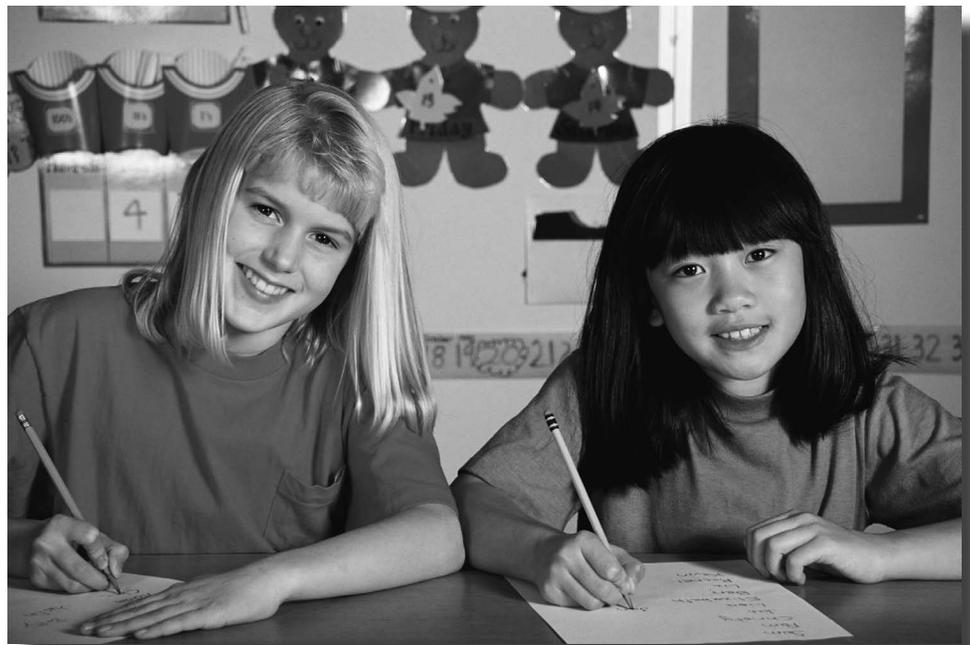




pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics Item and Scoring Sampler



2022–2023
Grade 4

TABLE OF CONTENTS

INFORMATION ABOUT MATHEMATICS	1
Introduction	1
General Introduction	1
Pennsylvania Core Standards (PCS).....	1
What Is Included	1
Purpose and Uses.....	2
Item Format and Scoring Guidelines	2
Item Alignment	2
Testing Time and Mode of Testing Delivery for the PSSA.....	3
Mathematics Reporting Categories	3
Item and Scoring Sampler Format	4
Grade 4 Protractor	5
General Description of Scoring Guidelines for Mathematics Open-Ended Items	6
Grade 4 Formula Sheet.....	7
PSSA MATHEMATICS GRADE 4	8
Mathematics Test Directions	8
Multiple-Choice Items	9
Open-Ended Question	32
Item-Specific Scoring Guideline	34
Mathematics—Summary Data	48

INTRODUCTION

General Introduction

The Pennsylvania Department of Education (PDE) 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 Anchors and Eligible Content (AAEC) 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 by providing samples of test item types and scored student responses. The item sampler is not designed to be used as a pretest, a curriculum, or any other benchmark for operational testing.

This Item and Scoring Sampler is available in Braille format. For more information regarding Braille, call (717) 901-2238.

Pennsylvania Core Standards (PCS)

This sampler contains examples of test questions designed to assess the Pennsylvania Assessment Anchors and Eligible Content aligned to the PCS. 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 PCS-aligned Assessment Anchors and Eligible Content documents are posted on this portal:

- www.education.pa.gov [Hover over “Data and Reporting,” select “Assessment and Accountability,” and select “PSSA-PA System of School Assessment.” Then select “Assessment Anchors/Eligible Content” on the right side of the screen.]

What Is Included

This sampler contains test questions, or test “items,” that have been written to align to the Assessment Anchors that are based on the PCS. The sample test questions model the types of items that may appear on an operational PSSA. Each sample test question has been through a rigorous review process to ensure alignment with the Assessment Anchors prior to being piloted in an embedded field test within a PSSA assessment and then used operationally on a PSSA assessment. Answer keys, scoring guidelines, and any related stimulus material are also included. Additionally, sample student responses are provided with each open-ended item to demonstrate the range of responses that students provided in response to these items.

Purpose and Uses

The items in this sampler may be used¹ as examples for creating assessment items at the classroom level. Classroom teachers may find it beneficial to have students respond to the open-ended (OE) item in this sampler. Educators may then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district. This sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Items* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines may be distributed to students for use during local assessments and may also be used by educators when scoring local assessments.

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 OE item is designed to take approximately ten to fifteen minutes to complete. 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.

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.

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

Testing Time and Mode of Testing Delivery for the PSSA

The PSSA is delivered in a 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. 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

During an official test administration, students are given as much additional time as is necessary to complete the test questions.

