



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

**PHYSICS**

**5054/31**

Paper 3 Practical Test

**October/November 2012**

**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.**



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 number quoted above.

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



## Instructions for preparing apparatus

These instructions detail the apparatus required for each experiment in this paper. No access is permitted to the Question Paper in advance of the examination session.

## Number of sets of apparatus

In addition to a few spare sets, the minimum number of sets of apparatus to be provided should be sufficient to enable candidates to spend 20 minutes with the apparatus for each of Questions 1, 2 and 3, and one hour with the apparatus for Question 4. The order in which candidates answer the questions will be determined by the Supervisor. Candidates may spend one hour circulating around Questions 1, 2 and 3, followed by an hour on Question 4, or vice versa.

It is assumed that candidates will supply their own calculator and geometrical instruments, such as a set square,  $0^\circ$  to  $180^\circ$  protractor, pair of compasses and 30 cm rule. Candidates should be advised in advance that they may, if they wish, use quartz wristwatches with stopwatch facilities, providing that such wristwatches afford the required precision.

## Instructions for the supervision of the examination

The Supervisor, who may be a Physics teacher, is responsible for the administration of the examination according to the procedures detailed in the Handbook for Centres. In all instances, a Physics teacher should be present. Preferably, this teacher should have been responsible for the preparation of the apparatus. Two invigilators must be present at all times: it is not acceptable for a teacher who has been responsible for preparing the candidates for this paper to be the sole Supervisor or Invigilator.

Supervisors may 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.'

Supervisors should note that a candidate may only be given enough assistance to allow some raw readings or observations to be made. On no account should any assistance be given with the treatment or analysis of these readings and observations.

Supervisors may draw to the attention of the candidates any significant deviation between the apparatus provided and that detailed in the Question Paper, particularly where diagrams are given in the paper.

Candidates should be reminded that all their work should be written on the Question Paper. Rough paper must not be used.

The Supervisor must complete the Report at the back of these Instructions. Details should be given of any significant deviation between the apparatus used and that specified in these Instructions. A sample set of results can often help Examiners. A copy of this Report must be included in **each** packet of scripts.

**Question 1****Items to be supplied by the Centre (per set of apparatus, unless otherwise specified)**

Polystyrene or plastic cup with a volume of at least 120 cm<sup>3</sup>.

Supply of water at approximately 20 °C or above (see Note 1).

100 cm<sup>3</sup> measuring cylinder.

Thermometer with a range of –10 °C to 110 °C.

Supply of crushed melting ice.

5 ml plastic spoon or plastic teaspoon to enable candidates to transfer ice from the supply to the cup.

Stirrer.

Paper towels (see Note 2).

**Notes**

1. There should be sufficient water for all candidates. Each candidate will require approximately 100 cm<sup>3</sup> of water at 20 °C or above. This can be achieved by leaving the water in a container overnight, provided the ambient temperature is above 20 °C.
2. The paper towels are to be used by the candidate to dry the ice before it is added to the water in the cup.
3. At the changeover, the Supervisor should
  - empty the measuring cylinder,
  - either dry or replace the cup,
  - ensure that the supply of water at 20 °C or above is sufficient for the next candidate,
  - ensure that the supply of melting ice is sufficient for the next candidate,
  - replace wet paper towels with dry ones.

**Information required by Examiners**

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

**Question 2****Items to be supplied by the Centre (per set of apparatus, unless otherwise specified)**

1.5 V d.c. power supply e.g. a 1.5 V dry cell in a suitable holder.

Metre rule with a millimetre scale.

1.10 m length of 28 swg (0.38 mm diameter) constantan wire to be labelled wire A (see Note 1).

1.10 m length of 32 swg (0.27 mm diameter) constantan wire to be labelled wire B (see Note 2).

Card, on which is written the ratio of the cross-sectional area of wire A to the cross-sectional area of wire B (see Note 3).

Adhesive tape (see Note 4).

