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**PHYSICS**

**5054/31**

Paper 3 Practical Test

**October/November 2019**

**CONFIDENTIAL INSTRUCTIONS**



**This document gives details of how to prepare for and administer the practical exam.**

**The information in this document and the identity of any materials supplied by Cambridge International are confidential and must NOT reach candidates either directly or indirectly.**

**The supervisor must complete the report at the end of this document and return it with the scripts.**

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If you have any queries regarding these confidential instructions, contact Cambridge International stating the centre number, the syllabus and component number and the nature of the query.

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This document consists of **12** printed pages.

## General information about practical exams

Centres must follow the guidance on science practical exams given in the *Cambridge Handbook*.

### Safety

Supervisors must follow national and local regulations relating to safety and first aid.

Only those procedures described in the question paper should be attempted.

Supervisors must inform candidates that materials and apparatus used in the exam should be treated with caution. Suitable eye protection should be used where necessary.

The following hazard codes are used in these confidential instructions, where relevant:

C	corrosive	MH	moderate hazard
HH	health hazard	T	acutely toxic
F	flammable	O	oxidising
N	hazardous to the aquatic environment		

Hazard data sheets relating to substances used in this exam should be available from your chemical supplier.

### Before the exam

- The packets containing the question papers must **not** be opened before the exam.
- It is assumed that standard school laboratory facilities, as indicated in the *Guide to Planning Practical Science*, will be available.
- Spare materials and apparatus for the tasks set must be available for candidates, if required.

### During the exam

- It must be made clear to candidates at the start of the exam that they may request spare materials and apparatus for the tasks set.
- Where specified, the supervisor **must** perform the experiments and record the results as instructed. This must be done **out of sight** of the candidates, using the same materials and apparatus as the candidates.
- Any assistance provided to candidates must be recorded in the supervisor's report.
- If any materials or apparatus need to be replaced, for example, in the event of breakage or loss, this must be recorded in the supervisor's report.

### After the exam

- The supervisor must complete a report for each practical session held and each laboratory used.
- Each packet of scripts returned to Cambridge International must contain the following items:
  - the scripts of the candidates specified on the bar code label provided
  - the supervisor's results relevant to these candidates
  - the supervisor's reports relevant to these candidates
  - seating plans for each practical session, referring to each candidate by candidate number
  - the attendance register.

## Specific information for this practical exam

### 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 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.

### Question 1

#### Items to be supplied by the Centre (per set of apparatus, unless otherwise specified):

- five expendable steel springs, with a spring constant of approximately 25 N/m, e.g. Griffin catalogue number 12463080 or legacy number XBV-590-010H (see note 1)
- a piece of card with a hole at the centre (see note 2)
- a 100g slotted mass hanger and two 100g slotted masses
- a stand, boss and clamp
- a G-clamp or heavy weight (see note 3)
- a stopwatch reading to 0.1 s or better.

#### Notes

1. The springs should be attached together end to end by threading the loops at the end of each spring through each other as shown in Fig. 1.1a. The chain of springs should then be attached to the clamp at one end and to the mass hanger and masses at the other as shown in Fig. 1.1b.

