

**Alberta Provincial
Achievement Testing**

**Assessment
Highlights
2016–2017**

**GRADE
9**

Mathematics

Alberta  Government

This document contains assessment highlights from the 2017 Grade 9 Mathematics Achievement Test. The examination statistics included in this document represent all writers in English. To obtain French-only statistics which may apply to your school, please refer to the French version of this document.

Assessment Highlights provide information about the overall test, the test blueprint, and student performance on the achievement test that was administered in 2017. Also provided is information on student performance at the acceptable standard and the standard of excellence on selected items from the 2017 Grade 9 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 posted on the Alberta Education website (see [Achievement Documents](#)).

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 2017 Grade 9 Mathematics Achievement Test

This report provides teachers, school administrators, and the public with an overview of the performance of those students who wrote the 2017 Grade 9 Mathematics Achievement Test. It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 40 084 students wrote the 2017 Grade 9 Mathematics Achievement Test. The English form of the test was written by 37 324 students, and the French form was written by 2 760 students.

What Was the Test Like?

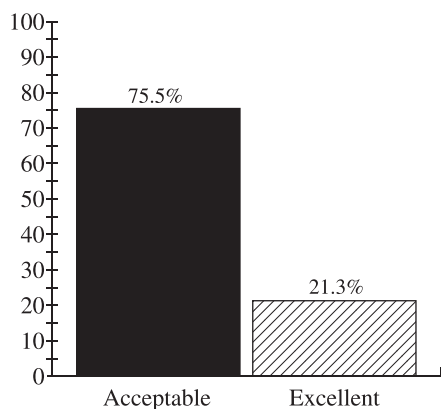
The 2017 Grade 9 Mathematics Achievement Test consisted of 40 multiple-choice and 10 numerical-response questions based on four strands: Number, Patterns and Relations, Shape and Space, and Statistics and Probability. In keeping with the intent of the 2007 Program of Studies, the questions on the test 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 2017 are shown in the graph below. In 2017, 75.5% of students who wrote the Grade 9 Mathematics Achievement Test achieved the acceptable standard, and 21.3% of students who wrote achieved the standard of excellence.

The provincial average on the test was 29.44/50 (58.88%). The results presented in this report are based on the scores of all students who wrote the test. Detailed provincial assessment results are provided in school and jurisdiction reports.

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



 The percentage of students in the province who met the acceptable standard on the 2017 Grade 9 Mathematics Achievement Test (based on those who wrote)

 The percentage of students in the province who met the standard of excellence on the 2017 Grade 9 Mathematics Achievement Test (based on those who wrote)

2017 Test Blueprint and Student Achievement

The blueprint below shows how the questions on the test were classified and includes the average raw score in each category for all Grade 9 students who wrote this test.

Strand	Level of Complexity*			Provincial Student Achievement (Average Raw Score and Percentage)
	Low	Moderate	High	
Number	9	6	3	10.63/18 (59.1%)
Patterns and Relations	8	10	0	10.67/18 (59.3%)
Shape and Space	4	7	0	5.94/11 (54.0%)
Statistics and Probability	1	2	0	2.20/3 (73.3%)
Provincial Student Achievement (Average Raw Score and Percentage)	13.16/22 (59.8%)	14.66/25 (58.6%)	1.62/3 (54.0%)	Total Test Raw Score 29.44/50 (58.88%)

*Each question is categorized according to its level of complexity (low, moderate, or high). Descriptions of the levels of complexity are in the [2017–2018 Mathematics 9 Subject Bulletin](#).

Sample Questions from the 2017 Grade 9 Mathematics Achievement Test

The following ten items illustrate significant performance differences between students who obtained the standard of excellence, those who obtained the acceptable standard, and those below the acceptable standard.

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
20	D	69.5	PR.4	Moderate	Translate a given problem into a single-variable linear inequality.

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	0.2	0.7	4.5	94.6	0.0
Students Achieving Acceptable Standard*	2.1	4.7	17.5	75.6	0.1
Students Below Acceptable Standard	14.7	21.5	29.4	34.0	0.4

*Includes those students who achieved the acceptable standard but not the standard of excellence

The cost of a team banquet is \$200 for the room rental and \$15 per person, n , for the meal. All taxes are included in these costs. The team has a maximum budget of \$650 for the banquet.

