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## Grade 9 Assessment of Mathematics Framework

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This framework provides a detailed description of the EQAO Grade 9 Assessment of Mathematics, which is conducted each year in Ontario. The framework also describes how the assessment aligns with the expectations in *The Ontario Curriculum*.

### Who Is This Framework For?

This framework has been prepared for

- educators;
- parents, guardians; and
- members of the general public.

### Contents

- What Is Assessed?
- The Assessment Process and Design
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- The Scoring and Reporting of Student Results



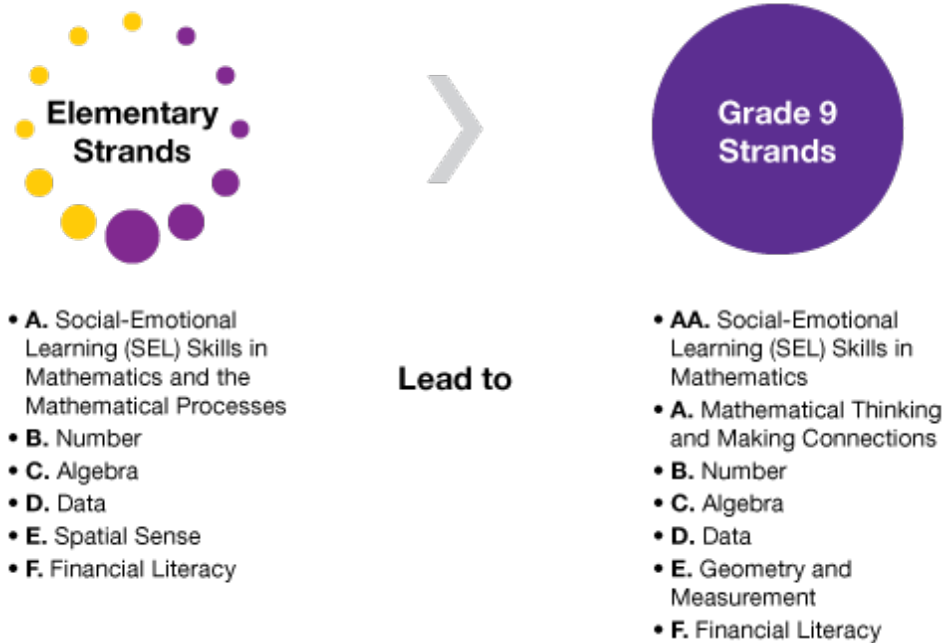
## Grade 9 Assessment of Mathematics

### WHAT IS ASSESSED?

#### What Is Assessed in the Grade 9 Assessment of Mathematics?

Students enrolled in the MTH1W Grade 9 de-streamed mathematics course learn the knowledge and skills that are defined in the expectations found in the 2021 Ontario Grade 9 mathematics curriculum. The Grade 9 mathematics curriculum was developed to build on learning from *The Ontario Curriculum, Grades 1–8: Mathematics, 2020*, specifically the Grade 8 curriculum. This Grade 9 mathematics curriculum includes a focus on coding, financial literacy and mathematical modelling, and it extends learning in data literacy. The curriculum also emphasizes connections among mathematical concepts, real-life applications and students’ lived experiences.

Mathematics spans several content strands. The Grade 9 content strands—Social-Emotional Learning (SEL) Skills in Mathematics;<sup>1</sup> Mathematical Thinking and Making Connections; Number; Algebra; Data; Geometry and Measurement; and Financial Literacy—reflect those of the elementary program, as shown in the following diagram:



The Grade 9 Assessment of Mathematics is a standards-referenced large-scale assessment based on Ontario Grade 9 mathematics curriculum expectations and standards (levels of achievement) for student proficiency. The assessment consists of questions that cover students’ knowledge and skills in the following strands: Number, Algebra, Data, Geometry and Measurement, and Financial Literacy. Although the

<sup>1</sup> Per 2021–2022 school-year sector direction from the Ministry of Education, social-emotional learning skills will not be assessed, evaluated or reported on.

assessment does not measure the content in the Social-Emotional Learning (SEL) Skills in Mathematics and the Mathematical Thinking and Making Connections strands, students are required to apply mathematical processes while completing the assessment.

