Information Bulletin

Mathematics 30–2

Diploma Examinations Program 2019–2020

Alberta

This document was written primarily for:

Students	✓	
Teachers	✓	of Mathematics 30–2
Administrators	✓	
Parents		
General Audience		
Others		

Alberta Education, Government of Alberta

2019–2020

Mathematics 30–2 Information Bulletin

Distribution: This document is posted on the Alberta Education website.

Contents

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 30–2 with information about the diploma examinations scheduled in the 2019–2020 school year. This bulletin should be used in conjunction with the current Mathematics 30–2 Program of Studies, the *Mathematics 30–2 Written-Response Information* document, and the *Mathematics 30–2 Assessment Standards and Exemplars* document to ensure that the curriculum and standards are addressed.

This bulletin includes descriptions of the *Mathematics 30–2 Diploma Examinations* that will be administered in January, April, June, and August of 2020; descriptions of the acceptable standard and the standard of excellence; and subject-specific information. The mark awarded to a student on the *Mathematics 30–2 Diploma Examinations* in the 2019–2020 school year will account for 30% of the student's final blended mark, and the school-awarded mark will account for the remaining 70%.

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

For further information regarding program implementation, refer to the Alberta Education website.

Examination Security

All *Mathematics 30–2 Diploma Examinations* will be held secure until they are 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. However, for the January and June examinations, teachers will be allowed access to a teacher perusal copy for review purposes one hour after the examination has started. All diploma examination booklets must be kept secure, with the exception of *Part A: Written Response* in the January and June administrations of humanities examinations after they have been written. **Unused copies of all secure examination booklets must be returned to Alberta Education**.

For more information about teacher perusal copies and 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 30–2 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 30–2 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 are 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 their difficulty level and appropriateness. 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.

Effective September 1, 2019, paper-format field tests that were previously only administered by an Alberta Education-contracted employee may now be administered at the school level, if requested by the classroom teacher or the principal.

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 weaknesses.

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 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 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

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

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 30–2 Diploma Examinations* are written by Mathematics 30–2 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 send out information to those Mathematics 30–2 teachers who are on our contact list. If you are not on that list and would like to receive updates related to Mathematics 30–2 assessment activities, please contact either Jenny Kim, Mathematics 30–2 Exam Manager, at Jenny.Kim@gov.ab.ca or Tony Cabay, Mathematics 30–2 Examiner, at Tony.Cabay@gov.ab.ca.

Using Calculators

The *Mathematics 30–2 Diploma Examination* requires the use of an approved graphing calculator. The list of approved graphing calculators, along with the directives, list of prohibited properties, criteria, and keystrokes required to properly clear and configure each approved graphing calculator, is found in the *General Information Bulletin*.

Approved graphing calculators must be properly cleared and configured before AND after each diploma exam administration. 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.

Course Objectives

The Mathematics 30–2 course is made up of outcomes, as specified in the program of studies, and emphasizes the mathematical understandings and critical thinking skills for daily life, direct entry into the workforce, and post-secondary studies in programs that do not require the study of calculus. In Mathematics 30–2, algebraic, numerical, and graphical methods are used to solve problems. Technology, such as graphing calculators, is also used to enable students to explore and create patterns, examine relationships, test conjectures, model, 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 apply mathematical concepts and procedures to meaningful real-world problems. It is important to realize that it is acceptable for students to solve problems in different ways and that solutions may vary depending upon how the problem is understood.

The program of studies is available online at alberta.ca.

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.

This program of studies incorporates the following interrelated mathematical processes. They are to permeate the teaching and learning of mathematics.

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

For further details about each of these processes, please refer to the Conceptual Framework for Grades 10–12 Mathematics found in the Mathematics Grades 10 –12 Program of Studies.

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 objectives specified in the Mathematics 30–2 Program of Study. The specific statements of standards are written primarily to inform Mathematics 30–2 teachers of the extent to which students must both know the Mathematics 30–2 content and demonstrate the required skills in order to pass the diploma 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% and 79% 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 30–2 in the program of studies. They demonstrate mathematical skills as well as conceptual understanding and 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% 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

A document that describes acceptable standard and standard of excellence performance levels appropriate to the Mathematics 30–2 Program of Studies can be found on the Alberta Education website. This document also contains assessment exemplars to assist teachers and students with the interpretation of curricular outcomes in the program of studies.

Examples of Written-response Questions

The *Mathematics 30-2 Written-response Information* document and the *Mathematics 30-2 Released Materials 2019* document contain examples of written-response questions, sample responses, and scoring rationales as they relate to the general scoring guides 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 on diploma examinations. A list of these directing words and their definitions can be found on page 23.

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 30–2 Diploma Examination* is designed to reflect the core content outlined in the Mathematics 30–2 Program of Studies. The examination is limited to those outcomes that can be measured by a paper-and-pencil test. Therefore, the percentage weightings shown below will not necessarily match the percentage of class time devoted to each topic. The diploma examination was developed to be completed in 2.5 hours.

