Nova Scotia Examinations

Information Guide

Nova Scotia Examination
Mathematics 10

Nova Scotia Examination
Mathematics at Work 10

Rev. 08/15

NOVA SCOTIA

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Introduction

The purpose of this Information Guide is to provide teachers with information about the Nova Scotia Examinations (NSE) Mathematics 10 and the NSE Mathematics at Work 10. Teachers are encouraged to share the contents of the guide, particularly the sample questions and answers, with their students.

Overview

The NSE Mathematics 10 and the NSE Mathematics at Work 10 are designed to evaluate student achievement in relation to the outcomes for each respective course. The examination results contribute 20% to students' final course mark.

All students registered in Mathematics 10 and Pre-IB Mathematics 10 will write the NSE Mathematics 10. Students registered in Mathematics at Work 10 will write the NSE Mathematics at Work 10. Students who have an Individual Program Plan (IPP) in mathematics, and therefore work toward a different set of mathematics outcomes, do not participate in the examination.

The NSE Mathematics Advisory Group, comprised of senior high school mathematics teachers and board mathematics leaders 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 Assessment Development Model. As well, an examination review team, comprised of 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 and Early Childhood Development.

The mathematics examination is constructed according to precise specifications. Questions are written to match curriculum outcomes and then are field-tested with students. Field-test results are then analyzed and items that meet provincial standards are approved for inclusion on examinations.

The examination is scored by Mathematics 10 and Mathematics at Work 10 teachers for individual student results. Provincial data is gathered from a central scoring session led by Evaluation Services Division staff and then provided to provincial educational partners. Standards for marking are set in consultation with the advisory group.

Curriculum Links

The curriculum documents for Mathematics 10 and Mathematics at Work 10 articulate the curriculum for both of these courses. The documents provide 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 Mathematics 10 and the NSE Mathematics at Work 10 are designed to reflect the tables of specifications in this guide (see page 3). The tables are aligned to reflect the prescribed curriculum. The outcomes listed in the appendices of this guide have been used to construct both examinations. Appendix A outlines those outcomes that may be addressed on the Mathematics 10 examination and, Appendix B outlines those that may be addressed on the Mathematics at Work 10 examination. Note that in any given year, 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 grouping 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 (knowledge, application, and analysis).

The Information Guide will be revised as needed to reflect any 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 website http://plans.ednet.ns.ca .

Examination Specifications

Examination Construction

The NSE Mathematics 10 and NSE Mathematics at Work 10 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 10 and Mathematics at Work 10 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 tables provide the approximate weightings of each unit on the examinations and are based on the recommendations for time allotment found in the curriculum documents for Mathematics 10 and Mathematics at Work 10.

Table 1 - Specifications for Mathematics 10

Unit of study	Approximate Weighting
Measurement	25% – 30%
Algebra and Number	20% – 25%
Relations and Functions	35% – 40%
Financial Mathematics	10% – 15%

Table 2 - Specifications for Mathematics at Work 10

Unit of study	Approximate Weighting
Measurement	35% – 40%
Geometry	40% – 45%
Number	15% – 20%

Note: no percentage of the examination is allocated to the Algebra unit as it is integrated throughout all other units of study.

Table 3 outlines the construction of the examinations 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.

Table 3 – Examination specifications according to question format

Question Format	# of Questions	Approximate Weighting
Selected response (multiple choice)	40	45% – 55%
Constructed response (short answer and extended response)	6 – 8	45% – 55%

Table 4 outlines the construction of each examination according to three cognitive levels: knowledge, application, and analysis.

Table 4 – Examination specifications according to cognitive level

Cognitive Level	Approximate Weighting
Knowledge	20% – 25%
Application	55% – 65%
Analysis	15% – 20%

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 section includes the marking scheme for sample constructed-response questions to illustrate the scoring process.

Knowledge

Facility in using mathematics, or reasoning about mathematical situations, depends on mathematical knowledge and familiarity with mathematical concepts. Knowledge of a wide range of mathematical terminology, number properties, geometric properties, basic facts, and mathematical procedures open the door to the development of a deeper mathematical understanding and purposeful mathematical thinking.

Knowledge questions will require students to recall and recognize previously learned concepts/skills and solve routine mathematical procedures. Knowledge questions include recognition or recall of terminology, formulae, algorithms, graphs, geometric figures, properties, and theorems. Questions at this level include key words such as: *identify, measure, find, solve, use, list, define, classify,* and *name*.

The following are some examples of what a knowledge question might require a student to do:

- recall definitions, terminology, number properties, geometric properties, and notation
- recognize mathematical objects, shapes, numbers, and expressions as well as mathematical entities that are mathematically equivalent
- compute a sum, a difference, a product, a quotient, or a combination of these with rational numbers, radicals, powers and polynomials; approximate numbers to estimate computations; carry out routine algebraic procedures; compute percentages, factorize, and add hours in a time chart
- retrieve information from a graph, a table, a figure or a function
- measure using appropriate instruments, use units of measure appropriately; estimate measures; convert units from imperial measure to SI and vice versa; express total time worked in decimal form and in hours and minutes
- classify/group objects, shapes, numbers, and expressions according to stated common properties; make correct decisions about class membership; and order numbers and objects by attributes

Examples of Knowledge Questions

Selected-response Question

Which of the following examples is the best referent for one millimetre?
{Mathematics 10 outcome M01/Mathematics 10 at Work 10 outcome M03}

a) the diameter of a quarter

✓b) the thickness of a fingernail

c) the length of a five-dollar bill

d) the distance from the floor to a door knob

In this example the student needs to recognize an example of a concept.

