

GCSE Physics B (Twenty First Century Science)
J259/04 Depth in physics (Higher Tier)

Question Set 4

1

This question is about a measurement of the speed of sound in air that Isaac Newton made over 300 years ago.

At Newton's college in Cambridge there was a long outdoor corridor where clapping his hands would give a loud echo a fraction of a second later.



- (a) Newton measured the distance from where he stood to the reflecting wall as 64 m.

To measure the time, he made a very tiny pendulum – a weight swinging on a thin cotton thread – and adjusted the length until one to-and-fro swing of this pendulum matched the time between the clap and the echo.

This happened when the length L of the pendulum was 4.6 cm (0.046 m).

- (i) Newton showed that the time of one swing, T , was given by the equation:

$$T^2 = kL$$

L = the length of the pendulum

$k = 4.02 \text{ s}^2/\text{m}$.

Calculate the swing time T of his 0.046 m pendulum.

$T = \dots\dots\dots \text{s}$ [3]

- (ii) Use Newton's data to calculate the speed of sound.
Distance to wall = 64 m

- (b) Speed of sound = m/s [3]
Newton's calculated value for the speed of sound was low when compared with the speed found by modern measurements.
- (i) Explain which of Newton's measurements (distance or time) was likely to be the least accurate. [1]
- (ii) Explain why Newton's value for the speed was too low. [2]

Total Marks for Question Set 4: 9

OCR

Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge