Alberta Provincial Achievement Testing

GRADE 6

Mathematics

Alberta Government

This document contains assessment highlights from the 2013 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 2013. Also provided is commentary on student performance at the acceptable standard and the standard of excellence on selected items from the 2013 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.

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 2013 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 2013 Grade 6 Mathematics Achievement Test. It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 40 104 students wrote the 2013 Grade 6 Mathematics Achievement Test. The English form of the test was written by 37 063 students, and the French form of the test was written by 3 041 students.

What Was the Test Like?

The 2013 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 2013 are shown in the graph below. Out of a total score of 50 on the test, the provincial average was 28.2/50 (56.4%). 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—2013 Mathematics Achievement Test		
	Acceptable (%)	Excellent (%)
2013	80.3	18.1

Percentage of Students Meeting the
Acceptable Standard & Standard of Excellence (%)
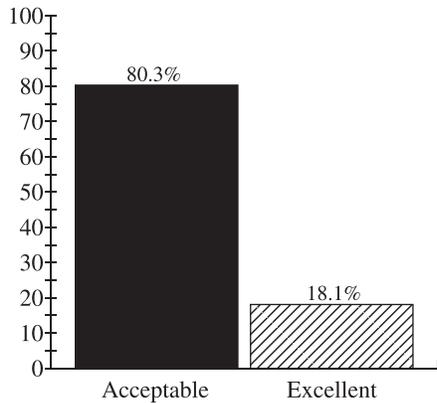
■ 2013 Achievement Standards: The percentage of students in the province who met the acceptable standard on the 2013 Grade 6 Mathematics Achievement Test (based on those who wrote)

▨ 2013 Achievement Standards: The percentage of students in the province who met the standard of excellence on the 2013 Grade 6 Mathematics Achievement Test (based on those who wrote)

2013 Test Blueprint and Student Achievement

In 2013, 80.3% of students who wrote the test achieved the acceptable standard on the Grade 6 Mathematics Achievement Test, and 18.1% of students who wrote achieved the standard of excellence.

Out of a total score of 50 on the test, the provincial average was 28.2/50 (56.4%). 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	5	13	1	**11.1/19** (58.4%)
Patterns and Relations	3	6	3	**7.0/12** (58.3%)
Shape and Space	6	4	3	**6.5/13** (50.0%)
Statistics and Probability	5	1	0	**3.5/6** (58.3%)
Provincial Student Achievement (Average Raw Score and Percentage)	**11.4/19** (60.0%)	**13.8/24** (57.5%)	**4.0/7** (57.1%)	**Total Test Raw Score 28.2/50** (56.4%)

*Each question is categorized according to its level of complexity (low, moderate, or high). Descriptions of the levels of complexity are in the *2013–2014 Mathematics 6 Subject Bulletin*.

2013 Grade 6 Mathematics Achievement Test Design Commentary

The 2013 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 *2013–2014 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 of the item and not the ability of the student. The cognitive demands that 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 (i.e., items that are of high complexity tend to be more challenging), there are instances in which this is not the case.

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 2013 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 versus those who achieved the acceptable standard.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
25	SP	4	Moderate	Determine the number of equivalent sections that a spinner must have for a certain theoretical probability of an event to occur.

	% of Student Responses (*Correct)			
	A	B*	C	D
Students Achieving the Standard of Excellence	7.5	78.9	10.3	3.2
Students Achieving the Acceptable Standard	28.8	27.7	29.4	13.8

Use the following information to answer question 25.

Jacob wants to create a spinner that can be used for giving away different prizes. He wants the theoretical probability of winning each prize to be 0.2.
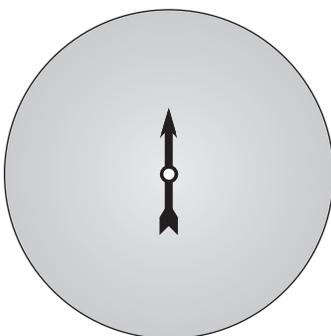
25. How many sections of equal size should the spinner shown above have?

    A. 4
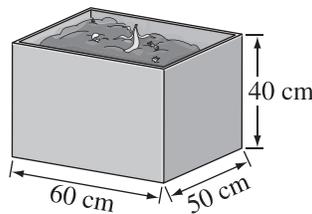   B. 5
    C. 6
    D. 7

Commentary:

Of the students who achieved the standard of excellence but answered the item incorrectly, approximately 49.0% chose option C as their response. This suggests that these students have difficulty working with probabilities that are expressed in decimal and fraction form. Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, 40.8% made the same interpretation and selected option C. It is also interesting to note that an additional 40.0% selected option A, which suggests that these students also did not understand how to represent the probability in both decimal and fraction form.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
22	SS	3	Moderate	Apply a formula for right rectangular prisms to determine which prism has twice the volume of a given prism (Gr.5, SS.4).

