



**pennsylvania**  
DEPARTMENT OF EDUCATION

**The Pennsylvania System of School  
Assessment  
Mathematics  
Item and Scoring Sampler  
2016–2017  
Grade 5**

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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 5.

A-T = Numbers and Operations in Base Ten

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## INFORMATION ABOUT MATHEMATICS

A-F = Numbers and Operations—Fractions

B-O = Operations and Algebraic Thinking

C-G = Geometry

D-M = Measurement and Data

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

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

## Grade 5 Formula Sheet

2016

Grade 5

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.

Standard Conversions 1 mile (mi) = 1,760 yards (yd)

1 mile = 5,280 feet (ft)

1 yard (yd) = 3 feet (ft)

1 foot = 12 inches (in.)

1 ton (T) = 2,000 pounds (lb)

1 pound = 16 ounces (oz.)

1 gallon (gal) = 4 quarts (qt)

1 quart = 2 pints (pt)

1 pint = 2 cups (c)

1 cup = 8 fluid ounces (fl oz.)

Metric Conversions

1 kilometer (km) = 1,000 meters (m)

1 meter = 100 centimeters (cm)

1 centimeter = 10 millimeters (mm)

1 kilogram (kg) = 1,000 grams (g)

1 liter (L) = 1,000 milliliters (mL)

Time Conversions

1 century = 10 decades

1 decade = 10 years (yr)

1 year (yr) = 12 months (mo)

1 year = 52 weeks (wk)

1 year = 365 days



1 week = 7 days

1 day = 24 hours (hr)

1 hour = 60 minutes (min)

1 minute = 60 seconds (sec)

Graphic of a Rectangular Prism showing height, width, and length

Volume = length  $\times$  width  $\times$  height  $V = l \times w \times h$

Volume = area of the base  $\times$  height  $V = B \times h$

Volume = area of the base  $\times$  width  $V = B \times w$

Volume = area of the base  $\times$  length  $V = B \times l$

## 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.

### 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.

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

**MULTIPLE-CHOICE ITEMS**

1. Subtract:  $124.8 - 9.34$

- A. 115.46
- B. 115.54
- C. 125.54
- D. 125.56

Item Information	
Alignment	A-T.2.1.3
Answer Key	A
Depth of Knowledge	1
p-value A	67% (correct answer)
p-value B	22%
p-value C	8%
p-value D	3%
Option Annotations	A. correct B. brings down 4 in hundredths place; completes remaining “subtraction” correctly C. subtracts lesser from greater digit in each place D. does not decrease previous digit by 1 when borrowing

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

2. Carlos is adding the mixed numbers  $1 \frac{1}{5}$  and  $2 \frac{1}{8}$  by changing each number into an improper fraction. Which pair of improper fractions should Carlos use?
- A.  $1 \frac{1}{5} = 8/40$  and  $2 \frac{1}{8} = 5/40$
  - B.  $1 \frac{1}{5} = 16/40$  and  $2 \frac{1}{8} = 15/40$
  - C.  $1 \frac{1}{5} = 48/40$  and  $2 \frac{1}{8} = 50/40$
  - D.  $1 \frac{1}{5} = 48/40$  and  $2 \frac{1}{8} = 85/40$

Item Information	
Alignment	A-F.1
Answer Key	D
Depth of Knowledge	2
p-value A	21%
p-value B	18%
p-value C	20%
p-value D	41% (correct answer)
Option Annotations	<ul style="list-style-type: none"> <li>A. ignores the whole number</li> <li>B. adds the whole number to the numerator and converts</li> <li>C. multiplies the numerator by the whole number and adds the denominator</li> <li>D. correct</li> </ul>

3. Maggie has two equal-sized boxes.

The first box is  $\frac{3}{4}$  filled with beads.

The second box is  $\frac{2}{3}$  filled with beads.

Which shaded picture could be used to model the difference in the amounts each box is filled with beads?

- A. A shape with 9 of 12 squares shaded, minus, a shape with 8 of 12 squares shaded, equals, a shape with 1 of 12 squares shaded.
- B. A shape with 9 of 12 squares shaded, minus, a shape with 8 of 12 squares shaded, equals, a shape with 5 of 12 squares shaded.
- C. A shape with 3 of 4 rectangles shaded, minus, a shape with 2 of 3 rectangles shaded, equals, a shape with 1 of 2 rectangles shaded.
- D. A shape with 3 of 4 rectangles shaded, minus, a shape with 2 of 3 rectangles shaded, equals, a shape with 1 of 7 rectangles shaded.