Constructed-response Question

How many sheets of $\frac{5}{8}$" plywood are in a sling load (or stack) 5' high?
{Mathematics 10 outcome M02/Mathematics at Work 10 outcome M03}

$5\text{ ft} \times \frac{12\text{ in}}{1\text{ ft}} = 60\text{ in}$

Points awarded:

- 1 pt : conversion of feet to inches
- 1 pt : division by $\frac{5}{8}$"
- 0.5 pt : manipulation to solve

$$\frac{60\text{ in}}{\frac{5}{8}\text{ in}} = 60 \times \frac{8}{5}$$

$$= \frac{480}{5}$$

$$= 96$$

There are 96 sheets of $\frac{5}{8}$" plywood in a sling load 5' high.

In this example the student needs to carry out a straightforward conversion and calculation.

Application

Application questions require students to answer questions that are typical of, but not identical to, the problems studied in class. Students are expected to understand the problem, as well as, identify and use the appropriate strategy to solve the problem. Questions at this level include key words such as: *organize, estimate, interpret, predict, translate, summarize, solve, explain, describe,* and *apply*.

The following are some examples of what an application question might require a student to do:

- select an efficient/appropriate operation, method or strategy for solving problems
- represent mathematical information and data in diagrams, tables, charts, or graphs, and select equivalent representations for a given mathematical entity or relationship
- model a routine problem using an appropriate equation or diagram
- implement and execute a set of mathematical instructions (i.e., given a set of specifications, draw figures and shapes)
- solve a routine problem requiring multiple steps
- identify and extend a pattern
- examine solutions to routine problems to identify the correct solution or identify errors in a given solution

Examples of Application Questions

Selected-response Question

Chelsea works at a furniture store and is paid a weekly salary of $125 plus 5.5% commission. In February she sold $15000 worth of stock. What was her gross salary for February? There are 4 weeks in February.
{Mathematics 10 outcome FM02/Mathematics at Work 10 outcome N02}

a) $950.00

b) $852.50

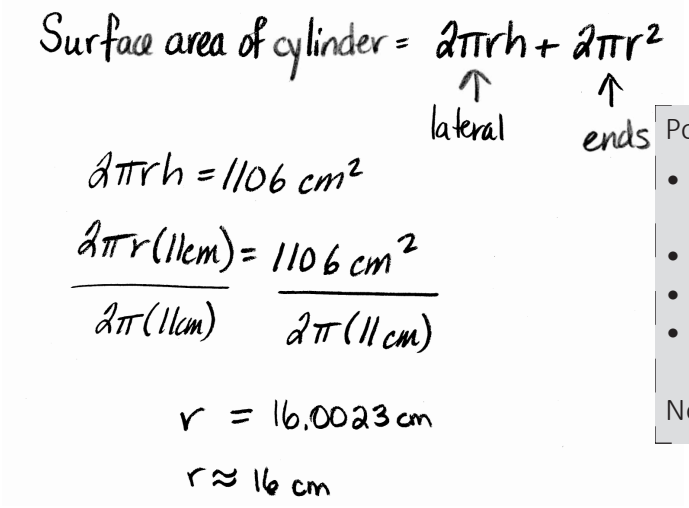
✓c) $1325.00

d) $831.88

In this case the student needs to select the appropriate method and apply this method to find the solution to a problem that is similar to prior problems encountered by the student.

Constructed-response Question

The lateral surface area of a cylinder is 1106 cm^2. Given that the height is 11 cm, calculate the radius. Answer to the nearest cm.
{Mathematics 10 outcome M03}



Points awarded:

- 1 pt : identifying/using formula for lateral surface area of cylinder
- 1 pt : substitution of total area
- 0.5 pt : substitution of height
- 0.5 pt : solve to final answer

Note: deduct 0.5 pt if no units given

In this example the student needs to solve a routine word problem involving multiple steps.

Analysis

An analysis question requires students to use reasoning to solve multi-step and non-routine problems. Students must draw on knowledge and understanding from previous learning and from different areas of mathematics to solve more complex problems. The student must make connections and generalize their learning to new situations. Questions at this level will include key words such as: *analyze*, *investigate*, *prove*, *explain*, *generalize*, *justify*, and *infer*.

The following are some examples of what an analysis question might require a student to do:

- analyze a mathematical situation by determining or describing the relationships between variables or objects; decomposing geometric figures to simplify solving a problem; drawing the net of a given, unfamiliar solid; visualizing transformations of a three-dimensional figure; making inferences from given information
- generalize results or patterns, sometimes to make them more widely applicable
- synthesize/integrate mathematical procedures to establish results or to produce further results; making connections among different elements of knowledge and related representations; and making connections between related mathematical ideas
- justify the truth or falsity of a statement by referencing mathematical results or properties
- provide a justification for steps in a solution process
- solve non-routine problems set in mathematical or real-life contexts where students are unlikely to have encountered closely similar items; applying mathematical procedures in unfamiliar or complex contexts; using geometric properties to solve non-routine problems

Examples of Analysis Questions

Constructed-response Question

Two acid solutions are to be mixed together.

Solution A is 30% acid by volume.
Solution B is 70% acid by volume.

How much of solution A is needed to mix with solution B to make an 800 mL mixture that is 54% acid by volume? Answer to the nearest millilitre.
{Mathematics 10 outcome RF10}

let a = amount of solution A
let b = amount of solution B

Equ'n ① $a + b = 800$

Equ'n ② $0.3a + 0.7b = 0.54 \cdot 800$
$0.3a + 0.7b = 432$

$a + b = 800$
$b = 800 - a$

$0.3a + 0.7b = 432$
$0.3a + 0.7(800 - a) = 432$
$0.3a + 560 - 0.7a = 432$
$\frac{-0.4a}{-0.4} = \frac{-128}{-0.4}$
$a = 320$

Points awarded:

- 1 pt : determining equation 1
- 1 pt : determining equation 2
- 1 pt : applying a method to solve the system of equations
- 1 pt : solve to final answer

Note: deduct 0.5 pt if no units given

One needs to mix 320 mL of solution A with 480 mL of solution B to make an 800 mL solution that is 54% acid by volume.

