



**pennsylvania**  
DEPARTMENT OF EDUCATION

**The Pennsylvania System of School  
Assessment  
Mathematics  
Item and Scoring Sampler  
2016–2017  
Grade 8**

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**PSSA MATHEMATICS GRADE 8**

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## INTRODUCTION

### General Introduction

The Pennsylvania Department of Education provides districts and schools with tools to assist in delivering focused instructional programs aligned with the Pennsylvania Core Standards (PCS). These tools include Academic Standards, Assessment Anchor documents, assessment handbooks, and content-based item and scoring samplers. This Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing local instructional programs. It can also be useful in preparing students for the statewide assessment.

### Pennsylvania Core Standards (PCS)

This sampler contains examples of test questions that are aligned to the new Pennsylvania Core Standards-based 2013 PSSA Assessment Anchors and Eligible Content. The Mathematics, Reading, and Writing PSSA transitioned to PCS-based operational Mathematics and English Language Arts assessments starting with the spring 2015 PSSA administration.

The 2013 PCS-aligned Assessment Anchor and Eligible Content documents are posted on this portal:

- [www.education.pa.gov](http://www.education.pa.gov) [Hover over “K–12,” select “Assessment and Accountability,” and select “Pennsylvania System of School Assessment (PSSA).” Then select “Assessment Anchors” from the “Other Materials” list on the right side of the screen.]

### What Is Included

This sampler contains test questions (items) that have been written to align to the Assessment Anchors that are based on the Pennsylvania Core Standards (PCS). The test questions provide an idea of the types of items that will appear on an operational, PCS-based PSSA. Each sample test question has been through a rigorous review process to ensure alignment with the Assessment Anchors.

### Purpose and Uses

The items in this sampler may be used as examples for creating assessment items at the classroom level, and they may also be copied and used as part of a local instructional program.<sup>1</sup> Classroom teachers may find it beneficial to have students respond to the open-ended item in this sampler. Educators can then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district.

### Item Format and Scoring Guidelines

The multiple-choice (MC) items have four answer choices. Each correct response to an MC item is worth one point.

Each open-ended (OE) item is designed to take approximately ten to fifteen minutes to complete.

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<sup>1</sup> The permission to copy and/or use these materials does not extend to commercial purposes.

During the administration of the PSSA, students are given additional time as necessary to complete the test items. Each OE item in mathematics is scored using an item-specific scoring guideline based on a 0–4-point scale. In this sampler, every item-specific scoring guideline is combined with examples of student responses that represent each score point to form a practical, item-specific scoring guide.

This sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines can be distributed to students for use during local assessments and can also be used by educators when scoring local assessments.<sup>2</sup>

## Item Alignment

All PSSA items are aligned to statements and specifications included in the *Assessment Anchors and Eligible Content Aligned to the Pennsylvania Core Standards*. The mathematics content, process skills, directives, and action statements included in the PSSA mathematics questions align with the Assessment Anchor Content Standards. The Eligible Content statements represent the limits of the content of the mathematics questions.

## Testing Time and Mode of Testing Delivery for the PSSA

The PSSA is delivered in traditional paper-and-pencil format as well as in an online format. The estimated time to respond to a test question is the same for both methods of test delivery. During an official testing administration, students are given additional time as necessary to complete the test questions. The following table shows the estimated response time for each item type.

Mathematics Item Type	MC	OE
Estimated Response Time (minutes)	2	10 to 15

## Mathematics Reporting Categories

The Assessment Anchors are organized into four classifications as listed below.

A = Numbers and Operations

B = Algebraic Concepts

C = Geometry

D = Data Analysis and Probability

These four classifications are used throughout the grade levels. In addition to these classifications, there are five Reporting Categories for each grade level. The first letter of each Reporting Category represents the classification; the second letter represents the Domain as stated in the Common Core State Standards for Mathematics. Listed below are the Reporting Categories for Grade 8.

<sup>2</sup> The permission to copy and/or use these materials does not extend to commercial purposes.

A-N = The Number System

B-E = Expressions and Equations

B-F = Functions

C-G = Geometry

D-S = Statistics and Probability

Examples of multiple-choice and open-ended items assessing these categories are included in this booklet.

