

Extraction and uses of metals

Mark Scheme 1

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 1

Time Allowed: 62 minutes

Score: /51

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)	<table border="1"> <thead> <tr> <th data-bbox="600 472 909 542">Metal</th> <th data-bbox="915 472 1224 542">Highest temperature</th> </tr> </thead> <tbody> <tr> <td data-bbox="600 547 909 581">aluminium</td> <td data-bbox="915 547 1224 581">42.0</td> </tr> <tr> <td data-bbox="600 586 909 620">copper</td> <td data-bbox="915 586 1224 620">25.0</td> </tr> <tr> <td data-bbox="600 625 909 659">iron</td> <td data-bbox="915 625 1224 659">29.0</td> </tr> <tr> <td data-bbox="600 664 909 698">magnesium</td> <td data-bbox="915 664 1224 698">46.5</td> </tr> <tr> <td data-bbox="600 703 909 737">zinc</td> <td data-bbox="915 703 1224 737">31.5</td> </tr> </tbody> </table>		Metal	Highest temperature	aluminium	42.0	copper	25.0	iron	29.0	magnesium	46.5	zinc	31.5	<p>M1 for magnesium and zinc M2 and M3 for other 3 metals – 1 mark for 2 correct, 2 marks for all 3 correct</p> <p>Penalise missing trailing 0 once only</p>	3
Metal	Highest temperature															
aluminium	42.0															
copper	25.0															
iron	29.0															
magnesium	46.5															
zinc	31.5															
(b) (i)	magnesium		mark csq on table in (a)	1												
(ii)	it/copper does not react (with sulfuric acid)		ACCEPT there is no reaction / the (sulfuric) acid does not react (with copper) IGNORE copper is unreactive	1												

(c)	<p>M1 (change/rise in temperature would be) less</p> <p>M2 because there is a larger volume/mass of solution/liquid (to be heated)</p> <p>OR</p> <p>same (amount of) energy distributed to a larger number of particles</p>	<p>ACCEPT halved IGNORE any quoted temperatures</p> <p>ACCEPT there is more/twice as much solution/liquid to be heated</p> <p>ALLOW acid for solution/liquid</p> <p>REJECT the magnesium has to react with more acid</p> <p>M2 dep on M1</p>	2
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Question number	Answer	Notes	Marks
2 (a)	propane		1
(b)	C ₄ H ₁₀	ACCEPT H ₁₀ C ₄ penalise incorrect use of symbols and subscripts REJECT structural and displayed formulae	1
(c)	W X Y	all three required	1
(d)	CH ₂	ACCEPT H ₂ C REJECT C _n H _{2n}	1
(e)	<p>M1 (unsaturated) contains a (carbon to carbon) double bond</p> <p>M2 (hydrocarbon) (compound/molecule/substance) contains (the elements/atoms) hydrogen and carbon...</p> <p>M3 ...only</p>	<p>ACCEPT multiple bonds IGNORE refs to single bonds</p> <p>REJECT element/atom/mixture for compound/molecule/substance REJECT ions/molecules for elements/atoms</p> <p>M3 dep on mention of hydrogen & carbon in M2 ACCEPT other equivalents e.g. solely, just, exclusively</p>	3

Question number	Answer	Notes	Marks
3 (a)	<p>M1 (Fe) (Ti) (O)</p> $\frac{36.8}{56} \quad \frac{31.6}{48} \quad \frac{31.6}{16}$ <p>M2 0.66 0.66 1.98</p> <p>M3 1 1 3</p> <p>OR</p> <p>M1 calculation of M_r of $\text{FeTiO}_3=152$</p> <p>M2 expression for % of <u>each</u> element e.g. Fe: $56 \div 152 \times 100\%$</p> <p>M3 evaluation to show these equal 36.8% Fe, 31.6% Ti, 31.6% O</p>	<p>Division by atomic number scores 0</p> <p>ACCEPT any number of sig figs except one ALLOW 0.65, 0.65, 1.97</p>	3
(b)	<p>M1 (element oxidised) – carbon / C</p> <p>M2 (reason) – (it has) gained/combined with oxygen / forms carbon dioxide</p> <p>M2 dep on M1</p>	<p>IGNORE refs to electron loss</p> <p>ACCEPT oxidation state/number increases</p> <p>ACCEPT oxidation state/number changes from 0 to (+)4</p>	2