In this example the student needs to solve a non-routine word problem involving multiple steps in a complex context.

Item Bank Submissions

Teachers are encouraged to submit test items of all types for consideration by the Nova Scotia Examination Advisory Group for NSE Mathematics 10 and NSE Mathematics at Work 10.

Send item submissions to:

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

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

Calculator Policy

Students should be made aware of the calculator policy from the beginning of the course and informed that it is their responsibility to ensure that they are in compliance with the following guidelines.

In order to be able to complete the questions on the examinations, a scientific calculator with the following functionality is required:

- addition, subtraction, multiplication, and division
- operations with exponents
- roots
- trigonometric functions
- π button

While there is no approved list of calculators, the following conditions must be enforced in order to ensure a fair, reliable, and valid measure of student achievement on the examination:

- **Only dedicated calculators are permitted.** Other electronic devices such as cell phones, translators, mini-computers, etc., that may have calculator functions are prohibited. Any device with wifi capabilities is not permitted.
- **Calculators must not have any additional information programmed into the memory.** A calculator that contains information that would be unacceptable in paper form is prohibited. Calculators containing built-in notes, definitions or student constructed programs are unacceptable for use. Calculators with this capacity should be cleared prior to the examination or an alternate calculator should be provided. Calculators must be inspected by a knowledgeable proctor prior to the examination session.
- **Students must not use a calculator model, graphing or scientific, that actively uses Computer Algebraic System (CAS).** Some examples include: Casio Classpad 300, HP-40G, HP-48G, TI-Nspire CAS, TI-86, TI-89.

Security

Nova Scotia Examinations are secure. This means that once the examinations are scored at the school and results are recorded, all examination materials must be returned to the Department of Education and Early Childhood Development. This includes all student materials and marking guides. All examination materials are numbered, personalized, and 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 achievement of students based on their scores.

The Department of Education and Early Childhood Development will use assessment items from past (secured) examinations in subsequent examinations. Exposure to assessment tasks prior to the examination compromises the validity of the conclusions drawn about student ability. **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 a number of 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

In addition to this Information Guide, the following materials relating to the administration of the examinations are distributed to schools along with examinations prior to the date of writing:

- Nova Scotia Examination (NSE) Packing Slip Mathematics 10/Mathematics at Work 10
- Student lists with corresponding booklet numbers
- Quality Control Declaration
- Instructions to Teachers (invigilating directions)
- Scoring Guide
- Canada Post Bill of Lading

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

- Teachers ensure that students have been informed of what they will need in advance of the examination: an HB pencil, a calculator, and a ruler.
- The School Assessment Coordinator and teachers ensure that the examination venue does not display material that might advantage students in writing the examination.
- The School Assessment Coordinator
  - ensures that exams are scheduled according to the dates in the provincial assessment schedule.
  - ensures that students with special needs will be accommodated.
  - verifies the correctness and number of materials sent by the department.
  - discusses exam protocol and specific instructions with invigilators, and distributes "Instructions to Teachers" sheet (see above).
  - 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. Only students with an adaptation for extra time (see p. 17) are permitted to go beyond this three hour time frame.
- Students are required to stay in the examination room for at least one hour after the administration has begun (or longer if required by school or board examination procedures).
- Ensure that students receive the correct examination materials.
- Teachers/invigilators ensure that students use a pencil to complete the examination.
- Students are **NOT** to be given scrap paper. All their work should be done in the *Student Booklet*. Work not done in the *Student Booklet* will **NOT** be evaluated.
- Teachers/invigilators collect all examination material from students before the students leave the examination room. All materials must be accounted for.

- Teachers/invigilators do not read questions to students or discuss examination questions with students. (*In cases where a student may not be familiar with a certain word it may be read to the student but no explanation can be given.)
- Students work at their own pace; however, they should be made aware of remaining time at half hour intervals.

Post-Administration

- Where a student has written the examination using adaptaions, this must be indicated on the back of the student examination booklet.
- As soon as possible following the completion of the examination scoring, teachers must return to the School Assessment Coordinator all student examination materials and the marking guide. The School Assessment Coordinator accounts for (and if necessary follows up on) all materials sent to the school, signs the *Quality Control Declaration Form*, and packages the required materials. Materials are to be returned to the Department of Education and Early Childhood Development using the Canada Post Bill of Lading included in the shipment.
- The Nova Scotia Examinations are secure. Therefore all examination material received by the school, used and unused, must be accounted for and returned to the department. Under no circumstances is reproduction of any part of the examination permitted. This includes student work.

Eligibility, Exemptions, and Adaptations

Eligibility – Mathematics 10

All students registered in Mathematics 10 and Mathematics 10 Pre-IB will write the NSE Mathematics 10 on the dates specified in the provincial assessment schedule. Students studying Mathematics 10 by correspondence will also write according to Correspondence Studies guidelines.

Students who are on Individual Program Plans relating to mathematics will not write the NSE Mathematics 10. These students will be evaluated using other forms of assessment as outlined in IPP documentation.

Eligibility – Mathematics at Work 10

All students registered in Mathematics at Work 10 will write the NSE Mathematics at Work 10 on the dates specified in the provincial assessment schedule. Students studying Mathematics at Work 10 by correspondence will write according to Correspondence Studies guidelines.

Students who are on Individual Program Plans relating to mathematics will not write the NSE Mathematics at Work 10. These students will be evaluated using other forms of assessment as outlined in IPP documentation.

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 10 or Mathematics at Work 10 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 10 and seeks a course credit in Mathematics 10 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

Adaptations are strategies and/or resources to accommodate the learning needs of an individual student. They are planned, implemented, and evaluated with the goal of enabling a student to achieve the prescribed curriculum outcomes. Further information about adaptations may be found in the *Supporting Student Success: Resource Programming and Services* document on the Nova Scotia Department of Education and Early Childhood Development website at studentservices.ednet.ns.ca/document. Adaptations are documented in the student's cumulative records (the *Student Records Policy* is available online at studentservices.ednet.ns.ca/document).

