OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



MARK SCHEME

C2.2 BONDING

SCORE	PERCENTAGE
/211	%

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td>i</td><td>Same number of electrons in outer shell / all have 7 electrons in outer shell (1)</td><td>1</td><td>ALLOW outer electrons or valence electrons rather than electrons in the outer shell

ALLOW valence shell rather than outer shell

DO NOT ALLOW the wrong number of electrons in the outer shell</td></tr>
<tr><td></td><td></td><td>ii</td><td>$2Na + Br_2 \rightarrow 2NaBr$

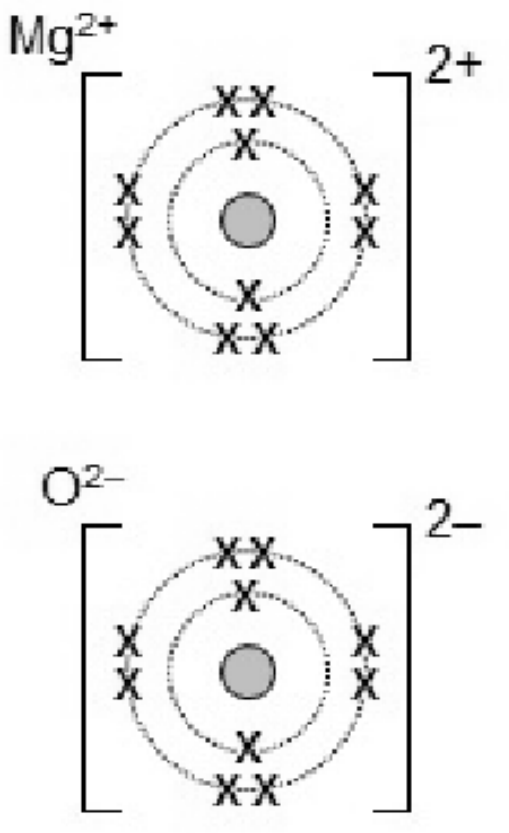
Correct formulae of reactants and products (1)
Balancing – depend on correct formulae (1)</td><td>2</td><td>ALLOW any correct multiple of the equation including fractions

ALLOW = or ⇌ instead of →
DO NOT ALLOW and or & instead of +
ALLOW one mark for correct balanced equation with minor errors of case and subscript e.g. 2NA + Br2 → 2NaBr</td></tr>
<tr><td></td><td></td><td>iii</td><td>KAt (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>2</td><td>a</td><td></td><td>
<table>
<tr><th>Particle</th><th>Atomic number</th><th>Mass number</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th><th>Electronic structure</th></tr>
<tr><td>A</td><td>11</td><td>23</td><td>11</td><td>12</td><td>11</td><td>2.8.1</td></tr>
<tr><td>B</td><td>9</td><td>19</td><td>9</td><td>10</td><td>9</td><td>2.7</td></tr>
<tr><td>C</td><td>17</td><td>37</td><td>17</td><td>20</td><td>17</td><td>2.8.7</td></tr>
<tr><td>D</td><td>13</td><td>27</td><td>13</td><td>14</td><td>10</td><td>2.8</td></tr>
</table>
</td><td>4</td><td>one mark scored for each correct line</td></tr>
<tr><td></td><td>b</td><td></td><td>particle A – one electron in outer shell or energy level (1)
particle D – has more protons than electrons (1)</td><td>2</td><td></td></tr>
<tr><td></td><td>c</td><td></td><td>group 7 (1) as 7 electrons in outer shell (1)
period 3 (1) as 3 shells occupied (1)</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
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Question			Answer/Indicative content	Marks	Guidance
3			 electronic structure of magnesium ion (1) electronic structure of oxide ion (1) charges correct on both ions (1)	3	
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
4		i	Same number of electrons in outer shell / all have 7 electrons in outer shell (1)	1	ALLOW outer electrons or valence electrons rather than electrons in the outer shell ALLOW valence shell rather than outer shell DO NOT ALLOW the wrong number of electrons in the outer shell
		ii	$2Na + Br_2 \rightarrow 2NaBr$ Correct formulae of reactants and products (1) Balancing – depend on correct formulae (1)	2	ALLOW any correct multiple of the equation including fractions **ALLOW** = or ⇌ instead of → DO NOT ALLOW and or & instead of + ALLOW one mark for correct balanced equation with minor errors of case and subscript, e.g. 2NA + Br2 → 2NaBr
		iii	KAt (1)	1	
			Total	**4**	
5			D	1	
			Total	**1**	
6			C	1	
			Total	**1**	

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<tr><td></td><td>d</td><td></td><td>
<table>
<tr><th></th><th>Charge</th><th>Mass in atomic mass units</th></tr>
<tr><td>proton</td><td>positive /+</td><td>1</td></tr>
<tr><td>neutron</td><td>neutral / no charge</td><td>1</td></tr>
<tr><td>electron</td><td>negative</td><td>0.0005</td></tr>
</table>
</td><td>2</td><td>one mark scored for each correct column (2)

ALLOW
1/1760
or 1/1836
or 1/2000</td></tr>
<tr><td></td><td>e</td><td></td><td>idea of the nuclear atom (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>14</td><td></td></tr>
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Question			Answer/Indicative content	Marks	Guidance
8			$2SO_2 + O_2$? $2SO_3$ formulae (1) balancing conditional on correct formulae (1)	2	**allow** any correct multiple e.g $4SO_2 + 2O_2$? $4SO_3$ (2) **allow** = or ? for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $2So_2 + O^2$? $2SO_3$ (1) **Examiner's Comments** Many candidates were able to write the correct balanced symbol equation for the reaction of sulfur dioxide with oxygen to make sulfur trioxide. One mark was awarded for the correct reactants and products and 1 mark for the correct balancing. The balancing mark was dependent on the correct formulae, but 1 mark was allowed for a balanced equation with a minor error in subscripts or formulae. When candidates did not gain marks it was often because they tried to balance the equation by writing the product as SO_4.
			Total	2	