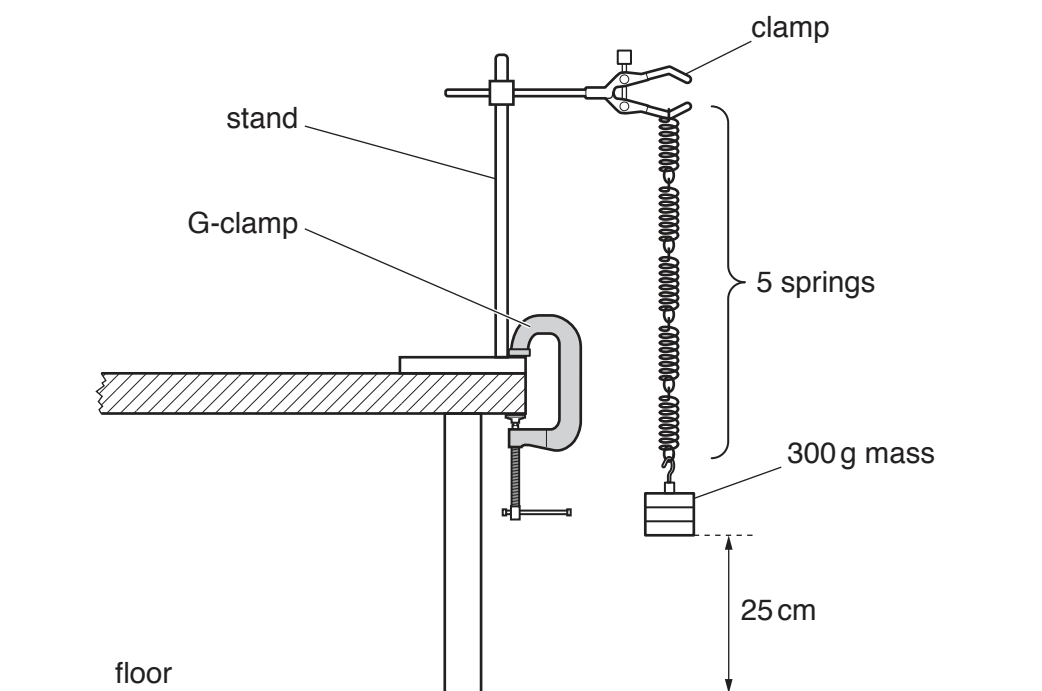


Fig. 1.1a

Fig. 1.1b

The height of the clamp should be adjusted so that the bottom of the mass hanger is 25 cm above the floor when the apparatus is assembled.

2. A piece of A4 card should be cut into a 21 cm × 21 cm square and a small hole should be made in its centre so that the stem of the mass hanger can pass through.
3. The stand should be clamped to the bench using a G-clamp. Alternatively a heavy weight such as a brick should be placed on the base of the stand so that it does not tip over.

#### Information required by Examiners

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

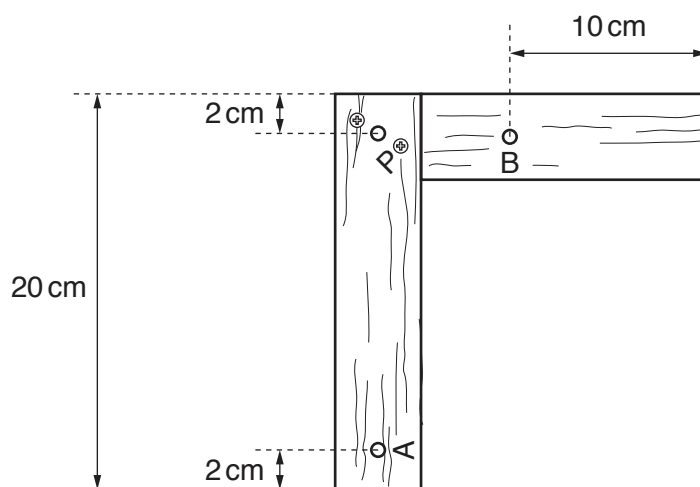
## Question 2

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

- L-shaped beam (see note 1)
- rod (see note 2)
- two wire hooks (see note 3)
- stand, clamp and two bosses
- 300g mass, e.g. 100g mass hanger and two 100g masses (see note 4)
- another 100g mass, e.g. 100g mass hanger
- protractor
- two metre rules
- set square.

### Notes

1. The L-shaped beam could be made by joining together two pieces of wood (20 cm × 4 cm × approx. 1 cm) as shown in Fig. 2.1. Alternatively, two pieces of thick corrugated card (20 cm × 4 cm × approx. 4 mm) can be used. The cardboard from sturdy packing boxes is suitable.



