

General Certificate of Education
June 2006
Advanced Subsidiary Examination

PHYSICS (SPECIFICATION A)

PHA3/P/TN

Instructions to Supervisors for the Unit 3 Practical Examination

CONFIDENTIAL

OPEN ON RECEIPT

The examination will be held on Wednesday 17 May 2006 9.00 am to 10.45 am.

- These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to the examination.
- The instructions explain how to set up the equipment for Question 2.
- Centres are at liberty to make any reasonable minor modifications to the apparatus which may be required for the successful working of the experiment but a note of all such modifications must be forwarded to the Examiner with the scripts. However, any such modifications must permit the experiment to be carried out in the specified manner.

INSTRUCTIONS TO THE SUPERVISOR OF THE PRACTICAL EXERCISES

Preparing for the Practical Examination

- 1 The instructions and details of materials contained in this document are for the use of the Supervisor and are strictly confidential. After use, these Instructions must be kept in safe custody by the Examinations Officer until after the issue of results (in March or August as appropriate).
- 2 The Supervisor has been granted access to some of the questions to aid the practical set up as part of these instructions. The relevant questions are printed to enable the Supervisor to carry out the experimental parts of the Exercises in order to ensure that the apparatus and materials obtained are satisfactory and to seek advice from AQA if there are any problems. The Instructions must be returned to safe custody at the earliest possible moment after the Supervisor has ensured that all is in order.

The Practical Examination

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

- 2 Details should be given to the Examiner 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.

In case of difficulty the Supervisor should telephone the Senior Subject Officer for A Level Physics, David Baker, at AQA (Manchester Office), telephone number 0161 9531180, or email dbaker@aqa.org.uk

Turn over for the start of the Instructions

Candidates are to investigate the characteristics of a circuit containing a variable resistor made from two rectangular pieces of conductive paper.

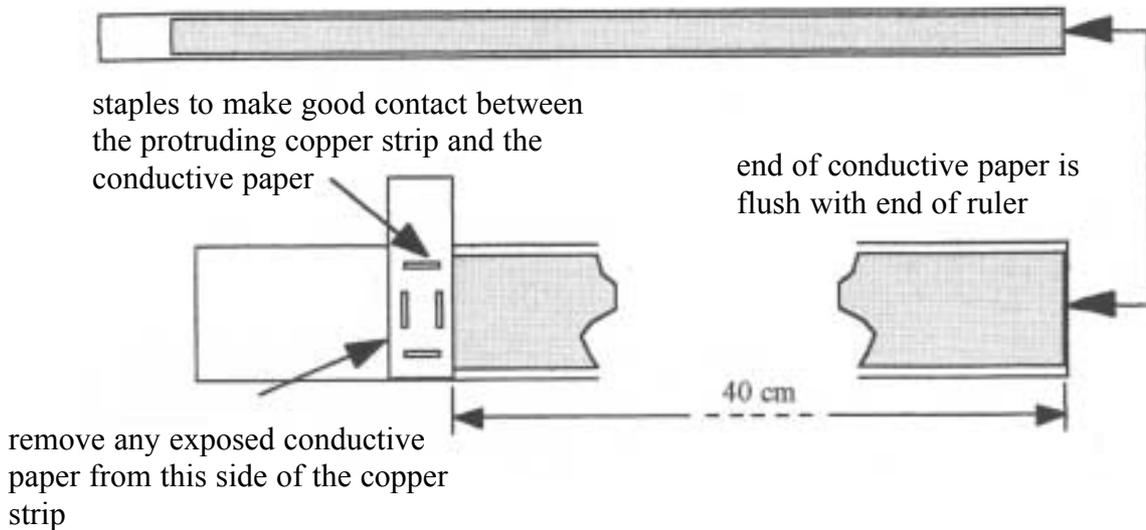
Apparatus required for each candidate:

- two rectangular pieces of conductive paper, width to be about 2.5 cm, length about 45 cm; rolls of conductive ('Teledeltos') paper are available from Philip Harris Ltd (code COA48252, roll dimensions 737 mm \times 2 m, price £15.83)
- two large bulldog clips, e.g. length about 6 cm
- two half metre rulers or similar wooden strips, of identical width (note that these do not act as rulers in the experiment)
- one 300 mm plastic ruler
- two strips of copper foil, suitable dimensions 1 cm \times 5 cm
- two crocodile clips
- paper glue, e.g. *Pritt Stick*, and staple gun for construction

for the circuit:

- dc power supply to suit available meters (see below); for meters with full scale reading of 20 V, four 1.5 V 'D' type cells, in holder, are ideal
- digital voltmeter, capable of reading to 0.01 V (most 3½ digit LCD multimeters will be suitable) capable of reading up to emf of supply
- one 47 k Ω resistor, carbon film, at least 0.25 W, in suitable component holder (e.g. two mounted crocodile clips)
- SPST switch, marked 'S' with 'open' (off)/'closed' (on) positions marked
- suitable connecting leads including flying lead terminating at 4 mm round plug and 4 mm round socket (see circuit diagram in **Figure 3** of the question paper)

To construct the variable resistor, cut rectangular strips of conductive paper that are approximately the same width as the largest faces (i.e. the graduated surface) of the half metre rulers or wooden strips. Ensuring one end is flush with the end of the ruler, (see opposite) use the *Pritt Stick* to glue a rectangular strip to the face of one of the rulers. Place a copper strip over the conductive paper, so that one end protrudes to enable connection, using a crocodile clip, to the external circuit. Adjust the position of the strip so the exposed length of conductive paper between the edge of the strip and the end of the ruler is 40 cm, then fix the copper strip in place using staples. Remove any conductive paper exposed between the edge of the strip and the closer end of the ruler.



Repeat this procedure exactly as before to produce the other part of the variable resistor.

Place the parts of the variable resistor together so that the conductive faces of the rectangles of paper are in contact. Adjust the position until the contact area between the rectangles is a maximum then secure the arrangement using the bulldog clips, as shown in **Figure 2** of the question paper.

Assemble the circuit, including the variable resistor, as shown in **Figure 3** of the question paper. To test the circuit connect the flying lead to the socket. With S in the open (off) position, the voltmeter should display the emf of the supply. When S is closed (on) the voltmeter should read approximately 60% of the emf (this assumes that the variable resistor has a minimum resistance of about $30\text{ k}\Omega$). If this is not the case adjust the resistance of the fixed resistor accordingly.

When the variable resistor is reassembled so that the area of the exposed parts of the conductive paper and the area of the parts in contact are roughly the same (this is when x is 25% of the maximum value) the voltmeter should read approximately 50% of the emf. Further increases of x will produce further reductions in the voltmeter reading until, with the contact area as small as possible (and x as large as possible), the reading should have fallen to approximately 30% of the emf

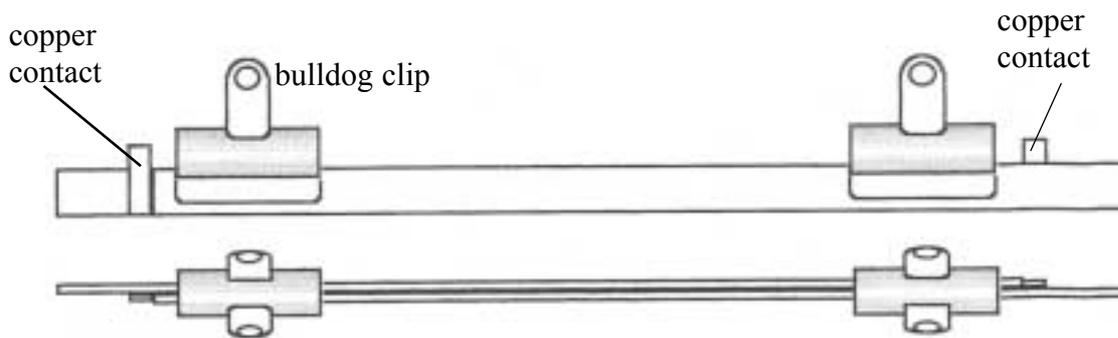
At the start of the examination, candidates should find the apparatus arranged as shown in **Figure 2** of the question paper.

Examiners will require no information for this question.

- 2 You are to investigate the characteristics of a circuit containing a resistor made from two rectangular pieces of paper that have electrically-conductive surfaces. The pieces of paper have identical dimensions and are mounted on strips of wood so their conductive surfaces can be placed in contact with each other. This arrangement is secured using bulldog clips and connections to the external circuit are made through copper contacts. Altering the contact area between conductive faces of the paper will change the resistance of this resistor.

