



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Advanced Subsidiary Level

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**PHYSICAL SCIENCE**

**8780/04**

Paper 4 Advanced Practical Skills

**October/November 2013**

CONFIDENTIAL INSTRUCTIONS

**Great care should be taken to ensure that any confidential information given does not reach the candidates either directly or indirectly.**

**No access to the Question Paper is permitted in advance of the examination.**

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**The Supervisor's attention is drawn to the form on page 11 which must be completed and returned with the scripts.**

If you have any problems or queries regarding these instructions, please contact CIE

by e-mail: International@cie.org.uk

by phone: +44 1223 553554

by fax: +44 1223 553558

stating the Centre number, the nature of the query and the syllabus and paper number.

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This document consists of **10** printed pages and **2** blank pages.



## Safety

Supervisors are advised to remind candidates that **all** substances in the examination should be treated with caution. Only those tests described in the Question Paper should be attempted. Pipette fillers and safety goggles should be used where necessary.

In accordance with COSHH (Control of Substances Hazardous to Health) Regulations, operative in the UK, a hazard appraisal of the examination has been carried out.

The following hazard codes are used where relevant.

<b>[C]</b> corrosive substance	<b>[F]</b> highly flammable substance
<b>[H]</b> harmful or irritating substance	<b>[O]</b> oxidising substance
<b>[T]</b> toxic substance	<b>[N]</b> dangerous for the environment

The attention of Centres is drawn to any local regulations relating to safety, first-aid and disposal of chemicals.

'Hazard Data Sheets', relating to materials used in this examination, should be available from your chemical supplier.

### Before the Examination

**1** These instructions detail the apparatus required for the experiments in the Question Paper. **Access to the Question Paper is NOT permitted in advance of the examination.** The contents of these Confidential Instructions must not be revealed either directly or indirectly to the candidates.

**2 Preparation of materials**

Where quantities are specified for each candidate, they are sufficient for the experiments described in the Question Paper to be completed.

**In preparing materials, the bulk quantity for each substance should be increased by 25%** as spare material should be available to cover accidental loss. More material may be supplied if requested by candidates, without penalty.

All solutions should be bulked and mixed thoroughly before use to ensure uniformity.

Every effort should be made to keep the concentrations accurate to within one part in two hundred of those specified.

If the concentrations differ slightly from those specified, the Examiners will make the necessary allowance. They should be informed in the Supervisor's Report of the exact concentrations.

**3 Labelling of materials**

Materials must be labelled as specified in these Confidential Instructions. It may be required for some materials to be labelled but **without** the identities being included on the label.

It should be noted that descriptions of materials given in the Question Paper may not correspond with the specifications in these Instructions. **The candidates must assume the descriptions given in the Question Paper.**

**4 Size of group**

In view of the difficulty in preparing large quantities of solution of uniform concentration, it is recommended that the maximum number of candidates per group be 30 and that separate supplies of solutions be prepared for each group.

**5 Number of sets of apparatus**

The minimum number of sets of apparatus provided for each experiment is half the number of candidates taking the examination. There should, in addition, be a few spare sets of apparatus available in case problems arise during the examination.

## The Examination

### 1 Organisation of the Examination

Essential Information relating to the conduct and invigilation of the Practical Examination is given in the Handbook for Centres.

Candidates should be allowed access to the apparatus for each experiment for 45 minutes only. After spending 45 minutes on one experiment, candidates should change over to the other experiment. The order in which a candidate attempts the two experiments is immaterial.

### 2 Assistance to Candidates

Supervisors should make the following announcement at the start of the examination:

'The Examiners do not want you to waste time when you are unable to do any experiment. Any candidate who is unable to get results with an experiment may ask for help. The extent of this help will be reported to the Examiners, who may make a deduction of marks.'

Assistance should only be given when it is asked for by a candidate, or as directed in the Notes sections of these Instructions, or where apparatus is seen to have developed a fault. Assistance should be restricted to enabling candidates to make observations and measurements. Observations and measurements must not be made for candidates, and no help should be given with data analysis or evaluation.