Mathematics Reporting Categories

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

• A = Numbers and Operations	• C = Geometry
• B = Algebraic Concepts	• 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 4.

- A-T = Numbers and Operations in Base Ten
- A-F = Numbers and Operations—Fractions
- B-O = Operations and Algebraic Thinking
- C-G = Geometry
- D-M = Measurement and Data

Examples of MC and OE items assessing these categories are included in this sampler.

Item and Scoring Sampler Format

This sampler includes the test directions and scoring guidelines that appear in the PSSA Mathematics assessments. Each MC item is followed by a table that includes the item alignment, the answer key, the depth of knowledge (DOK) level, the percentage² of students who chose each answer option, and a brief answer-option analysis or rationale. The OE item is followed by a table that includes the item alignment, the DOK level, and the 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 Items* 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. The student responses in this item and scoring sampler are actual student responses; however, the handwriting has been changed to protect the students' identities and to make the item and scoring sampler accessible to as many people as possible.

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 option A
p-value B	Percentage of students who selected option B
p-value C	Percentage of students who selected option C
p-value D	Percentage of students who selected option D
Option Annotations	Brief answer-option analysis or rationale

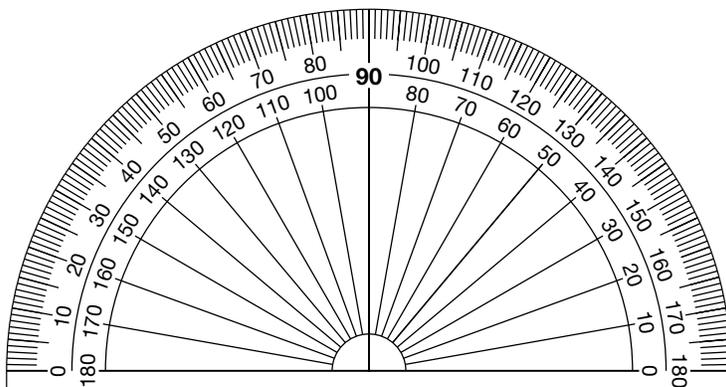
Example Open-Ended Item Information Table

Alignment	Assigned AAEC	Depth of Knowledge	Assigned DOK	Mean Score	Average Score

² All p-value percentages listed in the item information tables have been rounded.

Grade 4 Protractor

The protractor shown below is not intended to be used to measure. It has been included as a representation of the protractors that will be provided for students when they take the test. Due to differences in printers, the protractor in this sampler may not accurately reproduce to scale.



General Description of Scoring Guidelines for Mathematics Open-Ended Items

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. The 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.

The 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 4 Formula Sheet

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

2022
 Grade 4

Standard Conversions

1 yard (yd) = 3 feet (ft)

1 foot = 12 inches (in.)

1 pound (lb) = 16 ounces (oz.)

1 gallon (gal) = 4 quarts (qt)

1 quart = 2 pints (pt)

1 pint = 2 cups (c)

Metric Conversions

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

1 meter = 100 centimeters (cm)

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

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

Time Conversions

1 year (yr) = 12 months (mo)

1 year = 52 weeks (wk)

1 year = 365 days

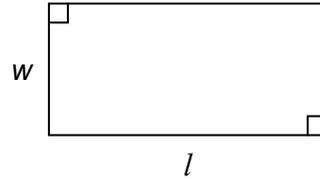
1 week = 7 days

1 day = 24 hours (hr)

1 hour = 60 minutes (min)

1 minute = 60 seconds (sec)

Rectangle



Area = length \times width

$$A = l \times w$$

Perimeter = length + length + width + width

$$P = l + l + w + w$$

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.

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

MULTIPLE-CHOICE ITEMS

1. Subtract: $5\frac{2}{5} - 2\frac{1}{5}$

A. $3\frac{1}{10}$

B. $3\frac{1}{5}$

C. $3\frac{2}{5}$

D. $3\frac{3}{5}$

Item Information	
Alignment	A-F.2.1.3
Answer Key	B
Depth of Knowledge	1
p-value A	5%
p-value B	89% (correct answer)
p-value C	3%
p-value D	3%
Option Annotations	<p>A. adds the denominators together when subtracting</p> <p>B. Correct: subtracts the whole parts as $5 - 2 = 3$ and subtracts the fractional parts as $\frac{2}{5} - \frac{1}{5} = \frac{1}{5}$ by subtracting the numerators</p> <p>C. subtracts only the whole numbers and keeps the original fractional part</p> <p>D. subtracts $5 - 2$ but then adds $\frac{2}{5} + \frac{1}{5}$</p>

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

2. Which number, when written in standard form, shows a digit with a value that is 10 times the 4 in the tens place?
- A. four thousand, three hundred forty-two
 - B. four thousand, four hundred thirty-two
 - C. five thousand, four hundred forty-three
 - D. five thousand, five hundred forty-four

