Information Bulletin
Mathematics 30–1
Diploma Examinations Program 2020–2021

Some information in this document may be subject to change due to COVID-19. See the Alberta Education website for updates.
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Please note that if you cannot access one of the direct website links referred to in this document, you can find diploma examination-related materials on the Alberta Education website.
Introduction

The purpose of this bulletin is to provide teachers of Mathematics 30–1 with information about the diploma examinations scheduled for the 2020–2021 school year. This bulletin should be used in conjunction with the current Mathematics 30–1 Program of Studies, the Mathematics 30–1 Assessment Standards and Exemplars document, and the Mathematics 30–1 Written-Response Information document to ensure that the curriculum and standards are addressed.

This bulletin includes descriptions of the Mathematics 30–1 Diploma Examinations that will be administered in November 2020 and in January, April, June, and August 2021; descriptions of the acceptable standard and the standard of excellence; and subject-specific information.

Teachers are encouraged to share the contents of this bulletin with students.

For further information about program implementation, refer to the Alberta Education website.
Examination Security

All diploma examinations will be held secure until they are released to the public by the Minister. No secure diploma examination is to be previewed until it is released to the public by the Minister. No secure diploma examination is to be previewed, discussed, copied, or removed from the room in which the examination is being written.

The perusal of diploma examinations is not permitted for any exam administration in 2021. Perusal copies will not be provided for the January 2021 or June 2021 administrations.

For mathematics and science diploma exams: All diploma examination booklets must be kept secure, without exception.

For humanities diploma exams: All diploma examination booklets, including humanities Part A: Written Response, must be kept secure, without exception.

All diploma exam booklets, including unused copies of all diploma exams, must be returned to Alberta Education as per the dates indicated in the Schedule of Significant Dates.

For more information about examination security, please refer to the General Information Bulletin.

Time Limits on Diploma Examinations

All students may use extra time to write diploma examinations. This means that all students have up to 6 hours to complete the Mathematics 30–1 Diploma Examination, if they need it. The examination is nevertheless designed so that the majority of students can complete it within 3 hours. The examination instructions state both the designed time and the total time available.

Extra time is available for diploma examinations in all subjects, but the total time allowed is not the same in all subjects. For more information about accommodations and provisions for students, please refer to the General Information Bulletin.
Maintaining Consistent Standards over Time on Diploma Examinations

A goal of Alberta Education is to make scores achieved on examinations within the same subject directly comparable from session to session, to ensure fairness to students across administrations.

To achieve this goal, the examination has a number of questions in common with a previous examination. Common items are used to find out if the student population writing in one administration differs in achievement from the student population writing in another administration. Common items are also used to find out if the unique items (questions that have never appeared in a previous examination) differ in difficulty from the unique items on the baseline examination that sets the standard to which all students are held.

A statistical process called equating adjusts for differences in difficulty between examinations. Examination marks may be adjusted depending upon the difficulty of the examination written relative to the baseline examination. Therefore, the resulting equated examination scores have the same meaning regardless of when and to whom the examination was administered. Equated diploma examination marks are reported to students. More information about equating is available here.

Because of the security required to ensure fair and appropriate assessment of student achievement over time, Mathematics 30–1 Diploma Examinations will be fully secured and will not be released at the time of writing.
Diploma Examinations: Multiple Forms

As part of Alberta Education’s commitment to fairness to students and flexibility in the writing of diploma examinations, there may be two distinct forms (versions) of diploma examinations in some subjects during major administrations (January and June). The two forms are equated to baseline examinations to ensure that the same standard applies to both forms. Both forms adhere to the established blueprint specifications and are reviewed by a technical review committee.

To facilitate the analysis of school-level results, each school receives only one examination form per subject. In subjects offering a translated French-language examination, both forms are administered in English and in French.

For more information, contact

Deanna Shostak
Director, Diploma Programs
780-422-5160 or Deanna.Shostak@gov.ab.ca

or

Pascal Couture
Director, Exam Administration
780-643-9157 or Pascal.Couture@gov.ab.ca
Field Testing

Field testing is an essential stage in the development of fair, valid, and reliable provincial examinations. Field testing is a process of collecting data on questions before they become part of a diploma examination. Potential diploma examination questions are administered to students in diploma courses throughout the province to determine the difficulty level and appropriateness of the questions. Each field test requires a large student sample to provide the examination developers with reliable information (statistical data and written validation comments from teachers and students).

How do field tests help teachers and students?

