InkPhysics

QUESTION WORKBOOK

The Michelson–Morley experiment

Turning points · Year 13

AQA 3.12.3.1, 3.12.3.2

10 questions · 28 marks

NAVY SCREEN EDITION

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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 3.0×10^4 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]