Assessment Report

New Zealand Scholarship Physics 2024

Performance standard 93103

General commentary

The 2024 paper again contained four questions. The questions covered physics concepts ranging from applications of mechanics to elements of modern physics. Candidates were expected to utilise the fundamental concepts of the Level 3 achievement standards, such as conservation laws. Many candidates completed the paper within the three-hour period. It was clear that candidates who did complete the paper well within the allowed time did not achieve to the level of candidates who utilised the entire time available. This paper was very similar in difficulty to recent examinations at this level. There were more candidates who attempted the examination compared to 2023, but the performance was consistent with recent years. There was no sign of a change in performance of candidates sitting this examination. Many candidates were well prepared and had the necessary skills and knowledge to be successful. However, far too many do not have the necessary conceptual understanding to succeed.

General performance across Questions Two and Three was reasonably similar. Question One was the most accessible question in the examination. Candidates found Question Four the most challenging of the four questions.

Once again, candidates who gained Scholarship with Outstanding Performance found the paper very accessible and consistently demonstrated a high level of performance across all four questions. Candidates at this level are remarkably dexterous in their thinking and their ability to see physics connections within a context. Candidates achieving Scholarship showed a sound breadth of conceptual understanding across most of the questions.

Responses to Question One showed that many candidates had a basic understanding of capacitance and could apply their understanding in a novel context. A surprising number of candidates showed a lack of understanding of the correct use of significant figures in calculations.

Question Two was based purely on mechanics, requiring candidates to understand both linear and rotational mechanics. There were many candidates with misconceptions around the concepts and effects of forces and torques. The mathematical manipulation skills of most candidates were satisfactory for this type of examination.

Question Three was reasonably well handled by many candidates. Many coped well with moving between mechanical and electrical concepts. The different approach of making realistic estimates did not prove to be a difficulty for most candidates, who were able to successfully carry out calculations for 3(c)(ii). However, the physical significance of the value they calculated was generally not explained well.

Responses to Question Four showed that candidates were lacking knowledge of some of fundamental ideas of modern physics. Many had an incorrect model of the photon and described the absorption of photons by an atom and the photoelectric effect, as if they were the same thing.

Candidates found 4(d) very challenging. It was only successfully attempted by high scoring candidates.

Report on performance standard

Candidates who were awarded Scholarship with **Outstanding Performance** commonly:

- displayed no knowledge gaps and were able to attempt the entire paper
- clearly stated assumptions made when carrying out calculations
- integrated concepts from a range of fields into cohesive explanations of complex phenomena
- linked a logical sequence of concepts to explain unintuitive phenomena
- thought beyond initial 'reflex' responses
- were able to correctly apply physics concepts, such as conservation laws or Newton's laws, including in unfamiliar contexts
- were able to synthesise concepts from across the curriculum
- provided full and clear explanations of their reasoning
- were able to carry out calculations using fundamental laws to derive specific results
- were able to follow complex problems through to a solution
- had a good understanding of rotational motion
- applied strong algebraic skills in a range of contexts
- could solve problems involving rotational inertia
- could calculate the percentage change in momentum of a photon, taking into consideration changes due to the Doppler effect
- could describe and calculate the effects of adding a third parallel plate to a capacitor with the resulting series / parallel combination.

Candidates who were awarded **Scholarship** commonly:

- attempted all questions
- presented well set out calculations in a logical sequence
- explained that a change in a system can cause other subsequent changes that have counteracting effects, and included these in calculations
- incorporated the significance of parameters that stay constant alongside parameters that change
- added clear explanations to support their working
- demonstrated broad knowledge of the curriculum
- correctly identified and applied fundamental physics concepts, such as conservation laws and Newton's laws
- were able to carry out calculations and to use basic laws to derive specific results
- described the effects of a dielectric on capacitance, voltage and charge stored on the plates of a capacitor in with the switch was closed and then opened
- understood that potential energy was converted to both rotational and linear energy in 2(a)
- demonstrated understanding of torques
- demonstrated understanding of the Doppler effect.

Candidates who were **not awarded Scholarship** commonly:

- incorrectly identified the number of significant figures in provided data
- attempted calculations without any apparent direction or sequential set out of their logic
- did not take note of conditions stated in in questions
- often left sections of the paper blank indicating gaps in their knowledge, particularly in Questions Three and Four

- did not explain their reasoning on questions where they were asked to demonstrate a particular result
- were unable to apply fundamental physics concepts, such as conservation laws or Newton's laws
- were unable to apply their existing knowledge in an unfamiliar situation
- failed to realise if their answers were nonsensical
- could generally calculate the capacitance and charge stored on a plate of a capacitor
- recalled Newton's Second Law
- could substitute values into a given formula
- had a limited understanding of concepts being tested and how to carry out calculations to support their answers.