



**Nova Scotia Examinations
Mathematics and Advanced Mathematics 12
2011–2012**

Information Guide

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Introduction

The purpose of this Information Guide is to provide teachers with information about the Nova Scotia Examinations (NSE) in Mathematics 12 and Advanced Mathematics 12. There is currently no NSE in Mathematics Foundations 12. Teachers are encouraged to share the contents of the guide, particularly the sample questions and answers, with their students.

Overview of NSE Mathematics 12/Advanced Mathematics 12

The NSE in Mathematics 12/ Advanced Mathematics 12 is designed to evaluate student achievement in relation to the outcomes for Mathematics 12/ Advanced Mathematics 12 prescribed by the Atlantic Canada Mathematics Curriculum. The examination results contribute 30% to students' final course mark.

All students registered in Mathematics 12/ Advanced Mathematics 12 are eligible to write the corresponding NSE. Students who have an Individual Program Plan (IPP) in Mathematics, and therefore engage with a different set of mathematics outcomes, do not participate in the examination.

The NSE Mathematics Advisory Group, comprised of senior high school mathematics teachers representing all school boards in Nova Scotia, assists in the development of examinations. The advisory group, under the guidance of department staff, follows the examination development procedures outlined in the Nova Scotia Examination Development Model. As well, an examination review team, comprising experienced senior high mathematics teachers, reviews and approves the final examination forms for each administration. All processes, examination development, administration, marking, and reporting are facilitated by the Evaluation Services Division of the Department of Education.

The mathematics examination is constructed according to precise specifications. Questions are written to match outcomes in the curriculum and these are field-tested with students in Nova Scotia schools. Field-test results are then analyzed.

Examination questions, either in selected response or constructed response format, are used to evaluate students' mathematics thinking and understanding in relation to quadratics, exponentials, geometry, and probability.

The examination is scored by Mathematics 12/ Advanced Mathematics 12 teachers at regional marking sessions led by Evaluation Services Division staff. Standards for marking are set by the Advisory Group. Results are published in the Minister's Report to Parents.

Curriculum Links and Rationale

The document for the Atlantic Canada Mathematics Curriculum, Mathematics 12 and Advanced Mathematics 12, articulates the curriculum for both of these courses. The document provides the teachers of each mathematics course with information to plan for instruction. Teachers must carefully follow the curriculum as contained therein to design learning experiences for their students.

The NSE in Mathematics 12 and Advanced Mathematics 12 are designed to reflect the tables of specifications in this guide (see page 3). The tables are aligned to reflect the Atlantic Canada Mathematics Curriculum. The outcomes listed in the appendices of this guide have been used to construct both examinations. Appendix B outlines those outcomes that may be addressed on the Mathematics 12 examination and Appendix C outlines those that may be addressed on the Advanced Mathematics 12 examination. Note that the examinations may not assess all outcomes listed in the appendices.

Some examination questions will assess students' understanding of an individual outcome, while other questions will assess a number of outcomes. The examinations are comprised of a variety of question types including selected response and constructed response, requiring both short and extended answers. Questions are developed to assess students' performance at different cognitive levels (low, moderate, and high complexity).

The Information Guide will be revised as needed to reflect changes in the examination process. Teachers will be notified as soon as possible when any changes occur. A copy of this guide is posted on the Evaluation Services Division website <http://plans.ednet.ns.ca> .

Tables of Specifications

Examination Construction

Nova Scotia Examinations in Mathematics 12 and Advanced Mathematics 12 are constructed in accordance with tables of specifications and the Nova Scotia Assessment Development Model. They include questions (items) that have met the following criteria:

- rigorous content review by the provincial mathematics examination advisory group for alignment with outcomes as listed in the appendices and for possible bias and construction flaws;
- field-testing under monitored conditions in Mathematics 12 and Advanced Mathematics 12 classrooms;
- statistical analysis of the students' responses following the field-testing to determine levels of difficulty, validity, and reliability of each question.

Specification Tables

The following table provides the approximate weightings of each unit on the examinations and is based on the recommendations for time allotment found in the Atlantic Canada Mathematics Curriculum for Mathematics 12 and Advanced Mathematics 12.

Table 1

<i>UNIT</i>	<i>Percentage of the examination Math 12</i>	<i>Percentage of the examination Advanced Math 12</i>
Quadratics	30% – 40%	30% – 35%
Exponential Growth	30% – 40%	30% – 35%
Circle Geometry	10% – 15%	20% – 25%
Probability	10% – 15%	10% – 15%

Table 2 outlines the construction of each examination according to question format, including selected-response and constructed-response questions. The selected-response questions offer the student four choices, three of which are plausible distractors, and one that is the correct response. Constructed-response questions may require the solution of a problem or a written response at any of the three cognitive levels.

Table 2

<i>Question Format</i>	<i># of Questions</i>	<i>Percentage of Examination</i>	<i>Cognitive Levels</i>
Selected response (multiple choice)	35	~ 35%	1 and 2
Constructed response (short answer and extended response)	14 – 18	~ 65% *	1, 2, and 3

*The exam does not necessarily add to 100 points.

Table 3 outlines the construction of each examination according to three levels of question complexity: low complexity (level 1), moderate complexity (level 2), and high complexity (level 3).

Table 3

<i>Cognitive Level</i>	<i>Approximate Weighting</i>
Low complexity (level 1)	30%
Moderate complexity (level 2)	50%
High complexity (level 3)	20%

Explanation of Cognitive Levels

Questions on the NSE are developed to assess students' performance at three cognitive levels. Cognitive levels indicate the type of intellectual process required to respond to each question. This guide includes the marking scheme for constructed-response questions so that you may familiarize yourself with scoring as it is done at regional sessions.

Low Complexity Questions (Level 1)

Low complexity questions will require students to recall and recognize previously learned concepts and principles. Students may demonstrate the use of routine procedures to solve a problem. Students are not be required to develop an original method for solving a problem. This level may include recognition or recall of terminology, formulae, algorithms, graphs, geometric figures, properties, and theorems. Questions at this level include key words such as: identify, compute, recall, recognize, find, use, what, list, define, and name.

The following are some examples of what a low-complexity question might require a student to do:

- recall or recognize a fact, term, or property
- recognize an example of a concept
- compute a sum, difference, product, or quotient
- perform a specific procedure
- solve a one-step word problem
- retrieve information from a graph, table, figure or function

Examples:

Selected-response question

Given $y = ax^2 + bx + c$. The value of $-\frac{b}{2a}$ represents {outcome C31}

- | | |
|----------------------------------|---------------------------------|
| a) the minimum or maximum value | ✓b) the 'x' value of the vertex |
| c) the coordinates of the vertex | d) the y-intercept |

In this example the student needs to recall or recognize a fact.

