

Physics

Standard level

Paper 1B



29 April 2025

Zone A afternoon | Zone B afternoon | Zone C afternoon

Candidate session number

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1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for paper 1B is **[20 marks]**.
- The maximum mark for paper 1A and paper 1B is **[45 marks]**.

Answer all questions. Answers must be written within the answer boxes provided.

1. A student is analysing a sample of water. To determine its density, the student measures the volume with a measuring cylinder and the mass with an electronic balance.

(a) Identify **one** way to ensure that the volume is read accurately.

[1]



The following data are collected:

$$\text{Volume} = (10.6 \pm 0.2) \text{ cm}^3$$

$$\text{Mass} = (10.82 \pm 0.01) \text{ g}$$

(b) (i) Calculate the density of the sample and its absolute uncertainty.

[2]

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(ii) State your answers in kg m^{-3} and with correct precision.

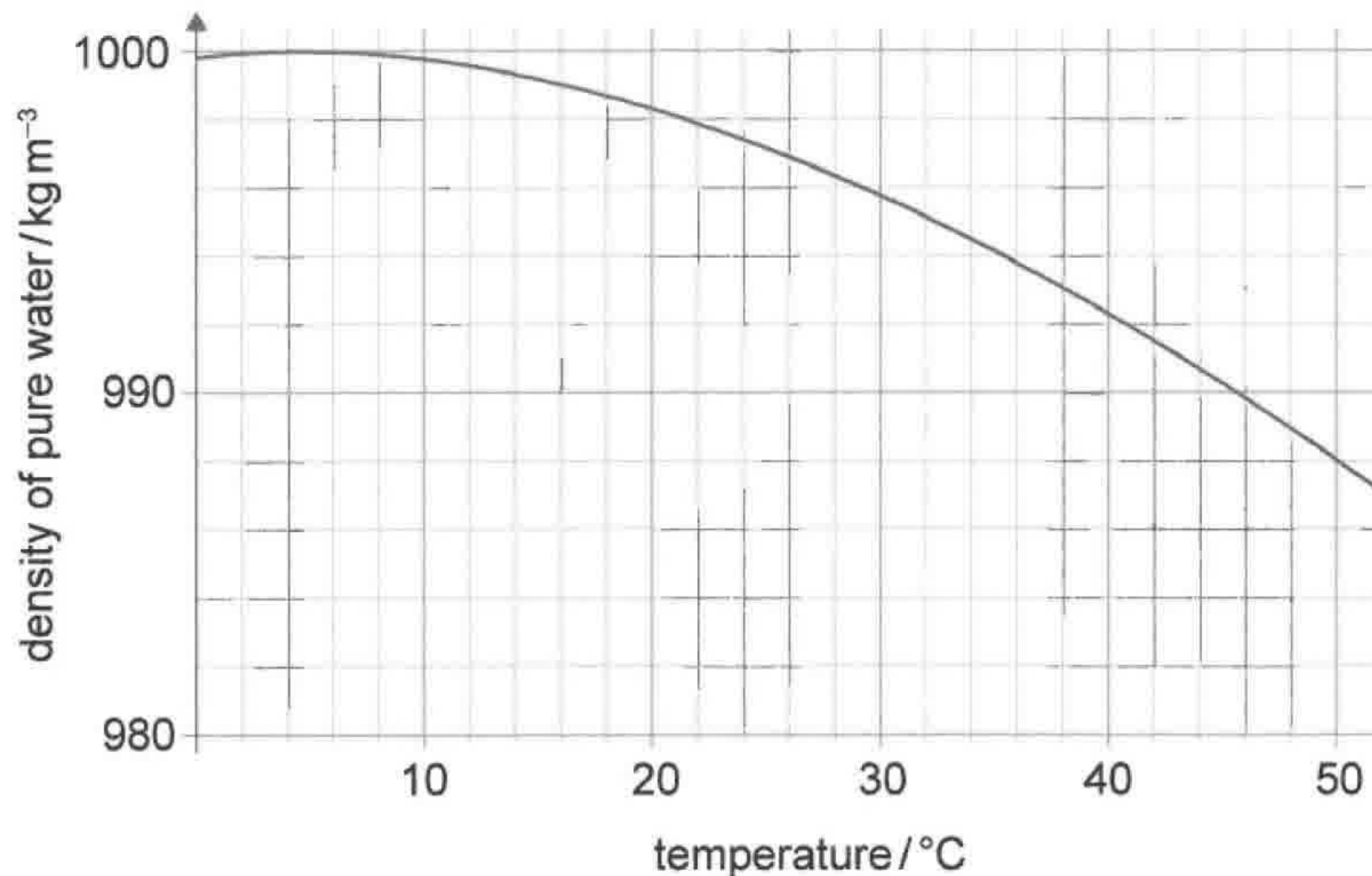
[1]



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When the density was measured, the sample was at 35 °C. The student has a graph that shows the variation with temperature of the density of pure water.



(c) Suggest whether the water sample can be considered pure.

[2]

