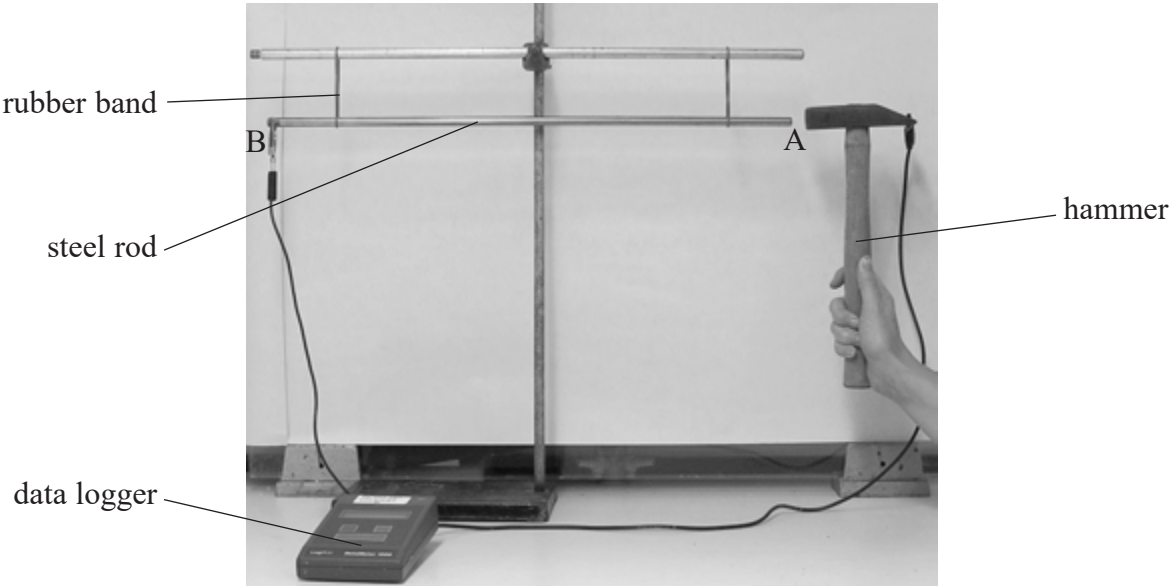
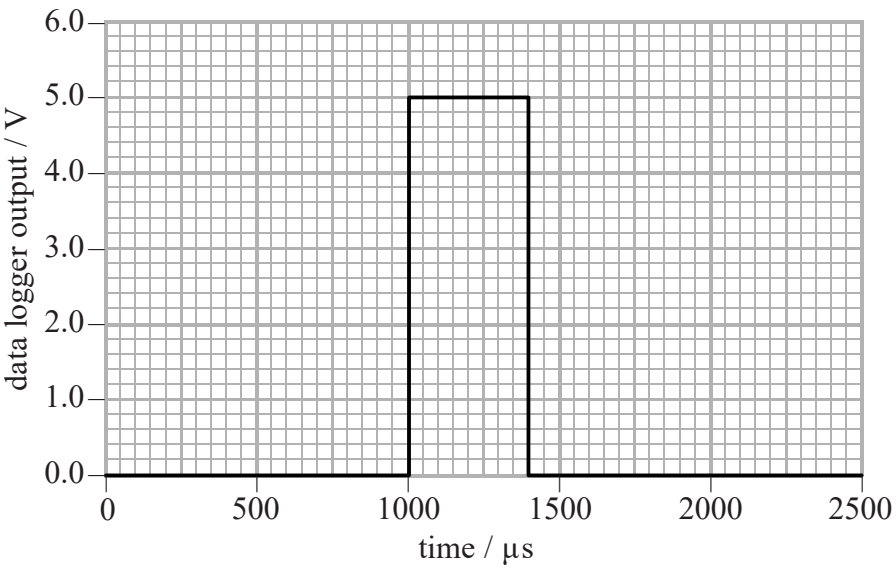


A teacher is demonstrating how to measure the speed of sound in a steel rod. The equipment comprises a hanging steel rod and a hammer connected to a data logger as shown.



The rod is tapped at A with the hammer. A compression pulse travels to B and is reflected back. When the reflection reaches A the hammer loses contact with the rod. Whilst the hammer is in contact with the rod the output from a 5 V supply is recorded by the data logger.

The graph shows the output from the data logger for one hammer tap.



(a) Explain why a data logger is appropriate for this demonstration. (2)

(b) (i) Use the graph to show that the speed of the pulse in the rod is about 6000 m s⁻¹.
length of steel rod = 1.18 m (3)

(ii) The speed of sound v in the rod depends on the Young modulus E and the density ρ of the material of the rod as given by the equation

$$v = \sqrt{\frac{E}{\rho}}$$

Calculate the Young modulus of steel.

$\rho_{\text{steel}} = 7850 \text{ kg m}^{-3}$ (2)

Young modulus of steel =

(Total for Question 7 = 7 marks)