General Certificate of Education
January 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 Tuesday 17 January 2006 1.30 pm to 3.15 pm

- **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.
- **These Instructions explain how to set up the equipment for Question 2.**
- **There is a loose insert, INSERT TO PHA3/P/TN, enclosed with these instructions, for use in Question 2.**
- **Question 2 is printed on pages 3 to 6 of this Instruction booklet.**
- **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 953 1180, or email dbaker@aqa.org.uk

Candidates are to investigate the deviation of a light ray as it passes through a semicircular transparent block.

Apparatus required for each candidate:

- ❒ semicircular block (acrylic plastic or glass) e.g. Philip Harris A45470
- ❒ suitable white light source, eg ray box fitted with cylindrical convex lens and slit to produce narrow parallel beam of white light
- ❒ power supply for ray box and connecting leads
- ❒ 1 A3 sheet, INSERT TO PHA3/P/TN, a copy of which is enclosed with these instructions
- ❒ set square
- ❒ 300 mm plastic ruler

The experiment may be conducted under conditions of subdued lighting but total black-out will not be necessary.
Place the apparatus on the bench. No assembly is required beforehand.

Candidates will need to use in Question 2, a flat A3 sheet provided in the loose insert, PHA3/P/TN. Hence, before the examination, supervisors should make full-scale A3 copies of the circle on the sheet provided as the loose insert with these instructions. Each candidate should be provided with a copy of this sheet at the start of the examination. Spare copies should be made: candidates are instructed to ask for additional sheets should this prove necessary. There will be no copy of this sheet enclosed with the candidates' paper.

Note that the examiners do not require the A3 sheets candidates will use: Centres should dispose of these after the examination and not forward them with the scripts.

Examiners will require no information for this question.

2 For Question 2 there is an A3 sheet, INSERT TO PHA3/P/TN, provided. This sheet will not be sent to the examiner but should be left with the paper at the end of the examination. If you require a further copy of this sheet, ask the supervisor.

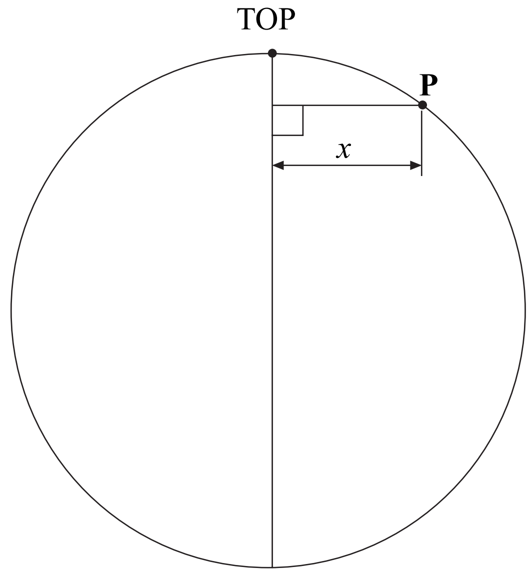
You are to investigate the deviation of a light ray passing through a semicircular transparent block.

(a) You are provided with a large sheet of paper (PHA3/P/TN) showing a diagram of a circle.
A diameter of the circle has been marked on the diagram.

(i) Measure and record below the diameter, D, of this circle.

(ii) With the point marked TOP furthest from you, measure and record the perpendicular distance, x, between the point **P** on the circle and the marked diameter, as shown in **Figure 3**.

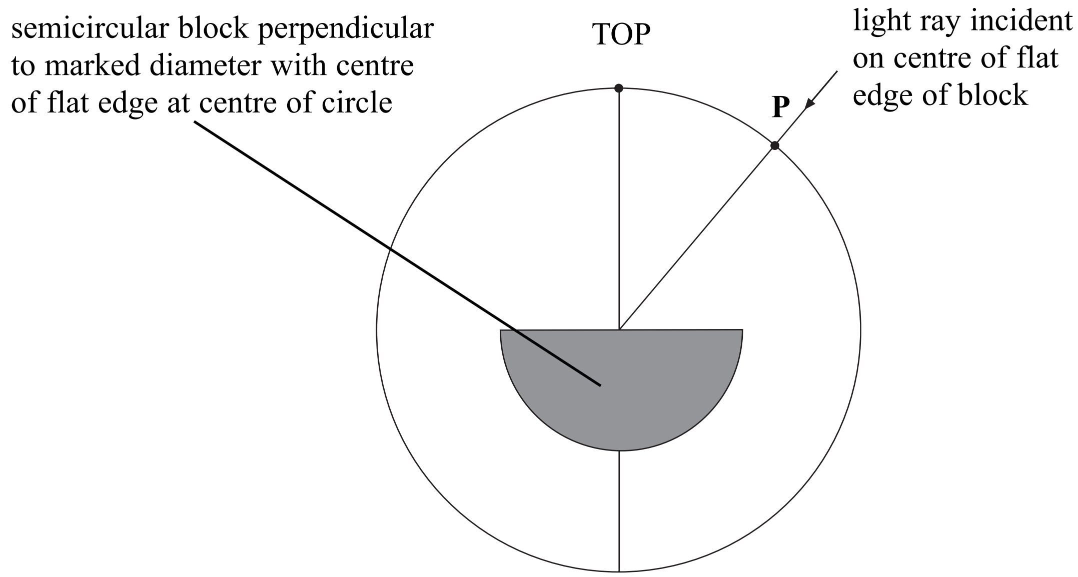
Figure 3



(2 marks)

(b) Position the semicircular block as shown in **Figure 4** so that the centre of the flat edge of the block is perpendicular to the marked diameter. Adjust the position of the block until the centre of the flat edge of the block is at the centre of the circle.

