Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2013

Physics
(Specifications A and B)

PHA3/B3/XPM1

Unit 3 Investigative and Practical Skills in AS Physics
Route X Externally Marked Practical Assignment (EMPA)

Section A Task 1

For this paper you must have:
- a calculator
- a pencil
- a ruler.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for Section A Task 1 is 15.

SECTION A TASK 1

Follow the instructions given below.

Give the information required in the spaces provided.

No description of the experiments is required.

1 You are to trace the path of a light ray passing through a semicircular transparent block.

1 (a) Measure and record the diameter, D, of the semicircular block.

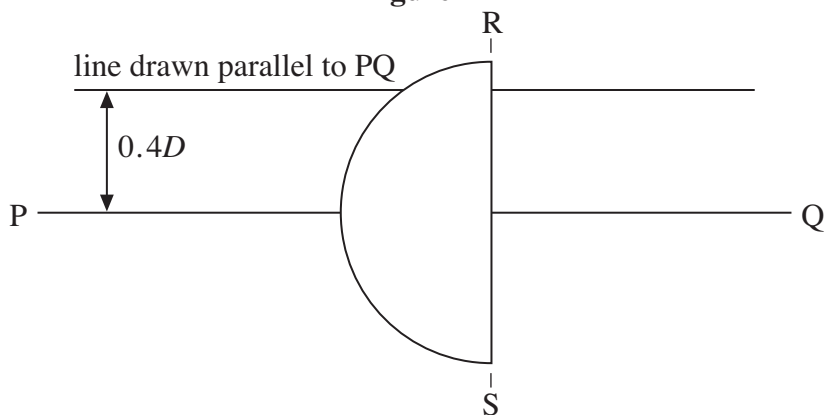
D = ...

(1 mark)

1 (b) You are provided with a sheet of paper, on which there is a solid line, PQ, and a dashed line, RS. Place this sheet on the table with P to your left.

1 (b) (i) Draw a line across the sheet parallel to PQ and $0.4D$ above it, as shown in **Figure 1**.

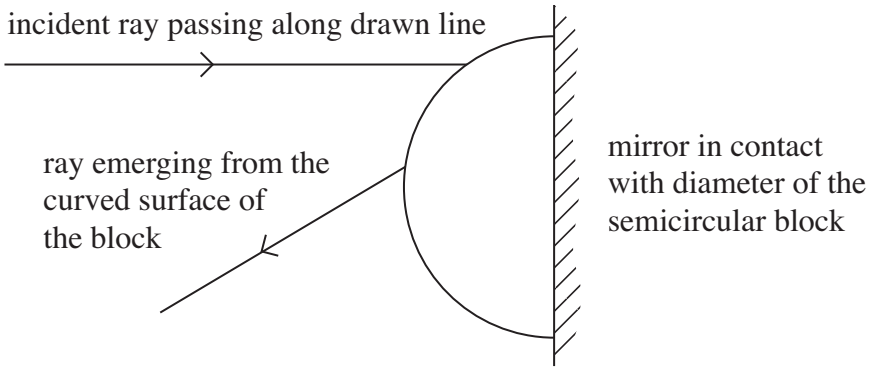
Figure 1



1 (b) (ii) Place the block on the sheet so that the diameter of the block is aligned with RS and the mid-point of the diameter of the block is where PQ and RS meet, as shown in **Figure 1**.
Mark the outline of the semicircular block on the paper.
Place the plane mirror with the reflective surface along the line RS, in contact with the diameter of the block.

1 (b) (iii) Use the ray box to direct a ray of light along the line you drew in part (i) so that the ray emerges from the curved surface of the block, as shown in **Figure 2**.

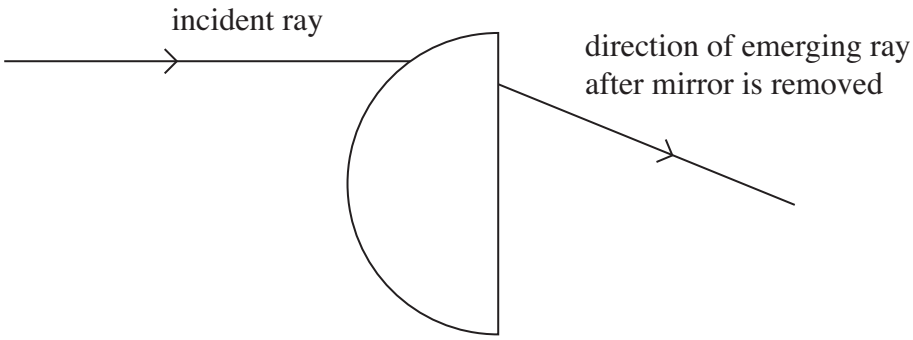
Figure 2



1 (b) (iv) Mark on the sheet of paper the direction of the ray emerging from the curved surface of the block.

