National Certificate of Educational Achievement

2014 Assessment Report

Physics Level 3

91523 Demonstrate understanding of wave systems

91524 Demonstrate understanding of mechanical systems

91526 Demonstrate understanding of electrical systems

COMMENTARY

It is important that candidates read the questions carefully and attempt to answer all questions. Many candidates would have been able to show better understanding had they drawn diagrams to help with their answers. Candidates should draw diagrams wherever relevant, even if the question does not explicitly require a diagram to be drawn.

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:

- knew that beats were related to interference or could give a basic description of beats
- remembered that longer waves produced higher frequency sound
- applied the wave equation ($v=f\lambda$)
- chose and applied the correct version of the doppler formula for an approaching source
- stated some conditions necessary for the formation of standing waves
- stated that pipe length affects wavelength and frequency
- applied diffraction formulae to make predictions.

NOT ACHIEVED

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

- described the features of a wave using incorrect terminology
- did not link the variables used in formulae to the correct physical quantities
- described interference using a simplistic model only
- described beat formation as if it were a stationary interference pattern with nodes and antinodes.

ACHIEVEMENT WITH MERIT

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

- combined their knowledge of beats and the doppler effect mathematically
- explained the effect of changing a variable on another physical quantity with reference to a formula
- used wave theory to explain the cause of observed phenomena such as interference fringes or doppler shifted frequencies.

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:

- followed several steps to arrive at a correct mathematical result
- explained the link between phase, interference and observed outcomes in interference situations.

OTHER COMMENTS

This paper required candidates to be able to explain wave phenomena in terms of phase difference. Some candidates were competent with equations and with explanations involving peaks and troughs but did not seem to be familiar with phase difference in the context of waves. Few candidates described sound waves in terms of compressions and rarefactions, with many incorrectly using the words crest and trough. Many candidates were confused about interference patterns, calling the angles at which nodes and antinodes appear “angles of diffraction”.

91524 Demonstrate understanding of mechanical systems

ACHIEVEMENT

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

- used relevant equations in a one-step calculation
- recognised when rotational inertia increased or decreased
- recognised that centripetal force equalled gravitational force for orbital motion
- recognised that the forces on a pendulum are tension and gravitational force
- used the equation for period of a pendulum correctly
- stated the relevant conservation law (e.g. linear momentum or angular momentum).

NOT ACHIEVED

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

- attempted to use irrelevant equations in explain questions
- confused momentum and angular momentum
- stated that there was no gravity in space
- identified “g” as mass or gravitational force
- answered questions about forces with a discussion on energy
- confused the concepts of momentum, force and energy.

ACHIEVEMENT WITH MERIT

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

- answered “show that” questions with correct equations or intermediate steps shown
- linked changing radius to changing rotational inertia and changing angular velocity
- equated the equations for centripetal force and gravitational force, and were able to perform some algebraic manipulation
- linked the direction of the force on a pendulum to the acceleration
- selected correct equations and used them for multistep calculations
- stated that momentum is conserved in the absence of external unbalanced forces, and linked this statement to the situation
- used linking words in their explanations, showing that one event causes another event.

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:

- used conservation laws, relevant equations and causal links, making “therefore” or “because” statements correctly
- merged the equations for centripetal force, gravitational force, and speed, and clearly manipulated these algebraically
- drew triangles from force diagrams and used trigonometry to identify unknown forces
- showed a clear understanding of the vector nature of momentum by using vectors to identify an unknown momentum
- stated the conditions for conservation of momentum, and used these to make causal statements linking these to all the stated information about the situation.

OTHER COMMENTS

Few candidates used vectors to solve momentum problems. Many simply added and subtracted numbers. There were a number of “show that” questions. Candidates must clearly show the equations they use in this type of question. Many candidates would have improved their answers had they drawn diagrams to help with their answers. Candidates should draw diagrams wherever relevant, even if the question does not explicitly require a diagram to be drawn.

91626 Demonstrate understanding of electrical systems

ACHIEVEMENT

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

- realised that rms voltage was not an average voltage
- calculated the reactance of an inductor
- knew that XL = XC at resonance
- identified that conventional current travels from the higher potential to the lower potential
- realised that an increase in internal resistance decreases the power output of a battery
- calculated the energy stored in a capacitor
- identified that energy is stored in the electric field of a capacitor or magnetic field of an inductor.

NOT ACHIEVED

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

- confused capacitance and charge
- confused reactance of an inductor and inductance
- couldn't calculate current using Kirchhoff's equation
- confused the terms emf and terminal voltage
- thought that positive charges moved onto a capacitor when being charged.

ACHIEVEMENT WITH MERIT

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

- calculated the impedance of a circuit by drawing a phasor diagram
- calculated the current in a resonant circuit
- used Kirchhoff's equations confidently to calculate current in a circuit
- explained the voltage across a capacitor, increases as it charges
- applied Faraday's law to explain an induced voltage due to a changing current
- explained why the energy stored in a capacitor decreases as it discharges.

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:

- calculated the voltage across the components in an LCR circuit
- linked the energy in the electric field of a capacitor to charge and the energy in the magnetic field of an inductor to moving charge (current)
- applied physical concepts to explain electrical oscillations in a CL circuit.

OTHER COMMENTS

Very few candidates were able to explain the difference between rms and peak voltage. Some candidates had a misconception that at resonance the VC and VL values are zero because XL and XC cancel each other and only the resistor has the maximum voltage. Many candidates thought that inductors create back currents, and some even provide more current than power supplies acting against them.