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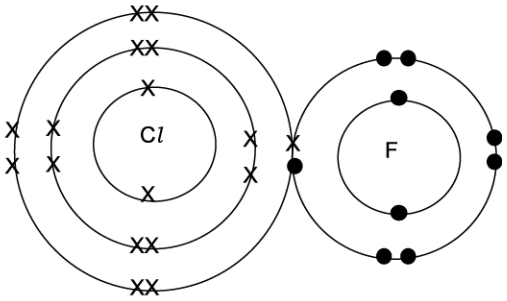
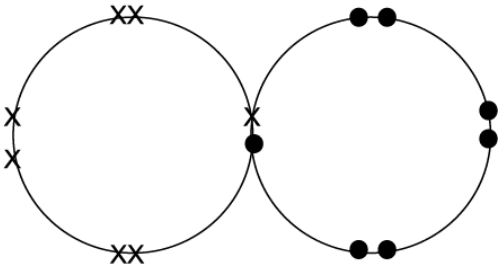
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Question			Answer/Indicative content	Marks	Guidance
9	a	i	aluminium and boron (1)	1	**both** required **allow** Al and B (1) **Examiner's Comments** Helium was a common misconception.
		ii	potassium and bromine (1)	1	**both** required **allow** K and Br (1) **Examiner's Comments** Helium was a common misconception.
		iii	silver (1)	1	**allow** Ag (1) **Examiner's Comments** A significant proportion of candidates did not gain credit as they wrote down the name of a transition metal, other than silver, thus failing to choose their answer from the list in the question.
	b		**any two from:** arranged elements in order of atomic mass (1) left gaps for elements not yet discovered (1) predicted properties of elements (1) arranged elements in periods (1) arranged elements in groups (1)	2	**allow** predicted properties of 'missing' elements for (2) **allow** arranged elements together with similar chemical properties (1) **Examiner's Comments** Good responses usually described how Mendeleev arranged elements in periods and groups. Many candidates, however, were unable to recall Mendeleev's work.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
10			all correct (2)  	2	**allow** one mark for bonding pair if the answer is incorrect **allow** diagrams using all dots or all crosses circles need not be drawn **allow** answer with outer shell electrons only i.e.  If inner shells shown they must be **correct** **ignore** any atomic symbol given in answer – just focus on the electrons ionic structure = 0 marks for the question **Examiner's Comments** This question was about chlorine and fluorine. Many candidates could draw the 'dot and cross' diagram for chlorine fluoride. A significant proportion of the candidates drew the inner shell electrons even though this was not needed in the answer. Some candidates neglected to include the symbol for each element and this type of answer was given full credit. Only a very small proportion of the candidates attempted an ionic 'dot and cross' diagram.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
11	a		**any two from:** low melting point (1) low boiling point (1) does not conduct electricity (1) does not conduct heat (1)	2	**ignore** it is a gas or a liquid but if melting point or boiling point not awarded **allow** it is a gas at room temperature / is a liquid at room temperature (1) **allow** low density **ignore** lightweight **allow** it is a poor conductor of electricity **allow** it is a poor conductor of heat **allow** it is a poor conductor / a bad conductor for one mark if does not conduct heat and electricity not given **ignore** references to colour **Examiner's Comments** This question was about chlorine and fluorine. Typically candidates referred to low melting and boiling point although some referred to the compound being a poor conductor of electricity. Answers that just stated that the compound was a gas or a liquid was not given credit unless there was a reference to room temperature and pressure. Only a small proportion of the candidates gave properties of a giant ionic substance. A significant proportion of the candidates mentioned weak intermolecular forces but did not give a property.

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Question			Answer/Indicative content	Marks	Guidance
	b		**any two from:** arranged elements in order of (relative) atomic mass (1) left gaps in his table (for elements not yet discovered) (1) predicted properties of elements (1) arranged elements in periods (1) arranged elements in groups (1) realised that there was a periodic behaviour in the properties of the elements (1)	2	**ignore** reference to atomic number **ignore** reference to mass number **allow** predicted properties of 'missing' elements for two marks **allow** arranged elements together with similar chemical properties **Examiner's Comments** This question was about chlorine and fluorine. Many candidates gave good answers about the Periodic table in terms of atomic number and outer shell electrons but did not realise that these were not discovered until much later than Mendeleev's Periodic Table. The best answers referred to grouping according to chemical properties and the gaps in the table that Mendeleev left for elements still to be discovered. A significant proportion of the candidates confused Mendeleev's work with that of Newlands.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
12			Level 3 Identifies (by name or by the ions present) both compounds A and B, with one explanation for each compound AND writes the balanced symbol equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) Level 2 Identifies one ion or one compound (in either A or B) AND writes the balanced symbol equation. OR Identifies one compound (either A or B) with one explanation OR Identifies two ions present (either/or in A and B) with one explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) Level 1 Identifies one ion or one compound in (either A or B) OR writes the balanced symbol equation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A. Indicative scientific points may include: Symbol equation $FeC?_3 + 3AgNO_3$? $3AgC? + Fe(NO_3)_3$ **allow** any correct multiple e.g. $2FeC?_3 + 6AgNO_3$? $6AgC? + 2Fe(NO_3)_3$ **allow** = or ? for arrow **not** 'and' or & for + **allow** correctly balanced equation with minor errors of case, subscript or superscript at level 1 e.g. $FEC?_3 + 3AgNO^3$? $3AgC? + Fe(NO_3)_3$ Compound A • compound **A** contains copper (ions) / Cu^{2+} • compound **A** contains chloride (ions) / $C?^?$ • compound **A** is copper chloride / $CuC?_2$ Reasons • because copper (ions) give a blue ppt with sodium hydroxide or hydroxide (ions) • because chloride (ions) give a white ppt with silver nitrate or silver ions Compound B • compound **B** contains iron(II) (ions) • compound **B** contains bromide (ions) • compound **B** is iron(II) bromide Reasons • iron(II) (ions) give a green ppt with sodium hydroxide or hydroxide (ions) • bromide (ions) give a cream ppt with silver nitrate or silver ions **allow** ppt or solid **allow** reference to chlorine and bromine

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Question			Answer/Indicative content	Marks	Guidance
					(ions) Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question involved the analysis of experimental observations concerned with qualitative analysis. Candidates were expected to make a conclusion and justify the conclusion based upon the experimental evidence. Candidates could either identify the name of the compound present or the ions contained in the solution. In terms of the justification the test, the ion present and the result all had to be included for example compound A contained copper ions because it gave a blue ppt. with sodium hydroxide. In addition candidates had to construct one balanced equation having been given the formulae for each reactant and product. Candidates had little difficulty constructing the balanced equation and some candidates only did this part of the question and as a result matched level 1. Candidates found the identification of the compound or ions much more difficult and often only identified one compound or one ion with no justification for this conclusion. This type of answer matched level 2 providing the balanced equation was given. The most able candidates were able to give a comprehensive and logical answer that explained the ions present and then deduced the name of the compound.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
13	a		do not contain carbon and hydrogen only / contain more elements than just hydrogen and carbon (1)	1	**allow** C and H for carbon and hydrogen (1) **allow** it contains oxygen / has three elements / has the symbol O in the formula (1) **not** contains an oxygen **molecule** (in the formula) **not** reference to a **mixture** **not** does not contain carbon and hydrogen **molecules** or **compounds** only **not** does not contain carbon and hydro only Examiner's Comments This question was about the use of esters in cosmetics. Many candidates could explain why esters were not hydrocarbons. Some candidates just referred to esters containing oxygen while other candidates gave a definition for a hydrocarbon.
	b		$C_7H_{14}O_2$ (1)	1	**allow** any order of atoms credit correct answer if written in box in table but answer line takes precedence Examiner's Comments This question was about the use of esters in cosmetics. Many candidates were able to identify the molecular formula as $C_7H_{14}O_2$, some wrote their answers on the answer line and other candidates wrote it in the table. Unless there was a contradiction a mark was awarded wherever the molecular formula was written.