Constructed-response question

Given the function $y = -2x^2 + 4x - 5$

(a) Write the function in standard or transformational form.

(2 points)
{outcomes C9, C31}

$$\begin{aligned}y + 5 &= -2x^2 + 4x \\y + 5 &= -2(x^2 - 2x) \\y + 5 - 2 &= -2(x^2 - 2x + 1) \\y + 3 &= -2(x - 1)^2 \\-\frac{1}{2}(y + 3) &= (x - 1)^2\end{aligned}$$

Points awarded:

- 0.5 pt : algebraic manipulation
- 1 pt : completing the square and balancing
- 0.5 pt : final answer

(b) What is the vertex of the parabola?

(1 point)

$$(1, -3)$$

(c) What is the equation of the axis of symmetry?

(1 point)

$$x = 1$$

The above example (a) requires a student to perform a specific procedure while parts (b) and (c) require the student to retrieve information from a given function. The scoring for (b) and (c) would be all or nothing.

Moderate Complexity Questions (Level 2)

Moderate-complexity questions require students to identify and understand how the parts of a question are connected to the task of solving the problem or question. A question at this level might be a problem that is typical of, but not identical to, ones studied in class and it requires that students identify and use the appropriate algorithm. At this level of complexity, students are asked to translate, interpret, or extrapolate. Translation refers to the ability to communicate the problem and its solution. Interpretation involves making inferences, generalizations, or summaries. Extrapolation would require the student to estimate or predict the solution from given information by identifying trends and tendencies. Questions at this level include key words such as: *classify, organize, estimate, interpret, predict, infer, translate, generalize, summarize, problem solve, and apply*.

The following are some examples of what a moderate-complexity question might require a student to do:

- make connections between facts, terms, properties, or operations
- solve a word problem requiring multiple steps
- compare figures or statements
- provide a justification for steps in a solution process
- interpret a visual representation
- extend a pattern
- retrieve information from a graph, table, or figure, and use it to solve a problem requiring multiple steps
- determine the formula for a relationship given data and conditions
- compute and solve using appropriate methods

Examples:

Selected-response question

Two dice are rolled. What is the probability that both dice will land on the same number?

a) $\frac{1}{36}$

b) $\frac{1}{18}$

✓c) $\frac{1}{6}$

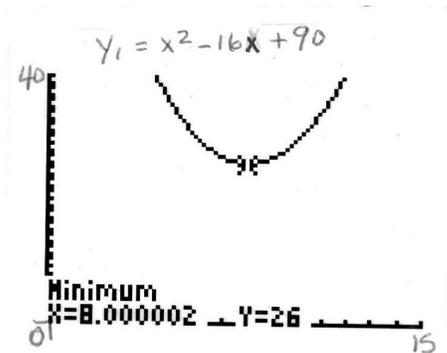
d) $\frac{1}{2}$

In this example, the student needs to solve using appropriate methods.

Constructed-response question

At the Halifax airshow, a plane performs a power dive. The equation $h = t^2 - 16t + 90$ expresses the relationship between height, h , in metres and time, t , in seconds.

- (a) What is the minimum height the plane reaches during the dive? (2 points)
 {outcomes C1, C23, C31}



Points awarded:

- 1.5 pt : graph with vertex clearly marked
- 0.5 pt : final answer

The plane reaches a minimum height of 26 m.

- (b) When will the plane be at a height of 35 metres? (2.5 points)
 {outcomes C1, C23}

$$\begin{aligned}
 t^2 - 16t + 90 &= 35 \\
 t^2 - 16t + 55 &= 0 \\
 (t-11)(t-5) &= 0 \\
 t-11=0 & \quad t-5=0 \\
 t=11 & \quad t=5
 \end{aligned}$$

Points awarded:

- 0.5 pt : substitution of 35 for h
- 1 pt : solving quadratic equation
- 1 pt : final answers

The plane will be at a height of 35m at 5s and at 11s.

In this example, the student needs to make a connection between (a) the minimum height of the plane and the vertex of the given function and (b) the height of the plane and the time needed to reach this height.

High Complexity Questions – Novel Problems (Level 3)

High-complexity questions include analysis, synthesis, and evaluation. At this level of questioning, students are required to think in an abstract and sophisticated way to reason, plan, analyse, judge, and create. Questions at this level will often include key words such as: *analyse, investigate, formulate, prove, derive, explain, and describe*.

Note: There are no level 3 questions in the selected-response portion of the examination.

The following are some examples of what a high-complexity question might require a student to do:

- explain relations among facts, terms, properties, or operations
- analyse similarities and differences between procedures and concepts
- generalize a pattern
- formulate an original problem, given a situation or function
- solve a problem in more than one way
- explain and justify a solution to a problem
- describe, compare, and contrast solution methods
- formulate a mathematical model for a complex situation
- analyse the assumptions made in a mathematical model
- analyse or produce a deductive argument
- provide a mathematical justification
- use concepts taught at prior levels to solve a novel problem

Examples:

Constructed-response question

Is $2^x, 2^{x+2}, 2^{x+4}$ a geometric sequence? Explain your reasoning.

(3 points)

{outcomes C4, C29}

The image shows handwritten work. On the left, the ratio $\frac{2^{x+2}}{2^x} = 2^2$ is written. On the right, the ratio $\frac{2^{x+4}}{2^{x+2}} = 2^2$ is written. A large arrow points from the text 'Common Ratio \therefore geometric sequence' at the bottom to the two equations above. The text 'Common Ratio' is written in a larger font, and the conclusion follows.

Points awarded:

- 2 pt : calculating ratios
- 1 pt : conclusion

This example requires students to use prior knowledge to solve a novel problem.

Create a problem that could be modelled by the equation $P = 5(2)^{\frac{t}{10}}$.

(2 points)
{outcomes A5, C2}

Given an initial count of 5 widgets. If the widgets double every 10 days, what is the population, P , after " t " days

Points awarded:

- 0.5 pt : initial amount
- 0.5 pt : doubling
- 0.5 pt : 10 units of time
- 0.5 pt : reasonable context

This example requires students to formulate an original problem, given a function.

Item Bank Submissions

Teachers are encouraged to submit test items of all types for consideration by the Nova Scotia Examination Advisory Group for Mathematics 12 and Advanced Mathematics 12.

