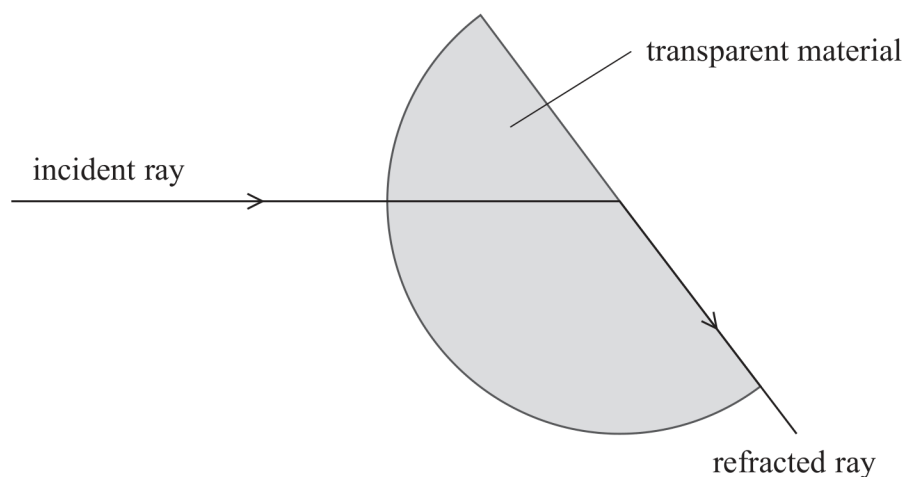2   A student determined the refractive index of a transparent material. The student had a semicircular block of the material as shown.

incident ray

transparent material

refracted ray

(a) (i)   Complete the diagram to show the critical angle.

(1)

(ii) Determine the refractive index of the transparent material, using measurements from the diagram.

(2)

....

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....

....

....

Refractive index = ...

(b) The student repeated the process for a second semicircular block of a different transparent material.

Her measured value for C was $41 \pm 0.5°$

Calculate the range of possible values of the refractive index.

(2)

....

....

....

Range of values of refractive index = ...

(c) The student had a rectangular block of transparent material. She made measurements as shown.
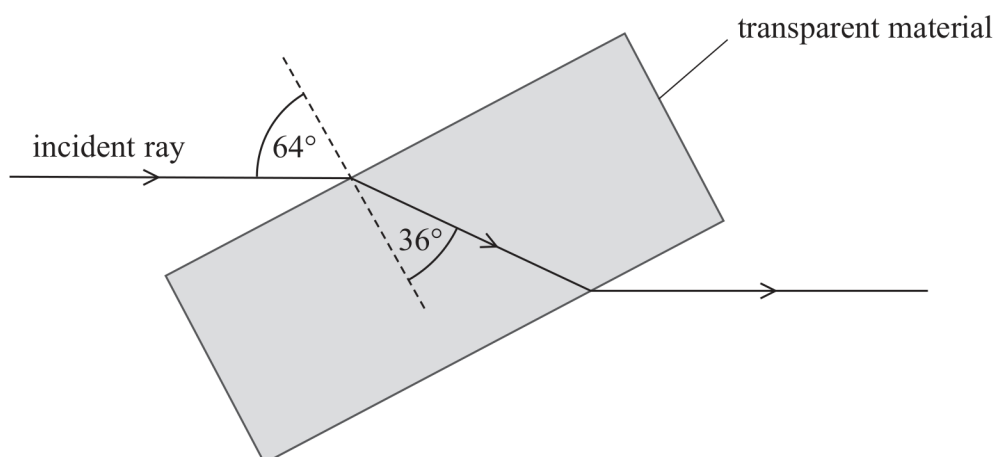
Deduce whether this block is made of the same material as the block in (b).
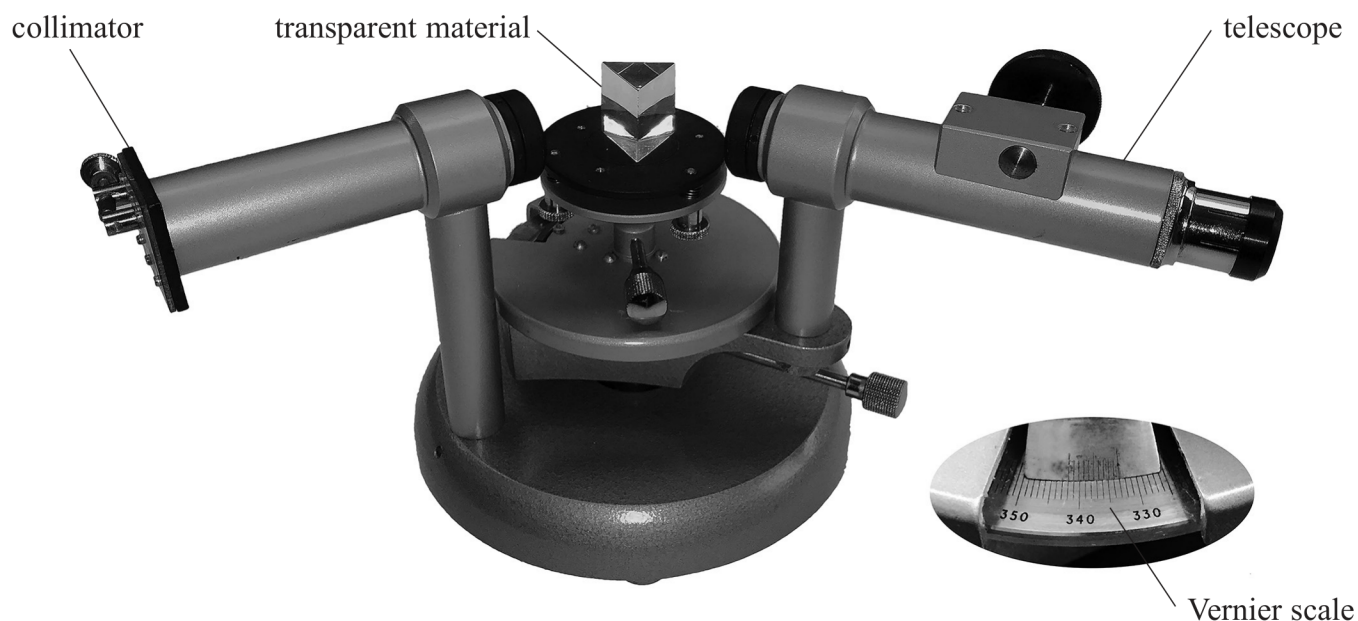
(3)

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(d) The student used rays of white light.

Explain why using monochromatic light would increase the validity of the conclusion made in (c).

(3)

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(e) The photograph shows a spectrometer. This can be used to measure angles when investigating refraction.

collimator   transparent material   telescope

Vernier scale

Light emerges from the collimator in a narrow parallel beam.

A Vernier scale allows the angles to be measured with a resolution of 0.1°

Using a spectrometer reduces the uncertainty in the value of the refractive index of the material compared with using a ray box and a protractor.

Justify this statement.

(3)

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(Total for Question 2 = 14 marks)