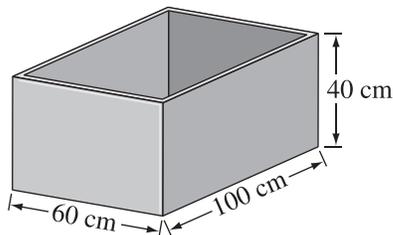|	% of Student Responses (*Correct)			
	A*	**B**	**C**	**D**
Students Achieving the Standard of Excellence	87.7	6.0	3.4	2.9
Students Achieving the Acceptable Standard	41.4	27.1	16.1	15.3

Use the following information to answer question 22.

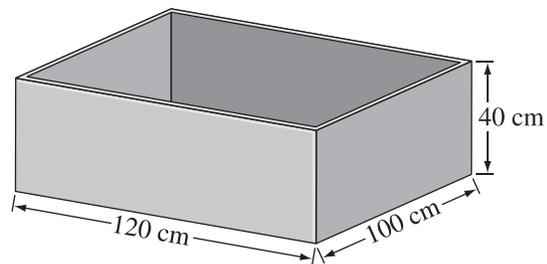Ginette has a compost bin with the dimensions shown below.

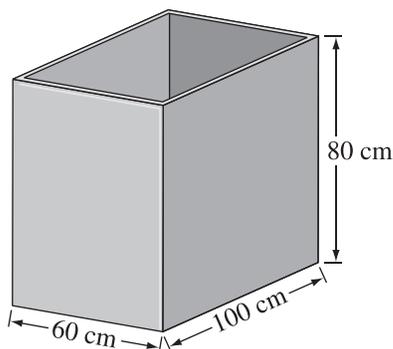**22.** Which of the following bins has a volume that is **twice** the volume of Ginette's bin?
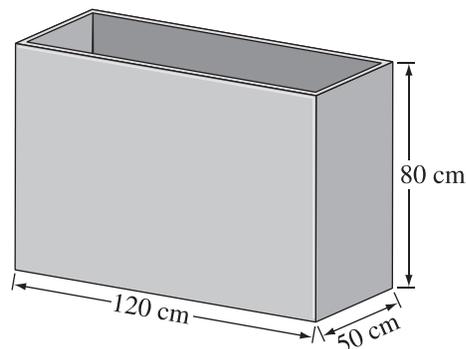
A.

B.

C.
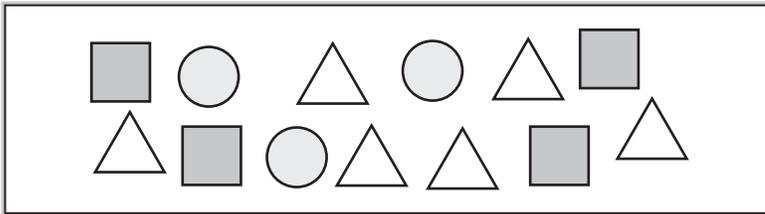

D.

Commentary:

Of the students who achieved the standard of excellence but answered the item incorrectly, approximately 48.8% chose option B as their response. This suggests that these students may have doubled both the length and width of the base to create a 3-D object with twice the volume. This illustrates a common misunderstanding of the relationship between the side length, surface area, and volume of 3-D objects. Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, 46.3% also selected option B.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
28	N	5	Moderate	For a given ratio, match the pictorial representation to an equivalent symbolic representation.

	% of Student Responses (*Correct)			
	A*	B	C	D
Students Achieving the Standard of Excellence	88.1	2.4	6.6	2.9
Students Achieving the Acceptable Standard	43.4	6.2	35.6	14.6

28. Which of the following diagrams represents a 3:2 ratio of triangles to squares?
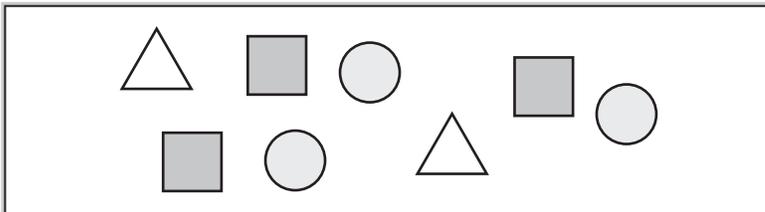
A.