2. A group of students is investigating refraction in a semi-circular glass block.

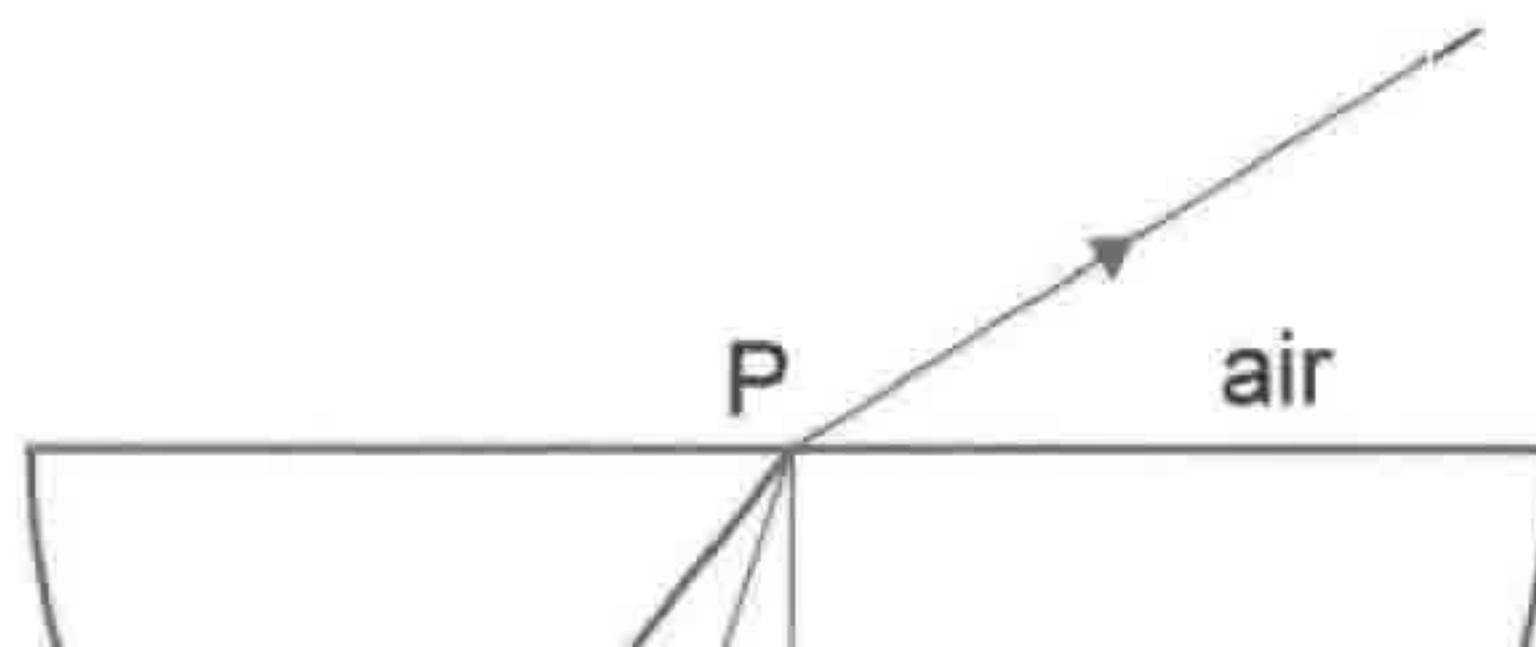
Light from a ray box enters the curved side of the block at O. The light passes through the block and leaves, refracted, at P.

- (a) Outline how the students can ensure that the light is not deflected at O.

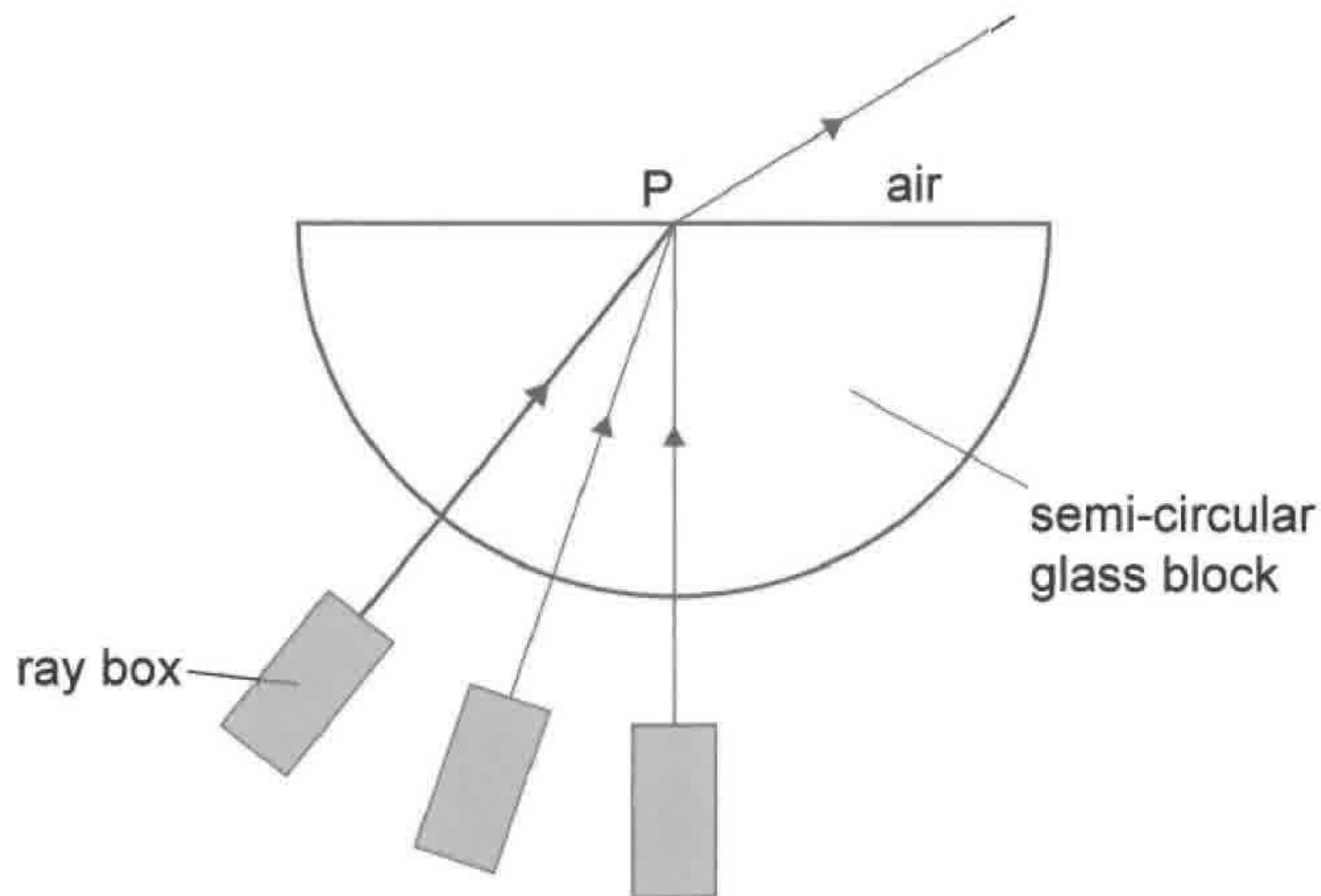
[1]

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The students vary the position of O to obtain data to determine the refractive index of the glass. They use a protractor to collect values for the angles of incidence θ_i and refraction θ_r at P and record them on a table.



