

National Certificate of Educational Achievement

2013 Assessment Report

Physics Level 3

- 91523 Demonstrate understanding of wave systems**
- 91524 Demonstrate understanding of mechanical systems**
- 91526 Demonstrate understanding of electrical systems**

COMMENTARY

Candidates should include learning the meanings of all common terms included in the standards in their exam preparation. It is important for candidates to attempt all questions, even if they are not sure how to finish them. Candidates are encouraged to use diagrams, charts and graphs as ways of providing evidence of higher order thinking.

STANDARD REPORTS

91523 Demonstrate understanding of wave systems

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:

- completed straightforward calculations regarding wavelength
- recognised that a longer pipe had a lower fundamental frequency
- identified the position of nodes and antinodes in resonating pipes
- identified the type of interference required to produce nodes or antinodes
- described changes in observed frequency that occur with a constantly moving and/or accelerating source
- described but could not explain the spectrum of colours produced from white by a diffraction grating.

NOT ACHIEVED

Candidates who were awarded Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:

- could not accurately draw a fundamental wave in a pipe
- wrote pre-prepared answers
- confused the speed of a source with the speed of the waves it produces
- confused pitch with volume
- described white light as being a single wavelength or monochromatic light as containing many colours
- used the terms nodes and anti-nodes to describe compressions and rarefactions.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:

- could accurately link pipe length and frequency for fundamental and overtone frequencies
- explained the location of nodes and antinodes in pipes
- attributed the Doppler effect to the relative motion between source and observer
- linked observations of the spectra of colours made when white light is diffracted to wavelength but not to interference
- explained visual effects of diffraction gratings and double slits using simple principles.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:

- linked their explanation of standing wave formation to a discrete set of wavelengths
- explained the concept of timbre using correctly identified overtones
- used understanding of the cause of the Doppler effect to predict the result of changing the velocity of a wave source
- explained the effect of adding extra wave sources to the types of interference that will result and the observation of that interference
- explained that light with different wavelengths will form maxima in different positions producing a spectrum of colours.

OTHER COMMENTS

Very few candidates left the paper blank and candidates generally wrote detailed answers. Basic errors like forgetting to set calculators to degrees, or starting, but not completely answering a question, were made by a noticeable proportion of candidates. Very few candidates showed enough depth of understanding to correctly explain the interference patterns produced when light is diffracted.

91524 Demonstrate understanding of mechanical systems

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:

- performed simple one step calculations
- had some idea of how conservation of energy applies to given situations
- recognised that centripetal and tension force acted towards the centre of the circle
- stated the condition for minimum speed in vertical circular motion (centripetal force equals gravitational force)
- showed on the graph that total energy in a damped oscillating system decreased over time
- identified one of the criteria needed for SHM.

NOT ACHIEVED

Candidates who were awarded Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:

- could not select the appropriate equation to solve a calculation problem
- confused the concepts of momentum, force and energy
- did not understand the difference between force and torque
- stated that an increasing force caused an increasing speed
- stated that gravitational force on an object changes.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:

- gave causal links e.g. the mass is closer to the centre therefore the rotational inertia is smaller
- explained that rotational inertia becomes smaller when mass is concentrated closer to the centre of motion
- were able to use energy conservation to explain or perform calculations
- used the condition for minimum speed in vertical circular motion (centripetal force equals gravitational force) to rearrange and solve for velocity
- could identify that for a pendulum to approximate SHM the amplitude had to be small, and related this to a condition for SHM
- were able to describe what resonance was in SHM and how to create resonance.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:

- were able to perform multi-step calculations selecting appropriate data from the question, and gave correct units
- could clearly link their ideas into a logical train and form a conclusion
- showed an understanding of the differences between rotational kinetic energy and linear kinetic energy, and that rotational kinetic energy of a spinning ball does not change during a ball's flight
- were able to describe what resonance was in SHM, how to create resonance, and describe the energy transformations occurring in forced SHM.

OTHER COMMENTS

It is important that candidates recognise whether a question involves forces or involves energy. There were a number of candidates who confused force and energy in their answers.

Many candidates also showed a lack of understanding of what types of forces act in the situations in the examination. Many candidates were unclear that centripetal force (in circular motion) and restoring force (in SHM) were resultant forces provided by the vector addition of the other forces acting on the object.

91626 Demonstrate understanding of electrical systems

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They commonly:

- sketched a simple exponential graph showing discharging of a capacitor
- understood the factors affecting capacitive time constant
- understood the factors affecting inductive time constant
- understood basic function of an inductor in a circuit

- described the relationship between frequency and reactance of capacitors and inductors
- described what happens at resonance.

NOT ACHIEVED

Candidates who were awarded Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They commonly:

- confused series and parallel capacitors
- confused maximum current in a DC circuit with I_{rms} in an AC circuit
- could not explain effect of resistance on current
- could not use the formula correctly (involving numbers with powers) to calculate impedance.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit commonly:

- identified that 5 time constants were required for a capacitor to be approximately fully charged
- could differentiate between the charging and discharging part of a circuit and used the correct time constant for the discharging process
- could explain the function of an inductor in terms of changing flux and induced voltage that opposed current in circuit
- drew vector diagrams to calculate phase angle between supply voltage and current
- could explain some aspects of resonance.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence commonly:

- understood that the charge and voltage of a capacitor decrease in a similar exponential manner and hence calculated the relevant time value correctly
- explained the production of a large spark when a switch is opened, linked to the very large voltage induced when magnetic flux in an inductor is reduced very rapidly
- explained how changing the frequency can make a resonating LCR circuit into an inductive or capacitive circuit and the effect on the sound produced.