It is important that the results of the examination accurately reflect what students know and can do independently in relation to learning outcomes. Adaptations used to support the student during classroom assessment should be available during the provincial examination. However, some adaptations may compromise or alter the validity of the examination. For example, if terms used on an assessment are explained to a student, this alters the validity of the examination since there is no evidence that the student has independently learned the concepts that are being assessed. Parents and guardians, through the program planning process, should be informed when an adaptation that has been provided to a student during his or her regular schoolwork is not acceptable on a provincial examination.

Adaptations made available to the student during the examination must be

- in place before the administration of the examination
- documented in TIENET
- communicated to parents/guardians through the program planning process.

The following is a description of adaptations that may be used during Nova Scotia Examinations.

Alternate Format
Alternate formats provided include large-print, black-and-white, and Braille versions of the examination as well as other formats on request. The adaptation must be documented in TIENET and the Request for Alternate Formats (NSA and NSE) form must be completed in TIENET by the deadline November 15 for first semester course examinations and April 1 for second semester or full-year course examinations.

Additional Time
Additional time can be given to a student during an examination if this adaptation has been documented in TIENET. A student eligible to receive an additional time adaptation can be given up to twice the allotted time for the examination with periodic, supervised breaks.

Alternate Setting
A student may complete any part of the examination in a setting different from that of the other students in the class if this is an adaptation documented in TIENET. The proctor must follow the guidelines for administration of the examination.

Assistive Technology
If assistive technology (e.g., text-to-speech, speech-to-text, word processor, writing software) is an adaptation documented in TIENET and used regularly in the classroom, it can be provided to a student during the examination.

Verbatim Scribing (See Appendix G)
A scribe may be made available to a student who has a scribe adaptation for assessments documented in TIENET. A student must use this adaptation on a regular basis in the classroom in order to be eligible for its use during the examination. A scribe may also be used in the case of physical injury that would limit a student's ability to write independently.

Verbatim Reading (See Appendix H)
If verbatim reading is an adaptation documented in TIENET and used regularly in the classroom, it can be provided to a student during the examination.

Other
Adaptations documented in TIENET other than those listed above may be provided to students if these adaptations do not compromise the validity of the examination. These adaptations must be used by the student on a regular basis in the classroom.

If you have further questions regarding the use of adaptations during a Nova Scotia Assessment, please contact your Board Assessment Coordinator. The Department of Education and Early Childhood Development may contact the school for further clarification regarding the use of certain adaptations.

Scoring and Reporting

School Level

The NSE Mathematics 10 and the NSE Mathematics at Work 10 examinations are scored by course teachers in order to provide the student with a mark on his/her report card. Teachers are to strictly follow the scoring guide provided by the Department.

Provincial Level

Following the end of the school year, all examinations will be scored at a summer scoring session in order to provide school boards and schools with data regarding student performance.

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

The re-scoring of the NSE Mathematics 10 and the NSE Mathematics at Work 10 are the responsibility of the course teacher. If upon appeal of a result the school wishes to re-score an examination, the principal of the school must contact Evaluation Services in order to arrange shipment of the student's examination back to the school.

Please note that once the examinations have been shipped to the Department for the summer scoring session the booklets will not be available for a re-score until that scoring session has been completed.

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 10 and Mathematics at Work 10 students should be proficient in the use of mathematics language and the scoring norms reflect this necessary adherence to the conventions.

- Do not write or place any marks in the student examination booklet.

- Strict adherence to the marking guide is necessary unless a valid alternate method is used. In such cases, use your professional judgement in determining how points will be awarded.

- Deduct 0.5 point for each:
  → computational error;
  → transcriptional error;
  → rounding error (including not rounding to the specified precision).
  The above deductions cannot exceed half the value of a question. For example, if a question is worth 2 points, do not deduct more than 1 point for such errors.

- Deduct only once if the same error is repeated within a question. Note that for the purposes of this examination multi-part questions, for example 47(a) and 47(b), are considered separate questions.

- Where indicated in this guide, deduct 0.5 point if final answer does not include correct units.

- If a student makes an error in part (a) and uses this value in part (b), award full value for a correct part (b) based on the error from part (a).

Appendices

Appendix A: Outcomes as outlined in the Mathematics 10 Curriculum

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 Mathematics 10 Curriculum for their complete course of study.

Those outcomes in italics will not be assessed on the NSE Mathematics 10.

GCO M: Students will be expected to develop spatial sense and proportional reasoning.

By the end of Mathematics 10 students will be expected to

M01 solve problems that involve linear measurement, using SI and imperial units of measure, estimation strategies, and measurement strategies.
M02 apply proportional reasoning to problems that involve conversions between SI and imperial units of measure.
M03 solve problems, using SI and imperial units, that involve the surface area and volume of 3-D objects, including right cones, right cylinders, right prisms, right pyramids, and spheres.
M04 develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles.

GCO AN: Students will be expected to develop algebraic reasoning and number sense.

By the end of Mathematics 10 students will be expected to

AN01 demonstrate an understanding of factors of whole numbers by determining the prime factors, greatest common factor, least common multiple, square root, and cube root.
AN02 demonstrate an understanding of irrational numbers by representing, identifying, and simplifying irrational numbers and ordering irrational numbers.
AN03 demonstrate an understanding of powers with integral and rational exponents.
AN04 demonstrate an understanding of the multiplication of polynomial expressions (limited to monomials, binomials and trinomials), concretely, pictorially, and symbolically.
AN05 demonstrate an understanding of common factors and trinomial factoring, concretely, pictorially and symbolically.

GCO RF: Students will be expected to develop algebraic and graphical reasoning through the study of relations.

