Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	Add hydrochloric acid / HCl(aq) / nitric acid / HNO_3(aq) ALLOW Just 'acid' only if a suitable acid is given in equation one Sulfuric acid / H_2SO_4((aq)) or HCl (1) IGNORE 'conc' Gas / carbon dioxide / CO_2 evolved turns lime water milky / cloudy / produces a white precipitate (1) MP2 is a stand alone mark but there must be some indication that a gas is being tested	Just 'acid' OR heating the carbonate	2

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)i)	**ALL** H_2CO_3(aq) for H_2O(l) + CO_2(g) $BaCO_3$(s) + 2HCl(aq) → $BaCl_2$(aq) + H_2O(l) + CO_2(g) OR $BaCO_3$(s) + 2HNO_3(aq) → $Ba(NO_3)_2$(aq) + H_2O(l) + CO_2(g) OR CO_3^{2-}(s) + 2H^+(aq) → H_2O(l) + CO_2(g) **ALLOW** $BaCO_3$(s) + H_2SO_4(aq) → $BaSO_4$(s/aq) + H_2O(l) + CO_2(g) OR $BaCO_3$(s) → BaO(s) + CO_2(g) (1) $Ca(OH)_2$(aq) + CO_2(g) → $CaCO_3$(s) + H_2O(l) (1) **All** state symbols in **both** equations correct (1) **ALLOW** State symbols mark if first equation not balanced but ALL species are correct. No TE on other equations		3

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	**MP1 and MP2** Dip (clean) nichrome / platinum wire ALLOW loop / rod for wire OR Silica rod (1) in hydrochloric acid / HCl(aq) ALLOW any mention of HCl(aq) e.g. cleaning or mixing solid and acid HCl for HCl(aq) (1) ALLOW (for MP1 and MP2) (Wooden) splint (1) Soaked in distilled / deionised water (1) **MP3** then dipped in solid **and** placed in (hot / roaring / blue-cone) (Bunsen) **flame** ALLOW On / over / under / above for 'in' (1) IGNORE inoculating / flame-test (wire)	Nickel / chrome / chromium spatula Other acids just 'water'	3

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	A = Mg^{2+} (1) B = Ca^{2+} (1) Penalise omission of $^{2+}$ only once Correct ions with correct charge but the wrong way round scores 1 mark Correct ions with incorrect / no charge scores 1 IGNORE Names / compounds		2

Question Number	Acceptable Answers	Reject	Mark
1(b)*(iii)	Read the whole answer before awarding marks. If no mention of electrons only MP3 may be awarded. Electrons promoted to higher energy level (by thermal energy / heat from (Bunsen) flame) (1) (Promoted) electrons fall / drop / relax to lower energy level / orbital / shell / subshell OR Electrons return to ground state (1) Emitting radiation / light / photons (in the visible region) (1) IGNORE Colour	 Just 'electrons promoted/ excited' Just 'energy lost' Just 'energy given out	3

Question Number	Acceptable Answers	Reject	Mark
1(b)(iv)	Emitted radiation is not in the visible region (of the spectrum) ALLOW Emitted radiation is in IR / UV		1

Question Number	Acceptable Answers	Reject	Mark
1(c)	As group is descended... **First mark (metal ion size)** (Metal) ion radius increases / has more (electron) shells (but charge remains the same) OR Charge density of metal ion decreases ALLOW (Metal) atomic radius increases / has more (electron) shells (1) **Second mark (polarizing species)** Polarizing (ALLOW distorting) power of **cation / metal ion** decreases (1) **Third mark (polarized species)** Polarization / distortion of (electron cloud of) carbonate ion /anion decreases ALLOW C—O / C═O for carbonate ion (1) (so carbonate more stable to heat) ALLOW reverse argument for ascent of the group.	Just "metal" Just 'ion' Just 'ion or bond'	3

Total for Question = 17 marks

Question Number	Acceptable Answers	Reject	Mark
2 (a)	The outer electrons are closer to the nucleus/smaller atomic radius/ less electron shells (in calcium) **(1)** Less shielding (in calcium) **(1)** OR Reverse argument for strontium Ignore reference to repulsion between shells	Ionic radius/ Molecules Just 'less electrons'	2

