



## Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(usually carbonates react with acids and ) produce a (colourless) gas / <math>\text{CO}_2</math> (which is an expected observation for the test) <b>(1)</b></li> <li>(but) the barium sulfate produced is insoluble (so the carbonate may appear to not react / not dissolve in acid) <b>(1)</b></li> </ul>	<p>Allow effervescence / fizzing / bubbles for observation            Allow little / no gas / <math>\text{CO}_2</math> formed when sulfuric acid is used            Ignore references to limewater / lighted splint to test for <math>\text{CO}_2</math></p> <p>Allow a (white) precipitate (of barium sulfate) forms            Allow they should have used hydrochloric / nitric acid as the salts formed are soluble</p> <p>Accept bubbles of gas would not be expected because barium sulfate is insoluble for 2 marks</p>	<b>(2)</b>



Q2.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• the <b>outer/ valence</b> electron is / the <b>outer electrons</b> are/ further from the nucleus <b>(1)</b></li> <li>• there is more shielding (from shells of inner electrons) <b>or</b> there is an increase in repulsion between the filled inner shells and the electron removed <b>(1)</b></li> <li>• so the (first) ionisation energy decreases (down the group) <b>and</b> so the reactivity increases <b>(1)</b></li> </ul>	<p>Allow the outer (s) electron is in a higher (quantum) shell / higher energy level Ignore the atomic / ionic radius increases Allow there is reduced attraction between the nucleus and the outer electrons</p> <p>Do not award any reference to charge or charge density for M2</p> <p>Allow the outer (s) electron(s) are removed more easily / it takes less energy to remove the (outer) electrons <b>and</b> so the reactivity increase</p>	<b>(3)</b>



Q3.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"><li>• (the Universal Indicator changes from green) to blue / purple (1)</li></ul> <p>or</p> <p>gas collects at the top of the test tube (1)</p>	<p>Allow to dark blue/ blue-green or green-blue Do not award from blue Do not award if the solution is described as 'acidic' or <math>[H^+]</math> increases Do not award any other starting colour</p> <p>Allow water level in the beaker rises</p> <p>Allow hydrogen / <math>H_2</math> for gas Do not award named incorrect gases (e.g. oxygen/air) Do not award magnesium oxide Do not award magnesium is a white powder Ignore magnesium disappears/dissolves</p>	(2)



Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>any mention of platinum / nichrome wire / loop (1)</li> <li>dip the wire into (clean / fresh concentrated) hydrochloric acid / HCl (1)</li> <li>dip the (wet) wire into the solid and place in a (non-luminous / roaring / blue Bunsen) flame (1)</li> </ul>	<p>Allow NiCr for nichrome Allow silica rod Ignore 'inoculating' / 'sterilising' Do not award just nickel or chromium</p> <p>Allow mention of HCl before or after dipping wire into solid e.g. cleaning or mixing solid and HCl to make a paste Ignore concentration of HCl Ignore just 'acid' / other acids specified Do not award HCl reacting with flame test wire</p> <p>Allow salt / compound / paste / sample / solution for solid Allow through the flame / on the edge of the flame for in the flame Do not award element / metal for solid Do not award over / above / under the flame Do not award just 'into a Bunsen' Do not award 'burn in flame' Do not award flame if Bunsen has air-hole closed / safety flame</p>	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>Na<sup>+</sup></li> </ul>	<p>Ignore state symbols Ignore sodium / sodium ion</p> <p>Do not award incorrect charge</p>	(1)

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>SO<sub>4</sub><sup>2-</sup></li> </ul>	<p>Ignore state symbols Ignore sulfate(VI) / sulfate/ sulphate</p> <p>Do not award sulfate(IV) / sulfite / hydrogensulfate Do not award incorrect charge</p>	(1)



Question Number	Answer	Additional Guidance	Mark
	Na <sub>2</sub> SO <sub>4</sub> .	Ignore state symbols Ignore names  Allow TE from other <b>ions</b> , with correct charges, given in (a)(ii) and (b)(i) Allow large numbers e.g. Na <sub>2</sub> SO <sub>4</sub> but not superscripts e.g. Na <sup>2</sup> SO <sup>4</sup>	(1)

