Alberta Provincial Achievement Testing

Mathematics

Government of Alberta ■

Alberta

Freedom To Create. Spirit To Achieve.

This document contains assessment highlights from the 2011 Grade 6 Mathematics Achievement Test (*2007 Program of Studies*). The examination statistics that are included in this document represent all writers: both French and English. If you would like to obtain English-only or French-only statistics that apply to your school, please refer to your detailed reports, which are available on the Extranet.

Assessment highlights provide information about the overall test, test blueprints, and student performance on the achievement test that was administered in 2011. This information is intended for teachers and is best used in conjunction with multi-year and detailed school reports that are available in schools via the extranet. **Assessment highlights reports** for all achievement test subjects and grades will be posted on the **Alberta Education website every year** in the fall.

All released achievement tests including test blueprints, answer keys with the item difficulty, reporting category, test section, and item description for each test item are located at:
education.alberta.ca/admin/testing/achievement/answerkeys.aspx
These materials, along with the *Program of Studies* and subject bulletins, provide information that can be used to inform instructional practice.

For further information, contact
Kelly Rota, Grade 6 and 9 Mathematics Assessment Standards Team Leader, at Kelly.Rota@gov.ab.ca;
Delcy Rolheiser, Grade 6 and 9 Mathematics Examiner, at Delcy.Rolheiser@gov.ab.ca; or
Ken Marcellus, Director, Achievement Testing, at Ken.Marcellus@gov.ab.ca
in the Assessment Sector, or call (780) 427-0010. To call toll-free within Alberta, dial 310-0000.

The Alberta Education Internet address is education.alberta.ca.

This document was written primarily for:

Students	
Teachers	✓ of Grade 6 Mathematics
Administrators	✓
Parents	
General Audience	
Others	

Contents

The 2011 Grade 6 Mathematics Achievement Test

This report provides teachers, school administrators, and the public with an overview of the performance of those students who wrote the 2011 Grade 6 Mathematics Achievement Test. It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 39 542 students wrote the 2011 Grade 6 Mathematics Achievement Test. The English form of the test was written by 36 499 students and the French form of the test was written by 3 043 students.

What Was the Test Like?

The 2011 Grade 6 Mathematics Achievement Test consisted of 40 multiple-choice and 10 numerical-response questions based on four strands: Number, Patterns and Relations, Shape and Space, Statistics and Probability. In keeping with the intent of the 2007 Program of Studies, the questions on the test required students to apply their understanding of one or more mathematical concepts from within and/or across the four strands. As they solved the mathematical problems, students were expected to use the interrelated mathematical processes of Communication, Connections, Mental Mathematics and Estimation, Problem Solving, Reasoning, and Visualization. A detailed explanation of these mathematical processes is in the Alberta K-9 Mathematics Program of Studies.

How Well Did Students Do?

The percentages of students meeting the *acceptable standard* and the *standard of excellence* in 2011 are shown in the graph below. Out of a total score of 50 on the test, the provincial average was 32.0/50 (64.0%). The results presented in this report are based on scores achieved by all students who wrote the test, including those in French Immersion and Francophone programs. Detailed provincial assessment results are provided in school and jurisdiction reports.

Grade 6—2011 Mathematics Achievement Test		
	Acceptable (%)	Excellence (%)
2011	81.2	19.6

Percentage of Students Meeting the
Acceptable Standard & Standard of Excellence **(%)**
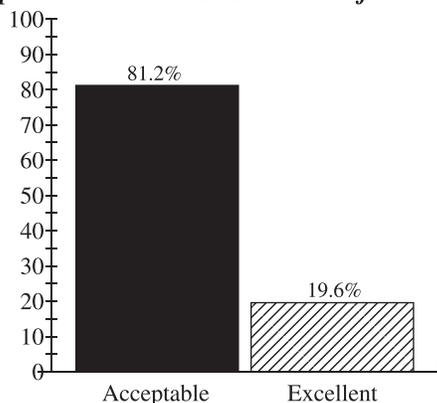
■ 2011 Achievement Standards: The percentage of students in the province who met the *acceptable standard* on the 2011 Grade 6 Mathematics Achievement Test (based on those who wrote)

▨ 2011 Achievement Standards: The percentage of students in the province who met the *standard of excellence* on the 2011 Grade 6 Mathematics Achievement Test (based on those who wrote).

