Individual Benchmark Specifications for Grades 9–10

This section of the *Specifications* describes how the FCAT benchmarks are assessed. The benchmarks are defined in the *Sunshine State Standards* at four developmental levels corresponding to the following grade ranges: PreK–2, 3–5, 6–8, and 9–12. FCAT Mathematics is administered at Grades 3 through 10. Two of these grades, 5 and 8, are at the upper end of the developmental range; therefore, all of the benchmarks that could be assessed by the item types for the FCAT will be included in the assessment.

Not all of the benchmarks for the 9–12 grade range are included in the assessment because students are tested in Grade 10. The criterion used to determine what should be assessed at Grade 10 was that the content should be challenging to all tenth grade students. As a result, a sampling of the Algebra II and Geometry content in the benchmarks is assessed. All of the content included in the benchmarks below the levels of Algebra II and Geometry is assessed.

The set of sample items that is included throughout the *Specifications* document represents a wide range of difficulty and cognitive complexity. Although most of the items are of average difficulty and moderate complexity and can be answered correctly by students that reach achievement level three, some of the items presented will be challenging for some students and are specifically included to prompt item writers to submit items that will measure the abilities of students in higher achievement levels. As the FCAT is constructed to measure various achievement levels, this document was constructed to help item writers see the range of difficulties and complexities of items that may appear on a test.

BENCHMARK MA.A.1.4.2

Strand	**A** Number Sense, Concepts, and Operations
Standard	**1** The student understands the different ways numbers are represented and used in the real world.
Benchmark	**MA.A.1.4.2 The student understands the relative size of integers, rational numbers, irrational numbers, and real numbers.**

Item Type At Grade 9, this benchmark will be assessed using MC items.

Benchmark Clarification Students will compare, order, and determine the relative size of real numbers.

Content Limits Items that involve exponents should include whole number bases.

Items may include integer exponents.

Stimulus Attributes Items may be set in either real-world or mathematical contexts.

Different types of numbers may be mixed within the same item.

Sample MC Item

The table below identifies several atoms and the mass in kilograms (kg) of each.

MASSES OF VARIOUS METAL ATOMS

Atoms	Mass (kg)
Aluminum	4.4816×10^{-26}
Copper	1.0555×10^{-25}
Gold	3.2716×10^{-25}
Nickel	9.7484×10^{-26}

Which of the atoms in the table has the **second smallest** mass?

A. aluminum

B. copper

C. gold

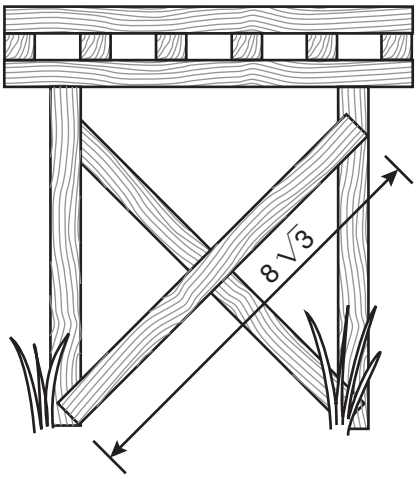
★ D. nickel

Item Context Science

Item Type	At Grade 10, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will compute, identify, and/or compare the relative size of real numbers.
Content Limit	Items may include integer exponents.
Stimulus Attributes	Items should be set in a real-world context. Different types of numbers may be mixed within the same item.

Sample MC Item

A building contractor is constructing a raised deck for a house. To stabilize the deck, the contractor must install diagonal bracing as shown in the picture below. The contractor used the Pythagorean theorem to determine that the length of 1 brace is $8\sqrt{3}$ feet.



Which of the following numbers is closest to the length of 1 brace?

A. $13\frac{1}{3}$ feet

B. $13\frac{2}{5}$ feet

C. $13\frac{4}{7}$ feet

★ D. $13\frac{7}{8}$ feet

Item Context Workplace

BENCHMARK MA.A.1.4.4

Strand **A** Number Sense, Concepts, and Operations

Standard **1** The student understands the different ways numbers are represented and used in the real world.

Benchmark **MA.A.1.4.4 The student understands that numbers can be represented in a variety of equivalent forms, including integers, fractions, decimals, percents, scientific notation, exponents, radicals, absolute value, and logarithms.**

Also assesses MA.A.1.4.1 The student associates verbal names, written word names, and standard numerals with integers, rational numbers, irrational numbers, real numbers, and complex numbers.

Also assesses MA.A.1.4.3 The student understands concrete and symbolic representations of real and complex numbers in real-world situations.

Item Types At Grade 9, this benchmark will be assessed using MC and GR items.

Benchmark Clarification Students will use numbers expressed in equivalent forms, including integers, fractions, decimals, percents, standard scientific notation and other exponential forms, radicals, and absolute value.

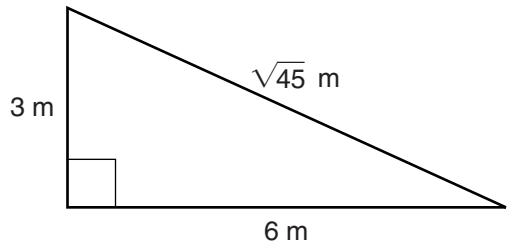
Content Limit Logarithms and imaginary numbers will not be assessed.

Stimulus Attributes Different forms of numbers may be mixed within the same item.

Items may be set in either real-world or mathematical contexts.

Sample MC Item

The measurements, in meters (m), of the sides of a right triangle are shown below.



Which of the following is equivalent to the length of the hypotenuse of this right triangle?

★ A. $3\sqrt{5}$ m

B. $5\sqrt{3}$ m

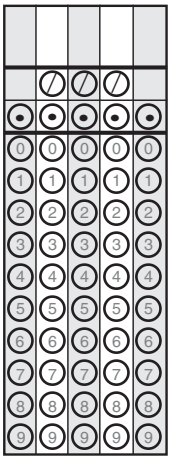
C. $5\sqrt{9}$ m

D. $9\sqrt{5}$ m

Item Context Mathematics

Sample GR Item

On a mathematics test, Ken earned a score of 446 points out of a possible score of 500 points. What **percent** is equivalent to Ken's score?



Sample Response 89.2

Item Context Mathematics

Item Types	At Grade 10, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will identify and/or represent numbers in equivalent forms.
Content Limit	Logarithms and imaginary numbers will not be assessed.
Stimulus Attributes	Different forms of numbers may be mixed within the same item. Items may be set in either real-world or mathematical contexts.

Sample MC Item

The number of bacteria, x, in a certain sample triples every two hours. Which of these could be used to determine the number of bacteria in the sample after n two-hour periods?

A. $3xn$

B. $3x^n$

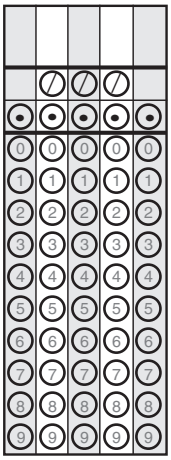
★ C. 3^nx

D. $(3x)^n$

Item Context	Science

Sample GR Item

An angstrom (Å) is a unit of measure used by scientists to measure very short distances. An angstrom is equivalent to 3.9×10^{-9} inch. How many inches, **written in standard notation**, equal 1,000,000 angstroms?



Sample Response .0039

Item Context Science

BENCHMARK MA.A.3.4.1

Strand **A** Number Sense, Concepts, and Operations

Standard **3** The student understands the effects of operations on numbers and the relationships among these operations, selects appropriate operations, and computes for problem solving.

Benchmark **MA.A.3.4.1 The student understands and explains the effects of addition, subtraction, multiplication, and division on real numbers, including square roots, exponents, and appropriate inverse relationships.**

Also assesses MA.A.2.4.2 The student understands and uses the real number system.

