Surname		Other Names	
Centre Number			Candidate Number					
Candidate Signature								

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General Certificate of Education
June 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

CHEMISTRY CHM3/P
Unit 3(b) Practical Examination

Thursday 20 May 2004 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 $7\frac{1}{2}$ 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 Examiner's Use			
Number	Mark	Number	Mark
Skill 1			
Skill 2			
Skill 3			
Skill 4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

This paper consists of the following.

Exercise 1	**Implementing**	Reactions of some ions.
Exercise 2	**Analysing and Evaluating**	Determination of the number of molecules of water of crystallisation in hydrated calcium sulphate crystals.
Exercise 3	**Planning**	Confirming the equation of an acid–metal reaction.

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.

I	II										III	IV	V	VI	VII	0
1.0 **H** Hydrogen 1																4.0 **He** Helium 2
6.9 **Li** Lithium 3	9.0 **Be** Beryllium 4										10.8 **B** Boron 5	12.0 **C** Carbon 6	14.0 **N** Nitrogen 7	16.0 **O** Oxygen 8	19.0 **F** Fluorine 9	20.2 **Ne** Neon 10
23.0 **Na** Sodium 11	24.3 **Mg** Magnesium 12										27.0 **Al** Aluminium 13	28.1 **Si** Silicon 14	31.0 **P** Phosphorus 15	32.1 **S** Sulphur 16	35.5 **Cl** Chlorine 17	39.9 **Ar** Argon 18
39.1 **K** Potassium 19	40.1 **Ca** Calcium 20	45.0 **Sc** Scandium 21	47.9 **Ti** Titanium 22	50.9 **V** Vanadium 23	52.0 **Cr** Chromium 24	54.9 **Mn** Manganese 25	55.8 **Fe** Iron 26	58.9 **Co** Cobalt 27	58.7 **Ni** Nickel 28	63.5 **Cu** Copper 29	65.4 **Zn** Zinc 30	69.7 **Ga** Gallium 31	72.6 **Ge** Germanium 32	74.9 **As** Arsenic 33	79.0 **Se** Selenium 34	79.9 **Br** Bromine 35	83.8 **Kr** Krypton 36
85.5 **Rb** Rubidium 37	87.6 **Sr** Strontium 38	88.9 **Y** Yttrium 39	91.2 **Zr** Zirconium 40	92.9 **Nb** Niobium 41	95.9 **Mo** Molybdenum 42	98.9 **Tc** Technetium 43	101.1 **Ru** Ruthenium 44	102.9 **Rh** Rhodium 45	106.4 **Pd** Palladium 46	107.9 **Ag** Silver 47	112.4 **Cd** Cadmium 48	114.8 **In** Indium 49	118.7 **Sn** Tin 50	121.8 **Sb** Antimony 51	127.6 **Te** Tellurium 52	126.9 **I** Iodine 53	131.3 **Xe** Xenon 54
132.9 **Cs** Caesium 55	137.3 **Ba** Barium 56	138.9 **La** Lanthanum 57 *	178.5 **Hf** Hafnium 72	180.9 **Ta** Tantalum 73	183.9 **W** Tungsten 74	186.2 **Re** Rhenium 75	190.2 **Os** Osmium 76	192.2 **Ir** Iridium 77	195.1 **Pt** Platinum 78	197.0 **Au** Gold 79	200.6 **Hg** Mercury 80	204.4 **Tl** Thallium 81	207.2 **Pb** Lead 82	209.0 **Bi** Bismuth 83	210.0 **Po** Polonium 84	210.0 **At** Astatine 85	222.0 **Rn** Radon 86
223.0 **Fr** Francium 87	226.0 **Ra** Radius 88	227 **Ac** Actinium 89 †															

Key

relative atomic mass — 6.9 **Li** Lithium

atomic number — 3

140.1 **Ce** Cerium 58	140.9 **Pr** Praseodymium 59	144.2 **Nd** Neodymium 60	144.9 **Pm** Promethium 61	150.4 **Sm** Samarium 62	152.0 **Eu** Europium 63	157.3 **Gd** Gadolinium 64	158.9 **Tb** Terbium 65	162.5 **Dy** Dysprosium 66	164.9 **Ho** Holmium 67	167.3 **Er** Erbium 68	168.9 **Tm** Thulium 69	173.0 **Yb** Ytterbium 70	175.0 **Lu** Lutetium 71
232.0 **Th** Thorium 90	231.0 **Pa** Protactinium 91	238.0 **U** Uranium 92	237.0 **Np** Neptunium 93	239.1 **Pu** Plutonium 94	243.1 **Am** Americium 95	247.1 **Cm** Curium 96	247.1 **Bk** Berkelium 97	252.1 **Cf** Californium 98	(252) **Es** Einsteinium 99	(257) **Fm** Fermium 100	(258) **Md** Mendelevium 101	(259) **No** Nobelium 102	(260) **Lr** Lawrencium 103

*** 58 – 71** Lanthanides

† 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_3CH	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}
C—H	2850–3300
C—C	750–1100
C═C	1620–1680
C═O	1680–1750
C—O	1000–1300
O—H (alcohols)	3230–3550
O—H (acids)	2500–3000

TURN OVER FOR THE FIRST EXERCISE

Exercise 1 Reactions of some ions.