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>• first error: 'emitted' <b>and</b> correction: replace with 'absorbed' (1)</li> <li>• second error: 'ions (move up)' <b>and</b> correction: remove 'ions' replace with 'electron(s)' (1)</li> <li>• third error: 'is always' <b>and</b> correction: remove 'always' replace with 'may be / sometimes' (1)</li> </ul>	Allow the three errors in any order  The mark is for replacement by 'electron(s)' Allow 'electron(s) <b>in</b> ions'  Allow expression that implies that the radiation can be emitted as visible light, e.g. 'usually' visible light  Do not award 'the error is lower energy levels' replace with return to ground state	(3)



Q6.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following points:</p> <p>(Magnesium carbonate is less thermally stable because) <b>Size</b></p> <ul style="list-style-type: none"> <li>the magnesium ion / <math>Mg^{2+}</math> is smaller / has a greater charge density (1)</li> </ul> <p><b>Polarising power</b></p> <ul style="list-style-type: none"> <li>so more likely to polarise / distort (the carbonate (ion) / anion) (1)</li> </ul> <p><b>Bonds</b></p> <ul style="list-style-type: none"> <li>and so weaken the C-O bond or the bond(s) within the carbonate ion (1)</li> </ul>	<p>Allow reverse arguments</p> <p>Ignore reference to 'covalent character'</p> <p>Ignore reference to lattice energies</p> <p>Allow ionic radius of cation increases down the group / charge density of cation decreases down the group</p> <p>Allow magnesium carbonate has a smaller <b>cation</b> Allow magnesium ions have fewer shells of electrons</p> <p>Ignore 'magnesium (atom) is smaller'</p> <p>Ignore atomic radius</p> <p>Do not award M1 if mention of different / incorrect charges on magnesium and barium ions</p> <p>Allow 'magnesium ion has more polarising power'</p> <p>Allow polarising power decreases down the group Allow magnesium ion has more electron pulling power on (the carbonate (ion) / anion) Do not award if <math>MgCO_3</math> stated as more stable</p> <p>Allow break (more easily) for weaken</p> <p>Allow C=O bonds for C-O</p> <p>Do not award reference to weakening unspecified bonds</p> <p>Do not award weakening bond between cation and anion</p>	(3)



Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>dot-and-cross diagram</li> </ul>	<p>Allow diagrams with all dots/all crosses etc            Allow lone pairs with electrons separated            Ignore covalent bonds (if shown)            'extra' electron may be shown as different shape, colour etc.            The double bond can be to any of the three oxygens</p>	(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>balanced equation</li> </ul>	<p><u>Example of equation</u></p> $2\text{LiNO}_3 \rightarrow \text{Li}_2\text{O} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$ <p>Allow multiples of equation            Ignore state symbols even if incorrect</p>	(1)



Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• calculation of moles of sodium nitrate (1)</li> <li>• calculation of moles of oxygen (1)</li> <li>• substitution in <math>pV = nRT</math> and rearrangement (1)</li> <li>• final answer to 2SF only and in <math>\text{cm}^3</math> (1)</li> </ul>	<p><u>Example of calculation</u> Ignore SF for M1, M2, M3 except 1SF, penalise once only</p> <p>Moles of sodium nitrate = <math>0.5 \div 85 = 5.8824 \times 10^{-3}</math> (mol)</p> <p>Moles of oxygen gas <math>\text{O}_2 = 5.8824 \times 10^{-3} \div 2 = 2.9412 \times 10^{-3}</math> (mol)</p> <p><math>pV = nRT</math> <math>V = \frac{nRT}{p} =</math> <math>\frac{2.9412 \times 10^{-3} \times 8.31 \times 298}{101000}</math></p> <p>(= <math>7.21136 \times 10^{-5} \text{ m}^3</math>) = <math>72 \text{ (cm}^3\text{)}</math> If M2 not divided by 2 then final answer = <math>140 \text{ cm}^3</math> – scores (3) marks. <math>144 \text{ cm}^3</math> – scores (2) marks. Correct final answer with no working scores (4)</p> <p>Allow TE throughout</p>	(4)

Question Number	Acceptable Answer	Additional Guidance	Mark
(iv)	<ul style="list-style-type: none"> <li>• incomplete reaction / decomposition</li> </ul>	<p>Ignore pressure not 101 kPa or temperature not 298 K Do not award reversible reaction / impure reactant or product / oxygen soluble in water / side reactions</p>	(1)



Q8.