Item Types	At Grade 9, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will determine, analyze, and/or identify the effects or results of mathematical operations (including appropriate inverse operations) on real numbers.
Content Limits	Items should require students to determine the effects of operations on real numbers including adding, subtracting, multiplying, dividing, raising to powers, and extracting square roots. Items that require determining inverses may include adding and subtracting, multiplying and dividing, and squaring and extracting square roots. Numbers may exceed the limits specified in the General Content Limits when the numbers are represented in word form (e.g., fifty billion) or as denominate numbers (e.g., 4.3 trillion).
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Graphics should be used in some of these items, as appropriate.

Sample MC Item

Which of the following numbers when multiplied by 3^{-2} is equal to 1?

A. 3^{-2}

B. -3^{-2}

★ C. 3^{2}

D. -3^{2}

Item Context	Mathematics

Item Types At Grade 10, this benchmark will be assessed using MC items.

Benchmark Clarification Students will determine, analyze, and/or identify the effects or results of mathematical operations (including appropriate inverse operations) on real numbers.

Content Limit Items should require students to determine the effects of operations on real numbers including adding, subtracting, multiplying, dividing, raising to powers, and extracting square roots.

Items that require determining inverses may include adding and subtracting, multiplying and dividing, and squaring and extracting square roots.

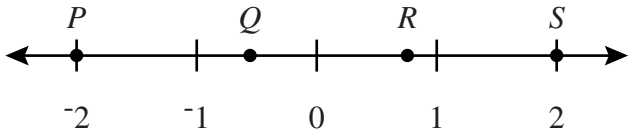
Numbers may exceed the limits specified in the General Content Limits when the numbers are represented in word form (e.g., fifty billion) or as denominate numbers (e.g., 4.3 trillion).

Stimulus Attributes Items may be set in either real-world or mathematical contexts.

Graphics should be used in some of these items, as appropriate.

Sample MC Item

P, Q, R, and *S* are four points on the number line below.



Which point on the number line represents a number that, when squared, will result in a number less than itself?

A. *P*

B. *Q*

★ C. *R*

D. *S*

Item Context Mathematics

BENCHMARK MA.A.3.4.2

Strand

A Number Sense, Concepts, and Operations

Standard

3 The student understands the effects of operations on numbers and the relationships among these operations, selects appropriate operations, and computes for problem solving.

Benchmark

MA.A.3.4.2 The student selects and justifies alternative strategies, such as using properties of numbers, including inverse, identity, distributive, associative, transitive, that allow operational shortcuts for computational procedures in real-world or mathematical problems.

Also assesses MA.A.2.4.2 The student understands and uses the real number system.

Also assesses MA.A.3.3.2 The student selects the appropriate operation to solve problems involving addition, subtraction, multiplication, and division of rational numbers, ratios, proportions, and percents, including the appropriate application of the algebraic order of operations.

Item Type	At Grade 9, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will use an alternative strategy that permits an operational shortcut and/or will use the correct order of operations to solve a problem.
Content Limits	Items may include numeric or variable expressions or equations. Expressions will contain no more than 2 variables. Equations will contain no more than 3 variables. Items will assess understanding of the properties and not the vocabulary.
Stimulus Attribute	Items may be set in either real-world or mathematical contexts.

Sample MC Item

The Master Frame Company hired a new frame maker. For each frame, the company supplies the frame maker with $12 of materials and pays $15 per hour. The company charges $80 for these frames and can determine its profit by using the following formula.

$$P = x[80 - (12 + 15t)]$$

Given:
P = profit
t = hours spent making 1 frame
x = number of frames built

Which equation shows the amount of profit earned if the frame maker built 5 frames?

A. $P = 340 + 75t$

★ B. $P = 340 - 75t$

C. $P = 388 + 75t$

D. $P = 388 - 75t$

Item Context	Workplace

Item Type	At Grade 10, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will use an alternative strategy that permits an operational shortcut and/or will use the correct order of operations to solve a problem.
Content Limits	Items may include numeric or variable expressions or equations. Items will assess understanding of the properties and not the vocabulary.
Stimulus Attribute	Items may be set in either real-world or mathematical contexts.

Sample MC Item

Cara needs to simplify the following expression for her homework assignment.

$$2(4x + y) - 5(2x + y) + 3(2x + y)$$

Which of the following expressions is equivalent to the expression above?

★ A. $4x$

B. $4x + y$

C. $4x + 2y$

D. $4x + 3y$

Item Context	Mathematics

BENCHMARK MA.A.3.4.3

Strand **A** Number Sense, Concepts, and Operations

Standard **3** The student understands the effects of operations on numbers and the relationships among these operations, selects appropriate operations, and computes for problem solving.

Benchmark **MA.A.3.4.3 The student adds, subtracts, multiplies, and divides real numbers, including square roots and exponents, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator.**

Also assesses MA.A.2.4.2 The student understands and uses the real number system.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve real-world problems using appropriate computations with real numbers.
Content Limit	See General Content Limits.
Stimulus Attributes	Items may include problems dealing with percents. Items should be set in a real-world context.

Sample MC Item

Stephen paid a $25 membership fee to join a wholesale shopping club. His first purchase was a case of chlorine treatment for his pool. The case contained 4 bottles and cost $33. The cost of 1 bottle for a non-member is $10.78. How many **full cases** of chlorine treatment will Stephen have to buy from the club in order to recover the $25 membership fee?

A. 1

B. 2

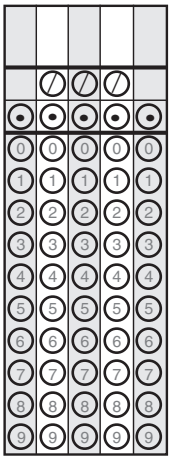
★ C. 3

D. 4

Item Context	Social Studies

Sample GR Item

Florida's population grew from 2.8 million in 1950 to 5 million in 1960. What was the **percent of increase** in Florida's population from 1950 to 1960?



Sample Response 78.57

Item Context Social Studies

Item Types	At Grade 10, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve real-world problems using appropriate computations with real numbers.
Content Limit	See General Content Limits.
Stimulus Attributes	Items may include problems dealing with percents. Items should be set in a real-world context.

Sample MC Item

In 2000, the total number of students enrolled in college in the United States was approximately 1,745,000. This was a 130 percent increase over the number of students enrolled in college in 1960. According to this information, which is closest to the number of students enrolled in college in 1960?

A. 524,000

★ B. 759,000

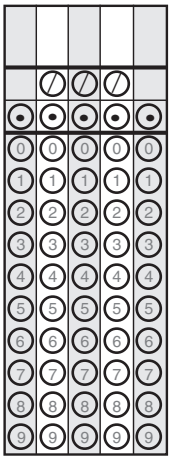
C. 1,342,000

D. 2,269,000

Item Context Social Studies

Sample GR Item

A department store marked all coats $\frac{1}{3}$ off the original price for a spring sale. Amanda has a store coupon that is good for an additional discount of 15% off the sale price. She purchases a coat that was originally priced $165.00. If she uses her discount coupon, what should be the cost of the coat before the sales tax is added?



Sample Response 93.50

Item Context Social Studies

BENCHMARK MA.A.4.4.1

Strand **A** Number Sense, Concepts, and Operations

Standard **4** The student uses estimation in problem solving and computation.