Item Information	
Alignment	A-F.1.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	46% (correct answer)
p-value B	9%
p-value C	26%
p-value D	19%
Option Annotations	A. correct B. keeps all nonoverlapping shaded portions C. subtracts shaded portions for numerator, keeps unshaded portions for denominator the same D. subtracts shaded portions for numerator, adds total numbers of portions for denominator

4. Stephen has  $\frac{1}{2}$  gallon of a chemical. He wants to put an equal amount of the chemical into each of 4 containers, using all of the chemical. Stephen wants to find the fraction of a gallon that will be in each container. Which equation correctly represents Stephen’s problem?
- A.  $4 \times 2 = 8$
  - B.  $4 \div \frac{1}{2} = 2$
  - C.  $\frac{1}{2} \div 4 = \frac{1}{8}$
  - D.  $\frac{1}{2} \times 4 = 2$

Item Information	
Alignment	A-F.2
Answer Key	C
Depth of Knowledge	2
p-value A	9%
p-value B	17%
p-value C	57% (correct answer)
p-value D	17%
Option Annotations	A. reverses dividend and divisor, writes as multiplication problem B. reverses dividend and divisor, multiplies instead of dividing C. correct D. multiplies the amount of chemical by 4 for a total of 2 gallons

5. Which expression is equivalent to  $\frac{6}{7} \times \frac{3}{4}$  ?

A.  $6 \times 3 / 7 \times 4$

B.  $6 \times 4 / 7 \times 3$

C.  $\frac{6}{7} / (\frac{1}{4}) \times \frac{3}{4} (\frac{1}{7})$

D.  $\frac{6}{7} (4) \times \frac{3}{4} (7)$

Item Information	
Alignment	A-F.2.1.2
Answer Key	A
Depth of Knowledge	1
p-value A	72% (correct answer)
p-value B	11%
p-value C	9%
p-value D	8%
Option Annotations	<p>A. correct</p> <p>B. inverts <math>\frac{3}{4}</math>; thinking of division</p> <p>C. thinks of finding common denominator</p> <p>D. thinks of finding common denominator</p>

6. Kaitlin walked the length of a path in a park 3 times. The total distance she walked was less than 1 mile. What must be true about the length of the path in the park?
- A. The length of the path must be shorter than  $\frac{1}{3}$  mile.
  - B. The length of the path must be between  $\frac{1}{3}$  and 1 mile.
  - C. The length of the path must be between 1 and 3 miles.
  - D. The length of the path must be longer than 3 miles.

Item Information	
Alignment	A-F.2.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	46% (correct answer)
p-value B	39%
p-value C	10%
p-value D	5%
Option Annotations	<ul style="list-style-type: none"> <li>A. correct</li> <li>B. miscalculates; given the numbers, the total distance walked would be 1 to 3 miles</li> <li>C. recycles the given numbers; the total distance walked would be 3 to 9 miles</li> <li>D. confuses the number of times she walked the path with the length of the path; the total distance walked would be more than 9 miles</li> </ul>



7. Paul brings 4 quarts of potato salad to a picnic. Each serving of potato salad is  $\frac{1}{8}$  quart. How many total servings of potato salad does Paul bring to the picnic?
- A. 2
  - B. 4
  - C. 12
  - D. 32

Item Information	
Alignment	A-F.2.1.4
Answer Key	D
Depth of Knowledge	2
p-value A	10%
p-value B	13%
p-value C	14%
p-value D	63% (correct answer)
Option Annotations	A. $8 \div 4$ B. $8 - 4$ C. $4 + 8$ D. correct

8. A decimal number is multiplied by  $10^6$ . Which statement describes the change in position of the decimal point in the decimal number as a result of the multiplication?
- A. The decimal point moves 5 places to the left.
  - B. The decimal point moves 6 places to the left.
  - C. The decimal point moves 6 places to the right.
  - D. The decimal point moves 10 places to the right.

