) + 2Cl^-(aq) \longrightarrow AgCl_2(s)$ $Ag(aq) + Cl(aq) \longrightarrow AgCl(s)$
		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+

Question			Expected Answers	Marks	Additional Guidance
		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** chlor**IDE** **IF CORRECT OXIDATION STATES IN (i), ALLOW 2 marks for:** it is oxidised to form HClO it is reduced to form HCl
		iii	$Cl_2 + 2NaOH \rightarrow NaClO + NaCl + H_2O$ ✓	**1**	**IGNORE** state symbols
	d	i	$2ClO_2 \rightarrow Cl_2 + 2O_2$ **OR** $ClO_2 \rightarrow ½Cl_2 + O_2$ ✓	**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 H_3Cl_3O (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 chlor**IDE** is 5'
			Total	**14**	

Question			Answer	Marks	Guidance
3	(a)	(i)	*Nuclear charge mark* (Across the period) number of protons increases **OR** greater nuclear charge ✓ ***Quality of written communication*** *– nuclear* ***OR*** *proton(s)* ***OR*** *nucleus spelled correctly ONCE for the first marking point* *Distance / shielding mark* (Outermost) electrons are in the same shell **OR** (Outermost) electrons experience the same shielding **OR** Atomic radius decreases ✓ *Nuclear attraction (to electron) mark* Greater nuclear attraction (on outermost electrons) **OR** (outer) electrons are attracted more strongly (to the nucleus) ✓	3	**FULL ANNOTATIONS WITH TICKS, CROSSES, CON, etc MUST BE USED** Comparison should be used for each mark **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 **ALLOW** shielding is similar BUT **IGNORE** 'there is shielding' **DO NOT ALLOW** sub-shells **OR** orbitals **ALLOW** greater nuclear pull for greater nuclear attraction **DO NOT ALLOW** use of greater nuclear charge for greater nuclear attraction for third mark
		(ii)	(Diamond and graphite form) **gaseous atoms** (of carbon when they are ionised) ✓	1	**ALLOW** the **atoms** are in the **gaseous** state

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th></th><th>Lithium</th><th>Carbon (diamond)</th><th>Fluorine</th></tr>
<tr><td>Structure</td><td>Giant</td><td>Giant ✓</td><td>Simple</td></tr>
<tr><td>Force or bond overcome on melting</td><td>Metallic bond</td><td>Covalent (bond) ✓</td><td>van der Waals' (forces) OR induced dipoles ✓</td></tr>
<tr><td>Particles between which the force or bond is acting</td><td>Li^+ ions and (delocalised) electrons ✓</td><td>Atoms ✓</td><td>Molecules ✓</td></tr>
</table>
</td><td>6</td><td>ALLOW shared pair of electrons for covalent (bond)

ALLOW vdw for van der Waals'
ALLOW temporary–induced or instantaneous–induced for van der Waals'

ALLOW Positive ions for Li^+ ions
IGNORE 'Lithium ions' but ALLOW 'Positive lithium ions'
DO NOT ALLOW Li^{2+}

IGNORE C and IGNORE F_2
IGNORE diagrams but ALLOW names of particles if seen as a label on a diagram

DO NOT ALLOW implication that covalent bonds are broken in fluorine for the particles mark of fluorine as this implies the particles are atoms</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
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