

**Alberta Provincial
Achievement Testing**

**Assessment
Highlights
2009-2010**

**GRADE
9**

Mathematics



**Government
of Alberta ■**

Alberta ■

Freedom To Create. Spirit To Achieve.

This document contains assessment highlights from the 2010 Grade 9 Mathematics Achievement Test (*1997 Program of Studies*) as well as some observations about the 2010 Pilot 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 2010. Also provided is commentary on student performance at the *acceptable standard* and the *standard of excellence* on selected items from the 2010 Mathematics Achievement Test (*1997 Program of Studies*). 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 9 Mathematics
Administrators	✓
Parents	
General Audience	
Others	

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The 2010 Grade 9 Mathematics Achievement Test (1997 Program of Studies)

This part of the report provides teachers, school administrators, and the public with an overview of the performance of students who wrote the 2010 Grade 9 Mathematics Achievement Test (1997 Program of Studies). It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 18 843 students wrote the English form of the 2010 Grade 9 Mathematics Achievement Test (1997 Program of Studies).

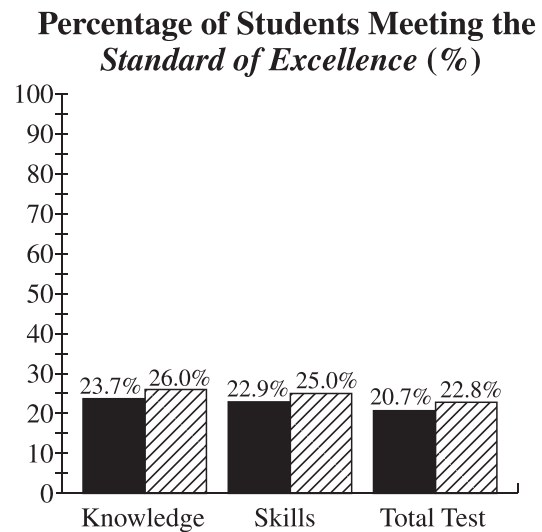
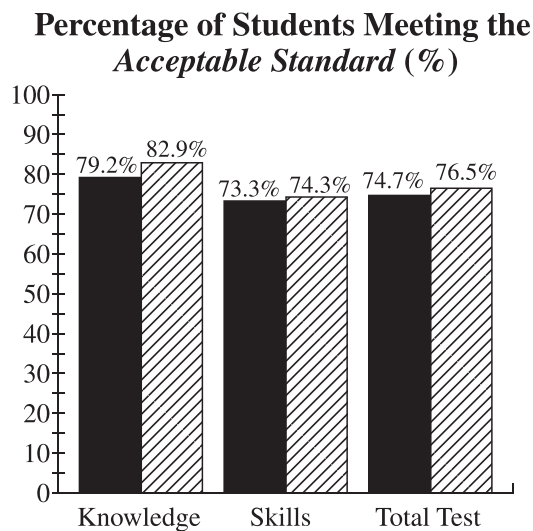
What Was the Test Like?


The 2010 Grade 9 Mathematics Achievement Test (1997 Program of Studies) consisted of 44 multiple-choice* and 6 numeric-response items based on four strands: Number; Patterns and Relations; Shape and Space; and Statistics and Probability.


* **Please note:** The English form had 43 multiple-choice items because item 25 was removed from the test due to a printing error.

How Well Did Students Do?

The percentages of students meeting the *acceptable standard* and the *standard of excellence* in 2010 are consistent with 2009, as shown in the graphs below. The provincial average on the test was 62.5%. The results presented in this report are based on scores achieved by all students who wrote the English and French forms of the test.



 2009 Achievement Standards: The percentage of students in the province who met the *acceptable standard* and the *standard of excellence* on the 2008 Grade 9 Mathematics Achievement Test (1997 Program of Studies) (based on those who wrote).

 2010 Achievement Standards: The percentage of students in the province who met the *acceptable standard* and the *standard of excellence* on the 2009 Grade 9 Mathematics Achievement Test (1997 Program of Studies) (based on those who wrote).

2010 Test Blueprint and Student Achievement (1997 Program of Studies)

In 2010, 76.5% of students achieved the *acceptable standard* on the Grade 9 Mathematics Achievement Test (*1997 Program of Studies*) and 22.8% of students achieved the *standard of excellence*. Compared with the results from 2009, the percentage of students achieving the *acceptable standard* increased by 1.8%, and the percentage of students achieving the *standard of excellence* increased by 2.1%.