Send materials to:

Lennie Comeau, Mathematics Evaluation Coordinator
Evaluation Services Division
Nova Scotia Department of Education
PO Box 578
Halifax, NS
B3J 2S9

or e-mail to comeaulj@gov.ns.ca

Security

Nova Scotia Examinations are secure. This means that all examination materials must be sent to your regional marking site as soon as possible as directed by your Board Assessment Coordinator. The materials include all Student Booklets, both used and unused. All examination materials are numbered and personalized, and each booklet sent to a school is tracked. No part of the examination, including student work, is to be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or by any other information storage or retrieval system. In addition, teachers must not make use of the exam questions in their teaching.

Securing the NSE is critical to ensuring that the evaluation of student achievement is valid and fair. Users of the examination results draw conclusions about the ability of students based on the scores the students achieve.

The evaluation of student achievement in relation to the selected learning outcomes on these examinations is premised on the students' encountering the tasks for the first time. Any prior exposure compromises the validity of the conclusions drawn about student ability. Because the Department of Education will use assessment items from past (secured) examinations in future examinations, all involved must do their part to secure these examinations.

The use of particular examination questions on a subsequent examination is an important part of ensuring that different examinations render reliable and valid information about student achievement over time. Through the use of one or more anchor questions, two different Mathematics examinations can be equated, meaning that we can calculate the degree to which one examination is easier or harder than another, and then make appropriate adjustments to equate the two administrations. In this way, we can assert with greater confidence that changes in results over a period of time represent real changes in the standard of student performance and not variation in the examinations themselves.

Administration of Examination

The 2011-2012 administration dates for NSE Mathematics 12 and Advanced Mathematics 12 are January 26 and June 15, 2012. In addition to this Information Guide, the following materials relating to the administration of the examinations are distributed to schools along with examinations in the week prior to the date of writing:

- Nova Scotia Examination (NSE) Packing Slip Mathematics 12/Advanced Mathematics 12 (used to verify the materials sent to the school and to account for materials returned to the regional marking site)
- Student lists with corresponding booklet numbers
- Quality Control Declaration (to be completed by the School Assessment Coordinator declaring that the examinations have been secured prior to the examination)
- Instructions to Teachers (invigilating directions)
- Instructions on clearing graphing calculator memory

Note: The School Assessment Coordinator should open the box(es) of examination materials as soon as possible after receipt and check that booklets match the school list.

Pre-Administration

- Two months prior to the date of the examination, teachers and the School Assessment Coordinator must consult regarding the number of examinations required for each course as well as the types and numbers of examinations required in alternate formats (Braille, large print, audio CD).
- Teachers ensure that students have been informed of what they will need in advance of the examination: an HB pencil, a graphing calculator, and a ruler.
NOTE: Schools should be able to provide graphing calculators to students who do not have their own.
- The School Assessment Coordinator ensures that exams are scheduled according to the dates in the provincial assessment schedule.
- The School Assessment Coordinator ensures that students with special needs will be accommodated.
- The School Assessment Coordinator verifies the correctness and number of materials sent by the department.
- The School Assessment Coordinator discusses exam protocol and specific instructions with invigilators, and distributes “Instructions to Teachers” sheet (see above).
- The School Assessment Coordinator that the examination venue does not display material that might advantage students in writing the examination.
- The School Assessment Coordinator maintains security of the examinations and ensures that neither students nor teachers have access to the examinations until the morning of the administration date.

During Administration

- Teachers/invigilators ensure students are under supervision at all times.
- Teachers/invigilators ensure students work independently at all times.
- Teachers/invigilators allow up to three hours to write the examinations.
- Students retain their examination and stay in the examination room for at least one hour after the administration has begun (or longer if so required by school examination procedures).
- Each student receives a personalized *Student Booklet*, a personalized *Student Response Form* for recording responses to selected response questions, and a personalized *Formula Booklet*.
- Teachers/invigilators ensure that students use a pencil to complete the selected response section of the *Student Response Form*.
- Students are to do all their work in the *Student Booklet*, work not done in the *Student Booklet* will **NOT** be evaluated.
- Teachers/invigilators collect all examination materials, including scrap paper and Formula Booklets from students before the students leave the examination room, all materials must be accounted for.
- Teachers/invigilators do not read to students or discuss examination questions with students.
- Students work at their own pace; however, they should take note of the suggested times given for each portion of the examination, one hour for the selected response section and two hours for the constructed response section.

Post-Administration

- In the case of a student for whom adaptations were made in his or her writing of the examination, the teacher must indicate so on the front cover and insert a copy of the adaptations checklist pertaining to assessment from the student's cumulative record file inside the front cover or the examination.
- Teachers write in and bubble each student's term mark on their corresponding *Student Response Form*. Teachers do this for all students currently registered in Mathematics 12 or Advanced Mathematics 12 even if the student did not write the examination.
- As soon as possible following the completion of the examination, teachers must return to the School Assessment Coordinator all student booklets (used and unused) and the School Assessment Coordinator all student booklets (used and unused). The School Assessment Coordinator accounts for (and if necessary follows up on) all materials sent to the school, sign the Quality Control Declaration, and packages the required materials. Instructions for posting or pick-up will be sent to schools by the Board Assessment Coordinator.
- The Nova Scotia Examinations are secure. Therefore all booklets received by the school, including the student booklets (used and unused) must be accounted for and returned to the department. Under no circumstances is reproduction of any part of the examination, including student work, permitted.

Eligibility/Exemptions

Eligibility – Mathematics 12

All students registered in Mathematics 12 will write the NSE Mathematics 12 on the dates specified in the provincial assessment schedule. Students studying Mathematics 12 by correspondence will also write on the specified dates.

Students who are on Individual Program Plans relating to Mathematics and students enrolled in the International Baccalaureate Mathematics course(s) are working within outcome frameworks that may differ from those of the Atlantic Canada Curriculum. These students will be evaluated using other approved forms of assessment and will not write NSE Mathematics 12.

Eligibility – Advanced Mathematics 12

All students registered in Advanced Mathematics 12 will write the NSE Advanced Mathematics 12 on the dates specified in the provincial assessment schedule. Students studying Advanced Mathematics 12 by correspondence will also write on the specified dates.

Students who are on Individual Program Plans relating to Mathematics and students enrolled in the International Baccalaureate Mathematics course(s) are working within outcome frameworks that may differ from those of the Atlantic Canada Curriculum. These students will be evaluated using other approved forms of assessment and will not write NSE Advanced Mathematics 12.