By the end of Mathematics 10 students will be expected to

RF01 interpret and explain the relationships among data, graphs, and situations.
RF02 demonstrate an understanding of relations and functions.
RF03 demonstrate an understanding of slope with respect to rise and run, line segments and lines, rate of change, parallel lines, and perpendicular lines.
RF04 describe and represent linear relations, using words, ordered pairs, tables of values, graphs, and equations.
RF05 determine the characteristics of the graphs of linear relations, including the intercepts, slope, domain, and range.
RF06 relate linear relations to their graphs expressed in

- slope-intercept form ($y = mx + b$)
- general form ($Ax + By + C = 0$)
- slope-point form [$(y - y_1) = m(x - x_1)$]

RF07 determine the equation of a linear relation to solve problems, given a graph, a point and the slope, two points, and a point and the equation of a parallel or perpendicular line.
RF08 solve problems that involve the distance between two points and the midpoint of a line segment.
RF09 represent a linear function, using function notation.
RF10 solve problems that involve systems of linear equations in two variables, graphically and algebraically.

GCO FM: Students will demonstrate number sense and critical thinking skills.

By the end of Mathematics 10 students will be expected to

FM01 solve problems that involve unit pricing and currency exchange, using proportional reasoning.
FM02 demonstrate an understanding of income to calculate gross pay and net pay, including wages, salary, contracts, commissions, and piecework.
FM03 investigate personal budgets.
FM04 explore and give a presentation on an area of interest that involves financial mathematics.

Appendix B: Outcomes as outlined in the Mathematics at Work 10 Curriculum

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 Mathematics 10 Curriculum for their complete course of study.

Those outcomes in italics will not be assessed on the NSE Mathematics 10.

GCO M: Students will be expected to develop spatial sense through direct and indirect measurement.

By the end of Mathematics at Work 10 students will be expected to

M01 demonstrate an understanding of the International System of Units (SI) by
- describing the relationships of the units for length, area, volume, capacity, mass and temperature;
- applying strategies to convert SI units to imperial units.

M02 demonstrate an understanding of the imperial system by
- describing the relationships of the units for length, area, volume, capacity, mass and temperature;
- *comparing the American and British imperial units for capacity*;
- applying strategies to convert imperial units to SI units.

M03 solve and verify problems that involve SI and imperial linear measurements, including decimal and fractional measurements.

M04 solve problems that involve SI and imperial area measurements of regular, composite and irregular 2-D shapes and 3-D objects, including decimal and fractional measurements, and verify the solutions.

GCO G: Students will be expected to develop spatial sense.

By the end of Mathematics at Work 10 students will be expected to

G01 *analyze puzzles and games that involve spatial reasoning, using problem-solving strategies.*

G02 demonstrate an understanding of the Pythagorean theorem by identifying situations that involve right triangles, verifying the formula, applying the formula, and solving problems.

G03 demonstrate an understanding of similarity of convex polygons, including regular and irregular polygons.

G04 demonstrate an understanding of primary trigonometric ratios (sine, cosine, tangent) by applying similarity to right triangles, applying the primary trigonometric ratios, and solving problems.

G05 solve problems that involve parallel, perpendicular, and transversal lines, and pairs of angles formed between them.

G06 demonstrate an understanding of angles, including acute, right, obtuse, straight, and reflex, by drawing, replicating and constructing, bisecting, and solving problems.

GCO N: Students will be expected to develop number sense and critical thinking skills.

By the end of Mathematics at Work 10 students will be expected to

N01 solve problems that involve unit pricing and currency exchange, using proportional reasoning.

N02 demonstrate an understanding of income to calculate gross pay and net pay, including wages, salary, contracts, commissions, and piecework.

GCO A: Students will be expected to develop algebraic reasoning.

By the end of Mathematics at Work 10 students will be expected to

A01 solve problems that require the manipulation and application of formulas related to perimeter, area, the Pythagorean theorem, primary trigonometric ratios, and income.

Appendix C: Mathematics 10 Data Sheets

	Measurement		
	Common Imperial	**Imperial and SI**	**SI**
Length	1 mile = 1760 yards 1 yard = 3 feet 1 foot = 12 inches	1 mile = 1.609 km 1 yard = 0.9144 m 1 foot = 30.48 cm 1 inch = 2.54 cm	1 km = 1000 m 1 m = 100 cm 1 cm = 10 mm
Common Abbreviations	mile ↔ mi yard ↔ yd feet ↔ ' or ft inch ↔ " or in ton ↔ tn pound ↔ lb ounce ↔ oz		kilometre ↔ km metre ↔ m centimetre ↔ cm millimetre ↔ mm tonne (metric) ↔ t gram ↔ g

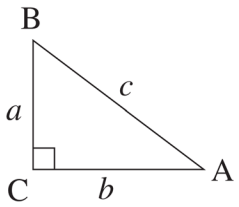
Trigonometry

Reminder: Put your calculator in degree mode.

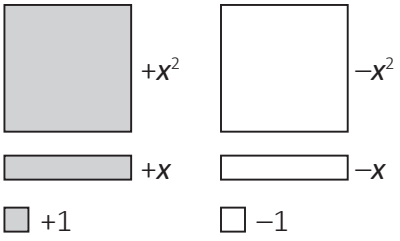
$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