20. The inequality that can be used to determine how many people can attend is
- A. $15n + 200 > 650$
 - B. $15n + 200 < 650$
 - C. $15n + 200 \geq 650$
 - D. $15n + 200 \leq 650$

Commentary: Multiple-choice question 20

Example of a correct response

$$\begin{aligned} 15n + 200 &\leq 650 \\ -200 &\quad -200 \\ \hline 15n &= 450 \\ \frac{15n}{15} &= \frac{450}{15} \\ n &\leq 30 \end{aligned}$$

Example of a common incorrect response

$$\begin{aligned} 200 + 15n \\ 15n + 200 &\geq 650 \end{aligned}$$

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
21	B	46.0	PR.3	Moderate	Solve a given problem by representing the problem as a linear equation and solving for the unknown variable (Gr.8, PR.2).

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	12.7	77.4	7.0	2.6	0.3
Students Achieving Acceptable Standard*	28.1	40.6	22.3	8.1	0.9
Students Below Acceptable Standard	29.5	30.6	27.4	11.6	0.9

*Includes those students who achieved the acceptable standard but not the standard of excellence

The total length of time it takes for a single passenger train to travel between Vancouver and Toronto is 80 h.

Starting Location	Ending Location	Time (h)
Vancouver	Jasper	$\frac{5}{9}x$
Jasper	Winnipeg	$\frac{2}{3}x$
Winnipeg	Toronto	x

21. How long does it take the train to travel between Winnipeg and Toronto?

- A. 24 h
- B. 36 h
- C. 44 h
- D. 53 h

Example of a correct response

$$x + \frac{2}{3}x + \frac{5}{9}x = 80$$

$$\frac{9}{9}x + \frac{6}{9}x + \frac{5}{9}x = 80$$

$$\frac{20}{9}x = 80$$

$$20x = 720$$

$$x = 36$$

Example of a common incorrect response

$$\frac{2}{3}x = 80$$

$$x = 0.66 \times 80$$

$$x = 53$$

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
29	B	59.1	N.5	High	Solve a multi-step problem by determining the square root of a given value, calculating a fraction of the square root, and then using this value in an operation.

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	1.1	95.2	2.3	1.4	0.0
Students Achieving Acceptable Standard*	11.4	57.5	24.7	6.2	0.2
Students Below Acceptable Standard	24.3	31.3	33.4	10.3	0.7

*Includes those students who achieved the acceptable standard but not the standard of excellence

Jack has a large, square section of land with an area of 160 000 m². A small, square section is fenced off to create a pasture for his goats. The length of one side of the small section of land is one-eighth of the length of one side of the large section of land.

29. What is the perimeter of the fence that encloses the small, square section of land?
- A. 160 m
 - B. 200 m
 - C. 400 m
 - D. 566 m

Example of a correct response

$$\sqrt{160\,000} = 400\text{ m}$$

$$\frac{1}{8} = 0.125$$

$$400 \times 0.125 = 50\text{ m}$$

$$50 \times 4 = 200$$

Examples of student work that did not lead to a correct solution

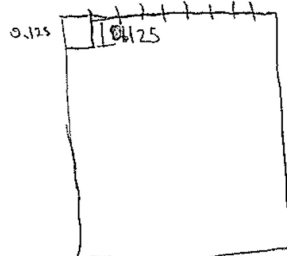
$$40000 \div \frac{1}{8} = 0.125$$

$$40000 \times 0.125$$

$$5000 \div 4$$

$$10000 = 1250 \div 4$$

$$400 \div 4 =$$



$$0.125$$

$$0.5$$

$$20000$$

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
30	A	33.6	SS.2	Moderate	Determine the surface area of a composite 3-D object.

