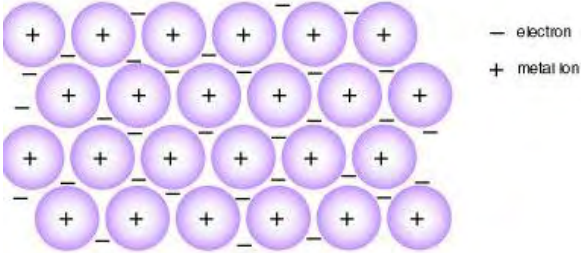


Question number	Answer	Notes	Marks
1 (a)	$\text{CuO} + 2\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O}$	Ignore state symbols	1
(b) (i)	to increase the rate of <u>reaction</u>	ignore references to dissolving/solubility	1
(b) (ii)	(copper(II) oxide/it) stops disappearing/ stays as a solid / forms as a solid (at the bottom of the beaker)	Accept stops dissolving / forms a suspension /forms a residue  Accept when copper oxide remains/settles in the beaker Allow liquid goes cloudy/black  ignore references to stops reacting ignore references to bubbling	1
(iii)	a drop of solution forms crystals when removed (and cooled)	Accept when crystals start to form/start to be seen  Reject if all water evaporated	1
(iv)	(stage) 3	accept any reference to <u>first</u> filtration stage	1

Question number	Answer	Notes	Marks						
2 a	<p><b>M1</b> oxygen / air</p> <p><b>M2</b> water (vapour) / moisture</p>	<p><b>ACCEPT</b> O<sub>2</sub> but not O</p> <p><b>ACCEPT</b> H<sub>2</sub>O</p> <p><b>IGNORE</b> steam</p>	2						
b	(hydrated) iron(III) oxide	<p><b>ACCEPT</b> iron oxide / ferric oxide</p> <p><b>REJECT</b> ferrous oxide and iron with other oxidation numbers</p> <p><b>IGNORE</b> iron trioxide</p> <p><b>ACCEPT</b> Fe<sub>2</sub>O<sub>3</sub>(.xH<sub>2</sub>O)</p> <p><b>IGNORE</b> all other formulae</p> <p>If both name and formula given mark name only</p>	1						
c	<table border="1"> <tbody> <tr> <td><b>M1</b> (galvanising)</td> <td>bucket / car body / railway bridge</td> </tr> <tr> <td><b>M2</b> (oiling)</td> <td>bicycle chain / car engine</td> </tr> <tr> <td><b>M3</b> (painting)</td> <td>car body / railway bridge</td> </tr> </tbody> </table>	<b>M1</b> (galvanising)	bucket / car body / railway bridge	<b>M2</b> (oiling)	bicycle chain / car engine	<b>M3</b> (painting)	car body / railway bridge	<p><b>DO NOT AWARD M3</b> for car body/railway bridge if already scored for <b>M1</b></p>	3
<b>M1</b> (galvanising)	bucket / car body / railway bridge								
<b>M2</b> (oiling)	bicycle chain / car engine								
<b>M3</b> (painting)	car body / railway bridge								
d	<p><b>M1</b> zinc corrodes/oxidises/reacts in preference to iron</p> <p><b>M2</b> (because) zinc is more reactive than iron / zinc (atoms) lose electrons more readily (than do iron atoms)</p>	<p><b>REJECT</b> zinc rusts</p> <p><b>IGNORE</b> reference to sacrificial protection</p> <p><b>ACCEPT</b> for <b>M1</b> zinc atoms react with iron(II) ions</p> <p><b>ACCEPT</b> for <b>M2</b> iron(II) ions are converted to iron atoms</p>	2						

