

# Ksp, precipitation and the common ion effect

## AP Chemistry · Lab

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

How soluble is calcium hydroxide in water? You prepare a saturated solution, titrate it with hydrochloric acid to find  $[\text{OH}^-]$ , and calculate the molar solubility and Ksp. This is a direct, simple measurement of an equilibrium constant.

**Level:** AP Chemistry · **Curriculum:** AP Chem Unit 7

## Aim

To find the molar solubility and Ksp of calcium hydroxide at room temperature by titrating its saturated solution with hydrochloric acid.

## Equipment

- Solid calcium hydroxide, 2 g, and 250 cm<sup>3</sup> of distilled water
- 0.0500 mol/dm<sup>3</sup> hydrochloric acid in a burette
- Filter funnel and filter paper, dry beaker, stirring rod
- 25.0 cm<sup>3</sup> pipette, filler, conical flask, white tile
- Phenolphthalein indicator, eye protection

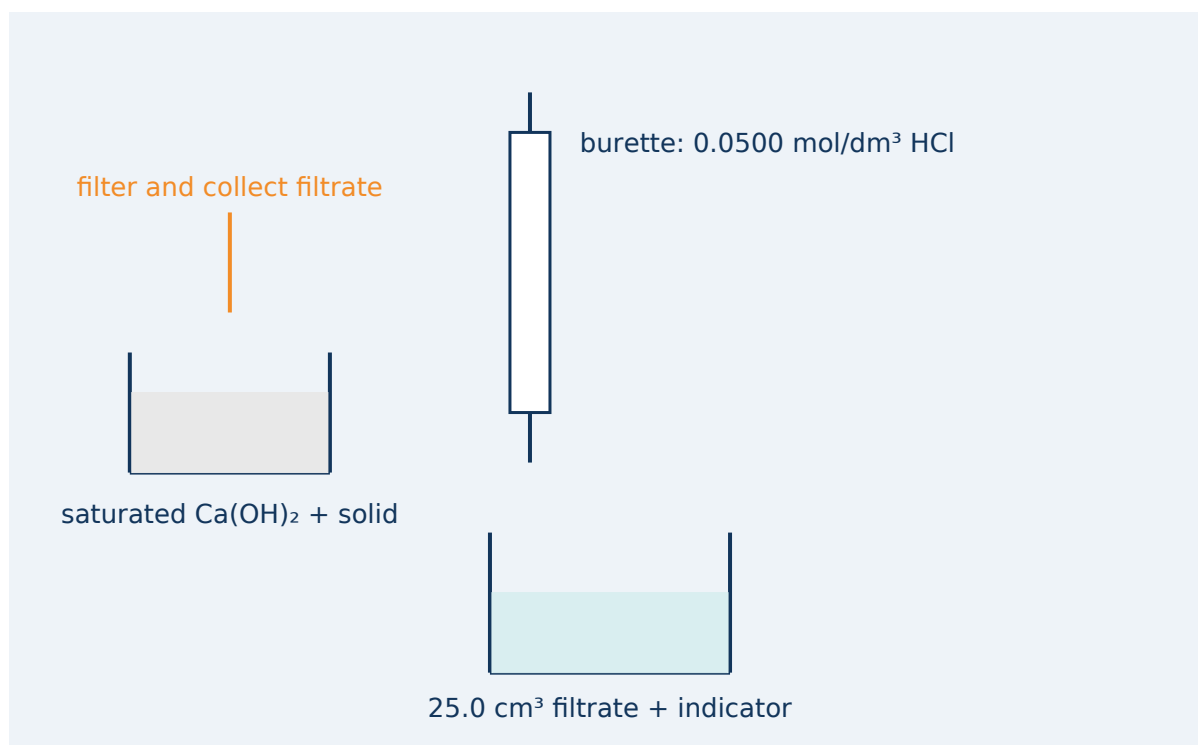
## Safety

### Safety

Wear eye protection. Saturated calcium hydroxide (limewater) is an irritant to eyes and skin, and the powder is irritant if inhaled. Rinse splashes with plenty of water. Avoid breathing in the dust when weighing.

## Method

1. Stir 2 g of  $\text{Ca}(\text{OH})_2$  into 250 cm<sup>3</sup> of water and leave it for 20 minutes, stirring now and then.
2. Filter into a dry beaker, discarding the first 10 cm<sup>3</sup>.
3. Pipette 25.0 cm<sup>3</sup> of the filtrate into a conical flask and add 2 drops of phenolphthalein.
4. Titrate with the hydrochloric acid to the first permanent loss of pink colour.
5. Do a rough titration first, then three more until two results agree within 0.2 cm<sup>3</sup>.
6. Record the room temperature.



Set-up: filter the saturated solution, then titrate a  $25.0 \text{ cm}^3$  portion with hydrochloric acid.

## Results

Sample results at  $24^\circ\text{C}$ :

| titration | volume of HCl ( $\text{cm}^3$ ) | concordant titres ( $\text{cm}^3$ ) |
|-----------|---------------------------------|-------------------------------------|
| rough     | 11.7                            | –                                   |
| 1         | 11.3                            | 11.3                                |
| 2         | 11.2                            | 11.2                                |
| 3         | 11.4                            | 11.4                                |

## Analysis questions

### Question 1 Mean titre

Calculate the mean of the concordant titres.

### Question 2 Amount of hydroxide

Calculate the amount of  $\text{OH}^-$  in  $25.0 \text{ cm}^3$  of filtrate ( $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ ).

### Question 3 Hydroxide concentration

Calculate  $[\text{OH}^-]$  in the saturated solution.

**Question 4 Molar solubility**

Calculate  $[\text{Ca}^{2+}]$  and hence the molar solubility of  $\text{Ca}(\text{OH})_2$ .

**Question 5 Calculate Ksp**

Calculate Ksp for  $\text{Ca}(\text{OH})_2$ .

**Question 6 Percentage difference**

The accepted Ksp at 25 °C is about  $5.0 \times 10^{-6}$ . Calculate the percentage difference.

**Question 7 Source of error**

Suggest one reason the filtrate could appear less basic than it should, and one improvement.

**Question 8 Common ion prediction**

Predict what happens to the volume of acid needed if you repeat the lab with  $0.10 \text{ mol/dm}^3$   $\text{CaCl}_2$  in place of water.