Exemptions

The principal, in consultation with the student and/or parent/guardian, may grant an exemption to an individual student in the case of illness, bereavement, or other exceptional circumstances, in such cases the student's mark will be determined by the Mathematics or Advanced Mathematics 12 teacher in consultation with the principal. Exceptional circumstances are determined on a case-by-case basis as professional judgement and consultation are required.

Exemptions are not granted on the basis of how challenging the examination might be for a particular student. For example, an international student who is enrolled in Mathematics 12 and seeks a course credit in Mathematics 12 must write the examination even if the teacher believes the language competence of that student might not be sufficient to allow success on the examination. The examination assesses the learning outcomes of the course, and it is a requirement for course completion.

Adaptations

Certain students will require adaptations in order to allow them to demonstrate their abilities in relation to learning outcomes. These adaptations should in no way change or modify the learning outcomes of the course, but rather provide for the long-term and short-term needs of the students by furnishing them with alternate ways to show that they have met the outcomes. Decisions regarding adaptations will be made at the school level and will reflect those adaptations documented in the student's cumulative record file as being needed during assessment periods, so long as these adaptations do not compromise or alter the validity of the examination.

For those students where adaptations were made for the writing of the NSE Mathematics 12 or NSE Advanced Mathematics 12, a copy of a list of relevant adaptations from the student's cumulative record file must be inserted in the inside front cover of the student's examination booklet.

Additional information on adaptations and the NSEs is available online at <http://plans.ednet.ns.ca>

Scoring and Reporting

Regional Level

As of January 2008, all NSE Mathematics 12 and Advanced Mathematics 12 examinations are scored at regional marking sessions under the guidance of the professional staff of Evaluation Services Division. Results are returned to Board Assessment Coordinators for distribution to schools within two to three days of the completion of all scoring.

Regional sessions are led by experienced mathematics teachers that attend a three day training session at the Department of Education. All regional sites are connected by Internet using video conferencing software. Should any revisions be made to the marking guide, all sites are consulted. Professional staff from the Evaluation Services Division are also on site in each region to assist session leaders.

Provincial Level

Given that all examinations are marked regionally under the guidance of trained teachers and Evaluation Services Division staff, there is no sampling for central marking. Results are reported based on the census scoring that occurs regionally.

Procedures for requesting a re-score of a Nova Scotia Examination

A request for the re-scoring of a provincially-scored examination is to be made to the school principal by a parent/guardian of the student or by the student him/herself. Deadlines for making such a request for the 2010-2011 NSE Mathematics 12 and Advanced Mathematics 12 examinations are February 10, 2012 for January examinations and July 3, 2012 for June examinations.

The principal will explain to the person making the request, in person or by telephone conversation, that the student examination will not be made available for viewing. The principal will explain the reasoning for this: that the NSE is a secured assessment instrument, and that there is no evidence on the student paper itself of how the examination was scored (so that all scoring is blind). The principal will further convey to the person(s) requesting the re-scoring information pertaining to:

- the tracking of the examination from the point of student writing to the receipt of the examination mark by the school;
- the procedures used in the scoring of the NSE to ensure reliable, accurate and fair scoring of student work;
- the outcome of the re-scoring request, that being the determination of the re-scoring will be final and the results will replace those of the original scoring of the examination.

The principal will then have the person requesting the re-scoring confirm their request for and the acceptance of the outcomes of the re-scoring by their signing in the required space the Request for Re-scoring form. The principal will complete the Request for Re-scoring form with all the requisite information.

The principal will forward the completed Request for Re-scoring forms to the Board Assessment Coordinator by February 10, 2012 or July 3, 2012.

The Board Assessment Coordinator will forward all requests from his/her board for any NSE to the appropriate coordinator in Evaluation Services by February 14, 2012 or July 4, 2012.

An expert panel of three teachers will convene on February 16, 2012 and July 5, 2012 to re-score the examinations. All examinations will be blind double-scored, and where there is variance between two re-scores, a third blind scoring will be undertaken. The agreement of any two re-scores will be the final determination. In the event none of the three scores are in agreement, the panel of three will discuss and make a determination, which will then be final. The score determined by the expert panel will be final even if the result is lower than the original score.

Evaluation Services will return to the school principal (by e-mail attachment, copied to the BAC) the results of the re-scoring of the NSE by February 17, 2012 or July 6, 2012.

The school principal will convey to the person who made the request the results of the re-scoring of the NSE by February 20, 2012 or July 9, 2012.

Exam Scoring Norms for Constructed Response

Solving problems by using mathematics is communicating your reasoning using a specialized language. Just as the English language has its grammatical conventions, the mathematics language has its own usage conventions. Mathematics 12 and Advanced Mathematics 12 students should be proficient in the use of mathematics language and the scoring norms reflect this necessary adherence to the conventions.

- Strict adherence to the marking guide is necessary.
- With the exception of answers in the probability section, all exact final answers must be simplified and reduced. (i.e. reduce fractions, express radicals in simplest radical form, etc...)
- There shall be a deduction (0.5 pt) for:
 - rounding errors a maximum of two times on the exam
 - failing to simplify a maximum of two times on the exam
 - for not using identified variables without restating, a maximum of two times on the exam.
- Deductions (0.5 pt) for computational and transcriptional errors shall not exceed half the value of the points awarded for the question. For example, if a question is worth 5 pts, no more than 2.5 pts may be deducted for computational and transcriptional errors.
- Deduct only once if the same error is repeated within a question.
- If a student makes a conceptual error the student shall receive no point value associated with **that** concept. The student may still receive points for the other concepts involved in the solving of the problem. Should the student make an error that completely changes the intent of the problem such that the intended concepts are now absent from the solution then no points will be awarded for work following that error.
- If an answer box states that students must show proof of work then a final answer only shall result in 0 pts.

Appendices

Appendix A: Outcomes as outlined in the Atlantic Canada Mathematics Curriculum – Mathematics 12/Advanced Mathematics 12

Specific Curriculum Outcomes for Nova Scotia Examinations in Mathematics 12 and Advanced Mathematics 12: Specific curriculum outcomes are statements that describe what students are expected to know and be able to do at each grade level. They are intended to help teachers design learning experiences and assessment tasks.

Note: Questions on the examination are based on the statements below and are arranged according to the tables of specifications (pages 3 and 4). Teachers have been provided with the Atlantic Canada Mathematics Curriculum, Mathematics 12 and Advanced Mathematics 12 for their complete course of study.