Teachers receive each student’s score promptly, gaining useful information about their students’ performance. Students benefit from writing a test that duplicates some of the experience of writing a diploma examination. Field tests provide students and teachers with examples of the format and content of questions that may appear on diploma examinations. Finally, because of field testing, students, teachers, and parents can be reassured that the questions on diploma examinations have undergone a rigorous process of development, improvement, and validation.

How are field-test data used?

The data received from field tests indicate the validity, reliability, and fairness of each question. Questions that meet specific standards are selected for use on future diploma examinations. Some questions or sets of questions may not initially perform as well as we require. These questions may be revised and field tested again. Revisions are influenced by the written comments of students and teachers, who provide valuable advice about the appropriateness of the questions, adequacy of writing-time limits, test length, text readability, artwork/graphics clarity and suitability, and question difficulty.

Mathematics field tests

Mathematics field tests are available in conventional paper form and offered online using Alberta Education’s Quest A+ online delivery system. Paper-format field tests contain machine-scored and written-response questions. Online field tests contain machine-scored questions only.

For online mathematics field tests, students may use the paper formula sheet. The same formulas will also appear in the online delivery system. Students should also have scrap paper, which may be accessed and downloaded from the “Teacher Resources” section on the home page of the Field Test Request System. All paper formula sheets or scrap paper with markings must be securely shredded at the end of the field-test administration.

Teachers have a 24-hour period to peruse digital field tests and are provided with data on how their students performed. These data include the proportion of students who chose each alternative for multiple-choice items and the proportion who left a numerical-response item blank. Test items are blueprinted to program of studies outcomes, which allows teachers to use field-test results to learn more about their students’ strengths and areas for improvement.
Once logged into the digital field test on the online delivery system, teachers have the same length of time to peruse the test as their students did to write it. Teachers might choose to log into the field test, submit the confidentiality form, and then log out of the test, so that they can finish perusing the test after receiving their students’ data.

More information about field-test registration deadlines, administration, and security is available [here](#).

It is important to note that the security of field-test items remains vital to the administration of diploma examinations. Participating teachers must commit to maintaining the security of field-test items. Paper-format field tests are mailed to schools and must be kept secure by the school principal until administration. After the administration, all paper copies must be mailed back to Alberta Education.

**How can teachers request field tests?**

Teachers requesting field tests must have a Public Authentication System (PAS) account. All requests are made through the Field Test Request System. Further information, including the closing dates to request and administer a field test, may be obtained [here](#), or by contacting Field.Test@gov.ab.ca. Practice tests are available [online](#).

**For more information, contact**

Deanna Shostak  
Director, Diploma Programs  
780-422-5160 or Deanna.Shostak@gov.ab.ca

or

Pascal Couture  
Director, Exam Administration  
780-643-9157 or Pascal.Couture@gov.ab.ca
Practice Tests

To give students an opportunity to practise diploma examination-style questions and content, Alberta Education produces practice tests for most subjects that have a diploma examination. Students can access these practice tests using Alberta Education’s online test delivery system.

Special-format Practice Tests

To give students an opportunity to practise diploma examination-style questions and content in Braille, audio, large print, or coloured print versions, Alberta Education produces special-format practice tests for all subjects that have a diploma examination. Alberta schools with registered Alberta K–12 students may place orders for these tests. Braille versions are available in English and, by request, in French. All tests are provided free of charge, but limits may be placed on order volumes to ensure access for all students.

For the greatest benefit, special-format practice tests should be written under conditions similar to those of the corresponding diploma examination. The same rules regarding the use of resources and devices should be followed.

Braille versions must be returned to Alberta Education after use.

For more information or to place an order, contact

Laura LaFramboise
Distribution Coordinator, Examination Administration
780-492-1644
Laura.LaFramboise@gov.ab.ca

Audio Descriptions

Examples of Descriptions Used in Audio Versions of Mathematics Diploma Exams has been developed to assist teachers and students planning to use an audio version during the administration of a diploma examination.
Course Objectives

The Mathematics 30–1 course contains topics and outcomes, as specified in the program of studies, that will provide students with the knowledge base, mathematical understandings, and critical-thinking skills identified for entry into post-secondary programs that require the study of calculus. In Mathematics 30–1, algebraic, numerical, and graphical approaches are used to solve problems. Technology is used to enable students to explore and create patterns, examine relationships, test conjectures, and solve problems.

Students are expected to communicate solutions clearly and effectively when solving both routine and non-routine problems. Students are also expected to develop both conceptual and procedural understandings of mathematics and apply them to real-life problems. It is important for students to realize that it is acceptable to solve problems in different ways, using a variety of strategies.
Mathematical Processes

The seven mathematical processes are critical aspects of learning, doing, and understanding mathematics. Students must encounter these processes regularly in a mathematics program in order to achieve the goals of mathematics education.

