Alberta Provincial Achievement Testing

Assessment Highlights 2013–2014

GRADE 6

Mathematics

Alberta Government

This document contains assessment highlights from the 2014 Grade 6 Mathematics Achievement Test. The examination statistics included in this document represent all writers, both French and English. 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 provides information about the overall test, test blueprints, and student performance on the achievement test that was administered in 2014. Also provided is commentary on student performance at the acceptable standard and the standard of excellence on selected items from the 2014 Grade 6 Mathematics Achievement Test. 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.

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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 2014 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 2014 Grade 6 Mathematics Achievement Test. It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 41 407 students wrote the 2014 Grade 6 Mathematics Achievement Test. The English form of the test was written by 38 209 students, and the French form of the test was written by 3 198 students.

What Was the Test Like?

The 2014 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, and 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 2014 are shown in the graph below. Out of a total score of 50 on the test, the provincial average was 28.53/50 (57.1%). 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—2014 Mathematics Achievement Test		
	Acceptable (%)	Excellent (%)
2014	80.7	17.0

Percentage of Students Meeting the
Acceptable Standard & Standard of Excellence (%)

Acceptable — 80.7%
Excellent — 17.0%
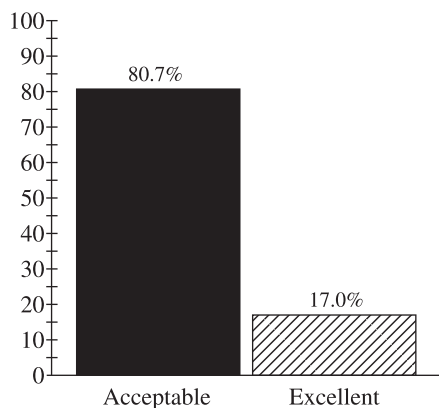
■ 2014 Achievement Standards: The percentage of students in the province who met the acceptable standard on the 2014 Grade 6 Mathematics Achievement Test (based on those who wrote)

▨ 2014 Achievement Standards: The percentage of students in the province who met the standard of excellence on the 2014 Grade 6 Mathematics Achievement Test (based on those who wrote)

2014 Test Blueprint and Student Achievement

In 2014, 80.7% of students who wrote the test achieved the acceptable standard on the Grade 6 Mathematics Achievement Test, and 17.0% of students who wrote achieved the standard of excellence.

Out of a total score of 50 on the test, the provincial average was 28.53/50 (57.1%). The blueprint below shows how the questions on the test were classified and includes the average raw score in each category for all Grade 6 students who wrote this test.

Strand	Level of Complexity*			Provincial Student Achievement (Raw Score and Percentage)
	Low	Moderate	High	
Number	8	8	1	**10.1/17 (59.4%)**
Patterns and Relations	1	8	5	**8.1/14 (57.9%)**
Shape and Space	4	7	3	**8.5/14 (60.7%)**
Statistics and Probability	3	2	0	**2.6/5 (52.0%)**
Provincial Student Achievement (Average Raw Score and Percentage)	**9.5/16 (59.4%)**	**15.1/25 (60.4%)**	**4.7/9 (52.2%)**	**Total Test Raw Score 28.53/50 (57.1%)**

*Each question is categorized according to its level of complexity (low, moderate, or high). Descriptions of the levels of complexity are in the *2014–2015 Mathematics 6 Subject Bulletin*.

2014 Grade 6 Mathematics Achievement Test Design Commentary

The 2014 Mathematics Provincial Achievement Test for Grade 6 was based on the 2007 Alberta K–9 Mathematics Program of Studies that was implemented in the 2011–2012 school year. The test blueprint provides information about new test design features (e.g., complexity) and modified test design features (e.g., 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 regard 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 *2014–2015 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 chose the correct answer. Items for which the correct answer is selected by more than 70% of the students are generally considered easy. Items for which the correct answer is selected by 50–70% of the students are about average in difficulty. Items for which the correct answer is selected by fewer than 50% 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 underlying the item and not the ability of the student. The cognitive demands that an item makes on 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 (i.e., items that are of high complexity tend to be more challenging), there are exceptions.

