The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

2021*
Grade 8

* This is a revised version of the 2017 Item and Scoring Sampler.

Mathematics Test Directions

On the following pages are the mathematics questions.

- You may <u>not</u> use a calculator for question 1. You may use a calculator for all other questions on this test.

Directions for Multiple-Choice Questions

Some questions will ask you to select an answer from among four choices.

For the multiple-choice questions:

- First solve the problem on scratch paper.

- Choose the correct answer and record your choice in the answer booklet.

- If none of the choices matches your answer, go back and check your work for possible errors.

- Only one of the answers provided is the correct response.

Directions for Open-Ended Questions

Some questions will require you to write your response.

For the open-ended questions:

- These questions have more than one part. Be sure to read the directions carefully.

- You cannot receive the highest score for an open-ended question without completing all tasks in the question. For example, if the question asks you to show your work or explain your reasoning, be sure to show your work or explain your reasoning in the space provided.

- If the question does **not** ask you to show your work or explain your reasoning, you may use the space provided, but only those parts of your response that the question specifically asks for will be scored.

- Write your response in the appropriate location within the response box in the answer booklet. Some answers may require graphing, plotting, labeling, drawing, or shading. If you use scratch paper, be sure to transfer your final response and any needed work or reasoning to the answer booklet.

General Description of Scoring Guidelines for Mathematics Open-Ended Questions

4—The response demonstrates a *thorough* understanding of the mathematical concepts and procedures required by the task.

The response provides correct answer(s) with clear and complete mathematical procedures shown and a correct explanation, as required by the task. Response may contain a minor "blemish" or omission in work or explanation that does not detract from demonstrating a *thorough* understanding.

3—The response demonstrates a *general* understanding of the mathematical concepts and procedures required by the task.

The response and explanation (as required by the task) are mostly complete and correct. The response may have minor errors or omissions that do not detract from demonstrating a *general* understanding.

2—The response demonstrates a *partial* understanding of the mathematical concepts and procedures required by the task.

The response is somewhat correct with *partial* understanding of the required mathematical concepts and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1—The response demonstrates a *minimal* understanding of the mathematical concepts and procedures required by the task.

0—The response has no correct answer and *insufficient* evidence to demonstrate any understanding of the mathematical concepts and procedures required by the task for that grade level.
Response may show only information copied from the question.

Special Categories within zero reported separately:

BLK (blank).............Is blank, is entirely erased, or gives a written refusal to respond

OT..........................Is off-task

LOE........................Is in a language other than English

IL............................Is illegible

Grade 8 Formula Sheet

Exponential Properties

$$a^m \cdot a^n = a^{m+n}$$

$$(a^m)^n = a^{m \cdot n}$$

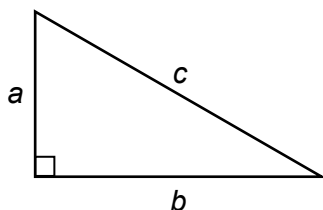$$\frac{a^m}{a^n} = a^{m-n}$$

$$a^{-1} = \frac{1}{a}$$

Algebraic Equations

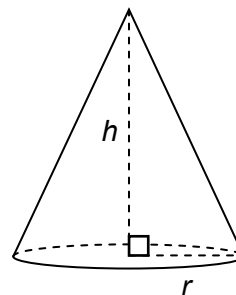**Slope:** $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

Slope-Intercept Form: $y = mx + b$
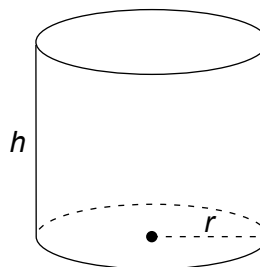
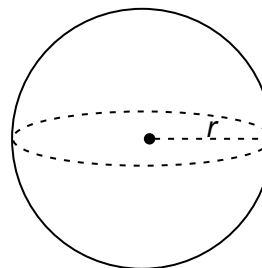### Pythagorean Theorem

$$a^2 + b^2 = c^2$$

Cone

$$V = \frac{1}{3}\pi r^2 h$$

Cylinder

$$V = \pi r^2 h$$

Sphere

$$V = \frac{4}{3}\pi r^3$$

> **Question 1 in this sampler is to be solved <u>without</u> the use of a calculator.**

MULTIPLE-CHOICE ITEMS

1. The volume of Jupiter is approximately 10^{14} cubic kilometers. The volume of Earth is approximately 10^{11} cubic kilometers. How many planets the size of Earth does it take to equal the volume of Jupiter?

    A. 10^{-3}

    B. 10^3

    C. 10^{25}

    D. 10^{154}

Item Information	
Alignment	B-E.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	5%
p-value B	71% (correct answer)
p-value C	20%
p-value D	4%
Option Annotations	A. subtracts the exponents as 11 – 14 (reverses the order of the subtraction) B. Correct: divides the volumes by subtracting the exponents C. adds the exponents D. multiplies the exponents

A calculator is permitted for use in solving questions 2–17 in this sampler.

2. The Blue Ridge Mountains are rising at a rate of 1×10^{-4} feet per year. To determine how many feet the mountains will rise over the next 1×10^6 years, a scientist performs the operation shown below.

$$(1 \times 10^{-4}) \times (1 \times 10^6)$$

How many feet will the Blue Ridge Mountains rise over the next 1×10^6 years?