The Mathematics 30–1 Program of Studies incorporates the following interrelated mathematical processes. They are to permeate the teaching and learning of mathematics.

<table>
<thead>
<tr>
<th>Students are expected to:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication [C]</strong></td>
</tr>
<tr>
<td>use <em>communication</em> in order to learn and express their understanding</td>
</tr>
<tr>
<td><strong>Connections [CN]</strong></td>
</tr>
<tr>
<td>make <em>connections</em> among mathematical ideas, other concepts in mathematics, everyday experiences, and other disciplines</td>
</tr>
<tr>
<td><strong>Mental Mathematics and Estimation [ME]</strong></td>
</tr>
<tr>
<td>demonstrate fluency with <em>mental mathematics and estimation</em></td>
</tr>
<tr>
<td><strong>Problem Solving [PS]</strong></td>
</tr>
<tr>
<td>develop and apply new mathematical knowledge through <em>problem solving</em></td>
</tr>
<tr>
<td><strong>Reasoning [R]</strong></td>
</tr>
<tr>
<td>develop mathematical <em>reasoning</em></td>
</tr>
<tr>
<td><strong>Technology [T]</strong></td>
</tr>
<tr>
<td>select and use <em>technology</em> as a tool for learning and solving problems</td>
</tr>
<tr>
<td><strong>Visualization [V]</strong></td>
</tr>
<tr>
<td>develop <em>visualization</em> skills to assist in processing information, making connections, and solving problems</td>
</tr>
</tbody>
</table>

For further details about each of these processes, refer to the [Mathematics Grades 10–12 Program of Studies](Mathematics_30-1_Program_of_Study.pdf).
Performance Expectations

Curriculum standards
Provincial curriculum standards help to communicate how well students need to perform in order to be judged as having achieved the learning outcomes specified in the Mathematics 30–1 Program of Studies. The specific statements of standards are written primarily to inform Mathematics 30–1 teachers of the extent to which students must know the Mathematics 30–1 curriculum and demonstrate the required skills in order to pass the examination.

Performance Standards

Acceptable standard
Students who attain the acceptable standard, but not the standard of excellence, will receive a final course mark between 50 percent and 79 percent, inclusive. Typically, these students have gained new skills and a basic knowledge of the concepts and procedures relative to the general and specific outcomes defined for Mathematics 30–1 in the program of studies. They demonstrate mathematical skills, as well as conceptual understanding, and they can apply their knowledge to familiar problem contexts.

Standard of excellence
Students who attain the standard of excellence will receive a final course mark of 80 percent or higher. Typically, these students have gained a breadth and depth of understanding regarding the concepts and procedures, as well as the ability to apply this knowledge and conceptual understanding to a broad range of familiar and unfamiliar problem contexts.

Assessment Standards and Exemplars

The Assessment Standards and Exemplars document that describes acceptable standard and standard of excellence performance levels appropriate to the Mathematics 30–1 Program of Studies can be found on the Alberta Education website. This document also contains notes and exemplars to assist teachers and students with the interpretation of curricular outcomes in the program of studies.
Examples of Written-response Questions

The Written-Response Information document and the Mathematics 30-1 Released Materials 2019 document contain examples of written-response questions, sample responses, and scoring rationales as they relate to the general scoring guide and can be found here. The purpose of these documents is to help teachers and students understand the intent of the written-response component of the diploma examination, provide information about how the scoring guide is applied to specific questions, and encourage the use of the general scoring guide in class assignments. Teachers and students should note that certain directing words are bolded in written-response questions. A list of these directing words and their definitions can be found on page 24.
Explanation of Cognitive Levels

Procedural
The assessment of students’ knowledge of mathematical procedures should involve recognition, execution, and verification of appropriate procedures and the steps contained within them. The use of technology can allow for conceptual understanding prior to specific skill development or vice versa. Students must appreciate that procedures are created or generated to meet specific needs in an efficient manner and thus can be modified or extended to fit new situations. Assessment of students’ procedural knowledge will not be limited to an evaluation of their proficiency in performing procedures, but will be extended to reflect the skills presented above.

Conceptual
An understanding of mathematical concepts goes beyond a mere recall of definitions and recognition of common examples. Assessment of students’ knowledge and understanding of mathematical concepts should provide evidence that they can compare, contrast, label, verbalize, and define concepts; identify and generate examples and counter-examples as well as properties of a given concept; recognize the various meanings and interpretations of concepts; and defend procedures and personal strategies. Students who have developed a conceptual understanding of mathematics can also use models, symbols, and diagrams to represent concepts. Appropriate assessment provides evidence of the extent to which students have integrated their knowledge of various concepts.

