

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 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).**

12 microscope slides each of approximate dimensions $7.5\text{ cm} \times 2.5\text{ cm} \times 0.1\text{ cm}$ (see Note 1).

Masking tape (see Note 2).

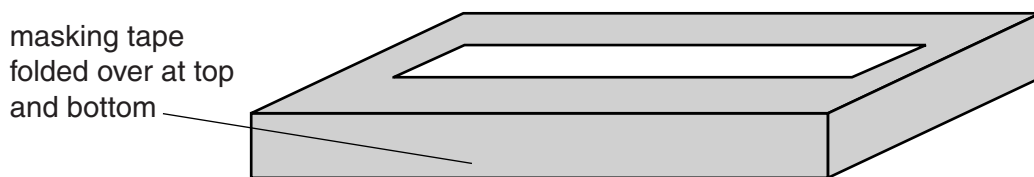
Card on which is written the thickness and the mass of a single microscope slide (see Note 3).

30 cm ruler with a millimetre scale.

Access to a top-pan balance (see Note 4).

Notes

1. The microscope slides should be selected so that they are all very similar. In particular the thickness of slides often varies, so they should be selected so that they have very similar thicknesses.
2. Eleven of the slides should be stacked together. Masking tape should then be wound around the edges of the stack and folded over the top and bottom of the stack, so that the candidate is unable to see how many slides are in the stack. This is shown in Fig. 1.1.

**Fig. 1.1**

3. The Supervisor should measure the thickness t and the mass m of the **single remaining slide**. The mass should be measured to 0.1 g and the thickness should be measured to 0.001 cm. The values of t and m should then be written on a card in the form shown in Fig. 1.2.

| |
|--|
| Thickness of a single slide $t = \dots\dots\dots$ cm Mass of a single slide $m = \dots\dots\dots$ g |
|--|

Fig. 1.2

4. The top-pan balance must be capable of measuring to a precision of 0.1 g. There should be sufficient top-pan balances to ensure that candidates do not face undue delay when measuring the mass of the stack of slides.
5. At the changeover, the Supervisor should check that the tape around the stack of slides has not been disturbed. The tape should be replaced if necessary.

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).

Mirror in holder (see Note 2).

Ray box with slit (see Note 3).

Protractor.

Notes

1. This experiment should be set up in a dimly lit area of the laboratory.
2. The mirror should have a minimum length of approximately 8 cm. The holder is to be used to secure the mirror such that the longest edge of the mirror can be placed on a page of the question paper with the mirror perpendicular to the page.
3. If a ray box with slit is not available, then a slit may be constructed as described below and a source of light may be placed behind the slit.

The slit should be formed using a 20 cm square piece of card or board. A slit should be made in the card, passing vertically upwards from the centre of the base of the card. The height of the slit should be slightly greater than the height of the plane mirror and its width should be approximately 1 mm. A piece of tracing paper should be taped across the back of the slit.

The slit should be supported so that it can stand perpendicular to the bench. This should be done by attaching wooden blocks to the base of the slit. The slit should not be obscured so two blocks should be used, one each side of the slit. This is shown in Fig. 2.1.

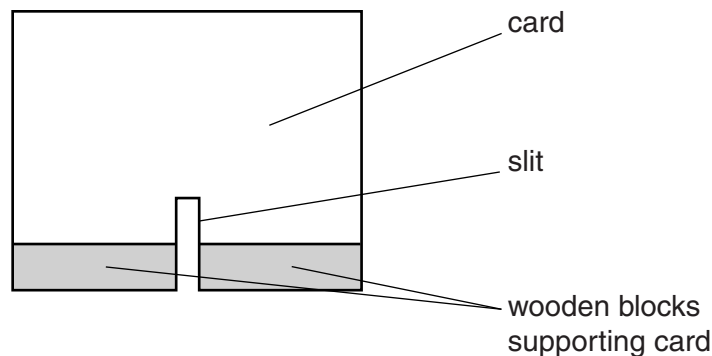


Fig. 2.1

4. At the changeover, the Supervisor should check that all the apparatus is still present, in particular the protractor.

Information required by Examiners

Sample set of numerical results, clearly labelled “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).