### **Mathematics Content Descriptors: Grade 9**

The following are highlights of student learning from the MTH1W Grade 9 mathematics course, listed by strand.

#### **Number**

- Development of Numbers and Number Sets
  - Development and Use of Numbers
  - Number Sets
- Powers
  - Powers
- Number Sense and Operations
  - Rational Numbers
  - Applications

#### **Algebra**

- Algebraic Expressions and Equations
  - Development and Use of Algebra
  - Algebraic Expressions and Equations
- Coding
  - Coding
- Application of Relations
  - Application of Linear and Non-Linear Relations
- Characteristics of Relations
  - Characteristics of Linear and Non-Linear Relations

#### **Data**

- Collection, Representation and Analysis of Data
  - Application of Data
  - Representation and Analysis of Data
- Mathematical Modelling
  - Application of Mathematical Modelling
  - Process of Mathematical Modelling

#### **Geometry and Measurement**

- Geometric and Measurement Relationships
  - Geometric and Measurement Relationships

#### **Financial Literacy**

- Financial Decisions
  - Financial Decisions

## Categories of Knowledge and Skills

Each question on the Grade 9 Assessment of Mathematics is mapped to an expectation in the Ontario Grade 9 mathematics curriculum and to one of three of the categories of knowledge and skills: Knowledge and Understanding, Application or Thinking.

Questions in the Grade 9 assessment are not mapped to the fourth category of knowledge and skills, Communication. EQAO has adapted the definitions of the three categories from the achievement chart found in *The Ontario Curriculum*. The following outlines EQAO's definitions that are used to determine the category for each assessment question.

### Knowledge and Understanding

A question is mapped to the category Knowledge and Understanding if in order to answer the question, students must demonstrate only

- subject-specific content (knowledge) *and/or*
- comprehension of its meaning and significance (understanding).

These questions assess basic knowledge and/or understanding of concepts.

### Application

A question is mapped to the category Application if in order to answer the question, students must either

- select the appropriate tool *or*
- get the necessary information and “fit” it to the problem.

A question may change from Knowledge and Understanding to Application if a context is added or if a tool required to answer the question is not provided.

### Thinking

A question is mapped to the category Thinking if in order to answer the question, students must either

- select and sequence a variety of tools *or*
- demonstrate a critical thinking process (e.g., reasoning).

Students may need to make a plan to answer these questions.

There may be more than one way to answer a mathematics question. EQAO does not assess the process or tools students use to determine their answer on selected-response questions. Each module has questions mapped to each of the categories. The category assigned to each question assumes that students have been taught the knowledge and skills outlined in the Grade 9 curriculum, as the EQAO assessment is completed at the end of the Grade 9 mathematics course.

## THE ASSESSMENT PROCESS AND DESIGN

### What Is in the Grade 9 Assessment of Mathematics?

The Grade 9 Assessment of Mathematics is an online assessment that consists of various types of selected-response questions, such as drag and drop, drop-down menu, ordering, and single- and multiple-selection questions.



**Introductory Session:** Students have the opportunity to participate in an introductory session to familiarize them with the assessment. During this introductory session, students can access a sample test of 27 questions delivered in two stages that shows the various types of questions that may be on the assessment. In the sample test and tool exploration, students are given the opportunity to try out the various tools (e.g., text-to-speech, zoom in and zoom out, highlighter to draw a line, calculator) in the e-assessment platform that are available during the assessment. The sample test is also available on EQAO's public website.



**Assessment Sessions:** Students complete the assessment in two sessions: Session A and Session B. Each session is designed to be completed in approximately 60 minutes, and students must complete each session in one sitting. The sessions can be attempted one after the other, either back to back with a break in between or on different dates and times.

The assessment contains 54 questions (50 operational and four field-test questions) assessing all of the content strands: Number, Algebra, Data, Geometry and Measurement, and Financial Literacy. Only the operational questions count toward a student's result. The four embedded field-test questions are not considered when determining a student's result and are fewer than 10% of the total number of questions completed by students.