2011 Test Blueprint and Student Achievement

In 2011, 81.2% of students who wrote the test achieved the *acceptable standard* on the Grade 6 Mathematics Achievement Test, and 19.6% of students who wrote achieved the *standard of excellence.*

Out of a total score of 50 on the test, the provincial average was 32.0/50 (64.0%). The blueprint below shows how the questions on the test were classified and includes the average raw score in each category for all grade nine students who wrote this test.

Strand	Level of Complexity*			Provincial Student Achievement (Raw Score and Percentage)
	Low	Moderate	High	
Number	6	8	3	**10.6/17** **(62.5%)**
Patterns and Relations	3	7	4	**9.3/14** **(66.1%)**
Shape and Space	7	6	1	**9.1/14** **(65.0%)**
Statistics and Probability	2	3	0	**3.0/5** **(60.2%)**
Provincial Student Achievement (Average Raw Score and Percentage)	**12.3/18** **(68.5%)**	**15.5/24** **(64.5%)**	**3.9/8** **(49.1%)**	**Total Test Raw Score** **32.0/50** **(64.0%)**

*Each question is categorized according to its level of complexity (Low, Moderate, or High). Descriptions of the levels of complexity are in the *2011-2012 Mathematics 6 Subject Bulletin*.

2011 Grade 6 Mathematics Achievement Test Design Commentary

The 2011 Mathematics Provincial Achievement Test for Grade 6 was based on the 2007 Alberta K–9 Mathematics Program of Studies that was implemented in the 2010–2011 school year. The test blueprint provides information about new test design features (i.e., complexity) and modified test design features (i.e., item format and strand). Items now are selected not only in terms of the knowledge and skills that they assess, but also in terms of their complexity with regards to content and cognition. The introduction of item complexity will provide more information about the depth to which students have mastered particular learning outcomes, as well as provide one more control in the selection of test items to better ensure that tests are equivalent from year to year. Please refer to the *2011–2012 Mathematics 6 Subject Bulletin* for more detailed information about item complexity.

The selection of test items within each of the four strands is now based on two primary factors: item difficulty and item complexity.

> **Item difficulty** refers to the percentage of students who actually chose the correct answer. Items for which the correct answer is chosen by more than 70 percent of the students are generally considered easy. Items for which the correct answer is chosen by 50–70 percent of the students are about average in difficulty. Items for which the correct answer is chosen by less than 50 percent of the students are regarded as challenging.

> **Item complexity** refers to the cognitive and content demands associated with an item. The rationale for classifying items by their level of complexity is to focus on the expectations of the item and not the ability of the student. The cognitive demands an item requires of a student, (i.e., what an item requires the student to recall, understand, analyze, and do), are made with the assumption that the student is familiar with the basic concepts of the task.

The categories—low complexity, moderate complexity, and high complexity—form an ordered description of the demands an item may make on a student. For example, low complexity items may require a student to solve a one-step problem. Moderate complexity items may require multiple steps. High complexity items go even further and require a student to analyze and synthesize information. It is therefore important to consider both the content being assessed by an item and the item complexity when making inferences about student performance on any one outcome. Although there is a logical and predictable relationship between item difficulty and item complexity (e.g., items that are of high complexity tend to be more challenging), there are instances in which this is not the case. For example, item #12 and item #28 both assess Specific Outcome #3 from the Number strand; however, student performance on these two items was significantly different; i.e., students actually did better on item #12, which was classified as a moderate complexity item, than on item #28, which was classified as a low complexity item.

