Question 19 (Answer: **D**)

- Down Group 2 the hydroxides get *more* soluble and the carbonates *more* thermally stable, so B and C are reversed.
- The atoms get bigger, so ionisation energies fall – A is wrong too.
- Reactivity with water increases down the group, so radium reacts fastest.

Question 20 (Answer: **B**)

- Per mole a nitrate gives $2NO_2 + \frac{1}{2}O_2 = 2.5$ mol of gas; a carbonate gives only 1 mol of CO_2.
- Equal *masses* means dividing by M_r: $Ca(NO_3)_2$ gives $2.5/164 = 0.0152$ mol g^{-1}.
- That beats $CaCO_3$ (0.0100) and both barium salts, which are heavier.

Question 19 (Answer: **C**)

- Group 2 nitrates decompose to the oxide, nitrogen dioxide and oxygen.
- Balanced: $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$.
- Check the oxygens: 12 on the left and $2 + 8 + 2 = 12$ on the right.

Question 20 (Answer: **B**)

- A white precipitate with Sr^{2+} suggests a carbonate or a sulfate, since $SrCl_2$ is soluble.
- A carbonate would fizz with dilute nitric acid, giving carbon dioxide.
- Nothing happens with the acid, so the anion must be the sulfate.

Question 19 (Answer: **A**)

- $M_r(Mg(NO_3)_2) = 24.3 + 2(62.0) = 148.3$, so $n = 29.7/148.3 = 0.200$ mol.
- The equation gives one O_2 for every two nitrates: 0.100 mol.
- Mass $= 0.100 \times 32.0 = 3.2$ g.

Question 20 (Answer: **B**)

- Thermal stability increases down the group: the larger cation polarises the nitrate ion less.
- Each mole always releases the same 2.5 mol of gas, but the molar mass rises down the group.
- So a fixed 1.0 g contains fewer moles and yields *less* gas.

1(a)(i)	$Sr(HCO_3)_2 \rightarrow SrCO_3 + CO_2 + H_2O$
1(a)(ii)	**M1**: radius of cation / M^{2+} increases **OR** charge density of cation / M^{2+} decreases **M2**: less polarisation / less distortion of the anion / carbonate ion
1(b)	**M1**: least soluble $CaF_2 < SrF_2 < BaF_2$ most soluble **M2**: ΔH_{latt} and ΔH_{hyd} both become less exothermic / less negative **M3**: ΔH_{hyd} changes less / becomes less exothermic by a smaller extent **OR** ΔH_{latt} changes more / becomes less exothermic by a larger extent **M4**: ΔH_{sol} becomes more exothermic / more negative
1(c)(i)	enthalpy change when one mole of gaseous ions dissolve in water to form a solution
1(c)(ii)	**M1**: ionic radii **AND** ionic charge **M2**: (ionic) radii increase / charge density decreases **AND** ΔH_{hyd} decreases/less exothermic **AND** less attraction between water molecules and (gaseous) ions **OR** as ionic charge increases / charge density increases **AND** ΔH_{hyd} increases/more exothermic **AND** more attraction between water molecules and (gaseous) ions
1(d)	**M1**: use of –2957 / –1926 / –505 **AND** $2 \times (-505)$ **M2**: correct signs and evaluation ΔH_{sol} of $MgF_2(s) = -1926 + (2 \times -505) - (-2957) = (+)21$ kJ mol^{-1}
1(e)(i)	**M1:** $K_{sp} = [Hg_2^{2+}] [F^-]^2$ **M2:** units = mol^3 dm^{-9}
1(e)(ii)	$K_{sp} = 2^2 \times (9.20 \times 10^{-3})^3$ = **3.11×10^{-6}** min 2sf

1(a)	$Mg(NO_3)_2 \rightarrow MgO + 2NO_2 + ½O_2$ **OR** $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
1(b)	**M1:** $Mg(NO_3)_2$ / magnesium nitrate **AND** magnesium ion / Mg^{2+} **AND** is smaller / has higher charge density **M2:** nitrate ion / anion is more distorted / polarised
1(c)(i)	magnesium sulfate and water / $MgSO_4$ and H_2O
1(c)(ii)	**M1:** magnesium sulfate / **A** has a more exothermic ΔH_{latt} and ΔH_{hyd} **M2:** difference in ΔH_{hyd} is greater **M3:** magnesium sulfate / **A** has a more exothermic ΔH_{sol}