

Extraction and uses of metals

Mark Scheme 2

Level	IGCSE(9-1)
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2C)
Topic	Inorganic Chemistry
Sub-Topic	Extraction and uses of metals
Booklet	Mark Scheme 2

Time Allowed: 60 minutes

Score: /50

Percentage: /100

Grade Boundaries:

9	8	7	6	5	4	3	2	1
>90%	80%	70%	60%	50%	40%	30%	20%	10%

Question number			Answer	Notes	Marks
1	a	i	(hydrated) iron(III) oxide / ferric oxide	Accept (hydrated) iron oxide Reject iron with other oxidation states Ignore formulae even if incorrect	1
		ii	no water / moisture	Accept drying agent absorbs water Prevents water from reaching nail reacting with nail Reject no air/oxygen	1
		iii	to keep air/oxygen out (of water)	Accept to keep air/oxygen from dissolving in water/away from nail	1
	b	i	galvanising	Ignore sacrificial protection	1
		ii	zinc more reactive than iron / above iron in reactivity series / better reducing agent than iron / loses electrons more readily zinc reacts/corrodes/oxidises (instead of iron) $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}$ (occurs) $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}$ does not occur OR $\text{Fe}^{2+} + 2\text{e} \rightarrow \text{Fe}$ (occurs)	Accept converse statements Reject zinc rusts Accept zinc reacts first/before iron If neither M3 nor M4 given, award 1 mark for $\text{Zn} + \text{Fe}^{2+} \rightarrow \text{Zn}^{2+} + \text{Fe}$	4

Question number			Answer	Notes	Marks
3	c	i	oxidation loss of electron(s)	Ignore ionisation Accept increase in oxidation number M2 DEP on M1 or near miss No ECF from reduction	1 1
		ii	copper ions are formed (at rod) AND reduced / removed (from solution) / converted to (copper) atoms formed (at nail) concentration/number/amount of copper ions remains constant	Accept Cu ²⁺ for copper ions and Cu for copper atoms Reject references to displacement Accept copper sulfate in place of copper ions	1 1

(Total for Question 1 = 12 marks)

Question number			Answer	Notes	Marks
2	a	i	gains oxygen	Accept increase in oxidation number/state Ignore reference to loss of electrons	1
		ii	$\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$	Accept $2\text{SO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$ OR $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ AND $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$	1
	b	i	covalent	Accept sharing electrons Reject sharing 1 electron Reject references to ions Ignore intermolecular forces Ignore simple Reject giant	1
		ii	intermolecular forces (of attraction) / forces (of attraction) between molecules weak / need little (thermal/heat) energy to overcome	Accept intermolecular bonds Accept easily overcome	1 1
		iii	Mo_2O_6	M2 DEP on M1 at least partially correct If only answer is weak bonds, then 0/2 If any reference to breaking covalent /ionic / metallic bonds, then 0/2	1

Question number			Answer	Notes	Marks
9	c	i	(giant structure of) positive ions	Accept cations but not just ions	1
			(surrounded by) delocalised electrons	Reject references to negative ions and molecules Accept sea of electrons Mark independently	1
		ii	(delocalised / sea of) electrons	Ignore free electrons Ignore references to carrying charge/current M2 DEP on M1	1
			move / flow (through structure) / are mobile (when voltage/potential difference applied)	No penalty for references to molybdenum atoms or ions / nuclei / protons, but any mention of these moving = 0/2	1
		iii	layers/sheets/planes/rows AND (positive) ions/atoms/particles slide (over each other)	If any reference to molecules/protons/electrons/nuclei, then 0/2	1
				Allow slip/flow/shift/move/OWTTE in place of slide M2 DEP on mention of either layers etc OR ions etc	1

(Total for Question 2 = 12 marks)

