

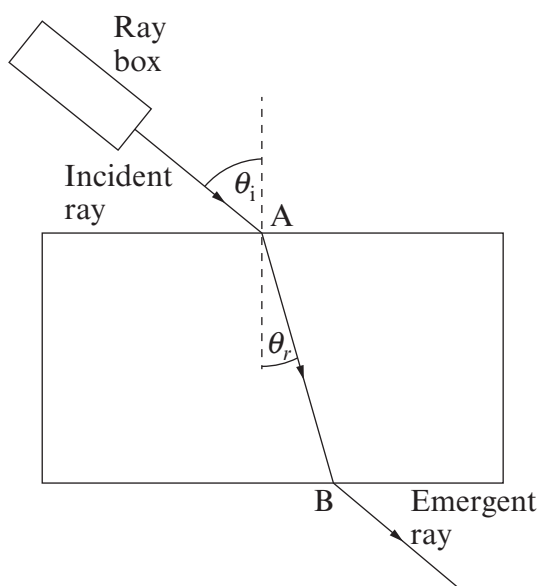
Task A2 (15 minutes)

In this task you are going to measure the refractive index of glass.

The refractive index, n of glass is given by the equation

$$n = \frac{\sin \theta_i}{\sin \theta_r}$$

where n = refractive index, θ_i is the angle of incidence and θ_r is the angle of refraction as shown for the following arrangement.



The angle of refraction, θ_r , can be measured by first drawing in the line AB joining incident and emergent rays.

- (a) Using the apparatus, measure the angle of refraction and calculate a value for the refractive index for an angle of incidence of 30° using the above equation. **Repeat readings are not required.** [2]

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- (b) Repeat this process and include your results for angles of incidence of 40° and 50° . Include your results in the following table. The values in the last 3 columns should be expressed to 3 significant figures. [4]

Angle of incidence, θ_i	Angle of refraction, θ_r	$\sin \theta_i$	$\sin \theta_r$	Refractive index, n
30°				
40°				
50°				

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- (c) Calculate a mean value for the refractive index of glass and quote the value along with its uncertainty. [2]

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TASK A2

Candidates will take measurements on the path of a light ray through a transparent rectangular block.

Test 1

Apparatus required:

Suitable white light source e.g. ray box fitted and slit to produce a narrow parallel beam of light
Power supply for ray box and connecting leads

Rectangular block of glass or Perspex: it is an advantage to candidates if the base of the block is frosted or painted matt white, so that the path of the light within the block is visible; candidates who are familiar with using glass blocks with polished bases should not require this.

1 or 2 sheets of plain paper, e.g. A3 or A4 copier paper, marked with angles of incidence of 30° , 40° and 50° [see below]

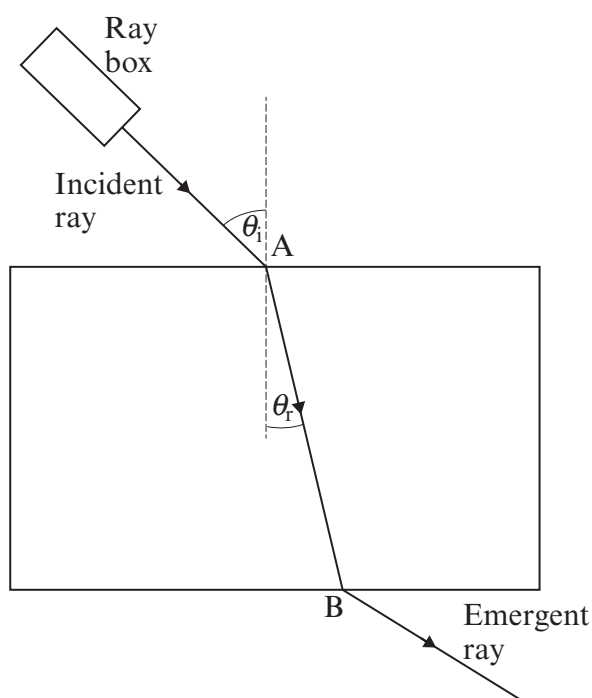
Protractor

30 cm rulers

Sharp pencil

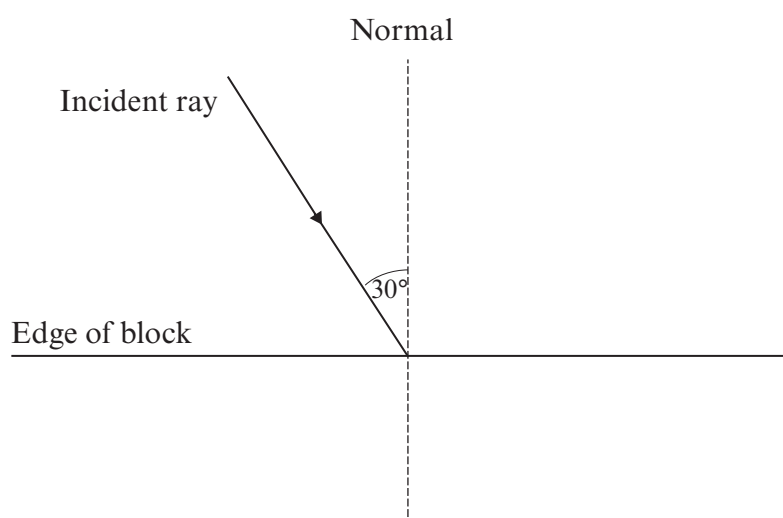
The experiment may be conducted under normal laboratory lighting. A dark room is not required.

Diagram of experimental arrangement:



The angles of incidence of 30° , 40° and 50° should be indicated on the paper for the candidates. A clean copy should be made available at the changeover for each candidate.

The following is a suggested layout of an A4 sheet for an angle of incidence of 30° [The layout is indicative only]. It is suggested that the reverse side be used for one of the other angles and a second sheet of A4 be used for the third.



Test 2

The apparatus is as for **Test 1** except that the angles indicated on the paper should be 20° , 30° and 45° and a different block should be used [i.e. glass if a Perspex block was used in **Test 1**].

TEST 1 – MARK SCHEME

- A2.** (a) Angle of refraction measured correctly $\pm 1^\circ$ from centre value. (1)
Refractive index calculated correctly (1) [e.c.f. on measured angle]. NB There is no s.f. penalty here. [2]
- (b) Angles of refraction to within 1° of centre value. (1)
Columns 3-5 correctly filled in with data to 3 s.f. (1 mark per column) [4]
- (c) Mean value calculated correctly and expressed to a precision consistent with the uncertainty. (1)
Absolute uncertainty calculated correctly [i.e. (max – min)/2] and expressed to 1 [accept 2] s.f. (1) [2]
- Total [8]