

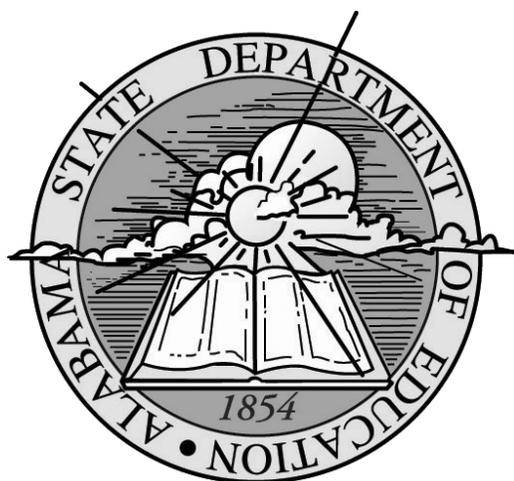
Alabama Reading and Mathematics Test⁺

Item Specifications

for

Mathematics

Grade 7



**Alabama State Department of Education
Montgomery, Alabama
December 2011**

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SAMPLE RESPONSE FORMAT127

INTRODUCTION

This document provides specific information about the *Alabama Reading and Mathematics Test*⁺ (ARMT⁺). Educators representing each State Board of Education district as well as both city and county school systems served on committees to determine the content standards on which the ARMT⁺ is based. In addition, educators from throughout the state of Alabama served on committees to review the content of the tests, including selecting and reviewing specific mathematics test items, and determining achievement levels.

Teachers must be familiar with the information in this document so that they may incorporate effective teaching of the mathematics content standards with classroom assessments. Using classroom assessments with similar test formats from time to time will help to enable students to demonstrate proficiency on the various content standards in mathematics.

Three item types are included in the ARMT⁺. Multiple-choice, gridded, and open-ended items assess student performance on the ARMT⁺ in mathematics. Multiple-choice items and gridded items carry a point value of 1, while open-ended items carry a point value of 3. In this document, teachers will see representative item types for each mathematics content standard.

Content Standard	A statement of what students should know and be able to do by the end of the academic year
Item Type	Multiple-choice, gridded, open-ended items
Additional Information	Further information about the test items for the content standard
Sample Items	A collection of item types for each content standard
Answer Key	Answers for multiple-choice items and gridded items
Scoring Rubrics for Open-Ended Items	Scoring guide for open-ended items

CONTENT STANDARDS
Grade 7

CONTENT STANDARD	POINTS POSSIBLE
<p>Number and Operations</p> <p>1- Demonstrate computational fluency with addition, subtraction, and multiplication of integers.</p> <p>2- Use order of operations to evaluate numerical expressions.</p> <p>3- Solve problems requiring the use of operations on rational numbers.</p>	<p>5</p> <p>4</p> <p><u>8</u></p> <p>17</p>
<p>Algebra</p> <p>4- Express a pattern shown in a table, graph, or chart as an algebraic equation.</p> <p>5- Translate verbal phrases into algebraic expressions and algebraic expressions into verbal phrases.</p> <p>6- Solve one- and two-step equations.</p>	<p>4</p> <p>4</p> <p><u>4</u></p> <p>12</p>
<p>Geometry</p> <p>7- Determine the transformation(s), including translations, reflections, or rotations, used to alter the position of a polygon on the coordinate plane.</p> <p>8- Recognize geometric relationships among two-dimensional and three-dimensional objects.</p>	<p>4</p> <p><u>6</u></p> <p>10</p>
<p>Measurement</p> <p>9- Solve problems involving circumference and area of circles.</p> <p>10- Find the perimeter of polygons and the area of triangles and trapezoids.</p> <p>11- Solve problems involving ratios or rates, using proportional reasoning.</p>	<p>4</p> <p>4</p> <p><u>6</u></p> <p>14</p>
<p>Data Analysis and Probability</p> <p>12- Determine measures of central tendency (mean, median, and mode) and the range using a given set of data or graphs, including histograms, frequency tables, and stem-and-leaf plots.</p> <p>13- Determine the probability of a compound event.</p>	<p>7</p> <p><u>6</u></p> <p>13</p>
<p>TOTAL POINTS POSSIBLE</p>	<p>66</p>

REFERENCE PAGE

Use the information below to answer the questions in this test booklet.

Some Abbreviations Used in Formulas

b_1, b_2 = bases of a trapezoid	\parallel = symbol for parallel lines	P = perimeter of a base
b = base of a polygon	C = circumference	D = distance
h = height or altitude	r = radius	$L.A.$ = lateral area
l = length	d = diameter	$S.A.$ = surface area
w = width	$\pi \approx 3.14$	V = volume
 = symbol for a right angle	A = area	B = area of a base
$m\angle$ = the measure of an angle		

Formulas

Triangle: $A = \frac{1}{2}bh$

Parallelogram: $A = bh$

Rectangle: $A = lw$
 $P = 2l + 2w$

Trapezoid: $A = \frac{1}{2}h(b_1 + b_2)$

Distance = rate \times time

Circle: $C = \pi d$
 $C = 2\pi r$
 $A = \pi r^2$
 $d = 2r$

Shape	Surface Area	Volume
Rectangular Prism	$L.A. = Ph$ $S.A. = Ph + 2B$ or $S.A. = 2(wh + lh + lw)$	$V = Bh$ or $V = lwh$
Cylinder	$L.A. = 2\pi rh$ $S.A. = 2\pi rh + 2\pi r^2$	$V = \pi r^2 h$
Square Pyramid	NA	$V = \frac{1}{3}Bh$
Triangular Pyramid	NA	$V = \frac{1}{3}Bh$

ITEMS BY CONTENT STANDARD

DIRECTIONS (These are the directions read by students and the test administrator for Part 1.)

Read the problem and find the answer.

Calculators may *not* be used for Part 1 of the test.

If the problem has a multiple-choice answer, darken the bubble in the correct space in your answer document.

If the problem has an answer grid:

- Write your answer in the boxes at the top of the grid.
- Darken the correct bubble of the number or symbol in the column below.

If your answer is a non-terminating decimal, round to the nearer hundredth.

For the problems that ask you to show your work, use the space given in your answer document.

- Be sure to show all of your work or explain how you got your answer in the space given.

For all problems, be sure to check your answers.

ITEMS BY CONTENT STANDARD

There are no written directions for Part 2. The directions will be given orally by the test administrator.

DIRECTIONS (These are the directions read by students and the test administrator for Part 3.)

Read the problem and find the answer.

Calculators may be used for Part 3 of the test.

If the problem has a multiple-choice answer, darken the bubble in the correct space in your answer document.

If the problem has an answer grid:

- Write your answer in the boxes at the top of the grid.
- Darken the correct bubble of the number or symbol in the column below.

If your answer is a non-terminating decimal, round to the nearer hundredth.

For the problems that ask you to show your work, use the space given in your answer document.

- Be sure to show all of your work or explain how you got your answer in the space given.
- If you use your calculator to get your answer, explain the steps you take.

For all problems, be sure to check your answers.

NUMBER AND OPERATIONS

Content Standard 1

Demonstrate computational fluency with addition, subtraction, and multiplication of integers.

Item Type

Multiple-choice
Gridded

Additional Information

Only one operation will be required for each item.

Parentheses or the multiplication symbol (\bullet) will be used for multiplication.

The multiplication symbol (\times) will not be used.

Negative integers may be in parentheses.

Integers will not exceed four digits in the stem.

Only two integers will be used in the stem.

No word problems/real-life situations will be used.

Sample Multiple-Choice Items

1. $(-81) + 15 = \square$

- -66 -99 66 96
A * **B** **C** **D**

3. $2,633 - (-837) = \square$

- A** 179
B 1,796
C 1,806
D 3,470 *

2. $(-37) \bullet 6 = \square$

- -222 -132 -31 222
A * **B** **C** **D**

4. $(-14)(-12) = \square$

- -168 -26 2 168
A **B** **C** **D ***

5. $215 + (-57) = \square$

-272

A

-158

B

158

C *

272

D

Sample Gridded Items

1. $157 - 284 = \square$

Mark your answer in the answer grid.

5. $225 - (-653) = \square$

Mark your answer in the answer grid.

2. $57 \cdot (-7) = \square$

Mark your answer in the answer grid.

6. $(-580) - 329 = \square$

Mark your answer in the answer grid.

3. $(-74) - (-46) = \square$

Mark your answer in the answer grid.

7. $-34 \cdot -5 = \square$

Mark your answer in the answer grid.

4. $(-46) \cdot (-3) = \square$

Mark your answer in the answer grid.

8. $(-36) + (-13) = \square$

Mark your answer in the answer grid.

Answer Key

Content Standard 1

Sample Multiple-Choice

1. A
2. A
3. D
4. D
5. C

Sample Gridded

1. -127
2. -399
3. -28
4. 138
5. 878
6. -909
7. 170
8. -49

NUMBER AND OPERATIONS

Content Standard 2

Use order of operations to evaluate numerical expressions.

Item Type

Multiple-choice

Gridded

Additional Information

More than one set of parentheses may be used.

The four basic operations (addition, subtraction, multiplication, and division) will be required.

Only integers may be used.

Either the division symbol (\div) or the fractional form may be used for division.

Parentheses or the multiplication symbol (\bullet) will be used for multiplication.

The multiplication symbol (\times) will not be used.

No word problems/real-life situations will be used.

Exponents may be used.

Sample Multiple-Choice Items

1. $(6 \bullet 5) - 2(6 - 3) = \square$

168 56 24 10

A **B** **C *** **D**

3. $2 \bullet (31 - 11 \bullet 5) + 43 = \square$

286 243 -5 -91

A **B** **C *** **D**

2. $4(6 + 12) \div 2 = \square$

48 36 30 18

A **B *** **C** **D**

4. $4 + 24 \div 2 - 2 \bullet 2 = \square$

12 16 24 28

A * **B** **C** **D**

5. $3 \cdot 2 + 16 \div 2 = \square$

11 14 27 44

A **B *** **C** **D**

7. $(26 \div 2 + 11) \div 2 - 3 \cdot 6 = \square$

-17 -6 -4 54

A **B *** **C** **D**

6. $(15 \div 3 + 2) + 4^2 = \square$

11 15 19 23

A **B** **C** **D ***

8. $5^2 \cdot (6 + 3) - 15 \div 3 = \square$

45 85 148 220

A **B** **C** **D ***

Sample Gridded Items

$$1. \quad 16 + 3^2 - 4 \cdot 2 = \square$$

Mark your answer in the answer grid.

$$6. \quad (9 + 18) \div 3 + (3)(5) = \square$$

Mark your answer in the answer grid.

$$2. \quad 25 + (15 - 3^2) = \square$$

Mark your answer in the answer grid.

$$3. \quad 65 + 60 \cdot 6 \div 3 - (13 - 39) = \square$$

Mark your answer in the answer grid.

$$4. \quad 8(124 - 42) + 5(7 + 6) = \square$$

Mark your answer in the answer grid.

$$5. \quad 25 + 6^2 \div 2 + 4 = \square$$

Mark your answer in the answer grid.

Answer Key

Content Standard 2

Sample Multiple-Choice

1. C
2. B
3. C
4. A
5. B
6. D
7. B
8. D

Sample Gridded

1. 17
2. 31
3. 211
4. 721
5. 47
6. 24

NUMBER AND OPERATIONS**Content Standard 3**

Solve problems requiring the use of operations on rational numbers.

Item Type

Multiple-choice

Additional Information

The four basic operations (addition, subtraction, multiplication, division) will be required.

Word problems/real-life situations may be required.

Money values may be used.

Mixed numbers may be used.

Solving problems involving addition and subtraction of fractions with common and uncommon denominators may be required.

Changing mixed numbers to improper fractions may be required.

Solving problems involving decimals and percents may be required.

Sample Multiple-Choice Items

1. $6\frac{1}{3} + 3\frac{7}{9} = \square$

- A** $9\frac{8}{27}$
- B** $9\frac{2}{3}$
- C** $10\frac{1}{9}$ *
- D** $11\frac{1}{12}$

2. $5\frac{2}{3} - 2\frac{1}{5} = \square$

- A** $3\frac{7}{15}$ *
- B** $3\frac{1}{2}$
- C** $7\frac{13}{15}$
- D** $7\frac{3}{8}$

3.

$$3\frac{8}{9} \cdot \frac{6}{7} = \square$$

- A** $1\frac{19}{21}$
- B** $3\frac{1}{3}$ *
- C** $3\frac{16}{21}$
- D** $4\frac{7}{8}$

4.

$$30\% \text{ of } 185 = \square$$

- A** 5.55
- B** 55.5 *
- C** 555
- D** 5,550

5.

$$4\frac{3}{8} \div \frac{5}{8} = \square$$

- A** $\frac{175}{64}$
- B** 7 *
- C** $\frac{75}{8}$
- D** 12

6.

$$252 \div -28 = \square$$

- | | | | |
|----------|----------|----------|------------|
| 4 | -4 | 9 | -9 |
| A | B | C | D * |

7. Nadir collected an average of 45.36 kilograms of paper from each of 20 people in his neighborhood.

If Nadir's goal is to collect 1,000 kilograms of paper, how many more kilograms of paper does he need to collect?

- A** 22.68
- B** 65.36
- C** 92.8 *
- D** 907.2

8. Darryl used a total of 715.74 kilograms of flour to fill bags at a local flour mill. He used 22.68 kilograms of flour to completely fill each bag.

What is the *greatest* number of bags Darryl completely filled?

- | | | | |
|----------|----------|------------|----------|
| 33 | 32 | 31 | 30 |
| A | B | C * | D |

9. Jeremy has a 20%-off coupon for his purchases at a store. His total purchases are \$27.50 without the coupon.

What is 20% off of Jeremy's purchases?

- A** \$1.38
- B** \$5.50 *
- C** \$7.50
- D** \$22.00

12. Jonathan picked $\frac{1}{12}$ of the vegetables in the garden. Claire picked $\frac{1}{9}$ of the vegetables in the garden.

What fraction of the vegetables in the garden did Jonathan and Claire pick all together?

- $\frac{1}{108}$ **A**
- $\frac{1}{36}$ **B**
- $\frac{2}{21}$ **C**
- $\frac{7}{36}$ **D** *

10. A bakery made 350 cupcakes. They sold 280 of those cupcakes.

What percentage of the cupcakes did they sell?

- 20% **A**
- 70% **B**
- 80% **C** *
- 125% **D**

11. At Ben's school, $\frac{3}{5}$ of the seventh-grade students play a sport. There are 450 students in seventh grade.

What is the total number of seventh-grade students who play a sport?

- 90 **A**
- 180 **B**
- 270 **C** *
- 750 **D**

Answer Key

Content Standard 3

Sample Multiple-Choice

1. C
2. A
3. B
4. B
5. B
6. D
7. C
8. C
9. B
10. C
11. C
12. D

ALGEBRA**Content Standard 4**

Express a pattern shown in a table, graph, or chart as an algebraic equation.

Item Type

Multiple-choice

Additional Information

Determining an algebraic equation for a pattern shown in a table, graph, or chart will be required.

Any representation of a rational number may be used as values in tables or charts.

Any representation of a rational number may be included in the algebraic equation as a coefficient of a variable or a constant.

Word problems/real-life situations may be used.

Sample Multiple-Choice Items

x	y
12	4
3	1
0	0
-6	-2

1. Which equation is true for all pairs of values for x and y given in the table?

A $y = \frac{x}{3}$ *

B $-3y = x$

C $-x = \frac{y}{3}$

D $3x = y$

2. The table below shows the number of pieces of paper Eric has remaining after x weeks.

Eric's Remaining Paper

Week (x)	Pieces of Paper (y)
1	165
3	95
4	60
5	25

Which equation represents the number of pieces of paper, y , Eric has remaining after x weeks?

- A** $y = -5x + 170$
- B** $x = -5y + 200$
- C** $x = -35y + 200$
- D** $y = -35x + 200$ *

3. The table below represents the number of compact discs that a company duplicates in a given amount of time.

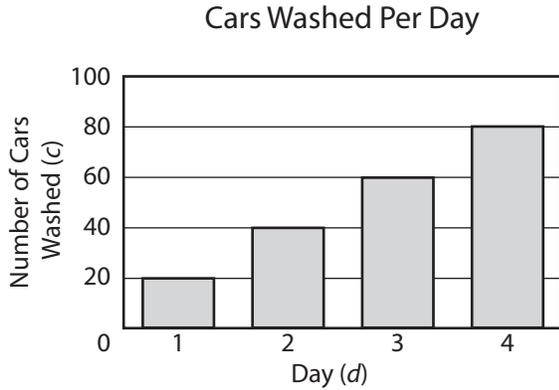
Compact Discs Duplicated

Time (in minutes) (x)	Number of Compact Discs (y)
1.0	120
2.0	240
4.0	480
5.5	660

Which equation below *best* represents the number of compact discs duplicated in a given amount of time?

- A** $x = 120 \div y$
- B** $x = 120y$
- C** $y = 120 \div x$
- D** $y = 120x$ *

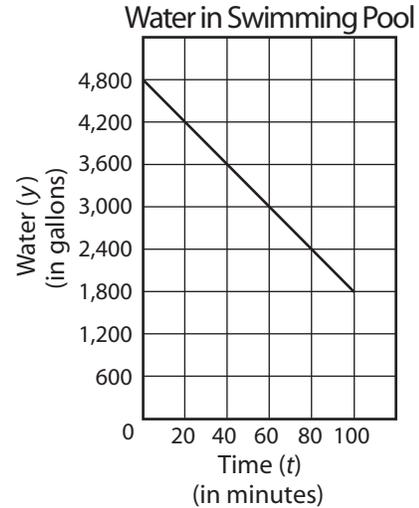
The graph below shows the number of cars washed per day at the local car wash.



