

**Instructions to Supervisors for the Practical Examination (Unit 3)**

**CONFIDENTIAL**

**OPEN ON RECEIPT**

The examination will be held on Thursday 15 May Morning Session.

- 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.
- Question 2 is printed on pages 3, 4 and 5 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.

Candidates are required to investigate the lateral displacement of a light ray as it passes through a transparent rectangular block.

**Apparatus required for each candidate:**

- rectangular block (glass, acrylic or perspex) typical dimensions  $100 \times 45 \times 25$  mm
- suitable white light source, e.g. ray box fitted with cylindrical convex lens and slit
- power supply for ray box
- 2 or 3 sheets of A3 photocopier paper
- protractor
- 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.

Note that the examiners do not require the A3 sheets candidates will use: they are instructed to ask for additional sheets should this prove necessary. Centres should dispose of these after the examination and not forward them with the scripts.

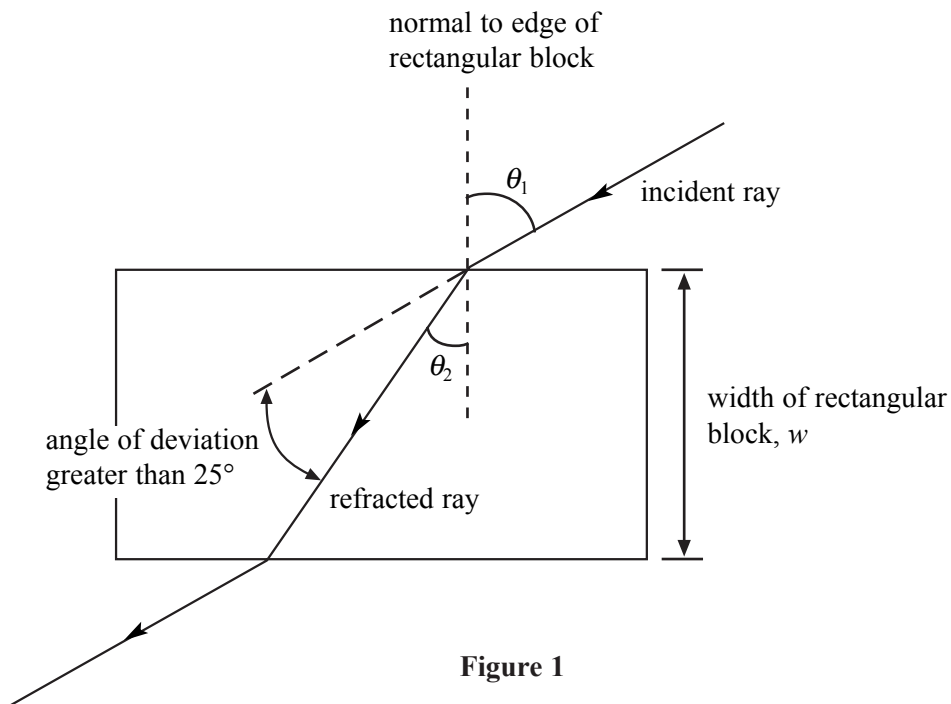
**Examiners will require no information for this question.**

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

- (a) Place a clean sheet of A3 plain paper on the bench and place the rectangular block with one of the largest faces in contact with the paper.

Use the ray box to direct a narrow ray of light on to the block so that it passes into the block through one of the longest edges, as shown in **Figure 1**.

Adjust the block until the light ray is deviated by at least  $25^\circ$  as it travels into the block.



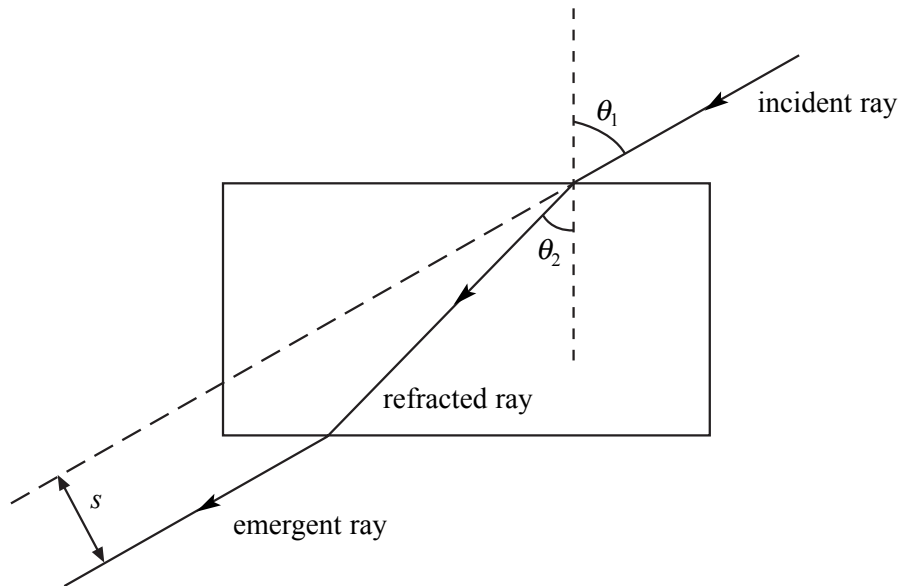
**Figure 1**

- (i) Measure and record,  $w$ , the width of the rectangular block and the angles  $\theta_1$  and  $\theta_2$  defined in **Figure 1**.
- (ii) Determine the refractive index,  $n$ , of the block given by  $\frac{\sin \theta_1}{\sin \theta_2}$

(3 marks)

Turn over ►

- (b) Mark the outline of the block on the paper then direct a narrow ray of light on to the block so that it passes into and out of the block through the (opposite) longest edge as shown in **Figure 2**. Adjust the angle of the incident ray until the lateral displacement,  $s$ , of the light ray defined in **Figure 2**, is approximately 10 mm.



**Figure 2**

Trace on to the paper the directions taken by the incident ray and the emergent ray. Remove the block and construct the refracted ray and the path of the incident ray, as shown in **Figure 2**. Measure and record  $\theta_1$  and  $\theta_2$ , and by using a suitable method, measure and record the lateral displacement,  $s$ , of the light ray which is defined in **Figure 2**. Replace the block in its original position and repeat the procedure for four larger values of  $s$ . You may ask the supervisor for additional sheets of A3 paper, if required.

Record your measurements and observations.

(5 marks)

- (c) Using the grid, plot a graph with  $(s \cos \theta_2/\text{mm})$  on the vertical axis and  $\sin (\theta_1 - \theta_2)$  on the horizontal axis.

Tabulate the data that you will plot on your graph.

(5 marks)

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

(3 marks)

- (e) (i) When you determined the refractive index,  $n$ , of the block in part (a)(ii) you were instructed to make the deviation of the light ray at least  $25^\circ$  as it entered the block. Explain why this precaution should reduce the uncertainty in your result for  $n$ .
- (ii) Give **two** precautions that you took to minimise the error in your measurements of the lateral displacement,  $s$ , of the light ray.
- (iii) A student performs part (b) of the experiment with light passing into and out of the block through the **shortest** edges.  
State how this modification affects the range of readings of  $s$  that can be obtained.  
State how this modification affects the range of readings of  $\theta_1$  and  $\theta_2$  that can be obtained.  
*(6 marks)*

**END OF QUESTIONS**

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