(c)	(i)	$\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$ <p>M1 all formulae correct</p> <p>M2 balanced</p>	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2
	(ii)	titanium / Ti / magnesium / Mg reacts with oxygen OR titanium / Ti / magnesium / Mg reacts with nitrogen	IGNORE refs to oxidation ACCEPT forms an oxide ACCEPT forms a nitride	1
	(iii)	<u>magnesium chloride</u> will dissolve more quickly / to help the <u>magnesium chloride</u> to dissolve / more of the <u>magnesium chloride</u> is in contact with the water	IGNORE to speed up the reaction IGNORE refs to increasing surface area	1
(d)	(i)	<p>M1 positive ions/cations/nuclei and delocalised electrons</p> <p>M2 attract (one another)</p> <p>M2 dep on M1</p>	IGNORE metal ions ALLOW sea of electrons IGNORE free electrons any refs to ionic bonding, covalent bonding or IMFs scores zero	2
	(ii)	(delocalised) electrons can flow/move (through structure)/are mobile (when voltage/pd is applied)	IGNORE carry charge	1

Question number	Answer	Notes	Marks
4 a i	$2\text{NdF}_3 + 3\text{Ca} \rightarrow 2\text{Nd} + 3\text{CaF}_2$	Accept fractions and multiples	1
	ii calcium fluoride AND neodymium fluoride (in either order)	Accept formulae	1
	iii ionic	Accept electrovalent Ignore giant Ignore electron transfer Reject covalent bonding/ intermolecular forces	1
	iv Nd_2O_3	penalise incorrect use of symbols and subscripts	1

b	<p>M1 (neodymium ions in) layers/rows/planes/sheets/OWTTE</p> <p>M2 slide/slip (over each other)</p> <p>M3 delocalised electrons OR sea of electrons</p> <p>M4 (can) flow/travel/move (through structure) / are mobile (when voltage/pd is applied)</p>	<p>Accept atoms/cations/particles for ions Reject molecules</p> <p>Allow OWTTE, eg flow/shift/roll/move</p> <p>M2 DEP on mention of EITHER layers or equivalent OR mention of ions or equivalent</p> <p>Do not award M2 if molecules/protons/electrons/nuclei in place of ions etc</p> <p>If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, no marks</p> <p>Not just electrons Ignore free electrons</p> <p>Ignore carry charge M4 DEP on M3 or near miss</p>	4
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Question number	Answer	Accept	Reject	Marks
5 (a) (i)	Any two from: <ul style="list-style-type: none"> • good conductor <u>of heat</u> • high melting point • malleable Apply list principle			2
	(ii) M1 – ductile M2 – good conductor <u>of electricity</u> Apply list principle Answers can be given in any order			1 1
(b) (i)	strong(er) IGNORE references to density and rusting	other correct descriptions		1
	(ii) lower density / resists corrosion IGNORE lighter	does not rust greater strength to weight ratio		1
(c) (i)	heat / thermal energy / heat energy is given out OR transferred/lost to the surroundings IGNORE references to bond formation and breaking	produced produces an increase in temperature it gets hot		1
	(ii) M1 - (aluminium/it is) more reactive M2 – (aluminium/it) displaces iron (from its oxide) M2 DEP on M1	iron is less reactive replaces it/aluminium takes oxygen away from iron (oxide)		1 1

(iii)	M1 – aluminium	loses (three) electrons /oxidation number increases		1
	M2 – gains oxygen M2 DEP on M1 IGNORE references to magnesium	combines with oxygen / forms aluminium oxide		1
(d)	temperature reached \geq m.pt of iron IGNORE exothermic / heat produced / lots of energy produced	<u>high</u> temperature reached / gets <u>very</u> hot		1

(Total marks for Question 5 = 12 marks)