Question Number	Acceptable Answers	Reject	Mark
2 (b)(i)	Nichrome wire / platinum wire / silica rods **(1)** (Dip / clean) in (concentrated) HCl/HCl(aq)/dilute HCl and place in Bunsen flame **(1)** OR Allow alternative procedures such as: Make a salt solution **(1)** Soak in wooden splint and place in Bunsen flame **(1)**	Nickel/Ni/ Chromium/Cr/ Metal loop/wire Yellow flame/burn	2

Question Number	Acceptable Answers	Reject	Mark
2 (b)(ii)	(Pale/Light) green / apple green	Blue-green	1

Question Number	Acceptable Answers	Reject	Mark
2 (b)(iii)	Electrons promoted to higher energy level **(1)** Electron(s) return to lower energy level **(1)** Release of (visible/ light) energy/ photon upon return **(1)**	 Proton	3

Question Number	Acceptable Answers	Reject	Mark
2 (c)(i)	Barium hydroxide / $Ba(OH)_2$ Allow product as part of the equation: $Ba + 2H_2O \rightarrow Ba(OH)_2 + H_2$		1

Question Number	Acceptable Answers	Reject	Mark
2 (c)(ii)	Bubbles / Fizzing / Effervescence IGNORE The Barium dissolves / forms a colourless solution Increase in temperature	The metal sinks Air bubbles Just 'a gas is produced'	1

Question Number	Acceptable Answers	Reject	Mark
2 (d)(i)	Barium is oxidized from 0 to +2 **(1)** Chlorine is reduced from 0 to -1 **(1)** Allow one mark if oxidized and reduced are the wrong way round Ignore reference to transfer of electron unless incorrect.		2

Question Number	Acceptable Answers	Reject	Mark
2 (d)(ii)	$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ One mark for chemical symbols **(1)** One mark for state symbols **(1)** Allow one mark maximum for: $BaCl_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$ OR Ions not cancelled	 $BaSO_4(aq)$	2

Question Number	Acceptable Answers	Reject	Mark
2 (d)(iii)	To prevent formation of carbonate / sulfite / sulfate(IV) (precipitate) / to remove carbonate / sulfite / sulfate(IV) ions	Just 'to remove other ions'	1

Question Number	Acceptable Answers	Reject	Mark
2 (e)(i)	$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$ Ignore state symbols even if incorrect ALLOW $MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2CO_3$		1

Question Number	Acceptable Answers	Reject	Mark
2 (e)(ii)	**Marking Point 1** (Factor) Use larger lumps **(1)** **Marking Point 2** (Explanation) Decreases surface area OR Fewer **collisions** between the reactants **(1)** Alternatively **Marking Point 1** (Factor) Decreases surface area **(1)** **Marking Point 2** (Explanation) Fewer **collisions** between the reactants **(1)** **Marking Point 3** (Factor) Decrease concentration (of acid) **(1)** **Marking Point 4** (Explanation) Fewer **collisions** between the reactants OR Fewer particles for the same volume **(1)** Explanation marking point only awarded for correct factor or a near miss.	Just 'increased size of $MgCO_3$' Just 'change in volume of acid'	4

Question Number	Acceptable Answers	Reject	Mark
2 (f)	Pressure only affects gaseous reactions/ There is no significant volume change/the liquids are incompressible		1

Question Number	Acceptable Answers	Reject	Mark
3(a)(i)	A hydrocarbon (solvent) / volasil / named hydrocarbon solvent / tetrachloromethane Formulae	Ethanol Alkenes	**1**

Question Number	Acceptable Answers	Reject	Mark
3(a)(ii)	Red / brown /orange / amber / yellow Or any combination No TE on incorrect / no reagent		**1**

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	Oxidation number of S in H_2SO_4 =(+)6 Oxidation number of S in SO_2 =(+)4 (1) Oxidation number had decreased (1) ALLOW S has gained electrons for second mark Second mark stands alone provided oxidation numbers have decreased, even if calculated wrongly	Just 'S has gained electrons' without calculating oxidation numbers	**2**

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	Black / (shiny) grey solid (1) Purple / violet / pink vapour / fumes (1) Smell of (bad) eggs (1) Yellow solid (1) **ALLOW** Brown liquid (1) Any two	Purple solid	**2**

Question Number	Acceptable Answers	Reject	Mark
3(b)(iii)	Oxidation number of S has reduced more / to –2 (in H_2S) (1) OR Oxidation number of S is lower in H_2S (than in SO_2) If ON of S in H_2S is calculated it must be correct		**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)	People can choose whether to take extra fluoride ALLOW Fluoride is not released into the environment	Fluoride can be monitored	**1**