Item Information	
Alignment	A-T.1.1.2
Answer Key	C
Depth of Knowledge	1
p-value A	10%
p-value B	27%
p-value C	56% (correct answer)
p-value D	7%
Option Annotations	<ul style="list-style-type: none"> <li>A. considers adding zeros instead of moving decimal point</li> <li>B. reverses direction of movement</li> <li>C. correct</li> <li>D. treats 10 as if it were the exponent</li> </ul>

9. A number written in expanded form is shown below.

$$(8 \times 1,000) + (3 \times 100) + (2 \times 1) + (4 \times 1/10) + (7 \times 1/1,000)$$

What is the number written in standard form?

- A. 832.47
- B. 8,302.407
- C. 8,302.47
- D. 8,320.407

Item Information	
Alignment	A-T.1.1.3
Answer Key	B
Depth of Knowledge	1
p-value A	10%
p-value B	67% (correct answer)
p-value C	12%
p-value D	11%
Option Annotations	A. omits zeros B. correct C. omits zero in fractional part D. misplaces zero in whole-number part

10. A scientist listed the volumes, in milliliters, of some liquids used in an experiment.

1.25 1.079 1.204 1.18

Which inequality correctly compares the volumes, in milliliters, of two of these liquids?

A.  $1.25 < 1.204$

B.  $1.079 < 1.25$

C.  $1.18 > 1.204$

D.  $1.079 > 1.18$

Item Information	
Alignment	A-T.1.1.4
Answer Key	B
Depth of Knowledge	1
p-value A	18%
p-value B	55% (correct answer)
p-value C	12%
p-value D	15%
Option Annotations	<p>A. compares whole numbers in which 25 is less than 204</p> <p>B. correct</p> <p>C. thinks 1.204 is the smaller number since it includes thousandths; 1.18 only goes to hundredths; thousandths is less than hundredths</p> <p>D. compares whole number in which 79 is greater than 18</p>

11. What is 27.462 rounded to the nearest tenth?

- A. 20
- B. 27.4
- C. 27.5
- D. 30

Item Information	
Alignment	A-T.1.1.5
Answer Key	C
Depth of Knowledge	1
p-value A	4%
p-value B	14%
p-value C	70% (correct answer)
p-value D	12%
Option Annotations	<ul style="list-style-type: none"> <li>A. truncates at tens place</li> <li>B. truncates instead of rounding</li> <li>C. correct</li> <li>D. rounds to tens place</li> </ul>

12. Juan is estimating the quotient of  $9,648.18 \div 15.85$ . He first rounds both 9,648.18 and 15.85 to the nearest whole number. What should be Juan’s estimated quotient?
- A. 63
  - B. 603
  - C. 630
  - D. 6,030

Item Information	
Alignment	A-T.2.1.2 A-T.1.1.5
Answer Key	B
Depth of Knowledge	1
p-value A	7%
p-value B	52% (correct answer)
p-value C	24%
p-value D	17%
Option Annotations	A. drops 0 from quotient B. correct C. swaps digit order in quotient D. adds extra 0 at end of quotient

13. Jerry has 56.92 centimeters (cm) of wire. He uses 2 pieces of the wire. Each piece he uses is 7.37 cm long. What is the length of the remaining wire, rounded to the nearest tenth of a centimeter?
- A. 7.7 cm
  - B. 42.2 cm
  - C. 49.6 cm
  - D. 71.7 cm

Item Information	
Alignment	A-T.2.1.3 A-T.1.1.5
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	58% (correct answer)
p-value C	20%
p-value D	8%
Option Annotations	A. divides 56.92 by 7.37 and rounds B. correct C. only subtracts one piece of wire and rounds D. adds 2 pieces of wire instead of subtracting; $56.92 + 14.74$

14. Four points are plotted on the coordinate grid shown below.

A coordinate grid is shown. The numbers to the left of the y-axis are 0, 1, 2, 3, 4, 5, 6. The numbers below the x-axis are 0, 1, 2, 3, 4, 5, 6. The four points on the coordinate grid are labeled P, Q, R, and S.

Which statement about the plotted points is true?

- A. Point P is located at the origin.
- B. Point Q has 4 as its x-coordinate.
- C. Point R is located on the y-axis.
- D. Point S has 3 as its y-coordinate.