Item Information	
Alignment	A-T.1.1.1 A-T.1.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	24%
p-value B	24%
p-value C	33% (correct answer)
p-value D	19%
Option Annotations	<p>A. selects a number with a digit that is 100 times the value of the 4 in the tens place</p> <p>B. selects a number with a 4 that is 10 times the value of the other 4 but does not consider that the other 4 is not in the tens place</p> <p>C. Correct: translates the word form to 5,443, identifies the value of the 4 in the hundreds place as 400, identifies the value of the 4 in the tens place as 40, and recognizes that 400 is 10 times 40</p> <p>D. selects a number with a digit that is $\frac{1}{10}$ the value of the 4 in the tens place</p>

3. When Diana bought her car, it had been driven a total of 42,753 miles. Now her car has been driven a total of 85,437 miles. Which number sentence correctly compares the number of miles the car had been driven when Diana bought it to the number of miles it has been driven since she bought it?
- A. $42,753 < 42,684$
 - B. $42,753 > 42,684$
 - C. $42,753 < 43,324$
 - D. $42,753 > 43,324$

Item Information	
Alignment	A-T.1.1.3 A-T.2.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	61% (correct answer)
p-value C	19%
p-value D	9%
Option Annotations	<p>A. determines the correct difference but either uses the wrong inequality sign (considers $<$ to mean “greater than”) OR compares the numbers starting with the ones place ($3 < 4$)</p> <p>B. Correct: subtracts 42,753 from 85,437 to get 42,684 and then identifies 42,753 as greater than 42,684 by comparing the digits in the ten thousands place ($4 = 4$), then the digits in the thousands place ($2 = 2$), and then the digits in the hundreds place ($7 > 6$)</p> <p>C. determines the difference by subtracting the low digit from the high digit for each place value and either uses the wrong inequality sign (considers $<$ to mean “greater than”) OR compares the numbers starting with the ones place ($3 < 4$)</p> <p>D. determines the difference by subtracting the low digit from the high digit for each place value (but uses the correct inequality sign)</p>

4. There were 1,289 people who attended a concert on Saturday. This is 306 more than the number of people who attended the concert on Wednesday. Which expression can be used to determine the number of people who attended the concert on Wednesday?
- A. $1,289 + 306$
 - B. $1,289 \div 306$
 - C. $1,289 \times 306$
 - D. $1,289 - 306$

Item Information	
Alignment	A-T.2.1
Answer Key	D
Depth of Knowledge	1
p-value A	34%
p-value B	5%
p-value C	8%
p-value D	53% (correct answer)
Option Annotations	<ul style="list-style-type: none"> A. selects operation based on the phrase “306 more” B. selects incorrect “reduction” operation C. selects operation based on the word “more” D. Correct: recognizes that since 306 more people attended Saturday’s concert than Wednesday’s concert, 306 must be subtracted from 1,289 to determine the number of people who attended Wednesday’s concert

5. Ms. Smith wants to replace the floors in her kitchen and her living room. The area of her kitchen floor is 120 square feet, and the area of her living room floor is 98 square feet. The table below shows the prices for different types of floor material Ms. Smith can buy.

Prices for Floor Material

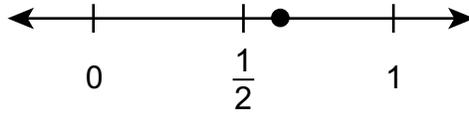
Material	Price for 1 Square Foot
bamboo	\$8
carpet	\$10
cork	\$6
laminated	\$2
wood	\$7

Ms. Smith decides to put a cork floor in her kitchen and a bamboo floor in her living room. What is the total price for the floor material Ms. Smith decides to buy?

- A. \$1,504
- B. \$1,526
- C. \$1,548
- D. \$3,052

Item Information	
Alignment	A-T.2.1.2 D-M.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	65% (correct answer)
p-value B	10%
p-value C	15%
p-value D	10%
Option Annotations	<p>A. Correct: multiplies 120 (area of kitchen) by \$6 (price for cork), multiplies 98 (area of living room) by \$8 (price for bamboo), and then adds the products \$720 and \$784</p> <p>B. multiplies the average of the costs ($6 + 8 = 14$, $14 \div 2 = 7$) by the sum of the areas ($120 + 98 = 218$)</p> <p>C. switches the cost of the two materials</p> <p>D. adds the costs ($6 + 8 = 14$) and the areas ($120 + 98 = 218$) before multiplying the two sums</p>

6. The point plotted on the number line below represents a fraction with a denominator of 8.



The fraction is less than $\frac{3}{4}$. What fraction is represented by the point on the number line?