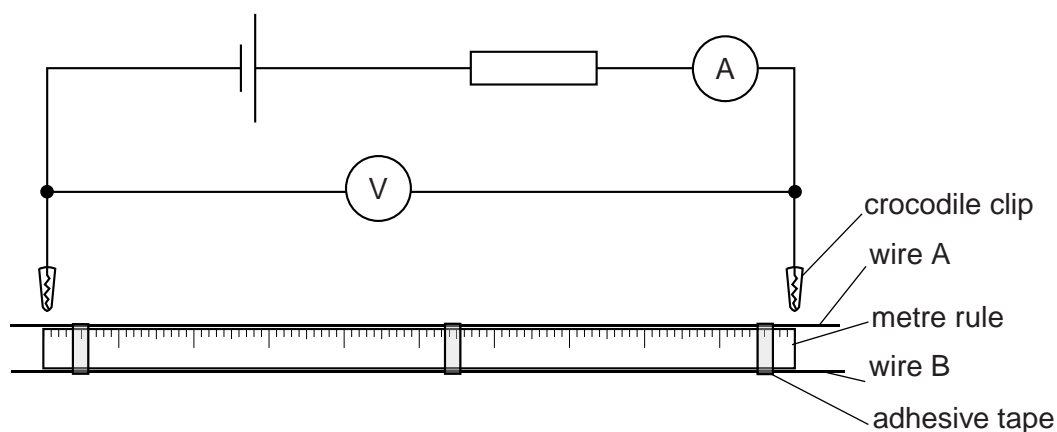
Ammeter capable of measuring a current of up to 200 mA to 10 mA or better. An analogue or digital meter is suitable.

Voltmeter capable of measuring a potential difference of up to 1.0 V to 0.05 V or better. An analogue or digital meter is suitable.

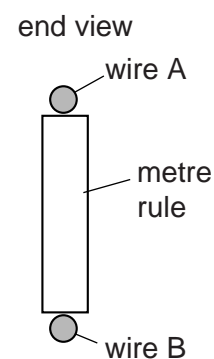
Two crocodile clips.

A protective resistor (see Note 5).

Six connecting leads to enable the Supervisor to set up the circuit shown in Fig. 2.1a (see Note 6).



**Fig. 2.1a**



**Fig. 2.1b**

## Notes

1. The 1.10 m length of constantan wire of 28 swg (0.38 mm diameter) should give an approximate resistance of  $5\ \Omega$ . If constantan wire is not available, then 28 swg (0.38 mm diameter) nichrome wire may be used as an alternative. A 1.10 m length of this wire should give an approximate resistance of  $11\ \Omega$ . The wire used should be labelled wire A. The candidate will connect the crocodile clips across a 1.00 m length of the wire. The label should be in the middle of the wire away from the ends.
2. The 1.10 m length of constantan wire of 32 swg (0.27 mm diameter) should give an approximate resistance of  $9\ \Omega$ . If constantan wire is not available, then 30 swg (0.32 mm diameter) nichrome wire may be used as an alternative. A 1.10 m length of this wire should give an approximate resistance of  $15\ \Omega$ . The wire should be labelled wire B. The label should be placed in the middle of the wire. **The same material must be used for wire A and wire B.**
3. If constantan wire is used, the ratio to be written on the card is

$$\frac{\text{cross-sectional area of wire A}}{\text{cross-sectional area of wire B}} = 1.88$$

If nichrome wire is used, the ratio to be written on the card is 1.42.

4. Wire A should be fixed to one side of the metre rule with adhesive tape. Wire B should be fixed to the opposite side, as shown in Fig. 2.1b.
5. The value used for the protective resistor is dependent on the material of the wire used. For constantan wire, the value is  $4.7\ \Omega$ . For nichrome wire the value is  $10\ \Omega$ .
6. The two connecting leads that are connected to the crocodile clips need to be at least 60 cm long so that the candidate can easily connect the leads to the resistance wires at the ends of the metre rule.
7. At the changeover, the Supervisor should check that the circuit is set up as in Fig. 2.1a with the crocodile clips disconnected from the resistance wire. If a cell is used, it should be checked and replaced if necessary.