GCO A: Students will demonstrate number sense and apply number theory concepts.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- A3 demonstrate an understanding of the role of irrational numbers in applications
- A4 demonstrate an understanding of the nature of the roots of quadratic equations
- A5 demonstrate an understanding of the role of real numbers in exponential and logarithmic expressions and equations
- A6 develop an understanding of factorial notation and apply it to calculating permutations and combinations
- A7 describe and interpret domains and ranges using set notation
- A9 represent non-real roots of quadratic equations as complex numbers

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- B1 demonstrate an understanding of the relationships that exist between arithmetic operations and the operations used when solving equations
- B2 demonstrate an understanding of the recursive nature of exponential growth
- B8 determine probabilities using permutations and combinations
- B10 derive and apply the quadratic formula
- B11Adv analyse the quadratic formula to connect its components to the graphs of quadratic functions
- B12 apply real number exponents in expressions and equations
- B13 demonstrate an understanding of the properties of logarithms and apply them

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- C1 model real-world phenomena using quadratic functions
- C2 model real-world phenomena using exponential functions
- C3 sketch tables and graphs from descriptions and collected data
- C4 demonstrate an understanding of patterns that are arithmetic, power, and geometric and relate them to corresponding functions
- C8 describe and translate between graphical, tabular, written, and symbolic representations of quadratic relationships
- C9 translate between different forms of quadratic equations
- C10Adv determine the equation of a quadratic function using finite differences
- C11 describe and translate between graphical, tabular, written, and symbolic representations of exponential and logarithmic relationships
- C15 relate the nature of the roots of quadratic equations and the x -intercepts of the graphs of the corresponding functions
- C19 demonstrate an understanding, algebraically and graphically, that the inverse of an exponential function is a logarithmic function
- C22 solve quadratic equations
- C23 solve problems involving quadratic equations
- C24 solve exponential and logarithmic equations
- C25 solve problems involving exponential and logarithmic equations
- C29 analyse tables and graphs to distinguish between linear, quadratic, and exponential relationships
- C31 analyse and describe the characteristics of quadratic functions
- C32 demonstrate an understanding of how the parameter changes affect the graphs of quadratic functions
- C33 analyse and describe the characteristics of exponential and logarithmic functions
- C34 demonstrate an understanding of how the parameter changes affect the graphs of exponential functions
- C35Adv write exponential functions in transformational form and as mapping rules to visualize and sketch graphs

GCO D: Students will demonstrate an understanding of, and apply concepts and skills associated with measurement.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- D1 develop and apply formulas for distance and midpoint

GCO E: Students will demonstrate spatial sense and apply concepts, properties and relationships.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- E3Adv write the equations of circles and ellipses in transformational form and as mapping rules to visualize and sketch graphs
- E4 apply properties of circles
- E5 apply inductive reasoning to make conjectures in geometric situations
- E7 investigate, make, and prove conjectures associated with chord properties of circles
- E8Adv investigate, make, and prove conjectures associated with angle relationships in circles
- E11 write proofs using various axiomatic systems and assess the validity of deductive arguments
- E12 demonstrate an understanding of the concept of converse
- E13Adv analyse and translate between symbolic, graphical, and written representations of circles and ellipses
- E14Adv translate between different forms of equations of circles and ellipses
- E15Adv solve problems involving the equations and characteristics of circles and ellipses
- E16Adv demonstrate the transformational relationship between the circle and the ellipse

GCO F: Students will solve problems involving the collection, display, and analysis of data.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- F1 analyse, determine, and apply scatter plots and determine the equations for curves of best fit, using appropriate technology

GCO G: Students will represent and solve problems involving uncertainty.

By the end of Mathematics 12 and Advanced Mathematics 12, students will be expected to

- G1 develop and apply simulations to solve problems
- G2 demonstrate an understanding that determining probability requires the quantifying of outcomes
- G3 demonstrate an understanding of the fundamental counting principle and apply it to calculate probabilities of dependent and independent events
- G4 apply area and tree diagrams to interpret and determine probabilities
- G5Adv determine conditional probabilities
- G7 distinguish between situations that involve combinations and permutations
- G8 develop and apply formulas to evaluate permutations and combinations
- G9Adv demonstrate an understanding of binomial expansion and its connection to combinations
- G10Adv connect Pascal's Triangle with combinatorial coefficients

Appendix B: Outcomes to be assessed in the NSE – Mathematics 12 (Grouped according to units of study)

Specific curriculum outcomes are statements that describe what students are expected to know and be able to do at each grade level. They are intended to help design learning experiences and assessment tasks.

Note: Only those outcomes that will be assessed on the NSE for Mathematics 12 are listed below. Please note that some curriculum outcomes are not assessed on the NSE for Mathematics 12.

Quadratics Unit:

- A3 demonstrate an understanding of the role of irrational numbers in applications
- A4 demonstrate an understanding of the nature of the roots of quadratic equations
- A7 describe and interpret domains and ranges using set notation
- A9 represent non-real roots of quadratic equations as complex numbers
- B1 demonstrate an understanding of the relationships that exist between arithmetic operations and the operations used when solving equations
- B10 derive and apply the quadratic formula
- C1 model real-world phenomena using quadratic functions
- C3 sketch tables and graphs from descriptions and collected data
- C4 demonstrate an understanding of patterns that are arithmetic, power, and geometric and relate them to corresponding functions
- C8 describe and translate between graphical, tabular, written, and symbolic representations of quadratic relationships
- C9 translate between different forms of quadratic equations
- C15 relate the nature of the roots of quadratic equations and the x -intercepts of the graphs of the corresponding functions
- C22 solve quadratic equations
- C23 solve problems involving quadratic equations
- C29 analyse tables and graphs to distinguish between linear, quadratic, and exponential relationships
- C31 analyse and describe the characteristics of quadratic functions
- C32 demonstrate an understanding of how the parameter changes affect the graphs of quadratic functions
- F1 analyse, determine, and apply scatter plots and determine the equations for curves of best fit, using appropriate technology

Exponential Growth unit:

- A5 demonstrate an understanding of the role of real numbers in exponential and logarithmic expressions and equations
- A7 describe and interpret domains and ranges using set notation
- B1 demonstrate an understanding of the relationships that exist between arithmetic operations and the operations used when solving equations