Benchmark **MA.A.4.4.1 The student uses estimation strategies in complex situations to predict results and to check the reasonableness of results.**

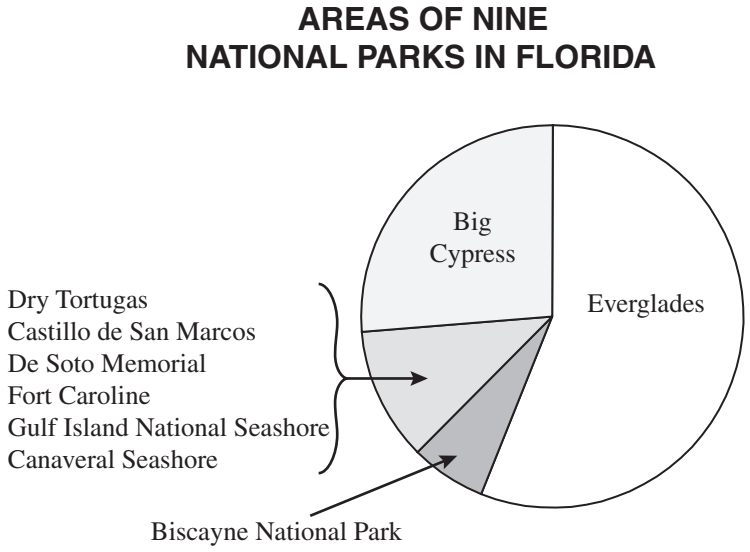
Also assesses MA.A.4.2.1 The student uses and justifies different estimation strategies in a real-world problem situation and determines the reasonableness of results of calculations in a given problem situation.

Also assesses MA.B.3.4.1 The student solves real-world and mathematical problems involving estimates of measurements, including length, time, weight/mass, temperature, money, perimeter, area, and volume, and estimates the effects of measurement errors on calculations.

Item Type	At Grade 9, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will use an appropriate estimation strategy or determine the reasonableness of results.
Content Limits	The data that are presented to students may be either precise values or a range of values. Items should not assess linear estimation.
Stimulus Attributes	Items should be set in a real-world context. Item contexts should require students to make an estimate and not to calculate an exact amount. Graphics should be used in all of these items.
Response Attribute	When ranges are used, they should not overlap.

Sample MC Item

The circle graph below represents the areas of nine national parks located in Florida in 2001.



The largest of these, the Everglades, contained about 1.5 million acres in 2001. Which of these is closest to the number of acres contained in the other eight designated parks in 2001?

A. 300,000 acres

B. 700,000 acres

★ C. 1,200,000 acres

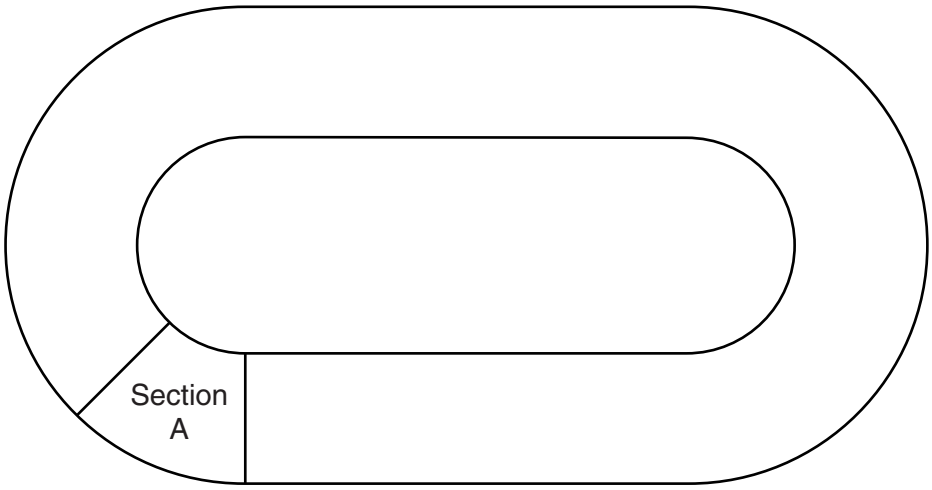
D. 2,700,000 acres

Item Context Social Studies

Item Type	At Grade 10, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will use an appropriate estimation strategy or determine the reasonableness of results.
Content Limits	The data that are presented to students may be either precise values or a range of values. Items should not assess linear estimation.
Stimulus Attributes	Items should be set in a real-world context. Item contexts should require students to make an estimate and not to calculate an exact amount. Graphics should be used in all of these items.
Response Attribute	When ranges are used, they should not overlap.

Sample MC Item

A sports reporter is estimating the number of people who are attending a football game. The people are distributed evenly around the stadium. Approximately 300 people are sitting in Section A, which is shown in the drawing of the stadium below.



Which of the following is closest to the number of people attending the football game?

A. 1600

B. 3000

★ C. 4800

D. 6000

Item Context Workplace

BENCHMARK MA.B.1.4.1

Strand **B** Measurement

Standard **1** The student measures quantities in the real world and uses the measures to solve problems.

Benchmark **MA.B.1.4.1 The student uses concrete and graphic models to derive formulas for finding perimeter, area, surface area, circumference, and volume of two- and three-dimensional shapes, including rectangular solids, cylinders, cones, and pyramids.**

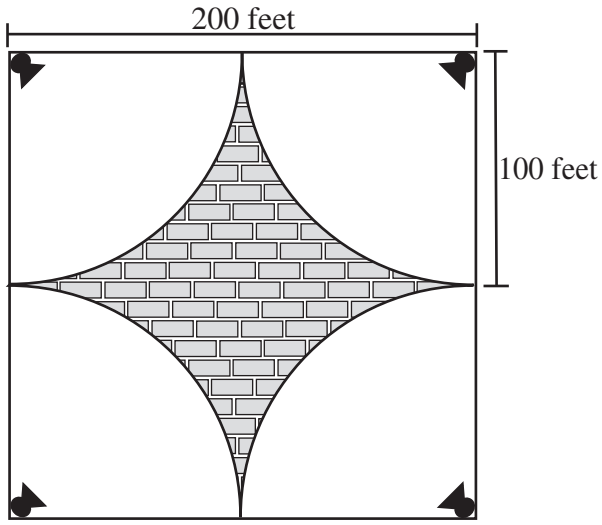
Also assesses MA.B.1.2.2 The student solves real-world problems involving length, weight, perimeter, area, capacity, volume, time, temperature, and angles.

Also assesses MA.B.1.4.2 The student uses concrete and graphic models to derive formulas for finding rate, distance, time, angle measures, and arc lengths.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve problems by using and/or deriving formulas for perimeter, area, surface area, circumference, arc lengths, or volume.
Content Limits	Surface area of cones and pyramids will not be assessed. Items should include either symmetric or regular figures or a combination of these figures. Items assessing cones or cylinders should include only right circular cones or right circular cylinders. Items assessing characteristics of pyramids should include only right square pyramids.
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items.

Sample MC Item

A water sprinkler was installed at each corner of the city park. A sketch of the square park is shown below.



Each sprinkler can water exactly halfway down each side of the park. The sprinklers would not reach the shaded areas, as shown in the diagram, so the city decided that bricks would be laid in this area. Which of the following expressions could be used to determine the area of the park that was laid with bricks?

A. $(100^2\pi - 200^2)$ square feet

★ B. $(200^2 - 100^2\pi)$ square feet

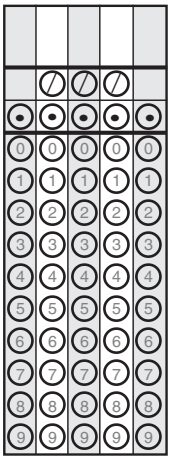
C. $(50^2\pi - 100^2)$ square feet

D. $(100^2 - 50^2\pi)$ square feet

Item Context Mathematics

Sample GR Item

Bernard is building a model of the Great Pyramid located in Giza, Egypt. The Great Pyramid is approximately 450 feet high, and each side of the square base is 750 feet long. For Bernard's scale model, 1 inch represents 25 feet. What is the volume, **in cubic inches**, of Bernard's model pyramid?



Sample Response 5400

Item Context Social Studies

Item Types At Grade 10, this benchmark will be assessed using MC, GR, and SR items.

Benchmark Clarification Students will solve problems by using and/or deriving formulas for perimeter, circumference, arc lengths, area, surface area, or volume.

Content Limits Items should include either symmetric or regular figures or a combination of these figures.

