Question Number	Answer	Acceptable answers	Mark
1(a)	• tin {more expensive/costs more} (than aluminium/steel) ORA (1) • amount of tin in Earth smaller (than aluminium/steel) ORA (1)	rarer	(2)

Question Number	Answer	Acceptable answers	Mark
1(b)	C - reduction		(1)

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	an explanation linking the following • a mixture of (1) • metals (1)	reject compound ignore combined/joined specific examples reject reference to non-metals metals melted together (2)	(2)

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	an explanation linking any **three** of • in pure metal /aluminium atoms are all same size (1) • in pure metal /aluminium {layers/sheets/atoms} {slide/slip/move} (over one another) easily(1) • magnesium atoms larger (1) • disrupt {layers/structure/arrangement} of aluminium atoms (1) • prevent {layers/sheets/atoms} {slip/slide/move} (1)	ions or particles for atoms reject molecules once only different sized particles {lock/hold/jam} layers together	(3)

Question Number	Answer	Acceptable answers	Mark
2(a)	gold		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	{loss of / remove} oxygen	gain of electrons	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)	An explanation linking **either** • aluminium high(er) in reactivity / aluminium more reactive than carbon / aluminium compounds are very stable (1) **or** • iron lower in reactivity / iron less reactive than carbon / iron compounds less stable (1) **plus** one of • (for aluminium) electrolysis is powerful means of reduction / needs powerful means of extraction / needs more energy (1) • (for iron) can be reduced with {carbon / carbon monoxide} / use of carbon is cheaper / use of electricity is expensive / ORA (1)	stronger means of reduction can be reacted with {carbon / carbon monoxide} **and** oxygen removed	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	An explanation linking the following points • (magnesium and aluminium) {atoms / ions / particles} are different sizes (1) • this prevents the layers (of atoms / ions / particles) sliding over each other (1)	magnesium atoms are larger than aluminium atoms **OR** aluminium atoms are larger than magnesium atoms sheets / rows penalise molecules only once	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(e)	4 (Al) + 3 (O_2) → ($2Al_2O_3$) 4 (1) 3 (1)		**(2)**

Question number	Answer	Mark
3(a)(i)	C	(1)

Question number	Answer	Mark
3(a)(ii)	C	(1)

Question number	Answer	Mark
3(b)	Any two of the following points. For the acid, use the same: • volume (1) • concentration (1) • temperature (1)	(2)

Question number	Answer	Mark
3(c)(i)	electrolysis (1)	(1)

Question number	Answer	Mark
3(c)(ii)	An answer that combines identification- knowledge (1 mark) and understanding (1 mark) and reasoning/justification- understanding (1 mark) • aluminium compounds are more stable than iron compounds (1) • so carbon is not a strong enough reducing agent to produce aluminium from its ore (1)	(2)

Question number	Answer	Mark
3(d)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ • Correct formulae (1) • Balancing of correct formulae (1)	(2)

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

Question Number	Answer	Acceptable answers	Mark
4(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
4(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	***4(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
5(a)	**B** tin oxide is reduced		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)(i)	An explanation linking two of the following • alloys have different sized atoms • {atoms/layers/sheets/particles} {slide/slip/move} over each other (easily) in pure metal • {structure/layers} disrupted (in alloy) • stop {atoms/layers/sheets/particles} {sliding/slipping/moving} over one another (easily) in	suitable labelled diagrams reject molecules once	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)(ii)	all points plotted correctly (1) best fit line across 4 plotted points (1)	+/- 1 small square	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b) (iii)	Correct value from their graph +/- one small square (%)		**(1)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	An explanation including some of the following points gold • gold is an unreactive metal/at the bottom of the reactivity series • it does not combine with other elements in the Earth's crust • so is found as uncombined metal • cost of recovery is low iron • iron is a more reactive metal than gold and less reactive than aluminium/middle of reactivity series • found combined with other elements • it is extracted by heating with carbon • electrolysis can be used • but electrolysis is more expensive (than heating with carbon) aluminium • aluminium is a very reactive metal/near to top of the reactivity series • found combined with other elements • it is extracted by electrolysis • because it is very difficult to reduce • electrolysis is a powerful method of reduction • use of electricity makes this method expensive	**(6)**
Level		No rewardable content	
1	**1 - 2**	• a limited description e.g. a simple justification in terms of reactivity or cost for how one of the metals is extracted OR an indication of how two of the metals are extracted • 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 e.g. a simple indication of how all three metals are extracted OR an indication of how two of the metals are extracted with a justification in terms of reactivity or cost for one • 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 e.g. indicates how all three metals are extracted with a justification for at least two in terms of reactivity and a reference to cost • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	