

General Certificate of Education  
June 2007  
Advanced Subsidiary Examination



**PHYSICS (SPECIFICATION B)**

**PHB3/TN**

**Instructions to Supervisors**

**CONFIDENTIAL**

**OPEN ON RECEIPT**

The examination will be held on Wednesday 16 May 2007 1.30 pm to 3.30 pm

**It is the responsibility of the Examinations Officer to ensure that these Instructions to Supervisors are given immediately to the Supervisor of the practical examination.**

**These Instructions are strictly confidential and must be kept in safe custody by the Examinations Officer or by the Supervisor. They should be given to the Invigilator for the duration of the actual examination and afterwards returned to the Examinations Officer. Additional copies of these Instructions cannot be supplied by AQA.**

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## INSTRUCTIONS TO THE SUPERVISOR OF THE PRACTICAL EXAMINATION

### General

- 1 The instructions and details of materials contained in this document are for the use of the Supervisor and are strictly confidential. In no circumstances should information concerning apparatus or materials be given before the examination to a candidate or other unauthorised person.
- 2 In a centre with a large number of candidates it may be necessary for two or more examination sessions to be organised. Candidates waiting for their session must be fully invigilated in a separate room throughout the period from the time of the first session until they enter the examination room. Requests for such arrangements, giving full details of invigilation arrangements and times, must be made in writing to AQA, Devas Street, Manchester, M15 6EX.
- 3 A suitable laboratory, or laboratories, must be reserved for the examination and kept locked throughout the period of preparation. Unauthorised persons not involved in the preparation for the examination must not be allowed to enter. Candidates must not be admitted until the specified time for commencement of the examination.
- 4 The examination paper contains three compulsory questions. Candidates are allowed 30 minutes on each of Questions 1 and 2, and 1 hour on Question 3.
- 5 Centres may provide sufficient sets of apparatus for half their candidates to work on Questions 1 and 2, while the other half work on Question 3. Under strict supervision, the groups of candidates change over after 1 hour. It will be necessary to allow a short period of time whilst the change-over takes place. During this time the apparatus should be returned to its original state, ready for use by the next group of candidates. A similar short delay for the same purpose will be needed in centres running two or more sessions.

Whatever arrangement is adopted, enough apparatus and materials must be prepared to ensure that in the case of failure of a set of apparatus, a substitute is available so that the candidate does not lose time.

- 6 AQA will provide the question paper/answer books and A4 graph paper for use in Question 3. All other materials required must be provided by the centre.
- 7 The apparatus and materials for each candidate must be arranged neatly, and ready to use, on the laboratory bench. No attempt should be made to connect together any parts or wire up any electrical circuits except when specifically stated in these Instructions.
- 8 Clear instructions must be given by the Supervisor to all candidates at the beginning of the examination concerning the organisation of the examination in the laboratory and the amount of time allowed for each question. Candidates must also be instructed that all readings must be entered in the question paper/answer book provided and all working must be shown. **Scrap paper must not be used.**

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- 9 If a candidate is unable to perform any experiment, or is performing an experiment incorrectly, the Supervisor is expected to give the minimum help required to enable the candidate to proceed. In this instance, a note bearing the candidate's name and number must be attached to the candidate's script reporting to the Examiner the extent of the help given. **No help should be given with the analysis of the experimental data.**

It is not the wish of the Examiner that a candidate should waste time because of, for example, an incorrect electrical connection. The Examiner wishes to test the candidate's ability to perform an experiment and carry out the subsequent analysis.

Any failure in the apparatus should also be reported to the Examiner.

- 10 The Supervisor is required to report details concerning the experiment, apparatus or materials to the Examiner on the *Supervisor's Report* located at the end of this document. **This Supervisor's Report must be attached to the topmost script before despatch to the Examiner.**

Details must be given on the *Supervisor's Report* if the apparatus or materials provided differ from that detailed in this document. Where specific information or data about apparatus or materials is requested in these Instructions, it is important that it is given accurately. In some cases it may represent the only means available to the Examiner of assessing the accuracy of a candidate's work.