Question Number	Acceptable Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>Group 2 ions have larger charge (than Group 1 ions) Or Group 2 ions have a 2+ charge and Group 1 ions have a 1+ charge</li> <li>Group 2 ions polarise bonds in the carbonate ion more (effectively)</li> <li>the C-O/C=O bond is weakened</li> </ul>	<p>(1) Allow the charge density of Group 2 ions is larger (than Group 1 ions) Allow reversed argument for Group 1 ions</p> <p>(1) Ignore reference to size Allow distort / polarise</p> <p>(1)</p>	(3)

Q9.

Question Number	Answer	Mark
(a)	C (potassium chloride)	(1)

Question Number	Answer	Mark
(b)	<p>Excited State</p> <p>B Ground State</p>	(1)

Question Number	Answer	Mark
(c)	B (magnesium sulfate)	(1)

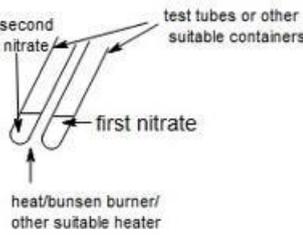


Question Number	Acceptable Answers	Additional Guidance	Mark
(d)	<ul style="list-style-type: none"> <li>(Observation) white <b>and</b> precipitate</li> </ul>	Do not allow 'off-white' Allow white solid Allow spelling of 'percipitate' Ignore identity of precipitate even if incorrect	<b>(2)</b>
	<ul style="list-style-type: none"> <li>hydrochloric acid <b>and</b> potassium chloride</li> </ul>	Both names are essential but can be in either order. Accept formulae HCl and KCl. Allow A and C.  Mark independently	

Question Number	Acceptable Answers	Additional Guidance	Mark
(e)	<ul style="list-style-type: none"> <li>fizzing/bubbles/effervescence</li> </ul>	Reject 'solid dissolves'/precipitate forms/ references to hydrogen gas  Ignore CO <sub>2</sub> / carbon dioxide/ gas given off	<b>(2)</b>
	$2\text{H}^+ + \text{CO}_3^{2-} \rightarrow \text{CO}_2 + \text{H}_2\text{O}$	Ignore state symbols even if correct	



Q10.

Question Number	Acceptable Answer	Additional Guidance	Mark
	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• Workable method + time / compare (1)</li> <li>• Same heat applied (1)</li> <li>• Same amount of each nitrate in separate test tubes (1)</li> <li>• safety precaution: fume cupboard/hood (1)</li> </ul>	<p><u>Examples of workable methods</u></p> <ul style="list-style-type: none"> <li>• First one to re-light a glowing splint / produce brown fumes. Accurate timing not essential.</li> <li>• Use of light sensor / meter to measure colour of gas</li> <li>• Use of gas syringe and measure rate of production of gas / time to produce specific volume</li> <li>• Bubble gas into indicator solution – time to change colour</li> <li>• Collection of gases over water and volume measured</li> </ul> <p>Reward any workable alternative. e.g. use the same Bunsen Award if implied by diagram</p> <p>Award 'equal masses'.</p> <p><u>Example diagram:</u></p>  <p>Ignore well ventilated room / face mask / goggles / gloves / lab coat This is the only acceptable safety precaution.</p>	(4)