All assistance given to candidates must be reported on the Supervisor's Report Form.

### 3 Colour blindness

It is permissible to advise candidates who request assistance on colours of, for example, precipitates and solutions (especially titration end-points). Please include with the scripts a note of the candidate numbers of such candidates. Reporting such cases with the scripts removes the need for a 'Special Consideration' application.

Candidates who are red/green colour blind do not generally have significant difficulty.

### 4 Faulty apparatus

In cases of faulty apparatus that prevent the required measurements from being taken, the Supervisor may allow extra time to give the candidate a fair opportunity to perform the experiment as if the fault had not been present.

### 5 Supervisor's Results

If asked to do so in the Confidential Instructions, the Supervisor, or other competent Physical Scientist, should carry out the required experimental work **out of sight of the candidates**. Access to the Question Paper is NOT permitted in advance of the examination.

Supervisor's Results are required for each session and each laboratory used in that session, and each set of solutions supplied. The Question Paper cover requests candidates to fill in details of the examination session and the laboratory used for the examination. It is essential that each packet of scripts contains a copy of the Supervisor's Results as the candidate's work cannot be assessed accurately without such information.

## After the Examination

**Each envelope returned to Cambridge must contain the following items:**

- 1 the scripts of those candidates specified on the bar code label provided,
- 2 a copy of the Supervisor's Results if required by the Confidential Instructions,
- 3 the Supervisor's Report, including details of any difficulties experienced by candidates (see pages 11 and 12),
- 4 the Attendance Register,
- 5 a plan of work benches, giving details by candidate number of the places occupied by the candidates for each experiment and session.

### Instructions for Preparing Apparatus and Materials

In addition to the fittings ordinarily contained in a Science laboratory, the apparatus and materials specified below will be necessary.

#### Question 1

##### Apparatus required (per set of apparatus unless otherwise specified)

- one metre rule (see notes 3 and 4)
- two clamp stands, minimum height 75 cm
- two bosses
- one rod (a reversed clamp will suffice); this is labelled **R** on Fig. 1.1 (see note 10)
- one thin, round metal rod, 1.5–2.5 mm diameter, to act as a pivot; a small screwdriver or nail would be suitable (see notes 5 and 6)
- one mass of 200 g labelled **Z**; the value of the mass should be covered so that it is hidden from candidates
- one weight holder of mass 100 g; this mass should be labelled 'weight holder' and should have its value covered so that it is hidden from candidates
- nine 10 g masses, each labelled 0.10 N, to fit on the weight holder
- two 180° protractors
- strong, smooth thread (fishing line, diameter 0.35 mm or nylon thread is suitable)
- Blu-tack
- PTFE tape (plumber's joint tape)

##### Notes

- 1 Each set of apparatus should be set up by the Supervisor as shown in Fig. 1.1. There should be no extra weights on the weight holder, and the thread **S** should **not** be perpendicular to the rule.