Problem solving
Appropriate assessment of problem-solving skills is achieved by allowing students to adapt and extend the mathematics they know and by encouraging the use of strategies to solve unique and unfamiliar problems. Assessment of problem solving involves measuring the extent to which students use these strategies and knowledge, and their ability to verify and interpret results. Students’ ability to solve problems develops over time as a result of their experiences with relevant situations that present opportunities to solve various types of problems. Evidence of problem-solving skills is often linked to clarity of communication. Students demonstrating strong problem-solving skills should be able to clearly explain the process they have chosen, using appropriate language and correct mathematical notation and conventions.
Examination Specifications and Design

Each Mathematics 30–1 Diploma Examination is designed to reflect the content outlined in the Mathematics 30–1 Program of Studies. The percentage weightings shown below will not necessarily match the percentage of class time devoted to each topic.

Specifications

The format and content of the Mathematics 30–1 Diploma Examinations in the 2020–2021 school year are as follows:

<table>
<thead>
<tr>
<th>Question Format</th>
<th>Number of Questions</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Scored</td>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>Multiple Choice</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Numerical Response</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Written Response</td>
<td>3</td>
<td>25%</td>
</tr>
</tbody>
</table>

Note: The three written-response questions are equally weighted.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relations and Functions</td>
<td>53%–58%</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>27%–33%</td>
</tr>
<tr>
<td>Permutations, Combinations, and Binomial Theorem</td>
<td>14%–18%</td>
</tr>
</tbody>
</table>

Procedural, conceptual, and problem-solving cognitive levels are addressed throughout the examination. The approximate emphasis of each cognitive level is given below.

<table>
<thead>
<tr>
<th>Cognitive Level</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>34%</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>36%</td>
</tr>
<tr>
<td>Procedural</td>
<td>30%</td>
</tr>
</tbody>
</table>
Machine-scored questions

Information required to answer multiple-choice and numerical-response questions is often located in a box preceding the question. The questions that require the use of the information given in the box will be clearly stated; e.g., “Use the following information to answer questions 5 and 6.”

For multiple-choice questions, students are to choose the correct or best possible answer from four alternatives.

The numerical-response questions are interspersed throughout the multiple-choice questions, according to content topic.

For some numerical-response questions, students are required to calculate a numerical answer and then record their answer in a separate area of the answer sheet. When the answer to be recorded cannot be a decimal value, students are asked to determine a whole-number value (e.g., the number of people is _____; the number of different routes is ____). If the answer can be a decimal value, then students are asked to record their answer to the nearest tenth or nearest hundredth, as specified in the question. Students should retain all decimals throughout the question, and rounding should occur only in the final answer.

Other numerical-response questions require students to record their understanding of a concept. These questions may require students to select appropriate responses from a list or a table or to arrange items in a specific order.

Instructions on how to record responses to numerical-response questions, with specific examples, are shown on page 15 and 16.
Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- Enter the first digit of your answer in the left-hand box. Any boxes on the right that are not needed are to remain blank.

Examples

Calculation Question and Solution

The average of the values 2.7, 8.1, and 5.2, to the nearest tenth, is _______.

(Record your answer in the numerical-response section on the answer sheet.)

Calculator value: 5.333333…
Answer: 5.3

Record 5.3 on the answer sheet

Any-order Question and Solution

<table>
<thead>
<tr>
<th>Four Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Circle</td>
</tr>
<tr>
<td>2 Multiply</td>
</tr>
<tr>
<td>3 Triangle</td>
</tr>
<tr>
<td>4 Rectangle</td>
</tr>
</tbody>
</table>

The three shapes in the list above are numbered ____, ____ , and ____.

(Record all three digits of your answer in any order in the numerical-response section on the answer sheet.)

Answer: 134 (in any order)

Record 134 on the answer sheet

Note: All answers containing only the three digits 1, 3, and 4, in any order, will be scored as correct.
Correct-order Question and Solution

Four exponential functions of the form $y = b^x$ are listed below.

Function 1 $y = 1.2^x$
Function 2 $y = 1.4^x$
Function 3 $y = 1.5^x$
Function 4 $y = 1.1^x$

When these four functions are arranged in order from the lowest $b$ value to the highest $b$ value, the order is ___, ___, ___, and ___.

