Information Bulletin

Mathematics 30–1

2016–2017 Diploma Examinations Program

This document was written primarily for:

Students	✓
Teachers	✓ of *Mathematics 30–1*
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.

Introduction

The purpose of this bulletin is to provide students and teachers of Mathematics 30–1 with information about the diploma examinations scheduled for the 2016–2017 school year. This bulletin should be used in conjunction with the current *Mathematics 30–1 Program of Studies* and the *Mathematics 30–1 Assessment Standards and Exemplars* documents 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 2016 and in January, April, June, and August 2017; 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.

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*.

Time Limits on Diploma Examinations

The Mathematics 30–1 Diploma Examination has a time limit of 3 hours. The time limits of other diploma examinations may differ.

Online Field Testing

Field tests for Mathematics 30–1 in the 2016–2017 school year will be offered in digital format, and two tests in each term will be hybrids. One hybrid will be for 50 minutes and one for 65 minutes.

Semester 1
Only year-end field tests will be offered of 50 and 65 minutes in length. One year-end field test each term will be translated into French. Also, a 40-question year-end field test 3 hours in length will be offered, in digital format only.

Semester 2
Only year-end field tests will be offered of 50 and 65 minutes in length. One year-end field test each term will be translated into French. Also, a 40-question year-end field test 3 hours in length will be offered, in digital format only.

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.

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 at Quest A+.

For more information, contact

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or

Dan Karas
Director, Examination Administration
780-492-1425 or Dan.Karas@gov.ab.ca

Released Exams

Mathematics 30-1 will release a full-length diploma in August 2016. It is the April 2016 diploma exam. It can be found here.

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.

For more information, contact

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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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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.

Teacher Involvement in the Diploma Examination Process

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 of diploma examination drafts.

The development of test items from their initial construction to their appearance on an examination takes at least one year. The writers of all items on diploma examinations are Mathematics 30–1 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 teachers and annually asks school jurisdictions for the names of teachers who are interested in being involved in all of the diploma examination development processes. Teachers who are interested in developing raw items, building field tests, or reviewing examinations are encouraged to ask their principals to submit their names to the Provincial Assessment Sector through their district office. Although the submission of these names occurs in early fall, teachers are welcome to have their names submitted at any time throughout the year.

Other opportunities to be involved, such as field testing, have specific closing dates. For more information on requesting field tests, please refer to the Field Testing section of the *General Information Bulletin*.

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 and standard of excellence performance standards for 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.

*NEW *Commentary on the Fourth Year of Mathematics 30–1 Diploma Examinations*

Introduction

Mathematics 30–1 diploma examinations were administered in November 2015, January 2016, April 2016, June 2016, and August 2016. January and June 2016 were large-scale administrations of the examination for the *Mathematics 30–1 Program of Studies*, 2008. This section is intended to provide teachers with information concerning the fourth year of these diploma examinations. 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. Before implementing the current *Mathematics 30–1 Program of Studies*, seven province-wide consultations involving over 120 teachers were held to discuss the blueprint for the Mathematics 30–1 diploma examinations. Teachers were also involved in developing items (exam questions) and performance standard descriptors.

The November 2015 and January, April, June, and August 2016 Mathematics 30–1 diploma examinations were built to the published blueprint specifications, based on the program of studies outcomes. To help ensure this, teachers, post-secondary representatives, and Alberta Education staff were extensively involved during the validation processes. After the administration of the January 2016 diploma examination, a standards confirmation working group, consisting of 20 teachers from across the province and curriculum staff, reaffirmed benchmarks of performance for the acceptable standard and the standard of excellence. Using two commonly accepted statistical procedures, it was established that the January 2016 Mathematics 30–1 diploma examination reflected the standards and outcomes of the current program. After the June 2016 Mathematics 30–1 examinations, 25 teachers along with curriculum staff met for 2 days and determined that the June 2016 Mathematics 30–1 examinations met the standards for the acceptable and excellence levels.

Fairness to students and student success will continue to be the focus of any changes to provincial assessments. In 2017, we plan to pick a baseline exam and start equating the marks for Mathematics 30-1 students.

Students' Strengths and Areas for Improvement

Strengths

- Working with stretches, reflections, and translations of functions and relations
- Working with logarithmic and exponential equations and functions and their graphs
- Identifying the equation of a transformed function described by mapping notation
- Identifying the graph of a polynomial function, given its graph
- Given the equation of a rational function, identify the equations of the horizontal and vertical asymptotes
- Simplifying trigonometric rational expressions
- Solving basic permutation and combination questions
- Converting from radian form to degree form of angles, and applying this to problem solving situations
- Solving the exact value of a trigonometric ratio given the value of another trigonometric ratio and conditions

Areas for Improvement

- Identifying the equation of a radical function that has undergone multiple transformations
- Identifying the equation of a logarithmic function that has been horizontally stretched by a factor about the *y*-axis
- Identifying the number of invariant points given the graph of a function and the equation of the square root of the function
- In an numerical response question, given 4 transformed logarithmic and exponential functions and a list of possible equations of their asymptotes, identifying the equation of the asymptote of each function
- Given the the equation and graph of a radical function and a point off the graph, identifying the stretch factor so that the new graph will pass through the point
- Given an amount of money, an interest rate, and a compounding period, identifying the equation for the amount to triple
- Given the graph of a transformed trigonometric function and the graph of its vertical reflection, identifying the parameters in the equation of the reflected graph
- Given the the coordinates of a point on the unit circle with a parameter, determining the value of the parameter
- Given a binomial expansion and 3 related statements, identifying whether each statement is true or false
- Given a binomial expansion of an expression with a non-linear term, determining the constant term

*NEW *Changes to the Assessment Standards and Exemplars Document*

Standards setters and Alberta Education staff made adjustments to the standards document in February 2016, after the January 2016 exam was administered and marked. Teachers should view the revised *Assessment Standards and Exemplars* document as posted.

