



QUESTION WORKBOOK

The Michelson–Morley experiment

Turning points · Year 13

AQA 3.12.3.1, 3.12.3.2

10 questions · 28 marks

PRINT EDITION

SECTION A · Warm-up

A1 Describe the principle of the Michelson interferometer. [2]

A2 State the two postulates of Einstein's theory of special relativity. [2]

A3 State what is meant by an inertial frame of reference. [2]

SECTION B · Standard

B1 A boat travels at 4.0 m s^{-1} in still water on a river flowing at 2.4 m s^{-1} . Calculate the round-trip times for 48 m straight across and back, and 48 m downstream and back, and state the relevance to the Michelson–Morley experiment. [4]

- B2** For an effective arm length of 11 m and an ether wind equal to the Earth's orbital speed of $3.0 \times 10^4 \text{ m s}^{-1}$, the expected time difference is roughly $\Delta t \approx (L/c)(v^2/c^2)$. Evaluate Δt and the corresponding path difference. [3]

- B3** Explain why the apparatus was rotated through 90° during the experiment. [3]

- B4** The experiment was repeated at different times of year. Explain why this mattered. [3]

SECTION C · Stretch

- C1** State and explain the two conclusions drawn from the failure of the Michelson–Morley experiment to detect any fringe shift. [4]

- C2** A spacecraft approaching Earth at $0.40c$ switches on a landing light. Using the second postulate, state the speed at which the light arrives at Earth, and explain why the everyday rule for adding velocities fails here. [3]

- C3** Explain why the Michelson–Morley result, though "null", is counted among the most important measurements in physics. [2]