Centres may make copies of this *Supervisor's Report* for attachment to individual scripts if necessary. If all the information cannot be included on the *Supervisor's Report*, separate sheets of paper, bearing the candidate's name and number, can be attached to the relevant candidate's script.

- 11 Note that candidates will require a separate sheet of A4 graph paper for Question 3. The graph paper for each candidate should be secured to their question paper/answer book using a treasury tag before despatch to the examiner.
- 12 The examination room must be cleared of candidates immediately after the examination.

In case of difficulty the Supervisor should telephone the Senior Subject Officer for A level Physics, David Baker, at AQA (Manchester Office), telephone 0161 953 1180, or email [dbaker@aqa.org.uk](mailto:dbaker@aqa.org.uk)

## Question 1

Candidates will be asked to time the flow of samples of granular solids through a filter funnel with a length of tubing attached.

### Apparatus and materials

The following items should be provided for each candidate:

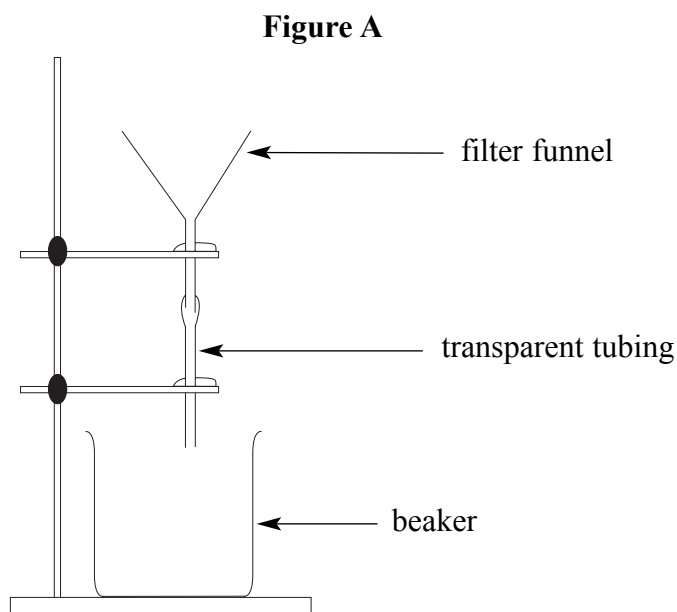
- (a) small filter funnel
- (b) about 25 cm of transparent tubing
- (c) 250 ml beaker labelled *Sample A* containing 25 cm<sup>3</sup> of table salt
- (d) 250 ml beaker labelled *Sample B* containing 25 cm<sup>3</sup> of granulated sugar
- (e) measuring cylinder (100 ml or 50 ml would be suitable)
- (f) stopclock or stopwatch reading to 0.1 or 0.01 s
- (g) retort stand, two bosses and two clamps.

The tubing should be fitted securely onto the stem of the funnel. It is not essential that the tubing is perfectly straight but it must be clean and dry.

The salt and sugar samples must be dry so that they flow freely through the funnel and tubing.

The apparatus should be assembled for the candidate as shown in **Figure A**.

Fresh samples of salt and sugar should be provided for each candidate. Extra samples should be prepared in case of spillage or other accidents.



**Question 2**

Candidates will be asked to investigate the sag produced when a horizontally supported plastic ruler is loaded at its centre.

