Question Number	Answer	Acceptable answers	Mark
1(a)(i)	C cations in a sea of electrons		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	(metals have) high melting <u>point</u>	a lot of energy needed to break/overcome (metallic) bonds energy needed to break/overcome strong (metallic) bonds Ignore references to boiling point Reject reference to intermolecular forces/covalent (bonds) /attraction between ions/breaking ionic bonds/ breaking covalent bonds	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	An explanation including two of the following points • argon is inert/does not react/is unreactive (1) • because it has 8 electrons in its outer shell (1) • metals would react in/with air/oxygen (1) • argon will exclude air from welding point (1)	 Ignore argon is in group 0/8 argon is a noble gas Ignore argon does not burn does not {gain/lose/share} electrons has a full outer shell (of electrons) has a stable electron configuration form (metal) oxide prevents oxidation	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)	$2\ Fe + 3\ Br_2 \rightarrow 2\ FeBr_3$ M1 Correct symbol/formulae (1) M2 balancing of correct symbol/formulae (1)	Reject incorrect use of upper/lower case / subscripts for M1 but allow ECF for M2	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)	C – grey solid		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(d)	A explanation including M1 order of reactivity chlorine > bromine > iodine (1) and M2 one of the following points • chlorine displaces bromine (from bromide) AND chlorine displaces iodine (from iodide) (1) • bromine displaces iodine (from iodide) AND bromine does not displace chlorine (from chloride) (1) • iodine does not displace chlorine(from chloride) AND iodine does not displace bromine (from bromide) (1)	For M1 reject reference to reactivity of halide ions eg chlorine more reactive than bromide halogens/they decrease in reactivity down the group/table chlorine is most reactive <u>and</u> iodine is least reactive Ignore reference to displacement of halide ions eg chlorine displaces bromide Ignore “replaces” chlorine reacts with bromide AND iodide chlorine takes part in two (displacement) reactions bromine reacts with iodide AND does not react with chloride bromine takes part in one (displacement) reactions iodine does not react with chloride or bromide iodine does not take part in any (displacement) reactions	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)	C oxygen other gases nitrogen		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	A description to include • Photosynthesis /absorb carbon dioxide and releases oxygen (1) • (green) plants (1)	reject respiration for photosynthesis ignore breathe in carbon dioxide ignore breathe out oxygen	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	A description to include second marking is dependent on the first • a glowing splint (1) • relights (1)	smouldering splint reject a blown out splint lit splint glows brighter (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	to ensure all the oxygen is removed/to ensure the oxygen is completely removed	ignore ensure all the air is removed	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	An explanation linking • measure the volume of gas in the syringe at the end of experiment (1) • subtract from {100 cm^3 / original volume} to give volume of oxygen (1)	e.g. 100-79 (= 21 cm^3)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)	loss of oxygen	gain of electrons	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)	An explanation to include • aluminium high in reactivity series / aluminium more reactive than {carbon / iron} (1) • (aluminium reduction) needs more energy / electrolysis is {more / very} powerful (means of reduction) / carbon cannot displace aluminium (from aluminium oxide) (1)	 aluminium compounds are stable aluminium is more reactive ignore just 'very reactive'/highly reactive allow stronger (method of reduction)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)	$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ (3) lhs (1) rhs (1) balancing correct formulae (1)		**(3)**

Question Number		Indicative Content	Mark
QWC	***3(d)**	A description including some of the following points **Property change (other than increased strength) or use of alloy** • increased hardness • decreased malleability • increased corrosion resistance • shape-memory • gold alloy for jewellery • stainless steel used for cutlery • steel used for construction • nitinol (shape-memory alloy) used for spectacle frames / stents • idea of any use of metal after alloying **Structural change** • pure metal – atoms are all the same size / suitable diagram of pure metal structure • atoms arranged in a regular way / lattice • alloy – atoms are of different sizes / suitable diagram of alloy structure • disrupts arrangement of atoms • atoms in pure metal structure can slide over each (when bent) • alloy – sliding prevented by different sized atoms	**(6)**