The following 8 items have been released to help illustrate areas of student strength and areas for improvement from each of the four strands. The reporting categories for each item, as well as the statistics in terms of the percentage of students who answered the item correctly and the percentages for the incorrect options chosen, have also been provided.
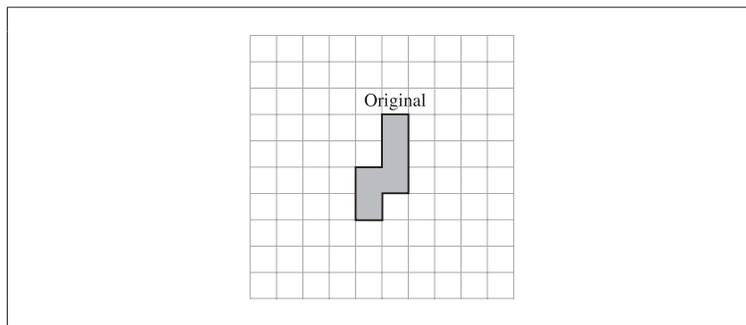
Sample Questions from the 2011 Grade 6 Mathematics Achievement Test

Items 1–4 Illustrate Student Strengths

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A	B*	C	D
1	4	SS	9	Moderate	12.2	75.4	3.3	9.0

* Correct response

Use the following diagram to answer question 4.

Original

4. Which of the following diagrams represents the correct position of the polygon shown above after it has been translated 3 units to the left and 1 unit up?

A.

Original

Image

B.

Image

Original

C.

Original

Image

D.

Image

Original
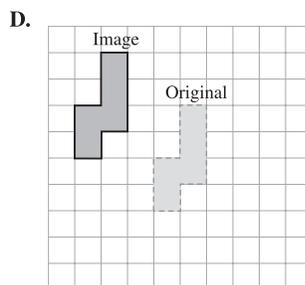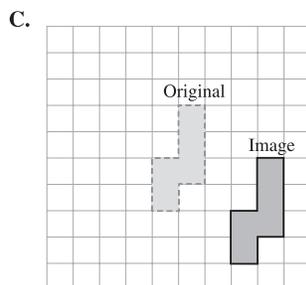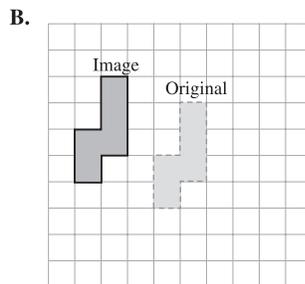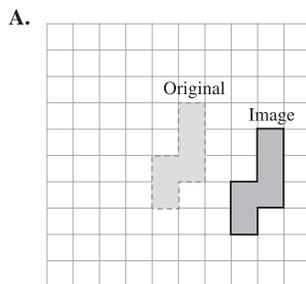
To answer this item correctly, students had to perform a combination of translations on a 2-D shape and identify the location of the image.

The most common incorrect response (A) suggests that students performed a translation of the shape 3 units to the right and 1 unit down – the exact opposite of what was asked.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option	
					Correct	Incorrect
2	NR 3	PR	2	Moderate	68.6	33.4

Use the following information to answer numerical-response question 3.

The table below shows the cost to rent a canoe by the hour.

Number of Hours	Cost
1	$5.25
2	?
3	$9.75
4	$12.00
5	$14.25

Numerical Response

3. What is the cost to rent a canoe for 2 hours?

Answer: $ _____

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

To answer this item correctly, students had to understand the relationship between the values provided in a table of values to solve the problem. Some students may have used the patterns within each column to determine the missing value while others may have created a rule to describe the relationship.

The most common incorrect response ($2.25) indicates that these students found only the difference of cost from one hour to the next instead of the sum cost for 2 hours of renting the canoe. Another common error ($4.50) indicates that these students simply doubled the difference in cost of one hour to the next.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A*	B	C	D
3	13	N	4	Moderate	70.1	9.7	7.0	13.1

* Correct response

Use the following information to answer question 13.

The following buckets were used to collect rainwater from a leaky roof.