Question number	Answer	Notes	Marks
3 a i	haematite	Ignore iron oxide / formulae	1
	ii $\text{Al}_2\text{O}_3 / \text{Al}^{3+}_2\text{O}^{2-}_3$	Ignore reactants in equation	1
	iii carbon / C (positive/negative) electrode	Accept graphite Ignore coke / anthracite DEP on M1 (including coke or any metal) Accept anode / cathode Accept references to letting electrons/electricity/current flow Accept references to letting electrons/electricity/current in/out of the cell/electrolyte Ignore references to attracting ions Accept references to conducting electricity Ignore references to electrolysis Ignore references to burning or combining with oxygen Ignore references to reduction/oxidation	1 1

Question number	Answer	Notes	Marks
3 iv	oxygen / O ₂ production of heat/maintaining temperature of furnace OR formation of reducing agent /carbon monoxide	Accept O Ignore air DEP on mention of oxygen/O ₂ /O/air Ignore combustion/oxidation/reaction of carbon/coke Ignore references to <u>increasing</u> temperature of furnace	1 1

Question number	Answer	Notes	Marks
3 (b) i	redox		1
ii	(it/ Al ³⁺ /aluminium ions) gain of electron(s) OR Al ³⁺ combines/reacts with electrons	Reject gain of electrons by Al/aluminium Accept decrease in oxidation state Ignore/ references to gain of oxygen	1
iii	C / carbon gain of oxygen / O / O ₂ OR reacts/combines/joins/bonds with oxygen or O or O ₂ OR reduces water/H ₂ O	Accept graphite/coke DEP on M1 Ignore forms carbon monoxide Ignore references to loss of electrons Accept increase in oxidation state Ignore (acts as) reducing agent	1 1

Question number	Answer	Notes	Marks
3 c i	(a substance that) increases rate of reaction / speeds up reaction / decreases time of reaction is (chemically) unchanged (at the end) OR mass does not change	Accept is not used up / does not change Accept reference to lowering activation energy Ignore reference to alternative route Ignore references to yield Ignore reference to not reacting or taking part in reaction Reject reference to providing/increasing energy Reject reference to incorrect statement such as removes impurities	1 1
ii	(acts as) solvent (for alumina/aluminium oxide) OR to lower the (operating) temperature	Accept to lower melting point (of mixture/electrolyte) Reject to lower melting point of alumina/aluminium oxide/aluminium/bauxite Accept to reduce (heat) energy requirement Accept to increase the conductivity of the mixture/electrolyte/alumina Reject acts as a catalyst	1

Question number	Answer	Notes	Marks
3 d i	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$	M1 for correct reactants and products M2 for balancing M2 dep on M1	1
ii	neutralisation	Accept acid-base Ignore all other descriptions	1
iii	slag		1
		Total	17

Question number	Answer	Notes	Marks
4 a i	delocalised electrons / sea of electrons move / flow (through structure) / mobile (when voltage/potential difference applied)	Ignore free electrons M2 needs mention of electrons, e.g. "electrons move/flow" scores M2 but not M1 Ignore references to carrying charge/current No penalty for references to aluminium atoms or ions / nuclei / protons, but any mention of these moving = 0/2	1
	ii layers/sheets/planes/rows AND (positive) ions/atoms/particles	Reject molecules/protons/electrons/nuclei	1
	slide (over each other)	Allow slip/flow/shift/roll/move/OWTTE in place of slide Do not award M2 if no mention of layers or equivalent Do not award M2 if protons/electrons/nuclei	1

Question number	Answer	Notes	Marks
4 b	<p>NITROGEN (simple) molecular structure</p> <p>intermolecular forces (of attraction) / forces between molecules</p> <p>weak / easily overcome /need little energy to overcome</p> <p>SILICA giant (structure)</p> <p>covalent (bonds)</p> <p>bonds strong / hard to break /need a lot of energy to break</p>	<p>Accept (nitrogen/N₂/small/discrete) molecules</p> <p>Accept intermolecular bonds Reference to intermolecular also scores M1</p> <p>If any reference to breaking covalent bonds or any other type of bonding, only M1 can be awarded</p> <p>Accept macromolecular Ignore lattice</p> <p>Covalent can be anywhere in answer</p> <p>If any reference to breaking intermolecular forces or any other type of bonding, only M4 can be awarded Any five for 1 mark each</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>
		Total	9