Skill assessed: **Implementing** (8 marks)

Introduction

You are provided with **five** solutions labelled A, B, C, D and E. Perform the tests described below on each solution in turn.

Record in Table 1 exactly what you observe.

You are **not** required to identify any of the reaction products.

Wear safety glasses at all times.
Assume that all of the solutions are toxic and corrosive.

Experimental details

Use a separate sample of each solution in each test.

Test 1 Reaction with silver nitrate solution.

Place about 10 drops of solution A in a test tube and add 10 drops of silver nitrate solution with shaking. Record your observations.
Repeat this test with separate solutions of B, C, D and E instead of solution A.

Test 2 Reaction with dilute hydrochloric acid.

Place about 10 drops of solution A in a test tube and add 10 drops of hydrochloric acid with shaking. Record your observations.
Repeat this test with separate solutions of B, C, D and E instead of solution A.

Test 3 Reaction with magnesium sulphate solution.

Place about 10 drops of solution A in a test tube and add 10 drops of magnesium sulphate solution with shaking. Record your observations.
Repeat this test with separate solutions of B, C, D and E instead of solution A.

You should not attempt to identify the ions present in any of the five samples.

Table 1

Test	Observations with Solution A	Observations with Solution B	Observations with Solution C	Observations with Solution D	Observations with Solution E
1. Reaction with silver nitrate solution					
2. Reaction with dilute hydrochloric acid					
3. Reaction with magnesium sulphate solution					

8

Turn over ▶

Exercise 2 Determination of the number of molecules of water of crystallisation in hydrated calcium sulphate crystals.

Skills assessed: **Analysing** (8 marks) **and Evaluating** (6 marks)

