Surname		Other	Names			
Centre Number			Candida	ate Number		
Candidate Signature	·					

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General Certificate of Education June 2005 Advanced Subsidiary Examination ASSESSMENT and QUALIFICATIONS

CHM3/P

CHEMISTRY
Unit 3(b) Practical Examination

Thursday 19 May 2005 9.00 am to 11.00 am

In addition to this paper you will require: a calculator.

Time allowed: 2 hours

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Carry out all three exercises.
- Answer all questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.
- Take careful note of all the instructions given in each exercise.
- The Periodic Table/Data Sheet is provided on pages 3 and 4. Detach this perforated sheet at the start of the examination.

Information

- The use of note books and laboratory books is **not** permitted.
- The maximum mark for this paper is 30.
- The skills which are being assessed are
 - Skill 1 Planning (8 marks)
 - Skill 2 Implementing (8 marks)
 - Skill 3 Analysing (8 marks)
 - Skill 4 Evaluating (6 marks)
- This paper carries 15 per cent of the total marks for AS. For Advanced Level this paper carries 7½ per cent of the total marks.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.

Advice

- You are advised to spend approximately 40 minutes on each of the three exercises.
- You are advised to carry out Exercise 1 first.

	For Exam	iner's Use	
Number	Mark	Number	Mark
Skill 1			
Skill 2			
Skill 3			
Skill 4			
Total (Column	1)	→	
Total (Column	2)	→	
TOTAL			
Examine	r's Initials		

This paper consists of the following.

Exercise 1 **Implementing** Titration of a sample of hydrochloric acid

Exercise 2 Analysing and Evaluating Identification of a Group II carbonate

Exercise 3 Planning Determination of an enthalpy change of

neutralisation

An essential part of any practical work is to plan for the most efficient use of the time available. There is enough time to complete the exercises set provided that a sensible approach is used.

You are advised to spend approximately

40 minutes on Exercise 1

40 minutes on Exercise 2

40 minutes on Exercise 3.

The Periodic Table of the Elements

■ The atomic numbers and approximate relative atomic masses shown in the table are for use in the examination unless stated otherwise in an individual question.

=	_											≡	≥	>	5	=	0
			Key														4.0 He Helium
9.0 Be			relative a	relative atomic mass		6.9 Li						10.8 B	ပ	14.0 N	16.0 O	0.6 L	20.2 Ne
Beryllium 4			atomic number	mber —		Lithium 3					-	Boron 6	Carbor	Nitrogen Oxygen 9	Oxygen 8	Fluorine	Neon 10
24.3 Mg												27.0 AI	[∞] .2	31.0 P	32.1 S	2 .5	39.9 Ar
												Aluminium 13	Silicon 4	Phosphorus 15	Sulphur 16	Chlorine 7	Argon
40.1 45.0 Ca Sc	45.0	l	47.9 Ti	50.9 V	52.0 Ç	54.9 Mn		58.9 Co	58.7 Ni	63.5 Cu	65.4 Zn	69.7 Ga	2.6 Ge	74.9 As	79.0 Se	9.9 D	83.8 K
	Sca 21	Scandium 21				d)	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	ermaniu 2	Arsenic 33	Selenium 34	Bromine 5	Krypton 36
87.6 88.9 Y	88		91.2 Zr	92.9 Nb	95.9 Mo	98.9 Tc	101.1 Ru	02.9 Rh	106.4 Pd	107.9 Ag	112.4 Cd	114.8 In	18.7 Sn	121.8 Sb	127.6 Te	26.9 –	131.3 Xe
	39 ≺	Yttrium 39	_	Niobium 41	_	_	Ruthenium 44	Rhodium 15	Palladium 46	Silver 47	Cadmium 48	Indium 49	O Tin	Antimony 51	Tellurium 52	lodine 3	Xenon 54
137.3 138 Ba	138	138.9 La	178.5 Hf	180.9 Ta	183.9 W	186.2 Re	190.2 Os	192.2 Ir	195.1 Pt	197.0 Au	200.6 Hg	204.4 TI	07.2 Pb	209.0 Bi	210.0 Po	10.0 At	222.0 Rn
	Lan 57	Lanthanum 57 *	Hafnium 72	Tantalum 73	Tungsten 74	Rhenium 75	Osmium 76	Iridium 7			Mercury 80	Thallium 81	Lead 2	Bismuth 83	Polonium 84	Astatine 5	Radon 86
	55.	Ac															
Radium Ac 88 89	88	Actinium 39 †					_										
			1		1				1			1					