4. Which equation below *best* represents the number of cars washed per day at the local car wash?

- A** $c = 2d + 18$
- B** $c = \frac{d}{20}$
- C** $c = 2d + 36$
- D** $c = 20d$ *

Jake emptied his swimming pool to make repairs. The graph below shows the amount of water in the swimming pool after a given amount of time.



5. Which equation below *best* represents the total amount of water in the swimming pool at any given time as Jake emptied it?

- A** $y = 4,800 - 30t$ *
- B** $y = -30t$
- C** $y = \frac{t}{30}$
- D** $y = 30t - 600$

The following table lists the distance completed in a long-distance race for a given amount of time.

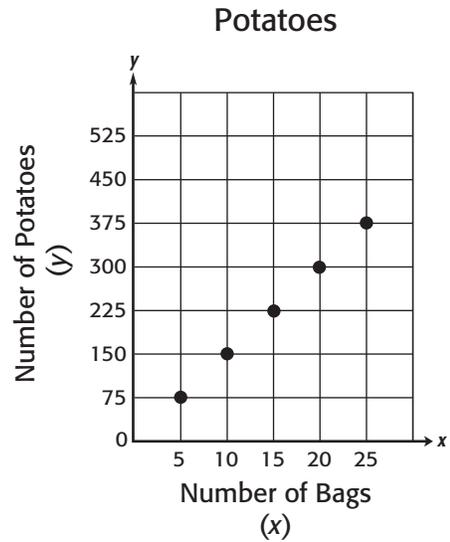
Race Distance

Time (in hours) (x)	Distance Completed (rounded to nearest mile) (y)
0.5	4
1.0	8
1.5	12

6. Which equation below represents the distance completed for a given amount of time?

- A** $x = y \div 4$
- B** $y = 4x$
- C** $x = 8y$
- D** $y = 8x$ *

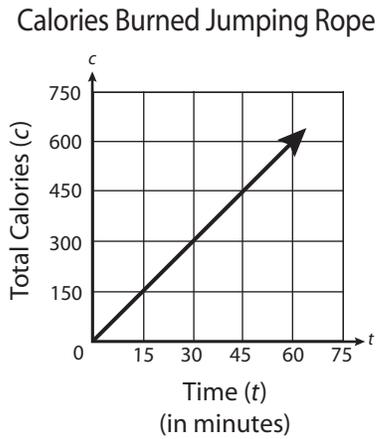
The points graphed below show the total number of potatoes in a specified number of bags at a grocery store.



7. Which equation below *best* represents the total number of potatoes in a specified number of bags?

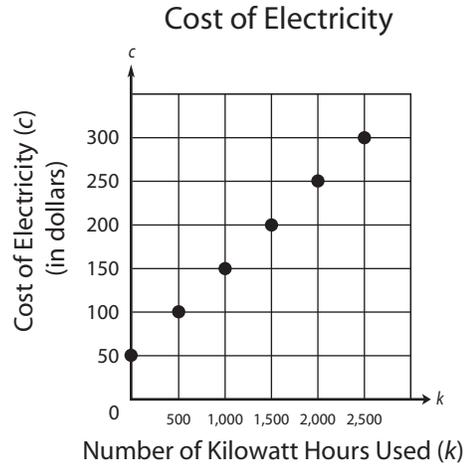
- A** $x = 15y$
- B** $x = 5 + 14y$
- C** $y = 15x$ *
- D** $y = 5 + 14x$

8. Using the graph below, which of the following equations *best* represents the number of calories (c) in relation to time (t)?



- A** $c = 10 + t$
- B** $c = 10t$ *
- C** $t = 10 + c$
- D** $t = 10c$

The graph below shows c , the cost of using electricity at a local business, as a function of k , the number of kilowatt hours of electricity used.



9. Which equation below *best* represents the cost of electricity at any specified number of kilowatt hours used?

- A** $c = 50 + 10k$
- B** $c = 50 - 10k$
- C** $c = 50 + 0.1k$ *
- D** $c = 50 - 0.1k$

The following table lists the amount Janine charges for a given number of hours of babysitting.

Babysitting Charges

Number of hours (x)	Charges (in dollars) (y)
1	3.50
2	6.50
3	9.50
4	12.50

10. Which equation below represents the charges (y) for any given number of hours (x)?

- A** $x = 3.50 \div y$
- B** $y = 3x + 0.50 *$
- C** $y = 4x - 0.50x$
- D** $x = 3.50y$

11. A chef measured the change in the oven temperature in degrees Fahrenheit (°F) every 3 minutes. The results are shown in the table below.

Oven Temperature

Time (in minutes) (x)	Temperature (in °F) (y)
0	70
3	130
6	190
9	250
12	310

Which equation represents the oven temperature, y, at x minutes?

- A** $y = 3x + 60$
- B** $y = 70x + 20$
- C** $y = 60x + 70$
- D** $y = 20x + 70 *$

Answer Key

Content Standard 4

Sample Multiple-Choice

1. A
2. D
3. D
4. D
5. A
6. D
7. C
8. B
9. C
10. B
11. D

ALGEBRA

Content Standard 5

Translate verbal phrases into algebraic expressions and algebraic expressions into verbal phrases.

Item Type

Multiple-choice

Additional Information

Any representation of a rational number may be included in the algebraic equation as a coefficient of a variable or a constant.

Word problems/real-life situations will be used.

Exponents may be used.

Sample Multiple-Choice Items

1. Which phrase below *best* represents the following expression?

$$4n + 17$$

- A** 17 more than a number divided by 4
- B** 4 times the sum of a number and 17
- C** 17 more than 4 times a number *
- D** 4 times a number

2. Which of the following is an expression for “four times the difference of 6 and k ”?

- A** $4 \cdot 6 - k$
- B** $4 - 6k$
- C** $4 \cdot k - 6$
- D** $4(6 - k)$ *

3. Which phrase below *best* represents the following expression?

$$3 + \frac{m}{5}$$

- A** The quotient of a number and 5
- B** 3 more than the product of 5 and a number
- C** The product of 5 and 3 more than a number
- D** 3 more than a number divided by 5 *

5. Tony's fish weighs five pounds more than three times the weight of Mary's fish. Let t represent the weight of Tony's fish, and let m represent the weight of Mary's fish.

Which expression below *best* represents the weight of Tony's fish?

- A** $3t + 5$
- B** $3m - 5$
- C** $3m + 5$ *
- D** $3t - 5m$

4. Manya and Rachel both checked books out of the library. Rachel's book is 32 pages less than 3 times the number of pages in Manya's book.

If the number of pages in Manya's book is represented by m , which expression below *best* represents the number of pages in Rachel's book?

- A** $32 - 3m$
- B** $3m - 32$ *
- C** $32 - m + 3$
- D** $32m - 3$

6. Which phrase below *best* represents the following expression?

$$15 - 3y$$

- A** The difference of 15 and 3 times a number *
- B** 3 less than 15 times a number
- C** The sum of 15 and 3 times a number
- D** 15 less than 3 times a number

7. Which phrase below *best* represents the following expression?

$$\frac{n}{4} + 3n$$

- A** The sum of a number divided by 4 and the number
- B** The sum of a number divided by 3 and the number
- C** The sum of a number divided by 4 and 3 times the number *
- D** The sum of a number divided by 3 and 4 times the number

8. Which phrase below *best* represents the following expression?

$$(k - 15) \cdot 3$$

- A** The product of 3 and the difference of a number and 15 *
- B** 15 less than 3 times a number
- C** The product of 15 and a number
- D** 3 more than the product of 15 and a number

9. Which phrase below *best* represents the following expression?

$$(y + 3)(y - 2)$$

- A** 2 less than 3 more than a number
- B** 3 more than the product of a number and 2
- C** The product of a number and 2 less than the number
- D** The product of 3 more than a number and 2 less than the number *

10. The following expression describes the total cost, in dollars, of ordering x DVDs from a website.

$$14.95x - 5.95$$

Which of the following *best* describes the cost for a DVD website order?

- A** Each DVD costs \$14.95, and there is a \$5.95 shipping fee per order.
- B** Each DVD costs \$14.95, and there is a \$5.95 discount per order. *
- C** Each DVD costs \$14.95, and there is a \$5.95 discount per DVD.
- D** Each DVD costs \$14.95, and there is a \$5.95 shipping fee per DVD.

11. Which of the following is an expression for “the sum of 4 and the product of 3 and x squared”?

- A** $(4 + 3)x^2$
- B** $4 + 3x^2$ *
- C** $(4)(3) + x^2$
- D** $4 + (3 + x)^2$

13. Which of the following is an expression for “the quotient of the product of 2 and z and the product of 4 and x ”?

- A** $(2 \div z)(4 \div x)$
- B** $2z \div 4x$ *
- C** $2z \cdot 4x$
- D** $(2 + z) \div (4 + x)$

12. Which phrase best represents the following expression?

$$\frac{3x}{(x + 2)}$$

- A** The product of 3 and x divided by the sum of x and 2 *
- B** The sum of 3 and x divided by the product of x and 2
- C** The quotient of 3 and x divided by the sum of x and 2
- D** The quotient of 3 and x divided by the product of x and 2

14. Which phrase below best represents the following expression?

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

- A** 4 less than the sum of the product of 3 and 2 and y
- B** 4 less than the product of 3 and the sum of 2 and y *
- C** The product of 3 and the sum of 2 and y less than 4
- D** The sum of the product of 3 and 2 and y less than 4

Answer Key

Content Standard 5

Sample Multiple-Choice

1. C
2. D
3. D
4. B
5. C
6. A
7. C
8. A
9. D
10. B
11. B
12. A
13. B
14. B

ALGEBRA

Content Standard 6

Solve one- and two-step equations.

Item Type

Multiple-choice

Additional Information

Any representation of a rational number may be used as the coefficient of the variable.
The solution of an equation may be any representation of a rational number.

Sample Multiple-Choice Items

1. What value of x makes the following equation true?

$$4x - 3 = 18$$

- 1.5 3.75 5.25 7.5
A **B** **C *** **D**

2. What value of x makes the following equation true?

$$\frac{x + 6}{2} = 9$$

- 1 5 12 24
A **B** **C *** **D**

3. What value of x makes the following equation true?

$$31 = x + 14$$

- 45 27 25 17
A **B** **C** **D ***

5. What value of x makes the following equation true?

$$94 = 4x + 6$$

- 84 25 22 $17\frac{1}{2}$
A **B** **C *** **D**

4. What value of y makes the following equation true?

$$42 = 7y$$

- 6 35 49 294
A * **B** **C** **D**

6. What value of x makes the following equation true?

$$\frac{x}{7} = 13$$

- 21 31 71 91
A **B** **C** **D ***

7. What value of x makes the following equation true?

$$\frac{x}{5} + 2 = 12$$

- 50 58 62 70
- A *** **B** **C** **D**

10. What value of x makes the following equation true?

$$48 = \frac{6x}{2}$$

- 21 16 8 4
- A** **B *** **C** **D**

8. What value of x makes the following equation true?

$$11x - 23 = 54$$

- 66 28 7 3
- A** **B** **C *** **D**

11. What value of n makes the following equation true?

$$4n \div 6 = 54$$

- 12 15 34 81
- A** **B** **C** **D ***

9. What value of x makes the following equation true?

$$-96 = 4x$$

- 24 100 24 -100
- A *** **B** **C** **D**

12. If $7h + 39 = 60$, what is the value of h ?

2 3 4 5

A **B *** **C** **D**

14. What value of x makes the following equation true?

$$\frac{x - 15}{5} = 5$$

-5 4 10 40

A **B** **C** **D ***

13. What value of x makes the following equation true?

$$32 = x + 13$$

19 25 29 65

A * **B** **C** **D**

Answer Key

Content Standard 6

Sample Multiple-Choice

1. C
2. C
3. D
4. A
5. C
6. D
7. A
8. C
9. A
10. B
11. D
12. B
13. A
14. D

GEOMETRY

Content Standard 7

Determine the transformation(s), including translations, reflections, or rotations, used to alter the position of a polygon on the coordinate plane.

Item Type

Multiple-choice

Additional Information

The four options may be four graphs.

The stem of the item may include a graph.

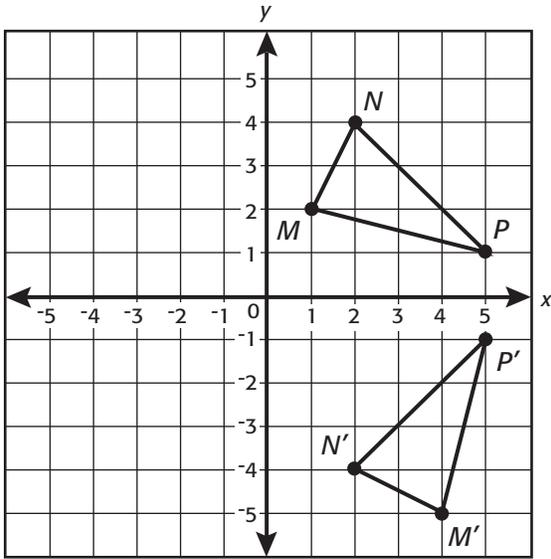
Changing the position of a polygon on the coordinate plane may require two transformations.

The identification of a transformation may be required.

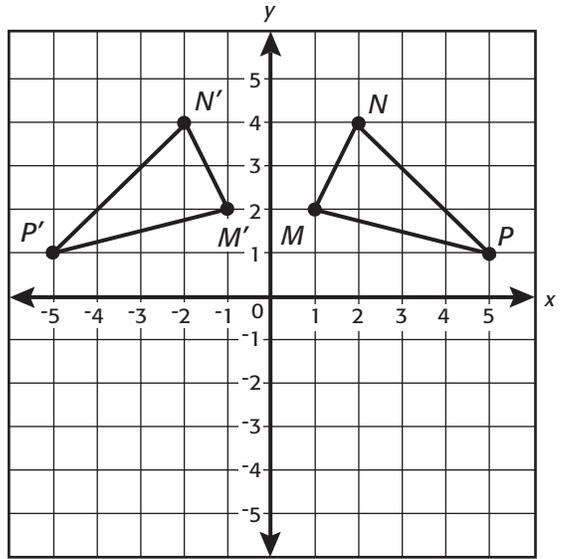
Sample Multiple-Choice Items

(continued on next page)

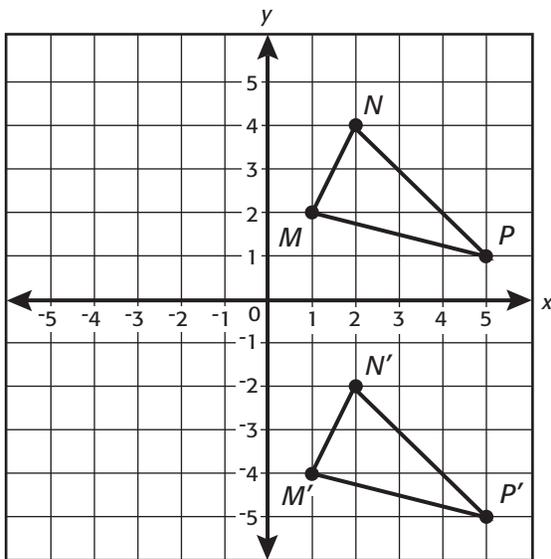
1. Which of the following diagrams shows the reflection of triangle MPN across the x -axis?