B.
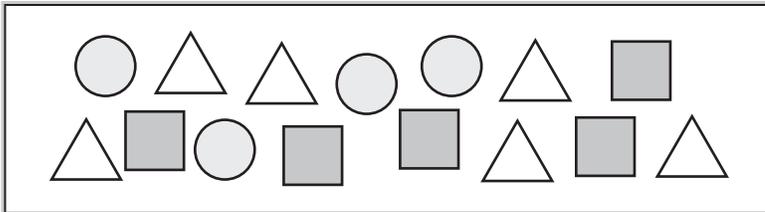
C.

D.

Commentary:

Of the students who achieved the standard of excellence but answered the item incorrectly, approximately 55.5% chose option C as their response. This suggests that these students reversed the order of the terms of the ratio, as evident from their selection of the pictorial representation that illustrates a 3:2 ratio of squares to triangles. Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, 63.1% also selected option C.

6

Item #	Strand	Specific Outcome	Item Complexity	Item Description
24	PR	3	Low	From a set of formulas, identify those that represent the perimeter of a given rectangle (Gr.5, SS.2).

	% of Student Responses (*Correct)			
	A	B	C	D*
Students Achieving the Standard of Excellence	6.2	7.9	7.3	78.6
Students Achieving the Acceptable Standard	23.3	14.7	21.9	39.9

Use the following information to answer question 24.

Four students are thinking about how to decorate a rectangular poster board for a school project.

24. The two students who correctly determined expressions for the perimeter of the poster board are students

   A.   1 and 4
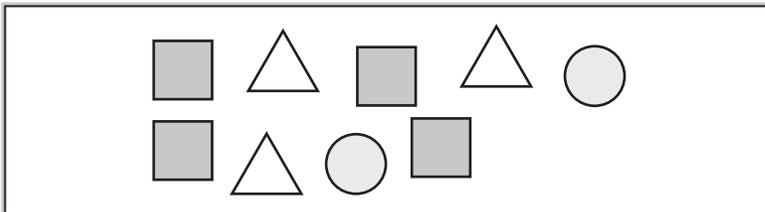
   B.   1 and 3

   C.   2 and 4

   D.   2 and 3

Commentary:

Of the students who achieved the standard of excellence but answered the item incorrectly, approximately 36.9% chose option B as their answer. This suggests that these students had difficulty identifying equivalent representations of a formula for the perimeter of a rectangle. Further evidence for this interpretation is the fact that 34.1% of these students selected option C, which also contained only one correct perimeter formula. Likewise, of the students who achieved the acceptable standard but answered the item incorrectly, 36.6% selected option C and 38.9% selected option A, which suggests that the students who achieved the acceptable standard made errors similar to those made by the students who achieved the standard of excellence.

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

Item #	Strand	Specific Outcome	Item Complexity	Item Description
38	N	4	Moderate	Translate a given mixed number between pictorial and symbolic representations.

	% of Student Responses (*Correct)			
	A	B	C*	D
Students Achieving the Acceptable Standard	5.1	10.3	75.0	8.7
Students Below the Acceptable Standard	13.8	22.6	27.8	32.3

Use the following information to answer question 38.

Patrick fills $3\frac{5}{12}$ of the egg cartons shown below with eggs.
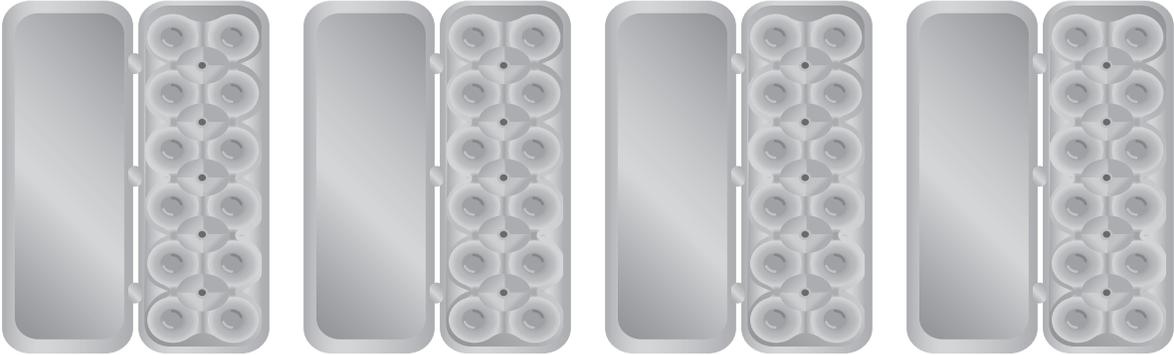
38. How many eggs in **total** does Patrick have?