13. Which of the following improper fractions shows the amount of water that is collected?

A. $\frac{15}{4}$

B. $\frac{15}{3}$

C. $\frac{13}{4}$

D. $\frac{4}{3}$

To answer this item correctly, students had to interpret the provided diagram to create an improper fraction that represents the sum of all 4 represented fractions.

The most common incorrect response (D) suggests that some students simply do not understand the concept of improper fractions; e.g., some students may have reasoned that there are 4 buckets and only 3 of them were completely full of water.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option	
					Correct	Incorrect
4	NR 9	SS	8	High	68.2	33.8

Use the following diagram to answer numerical-response question 9.
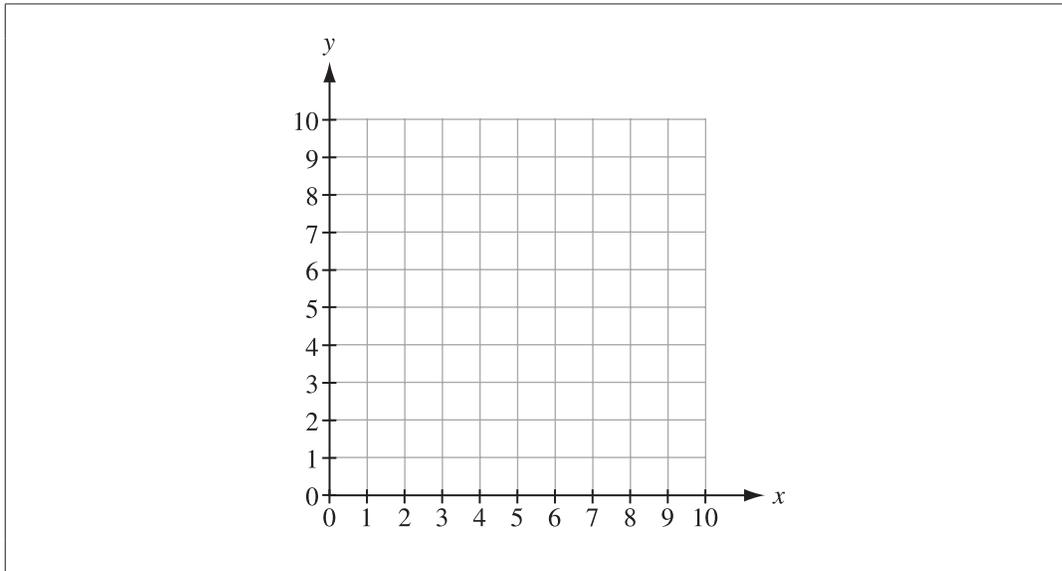
Numerical Response

9. What would be the area of a polygon with vertices (2, 3), (2, 5), (7, 3) and (7, 5)?

Answer: _____ **square units**

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

To answer this item correctly, students had to plot coordinates in the first quadrant of the Cartesian plane. They were also successful at creating the polygon by connecting the 4 coordinates that form the vertices of the polygon in order to determine its area.

The most common incorrect response (14) indicates that these students solved for the polygon's perimeter instead of its area.

Items 5–8 Illustrate Areas for Potential Improvement

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A	B*	C	D
5	21	SP	3	Moderate	46.2	27.4	15.1	11.0