**Apparatus and materials**

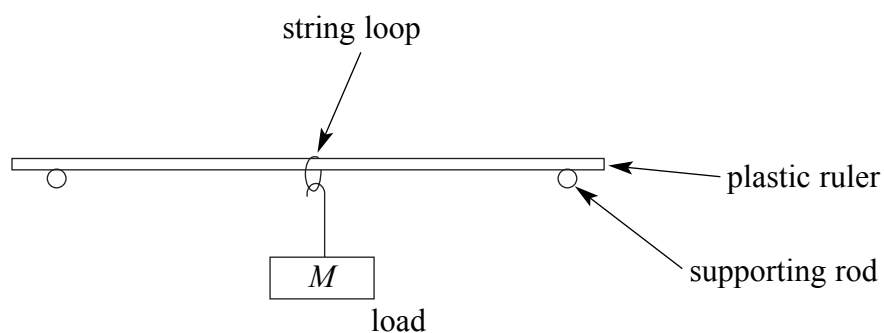
The following items should be provided for each candidate:

- (a) flexible 30 cm plastic ruler
- (b) 100 g hanger with five 100 g masses
- (c) two retort stands, each with a boss and clamp
- (d) small loop of string
- (e) half-metre ruler.

The apparatus should be arranged neatly on the bench for the candidate to assemble.

The plastic ruler should be sufficiently flexible so that it sags by about 2 or 3 cm when supported symmetrically as shown in **Figure B** with a 400 g load suspended at its centre. The distance between the supporting clamp rods should be 25 cm.

**Figure B**



Turn over ►

### Question 3

Candidates will be asked to measure the potential difference across a resistor network.

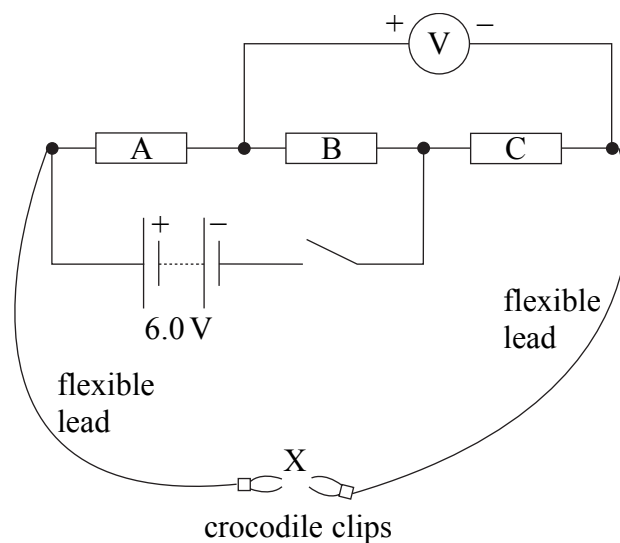
#### Apparatus and materials

The following items should be provided for each candidate:

- three  $100\ \Omega$  resistors connected in series and labelled A, B and C, with the coding bands obscured
- five test resistors with values  $3.9\ \Omega$ ,  $18\ \Omega$ ,  $33\ \Omega$ ,  $47\ \Omega$  and  $68\ \Omega$ , clearly labelled as such
- suitable leads and connectors (see below)
- digital voltmeter
- 6 volt battery or 6 V stable power supply
- switch.

The circuit is shown in **Figure C**.

**Figure C**



Any carbon film or metal film resistors would be suitable. Resistors from the Rapid carbon film range were used in tests (stock codes: 62-0310, 62-0322, 62-0334, 62-0334, 62-0338, 62-0342, 62-0346).

A, B and C should be soldered together with the flexible leads and crocodile clips attached to the ends. Crocodile clip leads would also be suitable for connecting the voltmeter and the power supply to the network.

The apparatus should be connected for the candidates so that **the voltmeter reading is positive** when the switch is closed and X is an open circuit.

**END OF TEACHERS NOTES**

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Answer **all** questions.