Level	**0**	No rewardable content
1	**1 – 2**	• a limited description of how one property changes, one use or one statement related to structure eg iron rusts, stainless steel does not; atoms in a pure metal all the same size • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 – 4**	• a simple description of how two properties change or two uses **or** a simple description of why alloys become stronger or a property/use and a statement about structure eg the atoms in a pure metal have a regular arrangement but in alloys there are different sized atoms • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 – 6**	• a detailed description of why alloys become stronger including at least one change in property of an alloy or use eg the atoms in a pure metal have a regular arrangement but in alloys the different sized atoms stops the atoms sliding over each other and how alloys are more useful such as gold alloys used in jewellery • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	carbon (is oxidised)	Just 'carbon dioxide' (0)	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	**1 mark if answer only mentions one of the metals.** An explanation linking two of iron is lower in reactivity than aluminium/ORA (1) carbon can remove the oxygen from iron oxide (1) electrolysis is a more powerful method (than using carbon) / electrolysis is needed to {remove the oxygen from/reduce} aluminium oxide (1) iron compounds less stable than aluminium compounds/ORA (1)	**Allow** carbon is more reactive than iron /ORA(1) **Allow** aluminium is more reactive than carbon /ORA (1) **Ignore** carbon can reduce iron oxide **Ignore** electrolysis is used to extract aluminium	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)	An explanation linking three of atoms of gold all the same (size) (1) in pure gold {layers/rows/sheets/lines} of the {gold / metal} atoms slide over each other (when force is applied) (1) copper atoms are {smaller / different size} (1) (copper atoms) {disrupt / distort /disturb} the {structure / layers} (1) stops {layers/rows/sheets/lines} of gold atoms from sliding over each other (1)	**Reject** the use of the word molecule once only **Allow** particles If layers/rows/sheets/lines is omitted twice, you can award one mark.	**(3)**

<table>
<tr><th colspan="2">Question Number</th><th>Indicative Content</th><th>Mark</th></tr>
<tr><td>QWC</td><td>*4(c)</td><td>An explanation including some of the following points
<table>
<tr><th>Use</th><th>Relevant properties</th></tr>
<tr><td>Aluminium</td><td></td></tr>
<tr><td>aeroplanes, cars, bicycles, trains, trucks, ladders, window frames, door frames, greenhouses, pylons, ship masts, walking poles, golf clubs, baseball bats</td><td>low density (allow light), strong, resistant to corrosion</td></tr>
<tr><td>(overhead) power/electricity cables</td><td>low density (allow light), good conductor of electricity, resistant to corrosion</td></tr>
<tr><td>foil, food packaging, cans, sweet wrappers, saucepans, blister packs for pills</td><td>low density (allow light), resistant to corrosion</td></tr>
<tr><td>Copper</td><td></td></tr>
<tr><td>electrical wires/cables, lightning conductors, electromagnets</td><td>good conductor of electricity</td></tr>
<tr><td>water pipes, roofing, coins, jewellery, statues, musical instruments</td><td>resistant to corrosion</td></tr>
<tr><td>Gold</td><td></td></tr>
<tr><td>jewellery, coins, in dentistry</td><td>excellent resistance to corrosion, valuable, low strength</td></tr>
<tr><td>electronic devices, circuit boards, switch contacts</td><td>excellent conductor of electricity</td></tr>
<tr><td>Silver</td><td></td></tr>
<tr><td>jewellery, cutlery, coins</td><td>very good resistance to corrosion, valuable, low strength</td></tr>
<tr><td>electronic devices, circuit boards, switch contacts</td><td>excellent conductor of electricity</td></tr>
</table>
General points
A property must be relevant to the use and from the table in the question.
Ignore additional properties.
Look for the use first, then the relevant property. Candidates who just re-write or compare the properties with no uses score no marks.
Ignore non-specific uses such as building materials/structures, making alloys</td><td>(6)</td></tr>
</table>

Level	**0**	No rewardable content
1	**1 - 2**	a limited explanation e.g. states correct uses of two metals / explains a use of one of the metals related to a property in the table the answer communicates ideas using simple language and uses limited scientific terminology spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	a simple explanation e.g. states correct uses of three metals and relates one use to a property / explains uses of two metals related to their properties in the table the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	a detailed explanation e.g. explains uses of three metals and relates use to property in the table in each case the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	$CuCl_2$		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	An explanation linking the following points **Either** • the amount of product calculated (1) • using the equation (for the reaction) (1) **Or** • the maximum amount of {product / copper chloride} (1) • when all {reactant / copper} reacts (1)	using reacting masses amount of product when all {reactant / copper} reacts (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)(i)	$2Fe(s) + 3Br_2(g) \rightarrow 2FeBr_3(s)$ reactant formulae (1) balancing correct formulae (1) state symbols (1) s and g must be lower case	**allow** state symbol mark even if other marks not awarded	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(b)(ii)	56 + (3 x 80) (1) = 296	give full marks for correct answer with no working	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)(iii)	ratio: 56/310 (1) % iron 56/310 x 100 (%) (1) (= 18 (%))	 any number/310 x 100 (%) 18.06/18.1 give full marks for correct answer with no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)(iv)	HO	OH, O_1H_1, H_1O_1	**(1)**