The following eight items have been released to illustrate significant performance differences between groups of students: (1) those students who achieved the standard of excellence as opposed to those who achieved the acceptable standard, and (2) those students who achieved the acceptable standard as opposed to those who were below the acceptable standard. The purpose of these comparisons is to provide additional information that may be used for instructional purposes.

Sample Questions from the 2014 Grade 6 Mathematics Achievement Test

The following four items, from all four strands, illustrate significant performance differences between students who achieved the standard of excellence and those who achieved the acceptable standard.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
14	SS	4	Moderate	Draw and classify a triangle by connecting three coordinates in the first quadrant of the Cartesian plane after one of the three coordinates has been plotted correctly.

	% of Student Responses (*Correct)			
	A	**B***	**C**	**D**
Performance of Students Achieving the Standard of Excellence	11.4	75.5	12.8	0.3
Performance of Students Achieving the Acceptable Standard	27.2	53.3	16.3	3.1

Plot a third point at (3, 9) on the grid below and label the point *A*. Connect all three points with two straight lines to create a triangle, *ABC*.
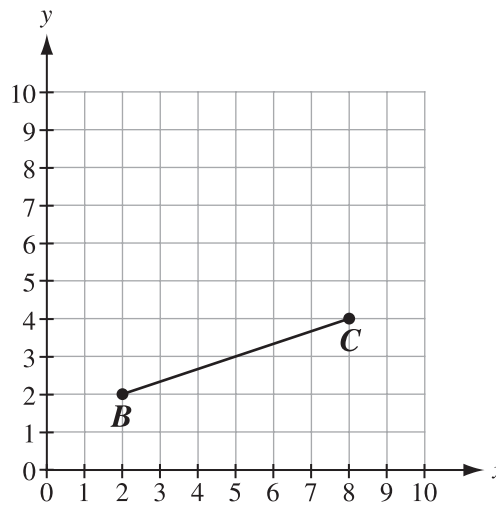
14. Triangle *ABC* is

    A.   an equilateral triangle

    B.   an isosceles triangle

    C.   a scalene triangle

    D.   a right triangle

Commentary:

Approximately three-quarters of the students who achieved the standard of excellence were successful on this item, while only approximately half of the students who achieved the acceptable standard were successful. Three-step items such as this, where students have to complete a drawing, decide on the criteria for a classification, and then make measurements to make a classification decision, are relatively straightforward for students who achieved the standard of excellence, but are very difficult for students who achieved the acceptable standard.

Of the students who achieved the standard of excellence but answered the item incorrectly, approximately half chose option C as their response. This suggests that these students incorrectly plotted point (3, 9) as point (9, 3), creating a scalene triangle. Approximately half of these students chose option A as their response, suggesting that they plotted point (3, 9) correctly but had difficulty classifying a triangle as equilateral or isosceles. Essentially none of these students chose option D as their response; nearly all of these students therefore rejected the idea of classifying the triangle as a right triangle.

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately one-third chose option C as their response, and over half chose option A as their response. This suggests that more of these students had difficulties with the classification of triangles than with the plotting of points. Again, very few of these students chose option D as their response; nearly all of these students therefore rejected the idea of classifying the triangle as a right triangle.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
21	N	1	Moderate	Determine the sum of two specific digits in a seven-digit whole number.

	% of Student Responses (*Correct)			
	A	B*	C	D
Performance of Students Achieving the Standard of Excellence	12.9	66.2	11.0	9.7
Performance of Students Achieving the Acceptable Standard	22.7	29.6	27.1	20.0

> Sam uses the digits from 3 to 9 to create a number with the largest possible value. All seven digits are used, and each digit is used only once.

