Centre Number	Candidate Number

Candidate Name _____

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

Joint Examination for the School Certificate and General Certificate of Education Ordinary Level

CHEMISTRY 5070/3

PAPER 3 Practical Test

OCTOBER/NOVEMBER SESSION 2001 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
As listed in Instructions to Supervisors

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page

Answer **both** questions.

Write your answers in the spaces provided on the question paper.

You should show the essential steps in any calculation and record all experimental results in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

Qualitative Analysis notes for this paper are printed on page 8.

FOR EXAMINER'S USE	
1	
2	
TOTAL	

This question paper consists of 7 printed pages and 1 blank page.

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[Turn over

1 Reactions between acids and alkali are exothermic. The changes in temperature when hydrochloric acid is added to aqueous sodium hydroxide can be used to determine the concentration of the sodium hydroxide.

P is 2.00 mol/dm^3 hydrochloric acid.
Q is aqueous sodium hydroxide of unknown concentration.

(a) (i) Put **P** into the burette.

(ii) Use a measuring cylinder to transfer 50 cm^3 of **Q** to a plastic cup. Measure the temperature of **Q** to the nearest 0.5 °C and record this value (T_o) in column **B** of Table 1.

(iii) Add 5.0 cm^3 of **P**, from the burette, to the sample of **Q** in the plastic cup. Stir the mixture using the thermometer. Measure the highest temperature reached. Record this value (T_1) in column **B** of Table 1.

(iv) Without delay, add another 5.0 cm^3 portion of **P** to the mixture. Stir and record the highest temperature reached (T_2).

(v) Repeat the procedure in **(iv)** until you have added a total of 40.0 cm^3 of **P**.

(vi) Calculate the values of $T_1 - T_0$, $T_2 - T_0$, etc. to complete column **C** in Table 1.

Results

Table 1

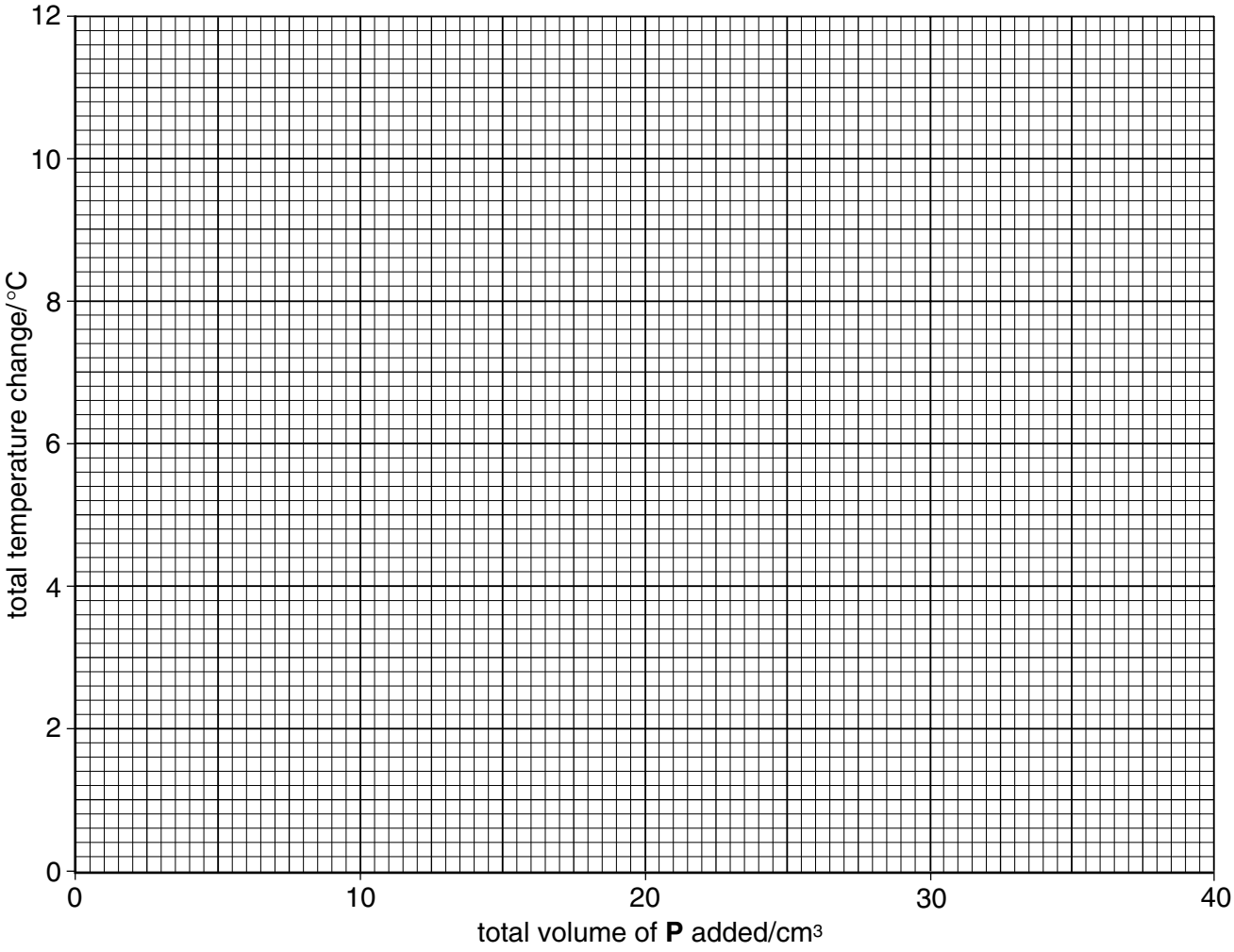
A	**B**	**C**
total volume of **P** added/cm^3	temperature / °C	**total** temperature change / °C
0	T_0 =	0
5	T_1 =	$T_1 - T_0$ =
10	T_2 =	$T_2 - T_0$ =
15	T_3 =	$T_3 - T_0$ =
20	T_4 =	$T_4 - T_0$ =
25	T_5 =	$T_5 - T_0$ =
30	T_6 =	$T_6 - T_0$ =
35	T_7 =	$T_7 - T_0$ =
40	T_8 =	$T_8 - T_0$ =

