

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY

2816/03/TEST

Practical Examination 2 (Part B – Practical Test)

Wednesday **28 JANUARY 2004** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry

Candidate's Plan (Part A of Practical Test)

Scientific calculator

Candidate Name	Centre Number	Candidate Number									
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TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read instructions and questions carefully.

INFORMATION FOR CANDIDATES

- In this part of the Practical Test, you will be assessed on the Experimental and Investigative Skills:
 - Skill I Implementing
 - Skill A Analysing evidence and drawing conclusions
 - Skill E Evaluating evidence and procedures
- You may use a scientific calculator.
- Use of a *Data Sheet for Chemistry* is allowed.
- You may refer to your plan produced for Part A.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
Planning	16	
Implementing & Analysing	30	
Evaluation	14	
TOTAL	60	

This question paper consists of 10 printed pages and 2 lined pages.

Introduction

Calcium hydroxide is an ionic compound that has a low solubility in water. The solubility of such a compound can be represented using a type of equilibrium constant called the **solubility product, K_s** .



In this practical you will determine the solubility product of calcium hydroxide by a titration method using sulphamic acid and an indicator that may be unfamiliar to you.

A detailed explanation of solubility product will be given later, in **Part 2(f)** on page 5 of this paper.

Part 1 Titration of sulphamic acid with calcium hydroxide Skill 1 (Implementing)

[13 marks]

For the titration, you are provided with three materials.

- Solution **Y** is a saturated solution of calcium hydroxide, $\text{Ca}(\text{OH})_2$, in water; irritant  .
- Solid **Z** is sulphamic acid, $\text{NH}_2\text{SO}_3\text{H}$, which is a strong, monobasic acid; irritant  .
- Bromothymol blue is an indicator which changes colour at about $\text{pH} = 7$.

Record all of your readings in a suitable format on page 3 of this booklet.

Weigh the container containing solid **Z**, sulphamic acid.

Tip all the solid into a beaker.

Re-weigh the empty container.

Dissolve the solid **Z** in about 100 cm^3 of distilled (or deionised) water.

Make this up accurately to 250 cm^3 in a volumetric flask.

Shake this solution thoroughly before using it.

Use your solution of **Z** in the burette for the titration.

Using a pipette and filler, transfer 25.0 cm^3 of solution **Y** into the conical flask.

Add about 10 drops of bromothymol blue indicator.

Carry out a trial/rough titration and record the readings in a table on page 3.

Read the burette to 0.05 cm^3 .

At the end point the colour changes from blue to yellow.

Use the trial titration to familiarise yourself with the colour change at the end point.

Then carry out accurate titrations until you obtain two consistent titres.

Calculate your mean titre. Show, with a tick, each reading you used to do this.

Note: You will also need solution Y later in Part 3 of this Test.

Write your readings in the space below.

Part 2 Analysis of titration results
Skill A (Analysing)**[12 marks]**

- (a) Calculate the concentration, in mol dm^{-3} , of $\text{NH}_2\text{SO}_3\text{H}$ in your solution of Z.

answer = mol dm^{-3}

- (b) Calculate the amount, in moles, of $\text{NH}_2\text{SO}_3\text{H}$ in your mean titre.

answer = mol

- (c) Complete the balanced equation for the neutralisation reaction between calcium hydroxide and sulphamic acid in the titration. Give state symbols.

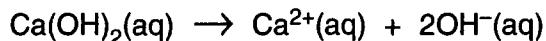


- (d) Calculate the concentration, in mol dm^{-3} , of Ca(OH)_2 in solution Y.

answer = mol dm^{-3}

(Note: If you were unable to calculate the concentration of $\text{Ca}(\text{OH})_2$, assume that it is $0.0280 \text{ mol dm}^{-3}$ so that you can continue the calculation in part (e)).

- (e) Aqueous calcium hydroxide is fully ionised in solution Y.



