
PHYSICS

5054/31

Paper 3 Practical Test

October/November 2016

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 Cambridge
by e-mail: info@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 **11** printed pages and **1** blank page.

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° to 180° 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 if 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 the help given 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)**

Expendable steel spring, with a spring constant of approximately 25 N/m, e.g. Griffin catalogue number 12463080 or legacy number XBV-590-010H.

Stand, boss and clamp to support the spring.

Small S-hook (see Note 1).

250 ml glass beaker.

Piece of modelling clay e.g. Plasticine (see Note 2).

String of approximate length 30 cm (see Note 3).

30 cm ruler with millimetre divisions.

Container with about 150 cm³ of water.

Paper towels or cloths to mop up spillages.

Notes

1. This can be a piece of stiff wire bent into an S-shape. Supervisors should ensure that this does not straighten when loaded with the modelling clay.
2. Supervisors should shape the modelling clay into an approximately cylindrical shape with flat ends. To ensure that the cylinder fits inside the beaker,
 - the height of the cylinder should be about 2 cm less than the internal height of the beaker,
 - the diameter of the cylinder should be about 2 cm less than the internal diameter of the beaker.
3. The cylinder of modelling clay should be formed around one end of the string. A loop should be tied at the other end of the string so that **candidates** can suspend the cylinder from the S-hook at the end of the spring.
4. At the changeover, the Supervisor should
 - dismantle any apparatus left set up by the candidate,
 - return water in the beaker to the container and replenish, if necessary,
 - remove any excess water from the surface of the modelling clay,
 - check that the cylinder is still attached to the string and that its shape is still as described in Note 2.

Information required by Examiners

Sample set of numerical results, clearly labelled “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)

Half-metre rule.

Two pieces of thread, each approximately 60 cm long (see Note 1).

Two split corks (see Note 2).

Two stands, bosses and clamps to support the split corks (see Note 3).

30 cm ruler with millimetre divisions.

Optical pin in cork to act as a fiducial mark.

Stopwatch.

Set square.

Notes

1. Loops should be tied at one end of each thread to support the half-metre rule as shown in Fig. 2.1. The loops should be tied quite tightly around the half-metre rule but **candidates** will need to slide the loops along the rule.

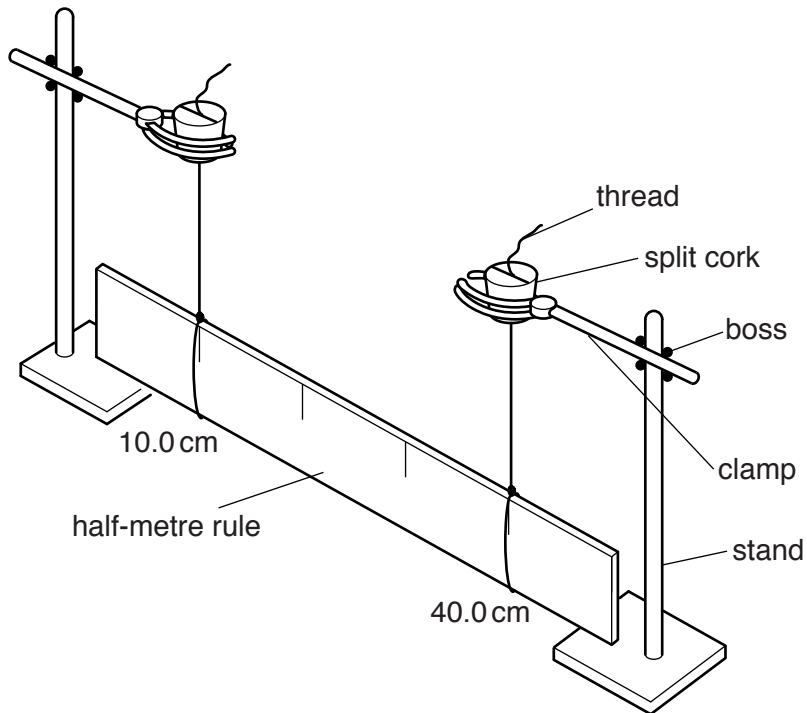


Fig. 2.1

2. The corks should be split vertically so that thread can pass between each half of the cork. The cork can then be tightly clamped so that the thread is held in the cork. Alternatively each cork can be replaced by two small rectangular blocks of wood, e.g. 5 cm × 5 cm × 1 cm and the thread can pass between these blocks.
3. The vertical threads should pass through the split corks which should then be supported by the clamps. The lengths of the threads between the top of the half-metre rule and the bottom of the split cork should be adjusted to 40.0 cm. When this has been done the clamps should be tightened and a mark should be made on the threads as they emerge from the split corks. The apparatus should be set up by the **Supervisor** with the half-metre rule about 10 cm above the bench and approximately horizontal. **Candidates** will be instructed not to adjust the heights of the clamps on the stands or the lengths of the threads.
4. Before the start of the experiment, the Supervisor should move the stands further apart **and** move the loops on the half-metre rule closer together so that the strings are not vertical.
5. At the changeover, the Supervisor should
 - adjust the apparatus, as necessary, so that it is set up as in Fig. 2.1,
 - move the stands further apart and the loops closer together.