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Question			Answer/Indicative content	Marks	Guidance
	c		ethyl ethanoate (1) **any two from:** dissolves the best in water (1) has a low boiling point (so evaporates easily) (1) is a liquid at room temperature (1)	3	incorrect ester = 0 mark for question **allow** dissolves easily / (very) soluble in water **ignore** reference to melting point Examiner's Comments This question was about the use of esters in cosmetics. Most candidates could evaluate the data in the table and decide that ethyl ethanoate was the best choice. Candidates generally gave two correct reasons for their choice. Some candidates neglected to include the name of the ester.
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
14	a		**A** (1)	1	**allow** ethanoic acid Examiner's Comments This question was about the displayed formulae of some carbon compounds. Some candidates could recognise that molecule **A** contains 8 carbon atoms. All the other options were popular incorrect responses.
	b		**E** (1)	1	**allow** ethene / C_2H_4 Examiner's Comments This question was about the displayed formulae of some carbon compounds. Many candidates could identify the alkene as compound **E**. A common misconception was to give compound **D**.
	c		**C and F** (1)	1	**allow** butane **and** methylpropane Examiner's Comments This question was about the displayed formulae of some carbon compounds. Some candidates recognised that compounds **C** and **F** had the same molecular formula although some candidates chose **A** and **B**.
	d		poly(tetrafluoroethene) (1)	1	**allow** name without brackets **allow** Teflon / ptfe Examiner's Comments This question was about the displayed formulae of some carbon compounds. Some candidates gave the correct name of the polymer although poly(ethene) was a common incorrect answer.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
15			LHS is 168 (1) RHS is 106 + 44 + 18 = 168 (1)	2	Examiner's Comments This question tested aspects of quantitative chemistry, including conservation of mass and percentage yield. Most candidates correctly illustrated that the mass on both the LHS and the RHS of the equation was equal to 168. In part (i) most candidates realised that 0.631 × 2.5 = 1.578g. Most candidates correctly calculated the percentage yield in part (ii). A common error was 45.0% where candidates calculated 1.124/2.500 × 100, incorrectly using 2.500g as the theoretical mass instead of 1.578g. A significant number of candidates were penalised for not expressing their answer to three significant figures.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
16	a		do not contain carbon and hydrogen **only** / contain more elements than just hydrogen and carbon (1)	1	**allow** C and H for carbon and hydrogen (1) **allow** it contains oxygen / has three elements / has the symbol O in the formula (1) **not** contains an oxygen **molecule** (in the formula) **not** reference to a **mixture** **not** does not contain carbon and hydrogen **molecules** or **compounds** only **not** does not contain carbon and hydro only Examiner's Comments This question focused on esters as solvents and provided the opportunity for candidates to analyse scientific data. Most candidates explained that esters are not hydrocarbons as they contain an oxygen atom or do not contain carbon and hydrogen only. When candidates did not gain credit it was usually because they referred to esters containing 'oxygen molecules' or 'not only containing carbon and hydrogen *molecules*'.
	b	i	any value between 147 and 157 °C (1)	1	Examiner's Comments This question focused on esters as solvents and provided the opportunity for candidates to analyse scientific data. In part (i) many candidates correctly used the data to predict the boiling point forpentyl ethanoate.

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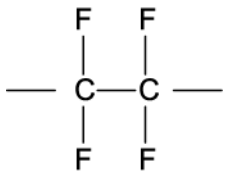
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Question			Answer/Indicative content	Marks	Guidance
		ii	**Any two from:** (not suitable as a nail varnish remover) idea that (boiling point is quite high so) it does not evaporate easily (1) idea that (pentyl ethanoate) will not dissolve very well (in water) (1) (cannot tell) idea that melting point is below room temperature / it is a liquid (1) idea that no obvious trend in solubility (so cannot tell if it dissolves or not) (1)	2	**marks are for explanation – ignore yes / no / cannot tell** **allow** ecf from (i) **ignore** answers simply quoting data Total Examiner's Comments This question focused on esters as solvents and provided the opportunity for candidates to analyse scientific data. Good responses in part (ii) linked the melting point and boiling point of pentyl ethanoate to melting and boiling and correctly stated that pentyl ethanoate is a liquid at room temperature and does not evaporate easily.
			Total	**4**	
17			**E** (1)	1	**allow** ethene / C_2H_4 (1) Examiner's Comments This question was about some of the hydrocarbons found in crude oil. Most candidates correctly identified compound E as a hydrocarbon.
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
18	a		**C** and **F** (1)	1	**allow** butane **and** methylpropane (1) Examiner's Comments This question was about some of the hydrocarbons found in crude oil. Most candidates correctly worked out that compounds C and F have the same molecular formula.
	b		C_8H_{18} (1)	1	**allow** any order of symbols not C^8H^{18} / C8H18 Examiner's Comments This question was about some of the hydrocarbons found in crude oil. The molecular formula for X was usually correct.
	c		 (1)	1	structure **must** have the **free** bonds at both ends **allow** with or without brackets **allow** with or without n **allow** two or more repeat units, but must be an even number of C atoms (1) Examiner's Comments This question was about some of the hydrocarbons found in crude oil. Many candidates drew the correct formula for the polymer. Common errors included the use of C=C or not showing the free bonds. A minority of candidates included hydrogen atoms in the formula instead of fluorine atoms.
			Total	3	

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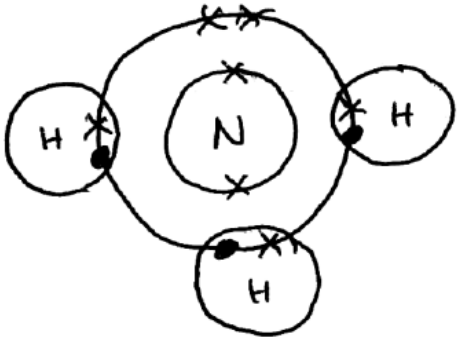
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Question			Answer/Indicative content	Marks	Guidance
19		i	H_2O (1)	1	Examiner's Comments Both parts of this question were well answered. A number of candidates offered 'N'.
		ii	Na^+ (1)	1	**not** NA^+ **not** Na
			Total	2	
20		i	3 (1)	1	Examiner's Comments was better answered than part (ii). '2' was a popular incorrect answer in part (i).
		ii	5 (1)	1	Examiner's Comments a number of candidates calculated the relative formula mass of copper carbonate and failed to score.
			Total	2	

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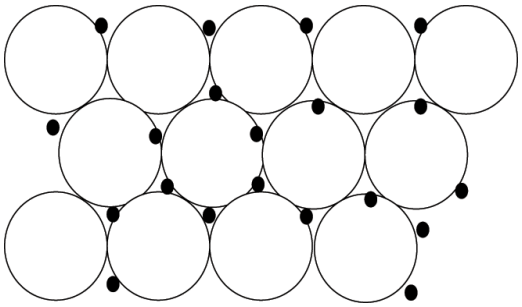
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Question			Answer/Indicative content	Marks	Guidance
21	a		At least one pair of electrons shared correctly between nitrogen and hydrogen (1) remainder of structure correct (1)  	2	can use all dots or all crosses **not** ionic structures = 0 for the question **allow** Lewis diagrams i.e. without circles **allow** lone pair electrons as two single electrons **ignore** inner electrons on nitrogen Examiner's Comments There were many examples of correct 'dot and cross' diagrams for ammonia. Candidates did not need to show the lone pair as electrons next to one another. The most common misconception involved having more than two non-bonding electrons in the outer shell of nitrogen or including an extra electron in the outer shell of hydrogen. Only a small proportion of the candidates drew ionic 'dot and cross' diagrams.
	b		solid – ions not free / ions cannot move / ions held in a lattice / ions in a giant structure (1) dissolved in water – ions can move (1)	2	**ignore** electrons / particles cannot move in a solid **allow** has free ions **not** electrons can move in a liquid **ignore** particles can move in a liquid ?Examiner's Comments ?? Many candidates referred to electrons rather than ions in their answer to this question. Good answers appreciated that ions did not move in the solid but would move in the aqueous solution.
			Total	4	