Items assessing cones or cylinders should include only right circular cones or right circular cylinders.

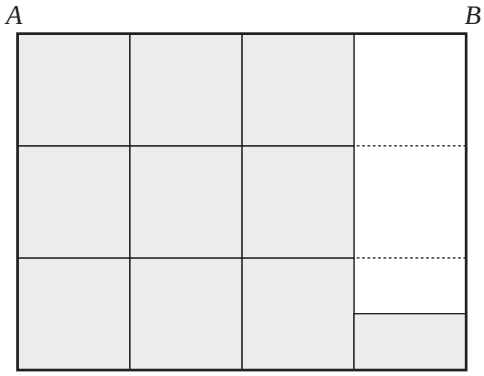
Items assessing characteristics of pyramids should include only right square pyramids.

Stimulus Attributes Items may be set in either real-world or mathematical contexts.

Graphics should be used in most of these items, as appropriate.

Sample MC Item

The rectangle below is divided into 12 congruent squares. The shaded region covers $9\frac{1}{2}$ squares.



If the area of the shaded region is 342 square inches, what is the length of $\overline{AB}$?

A. $16\frac{1}{2}$ inches

★ B. 24 inches

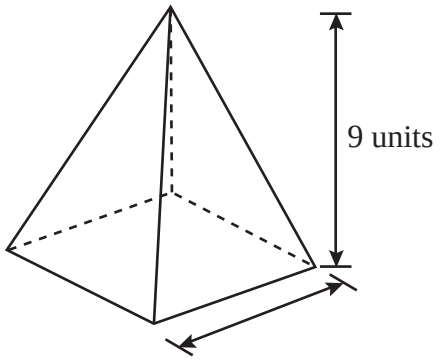
C. $28\frac{1}{2}$ inches

D. 36 inches

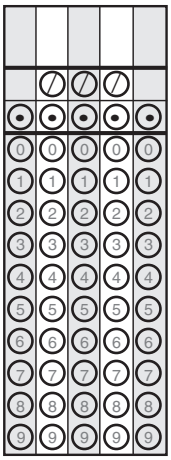
Item Context Mathematics

Sample GR Item

The right square pyramid below has a height of 9 units and a volume of 108 cubic units.



What is the length, to the nearest unit, of 1 side of the base of the pyramid?

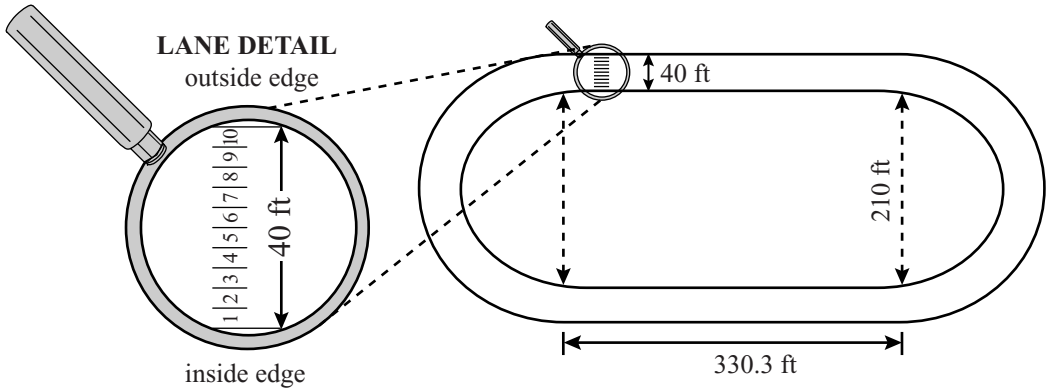


Sample Response 6

Item Context Mathematics

Sample SR Item THINK SOLVE EXPLAIN

When measured along the inside edge of lane 1, the distance around the jogging track below is one-quarter mile. The inside edge of the track is a 330.3-foot by 210-foot rectangle with semicircles on each end. The distance between the inside edge and the outside edge of the track is a constant 40 feet (ft). The track has 10 running lanes of equal width, as shown in the lane detail diagram below.



Part A Write an expression that can be used to find the distance around the track when measured along the **inside edge of lane 10**.

Expression _____

Part B What is the distance, in feet, around the track when measured along the **inside edge of lane 10**? Show your work or provide an explanation to justify your answer.

Distance, in feet _____

Item Context Health/Physical Education

Top-Score Response

Part A (a valid expression)

- $2(330.3) + \pi(d + 2(36))$
- OR $2(330.3) + \pi(210 + 72)$
- OR equivalent expression

AND

Part B (the correct distance)

- 1,546.08 (using 3.14 for π)
- OR 1,546.89 feet (using $\frac{22}{7}$ for π)

OR other acceptable rounded answer

Scoring Rubric

See Appendix D for the Short-Response Scoring Rubric.

BENCHMARK MA.B.1.4.2

Strand **B** Measurement

Standard **1** The student measures quantities in the real world and uses the measures to solve problems.

Benchmark **MA.B.1.4.2 The student uses concrete and graphic models to derive formulas for finding rate, distance, time, angle measures, and arc lengths.**

Also assesses MA.B.1.2.2 The student solves real-world problems involving length, weight, perimeter, area, capacity, volume, time, temperature, and angles.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve problems by using standard and/or derived formulas for rate, distance, time, or angle measures.
Content Limits	See General Content Limits.
Stimulus Attributes	Items that involve rated measures should not be limited to miles per hour or feet per second, but should include other rated measures. Items assessing angle measures should be based on real-world applications. Graphics should be used in most of these items, as appropriate.

Sample MC Item

Home run hitters Mark McGwire and Sammy Sosa often hit baseballs at speeds of 120 miles per hour (mph). At that rate, how many **feet** would a baseball travel in **1 second**?

A. 59

★ B. 176

C. 352

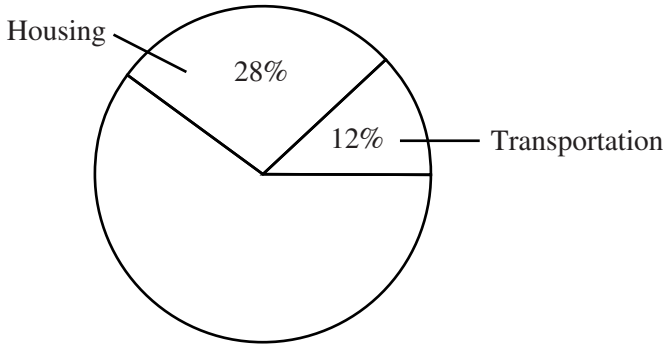
D. 1056

Item Context Health/Physical Education

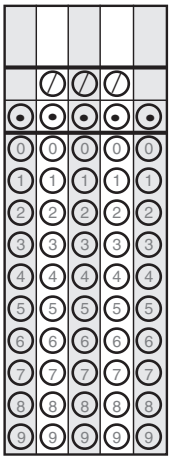
Sample GR Item

The circle graph below shows that 28% of the Walker family's monthly expenses is for housing and 12% is for transportation.

WALKER FAMILY MONTHLY EXPENSES



How many **degrees greater** is the measure of the angle that represents housing than the measure of the angle that represents transportation?



Sample Response 57.6

Item Context Social Studies

Item Types At Grade 10, this benchmark will be assessed using MC and GR items.

Benchmark Clarification Students will solve problems by using and/or deriving formulas for rate, distance, time, angle measures, arc measures, or arc lengths.

Content Limits See General Content Limits.

Stimulus Attributes Items that involve rated measures should not be limited to miles per hour or feet per second, but should include other rated measures.

Items assessing angle measures or arc lengths should be based on real-world applications.

Graphics should be used as appropriate in these items.