- (i) Use your answer to (d) to deduce the calcium ion concentration, $[\text{Ca}^{2+}(\text{aq})]$, in mol dm^{-3} , in solution Y.

$$[\text{Ca}^{2+}(\text{aq})] = \dots\dots\dots \text{mol dm}^{-3}$$

- (ii) Deduce the hydroxide ion concentration, $[\text{OH}^{-}(\text{aq})]$, in mol dm^{-3} , in solution Y.

$$[\text{OH}^{-}(\text{aq})] = \dots\dots\dots \text{mol dm}^{-3}$$

- (f) In the saturated solution Y, the **solubility product**, K_s , of calcium hydroxide, $\text{Ca}(\text{OH})_2$, is given by the following equation.

$$K_s = [\text{Ca}^{2+}(\text{aq})][\text{OH}^{-}(\text{aq})]^2$$

Use this equation and your answers to (e)(i) and (e)(ii) to calculate the solubility product, K_s , of $\text{Ca}(\text{OH})_2$. Deduce the units of K_s .

$$K_s = \dots\dots\dots$$

$$\text{units } \dots\dots\dots$$

Part 3 A test tube experiment with solution Y
Skills I and A (Implementing and Analysing)

[5 marks]

Transfer about 5 cm³ of saturated aqueous calcium hydroxide, solution **Y**, into a test tube.
Add an approximately equal volume of aqueous sodium hydroxide, of concentration 2.0 mol dm⁻³.
Allow the tube to stand for a while.

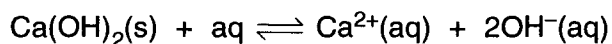
Sodium hydroxide is corrosive  .

(a) What observation did you make?

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(b) Solid calcium hydroxide dissolves in water according to the equation shown below.



Use Le Chatelier's principle to explain why the observation in **(a)** was made.

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(c) Safety

Why is special care needed during the test you have just carried out?

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Part 4 Skill E: Evaluation

[14 marks]

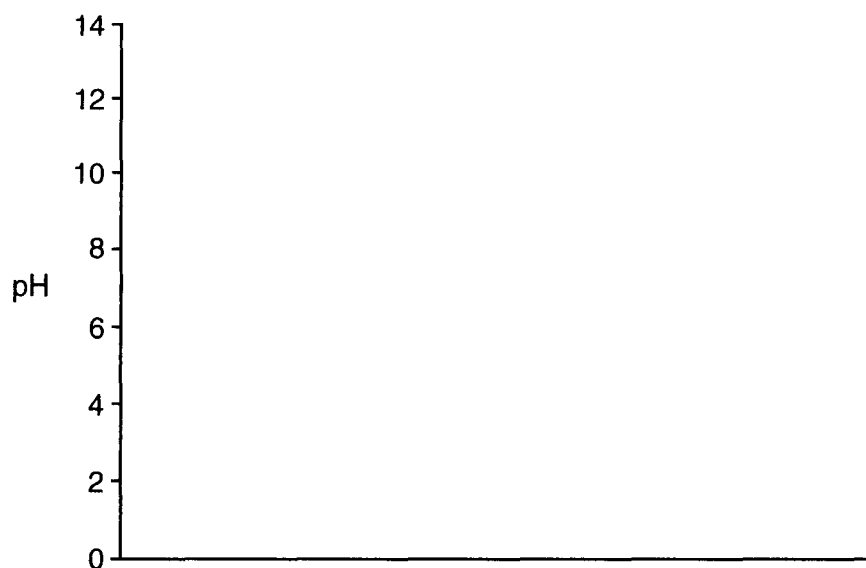
(a) and (b) each carry approximately equal marks.

- (a) You used bromothymol blue indicator, which changes colour at about $\text{pH} = 7$.
A student suggested that phenolphthalein, which changes colour at about $\text{pH} = 9$, is a better indicator to use.

State and explain whether or not you agree with this suggestion.

Sketch a titration-pH curve on the axes below to illustrate your answer.

Note that calcium hydroxide is a strong alkali and sulphamic acid is a strong acid.



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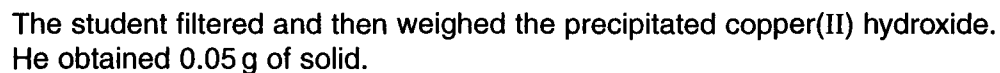
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[illegible]

He added an excess of aqueous copper(II) nitrate to 25 cm³ of a saturated solution of calcium hydroxide. The reaction below took place.



- Write the ionic equation for the reaction.
- Calculate the concentration of Ca(OH)_2 , in mol dm^{-3} , in the saturated solution, using the student's data.
- Compare the student's experiment with your own.
Explain which of the two methods gives a more reliable determination of the solubility of Ca(OH)_2 .

[illegible]