Information Bulletin | Mathematics 30–2

2016–2017 Diploma Examinations Program

This document was written primarily for:

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

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.

Field Testing

Online Field Testing

All Grade 12 science and mathematics field tests are offered exclusively through an enhanced Quest A+ online delivery system. In addition to digital field tests, hybrid field tests are also available this school year. With a hybrid field test, students receive a paper copy of the test but must respond to the questions online.

Students should use paper data booklets, data pages, or formula sheets for all science and mathematics field tests. These resources 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 data sheets or scrap paper with markings must be securely shredded at the end of the field test administration.

Teachers have a 24-hour window to peruse the digital or hybrid field test and are provided with data on how their students performed. These data include the proportion of students who chose each alternative on multiple-choice items and the proportion who left a numerical-response item blank. Test items are blueprinted to program of studies outcomes. This allows teachers to use field test results to learn more about their students' strengths and weaknesses.

Once logged into the digital or hybrid field test, 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.

In addition, teachers have greater flexibility in selecting the time and date when students write, rather than being bound to a pre-determined date.

Finally, online administration enables every school, large or small, to participate. Historically, it was impractical to send field-test administrators to remotely located schools, or schools with small classes. Now, all Alberta schools can participate in field tests.

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. In the case of hybrid field tests, paper copies are mailed to schools and the questions are accessed in the same format as digital-format field tests. Prior to the hybrid field test, the paper copies must be kept secure by the school principal. After the administration of a hybrid-format field test, teachers must mail all paper copies back to Alberta Education.

Benefits of Field Tests

How do field tests help teachers and students?

Teachers receive each student's score promptly, gaining useful, immediate information about their students' levels of expertise and knowledge. Students also benefit from writing a test that duplicates some of the experience of writing a diploma examination. Field tests provide students and teachers with good examples of the style 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.

Why are field tests necessary?

Field testing is an absolutely essential stage in the development of fair, valid, and reliable provincial examinations. Field testing is basically a process of "testing a test" and "testing 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. Ideally, 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 are field test data used?

The data received from field tests show the reliability of each question. Sometimes, after one field test round, it is clear that certain questions work very well in terms of fairness, validity, and appropriateness to course content. These questions then move into the diploma examination bank to be used at a future date.

Other questions or sets of questions may not perform as well as we require. These questions are subject to revision and review, and retested in a second or third field test with the aim of generating questions that meet our standards. These changes 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.

Further Information

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 by contacting Field.Test@gov.ab.ca, or from the *General Information Bulletin*. Practice items are available online.

For more information, contact

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or

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Diploma Examination Weighting

On September 1, 2015, the diploma examination weighting shifted from a 50/50 weighting to a 70/30 weighting, where the school-awarded grades are worth 70 percent. For further information, please refer to *Marks, Results, and Appeals*.

Diploma Examinations: Multiple Forms

As part of Alberta Education's commitment to fairness to students, and to expand flexibility in the writing of diploma examinations, the number of distinct examination forms (versions) has increased. There are now two forms 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 thoroughly 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.

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Introduction

The purpose of this bulletin is to provide students and teachers of Mathematics 30–2 with information about the diploma examinations scheduled in the 2016–2017 school year. This bulletin should be used in conjunction with the current *Mathematics 30–2 Program of Studies* 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 2017; 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 2016–2017 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.

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 a graphing calculator, 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 to problems clearly and effectively when solving both routine and non-routine problems. Students are also expected to apply mathematical concepts and procedures to meaningful life 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 education.alberta.ca.

Examination Development and Teacher Involvement

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 raw items; the building, reviewing, and administering of field tests; and the reviewing and validating 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, if not longer. The writers of all items on diploma examinations are Mathematics 30–2 teachers from across Alberta. After the first year of provincial implementation, 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 all of the development processes for diploma examinations. Teachers who are interested in developing raw items, field test construction, or the review and validation of examinations are encouraged to ask their principals to submit their names to the Provincial Assessment Sector through their district office. Although the call for submission occurs in early fall, teachers are welcome to have their names submitted at any time.

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 standards 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.

Special-format Practice Tests

To provide students an opportunity to practise diploma examination-style questions and content in Braille, audio, large print, or coloured print versions, Alberta Education is making special-format practice tests available. Tests are offered in all subjects with a corresponding diploma examination. Alberta schools with registered Alberta K-12 students may place orders for these tests. Braille tests 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 everyone.

For more information or to place an order, contact

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*NEW *Commentary on the Mathematics 30–2 Diploma Examinations*

Introduction

The 2015–2016 school year was the fourth year for the Mathematics 30–2 Diploma Examination. 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. During these consultations and other development work, teachers were involved in developing items, determining performance standard descriptors, and blueprint development. After implementation, teachers continue to be involved in developing items, reviewing field tests, and validating diploma examinations.

The January 2016 Mathematics 30-2 Diploma Examination and the June 2016 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 Programs of Study and Resources as well as French Language Education Services were extensively involved in the validation processes.

Final minor adjustments to the Assessment Standards were made this year to further refine the notes, standard statements, and examples. Fairness to students and student success continue to be the focus of any changes to provincial assessments.

Students' Strengths and Areas for Improvement

Logical Reasoning

- Students continue to perform well on puzzles and games involving numerical and logical reasoning.
- Students are able to organize and analyze two sets within a universal set, but they have difficulty analyzing or identifying the operation of sets that involve complements.
- Weaker students have trouble organizing and interpreting information that involve three sets.

