



## 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)**

Single sheet of plain A4 paper with a specification of  $80\text{ g/m}^2$  (see Notes 1 and 2).

Stack of 100 sheets of the same paper.

Two rubber bands (see Note 3).

30 cm ruler, with a millimetre scale.

Set square.

**Notes**

1. A4 paper should have dimensions  $29.7\text{ cm} \times 21.0\text{ cm}$ . If this is not available, the closest alternative should be chosen.
2. The single sheet of paper should be labelled A and its mass, to the nearest 0.1 g, should be written on the sheet in the form "Sheet A. mass  $m = \dots\dots\dots\text{ g}$ "
3. The stack of 100 sheets of paper should be held together by means of the rubber bands. The rubber bands should be chosen so that the stack of paper does not curl.
4. At the changeover, the Supervisor should replace the single sheet of paper labelled A if it has been marked and should also ensure that the rubber bands are still in place around the stack.

**Information required by Examiners**

Length and width of paper used (if not A4).

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)**

Ramp (see Note 1).

Block of wood or other means of supporting the ramp (see Note 2).

Blu-Tack (see Note 3).

Dynamics trolley (see Note 4).

Card, with the mass of the trolley given to the nearest 0.001 kg and written in the form “ $m = \dots\dots\dots$  kg”.

Additional block of wood to be placed at the end of the ramp (see Note 5).

Metre rule, with a millimetre scale.

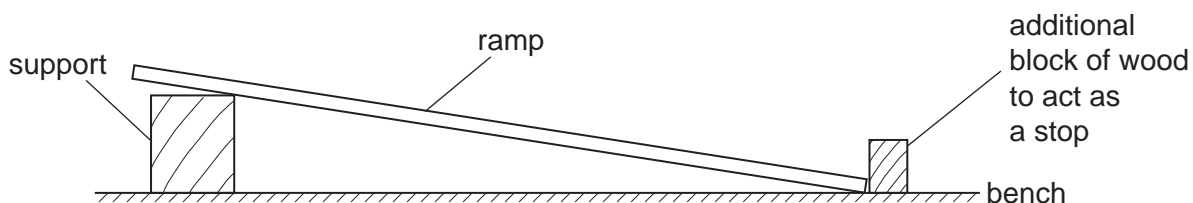
Set square.

Stopwatch reading to 0.1 s or better.

Opaque, removable, adhesive tape of length 15 cm (see Note 6).

**Notes**

1. The ramp should be approximately 1 m long and 15 cm wide. The candidate will need to release the trolley from a point that is 0.700 m from the bottom of the ramp. The ramp should be stiff so that it does not bend when the trolley runs down it.
2. The height of the block of wood or other support (e.g. stand and clamps) should be chosen such that the trolley takes between 1.5 s and 2.5 s to travel 0.70 m down the ramp. When the height of the support has been chosen, the Supervisor should set up the apparatus as shown in Fig. 2.1.

**Fig. 2.1**

Marking the position of the apparatus may help the Supervisor at the changeover.

3. Blu-Tack may be used to secure the ramp, support and block of wood in position.
4. If a dynamics trolley is not available, then a toy car may be used as a replacement. Supervisors should ensure that the toy car runs smoothly down the ramp.
5. This additional block of wood is to act as a stop, preventing the trolley rolling along the bench.
6. The tape is to be used by the candidate to mark the start position of the trolley. Masking tape would be suitable.
7. At the changeover, the Supervisor should check that the ramp is still in its original position and should remove any tape on the ramp.

### **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)

Rectangular glass or Perspex block of the type used in optics experiments (see Note 1).

Ray box with slit (see Note 2).

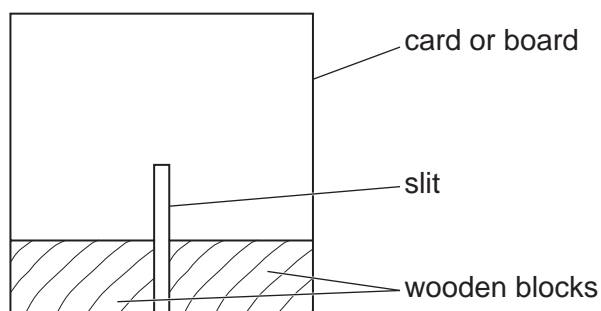
Protractor, with a scale reading to  $1^\circ$  or better.

#### Notes

1. The longest side of the block should have a length between 7 cm and 16 cm.
2. 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 transparent block 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. 3.1.



**Fig. 3.1**

#### 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)**

D.C. power supply capable of delivering a current of approximately 3 A to a load of  $2\ \Omega$  (see Note 1).

