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**PHYSICS**

**5054/31**

Paper 3 Practical Test

**May/June 2015**

**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.**

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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.

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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,  $0^\circ$  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 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)**

Salt solution of strength 20 g of sodium chloride (table salt) to 100 cm<sup>3</sup> of water (see Notes 1 and 2).

250 cm<sup>3</sup> beaker labelled “salt solution” (see Note 3).

100 cm<sup>3</sup> measuring cylinder.

Access to a top-pan balance capable of measuring up to 500 g to a precision of 1 gram or better.

Paper towels to mop up spillages.

**Notes**

1. **Each candidate** will require approximately 120 cm<sup>3</sup> of the solution.
2. It is advisable to prepare sufficient salt solution prior to the examination and store it in a sealed container.
3. About 120 cm<sup>3</sup> of the salt solution should be poured into this beaker just before the examination.
4. At the changeover, the Supervisor should ensure that
  - the measuring cylinder is empty,
  - the beaker contains approximately 120 cm<sup>3</sup> of salt solution.

**Information required by Examiners**

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

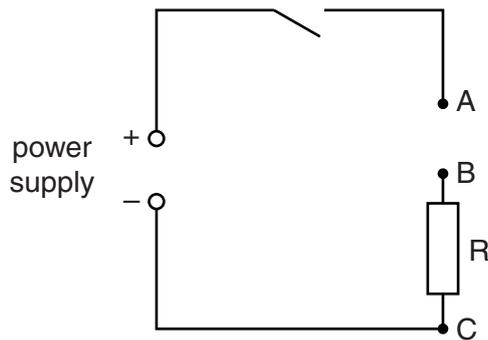
**Question 2****Items to be supplied by the Centre (per set of apparatus, unless otherwise specified)**

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

Switch or plug key.

Resistor of resistance  $100\ \Omega \pm 5\%$  resistor with a power rating of at least 0.25W, labelled R (see Note 2).

Sufficient connecting leads to enable the Supervisor to set up the circuit shown in Fig. 2.1. The points A, B and C should be labelled.



**Fig. 2.1**

Resistor of resistance  $100\ \Omega \pm 5\%$  (see Note 3).

Resistor of resistance  $220\ \Omega \pm 5\%$  (see Note 3).

Voltmeter capable of measuring a potential difference up to 5.0V to a precision of 0.1V or better. An analogue or digital meter is suitable (see Note 4).

Two connecting leads to enable the **candidate** to connect the voltmeter into the circuit.

If required, two additional connecting leads to enable the **candidate** to connect a resistor between A and B.

**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 4.5V 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. The resistor should have suitable terminals to enable it to be connected into the remainder of the circuit. The value of the resistor should be obscured from the candidates and the resistor should be labelled R. The RS Components product code of a suitable example is 707-7587.
3. The resistors should have suitable terminals to enable them to be connected into the remainder of the circuit. The Supervisor should label the resistors appropriately with their nominal values i.e. 100 $\Omega$  and 220 $\Omega$ . The power rating of the resistors should be at least 0.25W. The RS Components product codes of suitable resistors are:
  - 100 $\Omega$ : 707-7587
  - 220 $\Omega$ : 707-7612.
4. The Supervisor should ensure that it is possible to measure the e.m.f. of the power supply with the voltmeter.
5. Before the start of the experiment and at the changeover, the Supervisor should set up the circuit as shown in Fig. 2.1. The additional resistors, the voltmeter and the additional connecting leads should be laid out on the bench.

**Information required by Examiners**

Type and e.m.f. of power source, e.g. dry cells, 4.5V.

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)**

Two rubber stoppers (bungs) (see Note 1).

Card on which is written the average mass of a stopper to the nearest 0.1 g in the form “mass of stopper = ..... g”.

100 cm length of thin string (see Note 2).

Supply of water at room temperature (see Note 3).

250 cm<sup>3</sup> beaker, labelled C (see Note 4).

100 cm<sup>3</sup> beaker labelled D (see Note 5).

100 cm<sup>3</sup> measuring cylinder.

Thermometer with a range of –10 °C to 110 °C.

Stirrer.

Supply of boiling water (see Notes 6 and 7).

Paper towels to mop up spillages.