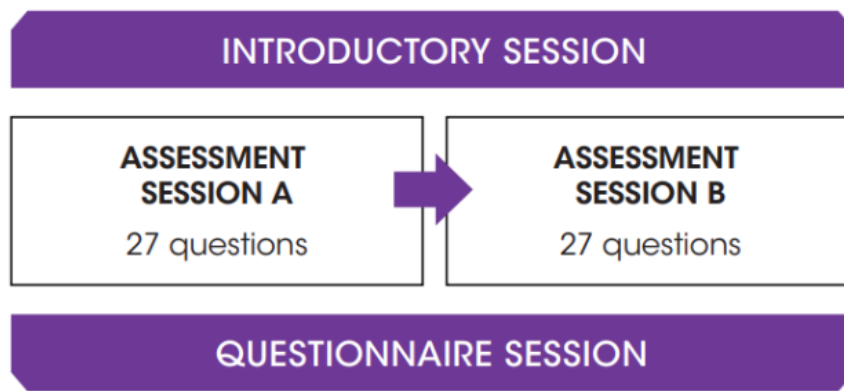


#### Grade 9 Assessment of Mathematics Questions

Question Type	Number of Questions
Operational	50
Field Test	4
<b>Total Number of Questions for Each Student</b>	<b>54</b>



**Questionnaire Session:** At the end of the two assessment sessions, students are presented with a voluntary questionnaire. The questionnaire asks them about their attitudes and perceptions with respect to mathematics, transferable skills and their learning environment. EQAO uses this data to provide schools, boards, teachers and parents/guardians with information on how students' attitudes and perceptions are related to their mathematics achievement.



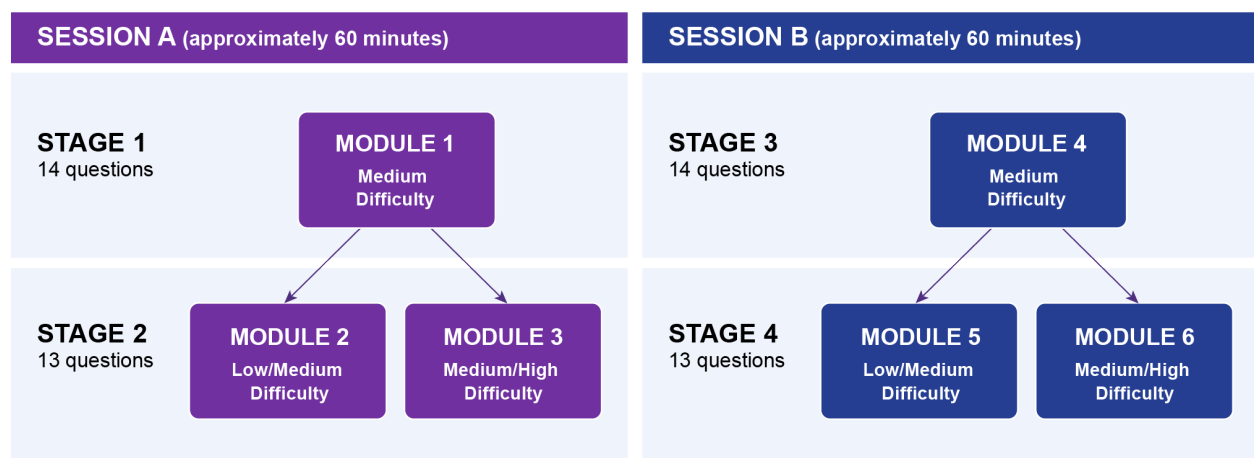
### What Is the Design of the Grade 9 Assessment of Mathematics?

The Grade 9 Assessment of Mathematics uses a multi-stage computer adaptive testing model that adapts to the individual student’s performance as the student progresses through each assessment session.

Each session is made up of two stages: the set of questions presented to students in the second stage is determined by their performance on the previous stage. Each stage is made up of modules that contain a set of questions of a specific overall level of difficulty (medium, low/medium or medium/high). Each module has questions that range in difficulty.