Sample MC Item

A truck left Charlotte, North Carolina, at 5:00 A.M. on day 1 to deliver cargo in the Florida cities of Jacksonville, Miami, and Key West. The driver stopped for breaks a total of 12 hours. His deliveries took an additional 4 hours. He completed his deliveries in Key West at 3:00 P.M. on day 2. If the driver averaged 55 miles per hour while driving, how many miles did the truck travel during the trip?

A. 550 miles

★ B. 990 miles

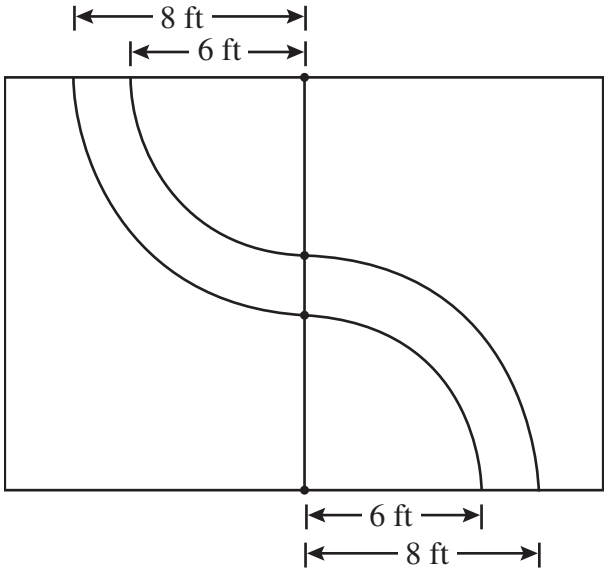
C. 1,210 miles

D. 1,870 miles

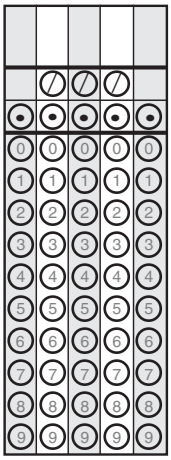
Item Context Workplace

Sample GR Item

Arthur is building a path through his garden. He will bend 4 thin pieces of wood into curves, as shown in the diagram below, and fill the space between the wood pieces with gravel.



Each piece of wood will be bent into a quarter circle. What should be the total length, to the nearer foot, of all 4 pieces of wood?



Sample Response 44

Item Context Workplace

BENCHMARK MA.B.1.4.3

Strand	**B** Measurement
Standard	**1** The student measures quantities in the real world and uses the measures to solve problems.
Benchmark	**MA.B.1.4.3 The student relates the concepts of measurement to similarity and proportionality in real-world situations.**

At Grade 10, this benchmark will be assessed with MA.C.2.4.1.

Item Types At Grade 9, this benchmark will be assessed using MC and GR items.

Benchmark Clarification Students will use appropriate proportions to solve real-world measurement problems, which may include similar figures or scale drawings.

Content Limit See General Content Limits.

Stimulus Attributes Items should be set in a real-world context.

Items requiring three-dimensional graphics must be realistic and must include verbal descriptions.

Graphics should be used in most of these items, as appropriate.

Sample MC Item

The nutrition label on a bag of chocolate chip cookies is shown below.

Nutrition Facts
Serving Size: 4 cookies
Servings per container: about 8

Amount Per Serving	
Calories: 140 Calories from Fat: 60	
	% Daily Value*
Total Fat: 7 grams	11%
Saturated Fat: 2 grams	10%
Cholesterol: 0 milligrams	0%
Sodium: 105 milligrams	4%
Total Carbohydrate: 18 grams	6%
Dietary Fiber: less than 1 gram	4%
Sugars: 10 grams	
Protein: 2 grams	

*based on a 2,000 calorie diet

Lyle ate 7 cookies from this bag. How many **calories from fat** did he consume?

A. 420 calories

B. 350 calories

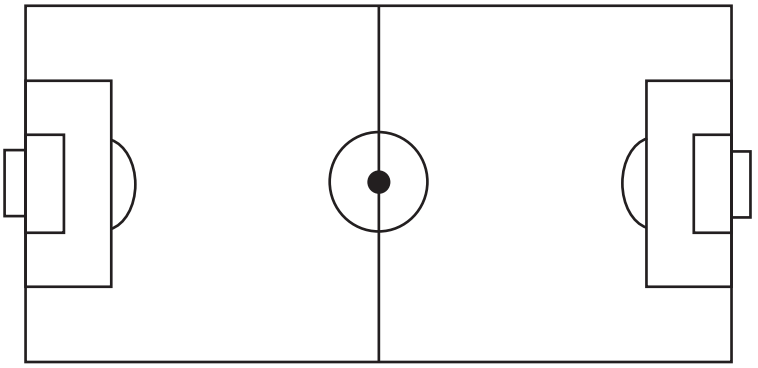
C. 245 calories

★ D. 105 calories

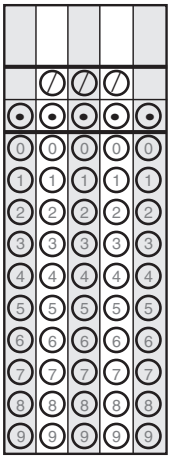
Item Context Health/Physical Education

Sample GR Item

A high school soccer field that meets the regulation size requirements measures 100 yards long by 60 yards wide.



Palmas Verdes High School uses a practice soccer field that is similar in shape, but with a length 20 yards less than the length of this regulation field. What is the width, **in yards**, of the school's practice field?



Sample Response 48

Item Context Health/Physical Education

BENCHMARK MA.B.2.4.1

Strand	**B** Measurement
Standard	**2** The student compares, contrasts, and converts within systems of measurement (both standard/nonstandard and metric/customary).
Benchmark	**MA.B.2.4.1 The student selects and uses direct (measured) or indirect (not measured) methods of measurement as appropriate.**

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will use indirect methods of measurement to solve problems.
Content Limit	Conversions must be within one system of measurement.
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Items may include similar figures and scale drawings. Graphics should be used in some of these items, as appropriate.

Sample MC Item

A catering company is preparing for a fundraiser that will be attended by 150 people. The punch served will be made of equal parts ginger ale and juice. The ginger ale will be purchased in bottles that contain 0.528 gallon each. What is the minimum number of bottles of ginger ale needed so that each person can have 2 servings of punch that are 8 ounces each?

A. 10 bottles

★ B. 18 bottles

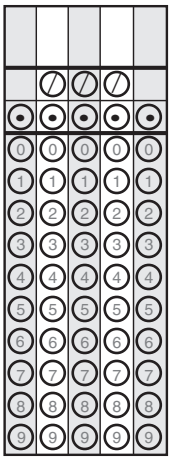
C. 19 bottles

D. 36 bottles

Item Context Workplace

Sample GR Item

Doug is visiting Fira, the capital of the Greek island Santorini. There are 566 steps in the stairway leading from the Aegean Sea to the city. Each step is 0.46 meter high. Doug has already climbed $\frac{2}{5}$ of the steps to the city. To the nearest thousandth of a kilometer, how many **kilometers** does Doug have **left** to climb?