The blueprint below shows the reporting categories and test sections (curricular content areas) by which 2010 summary data are reported to schools and school authorities, and the provincial average of student achievement by both raw score and percentage.

Test Sections	Reporting Category		Provincial Student Achievement Average (Raw Score and Percentage)	
	Knowledge	Skills		
	Recall facts, concepts, procedures, and terminology	Apply facts, concepts, procedures, terminology, and relationships to solve problems in a variety of situations		
Number <ul style="list-style-type: none"> • Number Concepts • Number Operations 			8.2/13 (63.1%)	
Patterns and Relations <ul style="list-style-type: none"> • Patterns • Variables and Equations • Relations and Functions 			9.3/15 (62.0%)	
Shape and Space <ul style="list-style-type: none"> • Measurement • 3-D Objects and 2-D Shapes • Transformations 			English Form 7.9/13 (60.8%)	French Form 10.0/14 (71.4%)
Statistics and Probability <ul style="list-style-type: none"> • Data Analysis • Chance and Uncertainty 			5.1/8 (63.8%)	
Provincial Student Achievement Average for Students Who Wrote the Test (Raw Score and Percentage)	English Form 9.9/15 (66.0%)	French Form 11.4/16 (71.3%)	2.07/34 (60.9%)	
			English Form 30.2/49 (61.6%)	French Form 34.4/50 (68.8%)

2010 Mathematics 9 PAT Student Performance Commentary

The following table provides a brief synopsis of student performance demonstrated on the 2010 Grade 9 Mathematics Achievement Test (*1997 Program of Studies*). The observations have been categorized in terms of student performance strengths and challenges in relation to outcomes that were tested in each of the four strands from the *1997 Alberta Program of Studies* for K–9 Mathematics.

Strand	Outcome Strengths	Outcome Challenges
Number	<ul style="list-style-type: none"> • Determining the value of powers with integral exponents, using the exponent laws • Solving multi-step problems using rational numbers in meaningful contexts • Using a calculator to perform calculations involving scientific notation and exponent laws 	<ul style="list-style-type: none"> • Determining whether or not a number is rational • Applying the exponent laws for powers with integral exponents • Applying the exponent laws to simplify expressions with variable bases and evaluating expressions with numerical bases • Applying proper calculator keying sequences to perform calculations involving rational numbers
Patterns and Relations	<ul style="list-style-type: none"> • Solving first-degree, single-variable equations • Simplifying polynomial expressions represented by diagrams • Determining the product of two monomials, a monomial and a polynomial, and two binomials 	<ul style="list-style-type: none"> • Modeling situations that can be represented by first-degree expressions • Solving, algebraically, first-degree inequalities with one variable and determining the correct representation of the solution on a number line • Determining the quotient when a polynomial is divided by a monomial
Shape and Space	<ul style="list-style-type: none"> • Recognizing why two triangles are similar and using the properties of similar triangles to solve problems • Relating congruence to similarity in the context of triangles • Matching a 3-D object with its plan and elevation views • Determining the image of a 2-D shape as a result of a single transformation 	<ul style="list-style-type: none"> • Relating expressions for volumes of cones to volumes of cylinders • Applying the rate of area to perimeter to solve design problems in two dimensions • Recognizing why two triangles are congruent and using the properties of congruent triangles to solve problems
Statistics and Probability	<ul style="list-style-type: none"> • Interpreting scatterplots to determine an apparent relationship • Determining the data collection method that would be most representative of a given population • Recognizing the use of statistical information by the media to influence conclusions made by consumers 	<ul style="list-style-type: none"> • Solving problems involving the probability of independent events • Recognizing the use of scatterplots to represent discrete and continuous variables

The following four pairs of items appeared on both the 2009 and 2010 Grade 9 Mathematics Provincial Achievement Tests, and have been selected as examples of areas that students demonstrated varying degrees mathematical knowledge and skill within each of the four strands.

Brief Commentary on Number Strand

Students had greater success at solving problems involving operations with rational numbers when the solution did not require any additional interpretation (e.g., when to round a solution up or down).

Item	2010 PAT Item #	Strand	% of Student Responses			
			A	B	C	D
1	9	N	7.0%	70.0%*	17.4%	5.4%
2	33	N	85.7%*	3.4%	9.5%	1.4%

* Correct response

Item 1

Channi saves 15% of her weekly \$625 paycheque.