Probability

- Stronger students are able to convert probability to odds, but weaker students continue to find this difficult.
- Students have difficulty differentiating between mutually exclusive and non-mutually exclusive events.
- Students continue to have difficulty calculating probability when there is more than one case to consider.
- 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 a particular concern in numerical-response questions.

Relations and Functions

- Students can perform regressions, but they need to pay special attention to the use of non-rounded values in the resulting regression equation to predict an unknown value.
- Weaker students struggle with solving exponential equations, as well as converting an equation from logarithmic form to exponential form (and vice versa).
- Students perform well on simplifying logarithmic expressions using the laws of logarithms.
- Weaker students continue to have difficulty simplifying and performing operations on rational expressions.
- Students have shown improvement in solving rational equations, but many continue to have difficulty when the rational equation simplifies to a quadratic equation.
- Many students have trouble analyzing the graph of a degree 3 polynomial function.
- Students continue to have difficulty finding the characteristics of a sinusoidal function from a context.

NOTE: Students need to attend to specified rounding in numerical-response questions.

Brief Note on Different Question Styles

Prior to provincial implementation, various question formats, many of which are similar to ones used on science diploma examinations, were validated with working groups and shared with teachers at information

sessions. Question styles may continue to evolve and will be validated through the field-testing process. Samples of some of these question styles can be found in the *Mathematics 30–2 Assessment Standards and Exemplars* and on *Quest A+*.

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 machine-scored 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 1/2 hours**; however, an additional **1/2 hour** is allowed for students to complete the exam.

The content for the Mathematics 30–2 Diploma Examinations in the 2016–2017 school year is emphasized as follows.

Specifications

Question Format	*Number of Questions*	*Emphasis*
Multiple Choice	28	70%
Numerical Response	12	30%

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

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

Diploma Examination Content	*Emphasis*
Logic and Reasoning	17%
Probability	33%
Relations and Functions	50%
Research Project	0%

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 stated 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

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

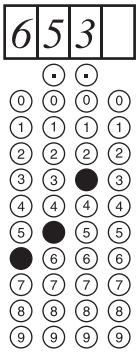
1	***a***
b	2
c	4

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.)

Value to be recorded: 653

Record 653 on the answer sheet →



Correct-Order Question and Solution

An exponential regression 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.

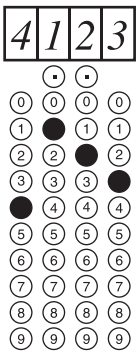
Investment 1	$A = 2300(1.09)^t$
Investment 2	$A = 5000(1.16)^t$
Investment 3	$A = 3500(1.24)^t$
Investment 4	$A = 1600(1.06)^t$

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.)

Value to be recorded: 4123

Record 4123 on the answer sheet →



Any-Order Question and Solution

The elements in sets A and B are defined below.

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

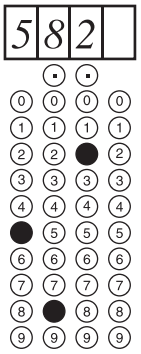
$B = \{1, 2, 5, 6, 8\}$

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.)

Digits to be recorded: 582 (in any order)

Record 582 on the answer sheet →



Using Calculators

The Mathematics 30–2 Diploma Examination requires the use of an approved graphing calculator. The calculator directives, expectations, criteria, and keystrokes required for clearing approved calculators can be found in the *General Information Bulletin* on the Alberta Education website.

Examination Security

All Mathematics 30–2 Diploma Examinations will be held secure until released to the public by the minister. No secure diploma examination is to be previewed, copied, or discussed.

Please refer to the *General Information Bulletin*.

Publications and Supporting Documents

The following documents are produced to provide teachers with information about the Mathematics 30–2 Diploma Examination:

- *Mathematics 30–2 Assessment Standards and Exemplars*

- *Mathematics 30–2 Practice Questions*
  Some practice questions have been released for Mathematics 30–2. The January 2013 Diploma Examination and the August 2013 Diploma Examination have both been released. The practice questions and both Diploma Examinations are available on Quest A+.

- *School Reports and Instructional Group Reports*
  Detailed statistical information on provincial, group, and individual student performance on the entire examination is available here.

Maintaining Consistent Standards over Time on Diploma Examinations

A goal of Alberta Education is to make examinations directly comparable from session to session, thereby enhancing fairness to students across administrations.

To achieve this goal, a number of questions, called anchor items, remain the same from one examination to another. Anchor 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. Anchor items are also used to find out if the unique items (questions that are different on each examination) differ in difficulty from the unique items on the baseline examination (the first examination to use anchor items). A statistical process called equating or linking adjusts for the differences in examination form difficulty. Examination marks may be adjusted slightly upward or downward, depending upon the difficulty of the examination written relative to the baseline examination. The resulting equated or linked examination scores have the same meaning regardless of when and to whom the examination was administered. Equated or linked diploma examination marks will be reported to students.

Because of the security required to enable 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. More information about equating is available here.

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.

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 for 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*.

Mathematics 30–2 Formula Sheet

The following information may be useful in writing this examination.

Relations and Functions

Graphing Calculator Window Format

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

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

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

$n! = n(n-1)(n-2)\ldots 3 \cdot 2 \cdot 1$,
where $n \in N$ 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

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