3V d.c. power supply (see Note 1).

Digital voltmeter capable of measuring a voltage of up to 4V to a precision of 0.01V (see Note 2).

Resistor of nominal value 470 k Ω , e.g. RS Components product code 707-8772, labelled 'resistor'.

Electrolytic capacitor of nominal value 100 μ F, e.g. RS Components product code 684-1905 (see Note 3).

Switch or plug key.

Stopwatch reading to 0.1 s or better.

Connecting leads to enable the Supervisor to set up the circuit shown in Fig. 3.1 (see Note 3).

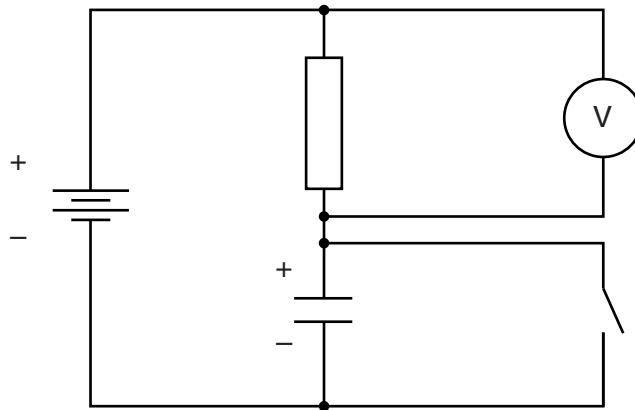


Fig. 3.1

Notes

1. Two 1.5V dry cells in a suitable holder may be used. If a variable power supply is used, the Supervisor must ensure that the candidates cannot alter the output voltage.
2. A **digital voltmeter** must be used so that it has the required high resistance. A digital multimeter fixed on an appropriate voltage range is suitable. If this is not available, then the capacitor and the resistor could be replaced by ones of value 1000 μ F and 47 k Ω respectively and these could be used with an analogue voltmeter of approximate resistance 50 k Ω .
3. The electrolytic capacitor should be labelled 'capacitor'. The circuit could be hazardous if the capacitor is connected the wrong way round or if higher voltages are used. The Supervisor must take care to connect the negative terminal of the electrolytic capacitor to the negative terminal of the power supply.
4. At the changeover, the Supervisor should check that the apparatus is still set up as in Fig. 3.1.

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).

Three expendable steel springs, with spring constants of approximately 25 N/m and with a coil of unstretched length approximately 2 cm, e.g. Griffin catalogue number XBV-590-010H (see Note 1).

Strong thread of approximate length 20 cm.

Rod or wooden dowel of approximate length 12 cm (see Note 2).

Stand, boss and clamp to support the rod (see Note 3).

100 g slotted mass hanger with five 100 g slotted masses.

30 cm ruler with a millimetre scale.

Notes

1. If new springs are used, they should be gently stretched a few times by hand, keeping well within the elastic limit of the springs. One of the springs should be left on the bench for the candidates to use and the other two springs should be set up as described in Note 2. If Griffin springs are not available, alternative springs with similar characteristics may be used, but the springs used at one station should be as identical as possible. If the alternative springs have a longer length than Griffin springs, then it may be necessary to increase the length of the rod.
2. The diameter of the rod should be the same as the diameter of the loops at the ends of the springs so that the loops are a tight fit onto the rod. The loop of one spring should be pushed onto one end of the rod and a loop of the second spring should be pushed onto the other end. The loops should be symmetrical about the centre of the rod and should be separated by about 8 cm. The lower loops should then be tied together with the thread and a loop should be created at the end of the thread so that the slotted mass hanger can be suspended from the loop. In this position, the springs should be approximately horizontal and not under any tension. If necessary the Supervisor should adjust the separation of the loops so that the apparatus is set up as shown in Fig. 4.1.