21. What is the sum of the digits that are in the tens' place and in the ten thousands' place?

    A. 10
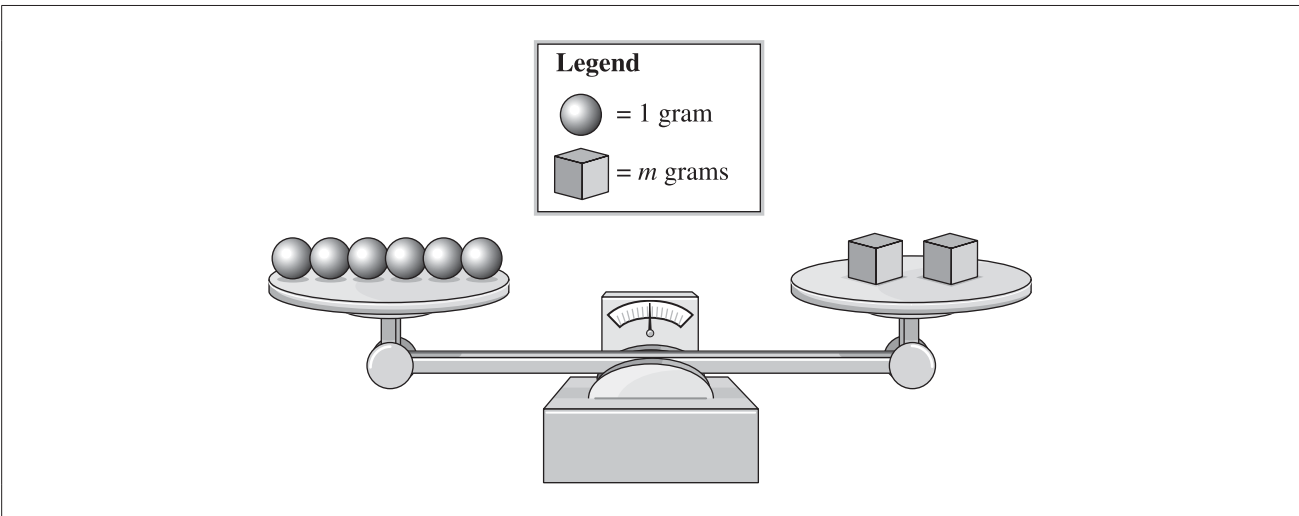   B. 11
    C. 12
    D. 13

Commentary:

Approximately two-thirds of the students who achieved the standard of excellence were successful on this item, while barely over a quarter of the students who achieved the acceptable standard were successful. Three-step items such as this, where students have to decide on a strategy to answer an open-ended problem described in the context box, carry out the strategy, and then show their understanding of place value in terms of the problem solution, are difficult for students who achieved the standard of excellence, but are exceptionally difficult for students who achieved the acceptable standard.

Of the students who achieved the standard of excellence and the acceptable standard but answered the item incorrectly, about two-thirds chose options A or C, indicating a problem with the identification of specific place value positions in a seven-digit number. Approximately one-third chose option D, which is the correct response for the smallest seven-digit numbers, rather than the largest number. However, of the students who achieved the acceptable standard, all four distractors drew proportions close to 25.0%, suggesting that a significant number of these students were simply guessing.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
23	PR	4	Moderate	Match a given context to a single-variable equation that represents the context. (Gr. 5, PR 2)

	% of Student Responses (*Correct)			
	A	B*	C	D
Performance of Students Achieving the Standard of Excellence	3.5	88.8	7.2	0.5
Performance of Students Achieving the Acceptable Standard	21.5	53.4	20.7	4.2

23. Which equation represents the balanced scale shown above?

- **A.** $6 = 2 + m$
- **B.** $6 = 2 \times m$
- **C.** $6 = m \div 2$
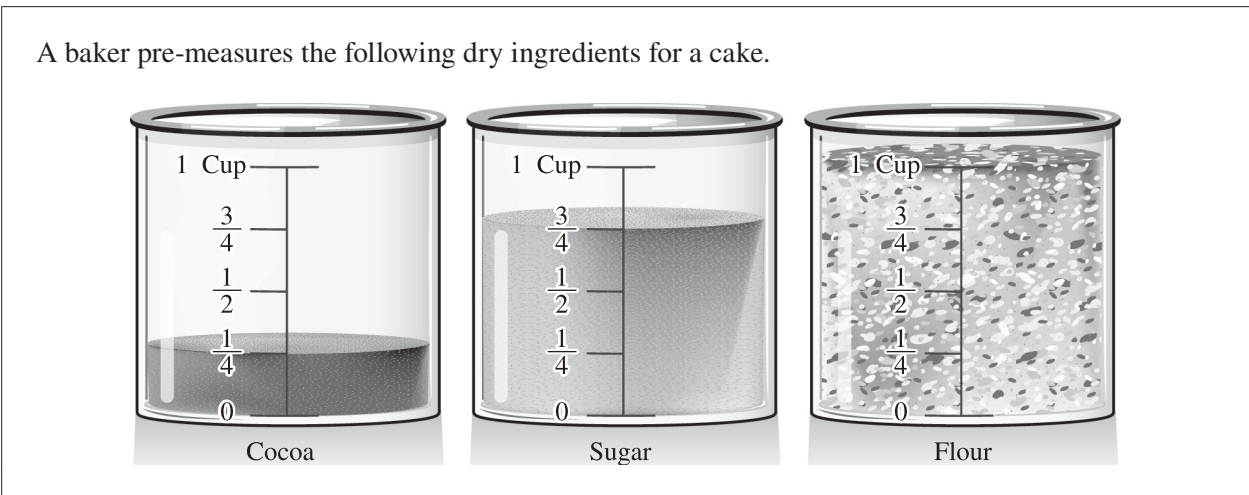- **D.** $6 = m - 2$