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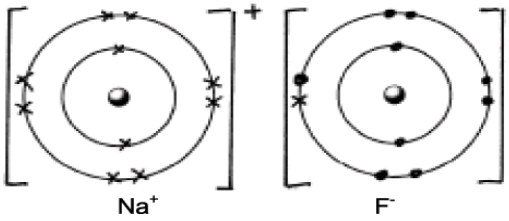
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Question			Answer/Indicative content	Marks	Guidance
22			idea of (close packed) positive metal ions (1) idea electrons interspersed within the particles drawn / sea of electrons / delocalised electrons (1) electrons can move / free electrons / electrons can carry the current (1)	3	 Large circle labelled positive ion / metal ion / cation Small circle labelled electron / e / $e^{?}$ **but** just a negative sign is not sufficient Mention of intermolecular forces / covalent bonds / ionic bonds can only score the electrons can move mark **Examiner's Comments** Many candidates illustrated their answers using a diagram, but often the diagram was not labelled so it was not possible to tell if the positive particle was a metal ion or a proton. Good diagrams were fully labelled and showed electrons interspersed between closely packed positive ions. The idea that the electrons could move resulting in electrical conductivity was well known.
			Total	3	

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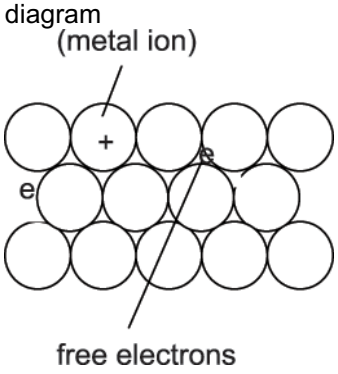
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Question			Answer/Indicative content	Marks	Guidance
23			 correct sodium ion / 2.8 (1) correct fluoride ion / 2.8 (1)	2	two correct electronic structures but no charges award one mark two correct charges with incorrect electronic structure award one mark one structure of 2,8 but unlabelled is **not** sufficient **but allow** both have a structure of 2,8 (1) the ionic charges must not be shown in the nucleus award 0 marks for structures with shared electrons One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks. **allow** answers showing the transfer of electrons providing the same electrons are not shown twice all electrons can be dots or crosses **Examiner's Comments** Most candidates attempted to draw an ionic rather than a covalent 'dot-and-cross' diagram however some neglected to include the charges on the ions. Other candidates did not show the full electronic structures which were required in this question. Candidates should be advised not to show the charge on the ions in the nucleus but should show the on the outside of the structure. Another misconception was to draw the electron transferred twice both in the shell of the sodium atom and in the outer shell of the fluoride ion.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
24			idea of an attraction or bond(ing) between positive ions and electrons (1) (closely packed) metal ions and delocalised electrons (1)	2	**do not allow** intermolecular forces / covalent bonding / ionic bonding / metal molecules = 0 for the question **allow** positive atoms, cations, positive ions instead of metal ions and free electrons instead of delocalised electrons. **allow** has electrons free to move instead of delocalised or free electrons / sea of electrons instead of delocalised electrons **allow** mark could be found on a labelled diagram  **Examiner's Comments** Most candidates could not describe metallic bonding and a significant proportion of candidates left this question blank. The best answers described the attraction between the delocalised electrons and positive ions however most candidates did not even appreciate that a metal has positive ions. Candidates often drew diagrams that were not labelled and did not show the positive ions in a closed packed arrangement. A small proportion of candidates tried to draw 'dot and cross' diagrams. Other candidates referred to ionic, covalent and intermolecular forces.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
25	a		beryllium / calcium / strontium / barium / radium (1)	1	**allow** Be / Ca / Sr / Ba / Ra (1) **Examiner's Comments** Most candidates correctly identified a group 2 element. Calcium was the commonest correct answer. Sodium was the most frequent incorrect answer.
	b		sodium / aluminium / silicon / phosphorus / sulfur / chlorine / argon (1)	1	**allow** Na / A*l* / Si / P / S / C*l* / Ar (1) **Examiner's Comments** Again this question was well answered. Sodium was the commonest correct answer, although aluminium and chlorine also featured. Confusion between groups and periods was seen from a minority of candidates who offered calcium.
	c		group 2 (1) 3rd period (1)	2	**Examiner's Comments** About half of candidates failed to score on this question. Many candidates scored 1 mark for correctly identifying group 2. Fewer also identified the 3rd period. A common misconception was period 2.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
26			Level 3 Two properties needed by the plastic are explained AND the flexibility of poly(propene) is explained in terms of the structure and bonding. Quality of communication does not impede communication of science at this level. (5–6 marks) Level 2 The flexibility of poly(propene) is explained in terms of the structure and bonding OR two properties needed by the plastic are explained OR one property of the plastic is explained and an attempt to explain why poly(propene) is flexible. Quality of written communication partly impedes communication of the science at this level. (3 - 4 marks) Level 1 One property needed by the plastic is explained OR an attempt to explain why poly(propene) is flexible. Quality of communication impedes communication of the science at this level. (1 - 2 marks) Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points for level 3 may include: • Poly(propene) molecules are attracted to one another by weak intermolecular forces or bonds that are easy to overcome • Poly(propene) molecules need very little energy to be separated • Poly(propene) molecules can slide over each other • Poly(propene) has atoms held together by strong covalent bonds Indicative scientific points for all levels may include: • Non-biodegradable so the plastic does not rot or decay • Insoluble in water or waterproof so that the sandwich box can be washed clean / so it will not dissolve / so moist foods can be stored • Non-toxic material so it will not contaminate the food or make the food dangerous to eat • Non-reactive or inert so will not react with chemicals in the food • Non-permeable so water doesn't reach the food ignore references to can be coloured / is strong / tough / durable / light or lightweight / ard / easily moulded / insulator / does not melt (in hot water) Use the L1, L2, L3 annotations in Scoris; do not use ticks Examiner's Comments This 6 mark question was targeted at all grades up to, and including, grade A* and discriminated well. At level 3 (5-6 marks)