**Notes**

1. All the stoppers at a Centre should be as close to identical as possible. The stoppers should have an approximate height of 20 mm and an approximate diameter of 20 mm. It is important that the stoppers sink in water. Most laboratory rubber stoppers are hardened rubber and will sink, but the Supervisor should check this. One of the stoppers should be labelled B with a permanent marker, as it will be in water at one stage during the experiment.
2. One end of the thin string should be tied tightly to the stopper that is not labelled. The stopper will be placed in boiling water and the thread is to enable the candidate to remove the stopper from the water.
3. Each candidate will require approximately 100 cm<sup>3</sup> of water at room temperature. There should be sufficient water for all candidates to use. This should have been placed in a container overnight so that it is in thermal equilibrium with its surroundings.
4. At the start of the examination and at the changeover, the Supervisor should put 100 cm<sup>3</sup> of water at room temperature in this beaker.
5. It must be possible for the stopper to fit into beaker D.
6. This should be used to heat the stoppers with thin string for several workstations. For example it could be a large Pyrex beaker, containing water that is heated by a hot plate or Bunsen burner. The stoppers are placed in the water and the strings are kept away from the heat source, e.g. by passing them over a rod that is high above and to the side of the beaker. **Each candidate** will then lift the string to remove the stopper from the beaker. **Supervisors should ensure that there is no danger of the beaker tipping when the candidate removes the stopper.**

7. The stopper with the string used by each candidate must be heated for 20 minutes before the experiment starts. This will mean that additional stoppers with string and a second heating station will be required. Stoppers that have been used for a particular 20 minute interval can be reheated during the next 20 minutes.
8. At the changeover, the Supervisor should:
- discard the water that is in beaker D,
  - ensure that the measuring cylinder is empty,
  - replenish the water in beaker C so that there is approximately  $100\text{ cm}^3$  of water at room temperature in this beaker,
  - ensure that a second stopper that has been heated for 20 minutes is ready for the next candidate.

If it will be needed by another candidate, place the used stopper with string back into boiling water and ensure that it is heated for 20 minutes.

### **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)**

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

Cross-wire object (see Note 2).

Screen (see Note 3).

Light source (see Note 4).

Lens holder (see Note 5).

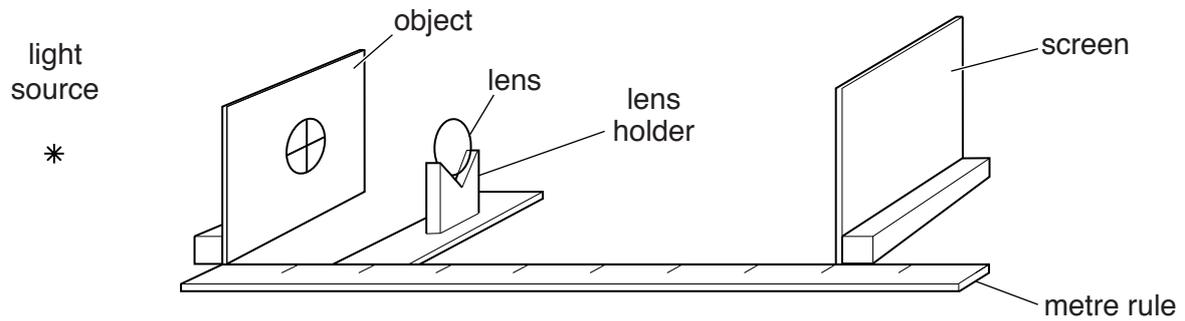
Metre rule with a millimetre scale.

Set square.

**Notes**

1. The Supervisor should ensure that each lens has a focal length between 14.5cm and 15.5cm. This may be done by focusing the image of a distant object on a screen. The focal length is the distance between the centre of the lens and the screen.
2. The cross-wire object should be formed by using a 20cm square piece of card or board. A hole of diameter 2.0cm 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.
3. The screen should be formed by using a 20cm 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 may be done either by attaching blocks of wood to the base of the object and screen or by supporting them with clamps, bosses and stands.
4. The apparatus should be in a dimly lit area of the laboratory and the light source should be bright enough so that candidates can see an image of the object when the distance between the object and the screen is 100 cm.

5. The centre of the 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. The **candidate** will set up the arrangement shown in Fig. 4.1.



**Fig. 4.1**

6. Before the start of the experiment and at the changeover, the Supervisor should place the object, lens and screen away from the metre rule.

### 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**

1. Type and e.m.f. of power source used in Question 2.

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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**