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	58.0	32.7	6.6	2.6	0.1
Students Achieving Acceptable Standard*	28.2	39.5	22.7	9.1	0.5
Students Below Acceptable Standard	24.4	32.9	27.7	13.9	1.1

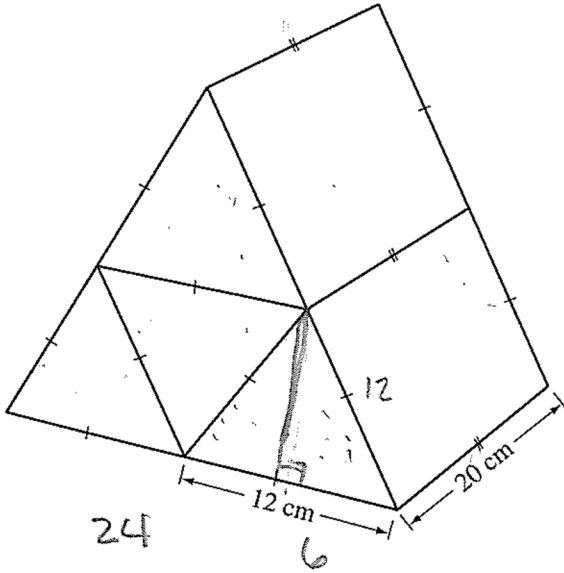
*Includes those students who achieved the acceptable standard but not the standard of excellence

Four identical triangular prisms are arranged together to form one large, triangular prism, as shown below. The five exterior surfaces of the large prism are then painted.

30. To the nearest square centimetre, what is the total area of the painted surfaces?

- A. 1 939 cm²
- B. 2 016 cm²
- C. 2 659 cm²
- D. 2 736 cm²

Example of a correct solution



$$c^2 - b^2 = a^2$$

$$12^2 - 6^2 = a^2$$

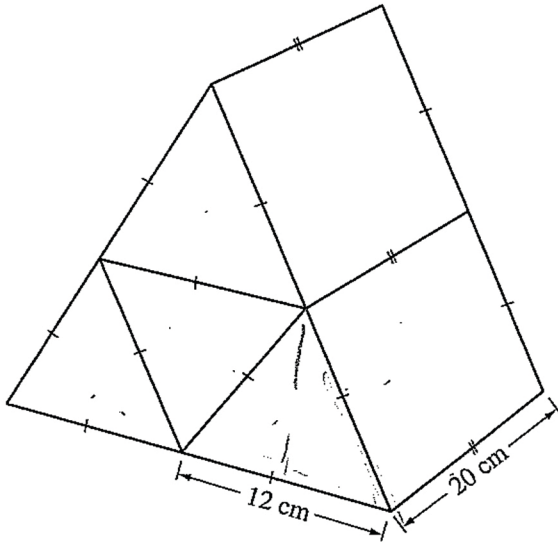
$$\sqrt{108} = 10.39230485$$

$$a = 10.39230485$$

$$16 \left(\frac{b \cdot a}{2} \right) =$$

$$498.8306328$$

Example of a common error caused by the incorrect application of the formula for area of a triangle



$$f_{00} + + b a c F$$

$$A = \frac{bh}{2} = 72 \times \frac{1}{2} = 288 \times 2$$

$$576$$

$$\square = 20 \times 12 = 1240 \times 2$$

$$= 480 \times 2 = 1960$$

$$\begin{array}{r} 480 \\ \times 2 \\ \hline 960 \end{array}$$

2016

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
34	C	47.0	N.5	Low	Determine the perimeter of a design composed of square shapes by calculating the square root of each given square's area, which is a perfect square number (Gr.8, N.1).

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	1.5	14.0	82.8	1.7	0.0
Students Achieving Acceptable Standard*	10.5	31.1	42.4	15.2	0.8
Students Below Acceptable Standard	21.0	27.1	25.8	24.7	1.4

*Includes those students who achieved the acceptable standard but not the standard of excellence

The design shown below is created by four squares with areas of 576 cm^2 , 400 cm^2 , 324 cm^2 , and 196 cm^2 .

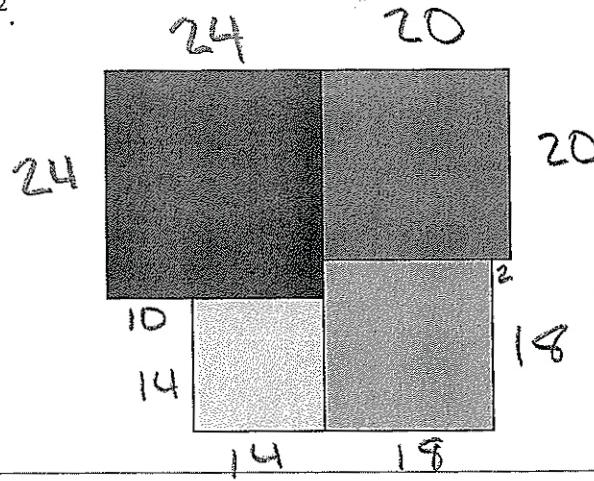
34. What is the perimeter of the design shown above?