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Question			Answer/Indicative content	Marks	Guidance
					all aspects of the question needed to be addressed and candidates were required to explain why poly(propene) is flexible and suggest and explain two other properties needed by a plastic used to make a lunchbox. When candidates did not gain full credit it was usually because they gave properties of the plastic which were not relevant or did not fully explain the flexibility of poly(propene) in terms of weak intermolecular forces that are easy to overcome, allowing the polymer chains to slide over each other.
			Total	6	
27		i	4 (1)	1	
		ii	15 (1)	1	Examiner's Comments This question was about fertilisers. The number of different elements shown in the displayed formula was usually correct.
			Total	2	
28			has two different symbols / has two elements (1)	1	**allow** more than one type of atom **allow** more than one element / made from hydrogen and oxygen / made from H and O **not** a mixture Examiner's Comments This question was about hydrogen peroxide. Candidates found (b) and (c) challenging and often left the question blank. Candidates often appreciated that the formula showed two different types of atoms or two different elements and this was sufficient to be awarded a mark. A common misconception was that the formula contained two molecules.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
29			nine (1)	1	more than one tick scores 0 Examiner's Comments Some candidates could deduce that a molecule of propenenitrile had nine covalent bonds. The most common incorrect answers were four or five covalent bonds.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
30	a		hexane / C_6H_{14} (1)	1	**allow** C^6H^{14} / C6H14 ?Examiner's Comments?? This question was about the homologous series of alkanes. Many candidates recognised that a molecule of hexane contains 20 atoms. A common misconception was to choose icosane which has a molecule with 20 carbon atoms.
	b		contains carbon and hydrogen (1) only / aw (1)	2	**allow** (formula) has only (1) C and H (1) the only is **not** an independent mark and must be linked to the carbon and hydrogen **not** contains carbon and hydrogen molecules = 0 marks for the question **not** contains a mixture of carbon and hydrogen = 0 marks for the question **not** an element containing carbon and hydrogen = 0 marks for the question **not** hydro atoms ?Examiner's Comments?? Many candidates appreciated that a hydrocarbon contains hydrogen and carbon but not all the candidates stated that these were the only elements present. Common misconceptions included referring to hydrocarbons as elements or mixtures or that they contained carbon and hydrogen molecules.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
31	a		H_2O (1)	1	**allow** other ways of indicating correct response eg ringing or ticking the correct answer **but** answer on answer line takes precedence **Examiner's Comments** Some candidates identified water as a molecule from the list but few candidates.
	b		(moist) litmus paper / pH paper (1) bleaches / (goes red) then white (1)	2	**allow** indicator paper for litmus **Examiner's Comments** Few candidates knew how to test for chlorine.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
32	a		K (1)	1	**allow** potassium **Examiner's Comments** Both data interpretation questions were well answered by the majority of candidates.
	b		**any two from:** high boiling point (1) (good) thermal conductor (1) (good) electrical conductor (1) high density (1) malleable / flexible (1) ductile (1) lustrous (1) hard (1) high tensile strength (1) sonorous (1) have basic oxides (1) form positive ions (1) form ionic compounds (1)	2	**ignore** just a good conductor **ignore** just dense **allow** shiny **allow** strong **allow** often react with acids to give hydrogen **Examiner's Comments** Not well answered. A lot of the candidates talked about metallic structure without mentioning any property, many others gave uses for metals.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
33	a		Mg **and** Ca / He and Ne(1)	1	both needed **allow** MG and CA / HE and NE **allow** magnesium and calcium / helium and neon answer must be in table **Examiner's Comments** Many correct answers except for a few candidates who mixed up “group” and “period”.
	b		O **and** Ne / Mg **and** C**l** (1)	1	both needed **allow** NE / MG and CL / Cl_2 **allow** oxygen / O_2 and neon / magnesium and chlorine answer must be in table **Examiner's Comments** Many correct answers except for a few candidates who mixed up “group” and “period”.
			Total	2	
34			nine (1)	1	**more than one tick scores 0** **Examiner's Comments** Most candidates appreciated that propanenitrile contains 9 covalent bonds, although 5 was a common misconception.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
35	a		contains carbon and hydrogen (1) only / aw (1)	2	**allow** (formula) has only (1) C and H (1) the only is **not** an independent mark and must be linked to the carbon and hydrogen **not** contains carbon and hydrogen **molecules** = 0 marks for the question **not** contains a **mixture** of carbon and hydrogen = 0 marks for the question **not** an **element** containing carbon and hydrogen = 0 marks for the question **not** hydro atoms Examiner's Comments Most candidates explained that propane is a hydrocarbon as it contains carbon and hydrogen only. When candidates did not gain credit it was usually because they referred to propane containing 'only carbon and hydrogen molecules' or they omitted the reference to 'only' and therefore only scored one mark.
	b		**all** (carbon-carbon) bonds are single bonds / contains **only** single bonds (1)	1	**allow** does not contain a double bond (1) **ignore** has maximum number of bonds **ignore** has the maximum number of hydrogen atoms Examiner's Comments ??Most candidates described a saturated compound as a compound that contains only single bonds. Answers that merely referred to propane having single bonds did not gain credit. A common misconception was that saturated compounds contain a double bond.
			Total	3	

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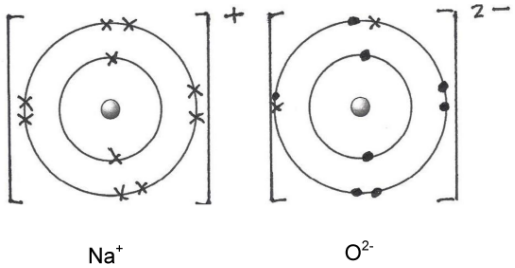
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Question			Answer/Indicative content	Marks	Guidance
36			any two from hard (1) high density (1) high tensile strength / strong (1) (good) conductors of electricity (1) (good) conductors of heat (1) malleable (1) ductile / can be made into wires (1) sonorous / when hit makes ringing sound (1)	2	allow good conductors (1) if no marks awarded for conductors of heat and electricity allow can be hammered into shape (1) ignore bendy / flexible ignore durable / tough / hardwearing / long lasting Examiner's Comments Most candidates could describe at least one correct property of metals with many giving two. ‘Hard’ was a common correct answer. Incorrect answers included ‘lightweight’ and ‘a solid’.
			Total	2	
37			carbon and tin (1) idea of same vertical arrangement (1)	2	both required allow same number of electrons in outer shell (1) allow they are both in Group 4 (1)
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
38	a		Mg^{2+} (1)	1	
	b		MgF_2 (1)	1	**Allow** F_2Mg **allow** $Mg^{2+}(F^-)_2$ **not** $Mg^{2+}F_2^-$
	c		lithium atom loses 1 electron (1) to gain a full outer shell / stable outer shell / full outer orbit / stable outer orbit (1)	2	**Allow** lithium loses electrons **allow** it loses the outer shell electrons **not** reference to stable outer octet **allow** without a full outer shell it is unstable
	d		 correct electronic structure of sodium ion (1) correct electronic structure of oxide ion (1) both charges correct (1)	3	sharing of electrons = 0 marks for this question use of dots and crosses not necessary i.e. can be all crosses or all dots no need to show $2Na^+$ inner shell must be shown and correct inner shell must be shown and correct **allow** diagram showing transfer of electrons providing electrons are not shown twice

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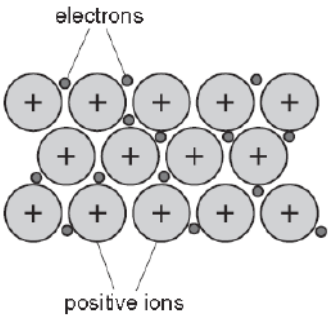
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Question			Answer/Indicative content	Marks	Guidance
			Total	7	
39			(group) 6	1	**allow** VI / 16 **not** the name of an incorrect group
			Total	1	
40			C ✓	1(AO1.1)	
			Total	1	
41			D ✓	1(AO1.1)	
			Total	1	
42			C ✓	1(AO2.1)	
			Total	1	
43			D ✓	1(AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
44		i	Positive (metal) **ions or cations** (in a lattice structure) ✓ Surrounded by sea of or delocalised electrons ✓	2(AO1.1)	**Any reference to ionic or covalent bonding or IMF scores 0** **ALLOW** a labelled diagram  If diagram must be at least one electron in the body of the ions Diagram must show **close packed** metal ions, in a regular arrangement **ALLOW** - / e / e^- / dots for electrons **ALLOW** Circles with + or circles labelled ions **IGNORE** free electrons If e or e^- used don't need labelling Examiner's Comments This question required candidates to appreciate that a metal contains positive metal ions in a sea of delocalised electrons. When candidates did not gain credit it was usually because they described the atomic structure of lithium (often also describing how it bonds with other elements), rather than the metallic structure.
		ii	Idea that layers or rows or sheets (of particles) slide over each other ✓	1(AO1.1)	**IGNORE** layers can bend **IGNORE** IMF Examiner's Comments Good responses to this question described that metals are malleable because the layers of particles can slide or move over each other. A common misconception was that metals have weak bonding.