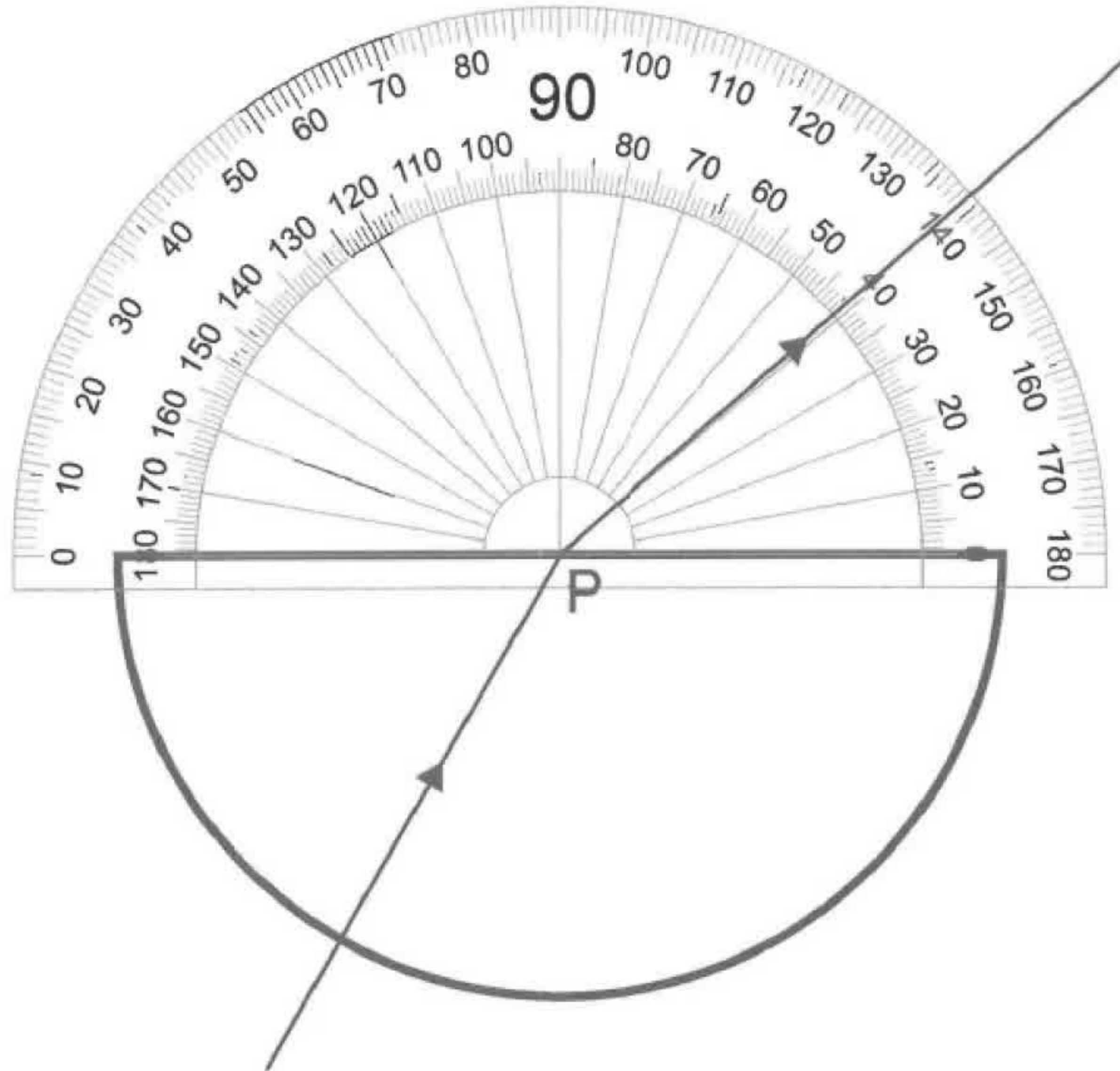
The students vary the position of O to obtain data to determine the refractive index of the glass. They use a protractor to collect values for the angles of incidence θ_i and refraction θ_r at P and record them on a table.



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(b) (i) One of their measurements is shown. State θ_r for this measurement.

[1]

