

Sulfate and carbonate solubility of Groups 1 and 2 – teacher notes

In this experiment students look to see whether precipitates form when they add drops of solutions of sulfates or carbonates to drops of solutions of Group 1 or 2 metal ions.

Students must wear eye protection.

Topic

Periodic Table – Groups 1 and 2

Timing

20 minutes

Equipment

Apparatus

- Eye protection
- Student worksheet
- Clear plastic sheet (eg ohp sheet)

Chemicals

Solutions should be contained in plastic pipettes. See the accompanying guidance on apparatus and techniques for microscale chemistry (<https://rsc.li/3tqe2gh>), which includes instructions for preparing a variety of solutions.

- Magnesium nitrate, 0.5 mol dm^{-3}
- Calcium nitrate, 0.5 mol dm^{-3}
- Strontium nitrate, 0.5 mol dm^{-3}
- Barium nitrate, 0.2 mol dm^{-3}
- Lithium bromide, 1 mol dm^{-3}
- Sodium chloride, 0.5 mol dm^{-3}
- Potassium bromide, 0.2 mol dm^{-3}
- Sodium carbonate, 0.5 mol dm^{-3}
- Sodium sulfate, 0.5 mol dm^{-3}

Observations

There should be no precipitates in Group 1, indicating that all Group 1 carbonates and sulfates are soluble.

For Group 2, magnesium sulfate is soluble while strontium and barium sulfates are insoluble. Calcium sulfate is particularly interesting because although it is only sparingly

soluble its solubility is much higher than is expected from the solubility product. This is due to ion pairing of the calcium and sulfate ions in aqueous solution. No precipitate will be seen.

The concepts of solubility product and ion pairing may be too complex for most pre-16 students.

Tips

Students might think that the Group 1 part of this experiment is rather dull. However, they can be told that chemistry experiments that seem to produce no visual results may nevertheless still produce useful information!

Students should also observe that all the precipitates are white not coloured. The accompanying solubility data will be useful.

Solubility data

The table below shows solubility in grams per 100 cm³ of water at 20 °C (except where indicated with a superscript).

	Carbonate	Hydroxide	Sulfate	Fluoride
Magnesium	0.0106	0.0009	73.8	0.0076 ²⁸
Calcium	0.0014	0.185	0.209	0.0016 ¹⁸
Strontium	0.0011	0.41	0.0113	0.012 ²⁷
Barium	0.002	5.6	0.00022	0.12 ²⁵

Source: *CRC handbook of chemistry and physics*, 74th edn., 1993–4.

Health, safety and technical notes

- [Read our standard health and safety guidance.](#) It is the responsibility of the teacher to carry out a risk assessment.
- Wear eye protection throughout.
- The following chemicals are skin/eye IRRITANTS:
 - Magnesium nitrate, Mg(NO₃)₂·6H₂O(aq), 0.5 mol dm⁻³ – see CLEAPSS Hazcard HC059b.
 - Calcium nitrate, Ca(NO₃)₂·4H₂O(aq), 0.5 mol dm⁻³ – see CLEAPSS Hazcard HC019B and CLEAPSS Recipe Book RB019.
 - Strontium nitrate, Sr(NO₃)₂·4H₂O(aq), 0.5 mol dm⁻³ – see CLEAPSS Hazcard HC019B and CLEAPSS Recipe Book RB095.
 - Barium nitrate, Ba(NO₃)₂, 0.2 mol dm⁻³ – see CLEAPSS Hazcard HC011 and CLEAPSS Recipe Book RB010.
 - Sodium carbonate, Na₂CO₃·10H₂O, 0.5 mol dm⁻³ – see CLEAPSS Hazcard HC095A and CLEAPSS Recipe Book RB080.

- The following chemicals are low hazard:
 - Sodium sulfate, $\text{Na}_2\text{SO}_4(\text{aq})$, 0.5 mol dm^{-3} – see CLEAPSS Hazcard HC098B.
 - Sodium chloride, $\text{NaCl}(\text{aq})$, 0.5 mol dm^{-3} – see CLEAPSS Hazcard HC047b.
 - Lithium bromide, $\text{LiBr}(\text{aq})$, 1 mol dm^{-3}
 - Potassium bromide, $\text{KBr}(\text{aq})$, 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC047b.