- A. $\frac{1}{8}$
- B. $\frac{3}{8}$
- C. $\frac{5}{8}$
- D. $\frac{6}{8}$

Item Information	
Alignment	A-F.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	32%
p-value B	20%
p-value C	37% (correct answer)
p-value D	11%
Option Annotations	<p>A. selects a unit fraction with a denominator of 8 but does not consider that the fraction shown on the number line is greater than $\frac{1}{2}$</p> <p>B. selects a fraction less than $\frac{3}{4}$ but does not consider that the fraction shown on the number line is greater than $\frac{1}{2}$</p> <p>C. Correct: recognizes that $\frac{5}{8}$ is greater than $\frac{1}{2}$ and less than $\frac{3}{4}$ by first converting $\frac{1}{2}$ to $\frac{4}{8}$ (by multiplying the numerator and denominator by 4) and by converting $\frac{3}{4}$ to $\frac{6}{8}$ (by multiplying the numerator and denominator by 2) and then comparing the numerators ($5 > 4$ and $5 < 6$)</p> <p>D. selects a fraction that falls between $\frac{1}{2}$ and 1 but does not consider that it is equivalent to $\frac{3}{4}$</p>

7. Rosa and four of her friends each have some coins. The table below shows the fraction of each friend’s coins that are pennies.

Rosa’s Friends’ Coins

Friend	Fraction of Coins That Are Pennies
Greg	$\frac{4}{12}$
Helen	$\frac{3}{5}$
Isaac	$\frac{4}{8}$
Josie	$\frac{3}{10}$

Rosa has 6 pennies out of a total of 10 coins. Which friend has an equivalent fraction of coins that are pennies to the fraction Rosa has?

- A. Greg
- B. Helen
- C. Isaac
- D. Josie

Item Information	
Alignment	A-F.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	52% (correct answer)
p-value C	14%
p-value D	20%
Option Annotations	<p>A. considers that the sum of the numerator and the denominator is the same for both Greg ($4 + 12 = 16$) and Rosa ($6 + 10 = 16$)</p> <p>B. Correct: converts $\frac{3}{5}$ to $\frac{6}{10}$ by multiplying the numerator and denominator by 2 ($3 \times 2 = 6$ and $5 \times 2 = 10$)</p> <p>C. considers that the difference between the denominator and the numerator is the same for both Isaac ($8 - 4 = 4$) and Rosa ($10 - 6 = 4$)</p> <p>D. considers that the denominators are the same for both Josie and Rosa</p>

8. Some fourth-grade students ate a total of $\frac{3}{4}$ of a bag of sunflower seeds. Each student ate the same amount. Which pair of equations could show how the sunflower seeds were equally shared by the students?

- A. $\frac{6}{8} + \frac{6}{8} + \frac{6}{8} = \frac{18}{24}$ and $\frac{18}{24} = \frac{3}{4}$
- B. $\frac{3}{12} + \frac{3}{12} + \frac{3}{12} = \frac{9}{12}$ and $\frac{9}{12} = \frac{3}{4}$
- C. $\frac{6}{8} + \frac{6}{8} + \frac{6}{8} + \frac{6}{8} = \frac{24}{32}$ and $\frac{24}{32} = \frac{3}{4}$
- D. $\frac{3}{12} + \frac{3}{12} + \frac{3}{12} + \frac{3}{12} = \frac{12}{13}$ and $\frac{12}{13} = \frac{3}{4}$

Item Information	
Alignment	A-F.2.1.2 A-F.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	22%
p-value B	49% (correct answer)
p-value C	16%
p-value D	13%
Option Annotations	<p>A. adds numerators and denominators</p> <p>B. Correct: adds the numerators while leaving the common denominator and then finds an equivalent fraction by dividing the numerator and denominator by 3 ($9 \div 3 = 3$ and $12 \div 3 = 4$)</p> <p>C. adds numerators and denominators</p> <p>D. adds numerators to get 12; adds 1 more to common denominator to get a “proper” fraction; subtracts 9 from both numerator and denominator to “reduce” the fraction to $\frac{3}{4}$</p>

9. Dominic drank $1\frac{2}{10}$ cups of juice for breakfast and 0.4 cup of juice for lunch. How many cups of juice did Dominic drink in all?
- A. 0.55
 B. 0.6
 C. 1.55
 D. 1.6

Item Information	
Alignment	A-F.3.1
Answer Key	D
Depth of Knowledge	1
p-value A	7%
p-value B	10%
p-value C	12%
p-value D	71% (correct answer)
Option Annotations	<p>A. converts the fraction to an incorrect decimal equivalent (0.15) and omits the whole number</p> <p>B. omits the whole number in the conversion and adds 0.2 and 0.4</p> <p>C. converts the fraction to an incorrect decimal equivalent (1.15)</p> <p>D. Correct: converts $1\frac{2}{10}$ to 1.2 and then adds 1.2 and 0.4 OR converts 0.4 to $\frac{4}{10}$, adds $1\frac{2}{10}$ to $\frac{4}{10}$ by adding the whole parts ($1 + 0 = 1$) and the fractional parts ($\frac{2}{10} + \frac{4}{10} = \frac{6}{10}$), and then converts $1\frac{6}{10}$ to a decimal</p>

10. A number sentence comparing two expressions is shown below.

$$0.4 + 0.09 + 0.6 \square 0.4 + 0.9 + 0.6$$

Which symbol should go in the box to correctly complete the number sentence?