Each student begins Session A by completing a set of questions with a medium overall level of difficulty contained in a module (Module 1 of Stage 1, as illustrated in the diagram below). Based on their performance on the operational questions in this first module, students are presented with a new module in Stage 2 with an overall level of difficulty of low/medium (Module 2) or medium/high (Module 3). The same process repeats for Session B.

For more information, refer to the literature review [Leveraging Multi-Stage Computer Adaptive Testing for Large-Scale Assessments—EQAO](#).



Any field-test questions in Stage 1 and Stage 3 are not considered when determining the module the student will be routed to in the next stage.

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## Understanding Ontario's Student Achievement Levels

After all the questions in a student's assessment are scored, the data from the operational questions are used to determine the student's overall level of achievement. The Individual Student Report shows both the level and the range within the level at which the student performed. This may provide information for parents/guardians and teachers to use in planning for improvement.

EQAO uses the definitions from the Ontario Ministry of Education levels of achievement for the levels it reports: Level 1 represents achievement that falls much below the provincial standard. Level 2 represents achievement that is below but approaching the provincial standard. Level 3 represents

achievement at the provincial standard. The characteristics given for Level 3 in the achievement charts in *The Ontario Curriculum* correspond to the provincial standard for achievement of the curriculum expectations.

Parents/guardians of students achieving Level 3 can be confident that their children will be prepared for work in the next grade. Level 4 identifies achievement that surpasses the provincial standard. It should be noted that achievement at Level 4 does not mean that the student has achieved expectations beyond those specified for a particular grade.

For more information, refer to the Levels of Achievement in the *Assessment and Evaluation* section of *The Ontario Curriculum*.

## THE BLUEPRINT

### How Are Curriculum Expectations Reflected in the Grade 9 Assessment of Mathematics?

The blueprint for the Grade 9 Assessment of Mathematics includes the overall and specific expectations from Strands B through F in the Ontario curriculum for the MTH1W Grade 9 de-streamed mathematics course (2021). The blueprint also provides the number of operational questions and the percentage of questions from each strand on the assessment that count toward the student's result.



#### Mathematical Processes

Although the Grade 9 assessment does not measure the mathematical processes students use, these are the processes through which students apply mathematical knowledge, concepts and skills.

Problem Solving

Reasoning and Proving

Reflecting

Connecting

Communicating

Representing

Selecting Tools and Strategies



## Grade 9 Assessment of Mathematics Blueprint

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
<b>B. Number</b>			
<b>B1</b>	<b>Development of Numbers and Number Sets</b>	10	$\frac{10}{50} = 20\%$ of the questions on the assessment
	demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers		
	<b>Specific Expectations for Overall B1</b>		
	<b>Development and Use of Numbers</b>		
<b>B1.1</b>	research a number concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context		
	<b>Number Sets</b>		
<b>B1.2</b>	describe how various subsets of a number system are defined, and describe similarities and differences between these subsets		
<b>B1.3</b>	use patterns and number relationships to explain density, infinity, and limit as they relate to number sets		
<b>B2</b>	<b>Powers</b>		
	represent numbers in various ways, evaluate powers, and simplify expressions by using the relationships between powers and their exponents		
	<b>Specific Expectations for Overall B2</b>		
	<b>Powers</b>		
<b>B2.1</b>	analyse, through the use of patterning, the relationship between the sign and size of an exponent and the value of a power, and use this relationship to express numbers in scientific notation and evaluate powers		
<b>B2.2</b>	analyse, through the use of patterning, the relationships between the exponents of powers and the operations with powers, and use these relationships to simplify numeric and algebraic expressions		
<b>B3</b>	<b>Number Sense and Operations</b>		
	apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems		
	<b>Specific Expectations for Overall B3</b>		
	<b>Rational Numbers</b>		
<b>B3.1</b>	apply an understanding of integers to describe location, direction, amount, and changes in any of these, in various contexts		
<b>B3.2</b>	apply an understanding of unit fractions and their relationship to other fractional amounts, in various contexts, including the use of measuring tools		
<b>B3.3</b>	apply an understanding of integers to explain the effects that positive and negative signs have on the values of ratios, rates, fractions, and decimals, in various contexts		
	<b>Applications</b>		
<b>B3.4</b>	solve problems involving operations with positive and negative fractions and mixed numbers, including problems involving formulas, measurements, and linear relations, using technology when appropriate		
<b>B3.5</b>	pose and solve problems involving rates, percentages, and proportions in various contexts, including contexts connected to real-life applications of data, measurement, geometry, linear relations, and financial literacy		