Commentary:

Almost all of the students who achieved the standard of excellence were successful on this item, while just over half of the students who achieved the acceptable standard were successful. Translation-type problems, where a pictorial representation is translated into algebraic symbols, are straightforward for students who achieved the standard of excellence, but are quite difficult for students who achieved the acceptable standard.

Of the few students who achieved the standard of excellence but answered the item incorrectly, approximately two-thirds chose option C as their response. This suggests that these students may have thought that the variable m represents the total mass on the right-hand side of the scale, rather than the mass of one cube, therefore concluding that the total (m) divided by 2 (cubes) would represent the 6 in this context.

Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, just under half demonstrated the same difficulty and selected option C. Just under half selected option A, which suggests that these students who achieved the acceptable standard also had difficulty analyzing a pictorial representation and matching it to a single-variable equation.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
31	N	5	High	Identify the part-to-whole ratio that represents a real-life context involving the measurement of ingredients for a recipe.

	% of Student Responses (*Correct)			
	A	B	C*	D
Performance of Students Achieving the Standard of Excellence	6.7	0.9	91.3	1.1
Performance of Students Achieving the Acceptable Standard	32.2	7.1	55.7	4.7

A baker pre-measures the following dry ingredients for a cake.

Cocoa   Sugar   Flour

31. What is the ratio of cocoa to **all** of the dry ingredients?

A. 1:4

B. 4:1

C. 1:8

D. 8:1

Commentary:

Almost all of the students who achieved the standard of excellence were successful on this item, while just over half of the students who achieved the acceptable standard were successful. Translation-type problems, where a pictorial representation is translated into a ratio statement, are straightforward for students who achieved the standard of excellence, but are quite difficult for students who achieved the acceptable standard.

Of the few students who achieved the standard of excellence but answered the item incorrectly, approximately three-quarters chose option A as their response. These students may have focused on the first cup that held cocoa and identified 1 out of 4 parts of that cup as the ratio representing cocoa to dry ingredients. These students recognized that the cocoa was a part of a larger whole, and rejected options B and D, where ratios were expressed in terms of whole to part and not part to whole.
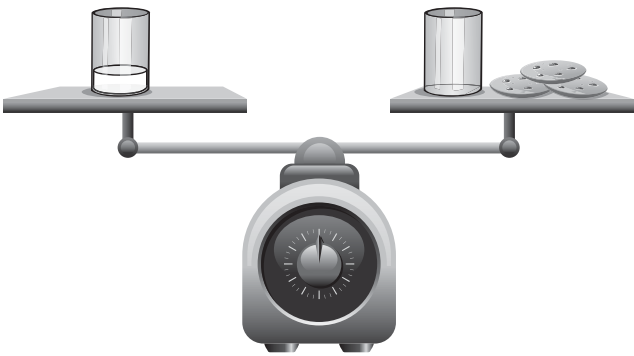
Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, approximately three-quarters made the same interpretation and selected option A, which suggests that they also have difficulty identifying part-to-whole ratios. These students also recognized that the cocoa was a part of a larger whole, and rejected options B and D, where ratios were expressed in terms of whole to part and not part to whole.