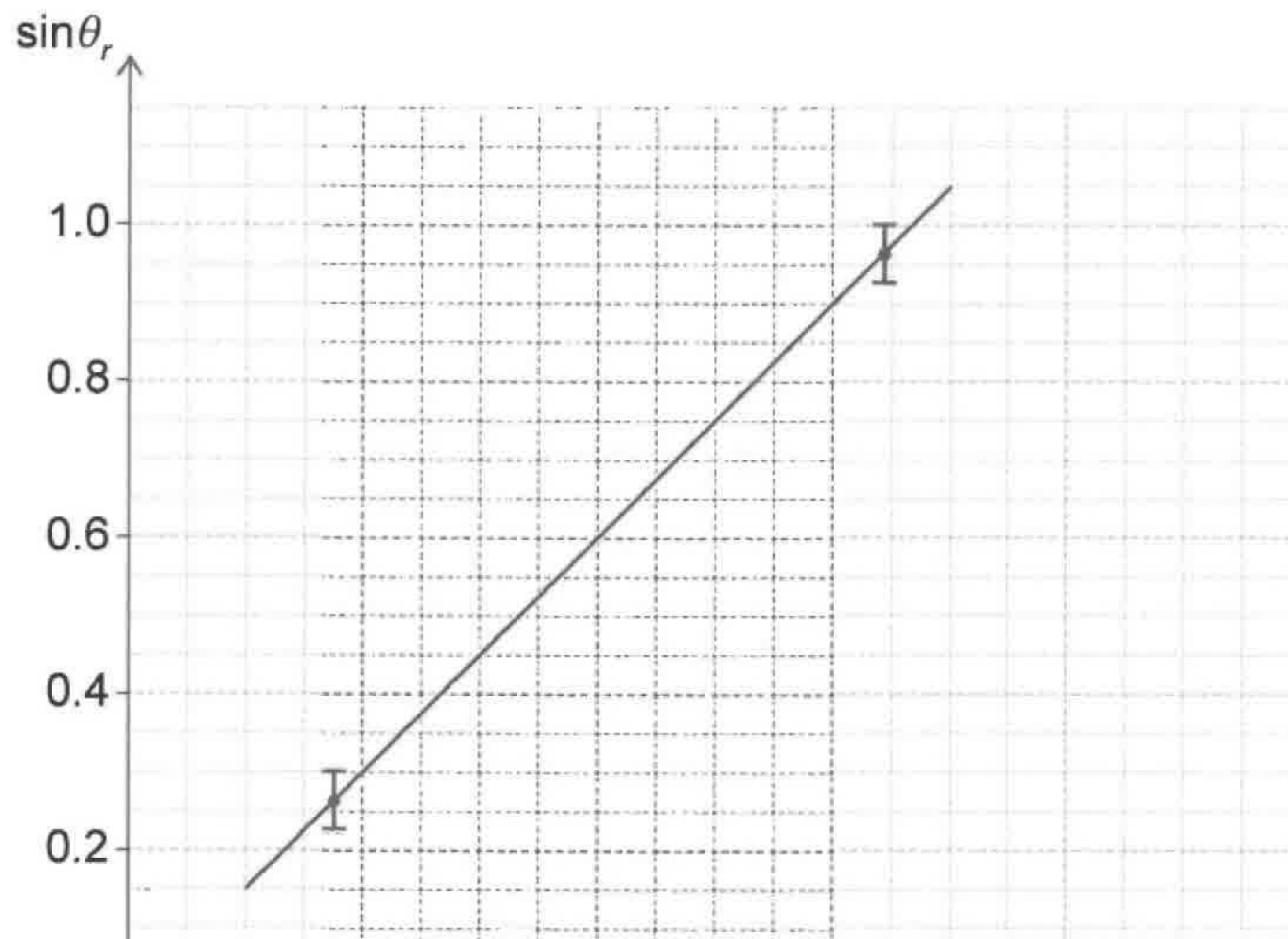


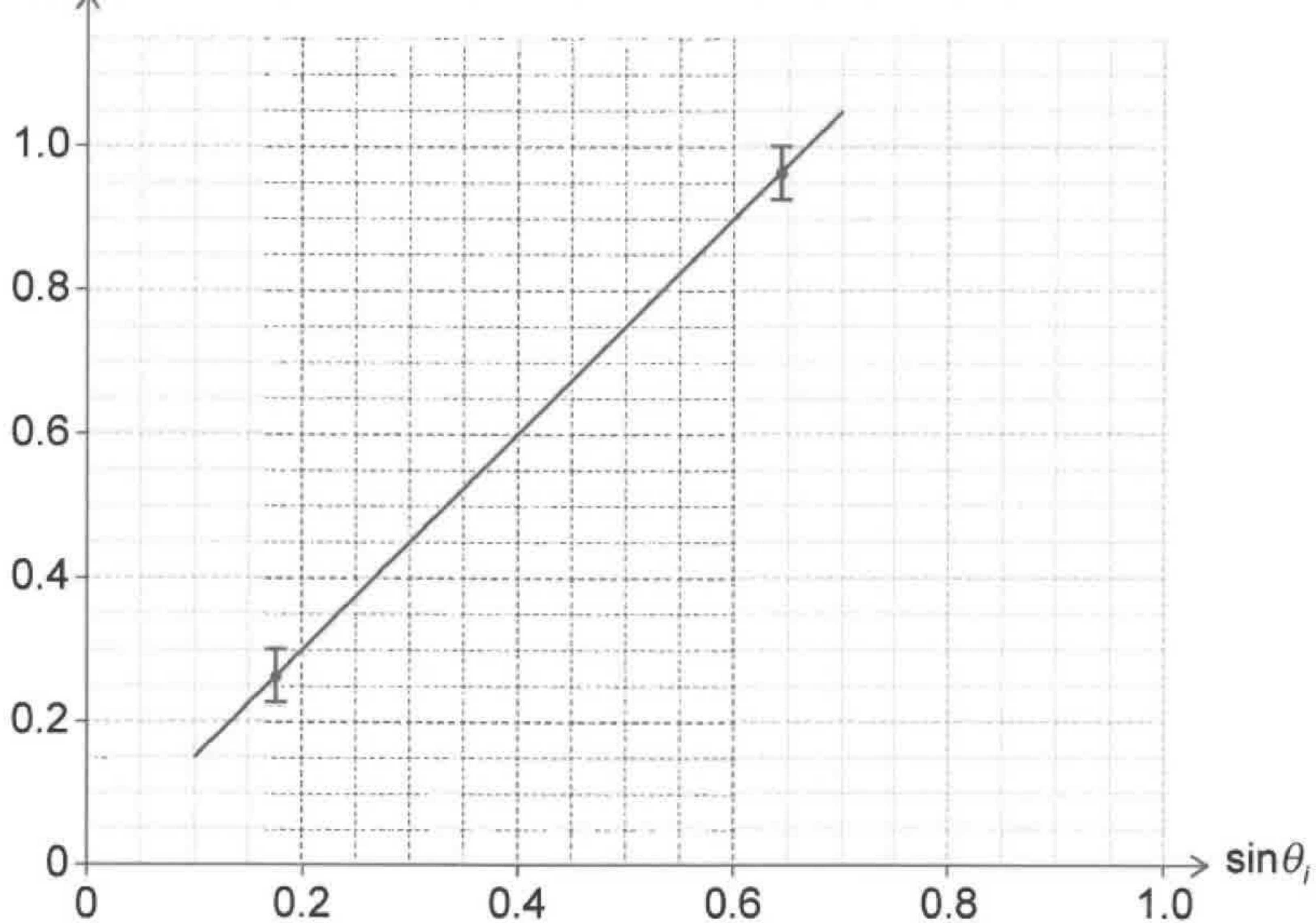
(ii) Complete the table. [1]

θ_i	θ_r	$\sin \theta_i$	$\sin \theta_r$
10	15	0.174	0.259
20	31	0.342	0.515
25	39	0.423	0.629
30	49	0.500	
35	60	0.574	0.866
40	75	0.643	0.966

They plot a graph of the variation with the sine of θ_i of the sine of θ_r .