Q11.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>any mention of platinum/nichrome wire (1)</li> <li>dip the wire into (clean/fresh concentrated) hydrochloric acid (1)</li> <li>dip the (wet) wire into the solid and place in a (non-luminous/roaring/blue Bunsen) flame (1)</li> </ul>	<p>Allow NiCr for nichrome Allow silica/magnesia for platinum or nichrome Allow loop / rod for wire Ignore inoculating / flame-test (wire)</p> <p>Allow any mention of HCl(aq) e.g. cleaning or mixing solid and acid or making a paste Allow HCl for HCl(aq)</p> <p>Ignore dilute</p> <p>Allow on / over / under / near / show / above for 'in'</p>	(3)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>mention of energy or heat or heating (from the flame) (1)</li> <li>electrons promoted to higher energy levels (1)</li> <li>electrons drop down / return (to lower energy levels / ground state) (1)</li> <li>light (in the visible region) is emitted / released / given out (1)</li> </ul>	<p>Do not award M1 for "burning"</p> <p>Allow just 'electrons excited' for M2</p> <p>Allow electromagnetic / e.m. radiation / photons instead of light</p>	(4)

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>no emission of light / energy in the visible region (of the spectrum)</li> </ul>	<p>Do not award any mention of (bright) white light emission</p> <p>Allow electromagnetic / e.m. radiation / photons / colour instead of light / energy Allow the light emitted is in the UV or IR</p> <p>Allow any references to frequency or wavelength being too high or too low</p>	(1)



Question Number	Acceptable Answer	Additional Guidance	Mark
(iv)	An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>(There are) other ions that do not produce a flame colour</li> </ul>	Allow a specific ion that does not have a flame colour e.g. 'beryllium' / $\text{Be}^{2+}$ Allow other "elements" do not produce a flame colour Do not award if any references to "burning"	(1)

## Q12.

Question Number	Acceptable Answers	Additional Guidance	Mark
(i)	A diagram of suitable apparatus such that: <ul style="list-style-type: none"> <li>a sample of the carbonate can be heated (1)</li> <li>delivery tube into limewater or gas collected in gas syringe (1)</li> </ul>	<p><u>Example diagram:</u></p> <p>Allow the collection of gas over water with measuring cylinder/burette Do not award M1 for heating a conical flask / crucible or for an open tube Do not award M1 for heating in a water bath Do not award M2 if the limewater is in a sealed apparatus</p>	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
(ii)	Any one from: <ul style="list-style-type: none"> <li>same Bunsen setting</li> <li>same distance between flame and test tube</li> </ul>	Ignore reference to 'same apparatus'  Allow same depth/volume of limewater / same amount of metal carbonate  Do not award same mass / volume (of metal carbonate)  Ignore Same amount of heat / same temperature	(1)



Question Number	Acceptable Answers	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to:</p> <ul style="list-style-type: none"> <li>the time taken for the limewater to go cloudy</li> </ul> <p><b>or</b></p> <ul style="list-style-type: none"> <li>the time for given volume to be produced (for use of syringe)</li> </ul>		(1)

Q13.

Question Number	Acceptable Answers	Additional Guidance	Mark
	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>magnesium ion is smaller (than the potassium ion) (1)</li> <li>magnesium ion has a higher charge (than the potassium cation)/ Mg ion is 2+ but K ion is 1+ (1)</li> <li>magnesium ion polarises nitrate (ion more) / distorts the (electron cloud of) nitrate (ion more) (1)</li> <li>so weakening the <b>N–O</b> bonds (more) / so weakening the <b>nitrate</b> bonds (more) (1)</li> </ul>	<p>Penalise the omission of Magnesium ion once only for M1 to M3</p> <p>Allow for M2: Magnesium ion has a higher charge density</p> <p>Allow description of polarisation Do not award references to molecule</p> <p>Do not award the weakening of bonds in magnesium nitrate</p>	(4)



Q14.

Question Number	Acceptable Answer	Additional Guidance	Mark
	$K_2CO_3$ / $KHCO_3$  $K^+$ with any anion <b>(1)</b>  $CO_3^{2-}$ / $HCO_3^-$ with any cation <b>(1)</b>	For 1 mark allow names  Award 1 mark for a correct formula containing $K^+$ , $HCO_3^-$ or $CO_3^{2-}$ , eg KCl, or $Na_2CO_3$  Award 1 mark for an incorrect formula containing both potassium and carbonate/hydrogencarbonate e.g. $KCO_3$  Do not award any marks for $KCO_2$  Ignore equations even if incorrect, but award marks for the compound as a reactant.	<b>(2)</b>