What is the fewest number of paycheques that it will take Channi to save a minimum of \$320?

- A. 5
- *B. 4
- C. 3
- D. 2

Item 2

Frank rented an amusement park for a party. He was charged an initial \$250 fee and \$0.75 for each guest.

If the total charge was \$342.25, then how many guests attended Frank's party?

- *A. 123
- B. 345
- C. 456
- D. 789

Brief Commentary on Patterns and Relations Strand

Students had a greater success at creating and working with equations and expressions that represent solutions to situations that involve a limited number of operations and concepts (e.g., the inclusion of percentage in item 3 may have caused some additional challenges for students).

Item	2010 PAT Item #	Strand	% of Student Responses			
			A	B	C	D
3	43	PR	18.7%	8.3%	57.3%*	15.4%
4	39	PR	3.3%	84.6%*	4.7%	7.3%

* Correct response

Item 3

Kayla has an average of 83% on 15 quizzes. If her teacher eliminates Kayla's lowest grade, a 56%, then which of the following equations can be used to find Kayla's new quiz average?

A. $a = \frac{83 - 56}{14}$

B. $a = \frac{83(56 - 15)}{14}$

*C. $a = \frac{(83 \times 15) - 56}{14}$

D. $a = \frac{(83 \times 15) - 56}{15}$

Item 4

Mira is going on a vacation with Jessie and Sam. Each person will pay an equal share for the cost of a rental car (r), hotel (h), and food (f).

Which of the following equations can Mira use to calculate the amount each person must pay, P ?

A. $P = \frac{1}{r + h + f}$

*B. $P = \frac{r + h + f}{3}$

C. $P = r + h + f$

D. $P = 3(r + h + f)$

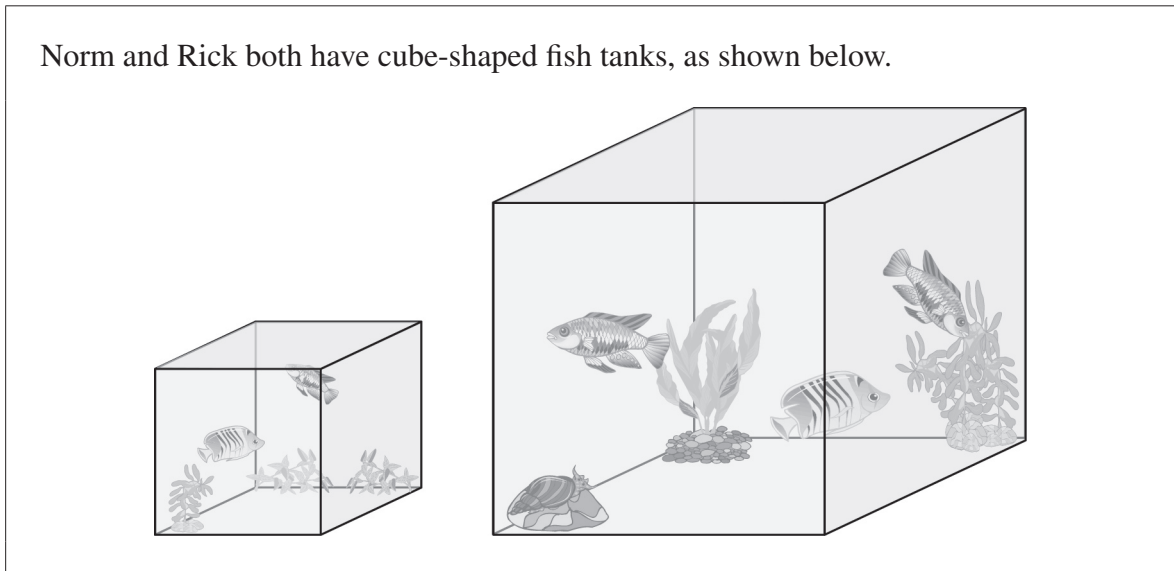
Brief Commentary on Shape and Space Strand

Students had greater success finding solutions to problems involving 3-D objects and 2-D shapes that required the application of procedures, such as using formulas, as opposed to tasks that required greater comprehension of the characteristics of 3-D objects and 2-D shapes and the relationships among them.