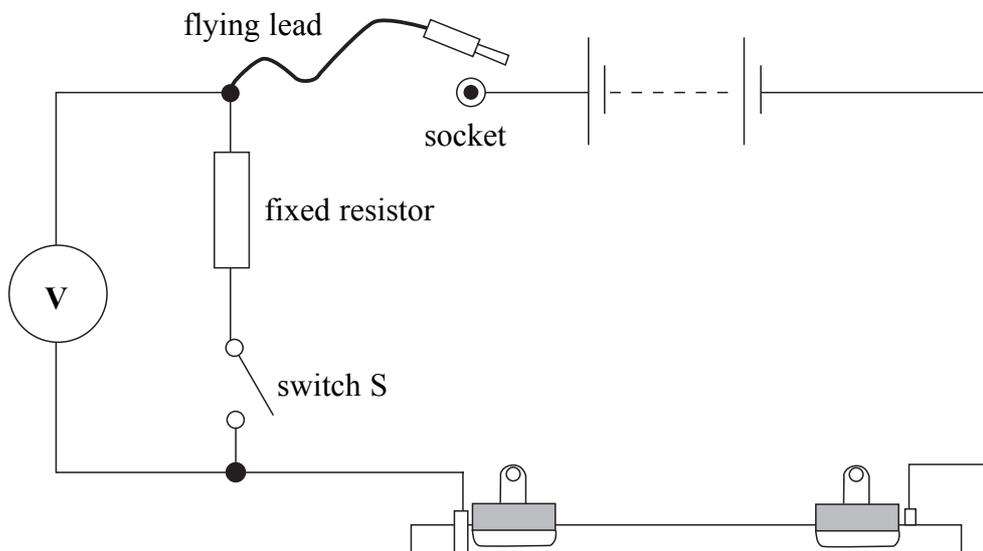
- (a) The resistor has already been assembled with the area of contact between the conductive surfaces of the paper at a maximum. Views of the resistor from the side and from above are shown in **Figure 2**.

Figure 2



You are provided with the circuit shown in **Figure 3**.

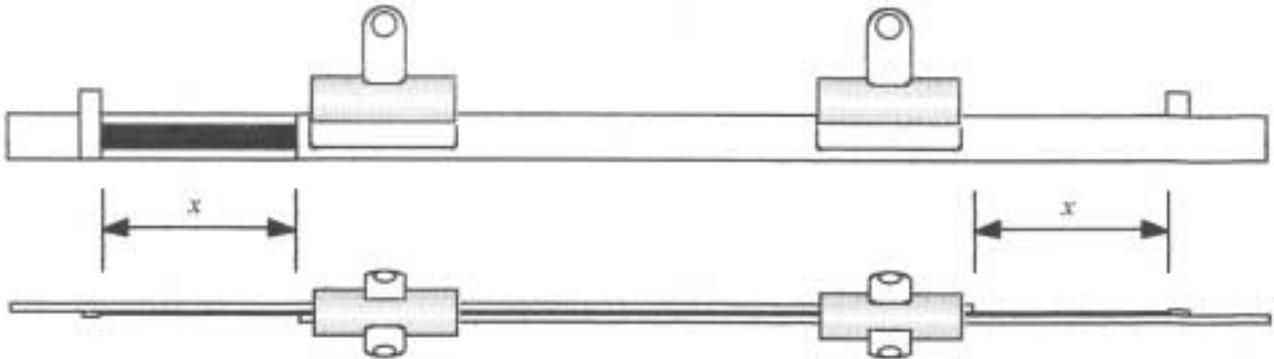
Figure 3



- (i) With switch S in the open (off) position, connect the flying lead to the socket. Read and record the voltmeter reading, E .
- (ii) Move switch S to the closed (on) position and then read and record the new voltmeter reading, V_0 . (1 mark)

- (b) Disconnect the flying lead from the socket and remove the bulldog clips. Reassemble the variable resistor so the contact area between the conductive faces of the paper is reduced and the exposed length of each piece of paper, x , is about 5.0 cm. Replace the bulldog clips to secure this arrangement, as shown in **Figure 4**.

Figure 4



Reconnect the flying lead to the socket and ensure that the switch, S , remains in the closed (on) position.

Measure and record the distance, x , and the voltmeter reading, V .

Repeating the procedure as before, measure and record additional values of x and V corresponding to **four larger** values of x . Throughout part (b) ensure that the flying lead is disconnected before making changes to the variable resistor.

Record all your measurements and observations.

(5 marks)

(c) Plot a graph with $\frac{E - V}{V}$ on the vertical axis and x on the horizontal axis.

Record the data you will plot on your graph. (7 marks)

(d) (i) Measure and record the gradient, G , of your graph.

(ii) Evaluate $\frac{3(E - V_0)}{GV_0}$. (3 marks)

The remaining questions for this examination are not provided in the Instructions to Supervisors. It is not necessary for the supervisor to be aware of the questions as they have no bearing on the setting up of the experiment.

However, centres are advised that in this experiment, the graph produced should be a straight line of positive gradient.

END OF QUESTIONS