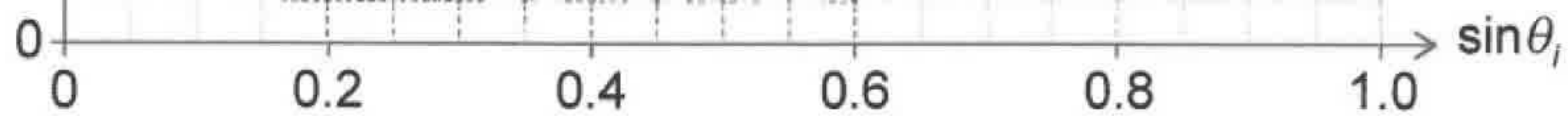
They add uncertainty bars for $\sin \theta_r$ for the first and last data point and draw the best-fit line.





(c) (i) Determine the gradient of the students' best-fit line.

[2]



- (c) (i) Determine the gradient of the students' best-fit line. [2]

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- (ii) Draw on the students' graph the line of maximum gradient. [1]

- (iii) Determine the value of the refractive index of the glass with its absolute uncertainty. [2]

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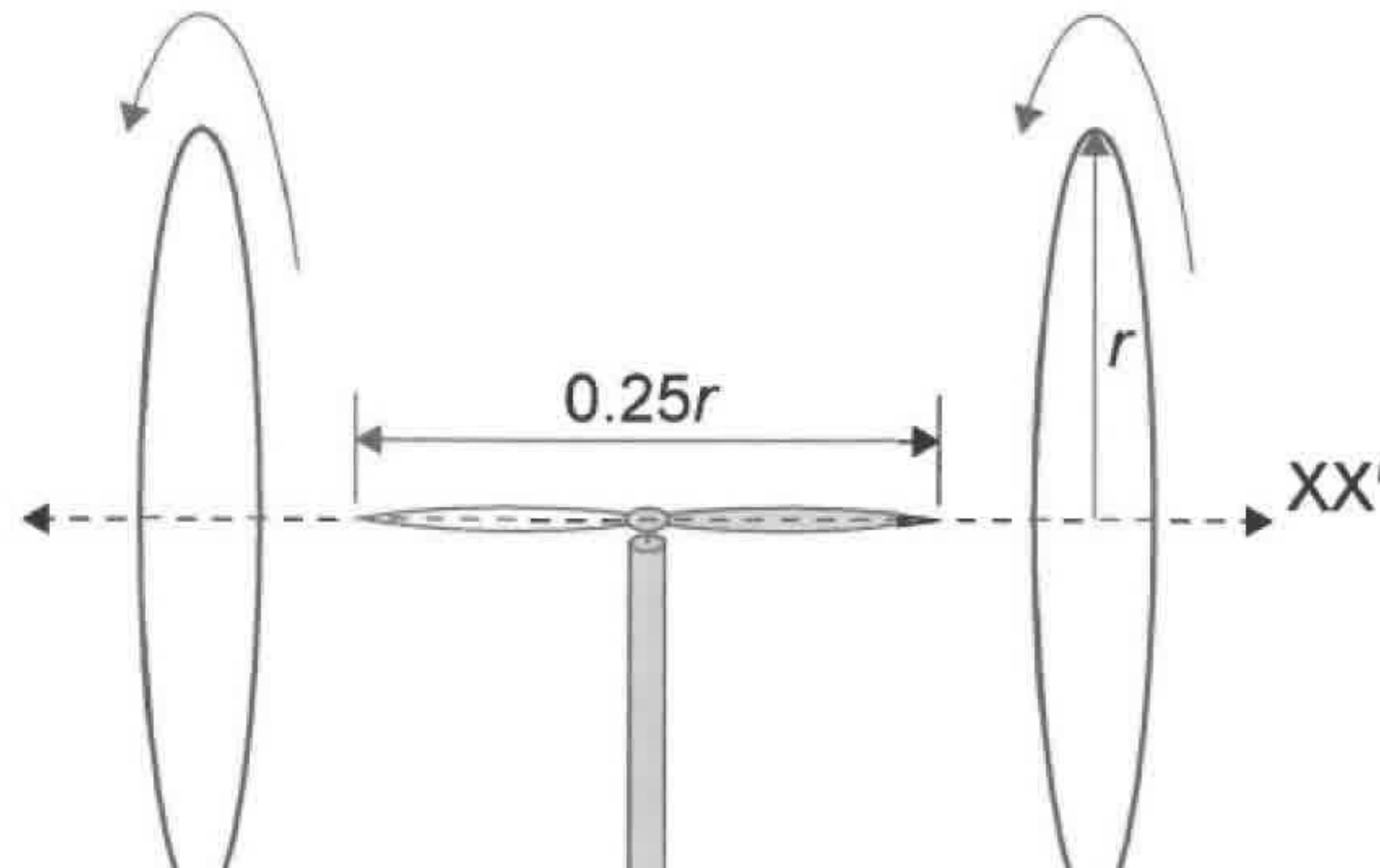
3. A group of students wants to determine the horizontal component B_H of the Earth's magnetic field.