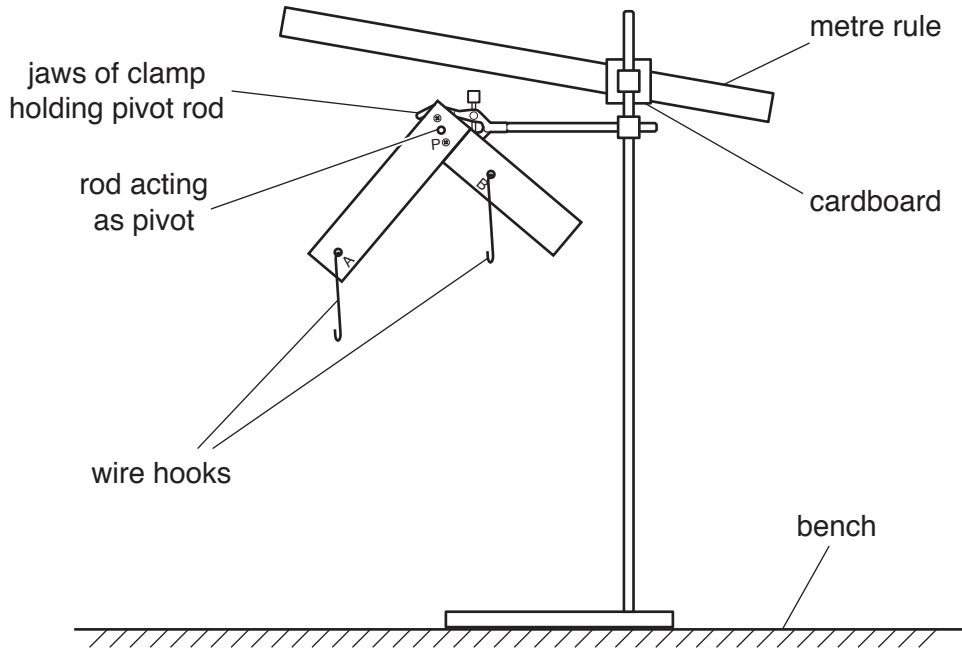
**Fig. 2.1**

One 7 mm diameter hole should be drilled at the centre point where the two adjoining pieces of wood or cardboard overlap. The hole should be labelled **P**. It must be slightly bigger than the rod so that the rod can pass through and act as a pivot.

One 5 mm diameter hole should be made with a drill or cork-borer along the centre of one of the pieces 2 cm from the end. This hole should be labelled **A**. Another 5 mm hole should be made in the other piece of wood 10 cm from the end. This hole should be labelled **B**.

If using wood, all rough edges should be smoothed using abrasive paper e.g. sandpaper or emery paper and the holes drilled from both sides.

2. The supervisor should set up the apparatus as shown in Fig. 2.2.



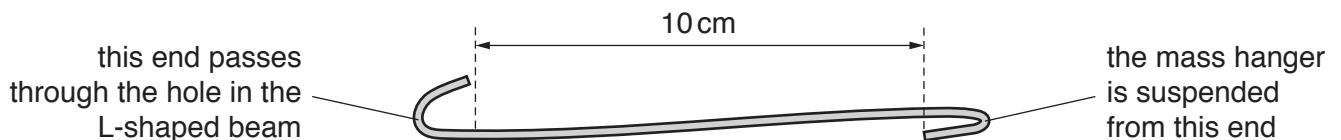
**Fig. 2.2**

The rod will act as a pivot so it must be rigid and have a smooth surface. The rod should be able to pass easily through the hole labelled P. A suitable rod is either a drill bit or a 15 cm steel nail. The pivot rod is held in the jaws of a clamp so that the pivot rod and the rod of the clamp are perpendicular to each other.

The metre rule is also attached to the stand using a boss. Small pieces of cardboard placed between the rule and the boss ensures that the rule remains upright and its surface is not damaged.

At the start of the experiment, the metre rule should be attached to the stand with the left hand side at an angle of approximately  $10^\circ$  above the horizontal.

3. Wire hooks are used to suspend masses at hole A and hole B. A suitable hook shape may be made from a large steel paper clip, but the hooked ends must be at least 10 cm apart as shown in Fig. 2.3.



**Fig. 2.3**

4. It must be possible to hang the masses from the wire hooks.

At the changeover the supervisor should ensure that the apparatus is returned to the arrangement shown in Fig. 2.2 with the ruler inclined at a  $10^\circ$  angle as described in note 2.

### 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):

- lamp in a lamp holder and connecting leads (see note 1)
- switch or plug key
- slit plate (see note 2)
- 3.0V d.c. power supply (see note 3)
- rectangular transparent block (see note 4)
- Blu Tack (see note 1 and note 2)
- protractor.

### Notes

1. One small torch lamp, of approximate diameter 1 cm, 2.5V, 250 mA, filament indicator lamp, clear, e.g. RS 106-313, placed in a lamp holder e.g. RS 171-2503. The lamp holder must be fixed to the bench with a piece of Blu Tack and tilted as shown in Fig. 3.1.

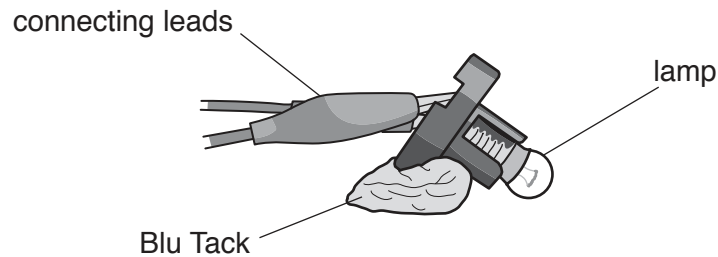


Fig. 3.1

There must be a small gap between the glass bulb of the lamp and the bench to allow a sheet of paper to slide underneath.