Information required by Examiners

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)**

4.5V to 5V d.c. power supply (see Note 1).

Switch or plug key.

Two resistors of nominal value 10Ω (see Note 2).

Semiconducting diode (see Note 3).

Voltmeter capable of measuring a potential difference of up to 1V to a precision of 0.01V or better. An analogue or digital meter is suitable.

Ammeter capable of measuring a current of up to 1.0A to a precision of 0.01A or better. An analogue or digital meter is suitable.

Connecting leads (see Note 4).

Notes

1. The following are suitable power sources but all the candidates at a centre must be supplied with the same type of source:
 - three 1.5V dry cells in suitable holders connected in series,
 - four 1.2V rechargeable cells in suitable holders connected in series,
 - d.c. power supply of 4V or 5V.If a variable d.c. power supply is used, the variable control should be taped to prevent candidates altering the output voltage.
2. One of the resistors should be labelled 10Ω . The other resistor should be labelled Y and its value should be concealed from the candidates. The resistors should have a power rating of 3W or higher. The resistors should have suitable terminals to enable them to be connected into the remainder of the circuit. The RS component code of a suitable 10Ω resistor is RS 762-9380.
3. The diode must be able to withstand a current of 0.5A with a power rating of at least 0.5W. The diode should have suitable terminals to enable it to be connected into the remainder of the circuit. A 1N4001 diode is suitable (RS component code 751-2718).

4. The Supervisor should set up the apparatus as shown in Fig. 3.1. The terminals P and Q should be clearly labelled. The Supervisor should check the circuit by connecting the terminals P and Q together and closing the switch. Voltmeter and ammeter readings should be obtained. If the ammeter reading is zero, the diode may have been connected the wrong way round. After this check has been made the switch should be opened and the terminals P and Q should be disconnected. **Candidates** will be required to connect the 10Ω resistor between P and Q.

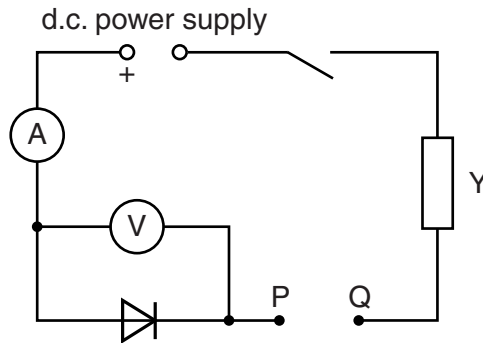


Fig. 3.1

5. At the changeover, the apparatus should be restored to its original state as in Fig. 3.1. There should be a gap between P and Q. The Supervisor should connect P and Q together, close the switch and check the ammeter and voltmeter readings have not changed significantly. If cells are used, they may need to be replaced and the diode replaced if the current is zero. The switch should then be opened and the terminals P and Q should be disconnected.

Information required by Examiners

Sample set of numerical results, clearly labelled "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)**

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

Cross-wire object (see Notes 2 and 4).

Screen (see Notes 3 and 4).

Light source.

Lens holder (see Note 5).

Metre rule with a millimetre scale.

Set square.

Notes

- Supervisors should select a lens that has a focal length in the range 14.5 cm to 15.5 cm.
- 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. Tracing paper should be attached to the back of the card to cover the hole.
- 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 could be done by attaching blocks of wood to the base of the object and screen, as shown in Fig. 4.1.

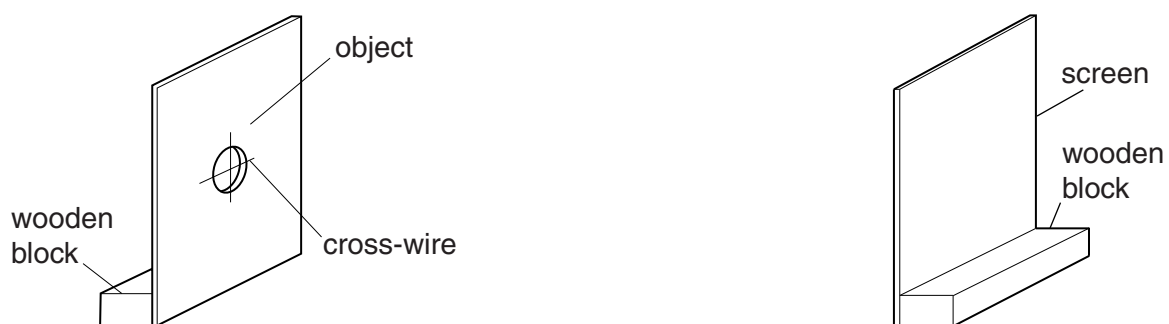


Fig. 4.1

5. The centre of the cross-wire object, the light source and the centre of the lens when it is supported in the holder should all be at the same height above the bench.
6. The apparatus should be in a dimly lit area of the laboratory. The lamp should be bright enough so that candidates can see a magnified image of the cross-wires formed on the screen when the distance between the object and the screen is 100 cm.
7. At the changeover, the Supervisor should dismantle any apparatus that has been left set up by the candidate.

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 Cambridge 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

For each question, 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