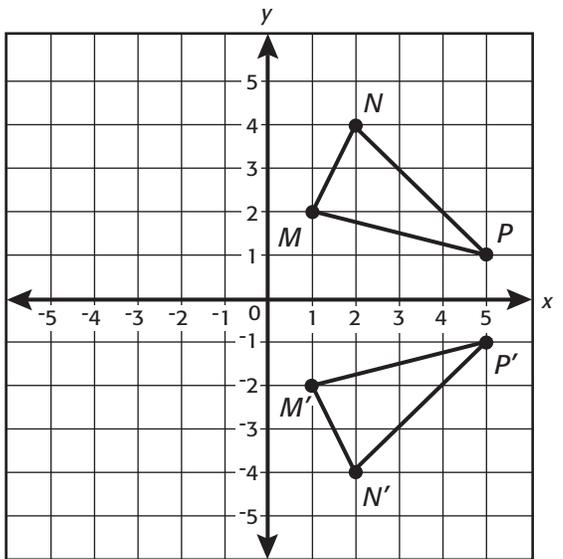
A



C

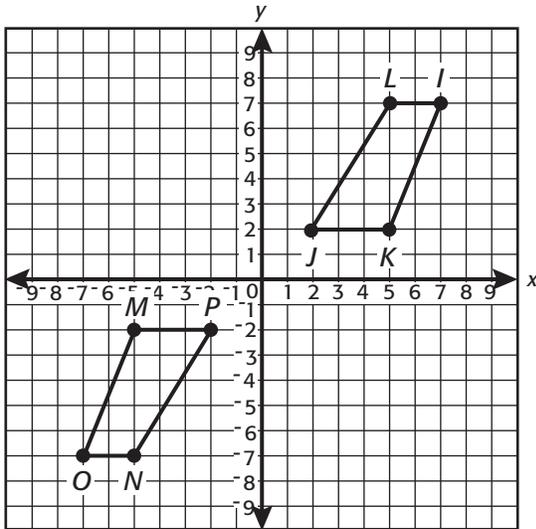


B



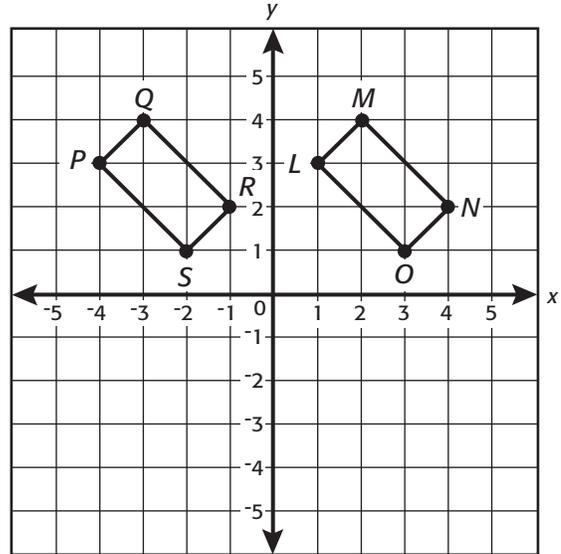
D *

2. Using the diagram below, which single transformation will move quadrilateral $LJKI$ to quadrilateral $NPMO$?



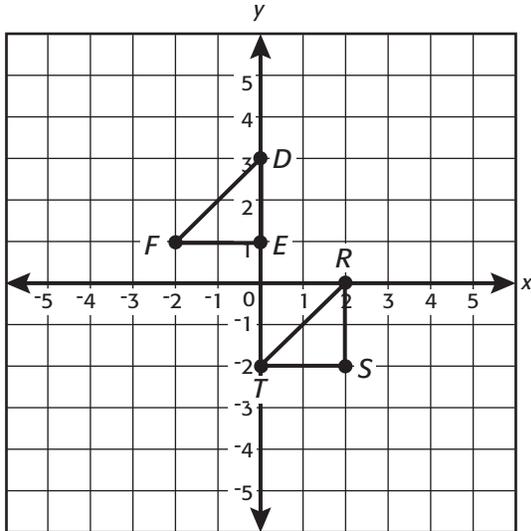
- A** Rotation of 180° around the origin *
- B** Reflection over the x -axis
- C** Reflection over the y -axis
- D** Rotation of 90° clockwise around the origin

3. Using the diagram below, which single transformation will move rectangle $LONM$ to rectangle $PSRQ$?



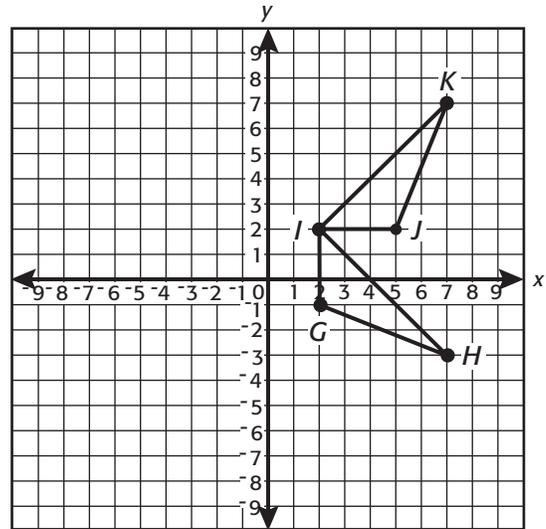
- A** Reflection across the x -axis
- B** Reflection across the y -axis
- C** Rotation of 90° clockwise around $(0, 2)$
- D** Translation of 5 units to the left *

4. Using the diagram below, which translations will move triangle RTS to triangle DFE ?



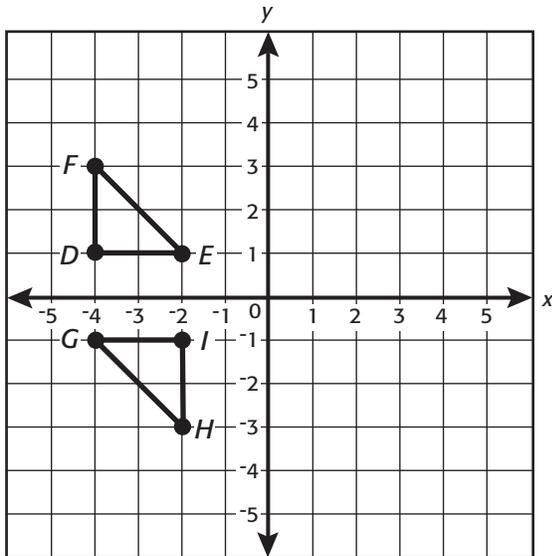
- A** Translations of 3 units down and 2 units to the right
- B** Translations of 3 units up and 2 units to the right
- C** Translations of 3 units up and 2 units to the left *
- D** Translations of 2 units down and 3 units to the left

5. Using the diagram below, which single transformation will move triangle IJK to triangle IGH ?



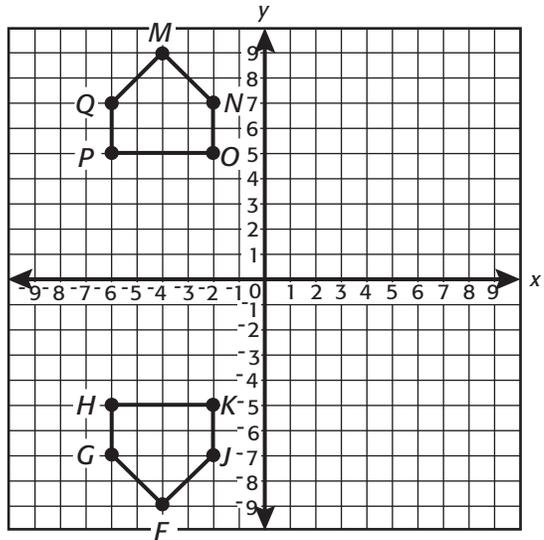
- A** Rotation of 270° clockwise around point I
- B** Rotation of 90° clockwise around point I *
- C** Rotation of 180° clockwise around point I
- D** Rotation of 90° counterclockwise around point I

6. Using the diagram below, which single transformation will move triangle DEF to triangle IGH ?



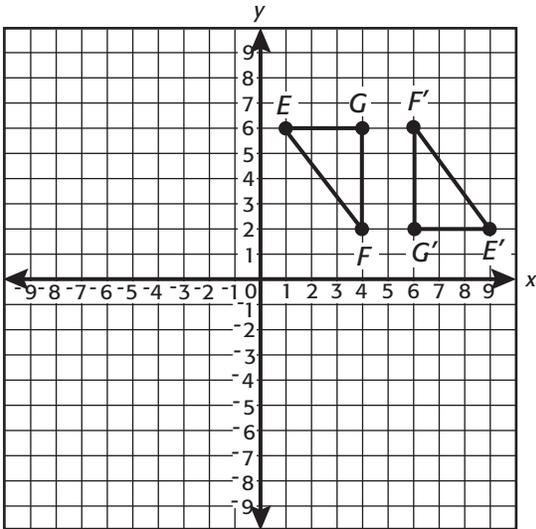
- A** Reflection over the x -axis
- B** Translation of 4 units down
- C** Rotation of 90° clockwise around $(-3, 0)$
- D** Rotation of 180° around $(-3, 0)$ *

7. Using the diagram below, which single transformation will move pentagon $MQPON$ to pentagon $FGHKJ$?

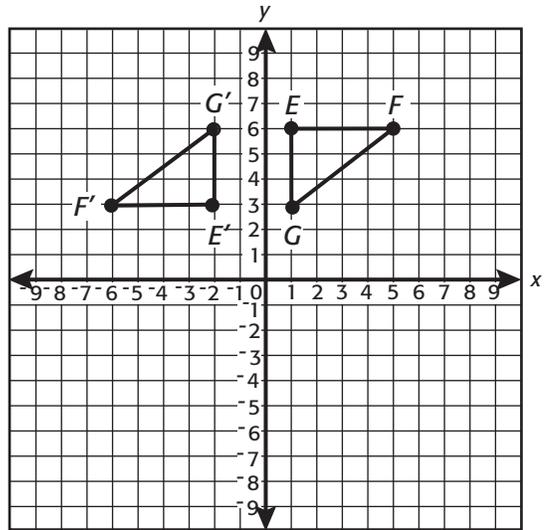


- A** Reflection across the x -axis *
- B** Reflection across the y -axis
- C** Transformation 18 units down
- D** Rotation of 180° around the origin

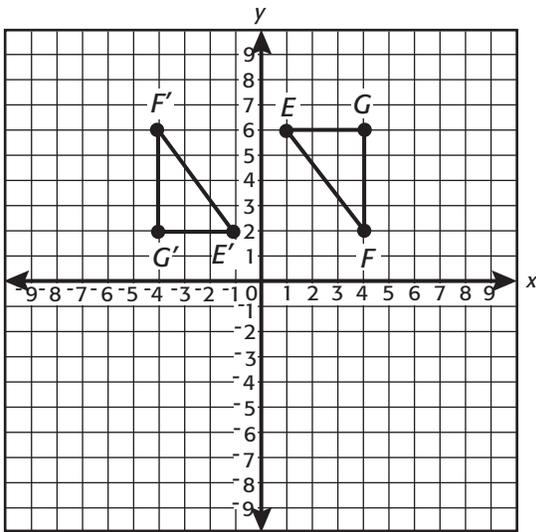
8. Which of the following shows a single rotation of triangle EGF of 180° around $(6, 4)$?



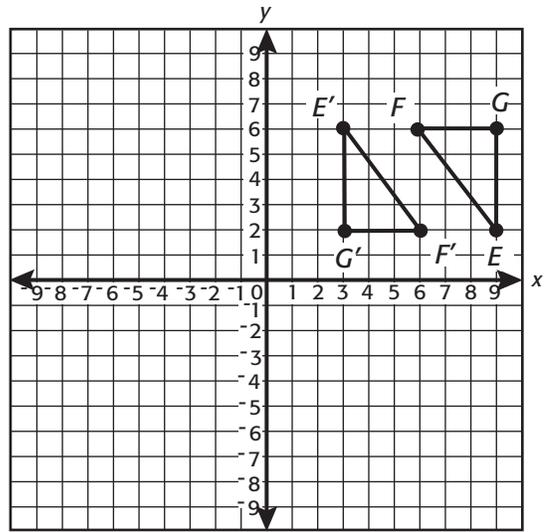
A



C

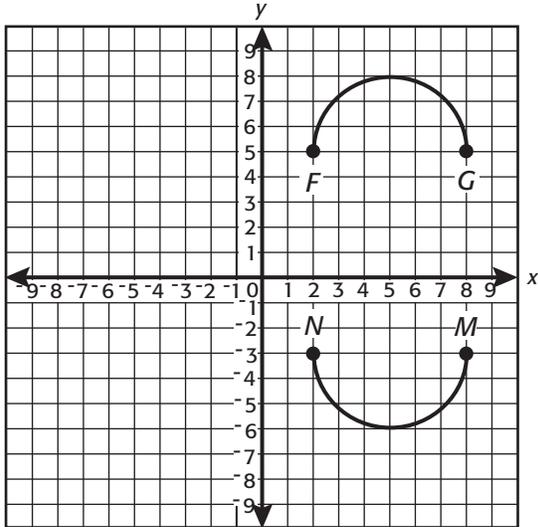


B

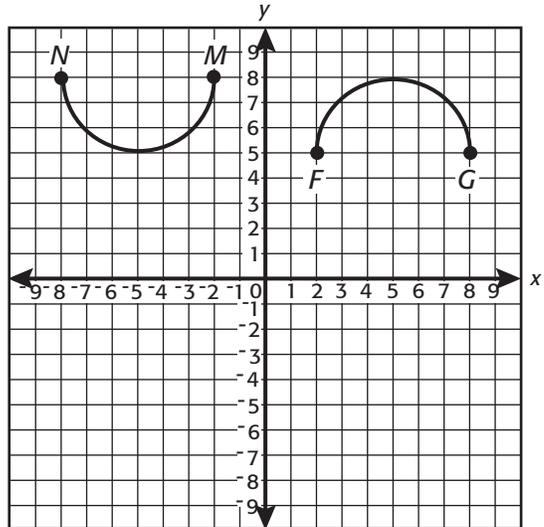


D *

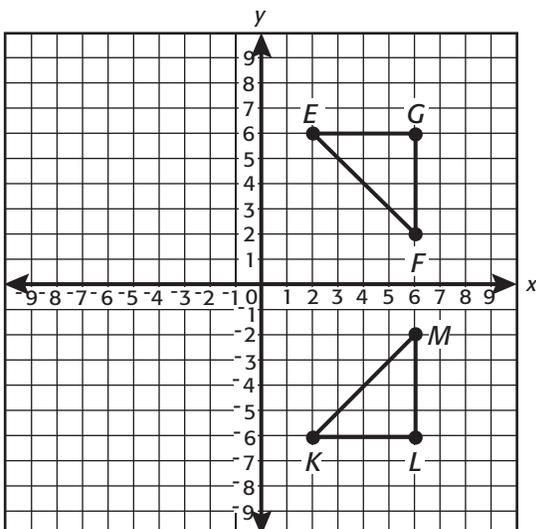
9. The four figures below represent different transformations. Which of these figures represents a reflection across the x -axis?



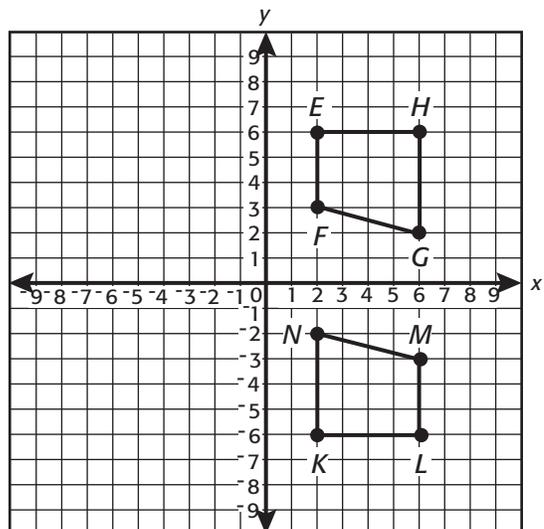
A



C

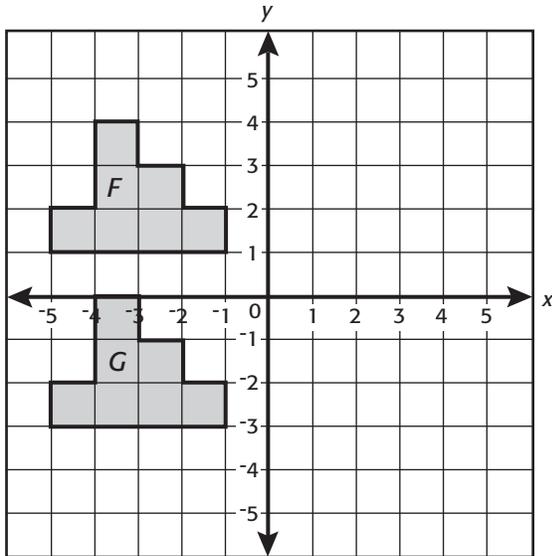


B *



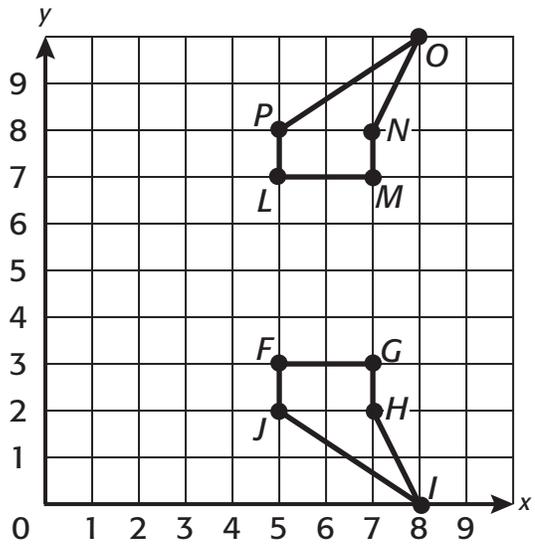
D

10. Using the diagram below, which single transformation will move polygon F to polygon G ?



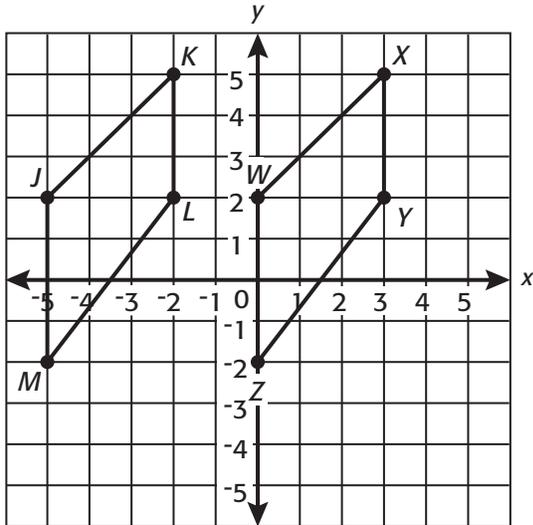
- A** Reflection across the x -axis
- B** Reflection across the y -axis
- C** Translation of 4 units down *
- D** Rotation of 180° around $(-3, 0)$

11. Using the diagram below, which transformation(s) will move polygon $LMNOP$ to polygon $FGHIJ$?



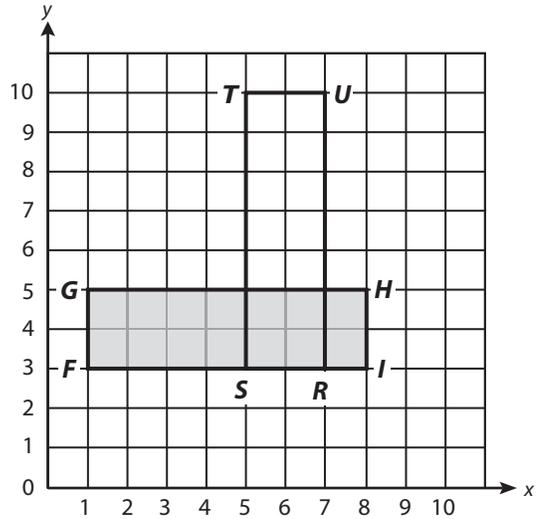
- A** Reflection across the line $y = 5$ *
- B** Reflection across the line $x = 5$
- C** Reflection across the line $y = 7$ and translation 3 units down
- D** Reflection across the line $x = 5$ and translation 3 units down

12. Using the diagram below, which single transformation will move quadrilateral $JKLM$ to quadrilateral $WXYZ$?



- A** Translation *
- B** Rotation
- C** Reflection
- D** Dilation

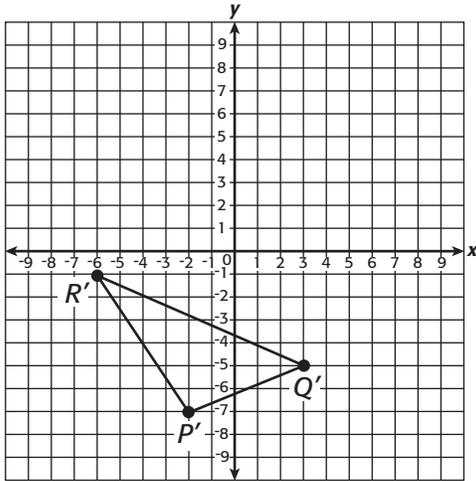
13. Using the diagram below, which single transformation below will move rectangle $FGHI$ to rectangle $RSTU$?