Q15.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>any mention of platinum / nichrome wire / loop <b>(1)</b></li> <li>dip the wire into (clean / fresh concentrated) hydrochloric acid <b>(1)</b></li> <li>dip the (wet) wire into the solid / sample <b>and</b> place in a (non-luminous / roaring Bunsen) flame <b>(1)</b></li> </ul>	Allow NiCr for nichrome Ignore inoculating / flame-test (wire) / spatula Do not award just nickel / chromium / Ni / Cr wire  Allow any mention of HCl(aq) e.g. cleaning or mixing solid and acid or making a paste / solution Allow HCl for HCl(aq) Ignore dilute  Allow on / over / under / near / show / above for 'in' flame	<b>(3)</b>



Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>electrons move up energy levels / are excited / promoted (1)</li> <li>electrons return to a lower energy level/ground state (1)</li> <li>energy emitted/lost / released from the atom as visible light / flame colour (1)</li> <li>different energy gaps / energy lost / emitted / released (in different elements) so different colours emitted. (1)</li> </ul>	<p>Penalise use of 'atom' in place of 'electron' once only</p> <p>Allow orbitals/subshells but not just shells</p> <p>Allow radiation for light</p> <p>Allow different amounts of energy are needed to excite the electrons, scores M1 and M4.</p>	(4)

## Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to:</p> <ul style="list-style-type: none"> <li>(potassium ions) lilac and (strontium ions) crimson / red</li> </ul>	<p>Allow scarlet Ignore 'shades' except Do not award 'brick red' / 'orange-red'</p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to:</p> <ul style="list-style-type: none"> <li>the crimson/red colour will mask/hide/obscure the (lighter) lilac colour</li> </ul>	<p>Allow 'one colour will hide the other' Allow only one colour seen Allow difficult to distinguish the two colours</p> <p>Allow TE from colours in (i)</p> <p>Do not award colour from chloride ions</p> <p>Do not award idea of new colour resulting from both</p> <p>Ignore reference to impurities</p>	(1)



Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to: <ul style="list-style-type: none"> <li>• nichrome produces no colour (when heated in the flame test) or iron can produce a colour/sparks (1)</li> <li>• nichrome is inert/ stable to heat/unreactive or iron reacts with oxygen/air and or hydrochloric acid (1)</li> </ul>	Allow does not change the flame colour  Ignore references to melting/cost Ignore reference to nichrome not being a transition element	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to: <ul style="list-style-type: none"> <li>• (the wire is heated) to remove the residue of any previous sample being tested</li> </ul>	Allow 'to clean the wire'  Ignore 'to sterilise/sanitise/disinfect the wire'	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to: <ul style="list-style-type: none"> <li>• the acid can become contaminated with residue from previous tests (which can give incorrect results)</li> </ul>		(1)

Question Number	Answer	Additional Guidance	Mark
(iv)	An answer that makes reference to: <ul style="list-style-type: none"> <li>• (concentrated hydrochloric acid) forms volatile chlorides</li> </ul>	Allow (the wire is moistened) to enable some of the solid metal salt to become attached/stick to the wire (and then tested in the Bunsen flame)  Do not award reference to bonding or reacting or adsorb or absorb with the wire	(1)



Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	Any two observations from <ul style="list-style-type: none"> <li>• solid dissolves / melts (1)</li> <li>• condensation on sides of test tube (1)</li> <li>• brown gas/ brown fumes/ brown NO<sub>2</sub>(g) produced (1)</li> <li>• white solid / powder forms (1)</li> </ul>	Do not award magnesium dissolved / just 'solid disappears'  Allow 'steam given off'  Ignore NO <sub>2</sub> / O <sub>2</sub> / gas given off/ bubbles/ effervescence / gas relights a glowing splint Allow red-brown  Ignore 'precipitate' Ignore 'magnesium oxide forms' Do not award 'Mg <sup>2+</sup> forms'	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>• Nitrates increase in stability down Group 2 as ionic radius increases (as you go down group) (1)</li> <li>• so polarising ability of metal (ion) decreases / distorts (the electron cloud of) the anion less (1)</li> <li>• weakening of N-O bonds (in nitrate ion) is less (1)</li> </ul>	Allow charge density decreases as you go down Group 2 Do not award <b>just</b> 'atomic radius increases' There has to be a mention of ions somewhere in M1 or M2  Allow reverse argument	(3)