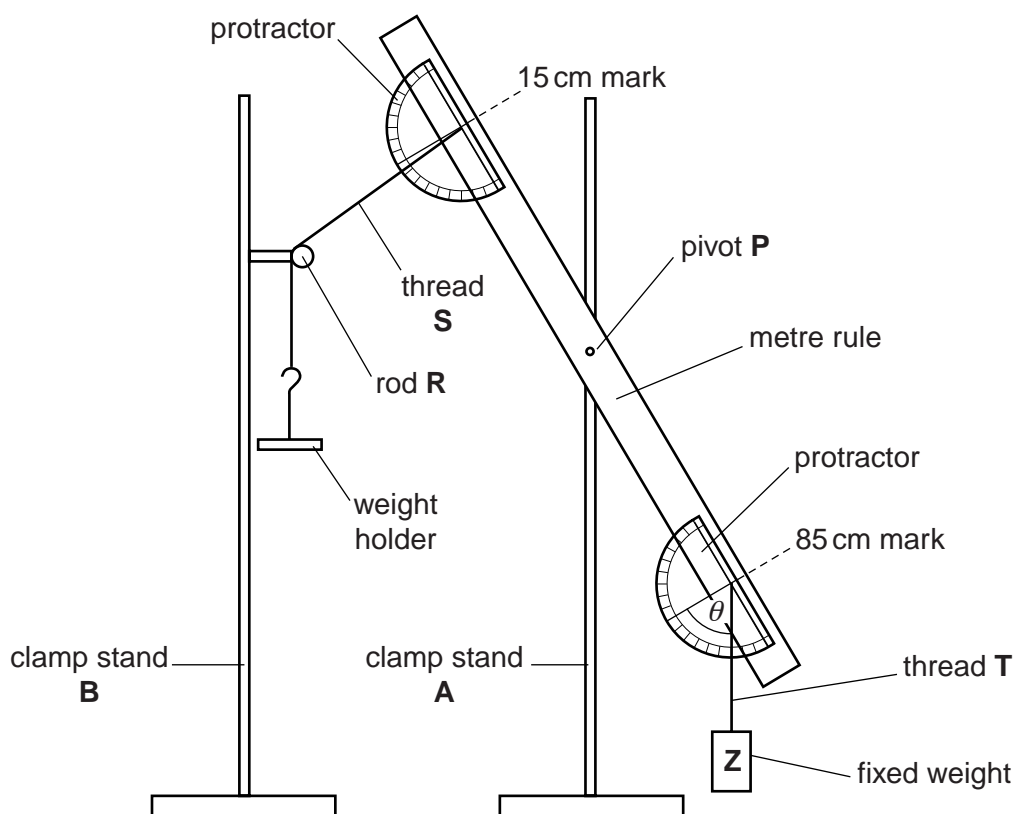
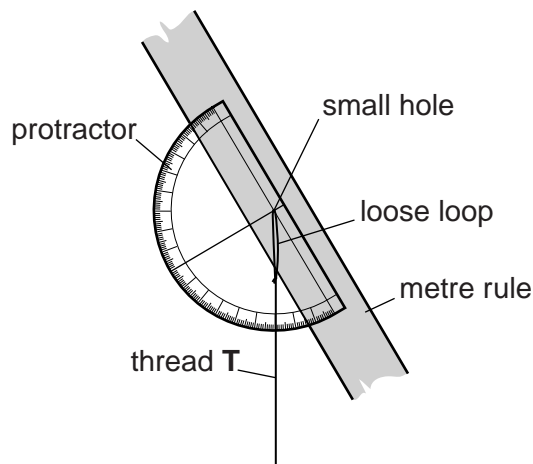


Fig. 1.1

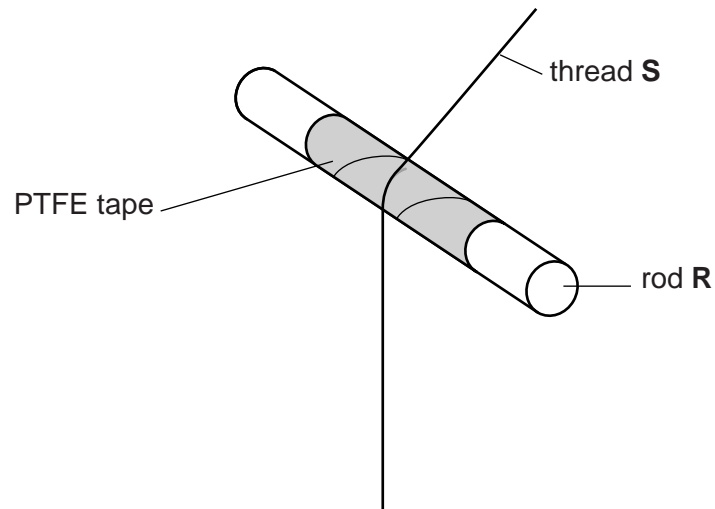
- 2 The height of the bench used should be such that the candidate can read the top protractor at the 15 cm mark when there are no extra weights on the weight holder.
- 3 Small holes need to be drilled on the centre line of the metre rule at the 15, 50 and 85 cm marks. The hole at the 50 cm mark should be just big enough for the pivot rod (a screwdriver or nail) to pass through and for the rule to pivot completely freely on it. The other holes are for threads **S** and **T** to pass through, and should be as small as possible.
- 4 Check that the centre of gravity of the drilled metre rule is at the 50 cm mark  $\pm 0.5$  cm. It may be necessary to adjust this using a piece of Blu-tack or similar at the light end of the rule.
- 5 The head of the nail or the handle of the screwdriver should be positioned so that it stops the rule from falling off the pivot.
- 6 The pivot rod must be securely clamped horizontally. The end of the pivot rod may be passed through a cork to facilitate secure clamping. The pivot rod must not bend under the weight of the loaded metre rule.
- 7 The protractors need to be attached to the rule using pieces of Blu-tack so that they are centred at the holes drilled at the 15 cm and 85 cm marks and parallel to the edge of the rule. The Blu-tack will hold the protractors away from the rule so that the threads holding the masses pass between the protractor and the rule.
- 8 Thread **T** should be approximately 15 cm in length such that, with no weights on the weight holder, weight **Z** should remain clear of the bench. The thread must be attached through the hole at the 85 cm mark with a large enough loop so that it swings freely as the angle varies (see Fig. 1.2). It may be necessary to have a loop at the other end of the thread to attach the 200 g mass. Thread **T** should not interfere with the protractor at the 85 cm mark or with the 200 g mass.