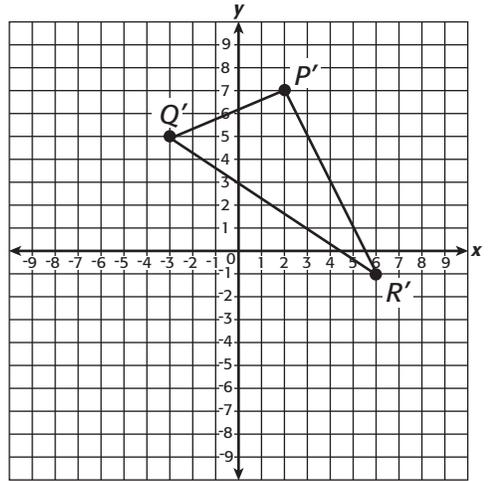
- A** Translation of 4 units to the right
- B** Counterclockwise rotation of 90° around $(4, 6)$ *
- C** Translation of 7 units up
- D** Clockwise rotation of 90° around $(5, 5)$

14. $\triangle PQR$ has vertices $P(-2, 7)$, $Q(3, 5)$, and $R(-6, -1)$.

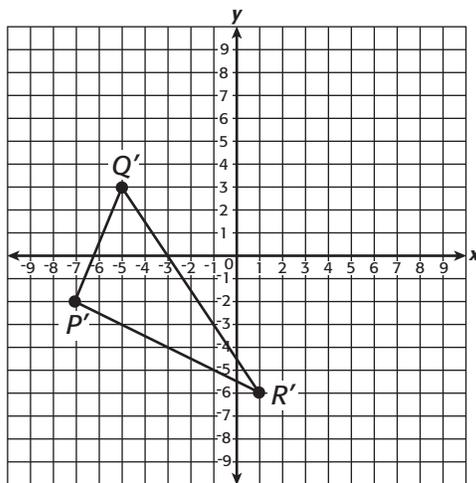
Which of the following *best* represents a reflection of $\triangle PQR$ across the x -axis to become $\triangle P'Q'R'$?



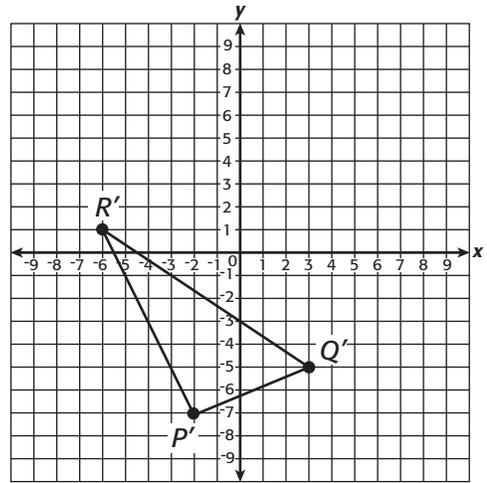
A



C

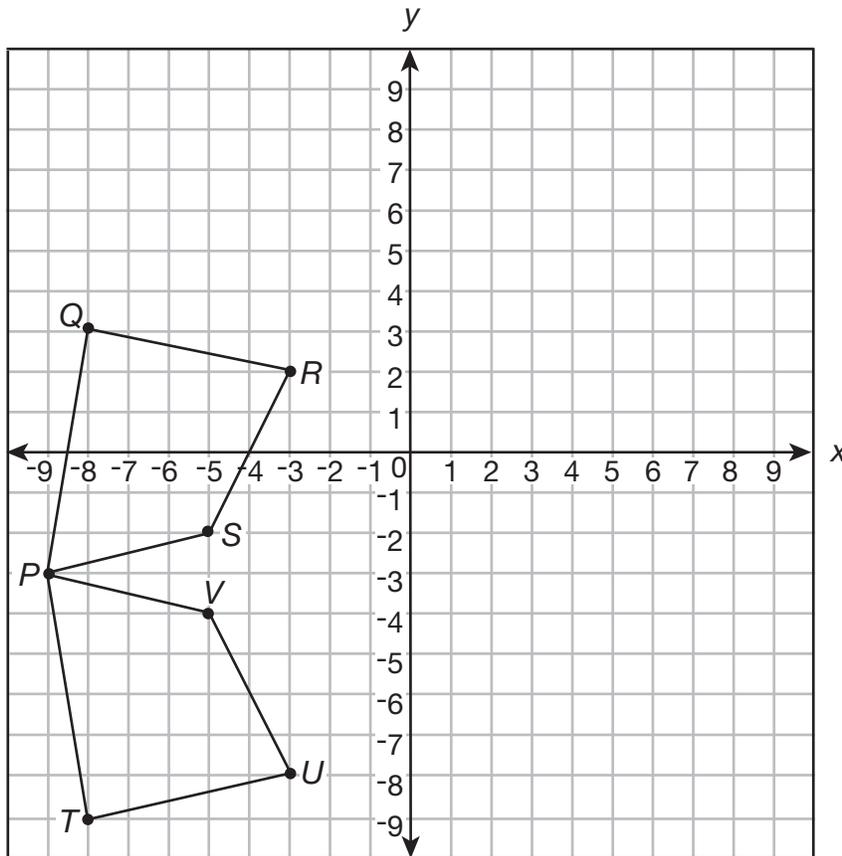


B



D *

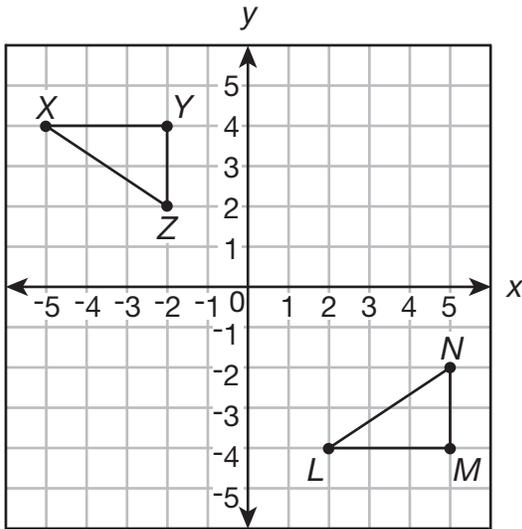
15. Using the diagram below, which single transformation will move quadrilateral $PQRS$ to quadrilateral $PTUV$?



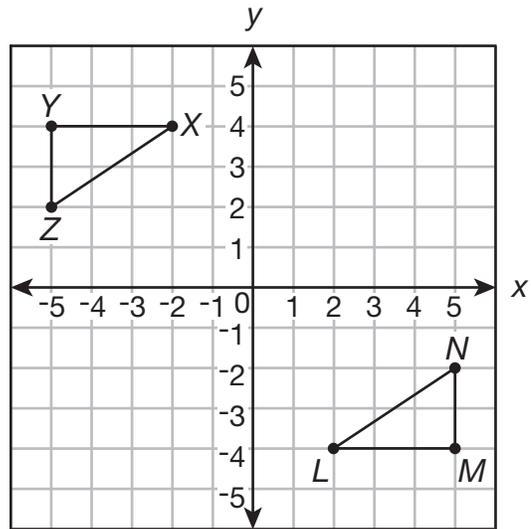
- A** Reflection over the line $y = -3$ *
- B** Reflection over the line $y = -5$
- C** Rotation of 180° clockwise about $(-5, -3)$
- D** Translation of 6 units down

16. Triangle LMN becomes triangle XYZ after a translation of 7 units to the left and a reflection across the x -axis.

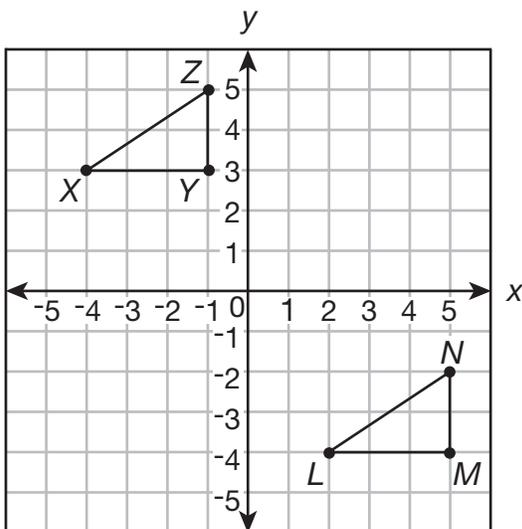
Which of the following shows these transformations?



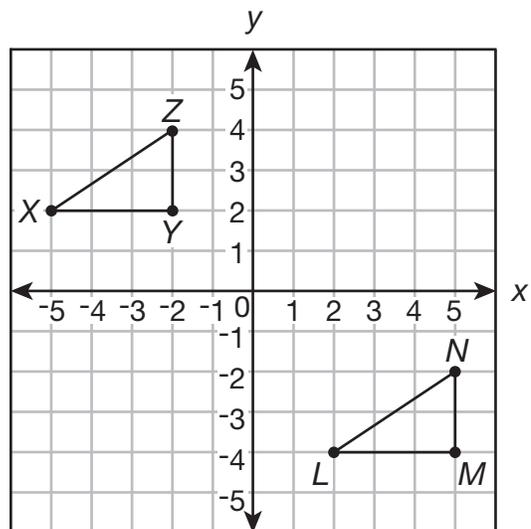
A *



C



B



D

Answer Key

Content Standard 7

Sample Multiple-Choice

1. D
2. A
3. D
4. C
5. B
6. D
7. A
8. D
9. B
10. C
11. A
12. A
13. B
14. D
15. A
16. A

GEOMETRY

Content Standard 8

Recognize geometric relationships among two-dimensional and three-dimensional objects.

Item Type

Multiple-choice

Open-ended

Additional Information

The drawings of two-dimensional and three-dimensional figures may be included.

The drawings of two-dimensional figures may be on a grid.

A two-dimensional figure may be compared to the same two-dimensional figure, a different two-dimensional figure, or a three-dimensional figure.

A three-dimensional figure may be compared to the same three-dimensional figure, a different three-dimensional figure, or a two-dimensional figure.

Sample Multiple-Choice Items

1. What do Figures A and B below have in common?

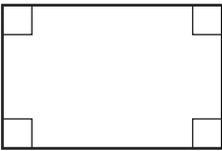


Figure A

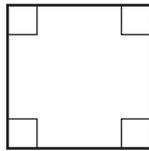


Figure B

- A** Both figures have four right angles. *
- B** Both figures have four congruent sides.
- C** Each angle measures exactly 45° .
- D** Each figure has four lines of symmetry.

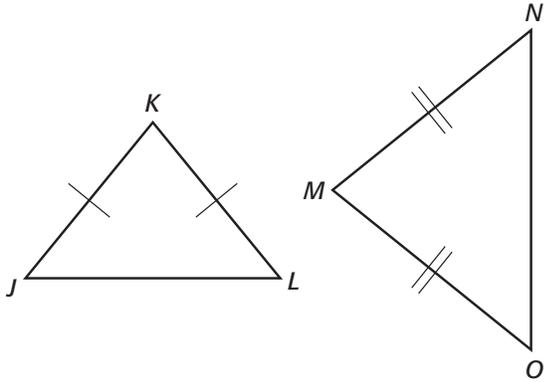
2. Which of the following quadrilaterals has *exactly* two sides that are parallel?

- A** Rhombus
- B** Rectangle
- C** Trapezoid *
- D** Parallelogram

3. What property does *not* apply to all right rectangular prisms?

- A** Opposite lateral faces are parallel.
- B** The lateral faces are all rectangles.
- C** The bases are right triangles. *
- D** The bases are parallel.

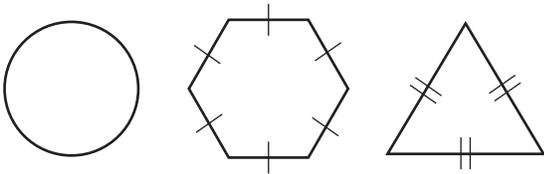
Compare triangles JKL and OMN as shown below.



4. Which of the statements below is *always* true?

- A** Both triangles are right.
- B** Both triangles are isosceles. *
- C** Both triangles are equilateral.
- D** Both triangles are scalene.

5. What do the three figures shown below have in common?



- A** They all have lines of symmetry. *
- B** They are all equilateral.
- C** They are all congruent.
- D** They are all polygons.

6. The quadrilaterals $LMNO$ and HJK are congruent.

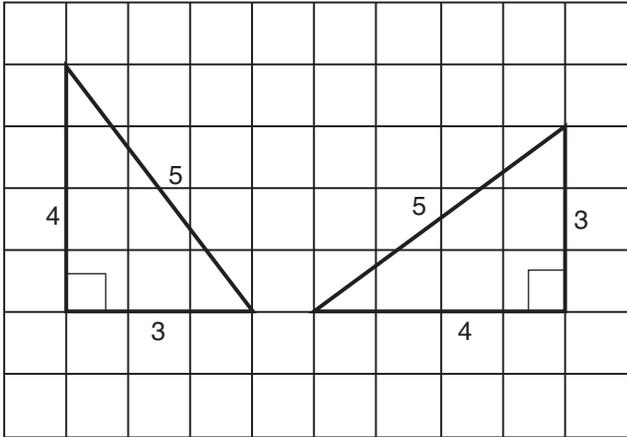
Which of the following statements about the quadrilaterals is *not* *always* true?

- A** They have equal corresponding angles.
- B** They are both the same size.
- C** They are both the same shape.
- D** They are equilateral. *

7. Which of the following statements must *always* be true of two similar, non-congruent triangles?

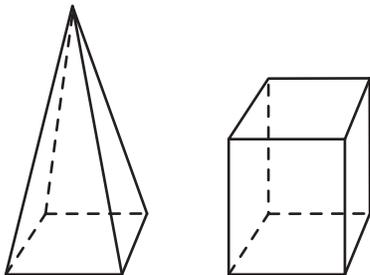
- A** Both triangles have the same shape. *
- B** All sides of both triangles are the same length.
- C** Both triangles have the same shape and the same size.
- D** All angles of both triangles have different measures.

8. Which is true about the two triangles below?



- A** They are congruent triangles. *
- B** They are equilateral triangles.
- C** They are isosceles triangles.
- D** They are acute triangles.

9. What do the figures shown below have in common?

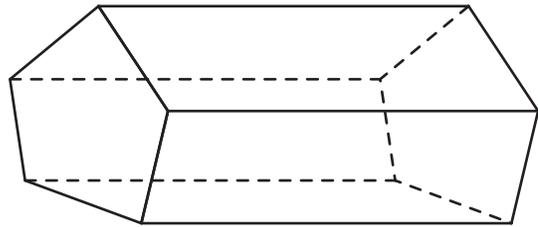


- A** Both have a triangular base.
- B** Both have a rectangular base. *
- C** Both have eight vertices.
- D** Both have twelve edges.

10. Which of the following three-dimensional objects are *always* similar to each other?

- A** Square pyramids
- B** Rectangular prisms
- C** Spheres *
- D** Cylinders

A pentagonal prism is shown below.



