National Certificate of Educational Achievement

2011 Assessment Report

Physics Level 2

90254 Demonstrate understanding of waves

90255 Demonstrate understanding of mechanics

90256 Demonstrate understanding of atoms and radioactivity

90257 Demonstrate understanding of electricity and electromagnetism

COMMENTARY

This was the final year for examinations to assess these achievement standards.

STANDARD REPORTS

90254 Demonstrate understanding of waves

ACHIEVEMENT

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

- did one-step calculations
- used units and / or significant figures appropriately
- showed some understanding of the properties of mirrors and lenses
- demonstrated limited ability drawing / completing diagrams
- showed some understanding of basic wave phenomena such as interference and diffraction
- demonstrated enough knowledge to answer parts of questions but showed insufficient depth of knowledge for higher grades.

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 typically:

- did not do one-step calculations
- did not use units or significant figures appropriately
- frequently confused mirrors and lenses
- did not know or use terms correctly
- did not explain simple wave phenomena
- did not interpret questions correctly and often left questions / parts of questions unfinished.

ACHIEVEMENT WITH MERIT

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

- understood standard form and the use of prefixes
- applied reasoning to solve a problem
- interpreted a context and described properties to explain it
- used formulae and rearranged correctly.

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 typically:

- completed problems involving multiple substitutions and used correct sign conventions

- interpreted complex situations correctly and made appropriate links in their answers
- applied knowledge correctly to unfamiliar contexts
- constructed accurate diagrams that linked correctly to an explanation.

OTHER COMMENTS

Handwriting that was small and/or illegible made quite a number of scripts difficult to mark. It was also evident that many candidates could not express themselves properly in English when it came to answers requiring an explanation or description. It is also important to use a ruler while drawing ray diagrams, and rays need to have arrows drawn to show their direction.

90255 Demonstrate understanding of mechanics

ACHIEVEMENT

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

- drew vector diagrams from given information
- demonstrated knowledge of what causes centripetal force
- calculated torque
- rounded to the correct number of significant figures
- demonstrated knowledge of what were elastic and inelastic collisions in terms of kinetic energy
- demonstrated knowledge of the effect of force and time on impact in a collision
- demonstrated knowledge of the correct unit for power
- calculated the horizontal and vertical components of a projectile
- demonstrated knowledge of the formula for finding the energy stored in a stretched spring
- calculated the value for spring constant from the formula $F = kx$.

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 typically:

- left out many question parts
- did not know the difference between conservation of momentum and conservation of kinetic energy for collisions
- did not draw a vector diagram from given information
- showed evidence of concluding that the energy stored in a stretched spring could be calculated using $Ep = mgh$
- did not illustrate understanding that a force applied at an angle has horizontal and vertical components.

ACHIEVEMENT WITH MERIT

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

- calculated the change in velocity from a vector diagram using Pythagoras' theorem
- calculated the angle from a vector diagram

- demonstrated knowledge of how to calculate at least one support force using the idea of torques
- showed understanding that it was the total kinetic energy that had to be calculated to find out if a collision was elastic or inelastic
- showed understanding that in a collision between two objects, the size of the change in momentum of each object is the same
- calculated the elastic potential energy stored in a stretched spring.

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 typically:

- drew a vector diagram correctly to show change in velocity and calculated it correctly, including the direction
- calculated both support forces using the concepts of torques
- calculated the final velocity of an object including direction, after a collision
- correctly differentiated between elastic and inelastic collisions using the knowledge of calculating total kinetic energy
- solved problems on projectile motion making links between distances and times
- justified the use of a formula for calculating the energy stored in a stretched spring.

OTHER COMMENTS

Candidates need to be aware that it is acceptable to answer in bullet points if they are running out of time.

It is also acceptable to annotate answers using diagrams to illustrate the meaning.

Good, legible handwriting and neatly laid out work helps in the marking process.

90256 Demonstrate understanding of atoms and radioactivity

ACHIEVEMENT

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

- provided a limited description of Thomson’s model of the atom
- described an aspect of the nucleus of a Rutherford atom
- described properties of alpha, beta, and gamma radiation
- stated the trajectories of alpha particles, beta particles, and gamma radiation in a magnetic field
- described the reason for the behaviour of one of the three types of nuclear radiation
- wrote a correctly balanced nuclear decay equation
- described nuclear half-life
- derived the points for a nuclear decay curve
- drew a simple decay curve
- described what was meant by the term radioactive half-life
- correctly plotted the points for a decay curve from supplied count and half-life data
- showed understanding of one aspect of the movement of charged particles in a magnetic field

- showed understanding that gamma radiation is unaffected by a magnetic field as it is uncharged
- interpolated a decay curve to estimate activity.