## General Description of Scoring Guidelines for Mathematics Open-Ended Questions

4: The response demonstrates a *thorough* understanding of 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) Blank, entirely erased, or written refusal to respond

OT Off task

LOE Response in a language other than English

IL Illegible

## Item and Scoring Sampler Format

This sampler includes the test directions and scoring guidelines that appear in the PSSA Mathematics assessments. Each multiple-choice item is followed by a table that includes the alignment, the answer key, the depth of knowledge (DOK) level, the percentage<sup>3</sup> of students who chose each answer option, and a brief answer option analysis or rationale. The open-ended item is followed by a table that includes the item alignment, DOK level, and mean student score. Additionally, each of the included item-specific scoring guidelines is combined with sample student responses representing each score point to form a practical, item-specific scoring guide. The *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

### Example Multiple-Choice Item Information Table

Item Information	
Alignment	Assigned AAEC
Answer Key	Correct Answer
Depth of Knowledge	Assigned DOK
p-value A	Percentage of students who selected each option
p-value B	Percentage of students who selected each option
p-value C	Percentage of students who selected each option
p-value D	Percentage of students who selected each option
Option Annotations	Brief answer option analysis or rationale

### Example Open-Ended Item Information Table

Alignment:   Assigned AAEC

Depth of Knowledge:   Assigned DOK

Mean Score

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<sup>3</sup>All *p*-value percentages listed in the item information tables have been rounded.

## Grade 8 Formula Sheet

2016

Grade 8

Formulas and conversions that you may need to work questions on this test are found below. You may refer back to this page at any time during the mathematics test.

You may use calculator  $\pi$  or the number 3.14.

Simple Interest

Exponential Properties

A to the M times A to the N equals A to the sum (M + N)

A to the M to the N equals A to the product (M times N)

The fraction A to the M over A to the N equals A to the difference (M minus N)

A to the negative 1 = 1 over A

Algebraic Equations

Slope:  $M = \frac{y \text{ sub } 2 \text{ minus } y \text{ sub } 1}{x \text{ sub } 2 \text{ minus } x \text{ sub } 1}$

Slope-Intercept Form:  $y = mx + b$

Pythagorean Theorem

A graphic of a right triangle with one leg labeled A, the other leg labeled B, and the hypotenuse labeled C.  $A \text{ squared} + B \text{ squared} = C \text{ squared}$

A graphic of a cone with the radius labeled R and the height labeled H.

$V = \pi R \text{ squared } H$

A graphic of a cylinder with the radius labeled R and the height labeled H.

$V = \pi r^2 h$

A graphic of a sphere with the radius labeled R.

$V = \frac{4}{3} \pi R \text{ cubed}$



## MATHEMATICS TEST DIRECTIONS

On the following pages are the Mathematics questions.

You may not use a calculator for question 1. You may use a calculator for all other questions on this test.

You may need a protractor for 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.

## MULTIPLE-CHOICE ITEMS

Question 1 in this sampler is to be solved without the use of a calculator.

1. Simplify:  $7^{-8} \times 7^{-4}$

A.  $1/7^{12}$

B.  $1/7^4$

C.  $7^{12}$

D.  $7^{32}$

Item Information	
Alignment	B-E.1.1.1
Answer Key	A
Depth of Knowledge	1
p-value A	41% (correct answer)
p-value B	12%
p-value C	29%
p-value D	18%
Option Annotations	<p>A. correct</p> <p>B. ignores the negative in the second exponent</p> <p>C. thinks 2 negatives make it positive</p> <p>D. multiplies the exponents</p>

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

2. Which equation shows how to find the product of 1,000,000 and 1,000,000 using scientific notation?

- A.  $1,000,000 \times 1,000,000 = (1 \times 10^6) \times (1 \times 10^6) = 1 \times 10^{(6 + 6)} = 1 \times 10^{12}$
- B.  $1,000,000 \times 1,000,000 = (1 \times 10^6) \times (1 \times 10^6) = 1 \times 10^{(6 \times 6)} = 1 \times 10^{36}$
- C.  $1,000,000 \times 1,000,000 = (1 \times 10^7) \times (1 \times 10^7) = 1 \times 10^{(7 + 7)} = 1 \times 10^{14}$
- D.  $1,000,000 \times 1,000,000 = (1 \times 10^7) \times (1 \times 10^7) = 1 \times 10^{(7 \times 7)} = 1 \times 10^{49}$

Item Information	
Alignment	B-E.1.1.4
Answer Key	A
Depth of Knowledge	1
p-value A	75% (correct answer)
p-value B	13%
p-value C	7%
p-value D	5%
Option Annotations	A. correct B. multiplies the exponents C. incorrectly uses 7, because of 7 digits D. incorrectly uses 7, because of 7 digits, and multiplies the exponents

3. Mr. Carter is mapping the boundaries of a park on a coordinate grid. The park’s headquarters are located at the origin. The equations shown below represent two boundaries of the park.

$$y = 2x - 5$$

$$2x + 4y = 12$$

The park’s entrance is located at the intersection of these two boundaries. Which coordinate grid correctly shows the two boundaries and the park’s entrance?