- B2 demonstrate an understanding of the recursive nature of exponential growth
- B12 apply real number exponents in expressions and equations
- B13 demonstrate an understanding of the properties of logarithms and apply them
- C2 model real-world phenomena using exponential functions
- C3 sketch tables and graphs from descriptions and collected data
- C4 demonstrate an understanding of patterns that are arithmetic, power, and geometric and relate them to corresponding functions
- C11 describe and translate between graphical, tabular, written, and symbolic representations of exponential and logarithmic relationships
- C19 demonstrate an understanding, algebraically and graphically, that the inverse of an exponential function is a logarithmic function
- C24 solve exponential and logarithmic equations
- C25 solve problems involving exponential and logarithmic equations
- C29 analyse tables and graphs to distinguish between linear, quadratic, and exponential relationships
- C33 analyse and describe the characteristics of exponential and logarithmic functions
- C34 demonstrate an understanding of how the parameter changes affect the graphs of exponential functions
- F1 analyse, determine, and apply scatter plots and determine the equations for curves of best fit, using appropriate technology

Circle Geometry unit:

- D1 develop and apply formulas for distance and midpoint
- E4 apply properties of circles
- E5 apply inductive reasoning to make conjectures in geometric situations
- E7 investigate, make, and prove conjectures associated with chord properties of circles
- E12 demonstrate an understanding of the concept of converse

Probability unit:

- A6 develop an understanding of factorial notation and apply it to calculating permutations and combinations
- B8 determine probabilities using permutations and combinations
- G2 demonstrate an understanding that determining probability requires the quantifying of outcomes
- G3 demonstrate an understanding of the fundamental counting principle and apply it to calculate probabilities of dependent and independent events
- G7 distinguish between situations that involve combinations and permutations
- G8 develop and apply formulas to evaluate permutations and combinations

Appendix C: Outcomes to be assessed in the NSE – Advanced Mathematics 12 (Grouped according to units of study)

Specific curriculum outcomes are statements that describe what students are expected to know and be able to do at each grade level. They are intended to help design learning experiences and assessment tasks.

Note: Only those outcomes that will be assessed on the NSE for Advanced Mathematics 12 are listed below. Please note that some curriculum outcomes are not assessed on the NSE for Advanced Mathematics 12.

Quadratics Unit:

- A3 demonstrate an understanding of the role of irrational numbers in applications
- A4 demonstrate an understanding of the nature of the roots of quadratic equations
- A7 describe and interpret domains and ranges using set notation
- A9 represent non-real roots of quadratic equations as complex numbers
- B1 demonstrate an understanding of the relationships that exist between arithmetic operations and the operations used when solving equations
- B10 derive and apply the quadratic formula
- B11Adv analyse the quadratic formula to connect its components to the graphs of quadratic functions
- C1 model real-world phenomena using quadratic functions
- C3 sketch tables and graphs from descriptions and collected data
- C4 demonstrate an understanding of patterns that are arithmetic, power, and geometric and relate them to corresponding functions
- C8 describe and translate between graphical, tabular, written, and symbolic representations of quadratic relationships
- C9 translate between different forms of quadratic equations
- C10Adv determine the equation of a quadratic function using finite differences
- C15 relate the nature of the roots of quadratic equations and the x -intercepts of the graphs of the corresponding functions
- C22 solve quadratic equations
- C23 solve problems involving quadratic equations
- C29 analyse tables and graphs to distinguish between linear, quadratic, and exponential relationships
- C31 analyse and describe the characteristics of quadratic functions
- C32 demonstrate an understanding of how the parameter changes affect the graphs of quadratic functions
- F1 analyse, determine, and apply scatter plots and determine the equations for curves of best fit, using appropriate technology

Exponential Growth unit:

- A5 demonstrate an understanding of the role of real numbers in exponential and logarithmic expressions and equations
- A7 describe and interpret domains and ranges using set notation
- B1 demonstrate an understanding of the relationships that exist between arithmetic operations and the operations used when solving equations
- B2 demonstrate an understanding of the recursive nature of exponential growth
- B12 apply real number exponents in expressions and equations
- B13 demonstrate an understanding of the properties of logarithms and apply them
- C2 model real-world phenomena using exponential functions
- C3 sketch tables and graphs from descriptions and collected data
- C4 demonstrate an understanding of patterns that are arithmetic, power, and geometric and relate them to corresponding functions
- C11 describe and translate between graphical, tabular, written, and symbolic representations of exponential and logarithmic relationships
- C19 demonstrate an understanding, algebraically and graphically, that the inverse of an exponential function is a logarithmic function
- C24 solve exponential and logarithmic equations
- C25 solve problems involving exponential and logarithmic equations
- C29 analyse tables and graphs to distinguish between linear, quadratic, and exponential relationships
- C33 analyse and describe the characteristics of exponential and logarithmic functions
- C34 demonstrate an understanding of how the parameter changes affect the graphs of exponential functions
- C35Adv write exponential functions in transformational form and as mapping rules to visualize and sketch graphs
- F1 analyse, determine, and apply scatter plots and determine the equations for curves of best fit, using appropriate technology

Circle Geometry unit:

- A7 describe and interpret domains and ranges using set notation
- D1 develop and apply formulas for distance and midpoint
- E3Adv write the equations of circles and ellipses in transformational form and as mapping rules to visualize and sketch graphs
- E4 apply properties of circles
- E5 apply inductive reasoning to make conjectures in geometric situations
- E7 investigate, make, and prove conjectures associated with chord properties of circles
- E8Adv investigate, make, and prove conjectures associated with angle relationships in circles
- E11 write proofs using various axiomatic systems and assess the validity of deductive arguments
- E12 demonstrate an understanding of the concept of converse
- E13Adv analyse and translate between symbolic, graphical, and written representations of circles and ellipses
- E14Adv translate between different forms of equations of circles and ellipses

E15Adv solve problems involving the equations and characteristics of circles and ellipses

E16Adv demonstrate the transformational relationship between the circle and the ellipse

Probability unit:

A6 develop an understanding of factorial notation and apply it to calculating permutations and combinations

B8 determine probabilities using permutations and combinations

G2 demonstrate an understanding that determining probability requires the quantifying of outcomes

G3 demonstrate an understanding of the fundamental counting principle and apply it to calculate probabilities of dependent and independent events

G5Adv determine conditional probabilities

G7 distinguish between situations that involve combinations and permutations

G8 develop and apply formulas to evaluate permutations and combinations

Appendix D: Formula Sheet – Mathematics 12

Quadratics Unit

General form: $y = ax^2 + bx + c$

Standard form: $y = a(x - h)^2 + k$

Transformational form: $\frac{1}{a}(y - k) = (x - h)^2$

If $ax^2 + bx + c = 0$ then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Circle Geometry Unit