The following four items, from all four strands, illustrate significant performance differences between students who achieved the acceptable standard and those who were below the acceptable standard.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
3	PR	5	Moderate	Apply knowledge of preservation of equality to solve a problem involving the value of one unknown object on a balance scale.

	% of Student Responses (*Correct)			
	A	B	C*	D
Performance of Students Achieving the Acceptable Standard	13.6	15.4	68.8	2.2
Performance of Students Below the Acceptable Standard	41.0	27.8	26.8	4.1

The glass shown on the left side of the balanced scale is $\frac{1}{4}$ full of milk.

3. How many cookies in **total** will be needed to balance the scale if the glass of milk on the left side is full?

A.   6

B.   9

C.   12

D.   15

Commentary:

Approximately two-thirds of the students who achieved the acceptable standard were successful on this item, while barely over a quarter of the students who did not achieve the acceptable standard were successful. Two-step items such as this, where students have to translate a pictorial representation into a numerical representation and then carry out an operation on the numbers, are difficult for students who achieved the acceptable standard, but are extremely difficult for students who did not achieve the acceptable standard. The difficulty of 68.8% on this item for the group of students who achieved the acceptable standard, when contrasted with the difficulty of 29.6% (little better than the 25.0% obtained by pure guessing) for the group of students who did not achieve the acceptable standard on the complete test, indicates one type of item that can clearly distinguish students at or above the acceptable standard from students below the acceptable standard.

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately half chose option B as their response. This suggests that these students may have calculated nine more cookies to be added; however, they did not include the cookies already on the scale in the final calculation of the total. This error may also have been made by just over half of the students who achieved below the acceptable standard and answered the item incorrectly and selected option B.

Just under half of the students who achieved the acceptable standard but answered the item incorrectly selected option A. These students may have incorrectly assumed that ¼ cup of milk is equivalent to one cookie. Therefore, adding three more units of milk on the left side of the balance scale would result in the addition of three more cookies on the right side of the balance scale. This error may also have been made by just under half of the students who achieved below the acceptable standard and answered the item incorrectly and selected option A.

As very few students chose option D, there is evidence that options A and B were chosen after some mathematical considerations, rather than by guessing. If guessing were a major factor, each of the options would have drawn close to 25.0%.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
26	PR	2	Moderate	Identify the table of values that represents the relationship between two variables in a given linear equation.

	% of Student Responses (*Correct)			
	A	B	C*	D
Performance of Students Achieving the Acceptable Standard	11.2	21.7	53.4	13.0
Performance of Students Below the Acceptable Standard	17.7	34.6	23.2	21.9

26. Which of the following tables of values could be produced by the equation $y = 3x - 2$?

A.

x	y
1	6
2	7
3	8
4	9

B.

x	y
1	0
2	1
3	2
4	3

C.

x	y
1	1
2	4
3	7
4	10

D.

