ALBERTA EDUCATION

Information Bulletin Mathematics 30–1

Diploma Examinations Program **2022–2023**

Alberta

This document was primarily written for:		
Students		
Teachers	✓	of Mathematics 30–1
Administrators		
Parents		
General Audiences		
Others		

2022–2023 Mathematics 30–1 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 30–1 with information about the diploma examinations scheduled for the 2022–2023 school year. This bulletin should be used in conjunction with the current Mathematics 30–1 Program of Studies, the *Mathematics 30–1 Assessment Standards and Exemplars* document, and the *Mathematics 30–1 Written-Response Information* document to ensure that the curriculum and standards are addressed.

This bulletin includes descriptions of the *Mathematics 30–1 Diploma Examinations* that will be administered in November 2022 and in January, April, June, and August 2023; descriptions of the acceptable standard and the standard of excellence; and subject-specific information.

For the 2022–2023 school year, the weighting of diploma exams will be temporarily changed to 20% and the school-awarded mark will constitute 80% of a student's final mark.

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

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

Examination Security

All diploma examinations will be held secure until they are released to the public by the Minister. No secure diploma examination is to be viewed until it is released to the public by the Minister. No secure diploma examination is to be previewed, discussed, copied, or removed from the room in which the examination is being written. However, for the January and June administrations only, teachers will be allowed access to a teacher perusal copy for review purposes one hour after the examination has started.

For mathematics and science diploma examinations: All diploma examination booklets must be kept secure, before, during, and after administration, without exception.

For humanities diploma examinations: The humanities Part A: Written Response booklets in the January and June administrations must be kept secure until after they are administered. All other humanities Part A: Written Response booklets, and all humanities Part B booklets, must be kept secure before, during, and after administration, without exception.

Unused copies of all secured diploma examinations must be returned to Alberta Education as per the dates indicated in the *Significant Dates at-a-Glance*.

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 30–1 Diploma Examination*, if they need it. **The examination is nevertheless designed so that the majority of students can complete it within 3 hours.** The examination instructions state both the designed time and the total time allowed.

Although extra time is allowed for diploma examinations in all subjects, 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*.

Equating to Maintain 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 on the Administering diploma exams web page.

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

Diploma Examinations: Multiple Forms

Some subjects may have two distinct forms (versions) of diploma examinations 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

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 the *Mathematics 30–1 Diploma Examinations* are written by Mathematics 30–1 teachers from across Alberta. After the first year of provincial implementation of the program of studies, items are field tested to ensure their reliability and validity. Diploma examinations are reviewed by editors; a technical advisory working group composed of mathematics experts from post-secondary institutions, teachers, and curriculum staff; translators; and a French validation working group.

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

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

Periodically, we send out information to those Mathematics 30–1 teachers who are on our contact list. If you are not on that list and would like to receive updates related to Mathematics 30–1 assessment activities, please contact either Delcy Rolheiser, Mathematics 30–1 Diploma Exam Lead, at Delcy.Rolheiser@gov.ab.ca or Jason Kosik, Mathematics 30–1 Examiner, at Jason.Kosik@gov.ab.ca.

Field Testing

Field testing is an essential stage in the development of fair, valid, and reliable provincial examinations. Field testing is a process of collecting data on questions before they become part of a diploma examination. Potential diploma examination questions are administered to students in diploma courses throughout the province to determine the difficulty and appropriateness of the questions. Each field test requires a large student sample to provide the examination developers with reliable information (i.e., 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, the 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. Digital field tests contain machine-scored questions only.

For digital 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 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 numerical-response items blank. Test items address learning outcomes in the program of studies, which allows teachers to use field-test results to learn more about their students' strengths and areas for improvement.

Teachers have a 24-hour window to peruse digital field tests. 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.

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 within two business days.

More information about field-test registration deadlines, administration, and security is available at the Teacher participation in provincial assessments web page.

How can teachers request field tests?

Teachers requesting field tests must have a Public Authentication System (PAS) account. All requests are made through the Field Test Request System.

Further information, including the closing dates to request and administer a field test, may be obtained at the Teacher participation in provincial assessments web page, or by contacting Field.Test@gov.ab.ca.

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

Mathematics 30–1 Field Testing

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

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

The table below shows the format, length of time, and number of questions for field tests available for the 2022–2023 school year.

Field Test Format	Test Length	Number of Questions
Digital	50 minutes	10 multiple choice 3 numerical response
	65 minutes	13 multiple choice 4 numerical response
Paper	50 minutes	7 multiple choice 2 numerical response 1 written response
	65 minutes	7 multiple choice 2 numerical response 2 written response

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

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

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

Practice Tests

To give students an opportunity to practise diploma examination-style questions that address learning outcomes in the program of studies, Alberta Education produces practice tests for most subjects that have a diploma examination. Students can access these practice tests using Alberta Education's Quest A+ online delivery system.