- A. A coordinate grid is shown. The numbers to the left of the y-axis are negative 4, negative 2, 2, 4. The numbers below the x-axis are negative 4, negative 2, 2, 4. Two lines are graphed on the coordinate grid.
- B. A coordinate grid is shown. The numbers to the left of the y-axis are negative 4, negative 2, 2, 4. The numbers below the x-axis are negative 4, negative 2, 2, 4. Two lines are graphed on the coordinate grid.
- C. A coordinate grid is shown. The numbers to the left of the y-axis are negative 4, negative 2, 2, 4. The numbers below the x-axis are negative 4, negative 2, 2, 4. Two lines are graphed on the coordinate grid.
- D. A coordinate grid is shown. The numbers to the left of the y-axis are negative 4, negative 2, 2, 4. The numbers below the x-axis are negative 4, negative 2, 2, 4. Two lines are graphed on the coordinate grid.

Item Information	
Alignment	B-E.3.1.4
Answer Key	A
Depth of Knowledge	1
p-value A	46% (correct answer)
p-value B	19%
p-value C	22%
p-value D	13%
Option Annotations	<p>A. correct</p> <p>B. uses a negative slope for the first equation and a positive slope for the second equation</p> <p>C. uses the correct first equation but reverses the intercepts for the second equation</p> <p>D. uses the reciprocal of the slope for the first equation and reverses the intercepts for the second equation</p>

4. A cleaning company charges  $x$  dollars per hour to clean floors and  $y$  dollars per hour to clean the rest of a house.

When the company spends 2 hours to clean floors and 3 hours to clean the rest of a house, the total charge is \$84.

When the company spends 1 hour to clean floors and 4 hours to clean the rest of a house, the total charge is \$87.

Which ordered pair represents the hourly charges to clean floors and to clean the rest of the house?

- A. (12, 20)
- B. (15, 18)
- C. (18, 15)
- D. (20, 12)

Item Information	
Alignment	B-E.3.1.5
Answer Key	B
Depth of Knowledge	2
p-value A	19%
p-value B	55% (correct answer)
p-value C	15%
p-value D	11%
Option Annotations	<p>A. tries these values in the first example; <math>2 \times 12 + 3 \times 20 = 84</math></p> <p>B. correct</p> <p>C. reverses the solution</p> <p>D. reverses the meaning of each value in the ordered pair and tries the values in the first example</p>

5. Marianna has been adding \$30 to her savings account every month. Which model could represent the money in Marianna’s savings account ( $y$ ) after  $x$  months?

A.  $y = 10x + 30$

B.  $y = 10 - 30x$

C. Marianna’s Savings Account

Month ( $x$ )	Money in Savings Account ( $y$ )
3	\$100
5	\$160
7	\$220

D. A coordinate grid is shown. The title of the coordinate grid is Marianna’s Savings Account. The label to the left of the  $y$ -axis is Money in Savings Account (dollars). The numbers to the left of the  $y$ -axis are 0, 20, 40, 60, 80. The label below the  $x$ -axis is Month. The numbers below the  $x$ -axis are 0, 2, 4, 6, 8. A ray is graphed on the coordinate grid.

Item Information	
Alignment	B-F.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	28%
p-value B	9%
p-value C	48% (correct answer)
p-value D	15%
Option Annotations	A. sees 30 is represented, but not as slope B. sees 30 and ignores the negative part of the slope C. correct D. identifies slope as 30/1 instead of 10/3

6. The graph below represents a function.

A coordinate grid is shown. The numbers to the left of the y-axis are 5, 10, 15. The numbers below the x-axis are negative 8, negative 4, 4, 8. A curved path is graphed on the coordinate grid.

Which single transformation could be applied to the graph so that it no longer represents a function?