**Fig. 1.2**

- 9 Thread **S** should be of a length such that, with 90 g on the weight holder and the rod **R** adjusted so that thread **S** is at  $90^\circ$  to the rule, the weight holder remains clear of the bench and rod **R** does not interfere with the protractor at the 15 cm mark nor with the hook of the weight holder (approximately 55 cm between the hole and the bottom of the weight holder).

- 10** Friction between the rod **R** and thread **S** is reduced by wrapping the rod with PTFE tape (see Fig. 1.3). The pivot rod may also be wrapped in PTFE tape if this is found to help the rule to pivot more freely.



**Fig. 1.3**

**Action at changeover**

Remove weights from the weight holders. Reset all sets of apparatus as described in note 1 and shown in Fig. 1.1.

**Information required by Examiners**

Sample set of numerical results, clearly marked 'Supervisor's Results', obtained out of sight of the candidates.

## Question 2

Under no circumstances must the identity and concentration of solution A, or the identity of solution C, be divulged to candidates.

### Apparatus required (per set of apparatus unless otherwise specified)

- 1 x 50 cm<sup>3</sup> burette (per candidate)
- 1 x burette clamp
- 1 x stand
- 1 x funnel for filling burette
- 3 x 250 cm<sup>3</sup> conical flasks (per candidate)
- 1 x 25 cm<sup>3</sup> pipette (per candidate)
- 1 x pipette filler
- 1 x white tile
- 1 x wash-bottle containing distilled water
- 1 x 10 cm<sup>3</sup> measuring cylinder
- 2 x test-tubes (per candidate)
- 1 x test-tube rack
- 4 x dropping pipettes (per candidate)
- red and blue litmus paper
- beaker of very hot water (see note 1)
- paper towels

### Chemicals

See table on page 8.

### Notes

- 1 At some point in the experiment, candidates will need immediate access to a beaker of very hot water. Candidates may heat their own water (to close to boiling) or set up or have the use of a suitable water bath.
- 2 Spare materials and equipment should be available and can be provided without penalty. **Candidates should be made aware of this.**
- 3 Pipette fillers (or equivalent safety devices), safety goggles and disposable plastic gloves should be used where necessary.
- 4 Candidates should be warned of the dangers of using very hot water.

### Information required by Examiners

Sample set of numerical results for part (a), clearly marked 'Supervisor's Results', obtained out of sight of the candidates.

