



## Instructions for preparing apparatus

These Confidential 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 30cm ruler. Candidates should be advised in advance that they may, if they wish, use 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 Supervisor's Report at the back of these Confidential Instructions. Details should be given of any significant deviation between the apparatus used and that specified in these Confidential Instructions. A sample set of results can often help Examiners. A copy of this Supervisor's 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 an outside diameter approximately 15 mm, coiled length approximately 20 mm and spring constant approximately 25 N/m e.g. Philip Harris product code B8G87194.

Loop of string (see note 1).

Roll of clear adhesive tape (see note 2).

Scissors to cut the adhesive tape.

30 cm ruler with a mm scale.

Stopwatch.

Sheet of 2 mm graph paper

Exhibit A (see note 3).

**Notes**

1. The string should be approximately 20 cm long, 1.5 mm wide and made of cotton or nylon. The string should be tied into a loop that passes through one end of the spring. The string should be strong enough to support a 0.5 kg load without stretching or breaking.
2. 20 mm wide sellotape or scotch tape are suitable. There must be sufficient tape for each candidate to detach a 20 cm length for the experiment and another short length to affix one end of the graph paper to the bench.
3. Exhibit A shows the candidate what their equipment will look like when assembled.

The Supervisor should construct exhibit A using another:

- expendable steel spring
- loop of string
- 20 cm of adhesive tape
- sheet of graph paper.

Exhibit A consists of the 20cm long piece of adhesive tape with 15cm of its length affixed to the sheet of graph paper and the remaining 5cm of tape passed through the loop of string and pressed together as shown in Fig. 1.1. The other end of the loop in the string should pass through one end of the spring.

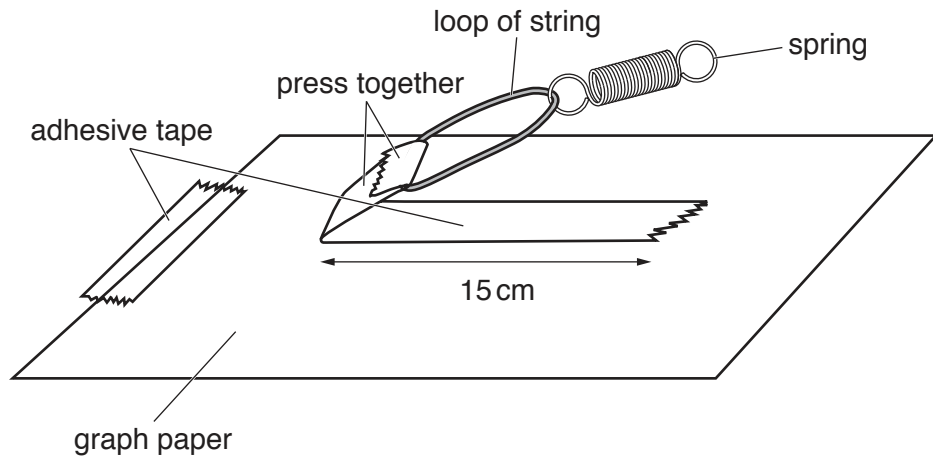


Exhibit A – for reference only

**Fig. 1.1**

4. At the changeover, the Supervisor should:

- check that there is sufficient adhesive tape available for the next candidate
- remove the tape from the loop of string (Supervisors may wish to have another spring and loop available for the next candidate)
- remove and discard the graph paper and tape used by the previous candidate
- check that exhibit A is still available for candidates to look at.

### 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)**

Converging lens with focal length of approximately 15 cm (see note 1).

Stand, two bosses and two clamps.

Lamp in a lamp holder with connecting leads (see note 2).

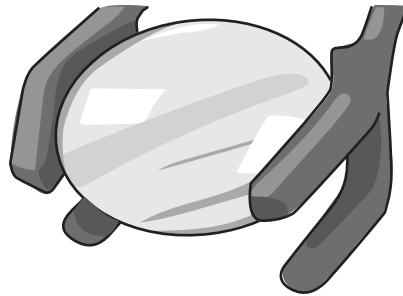
Power supply (see note 3).

Sheet of 2 mm graph paper.

Metre rule with a mm scale.