- A. reflection across the x-axis
- B. reflection across the y-axis
- C. rotation of 90° clockwise about the origin
- D. translation 5 units to the left

Item Information	
Alignment	B-F.1.1.1 C-G.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	14%
p-value B	22%
p-value C	48% (correct answer)
p-value D	16%
Option Annotations	A. thinks a function must have some positive y-values B. confuses this with a reflection across $y = x$ C. correct D. thinks all functions must go through the origin

7. Two linear functions of  $x$  are shown below.

Function 1

$$y = 30x + 19$$

Function 2

$x$	$y$
-12	-311
-8	-211
-3	-86
1	14

Which statement about the functions is true?

- A. Function 2 can be described by the equation  $y = 35x - 109$ .
- B. Function 2 can be described by the equation  $y = 100x - 11$ .
- C. The  $y$ -intercept of function 1 is less than the  $y$ -intercept of function 2.
- D. The rate of change of function 1 is greater than the rate of change of function 2.

Item Information	
Alignment	B-F.1.1.2 B-F.1.1.3
Answer Key	D
Depth of Knowledge	2
p-value A	10%
p-value B	12%
p-value C	30%
p-value D	48% (correct answer)
Option Annotations	A. sees $35x + 109$ works for first pair in table, but writes as $35x - 109$ B. uses difference of first two $y$ -values as slope C. misidentifies $y$ -intercept of function 2 D. correct



8. Luis is building a new deck and needs to have a slab of concrete poured. He knows the contractor charges an initial cost of \$75 plus an additional \$2.50 per square foot of concrete. Which equation can be used to determine the cost ( $y$ ), in dollars, to pour a concrete slab with an area of  $x$  square feet?

A.  $y = 2.5x + 75$

B.  $y = 7.5x + 2.5$

C.  $y = 75x + 2.5$

D.  $y = 77.5x$

Item Information	
Alignment	B-F.2.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	70% (correct answer)
p-value B	8%
p-value C	17%
p-value D	5%
Option Annotations	<p>A. correct</p> <p>B. converts 75 to 7.5 and uses it as the rate</p> <p>C. reverses the rate and initial cost</p> <p>D. adds 75 and 2.5 and assumes that is the rate per square foot</p>

9. The graph below shows the relationship between the number of years after a car is purchased and the car’s value.’

A coordinate grid is shown. The title of the coordinate grid is Value of Car over Time. The label to the left of the y-axis is Value of Car (dollars). The numbers to the left of the y-axis are 6,000, 12,000, 18,000, 24,000, 30,000, 36,000. The label below the x-axis is Years after Purchase. The numbers below the x-axis are 0, 1, 2, 3, 4, 5, 6. A ray is graphed on the coordinate grid.

Which statement correctly describes the relationship shown in the graph?

- A. The car’s initial value is \$2,000, and the car’s value increases \$30,000 each year.
- B. The car’s initial value is \$18,000, and the car’s value increases \$2,000 each year.
- C. The car’s initial value is \$30,000, and the car’s value decreases \$2,000 each year.
- D. The car’s initial value is \$30,000, and the car’s value decreases \$12,000 each year.

Item Information	
Alignment	B-F.2.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	3%
p-value B	5%
p-value C	79% (correct answer)
p-value D	13%
Option Annotations	A. reverses meaning for slope and y-intercept and misreads direction of slope in graph B. reads graph from right to left C. correct D. uses change in value at end of 6 years as rate of change

10. Which coordinate plane shows that the shaded polygon is the image of the unshaded polygon after a  $90^\circ$  counterclockwise rotation about the origin?
- A. A coordinate grid is shown. The numbers to the left of the  $y$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. The numbers below the  $x$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. Two shapes, one of which is shaded, are shown on the coordinate grid.
  - B. A coordinate grid is shown. The numbers to the left of the  $y$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. The numbers below the  $x$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. Two shapes, one of which is shaded, are shown on the coordinate grid.
  - C. A coordinate grid is shown. The numbers to the left of the  $y$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. The numbers below the  $x$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. Two shapes, one of which is shaded, are shown on the coordinate grid.
  - D. A coordinate grid is shown. The numbers to the left of the  $y$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. The numbers below the  $x$ -axis are negative 12, negative 8, negative 4, 4, 8, 12. Two shapes, one of which is shaded, are shown on the coordinate grid.