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
<b>C. Algebra</b>			
<b>C1</b>	<b>Algebraic Expressions and Equations</b>	18	$\frac{18}{50} = 36\%$ of the questions on the assessment
	demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations		
	<b>Specific Expectations for Overall C1</b>		
	<b>Development and Use of Algebra</b>		
<b>C1.1</b>	research an algebraic concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context		
	<b>Algebraic Expressions and Equations</b>		
<b>C1.2</b>	create algebraic expressions to generalize relationships expressed in words, numbers, and visual representations, in various contexts		
<b>C1.3</b>	compare algebraic expressions using concrete, numerical, graphical, and algebraic methods to identify those that are equivalent, and justify their choices		
<b>C1.4</b>	simplify algebraic expressions by applying properties of operations of numbers, using various representations and tools, in different contexts		
<b>C1.5</b>	create and solve equations for various contexts, and verify their solutions		
<b>C2</b>	<b>Coding</b>		
	apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands		
	<b>Specific Expectations for Overall C2</b>		
	<b>Coding</b>		
<b>C2.1</b>	use coding to demonstrate an understanding of algebraic concepts including variables, parameters, equations, and inequalities		
<b>C2.2</b>	create code by decomposing situations into computational steps in order to represent mathematical concepts and relationships, and to solve problems		
<b>C2.3</b>	read code to predict its outcome, and alter code to adjust constraints, parameters, and outcomes to represent a similar or new mathematical situation		
<b>C3</b>	<b>Application of Relations</b>		
	represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions		
	<b>Specific Expectations for Overall C3</b>		
	<b>Application of Linear and Non-Linear Relations</b>		
<b>C3.1</b>	compare the shapes of graphs of linear and non-linear relations to describe their rates of change, to make connections to growing and shrinking patterns, and to make predictions		
<b>C3.2</b>	represent linear relations using concrete materials, tables of values, graphs, and equations, and make connections between the various representations to demonstrate an understanding of rates of change and initial values		
<b>C3.3</b>	compare two linear relations of the form $y = ax + b$ graphically and algebraically, and interpret the meaning of their point of intersection in terms of a given context		

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
<b>C. Algebra (continued)</b>			
<b>C4</b>	<b>Characteristics of Relations</b>	Continued from previous page	Continued from previous page
	demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate		
	<b>Specific Expectations for Overall C4</b>		
	<b>Characteristics of Linear and Non-Linear Relations</b>		
<b>C4.1</b>	compare characteristics of graphs, tables of values, and equations of linear and non-linear relations		
<b>C4.2</b>	graph relations represented as algebraic equations of the forms $x = k$ , $y = k$ , $x + y = k$ , $x - y = k$ , $ax + by = k$ , and $xy = k$ , and their associated inequalities, where $a$ , $b$ , and $k$ are constants, to identify various characteristics and the points and/or regions defined by these equations and inequalities		
<b>C4.3</b>	translate, reflect, and rotate lines defined by $y = ax$ , where $a$ is a constant, and describe how each transformation affects the graphs and equations of the defined lines		
<b>C4.4</b>	determine the equations of lines from graphs, tables of values, and concrete representations of linear relations by making connections between rates of change and slopes, and between initial values and $y$ -intercepts, and use these equations to solve problems		
<b>D. Data</b>			
<b>D1</b>	<b>Collection, Representation and Analysis of Data</b>	8	$\frac{8}{50} = 16\%$ of the questions on the assessment
	describe the collection and use of data, and represent and analyse data involving one and two variables		
	<b>Specific Expectations for Overall D1</b>		
	<b>Application of Data</b>		
<b>D1.1</b>	identify a current context involving a large amount of data, and describe potential implications and consequences of its collection, storage, representation, and use		
	<b>Representation and Analysis of Data</b>		
<b>D1.2</b>	represent and statistically analyse data from a real-life situation involving a single variable in various ways, including the use of quartile values and box plots		
<b>D1.3</b>	create a scatter plot to represent the relationship between two variables, determine the correlation between these variables by testing different regression models using technology, and use a model to make predictions when appropriate		
<b>D2</b>	<b>Mathematical Modelling</b>		
	apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations		
	<b>Specific Expectations for Overall D2</b>		
	<b>Application of Mathematical Modelling</b>		
<b>D2.1</b>	describe the value of mathematical modelling and how it is used in real life to inform decisions		
	<b>Process of Mathematical Modelling</b>		
<b>D2.2</b>	identify a question of interest requiring the collection and analysis of data, and identify the information needed to answer the question		
<b>D2.3</b>	create a plan to collect the necessary data on the question of interest from an appropriate source, identify assumptions, identify what may vary and what may remain the same in the situation, and then carry out the plan		