- A. +
- B. =
- C. <
- D. >

Item Information	
Alignment	B-O.1.1.4 A-F.3.1.3
Answer Key	C
Depth of Knowledge	1
p-value A	20%
p-value B	24%
p-value C	35% (correct answer)
p-value D	21%
Option Annotations	<p>A. assumes since the other numbers are separated by plus signs, the answer is +</p> <p>B. does not note the difference in the second term in each expression OR finds the value of each expression (1.09 and 1.9) but compares the digits after the decimal point as 09 = 9</p> <p>C. Correct: finds the value of each expression (1.09 and 1.9) and then identifies that 1.09 is less than 1.9 either by comparing the digits in the ones place (1 = 1) and then the digits in the tenths place (0 < 9) OR by expanding 1.9 to 1.90 and then comparing the digits after the decimal point (09 < 90)</p> <p>D. considers > to mean “less than”</p>

11. Tiles are placed into rows. Each tile is $\frac{1}{4}$ foot long. The pattern below shows the total length, in feet, of each row of tiles.

$$\frac{1}{4}, \frac{2}{4}, \frac{3}{4}, 1, 1\frac{1}{4}, 1\frac{2}{4}$$

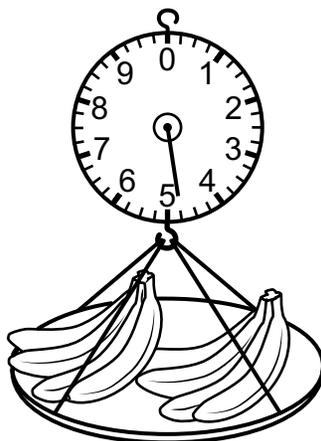
The pattern continues. How would the pattern be different if each tile was $\frac{1}{2}$ foot long?

- A. The pattern would not be different at all.
- B. Each term in the pattern would be twice as great as it is now.
- C. The pattern would start with the same first term and then skip every other term.
- D. The pattern would follow the same rule, except it would start at 1 instead of $\frac{1}{4}$.

Item Information	
Alignment	B-O.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	47% (correct answer)
p-value C	17%
p-value D	22%
Option Annotations	<p>A. does not see any difference between the two patterns</p> <p>B. Correct: recognizes that $\frac{1}{2}$ is twice as great as $\frac{1}{4}$ and that both the starting number and the rule would be twice as great, which would result in each term being twice as great</p> <p>C. intends to skip every other term but starts at the wrong term</p> <p>D. does not change the rule and starts with the second term</p>

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12. The total weight, in pounds, of two bunches of bananas is shown on the scale in the picture below.



One of the bunches of bananas weighs $2\frac{1}{4}$ pounds. How many pounds does the other bunch of bananas weigh?

- A. $\frac{2}{4}$
- B. 2
- C. $2\frac{2}{4}$
- D. 7

Item Information	
Alignment	D-M.1.1 A-F.2.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	14%
p-value B	8%
p-value C	73% (correct answer)
p-value D	5%
Option Annotations	<p>A. does not consider the whole number parts of the mixed numbers</p> <p>B. does not consider the fractional parts of the mixed numbers</p> <p>C. Correct: reads the scale as showing $4\frac{3}{4}$ pounds and then subtracts $2\frac{1}{4}$ from $4\frac{3}{4}$ by subtracting the whole parts ($4 - 2 = 2$) and the fractional parts $\left(\frac{3}{4} - \frac{1}{4} = \frac{2}{4}\right)$</p> <p>D. adds the two amounts</p>

13. Luisa started reading at 12:30. She read for 1 hour and 20 minutes. At what time did Luisa stop reading?
- A. 10 minutes after 1:00
 - B. 10 minutes before 2:00
 - C. 10 minutes after 2:00
 - D. 10 minutes before 3:00

Item Information	
Alignment	D-M.1.1.2 D-M.1.1.4
Answer Key	B
Depth of Knowledge	1
p-value A	21%
p-value B	65% (correct answer)
p-value C	8%
p-value D	6%
Option Annotations	<p>A. does not change the hour or gets 1:50 and assumes 1:00 must be in the answer</p> <p>B. Correct: recognizes that 1 hour after 12:00 is 1:00 and adds 20 minutes to :30 to get 1:50, and then recognizes this as 10 minutes before 2:00 since there are 60 minutes in an hour ($60 - 50 = 10$ minutes) and that the time has not yet reached 2:00</p> <p>C. confuses before and after 2:00</p> <p>D. counts an additional hour</p>

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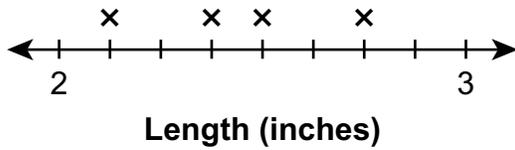
14. The lengths, in inches, of five crayons are listed below.

$$2\frac{3}{4} \quad 2\frac{1}{8} \quad 2\frac{1}{2} \quad 2\frac{1}{2} \quad 2\frac{3}{8}$$

Which line plot shows the lengths, in inches, of the five crayons?