2. A slit plate may be found in a ray box kit if one is available. Alternatively, the plate should be cut from a piece of rigid card into a rectangle of length 80 mm and width 50 mm. A slit of width 1.0 mm and length 25 mm should be cut into the card at 25 mm shown in Fig. 3.2.

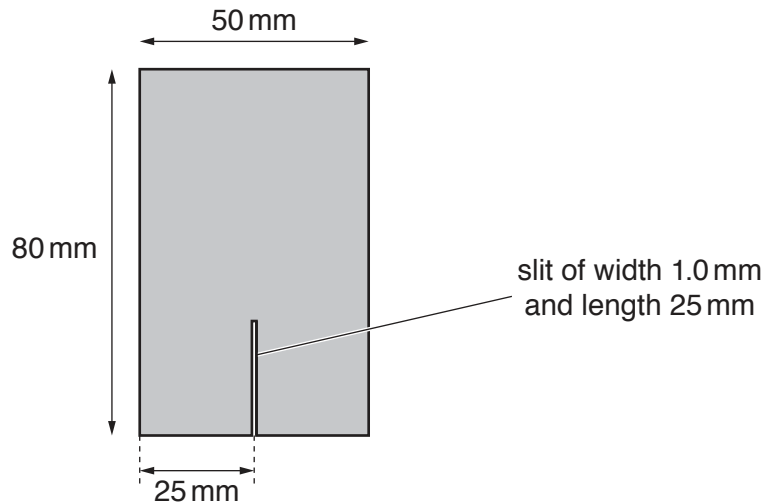
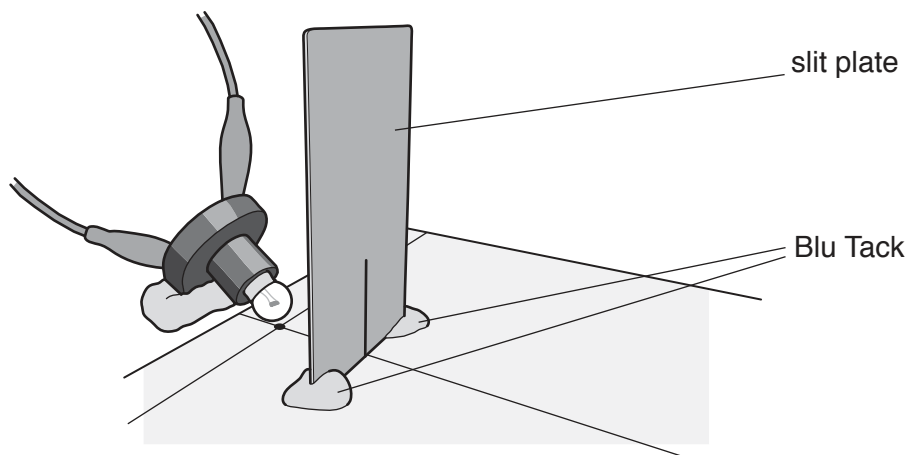


Fig. 3.2

Pieces of Blu Tack should be fixed to the bottom corners of the slit plate as shown in Fig. 3.3.



**Fig. 3.3**

Sufficient Blu Tack should be used to enable the slit plate to stand vertically without assistance from the candidate. Candidates will move the slit plate so the Blu Tack should **not** be pressed too firmly to the bench.

3. A power supply with a potential difference of 3.0V is sufficient to power the lamp at a suitable brightness. The experiment must be performed in a darkened part of the laboratory.

The following are suitable power sources:

- two 1.5V dry cells in suitable holders connected in series
  - three 1.2V rechargeable cells in suitable holders connected in series
  - d.c. power supply of 3.0V. If a variable power supply is used the supervisor must ensure that candidates cannot alter the output voltage.
4. A transparent acrylic, glass or perspex block with approximate dimensions 110 mm × 70 mm × 20 mm is suitable.

At the changeover the supervisor must ensure that the lamp is still working and replace it if necessary.

### **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)

- 4.5V d.c. power supply (see note 1)
- five resistors of resistance  $22\ \Omega$ , 5%, 2W (see note 2)
- thermistor (see note 3)
- resistor with a resistance of  $100\ \Omega$  (see note 4)
- two switches or plug keys
- stopwatch reading to 1 s or better
- Blu Tack (see note 2 and note 3)
- voltmeter (see note 5)
- connecting leads and crocodile clips.