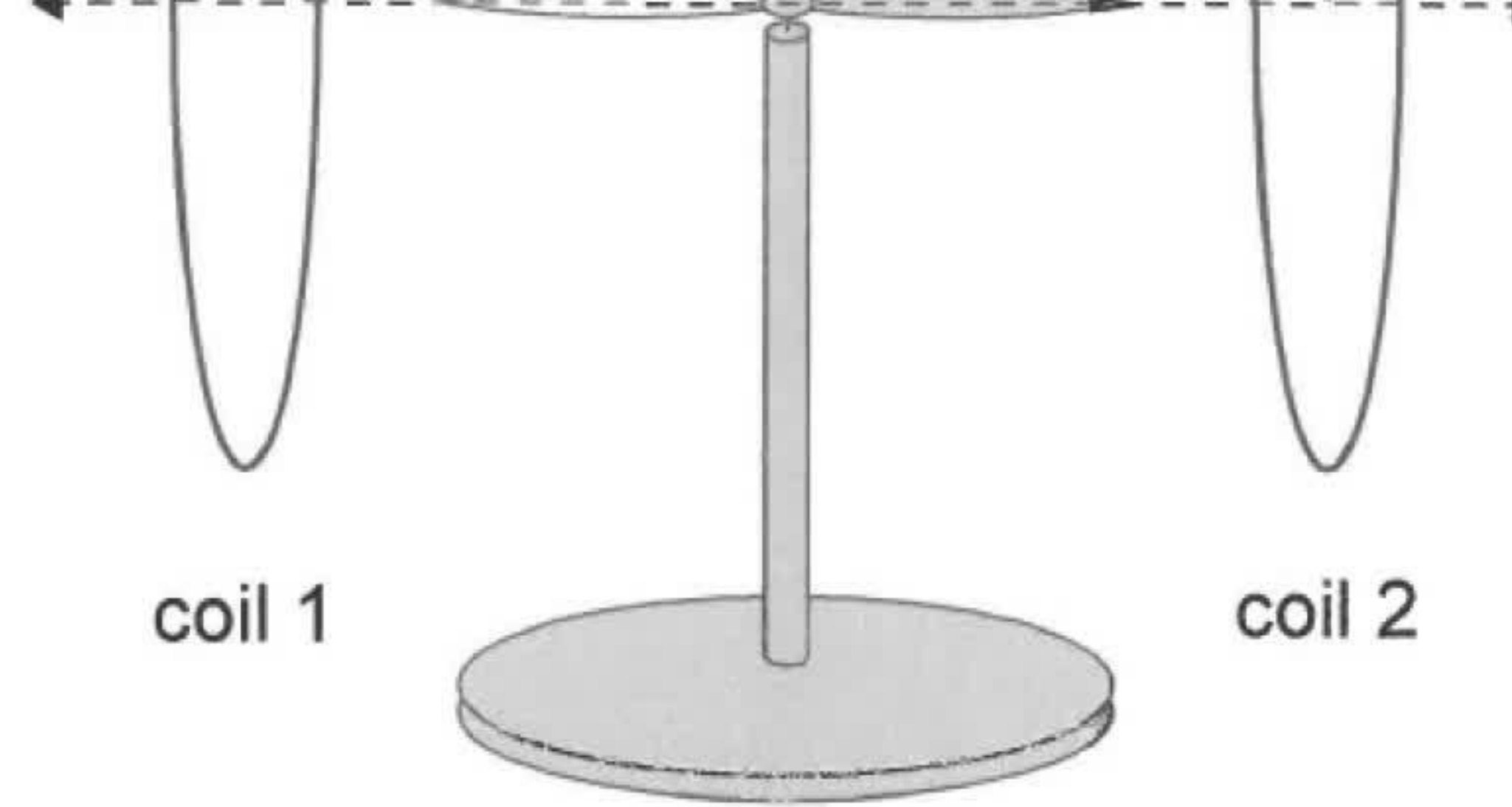
They place a magnet (in the form of a magnetic needle) midway between two coils.

When there is no current through the coils, the magnet aligns itself in the north-south direction. When there is an identical current established in the coils, the magnetic field produced deflects the magnet.