Item	2010 PAT Item #	Strand	% of Student Responses			
			A	B	C	D
5	18	SS	27.4%	24.4%	7.5%	40.5%*
6	15	SS	9.1%	3.2%	6.5%	81.0%*

* Correct response

Item 5



If each side of Norm's fish tank is half the length of each side of Rick's fish tank, then how much more water will Rick's fish tank hold?

- A. 2 times as much
- B. 4 times as much
- C. 6 times as much
- *D. 8 times as much**

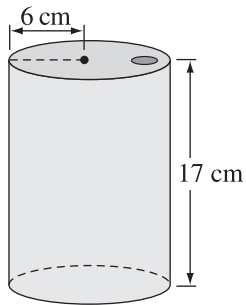
Item 6

$$\text{Volume of a cylinder} = \pi r^2 h$$

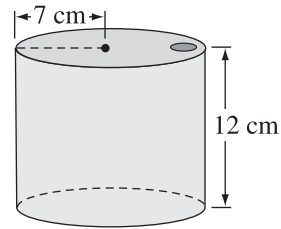
$$\text{Volume of a cone} = \frac{\pi r^2 h}{3}$$

Which of the following containers has the greatest volume?

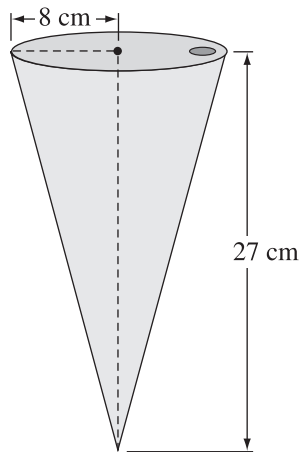
A.



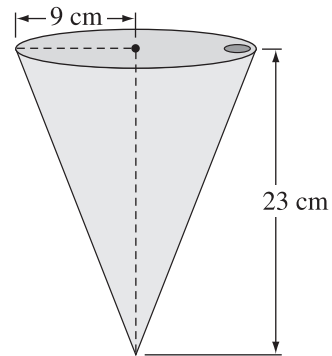
B.



C.



D.



Correct response is **D**

Brief Commentary on Statistics and Probability Strand

Students had greater success at determining the probability of independent events, as opposed to interpreting the results from such calculations.

Item	2010 PAT Item #	Strand	% of Student Responses			
			A	B	C	D
7	42	SP	51.6%*	5.2%	18.2%	24.7%
8	36	SP	63.5%*	3.9%	23.4%	9.0%

* Correct response

Item 7

A teacher has four bags that contain both red and green marbles. The number of red and green marbles in each bag is shown in the table below. The teacher asks one of her students to reach into one of the bags and select a marble without looking.








Bag	Number of Red Marbles	Number of Green Marbles
1	3	7
2	4	8
3	8	17
4	10	19

In order to have the **greatest** probability of selecting a green marble, the student should select a marble from bag

- *A. 1
- B. 2
- C. 3
- D. 4

Item 8

A student must describe the weather by using only 1 of the 4 sky condition symbols given below and only 1 of the 3 wind condition symbols given below.

Sky condition symbols	Wind condition symbols
 Sunny	 No wind
 Cloudy	 Light wind
 Rainy	 Strong wind
 Partly sunny	

On any given day, what is the probability that the student will describe the sky condition as “sunny” and the wind condition as “no wind”?

- *A. $\frac{1}{12}$
- B. $\frac{1}{4}$
- C. $\frac{2}{7}$
- D. $\frac{1}{7}$

The 2010 Grade 9 Pilot Mathematics Achievement Test (2007 Program of Studies)

This report, written by the Grade 6 and 9 Mathematics Examination Manager, is intended to provide classroom teachers with information about student performance at the provincial level, as demonstrated on the January and June 2010 Mathematics 9 Provincial Achievement Tests (*2007 Program of Studies*). *Assessment Highlights* is best used in conjunction with the school and/or school authority report for this test, along with the classroom teacher's knowledge of his/her students' abilities.

How Many Students Wrote the Test?

A total of 19 785 students wrote the 2010 Grade 9 Pilot Mathematics Achievement Test (*2007 Program of Studies*), of which 19 556 students wrote the English test form and 229 students who wrote the French test form.

What Was the Test Like?