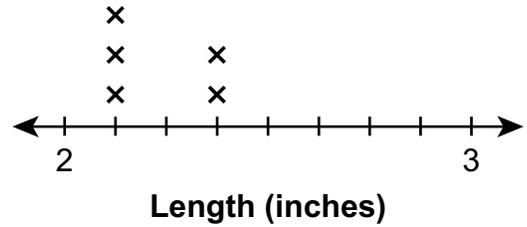
A.

Crayons



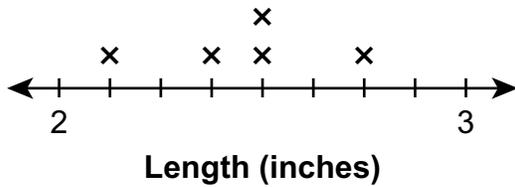
B.

Crayons



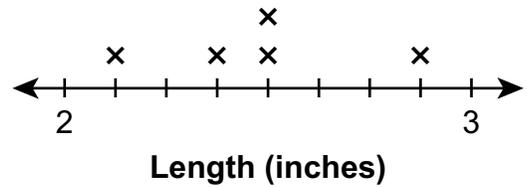
C.

Crayons



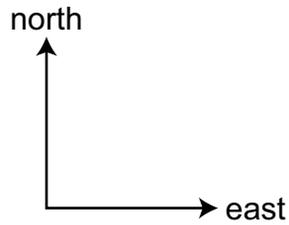
D.

Crayons



Item Information	
Alignment	D-M.2.1.1 A-F.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	8%
p-value B	19%
p-value C	46% (correct answer)
p-value D	27%
Option Annotations	<p>A. uses just one \times for each unique value</p> <p>B. uses the numerators of the fractions in the list and does not find equivalent fractions</p> <p>C. Correct: converts $2\frac{3}{4}$ to $2\frac{6}{8}$ by multiplying the numerator and denominator by 2 ($3 \times 2 = 6$ and $4 \times 2 = 8$), converts $2\frac{1}{2}$ to $2\frac{4}{8}$ by multiplying the numerator and denominator by 4 ($1 \times 4 = 4$ and $2 \times 4 = 8$), and then uses one \times for each number, including two \timess for $2\frac{4}{8}$</p> <p>D. incorrectly converts $2\frac{3}{4}$ to $2\frac{7}{8}$ (adds 4 to the numerator and denominator)</p>

15. Ryan and Tom are standing next to each other. Ryan walks north in a straight line. Tom walks east in a straight line.



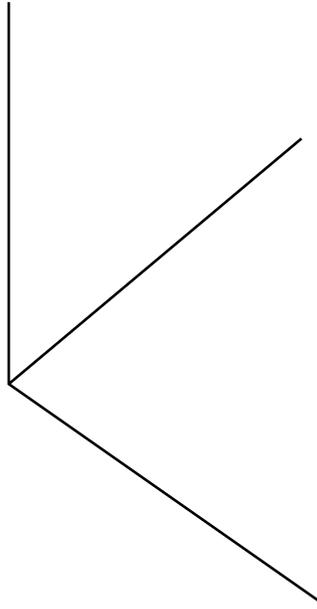
What angle is formed by their walking paths?

- A. acute
- B. obtuse
- C. right
- D. straight

Item Information	
Alignment	D-M.3
Answer Key	C
Depth of Knowledge	2
p-value A	6%
p-value B	6%
p-value C	84% (correct answer)
p-value D	4%
Option Annotations	<ul style="list-style-type: none"> A. confuses acute for a right angle B. confuses obtuse for a right angle C. Correct: identifies an angle as a right angle when one ray is horizontal and the other ray is vertical D. confuses a straight angle for a right angle

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16. The diagram below shows three line segments that meet at one point.



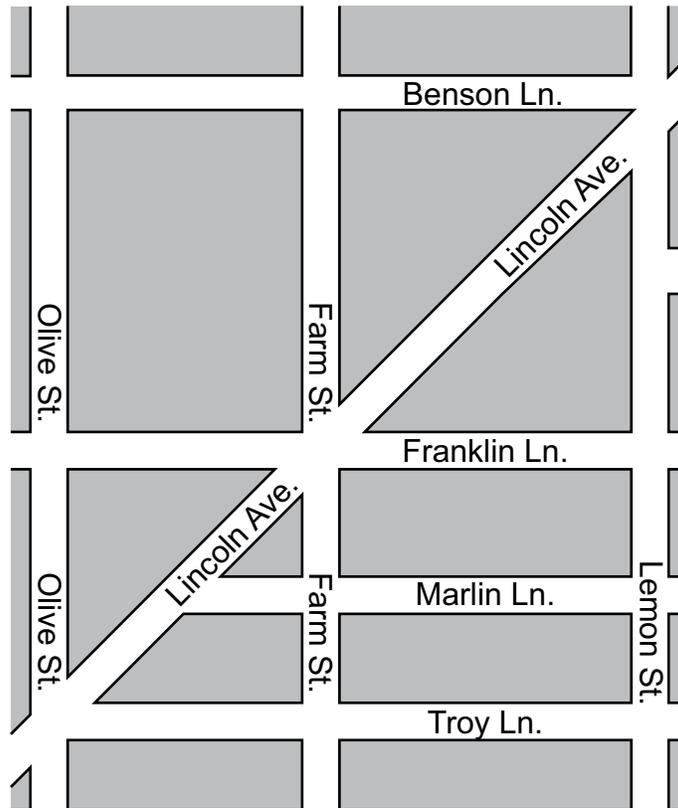
Using your protractor, what is the measure of the obtuse angle created by two of the line segments?