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Question			Answer/Indicative content	Marks	Guidance
		iii	Has electrons ✓ (Electrons) can move / that can carry the charge ✓ BUT Delocalised electrons scores 2 marks	2(AO1.1)	DO NOT ALLOW free ions – scores 0 IGNORE free (electrons) for idea of movement Examiner's Comments Good responses to this question described that metals contain delocalised electrons.
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
45	a	i	C ✓ Low density **and** good **electrical** conductor ✓	2(AO3.2a) (AO1.1)	**Second mark is dependent on correct choice of C** **BOTH** properties required for second mark **IGNORE** good conductor **DO NOT ALLOW** light / lighter for low density Examiner's Comments Element C was usually correctly identified. When candidates did not gain the second mark it was usually because they omitted to refer low density being an important property. Lower ability candidates tended to use imprecise terminology, e.g. 'good conductor' rather than 'good **electrical** conductor' or 'light' instead of 'low density'.
		ii	Idea of a feature of a substance that can be observed or measured ✓	1(AO1.1)	**ALLOW** a specific example eg the appearance of something or the state (of matter) or melting point / boiling point **IGNORE** idea of a property that is reversible Examiner's Comments Good responses to this question described a physical property as a feature that can be observed or measured. Credit was also given for a specific example of a physical property, e.g. melting / boiling point or state of matter.

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Question			Answer/Indicative content	Marks	Guidance
	b		Dissolve gas or oxide in water / make a solution of the oxide ✓ Test with universal indicator (paper) ✓ (universal indicator) would turn blue / pH greater than 7 ✓	3(AO3.3a)	**ALLOW** shake gas or oxide with water **ALLOW** use a pH meter / pH probe **ALLOW** test with (damp) red litmus (paper) **ALLOW** (damp red litmus paper) turns blue <u>Examiner's Comments</u> Good responses to this question described the idea of making a solution of the oxide, testing the pH and obtaining a pH greater than 7 (or universal indicator / damp red litmus paper turning blue). Examiners saw a wide range of incorrect responses including: • addition of acid, followed by testing for hydrogen gas • flame test • electrolysis • testing electrical conductivity.
			Total	6	

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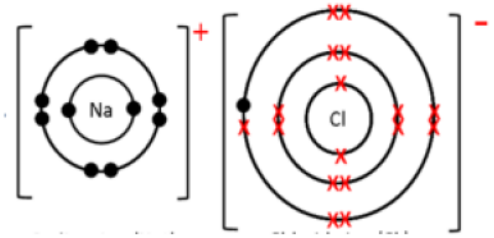
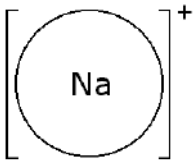
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Question			Answer/Indicative content	Marks	Guidance
46		i	**Any two from:** Size of atoms or ions is not accurate ✓ Idea that atoms or ions are held together by forces not physical bonds ✓ Idea that it show the atoms or ions **too far apart** ✓ There are not really 'sticks' holding the atoms or ions together ✓ Charges on **ions** are not shown ✓	2(AO3.1b)	**ALLOW** doesn't show relative size of atoms or ions **IGNORE** idea that you cannot see the forces between the atoms / ions **DO NOT ALLOW** charges on **atoms** are not shown Examiner's Comments Good responses to this question usually described that the ball-and-stick model does not show the charges on the ions and the idea that it shows the ions too far apart. AfL Candidates should be encouraged to use precise terminology. In this question credit was given for the idea that the size of the atoms or ions is not accurate or the diagram doesn't show the relative size of the ions. Many candidates, however, simply wrote that the diagram doesn't show the size of the ions. Many candidates also did not seem to understand the word 'limitations'.

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Question			Answer/Indicative content	Marks	Guidance
		ii	 Correct sodium ion / 2.8 **OR** empty outer shell ✓ ie  Correct chloride ion / 2.8.8 **OR** correct chloride ion showing full outer shell only ✓	2(AO2.1)	Two correct electronic structures but no charges award one mark Two correct charges with incorrect electronic structure award one mark The ionic charges must **not** be shown in the nucleus Award 0 marks for structures with shared electrons One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks. **ALLOW** answers showing the transfer of electrons providing the same electrons are not shown twice All electrons can be dots or crosses **Examiner's Comments** This question required candidates to draw a correct 'dot and cross' diagram, including the charges on the ions. Many excellent diagrams were seen by examiners. Others lost marks as the chloride ion was often drawn as 2.8 rather than 2.8.8. Lower ability candidates tended to draw diagrams showing the sharing of electrons.
			Total	**4**	
47			C	1 (AO 2.1)	**Examiner's Comments** Candidates found this difficult. Either missing Period 1 and answering D or confusing Period with Group and answering B.
			Total	**1**	
48			C	1 (AO2.1)	**Examiner's Comments** A and B were common incorrect responses.
			Total	**1**	

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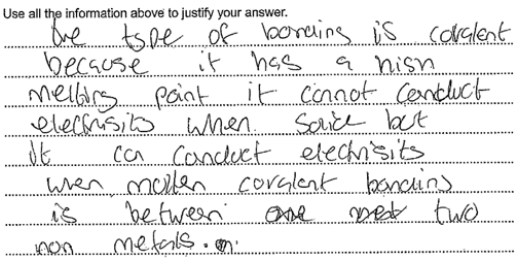
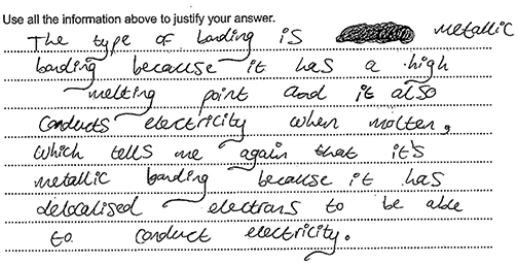
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Question			Answer/Indicative content	Marks	Guidance
49			*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Describes the bonding in compound X in detail. **AND** Links explanation to at least two of the properties to the bonding in compound X. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes the bonding in compound X. **AND** Links explanation to one of the properties to the bonding in compound X. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts to describe the bonding in compound X. **OR** Attempts to link explanation to one of the properties to the bonding. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6 (AO1.1 ×2) (AO2.1 ×2) (AO3.2a ×2)	**AO1.1 Knowledge and understanding of ionic bonding** • Ions cannot move in a solid so will not conduct electricity • No delocalised electrons, cannot conduct as a solid • Ions can move in a liquid, so it will conduct electricity when molten • Bonding is very strong and takes a lot of energy to break, so it will have a high melting point • Ionic bonds are strong electrostatic forces of attraction between oppositely charged ions **AO2.1 Application of knowledge and understanding of properties linked to the bonding in a compound** • Compound X has positive and negative ions. • Compound X contains ions • Compound X does not have mobile electrons **AO3.2a Analysis of information and ideas to make judgements** • The bonding in compound X is ionic • The bonding in compound X is very strong • The bonding cannot be metallic • The bonding cannot be covalent **Examiner's Comments** Candidates found this question very difficult. Some repeated the properties listed in the notebook without applying them to a type of bonding. High melting point meaning strong bonding was the most common creditworthy response. Many candidates named a type of bonding but found explaining their choice very difficult. Covalent was the most chosen bonding with many explaining conductivity in terms of moving or delocalised electrons not appreciating that non-conduction in