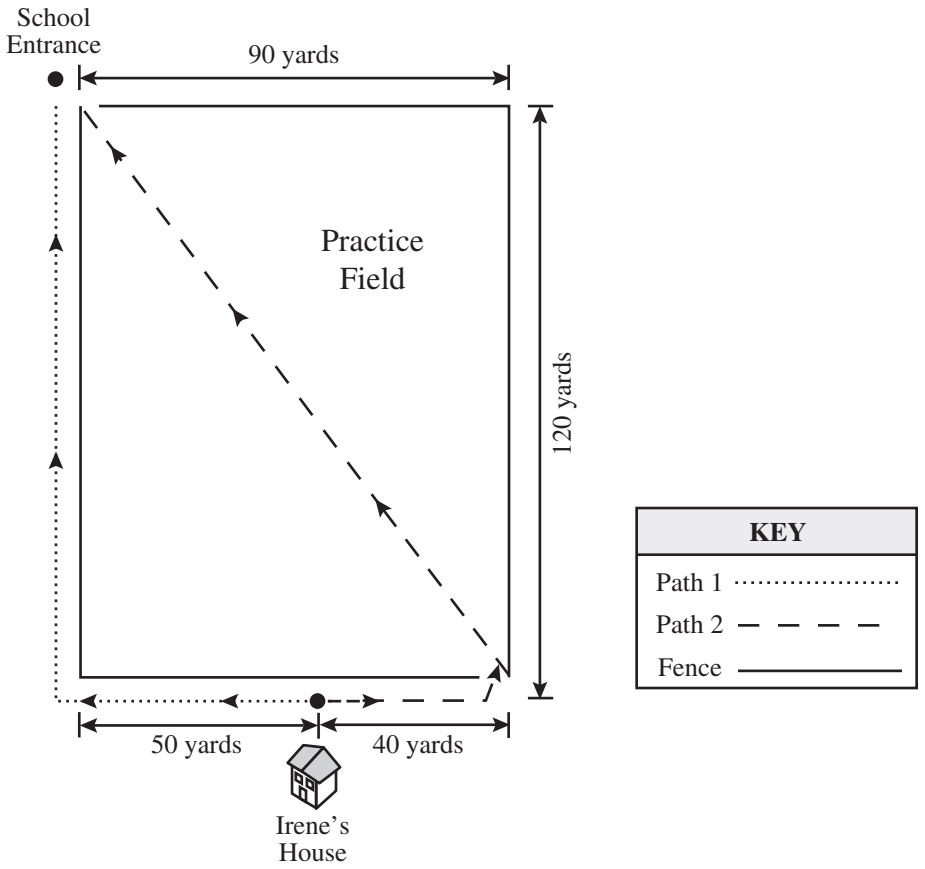
Sample Response 0.156

Item Context Social Studies

Item Type	At Grade 10, this benchmark will be assessed using MC items.
Benchmark Clarification	Students will use indirect methods of measurement to solve problems.
Content Limit	Conversions should be within one system of measurement.
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Graphics should be used as appropriate in these items.

Sample MC Item

Irene's house is located near the perimeter fence of her school's rectangular practice field, as shown in the diagram below.



There are two paths Irene can follow from her house to the school entrance. She can walk along the fence that surrounds the practice field to get to the entrance of her school (Path 1). She can also go through the gate and cut across the practice field (Path 2). Which of the following statements comparing Irene's two paths to school is true?

A. Path 2 is about 20 yards shorter.

B. Path 2 is about 60 yards shorter.

★ C. Path 1 is about 20 yards shorter.

D. Path 1 is about 40 yards shorter.

Item Context Health/Physical Education

BENCHMARK MA.B.2.4.2

Strand **B** Measurement

Standard **2** The student compares, contrasts, and converts within systems of measurement (both standard/nonstandard and metric/customary).

Benchmark **MA.B.2.4.2 The student solves real-world problems involving rated measures (miles per hour, feet per second).**

Also assesses MA.B.2.3.2 The student solves problems involving units of measure and converts answers to a larger or smaller unit within either the metric or customary system.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve problems involving units of measure, conversions, and rated measures (e.g., miles per hour, feet per second).
Content Limit	See General Content Limits.
Stimulus Attributes	All items should be set in a real-world context. Items assessing this benchmark should not be limited to miles per hour or feet per second, but should include other rated measures. All GR items should specify the unit of the rated measures required. Items should contain multiple steps in the solution process. Graphics should be used in some of these items, as appropriate.

Sample MC Item

Diedra works at a computer store and earns a $12 bonus for each computer she sells. Her bonus check was $756 for 21 days of work. If she sold the same number of computers each day, how many computers did Diedra sell per day?

A. 2

★ B. 3

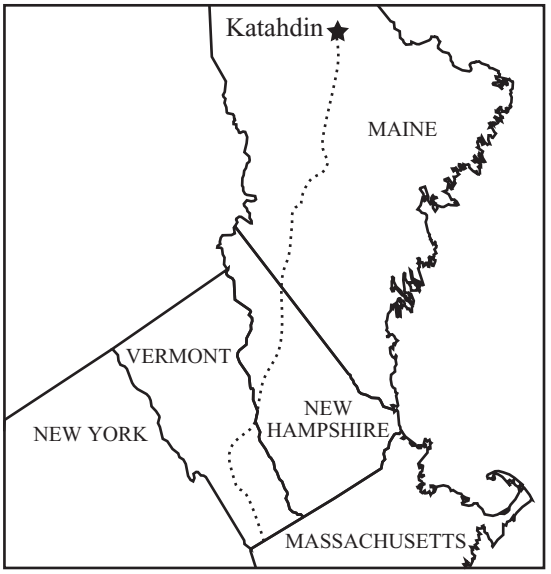
C. 36

D. 63

Item Context	Workplace

Sample GR Item

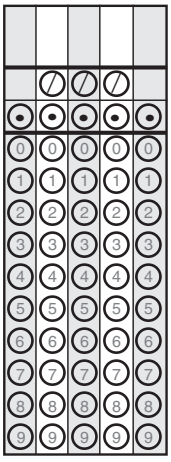
Trenton and Bianca will be hiking on the Appalachian Trail beginning at Katahdin, Maine, through New Hampshire and Vermont, to the Vermont-Massachusetts border.



Segment of Hike	Number of Miles
Hike through Maine	281
Hike through New Hampshire	161
Hike through Vermont	146

KEY	
Appalachian Trail	·····
State Border	———

They expect to travel at a rate of 12 miles per day. How many days of hiking will it take them to reach the Massachusetts border?



Sample Response 49

Item Context Social Studies

Item Types	At Grade 10, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will solve problems involving units of measure, conversions, and rated measures (e.g., miles per hour, feet per second).
Content Limit	See General Content Limits.
Stimulus Attributes	All items should be set in a real-world context. Items assessing this benchmark should not be limited to miles per hour or feet per second, but should include other rated measures. All GR items should specify the unit of the rated measures required. Items should contain multiple steps in the solution process. Graphics should be used as appropriate in these items.

Sample MC Item

Malcolm's lawnmower has a fuel tank with a $1\frac{1}{2}$ - gallon capacity. He added $2\frac{3}{4}$ quarts of fuel to completely fill the tank. How many **ounces** of fuel were in the tank before Malcolm added fuel to fill the tank?

A. 52 ounces

B. 88 ounces

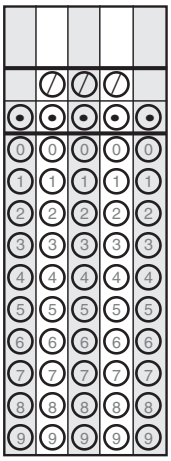
★ C. 104 ounces

D. 192 ounces

Item Context	Mathematics

Sample GR Item

The Franklin family's house is on a $2\frac{1}{2}$ - acre plot of land. They use $\frac{1}{10}$ of the land for a vegetable garden. How many **square feet** are in the Franklin's vegetable garden?



Sample Response 10890

Item Context Social Studies

BENCHMARK MA.C.1.4.1

Strand **C** Geometry and Spatial Sense

Standard **1** The student describes, draws, identifies, and analyzes two- and three-dimensional shapes.

Benchmark **MA.C.1.4.1 The student uses properties and relationships of geometric shapes to construct formal and informal proofs.**

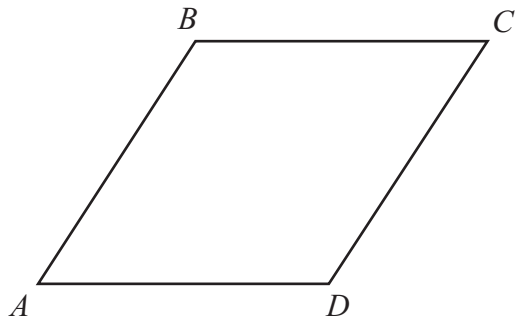
Also assesses MA.C.1.2.1 The student, given a verbal description, draws and/or models two- and three-dimensional shapes and uses appropriate geometric vocabulary to write a description of a figure or a picture composed of geometric figures.