- A. 144 cm
- B. 152 cm
- C. 164 cm
- D. 176 cm

Example of a correct solution

Use the following information to answer question 34.

The design shown below is created by four squares with areas of 576 cm^2 , 400 cm^2 , 324 cm^2 , and 196 cm^2 .



34. What is the perimeter of the design shown above?

- A. 144 cm
- B. 152 cm
- C. 164 cm
- D. 176 cm

$$\sqrt{576} = 24$$

$$\sqrt{400} = 20$$

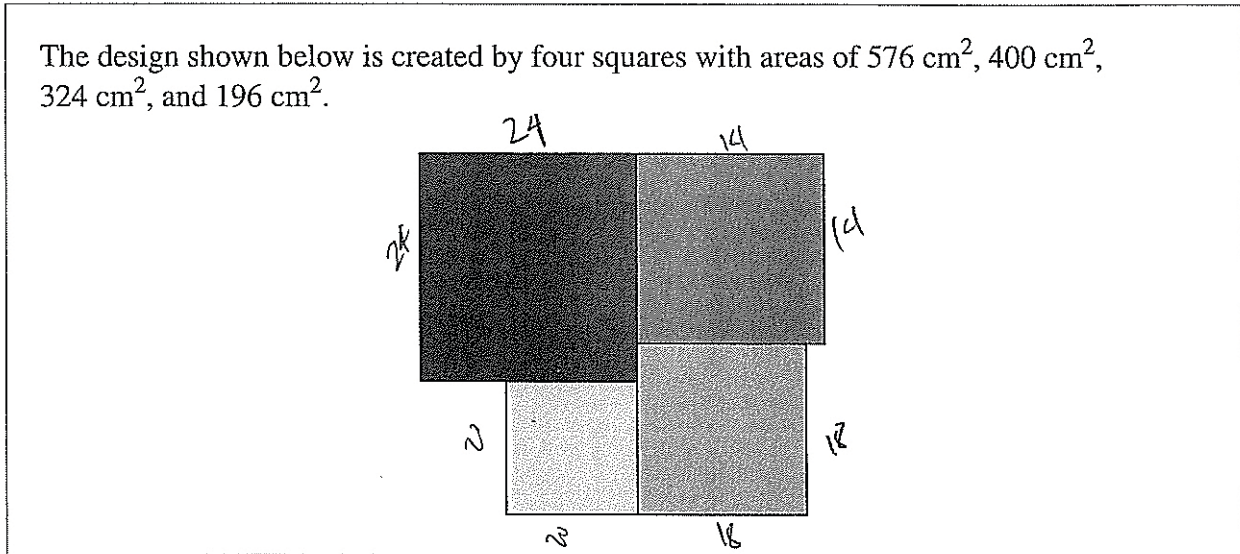
$$\sqrt{324} = 18$$

$$\sqrt{196} = 14$$

$$24(2) + 20(2) + 18(2) + 14(2) + 12 = 164$$

The following example represents a common error made by students that was caused by not including two side lengths.

Use the following information to answer question 34.



34. What is the perimeter of the design shown above?

- A. 144 cm
- B. 152 cm
- C. 164 cm
- D. 176 cm


Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
36	B	53.6	SP.1	Moderate	Identify the issue that would have the greatest effect on the analysis of the data of a given survey.


Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	6.0	72.7	14.3	7.0	0.0
Students Achieving Acceptable Standard*	10.6	55.0	23.1	10.8	0.5
Students Below Acceptable Standard	16.3	33.7	31.7	17.1	1.2


*Includes those students who achieved the acceptable standard but not the standard of excellence

Jonas conducts a survey to determine which flavour of ice cream is the favourite among the students at his school. He plans to hand out the questionnaire shown below to 100 randomly selected students.

Which of the following ice cream flavours is the best?