Question number	Answer	Notes	Marks
3 a i	Ni/nickel has lost oxygen (atoms / ions) OR nickel <u>ions</u> gain electrons	Accept NiO/nickel oxide has lost oxygen Accept nickel(II) loses oxygen Ignore <u>it</u> loses oxygen / gains electrons Reject nickel oxide gains electrons Reject nickel loses oxygen molecules Reject any answer that does not refer to Ni or NiO	1
ii	M1 equilibrium (position) shifts to right  M2 (forward) reaction is exothermic	Mark independently Ignore forward reaction favoured/occurs more readily/is faster / more product formed  Accept heat / thermal energy given out Ignore just gives out energy  Ignore because stage 3 is decomposition which is endothermic/takes in heat  Ignore references to bond breaking and making and Le Chatelier's principle and different numbers of (gas) moles on each side and rate of reaction	2

Question number	Answer	Notes	Marks
3 b i	diagram showing: M1 minimum of 5 circles in regular pattern in 2 rows  M2 +/2+ charges in each circle / appropriate key  M3 some indication of electrons between ions / appropriate key	Accept labelled as cations/positive ions not just ions Reject atoms / protons / nuclei  eg e / e <sup>-</sup> / - / (shaded) area labelled electrons Do not award M3 if electrons shown in circles more than half the size of the ions Ignore lines between circles Max 1 if negative ions shown Reject electrons shown in pairs between nickel particles for M3 Ignore intermolecular forces label Example: 	3

Question number	Answer	Notes	Marks
3 b ii	<p>malleability (2 marks):</p> <p>M1 layers / sheets / planes / rows AND (positive) ions / atoms / particles</p> <p>M2 slide (over each other)</p> <p>conductivity (2 marks):</p> <p>M3 – delocalised electrons</p> <p>M4 – that flow (when a potential difference is applied)</p>	<p>Reject molecules / protons / electrons</p> <p>M2 needs reference to either layers or equivalent OR ions/particles/atoms Allow OWTTE, eg slip / flow / shift / roll / move M2 DEP on mention of EITHER layers or equivalent OR mention of ions or equivalent</p> <p>Do not award M2 if protons / electrons / nuclei / molecules in place of ions, etc If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, no M1 or M2</p> <p>Accept sea of electrons Ignore free electrons</p> <p>Accept move / mobile in place of flow M4 DEP on mention of electrons Ignore reference to intermolecular forces for M3 and M4</p>	4
<b>Total 10 marks</b>			

Question number			Answer	Notes	Marks
4	a	(i)	M1 Iron(III) oxide	Accept Iron oxide / ferric oxide Ignore formula whether right or wrong	1
		(ii)	M1 calcium carbonate	Ignore formula whether right or wrong	1
	b	(i)	M1 A		1
		(ii)	M1 E		1
		(iii)	M1 B		1
		(iv)	M1 C		1
	c		M1 slag	Accept calcium silicate Ignore formula	1
	d	(i)	M1 aluminium/it is more reactive than iron/carbon OR above iron/carbon in reactivity series OR cannot be reduced by/does not react with carbon (monoxide) OR cannot be displaced by carbon	Comparison with iron or carbon must be stated or implied, eg not just aluminium is (very/too) reactive  Accept reverse argument for iron	1
		(ii)	M1 (cost of) electricity	Accept keeping electrolyte molten Accept high current Ignore energy Ignore references to electrode replacement	1

Question number			Answer	Notes	Marks	
4	e		M1	electrode(s) / to conduct electricity	Accept cathode / anode	1
	f		M1	$\text{Al}^{3+} + 3\text{e} \rightarrow \text{Al}$	M1 for both aluminium formulae on correct sides of equation M2 for both oxygen formulae on correct sides of equation M3 for balancing both equations even if one or both reversed	3
			M2	$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e} / 2\text{O}^{2-} - 4\text{e} \rightarrow \text{O}_2$		
			M3			
					Accept in either order	
					<b>Total 13 marks</b>	