Item Information	
Alignment	C-G.1.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	49% (correct answer)
p-value B	20%
p-value C	7%
p-value D	24%
Option Annotations	A. correct B. uses reflection across $x$ -axis C. uses a translation, but thinks 90 degrees because of shifting from one quadrant to another D. uses 180-degree rotation

11. In the figure shown below, triangle PQR is transformed to create triangle P'Q'R'.

A coordinate grid is shown. The numbers to the left of the y-axis are negative 10, negative 8, negative 6, negative 4, negative 2, 2, 4, 6, 8, 10. The numbers below the x-axis are negative 10, negative 8, negative 6, negative 4, negative 2, 2, 4, 6, 8, 10. Two triangles are shown on the coordinate grid. One triangle is labeled P Q R, the other triangle is labeled P prime, Q prime, R prime. A point on the coordinate grid is labeled S.

Point S will be transformed the same way as triangle PQR. Which sentence could describe how point S will be transformed?

- A. Point S will be translated to (6, 0) and then rotated to (0, 6).
- B. Point S will be translated to (6, 0) and then rotated to (0, -6).
- C. Point S will be translated to (4, 3) and then reflected to (-4, 3).
- D. Point S will be translated to (4, 3) and then reflected to (4, -3).

Item Information	
Alignment	C-G.1.1.2 C-G.1.1.3
Answer Key	D
Depth of Knowledge	2
p-value A	15%
p-value B	20%
p-value C	22%
p-value D	43% (correct answer)
Option Annotations	A. picks an option that includes the axes B. thinks the two triangles are rotations of one another C. reflects the point across the wrong axis D. correct

12. A balloon in the shape of a crayon is shown below.

The title of the shape is Crayon Balloon. The shape is made up of a cone and a cylinder. Both the cone and the cylinder have a diameter of 2 inches. The cone has a height of 3 inches. The cylinder has a height of 21 inches.

The crayon balloon is made up of a cone and a cylinder. What is the volume, in cubic inches, of the crayon balloon?

- A. 69.12
- B. 75.40
- C. 138.23
- D. 276.46

Item Information	
Alignment	C-G.3.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	49% (correct answer)
p-value B	19%
p-value C	18%
p-value D	14%
Option Annotations	A. correct B. uses formula for volume of a cylinder instead of a cone C. calculates 1 squared as 1 times 2 D. uses 2 inches as the radius

13. Part of a sculpture is a stone sphere with a volume of  $36\pi$  cubic feet. What is the radius, in feet, of the stone sphere?
- A. 3
  - B. 6
  - C. 9
  - D. 12

Item Information	
Alignment	C-G.3.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	40% (correct answer)
p-value B	26%
p-value C	15%
p-value D	19%
Option Annotations	<ul style="list-style-type: none"> <li>A. correct</li> <li>B. finds square root of 36</li> <li>C. finds value of <math>r</math> cubed and then divides by 3</li> <li>D. divides 36 by 3</li> </ul>

14. Christy created the scatter plot shown below.

A scatter plot is shown. The title of the scatter plot is Length of Pinball Games Based on Experience. The label to the left of the y-axis is Length of Game (minutes). The numbers to the left of the y-axis are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. The label below the x-axis is Number of Previous Plays. The numbers below the x-axis are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15. There are 15 points plotted on the scatter plot.

Christy finds that the line of best fit for the data has the equation  $y = 0.51x + 1.48$ . Which statement **best** explains how removing the point (15, 7) would affect the slope of the line of best fit?

- A. The slope of the line of best fit would decrease because the point lies below the original line of best fit.
- B. The slope of the line of best fit would decrease because the point lies above the original line of best fit.
- C. The slope of the line of best fit would increase because the point lies below the original line of best fit.
- D. The slope of the line of best fit would increase because the point lies above the original line of best fit.

Item Information	
Alignment	D-S.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	20%
p-value B	9%
p-value C	56% (correct answer)
p-value D	15%
Option Annotations	<p>A. identifies where the point lies but thinks removing it would cause the line to move further down</p> <p>B. gets the correct relationship between the location of the point and the slope but the wrong location of the point</p> <p>C. correct</p> <p>D. gets the location of the line incorrect and thinks that removing a point above the line will cause the slope of the line to increase</p>

15. The scatter plot below shows the temperatures ( $y$ ), in degrees Fahrenheit ( $^{\circ}\text{F}$ ), that were recorded at different altitudes ( $x$ ), in thousands of feet.