140.1	140.9 Dr	144.2 NA	144.9 D m	150.4 Sm	152.0 F.1	157.3	158.9 Th	162.5	162.5 164.9 HO	167.3 Fr	168.9 173.0 1	173.0 Vh	175.0
Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
58	29	. 09	61	62	63	64	92	. 99	29	89	69	70	71
232.0 Th	231.0 Pa	238.0 U	237.0 ND	239.1 Pu	243.1 Am	247.1 Cm	247.1 Bk	252.1 Cf	,,	257) Fm	(258) (2 Md	(259) (X	(260) Lr
Thorium 90	Protactinium 91	Uranium 92	Thorium Protactinium Uranium Neptunium Plutonium Americium Curium Berkelium 90 91 95 96 97	Plutonium 94	Americium 95	Curium 96	Berkelium 97	Californium 98	Einsteinium 99	Fermium 100	Mendelevium 101	Nobelium 02	Lawrencium 103

† 90 – 103 Actinides

Table 1 Proton n.m.r chemical shift data

Type of proton	δ/ppm
RCH_3	0.7–1.2
R_2CH_2	1.2–1.4
R_3 CH	1.4–1.6
RCOCH ₃	2.1–2.6
$ROCH_3$	3.1–3.9
$RCOOCH_3$	3.7–4.1
ROH	0.5–5.0

Table 2 Infra-red absorption data

Bond	Wavenumber/cm ⁻¹
С—Н	2850–3300
С—С	750–1100
C=C	1620–1680
C=O	1680–1750
С—О	1000-1300
O—H (alcohols)	3230–3550
O—H (acids)	2500–3000

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Exercise 1 Titration of a sample of hydrochloric acid

Skill assessed Implementing (8 marks)

Introduction

You are provided with a sample of hydrochloric acid whose concentration is approximately 0.1 mol dm⁻³. Titrate the hydrochloric acid with a 0.100 mol dm⁻³ solution of sodium hydroxide.

Wear suitable eye protection.

Procedure

- 1 Rinse the burette with the hydrochloric acid provided. Set up the burette and, using a funnel, fill it with the hydrochloric acid provided. Record the initial burette reading.
- 2 Rinse a pipette with the sodium hydroxide solution provided. Using this pipette, transfer 25.0 cm³ of the sodium hydroxide solution to a 250 cm³ conical flask.
- 3 Add 3 or 4 drops of **phenol red** indicator to the conical flask. This indicator changes from **pink** in alkaline solution to **yellow** in acid solution. The end-point has been reached when the solution just turns yellow.
- 4 Add the acid from the burette until the mixture in the conical flask just changes colour. Record your burette reading in the table below.
- 5 Rinse the conical flask with water and repeat the titration until you obtain **two** titres which are within 0.10 cm³ of each other. (You should do no more than five titrations.)

 Have one of your final burette readings checked by your supervisor.
- 6 Calculate and record the mean titre.

Final burette reading/cm ³			
Initial burette reading/cm ³			
Volume of hydrochloric acid used/cm ³			
Tick the titres to be used in calculating the mean			

		3
Mean	titre =	 cm

	For E	Examine	er's use	only	
M		С		P	
Т		A			



Turn over

Exercise 2 Identification of a Group II carbonate

Skill assessed Analysing (8 marks) and Evaluating (6 marks)

Introduction

A pure compound was known to be the carbonate of a Group II metal. A student was asked to identify this carbonate by titration of a sample of the compound with hydrochloric acid.

The method chosen by the student involved rinsing a weighing bottle with pure water and then adding 1.00 g of the carbonate to the bottle. The contents of the weighing bottle were then transferred to a conical flask. About 20 cm³ of pure water were added to the conical flask.

The student filled a burette with 1.00 mol dm⁻³ hydrochloric acid. The sample was titrated with the acid solution, using methyl orange indicator. The student then repeated the titration using further 1.00 g samples of the carbonate. The following results were obtained.

Titration number	1	2	3	4	5
Final burette reading/cm ³	19.60	19.20	19.35	19.15	25.85
Initial burette reading/cm ³	0.05	0.05	0.05	0.10	6.75
Titre per 1.00 g of carbonate/cm ³					

Analysis Full marks can only be scored in calculations if you show all of your working.

I	equation for the reaction, representing the metal carbonate as MCO ₃
2	Use all of the concordant results in the table above to determine the mean titre.
3	Use the mean titre to calculate the number of moles of the metal carbonate present in 1.00g of the sample.

4	Using your result from part 3, determine the relative formula mass, M_r , of the metal carbonate.
5	Use your result from part 4 to show that the Group II metal present in the carbonate is calcium.
6	Assume that the maximum errors for the apparatus used in this experiment were
	balance total error $\pm 0.01 \mathrm{g}$ burette total error $\pm 0.15 \mathrm{cm}^3$ (from two readings and an end-point error)
	Calculate the maximum percentage errors in using the balance and in using the burette in this experiment, and hence the overall maximum percentage error.