[12]

(b) Plot a graph of **total** temperature change (column **C**) against **total** volume of **P** (column **A**) on the grid opposite. Draw two straight best-fit lines which intersect, through these points. [3]

(c) Use your **graph** to determine the maximum temperature change.

Maximum temperature change..... °C. [1]



(d) From the graph, read the volume of **P** needed to cause this maximum temperature change. This volume of **P** neutralises 50 cm^3 of **Q**.

..... cm^3 of **P** neutralises 50 cm^3 of **Q**.

[1]

(e) **P** is 2.00 mol/dm^3 hydrochloric acid.

Using your answer to **(d),** calculate the concentration, in mol/dm^3, of sodium hydroxide in **Q**.

Concentration of sodium hydroxide in **Q** = ... mol/dm^3.

[2]

R is an aqueous solution of a different alkali whose concentration, in mol/dm^3, is the same as **Q**.

(f) (i) Use a measuring cylinder to transfer 50 cm^3 of **R** to a plastic cup. Measure the temperature of **R** to the nearest 0.5 °C and record the value in Table 2.

(ii) Using the burette add the same volume of **P** as your answer to **(d)** to the sample of **R** in the plastic cup. Stir the mixture using the thermometer. Measure the highest temperature reached. Record this value in Table 2 and calculate the change in temperature.

Table 2

initial temperature of 50 cm^3 of **R**/ °C	temperature after adding **P**/ °C	change in temperature/ °C

[2]

(g) The Table below shows some possible pH values for solutions **Q** and **R**. Using your results from **(c)** and **(f)**, decide which is the most likely set of values and tick (✓) your choice.

pH of solution **Q**	pH of solution **R**	answer (✓)
1	1	
1	3	
3	1	
11	14	
14	11	
14	14	

[1]

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QUESTION 2 IS ON PAGE 6

2 Carry out the following experiments on solution **S** and record your observations in the table. You should test and name any gas evolved.

Test No.	Test	Observations
1	**(a)** To a portion of solution **S**, add aqueous sodium hydroxide until a change is seen. **(b)** Add an excess of aqueous sodium hydroxide to the mixture from **(a)**.	
2	**(a)** To a portion of solution **S**, add aqueous ammonia until a change is seen. **(b)** Add an excess of aqueous ammonia to the mixture from **(a)**.	
3	**(a)** To a portion of solution **S**, add an equal volume of aqueous barium nitrate and leave to stand for a few minutes. **(b)** Add dilute nitric acid to the mixture from **(a)**.	

Test No.	Test (continued)	Observations (continued
4	To a portion of solution **S in a boiling tube**, slowly add an equal volume of aqueous sodium chlorate(I). **Warm gently**. Allow the mixture to cool and use it for **Test 5**.	
5	To the mixture from **Test 4**, add an equal volume of aqueous hydrogen peroxide.	

[17]

Conclusion

The formula of the anion (negative ion) present in solution **S** is ..... [1]

CHEMISTRY PRACTICAL NOTES

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous lead(II) nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulphate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	“pops” with a lighted splint
oxygen (O_2)	relights a glowing splint
sulphur dioxide (SO_2)	turns aqueous potassium dichromate(VI) green