The 2010 Grade 9 Pilot Mathematics Achievement Test (*2007 Program of Studies*) consisted of one test booklet. There were 40 multiple-choice and 10 numerical-response questions based on the four strands: Number; Patterns and Relations; Shape and Space; and Statistics and Probability.

Each question addressed at least one learning outcome from a strand. The intent of the revised *Program of Studies* is to ensure that student learn how to apply their mathematical understanding across the outcomes and strands. In order to reflect this intent on the test, students had to apply their understanding of more than one outcome when answering many of the questions.

How Well Did Students Do?

Out of a total score of 50 on the test, the provincial average was 28.9/50 (57.5%), which was about 6% lower than historic Math 9 test means; however, the results are within the expected range given the fact that it was the year in which the new program was optionally implemented. The results presented in this report are based on scores achieved by all students who wrote the test. Detailed provincial assessment results are provided in school and jurisdiction reports.

What are the cut-scores for the Acceptable and Excellence standards on the test?

Cut-scores were not established for the 2010 Grade 9 Pilot Mathematics Achievement Test (*2007 Program of Studies*). Only the raw scores will be reported to school jurisdictions, schools, and students. Cut scores for the *Acceptable Standard* and *Standard of Excellence* will be developed and reported in 2011.

Students Strengths and Areas for Improvement

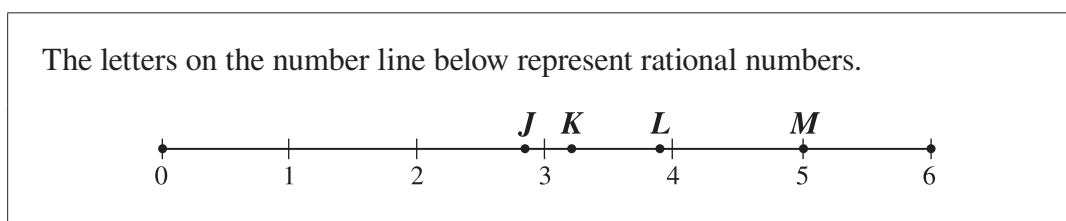
One of the challenges in identifying areas of student strength and areas for improvement according to specific learning outcomes is that not all outcomes have test-item representation, and for some outcomes, there may only be one or two items on the test. Another challenging aspect in classifying student performance is that success on any one item is influenced by two main factors of the test: content and item complexity. For example, item 6 and item 12 both assess Specific Outcome #4 from the Patterns and Relations strand; however, student performance on these two items was significantly different - a difference that is likely attributable to item complexity. 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 with the understanding that as item complexity increases, student performance typically decreases. The following 8 items have been released to help identify a select group of outcomes that illustrate areas of student strength and areas for improvement from each of the four strands.

Items 1–4 illustrate student strengths according to results from the 2010 Mathematics 9 Pilot Provincial Achievement Test (2007 Program of Studies)

Item	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
				A	B	C*	D
1	N	6	Low	4.3	5.5	85.1	5.1

* Correct response

Use the following information to answer question 1.



- The approximate value of $\sqrt{15}$ is represented by the letter
 - J
 - K
 - *C. L
 - D. M

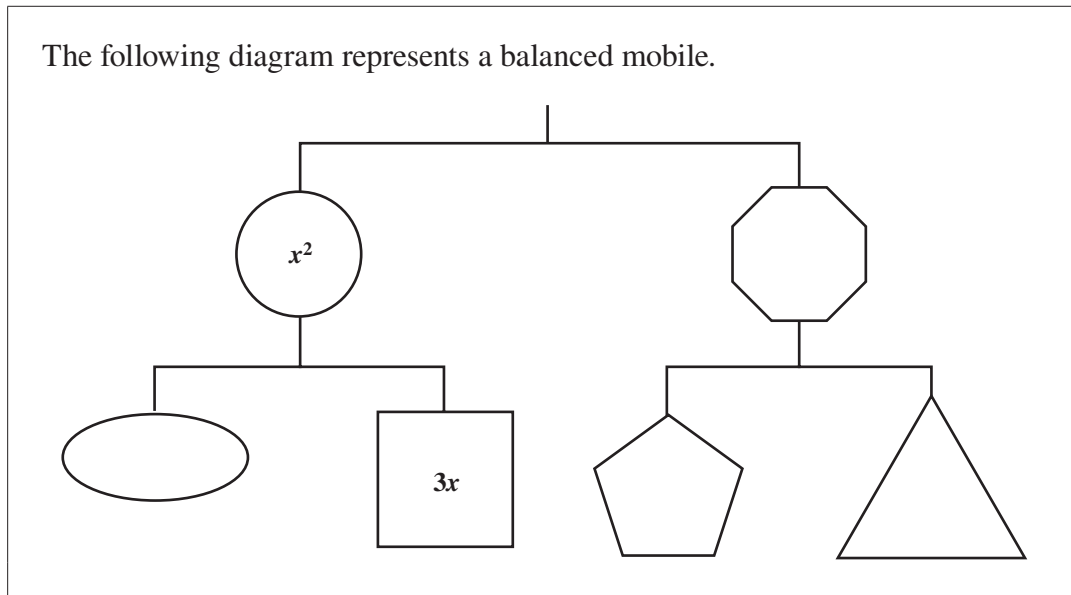
To answer this item correctly, students had to determine the approximate square root of a positive rational number that is a non-perfect square, and identify where on the number line it should be placed.