## Information required by Examiners

Material of the wires, constantan or nichrome.

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

**Question 3****Items to be supplied by the Centre (per set of apparatus, unless otherwise specified)**

Converging lens of focal length 15 cm (see Note 1).

Cross-wire object (see Note 2).

Screen (see Note 3).

Light source (see Note 4).

Lens holder (see Note 5).

Metre rule with a millimetre scale.

Set square.

**Notes**

1. The Supervisor should ensure that each lens has a focal length between 14.5 cm and 15.5 cm. This may be done by focusing the image of a distant object on a screen. The focal length is the distance between the centre of the lens and the screen.
2. The cross-wire object should be formed by using a 20 cm square piece of card or board. A hole of diameter 2.0 cm should be made in the card. Two small pieces of thin wire should be glued to the front of the card so that they cross the hole along two perpendicular diameters. Thin tracing paper should be attached to the back of the card to cover the hole.
3. The screen should be formed by using a 20 cm square piece of card or board. The screen should have a white surface. The object and the screen should be supported so that they can stand perpendicular to the bench. This may be done either by attaching blocks of wood to the base of the object and screen or by supporting them with clamps, bosses and stands.
4. The apparatus should be in a dimly lit area of the laboratory and the light source (e.g. lamp) should be bright enough so that candidates can see an image of the cross-wire, magnified by a factor of 5, formed on the screen.
5. The centre of the cross-wire, the lamp and the centre of the lens when it is supported in the holder should all be at the same height above the bench.
6. At the changeover, the Supervisor should place the cross-wire object and the screen at a distance apart that is less than 1 m.

**Information required by Examiners**

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

**Question 4****Items to be supplied by the Centre (per set of apparatus, unless otherwise specified)**

Half-metre rule with a millimetre scale (see Note 1).

Round-headed nail, of length approximately 8–10 cm and of diameter approximately 2–3 mm (see Note 2).

Stand and boss to support the nail about 60 cm above the bench.

G-clamp (see Note 3).

Pulley wheel, supported about 40 cm above the bench (see Note 4).

10 g mass hanger with five 10 g slotted masses.

Thin string of approximate length 70 cm (see Note 5).

Length of string with a mass at the end to form a plumb-line (see Note 6).

Metre rule with a millimetre scale.

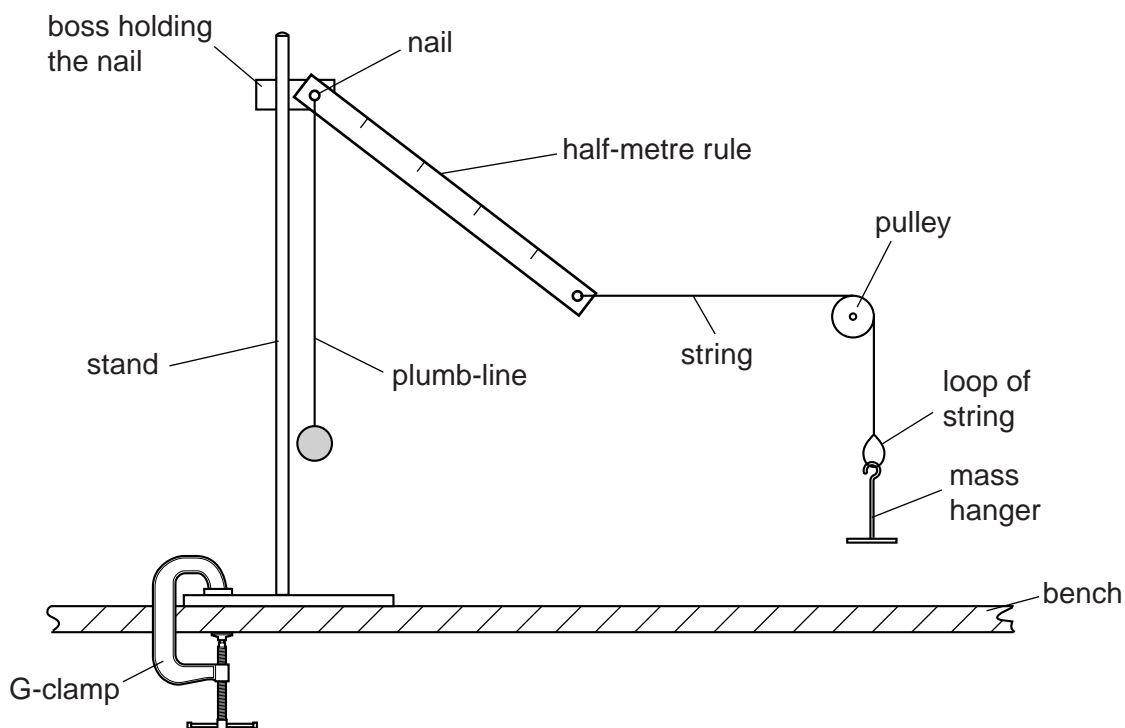
Set square.