A scatter plot is shown. The title of the scatter plot is Temperature versus Altitude. The label to the left of the  $y$ -axis is Temperature (degrees Fahrenheit). The numbers to the left of the  $y$ -axis are 0, 10, 20, 30, 40, 50, 60, 70. The label below the  $x$ -axis is Altitude (thousands of feet). The numbers below the  $x$ -axis are 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20. There are 8 points plotted on the scatter plot.

Which equation could represent the line of best fit for the temperatures, in degrees Fahrenheit, based on the altitudes, in thousands of feet?

- A.  $y = -9/4x + 47$
- B.  $y = -7/2x + 59$
- C.  $y = -5x + 69$
- D.  $y = -5x + 80$

Item Information	
Alignment	D-S.1.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	20%
p-value B	46% (correct answer)
p-value C	21%
p-value D	13%
Option Annotations	A. chooses line that passes through data points (8, 29) and (12, 20) B. correct C. chooses line that passes through data points (6, 39) and (8, 29) D. chooses line that passes through data points (12, 20) and (14, 10)



16. Blake interviewed 24 students to see whether they collected sports cards and whether they participated in sports. The table below shows his data.

Sports-Card Collecting and Sports Participation

	Participates in Sports	Does not Participate in Sports
Collects Sports Cards	6	3
Does Not Collect Sports Cards	x	7

How many of the students Blake interviewed participate in sports?

- A. 4
- B. 10
- C. 14
- D. 15

Item Information	
Alignment	D-S.1.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	16%
p-value B	17%
p-value C	63% (correct answer)
p-value D	4%
Option Annotations	A. thinks both columns should be equal ( $6 + x = 3 + 7$ ) B. finds how many do not participate in sports C. correct D. finds how many do not collect sports cards

## OPEN-ENDED QUESTION

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

- B. Write an equation to describe the relationship between the time ( $t$ ), in minutes, and the amount of rain ( $r$ ), in centimeters.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

## Item-Specific Scoring Guideline

### #17 Item Information

Alignment B-E.2

Depth of Knowledge 2

Mean Score 1.73

### Assessment Anchor this item will be reported under:

M08.B-E.2—Understand the connections between proportional relationships, lines, and linear equations.

### Specific Anchor Descriptor addressed by this item:

M08.B-E.2.1—Analyze and describe linear relationships between two variables, using slope.

### Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of connections between proportional relationships, lines, and linear equations by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of connections between proportional relationships, lines, and linear equations by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of connections between proportional relationships, lines, and linear equations by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of connections between proportional relationships, lines, and linear equations.
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.

Score	Description
1	Student earns 0.5–1.5 points.  OR  Student demonstrates minimal understanding of connections between proportional relationships, lines, and linear equations.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (1 point):

$\frac{1}{2}$  point for each correct answer

What?								Why?
Rainfall								
Time (minutes)	30	45	60	90	<u>135</u>	150	180	
Rain (cm)	2	3	4	6	9	10	12	

Part B (1 point):

1 point for correct equation

What?	Why?
$t = 15r$  <b>OR</b>  $r = \frac{1}{15}t$  <b>OR equivalent</b>	

Part C (1 point):

1 point for complete explanation

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

What?	Why?
	<b>Sample Explanation:</b> The slope is steeper for the second part. This means it is raining more during that time.

Part D (1 point):

1 point for complete explanation

What?	Why?
	<b>Sample Explanation:</b> A slope of 0 means it stopped raining.

## STUDENT RESPONSE

## Handwritten Response Score: 4 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

**Student Response:** Fills in Time (minutes) BLANK with 135

Fills in Rain (cm) BLANK with 10

**Annotation:** The student has given two correct answers.

- B. Write an equation to describe the relationship between the time ( $t$ ), in minutes, and the amount of rain ( $r$ ), in centimeters.

**Student Response:**  $t = 15r$

**Annotation:** The student has given a correct equation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

**Student Response:**  $m = 1/10$

In this scatter plot it takes 10 minutes to get a cm of rain compared to the previous 15 minutes. This means it is steadily increasing and will yield a larger amount of rain faster.

**Annotation:** The student has given a complete description.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

**Student Response:** It means the rain has stopped.

**Annotation:** The student has given a complete explanation.

## STUDENT RESPONSE

## Online Response Score: 3 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

**Student Response:** Fills in Time (minutes) BLANK with 135

Fills in Rain (cm) BLANK with 10

**Annotation:** The student has given two correct answers.

- B. Write an equation to describe the relationship between the time ( $t$ ), in minutes, and the amount of rain ( $r$ ), in centimeters.