* Correct response
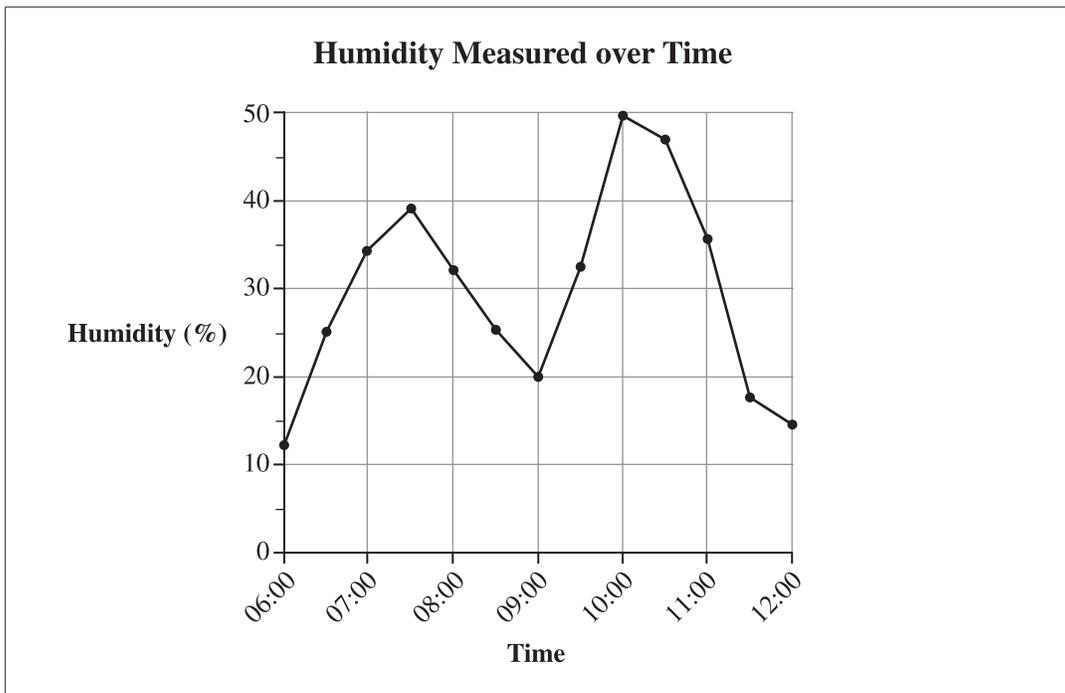
Use the following information to answer question 21.

Humidity Measured over Time

21. According to the graph shown above, approximately how many minutes in **total** did the humidity stay above 35%?

    A.   60 to 120 minutes

    B.   120 to 150 minutes

    C.   150 to 180 minutes

    D.   180 to 210 minutes
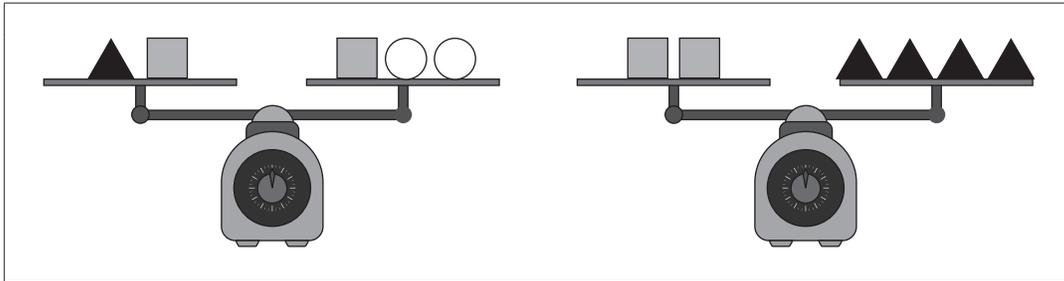
To answer this item correctly, students had to read and interpret the provided graph in order to determine the total number of minutes that the humidity stayed above 35%.

The most common incorrect response (A) suggests that these students may not have used an adequate strategy, e.g., drawing a horizontal straight line across from the humidity value of 35%) to solve the problem.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A	B*	C	D
6	25	PR	5	High	49.2	43.0	3.9	3.6

* Correct response

Use the following information to answer question 25.

25. How many circles does it take to balance one square?

    A.   2

    B.   4

    C.   6

    D.   8

To answer this item correctly, students had to determine the relationship between the different shapes for the balance scales to be balanced.

The most common incorrect response (A) suggests that students considered 1 square to equal 2 circles instead of 1 triangle equaling 2 circles.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A	B*	C	D
7	28	N	3	Low	10.2	46.1	15.8	27.6

* Correct response

28. Which of the following sets of numbers contains only composite numbers?

    A.   1, 2, 17, 29, 37

    B.   4, 9, 16, 21, 38

    C.   1, 8, 14, 25, 32

    D.   5, 11, 19, 23, 41

To answer this item correctly, students had to recall the concept of composite numbers, and apply their understanding of factors, to determine the sets of numbers that contained only composite numbers.

