2023 NCEA Assessment Report

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Subject: Physics
Level: Level 2
Achievement standard(s): 91170, 91171, 91173

General commentary

This year there were two opportunities to gain an Excellence grade in every question. Sometimes this took the form of gaining either 1E or both Es from the same part question, depending on the standard of the response.

When faced with a 'show' question, candidates need to provide sufficient evidence that they know how the value was calculated. Normally this would require them showing the formula used and the substitution into that formula.

Report on individual achievement standard(s)

Achievement standard 91170: Demonstrate understanding of wave systems

Assessment

A paper-based one-hour examination containing three questions. Question One tested candidate's knowledge of ray diagrams and images formed by mirrors. Question Two tested candidates on refraction and the cortical angle. Question Three tested candidates on lenses and diffraction.

Commentary

The paper seemed reasonably accessible and enabled students to demonstrate their knowledge at all levels.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- completed simple diagrams for rays and waves
- could define key terms such as "real" image
- identified basic physics concepts such as total internal reflection and interference
- identified how waves diffract around corners
- substituted into formulae and solved simple one step calculations.

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

- drew correct complex ray diagrams for curved mirrors and lenses
- drew correct diagrams for the diffraction and interference of sound waves
- made appropriate links for physics phenomena, e.g. loud sounds and constructive interference, no sound and destructive interference

- correctly calculated magnification from image distance
- knew the difference between velocity and frequency of sound.

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

- wrote coherent statements that were both concise and accurate
- linked explanations back to the context of the question rather than generic statements
- linked their calculations to their explanations, e.g. negative image distance indicates a virtual image in concave mirrors.

Candidates who were awarded **Not Achieved** commonly:

- did not draw ray or wave diagrams correctly
- did not describe image types for curved mirrors
- did not know the difference between mirrors and lenses and refraction and diffraction
- substituted values incorrectly into formulae
- di not do simple calculations
- did not show full working for calculations, especially “show that” questions.

Achievement standard 91171: Demonstrate understanding of mechanics

Assessment

The examination consisted of three main questions that covered constant acceleration, momentum, circular motion, projectiles and equilibrium.

Commentary

Candidates who wrote answers relating to the context of the question performed better than those who gave generic responses.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- selected correct equations and completed single-step substitution/solve for kinematics, momentum, centripetal force and torque
- drew correctly-labelled vector arrows to represent force, velocity and acceleration
- identified conservation of momentum
- identified loss of centripetal force resulted in tangential motion
- displayed a poor understanding of projectile motion – often described the gravitational force as changing throughout the flight, or forces being “balanced” when the ball had no vertical velocity at its highest point. Also had a tendency to identify multiple forces acting on the ball, such as “thrust” and “support”
- correctly located forces acting on a system in equilibrium, but were unable to complete a calculation finding the unknown forces. Often confused torques with forces, or had all torques associated with downward forces all going the same way.
- were unable to state that impulse means “change in momentum”
- used trigonometry to resolve horizontal and vertical components of a velocity
- identified and drew forces acting on a beam in equilibrium
- identified how friction can be reduced
- used incorrect distances when calculating torques
- did not know the difference between “displacement” and “distance”, or “vector” and “scalar”
- did not know that direction needs to be applied in conservation of momentum questions.

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

- demonstrated an understanding of impulse and longer impact time being associated with a lower average force, but did not take into account the different directions of the momentum while solving collision problems
- linked loss of friction with a loss of centripetal force and how this led to an object moving out of circular motion
- showed an understanding of how to find unknown forces acting on a system in equilibrium, but used incorrect distances
- calculated force acting in a collision using impulse principles
- explained horizontal or vertical motion in terms of force and acceleration for a projectile
- used kinematic equations correctly for projectile motion.