1 (c) With the block and the ray box in the same positions, remove the plane mirror so that the ray now emerges from the diameter of the block, as shown in **Figure 3**.

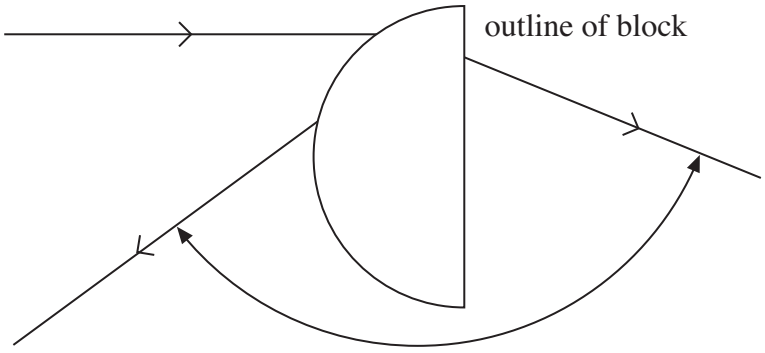
Figure 3



1 (c) (i) Mark on the sheet the direction of the ray emerging from the diameter of the block.

1 (c) (ii) Remove the block.
Measure and record the angle, θ_d, defined in **Figure 4**.

Figure 4



θ_d = ...

1 (c) (iii) **Figure 5** shows how θ_d, varies with n, the refractive index of the block. Showing your method on **Figure 5**, determine n for your block.

n = ...

(3 marks)

1 (d) **Table 1** shows the steps involved in performing the experimental procedure to determine θ_d.

Table 1

step	question	procedure
A	(a)	measuring D, the diameter of the semicircular block
B	(b)(i)	drawing the direction of the line parallel to PQ
C	(b)(ii)	positioning the block in the specified position
D	(b)(iii)	aligning the light ray with the line marked parallel to PQ
E	(b)(iv) and (c)(i)	marking the direction of the rays emerging from the block
F	(c)(ii)	measuring the angle θ_d

State and explain which of the steps, A to F, contributed most to the uncertainty in your result for θ_d.

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(2 marks)

1 (e) Describe with the aid of a sketch how you positioned the protractor before measuring θ_d.