Item Information	
Alignment	C-G.1.1.1 C-G.1.1.2
Answer Key	D
Depth of Knowledge	1
p-value A	11%
p-value B	10%
p-value C	7%
p-value D	72% (correct answer)
Option Annotations	A. sees (1, 1) as the origin B. misinterprets 4 as an x-coordinate instead of a y-coordinate C. confuses x-axis and y-axis D. correct



15. Mason graphs point M on a coordinate grid to represent the number of pens ( $x$ ) he bought and the number of dollars ( $y$ ) he paid for the pens as shown below.

A coordinate grid is shown. The title of the coordinate grid is Pen Purchases. The label to the left of the  $y$ -axis is Number of Dollars. The numbers to the left of the  $y$ -axis are 0, 1, 2, 3, 4, 5, 6, 7, 8. The label below the  $x$ -axis is Number of Pens. The numbers below the  $x$ -axis are 0, 1, 2, 3, 4, 5, 6, 7, 8. The point on the coordinate grid is labeled M.

Franco will graph point F on the same coordinate grid to represent that he bought 3 **more** pens than Mason and paid \$5 **more** than Mason. What ordered pair describes the location of point F?

- A. (5, 8)
- B. (6, 7)
- C. (7, 6)
- D. (8, 5)

Item Information	
Alignment	C-G.1.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	66% (correct answer)
p-value B	12%
p-value C	10%
p-value D	12%
Option Annotations	A. correct B. reverses quantities, counts 3 more dollars and 5 more pens; reverses $x$ -axis and $y$ -axis C. reverses quantities, counts 3 more dollars and 5 more pens D. reverses $x$ -axis and $y$ -axis

16. Quadrilateral JKLM is shown below.

A quadrilateral is shown. The vertices around the quadrilateral are J, K, L, M. Each of the four sides are labeled 5 centimeters.

Which statement gives the **most** specific name for quadrilateral JKLM and the reason for that name?

- A. Quadrilateral JKLM is a rhombus because it is a trapezoid and contains no right angles.
- B. Quadrilateral JKLM is a rhombus because it is a parallelogram with all sides equal in length.
- C. Quadrilateral JKLM is a parallelogram because it is a trapezoid with all sides equal in length.
- D. Quadrilateral JKLM is a parallelogram because it is a trapezoid and because both pairs of opposite angles have equal measures.

Item Information	
Alignment	C-G.2.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	16%
p-value B	51% (correct answer)
p-value C	15%
p-value D	18%
Option Annotations	A. uses most specific name, but figure is not a trapezoid B. correct C. not most specific name, and figure is not a trapezoid D. not most specific name, and figure is not a trapezoid

## OPEN-ENDED QUESTION

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

## Item-Specific Scoring Guideline

### #17 Item Information

Alignment B-O.2

Depth of Knowledge 3

Mean Score 1.20

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

M05.B-O.2—Analyze patterns and relationships.

### Specific Anchor Descriptor addressed by this item:

M05.B-O.2.1—Create, extend, and analyze patterns.

### Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of how to analyze patterns and relationships by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to analyze patterns and relationships by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to analyze patterns and relationships by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to analyze patterns and relationships.
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 points.
2	Student earns 2 points.
1	Student earns 1 point.  OR  Student demonstrates minimal understanding of how to analyze patterns and relationships.
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):**

1 point for correct answer

What?	Why?
3, 9, 15, 21	

**Part B (1 point):**

1 point for correct answer

What?	Why?
33	

**Part C (2 points):**

1 point for correct answer

1 point for complete explanation

What?	Why?
19	<p><b>Sample Explanation:</b></p> <p>Each term in Adam’s pattern is always increasing by one more than the same term in Brianna’s pattern. Since they started with the same number, the difference in the 20th term will be <math>20 - 1 = 19</math>.</p>

## STUDENT RESPONSE

## Online Response Score: 4 points

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

**Student Response:** 3, 9, 15, 21

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

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

**Student Response:** 33

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

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

**Student Response:** Briannas 20th term is 19 numbers smaller than Adam. Since they both start with 3 and go 20 terms it would be 19 because thats how many numbers are inbetween the 1st term and the 20th term and there is only a one number difference in what they do.

