National Certificate of Educational Achievement

2013 Assessment Report

Mathematics and Statistics Level 2

91261 **Apply algebraic methods in solving problems**

91262 **Apply calculus methods in solving problems**

91267 **Apply probability methods in solving problems**

COMMENTARY

Candidates appeared to have been well prepared for the 2013 paper with those who persisted throughout the paper being well rewarded for their efforts.

The use of a Graphics Calculator was not essential but definitely assisted candidates in this assessment.

The paper highlighted the need for students to be prepared in all areas of learning determined by the Achievement Standard, as a lack of learning or understanding in one or more areas compromised the final result.

STANDARD REPORTS

91261 Apply algebraic methods in solving problems

ACHIEVEMENT

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

- re-arranged log statements correctly
- factorised and solved quadratic equations
- manipulated expressions involving exponents
- substituted into a formula involving exponents successfully
- used a graphics calculator successfully to solve a quadratic equation
- solved simple logarithmic equations, showing understanding of properties of logarithms
- recognised when the use of the quadratic formula was appropriate
- recognised when the discriminant should be used.

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:

- lacked an understanding of the use of a graphics calculator
- manipulated logarithmic and exponent expressions incorrectly
- factorised and/or expanded equations incorrectly
- cancelled terms in algebraic fractions incorrectly.

ACHIEVEMENT WITH MERIT

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

- interpreted questions in context
- substituted into formulae accurately
- rearranged and simplified rational and quadratic equations successfully
- used the graphics calculator accurately
- comprehended word questions
- demonstrated competence in solving index/logarithmic equations
- solved, simplified and factorised accurately

- demonstrated knowledge of quadratic equations including the use of the quadratic formula
- knew the relationship between the discriminant and real roots of a quadratic equation.

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 and applied laws of indices
- were able to successfully develop and apply a quadratic model in context
- understood the quadratic formula and applied the properties of the discriminant successfully
- solved equations in unfamiliar situations involving indices and applied algebraic logic to validate solutions
- showed good mastery of algebraic manipulation in complex situations
- incorporated other strands of mathematics, like graphing, into their abstract thinking to evaluate a word problem
- knew the relationship between the discriminant and real roots and used it insightfully to find conditions on given parameters involving inequalities
- produced chains of reasoning that were logical and clearly expressed.

91262 Apply calculus methods in solving problems

ACHIEVEMENT

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

- identified the use of differentiation and anti-differentiation appropriately
- differentiated and anti-differentiated polynomials correctly including a term of degree 1 and with coefficient 1
- followed through correctly the algebraic processes involved in the calculus method
- substituted correctly into formulae
- understood the Cartesian system and identified x or y value
- used a derivative to find a gradient
- used a derivative to find a point with a given gradient
- used a point to find a constant of integration
- recognised the gradient function for a positive cubic is represented by a positive parabola
- recognised that the roots of a gradient function correspond to maxima/minima of the original function.

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 substitute correctly including negative values
- incorrectly differentiated or integrated including a term of degree 1 and with coefficient 1
- did not attempt to find a constant of anti-differentiation

- did not substitute a known point when attempting to find a constant of anti-differentiation
- made errors when solving a simple linear equation to find the constant of integration
- did not recognise that the gradient function for a positive cubic is represented by a positive parabola
- did not recognise that the roots of a gradient function correspond to maxima/minima of the original function.

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 turning points correctly from formulae or graphs
- understood the relationships between displacement, velocity, and acceleration
- dealt with a multi-step problem
- used calculus methods to solve a kinematics question (i.e. recognised maximum height corresponds to zero velocity, and differentiated accordingly)
- interpreted answers in context (i.e. recognised the difference between time and height)
- differentiated to find a rate
- distinguished between the derivative and the original variable (i.e. knew not to equate the derivative of area with an area)
- identified “49π” as a numeric value, rather than treating “π” as a unit
- recognised that a linear gradient function (with negative gradient) describes a (negative) parabola
- recognised that the root of a gradient function corresponds to the maximum/minimum of the original function
- read the question and used all information provided (i.e. used the maximum value as given)
- found the equation of a straight line from a derivative and a given point
- found the equation of a straight line from graph
- identified and used important points from given graphs (i.e. knowing to substitute the minimum point to find the constant term).

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:

- differentiated or anti-differentiated functions involving 2 unknowns
- processed multi-step problems accurately
- formed functions to represent a situation and then worked with these
- used inequality symbols correctly to describe an interval
- demonstrated understanding of a “decreasing function”
- supported their answer with justification
- manipulated algebraic equations to find a solution
- recognised a curve with a non-constant gradient
- provided justification (of their choice of minimum point)
- followed a chain of steps
- identified constants of integration from boundary conditions supplied in context
- expressed an equation in a single variable before differentiating.

OTHER COMMENTS

Proficiency in algebra is required for success in the calculus paper. In order to get to an achieved level candidates need to go at least one step further into a problem than the simple processes of differentiation and anti-differentiation.

The underlying concept of rate of change was well understood by many candidates and there were some exceptional scripts at the excellence level. Candidates, even weaker ones, are being better prepared for graphical interpretations of rate of change, and those questions were generally well answered.

Students could be better prepared in justifying a maximum or minimum turning point. There are several acceptable methods such as a graphical interpretation; a second derivative test; or the testing of gradients. Too often a justification was overlooked and an unreasonable assumption made.

Students need good practice with these derivatives, as is the case when the coefficient is a fraction.

The optimisation was very poorly done, with few candidates getting a start.

91267 Apply probability methods in solving problems

ACHIEVEMENT

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

- calculated probabilities or percentages using probability tree diagrams, normal distribution tables or a graphics calculator
- calculated a proportion from a histogram
- made a valid point in context when discussing features of a graph or distribution
- calculated probabilities or proportions from the information presented in contingency tables
- made a relevant general statement when making a comparison between graphs.

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 correctly add probabilities to a probability tree diagram
- did not show working
- were unable to solve normal distribution problems using the standard normal distribution table provided or by calculation
- did not realise that proportions and risk are probabilities
- did not identify the group of interest when calculating a probability from a contingency table
- did not understand the calculation of a probability when using a reduced sample space
- did not interpret or explain their answer in the context of the question being asked
- did not provide the necessary evidence and meaning relevant to the question when making a comparison.

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 probabilities for multiple events using probability tree diagrams
- calculated a probability (or percentage) from either a tree diagram or a two way contingency table in questions related to a reduced sample space
- determined the probability of an outcome using a variable
- calculated probabilities or proportions to determine the expected values
- considered the answer in context
- multiplied probabilities when finding the probability for two independent events occurring
- used their graphics calculator to solve more complex normal distribution problems (e.g. inverse normal distribution problems)
- compared features of a sample distribution with a normal distribution by providing evidence and a meaning in context relevant to the question.

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:

- determined relative risk and drew a conclusion
- used algebraic techniques, and determined a comparative probability involving a variable
- calculated an answer using inverse normal techniques and interpreted the answer in the context of the question
- applied their understanding of inverse normal probability to find an unknown parameter (e.g. a new mean) and interpreted the answer in context
- calculated probability for an event using either an extended probability tree diagram or a reduced sample space
- made comparisons involving centre, shape and spread using correct statistical language in a logical manner.