Question number	Expected answer	Accept	Reject	Marks
5 (a)(i)	Magnesium	Mg		1
(a)(ii)	It would react with the sulfuric acid / the clouds / the atmosphere / it will fizz	It is <u>too</u> reactive / <u>very</u> reactive / the <u>most</u> reactive  Dissolve <u>in the</u> (sulfuric) acid/ eq	"reactive" by itself	1
(b)	it has low melting point / would melt / temperature on Venus is higher than the melting point of lead (ora) IGNORE heavy / dense	Lead would be a liquid Answer using data from table e.g. 328°C is lower than temp on Venus		1
(c)	Titanium  Any two from: <ul style="list-style-type: none"> <li>• it has a low density / is lightweight</li> <li>• it has a high melting point / wouldn't melt / temperature on Venus is lower than the melting point of titanium (ora)</li> <li>• does not react with sulfuric acid / the clouds / the atmosphere / it will not fizz</li> </ul>	Ti  The <u>probe</u> would be light  Remains solid  <b>Reason marks can be scored for copper (density mark would need to be compared to lead)</b>	Light on its own / light <u>in</u> weight on its own	1  1  1

**Total 6 Marks**



Question number			Answer	Notes	Marks									
6	a	i	tungsten(VI) oxide / tungsten trioxide	Accept tungsten oxide Reject tungsten oxide with other oxidation numbers or prefixes such as mono- and di-	1									
		ii	(1) (1) 3	Accept multiples and fractions	1									
		iii	loss of oxygen (by it / tungsten / tungsten oxide)	Accept decrease in oxidation number of tungsten Accept tungsten <u>ions</u> gain electrons	1									
	b	M1	<table style="margin-left: auto; margin-right: auto;"> <tr> <td>Ca</td> <td>W</td> <td>O</td> </tr> <tr> <td><math>\frac{13.9}{40}</math></td> <td><math>\frac{63.9}{184}</math></td> <td><math>\frac{22.2}{16}</math></td> </tr> </table> <p>OR</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>0.348</td> <td>0.347</td> <td>1.39</td> </tr> </table>	Ca	W	O	$\frac{13.9}{40}$	$\frac{63.9}{184}$	$\frac{22.2}{16}$	0.348	0.347	1.39	Apply ECF 0/3 for use of any atomic numbers / division wrong way round / multiplication If division by 32 instead of 16 for O, then no M1, but M2 and M3 can score by ECF (CaWO <sub>2</sub> ) If any transcription error (eg 69.3 in place of 63.9), then no M1, but M2 and M3 can score by ECF	1
Ca	W	O												
$\frac{13.9}{40}$	$\frac{63.9}{184}$	$\frac{22.2}{16}$												
0.348	0.347	1.39												
		M2	<table style="margin-left: auto; margin-right: auto;"> <tr> <td><math>\frac{0.348}{0.347}</math></td> <td><math>\frac{0.347}{0.347}</math></td> <td><math>\frac{1.39}{0.347}</math></td> </tr> </table> <p>OR</p> <p>1 : 1 : 4</p>	$\frac{0.348}{0.347}$	$\frac{0.347}{0.347}$	$\frac{1.39}{0.347}$		1						
$\frac{0.348}{0.347}$	$\frac{0.347}{0.347}$	$\frac{1.39}{0.347}$												
		M3	CaWO <sub>4</sub>	Accept elements in any order Correct final answer scores 3	1									

Question number			Answer	Notes	Marks
6	c	i	$\frac{59.6 \times 184}{298}$	Award 1 for $n(\text{WF}_6) = 0.2$ mol and any sight of 0.2	1
	M1	M2	36.8 (g)	No ECF from incorrect expression except for transcription error - eg using 289 instead of 29 ECF from incorrect number of moles Award 2 for correct final answer	1
	ii	M1	$\frac{47.5 \times 100}{52.0}$		1
		M2	91.3 (%)	Accept any answer in range 91 - 91.4 Do not penalise excessive numbers of dp	1
				Award 2 for correct final answer	
<b>TOTAL</b>					<b>14</b>