1. State which of the group 2 nitrates (Ca, Mg, Ra) requires highest temperature to decompose. Explain your answer.
   - Radium
   - Thermal stability increases down the group/ it has highest thermal stability

2. Predict what is observed when aq. RaCl2 is added to aq. Na2So4. Do not refer to temperature changes in your answer
   - White ppt

3. Cold water reacts slowly with a piece of Mg to produce bubbles of H2(g).
   Cold water reacts rapidly with burning Mg to produce H2(g) in an explosive mixture.
   Explain why rate of reaction of cold water with burning Mg is greater.
   - heat/ energy released from burning Mg provides more particles w energy > Ea.
   - Frequency of successful/effective collisions is greater

4. Identify which element, Ra or Ca, reacts with H2O at a faster rate. Suggest how the observations of each reaction would differ.
   Ra
   - With Ra, more bubbles per unit time
   - With Ra, solid would disappear more quickly
   - Ra is the first to stop fizzing

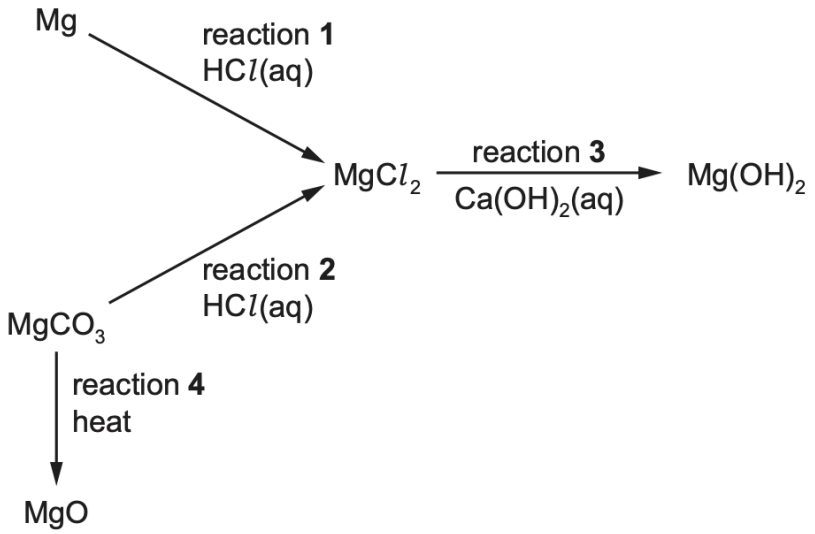
5. Suggest why reactions of Ra and Ca with H2O occur at different rates.
   Option 1:
   - difference in activation energy / ionisation energy
   - affects the frequency of effective collisions (between particles / molecules) OR affects the proportion of particles with energy greater than activation energy.

   Option 2:
   - ionisation energies are different
   - a decrease in nuclear attraction due to increase in shielding OR increase in distance of outer electron from nucleus OR increase in number of shells of electrons

6. Suggest pH values of the solutions made in both reactions (Ca + H2O AND Ra + H2O)
   - pH value (or values) for each solution must be greater > 7 AND pH value (or range values) identified for solution made from Ra must be greater than pH values (or range of values) stated for Ca.
   - solubility of group 2 hydroxides increases down the group // Ra(OH)2 is more soluble // greater concentration of $OH^-(aq)$ in the solution involving Ra

7.

Fig. 2.1 shows some reactions of magnesium and its compounds.



Reaction 3 is used to form a precipitate of Mg(OH)2 from MgCl2(aq). State why Ca(OH)2(aq) would not form a precipitate of Ba(OH)2 from BaCl2(aq).