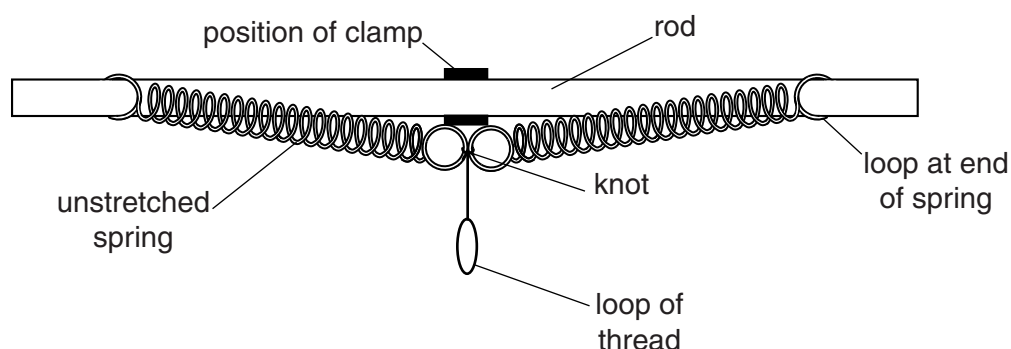


Fig. 4.1

3. The clamp, boss and stand should support the rod at its centre so that it is about 50 cm above the bench. The Supervisor should hang a total mass of 600 g from the loop in the thread, to check that the masses do not touch the bench. If the masses touch the bench, the height of the rod should be increased. The loops should then be secured to the rod with adhesive tape. The Supervisor should remove the slotted masses but leave the mass hanger in position, as shown in Fig. 4.2.

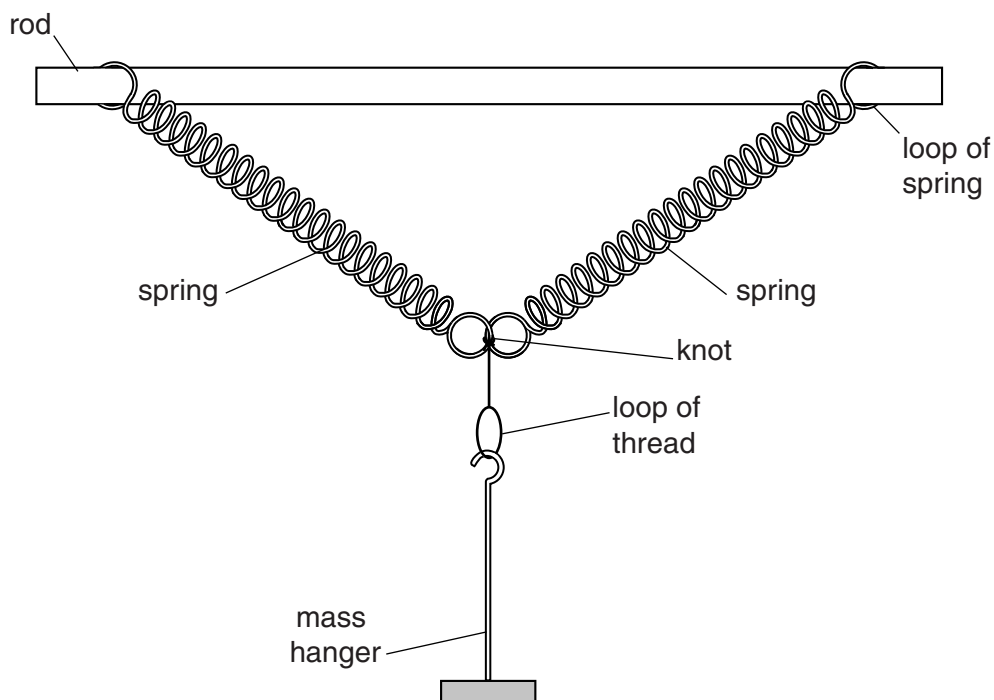


Fig. 4.2

4. At the changeover, the Supervisor should remove any slotted masses from the hanger and check that the apparatus is still set up as in Fig. 4.2.

Information required by Examiners

Sample set of numerical results, clearly labelled “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