A. 0.001

B. 0.01

C. 10

D. 100

Item Information	
Alignment	B-E.1.1.4
Answer Key	D
Depth of Knowledge	1
p-value A	8%
p-value B	9%
p-value C	11%
p-value D	72% (correct answer)
Option Annotations	A. incorrectly simplifies expression as 1×10^{-2} and incorrectly applies the $^-2$ in the exponent by placing two 0s between the decimal point and the 1 B. incorrectly simplifies expression as 1×10^{-2} C. incorrectly applies the 2 in the exponent by making the value of the expression a 2-digit number D. Correct: multiplies the coefficients (1×1), multiplies the 10s by adding the exponents ($^-4 + 6$), and then converts 1×10^2 to standard notation using $10^2 = 100$

3. Trevor is riding his bicycle for a workout. The graph below shows the relationship between the amount of time, in minutes, he rides and the distance, in kilometers, he rides during his 25-minute workout.

Bicycle Workout
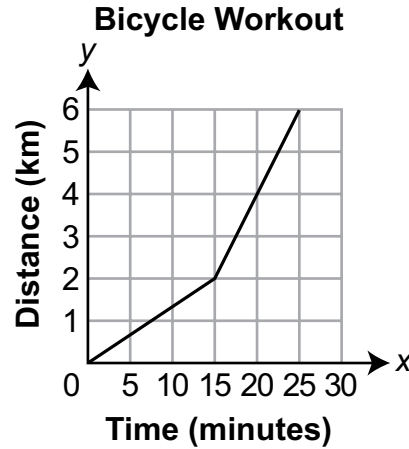
Based on the graph, which statement about the rate at which Trevor rides during his workout is true?

A. Trevor's rate changes from 7.5 kilometers per minute to 2.5 kilometers per minute.

B. Trevor maintains a steady rate of 2 kilometers per 5 minutes during the workout.

C. Trevor maintains a steady rate of 2.4 kilometers per 10 minutes during the workout.

D. Trevor's rate changes from 1 kilometer every 7.5 minutes to 1 kilometer every 2.5 minutes.

Item Information

Alignment	B-E.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	12%
p-value B	14%
p-value C	10%
p-value D	64% (correct answer)
Option Annotations	A. inverts the slopes of the two line segments
	B. identifies the rate of change only from 15 minutes to 25 minutes
	C. uses the "average" rate of change from (0, 0) to (25, 6)
	D. Correct: uses the slope formula $\left(m = \dfrac{y_2 - y_1}{x_2 - x_1}\right)$ to determine the first rate as $m = \dfrac{2 - 0}{15 - 0} = \dfrac{2}{15} = 2$ kilometers every 15 minutes and the second rate as $m = \dfrac{6 - 2}{25 - 15} = \dfrac{4}{10} = 4$ kilometers every 10 minutes, and then converts each rate to a unit rate by dividing the values in each rate by the number of kilometers ($2 \div 2 = 1$ and $15 \div 2 = 7.5$; $4 \div 4 = 1$ and $10 \div 4 = 2.5$)

4. Davis is comparing the gas mileage for his old car with the gas mileage for his new car. His old car used 19 gallons of gas to travel 323 miles. The graph shown below represents the gas mileage for his new car.

New Car Gas Mileage
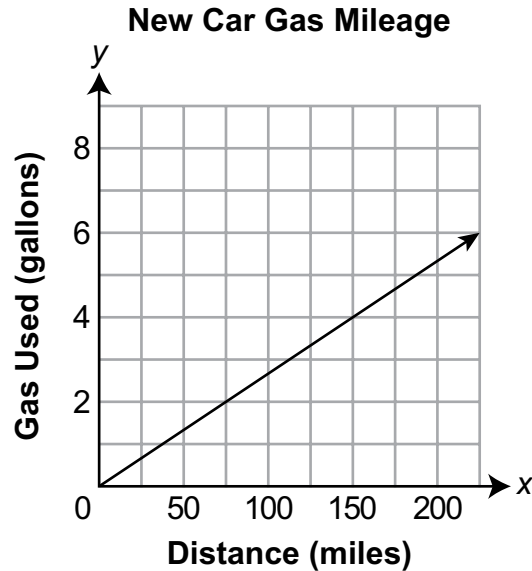
What is the difference in the gas mileages for the two cars?

A. 8 miles per gallon

B. 11.2 miles per gallon

C. 17 miles per gallon

D. 20.5 miles per gallon

Item Information	
Alignment	B-E.2.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	14%
p-value B	17%
p-value C	20%
p-value D	49% (correct answer)
Option Annotations	A. for the new car, divides the *x*-scale by the *y*-scale (50 ÷ 2 = 25) and then subtracts 17 from 25 B. determines the difference in distance by subtracting the greatest value on the *x*-axis from 323, determines the difference in gas used by subtracting the greatest value on the *y*-axis from 19, and then divides the difference of the distances by the difference of the gas used (123 ÷ 11) C. calculates the gas mileage only for the old car D. Correct: determines the gas mileage for the old car by dividing 323 miles by 19 gallons to get 17 miles per gallon, determines the gas mileage for the new car by selecting a point on the line and dividing the *x*-value by the *y*-value (e.g., 150 ÷ 4) to get 37.5 miles per gallon, and then finds the difference between these two gas mileages

5. Line *j* and line *k* are graphed on the same coordinate grid.

   • Line *j* has a slope of $\frac{-2}{3}$ and intersects the *y*-axis at ⁻4.

   • Line *k* has a different negative slope than line *j* and intersects the *y*-axis above line *j*.

   Which equation could describe line *k*?