The format and content of the *Mathematics 30–2 Diploma Examinations* in the 2019–2020 school year are as follows.

Specifications

Question Format	Number of Questions	Emphasis
Machine Scored		75%
Multiple Choice	24	
Numerical Response	8	
Written Response	2	25%

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

Diploma Examination Content by Topic	Emphasis
Logical Reasoning	15%–20%
Probability	30%–35%
Relations and Functions	45%–55%
Research Project	0%

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

Multiple Choice, Numerical Response, and Written Response	Emphasis
Conceptual	34%
Procedural	30%
Problem Solving	36%

Machine-scored questions

Information required to answer **multiple-choice** and/or **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 listed above the box: e.g., "*Use the following information to answer questions 3 and 4*."

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

For some **numerical-response questions**, students are to calculate a numerical answer and 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 degree of this polynomial 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. The following are examples of these types of questions.

Correct-order Question and Solution

An exponential function in the form $y = a \cdot b^x$ can be used to model investment data. The four exponential functions shown below model the current value of four different investments, A, after t years.

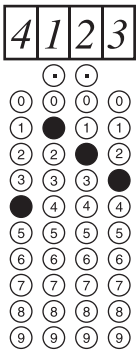
Investment 1	$A = 2\,300(1.09)^t$
Investment 2	$A = 5\,000(1.16)^t$
Investment 3	$A = 3\,500(1.24)^t$
Investment 4	$A = 1\,600(1.06)^t$

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

Record 4123 on the answer sheet →



Correct-order Question and Solution

The digits 1 through 6 are arranged in the puzzle below so that the sum of each horizontal row is 7.

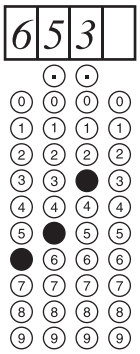
1	***a***
b	2
c	4

In the puzzle 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

Record 653 on the answer sheet →



Any-order Question and Solution

Two Sets

$A = \{2, 3, 4, 5, 7, 8, 9\}$

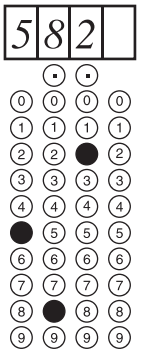
$B = \{1, 2, 5, 6, 8\}$

The three elements that are in Set A and Set B are ___, ___, and ___.

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

Answer: 582 (in any order)

Record 582 on the answer sheet →



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 will cover more than one specific outcome and will require students to make connections between concepts.

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 23.

Students should be encouraged to try to solve all problems, as an attempt at a solution may be worth partial marks. The two written-response questions each consist of four parts and will address multiple cognitive levels. Each question is scored with a 7-mark scoring rubric; it will begin with a 1-mark part followed by three 2-mark parts. Students should note that all of their solutions to written-response questions should include appropriate use of units and appropriate rounding.

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.

1-mark part

Score	General Scoring Guide
NR	No response is provided.
0	In the response, the student does not address the question or provides a solution that is invalid.
0.5	
1	In the response, the student applies appropriate mathematical knowledge to find a complete and correct solution.

2-mark part

Score	General Scoring Guide
NR	No response is provided.
0	In the response, the student does not address the question or provides a solution that is invalid.
0.5	
1	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.
1.5	
2	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.

Specific Scoring Guides for each written-response question will provide detailed descriptions to clarify expectations of student performance at each benchmark score: 0, 1, and 2. A student response that does not meet the performance level of a benchmark score may receive an augmented score of 0.5 or 1.5. Descriptions of these augmented scores will be determined with teachers at each marking session and are not an exhaustive list.

Commentary on the *Mathematics 30–2 Diploma Examinations*

Introduction

The 2018–2019 school year was the seventh year for the *Mathematics 30–2 Diploma Examination* and the first year with a written-response component. This section is intended to provide teachers with information concerning these diploma examinations. In general, feedback from teachers has indicated a high degree of satisfaction with the examinations in terms of fidelity to, and support of, the program of studies.

Overview of diploma examination development process

Throughout the diploma examination development process, Alberta Education makes every effort to ensure that examinations reflect the content of new programs. Prior to implementation in 2013, seven province-wide consultations, involving over 120 teachers, were held to discuss the blueprint for the Mathematics 30–2 Diploma Examinations. Also, following the announcement in 2016 that a written-response component would be integrated into the examinations, further consultations involving over 200 teachers were held across Alberta to discuss the new blueprint as well as the 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.

The January *2019 Mathematics 30–2 Diploma Examination* and the *June 2019 Mathematics 30–2 Diploma Examination* were built to the published blueprint, which reflects the program of studies. To help ensure this, teachers, post-secondary representatives, and staff from the High School Curriculum Sector were extensively involved in the validation processes.