diagram not to scale





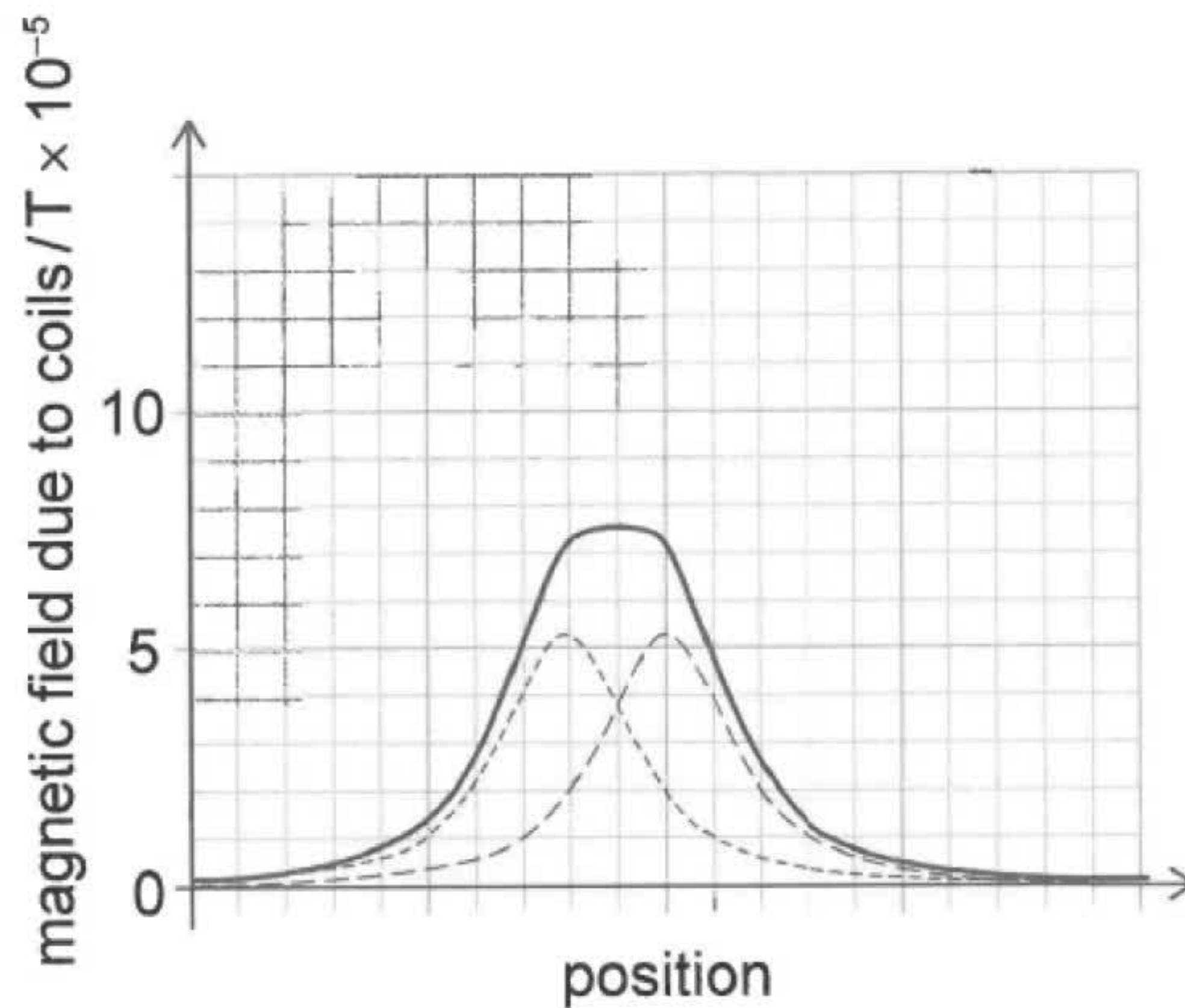
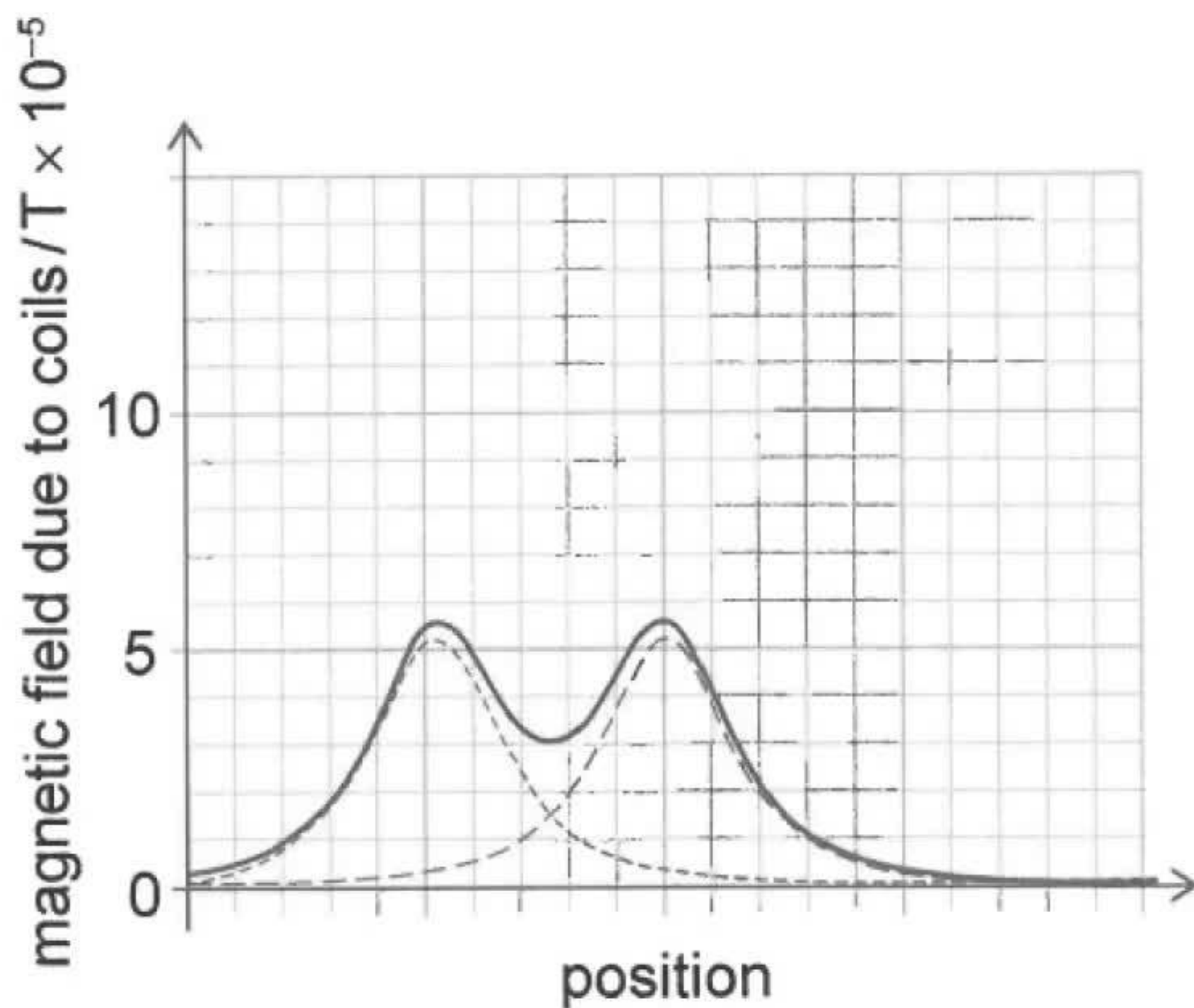
Each coil has a radius r . The length of the magnet is $0.25r$.