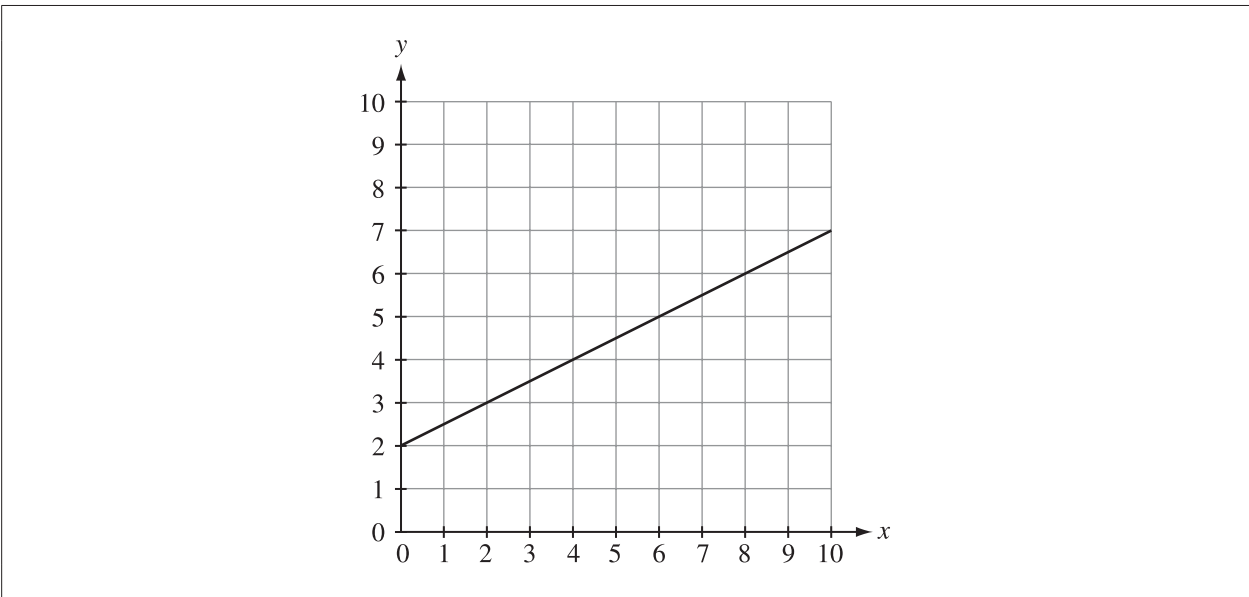| x	y
1	2
2	5
3	8
4	11

Commentary:

Just over half of the students who achieved the acceptable standard were successful on this item, while just under a quarter of the students who did not achieve the acceptable standard were successful. Two-step items such as this, where students have to interpret an algebraic relationship and then represent this relationship using a table-of-values format, are difficult for students who achieved the acceptable standard, but are extremely difficult for students who did not achieve the acceptable standard. The difficulty of 53.4% on this item for the group of students who achieved the acceptable standard, when contrasted with the difficulty of 23.2% (which is not even at the level of 25.0% obtained by pure guessing) for the group of students who did not achieve the acceptable standard on the complete test, indicates one type of item that can clearly distinguish students at or above the acceptable standard from students below the acceptable standard.

Of the students who achieved the acceptable standard but answered the item incorrectly, nearly half chose option B as their response. This suggests that these students had difficulty applying the rule represented by the equation (3 times the variable x minus 2) to calculate the value of y. Just over one-tenth of these students were able to recognize that y changes by 3 when x changes by 1, and use this to choose option D rather than either of options A and B.

Of the students who achieved below the acceptable standard and answered the item incorrectly, nearly half may have made the same error and selected option B. Of these students, just over one-quarter selected option D and just under one-quarter selected option A, suggesting that these students may lack knowledge of how to identify a rule (or equation) that describes the relationship between two columns of numbers in a table of values. An alternative hypothesis for these results is that there was significant guessing from these students, as all four options drew near or above 20.0% and one option was more often selected than the correct option.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
28	SS	8	Low	Identify the ordered pair that is located on a given line in the first quadrant of the Cartesian plane.

	% of Student Responses (*Correct)			
	A	B	C	D*
Performance of Students Achieving the Acceptable Standard	18.4	3.0	6.4	72.0
Performance of Students Below the Acceptable Standard	39.4	12.9	17.1	28.3