Pythagorean Theorem

$a^2 + b^2 = c^2$



Math Tiles Legend



Linear Functions

Linear equations

$y = mx + b$

$Ax + By + C = 0$

$y - y_1 = m(x - x_1)$

The slope of a line

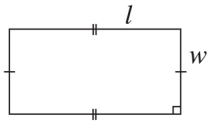
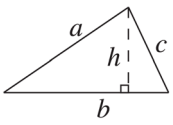
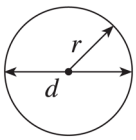
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

distance = speed × time

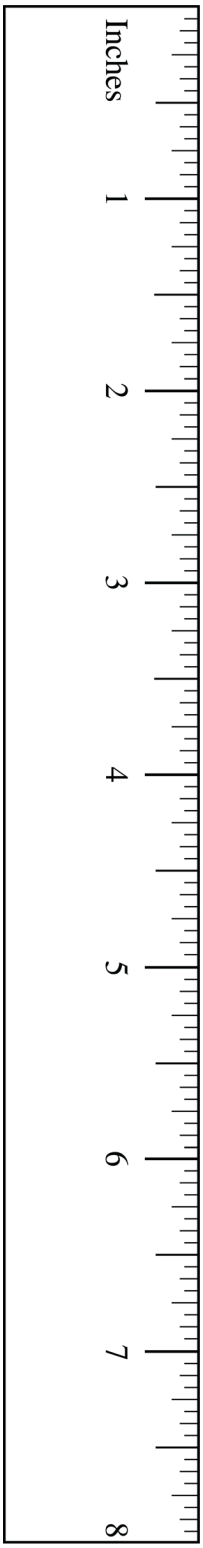
Analytical Geometry

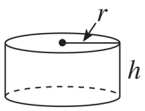
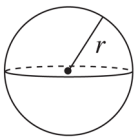
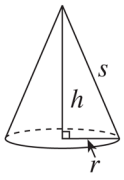
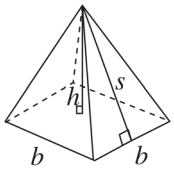
Midpoint : $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Distance formula : $D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Geometric Figure	Perimeter	Area
Rectangle 	$P = 2l + 2w$	$A = lw$
Triangle 	$P = a + b + c$	$A = \frac{bh}{2}$
Circle 	$C = 2\pi r$	$A = \pi r^2$

NOTE: Use the value of π programmed in your calculator rather than the approximation of 3.14.



Geometric Solid	Surface Area	Volume
Cylinder 	$SA = 2\pi r^2 + 2\pi rh$	$V = (\text{area of base}) \times h$
Sphere 	$SA = 4\pi r^2$	$V = \frac{4}{3}\pi r^3$
Cone 	$SA = \pi r^2 + \pi rs$	$V = \frac{1}{3} \times (\text{area of base}) \times h$
Right Square-Based Pyramid 	$SA = 2bs + b^2$	$V = \frac{1}{3} \times (\text{area of base}) \times h$
General Right Prism	*SA* = the sum of the area of all the faces	$V = (\text{area of base}) \times h$
General Right Pyramid	*SA* = the sum of the area of all the faces	$V = \frac{1}{3} \times (\text{area of base}) \times h$

NOTE: Use the value of π programmed in your calculator rather than the approximation of 3.14.

Appendix D: Mathematics at Work 10 Data Sheets

	Measurement		
	Common Imperial	**Imperial and SI**	**SI**
Length	1 mile = 1760 yards 1 yard = 3 feet 1 foot = 12 inches	1 mile = 1.609 km 1 yard = 0.9144 m 1 foot = 30.48 cm 1 inch = 2.54 cm	1 km = 1000 m 1 m = 100 cm 1 cm = 10 mm
Mass	1 ton = 2000 pounds 1 pound = 16 ounces	1 pound = 454 g 2.2 pounds = 1 kg 1 ounce = 28.35 g	1 t = 1000 kg 1 kg = 1000 g
Common Abbreviations	mile ↔ mi yard ↔ yd feet ↔ ' or ft inch ↔ " or in ton ↔ tn pound ↔ lb ounce ↔ oz		kilometre ↔ km metre ↔ m centimetre ↔ cm millimetre ↔ mm tonne (metric) ↔ t gram ↔ g

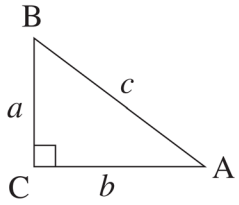
Trigonometry

Reminder: Put your calculator in degree mode.

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

Pythagorean Theorem

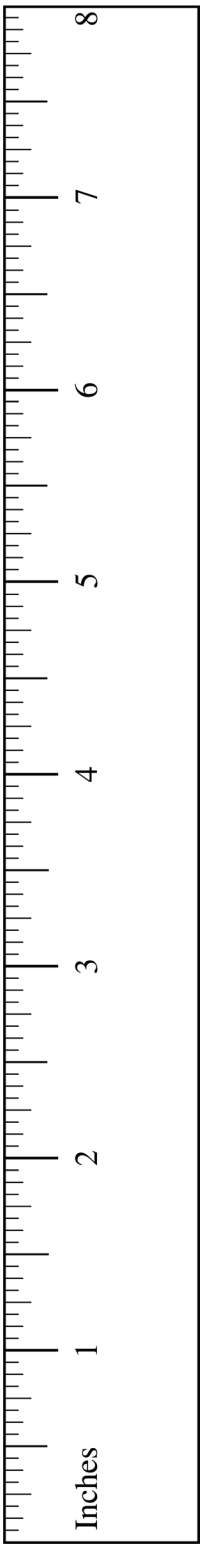
$a^2 + b^2 = c^2$

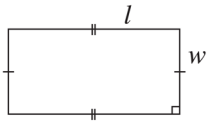
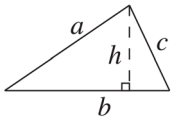
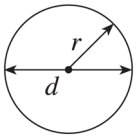