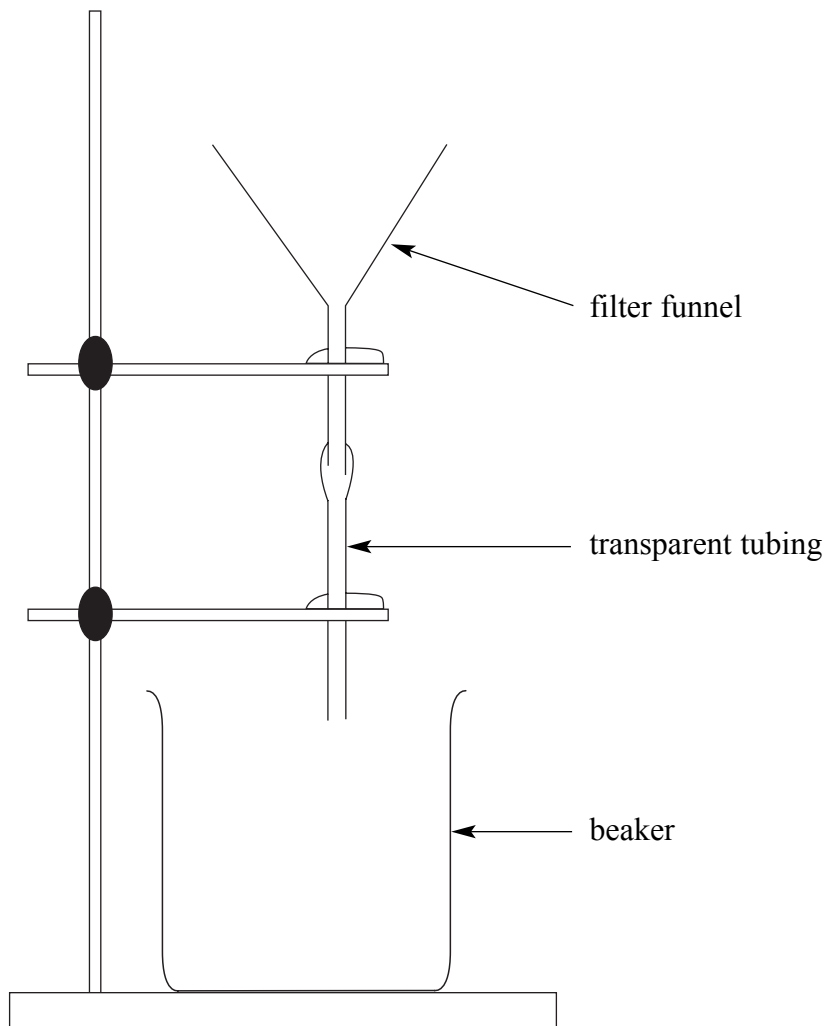
You are allowed 30 minutes for this question.

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- 1** Granular solids, such as table salt and sugar, exhibit fluid properties when they are caused to flow through tubes and pipes. In this question you are going to investigate the flow of granular solids through a tube and consider the physical factors which affect the rate of flow.

The apparatus is shown in **Figure 1**.

**Figure 1**



Turn over ▶

- (a) You are going to measure the time taken for each of two samples of granular solids to flow through the apparatus. Hold your finger over the lower end of the tubing and carefully fill the tubing and funnel with all of sample A. Place the beaker under the bottom of the tube, remove your finger and time the flow of the “fluid” back into the beaker. Repeat this procedure with sample B.

**If at any stage of the experiment you spill a significant quantity of either of the samples, or mix the samples together, ask the supervisor to provide you with replacement samples.**

*(5 marks)*

- (b) Use the measuring cylinder to find the volume of each of the samples. For each sample calculate its average rate of flow through the apparatus using the formula

$$\text{average rate of flow} = \frac{\text{volume}}{\text{time}}$$

*(2 marks)*

- (c) One of the physical factors expected to affect the rate of flow of granular solids is the grain size. Referring to your results, suggest how grain size affects the rate of flow.

*(2 marks)*

- (d) Suggest **two** factors, other than grain size and tube diameter, that you would expect to affect the rate of flow of a granular solid through a tube of circular cross-section. For each factor state how you would expect it to change the rate of flow.

