

Question number	Answer	Notes	Marks
1 (a)	A (argon)		1
(b)	CO <sub>2</sub> / H <sub>2</sub> O do not allow as part of an equation	IGNORE names even if correct	1
(c) (i)	M1 (the copper) <u>reacts/combines</u> with oxygen / oxidised  M2 to form copper(II) oxide	IGNORE bonds with oxygen IGNORE burns / combusts REJECT refs to rust  ACCEPT copper oxide REJECT any other oxidation state	2
(ii)	the volume of a gas changes with temperature / gas expands when hot/heated	ACCEPT reverse argument IGNORE refs to density	1
(iii)	<u>all</u> the oxygen has reacted / the oxygen has been used up / no oxygen (left to react)	DO NOT ACCEPT refs to <b>'not enough oxygen'</b>	1
(d)	M1 (150 - 125) or 25 (cm <sup>3</sup> )  M2 (25/150) x 100 = 16.7 (%)  OR  M1 100 x (125/150) = 83.3 (cm <sup>3</sup> )  M2 100 - 83.3 = 16.7 (%)  M2 is cq on M1	ACCEPT 17 / 16.67 / <b>16.6</b>  ACCEPT 83 / 83.33 / <b>83.3</b>  REJECT 16.6 for M2  correct answer (with no working) scores 2	2

Question number	Answer	Accept	Reject	Marks
2 (a)	D			1
(b)	M1 before heating – colourless (solution/liquid) IGNORE clear/transparent/looks like water  M2 after heating – milky/chalky/cloudy/white (precipitate)/turbid  IGNORE references to goes clear OWTTE	no colour	white solution/liquid any colour other than white	1  1
(c)	M1 (sulfur dioxide/it) dissolves in/reacts with (rain) water  M2 to form an acidic solution/an acid/sulfurous acid /acid rain IGNORE references to any other products whether correct or not  M3 which reacts with/corrodes the marble/calcium carbonate  IGNORE erodes / weathers / melts / eats into	$\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$ OR $\text{SO}_2 + \text{H}_2\text{O} + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{SO}_4$ for both M1 and M2  sulfuric acid  <u>chemical</u> weathering dissolves correct equation for reaction with either sulfurous or sulfuric acid  $\text{SO}_2$ reacts with marble for M3 only		1  1  1
			Total	<b>6</b>

Question number	Answer	Notes	Marks
3 (a)	water	accept H <sub>2</sub> O accept water vapour  if both name and formula given mark name only	1
(b)	carbon dioxide	accept CO <sub>2</sub>  if both name and formula given mark name only	1
(c)	M1 (the copper / it) reacts with oxygen / oxidises  M2 to form copper(II) oxide (which is black)	accept 'combines with/joins with/burns in oxygen' ignore 'air'  accept 'copper oxide' reject 'copper(I) oxide'	2

Question number	Expected Answer	Accept	Reject	Marks
4 (a)(i)	nitrogen <u>and</u> oxygen  IGNORE formulae whether right or wrong			1
(ii)	argon  IGNORE formula whether right or wrong			1
(b)	Any one from: <ul style="list-style-type: none"> <li>• manufacture of ammonia/in the Haber process</li> <li>• food packaging/preservative</li> <li>• aircraft tyres</li> <li>• (in) light bulbs</li> <li>• coolant/refrigerant/freezing agent</li> <li>• treatment of warts</li> </ul>			1
(c)	Any one from: <ul style="list-style-type: none"> <li>• sulfur dioxide</li> <li>• nitrogen monoxide</li> <li>• nitrogen dioxide</li> <li>• dinitrogen tetr(a)oxide</li> <li>• oxide(s) of nitrogen</li> </ul> <p>If both a name and a formula are given, IGNORE the formula</p> <p>IGNORE carbon dioxide</p>	nitrogen oxide  a correct formula	any other gas	1

(d)	(i)	iron + oxygen (+ water) → (hydrated) iron (III) oxide M1 lhs M2 rhs	ferric oxide/iron oxide correct chemical equation M1 all formulae correct M2 balanced	any other oxidation state	2
	(ii)	M1 volume of oxygen = $80 - 63 / 17 \text{ (cm}^3\text{)}$  M2 percentage = $(\frac{63}{80} \times 100) / 21$  OR $\frac{63}{80} \times 100$ correctly evaluated  21 with no working scores 1  78.75/78.8/78.7 with no working scores 1  $\frac{63}{80} \times 100 = 79$ scores 1  79 with no working scores 0	21.25 / 21.3/21.2		1  1
(e)		(whether it/the height / the measurement is) the same as before I G N O R E references to iron had stopped rusting	no change		1
				Total	9

Question number	Answer	Notes	Marks
5 (a)	<p>M1    (Fe)        (Ti)        (O)            <u>36.8</u>        <u>31.6</u>        <u>31.6</u>            56            48            16</p> <p>M2    0.66        0.66        1.98</p> <p>M3    1            1            3</p> <p>OR</p> <p>M1    calculation of <math>M_r</math> of <math>\text{FeTiO}_3 = 152</math></p> <p>M2    expression for % of <u>each</u>  element e.g. Fe: <math>56 \div 152 \times 100\%</math></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  ACCEPT oxidation state/  number increases  ACCEPT oxidation state/  number changes from 0  to (+)4</p>	2
(c) (i)	<p><math>\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2</math></p> <p>M1 all formulae correct</p> <p>M2 balanced</p>	<p>ACCEPT multiples and halves  IGNORE state symbols  even if incorrect</p>	2  1
(ii)	<p>titanium / Ti / magnesium / Mg  reacts with oxygen  OR  titanium / Ti / magnesium / Mg  reacts with nitrogen</p>	<p>IGNORE refs to oxidation  ACCEPT forms an oxide</p> <p>ACCEPT forms a nitride</p>	
(iii)	<p><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</p>	<p>IGNORE to speed up the  reaction  IGNORE refs to increasing  surface area</p>	1

(d) (i)	M1 positive ions/cations/nuclei and delocalised electrons M2 attract (one another) M2 dep on M1	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
6 (a)	nitrogen / N <sub>2</sub>	accept N	1
(b)	oxygen AND water	accept steam	1
(c)	incomplete combustion (of the octane / fuel)	accept '(burns in a) limited supply / shortage of oxygen/air' reject 'no oxygen'	1
(d) (i)	$N_2 + 2O_2 \rightarrow 2NO_2$	accept halves and multiples accept as two correct equations via NO	1
(ii)	(It produces ) acid rain OR (it causes) breathing problems / asthma	accept 'photochemical smog' ignore refs to greenhouse gas / global warming / climate change ignore refs to pollution	1