

Overall, most marks were lost for

- omitting parts of a question
- failure to read the question; answering a question different from that set
- offering a description in place of a derivation or quantitative, analytical answer
- reliance upon (flawed) memory rather than thought and analysis
- lack of logic, care and rigour

Section A

mean 13.8/20

A1 Transverse and longitudinal wave natures

mean 3.7

This was well rehearsed, core material, and generally well answered, with most marks lost for failing to give the requested examples.

A2 Fermat's principle of least time

mean 3.6

More core material, and again well answered by most, though some diagrams indicated a remarkable lack of thought and some students based their answers upon Snell's law where analysis based upon Fermat's principle was required. A few referred to the shortest distance; the whole point of Fermat's principle is that it is the least ('shortest') time instead that matters.

A3 Wavelength, frequency and speed

mean 3.0

This question required a little thought but then just the most basic physics for the first three marks, which most successfully obtained. Only a handful made much headway with the final part.

A4 Fourier principles

mean 2.3

It was clear from some answers - or their absence - that some students had entirely omitted this later section of the course. Considerable latitude was given to those whose answers referred to only periodic or sinusoidal waves, provided the overall sense was apparent.

A5 Phase and group velocity

mean 1.3

This question referred again to oft-rehearsed, core material, and many answers belied a common inability to do what the question specified: those who derived a linear wave equation sadly scored zero, unless they also arrived at the required speed by a roundabout route involving the ratio of partial derivatives. A notable minority demonstrated an alarming confusion regarding the group velocity.

Section B

mean 19.5/40

B1 Travelling waves, standing waves, boundary conditions 52 attempts mean 9.0

Like the final question, this appealed to weaker students who, having covered the motion of bound strings extensively in lectures and exercises, thought that they would score highly. Sadly, they were wrong. An alarming minority of students continue to think $f(x-vt)$ a product, and several considered $dy/dt = 0$ to imply $d^2y/dt^2 = 0$. Many confused boundary conditions with initial conditions, and a lot of marks were lost for poor sketch graphs. A common misunderstanding of asymmetry - which applies to a single function rather than linking a pair - was treated tolerantly.

B2 The Michelson interferometer 34 attempts mean 9.9

A generally straightforward question, which yielded good answers to the initial description and some successful but astonishingly scrappy attempts at the instrument analysis. Sketches unearthed a tendency to plot from (flawed) memory rather than consider the function given, and very few made headway with the sodium spectrum which, even if new, was straightforward to obtain from the information given.

B3 Fraunhofer diffraction 34 attempts mean 11.7

General success with the initial description - let down only by omission of the requested example - was followed by some very long and tortuous but ultimately correct derivations. Converting the formulae given to sketches sadly proved beyond many, who tended instead to sketch what they thought they remembered. Few commented on the final result.

B4 Standing wave modes and Fourier analysis 44 attempts score 8.4

This again appealed to fans of guitar strings, and again demonstrated their confidence unfounded. While most were good at sketching modes, wavenumbers and frequencies proved more challenging, and many failed to answer in terms of the parameters given. A number gave qualitative analysis of the pick-up sensitivity, where calculation was specified, and many then analysed a single ramp rather than the triangular form given. Few could convert their initial expression into a dimensionless form to use the given integral identity.

Where previous years have given an impression of extreme reluctance to undertake logical analysis, this year's cohort included a notable minority more prepared to give it a go. Sadly, the remainder demonstrated an elevated aversion to mathematics - and often a depressing inability to sketch and label graphs. Messy answers, atrocious handwriting and near illiteracy cannot have helped many students to develop logic and structure in their solutions.

Exam technique once again let many students down. Omitting whole sections, failing to provide requested examples, and answering a different question - or in a different manner - from that specified, all cause marks to be shed. Those who ran out of time generally wrote unnecessary or unnecessarily long answers to earlier questions.