 Strawberry

 Chocolate

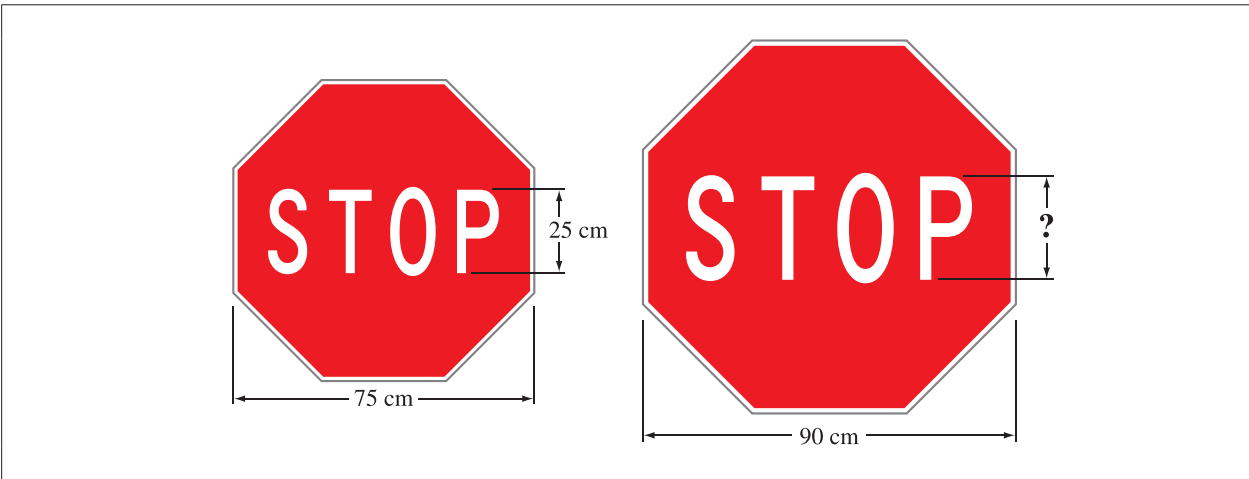
 Vanilla

36. The analysis of the data collected by this survey would be **most** affected by issues related to
- privacy
 - use of language
 - time and timing
 - cultural sensitivity

Item #	Key	% of Students with Correct Solution	Strand & Outcome	Item Complexity	Item Description
40	A	61.5	SS.3	Low	Solve a given problem using the properties of similar polygons.

Standards Achieved by Students	% of Student Responses				
	A	B	C	D	No Response
Students Achieving Standard of Excellence	97.1	2.3	0.2	0.2	0.2
Students Achieving Acceptable Standard*	64.3	30.0	2.3	2.6	0.8
Students Below Acceptable Standard	24.2	49.8	11.5	12.9	1.6

*Includes those students who achieved the acceptable standard but not the standard of excellence



40. If the two stop signs shown above are similar, what is the height of the letters in the larger stop sign?
- A. 30 cm
 - B. 40 cm
 - C. 45 cm
 - D. 50 cm

Examples of correct solutions

$$1\frac{1}{5}$$

$$25(1\frac{1}{5}) = 30$$

$$\frac{75}{90} = \frac{25}{x}$$

$$75x = 2250$$

$$x = 30$$

Example of a common incorrect response

$$\begin{array}{r} 1 \\ 25 \\ 15 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 90 \\ - 75 \\ \hline 15 \end{array}$$

Item #	Key	% of Students with Correct Solution	# of Unique Errors	Strand & Outcome	Item Complexity	Item Description
NR 5	13	71.2	495	PR.3	Moderate	Create and solve a linear inequality that represents a given context.

Standards Achieved by Students	% of Students with Correct Solution	# of Unique Errors	Three Most Common Errors (Number of Students)		
Students Achieving Standard of Excellence (n = 8 540)	96.4	27	12 (101)	12.3 (75)	16 (27)
Students Achieving Acceptable Standard* (n = 21 718)	76.3	119	12 (2 115)	12.3 (1 347)	16 (328)
Students Below Acceptable Standard (n = 9 826)	38.0	374	12 (1 902)	12.3 (731)	16 (490)

*Includes those students who achieved the acceptable standard but not the standard of excellence

Amy has already saved \$50 toward the purchase of a new camera that has a total cost of \$235. She earns the rest of the money she needs to buy the camera by babysitting her sister. Each time she babysits, she is paid \$15.