- Ba(OH)2 is soluble (in aqueous solution) / solubility of Group 2 hydroxides increases down group

8. A student titrates nitric acid with a base to form a solution containing aqueous magnesium nitrate. Identify a base that the student could use.
   - magnesium hydroxide / Mg(OH)2
     CAREFUL: <u>base</u> = oxide / hydroxide

9. Construct an equation for the reaction of CO2 with Mg(OH)2.

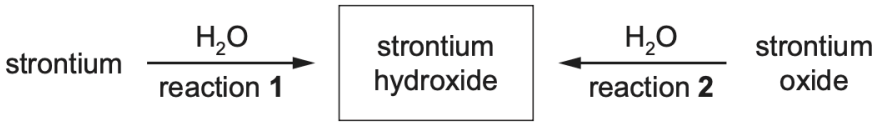
$$CO_2 + Mg(OH)_2 \rightarrow MgCO_3 + H_2O$$

10. Write an ionic equation for the reaction of magnesium hydroxide, Mg(OH)2, with hydrochloric acid.

$$OH^- + H^+ \rightarrow H_2O$$

11.

Two methods of preparing strontium hydroxide are shown.



State **one** difference between the observations you would make for reaction **1** and reaction **2**.

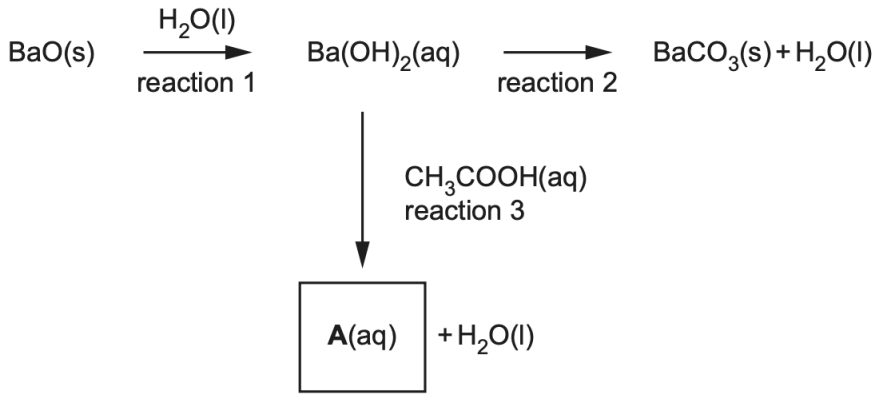
- reaction 1 will effervesce / fizz / bubble // no fizzes / bubbles / effervescence in reaction 2

12. Magnesium nitride reacts with an excess of water to produce ammonia and magnesium hydroxide only. Explain why the solution produced in this reaction has a pH greater than 7. Refer to the products of the reaction in your answer.
    - due to OH–
    - acid-base reaction of water by ammonia OR dissociation of some Mg(OH)2

13.

Barium hydroxide, $Ba(OH)_2$, is a strong base used in inorganic and organic reactions.

Fig. 2.1 shows a reaction scheme involving $Ba(OH)_2$.



State what is observed in reaction 1

- White solid disappears

Suggest a reactant for reaction 2.

- Carbon dioxide
  NOTE: the reaction given is balanced. If H2CO3 was added, you would get 2H2O. Look for the atoms needed to balance the reaction.

14. Construct an equation for the complete thermal decomposition of BaCa(CO3)2.

$$BaCa(CO_3)_2 \rightarrow BaO + CaO + 2CO_2$$

15. Separate 1.0g samples of three different magnesium salts are tested in order to identify the anion present in each sample. Explain how the action of heat is used to identify which sample is:
    - $MgCO_3$
    - $Mg(NO_3)_2$
    - MgO
- Nitrate and carbonate lose mass/ less than 1g
- MgO no reaction/ no change
- Nitrate produces brown fumes (NO_2)

16. A sample of $MgCO_3(s)$ is distinguished from a sample of $Mg(OH)_2(s)$ by adding a small amount of each solid to $HCl(aq)$. State one similarity and one difference in these two reactions.
- Similarity: solid disappears
- Difference: $MgCO_3$ fizzes due to CO_2 OR no fizzing with $Mg(OH)_2$

17.