Special-format Practice Tests

To give students an opportunity to practise diploma examination-style questions that address learning outcomes in the program of studies 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 Field.Test@gov.ab.ca.

Audio Descriptions

A support document, *Examples of Descriptions Used in Audio Versions of Mathematics Diploma Exams*, has been developed to assist teachers and students planning to use an audio version during the administration of a mathematics diploma examination.

Course Objectives

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

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

Mathematical Processes

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

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

	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, refer to 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 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.

Diploma exams are designed to match the program of studies of each subject, but what the diploma exams measure may not be the same in scope as what teachers measure. Diploma exam marks and teacher-awarded marks should reflect the same standard, however, because both assess students based on the same program of studies (curriculum). Alberta Education works with teachers to set and maintain the standards of achievement for diploma exams. This information bulletin is intended to assist teachers in understanding the provincial standards for Mathematics 30-1.

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.

When analyzing the data in Table 1 of the detailed reports, note that the percentage of students who achieved the acceptable standard includes students who achieved the standard of excellence.

Assessment Standards and Exemplars

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

Examples of Written-response Questions

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

Explanation of Cognitive Levels

Procedural

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

Conceptual

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

Problem solving

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

Examination Specifications and Design

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

Specifications

The format and content of the *Mathematics 30–1 Diploma Examinations* in the 2022–2023 school year are as follows:

Question Format	Number of Questions	Emphasis
Machine Scored		75%
• Multiple Choice	24	
• Numerical Response	8	
Written Response	3	25%

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

Topic	Emphasis
Relations and Functions	53%–58%
Trigonometry	27%–33%
Permutations, Combinations, and Binomial Theorem	14%–18%

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

Cognitive Level	Emphasis
Conceptual	34%
Problem Solving	36%
Procedural	30%

Machine-scored questions

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

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

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

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

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

Instructions on how to record responses to numerical-response questions, with specific examples, are shown on pages 19 and 20.

Written-response questions

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

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

General Scoring Guides

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

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

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

2-MARK PART

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.

3-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 minimal mathematical understanding of the problem by applying an appropriate strategy or some relevant mathematical knowledge to complete initial stages of a solution.
1.5	
2	In the response, the student demonstrates good mathematical understanding of the problem by applying an appropriate strategy or relevant mathematical knowledge to find a partial solution.
2.5	
3	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 of 0, 1, 2, and 3. A student response that does not meet the performance level of a benchmark score may receive an augmented score of 0.5, 1.5, or 2.5. Descriptions of these augmented scores will be determined with teachers at each marking session and will not be an exhaustive list. Each part will be scored separately and the scores will be combined for a total of 5 marks.

Using Calculators

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

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

Mathematics 30-1 Diploma Examination Instructions Pages

Mathematics 30–1

Grade 12 Diploma Examination

Description

Time: 3 hours. This closed-book examination was developed to be completed in 3 hours; however, you may take up to 6 hours to complete the examination, should you need it.

This examination consists of:

- 24 multiple-choice and 8 numerical-response questions worth 75% of the total examination mark
- 3 written-response questions worth 25% of the total examination mark

A tear-out formula sheet is included in this booklet.

All graphs on this examination are computer-generated.

Do not write your name anywhere in this booklet.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Instructions

- Turn to the last page of the examination booklet. Carefully fold and tear out the machine-scored answer sheet along the perforation.
- Use **only** an **HB** pencil for the answer sheet.
- Fill in the information on the back cover of the examination booklet and the answer sheet as directed by the presiding examiner.
- You must use a graphing calculator approved by Alberta Education.
- You **must** have cleared your calculator of all information that is stored in the programmable or parametric memory.
- You may use a ruler and a protractor.
- Read each question carefully.
- Consider all numbers to be **exact** numbers and not the result of a measurement.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do **not** fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. biology
B. physics
C. chemistry
D. mathematics

Answer: D

Record D on the answer sheet: Ⓐ Ⓑ Ⓒ ●

Numerical Response

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

Examples

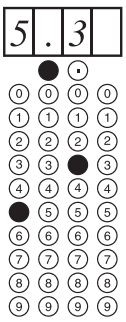
Calculation Question and Solution

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

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

Calculator value: 5.333333…
Answer: 5.3

Record 5.3 on the answer sheet →



Any-order Question and Solution

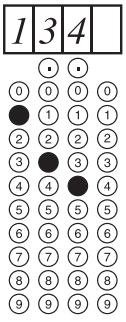
Four Words			
1	Circle	**3**	Triangle
2	Multiply	**4**	Rectangle