Turn over ▶

Evaluation		Full marks can only be scored in calculations if you show all of your working.					
1	Comment	on the consistency of the titres. Suggest one possible reason for an anomalous result.					
	•••••						
2	the actual	the difference between the experimental M_r value determined by the student and M_r value of calcium carbonate. Express this difference as a percentage of the actual of calcium carbonate.					
		ald not complete the calculation in part 4 of the Analysis section, you should assume aperimental $M_{\rm r}$ value is 106. This is not the correct answer.)					
	Difference	·					
	Percentage	?					
3	and your o	on the significance of the difference between the actual $M_{\rm r}$ of calcium carbonate calculated value. Assume that this difference is not due to impurities.					
4	case expla	ways of improving the student's method of weighing the metal carbonate. In each in why the accuracy of the experiment would be improved. ent 1					
	Explanatio	On					
	Improvem	ent 2					
	Explanatio	on					



Exercise 3 Determination of an enthalpy change of neutralisation

Skill assessed Planning (8 marks)

Introduction

When a monobasic acid, HA, in aqueous solution is neutralised by a solution of sodium hydroxide, the following exothermic reaction occurs.

$$HA(aq) + NaOH(aq) \rightarrow NaA(aq) + H_2O(l)$$

When equal volumes of a 0.2 mol dm⁻³ solution of HA and a 0.2 mol dm⁻³ solution of sodium hydroxide react together, the temperature rises by about 1 °C.

Question

Using the information above, describe how you would measure the enthalpy change of the reaction between the unknown acid, HA, and sodium hydroxide. Assume that you have access to solutions of HA and of sodium hydroxide of the concentrations you choose.

Your answer must include the following

- 1 The volumes and concentrations of the solutions of the unknown acid, HA, and of sodium hydroxide to be used, and your reasons for choosing these concentrations.
- 2 A description of the experiment you would perform. Include details of the apparatus you would use and the precautions you would take to minimise heat loss. A diagram is not essential but may help your answer.
- 3 A clear explanation, including a sketch graph of temperature against time, showing how you would use your results to calculate, in kJ mol⁻¹, the enthalpy change of neutralisation of the unknown acid, HA.

4 Details of the potential hazards, and the relevant safety precautions you would take.



Turn over

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General Certificate of Education June 2005 Advanced Subsidiary Examination



CHEMISTRY PRACTICAL EXAMINATION Instructions to Supervisors

CHM3/P/TN

CONFIDENTIAL

1 The practical examination will be held on Thursday 19 May 2005, 9.00 am to 11.00 am.

Centres are permitted to run more than one session for the Practical Examination provided that the following conditions are met:

- all candidates to be examined must be present in the centre by 9.30 am at the latest;
- all candidates who are waiting to be examined must be supervised until their session begins;
- candidates who are released at the end of their session must have no contact with any candidate yet to be examined.
- 2 The strictest possible precautions are to be taken to prevent these exercises becoming known to the candidates in advance, either directly or indirectly. AQA emphasises the need to preserve the absolute fairness and integrity of this examination. This copy of Instructions to Supervisors is to be kept at the centre under secure conditions when not in use; it is not to be removed from the centre.
- A combined question paper/answer book will be supplied. If an answer book is badly damaged, e.g. by spillage, a candidate may be given a fresh book, but both books must be sent to the Examiner, together with a statement of the reasons for issuing a duplicate answer book. The damaged book must be sealed in a polythene bag.

The Periodic Table/Data Sheet will be provided as a perforated sheet on pages 3 and 4 of the question paper/answer book. Candidates will be instructed to detach this sheet at the start of the examination.

- 4 The use of books and laboratory notebooks is **not** permitted.
- 5 The attention of candidates must be drawn to the requirement that all rough work must be done in the answer book. **Extra paper is not to be supplied for this purpose**. Candidates' attention should also particularly be drawn to the instructions contained in the question paper.



- As far as possible, apparatus and special materials should not be put away until the end of the examination period; an Inspector who arrives late will thus be able to see the preparations that have been made.
- 7 If a candidate fails with the material allotted to him/her and asks to be allowed a second opportunity, he/she may be allowed it at the discretion of the Supervisor. Under no circumstances may materials from other sources be used. Supervisors should bear this in mind as well as the availability of apparatus and the amount of time remaining when exercising this discretion. No extra time is to be allowed to such a candidate and he/she must hand in his/her script at the same time as other candidates at the centre. A full report, in writing, of any such incident must be sent to AQA. Supervisors must not allow extra time to candidates unless specific permission is given by AQA. Any circumstance which leads to a shortage of time should be reported to AQA.
- A Supervisor must not give any advice to candidates about the way they are conducting experiments unless it is to prevent personal injury to the candidates or damage to apparatus. If any such incident occurs, the Supervisor should report details, in writing, to the Examiner when scripts are sent. Unless specific mention to the contrary is made in the instructions, Supervisors must not give any advice or information to candidates, whether it is asked for or not.