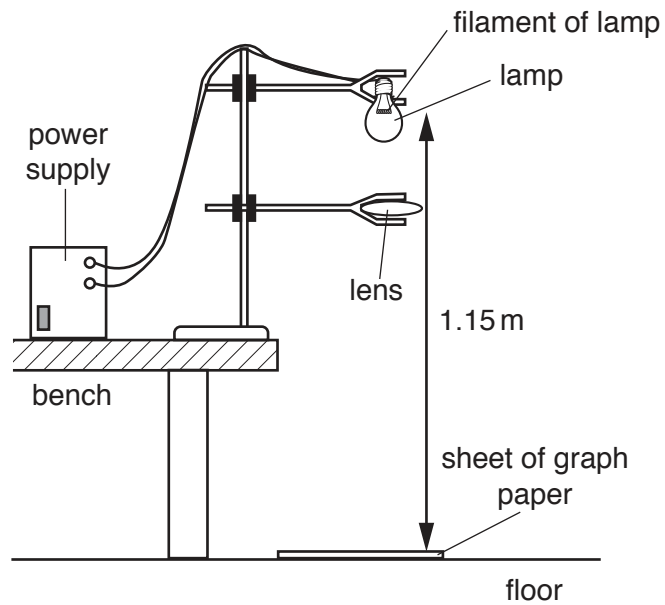
**Notes**

1. The lens must be fixed securely in the jaws of a clamp, as shown in Fig. 2.1.



**Fig. 2.1**

2. Small torch lamp of approximate diameter 1 cm, 2.5 V, 250 mA, filament indicator lamp, clear, e.g. RS 106-313. It must be placed in a small holder e.g. RS 171-2503 so that it can be gripped by the second clamp. This clamp should be fastened to the stand so that the filament of the lamp is 1.15 m above the graph paper as shown in Fig. 2.2. With the lamp at this height it must be possible to move the lens up and down between 0 and 25 cm from the lamp. If this is not possible due to the height of the bench, the graph paper can be supported above the floor whilst keeping a distance of 1.15 m between the lamp and the graph paper.



**Fig. 2.2**

3. The power supply should be sufficient to power the lamp at its normal operating brightness. The experiment should be performed in a darkened part of the laboratory.
4. At the changeover the Supervisor should ensure that the lamp is still working and is 1.15 m above the graph paper.

#### **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)**

Cooking oil – approximately 130 cm<sup>3</sup> in a beaker labelled **cooking oil**.

100 cm<sup>3</sup> capacity measuring cylinder (see note 1).

Access, without undue delay, to a top-pan balance reading to a precision of at least 1 g.

Paper towels to mop up any spillages.

**Notes**

1. All the measuring cylinders used by the candidates should be identical to the measuring cylinder used by the Supervisor.
2. At the changeover the Supervisor should ensure that the next candidate has an empty measuring cylinder and that there is sufficient cooking oil.

**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)**

4V to 5V d.c. power supply (see note 1).

Switch or plug key.

Resistor with a resistance of  $47\ \Omega$  (see note 2).

Thermometer,  $-10\ ^\circ\text{C}$  to  $110\ ^\circ\text{C}$  to a precision of at least  $1\ ^\circ\text{C}$ .

Thermistor and a means of supporting it (see note 3).

Supply of very hot water of at least  $90\ ^\circ\text{C}$ , e.g. access to a kettle.

$250\ \text{cm}^3$  graduated beaker.

Voltmeter capable of measuring a potential difference of up to  $5.0\ \text{V}$  to a precision of  $0.1\ \text{V}$  or better. An analogue or digital meter is suitable.

Connecting leads.

Beaker of cold water and a dropping pipette (see note 4).

Stirrer

Paper towels to mop up any spillages.

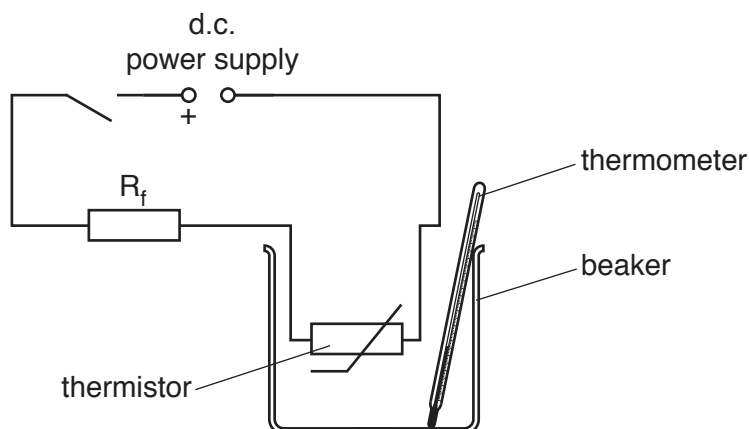
**Notes**

1. The following are suitable power sources, but all the candidates at a centre must be supplied with the same type of source:

- three  $1.5\ \text{V}$  dry cells in suitable holders connected in series
- four  $1.2\ \text{V}$  rechargeable cells in suitable holders connected in series
- d.c. power supply of  $4\ \text{V}$  to  $5\ \text{V}$ .

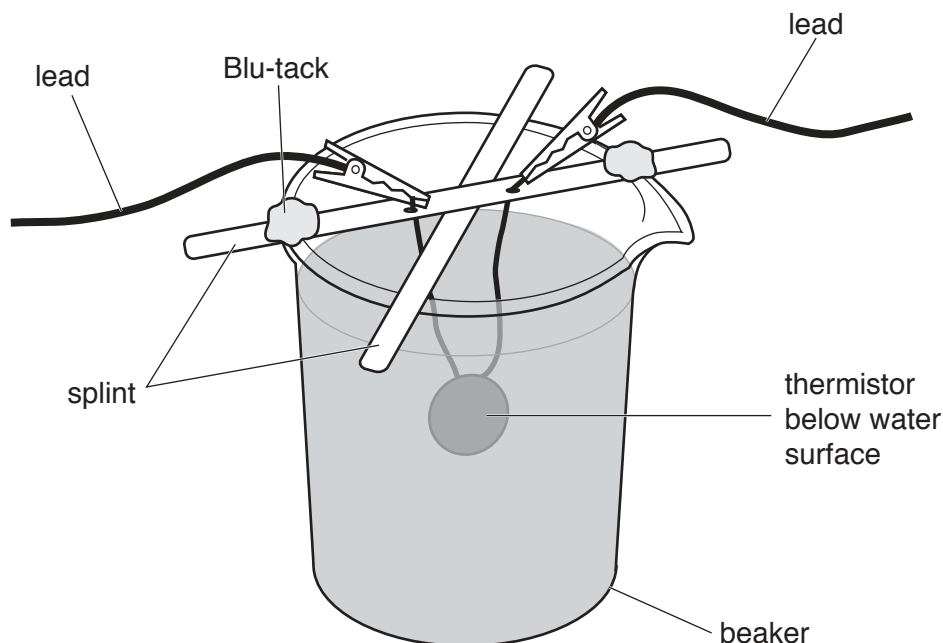
If a variable d.c. power supply is used, the variable control should be taped to prevent the candidates altering the output voltage.

2. The  $47\ \Omega$  fixed resistor is part of a circuit shown in Fig. 4.1 which must be set up by the Supervisor. The resistor should have a power rating of  $0.5\ \text{W}$  or higher. The resistor should have suitable terminals to enable further connections to be made.



**Fig. 4.1**

3. A suitable disc thermistor has a resistance of about  $500\ \Omega$  at  $25^\circ\text{C}$ . The RS component code of such a thermistor is RS 191-2229. The thermistor will be submerged in very hot water. A suitable way of suspending the thermistor is shown in Fig. 4.2.



**Fig. 4.2**

Fig. 4.2 shows a simple framework of wooden splints across the top of the beaker. The wires of the thermistor pass through very small holes in one of the splints and the ends are attached to crocodile clips and connecting leads. Blu-tack is used to ensure that the framework does not slip.

4. A 5 ml dropping pipette is suitable. Candidates will use the dropping pipette to remove small amounts of hot water from the beaker containing the thermistor and replace this water with a similar amount of cold water.
5. At the changeover the Supervisor should ensure that the beaker containing the thermistor has no water in it, that sufficient hot water is available for the next candidate and that the circuit is restored to the arrangement shown in Fig. 4.1 with the switch open.

### Information required by Examiners

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

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

### **SUPERVISOR'S REPORT**

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 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 .....

**Information required**

1. Type and e.m.f. of power source used in Question 4.

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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**

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