Stand, boss and clamp to support the metre rule.

**Notes**

1. The half-metre rule should be stiff and preferably made of wood. A hole should be drilled in the rule at the 1.0 cm mark. This hole should have a diameter that is slightly greater than the diameter of the nail but less than the diameter of the head. When the half-metre rule is suspended from the nail it must be free to turn. A hole should also be drilled at the 49.0 cm mark. This should be of sufficient diameter to allow the thin string to pass through it.
2. Ideally it should be possible to secure the nail directly into the boss. If necessary, use a larger diameter nail or wrap tape around the nail so that it is secured horizontally in the boss.
3. The stand should be clamped to the bench using the G-clamp, as shown in Fig. 4.1.
4. Candidates will need to adjust both the height of the pulley wheel and the distance between the pulley wheel and the stand holding the nail. A suitable arrangement for holding the pulley should therefore be chosen.
5. One end of the thin string should be passed through the hole at the 49.0 cm mark and tied to the rule by creating a loose loop at the end of the string. A second loop should be tied at the other end of the string. The Supervisor should ensure that the knots do not slip. The **candidate** will pass the string over the pulley wheel and suspend the mass hanger from the second loop.
6. The plumb-line should be at least 50 cm long.

7. The Supervisor should pass the nail through the hole at the 1.0 cm mark on the half-metre rule so that the head of the nail is on the scale side of the rule. The pointed end of the nail should then be secured in the boss. In this way the head of the nail will prevent the rule falling off the nail. The Supervisor should then suspend the plumb-line from the nail. The **candidate** will then set up the remainder of the apparatus as shown in Fig. 4.1.



**Fig. 4.1**

8. Before the examination starts, and at the changeover, the Supervisor should ensure that the string does not pass over the pulley and the mass hanger is not attached to the loop of string.

### Information required by Examiners

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



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**This form must be completed and returned with the candidates' scripts.**

### REPORT ON PRACTICAL PHYSICS

The Supervisor is asked to give the following details, using the space provided on page 12.

- (a) Information required at the end of the test, as indicated in the Instructions.
- (b) Any help given to a candidate.
- (c) Any general difficulties encountered in preparing the apparatus.
- (d) Any difficulties experienced by particular candidates. These should include reference to difficulties due to faulty apparatus or materials and accidental damage to apparatus or materials. Candidates should be identified by name and candidate number.

Other cases of hardship, such as disability or illness, should be reported to CIE in the normal way.

The Supervisor is asked to provide a plan of the work benches, giving details by candidate numbers of the places occupied by the candidates for each session. The plan and report should be enclosed in the envelope containing the candidates' scripts. If more than one envelope is used, a copy of the report must be enclosed in each envelope.

#### Declaration to be signed by the Principal

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 .....



**Information required**

1. Material of the wires used in Question 2, constantan or nichrome.

material: .....

2. For questions 1, 2, 3 and 4, please enclose a sample set of numerical results, obtained out of sight of the candidates and clearly labelled "Supervisor's Results".

**Details of difficulties and any help given to candidates**