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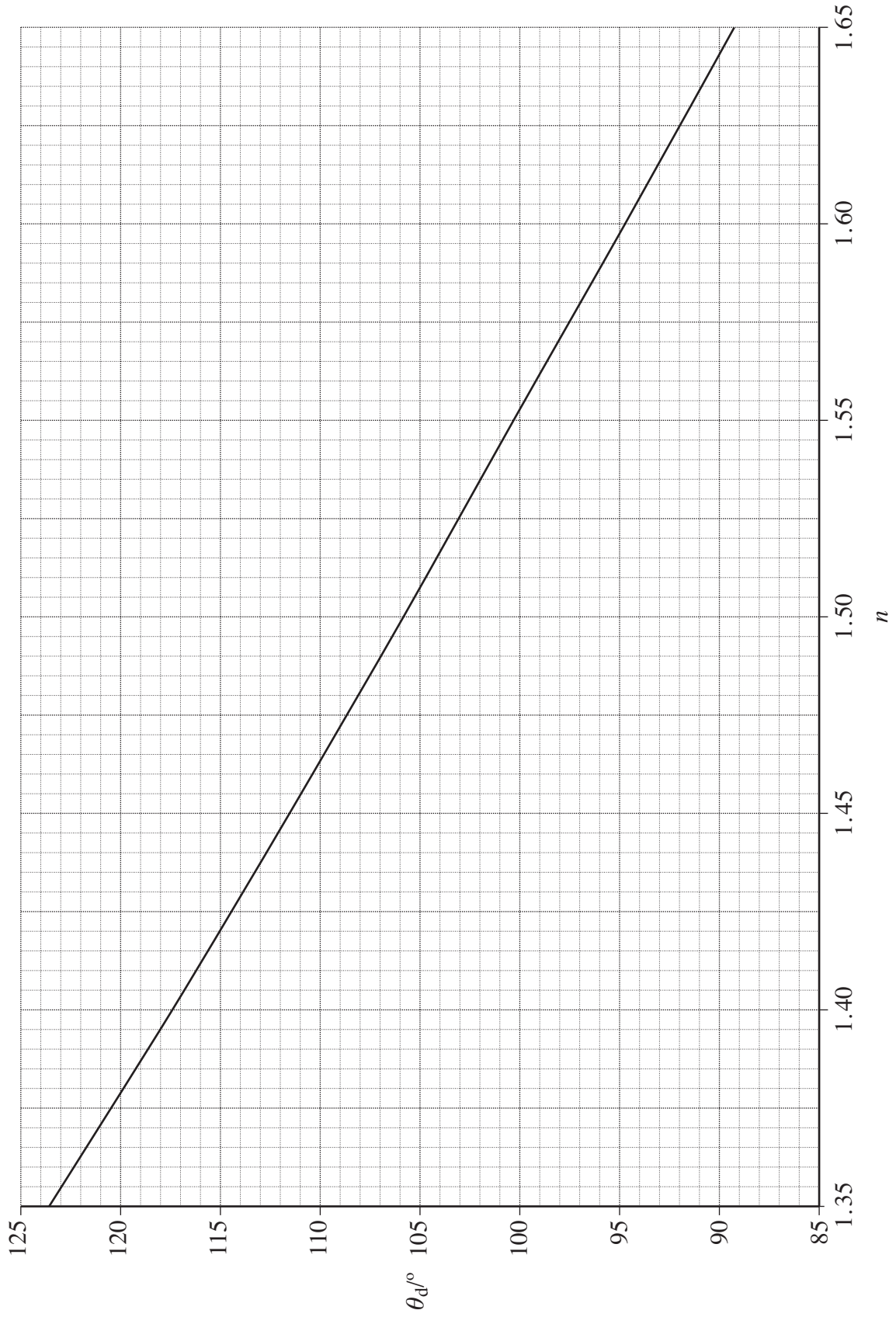
(2 marks)

8

Figure 5

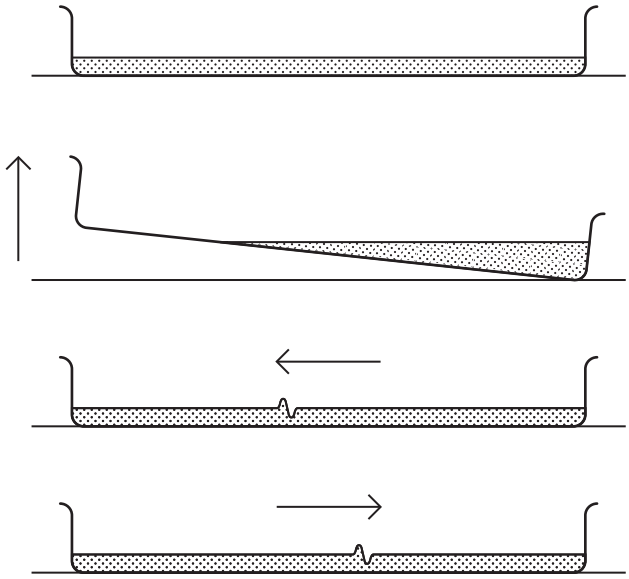


2 You are to measure the transit time for water waves for three different depths of water.

2 (a) A container has been marked to show when it holds **one measure** of water.
Fill the container with water up to this mark then carefully pour this into the shallow tray.
Repeat the process so that the tray contains **two measures** of water.

2 (a) (i) Carefully lift one end of the tray about 2 cm above the bench then let it fall back. This will cause a plane wave to travel along the surface of the water, as shown in **Figure 6**.

Figure 6



2 (a) (ii) Make suitable measurements to determine T, the time for the water wave to travel **from one end of the tray to the other** when m, the number of measures of water in the tray is 2.

2 (a) (iii) Repeat the procedure for $m = 3$ and for $m = 4$.

Record your measurements below.
Note that the independent variable should be recorded in the **left-hand** column of your table.

(3 marks)

2 (b) A teacher suggests that for this experiment,

$$T\sqrt{m} = k$$

where k is a constant.

2 (b) (i) By performing suitable calculations with your data from part (a), state and explain whether you think the teacher's theory is correct.

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2 (b) (ii) The teacher's theory is based on the assumption that m is directly proportional to the depth of the water in the tray.
For the tray that you used, explain whether you think the teacher's assumption is valid.

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(4 marks)

7

END OF QUESTIONS