- A. 50°
- B. 75°
- C. 105°
- D. 125°

Item Information	
Alignment	D-M.3.1.1 C-G.1.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	15%
p-value B	13%
p-value C	17%
p-value D	55% (correct answer)
Option Annotations	<p>A. measures the smallest angle</p> <p>B. associates “obtuse” with “larger” and measures the larger of the two acute angles</p> <p>C. measures the larger acute angle and reads the protractor incorrectly, knowing the answer must be greater than 90</p> <p>D. Correct: lines up the 0° line on the protractor with the vertical line segment, placing the center of the protractor at the point of intersection, and then reads the outer number that the lower right line segment passes through OR lines up the 0° line on the protractor with the lower right line segment, placing the center of the protractor at the point of intersection, and then reads the inner number that the vertical line segment passes through</p>

OPEN-ENDED QUESTION

17. A map is shown below.



There are right triangles shown on the map.

A. List three roads that form a right triangle.

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Go to the next page to finish question 17.



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

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

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



Item-Specific Scoring Guideline

#17 Item Information

Alignment	C-G.1.1.1 C-G.1.1.2 C-G.1.1.3	Depth of Knowledge	2	Mean Score	1.81
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Assessment Anchor this item will be reported under:

M04.C-G.1 — Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Specific Anchor Descriptor addressed by this item:

M04.C-G.1.1 — List properties, classify, draw, and identify geometric figures in two dimensions.

Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of drawing and identifying lines and angles and classifying shapes by properties of their lines and angles by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of drawing and identifying lines and angles and classifying shapes by properties of their lines and angles by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of drawing and identifying lines and angles and classifying shapes by properties of their lines and angles by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of drawing and identifying lines and angles and classifying shapes by properties of their lines and angles.
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. The 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 drawing and identifying lines and angles and classifying shapes by properties of their lines and angles.
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?
<p>Students must have 1 of these 8 combinations (order does not matter):</p> <ul style="list-style-type: none"> • Olive St., Benson Ln., Lincoln Ave. • Olive St., Franklin Ln., Lincoln Ave. • Farm St., Benson Ln., Lincoln Ave. • Farm St., Troy Ln., Lincoln Ave. • Farm St., Marlin Ln., Lincoln Ave. • Lemon St., Troy Ln., Lincoln Ave. • Lemon St., Marlin Ln., Lincoln Ave. • Lemon St., Franklin Ln., Lincoln Ave. 	

Part B (1 point):

1 point for correct answer

OR $\frac{1}{2}$ point for 2 correct roads and no incorrect roads

What?	Why?
Marlin Ln., Franklin Ln., Benson Ln. (order does not matter)	

Part C (1 point):

1 point for correct answer

What?	Why?
Lincoln Ave.	

Part D (1 point):

1 point for correct and complete explanation

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

What?	Why?
	<p>Sample Explanation: The reason the map does not have a line of symmetry is because the roads on the map are not set up symmetrically.</p> <p>OR</p> <p>The reason the map does not have a line of symmetry is because the left side and the right side of the map are not mirror images, and the top half and the bottom half of the map are not mirror images.</p> <p>OR equivalent</p>

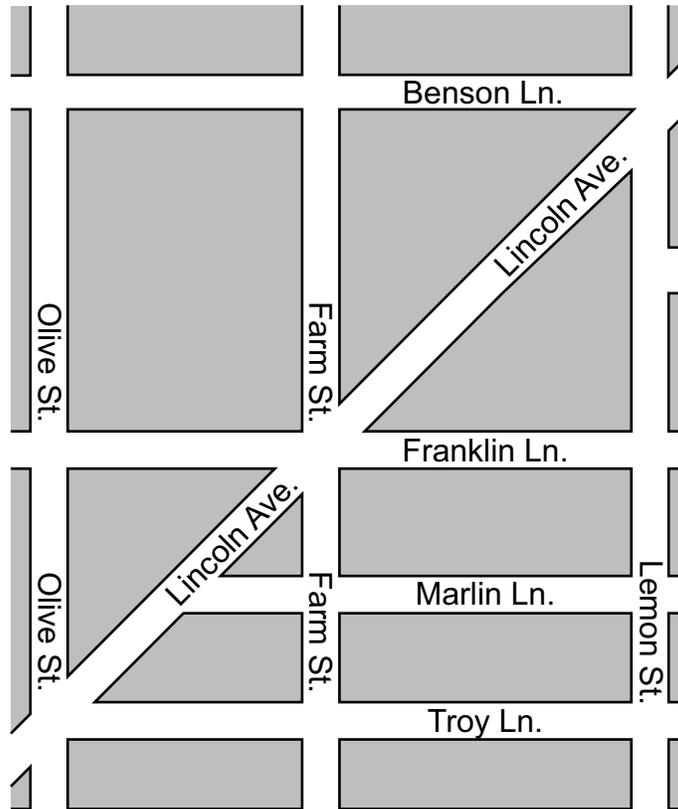
Note: Throughout the item, students should not lose any credit for not including or for misidentifying Ave., Ln., or St.