   A. $y = \frac{-1}{6}x$

   B. $y = \frac{-2}{3}x - 3$

   C. $y = \frac{-1}{2}x - 5$

   D. $y = x + 1$

Item Information	
Alignment	B-E.2.1.3
Answer Key	A
Depth of Knowledge	1
p-value A	35% (correct answer)
p-value B	33%
p-value C	24%
p-value D	8%
Option Annotations	A. Correct: recognizes that $\frac{-1}{6}$ is a negative slope not equal to $\frac{-2}{3}$ and that the *y*-intercept (0) means the line intersects the *y*-axis above line *j*
	B. does not consider that the slope $\left(\frac{-2}{3}\right)$ is the same as the slope for line *j*
	C. does not consider that the *y*-intercept (–5) means the line intersects the *y*-axis below line *j*
	D. does not consider that the slope is supposed to be negative

6. Luisa is solving an equation on the bottom of a page. The corner of the page where the equation is written is torn off as shown below.

$$7(x + 3) = 7(x + 5) -$$

Luisa knows only one number was torn off, and she knows that the equation has an infinite number of solutions. What **must** be the missing number?

A.   2

B.   14

C.   21

D.   35

Item Information	
Alignment	B-E.3.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	27%
p-value B	58% (correct answer)
p-value C	9%
p-value D	6%
Option Annotations	A. does not apply the distributive property when solving the equation B. Correct: interprets "infinite number of solutions" as meaning that the two sides of the equation must be equal, sets up the left side of the equation as $7x + 21$ and the right side of the equation as $7x + 35 - \Box$, and then solves for the missing number by subtracting $7x$ and 21 from both sides to get $0 = 14 - \Box$ C. correctly sets up the left side of the equation as $7x + 21$ but then misidentifies the missing number as 21 to "cancel out" the 21 D. correctly sets up the right side of the equation as $7x + 35$ but then misidentifies the missing number as 35 to "cancel out" the 35 without considering the $7 \bullet 3$ value on the left side of the equation

7. A system of two linear equations is graphed on the coordinate grid shown below.
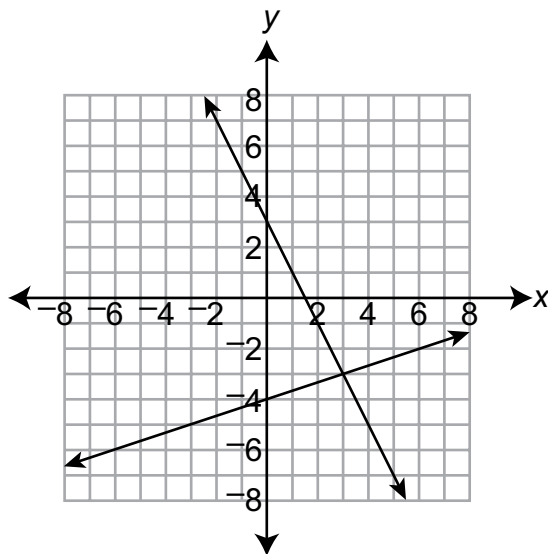
What ordered pair is the solution of the system of equations?

A. $(0, {}^-4)$

B. $(0, 3)$

C. $(3, {}^-3)$

D. $(3, {}^-1)$

Item Information	
Alignment	B-E.3.1.3
Answer Key	C
Depth of Knowledge	1
p-value A	8%
p-value B	6%
p-value C	81% (correct answer)
p-value D	5%
Option Annotations	A. identifies the *y*-intercept of the "lower" line B. identifies the *y*-intercept of the "upper" line C. Correct: identifies the point of intersection as the solution of the system of equations D. identifies the correct *x*-coordinate but adds the two *y*-intercepts to determine the *y*-coordinate

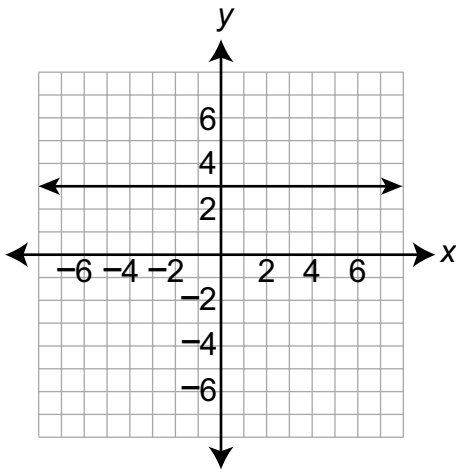8. Which relation is a linear function with the **greatest** slope?

A.

x	y
⁻3	1
0	3
3	5

B.

x	y
4	0
4	10
4	20
4	30

C.

D. $y = 5x + 1$

Item Information

Alignment	B-F.1.1.2
	B-F.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	14%
p-value B	27%
p-value C	9%
p-value D	50% (correct answer)
Option Annotations	A. recognizes the table represents a function but incorrectly determines slope by subtracting the least value in the table from the greatest value
	B. incorrectly identifies the table as representing a function and uses the change of 10 in *y*-values as the slope
	C. recognizes the line represents a function but incorrectly determines slope by subtracting the least value on the *x*-axis from the greatest value
	D. Correct: uses the slope formula $\left(m = \dfrac{y_2 - y_1}{x_2 - x_1}\right)$ to determine that the slope of answer choice A is $\dfrac{5 - 3}{3 - 0} = \dfrac{2}{3}$, recognizes that answer choice B is not a function since multiple *y*-values are paired with the same *x*-value, recognizes the slope of answer choice C is 0 since the line is horizontal ("flat"), identifies the slope of answer choice D is 5 since the equation is written in slope-intercept form ($y = mx + b$), and then selects the greatest value of $\dfrac{2}{3}$, 0, and 5

9. A parking lot charges a monthly fee plus a charge per day for a car parked in the lot. The graph below shows the relationship between the total cost (*y*), in dollars, and the number of days (*x*) the car is parked in the lot.