The most common incorrect response (D) suggests that students were unable to recall the meaning of composite numbers and instead chose the set of numbers that contained only prime numbers. The next most common incorrect response (C) suggests that students considered 1 to be a composite number.

Item	Question # on PAT	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
					A	B	C	D*
8	34	N	6	High	40.7	8.5	7.3	43.2

* Correct response

Use the following information to answer question 34.

Several ice cream cones were sold from an ice cream truck in one day. The chart below shows the number of ice cream cones of each flavour that were sold.

Ice Cream Flavour	Number of Ice Cream Cones Sold
Chocolate	20
Strawberry	15
Vanilla	10
Bubble Gum	5

34. Which 2 flavours of ice cream **together** made up 30% of the total ice cream cones sold?

    A.   Chocolate and Vanilla

    B.   Chocolate and Strawberry

    C.   Strawberry and Bubble Gum

    D.   Vanilla and Bubble Gum

To answer this item correctly, students had to use the table of values to create a fraction that would be equivalent to 30%.

The most common set of incorrect responses (A) suggests that many students believed that 30% equaled the number of ice cream cones sold, i.e., the sum of chocolate ice cream cones and vanilla ice cream cones sold.

Achievement Testing Program Support Documents

The Alberta Education website contains several documents that provide valuable information about various aspects of the achievement testing program. To access these documents, go to the Alberta Education website at education.alberta.ca. From the home page, follow this path: *Teachers > Provincial Testing > Achievement Tests*, and then click on one of the specific links under the *Achievement Tests* heading to access the following documents.

Achievement Testing Program *General Information Bulletin*
The *General Information Bulletin* is a compilation of several documents produced by Alberta Education and is intended to provide superintendents, principals, and teachers with easy access to information about all aspects of the achievement testing program. Sections in the bulletin contain information pertaining to schedules and significant dates; security and test rules; test administration directives, guidelines, and procedures; calculator and computer policies; test accommodations; test marking and results; field testing; resources and web documents; forms and samples; and Assessment Sector contacts.

Subject Bulletins
At the beginning of each school year, subject bulletins are posted on the Alberta Education website for all achievement test subjects for grades 3, 6, and 9. Each bulletin provides descriptions of assessment standards, test design and blueprinting, and scoring guides (where applicable) as well as suggestions for preparing students to write the tests and information about how teachers can participate in test development activities.

Examples of the Standards for Students' Writing
For achievement tests in grades 3, 6, and 9 English Language Arts and Français/French Language Arts, writing samples have been designed to be used by teachers and students to enhance students' writing and to assess this writing relative to the standards inherent in the scoring guides for the achievement tests. The exemplars documents contain sample responses with scoring rationales that relate student work to the scoring categories and scoring criteria.

Previous Achievement Tests and Answer Keys
All January achievement tests (parts A and B) for Grade 9 semestered students are secured and must be returned to Alberta Education. All May/June achievement tests are secured except Part A of grades 3, 6, and 9 English Language Arts and Français/French Language Arts. Unused or extra copies of only these Part A tests may be kept at the school after administration. Teachers may also use the released items and/or tests that are posted on the Alberta Education website.

Parent Guides
Each school year, versions of the *Parent Guide to Provincial Achievement Testing* for grades 3, 6, and 9 are posted on the Alberta Education website. Each guide presents answers to frequently asked questions about the achievement testing program as well as descriptions of and sample questions for each achievement test subject.

Involvement of Teachers
Teachers of grades 3, 6, and 9 are encouraged to take part in activities related to the achievement testing program. These activities include item development, test validation, field testing, and marking. In addition, arrangements can be made through the Alberta Regional Professional Development Consortia for teacher in-service workshops on topics such as Interpreting Achievement Test Results to Improve Student Learning.