28. Which of the following ordered pairs is located on the line in the graph shown above?

A. (2, 0)

B. (4, 5)

C. (5, 6)
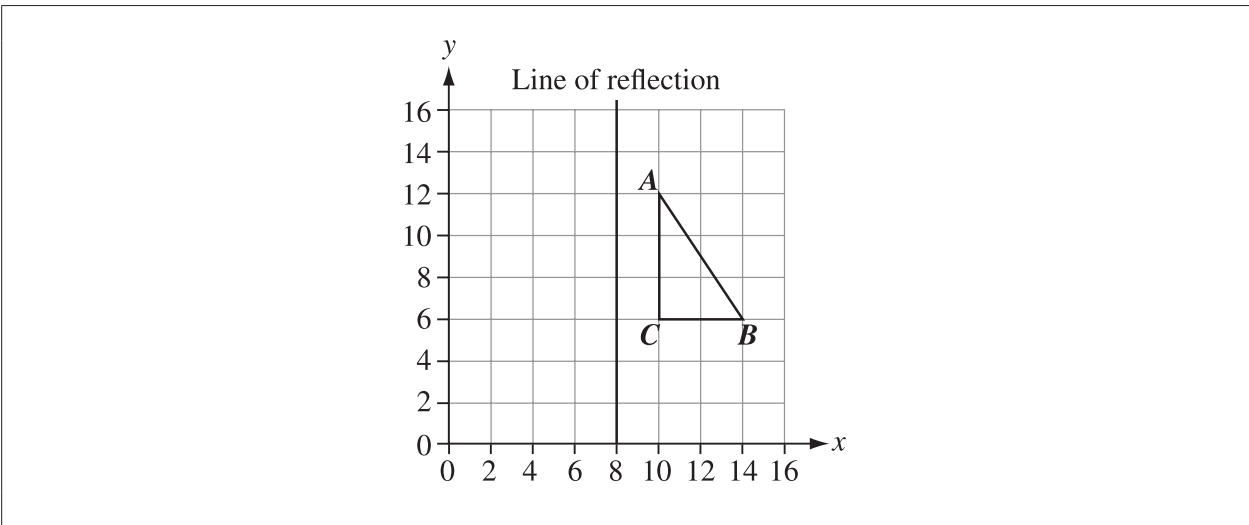
D. (8, 6)

Commentary:

Nearly three-quarters of the students who achieved the acceptable standard were successful on this item, while just over a quarter of the students who did not achieve the acceptable standard were successful. Translation items such as this, where students have to decide whether given ordered pairs are on or off a given line, are relatively easy for students who achieved the acceptable standard, but are extremely difficult for students who did not achieve the acceptable standard. The difficulty of 72.0% on this item for the group of students who achieved the acceptable standard, when contrasted with the difficulty of 28.3% (which is just over the level of 25.0% obtained by pure guessing) for the group of students who did not achieve the acceptable standard on the complete test, indicates one type of item that can clearly distinguish students at or above the acceptable standard from students below the acceptable standard.

Of the students who achieved the acceptable standard but answered the item incorrectly, nearly two-thirds chose option A as their response. This suggests that these students incorrectly plotted the first number of a prominent ordered pair on the y-axis and the second number of the same ordered pair on the x-axis. About one-fifth of these students chose option C, where they described the less prominent point (6, 5) on the line as the point (5, 6).

Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, just over half selected option A, reversing the coordinates of the prominent point (0, 2), and approximately one-quarter selected option C, reversing the coordinates of the less prominent point (6, 5). With almost one-fifth of these students choosing option B, where neither (4, 5) nor (5, 4) is on the line, there is some evidence of guessing by students who did not achieve the acceptable standard.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
33	SS	9	Moderate	Identify the positional change of a specified vertex of a 2-D shape to the corresponding vertex of its image as a result of a single transformation.

	% of Student Responses (*Correct)			
	A*	B	C	D
Performance of Students Achieving the Acceptable Standard	84.7	7.7	2.7	4.6
Performance of Students Below the Acceptable Standard	38.8	22.0	16.4	19.8

33. What are the coordinates of B' after the triangle ABC is reflected across the line of reflection shown above?

    A. (2, 6)

    B. (6, 6)

    C. (10, 6)

    D. (14, 6)

Commentary:

Over four-fifths of students who achieved the acceptable standard were successful on this item, while just under two-fifths of the students who did not achieve the acceptable standard were successful. Application-type items, where the application is restricted to one coordinate of one point of a figure, are straightforward for students who achieved the acceptable standard, but are quite difficult for students who did not achieve the acceptable standard.

Of the students who achieved the acceptable standard but answered the item incorrectly, just over half chose option B as their response. This suggests that these students translated triangle ABC four units to the left rather than reflecting it across the line of reflection.

Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, just over two-fifths made the same interpretation and selected option B.

Of the remaining students who achieved below the acceptable standard, approximately one-third chose option D and just over one-quarter chose option C. This suggests that these students have difficulty performing transformations on 2-D shapes and identifying the location of vertices on transformed 2-D shapes. However, since all three incorrect distractors drew proportions close to 20.0%, there may be evidence of a large guessing factor in the results of the students who did not achieve the acceptable standard.

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 the path *Teachers > Provincial Testing > Provincial Achievement Tests (PAT)*, and then click on one of the specific links 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 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 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 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 *Alberta Provincial Achievement Testing Parent Guide* for grades 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 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.