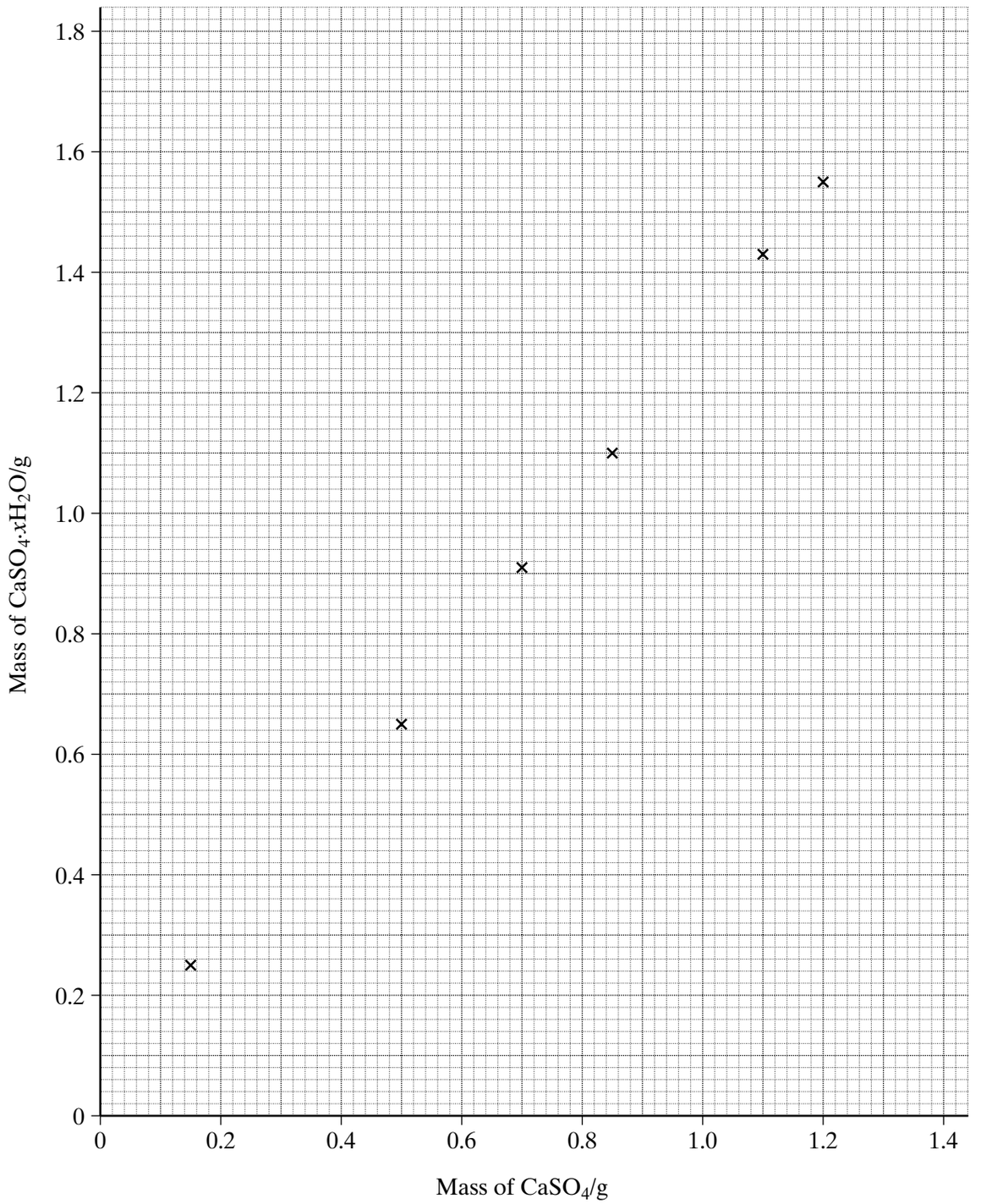
Introduction

The water of crystallisation in calcium sulphate crystals can be removed as water vapour by heating as shown in the following equation.

$$\underset{\text{hydrated calcium sulphate}}{CaSO_4 \cdot xH_2O(s)} \longrightarrow \underset{\text{anhydrous calcium sulphate}}{CaSO_4(s)} + xH_2O(g)$$

A student weighed a clean dry crucible. The student transferred 0.250 g of hydrated calcium sulphate to the crucible. The crucible was then heated. When the crucible and its contents had reached constant mass, the mass was recorded.
The experiment was repeated using different masses of hydrated calcium sulphate.

For each experiment, the student recorded the original mass of hydrated calcium sulphate and the mass of anhydrous calcium sulphate left after heating. The student's results are shown on the graph opposite.



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

1. Draw a best fit straight line on the graph.

2. Use the graph to determine the mass of hydrated calcium sulphate which would have formed 1.000 g of anhydrous calcium sulphate.

   Mass of hydrated calcium sulphate .....

3. Calculate the number of moles of $CaSO_4$ present in 1.000 g of anhydrous calcium sulphate.

   .....

   .....

4. Use your answers to part 2 and part 3 to calculate the M_r of hydrated calcium sulphate.

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5. Use your answer to part 4 to calculate the value of x in $CaSO_4 \cdot xH_2O$

   .....

   .....

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6. Assume that the maximum error in weighing 0.250 g on a balance was 0.001 g. Calculate the percentage error in using the balance.

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Evaluation

1. Consider your graph and comment on the results obtained by the student. Is your line of best fit good enough for you to use with confidence? Identify any anomalous results.

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2. Explain why it was necessary for the student to heat the crucible to constant mass.

   .....

3. Pure hydrated calcium sulphate has the formula $CaSO_4 \cdot 2H_2O$ Calculate the difference between the M_r determined in part 4 of the Analysis section and the M_r of the literature value, 172.2 Express this as a percentage of the M_r of the literature value.

   If you could not complete part 4 of the Analysis section, you should assume that the M_r determined from the graph is 165.2; this is not the correct result.

   Difference .....

   Percentage .....

4. Suggest **one** reason in each case why

   (a) small amounts of hydrated calcium sulphate, such as 0.100 g, should **not** be used in this experiment,

   .....

   .....

   (b) large amounts of hydrated calcium sulphate, such as 50 g, should **not** be used in this experiment.

   .....

   .....

6

Exercise 3 Confirming the equation of an acid–metal reaction.

Skill assessed: **Planning** (8 marks)

Introduction

It is thought that strontium metal and hydrochloric acid react as follows.

$$Sr(s) + 2HCl(aq) \rightarrow SrCl_2(aq) + H_2(g)$$

It is very difficult to weigh accurately the hydrogen gas produced in this reaction. However, its volume can be measured by collecting the gas over water or in a gas syringe.

Both strontium and hydrogen are flammable.

Question

You are provided with strontium and dilute hydrochloric acid. Describe how, by experiment, you would confirm that one mole of strontium produces one mole of hydrogen as shown in the equation above.

Your answer must include

1. A suitable volume of hydrogen to be collected.
2. A suitable mass of strontium to be used. Assume that under the conditions of this experiment the volume of one mole of hydrogen is 24 dm^3.
3. Details of the apparatus you would use, a detailed description of the measurements you would make and a diagram, where appropriate, to illustrate your description.
4. A brief explanation of how you would use your results to confirm the number of moles of hydrogen produced for each mole of strontium reacted.
5. Details of the potential hazards, and the relevant safety precautions.

