NZQA
New Zealand Qualifications Authority
Mana Tohu Matauranga O Aotearoa

Assessment Report

On this page

Level 3 Physics 2021

Standards 91523 91524 91526

Part A: Commentary

Candidates who read the questions properly and answered to the point, using correct physics terms and principles, were able to demonstrate their understanding of Level Three Physics. Successful candidates laid out their calculations clearly so they were easy to follow. High performing candidates had an excellent grasp of cause-and-effect' as to what phenomenon causes the next phenomenon.

Candidates are reminded that underlining key parts in the question can assist them to identify correct data (both known and unknown) to be used in calculations.

Greater care in reading and extracting key information from the question is required to perform well. Candidates need to consider all parts that the question has asked for.

Candidates should learn key definitions and make sure they are using language that is appropriate for Level 3 Physics.

Part B: Report on standards

91523: Demonstrate understanding of wave systems

Examinations

The examination consisted of three questions with each question consisting of four parts. In each question, there was one Achievement opportunity, two opportunities for Merit and one opportunity for Excellence. The Merit and Excellences were scaffolded. Questions were either a calculation question or one that needed a description or an explanation. Questions were based on standing waves, interference and Doppler effect.

Observations

Some candidates recognised that the path difference of the source waves is the key factor leading to the change in phase and hence formation of the interference pattern from two-point sources (or multiple sources/diffraction gratings). They explained that path difference does not lead to the formation of beats or standing waves.

Candidates are encouraged to draw diagrams for the formation of beats. Beats do not have nodes, and antinodes. In a standing wave, nodes and antinodes are evenly spaced.

Some candidates explained that the wave from a point source, such as a speaker, is not diffracting, and the wave will not diffract more or less by changing the position of the speakers.

Candidates able to apply the appropriate formula (and consider all variables in the formula) to both calculation and description questions consistently gained higher grades.

Candidates are reminded that interference does not only occur at particular points (of crests and troughs), but is the result of the overall superposition of the waves.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- provided generic answers, rather than focusing on what the question was asking

- described basic phenomena and performed simple calculations
- stated changes to variables in given situations
- explained superposition in terms of interference of troughs and crests leading to loud/quiet regions
- drew clear diagrams
- did not describe the formation of standing waves
- struggled to rearrange formulae.

Candidates whose work was assessed as **Not Achieved** commonly:

- did not identify the relevant variables or formulae
- did not perform simple calculations or show working in calculations
- did not understand basic concepts and definitions
- failed to state the direction of a change, i.e. frequency increased, not just changed
- identified minima as the midpoint
- did not calculate wavelength of waves in a pipe
- did not draw and label standing wave diagrams
- described "the waves bunching" with the Doppler effect, without stating that the wavelength decreases
- talked about volume instead of frequency when describing/ explaining the Doppler effect.

Candidates who were awarded **Achievement with Merit** commonly:

- performed more complex calculations
- supported their answers with formulae/evidence, including which variables remained constant
- described and explained only one aspect of the question (omitting others)
- drew and labelled clear diagrams
- explained superposition in terms of phase for multiple situations
- used the Doppler formula well to calculate observed frequencies.

Candidates who were awarded **Achievement with Excellence** commonly:

- answered the questions fully and generally, and wrote comprehensively to respond to the entire question
- used terminology correctly
- explained the effect of path difference, to phase and its consequent superposition
- described the relationship of different harmonics
- described the formation of standing waves in an open-closed pipe
- explained and contrasted the effects of the relative motion of both a stationary observer and an observer moving with a source.

91524: Demonstrate understanding of mechanical systems

Examinations

The examination consisted of three main questions that covered linear motion, rotational motion, and simple harmonic motion. Each question had four parts with one Achievement opportunity, two Merit opportunities and one Excellence opportunity. The Merit and Excellences were scaffolded. Questions were either a calculation question, or one that needed a description or an explanation. The questions were based on translational motion and rotating systems, circular motion and gravity, and oscillating systems (with simple harmonic motion).

Observations

Some candidates were able to state the two conditions required for oscillation to be considered simple harmonic motion, but there are significant misconceptions around conservation of energy being applied to simple harmonic motion.

Candidates who demonstrated practiced algebraic skills were able to use the provided formulae to perform accurate calculations. Candidates needed to demonstrate their working for show questions. This included choosing the right formula, substituting appropriate values and coming up with the required answer. It is often a good idea to first write down the unrounded answer, before rounding to appropriate significant figures.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- used relevant formulas in a one-step calculation, when a more complex calculation was required
- used the correct method with incorrect calculation for the angular momentum
- did describe energy transformations in terms of gravitational potential energy and kinetic energy and identified why the motion of the pendulum reduced over time
- did not convert units appropriately.