Cost to Park in Parking Lot
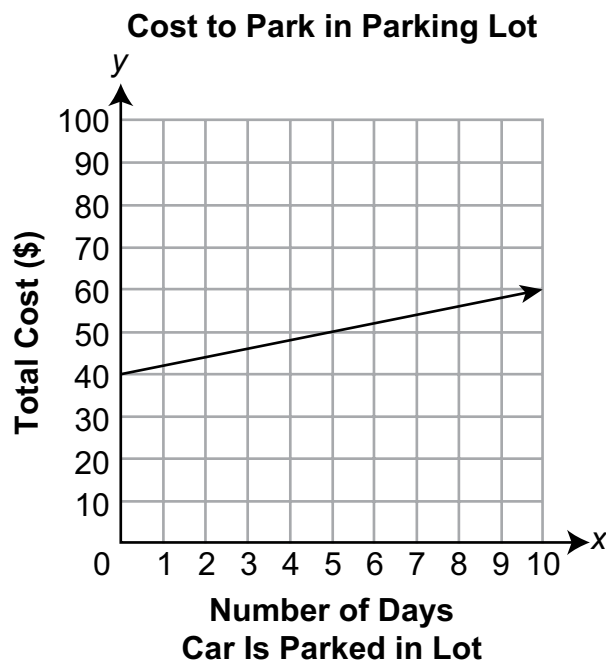
Which equation could represent the relationship between the total cost (*y*), in dollars, and the number of days (*x*) the car is parked in the lot?

A. $y = mx$

B. $y = mx + b$

C. $y = x^2$

D. $y = x^2 + b$

Item Information	
Alignment	B-F.1.1.3
Answer Key	B
Depth of Knowledge	1
p-value A	12%
p-value B	73% (correct answer)
p-value C	8%
p-value D	7%
Option Annotations	A. does not consider that the y-intercept is not 0 (i.e., the line does not pass through the origin) B. Correct: recognizes that the relationship is linear ($y = mx$) and has a y-intercept other than 0 ($+ b$) C. selects a nonlinear equation ($y = x^2$) and does not consider that the y-intercept is not 0 (i.e., the line does not pass through the origin) D. selects a nonlinear equation ($y = x^2$) that has a y-intercept other than 0 ($+ b$)

10. Which situation can be modeled by the equation $y = mx + b$?

    A.   The number of butterflies (y) in a population doubles every month (x).

    B.   The time (y) it takes a car to travel 100 miles depends on the speed (x) of the car.

    C.   The volume (y) of a cylindrical tank with a height of 2 feet depends on the radius (x) of the tank.

   D.   The total income (y) of a worker who earns 8 dollars per hour depends on the number of hours (x) worked.

Item Information	
Alignment	B-F.1.1.3
Answer Key	D
Depth of Knowledge	2
p-value A	15%
p-value B	18%
p-value C	14%
p-value D	53% (correct answer)
Option Annotations	A. misidentifies "doubles every month" as $y = 2x$ instead of as $y = 2^x$ B. uses $d = rt$ to write the equation $100 = xy$ but does not consider that the equation needs to be solved for y to get $y = \dfrac{100}{x}$ C. uses $V = \pi r^2 h$ to write the equation $y = \pi(2)^2 x = 12.56x$ (uses x for the height) instead of writing $y = \pi x^2(2) = 6.28x^2$ (uses x for the radius) D. Correct: uses "8 dollars per hour" to write the equation $y = 8x + 0$

11. Ben currently has $70 in his trip fund. He makes $45 per week doing yard work for his neighbors. He keeps $18 of the $45 for weekly expenses. The remaining amount goes into his trip fund. Which function can be used to determine the amount of money (y), in dollars, that Ben has in his trip fund at the end of x weeks?

    A. $y = 70 + 27x$

    B. $y = 52 + 45x$

    C. $y = 45 + 52x$

    D. $y = 27 + 70x$

Item Information	
Alignment	B-F.2.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	73% (correct answer)
p-value B	9%
p-value C	7%
p-value D	11%
Option Annotations	A. Correct: uses 70 as the initial value and 45 − 18 = 27 as the rate of change B. uses 70 − 18 = 52 as the initial value and 45 as the rate of change C. uses 45 as the initial value and 70 − 18 = 52 as the rate of change D. switches the initial value and the rate of change

12. Zach is studying the school furnace's oil usage. He records the amount of oil remaining in the tank at 8 A.M. every day for a week. No additional oil is added to the tank during the week. The graph below shows his data.