*(4 marks)*

- (e) The rate of flow of a granular solid through a tube of circular cross-section is predicted to be directly proportional to the square of the tube diameter. Carefully describe an experiment, based on the apparatus used in this question, to test this prediction.

Two of the 7 marks are available for the quality of your written communication.

*(7 marks)*

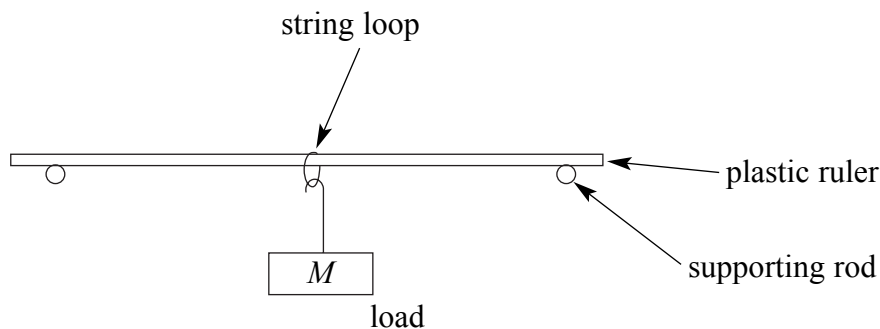


You are allowed 30 minutes for this question.

- 2 Arrange the apparatus so that the plastic ruler is supported horizontally as shown in **Figure 2**.

**Without** the load  $M$  in position, adjust the apparatus so that the supporting rods are 25 cm apart and the ruler is resting symmetrically upon them.

**Figure 2**



- (a) Measure  $H_0$ , the height of the centre of the ruler above the surface of the bench. (1 mark)
- (b) (i) With  $M = 200$  g, and using the string loop provided, hang the load from the centre of the ruler. Measure  $H$  the new height of the centre of the ruler above the bench. Repeat the experiment with  $M = 400$  g and  $M = 600$  g.

**It is not necessary for you to take repeat readings for each value of  $M$ .**

- (ii) For each value of  $M$ , calculate the sag  $s$  using the formula

$$s = H_0 - H$$

(3 marks)

- (c) Estimate the absolute uncertainty in your value for  $s$  when  $M = 200$  g. Clearly show your working and state your reasoning. (3 marks)
- (d) Theory predicts that  $s$  is directly proportional to  $M$ .

Without plotting a graph, use your data to show whether or not your results support this theory.

(3 marks)

The sag  $s$  depends not only on the value of  $M$ , but also on the dimensions of the ruler and  $E$ , the Young modulus of the material from which it is made. It can be shown that

$$E = \frac{kMl^3}{s},$$

where  $l$  is the distance between the supporting rods and  $k$  is a constant.

**Turn over ▶**

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- (e) Use your data for  $M = 200$  g to estimate the percentage uncertainty in  $E$  when calculated using the above formula. You can neglect uncertainties in both  $k$  and  $M$ . (3 marks)

Two of the 7 marks in part (f) are available for the quality of your written communication.

- (f) The apparatus can be used to measure  $E$ , given that

$$k = \frac{g}{4bd^3},$$

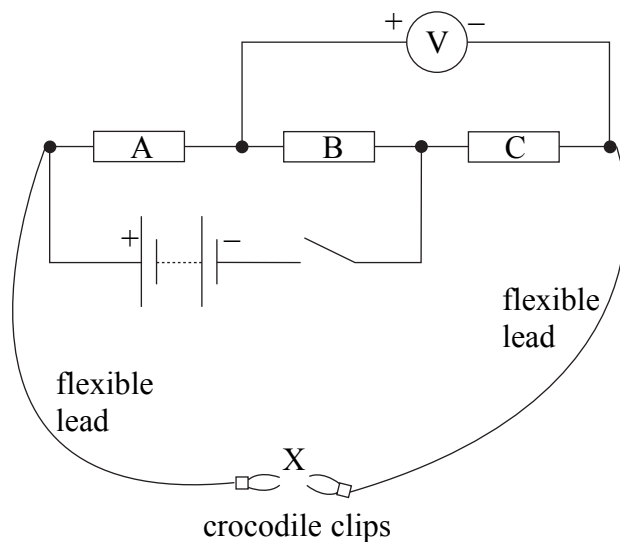
where  $d$  is the average thickness of the ruler,  $b$  is the width of the ruler and  $g$  is the gravitational field strength.