The percentage of students answering the item correctly is within the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
				A*	B	C	D
23	PR	6	Moderate	56.2	16.8	12.0	14.7

* Correct response

Use the following information to answer question 23.



23. The sum of all parts of the mobile is

- *A. $2x^2 + 12x$
- B. $2x^2 + 9x$
- C. $x^2 + 6x$
- D. $x^2 + 3x$

To answer this item correctly, students had to determine the relationship that exists among the different symbols (i.e., shapes) in order to determine the expression that the mobile represents. Students had to also apply their knowledge of preservation of equality (Grade 6, PR #5) in order to determine these relationships.

The percentage of students answering the item correctly is within the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	% of Student Responses			
				A	B*	C	D
29	PR	4	High	8.0	69.0	5.8	17.1

* Correct response

Use the following information to answer question 29.

Sandy has a budget of \$100 to spend on back-to-school clothes. The shirts she wants to buy are \$12 each, and the pants she wants to buy are \$25 each. All prices include tax.

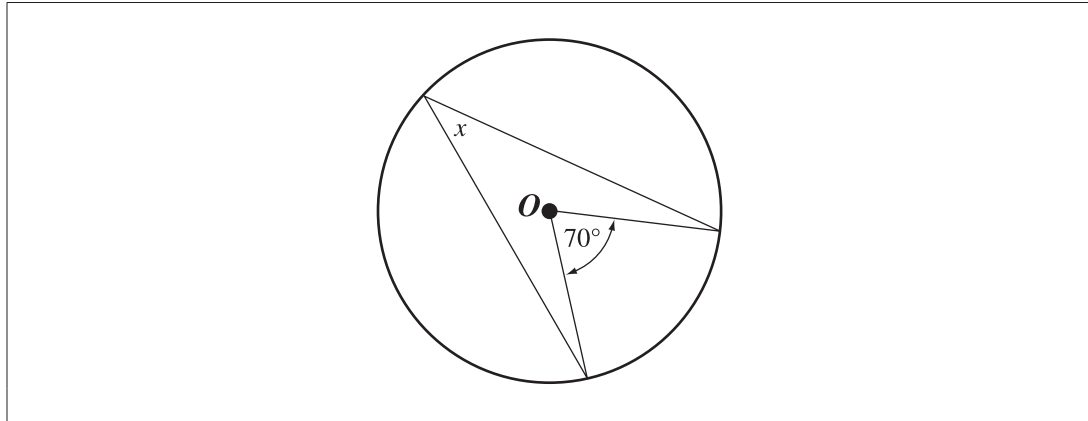
29. Which of the following inequalities could be used to determine the maximum number of shirts, n , Sandy can buy if she also buys 2 pairs of pants?
- A. $12n - 2(25) \leq 100$
 - *B. $12n + 2(25) \leq 100$
 - C. $2(25) - 12n \geq 100$
 - D. $2(25) + 12n \geq 100$

To answer this item correctly, students had to represent the solution to a word problem with a single variable linear inequality.

The percentage of students answering the item correctly is within the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option	
				Correct	Incorrect
NR 5	SS	1	1	71.2	28.8

Use the following information to answer numerical-response question 5.



Numerical Response

5. If O is the centre of the circle, the measure of x is _____ $^\circ$.

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

To answer this item correctly, students had to solve a problem involving a circle property whereby the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc.