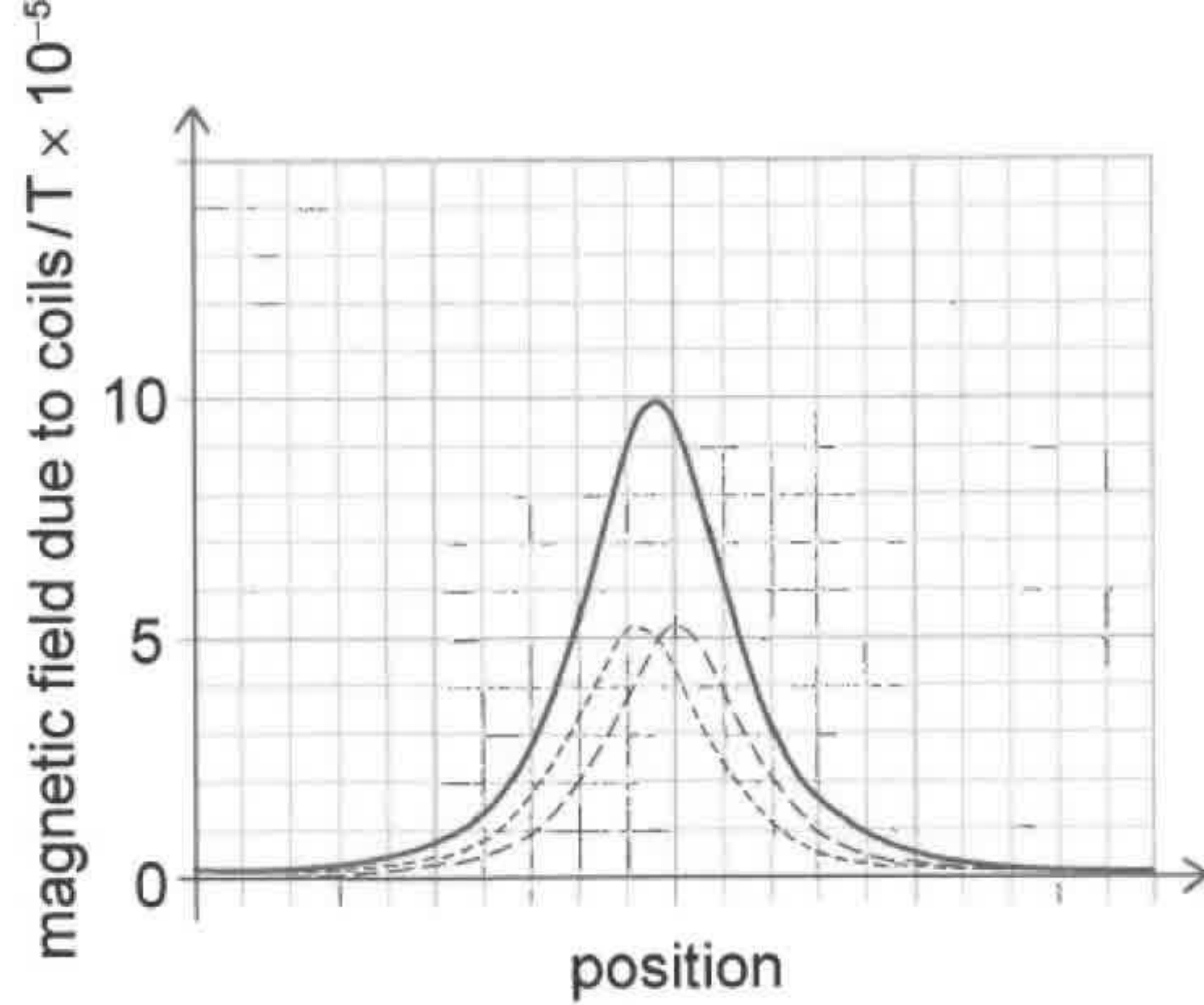
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(Question 3 continued)

The students have to decide on the horizontal separation of the two coils. Their choices are separations of $2r$, r and $0.5r$.

The variation with distance of the magnetic field strength due to each coil and the resultant magnetic field strength for both coils are shown for each of these separations.





- (a) State and explain which coil separation the students should choose for this experiment. [2]

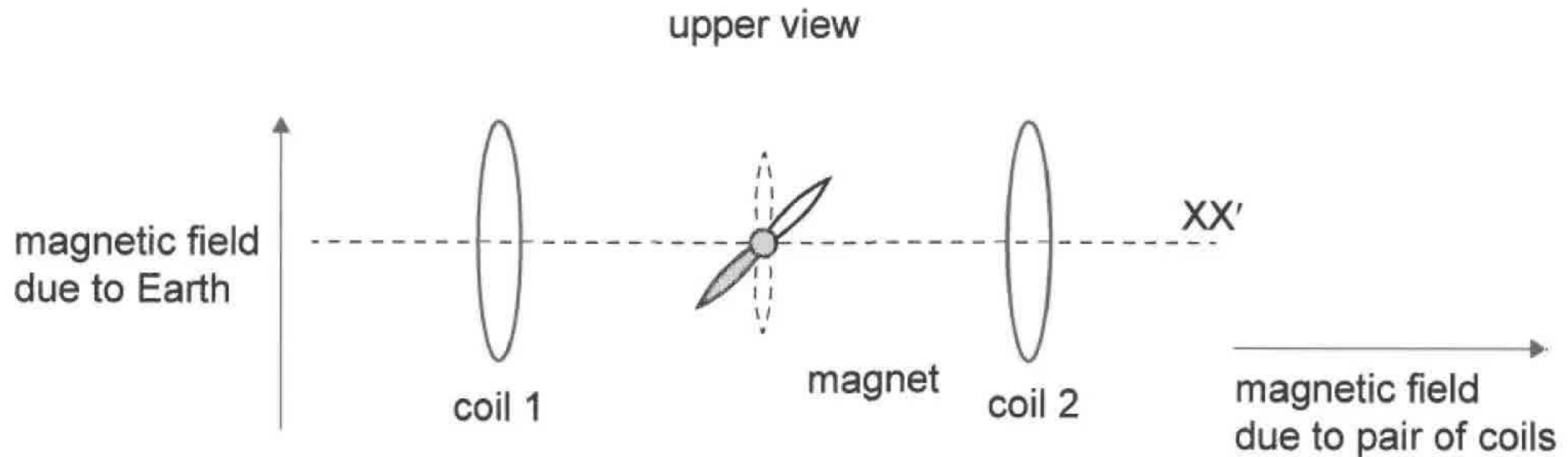
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- (c) The deflection of the magnet is shown.



The magnet comes to rest when it makes an angle of 24° to XX' .

Determine, using the graphs, B_H .

[2]