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
<b>D. Data (continued)</b>			
<b>D2.4</b>	determine ways to display and analyse the data in order to create a mathematical model to answer the original question of interest, taking into account the nature of the data, the context, and the assumptions made	Continued from previous page	Continued from previous page
<b>D2.5</b>	report how the model can be used to answer the question of interest, how well the model fits the context, potential limitations of the model, and what predictions can be made based on the model		
<b>E. Geometry and Measurement</b>			
<b>E1</b>	<b>Geometric and Measurement Relationships</b>	8	$\frac{8}{50} = 16\%$ of the questions on the assessment
	demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations		
	<b>Specific Expectations for Overall E1</b>		
	<b>Geometric and Measurement Relationships</b>		
<b>E1.1</b>	research a geometric concept or a measurement system to tell a story about its development and use in a specific culture or community, and describe its relevance in connection to careers and to other disciplines		
<b>E1.2</b>	create and analyse designs involving geometric relationships and circle and triangle properties, using various tools		
<b>E1.3</b>	solve problems involving different units within a measurement system and between measurement systems, including those from various cultures or communities, using various representations and technology, when appropriate		
<b>E1.4</b>	show how changing one or more dimensions of a two-dimensional shape and a three-dimensional object affects perimeter/circumference, area, surface area, and volume, using technology when appropriate		
<b>E1.5</b>	solve problems involving the side-length relationship for right triangles in real-life situations, including problems that involve composite shapes		
<b>E1.6</b>	solve problems using the relationships between the volume of prisms and pyramids and between the volume of cylinders and cones, involving various units of measure		
<b>F. Financial Literacy</b>			
<b>F1</b>	<b>Financial Decisions</b>	6	$\frac{6}{50} = 12\%$ of the questions on the assessment
	demonstrate the knowledge and skills needed to make informed financial decisions		
	<b>Specific Expectations for Overall F1</b>		
	<b>Financial Decisions</b>		
<b>F1.1</b>	identify a past or current financial situation and explain how it can inform financial decisions, by applying an understanding of the context of the situation and related mathematical knowledge		
<b>F1.2</b>	identify financial situations that involve appreciation and depreciation, and use associated graphs to answer related questions		
<b>F1.3</b>	compare the effects that different interest rates, lengths of borrowing time, ways in which interest is calculated, and amounts of down payments have on the overall costs associated with purchasing goods or services, using appropriate tools		
<b>F1.4</b>	modify budgets displayed in various ways to reflect specific changes in circumstances, and provide a rationale for the modifications		

## THE SCORING AND REPORTING OF STUDENT RESULTS

### How Are the Questions on the Grade 9 Assessment of Mathematics Scored?

All the questions on the mathematics assessment are scored automatically (computer scored).

### How Is a Student's Overall Level of Achievement Determined?

The Individual Student Report provides an outcome for each student by indicating the overall level of achievement and the dot score. The dot score and accompanying image on the ISR indicate where within a level the student's result is located. EQAO uses Item Response Theory (IRT) to determine a student's overall level of achievement as well as the dot score. The IRT-based statistical models that EQAO uses take into account whether the student answered each operational question they were assigned correctly or incorrectly, along with the properties of each of these questions (e.g., the difficulty). This approach assumes a continuum of mathematics ability and locates the student's performance along this continuum, as reflected by achievement levels 1 to 4. The four embedded field-test questions are not included in determining the student's overall level of achievement or dot score.