Numerical Response

5. What is the minimum number of times Amy must babysit her sister in order to earn enough money to purchase the camera?

Answer: _____ times

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

Example of a correct response

$$\begin{array}{r} 50 + 15n \geq 235 \\ -50 \qquad \qquad -50 \\ \hline 15n \geq 185 \\ \frac{15n}{15} \geq \frac{185}{15} \end{array}$$

$n \geq 12.3$
minimum = 13

The following example shows a solution process in which the calculations are performed correctly; however, to answer the question it was necessary to round up to 13.

$$\begin{array}{r} 50 + 15x = 235 \\ -50 \qquad \qquad -50 \\ \hline 15x = 185 \\ \frac{15x}{15} = \frac{185}{15} \\ x = 12.3 \end{array}$$

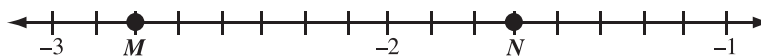
Item #	Key	% of Students with Correct Solution	# of Unique Errors	Strand & Outcome	Item Complexity	Item Description
NR 6	3	42.7	432	N.3	Low	Order a given set of rational numbers in fraction and decimal form by placing them on a number line.

Standards Achieved by Students	% of Students with Correct Solution	# of Unique Errors	Three Most Common Errors (Number of Students)		
Students Achieving Standard of Excellence (n = 8 540)	65.4	122	4 (1 879)	2 (616)	5 (319)
Students Achieving Acceptable Standard* (n = 21 718)	39.0	130	4 (6 880)	2 (3 473)	5 (1 732)
Students Below Acceptable Standard (n = 9 826)	31.1	378	2 (2 253)	4 (2 113)	5 (515)

*Includes those students who achieved the acceptable standard but not the standard of excellence

Sam plans to graph the following rational numbers on the number line shown below.

Rational Numbers: $-2\frac{1}{4}$ -1.75 $-\frac{3}{2}$ $-2.\bar{8}$ $-1\frac{3}{5}$ $-(1.4)^2$



Numerical Response

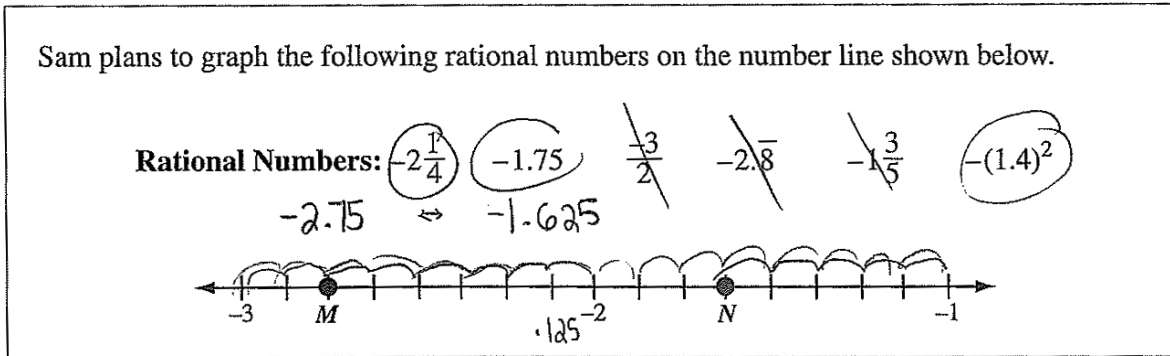
6. How many of the rational numbers shown above should be graphed between Point *M* and Point *N* on the number line?