    A.   35

    B.   36

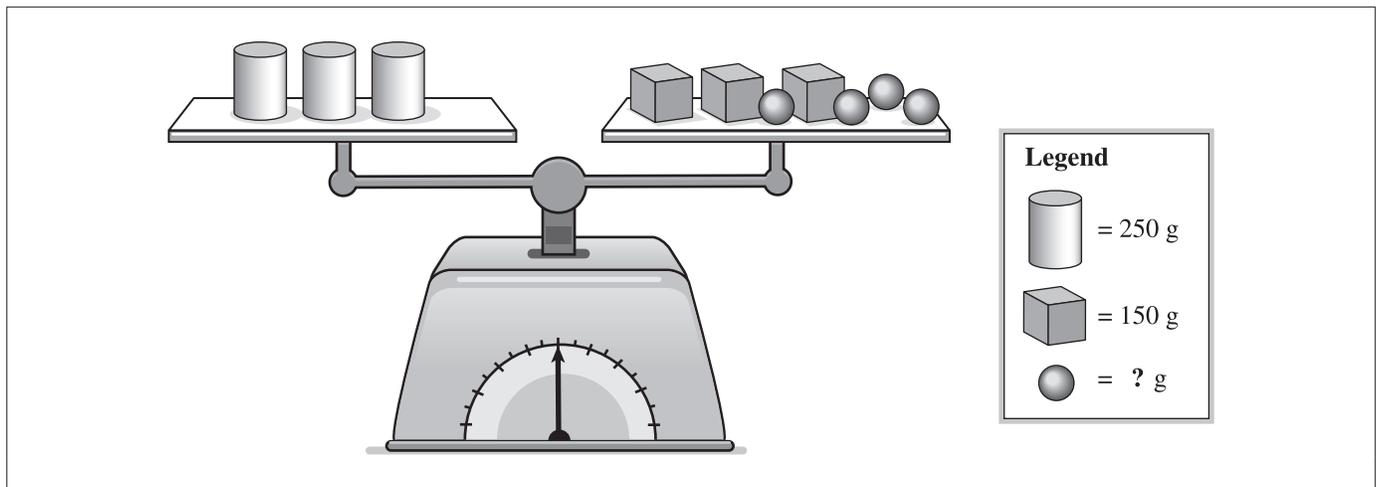   **C.**   41

    D.   43

Commentary:

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately 42.7% chose option B as their response. This suggests that these students may not have understood how to treat the numerator of the mixed number when determining the total number of eggs. Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, 33.9% selected option B and 47.0% selected option D, which may imply that these students have additional difficulties with correctly performing operations involving whole numbers.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
10	PR	5	High	Apply knowledge of preservation of equality to determine the mass of an object on a balanced scale when the mass of other objects is given.

	% of Student Responses (*Correct)			
	A	**B***	**C**	**D**
Students Achieving the Acceptable Standard	13.8	77.1	2.4	6.7
Students Below the Acceptable Standard	45.8	36.9	7.8	9.0

Use the following information to answer question 10.

10. What is the mass of one ⬤?

- **A.** 50 g
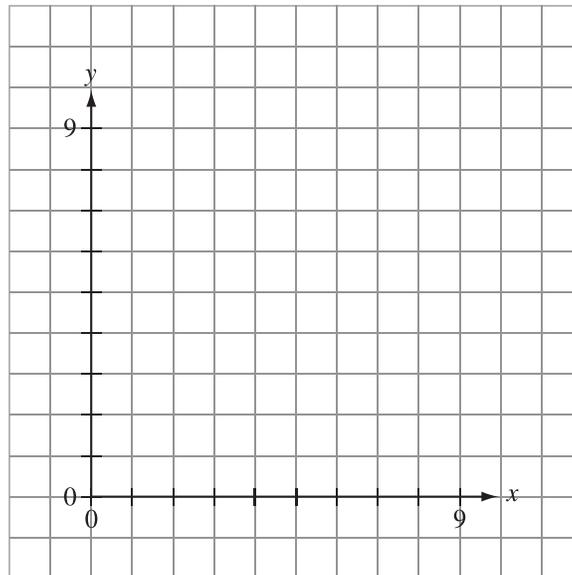- **B.** 75 g
- **C.** 150 g
- **D.** 300 g