Candidates whose work was assessed as **Not Achieved** commonly:

- did not select the appropriate formula to solve a calculation problem
- used conservation of energy not conservation of momentum to explain the effect of increasing mass distribution of the panel on the motion of the satellite
- did not describe energy transformations correctly. This included confusing elastic potential energy with gravitational potential energy
- did not read the questions correctly.

Candidates who were awarded **Achievement with Merit** commonly:

- defined simple harmonic motion clearly
- completed multi-stage calculations accurately
- explained the effect of mass distribution on inertia, recognised conservation of momentum, and then linked the two concepts to justify the impact this had on rotational velocity
- used linking words in their explanations, showing that one event caused another.

Candidates who were awarded **Achievement with Excellence** commonly:

- demonstrated clear understanding of the conservation of angular momentum and used links to justify and explain these phenomena
- demonstrated clear understanding of simple harmonic motion

- were able to perform multi-step calculations in simple harmonic motion using the correct formulae, selected appropriate data from the question, and gave the correct units.

91526: Demonstrate understanding of electrical systems

Examinations

The examination consisted of three questions. Each question had four parts with one Achievement part, two Merit parts and one Excellence part. The questions were based on alternating current (AC), electromagnetic inductors and direct current (DC) and capacitors. Questions involved a description, explanation, or calculation. A resource sheet containing useful formulae and useful physical constants was supplied.

Observations

Successful candidates were able to distinguish between the effects of inductors and capacitors in circuits and were able to explain the back emf produced by inductors.

Only a few candidates demonstrated understanding of phasor diagrams and the effect of internal resistance on the current in a circuit.

Candidates that were able to explain the effect of increasing the number of bulbs in a circuit achieved higher grades. Candidates knew the resistors in parallel generally dropped the net resistance, but some were not able to explain how this would increase the circuit current, which caused more 'lost volts' and therefore less terminal voltage.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- stated the conditions for resonance
- calculated the reactance of a capacitor
- stated that iron rods increase the inductance of an inductor
- drew a phasor diagram

- calculated the time constant for an inductor and the energy stored in an inductor
- stated the meaning of emf and/or used a graph to determine the emf or internal resistance of a battery
- stated Kirchhoff's current rule.

Candidates whose work was assessed as **Not Achieved** commonly:

- did not read the questions properly and assumed that the focus for one of the questions was about the inductor rather than the bulb
- mixed up the language used for capacitors and inductors swapping current for voltage, charges for flux and referred to inductors as being charged up
- did not state condition for resonance, and did not calculate the reactance of a capacitor
- did not state that inductance increases when soft iron rods are introduced into the core of an inductor, and did not say if source voltage leads or lags circuit current
- did not draw an exponential growth curve to show the effect of an inductor in an DC circuit, and did not calculate the energy stored in an inductor
- did not display an understanding of what emf meant, and did not use a graph to determine the emf and internal resistance of a battery
- did not use Kirchhoff's current rule.

Candidates who were awarded **Achievement with Merit** commonly:

- used the conditions for resonance to calculate the reactance of an inductor
- stated the effect of inserting iron rods in an inductor on the brightness of a light bulb
- used a phasor diagram to calculate the combined voltage across a capacitor and inductor
- used the appropriate formula correctly to calculate resistance, and then the time constant for an inductor and the energy stored in an inductor
- stated the meaning of emf and used a graph to determine the emf and internal resistance of a battery

- explained how an inductor affected the voltage across a light bulb when the switch was closed
- explained why terminal voltage decreased when bulbs were added in parallel in a circuit
- provided Kirchhoff's current rule and used the voltage rule.

Candidates who were awarded **Achievement with Excellence** commonly:

- explained why the brightness of a light bulb decreased if iron rods were inserted in an inductor
- used a phasor diagram to calculate the combined voltage across a capacitor and inductor, and identified the relationship between current and supply voltage
- calculated the voltage across a lightbulb for three time constants correctly, and plotted points on an exponential growth curve graph
- used Kirchhoff's current and voltage rules correctly
- showed a deep understanding of the effect varies components have on a circuit, and clearly predicted outcomes if and when conditions are changed in a circuit
- gave explanations that were complete and well-written.

Physics subject page

Previous years' reports

2020 (PDF, 172KB)

2019 (PDF, 134KB)

2018 (PDF, 137KB)

2017 (PDF, 50KB)

2016 (PDF, 243KB)