**Furnace's Oil Level at 8 A.M.**
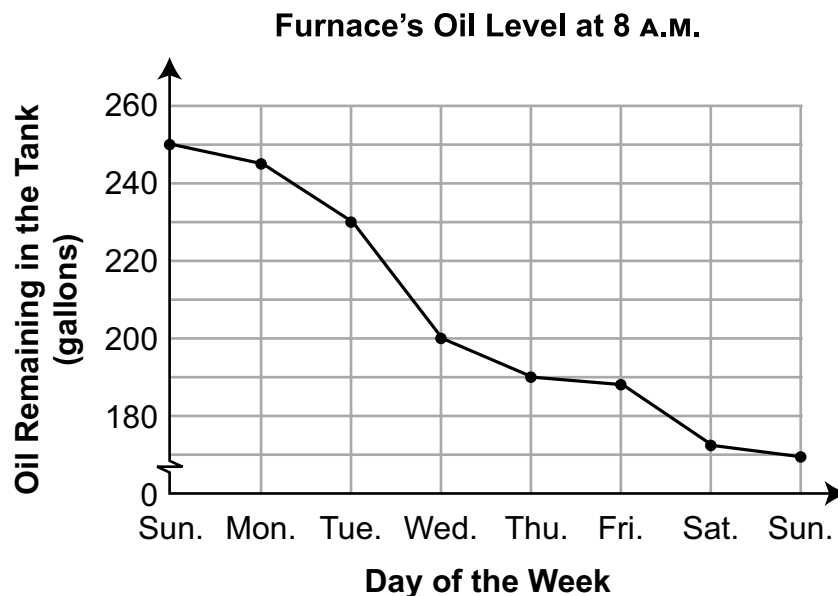
As the outdoor temperature gets colder, more oil is used to keep the indoor temperature constant. Based on the graph, which 24-hour time interval indicates the coldest period for the week?

A. Sunday to Monday

B. Tuesday to Wednesday

C. Friday to Saturday

D. Saturday to Sunday

Item Information	
Alignment	B-F.2.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	17%
p-value B	47% (correct answer)
p-value C	5%
p-value D	31%
Option Annotations	A. selects the first decrease
	B. Correct: interprets the greatest 1-day decrease ("drop") in the amount of oil remaining in the tank (230 to 200 gallons) as representing the coldest 24-hour time interval for the week
	C. selects the second-largest decrease
	D. uses the interval with the lowest levels in the tank for the week

13. A triangular sign was moved. The new location of the sign is represented by the shaded triangle.
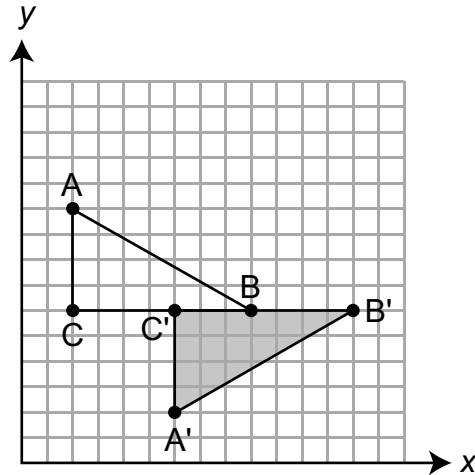
Which transformations could have been used to move the sign to the new location?

A.   reflection across $\overline{BC}$ and reflection across $\overline{AC}$

B.   reflection across $\overline{BC}$ and translation 4 units right

C.   translation 4 units right and translation 4 units down

D.   rotation 180 degrees clockwise about C and translation 4 units right

Item Information	
Alignment	C-G.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	10%
p-value B	58% (correct answer)
p-value C	11%
p-value D	21%
Option Annotations	A. identifies a potentially correct first transformation but the second transformation would move point B to quadrant II and points A and C would be 4 units from points A' and C', respectively
	B. Correct: identifies a set of transformations that moves point A to point A' by reflecting point A from 4 units above point C to 4 units below point C and then translating it right 4 units, moves point B to point B' by reflecting point B onto itself (since it is on line segment BC) and then translating it right 4 units, and moves point C to point C' by reflecting point C onto itself (since it is on line segment BC) and then translating it right 4 units
	C. identifies a potentially correct first transformation but the second transformation would move point A to point C', point C to point A', and point B 4 units below point B'
	D. identifies a set of transformations that would move point A to point A' and point C to point C', but point B would move to quadrant II

14. The diagonal of Andre's rectangular TV screen is 39 inches. The width of his TV screen is 34 inches. Which measurement is **closest** to the height of Andre's TV screen?

    A.   8.5 inches

    B.   19.1 inches

    C.   36.5 inches

    D.   51.7 inches

Item Information	
Alignment	C-G.2.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	12%
p-value B	49% (correct answer)
p-value C	28%
p-value D	11%
Option Annotations	A. determines the square root of the sum $39 + 34$ B. Correct: uses the Pythagorean theorem ($a^2 + b^2 = c^2$) to set up $34^2 + b^2 = 39^2$, simplifies this to $b^2 = 1{,}521 - 1{,}156 = 365$, and then solves for b by determining the square root of 365 ($19.104973\ldots$) C. divides the sum $39 + 34$ by 2 D. determines the square root of the sum $39^2 + 34^2$ instead of the difference $39^2 - 34^2$