11. Which is a property of a pentagonal prism?

- A** It has two hexagons as bases.
- B** It has five pentagons as faces.
- C** It has exactly seven edges.
- D** It has exactly ten vertices. *

12. How are figures R and S the same?

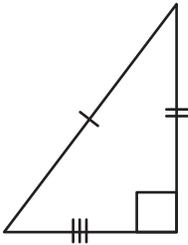


Figure R

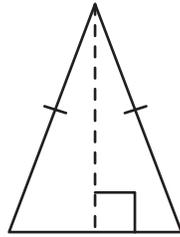
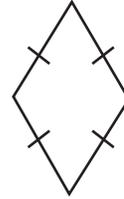


Figure S

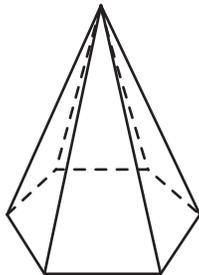
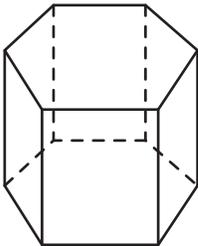
- A** Both are congruent polygons.
- B** Both are regular polygons.
- C** Both have acute angles. *
- D** Both have obtuse angles.

14. Which term does *not* apply to the figure below?



- A** Rhombus
- B** Square *
- C** Quadrilateral
- D** Parallelogram

13. What do the figures shown below have in common?



- A** Both have parallel faces.
- B** Both have eight faces.
- C** Both have a pentagon as a base.
- D** Both have a hexagon as a base. *

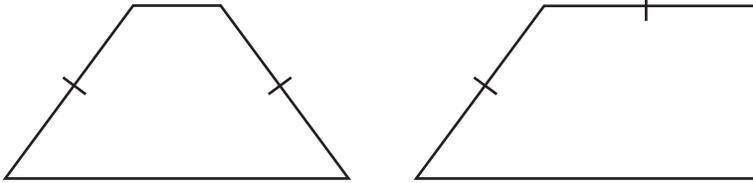
15. Which statement is true for the figures shown below?



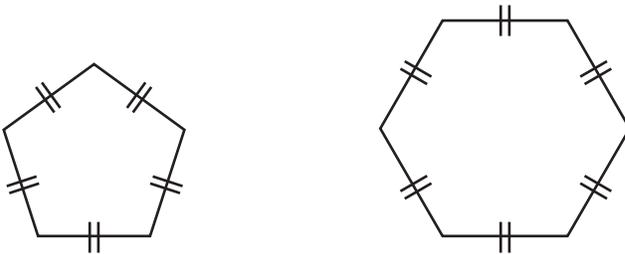
- A** Both figures have 2 sets of opposite angles that are congruent.
- B** Both figures have 2 obtuse angles. *
- C** Both figures have 2 right angles.
- D** Both figures have 2 sets of opposite sides that are congruent.

16. Which figures can both be described as rhombuses?

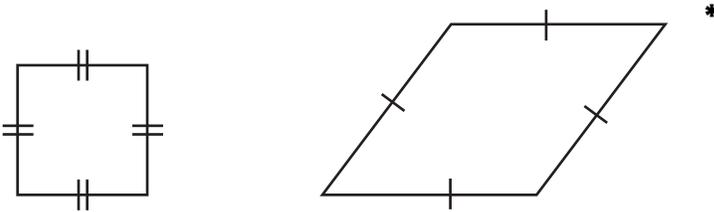
A



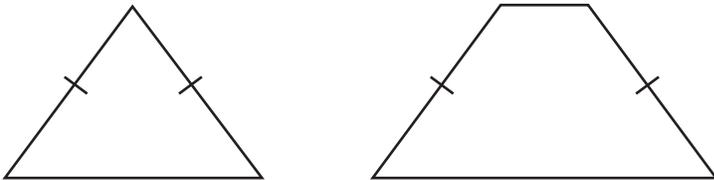
B



C

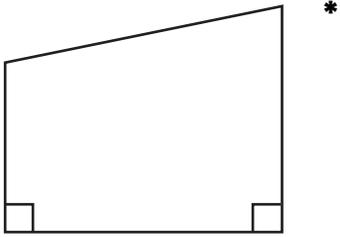


D

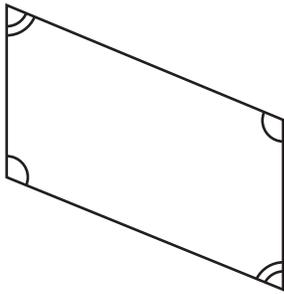


17. Which figure is a trapezoid?

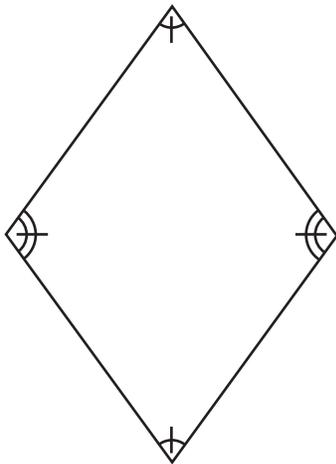
A



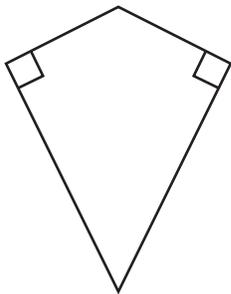
B



C



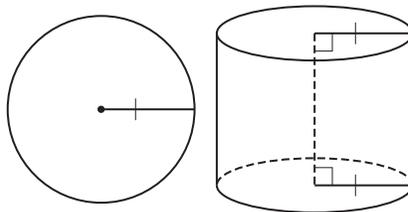
D



Sample Open-Ended Items

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

1. Use the two-dimensional and three-dimensional figures shown below to explain the geometric relationships of the figures.

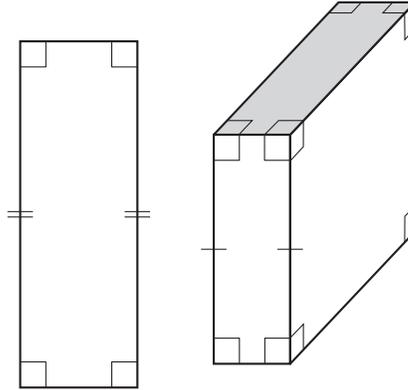


- a. Explain two ways the figures shown are the same.
- b. Explain one way the figures shown are different.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

2. Use the two-dimensional and three-dimensional figures shown below to explain the geometric relationships of the figures.

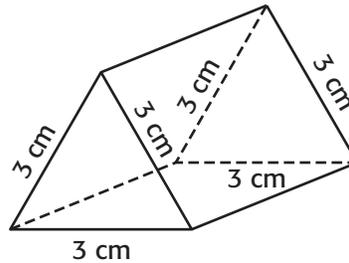
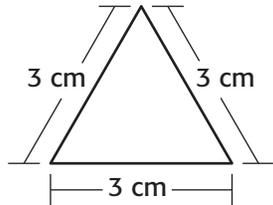


- a. Explain one way the figures shown are the same.
- b. Explain two ways the figures shown are different.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

3. Use the two-dimensional and three-dimensional figures shown below to explain the geometric relationships of the figures.

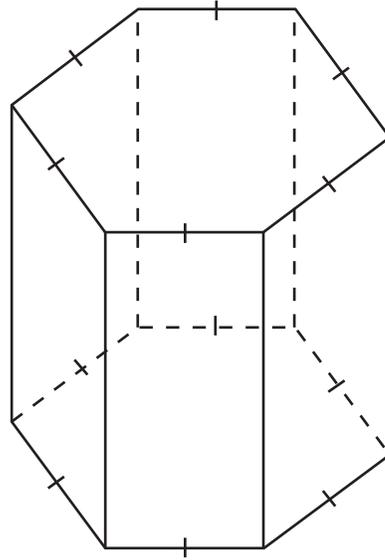
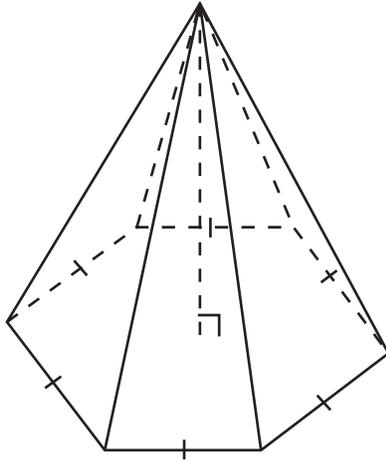


- Explain two ways the figures shown above are the same.
- Explain one way they are different.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

4. Use the three-dimensional figures shown below to explain the geometric relationships of the figures.

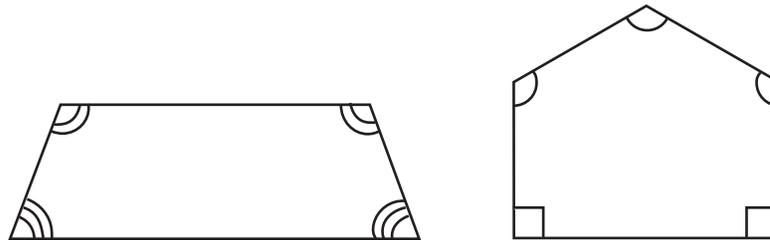


- a. Explain one way the figures shown above are the same.
- b. Explain two ways they are different.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

5. Use the two-dimensional figures shown below to explain the geometric relationships of the figures.



- a. Explain two ways the figures shown above are different.
- b. Explain one way they are the same.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

Answer Key

Content Standard 8

Sample Multiple-Choice

1. A
2. C
3. C
4. B
5. A
6. D
7. A
8. A
9. B
10. C
11. D
12. C
13. D
14. B
15. B
16. C
17. A

Sample Open-Ended

1. Sample Response(s): <ol style="list-style-type: none"> a. The figures are the same in that the circle and the base of the right cylinder both have equal diameters, equal radii, and equal circumferences. b. The figures are different because one is two-dimensional (circle), and the other is three-dimensional (cylinder). 	
Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

2. Sample Response(s):

- a. The figures are the same in that both the figure on the left and the figure on the right are made up of at least one rectangle.
- b. The figures are different because the length of one of the sides of the rectangle is different than the length of one of the sides of the rectangular prism. This is known because of the markings. Also, the two-dimensional figure has sides and vertices, and the three-dimensional figure has faces, edges, and vertices.

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

3. Sample Response(s):

- a. The figures are the same in that both the triangle and the base of the triangular prism are congruent. Also, both figures are made up of at least one triangle.
- b. The figures are different because one is two-dimensional (triangle), and the other is three-dimensional (triangular prism).

OR

The two-dimensional figure has sides and vertices, and the three-dimensional figure has edges, faces, and vertices.

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

4. Sample Response(s):

- a. One way the figures are the *same* is that both have at least one hexagon for a base.

OR

Equivalent

- b. One way the figures are *different* is that each figure has a different number of edges, faces, and vertices.

OR

Equivalent

AND

Another way the figures are *different* is that the figure on the left has triangular faces, and the figure on the right has rectangular faces.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Two logics are correct.
1	One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

5. Sample Response(s):

- a. One way the figures are *different* is that one is 4-sided (quadrilateral), and the other is 5-sided (pentagon).

OR

The figure on the right has two right angles in it (as noted by the angle symbol in the shape of a square), and the other figure (on the left) does not.

OR

Equivalent

AND

Another way the figures are *different* is that the trapezoid has exactly two pairs of equal angles, and the pentagon does not.

OR

The pentagon has three equal angles, and the trapezoid does not, as indicated by the angle markings.

OR

Equivalent

- b. One way the figures are the *same* is that both are polygons.

OR

They each have a pair of (adjacent and interior) angles that are equal to each other.

OR

They each have one pair of parallel lines.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Two logics are correct.
1	One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

MEASUREMENT

Content Standard 9

Solve problems involving circumference and area of circles.

Item Type

Multiple-choice
Gridded

Additional Information

Word problems/real-life situations may be used.

The drawing of a circle may be included.

The value of “pi” (π) will be 3.14.

Any representation of a rational number may be used for the dimension of the circle.

The formulas will be given on the reference page.

Finding the radius or diameter when given the area or circumference may be required.

In rounding numbers, *closest* may be used.

Sample Multiple-Choice Items

1. Brian is measuring one of his family's round dinner plates so that he can buy more plates of the same size. He found that it is 14 centimeters from the edge of the plate to the center of the plate.

Which is *closest* to the circumference, in centimeters, of the plate?

- A** 43.96
B 87.92 *
C 153.86
D 615.44

2. Mr. Brown is building a circular patio in his yard. The diameter of the patio is 16 feet.

Which is *closest* to the area, in square feet, of Mr. Brown's patio?

- | | | | |
|----------|----------|------------|----------|
| 30 | 50 | 200 | 800 |
| A | B | C * | D |

3. A circle has a radius of 6 inches. Which is the *closest* to the area, in square inches, of the circle?

- A** 59.16
- B** 113.04 *
- C** 118.32
- D** 452.16

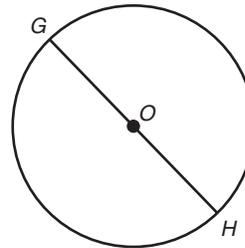
5. Which is *closest* to the area, in square centimeters, of a circle that has a radius of 11 centimeters?

- A** 35
- B** 95
- C** 380 *
- D** 1,520

4. Which is *closest* to the area, in square centimeters, of a circle that has a diameter of 15 centimeters?

- A** 176 *
- B** 94
- C** 47
- D** 24

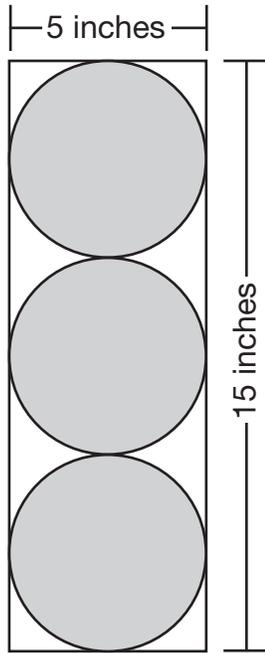
\overline{GH} is a diameter of circle O and measures 9 yards in length.



6. Which is *closest* to the circumference of the circle?

- A** 14 yd
- B** 28 yd *
- C** 57 yd
- D** 64 yd

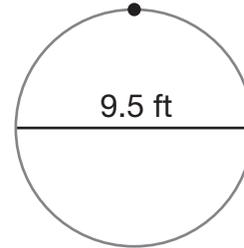
7. Tyler drew a rectangle around 3 circles as shown below.



Which is *closest* to the total area, in square inches, of the 3 circles?

- A** 19.63
- B** 58.88 *
- C** 78.50
- D** 706.50

8. The path of an amusement park ride is a circle with a diameter of 9.5 feet. Melanie is at the point marked on the path, as shown below.



Which is *closest* to the distance, in feet, Melanie will travel in one complete turn of the ride?

- A** 14.92
- B** 29.83 *
- C** 59.66
- D** 70.85

9. A hole punch cuts a circular hole with a diameter of 8 millimeters in a piece of paper.

Which is *closest* to the area, in square millimeters, of the hole?

- A** 12.56
- B** 25.12
- C** 50.24 *
- D** 200.96

10. Ray is putting a piece of material around the circular top of his drum. The radius of the top is 17.5 centimeters.

Which is *closest* to the circumference, in centimeters, of the top of the drum?

- A** 54.95
- B** 109.9 *
- C** 219.8
- D** 961.63

Sample Gridded Items

1. The radius of a coin is $\frac{1}{2}$ inch.

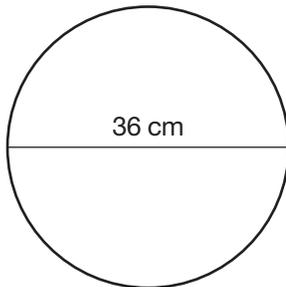
What is the area, in square inches, of the coin?

Mark your answer in the answer grid.

2. What is the area, to the *nearer* square centimeter, of a circle with a diameter of 70 centimeters?

Mark your answer in the answer grid.

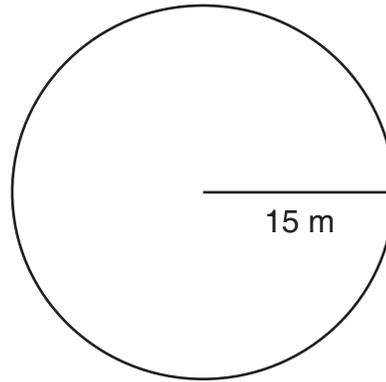
The circle shown below has a diameter of 36 centimeters.



3. What is the circumference, in centimeters, of the circle?

Mark your answer in the answer grid.

The circle shown below has a radius of 15 meters.



4. What is the area, in square meters, of the circle?

Mark your answer in the answer grid.

5. A circle has a circumference of 37.68 centimeters.

What is the radius, in centimeters, of the circle?

Mark your answer in the answer grid.

6. A circle has a diameter of 10 feet.

What is the area, in square feet, of the circle?

Mark your answer in the answer grid.

Answer Key

Content Standard 9

Sample Multiple-Choice

1. B
2. C
3. B
4. A
5. C
6. B
7. B
8. B
9. C
10. B

Sample Gridded

Listed answers are from using 3.14 for pi **OR** a more exact approximation of pi.