Temperature Conversions

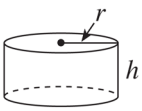
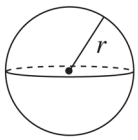
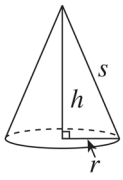
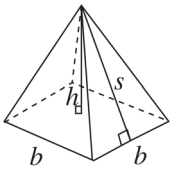
$$C = \frac{5}{9}(F - 32)$$

$$F = \frac{9}{5}C + 32$$

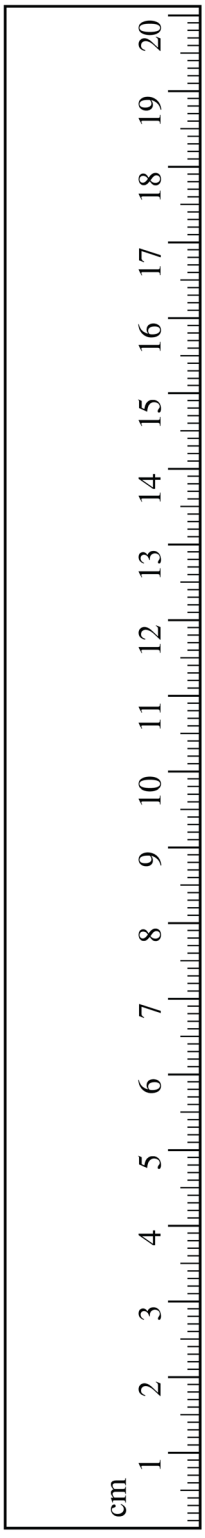


Geometric Figure	Perimeter	Area
Rectangle 	$P = 2l + 2w$	$A = lw$
Triangle 	$P = a + b + c$	$A = \frac{bh}{2}$
Circle 	$C = 2\pi r$	$A = \pi r^2$

NOTE: Use the value of π programmed in your calculator rather than the approximation of 3.14.

Geometric Solid	Surface Area
Cylinder 	$SA = 2\pi r^2 + 2\pi rh$
Sphere 	$SA = 4\pi r^2$
Cone 	$SA = \pi r^2 + \pi rs$
Right Square-Based Pyramid 	$SA = 2bs + b^2$
General Right Prism	*SA* = the sum of the area of all the faces
General Right Pyramid	*SA* = the sum of the area of all the faces

NOTE: Use the value of π programmed in your calculator rather than the approximation of 3.14.



Appendix E: List of Mathematical Terms and Concepts for Mathematics 10

Note: This is not meant to be an exhaustive list. Some key terms may have been introduced in earlier grades and as such may not be included in this list.

Measurement Unit

– acre
– acute angle
– acute triangle
– angle of depression
– angle of elevation
– angle of inclination
– apex
– base
– calipers
– capacity
– central angle
– circumference
– composite object
– cone
– congruent
– conversion factor
– corresponding angles
– corresponding lengths
– corresponding sides
– cosine ratio
– cubic units
– decagon
– diagonal
– diameter
– dimensions
– direct measurement
– displacement
– edge
– equilateral triangle
– face
– foot
– formula
– girth
– hectare
– height
– hemisphere
– hexagon
– hypotenuse
– imperial units
– inch
– indirect measurement
– isometric
– isosceles trapezoid
– isosceles triangle
– kite
– lateral area
– leg
– line segment
– mass
– metre (and associated units)
– mile
– net
– object
– obtuse triangle
– octagon
– parallelogram
– pentagon
– perimeter
– perpendicular
– pi
– polygon
– polyhedron
– primary trigonometric ratios
– prism
– proportion
– proportional reasoning
– Pythagorean theorem
– quadrilateral
– radius
– ratio
– rectangle
– rectangular prism
– rectangular pyramid
– referent
– regular polygon
– regular prism
– regular pyramid
– regular tetrahedron
– rhombus
– right angle
– right cone
– right cylinder
– right prism
– right pyramid
– right rectangular prism
– right rectangular pyramid
– right triangle
– scale factor
– SI system of measure
– similar polygons
– sine ratio
– slant height
– solving a triangle
– sphere
– square
– square units
– surface area
– tangent ratio
– tetrahedron
– three-dimensional
– trapezoid
– triangle
– triangular prism
– trigonometry
– two-dimensional
– unit analysis
– vertex
– volume
– yard

Algebra and Number Unit

– algebraic expression
– approximate
– bar notation
– base of a power
– binomial
– coefficient
– common factor
– common multiple
– composite number
– consecutive numbers
– constant term
– cube number
– cube root
– denominator
– difference of squares
– distributive property
– divisor
– entire radical
– equation
– equivalent
– expanding an expression
– exponent
– exponent laws
– expression
– factor
– factor tree
– factored fully
– factoring by decomposition
– fraction
– greatest common factor
– index
– irrational number
– least common multiple
– like terms
– mixed radical
– monomial
– multiple
– numerator
– percent
– perfect cube
– perfect square
– perfect square trinomial
– polynomial
– power
– prime factor
– prime factorization
– prime number
– radical
– radicand
– real number
– repeating decimal
– simplest form
– square number
– square root
– term
– terminating decimal
– trinomial
– variable

Relations and Functions Unit

– arrow diagram
– coincident lines
– coordinate axes
– coordinates
– dependent variable
– domain
– element
– equation
– equivalent systems
– expression
– function
– function notation
– general form
– horizontal axis
– horizontal intercept
– horizontal line
– independent variable
– infinite
– integers
– linear function
– linear relation
– linear system
– midpoint
– natural numbers
– negative reciprocals
– ordered pair
– origin
– parallel lines
– perpendicular
– point of intersection
– range
– rate of change
– relation
– rise
– run
– scale
– set
– slope
– slope-intercept form
– slope-point form
– solving by elimination
– solving by substitution
– standard form
– substituting into an equation
– systems of linear equations
– vertical intercept
– whole numbers
– *x*-axis
– *x*-coordinate
– *x*-intercept
– *y*-axis
– *y*-coordinate
– *y*-intercept

Financial Mathematics Unit

– best buy
– bonus
– buying rate
– Canada Pension Plan (CPP)
– commission
– contract
– currency
– currency exchange
– deductions
– Employment Insurance (EI)
– exchange rate
– Federal Income Tax
– foreign currency
– gross income
– gross pay
– hourly wage
– income
– net income
– net pay
– overtime
– piecework
– percentage decrease
– percentage increase
– proportional reasoning
– Provincial Income Tax
– purchasing rate
– salary
– selling rate
– shift premium
– time and a half
– tips
– union dues
– unit price
– wage

Appendix F: List of Mathematical Terms and Concepts for Mathematics at Work 10

Note: This is not meant to be an exhaustive list. Some key terms may have been introduced in earlier grades and as such may not be included in this list.