- (i) A major source of uncertainty in  $E$  arises from the measurement of  $d$ . Explain why this is so and suggest a suitable instrument for measuring  $d$ .
- (ii) Apart from the measurement of  $d$ , identify sources of uncertainty in this determination of  $E$  and describe how you would minimise their effect on the accuracy of the experiment. (7 marks)

You are allowed one hour for this question.

- 3 You are going to investigate a simple network of resistors. The circuit is shown in **Figure 4**.

**Figure 4**



The circuit has been connected for you. A, B and C form a row of three equal fixed resistors. A flexible lead with a crocodile clip has been connected to each end of the row of resistors so that a test resistor  $R$  can be clipped into the network at X.

- (a) Ensure that the crocodile clips are not in contact at X and switch on the circuit. Record  $V_0$ , the reading on the voltmeter. (1 mark)

You are going to connect each of five test resistors into the network at X in turn and record  $V_x$ , the value of the voltmeter reading.

**Treat all these voltmeter readings as positive values.**

- (b) Construct a table for recording all of your readings and results. Include in this table columns for  $V$  and for  $\frac{1}{V}$ , where

$$V = V_0 + V_x \quad (5 \text{ marks})$$

- (c) Connect resistors with  $R = 3.9 \Omega$ ,  $18 \Omega$ ,  $33 \Omega$ ,  $47 \Omega$  and  $68 \Omega$  in turn into the network at X. Record your readings and the corresponding results for  $V$  and  $\frac{1}{V}$  in your table.

(11 marks)

**Turn over ▶**

- (d) (i) Plot a graph of  $\frac{1}{V}$  ( $y$ -axis) against  $R$  ( $x$ -axis).

Draw the best straight line through your points.

- (ii) Determine the gradient of your graph. *(10 marks)*

The equation for your line is

$$\frac{1}{V} = \frac{R}{2V_0S} + \frac{1}{2V_0}$$

where  $S$  is the value of each of the resistors A, B and C.

- (e) Use the intercept on the  $y$ -axis of your graph to find a value for  $V_0$ . *(3 marks)*
- (f) Use your gradient and your answer to part (e) to find a value for  $S$ . *(4 marks)*
- (g) Your answer to part (e) should be the same as your answer to part (a).

By considering the apparatus, and the method used, suggest and explain **two** reasons, other than human error, why the answers to parts (a) and (e) may not be the same.

*(4 marks)*

**END OF QUESTIONS**

General Certificate of Education  
June 2007  
Advanced Subsidiary Examination



**PHYSICS (SPECIFICATION B)**  
**Unit 3**

**PHB3/TN**

## **SUPERVISOR'S REPORT**

**When completed by the Supervisor, this Report must be attached firmly to the topmost script, before despatch to the Examiner.**

**Information to be provided by the centre.**

**Question 1** Specimen reading for the time of flow for sample A and the time of flow for sample B.

Time for sample A.....

Time for sample B.....

**Question 2** No information required.

**Question 3** Sample set of voltmeter readings for the five test resistors.

<b>Resistance/<math>\Omega</math></b>	<b>Voltmeter Reading/V</b>
3.9	
18	
33	
47	
68	

**Comments:**

Supervisor's Signature .....

Centre Number.....

Date .....

Centres may make copies of this Supervisor's Report for attachment to individual scripts where necessary.

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