Students complete enough questions on the Grade 9 assessment for EQAO to report a single overall outcome reliably and validly. EQAO does provide additional results by strand and category of knowledge and skills at the school, school board and provincial levels. Schools and school boards can use this information for school improvement planning. Teachers who work with students throughout the year are best able to provide descriptive feedback on student achievement.

### What are the Grade 9 Assessment of Mathematics results used for?

The Ministry of Education has determined that results of the EQAO Grade 9 Assessment of Mathematics are to be included in the final evaluation of the Grade 9 mathematics course, for at least 10%, and up to a maximum of 30% of the final mark. Each school and school board is responsible for determining the percentage between 10% and 30% inclusive. EQAO results also enable students, parents/guardians and teachers to plan for improvement.

Teachers will provide the Individual Student Reports to students to share with their parents/guardians. The following is a sample Individual Student Report.



## Grade 9 Assessment of Mathematics

Individual Student Report, **ISR Administration Date**

### STUDENT NAME

Ontario Education Number: **000-000-000**  
 School: **Example School (000000)**  
 School Board: **Example Board**  
 Date of Generation: **DD-MM-YY**

### STUDENT RESULTS

Thank you for participating in the online Grade 9 Assessment of Mathematics, which measures the knowledge and skills students are expected to have learned by the end of the Ontario Grade 9 mathematics course (MTH1W). The assessment is a multi-stage computer adaptive test that adjusts its difficulty according to the student's ability as the student progresses through each session.

	<b>Below Level 1</b> Below Level 1 or not enough evidence to assign Level 1 0 to 49%	<b>Level 1</b> Much below the provincial standard 50 to 59%	<b>Level 2</b> Approaches the provincial standard 60 to 69%	<b>Level 3</b> Meets the provincial standard 70 to 79%	<b>Level 4</b> Surpasses the provincial standard 80 to 100%
<b>Overall Level: 3</b> <b>Dot Score<sup>1</sup>: 3.3</b>					

Students who achieved a result of

<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>
demonstrated the specified knowledge and skills in the Ontario Grade 9 mathematics curriculum expectations with limited effectiveness. Achieving this level represents achievement that falls much below the provincial standard.	demonstrated the specified knowledge and skills in the Ontario Grade 9 mathematics curriculum expectations with some effectiveness. Achieving this level represents achievement that approaches the provincial standard.	demonstrated the specified knowledge and skills in the Ontario Grade 9 mathematics curriculum expectations with considerable effectiveness. Achieving this level represents the provincial standard.	demonstrated the specified knowledge and skills in the Ontario Grade 9 mathematics curriculum expectations with a high degree of effectiveness. Achieving this level does not mean the student has achieved expectations beyond those specified in the Grade 9 curriculum.

These results give a measure of the student's achievement in mathematics in relation to the provincial standard.

The provincial standard is Level 3. The four achievement levels are the same levels teachers use in the classroom to evaluate students' progress. The percentages associated with each level are based on those outlined in the Ministry of Education's Achievement Chart for Grade 9 Mathematics.

**NOTE:** Results at the school, board and provincial levels will be released in the fall.

Please share the results of your performance on the EQAO Grade 9 Assessment of Mathematics with your parents and/or guardians.

<sup>1</sup> Dot score indicates where within a level the student's result is located. EQAO uses Item Response Theory (IRT) to determine a student's dot score. The IRT-based statistical models that EQAO uses take into account whether the student answered correctly or incorrectly each operational question they were assigned and also the properties of each of these questions (e.g., difficulty of each question). Field-test questions that are being tried out are not included in the determination of a student's dot score.

EQAO conducts province-wide assessments at the primary, junior and secondary levels to measure student achievement against curriculum expectations. The data are widely used as an additional tool to guide improvements in education at the individual, school and provincial levels. For additional information and useful resources, visit [www.eqao.com](http://www.eqao.com).

This report contains personal information that is protected under the *Freedom of Information and Protection of Privacy Act*.



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