## Chemicals Required for Question 2

### Particular requirements

hazard	label	per candidate	identity	notes
[H]	<b>A</b>	150 cm <sup>3</sup>	0.08 mol dm <sup>-3</sup> iron(II) ammonium sulfate	Dissolve 31.4 g of freshly purchased iron(II) ammonium sulfate hexahydrate, Fe(NH <sub>4</sub> ) <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub> ·6H <sub>2</sub> O [ <b>H</b> ], in 1 mol dm <sup>-3</sup> H <sub>2</sub> SO <sub>4</sub> [ <b>H</b> ] to make 1 dm <sup>3</sup> solution.
[N]	<b>B</b>	150 cm <sup>3</sup>	0.02 mol dm <sup>-3</sup> potassium manganate(VII)	Dissolve 3.16 g of freshly purchased potassium manganate(VII) KMnO <sub>4</sub> [ <b>N</b> ][O][ <b>H</b> ] in 0.1 mol dm <sup>-3</sup> H <sub>2</sub> SO <sub>4</sub> to make 1 dm <sup>3</sup> solution.
[H]	<b>C</b>	10 cm <sup>3</sup>	0.2 mol dm <sup>-3</sup> iron(II) ammonium sulfate	Dissolve 78.4 g of freshly purchased iron(II) ammonium sulfate hexahydrate, Fe(NH <sub>4</sub> ) <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub> ·6H <sub>2</sub> O, in 1 mol dm <sup>-3</sup> H <sub>2</sub> SO <sub>4</sub> [ <b>H</b> ] to make 1 dm <sup>3</sup> solution.
[H]	<b>dilute sulfuric acid</b>	30 cm <sup>3</sup>	1 mol dm <sup>-3</sup> sulfuric acid	See syllabus for preparation.

Supervisors should carry out a titration between an acidified solution of **A** and solution **B** to ensure that the concentrations of the two solutions fall within the given range: 25.0 cm<sup>3</sup> of **A** should react with between 24.0 cm<sup>3</sup> and 26.0 cm<sup>3</sup> of **B**.

The standard bench reagents are set out below. If necessary, they may be made available from a communal supply: however, the attention of the Invigilators should be drawn to the fact that such an arrangement may enhance the opportunity for malpractice between candidates. Unless otherwise noted, each candidate should require no more than 10 cm<sup>3</sup> of any of these reagents.

hazard	label	identity	notes
[C]	<b>aqueous sodium hydroxide</b>	2.0 mol dm <sup>-3</sup> NaOH	See syllabus for preparation.
[H]	<b>aqueous hydrogen peroxide</b>	20 vol H <sub>2</sub> O <sub>2</sub>	Freshly purchased 20 vol H <sub>2</sub> O <sub>2</sub> [ <b>H</b> ] (1.7 mol dm <sup>-3</sup> / 5.7%).
	<b>distilled water / deionised water</b>		Access to distilled water, e.g. a wash-bottle.







**This form should be completed and sent to the Examiner with the scripts.**

### **SUPERVISOR'S REPORT FORM**

The Supervisor's Report should give full details of:

- (a)** any help given to a candidate (including the nature of the help given and the name and candidate number of the candidate),
- (b)** any cases of faulty apparatus (including the nature of the problem, the action taken to rectify it, any additional time allowed, and the name and candidate number of the candidate),
- (c)** assistance provided in the case of colour blindness,
- (d)** any other difficulties experienced by candidates, or any other information that is likely to assist the Examiner, especially if this information cannot be discovered in the scripts.

Cases of individual hardship, such as illness, bereavement or disability, should be reported direct to CIE on the normal Special Consideration form.

#### **Supervisor's Report**



**Information required by Examiners**

Sample set of numerical results, clearly marked 'Supervisor's Results'. These may be recorded on a spare copy of the Question Paper.

**A plan of work benches for each session/laboratory.**

**Declaration** (to be signed by the Supervisor)

The preparation of this practical examination has been carried out so as to maintain fully the security of the examination.

Signed .....

Name (in block capitals) .....

Centre Number .....

Centre Name .....

If scripts are required by CIE to be despatched in more than one envelope, it is essential that a copy of the relevant Supervisor's report, Supervisor's results and the appropriate seating plan(s) are sent inside **each** envelope.