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Answer: 4123

Correct-order Question and Solution

In the table below, the two numbers in each horizontal row add to 7.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

In the table above, the value of $a$ is ________ (Record in the first column)$b$ is ________ (Record in the second column)$c$ is ________ (Record in the third column)

(Record your answer in the numerical-response section on the answer sheet.)

Answer: 653
Written-response questions

The written-response component is designed to assess the degree to which students can draw on their mathematical experiences to solve problems, explain mathematical concepts, and demonstrate their algebraic skills. A written-response question may cover more than one specific outcome and will require students to make connections between concepts. Each written-response question will consist of two parts and will address multiple cognitive levels. Students should be encouraged to try to solve the problems in both parts because an attempt at a solution may be worth partial marks.

Students may be asked to solve, explain, or prove in a written-response question. Students are required to know the definitions and expectations of directing words such as algebraically, compare, determine, evaluate, justify, and sketch. A list of these directing words and their definitions can be found on page 24.

The following instructions will be included in the instructions pages of all mathematics diploma exam booklets.

- Write your responses in the examination booklet as neatly as possible.
- For full marks, your responses must address all aspects of the question.
- All responses, including descriptions and/or explanations of concepts, must include pertinent ideas, calculations, formulas, and correct units.
- Your responses must be presented in a well-organized manner. For example, you may organize your responses in paragraphs or point form.
General Scoring Guides

The general scoring guides, developed in consultation with teachers and Alberta Education staff, describe the criteria and performance level at each score-point value. These general scoring guides will be used to develop specific scoring descriptions for each written-response question.

In scoring the written-response questions, markers will evaluate how well students

• demonstrate their understanding of the problem or the mathematical concept
• correctly apply mathematical knowledge and skills
• use problem-solving strategies and explain their solutions and procedures
• communicate their solutions and mathematical ideas
### 2-mark part

<table>
<thead>
<tr>
<th>Score</th>
<th>General Scoring Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR</td>
<td>No response is provided.</td>
</tr>
<tr>
<td>0</td>
<td>In the response, the student does not address the question or provides a solution that is invalid.</td>
</tr>
<tr>
<td>0.5</td>
<td>In the response, the student demonstrates basic mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.</td>
</tr>
<tr>
<td>1</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
<tr>
<td>1.5</td>
<td>In the response, the student demonstrates minimal mathematical understanding of the problem by applying an appropriate strategy or some relevant mathematical knowledge to complete initial stages of a solution.</td>
</tr>
<tr>
<td>2</td>
<td>In the response, the student demonstrates good mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.</td>
</tr>
<tr>
<td>2.5</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
<tr>
<td>3</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
</tbody>
</table>

### 3-mark part

<table>
<thead>
<tr>
<th>Score</th>
<th>General Scoring Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR</td>
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<tr>
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</tr>
<tr>
<td>1</td>
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</tr>
<tr>
<td>1.5</td>
<td>In the response, the student demonstrates minimal mathematical understanding of the problem by applying an appropriate strategy or some relevant mathematical knowledge to complete initial stages of a solution.</td>
</tr>
<tr>
<td>2</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
<tr>
<td>2.5</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
<tr>
<td>3</td>
<td>In the response, the student demonstrates complete mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a complete and correct solution.</td>
</tr>
</tbody>
</table>

Specific scoring guides for each written-response question will provide detailed descriptions to clarify expectations of student performance at each benchmark score of 0, 1, 2, and 3. A student response that does not meet the performance level of a benchmark score may receive an augmented score of 0.5, 1.5, or 2.5. Descriptions of these augmented scores will be determined with teachers at each marking session and will not be an exhaustive list. Each part will be scored separately and the scores will be combined for a total of 5 marks.
Commentary on the Mathematics 30–1 Diploma Examinations

The 2019–2020 school year was the second year of the Mathematics 30–1 Diploma Examination with a written-response component. In general, feedback from teachers indicates a high degree of satisfaction with the Mathematics 30–1 examinations in terms of fidelity to, and support of, the program of studies.

Overview of diploma examination development process and standards confirmation

Throughout the diploma examination development process, Alberta Education makes every effort to ensure examinations reflect the standards of the programs of study. Prior to implementing the Mathematics 30–1 Program of Studies in 2013, seven province-wide consultations involving over 120 teachers were held to discuss the blueprint for the Mathematics 30–1 Diploma Examination. With the 2016 announcement to integrate a written-response component into mathematics diploma exams, consultations involving over 200 teachers were held across Alberta to discuss the new blueprint, format, and weighting of the written-response component. During both of these consultations and other development work, teachers were involved in developing items, determining performance standard descriptors, and developing the blueprint. After implementation, teachers continue to be involved in developing items, reviewing field tests, and validating diploma examinations.