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The coordinates of M are: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

$$m = \frac{\Delta y}{\Delta x}$$

Exponential Growth Unit

$$y = ab^x$$

$$\log_a(xy) = \log_a x + \log_a y$$

$$\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$$

$$\log_a x^b = b(\log_a x)$$

Probability Unit

$$P(A \text{ and } B) = P(A) \times P(B)$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$${}_n P_r = \frac{n!}{(n-r)!}$$

$${}_n C_r = \frac{n!}{r!(n-r)!}$$

Appendix E: Formula Sheet – Advanced Mathematics 12

Quadratics Unit

General form: $y = ax^2 + bx + c$

Standard form: $y = a(x - h)^2 + k$

Transformational form: $\frac{1}{a}(y - k) = (x - h)^2$

If $ax^2 + bx + c = 0$ then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Circle Geometry Unit

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The coordinates of M are: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$$m = \frac{\Delta y}{\Delta x}$$

General form: $Ax^2 + Ay^2 + Dx + Ey + F = 0$
 $Ax^2 + By^2 + Dx + Ey + F = 0$

Standard form: $(x - h)^2 + (y - k)^2 = r^2$

Trans. form: $\left[\frac{1}{r}(x - h)\right]^2 + \left[\frac{1}{r}(y - k)\right]^2 = 1$
 $\left[\frac{1}{a}(x - h)\right]^2 + \left[\frac{1}{b}(y - k)\right]^2 = 1$

Exponential Growth Unit

$$y = ab^x$$

$$A(y - C) = b^{B(x - D)}$$

$$\log_a(xy) = \log_a x + \log_a y$$

$$\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$$

$$\log_a x^b = b(\log_a x)$$

Probability Unit

$$P(A \text{ and } B) = P(A) \times P(B)$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$$

$${}_n P_r = \frac{n!}{(n - r)!}$$

$${}_n C_r = \frac{n!}{r!(n - r)!}$$

Appendix F: List of Mathematical Terms and Concepts

Students should be familiar with the mathematical terms and concepts below. The terms pertinent only to Advanced Mathematics 12 are marked with an asterisk

Quadratic Unit

- 1st, 2nd...degree function
- 1st, 2nd...level of differences
- altitude
- appropriate scale
- arithmetic and power sequence
- axis of symmetry
- coefficient, integral coefficient
- common difference
- completing the square
- complex numbers
- cubic, quartic
- curve of best fit
- difference of squares
- discrete
- discriminant
- domain
- factors
- finite differences*
- finite sequence
- general form
- horizontal distance
- horizontal translation
- imaginary number
- inadmissible root
- infinite sequence
- intersect
- labeling axis
- mapping rule
- maximize
- maximum value
- minimum value
- model
- nth term of a sequence
- non-linear
- number systems (I, R, N, W)
- parabola
- parabolic
- perfect square
- projectile
- quadratic function
- quadratic sequence
- quadratic formula
- radicals
- range
- reflection
- regression
- roots
- scatter plot
- sequence of differences
- set notation (interval notation)
- standard form
- transformational form
- transformations
- vertex
- vertical distance
- vertical stretch
- vertical translation
- units of measure
- x-intercept(s)
- y-intercept
- zeroes

Exponential Unit

- argument
- asymptote
- base
- common difference
- common ratio
- decay curve
- decreasing function
- dependent
- domain
- exponent
- exponential sequence
- extraneous root
- focal point
- geometric sequence
- growth curve
- increasing function
- independent
- half-life
- laws of exponents
- laws of logarithms
- logarithmic scales*
- logarithms
- power
- range

Circle Geometry Unit

- acute
- altitude
- angles
- bisect
- central angle*
- centre
- chord
- circle
- circumcentre
- circumference
- collinear
- complementary angle
- concentric
- congruent
- conjecture
- converse statement
- corresponding angles
- cyclic quadrilateral*
- diagonals
- diameter
- distance
- ellipse*
- equiangular
- equidistant
- equilateral triangle
- Euclidian geometry
- exterior angle
- iff statements
- inscribed*
- intercepted arc*
- interior angle
- intersect
- isocles triangle
- line segment
- major axis*
- midpoint
- minor axis*
- obtuse
- parallel
- perpendicular
- perpendicular bisector
- Pythagorean theorem
- radius
- scalene triangle
- semicircle
- similar
- subtended*
- supplementary angle
- transversal
- unit circle
- vertically opposite angles
- vertices

Probability Unit

- area diagram
- combinations
- complement of event
- conditional probability*
- dependent events
- event
- expected value
- experimental probability
- factorial
- fundamental counting principle
- independent events
- multiplication principle
- mutually exclusive events
- outcomes
- permutations
- probability
- random sample
- random variable
- sample space
- simulation
- success
- theoretical probability
- tree diagram
- Venn diagram

Appendix G : Using a Graphing Calculator

In order for students to show their understanding when solving a problem using a graphing calculator, some demonstration of that use will be required to obtain full value on any given question.

As a teacher said at a previous session:

“I would expect students to show graphs when solving graphically just like I would expect students to show algebra when solving algebraically.”

Beth Calabrese, J.L. Ilsley, Halifax, October 2003.

Please note:

- A graphing calculator (TI-82, TI-83, TI-83PLUS, TI-84, TI-84PLUS) should be available to students when writing the NSE in Mathematics 12 or Advanced Mathematics 12.
- The memory of all graphing calculators will be cleared (instructions provided in Appendix H). If students choose to use their own graphing calculators, they should be advised that the memory will be cleared by the teacher before writing the exam.
- If a question instructs students to solve:
 - without the use of the graphing calculator...;
 - algebraically...;
 - without using regression...;no points will be awarded if solved by using the graphing calculator other than for basic calculations.

Examples are provided on the following pages that indicate the expectations for writing solutions when using a graphing calculator to solve a given problem.

EXAMPLE - Question #8, page 17 (selected from *Mathematical Modeling Book 3*)

The rides Superman the Escape and Tower of Terror accelerate riders to 160 km/h in 7 s, then raise them to a vertical height of 40 storeys. On the reverse route, riders travel backward up to 160 km/h again before magnetic brakes bring them to a complete stop.

The table shows the horizontal distance traveled in each second of acceleration.