1. 0.785 OR 0.79
2. 3847 OR 3848
3. 113.04 OR 113.10
4. 706.5 OR 706.86
5. 6
6. 78.5 OR 78.54

MEASUREMENT

Content Standard 10

Find the perimeter of polygons and the area of triangles and trapezoids.

Item Type

Multiple-choice
Gridded

Additional Information

Drawings may be used.

Word problems/real-life situations may be used.

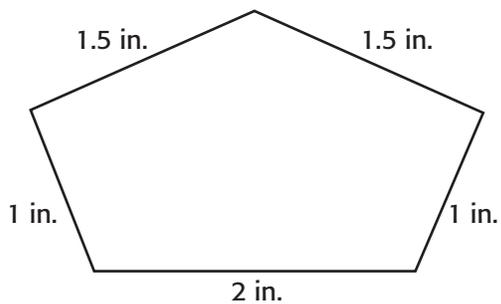
Determining the perimeter of a regular polygon may be required.

Unnecessary dimensions may be included.

The properties of all types of triangles may be required to determine the area of a triangle.

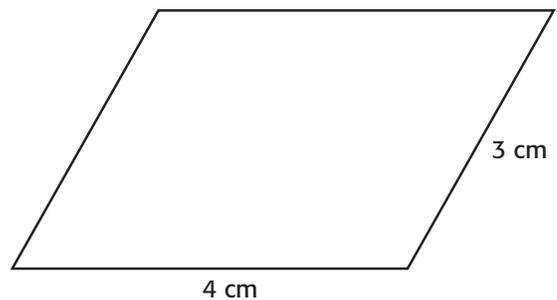
Sample Multiple-Choice Items

1. What is the perimeter, in inches, of the pentagon shown below?



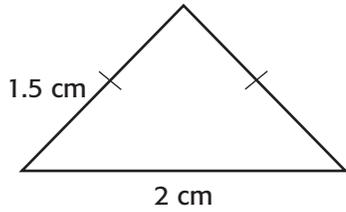
- 3 5 7 9
A **B** **C *** **D**

2. What is the perimeter, in centimeters, of the parallelogram shown below?



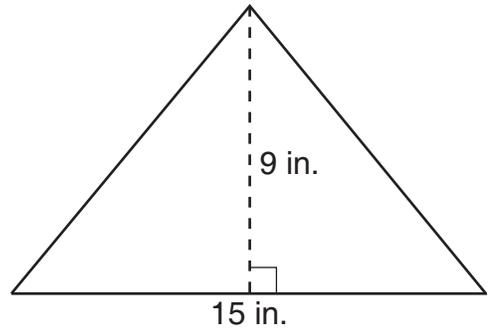
- 4 7 11 14
A **B** **C** **D ***

3. What is the perimeter, in centimeters, of the isosceles triangle shown below?



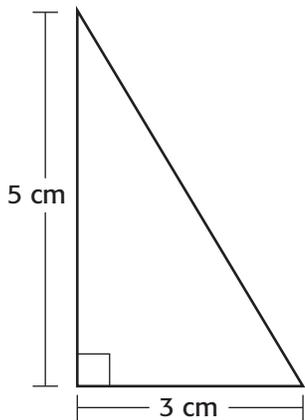
- 5.5 5 4.5 4
A **B *** **C** **D**

5. What is the area, in square inches, of the triangle shown below?



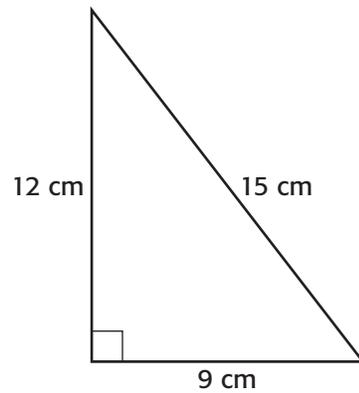
- 15.5 24 67.5 135
A **B** **C *** **D**

4. What is the area, in square centimeters, of the right triangle shown below?



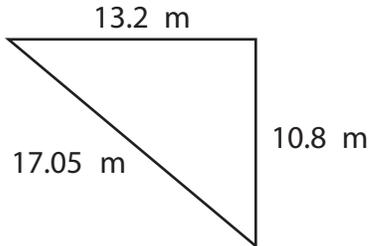
- 5 7.5 8.5 15
A **B *** **C** **D**

6. What is the area, in square centimeters, of the triangle shown below?



- 36 54 108 216
A **B *** **C** **D**

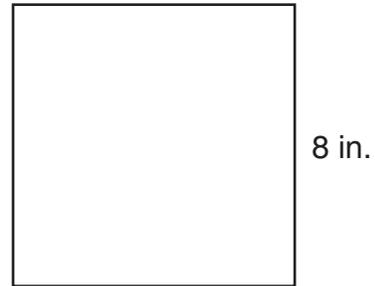
Jill wanted to place rope around three sides of the playground. The sides measure 13.2 meters, 17.05 meters, and 10.8 meters as shown below.



7. What is the *least* amount of rope, in meters, she will need to place around the playground?

- A** 27.85
- B** 30.25
- C** 40.80
- D** 41.05 *

9. What is the perimeter, in inches, of the square shown below?



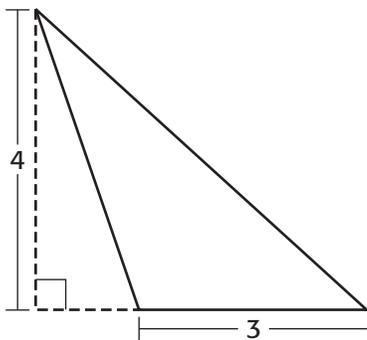
- 8
- 16
- 32
- 64
- A**
- B**
- C** *
- D**

10. Each side of a regular hexagon has a length of 8 inches.

What is the perimeter, in inches, of the hexagon?

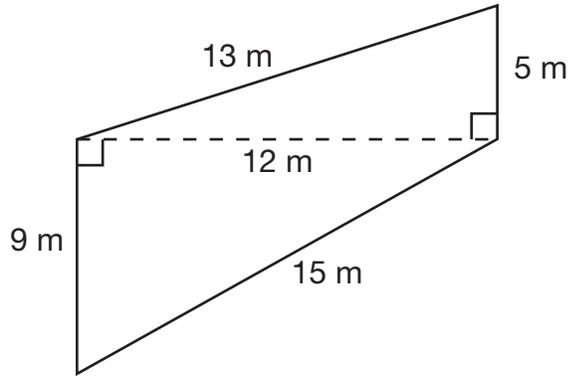
- 32
- 40
- 48
- 54
- A**
- B**
- C** *
- D**

8. What is the area, in square units, of the triangle shown below?



- 12
- 6
- 4
- 3
- A**
- B** *
- C**
- D**

11. What is the area, in square meters, of the trapezoid shown below?



42

84

132

168

A

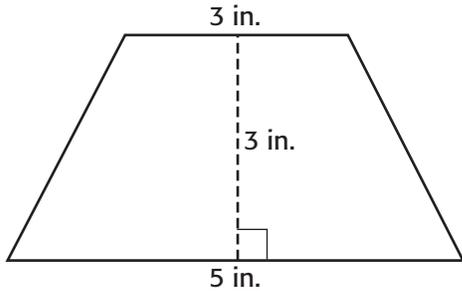
B *

C

D

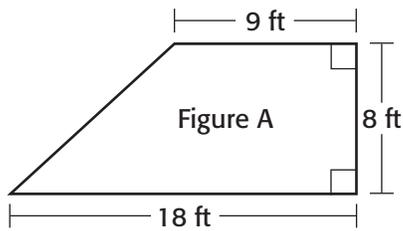
Sample Gridded Items

1. What is the area, in square inches, of the trapezoid shown below?



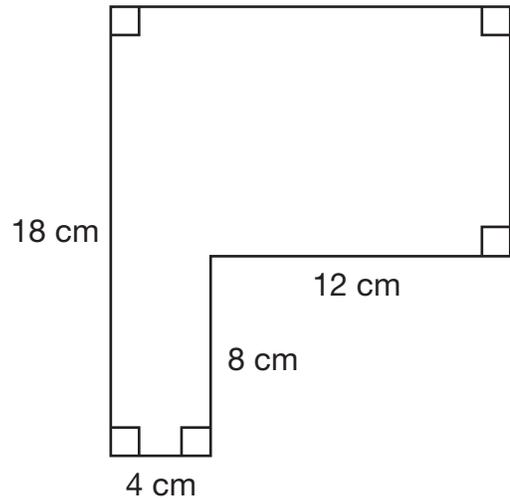
Mark your answer in the answer grid.

2. What is the area, in square feet, of Figure A shown below?



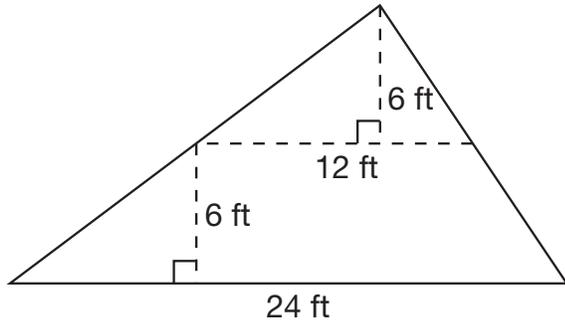
Mark your answer in the answer grid.

3. What is the perimeter, in centimeters, of the polygon shown below?



Mark your answer in the answer grid.

4. What is the area, in square feet, of the figure shown below?



Mark your answer in the answer grid.

5. Each side of a regular pentagon has a length of 6.5 centimeters.

What is the perimeter, in centimeters, of the pentagon?

Mark your answer in the answer grid.

Answer Key

Content Standard 10

Sample Multiple-Choice

1. C
2. D
3. B
4. B
5. C
6. B
7. D
8. B
9. C
10. C
11. B

Sample Gridded

1. 12
2. 108
3. 68
4. 144
5. 32.5

MEASUREMENT**Content Standard 11**

Solve problems involving ratios or rates, using proportional reasoning.

Item Type

Multiple-choice

Open-ended

Additional Information

Word problems/real-life situations will be used.

Any representation of a rational number may be used.

Verbal descriptions of proportions may be used.

Sample Multiple-Choice Items

1. Seven of a baseball player's first 28 hits were triples. The baseball player had a total of 140 hits.

If the baseball player maintained his rate of hitting triples, how many triples did this baseball player hit in all?

7 14 28 35

A B C D *

2. Alabama has 21,653,000 acres of forests and a total land area of 32,480,000 acres.

If a 210-acre farm has the same ratio of forested land to total land area, approximately how many acres of the farm are forested?

140 160 180 210

A * B C D

3. In 18 minutes, Karl can walk 4 laps around the track at his school.

If his pace stays the same, how many laps should Karl be able to walk in $1\frac{1}{2}$ hours?

5 18 20 48

A **B** **C *** **D**

5. The ratio of red candy to green candy in a bag is 3 to 4.

If there were 36 pieces of green candy in the bag, how many pieces of candy in the bag were red?

7 9 12 27

A **B** **C** **D ***

4. Emma saves 28 cents of every dollar that she earns. Emma earned \$75 last week.

How much money did Emma save last week?

\$21 \$28 \$47 \$75

A * **B** **C** **D**

Sample Open-Ended Items

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

1. Jessica joined the 100-mile swimming club. She will record the number of laps she swims in the pool until she swims 100 miles. In the pool, swimming 18 laps is equal to $\frac{1}{2}$ mile.
 - a. Jessica swims 18 laps 3 times a week. How many miles does she swim in 1 week?
 - b. Jessica's friend, Tonya, swims $3\frac{1}{2}$ miles each week for 1 year. There are 52 weeks in 1 year. How many miles does Tonya swim in 1 year?
 - c. Jessica decides that she wants to swim at least 100 miles in 1 year. She will swim the same number of laps each week for 50 weeks. She will take 2 weeks off. How many laps does she need to swim each week to swim 100 miles?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

2. Jenna went on a 140-mile road trip. When it was not raining, she drove 50 miles per hour. When it was raining, she drove 40 miles per hour.
 - a. It rained for $1\frac{1}{2}$ hours during her road trip. How many miles in total did Jenna drive when it was raining?
 - b. The rest of her trip it did not rain. How much time did it take Jenna to drive the rest of her road trip?
 - c. On Jenna's return trip, she drove the 140 miles in $2\frac{1}{3}$ hours. She drove at a constant speed the entire trip and did not stop. What was Jenna's speed on her return trip?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

3. Jamaal mixes oil and gasoline to make fuel for his yard equipment.
 - a. To make 1 gallon of fuel, he uses 4 fluid ounces of oil. He has 15 fluid ounces of oil. Using the same proportion, how many gallons of fuel can Jamaal make?
 - b. To mix the fuel, the ratio of fluid ounces of oil to fluid ounces of gasoline is 1:31. How many fluid ounces of oil does Jamaal need when he uses 186 fluid ounces of gasoline?
 - c. Jamaal decides to make 272 fluid ounces of fuel. How many fluid ounces of oil will he need?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

4. For every 12 minutes Casey runs, he walks for 3 minutes.
 - a. When Casey runs for 36 minutes, how many minutes does he walk?
 - b. When Casey has been walking for 15 minutes, how many total minutes has he been running?
 - c. The total time Casey has been running and walking is 90 minutes. Of the 90 minutes, how many minutes did Casey run?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

5. Roger prepared pasta for a dinner party. He prepared 2 pounds of spaghetti for every 15 people served.
 - a. When Roger prepares 6 pounds of spaghetti, how many people will be served?
 - b. Roger served 180 people. How many pounds of spaghetti did he prepare?
 - c. Roger also prepared macaroni. He prepared 3 pounds of macaroni for every 30 people served. Explain why Roger will prepare 6 pounds less macaroni than spaghetti to serve 180 people.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

Answer Key

Content Standard 11

Sample Multiple-Choice

1. D
2. A
3. C
4. A
5. D

Sample Open-Ended

1. Sample Response(s):

a. $\frac{1}{2} \times 3 = \frac{3}{2}$ or $1\frac{1}{2}$ or 1.5 miles per week

OR

Equivalent

b. $52 \times 3\frac{1}{2} = 182$ miles per year

OR

Equivalent

c. $100 \div \frac{1}{2} \times 18 = 3,600$ (total laps), then $3,600 \div 50$ (weeks) = 72 (laps each week)

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

2. Sample Response(s):

a. $40 \times 1 \frac{1}{2}$ or $40 \times 1.5 = 60$ miles
OR

Equivalent

b. $140 - 60 = 80$ and $80 \div 50 = 1.6$ hours or 1 hour and 36 minutes
OR

Equivalent

c. $140 \div 2 \frac{1}{3}$ or $140 \div \frac{7}{3}$ or $140 \times \frac{3}{7} = 60$ miles per hour
OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All logics are correct. OR Two correct logics and correct answers for one or more problems. OR One correct logic and correct answers for all problems.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

3. Sample Response(s):

a. $\frac{\text{gallons of fuel}}{\text{fluid ounces of oil}} = \frac{1}{4} = \frac{g}{15}$ and solve for g .

$4g = 15$ and $g = \frac{15}{4} = 3.75$ (gallons)

OR

Equivalent

b. $\frac{\text{fluid ounces of oil}}{\text{fluid ounces of gasoline}} = \frac{1}{31} = \frac{x}{186}$ and solve for x .

$31x = 186$ and $x = \frac{186}{31} = 6$ (fluid ounces)

OR

Equivalent

c. $\frac{\text{fluid ounces of oil}}{\text{fluid ounces of fuel}} = \frac{1}{1+31} = \frac{1}{32} = \frac{y}{272}$ and solve for y .

$32y = 272$ and $y = \frac{272}{32} = 8.5$ (fluid ounces)

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All logics are correct. OR Two correct logics and correct answers for one or more problems. OR One correct logic and correct answers for all problems.
1	One or more answers to problems are correct without logic. OR One correct logic.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

4. Sample Response(s):

a. $\frac{\text{minutes walked}}{\text{minutes run}} = \frac{3}{12} = \frac{w}{36}$ and solve for w .

$12w = 3 \times 36$ so $w = \frac{3 \times 36}{12} = 9$ (minutes)

OR

Equivalent

b. $\frac{\text{minutes walked}}{\text{minutes run}} = \frac{3}{12} = \frac{15}{r}$ and solve for r .

$3r = 12 \times 15$ so $r = \frac{12 \times 15}{3} = 60$ (minutes)

OR

Equivalent

c. Casey runs 12 of every 15 minutes, thus, $\left(\frac{12}{15}\right) \times 90 = 72$ (minutes)

OR

Equivalent (e.g., may see proportion set up: $\left(\frac{12}{15}\right) = \frac{r}{90}$ and solve for r).

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

5. Sample Response(s):

a. $\frac{\text{pounds of spaghetti}}{\text{people}} = \frac{2}{15} = \frac{6}{p}$ and solve for p .

$$2p = 6 \times 15 \text{ so } p = \frac{6 \times 15}{2} = 45 \text{ (people)}$$

OR

Equivalent

b. $\frac{\text{pounds of spaghetti}}{\text{people}} = \frac{2}{15} = \frac{s}{180}$ and solve for s .

$$15s = 2 \times 180 \text{ so } s = \frac{2 \times 180}{15} = 24 \text{ (pounds of spaghetti)}$$

OR

Equivalent

c. To find the pounds of macaroni, we set up the equation as

$$\frac{\text{pounds of macaroni}}{\text{people}} = \frac{3}{30} = \frac{m}{180} \text{ and solve for } m.$$

$$30m = 3 \times 180 \text{ so } m = \frac{3 \times 180}{30} = 18 \text{ (pounds of macaroni)}$$

Roger will have prepared 6 pounds less of macaroni because the difference in pounds is $24 - 18$, or 6 pounds.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

DATA ANALYSIS AND PROBABILITY**Content Standard 12**

Determine measures of central tendency (mean, median, and mode) and the range using a given set of data or graphs, including histograms, frequency tables, and stem-and-leaf plots.