Every Mathematics 30–1 Diploma Examination is built to the published blueprint specifications, based on the program of studies outcomes. To help ensure this, teachers, post-secondary representatives, and staff from the High School Curriculum sector were extensively involved in the validation process. Fairness to students and student success will continue to be the focus of any changes to provincial assessments.
Students’ strengths and areas for improvement

Relations and Functions

- Students continue to perform well on questions regarding the interpretation of transformation equations involving stretches, reflections, and translations to determine the coordinates of a transformed point.

- Students are able to identify transformations when given a transformation equation, and have improved in their ability to use the correct terminology in their descriptions, but many have difficulty representing the transformation using mapping notation.

- Students continue to have difficulty determining the number of invariant points associated with different transformations.

- Students are able to use a logarithm law to evaluate a logarithmic expression, but continue to have difficulty using multiple logarithm laws to simplify an expression into a single logarithm.

- Students are improving in their ability to relate the characteristics of the graph of an exponential function to the parameters of the corresponding equation.

- Students are able to solve logarithmic equations and exponential equations that can be simplified to a common base.

- Students are able to determine the domain and range of a function after a transformation, but many students have difficulty determining the domain after the division of two functions.

Trigonometry

- Students continue to perform well on problems involving coterminal angles and arc length.

- Students are improving in their ability to apply the equation of the unit circle to solve problems.

- Students continue to perform well on questions that require them to relate the parameters in the equation of a sinusoidal function to the characteristics of the corresponding graph of the function.

- Students are able to solve second-degree trigonometric equations in a variety of domains, but many students have difficulty solving equations when an identity substitution is required.

- Students have difficulties determining the general solution of a trigonometric equation when given the solutions to the equation in a restricted domain.

- Students are able to determine the exact value of a trigonometric expression when verifying a trigonometric identity.
Permutations, Combinations, and Binomial Theorem

- Stronger students are able to solve permutation problems that involve one or two constraints, but weaker students have difficulty solving problems with multiple cases.
- Students are able to solve problems involving repeated elements, but many students have difficulty relating an expression involving factorial notation to a real-life context.
- Students are able to solve equations involving one occurrence of $nC_r$ where $r \leq 3$.
- Students are able to identify the correct statements about the expansion of a binomial with linear terms.

Observations from written-response component

- Markers noted that students are able to illustrate the steps of their work, but many need to focus on organizing their work in a logical way. Additionally, many students need to focus on the details within their work (i.e., including all necessary brackets, relating the solution to the context, including the angle argument when writing trigonometric ratios, and setting factors equal to zero when solving an equation).
- Students continue to have difficulty including all of the key characteristics in their sketch of the graph of a function. Key characteristics may include vertices, endpoints, maximum and minimum points, intercepts, and asymptote lines. Additionally, many students have difficulty illustrating the correct graph shape when sketching the graph of a function.
- Students should be reminded that they must be familiar with the specific meaning of the directing words. Markers noted that many students did not demonstrate that they know, for example, that the directing word determine requires that students include supporting evidence with their solution and that the word algebraically requires students to demonstrate a complete algebraic process or procedure when solving the problem. Teachers may wish to discuss the meanings of these words with their students.
Mathematics 30-1 Field Testing

All field tests in Mathematics 30-1 are year-end field tests that are offered in two formats.

Digital field tests are administered online and contain only machine-scored items. Paper field tests are administered at the school level and contain machine-scored and written-response items. Each semester, one digital field test and one paper field test will be translated into French.

The table below shows the format, length of time, and number of questions for field tests available for the 2020-2021 school year.

<table>
<thead>
<tr>
<th>Field Test Format</th>
<th>Test Length</th>
<th>Number of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital</td>
<td>50 minutes</td>
<td>10 multiple choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 numerical response</td>
</tr>
<tr>
<td></td>
<td>65 minutes</td>
<td>13 multiple choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 numerical response</td>
</tr>
<tr>
<td>Paper</td>
<td>40 minutes</td>
<td>3 written response</td>
</tr>
<tr>
<td></td>
<td>(semester 1 only)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 minutes</td>
<td>7 multiple choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 numerical response</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 written response</td>
</tr>
<tr>
<td></td>
<td>65 minutes</td>
<td>7 multiple choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 numerical response</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 written response</td>
</tr>
</tbody>
</table>

The field tests are designed to be completed in the times listed in the table; however, an additional 15 minutes may be used if available.