Q19.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>use of a nichrome / platinum wire / ceramic / silica rod <b>(1)</b></li> <li>use of (conc.) HCl/HCl(aq)/dilute HCl <b>(1)</b></li> </ul> <p>AND</p> <p>dip into the sample and place in / over a (blue) Bunsen burner flame <b>(1)</b></p>	<p>Allow splint, spray method for both marks</p> <p>Reject just 'nichrome', nickel/chromium, inoculation loop, spatula, capillary tubing</p> <p>Reject other acids, just 'acid'</p> <p>Assume blue/roaring flame if not stated but reject use of yellow/safety flame</p>	<b>(2)</b>

Question Number	Answer	Mark
(ii)	<p>The only correct answer is <b>A</b></p> <p><i>B is not correct because this would give a red flame (brick red)</i></p> <p><i>C is not correct because this would give a red flame (carmine red)</i></p> <p><i>D is not correct because this would give a red flame (crimson red)</i></p>	<b>(1)</b>

Question Number	Answer	Mark
(iii)	<p>The only correct answer is <b>C</b></p> <p><i>A is not correct because bromine is a brown gas, but bromide does not decompose to give it.</i></p> <p><i>B is not correct because nitrate(III) not nitrate(V) and does not give NO<sub>2</sub> by decomposing</i></p> <p><i>D is not correct because O<sup>2-</sup> does not decompose in this way</i></p>	<b>(1)</b>



Q20.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An answer that makes reference to the following points:	Mark independently	<b>(2)</b>
	<ul style="list-style-type: none"> <li>ammonium <b>(1)</b></li> </ul>	Allow names in either order Ignore symbols as well as names Do not award ammonia	
	<ul style="list-style-type: none"> <li>bromide <b>(1)</b></li> </ul>	Do not award bromine Allow (1) for just NH <sub>4</sub> Br	

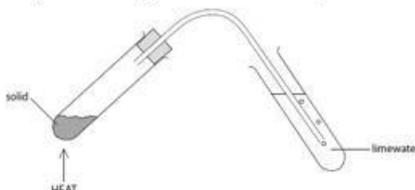
Q21.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following point:		<b>(1)</b>
	<ul style="list-style-type: none"> <li>(Identity of gas is) oxygen/O<sub>2</sub> and (test result is that the splint) relights</li> </ul>	Do not award just 'O' Allow 'rekindle'/'reignites'	

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following point:		<b>(1)</b>
	<ul style="list-style-type: none"> <li>(Identity of gas is) nitrogen dioxide and (appearance is) brown (gas/fumes)</li> </ul>	If name and formula given then both must be correct Allow NO <sub>2</sub> Do not award NO or N <sub>2</sub> O <sub>4</sub> Do not award if liquid referred to Do not award if two gases are given unless one of the gases stated is colourless oxygen Ignore shades of colour	



Question Number	Answer	Additional Guidance	Mark
(iii)	<ul style="list-style-type: none"> <li>equation</li> </ul>	<p>Example of equation</p> $2\text{NaNO}_3 \rightarrow 2\text{NaNO}_2 + \text{O}_2$ <p>Accept multiples</p> <p>Ignore state symbols even if incorrect</p>	(1)

Question Number	Answer	Additional Guidance	Mark
(iv)	<p>A description that makes reference to following points:</p> <ul style="list-style-type: none"> <li>use of a delivery tube to bubble gas into limewater (1)</li> <li>compare the time taken for the limewater to go cloudy (1)</li> </ul>	<p>Allow annotated diagrams to illustrate the marking points</p> <p>Example of a diagram that could be given credit</p>  <p>Do not award if the apparatus setting would not be feasible such as</p> <ul style="list-style-type: none"> <li>missing cork/bung or gaps around delivery tube</li> <li>horizontal tube with limewater in</li> <li>bung in the test tube with limewater</li> </ul> <p>Allow TE from an incorrect/unsuitable method Allow Any length of time, e.g. 10 minutes</p>	(2)