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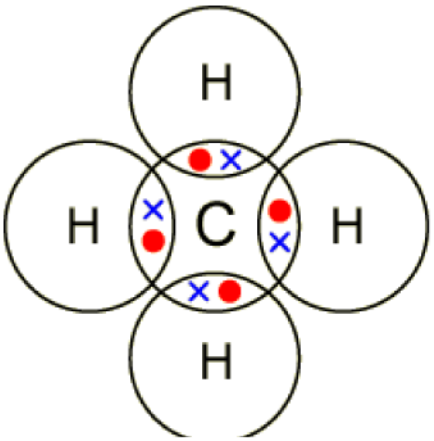
Question	Answer/Indicative content	Marks	Guidance
			solid but conduction when molten signals ions and ionic bonding. Some chose metallic bonding due to the conduction when molten. Those who chose ionic bonding did not link to the ions making up compound X or the electrostatic charge between them. **Exemplar 1**  Use all the information above to justify your answer. the type of bonding is covalent because it has a high melting point it cannot conduct electricity when solid but it can conduct electricity when molten covalent bonding is between one most two non metals. on. The candidate has chosen a type of bonding, covalent. They have listed properties from the notebook but have not explained them. This is Level 1, 1 mark. **Exemplar 2**  Use all the information above to justify your answer. The type of bonding is metallic bonding because it has a high melting point and it also conducts electricity when molten, which tells me again that it's metallic bonding because it has delocalised electrons to be able to conduce electricity. The candidate has chosen a type of bonding, metallic. They have taken a property from the notebook, in this case conduction of electricity, and have explained that delocalised electrons are responsible for this conduction. This is Level 1, 2 marks. **Exemplar 3**

Question	Answer/Indicative content	Marks	Guidance
			The high melting Point of the compound along with the Fact that it only conducts electricity when molten suggests that the bonding is ionic between a metal and a non-Metal. The high melting Point means that a lot of energy is needed to break the bonds meaning it has Strong intermolecular bonds. The candidate has chosen the correct bonding, ionic. They have taken a property from the notebook, in this case high melting point, and have explained that the strong bonds are responsible for this. They have also mentioned that since it only conducts when molten this leads them to ionic bonding. This is Level 2. The candidate has confused the bonding by discussing intermolecular forces and not forces between ions. This is 3 marks. **Exemplar 4** Use all the information above to justify your answer. it would be ionic bonding because it has a high melting point which means the bonds are strong and there is a metal ion present And it does not conduct electricity when solid which suggests that there is not delocalised electrons present unlike there is in metallic bonding but the is when it's molten which also is not covalent as covalent does not conduct electricity so it must be [6] ionic bonding. The candidate has chosen the correct bonding, ionic. They have taken a property from the notebook, in this case high melting point, and have explained that the strong bonds are responsible for this. They have described why it cannot be metallic or covalent. This is Level 2, 4 marks.

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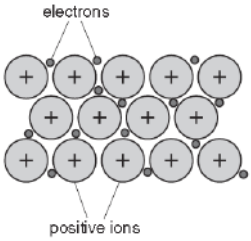
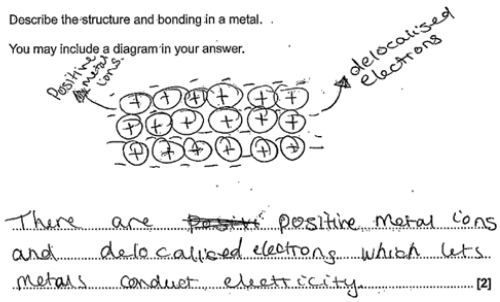
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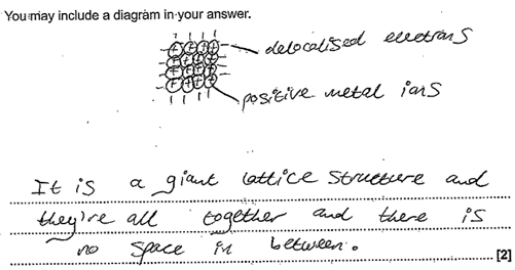
Question			Answer/Indicative content	Marks	Guidance
					To access Level 3 the candidate needed to include a detailed explanation of the properties e.g. ionic substances made up of positive and negative ions or the strong bonds being due to strong (electrostatic) attractions between positive and negative ions or non-conduction in solid because the ions cannot move or conduction in liquid because the ions can move.
			Total	6	
50		i		2 (AO2.2)	**ALLOW** all dots or all crosses Inner shell electrons on carbon not needed **ALLOW** 1 mark only for correct bonding pairs and a non bonding electron on H Examiner's Comments Common errors included one electron in each bond, an extra non-bonding electron on each hydrogen and four extra non-bonding electrons on carbon.
		ii	Weak forces ✓ Between molecules ✓	2 (AO2.1)	**DO NOT ALLOW** mention of intramolecular bonding **IGNORE** weak bonds alone **DO NOT ALLOW** weak covalent bonds weak intermolecular forces/bonds ✓✓ Examiner's Comments Candidates found this extremely difficult. Many discussed weak bonding, weak covalent bonds, few electrons or only single bonds.
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
51		i	Positive (metal) ions / cations ✓ Surrounded by sea of or delocalised electrons ✓	2 (AO1.1)	**Any reference to ionic or covalent bonding or IMF scores 0** **ALLOW** a labelled diagram  If diagram must be at least one electron in the body of the ions Diagram must show **close packed** metal ions, in a regular arrangement **ALLOW** - / e / e^- / dots for electrons **ALLOW** Circles with + or circles labelled ions **IGNORE** free electrons If e or e^- used don't need labelling Examiner's Comments Very few candidates drew a creditworthy diagram and of those that did, few included labels. Most candidates drew a lithium atom or a lithium atom changing into a lithium ion and discussed the formation of ions and ionic bonding. A significant number omitted the question. **Exemplar 8**  The diagram scores both marks. The circles have a + and are labelled as ions. The electrons surround the ions and are

Question			Answer/Indicative content	Marks	Guidance
					labelled. The writing underneath the diagram would only have scored marking point one for the positive ions. Although delocalised electrons are mentioned there is no mention of where they are. Exemplar 9  The diagram scores marking point one, the circles have a + and are labelled as ions. The electrons are only shown around the outside of the bulk of the ions and so do not score marking point two, they should also be among the positive ions. This is a common misconception of the phrase "surrounded by".
		ii	Idea that layers or rows or sheets (of particles) slide over each other ✓	1 (AO1.1)	IGNORE layers can bend IGNORE IMF <u>Examiner's Comments</u> Most able candidates discussed layers sliding, the majority discussed the metal bending and many omitted the question.