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

- showed a comprehensive understanding of concepts and principles in different contexts
- wrote succinct, well-structured answers
- read the questions carefully and answered what was required
- drew well-labelled, accurate diagrams
- explained how velocity and acceleration are linked in circular motion
- explained projectile motion in terms of force and acceleration for both vertical and horizontal components, along with representing these using a force diagram
- recognised the role of vector direction in conservation of momentum analysis
- performed calculations using logical sequence of steps, completing complex calculations without errors
- calculated support forces correctly in a rotational equilibrium situation
- showed attention to detail in using correct numbers or transcribing information accurately
- linked knowledge to explain phenomena, using correct terminology.

Candidates who were awarded **Not Achieved** commonly:

- confused different physical quantities, such as force and acceleration, or velocity and acceleration
- demonstrated a poor understanding of projectile motion and of equilibrium
  made mathematical errors
- did not identify the appropriate equation to use or the correct variables for an equation
- used mass instead of weight force for torque calculations
- confused horizontal and vertical motion of a projectile
- did not to use kinematic equations and trigonometry
- did not draw or describe forces in rotational equilibrium
- used $v = d/t$ even for accelerated motion
- omitted to square quantities in calculations
- used kinetic energy instead of momentum in solving a collision problem.

Achievement standard 91173: Demonstrate understanding of electricity and electromagnetism

Assessment

The examination consisted of three main questions that covered electric fields between parallel plates, circuits and electromagnetism.

Commentary

A reasonable number of candidates did not complete Question One (a) or Question One (c), both of which required the use of a “right hand rule” or similar to determine a direction.

Right hand rules are used to determine direction; they are not the reason why a physics phenomenon exists or occurs.

The term electrostatic-principles was used as a guide to candidates to consider only electrostatic concepts. Many however, incorrectly wrote about gravity and friction.

The *d* in *Eqd* was often quoted as being the distance the plates were apart, instead of the distance moved toward a plate.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- performed one step calculations
- applied right hand rules or similar to determine force directions
- used $V = IR$ to find V, I, or R given two of the values
- calculated the change in electric potential energy of an electron moved from one plate to the other
- calculated the total resistance of two resistors in parallel
- demonstrated knowledge that *d* in *Eqd* is the distance moved towards a plate and not the plate separation
- demonstrated knowledge that 2 minutes was 120 seconds.

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

- were able to find the resistance of a circuit and use it to find the circuit current
- explained why the force on a charged object inside a uniform electric field was constant
- drew complete and accurate diagrams of the electric field generated by parallel plates
- identified that the change in electro potential energy was 0J if the distance travelled was parallel to the plates
- identified which length to use for a conductor moving in a magnetic field
- calculated the total resistance of a circuit that involved parallel and series combinations
- used $P = E/t$ to calculate the energy output for a given time.

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

- gave complete explanations especially when identifying the effects of changes to a circuit. They identified at all stages that they quantity they were referring to was for a specific component or for a part of the circuit or for the full circuit
- argued using $P = I^2R$ that if I increased when R constant, that the power increased
- described how there is an opposing force when a conductor connected to a circuit is cutting a magnetic field and what effect this would have on the conductor’s motion
- described no work was done if an electron moved across an electric field but work was done if the electron moved along the field lines
- demonstrated understanding that the formula $\Delta E = Eqd$ calculated the change in energy when a charge was moved a distance d parallel to field and not its absolute energy.

Candidates who were awarded **Not Achieved** commonly:

- failed to identify the correct direction of the magnetic force on a current carrying wire in a magnetic field
- did not identify the negative end of a conductor moving through a magnetic field
- identified the positive terminal of a cell incorrectly, causing them to give the incorrect direction to an electric field
- did not convert 2 minutes to 120 seconds before calculating energy in 2 minutes

- confused *E* (for electric field strength) to mean energy in a formula
- wrote about energy and not force when asked about the force on an electron between two plates
- gave a written answer for the direction of a force that contradicted the arrow they drew on the diagram
- stated there was no force then calculated a value for the force
- gave Tesla as the unit for the electric field strength
- assumed *d* in *Eqd* was always the distance between the plates and not the distance moved parallel to the field
- wrote about gravity and used mgh when the question asked about electrostatic energy
- mixed and matched whole circuit values with component values when applying $V = IR$.