The percentage of students answering the item correctly is within the expected range given the content being assessed and the complexity of the item.

Items 5–8 illustrate areas for improvement according to the results from the 2010 Mathematics 9 Pilot Provincial Achievement Test (2007 Program of Studies)

Item	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option			
				A	B*	C	D
2	PR	3	Moderate	9.0	18.2	29.6	42.8

* Correct response

Use the following information to answer question 2.

A truck heads north at a constant speed of 80 km/h. A car leaves 20 minutes later heading north along the same road and travelling at a constant speed of 90 km/h.

2. Which of the following equations could be used to determine how much time in hours, t , the car travels until it catches up to the truck?

A. $90t = 80\left(t - \frac{1}{3}\right)$

*B. $90t = 80\left(t + \frac{1}{3}\right)$

C. $90t = 80(t - 20)$

D. $90t = 80(t + 20)$

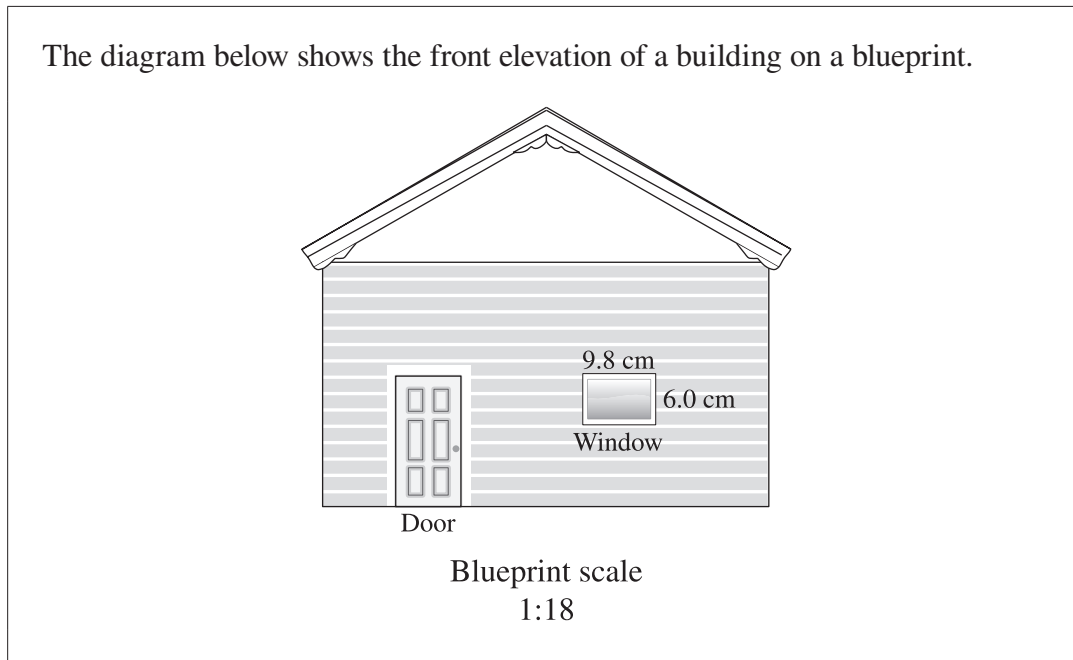
To answer this item correctly, students had to represent a word problem as a single variable linear equation. Over 42% of students answered this question incorrectly because they did not express 20 minutes as $\frac{1}{3}$ of an hour (Grade 3, SS #2; Grade 4, N #8).

The percentage of students answering the item correctly is below the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option			
				A	B	C*	D
25	SS	4	2	20.3	13.9	49.9	14.7

* Correct response

Use the following information to answer question 25.



25. Based on the dimensions shown on the blueprint, the actual dimensions of the window, to the nearest tenth of a metre, will be
- A. 0.5 m × 0.3 m
 - B. 1.0 m × 0.6 m
 - *C. 1.8 m × 1.1 m
 - D. 1.8 m × 3.0 m

To answer this item correctly, students had to interpret a scale diagram of a 2-D shape to determine the dimensions of the original 2-D shape. Over 20% of students chose option A, indicating that they divided instead of multiplying the scaled dimensions by the given scale factor.

The percentage of students answering the item correctly is below the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option	
				Correct	Incorrect
NR 3	SS	3	2	51.2	48.8

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

Sam draws two polygons that are similar. The first polygon has a perimeter of 16 cm and the second polygon has a perimeter of 10 cm.

