General Certificate of Education
January 2008
Advanced Subsidiary Examination

PHYSICS (SPECIFICATION B) **PHB3/TN**

ASSESSMENT and QUALIFICATIONS ALLIANCE

Instructions to Supervisors

CONFIDENTIAL

OPEN ON RECEIPT

The examination will be held on Wednesday 16 January 2008 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.

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 The Supervisor has been granted access to the questions for the PHB3 examination as part of these Instructions. All the relevant questions are printed to enable the Supervisor to carry out the experimental parts of the paper in order to ensure that the apparatus and materials obtained are satisfactory. It is also hoped that they will be able to note that minor modifications can be made without jeopardising the integrity of the examination. Any problems should be discussed with AQA as early as possible. The Instructions must be returned to safe custody at the earliest possible moment after the Supervisor has ensured that all is in order.

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 for Question 3.

5 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.

6 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.

7 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.

8 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.

9 Clear instruction 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**.

10 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.

11 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.

12 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.

In case of difficulty the Supervisor should telephone the Assistant Subject Officer for GCE Physics, Philip Bridgehouse at AQA (Manchester office), telephone number 0161 953 1180, or e-mail physics-gce@aqa.org.uk.

Question 1

Candidates will be required to consider how a light dependent resistor is affected by light from a lamp.

Apparatus and materials

The following items should be supplied for each candidate:

(a) mes filament lamp with suitable holder eg 1.5 V, 300 mA

(b) two suitable power supplies of emf approximately 1.5 V eg 1.5 V cells in holders

(c) analogue or digital ammeter capable of reading up to the nearest 10 mA or 1 mA

(d) 30 cm ruler

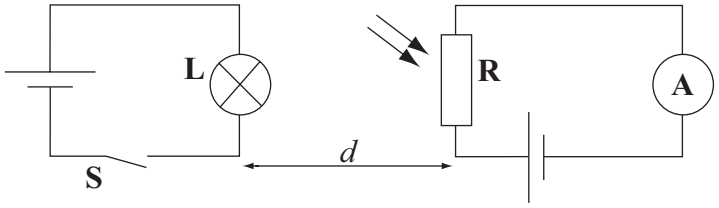
(e) LDR (ORP 12)

(f) switch

(g) supply of connecting leads

The apparatus should be provided with the two circuits shown in **Figure 1** ready connected.

Figure 1



The lamp should be clearly labelled **L** and the LDR **R**. Neither the lamp nor the LDR should be clamped or otherwise supported; to do so would restrict the candidates' answers relating to improvement of the experiment. The switch should be labelled **S**.

Question 2

Candidates will be required to investigate the toppling of rectangular plywood tiles.

Apparatus and materials

The following items should be supplied for each candidate:

(a) 14 rectangular plywood (5 ply) tiles each of dimension 70 mm × 35 mm × 6 mm

(b) stop-clock or stop-watch with a precision of 0.1 – 0.01 s

(c) sheet of plain A3 paper

(d) 15 or 30 cm ruler

Using a half-metre ruler, draw 14 lines on the A3 paper, parallel to the shorter edge. The lines should be 20 mm apart. This separation should ensure that the tiles collide with each other when they topple having been lined up with their longest edge on the ruled lines. **The tiles must be sufficiently square and smooth so that they can be balanced easily on their edges**.

Question 3

Candidates will be required to determine the emf and internal resistance of a modified cell.

Apparatus and materials

The following items should be supplied for each candidate:

(a) 1.5 V cell in a suitable holder

(b) 10 Ω resistor with a minimum power rating of 0.5 W

(c) 55 cm length of swg 28 (0.38 mm diameter) nichrome wire

(d) digital milliammeter (or multimeter) set to 200 or 500 mA scale

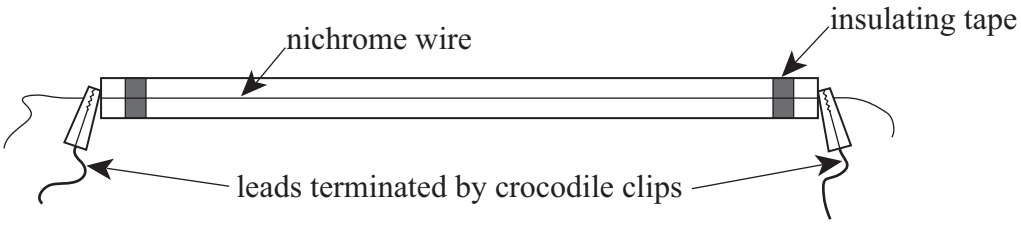
(e) switch labelled **S**

(f) supply of connecting leads, two of which should be terminated by crocodile clips

(g) half-metre ruler

The nichrome wire should be attached to the half-metre ruler using insulating tape at the 2 cm and 48 cm marks as shown in **Figure 2** – this allows the full 50 cm to be connected into the circuit.