**Student Response:**  $t = 15r$

**Annotation:** The student has given a correct equation.



The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

**Student Response:** the slope is going at the same rate. For every 15 minutes it is 1 centimeter of rainfall.

**Annotation:** The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

**Student Response:** When it goes down to 0, that means that it has stopped raining.

**Annotation:** The student has given a complete explanation.

## STUDENT RESPONSE

## Handwritten Response Score: 2 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

**Student Response:** Fills in Time (minutes) BLANK with 135

Fills in Rain (cm) BLANK with 10

**Annotation:** The student has given two correct answers.

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

**Student Response:**  $15r = T$

Time = T

Rain =

**Annotation:** The student has given a correct equation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

**Student Response:** The change in slope is because instead of the minutes increasing by 16 they are increasing by 20. This would make the slope decrease

**Annotation:** The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

**Student Response:** A slope of 0 means the line doesn't move.

**Annotation:** The student has given an incorrect explanation.

## STUDENT RESPONSE

## Online Response Score: 1 point

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

**Student Response:** Fills in Time (minutes) BLANK with 105

Fills in Rain (cm) BLANK with 11

**Annotation:** The student has given two incorrect answers.

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

**Student Response:**  $t = r \cdot 10 + 15$

**Annotation:** The student has given an incorrect equation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

**Student Response:** the slope goes straight up meaning the rainfall was consistent

**Annotation:** The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

**Student Response:** the rain stopped falling

**Annotation:** The student has given a complete explanation.

## STUDENT RESPONSE

## Handwritten Response Score: 0 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	BLANK	150	180
Rain (cm)	2	3	4	6	9	BLANK	12

**Student Response:** Fills in Time (minutes) BLANK with 120

Fills in Rain (cm) BLANK with 11

**Annotation:** The student has given two incorrect answers.

- B. Write an equation to describe the relationship between the time ( $t$ ), in minutes, and the amount of rain ( $r$ ), in centimeters.

**Student Response:** for every 30 min theres 2 cm of rain

**Annotation:** The student has not given a correct equation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

A scatter plot is shown. The title of the scatter plot is Total Rainfall. The label to the left of the y-axis is Rain (centimeters). The numbers to the left of the y-axis are 0, 5, 10, 15, 20, 25. The label below the x-axis is Minutes. The numbers below the x-axis are 0, 180, 200, 220, 240, 260, 280. There is a break in the x-axis between the 0 and the 180. There are 6 points plotted on the scatter plot.

- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

**Student Response:** the amount of rain went up a lot

**Annotation:** The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

**Student Response:** its not going up any more

**Annotation:** The student has given an incorrect explanation.

**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	A	1	41% (correct answer)	12%	29%	18%
2	B-E.1.1.4	A	1	75% (correct answer)	13%	7%	5%
3	B-E.3.1.4	A	1	46% (correct answer)	19%	22%	13%
4	B-E.3.1.5	B	2	19%	55% (correct answer)	15%	11%
5	B-F.1.1	C	2	28%	9%	48% (correct answer)	15%
6	B-F.1.1.1 C-G.1.1.1	C	2	14%	22%	48% (correct answer)	16%
7	B-F.1.1.2 B-F.1.1.3	D	2	10%	12%	30%	48% (correct answer)
8	B-F.2.1.1	A	2	70% (correct answer)	8%	17%	5%
9	B-F.2.1.2	C	2	3%	5%	79% (correct answer)	13%
10	C-G.1.1.1	A	2	49% (correct answer)	20%	7%	24%
11	C-G.1.1.2 C-G.1.1.3	D	2	15%	20%	22%	43% (correct answer)
12	C-G.3.1.1	A	2	49% (correct answer)	19%	18%	14%
13	C-G.3.1.1	A	2	40% (correct answer)	26%	15%	19%



**PSSA MATHEMATICS GRADE 8**

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
14	D-S.1.1.1	C	2	20%	9%	56% (correct answer)	15%
15	D-S.1.1.2	B	2	20%	46% (correct answer)	21%	13%
16	D-S.1.2.1	C	2	16%	17%	63% (correct answer)	4%

**OPEN-ENDED**

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	B-E.2	4	2	1.73

# **PSSA Grade 8 Mathematics Item and Scoring Sampler**