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General Certificate of Education
June 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

CHEMISTRY PRACTICAL EXAMINATION **CHM3/P/TN**
Instructions to Supervisors

CONFIDENTIAL

1 The practical examination will be held on Thursday 20 May 2004, 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.**

3 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.

6 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 the Examiner together with the scripts. **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 the Examiner.

8 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 an investigation of the reactions of metal salts in solutions with solutions of silver nitrate, hydrochloric acid and magnesium sulphate.

Materials

1 Each candidate will require the following reagent solutions (concentrations are approximate):

silver nitrate solution	of concentration 0.05 mol dm^{-3}
hydrochloric acid	of concentration 2.0 mol dm^{-3}
magnesium sulphate solution	of concentration 0.2 mol dm^{-3}

These solutions 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 each solution. It must be stressed that the accuracy of these solutions is the responsibility of the centre **alone**.

Each candidate will require 20 cm^3 of each solution. It is not essential to provide individual supplies of the reagent solutions.

2 Each candidate will require the following solutions (concentrations are approximate):

sodium chromate(VI) solution	of concentration 0.2 mol dm^{-3}
barium chloride solution	of concentration 0.2 mol dm^{-3}
lead(II) nitrate solution	of concentration 0.1 mol dm^{-3}
potassium iodide solution	of concentration 0.2 mol dm^{-3}
sodium carbonate solution	of concentration 0.2 mol dm^{-3}

These solutions should be made up in the centre, no more than one day before the examination. Wherever possible the centre should prepare one bulk batch only of each solution. It must be stressed that the accuracy of these solutions is the responsibility of the centre **alone**.

Each candidate will require 10 cm^3 of each of the metal salt solutions, in a labelled container marked as follows:

sodium chromate(VI) solution	labelled **A**
barium chloride solution	labelled **B**
lead(II) nitrate solution	labelled **C**
potassium iodide solution	labelled **D**
sodium carbonate solution	labelled **E**

The strictest possible precautions are to be taken to prevent the identities of these metal salt solutions becoming known to the candidates, either directly or indirectly.

3 Reagents of good 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 observation exercises and to complete the grid on page 5 of this booklet. This form must be sent to the Examiner with the scripts. The accuracy of the candidates' results will be assessed against the supervisor's results. Supervisors must **not** carry out the exercises in the presence of the candidates.

If a centre needs to conduct the examination in two or more separate sessions a photocopy of the Supervisor's Results, written on page 5, must be sent to the examiner with each group of scripts.

Supervisors are also asked to keep a sample (not less than 100 cm^3) of each 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.

5 Supervisors are required to assess the manipulative skills of candidates and to complete the grid on page 6 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 6 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:

test tubes; the number per candidate is at the centre's discretion, but a minimum of 5 test tubes will be needed
dropping pipettes; the number per candidate is at the centre's discretion. We recommend you use a maximum of 8 pipettes
test tube rack
one wash bottle
a plentiful supply of purified water (either distilled or de-ionised)
suitable eye protection.

The candidate may be given a suitable pen to mark his/her test tubes.

Candidates may use disposable gloves if these are available.

Supervisor's Results

Centre No. ..... **Supervisor's name** ..... **Group** .....

Test	Observations with Solution A	Observations with Solution B	Observations with Solution C	Observations with Solution D	Observations with Solution E
1. Reaction with silver nitrate solution					
2. Reaction with dilute hydrochloric acid					
3. Reaction with magnesium sulphate solution					

CHEMISTRY PRACTICAL EXAMINATION CHM3/P June 2004

Centre Number _____

Supervisor _____ Date _____

Name of Candidate	1 Uses appropriate quantities	2 Dropwise addition where appropriate	3 Shakes mixture	4 No spillages	5 Doesn't need additional sample	6 Works safely		TOTAL (6)

Notes for the Assessment of Manipulative Skills listed 1–6 above.

1–3 The supervisor should observe the candidate in the use of the correct quantities, dropwise, with shaking, at an appropriate time during the exercise. The candidate scores the mark if the correct technique is used **once**.

4 The candidate scores the mark is there are no major spillages during the exercise.

5 The candidate loses this mark if an additional sample of any solution is required when the reason for the additional sample is clearly the fault of the candidate e.g. careless measurement of volumes or using the wrong solution. If the candidate spills a solution, penalise under Part 4, but do not penalise a second time in part 5.

6 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

THERE ARE NO INSTRUCTIONS PRINTED ON THIS PAGE

THERE ARE NO INSTRUCTIONS PRINTED ON THIS PAGE