15. In the grid shown below, rectangle ABCD represents the location of a pool at a city park.
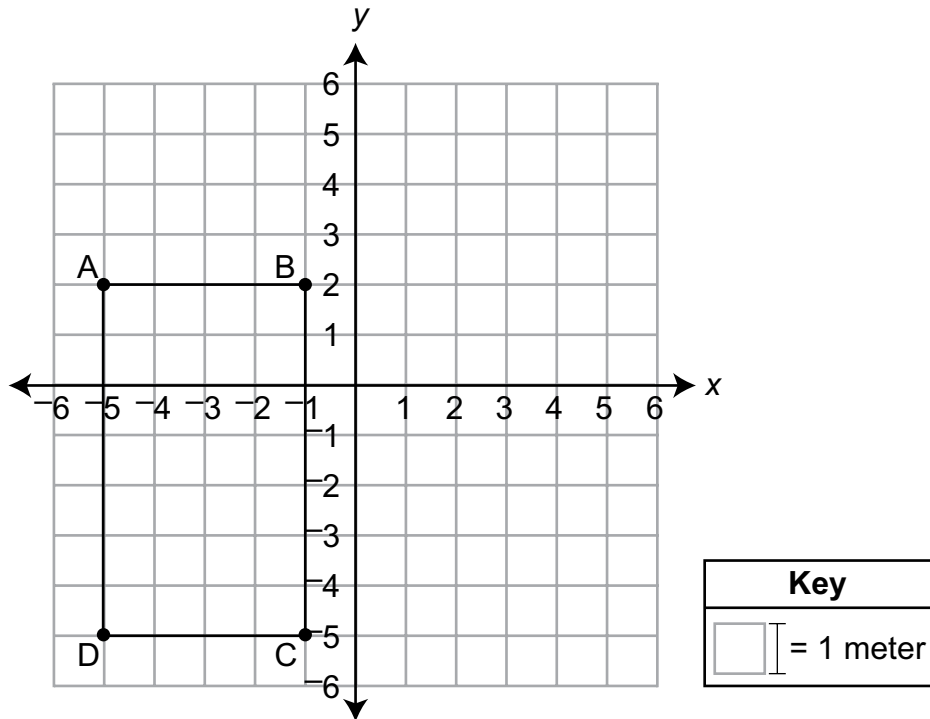
Anna swims in a straight line from corner A to corner C of the swimming pool. What is the distance, in meters, Anna swims?

A. $\sqrt{22}$

B. 7

C. $\sqrt{65}$

D. 11

Item Information	
Alignment	C-G.2.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	10%
p-value B	35%
p-value C	39% (correct answer)
p-value D	16%
Option Annotations	A. selects the square root of the sum 2(7) + 2(4) instead of the square root of the sum $7^2 + 4^2$ B. determines the length of the pool and does not consider the width C. Correct: determines the differences between the *x*-values and between the *y*-values for point A and point C ($^-1 - {}^-5 = 4$ and $2 - {}^-5 = 7$), uses the Pythagorean theorem ($a^2 + b^2 = c^2$) to get $4^2 + 7^2 = (AC)^2$, and then simplifies this to $(AC)^2 = 16 + 49 = 65$ before taking the square root OR uses the Pythagorean theorem ($a^2 + b^2 = c^2$) to set up $(AB)^2 + (BC)^2 = (AC)^2$, substitutes the lengths of sides AB and BC to get $4^2 + 7^2 = (AC)^2$, and then simplifies this to $(AC)^2 = 16 + 49 = 65$ before taking the square root D. adds the length and the width OR divides the sum 2(7) + 2(4) by 2

16. A cone-shaped dispenser is filled with cake frosting. The cone has a radius of 1.5 inches and a height of 5 inches. Which measurement is **closest** to the volume of cake frosting that the cone-shaped dispenser holds?

    A.   3.75 cubic inches

    B.   11.78 cubic inches

    C.   47.12 cubic inches

    D.   141.37 cubic inches

Item Information	
Alignment	C-G.3.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	15%
p-value B	73% (correct answer)
p-value C	9%
p-value D	3%
Option Annotations	A. omits π (i.e., uses $V = \frac{1}{3}r^2h$ instead of $V = \frac{1}{3}\pi r^2h$)
	B. Correct: uses the volume formula for a cone ($V = \frac{1}{3}\pi r^2h$) to set up $V = \frac{1}{3}\pi(1.5)^2(5)$, simplifies this to $V = 3.75\pi$, and then uses either calculator π or 3.14 to determine an approximation of the volume (either 11.780972 . . . or 11.775)
	C. uses the diameter (3) instead of the radius (1.5) in the volume formula
	D. uses the volume formula for a cylinder ($V = \pi r^2h$) instead of the volume formula for a cone ($V = \frac{1}{3}\pi r^2h$) and uses the diameter (3) instead of the radius (1.5) in the volume formula

OPEN-ENDED QUESTION

17. The locations of four points on a number line are described by the numbers listed below.
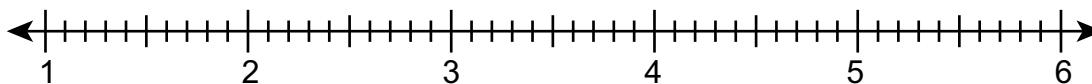
point J: $\sqrt{12}$ point K: $\dfrac{15}{7}$ point L: $\sqrt{16}$ point M: $\dfrac{3\pi}{2}$

A. For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.

Go to the next page to finish question 17.

GO ON

17. *Continued.* Please refer to the previous page for task explanation.

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\dfrac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP

Item-Specific Scoring Guideline

#17 Item Information

Alignment	A-N.1	Depth of Knowledge	3	Mean Score	0.98

Assessment Anchor this item will be reported under:

M08.A-N.1—Demonstrate an understanding of rational and irrational numbers.

Specific Anchor Descriptor addressed by this item:

M08.A-N.1.1—Apply concepts of rational and irrational numbers.

Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of rational and irrational numbers by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of rational and irrational numbers by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of rational and irrational numbers by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of rational and irrational numbers.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

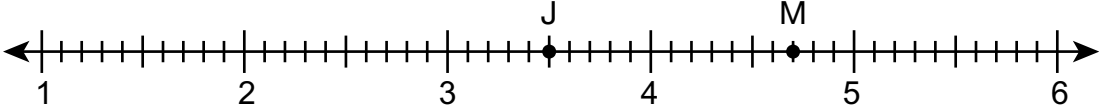### Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of rational and irrational numbers.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (2 points):

$\frac{1}{2}$ point for <u>each</u> correct decimal (ignore decimals for K and L)

$\frac{1}{2}$ point for <u>each</u> correctly plotted and labeled point (lose $\frac{1}{2}$ point for plotted K and/or L)

What?	Why?
point J: 3.5 point M: 4.7 ![Number line from 1 to 6 with point J plotted at 3.5 and point M plotted at 4.7]	

Part B (2 points):

$\frac{1}{2}$ point for <u>each</u> correct answer

1 point for correct and complete explanation

OR $\frac{1}{2}$ point for correct but incomplete explanation

What?	Why?
25 **AND** 36	**Sample Explanation:** The value of $\frac{84}{18}$ is approximately 4.7. The value of $\sqrt{41}$ is between 6.4 and 6.5. So $\sqrt{x}$ is between 4.7 and 6.5. That means x must be between 4.7^2, or 22.09, and 42.25. There are only two perfect squares between 22.09 and 42.25, and they are 25 and 36.

Question 17
Page 1 of 2

Line Guide

Item ID ?

The locations of four points on a number line are described by the numbers listed below.

point J: $\sqrt{12}$ point K: $\dfrac{15}{7}$ point L: $\sqrt{16}$ point M: $\dfrac{3\pi}{2}$

A. For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.

EQ

Point J = $\sqrt{12}$ = 3.5
Point M = $\dfrac{3\pi}{2}$ = 4.7

34 / 1000

?

J M

1 2 3 4 5 6

The student has determined the correct decimal approximations for the two irrational numbers

(*Point J* = $\sqrt{12}$ = 3.5 and *Point M* = $\dfrac{3\pi}{2}$ = 4.7) and has plotted and labeled both correctly on the provided

number line. [2 points]

Review/End Test Pause Flag Options Next

Question 17
Page 2 of 2

Line Guide

Item ID ?

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\frac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.

EQ

There are only 2 possible values of x, which are 25 and 36 because, since x has to be an integer, any numbers that are not perfect square integers will be come irrational when square rooted. since the value of $\sqrt{x}$ is between $\frac{84}{18}$, or $4\frac{2}{3}$, and $\sqrt{41}$, or 6.4, in order for x to be an integer, $\sqrt{x}$ must be a positive integer as well. So, $\sqrt{x}$ must be 5 or 6. 5 squared is 25, and 6 squared is 36. So, x must be either 25 or 36.

413 / 1000

The student has given two correct answers (*25 and 36*) and a correct and complete explanation (*since x has to be an integer, any numbers that are not perfect square integers will be come irrational when square rooted. since the value of $\sqrt{x}$ is between $\frac{84}{18}$, or $4\frac{2}{3}$, and $\sqrt{41}$, or 6.4, in order for x to be an integer, $\sqrt{x}$ must be a positive integer as well. So, $\sqrt{x}$ must be 5 or 6. 5 squared is 25, and 6 squared is 36*). [2 points]

Review/End Test   Pause   Flag   Options

Back   Next

STUDENT RESPONSE

Response Score: 3 points

17. The locations of four points on a number line are described by the numbers listed below.

point J: $\sqrt{12}$ point K: $\frac{15}{7}$ point L: $\sqrt{16}$ point M: $\frac{3\pi}{2}$

> **A.** For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.
>
> Point J: $\sqrt{12} = 3.5$
> Point K: $15/7 = 2.1$
> Point L: $\sqrt{16} = 4$
> Point M: $\frac{3\pi}{2} = 4.7$
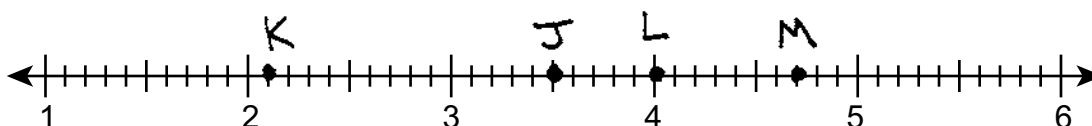
> The student has determined the correct decimal approximations for the two irrational numbers (*Point J: $\sqrt{12}$ = 3.5 and Point M: $\frac{3\pi}{2}$ = 4.7*) and has plotted and labeled both correctly on the provided number line; however, the student has determined the decimal approximations for the two rational numbers (*Point K and Point L*) and has plotted these as well. [1.5 points]

Go to the next page to finish question 17.   GO ON ⟹

17. *Continued.* Please refer to the previous page for task explanation.

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\frac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.
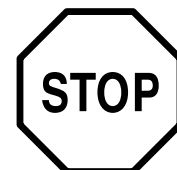
$84 \div 18 = 4.7$

$\sqrt{41} = 6.4$

The two possible values of x are 25 and 36. There are only two possible values because 25 and 36 are the only numbers that have a rational square root that is in between 4.7 and 6.4. Any other numbers that would have a square root between 4.7 and 6.4 would also have an irrational square root. For example, $\sqrt{35} = 5.91607...$ a non-terminating decimal. Therefore it is not rational.

The student has given two correct answers (*The two possible values of x are 25 and 36*) and a correct and complete explanation (*25 and 36 are the only numbers that have a rational square root that is in between 4.7 and 6.4*). [2 points]

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP

Question 17
Page 1 of 2

Line Guide

Item ID ?

The locations of four points on a number line are described by the numbers listed below.

$$\text{point J: } \sqrt{12} \qquad \text{point K: } \frac{15}{7} \qquad \text{point L: } \sqrt{16} \qquad \text{point M: } \frac{3\pi}{2}$$

A. For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.

EQ

J $\sqrt{12} = 3.5$

M $\frac{3\pi}{2} = 4.7$

---

20 / 1000

?