Students' strengths and areas for improvement

Logical Reasoning

- Students continue to perform very well on puzzles and games involving numerical and logical reasoning.
- Students have shown improvement in their ability to organize and analyze two sets within a universal set, including the operation of two sets that involve complements.
- Weaker students continue to have trouble organizing and interpreting information that involves three sets, but they tend to perform better when a diagram is provided.

Probability

- Students are able to convert probability to odds and vice versa, but weaker students continue to find this difficult.
- Some students are having difficulty with odds statements compared to probability statements; i.e., odds are considered “part-part” and probability is considered “part-whole”.
- Students continue to have difficulty differentiating between mutually exclusive and non-mutually exclusive events, and when calculating the probability of non-mutually exclusive events.
- Some students confuse the distinction between mutually exclusive and non-mutually exclusive events, with the distinction between independent and dependent events.
- Students continue to have difficulty calculating probability when there is more than one case to consider. Most students are able to recognize that there is more than one case, but they either do not combine them or combine them incorrectly.
- Students perform well on permutation questions that involve one restriction, as well as combination questions that involve a single case.
- Some students continue to express probability as a percent, rather than a value in the range of 0 to 1. This is of particular concern in numerical-response questions.

Relations and Functions

- Students are generally very successful in performing regressions, but they need to pay special attention to the use of non-rounded values in the resulting regression function to predict an unknown value.
- Students continue to have difficulty solving exponential equations that cannot be written as powers with a common base.
- Students have shown improvement in simplifying logarithmic expressions using the laws of logarithms.
- Students are proficient in the simplification of rational expressions and stating non-permissible values.
- Students are becoming more proficient in multiplying and dividing rational expressions, but continue to have difficulty in adding and subtracting rational expressions.
- Students continue to have difficulty in solving rational equations, especially when the rational equation simplifies to a quadratic equation.
- Students have difficulty analyzing sinusoidal functions, especially when the function models a context.
- Students continue to have difficulty solving contextual problems when the equation, table of values, or graph is not provided.

NOTE: Students need to round their answers as specified in numerical-response questions.

*NEW Observations from written-response component

- The first entry level bullet was generally done well.
- Students should be made aware that for each written-response question, part a is worth 1 mark, and parts b, c, and d are each worth 2 marks.
- Students should be reminded that their response must address **all** aspects of the question, and must include all relevant ideas, calculations, formulas, and correct units. Markers noted that students were either not showing their process or showing an incomplete process.
- Students must be aware of the importance of communicating clearly and accurately in their response: i.e., use of proper notation and proper terminology. This is especially evident with outcomes covered in the topic of probability. For example, students are not indicating "odds in favour of A", "odds against A", or *P*(event A). As well, students often omit operation signs in their calculations. Markers noted that students were missing key labels in their work and they were not clearly indicating their final answer.
- Students should be reminded that they must be familiar with the specific meaning of the directing words. Many students did not demonstrate that they know, for example, that the directing word *determine* means "Find a solution, to a specified degree of accuracy, to a problem by showing appropriate formulas, procedures, and/or calculations." As well, they did not demonstrate an understanding that *algebraically determine* requires a complete algebraic process to be shown in their response. Teachers may wish to discuss this with their students.
- Markers felt that students had difficulty relating or connecting their response back to the given context of a question.
- Markers noted that incorrect rounding was an issue, as was a lack of basic algebra skills.
- Students should be aware that if no rounding directions are provided, then an exact-value answer is appropriate.
- Students should be encouraged to attempt each part of a question as they may receive partial marks.

*NEW 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.

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

Mathematics 30–2 Formula Sheet

Relations and Functions

Graphing Calculator Window Format

x: $[x_{min}, x_{max}, x_{scl}]$

y: $[y_{min}, y_{max}, y_{scl}]$

Exponents and Logarithms

$$y = a^x \leftrightarrow x = \log_a y$$

$$\log_b c = \frac{\log_a c}{\log_a b}$$

Laws of Logarithms

$$\log_b(M \cdot N) = \log_b M + \log_b N$$

$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

$$\log_b(M^n) = n \log_b M$$

Exponential functions

$$y = a \cdot b^x$$

Logarithmic functions

$$y = a + b \cdot \ln x$$

Sinusoidal functions

$$y = a \cdot \sin(bx + c) + d$$

$$\text{Period} = \frac{2\pi}{b}$$

Quadratic equations

For $ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Probability

$$n! = n(n-1)(n-2)\ldots 3 \cdot 2 \cdot 1, \quad \text{where } n \in N \text{ and } 0! = 1$$

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

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

$${}_nC_r = \binom{n}{r}$$

$$P(A \cup B) = P(A) + P(B)$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) \cdot P(B)$$

$$P(A \cap B) = P(A) \cdot P(B \mid A)$$

Logical Reasoning

A'	Complement
$\varnothing$	Empty set
$\cap$	Intersection
$\subset$	Subset
$\cup$	Union

Website Links

education.alberta.ca

Programs of Study

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

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

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special.cases@gov.ab.ca

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

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