Assessment Report

Level 3 Calculus 2017

Standards 91577 91578 91579

Part A: Commentary

The 2017 papers were of a similar format and level to recent years' examinations. Relative to 2016 the Algebra paper proved a little more difficult and the Differentiation paper showed itself to be somewhat more straightforward.

Panel leader reports once again stressed that the ability to differentiate or integrate is not in itself sufficient for candidates to achieve success in the respective standards. Both standards have an emphasis on problem solving which requires a wider range of skills. In particular the ability to model a situation with an equation, to manipulate the equation into a format that can be differentiated/ integrated, and the algebraic ability to solve the problem. Strong candidates, who possess all these skills, have a very good likelihood of achieving Excellence.

There are errors that are common among a number of candidates; failure to properly apply simple formulae such as the trapezium rule, confusion about when to use the chain rule versus the product rule and ignoring the constant of integration when it is an important aspect of the problem.

Part B: Report on standards

91577: Apply the algebra of complex numbers in solving problems

Candidates who were awarded **Achievement** commonly:

- manipulated complex numbers successfully
- manipulated surds successfully
- understood the use of conjugates
- solved a quadratic equation with complex roots
- performed operations with complex numbers in the form given (rectangular or polar)
- used the remainder and/or factor theorems successfully.

Candidates who were assessed as **Not Achieved** commonly:

- lacked the basic algebra skills needed to solve, simplify, expand, factorise
- failed to accurately set up an equation to solve a problem
- neglected to show the calculations needed to support their answers

- failed to accurately manipulate rectangular form complex numbers
- attempted to substitute remainder theorem substitution with polynomial division and failed
- incorrectly subtracted angles in terms of pi
- failed to apply the quadratic formula correctly and/or simplify the surd that resulted.

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

- correctly used algebra when solving equations or manipulating expressions
- understood and correctly applied De Moivre's Theorem
- solved equations with complex solutions
- understood and manipulated conjugates for complex numbers, especially when solving complex equations
- could use exact values when finding an argument and understood the concept of an argument.

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

- understood the concept of locus and how to represent the situation algebraically and follow it through to the required result
- possessed the algebra skills to accurately set up and solve equations without unnecessary or confusing statements in their working
- understood the concept of "proof" and were able to clearly show the necessary steps in obtaining the required result
- communicated their thinking clearly about what they were doing while completing multi-step problems
- correctly simplified the quotient of two complex numbers and understood how to separate into real and imaginary parts before solving for required values of k.

Standard specific comments

Candidates who relied solely on the use of a graphic calculator did not perform well.

Candidates should sketch an Argand diagram to ensure they have the correct argument for a given complex number.

Good setting out, whilst not directly examined, gave the candidates the best chance of success.

91578: Apply differentiation methods in solving problems

Candidates who were awarded **Achievement** commonly:

- converted a surd expression to fractional index form and correctly differentiated it
- correctly applied the chain rule, product rule or quotient rule to find derivatives of functions involving combinations of power, trigonometric, exponential and logarithmic functions
- correctly found gradient functions and used them to evaluate gradients of tangents and normals at given points
- solved derivatives equal to zero in order to maximise the function
- identified x values of a piecewise function for specified features such as differentiability, continuity, gradients, concavity and limits.

Candidates who were assessed as N**ot Achieved** commonly:

- failed to convert a surd expression to fractional index form and differentiate it
- failed to apply the chain rule, product rule or quotient rule correctly to find derivatives of functions involving combinations of power, trigonometric, exponential and logarithmic functions

- failed to check their work in order to find their careless errors.

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

- accurately found equations of tangents and normals
- correctly used the equations of tangents and normals to solve problems such as finding the y-intercept and finding the point of intersection between the normal and the original function
- accurately found an expression for using parametric differentiation
- correctly used the derivative of a curve defined parametrically to evaluate a gradient for a given t value
- formed a model for the distance between a point and a curve and then use differentiation to minimise that distance
- correctly found the values of x of a piecewise function to meet given conditions about continuity, differentiability, gradients, concavity and limits
- correctly used the chain rule to solve a related rates of change problem.

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

- correctly applied algebraic processes involving pronumerals (a, b, k) to first and second derivatives involving any of the product, quotient and chain rules to solve problems
- successfully set up an algebraic model for an area of a rectangle subscribed in a semi-circle and apply differentiation to maximise that area
- accurately completed multistep problems involving a lot of algebraic methods without error.

Standard specific comments

The ability to differentiate a range of functions does not alone guarantee success in this standard. Candidates need to be able to manipulate expressions into a form that is capable of being differentiated. Also, once the differentiation is complete, candidates need to have the Algebra skills necessary to solve the problem.

Candidates need to recognise when it is appropriate to use product, quotient and chain rules.

Forming the model, that is generating an equation that models a particular situation, is a skill that is often required in more complex problems. It is also a skill that many candidates struggle with.

91579: Apply integration methods in solving problems

Candidates who were awarded **Achievement** commonly:

- integrated exponential and trigonometric functions correctly
- manipulated expressions into a form that could be integrated
- correctly integrated x raised to negative and fractional powers
- correctly used the trapezium rule given a diagram
- substituted into an integrated expression to find a definite integral
- integrated acceleration to find an expression for velocity including the constant.

Candidates who were assessed as **Not Achieved** commonly:

- were not able to create a table in order to use the trapezium rule
- failed to correctly find the value of h in the trapezium rule
- failed to integrate expressions and just used GC to calculate answer for definite integrals

- incorrectly integrated trigonometric expressions with constants in the expression
- incorrectly integrated any negative power of x, or any function with a denominator which contained a function of x, to ln(x)
- confused integration and differentiation.

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

- correctly calculated areas under and between curves
- solved differential equations, including calculating the value of the constant of integration
- were able to calculate a definite integral, and equate it with a given value and solve to find a constant
- successfully solved a differential equation by separating the variables to find a particular solution
- correctly applied a trigonometric product to sum rule to get an expression that could be integrated
- integrated a rational function correctly either by using long division or integration by substitution.

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

- applied trigonometric identities correctly to write sine squared in a form that could be integrated
- applied the reverse of the chain rule, or integration by substitution, correctly
- recognised the relationship between 1/x and ln(x) in question 2 (e).

Standard specific comments

A number of candidates attempted to gain an Excellence grade by only attempting the questions that they interpreted to be ‘excellence’ questions. This is not to be recommended as errors in the few questions they attempted, and no ‘back-up’ answers, regularly resulted in a disappointing final grade.

Some candidates were unable to use their calculator correctly, especially with the use of brackets, fractions, and exponents.

Some candidates failed to show an integration before giving the value of an area under a curve even though the question clearly states: “you must use calculus and show the results of any integration needed to solve the problem”.

Candidates who used the formula to calculate hin the trapezium formula generally got it wrong. It is much simpler, and more reliable, to find hby looking at the diagram/table provided.

Mathematics and Statistics subject page

Previous years' reports
2016 (PDF, 0KB)