Figure 2

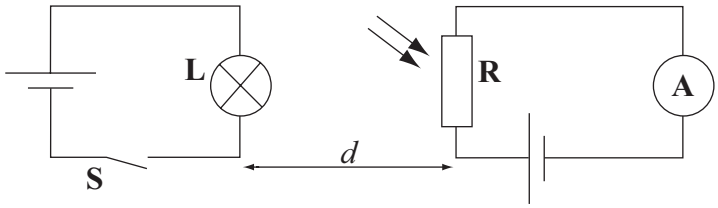


The resistor should be connected in series with the cell either by soldering or other means such as inserting it in the space vacated by a cell in a two or four cell battery pack containing a single cell. The value of the resistor should be covered with insulating tape. It is not necessary to hide the presence of the resistor so long as it is not possible to connect the cell into the circuit without the series resistor. **The remainder of the circuit is to be connected by the candidate**.

1 You are going to consider how a light dependent resistor (LDR) is affected by light from a lamp.

(a) The circuits for the LDR **R** and lamp **L** shown in **Figure 1** have been connected for you.

Figure 1



(i) With the switch **S** open, record a value for the ammeter reading under normal background lighting conditions.
The distance between **R** and **L** is *d*.

(ii) Close **S** and determine the ammeter readings, *I*, corresponding to values of *d* of 10 mm and 40 mm. Complete the table below.
Do **not** repeat your readings.

***d*/mm**	***I***
10	
40	

(iii) Explain how you ensured that the distances for *d* were the values shown in the table.

(5 marks)

(b) Use a non-graphical method to test whether or not your data support the relationship

$I \propto \frac{1}{d^2}$.

State and explain the outcome of your test. *(3 marks)*

(c) With a colour filter placed between the lamp and the LDR, you might expect the readings on the ammeter to decrease when compared with the experiment that you have performed. One variable which would be expected to affect the readings would be the thickness of the filter.

Two of the 10 marks in parts (c)(i) and (c)(ii) are available for the quality of your written communication.

(i) Suggest another factor, **other than** the thickness of the filter or the separation between the lamp and the LDR, which would be expected to affect the ammeter reading. Explain clearly how varying this factor would affect the ammeter reading.

(ii) Describe how you would investigate the relationship between the thickness of a coloured filter and the ammeter reading.
Your description should include:

- improvements that you would make compared with the apparatus used in part (a)
- how you would measure the thickness of the filter with suitable precision
- a statement of any variables that you would control
- how you would display your results
- the likely outcome of your experiment. *(10 marks)*

2 You are going to consider the toppling of rectangular plywood tiles.

(a) (i) Using the ruler provided, measure the dimensions of a tile in cm and hence calculate its volume.

(ii) Estimate the absolute uncertainty in the length of each side of a tile.

(iii) Calculate the percentage uncertainty in the volume of the tile.

(iv) Taking the density of the plywood to be $(0.75 \pm 0.05)\,\text{g cm}^{-3}$, calculate the mass of the tile.

(v) Calculate the percentage uncertainty in the mass of the tile. *(9 marks)*

(b) Two of the 9 marks in this question are available for the quality of your written communication.

Figure 2

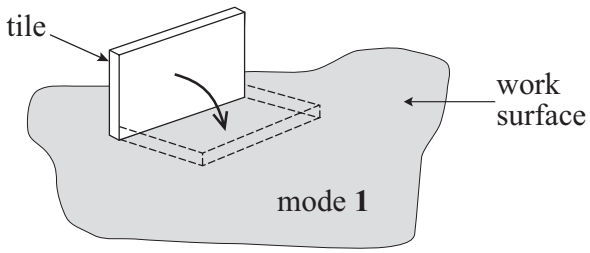
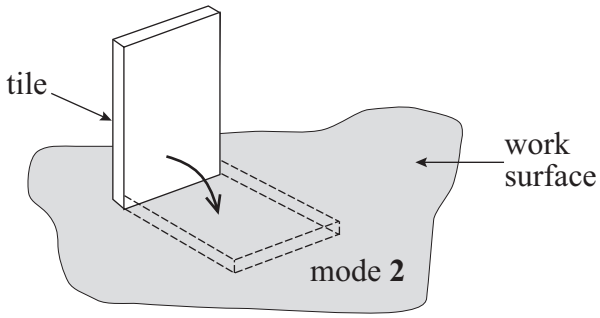


Figure 3



(i) A single tile can be balanced on a long edge or a short edge and toppled onto the work surface by giving the top of the tile a small push.
Calculate the maximum kinetic energy of the tile falling from a long edge as shown in **Figure 2**. This way of falling is called mode **1**.