The student has determined the correct decimal approximations for the two irrational numbers ($J \sqrt{12} = 3.5$ and $M \frac{3\pi}{2} = 4.7$) and has plotted and labeled both correctly on the provided number line. [2 points]

Review/End Test   Pause   Flag   Options   Next

Question 17
Page 2 of 2

Line Guide

Item ID   ?

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\frac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.

EQ

$\frac{84}{18}$ and $\sqrt{41}$

$\frac{84}{18} = \frac{42}{9} = \frac{14}{3}$ $\sqrt{41} = 6.4$

These are the only 2 possible values of x, because irrational numbers are ones you cannot make into fractions. As a result $\frac{84}{18}$ and $\sqrt{41}$ are the only possible x.

190 / 1000

The student has given no correct answers and an incorrect explanation, demonstrating insufficient evidence of how to determine the two possible values of x. [0 points]

Review/End Test   Pause   Flag   Options   Back   Next

STUDENT RESPONSE

Response Score: 1 point

17. The locations of four points on a number line are described by the numbers listed below.

point J: $\sqrt{12}$ point K: $\dfrac{15}{7}$ point L: $\sqrt{16}$ point M: $\dfrac{3\pi}{2}$

A. For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.

J = 3.5
K = 2.1
L = 4 (rational)
M = 4.7
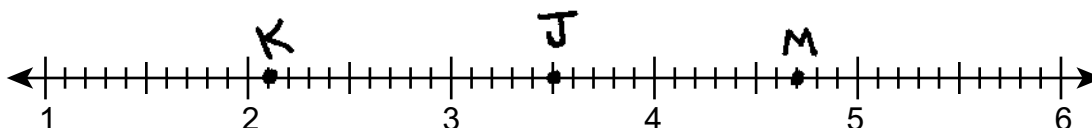
The student has determined the correct decimal approximations for the two irrational numbers (*J = 3.5 and M = 4.7*) and has plotted and labeled both correctly on the provided number line; however, the student misidentified point K as being irrational and plotted this point as well. [1.5 points]

Go to the next page to finish question 17.

GO ON ⟹

17. _Continued._ Please refer to the previous page for task explanation.

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\dfrac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.

$$\underset{\sqrt{x}}{\overset{x}{}} = \dfrac{84}{18} \qquad \sqrt{41}$$

$$4.7 \qquad \overline{5.6} \atop 5.4 \qquad 6.4$$

There are only 2 possible values of x because when you divide 84 by 18 you get 4.7 and when you solve for the square root of 41 you get 6.4 When you add these 2 numbers and divide by 2 To get the middle you get 5.55.

This means that one value could round to an irrational number of 5.6 but one could round to a rational number of 6. This could allow x to be rational.

> The student has given no correct answers and an incorrect explanation, demonstrating insufficient evidence of how to determine the two possible values of x. [0 points]

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP

Question 17
Page 1 of 2

Line Guide

Item ID

The locations of four points on a number line are described by the numbers listed below.

point J: $\sqrt{12}$　　　point K: $\dfrac{15}{7}$　　　point L: $\sqrt{16}$　　　point M: $\dfrac{3\pi}{2}$

A. For **only** the **irrational** numbers that are listed, write the approximate value of each irrational number as a decimal rounded to the nearest tenth. Graph these approximate values on the number line below to show the locations of the irrational numbers. Label each graphed point with the correct letter.

EQ

0 / 1000

K　M　　L　　　　　　J

1　　2　　3　　4　　5　　6

The student has given no decimal approximations, and none of the plotted points are correct. [0 points]

Review/End Test　　Pause　　Flag　　Options　　Next

Question 17
Page 2 of 2

Item ID | ?

An integer is represented by x. A rational number is represented by $\sqrt{x}$. The value of $\sqrt{x}$ is between $\frac{84}{18}$ and $\sqrt{41}$.

B. Explain why there are only two possible values of x. As part of the explanation, state the two possible values of x.

EQ

The reason that there is only two possible values of x is because $x = 4\frac{2}{3}$ and there are only two of them that are close to that fraction.

The student has given no correct answers and an incorrect explanation, demonstrating insufficient evidence of how to determine the two possible values of x. [0 points]

133 / 1000

Review/End Test | Pause | Flag | Options | Back | Next

MATHEMATICS—SUMMARY DATA

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	B-E.1.1.1	B	2	5%	71%	20%	4%
2	B-E.1.1.4	D	1	8%	9%	11%	72%
3	B-E.2.1	D	2	12%	14%	10%	64%
4	B-E.2.1.1	D	2	14%	17%	20%	49%
5	B-E.2.1.3	A	1	35%	33%	24%	8%
6	B-E.3.1.1	B	2	27%	58%	9%	6%
7	B-E.3.1.3	C	1	8%	6%	81%	5%
8	B-F.1.1.2 B-F.1.1.1	D	2	14%	27%	9%	50%
9	B-F.1.1.3	B	1	12%	73%	8%	7%
10	B-F.1.1.3	D	2	15%	18%	14%	53%
11	B-F.2.1.1	A	2	73%	9%	7%	11%
12	B-F.2.1.2	B	2	17%	47%	5%	31%
13	C-G.1.1.1	B	2	10%	58%	11%	21%
14	C-G.2.1.2	B	2	12%	49%	28%	11%
15	C-G.2.1.3	C	2	10%	35%	39%	16%
16	C-G.3.1.1	B	1	15%	73%	9%	3%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	A-N.1	4	3	0.98