## Q22.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>correct formulae and state symbols of each species</li> </ul>	$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$	(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>ionic and covalent (bonding)</li> </ul>	<p>Ignore reference to single/double/dative</p>	(1)



Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	<ul style="list-style-type: none"> <li>strong bonds within the carbonate ion / <math>\text{CO}_3^{2-}</math> / C-O bond / C=O bond</li> </ul>	Ignore bonds between the ions / ( $\text{Ca}^{2+}$ and $\text{CO}_3^{2-}$ ) are strong	(1)

## Q23.

Question Number	Answer	Additional Guidance	Mark																
*	<p>This question assesses the student's ability to show a coherent and logically structured answer with linkages and fully sustained reasoning.</p> <p>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.</p> <p>The following table shows how the marks should be awarded for indicative content.</p> <table border="1"> <thead> <tr> <th>Number of indicative marking points seen in answer</th> <th>Number of marks awarded for indicative marking points</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>4</td> </tr> <tr> <td>5-4</td> <td>3</td> </tr> <tr> <td>3-2</td> <td>2</td> </tr> <tr> <td>1</td> <td>1</td> </tr> <tr> <td>0</td> <td>0</td> </tr> </tbody> </table> <p>The following table shows how the marks should be awarded for structure and lines of reasoning</p> <table border="1"> <thead> <tr> <th></th> <th>Number of marks awarded for structure of answer and sustained lines of reasoning</th> </tr> </thead> <tbody> <tr> <td>Answer shows a coherent logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td> <td>2</td> </tr> </tbody> </table>	Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points	6	4	5-4	3	3-2	2	1	1	0	0		Number of marks awarded for structure of answer and sustained lines of reasoning	Answer shows a coherent logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2	<p>Guidance on how the mark scheme should be applied: The mark for indicative content should be added to the mark for lines of reasoning. For example, a response with four indicative marking points that is partially structured with some linkages and lines of reasoning scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning). If there were no linkages between the points, then the same indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and zero marks for linkages).</p> <p>If there is any incorrect chemistry, deduct mark(s) from the reasoning. If no reasoning mark(s) awarded do not deduct mark(s).</p> <p>More than one indicative marking point may be made within the same comment or explanation</p>	(6)
Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points																		
6	4																		
5-4	3																		
3-2	2																		
1	1																		
0	0																		
	Number of marks awarded for structure of answer and sustained lines of reasoning																		
Answer shows a coherent logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2																		
	<p>Answer is partially structured with some linkages and lines of reasoning</p>	1	Deduct a reasoning mark if no comparison made																
	<p>Answer has no linkages between points and is unstructured</p>	0	Penalise the use of 'atom' instead of ion once only against any indicative point																



	<p><b>Indicative content</b> Similarities</p> <ul style="list-style-type: none"> <li>• <b>(IP1)</b> the differences in energy levels determines the colour of the flame test and complex ion</li> </ul> <p>Differences Flame test</p> <ul style="list-style-type: none"> <li>• <b>(IP2)</b> heat (energy) results in electron promotion</li> <li>• <b>(IP3)</b> return of an (excited) electron to a lower (energy) state</li> </ul> <p>Complex ion</p> <ul style="list-style-type: none"> <li>• <b>(IP4)</b> d orbitals are split (in energy by the ligands)</li> <li>• <b>(IP5)</b> light (energy) is needed for electron promotion</li> <li>• <b>(IP6)</b> the colour not absorbed is the colour seen</li> </ul>	<p>Ignore incorrect colours</p> <p>This can be mentioned separately or as a comparison</p> <p>Allow electrons excited by <b>heat</b></p> <p>Allow electron is 'de-excited' to a lower (energy) state Do not award if d-d transitions stated</p> <p>Allow d subshell splitting Do not award singular "d orbital" splitting</p> <p>Accept "The colour seen is complimentary to that absorbed" Allow 'colour reflected is the colour seen' Do not award if colour attributed to 'fall' of electron to lower energy d orbital Do not award 'emission of light'</p>	
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