Commentary:

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately 60.3% chose option A as their response. This suggests that these students may have incorrectly determined the mass of the 3-D objects on the right side of the balanced scale. Students who selected option A may have mistakenly multiplied 150 g by 4 (the number of spheres) rather than by 3 (the number of cubes) in the calculation. Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, 73.2% selected option A, which suggests that they made a similar error in their calculations. The remaining 26.8% of these students selected the other two options almost equally, which suggests that they may lack knowledge regarding the concept of preservation of equality.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
31	SS	8	Low	Identify the 2-D shape whose vertices match given coordinates in the first quadrant of the Cartesian plane.

|	% of Student Responses (*Correct)			
	A	**B**	**C**	**D***
Students Achieving the Acceptable Standard	8.3	6.7	10.3	74.4
Students Below the Acceptable Standard	18.0	21.5	22.5	35.5

Use the following information to answer question 31.

Sebastian created a 2-D shape in the first quadrant of the Cartesian plane by plotting the points (2, 0), (2, 4), (5, 7), and (6, 0) and connecting the points in this order.
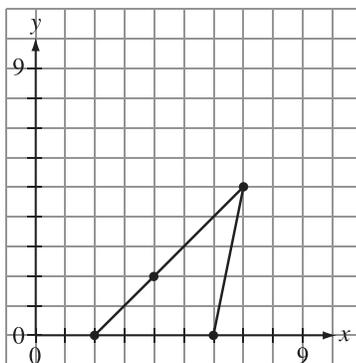
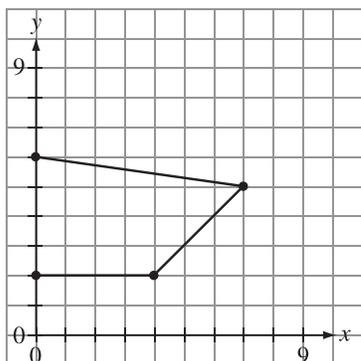**31.** Which of the following 2-D shapes matches the shape that Sebastian creates?
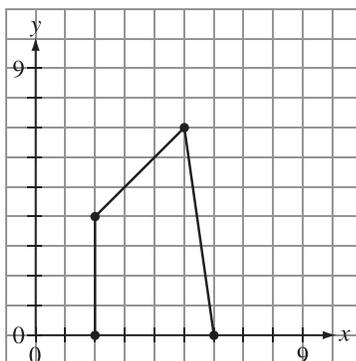
A.
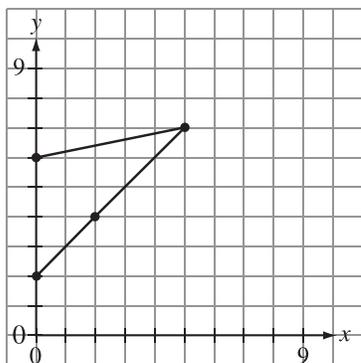
B.

C.

D.

Commentary:

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately 40.7% chose option C as their response. This suggests that these students may have mixed up the x-coordinates with the y-coordinates when plotting or matching the ordered pairs with the vertices of the correct 2-D shape. Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, 36.3% selected option C, which suggests that they made a similar mistake in their calculations. The remaining 63.7% of these students selected the other two options almost equally, which suggests that they may lack knowledge regarding the concept of plotting points in the first quadrant of the Cartesian plane.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
29	SP	1	Low	Identify the data set that would be most appropriately represented by a line graph.

	% of Student Responses (*Correct)			
	A	B	C*	D
Students Achieving the Acceptable Standard	25.3	8.4	53.2	12.9
Students Below the Acceptable Standard	36.6	18.3	21.8	21.4

29. Which of the following sets of data is **best** represented by a line graph?

    A.   Heights of Grade 6 students

    B.   Shoe sizes of Grade 6 students

    C.   Temperatures in the playground during the day

    D.   Number of students who walk home for lunch

Commentary:

Of the students who achieved the acceptable standard but answered the item incorrectly, approximately 54.3% chose option A as their response. This suggests that these students may have difficulty identifying types of data that would be best represented with a line graph. Likewise, of the students who achieved below the acceptable standard and answered the item incorrectly, 48.0% selected option A, which suggests that they made a similar mistake in their calculations. The remaining 52.0% of these students selected the other two options almost equally, which suggests that they may lack knowledge regarding when to use a line graph to represent data.

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.