Ammeter capable of measuring a current of up to 5 A to 0.1 A or better. An analogue or digital meter is suitable.

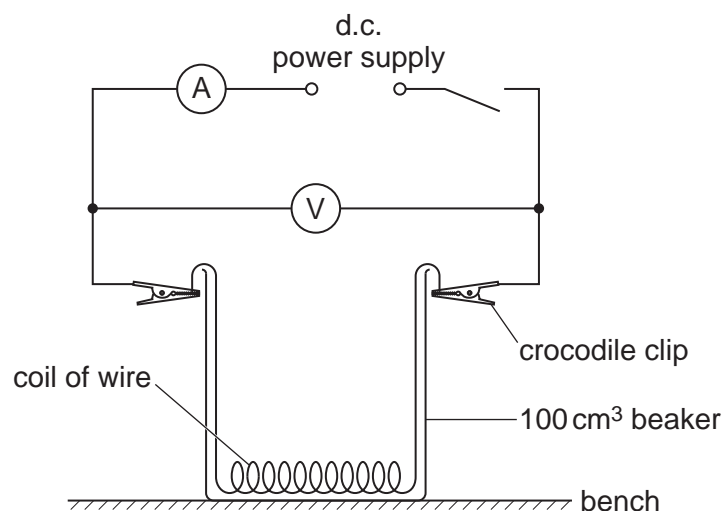
Voltmeter capable of measuring a potential difference of up to 10 V to 0.1 V or better. An analogue or digital meter is suitable.

Switch or plug key.

28 swg (0.38 mm diameter) constantan wire (see Notes 2 and 3).

Two crocodile clips (see Note 4).

Six connecting leads to enable the Supervisor to set up the circuit shown in Fig. 4.1.



**Fig. 4.1**

100 cm<sup>3</sup> heat resistant beaker (e.g. Pyrex beaker).

250 cm<sup>3</sup> container with a spout, containing 200 cm<sup>3</sup> of water at room temperature.

Measuring cylinder capable of measuring 50 cm<sup>3</sup>.

Thermometer, with range  $-10\ ^\circ\text{C}$  to  $110\ ^\circ\text{C}$ , supported by a stand, boss and clamp (see Note 5).

Glass stirrer.

Paper towels to mop up spillages.

Stopwatch or stop clock (see Note 6).

## Notes

1. This could be a 6V power supply provided it can deliver the required current. Dry cells **cannot** provide the required current for a sufficient time and cannot be used. Alternatively a supply of higher voltage may be used with an appropriate series resistor, e.g. if a 9V supply were used then a  $1\ \Omega$  series resistor should be used. Note the series resistor must have a high power rating. The  $1\ \Omega$  resistor in the above example would need to have a minimum power rating of 9W. Such a resistor will need to be placed on a heat-proof mat and candidates should be warned that the resistor will get hot.
2. A 50cm length of constantan wire of 28swg (0.38mm diameter) should give an approximate resistance of  $2\ \Omega$ . The constantan wire should be wound around a pencil to form a coil. This should then be placed at the bottom of the  $100\text{cm}^3$  beaker with the two ends of wire protruding over the side of the beaker as shown in Fig. 4.1. The wire should be taped to the top edge of the beaker. The Supervisor should ensure that the turns of the coil do not touch.
3. If 28swg constantan wire is not available, then constantan wire of lower swg (higher diameter) may be used. In this case the length of wire will need to be increased to give a resistance of  $2\ \Omega$ , e.g. for 26swg (0.46mm diameter) constantan wire, the length will need to be about 70cm. If very long wire is used, the Supervisor should ensure that the turns of the coil formed by the wire do not touch.

Alternatively 24swg (0.56mm diameter) nichrome wire may be used. A 50cm length of this wire should give an approximate resistance of  $2\ \Omega$ . If a lower swg (higher diameter) nichrome wire is used, then a longer length will be required.

The Supervisor should **not** use short lengths of higher swg (lower diameter) wire because the wire may overheat and melt.

4. The two crocodile clips should be used to connect the coil to the remainder of the circuit.
5. The thermometer should have  $1^\circ\text{C}$  divisions, such that the candidate can interpolate to at least  $0.5^\circ\text{C}$ .
6. Stop clocks recording times to the nearest second would be adequate for this experiment.
7. At the changeover, the Supervisor should check that the circuit is set up as in Fig. 4.1 with the switch open. Water in the  $100\text{cm}^3$  beaker should be discarded. The Supervisor should ensure that there is sufficient water at room temperature for the next 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 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. Length  $l$  and width  $w$  of paper used in Question 1 (if not A4):

$l =$  .....

$w =$  .....

2. 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**