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Question			Answer/Indicative content	Marks	Guidance
		iii	Has electrons ✓ That can move / that can carry the charge ✓ BUT Delocalised electrons scores 2 marks	2 (AO1.1)	DO NOT ALLOW free ions – scores 0 IGNORE free (electrons) for idea of movement <u>Examiner's Comments</u> Higher ability candidates identified electrons but fewer included the movement of the electrons. A small number discussed delocalised electrons. Discussions of melting point or reactivity were common. A significant number omitted the question.
			Total	5	
52			B	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
53	a	i	A **AND** D ✓	1 (AO3.1a)	
		ii	**Any two from:** Conducts electricity in molten state ✓ Does not conduct electricity in solid state ✓ High melting point ✓	2 (AO3.2b)	ALLOW dissolve in water
	b	i	Add water (and stir) ✓ Filtration ✓ **B** collects on filter paper ✓	3 (AO3.3a 1.2 3.3a)	
		ii	Distillation **OR** evaporation **OR** heating ✓ Removes water **OR** dries C **OR** removes some water and leave to crystalise ✓	2 (AO1.2 3.3a)	**ALLOW** boiling
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
54	a	i	ionic✓ oppositely charged ions✓	2 (AO1.1)	**ALLOW** oppositely charged particles / has + and – particles **IGNORE** contains anions and cations (in diagram) **IGNORE** oppositely charged atoms / molecules **DO NOT ALLOW** positive nucleus and negative electrons **Mark independently**
		ii	**Any two from:** Idea of many strong ✓ covalent bonds ✓ (which) require a lot of energy to break ✓	2 (AO1.1)	**Reference to intermolecular forces / bonds / molecular forces scores 0 for question** **ALLOW** many covalent bonds break at high temperatures for 2 marks **ALLOW** idea that each atom has 4 strong covalent bonds for 2 marks **ALLOW** giant covalent structure for 1 mark
		iii	No delocalised electrons / no sea of electron / no mobile charge carriers / ions / electrons structure contains atoms ✓	1 (AO1.1)	**IGNORE** just free electrons
	b		Layers / metal ions ✓ slide over each other ✓	2 (AO1.1)	**IGNORE** metal atoms / electrons **Mark independently**
			Total	7	

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Question			Answer/Indicative content	Marks	Guidance
55	a		Any two from: In order of (Increasing) atomic mass / weight ✓ In groups showing similar chemical properties ✓ Left gaps for elements that had not been discovered ✓	2 (AO1.1)	ALLOW (increasing) mass number IGNORE just in order of mass
	b		In order of (Increasing) atomic number / proton number ✓	1 (AO1.1)	IGNORE electrons DO NOT ALLOW atomic mass
	c	i	Germanium ✓	1 (AO3.1a)	
		ii	Idea of similar atomic mass / 72.6 is closest to 72 / closest atomic mass ✓ Idea of similar density / 5.35 is closest to 5.5 / closest density ✓	2 (AO3.2a)	ALLOW (Relative) atomic mass of 72.6 is very close to 72 IGNORE just atomic masses are 72 and 72.6 ALLOW density of 5.35 is very close to 5.5 IGNORE just densities are 5.35 and 5.5 IGNORE comments about melting point or colour If no marks awarded ALLOW 1 for density and relative atomic mass and not melting point

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>d</td><td>i</td><td>Unreactive ✓

Full outer shell (of electrons) ✓</td><td>2
(AO2.1
1.1)</td><td>ALLOW doesn’t bond / doesn’t lose or gain electrons / doesn’t share electrons

ALLOW (argon has a) stable electronic structure / 8 electrons in outer shell</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th></th><th>$^{20}_{10}Ne$</th><th>$^{22}_{10}Ne$</th></tr><tr><td>Proton</td><td>10</td><td>10</td><td>✓</td></tr><tr><td>Neutron</td><td>10</td><td>12</td><td>✓</td></tr><tr><td>Electron</td><td>10</td><td>10</td><td>✓</td></tr></table></td><td>3
(AO2.1)</td><td>1 mark for each row</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>56</td><td></td><td></td><td>D ✓</td><td>1
(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>57</td><td></td><td></td><td>D ✓</td><td>1
(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
58	a	i	Ionic ✓ oppositely charged ions ✓	2 (AO1.1)	**ALLOW** oppositely charged particles / has + and - particles **IGNORE** contains anions and cations (in diagram) **IGNORE** oppositely charged atoms / molecules **DO NOT ALLOW** positive nucleus and negative electrons **Mark independently**
		ii	**Any two from:** Idea of many strong ✓ covalent bonds ✓ (which) require a lot of energy to break ✓	2 (AO1.1)	**Reference to intermolecular forces / bonds / molecular forces scores 0 for question** **ALLOW** many covalent bonds break at high temperatures for 2 marks **ALLOW** idea that each atom has 4 strong covalent bonds for 2 marks **ALLOW** giant covalent structure for 1 mark
		iii	No delocalised electrons / no sea of electrons / no mobile charge carriers / ions / electrons / structure contains atoms ✓	1 (AO1.1)	**IGNORE** just free electrons
	b		Layers / metal ions ✓ slide over each other ✓	2 (AO1.1)	**IGNORE** metal atoms / electrons **Mark independently**
			Total	**7**	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>59</td><td>a</td><td></td><td>Any two from:

In order of (increasing) atomic mass / weight ✓

In groups showing similar <u>chemical</u> properties ✓

Left gaps for elements that had not been discovered ✓</td><td>2
(AO1.1)</td><td>ALLOW (increasing) mass number
IGNORE just in order of mass</td></tr>
<tr><td></td><td>b</td><td></td><td>In order of (increasing) atomic number / proton number ✓</td><td>1
(AO1.1)</td><td>IGNORE electrons
DO NOT ALLOW atomic mass</td></tr>
<tr><td></td><td>c</td><td>i</td><td>Germanium ✓</td><td>1
(AO3.1a)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>Idea of similar atomic mass / 72.6 is closest to 72 / closest atomic mass ✓

Idea of similar density / 5.35 is closest to 5.5 / / closest density ✓</td><td>2
(AO2×3.2 a)</td><td>ALLOW (Relative) atomic mass of 72.6 is very close to 72
IGNORE just atomic masses are 72 and 72.6

ALLOW density of 5.35 is very close to 5.5
IGNORE just densities are 5.35 and 5.5

IGNORE comments about melting point or colour

If no marks awarded, ALLOW 1 for density and relative atomic mass and not melting point</td></tr>
<tr><td></td><td>d</td><td>i</td><td><u>Unreactive</u> ✓

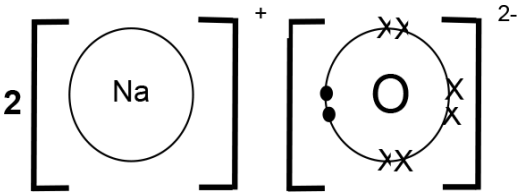
Full outer shell (of electrons) ✓</td><td>2
(AO2.1 1.1)</td><td>ALLOW doesn’t bond / doesn’t lose or gain electrons / doesn’t share electrons

ALLOW (argon has a) stable electronic structure / 8 electrons in outer shell</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th></th><th>$^{20}_{10}Ne$</th><th>$^{22}_{10}Ne$</th></tr><tr><td>Proton</td><td>10</td><td>10</td><td>✓</td></tr><tr><td>Neutron</td><td>10</td><td>10</td><td>✓</td></tr><tr><td>Electron</td><td>10</td><td>10</td><td>✓</td></tr></table></td><td>3
(AO2.1)</td><td>1 mark for each row</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
			Total	11	
60		i	Idea of preventing potassium reacting with air or oxygen / idea of preventing potassium reacting with water ✓	1 (AO1.1)	**ALLOW** potassium reacts with air or oxygen / potassium reacts with water
		ii	(Sodium and potassium) both have 1 electron in their outer shell / both have the same number of electrons in their outer shell ✓	1 (AO1.1)	**ALLOW** both form 1+ ions
			Total	2	
61			 Outer shells correctly drawn ✓ Correct charges ✓	2 (AO2.1)	**ALLOW** all dots / all crosses / mix of dots and crosses **ALLOW** eight electrons shown on outer shell of sodium ion **ALLOW** just one sodium ion drawn **If inner shells are drawn, they must be correct** **ALLOW** 1 mark for correct diagram of either a Na^+ or O^{2-} ion, if no other mark awarded
			Total	2	

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