Item Type

Multiple-choice
Gridded
Open-ended

Additional Information

Word problems/real-life situations may be used.

An explanation of how mean, median, and mode are found may be required.

A description of the effects of adding data to a set may be required.

Tables and charts may be used.

Sample Multiple-Choice Items

1. The chart below shows the number of books read in a month in each of Mrs. Graham's language arts classes.

Number of Books Read

Class	1st Period	2nd Period	3rd Period	4th Period	5th Period
Number of Books	68	72	53	77	57

What is the mean number of books read per class?

54.0

A

54.8

B

65.4

C *

67.4

D

2. The list below shows the monthly earnings of the employees in a video store.

- \$1,000
- \$1,000
- \$1,300
- \$1,900
- \$2,000
- \$2,300
- \$2,300

What is the range of these earnings?

- A** \$1,300 *
- B** \$1,650
- C** \$1,700
- D** \$1,900

3. The number of points Kyle's basketball team scored in each of their last 6 games is shown below.

88, 70, 84, 93, 84, 97

Which is true about the number of points Kyle's basketball team scored?

- A** The mean is less than the mode.
- B** The median is less than the mode.
- C** The mean and median are the same. *
- D** The median and mode are the same.

4. The stem-and-leaf plot shows the number of fishing licenses purchased on different days last month.

Fishing Licenses					
0	8	8			
1	4	8	9	9	
2	0	3	6	8	8
3	5	5	7	8	9
4	1	1	1	6	7
5	2	2	3		

$$1 \mid 9 = 19$$

What is the median number of fishing licenses purchased?

- A** 32
- B** * 35
- C** 41
- D** 45

5. Which set of numbers has a median of 36?

- A** 38, 36, 40, 41, 36
- B** 35, 39, 36, 40, 42
- C** 32, 36, 37, 38, 37
- D** 41, 36, 40, 32, 35 *

Sample Gridded Items

Mr. Mahoney asked his students to give a source of information about world events. The frequency table below shows his results.

Mr. Mahoney's Data

Source of Information	Number of Students
Listen to radio	8
Watch TV	12
Talk to parents	3
Talk to friends	6
Read a newspaper	4
Other/No response	12

1. What is the mode of the number of students?

Mark your answer in the answer grid.

Kanesha collected data on the number of students served in the cafeteria each day during an 11-day period. The table below shows the results of her research.

Number of Students Served in the Cafeteria

Day	Number of Students
Sept. 12	56
Sept. 13	98
Sept. 14	111
Sept. 15	78
Sept. 16	66
Sept. 19	103
Sept. 20	83
Sept. 21	89
Sept. 22	95
Sept. 23	115
Sept. 26	78

2. What was the median number of students served in the cafeteria over the 11-day period?

Mark your answer in the answer grid.

The table below shows the number of students in attendance at Blanco Middle School for a one-week period.

Blanco Middle School Students

Day	Number of Students in Attendance
Monday	788
Tuesday	872
Wednesday	1,014
Thursday	935
Friday	961

3. What is the mean number of students in attendance at Blanco Middle School for the one-week period?

Mark your answer in the answer grid.

The stem-and-leaf plot below shows the scores Leon received on each of his science quizzes.

Leon's Science Quiz Scores



5 | 7 represents 57.

4. Use this data set to find the mode of all of Leon's scores.

Mark your answer in the answer grid.

The list below shows the total fat content, in grams, of some menu items at a fast-food restaurant.

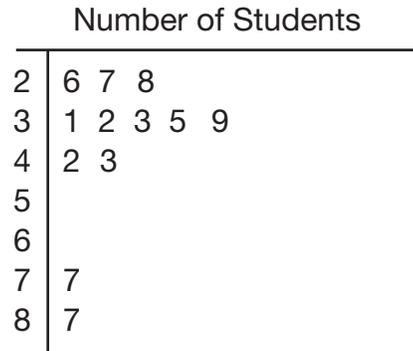
**Fat Content
(in grams)**

45	20	34	8	14
32	26	21	10	24
16	4	26	9	36

5. What is the median fat content of the data listed?

Mark your answer in the answer grid.

The teachers of Lee Middle School take attendance at 9:00 A.M. every school day. The stem-and-leaf plot shows the number of students in each teacher's classroom at 9:00 A.M. on one school day.



2 | 6 represents 26 students.

6. Use this data set to find the mean number of students per classroom on that one day.

Mark your answer in the answer grid.

7. The weights, in pounds, of dogs in a show are shown in the stem-and-leaf plot below.

Dog Weights (in pounds)

0	6		
1	0	3	
2	1	8	
3	2	2	4
4	0	1	
5			
6	2		
7			
8	4	5	

0 | 6 represents 6 pounds

What is the range, in pounds, of the weights of the dogs?

Mark your answer in the answer grid.

8. The list below shows the number of collectible cards owned by Stefanie's friends.

181, 256, 301, 72, 97, 412

What is the range of the number of collectible cards owned?

Mark your answer in the answer grid.

Sample Open-Ended Items

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

1. The stem-and-leaf plot below shows the total caloric content of several main dishes.

Caloric Content	
11	6
12	0 7 9
18	2 4 4 4 9 9
21	8 9

11 | 6 represents 116

- a. Use this data set to find the median of the total caloric content.
- b. Use this data set to find the mode of the total caloric content.
- c. Use this data set to find the mean of the total caloric content.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

2. The frequency table below shows the total points scored by several high school basketball players for the year.

Basketball Team Points

Player	Points
1	47
2	52
3	41
4	49
5	51
6	58
7	52
8	47
9	63
10	52
11	60

- Use this data set to determine the median number of points scored by the players.
- Use this data set to determine the mode of the number of points scored by the players.
- Use this data set to determine the mean number of points scored by the players.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

3. The frequency table below shows the number of hours Mrs. Rose's students spent watching TV during one specific school week.

**Hours Spent Watching TV
During One School Week**

Number of Hours	Number of Students
0	2
1	2
2	6
3	7
4	8
5	4
6	3

- Use this data set to find the mean number of hours the students spent watching TV during that week.
- Use this data set to find the median number of hours the students spent watching TV during that week.
- Use this data set to find the mode of the number of hours the students spent watching TV during that week.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

4. Dan kept track of how many passengers were in each car as it passed on the road. The data for 25 cars is shown below.

Car Passengers

Number of Passengers	Frequency
1	13
2	6
3	3
4	1
5	1
6	0
7	1

- What is the mean number of passengers and how is it found?
- The next three cars had 6, 5, and 2 passengers. By how much would the addition of this data affect the mean number of passengers?
- By how much would the addition of the new data affect the mode?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

5. A police officer recorded the speeds, in miles per hour, traveled by cars on a residential street. He recorded the results on the stem-and-leaf plot shown below.

Speed of Cars (in miles per hour)						
2	5	6	7	9	9	
3	0	0	1	1	1	4
4	1					

- a. Explain why adding another number to the data set will not affect the median.
- b. What is the mode of the data set and how is it found?
- c. The speed, in miles per hour, of two more cars was recorded after the stem-and-leaf plot was created. Both cars traveled the same speed. When the police officer included the data in the stem-and-leaf plot, the mode of the speed of cars did not change. What is a possible speed, in miles per hour, that both cars traveled?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

6. The list below shows the number of wins by 8 basketball teams.

29, 25, 19, 12, 23, 16, 10, 18

- a. Explain how two numbers in the data set could be changed yet the median could remain the same.
- b. What is the mean number of wins and how is it found?
- c. Explain how it is possible for each of the 8 teams to play 3 more games and have no change in the value of the range.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

7. A physical education teacher recorded the number of exercises performed by each of the students in a class. The teacher made the frequency table shown below.

Exercises Performed by Students

Number of Exercises	Number of Students
3	4
4	5
5	3
6	8
7	5
8	3

- How many students performed more than 5 exercises but no more than 7 exercises?
- What was the median number of exercises performed?
- What was the mean number of exercises performed and how is this found?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

8. Keisha kept track of the number of goals she scored in each of her last 11 soccer games. She recorded the data in the frequency table shown below.

Soccer Goals Scored

Goals Scored	Number of Games
0	2
1	4
2	2
3	2
4	1

- What is the median number of goals Keisha scored in her last 11 games?
- After recording the number of goals she scored in each of the next 2 games, the median increased by one. What is one *possible* combination of goals she could have scored in the next 2 games?
- Keisha says the median could be 1.5 goals after 14 games, even though she can never score half a goal. Explain why Keisha is mathematically correct.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

Answer Key

Content Standard 12

Sample Multiple-Choice

1. C
2. A
3. C
4. B
5. D

Sample Gridded

1. 12
2. 89
3. 914
4. 84
5. 21
6. 41.67
7. 79
8. 340

Sample Open-Ended

(continued on next page)

Sample Open-Ended

1. Sample Response(s):

- a. To find the median, the values in the data set must first be ordered, then find the number that is exactly in the middle.

116, 120, 127, 129, 182, 184, 184, 184, 189, 189, 218, 219

Since there is an even number of data values, the median is the average of the two middle values. Since the two middle values are 184 there is no need to take the average. The median is 184 caloric content.

- b. The mode is the value that occurs most often. Since there are three 184s, the mode is 184 caloric content.

- c. The mean is the sum of the data values divided by the number of data values.

$$116 + 120 + 127 + 129 + 182 + 184 + 184 + 184 + 189 + 189 + 218 + 219 = 2,041$$

$$2041 \div 12 = 170.08\bar{3}$$

The mean is approximately 170.08.

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

2. Sample Response(s):

a. To find the median, the values in the data set must first be ordered, then find the number that is exactly in the middle.

41, 47, 47, 49, 51, 52, 52, 52, 58, 60, 63

Since there is odd number of data values, the number that is exactly in the middle is 52. The median is 52 points scored.

b. The mode is the value that occurs most often. Since there are three 52 points scored, the mode is 52 points scored.

c. The mean is the sum of the data values divided by the number of data values.

$$41 + 47 + 47 + 49 + 51 + 52 + 52 + 52 + 58 + 60 + 63 = 572,$$

$$572 \div 11 = 52.$$

The mean is 52 points scored.

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

3. Sample Response(s):

- a. The mean is the sum of the data values divided by the number of data values.

The mean number of hours is:

$$0 + 0 + 1 + 1 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 +$$

$$4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 5 + 5 + 5 + 5 + 6 + 6 + 6 = 105.$$

$$\frac{105}{32} = 3.28125 \text{ hours, which is approximately } 3.3 \text{ hours.}$$

OR

$$0 \times 2 = 0$$

$$1 \times 2 = 2$$

$$2 \times 6 = 12$$

$$3 \times 7 = 21$$

$$4 \times 8 = 32$$

$$5 \times 4 = 20$$

$$6 \times 3 = 18$$

Therefore, $0 + 2 + 12 + 21 + 32 + 20 + 18 = 105$, and $105 \div 32$ is approximately 3.3 hours.

- b. To find the median, the values in the data set must first be put in ascending order, then find the number that is exactly in the middle.

0, 0, 1, 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5, 5, 6, 6, 6

Since there is an even number of data values, the median is the average of the two middle values. Since the two middle values are both 3, there is no need to take the average. The median is 3 hours.

- c. The mode is the value that occurs most often. Since there were 8 students who watched 4 hours of TV during that week, the mode is 4 hours.

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

4. Sample Response(s):

- a. The mean is the arithmetic average of the data and is found by adding all of the data and dividing by the number of data points.

$$1 \times 13 + 2 \times 6 + 3 \times 3 + 4 \times 1 + 5 \times 1 + 6 \times 0 + 7 \times 1 = 50 \text{ then } 50 \div 25 = 2.$$

The mean number of passengers per car is 2.

OR

Equivalent

- b. We add the new numbers to the previous total $50 + 6 + 5 + 2 = 63$, then

$$63 \div 28 = 2.25. \text{ The addition of the new data increased the mean by } 2.25 - 2 = 0.25.$$

OR

Equivalent

- c. The new data would have no effect on the mode. The mode number of passengers is 1, with a frequency of 13. The new frequencies for 6, 5, and 2 passengers would be 1, 2, and 7 respectively, so the mode has not changed.

OR

The new data table would be as follows.

Car Passengers

Number of Passengers	Frequency
1	13
2	7
3	3
4	1
5	2
6	1
7	1

The mode is still 1 passenger, with 13 cars having 1 passenger.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

5. Sample Response(s):

- a. The median, as it stands now, is the average of 30 and 30 because there is an even number of data points. Adding one more data point will make an odd number of data points so the median will no longer be an average, but whether a number less than 30, more than 30, or 30 itself is added to the data, the median will still be 30.

OR

If a number less than 30 is added...

25, 26, 27, 28, 29, 29, 30, 30, 31, 31, 31, 31, 34, 41

If a number greater than 30 is added...

25, 26, 27, 29, 29, 30, 30, 31, 31, 31, 34, 35, 41

If 30 is added...

25, 26, 27, 29, 29, 30, 30, 30, 31, 31, 31, 34, 41

OR

Equivalent

- b. The mode is the number that occurs most often in a set of data. The number “31” occurs 3 times. No other number occurs that often. The mode is 31.

OR

Equivalent

- c. If the next two cars travel 25, 26, 27, 29, 30, 34, or 41 miles per hour, then there will either be a new mode (29 or 30) or the data will have two modes (25, 26, 27, 34, 41). So any number other than 25, 26, 27, 29, 30, 34, or 41. 28 would be an example, as would 31.

OR

I added 2 cars with a speed of 42 to the stem-and-leaf plot.

Speed of Cars (in miles per hour)						
2	5	6	7	9	9	
3	0	0	1	1	1	4
4	1	2	2			

The mode (31) remained unchanged, so 42 is a possible speed of the two new cars.

OR

Equivalent

ARMT+ Grade 7 MATHEMATICS

Score Point	Response Attributes
3	All is correct.
2	All logics are correct. OR All of Part b and all of Part c are correct. OR All of Part a is correct and correct answers for Parts b and c. OR One correct logic for Part b or c, Part a is correct, and correct answer for either Part b or c.
1	One or more answers to problems are correct without logic. OR One correct logic.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

6. Sample Response(s):

a. The median is 18.5, found by averaging the middle two numbers when the numbers are ordered (10, 12, 16, 18, 19, 23, 25, 29). The numbers on either side of 18 and 19 could be changed as long as they remain on the sides they are on now. 18 could go to 17, and 19 could go to 20, and the median would still be the average of the middle two numbers or 18.5.

OR

Equivalent

b. The mean is the average of the numbers: add them up and divide by how many numbers there are: $29 + 25 + 19 + 12 + 23 + 16 + 10 + 18 = 152$ and $152 \div 8 = 19$.

OR

Equivalent

c. Range is the difference between the largest and smallest value: $29 - 10 = 19$. If all the teams lose their next 3 games, then the number of wins remains the same, and $29 - 10 = 19$; if they all win their next 3 games, then the range would be $32 - 13$ which still equals 19. Similarly, if they all won 1 game, or all won 2 games, the differences would still remain the same: $30 - 11 = 19$, or $31 - 12 = 19$.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Logics in Part a and Part c are correct. OR Two logics and one answer are correct.
1	One answer is correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

7. Sample Response(s):

- a. 6 and 7 exercises are “more than 5 exercises” and “no more than 7 exercises,” so one would add the “Number of Students” for those exercises, to get 13 students.

OR

Equivalent

- b. The median is the point at which half of the data has a lower value and half has a higher value. There are 28 pieces of data. 12 pieces of data have a value of 5 or less and 8 pieces of data have a value of 7 or more, so the median must have a value of 6.

OR

When the data is written out in order, it can be shown that the median is 6.

3, 3, 3, 3, 4, 4, 4, 4, 4, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 8, 8, 8

OR

Equivalent

- c. The mean is found by adding all the data and dividing by the number of data points.
 $3 \times 4 + 4 \times 5 + 5 \times 3 + 6 \times 8 + 7 \times 5 + 8 \times 3 = 154$ then $154 \div 28 = 5.5$

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All logics are correct. OR Two correct logics and correct answers for one or more problems. OR One correct logic and correct answers for all problems.
1	One or more answers to problems are correct without logic. OR One correct logic.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

8. Sample Response(s):

- a.** The median is the middle number in an ordered set of data. Out of 11 games that would be the 6th game. Looking at the frequency table, the 6th game is the last game in the “1 Goals Scored” row.

OR

Equivalent (may see ordering of data: 0, 0, 1, 1, 1, 1, 2, 2, 3, 3, 4)

- b.** The median for 11 + 2 (or 13 games) would be the 7th game, which would need to be 2 goals (1 more than 1). This can be done using any pairing of numbers greater than or equal to 2 (e.g., 0, 0, 1, 1, 1, 1, 2, 2, 3, 3, **3**, 4, **4**, which has a “3 and 4 Goals Scored” added to the ordering). Counting over to the 7th game shows “2 Goals Scored.”