Answer: _____

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

Example of a correct response

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



Numerical Response

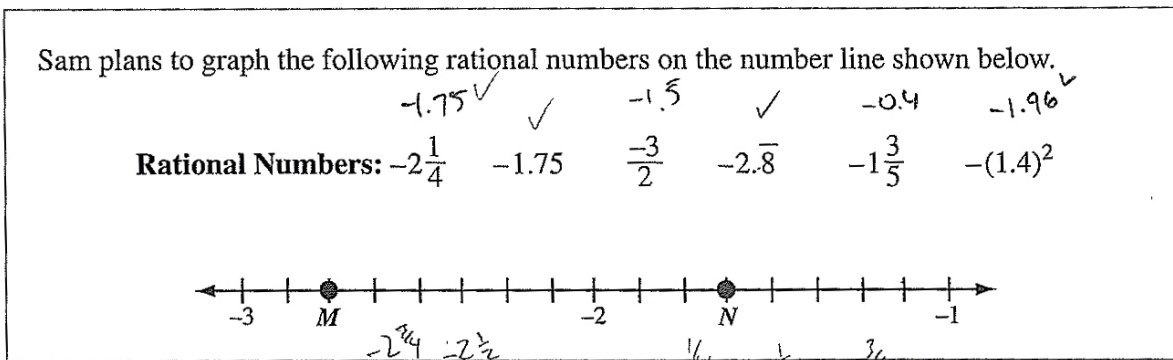
6. How many of the rational numbers shown above should be graphed between Point *M* and Point *N* on the number line?

Answer: 3

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

Example of a common incorrect response. The error illustrated by this example is incorrect conversion of mixed numbers to decimal values.

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



Numerical Response

6. How many of the rational numbers shown above should be graphed between Point *M* and Point *N* on the number line?

Answer: 4

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

Item #	Key	% of Students with Correct Solution	# of Unique Errors	Strand & Outcome	Item Complexity	Item Description
NR 8	2	53.6	313	N.2	Moderate	Identify the error in a given simplification of an expression involving powers

Standards Achieved by Students	% of Students with Correct Solution	# of Unique Errors	Three Most Common Errors (Number of Students)		
Students Achieving Standard of Excellence (n = 8 540)	84.8	8	1 (563)	3 (477)	4 (172)
Students Achieving Acceptable Standard* (n = 21 718)	53.7	225	3 (6 671)	1 (2 154)	4 (518)
Students Below Acceptable Standard (n = 9 826)	26.5	414	3 (4 501)	1 (803)	4 (661)

*Includes those students who achieved the acceptable standard but not the standard of excellence

An incorrect simplification of the expression $(2^3)(2^5)^2 \div (4 \times 2)^2$ is shown below.

$$(2^3)(2^5)^2 \div (4 \times 2)^2$$

Step 1 $(2^3)(2^5)^2 \div (8)^2$

Step 2 $(2^3)(2^7) \div (8)^2$

Step 3 $(2^3)(2^7) \div (2^3)^2$

Step 4 $(2^3)(2^7) \div (2^5)$

Step 5 $2^{10} \div 2^5$

Step 6 2^2

Numerical Response

8. In which step is the **first** recorded error?

Answer: Step _____

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

Example of a correct response

Numerical Response

8. In which step is the **first** recorded error?

Answer: Step 2

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

$$\begin{array}{l} (2^3)(2^{10}) \\ \swarrow \searrow \\ (2^{13}) \div (8^2) \\ 8 \\ 128 \end{array}$$

Example of a common incorrect response

Use the following information to answer numerical-response question 8.

An incorrect simplification of the expression $(2^3)(2^5)^2 \div (4 \times 2)^2$ is shown below.

	$(2^3)(2^5)^2 \div (4 \times 2)^2$	2^{13}
Step 1	$(2^3)(2^5)^2 \div (8)^2$	$\frac{2^{13}}{4^2 \times 2^2}$
Step 2	$(2^3)(2^7) \div (8)^2$	
Step 3	$(2^3)(2^7) \div (2^3)^2$	
Step 4	$(2^3)(2^7) \div (2^5)$	
Step 5	$2^{10} \div 2^5$	
Step 6	2^2	

Numerical Response

8. In which step is the **first** recorded error?

Answer: Step 1

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

Provincial Achievement Testing Program Support Documents

The Alberta Education website contains several documents that provide valuable information about various aspects of the provincial achievement testing program. To access these documents, go to the [Alberta Education website](#). 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 provincial 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 Provincial Assessment Sector contacts.

Subject Bulletins

At the beginning of each school year, subject bulletins are posted on the Alberta Education website for all provincial 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 provincial achievement tests in grades 6 and 9 English Language Arts and Français/French Language Arts, writing samples are designed for 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 provincial achievement tests (parts A and B) for Grade 9 semestered students are secured and must be returned to Alberta Education. All May/June provincial 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 answers frequently asked questions about the provincial achievement testing program and provides 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 provincial 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 provincial achievement test results to improve student learning.