An additional 10 minutes of time is required for each field test administration to complete the setup procedures and go through the instructions with students.

For information on requesting field tests, please refer to the Field Testing Program Rules, Procedures, and Request Guide.
### Mathematics Directing Words

In Provincial Assessment Sector use, mathematics directing words have the following definitions, which students are required to know. These words will be bolded in the written-response questions.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebraically</td>
<td>Using mathematical procedures that involve variables or symbols to represent values</td>
</tr>
<tr>
<td>Analyze</td>
<td>Make a mathematical examination of parts to determine the nature, proportion, function, interrelationships, and characteristics of the whole</td>
</tr>
<tr>
<td>Classify</td>
<td>Arrange items or concepts in categories according to shared qualities or characteristics</td>
</tr>
<tr>
<td>Compare</td>
<td>Examine the character or qualities of two things by providing characteristics of both that point out their mutual similarities and differences</td>
</tr>
<tr>
<td>Conclude</td>
<td>Make a logical statement based on reasoning and/or evidence</td>
</tr>
<tr>
<td>Describe</td>
<td>Give a written account of a concept</td>
</tr>
<tr>
<td>Determine</td>
<td>Find a solution, to a specified degree of accuracy, to a problem by showing appropriate formulas, procedures, and/or calculations</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Find a numerical value or equivalent for an equation, formula, or function</td>
</tr>
<tr>
<td>Explain</td>
<td>Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail</td>
</tr>
<tr>
<td>Illustrate</td>
<td>Make clear by giving an example. The form of the example will be specified in the question: e.g., a word description, sketch, or diagram</td>
</tr>
<tr>
<td>Interpret</td>
<td>Provide a meaning of something; present information in a new form that adds meaning to the original data</td>
</tr>
<tr>
<td>Justify</td>
<td>Indicate why a conclusion has been stated, by providing supporting reasons and/or evidence that form a mathematical argument</td>
</tr>
<tr>
<td>Model</td>
<td>Represent a concept or situation in a concrete or symbolic way</td>
</tr>
<tr>
<td>Prove</td>
<td>Establish the truth or validity of a statement by giving factual evidence or logical argument</td>
</tr>
<tr>
<td>Sketch</td>
<td>Provide a drawing that represents the key features or characteristics of an object or graph</td>
</tr>
<tr>
<td>Solve</td>
<td>Give a solution to a problem</td>
</tr>
<tr>
<td>Verify</td>
<td>Establish, by substitution for a particular case or by geometric comparison, the truth of a statement</td>
</tr>
</tbody>
</table>
Mathematics 30–1 Formula Sheet

For \( ax^2 + bx + c = 0 \),
\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]

Relations and Functions

Graphing Calculator Window Format
\[
x: [x_{\text{min}}, x_{\text{max}}, x_{\text{scl}}]
\]
\[
y: [y_{\text{min}}, y_{\text{max}}, y_{\text{scl}}]
\]

Laws of Logarithms
\[
\log_b(M \times N) = \log_b M + \log_b N
\]
\[
\log_b \left( \frac{M}{N} \right) = \log_b M - \log_b N
\]
\[
\log_b (M^n) = n \log_b M
\]
\[
\log_b c = \frac{\log_a c}{\log_a b}
\]

Growth/Decay Formula
\[
y = ab^t
\]

General Form of a Transformed Function
\[
y = af[b(x - h)] + k
\]

Permutations, Combinations, and the Binomial Theorem
\[
n! = n(n - 1)(n - 2)\ldots3 \times 2 \times 1,
\]
where \( n \in N \) and \( 0! = 1 \)
\[
P_r = \frac{n!}{(n-r)!}
\]
\[
C_r = \frac{n!}{(n-r)!r!}
\]
\[
\]
In the expansion of \( (x + y)^n \), written in descending powers of \( x \), the general term is \( t_{k+1} = nC_k x^{n-k} y^k \).