OR

Equivalent

- c.** When the data is an even number of entries, one averages the middle two numbers, so one could be averaging 1 and 2 goals, which would be 1.5 goals.

OR

With 14 entries, the median is the average of the 7th and 8th entries in an ordered set of data, which would be 1 and 2 goals.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Three logics are correct. OR Two correct logics and correct answers for Parts a and b. OR One correct logic and correct answers for Parts a and b.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

DATA ANALYSIS AND PROBABILITY**Content Standard 13**

Determine the probability of a compound event.

Item Type

Multiple-choice

Gridded

Open-ended

Additional Information

The drawing of one or more spinners may be used.

Coins may be used.

Compound events with replacement or without replacement will be required.

Word problems/real-life situations may be used.

Sample Multiple-Choice Items

1. A jar contains 3 red marbles and 2 black marbles. All the marbles are the same size and there are no other marbles in the jar. On the first selection, a marble is chosen at random and not replaced. Then a second marble is chosen at random.

What is the probability that the marbles chosen at random will first be a black marble and then a red marble?

$$\frac{6}{25}$$

A

$$\frac{3}{10}$$

B *

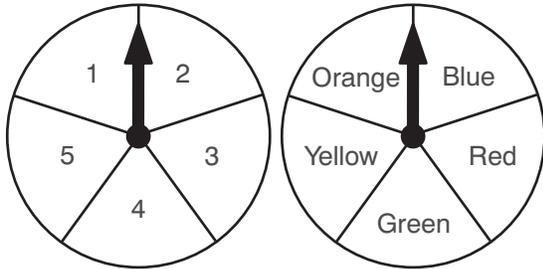
$$\frac{3}{5}$$

C

$$\frac{2}{3}$$

D

The spinners shown below are each divided into 5 equal sections. Each spinner is spun one time.



First Spinner

Second Spinner

2. What is the probability that the arrow on the first spinner will land on a space with an odd number, and the arrow on the second spinner will land on a space marked blue?

$\frac{3}{5}$

$\frac{2}{5}$

$\frac{3}{10}$

$\frac{3}{25}$

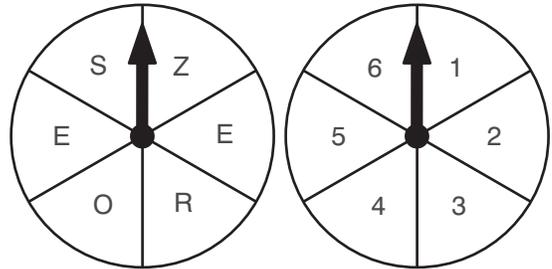
A

B

C

D *

The spinners shown below are divided into 6 equal sections. Each spinner is spun one time.



First Spinner

Second Spinner

3. What is the probability that the arrow on the first spinner will land on a space with either the letter R or the letter S, and the arrow on the second spinner will land on a space with an even number?

$\frac{5}{36}$

$\frac{1}{6}$

$\frac{1}{3}$

$\frac{5}{12}$

A

B *

C

D

4. What is the probability of flipping 4 fair coins 1 time and getting all tails?

- $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{16}$ $\frac{1}{32}$

A **B** **C *** **D**

6. Jesse rolls 2 number cubes. They each have six faces numbered 7 through 12.

What is the probability Jesse rolls a 7 or an 8 on both number cubes?

- $\frac{1}{36}$ $\frac{1}{9}$ $\frac{1}{6}$ $\frac{2}{3}$

A **B *** **C** **D**

5. What is the probability of flipping 6 fair coins 1 time and getting all heads?

- $\frac{1}{64}$ $\frac{1}{36}$ $\frac{1}{12}$ $\frac{1}{6}$

A * **B** **C** **D**

7. Shelly has a number cube with the faces numbered 1 through 6. She will roll the number cube twice.

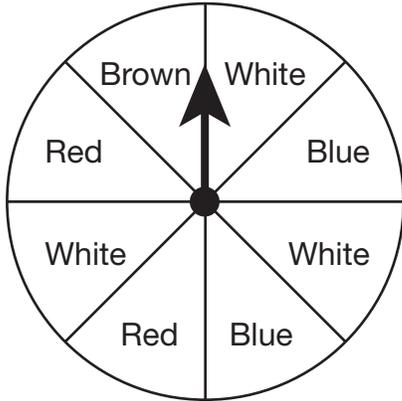
What is the probability Shelly's first roll is a 5 and her second roll is a 4?

- $\frac{1}{36}$ $\frac{1}{30}$ $\frac{1}{6}$ $\frac{1}{3}$

A * **B** **C** **D**

Sample Gridded Items

1. The spinner below is divided into 8 equal sections.



What is the probability of the arrow on the spinner stopping on a space marked blue on the first spin, then landing on a space marked red or brown on the second spin?

Express your answer as a fraction.

Mark your answer in the answer grid.

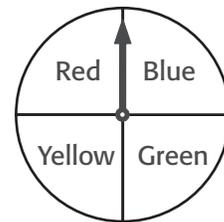
2. A bag contains only 2 green boxes, 2 red boxes, and 3 blue boxes. All of the boxes are the same size and texture. One box is taken from the bag at random and replaced. A second box is taken out at random.

What is the probability that the first box is green and the second is blue?

Express your answer as a fraction.

Mark your answer in the answer grid.

The spinner below is divided into four equal sections.



3. What is the probability of the arrow on the spinner landing on the space marked blue on the first spin, then landing on a space *not* marked blue on the second spin?

Express your answer as a fraction.

Mark your answer in the answer grid.

Sample Open-Ended Items

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

1. In a probability experiment with her class, Mrs. Jones placed 16 red marbles and 10 white marbles in a bag. There were no other marbles in the bag, and each of the marbles was the same size and shape.

Mrs. Jones asked Teresa to select 1 marble and hold it in her hand. Then she asked Teresa to select 1 more marble from the bag.

- a. What is the probability that Teresa selected a red marble first and a white marble second?

After Teresa put the 2 marbles she had drawn back in the bag, Mrs. Jones removed 6 red marbles and 6 white marbles from the bag. Then she asked Teresa to repeat the experiment. This time, before Teresa showed the colors of the two marbles she had chosen, Mrs. Jones asked her class this question.

“Has the probability that Teresa selected a red marble first and a white marble second changed?”

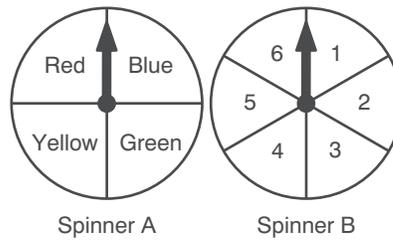
- Luke said that the probability was less than it was before.
- Martin said the probability was greater than it was before.
- Eddie said the probability was the same as before the marbles were removed.

- b. Who is right? Justify your answer.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

2. John is going to perform the same experiment 10 times. He spins the arrows on both spinners at the same time. Spinner A has equal sectors marked red, yellow, green, and blue, and spinner B has equal sectors labeled 1 through 6.



The results for the first 4 times that John tried the experiment are shown in the table below.

John's Experiment

Experiment Number	Result	
	Spinner A	Spinner B
1	Blue	6
2	Blue	6
3	Blue	6
4	Blue	6

Before John could perform the next experiment, three of his classmates drew the following conclusions about possible results for Experiment Number 5.

- Spencer said that the probability that John's result will be "blue" on Spinner A and "6" on Spinner B is between 0 and $\frac{1}{6}$.
- Glenn said that the probability that John's result will be "blue" on Spinner A and "6" on Spinner B is zero.
- Morgan said that the probability that John's result will be "blue" on Spinner A and "6" on Spinner B is one.

Which classmate is correct? Justify your answer.

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

3. The sandwich menu at the local sandwich shop is shown below. A customer may choose one type of bread and one type of cheese from the menu.

Sandwich Menu

Bread	Cheese
Wheat	American
White	Swiss
Whole Grain	Cheddar
Rye	

What is the probability of randomly selecting a rye bread with Swiss cheese sandwich?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

4. Five different colored pencils all the same size are placed into a box. The pencil colors are red, green, blue, yellow, and black. Three pencils will be randomly selected one at a time. The pencils are not replaced after each selection.

What is the probability that the first pencil selected is red, and the second pencil selected is yellow?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

5. In a chess club, there are 6 girls and 5 boys. Their names are listed in the chart below.

Girls	Boys
Anna	Alberto
Betty	Brad
Christine	Carl
Dawn	DeShawn
Emily	Ervin
Fran	

- One girl and one boy are chosen at random to represent the club. What is the probability that both Emily and Ervin are chosen?
- For a practice game, the coach randomly chooses two boys to play against one another and two girls to play against one another. What is the probability that Alberto, Brad, Anna, and Betty are chosen?
- Some more boys join the club. Now, when the coach chooses one boy and one girl at random, the probability that the coach chooses both Christine and Carl is $\frac{1}{48}$.
How many boys in total are in the club now?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

6. Judith has 8 letter cards with a letter from A through H written on each card. Each letter is on exactly one card. She also has 5 color cards with blue, green, orange, red, and yellow on each card. Each color is on exactly one card. Judith will select one letter card and one color card at random.
- What is the probability that Judith selects a D letter card and a green color card?
 - What is the probability that Judith selects a letter card that is *not* C or a red color card?
 - Judith replaces some of the other color cards with more orange color cards. She wants the probability of selecting a B letter card and an orange color card to be $\frac{1}{10}$.
How many orange color cards should there be after Judith makes the replacements?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

This problem requires you to show all your work or explain all your reasoning. You may use drawings, words, or numbers in your answer. Your answer should be written so that another person could read it and understand your reasoning.

7. Javier has a bag of jelly beans. The bag has 7 grape, 5 strawberry, and 4 banana jelly beans. He selects one jelly bean at random, records the flavor, replaces it, and then chooses a second jelly bean at random.
 - a. What is the probability that Javier chooses 2 grape jelly beans or 2 banana jelly beans?
 - b. What is the probability that Javier chooses a strawberry jelly bean first and then a banana jelly bean?
 - c. Javier selects a jelly bean at random, *does not* return it to the bag, and chooses a second jelly bean at random. What is the probability that he chooses 2 strawberry jelly beans?

Show all your work or explain your reasoning *for each part* in the space provided in the answer document.

Answer Key

Content Standard 13

Sample Multiple-Choice

1. B
2. D
3. B
4. C
5. A
6. B
7. A

Sample Gridded

1. $\frac{3}{32}$ OR $\frac{6}{64}$
2. $\frac{6}{49}$
3. $\frac{3}{16}$

Sample Open-Ended

1. Sample Response(s):

a. There is a total of 26 marbles. The first marble Teresa wants to select is red so that is $\frac{16}{26}$. The second marble she wants to select is white and this will be $\frac{10}{25}$. The reason it is 25 in the denominator is that when Teresa selected the first marble she didn't return it to the bag. Multiply these two fractions together:

$$\frac{16}{26} \times \frac{10}{25} = \frac{160}{650} = \frac{32}{130} = \frac{16}{65} = 0.246 \text{ or } 0.25.$$

OR

Equivalent

b. Luke is correct. Since 6 marbles of each color are taken out of the bag, that leaves 10 red and 4 white marbles for a total of 14 marbles. The first marble we want Teresa to select is red so the answer is $\frac{10}{14}$, and the second marble we want her to select is white and the answer is $\frac{4}{13}$. Again it is 13 because she did not replace the first marble selected. Multiply these two fractions together:

$$\frac{10}{14} \times \frac{4}{13} = \frac{40}{182} = \frac{20}{91} = 0.219 \text{ or } 0.22$$

Therefore Luke is correct because 0.22 is less than 0.25.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

2. Sample Response(s):

There is a 1 in 24 chance of getting Spinner A to be blue and Spinner B to be 6.

$$\frac{1}{4} \times \frac{1}{6} = \frac{1}{24} \text{ or } 0.042$$

Therefore, Spencer is correct because $\frac{1}{6}$ is 0.167 and 0.042 lies between 0 and 0.167.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

3. Sample Response(s):

The probability of selecting rye bread with Swiss cheese is $\frac{1}{12}$. Since there are 4 breads to choose from and 3 cheeses to choose from, then the answer is

$$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$$

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

4. Sample Response(s):

There are five different colored pencils in a box. The probability of first selecting a red pencil is $\frac{1}{5}$, and the probability of selecting a yellow pencil second is $\frac{1}{4}$. The reason it is 4 in the denominator is because the first pencil selected was not replaced. Therefore, the answer is $\frac{1}{5} \times \frac{1}{4} = \frac{1}{20}$.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	Both logics are correct. OR One logic and both answers are correct.
1	One or both answers are correct. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

5. Sample Response(s):

a. Probability of Emily being chosen is $\frac{1}{6}$, and probability of Ervin being chosen is $\frac{1}{5}$.

Combined probability of the two is $\frac{1}{6} \times \frac{1}{5} = \frac{1}{30}$.

OR

Equivalent

b. Probability of Alberto and Brad is $\frac{2}{5} \times \frac{1}{4} = \frac{2}{20} = \frac{1}{10}$.

Probability of Anna and Betty is $\frac{2}{6} \times \frac{1}{5} = \frac{2}{30} = \frac{1}{15}$.

The combined probability of those two events is $\frac{1}{10} \times \frac{1}{15} = \frac{1}{150}$.

OR

Equivalent

c. The probability of Christine being chosen is $\frac{1}{6}$. To find the probability of Carl being chosen can be found by solving for b , the total number of boys, in the equation

$\frac{1}{6} \times \frac{1}{b} = \frac{1}{48}$. So $\frac{1}{b} = 6\left(\frac{1}{48}\right) = \frac{6}{48} = \frac{1}{8}$, therefore $b = 8$. There are now 8 boys in the club.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

6. Sample Response(s):

- a. The probability of selecting a D letter card is $\frac{1}{8}$, and the probability of selecting a green color card is $\frac{1}{5}$. The probability of selecting both is $\frac{1}{8} \times \frac{1}{5} = \frac{1}{40}$.

OR

Equivalent

- b. The probability of selecting a letter card that is *not* C is $\frac{7}{8}$.

The probability of selecting a red color card is $\frac{1}{5}$.

The probability of selecting a letter card that is not C and selecting a red color card is

$$\frac{7}{8} \times \frac{1}{5} = \frac{7}{40}$$

The probability of selecting a letter card that is not C or a red color card is

$$\frac{7}{8} + \frac{1}{5} - \frac{7}{40} = \frac{35}{40} + \frac{8}{40} - \frac{7}{40} = \frac{36}{40} \text{ or } \frac{9}{10} \text{ or } 0.9 \text{ or } 90\%$$

OR

Equivalent

- c. Let x be the number of orange color cards, then $\frac{1}{8} \times \frac{x}{5} = \frac{1}{10}$. Then $\frac{x}{40} = \frac{1}{10}$ so $x = 4$. There should be 4 orange cards.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All logics are correct. OR Two correct logics and correct answers for one or more problems. OR One correct logic and correct answers for all problems.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

7. Sample Response(s):

a. The probability of choosing a grape jelly bean both times is $\frac{7}{16} \times \frac{7}{16} = \frac{49}{256}$.

The probability of choosing a banana jelly bean both times is $\frac{4}{16} \times \frac{4}{16} = \frac{16}{256}$.

The sum of these two probabilities gives the total probability of 2 grape jelly beans or 2 banana jelly beans. $\frac{49}{256} + \frac{16}{256} = \frac{65}{256}$

OR

Equivalent

b. The probability of choosing a strawberry jelly bean and then choosing a banana jelly bean is $\frac{5}{16} \times \frac{4}{16} = \frac{20}{256}$ or $\frac{5}{64}$.

OR

Equivalent

c. Since the jelly bean is not replaced, the probability of selecting the first strawberry jelly bean is $\frac{5}{16}$ but the probability of selecting the second strawberry jelly bean is $\frac{4}{15}$. The probability of selecting 2 strawberry jelly beans without putting the first one back in the bag is $\frac{5}{16} \times \frac{4}{15} = \frac{20}{240}$ or $\frac{1}{12}$.

OR

Equivalent

Score Point	Response Attributes
3	All is correct.
2	All three logics are correct. OR Two correct logics and correct answers for one or more problems. OR One logic and all three answers to problems are correct.
1	One or more answers to problems are correct without logic. OR One logic is correct.
0	None correct. (Also, blanks, rewrites problem, foreign language, illegible, refusals, off-task, etc., scored as invalid.)

SAMPLE RESPONSE FORMAT

SAMPLE RESPONSE: MULTIPLE-CHOICE

Page _____

1	(A)	(B)	(C)	(D)
2	(A)	(B)	(C)	(D)
3	(A)	(B)	(C)	(D)
4	(A)	(B)	(C)	(D)
5	(A)	(B)	(C)	(D)

Page _____

6	(A)	(B)	(C)	(D)
7	(A)	(B)	(C)	(D)
8	(A)	(B)	(C)	(D)

Page _____

9	(A)	(B)	(C)	(D)
10	(A)	(B)	(C)	(D)

SAMPLE RESPONSE: GRIDDED

1

-	%
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9	9	9	9	9	9	9	9	9	9

2

-	%
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3

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4

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5

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8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9

SAMPLE RESPONSE: OPEN-ENDED

Be sure to leave room in your answer space for all parts of this test question.

Answer question ___ in this box.

DO NOT WRITE OUTSIDE THE BOX.

DO NOT WRITE OUTSIDE THE BOX.

DO NOT WRITE OUTSIDE THE BOX.