Examination Specifications and Design

Each Mathematics 30–1 diploma examination is designed to reflect the core content outlined in the *Mathematics 30–1 Program of Studies*. The examination is limited to those expectations that can be measured by a machine-scored test. Therefore, the percentage weightings will not necessarily match the percentage of class time devoted to each unit.

Specifications

The format and content of the Mathematics 30–1 diploma examinations in the 2016–2017 school year are as follows:

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

Mathematical Understanding	*Percentage Emphasis*
Conceptual	34%
Procedural	30%
Problem Solving	36%

Diploma Exam Content	*Percentage Emphasis*
Relations and Functions	55%
Trigonometry	29%
Permutations, Combinations, and Binomial Theorem	16%

Machine-scored Questions

Information required to answer **multiple-choice** and/or **numerical-response questions** is often located in a box preceding the question. The number of 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 the next two questions.*"

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. The following are examples of these types of questions.

Correct-Order Question and Solution

Four Expressions

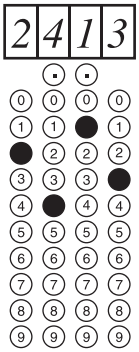
1 $5 \times 4 \times 3$
2 ${}_5C_2$
3 5!
4 ${}_5P_2$

When the expressions above are arranged in ascending order, their order is ___, ___, ___, and ___.

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

Value to be recorded: 2413

Record 2413 on the answer sheet →



Calculation Question and Solution

If $f(x) = 2x^2 + 3x + 5$ and $g(x) = x^2 + 2x - 3$, then $f(x) + g(x)$ can be expressed in the form $ax^2 + bx + c$.

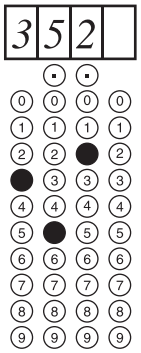
In the expression above, the value of

a is _____ (Record in the **first** column)
b is _____ (Record in the **second** column)
c is _____ (Record in the **third** column)

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

Value to be recorded: 352

Record 352 on the answer sheet →



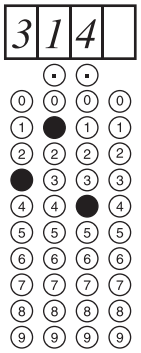
Any-Order Question and Solution

The zeros of the polynomial function $P(x) = x^3 - 8x^2 + 19x - 12$ 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: 314

Record 314 on the answer sheet →



Using Calculators

The Mathematics 30–1 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* under the Using Calculators and Using Computers sections.

Examination Security

All Mathematics 30–1 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. For the January and June 2017 examinations, teachers will be allowed access to a *Teacher Perusal Copy* for review purposes 1 hour after the examination has started.

For more information about teacher perusal copies and examination security, please refer to the *General Information Bulletin* on the Alberta Education website under Security & Examination Rules.

Publications and Supporting Documents

The following documents are produced to provide teachers with information about the Mathematics 30–1 diploma examination:

Mathematics 30–1 Assessment Standards and Exemplars

School Reports and Instructional Group Reports

Website Links

Publication/Resource ***Mathematics 30–1 Program of Studies***
Mathematics Grades 10–12 Program of Studies ***General Information Bulletin*** **Using Calculators** **Using Computers** **QuestA+** **Mathematics and Science Directing Words** **FAQs for Educators** **Fact Sheets & Useful Links** ***Released Materials***

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 whether 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 whether 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 30–1 diploma examinations will be fully secured and will not be released at the time of writing. For more information about equating or linking, please go to the Alberta Education website under Maintaining Consistent Standards Through Equating.

* Please note that the process of examination equating or linking for Mathematics 30–1 will not be implemented until extensive standard-setting has been performed.

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.

The *Mathematics 30–1 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 Mathematics Grades 10–12 Program of Studies.

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

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

Laws of Logarithms

$$\log_b\left(M \times N\right) = \log_b M + \log_b N$$

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

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

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

Growth/Decay Formula

$$y = ab^{\frac{t}{p}}$$

General Form of a Transformed Function

$$y = af\left[b(x - h)\right] + k$$

Permutations, Combinations, and the Binomial Theorem

$n! = n(n-1)(n-2)\ldots 3 \times 2 \times 1$,
where $n \in N$ and $0! = 1$

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

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

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

$$\theta = \frac{a}{r}$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta} \qquad \cot\theta = \frac{\cos\theta}{\sin\theta}$$

$$\csc\theta = \frac{1}{\sin\theta} \qquad \sec\theta = \frac{1}{\cos\theta}$$

$$\cot\theta = \frac{1}{\tan\theta}$$

$$\sin^2\theta + \cos^2\theta = 1$$

$$1 + \tan^2\theta = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

$$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$$

$$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$$

$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$$

$$\tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

$$\sin(2\alpha) = 2\sin\alpha\cos\alpha$$

$$\cos(2\alpha) = \cos^2\alpha - \sin^2\alpha$$

$$\cos(2\alpha) = 2\cos^2\alpha - 1$$

$$\cos(2\alpha) = 1 - 2\sin^2\alpha$$

$$\tan(2\alpha) = \frac{2\tan\alpha}{1 - \tan^2\alpha}$$

$$y = a\sin\left[b(x - c)\right] + d$$

$$y = a\cos\left[b(x - c)\right] + d$$

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