Time (s)	1	2	3	4	5	6	7
Distance (m)	3.17	12.7	28.57	50.79	79.36	114.27	155.54

- (a) Find the equation of the curve of best fit using technology, and justify why your equation best models the situation. (2 points) {C1, C4, C8, C29, F1 – Level 2}
- (b) How many seconds, correct to two decimal places, would it take to reach a horizontal distance 200 m? (2 points) {C22, C23 – Level 2}

Solutions for (a)

Points awarded:

- 1 pt : work showing quadratic model is best fit
- 0.5 pt : indication of regression
- 0.5 pt : equation

(a)

t	1	2	3	4	5	6	7
d	3.17	12.7	28.57	50.79	79.36	114.27	155.54

\downarrow 9.53 \downarrow 15.87 \downarrow 22.22 \downarrow 28.57 \downarrow 34.91 \downarrow 41.27
 \downarrow 6.34 \downarrow 6.35 \downarrow 6.35 \downarrow 6.34 \downarrow 6.36

← constant 2nd level difference \therefore quadratic

Quad reg $\Rightarrow y = 3.17x^2 + 0.0038x - 0.0057$

OR

(a)

Quadreg	$R^2 = 0.9999$	}	\therefore Quadratic $y = 3.17x^2 + 0.0038x - 0.0057$
Expreg	$R^2 = 0.9268$		

Solutions for (b)

Points awarded:

- 0.5 pt : for identifying graphed functions
- 0.5 pt : graph identifying intersection point (or x-intercept (or using tables)
- 0.5 pt : solution

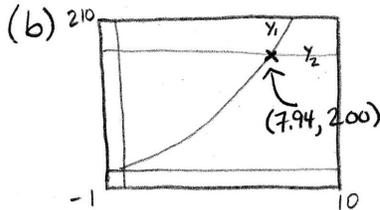
(b)

7.92	199.106
7.93	199.609
7.94	200.113
7.95	200.617

It will take 7.94 sec.

Note: since table illustrated uses the function established in (a) it does not need to be re-stated. However, it would be good practice to do so.

OR



$$y_1 = 3.17x^2 + 0.0038x - 0.0057$$

$$y_2 = 200$$

It will take 7.94 sec.

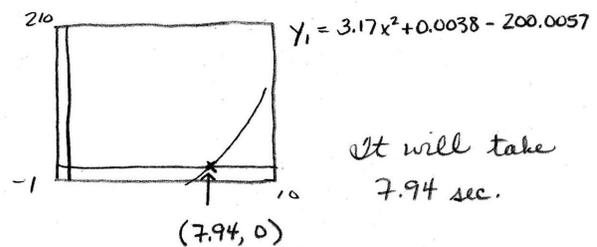
OR

(b)

$$y = 3.17x^2 + 0.0038x - 0.0057$$

$$200 = 3.17x^2 + 0.0038x - 0.0057$$

$$0 = 3.17x^2 + 0.0038x - 200.0057$$



It will take 7.94 sec.

OR

(b)

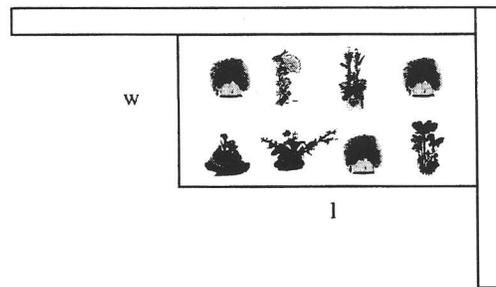
$$y = 3.17x^2 + 0.0038x - 200.0057$$

x	y
7.93	-0.6568
7.94	-0.1537
7.95	0.3500

⇒ It will take 7.94 sec.

EXAMPLE - Question #21, page 21 (selected from *Mathematical Modeling Book 3*)

Suppose the gardener used two adjacent sides of the wall and 50 m of bordering to form the garden.



(a) Express the area of the garden as a function of its width. (2 points) {C1, C8 – Level 2}

(b) Find the maximum area of the garden. (2 points) {C1, C23, C31 – Level 1}

Solution for (a)

Points awarded:

- 1 pt : calculating the length as a function of the width
- 1 pt : calculating the area as a function of the width

$$(a) \quad l + w = 50$$

$$l = 50 - w$$

$$A = l \times w$$

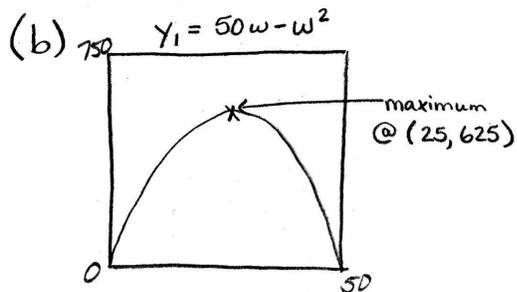
$$= (50 - w)w$$

$$= 50w - w^2$$

Solution for (b)

Points awarded:

- 1.5 pt : graph showing maximum point
- 0.5 pt : solution



The maximum area of the garden is 625 m^2 .

EXAMPLE - Question #29, page 35 (selected from *Mathematical Modeling Book 3*)

Find two numbers whose difference is 13 and whose squares when added together yield a minimum.
(3 points) {C8, C9, C23, C31 – Level 2}

Solution

Points awarded:

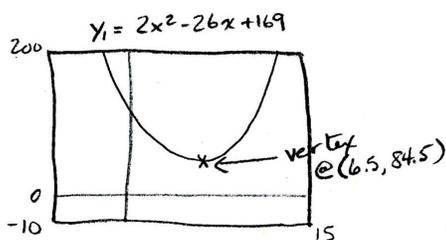
- 1 pt : setting up quadratic equation
- 1 pt : graph with vertex clearly identified
- 1 pt : solutions

Let x represent a number.

$$x^2 + (x-13)^2 = M$$

$$x^2 + x^2 - 26x + 169 = M$$

$$M = 2x^2 - 26x + 169$$



Therefore one of the numbers is 6.5.

$$\begin{aligned} \text{Second number} &= 6.5 - 13 \\ &= -6.5 \end{aligned}$$

The two numbers are 6.5 and -6.5.

Appendix H: How to clear the memory on graphing calculators (TI-82, TI-83, TI-83PLUS, TI-84, TI-84PLUS)

All memory should be cleared from the calculators before students write the examination. Teachers must follow the following steps:

→ To clear the memory, turn the calculator 'ON'.

→ Press  

→ Select reset.

→ Press  twice.

→ Select reset.

→ Press 

Note, the screen should display DONE, RAM Cleared, or MEMORY Cleared.

After resetting the graphing calculator:

→ The values of 'R' (correlation coefficient) or 'R²' will not appear when performing a regression.

To set diagnostic on, press    scroll down using  and select diagnostic on.

Press  twice.

→ The display contrast will also be reset. If the screen display is too light press  and press and hold  until you reach the desired contrast.

→ You should also have extra batteries on hand.

Note: This procedure does not erase archived memory, if you wish to delete such memory - note that you are not required to - please refer to the Texas Instruments website (<http://education.ti.com>) and follow their instructions.