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 typically:

- did not read the questions or provide appropriate responses
- used incorrect terminology to describe Thomson's model
- did not use observations from Rutherford's experiment to describe Rutherford's atom
- did not give the trajectories of radiation in a magnetic field
- did not describe three types of nuclear radiation
- did not describe correctly the reason for the behaviour of one of the three types of nuclear radiation in a magnetic field
- did not write a balanced nuclear equation
- did not describe half-life
- did not derive the points for a nuclear decay curve
- did not draw a decay curve.

ACHIEVEMENT WITH MERIT

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

- described Thomson's model fully and recalled that is was overall neutral in charge
- linked relevant observations from Rutherford's gold foil experiment with evidence for the structure of atoms
- interpreted that alpha particle behaviour gave information about atomic structure
- fully and accurately sketched the paths of radiation in a magnetic field
- showed understanding that the path of beta particles has a greater curvature in a magnetic field than alpha particles, and that they would "bend" in opposite directions
- described aspects of at least two of the types of nuclear radiation thoroughly
- derived the values for radioactive half-life and then used them to plot a decay curve
- drew a smooth exponential decay curve and interpolated correctly from this curve
- described the origin of alpha, beta, and gamma radiation or their effects on atomic and mass numbers.

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 typically:

- described the reason(s) for the behaviour of the three types of nuclear radiation in a magnetic field, including the difference in direction of curvature of alpha and beta in a magnetic field based on their opposite charge or an appropriate physics "rule", and explained the difference in radius of curvature of alpha and beta in terms of relative mass, or less often, in terms of charge-to-mass ratio
- identified what alpha, beta, and gamma radiation are and described the origin of alpha, beta, and gamma radiation and their effects on atomic and mass numbers of the nucleus.

90257 Demonstrate understanding of electricity and electromagnetism

ACHIEVEMENT

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

- correctly applied $P = IV$
- identified the positive plate given the electric field lines
- applied $V = Ed$
- showed knowledge of voltages in series added to the supply voltage
- applied $V = IR$
- interpreted a voltage current graph
- correctly applied the righthand slap rule to find direction of force.

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 typically:

- did not apply simple formulae
- did not know that electric field lines go from positive to negative plates
- did not know that parallel evenly spaced lines show a uniform field
- showed a lack of understanding of basic physics concepts
- did not correctly identify which concepts were required to answer questions
- did not show any working
- confused electric fields and magnetic fields
- did not answer the question asked
- thought protons moved in a circuit.

ACHIEVEMENT WITH MERIT

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

- carried out two step calculations
- gave correct reasons for their answers.
- converted cm to m and mV to V
- gave two relevant facts when giving descriptive answers to problems
- wrote clear explanations relevant to the situations given
- showed good understanding of ideas and linked two or more concepts
- interpreted questions requiring calculations with more than one step, and solved calculations systematically
- attempted all questions
- used correct physics language
- stated that a charged object would be attracted towards an oppositely charged object OR repelled from an object with a similar charge
- showed knowledge that adding a resistor (or diode) in parallel to others decreased the overall resistance of the circuit

- stated both the current direction and the direction of the resulting motor force.

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 typically:

- gave clear and complete explanations showing a full understanding of concepts relevant to given situations
- carried out complex calculations that involved several steps in a logical manner
- showed understanding that adding another diode in parallel was like adding another resistor in parallel and fully explained the effects
- correctly recognised the physics concepts and principles needed when solving complex problems
- explained movement of charge in terms of electron movement
- wrote clear and concise explanations, using sound physics ideas
- knew that adding a resistor (or diode) in parallel to others decreased the overall resistance of the circuit AND knew that this resulted in an increase in circuit current and could then explain why the voltage across a resistor in series would increase
- calculated the speed of a charged particle in an electrical field
- explained why a current in a magnetic field experiences a force and clearly stated the direction of the force
- showed understanding that electrons were transferred when a neutral object came into contact with a positively or negatively charged plate.

OTHER COMMENTS

Many candidates gave the RH rule as why the loop moves, rather than used it as an aid.

Candidates needed to read the question carefully. For example, a question that asked for an explanation in terms of resistance was expected to have “resistance” in the response.

Answers to “show” questions should have been clearly set out. The best methods were ones that did not initially assume the given answer.

When labeled directional arrows are used in a diagram, the labels should be used to describe directions in answers.

Many candidates confused or ignored prefixes in calculations.