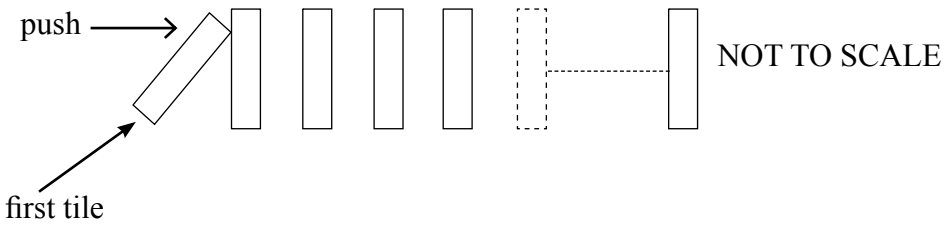
gravitational field strength, $g = 9.8\,\text{ms}^{-2}$

(ii) Mode **2** falling occurs when a tile topples from one of its shorter edges as shown in **Figure 3**.

Without performing further calculations, state and explain how the maximum kinetic energy of a tile toppling in mode **2** compares with that in mode **1**.

(iii) Consider a series of tiles lined up at 20 mm spacing and being made to topple in each of modes **1** and **2** as shown in **Figure 4**.

Figure 4



Suggest reasons why one of the modes would result in energy travelling along the series of tiles at a higher rate than the other mode.

(9 marks)

(c) (i) You have been provided with a sheet of paper with lines drawn at 20 mm intervals. Place 14 tiles with the front of their edges on the lines. Measure the time taken for energy to pass through the series of tiles when they topple in each of modes 1 and 2.

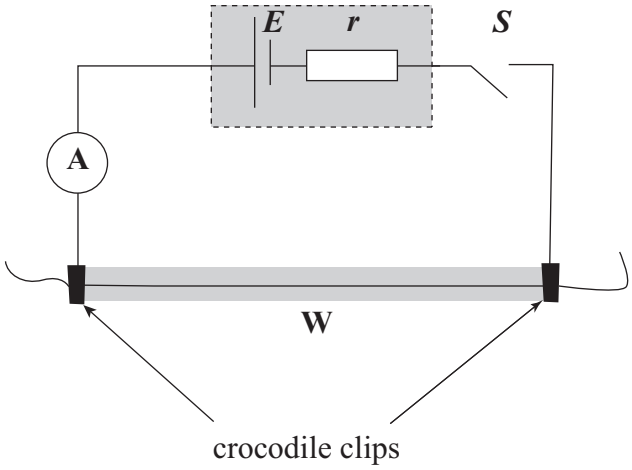
(ii) Comment on the consistency of your results with your suggestion in part (b)(ii).

(3 marks)

3 You are to take measurements which will allow you to measure the emf E and internal resistance r of a cell modified by the addition of a resistance as shown in **Figure 5**.

(a) Connect the circuit shown in **Figure 5**. **W** is a length of wire mounted on a half-metre ruler. Make sure that the switch ***S*** is open and that the length of wire between the crocodile clips is 50 cm.

Figure 5



(b) Now close the switch and record, in mA, the reading on the ammeter. *(3 marks)*

(c) You are going to investigate how the current I varies with the length of wire L in the circuit. Construct a table in which to record your results. This should include columns for the length L in metres, the current I in milliamps and $\frac{1}{I}$.

You should include a suitable unit for $\frac{1}{I}$.

(5 marks)

(d) Take and record in your table a series of readings of L and I. Complete your table by calculating and recording values of $\frac{1}{I}$. *(12 marks)*

(e) Plot a graph of L (y-axis) against $\frac{1}{I}$ (x-axis).

Start the L axis from the origin but use a false origin for the $\frac{1}{I}$ axis.

Draw the best straight line through your plotted points. *(8 marks)*

Question 3 continues on the next page

(f) Calculate the gradient of your best straight line. *(3 marks)*

(g) For the circuit, E and r are related to L and I by the equation

$$L = \left(\frac{E}{k}\right)\frac{1}{I} - \frac{r}{k}$$

where k is a constant of magnitude 10.0.

(i) Suggest a suitable unit for k.

(ii) By comparing this equation with the general equation of a straight line graph, $y = mx + c$, calculate values for E and r.

(8 marks)

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PHYSICS (SPECIFICATION B) PHB3/TN
Unit 3

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 No information is required

Question 2 No information is required

Question 3 No information is required

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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