APPARATUS AND MATERIALS

Exercise 1

This exercise involves the reaction of a solution of hydrochloric acid with sodium hydroxide solution.

Materials

Each candidate will require two volumetric solutions:

1 (a) A standard **sodium hydroxide** solution of concentration between 0.090 and 0.110 mol dm⁻³.

This solution may be made up in the centre or purchased from a reputable manufacturer at the discretion of the centre. Wherever possible the centre should prepare one bulk batch only of this solution. It is essential that the concentration of the solution should be in the range specified. It must be stressed that the accuracy of this solution is the responsibility of the centre alone.

Each candidate will require 200 cm³ of this solution, in a closed container labelled sodium hydroxide.

(b) A solution of **hydrochloric acid** of concentration between 0.090 and 0.100 mol dm⁻³.

This solution may be made up in the centre or purchased from a reputable manufacturer at the discretion of the centre. Wherever possible the centre should prepare one bulk batch only of this solution. It is essential that the concentration of the solution should be in the range specified. It must be stressed that the accuracy of this solution is the responsibility of the centre alone.

Each candidate will require 150 cm³ of this solution, in a closed container labelled hydrochloric acid.

- 2 Each candidate will require access to a solution of **phenol red** as indicator. It is not essential to provide individual supplies of the indicator.
- Reagents of good analytical quality should be used in preparing the solutions, and they should be carefully stored in bottles fitted with air-tight stoppers. Great care must be taken in the storage and dispensing of each solution to ensure that its concentration is unaltered.
- 4 Supervisors are required, in every instance, to carry out the volumetric exercise and to report the result to the Examiner on the form provided on page 5 of this booklet. A Supervisor result is required for each group of candidates. The Supervisor result must be entered with the list of candidates supervised in the group on the form provided. The accuracy of the candidates' results will be assessed against the Supervisor's results for the titration. Supervisors must **not** carry out the exercises in the presence of the candidates.

Supervisors are also asked to keep a sample (at least 100 cm³) of each volumetric solution used in a small stoppered bottle. These samples should be kept for a period of four weeks after the examination and should be available to the Examiners if called for.

It is essential that orders for solutions which are not to be made up in the centre should be placed without delay.

Spare supplies of all solutions specified in these instructions must be available.

Supervisors are required to assess the manipulative skills of candidates and to complete the grid on page 5 of this booklet. This form must be sent to the Examiner with the scripts.

If a centre needs to conduct the examination in two or more separate sessions, the form on page 5 must be completed and sent to the Examiner with each group of scripts. This form may be photocopied if centres have large numbers of candidates.

Apparatus

The apparatus specified below represents the minimum requirement. Candidates will be advised to carry out Exercise 1 first.

Each candidate will require:

one 50 cm³ burette and stand one funnel one 25 cm³ pipette one pipette filler two or more 250 cm³ conical flasks one wash bottle a plentiful supply of purified water (either distilled or de-ionised) suitable eye protection.



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CHEMISTRY PRACTICAL EXAMINATION C

CHM3/P

June 2005

Centre Number											
Supervisor]	Date	·					
Supervisor's mean titre cm ³											
	1	2	3	4	5	6	7	8	9	10	
Name of Candidate	 	Transfers from pipette without spillage	Touches surface with pipette	Uses HCl in burette, NaOH in pipette	Removes funnel before titrating	Dropwise addition near end-point	Swirls mixture	Reads burette correctly	Does not need additional reagent	Works safely	TOTAL (10)
									<u> </u>		

Notes for the Assessment of Manipulative Skills listed 1–10 above

- 1–3 The Supervisor should observe the candidate in the use of the pipette at an appropriate time during the titration. The candidate scores the mark if the correct technique is used **once**.
- 4 The mixture in the flask at the beginning of the titration should be pink.
- 5–8 The Supervisor should observe the candidate in the use of the burette at an appropriate time during the titration. The candidate scores the mark if the correct technique is used **once**.
- 9 The candidate loses this mark if an extra supply of hydrochloric acid or sodium hydroxide is needed, when the reason for the additional sample is clearly the fault of the candidate, e.g. spillage, careless measurement of volumes or using the wrong solution.
- The candidate loses this mark if he/she does not wear eye protection, or does anything which the Supervisor regards as potentially hazardous.

This sheet may be photocopied



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THERE ARE NO INSTRUCTIONS PRINTED ON THIS PAGE

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