Trigonometry
\[
\theta = \frac{a}{r}
\]
\[
\tan \theta = \frac{\sin \theta}{\cos \theta} \quad \cot \theta = \frac{\cos \theta}{\sin \theta}
\]
\[
csc \theta = \frac{1}{\sin \theta} \quad \sec \theta = \frac{1}{\cos \theta}
\]
\[
\cot \theta = \frac{1}{\tan \theta}
\]
\[
\sin^2 \theta + \cos^2 \theta = 1
\]
\[
1 + \tan^2 \theta = \sec^2 \theta
\]
\[
1 + \cot^2 \theta = \csc^2 \theta
\]
\[
\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta
\]
\[
\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta
\]
\[
\cos(\alpha + \beta) = \cos \alpha \cos \beta - \sin \alpha \sin \beta
\]
\[
\cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta
\]
\[
\tan(\alpha + \beta) = \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \tan \beta}
\]
\[
\tan(\alpha - \beta) = \frac{\tan \alpha - \tan \beta}{1 + \tan \alpha \tan \beta}
\]
\[
\sin(2\alpha) = 2 \sin \alpha \cos \alpha
\]
\[
\cos(2\alpha) = \cos^2 \alpha - \sin^2 \alpha
\]
\[
\cos(2\alpha) = 2 \cos^2 \alpha - 1
\]
\[
\cos(2\alpha) = 1 - 2 \sin^2 \alpha
\]
\[
\tan(2\alpha) = \frac{2 \tan \alpha}{1 - \tan^2 \alpha}
\]
\[
y = a \sin[b(x - c)] + d
\]
\[
y = a \cos[b(x - c)] + d
\]
Website Links

Alberta Education website

Programs of Study

General Information Bulletin
contains specific directives, guidelines, and procedures of diploma examinations

Diploma Examinations Program

Writing Diploma Examinations
contains Guides for Students, exemplars, and other support documents

Quest A+
contains practice questions and questions from previous diploma examinations

Field Test Request System

Field-test Information

School Reports and Instructional Group Reports
contain detailed statistical information on provincial, group, and individual student performance on the entire examination
**NEW** **Using Calculators**

The *Mathematics 30–1 Diploma Examination* requires the use of an approved graphing calculator. The list of approved graphing calculators, along with the rules, list of prohibited properties, criteria, and keystrokes required to properly clear and configure each approved graphing calculator, is *found on the Alberta Education website*.

Students may bring **one** approved calculator that must be properly cleared and configured before AND after each diploma exam administration by the exam supervisor or teacher. If an approved graphing calculator is not cleared and configured properly, it may have prohibited properties such as symbolic manipulation capabilities, downloaded programs, the ability to provide exact trigonometric values, or the ability to simplify radicals and rationalize denominators. Teachers and students should recognize that the different models of approved graphing calculators have a range of capabilities, and the choice of model to use or purchase will require personal or teacher analysis of the calculator’s capabilities and one’s individual or school circumstances. Teachers should also be aware of the capabilities that are available when the calculator is not configured for exam purposes as these capabilities may impact classroom instruction and assessment. These capabilities may also be applicable to other high school math and science courses.
How to Get Involved

High-quality diploma examinations are the product of close collaboration between classroom teachers and Alberta Education. Classroom teachers from across Alberta are involved in many aspects of diploma examination development, including the development of items; the building, reviewing, administering, and marking of field tests; the reviewing and validating of diploma examinations; and the marking of diploma examinations.

The development of test items from when they are written until when they appear on an examination takes at least one year. All items on *Mathematics 30–1 Diploma Examinations* are written by Mathematics 30–1 teachers from across Alberta. After the first year of provincial implementation of the program of studies, items are field tested to ensure their reliability and validity. Diploma examinations are reviewed by editors; a technical advisory working group composed of mathematics experts from post-secondary institutions, teachers, and curriculum staff; translators; and a French validation working group.

Alberta Education values the involvement of the teachers and annually asks school jurisdictions for the names of teachers who are interested in being involved in any of the development processes for diploma examinations. Teachers who are interested in developing items, constructing field tests, or reviewing and validating examinations are encouraged to talk to their principals about how they can submit their names for approval to be involved in these processes. Although the call for submissions occurs each fall, teachers are welcome to have their names submitted at any time.

Teachers may also be nominated by their school authority to mark written-response assignments for Humanities and Mathematics Diploma Examinations. The call for nominations occurs in early September (for January and April marking) and again in February (for June, August and November marking). Teachers who would like to be nominated to mark diploma exams are encouraged to talk to their principals.

Periodically, we may send out information to those Mathematics 30–1 teachers who are on our contact list. If you are not on that list and would like to receive updates related to Mathematics 30–1 assessment activities, please contact either Delcy Rolheiser, Mathematics 30–1 Exam Manager, at Delcy.Rolheiser@gov.ab.ca or Jessica Handy, Mathematics 30–1 Examiner, at Jessica.Handy@gov.ab.ca.
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Inquiries about special cases, diploma examination accommodations, and special-format materials can be sent by email to
special.cases@gov.ab.ca

Inquiries about field testing can be sent by email to
field.test@gov.ab.ca

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alberta.ca/education