Also assesses MA.C.1.3.1 The student understands the basic properties of, and relationships pertaining to, regular and irregular geometric shapes in two and three dimensions.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will use geometric properties and relationships to determine numerical and/or definitional characteristics of geometric shapes.
Content Limits	Formal and informal geometric proofs will be assessed at an introductory level. Three-dimensional shapes should be limited to right circular cones or cylinders, right square pyramids, spheres, or rectangular prisms.
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Graphics should be used in all of these items.

Sample MC Item

Figure *ABCD* is a rhombus. The length of line segment *AB* measures $(x + 5)$, and the length of line segment *BC* measures $(2x)$.



Which statement explains why the equation $\mathbf{2}x = x + \mathbf{5}$ can be used to solve for x?

A. A square is a type of rhombus.

★ B. All sides in a rhombus are congruent.

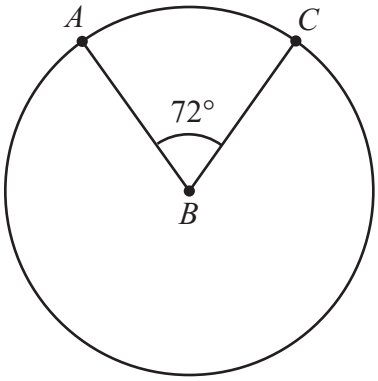
C. Opposite sides in a rhombus are parallel.

D. Opposite angles in a rhombus are congruent.

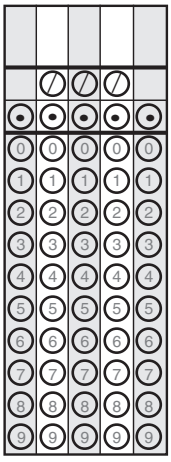
Item Context Mathematics

Sample GR Item

Mark baked a circular pie with center B as shown below. Susie cut a slice of pie as shown by $\angle ABC$. The measure of $\angle ABC$ is 72°.



What **percent** of the pie **remains**?



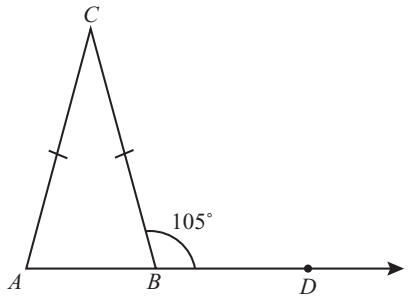
Sample Response 80

Item Context Mathematics

Item Types	At Grade 10, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will use geometric properties and relationships to determine and/or explain numerical and definitional characteristics of geometric shapes.
Content Limits	Formal and informal geometric proofs will be assessed at an introductory level. Three-dimensional shapes should be limited to right circular cones or cylinders, right square pyramids, spheres, or rectangular prisms.
Stimulus Attributes	Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.

Sample MC Item

In the figure below, point B is on ray AD, $\overline{AC} \cong \overline{BC}$, and $m\angle CBD = 105°$. The informal proof, shown below the figure, lists the reasons needed to justify the $m\angle ACB$.



1. $\triangle ABC$ is isosceles, because $\overline{AC} \cong \overline{BC}$.
2. $m\angle CBA = 75°$, because _____
3. $\angle CAB \cong \angle CBA$, because angles opposite congruent sides of an isosceles triangle are congruent.
4. $m\angle CAB = 75°$, because congruent angles have equivalent measures.
5. $m\angle ACB = 30°$, because the sum of the measures of the angles of a triangle is 180°.

Which of the following phrases can be used in the blank space above to justify the statement in Step 2 ?

A. All the angles in an isosceles triangle must be acute angles.

B. $\angle ACB$ and $\angle CBD$ are complementary angles.

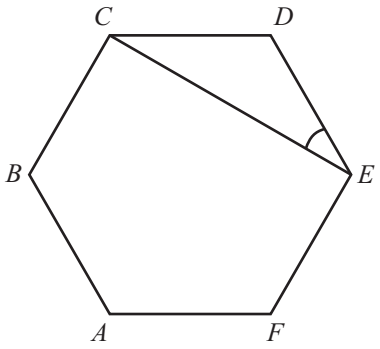
★ C. $\angle CBA$ and $\angle CBD$ are supplementary angles.

D. $\angle CBD$ is an obtuse angle.

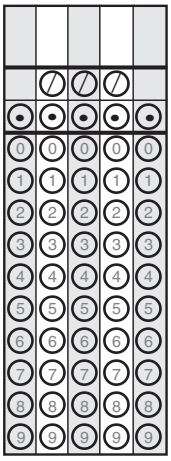
Item Context Mathematics

Sample GR Item

Figure *ABCDEF* below is a regular hexagon.



What is the measure, in degrees, of $\angle DEC$?



Sample Response 30

Item Context Mathematics

BENCHMARK MA.C.2.4.1

Strand **C** Geometry and Spatial Sense

Standard **2** The student visualizes and illustrates ways in which shapes can be combined, subdivided, and changed.

Benchmark **MA.C.2.4.1 The student understands geometric concepts such as perpendicularity, parallelism, tangency, congruency, similarity, reflections, symmetry, and transformations including flips (reflections), slides (translations), turns (rotations), enlargements, rotations, and fractals.**

Also assesses MA.B.1.4.3 The student relates the concepts of measurement to similarity and proportionality in real-world situations.

Also assesses MA.C.1.4.1 The student uses properties and relationships of geometric shapes to construct formal and informal proofs.

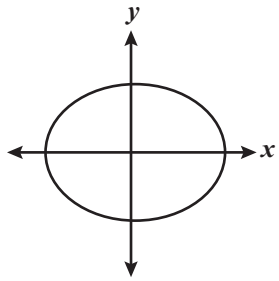
Also assesses MA.C.3.4.1 The student represents and applies geometric properties and relationships to solve real-world and mathematical problems including ratio, proportion, and properties of right triangle trigonometry.

Item Types	At Grade 9, this benchmark will be assessed using MC and GR items.
Benchmark Clarification	Students will apply geometric concepts, properties, formulas, and/or relationships to solve problems.
Content Limits	Items should not assess tangency or fractals. Items should not focus on the conditions that cause figures to be similar or congruent. Items will not assess trigonometric functions.
Stimulus Attributes	Items may assess understanding and application of perpendicularity, parallelism, complementary and supplementary angles, sum of triangle measures, symmetry, congruency, and similarity. Items may assess transformations, including translations, reflections, rotations, and dilations. Items may assess right-triangle geometry. Methods of solving may include the Pythagorean theorem, and should not rely exclusively on the 30-60-90 or 45-45-90 triangle relationships. Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.

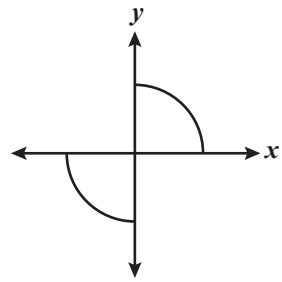
Sample MC Item

Which of the following graphs best represents a curve that is symmetric with respect to only the *y*-axis?

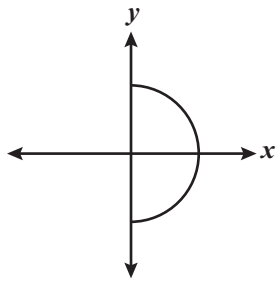
A.



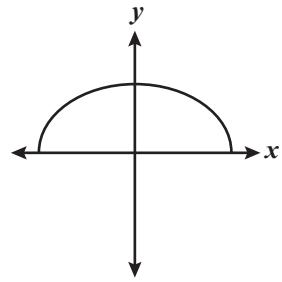
C.



B.