Numerical Response

- 3.** If the shortest side of the first polygon has a length of 4 cm, then the corresponding side of the second polygon has a length of _____ cm.

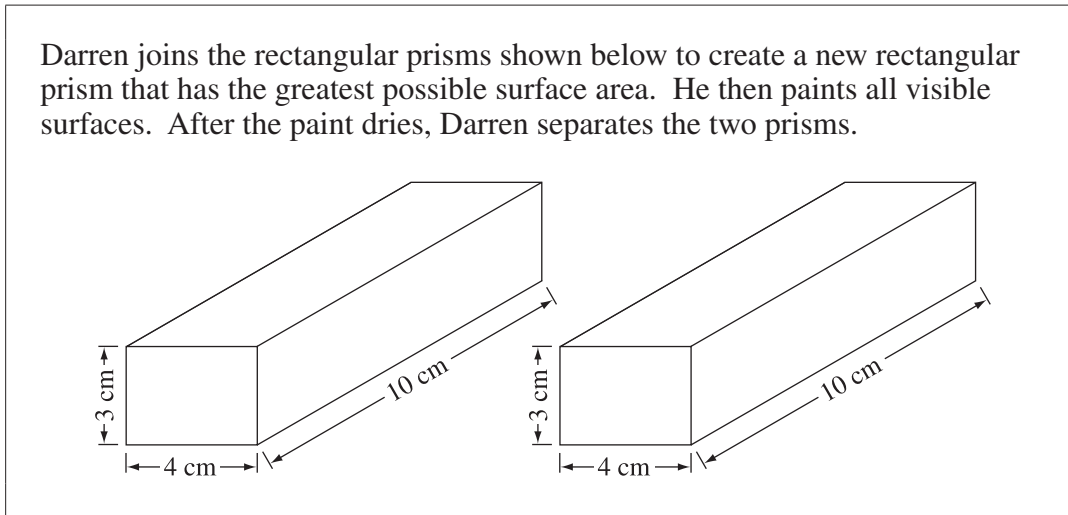
(Record your answer in the numerical-response section on the answer sheet.)

To answer this item correctly, students had to use the properties of similar polygons to solve a word problem. Incorrect student responses were quite varied. The most common incorrect response was 2, reflecting approximately 12% of the student population.

The percentage of students answering the item correctly is below the expected range given the content being assessed and the complexity of the item.

Item	Strand	Primary Outcome Number	Item Complexity	Percentage of Students Selecting Each Option	
				Correct	Incorrect
NR 6	SS	2	3	20.0	80.0

Use the following information to answer numerical-response question 6.



Numerical Response

6. The total area of both prisms that has **not** been painted is _____ cm^2 .

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

To answer this item correctly, students had to create a composite 3-D object with the largest surface area possible by joining together two identical 3-D objects and find the shared area that is common to both 3-D objects. Over 30% of students who answered this item incorrectly provided an answer of 60, which indicates that they did not know how to create the new prism with the greatest possible surface area. Instead of putting the two prisms end to end, these students simply joined their longest sides together. The word “visible” did not appear to cause any confusion for students, as only 0.01% of students provided a response that was based on only the three visible surfaces.

The percentage of students answering the item correctly is below the expected range given the content being assessed and the complexity of the item.

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 and directives; test accommodations; field testing; resources and web documents; calculator and computer policies; test marking and results; samples, forms, and letters; and Learner Assessment 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 as well as suggestions for preparing students to write the tests and information about how teachers can participate in test development activities.

Writing Samples

For achievement tests in grades 3, 6, and 9 English Language Arts and Français/French Language Arts, and grades 6 and 9 Mathematics, 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 writing samples documents contain sample responses with scoring rationales that relate student work to the scoring categories and scoring criteria for the writing assignments.

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; descriptions of and sample questions for each achievement test subject; and excerpts from the *Curriculum Handbook for Parents* identifying what students should know and be able to do in each subject by the end of grades 3, 6, and 9.

Involvement of Teachers

Teachers of grades 3, 6, and 9 are encouraged to take part in a variety of activities related to the achievement testing program. These activities include item development, test validation, field testing, and marking. In addition, regional consortia can make arrangements for teacher in-service workshops on topics such as Interpreting Achievement Test Results to Improve Student Learning.