#### Notes

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

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 4.0 to 5.0V.
2. Five resistors of resistance  $22\ \Omega$  5% 2W (e.g. RS 707-8808) should be twisted together and pressed into a piece of Blu Tack (approximately 10g). The resistors should have a tolerance of 5% and a power rating of 2W. Crocodile clips should be attached to the resistor wires as shown in Fig. 4.1. The resistors will act as a heater when the circuit is complete so the Blu Tack must be placed on a heat resistant mat.

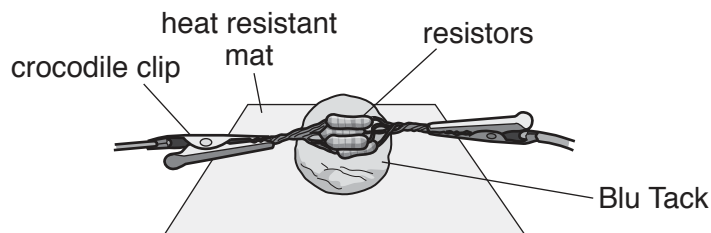


Fig. 4.1

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. Two crocodile clips should be attached to the wires of the thermistor and the thermistor disc should be placed on top of the heater shown in Fig. 4.2.

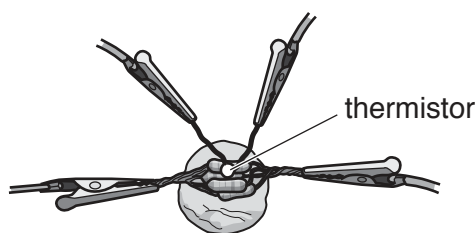


Fig. 4.2

A second similar sized piece of Blu Tack should be placed on top of the resistors and thermistor and pressed down gently to seal the components inside.

4. The  $100\ \Omega$  fixed resistor (e.g. RS component 707-7587) is part of a circuit shown in Fig. 4.3 which must be set up by the supervisor.

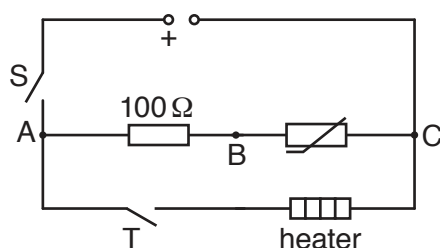


Fig. 4.3

The heater (note 2) and thermistor (note 3) are assembled as shown in Fig. 4.2. Switch S and switch T should be labelled. It must be possible for the candidates to connect leads from a voltmeter between positions A, B and C so these points should also be labelled on the apparatus.

5. A voltmeter capable of measuring a potential difference of up to 5.0V to a precision of 0.1V or better. An analogue or digital multimeter is suitable. The supervisor should connect the leads to each terminal of the voltmeter with the other end of each lead left free.

At the changeover the supervisor must ensure that the apparatus is returned to the arrangement shown in Fig. 4.3. The heater and thermistor assembly should remain inside the ball of Blu Tack. However, it should be disconnected from the circuit and replaced by an identical assembly, also encased in Blu Tack that is at room temperature. The original assembly should be placed away from candidates so that it has time to cool down to room temperature so that it can be used in later experiments. This means that a spare set of the heater and thermistor assembly will be required.

### Information required by Examiners

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

Details of any power supply used (photographs will be sufficient).

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**Supervisor's report**

Syllabus and component number

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Centre number

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Centre name .....

Time of the practical session .....

Laboratory name/number .....

**Give details of any difficulties experienced by the centre or by candidates (include the relevant candidate names and candidate numbers).**

You must include:

- any difficulties experienced by the centre in the preparation of materials
- any difficulties experienced by candidates, e.g. due to faulty materials or apparatus
- any specific assistance given to candidates.

### Declaration

- 1 Each packet that I am returning to Cambridge International contains the following items:
  - the scripts of the candidates specified on the bar code label provided
  - the supervisor's results relevant to these candidates
  - the supervisor's reports relevant to these candidates
  - seating plans for each practical session, referring to each candidate by candidate number
  - the attendance register
- 2 Where the practical exam has taken place in more than one practical session, I have clearly labelled the supervisor's results, supervisor's reports and seating plans with the time and laboratory name/number for each practical session.
- 3 I have included details of difficulties relating to each practical session experienced by the centre or by candidates.
- 4 I have reported any other adverse circumstances affecting candidates, e.g. illness, bereavement or temporary injury, directly to Cambridge International on a *special consideration form*.

Signed ..... (supervisor)

Name (in block capitals) .....