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

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

Answer: 134 (in any order)

Record 134 on the answer sheet →



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

Correct-order Question and Solution

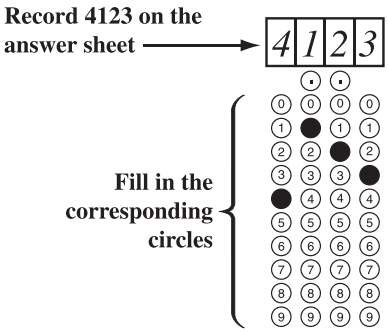
Four exponential functions of the form $y = b^x$ are listed below.

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

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

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

Answer: 4123



Correct-order Question and Solution

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

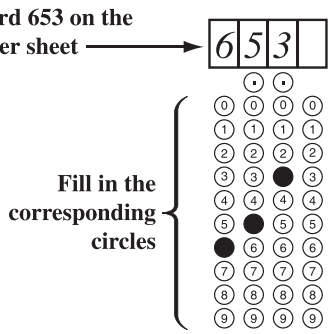
1	***a***
b	2
c	4

In the table above, the value of

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

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

Answer: 653



Written Response

- 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Commentary on the *Mathematics 30–1 Diploma Examinations*

Because diploma exams were optional for students in the 2020–2021 school year and cancelled for the January 2022 administration, the observations about student performance outlined below are based on the results from the diploma exams administered in the 2019–2020 school year.

Students' strengths and areas for improvement

Relations and Functions

- Students continue to perform well on questions regarding the interpretation of transformation equations involving stretches, reflections, and translations to determine the coordinates of a transformed point.
- Students are able to identify transformations when given a transformation equation, but many have difficulty representing the transformation using mapping notation.
- Students continue to have difficulty determining the number of invariant points associated with different transformations.
- Students are able to use a logarithm law to evaluate a logarithmic expression, but continue to have difficulty using multiple logarithm laws to simplify an expression into a single logarithm.
- Students are improving in their ability to relate the characteristics of the graph of an exponential function to the parameters of the corresponding equation.
- Students are able to solve logarithmic equations and exponential equations that can be simplified to a common base.
- Students are able to determine the domain and range of a function after a transformation, but many students have difficulty determining the domain after the division of two functions.

Trigonometry

- Students continue to perform well on problems involving coterminal angles and arc length.
- Students are improving in their ability to apply the equation of the unit circle to solve problems.
- Students continue to perform well on questions that require them to relate the parameters in the equation of a sinusoidal function to the characteristics of the corresponding graph of the function.
- Students are able to solve second-degree trigonometric equations in a variety of domains, but many students have difficulty solving equations when an identity substitution is required.
- Students have difficulties determining the general solution of a trigonometric equation when given the solutions to the equation in a restricted domain.
- Students are able to determine the exact value of a trigonometric expression when verifying a trigonometric identity.

Permutations, Combinations, and Binomial Theorem

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

Observations from written-response component

- Students should be reminded that they must be familiar with the specific meaning of the directing words. Markers noted that many students did not demonstrate that they know, for example, that the directing word **determine** requires that students include supporting evidence with their solution and that the word **algebraically** requires students to demonstrate a complete algebraic process or procedure when solving the problem. Students should also be aware that the directing word **compare** requires an explicit statement of similarities and differences along with supporting evidence. Teachers may wish to discuss the meanings of these words with their students.
- Markers noted that some students are able to clearly illustrate the steps of their work, but many need to focus on organizing their work in a logical way.
- Many students need to focus on the details within their written work. Markers noted that students often omit the correct units in their final answer, forget to include the angle argument when writing trigonometric expressions, do not include all of the necessary brackets, and write expressions in place of equations. Additionally, students should be reminded to set factors equal to zero when solving equations, relate their solution to the context of the problem, and use the proper notation and vocabulary in their explanations of concepts.
- Students continue to have difficulty including all of the key characteristics in their sketch of the graph of a function. Key characteristics may include vertices, endpoints, maximum and minimum points, intercepts, and asymptote lines. Additionally, many students have difficulty illustrating the correct graph shape and drawing appropriately scaled axes when sketching the graph of a function.

Mathematics Directing Words

In Provincial Assessment 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 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

Website Links

Alberta Education website

Programs of study

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

Diploma Examinations Program

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

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

Field Test Request System

Field Test Information

Teacher Participation in Provincial Assessments
contains information about marking, field testing, item development, and examination validation

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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Inquiries about field testing can be sent by email to
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