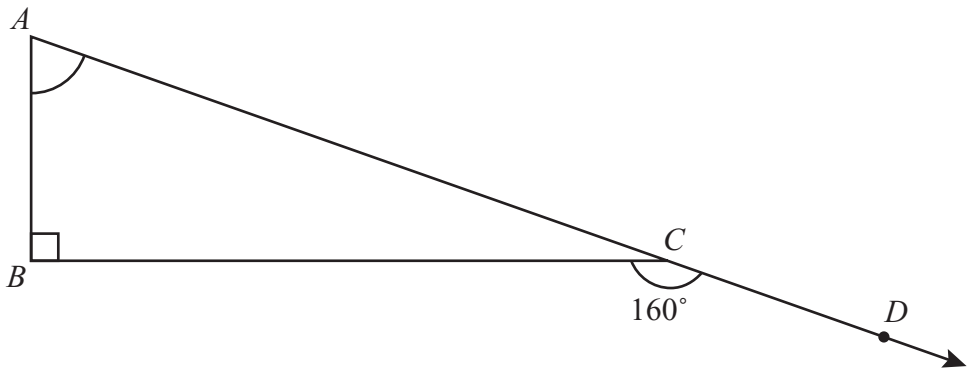
★ D.



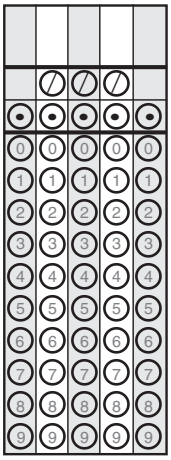
Item Context Mathematics

Sample GR Item

In $\triangle ABC$ below, hypotenuse $\overline{AC}$ is on $\overrightarrow{AD}$.



What is the measure, in degrees, of $\angle BAC$?



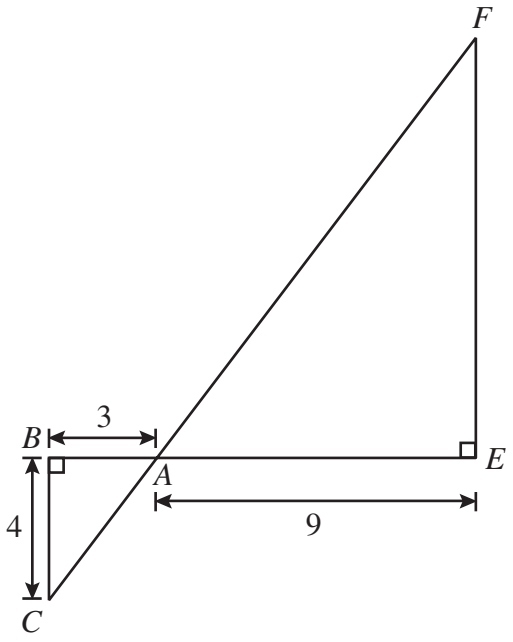
Sample Response 70

Item Context Mathematics

Item Types	At Grade 10, this benchmark will be assessed using MC, GR, and ER items.
Benchmark Clarification	Students will recognize, represent, apply, and/or explain geometric concepts, properties, formulas, and relationships to solve problems.
Content Limits	Items should not assess tangency or fractals. Items assessing the concept of similarity should focus on the conditions that cause figures to be similar. Items will not assess trigonometric functions.
Stimulus Attributes	Items may assess understanding and application of perpendicularity, parallelism, complementary and supplementary angles, sum of triangle measures, symmetry, congruency, and similarity. Items may assess transformations, including translations, reflections, rotations, and dilations. Items may assess right-triangle geometry. Methods of solving may include the Pythagorean theorem, and should not rely exclusively on the 30-60-90 or 45-45-90 triangle relationships. Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.

Sample MC Item

In the diagram below, $\overline{BE}$ and $\overline{CF}$ intersect at point A.



Based on the information in the diagram, which of the following proves that $\triangle ABC$ is similar to $\triangle AEF$?

★ A. Corresponding angles are congruent.

B. $\triangle ABC$ and $\triangle AEF$ are right triangles.

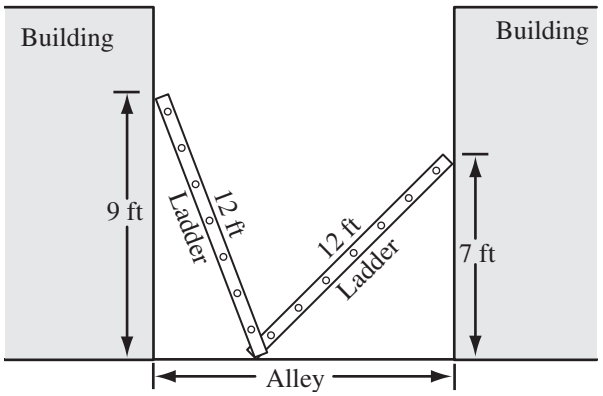
C. The length of $\overline{AE}$ is 3 times the length of $\overline{AB}$.

D. The length of $\overline{BC}$ is proportional to the length of $\overline{EF}$.

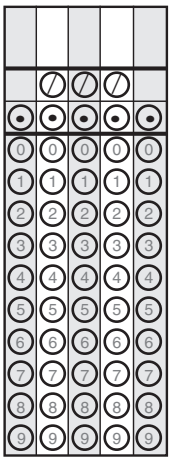
Item Context Mathematics

Sample GR Item

Stacey placed a 12-foot (ft) ladder in an alley, between two buildings.



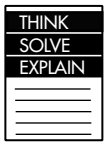
When Stacey tipped the ladder to the left, the top of it reached a point 9 feet high on one of the buildings. Leaving the bottom of the ladder in the same spot, Stacey then tipped the ladder to the right, where the top of it reached a point 7 feet high on the other building. To the nearer tenth of a foot, how wide is the alley?



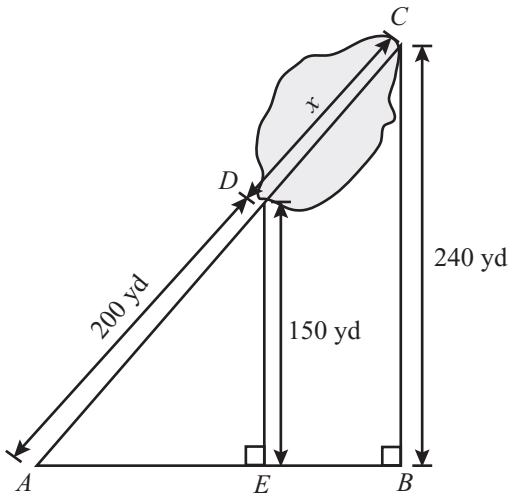
Sample Response 17.7

Item Context Mathematics

Sample ER Item



A surveyor wants to determine the distance, *x,* across a lake, but she is not able to make the measurement directly. She will use $\triangle ADE$ and $\triangle ACB$, shown with measurements in yards (yd) below, to help determine the distance across the lake.



Part A Explain in geometric terms why $\triangle ADE$ is similar to $\triangle ACB$.

Part B Write a proportion that can be used to find the distance *x.*

Proportion_____

Part C Solve the proportion to determine the distance, in yards, across the lake. Show work or provide an explanation to support your answer.

Distance, in yards_____

Item Context Workplace

Top-Score Response

Part A

- Triangle ADE and triangle ABC are similar because one triangle has two angles that are congruent to two angles in the other triangle and one angle in common.

- OR other valid explanation

Part B

Proportion $\frac{240}{150} = \frac{200 + x}{200}$ OR other valid proportion

Part C $\frac{240}{150} = \frac{200 + x}{200}$

$150(200 + x) = 200(240)$ OR other valid work leading to
$30{,}000 + 150x = 48{,}000$ correct answer
$150x = 18{,}000$
$x = 120$

Distance, in yards 120

Scoring Rubric See Appendix D for the Extended-Response Scoring Rubric.