Figure 4

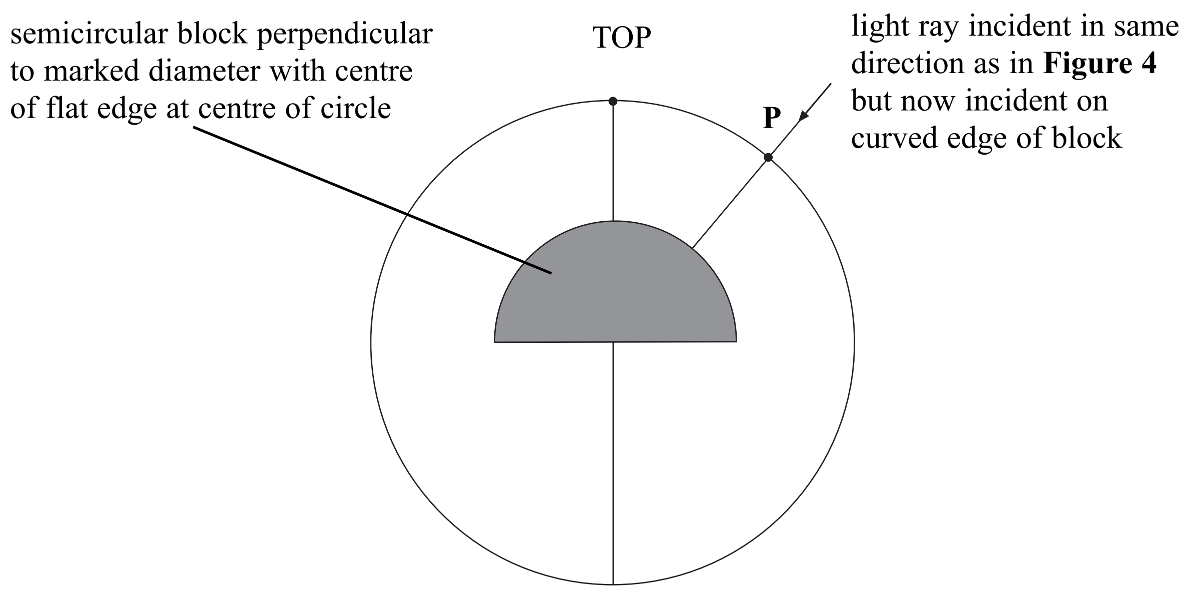


Position the ray box so that a ray of light passes through point **P** and is then incident on the centre of the flat edge of the block.
Mark on the diagram the path of the ray emerging from the curved edge of the block.
Extend this line to reach the circle.

Measure and record the perpendicular distance, y, between the point where the emergent ray reaches the circle and the marked diameter.

Rotate the block to the position shown in **Figure 5**. Note that the centre of the flat edge of the block should still be perpendicular to the marked diameter and the centre of the flat edge of the block should remain at the centre of the circle.

Figure 5



Mark on the diagram the path of the ray emerging from the flat edge of the block.
Extend this line to reach the circle.
Measure and record the perpendicular distance, *z*, between the point where the emergent ray reaches the circle and the marked diameter.

Replace the block as in **Figure 4** and reposition the ray box so that the ray of light now enters the circle **between** point **P** and the point marked TOP on the marked diameter. Ensure that the ray is once again incident on the centre of the flat edge of the block.
Repeating the procedure as before, measure and record additional values of *y* corresponding to **five smaller** values of *x*.
Reposition the block as in **Figure 5** and repeat the procedure to measure and record values of *z* corresponding to the **same four smaller** values of *x*.
You may ask the supervisor for additional sheets of paper, if required.

Record all your measurements and observations. *(6 marks)*

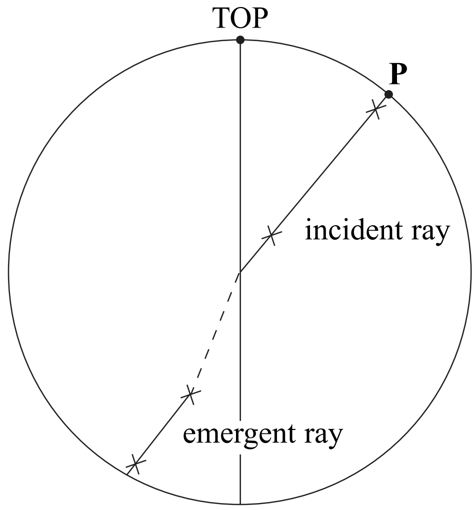
(c) Using the grid, plot a graph with *z* on the vertical axis and *y* on the horizontal axis. *(5 marks)*

(d) Measure and record the gradient, G, of your graph. *(3 marks)*

(e) (i) Explain the procedure you used to position the semicircular block as in **Figure 4**.

(ii) A student, performing the experiment, attempts to arrange the block as shown in **Figure 4**, so that light passes in through the flat edge and traces the paths of the incident and emergent rays to and from the block. When the block is removed, the student draws a line (shown dotted in **Figure 6**) to join the incident and emergent rays.

Figure 6



Assuming that the block was of constant radius, state and explain the mistake the student has made. *(6 marks)*

END OF QUESTIONS

There are no instructions printed on this page

There are no instructions printed on this page