**Annotation:** The student has given a correct answer and complete explanation.

## STUDENT RESPONSE

## Handwritten Response Score: 3 points

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

**Student Response:** 3, 9, 15, 21

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

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

**Student Response:** The first number greater than three in both patterns is 33.

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

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

**Student Response:** The 20th term in Brianna's pattern is 20 less than the 20th term in Adams pattern. Besides expanding the patterns to the 20th term, for Adam and Brianna you can add the number they started with and the rule then multiply it by 20 to get the 20th term in the patterns.

$$\text{Adam} = 3 + 6 \times 20 = 20\text{th term} = 123$$

$$\text{Brianna} = 3 + 5 \times 20 = 20\text{th term} = 103$$

**Annotation:** The student has given an incorrect answer due to a counting error and has given a complete explanation.

## STUDENT RESPONSE

## Handwritten Response Score: 2 points

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

**Student Response:** 3, 9, 15, 21, 27

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

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

**Student Response:** 3, 8, 13, 18, 24

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

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

**Student Response:** Briannas is way smaller than Adams Just think they both started with three and Adam is adding 6 to 3 20 times an Brianna is starting with 3 and Adding 5 You know from the top of your head that Adam is always going to be ahead of Brianna

So

$$20 \times 5 + 3 = 103$$

$$20 \times 6 + 3 = 123$$

$$123 - 103 = 20$$

So brianna is 20 numbers smaller than Adam

**Annotation:** The student has given an incorrect answer due to a counting error and has given a complete explanation.



## STUDENT RESPONSE

## Online Response Score: 1 point

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

**Student Response:** 3, 9, 15, 21

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

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

**Student Response:** 3, 8, 13, 18

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

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

**Student Response:** brinna's smaller term is 18

adam's term is 21

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

## STUDENT RESPONSE

## Handwritten Response Score: 0 points

17. Adam and Brianna each made a number pattern.

Adam's pattern starts with the number 3 and follows the rule "add 6."

A. What are the first four terms of Adam's pattern?

**Student Response:** 9, 13, 19, 25, 31, 37, 43, 49, 55, 61, 67, 73, 79, 85, 91, 97, 103, 109, 115, 121

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

Brianna's pattern starts with the number 3 and follows the rule "add 5."

B. What is the first number greater than 3 that will be in both Adam's pattern and Brianna's pattern?

**Student Response:** 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120

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

Adam and Brianna each wrote the first 20 terms in their patterns.

C. How much smaller is the 20th term in Brianna's pattern than the 20th term in Adam's pattern? Explain how to determine the difference **without** expanding both patterns to the 20th term.

**Student Response:** 1 Because, Brianna pattern goes up to 120, and Adam pattern goes up to 12, then I do  $121 - 120 = 1$ .

**Annotation:** The student has given an incorrect answer and 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	A-T.2.1.3	A	1	67% (correct answer)	22%	8%	3%
2	A-F.1	D	2	21%	18%	20%	41% (correct answer)
3	A-F.1.1.1	A	2	46% (correct answer)	9%	26%	19%
4	A-F.2	C	2	9%	17%	57% (correct answer)	17%
5	A-F.2.1.2	A	1	72% (correct answer)	11%	9%	8%
6	A-F.2.1.3	A	2	46% (correct answer)	39%	10%	5%
7	A-F.2.1.4	D	2	10%	13%	14%	63% (correct answer)
8	A-T.1.1.2	C	1	10%	27%	56% (correct answer)	7%
9	A-T.1.1.3	B	1	10%	67% (correct answer)	12%	11%
10	A-T.1.1.4	B	1	18%	55% (correct answer)	12%	15%
11	A-T.1.1.5	C	1	4%	14%	70% (correct answer)	12%
12	A-T.2.1.2 A-T.1.1.5	B	1	7%	52% (correct answer)	24%	17%
13	A-T.2.1.3 A-T.1.1.5	B	2	14%	58% (correct answer)	20%	8%

**PSSA MATHEMATICS GRADE 5**

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
14	C-G.1.1.1 C-G.1.1.2	D	1	11%	10%	7%	72% (correct answer)
15	C-G.1.1.2	A	2	66% (correct answer)	12%	10%	12%
16	C-G.2.1.1	B	2	16%	51% (correct answer)	15%	18%

**OPEN-ENDED**

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	B-O.2	4	3	1.20



# **PSSA Grade 5 Mathematics Item and Scoring Sampler**