Measurement Unit

– acre
– apex
– base
– calipers
– capacity
– circumference
– composite object
– cone
– conversion factor
– cubic units
– cup
– decagon
– degree Celcius
– degree Fahrenheit
– diagonal
– diameter
– dimensions
– displacement
– edge
– equilateral triangle
– face
– fluid ounce
– foot
– formula
– gallon
– girth
– gram (and associated units)
– hectare
– height
– hemisphere
– hexagon
– imperial units
– inch
– isometric
– isosceles trapezoid
– isosceles triangle
– kite
– lateral area
– line segment
– litre (and associated units)
– mass
– metre (and associated units)
– mile
– net
– object
– obtuse triangle
– octagon
– ounce
– parallelogram
– pentagon
– perimeter
– perpendicular
– pi
– pints
– polygon
– polyhedron
– pound
– prism
– proportion
– proportional reasoning
– quadrilateral
– quarts
– radius
– ratio
– rectangle
– rectangular prism
– rectangular pyramid
– referent
– regular polygon
– regular prism
– regular pyramid
– regular tetrahedron
– rhombus
– right angle
– right cone
– right cylinder
– right prism
– right pyramid
– right rectangular prism
– right rectangular pyramid
– right triangle
– scale factor
– SI system of measure
– slant height
– sphere
– square
– square units
– surface area
– tablespoon
– teaspoon
– tetrahedron
– three-dimensional
– trapezoid
– triangle
– triangular prism
– two-dimensional
– unit analysis
– vertex
– volume
– yard

Geometry Unit

– acute angle
– adjacent side
– alternate exterior angles
– alternate interior angles
– angle
– angle bisector
– bisect
– clinometer
– complementary angles
– concave polygon
– convex polygon
– corresponding angles
– corresponding sides
– cosine ratio
– degree
– diagonal
– hypotenuse
– irregular polygon
– leg
– obtuse angle
– opposite angles
– opposite side
– parallel lines
– perpendicular lines
– polygon
– primary trigonometric ratios
– Pythagorean theorem
– ratio
– reflex angle
– regular polygon
– right angle
– right triangle
– same side exterior angles
– same side interior angles
– scale
– scale diagram
– similar figures
– similarity
– sine ratio
– straight angle
– supplementary angles
– tangent ratio
– transversal
– vertex
– vertically opposite angles

Number Unit

– best buy
– bonus
– buying rate
– Canada Pension Plan (CPP)
– commission
– contract
– currency
– currency exchange
– deductions
– Employment Insurance (EI)
– exchange rate
– Federal Income Tax
– foreign currency
– gross income
– gross pay
– hourly wage
– income
– net income
– net pay
– overtime
– piecework
– percentage decrease
– percentage increase
– proportional reasoning
– Provincial Income Tax
– purchasing rate
– salary
– selling rate
– shift premium
– time-and-a-half
– tips
– union dues
– unit price
– wage

Appendix G: Verbatim Scribing Adaptation Information

This adaptation provides writing assistance to a student

- who has a documented scribe adaptation for assessments and examinations, and
- who normally has forms of assessment scribed, or
- who has a temporary condition (such as a broken arm) and is unable to write

A student requiring a scribe must complete the examination in a separate quiet area so that other students are not disturbed.

The scribe must

- write by hand or type exactly what the student dictates. Handwritten transcriptions must be made directly in the booklet. Typed transcriptions must be inserted inside the front cover of the student's examination booklet. Do not use staples or paper clips. Once a hard copy has been printed, the computer file must be deleted.
- show the student the transcription, after the student has finished dictating his or her work
- make any other modifications the student requests (the scribe may erase, cross out or insert the student's corrections)
- fill in the circles on selected-response questions, as directed by the student
- read the dictation back to the student, if requested

The scribe must not

- edit or alter the student's dictation in any way without student request
- alert the student to mistakes
- prompt the student in any way
- initiate the use of test-taking strategies
- show any reaction to the student's responses
- correct the student's responses or computations
- engage in incidental conversation with the student or others during the administration of the examination

The teacher will record that a verbatim scribing adaptation was provided as described on the teacher instructions.

The student must complete the examination in the allotted time, unless additional time is a documented adaptation used regularly in classroom assessment by the student. All adaptations used during the examination must be recorded on the back cover of the student's examination booklet.

Appendix H: Verbatim Reading Adaptation Information

This adaptation provides reading assistance for the examination to a student

- who has a documented reader adaptation for assessments and
- who normally has forms of assessment read verbatim

The reader should be an educator from the school or the Board. A student requiring a reader must complete the examination in a separate quiet area so that other students writing the examination are not disturbed.

The reader must

- read the examination verbatim (exactly as it appears in the examination)
- be aware of and obey all punctuation
- without leading the student, read in such a way that the student understands the use and purpose of punctuation, including the beginning and the end of each sentence
- repeat readings as often as necessary and read consistently in the same way each time

The reader must not

- add emphasis, inflection, or read in such a way as to prompt or guide the student
- ask leading questions, provide suggestions, provide interpretations, or word definitions of any kind
- alert the student to mistakes
- prompt the student in any way
- initiate the use of test-taking strategies
- show any reaction to the student's responses
- correct the student's responses or computations
- engage in incidental conversation with the student or others during the administration of the examination

The teacher will record that a verbatim reading adaptation was provided as described on the teacher instructions.

The student must complete the examination in the allotted time, unless additional time is a documented adaptation used regularly in classroom assessment by the student. All adaptations used during the examination must be recorded on the back cover of the student's examination booklet.

Appendix I: 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 2nd +

→ Select reset.

→ Press ENTER twice.

→ Select reset.

→ Press ENTER

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