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STUDENT RESPONSE

Response Score: 4 points

17. A map is shown below.



There are right triangles shown on the map.

A. List three roads that form a right triangle.

Lemon st. lincoln Ave.
Franklin Ln.

The student provided a correct combination of three named roads on the map that form the three sides of a right triangle (*Lemon st.*, *lincoln Ave.*, *Franklin Ln.*). [1 point]

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Marlin Ln. Franklin Ln.
Benson Ln.

The student correctly named the three roads that run parallel to Troy Ln. (*Marlin Ln.*, *Franklin Ln.*, *Benson Ln.*). [1 point]

Go to the next page

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

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

Lincoln Ave.

The student provided a correct answer (*Lincoln Ave.*) that proves Jack's claim is not correct, since Lincoln Ave. intersects Farm St. and is not perpendicular to it. [1 point]

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

It does not have a line of symmetry because if you were to split the map in half any way the roads aren't the same

The student provided a correct and complete explanation of why the map does not have a line of symmetry (*if you were to split the map in half any way the roads aren't the same*). [1 point]

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



STUDENT RESPONSE

Response Score: 3 points



PARTS A and B

Question 17
Page 1 of 2

Item ID

?

A map is shown below.

There are right triangles shown on the map.

A. List three roads that form a right triangle.

Lincoln Ave., Farm St., Franklin Ln.

The three-road combination provided by the student (*Lincoln Ave., Farm St., Franklin Ln.*) does not form the three sides of a right triangle. [0 points]

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Marlin Ln., Franklin Ln., Benson Ln.

The student correctly named the three roads that run parallel to Troy Ln. (*Marlin Ln., Franklin Ln., Benson Ln.*). [1 point]

Line Guide

Calculator

Ruler

Eraser

Highlighter

Arrow

Options

Flag

Pause

Review/End Test

Next

PARTS C and D

Question 17
Page 2 of 2

Item ID

?

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

Lincoln Ave.

The student provided a correct answer (*Lincoln Ave.*) that proves Jack's claim is not correct, since Lincoln Ave. intersects Farm St. and is not perpendicular to it. [1 point]

EO

EO

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

The way the map is separated by the streets makes no lines of symmetry.

The student provided a correct and complete explanation of why the map does not have a line of symmetry (*The way the map is separated by the streets makes no lines of symmetry.*). [1 point]

EO

Options

Flag

Pause

Review/End Test

Back

Next

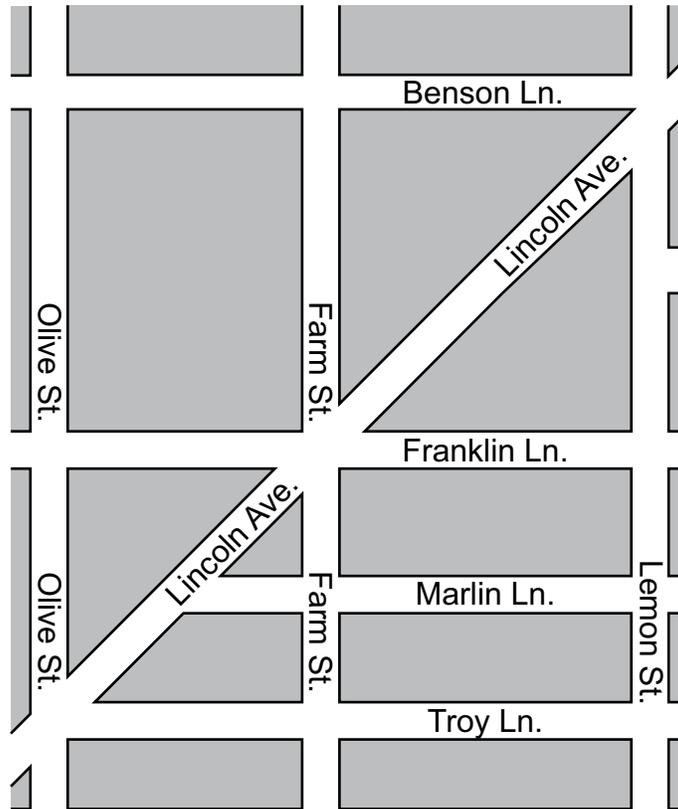
71 / 1000

A map is shown below.

STUDENT RESPONSE

Response Score: 2 points

17. A map is shown below.



There are right triangles shown on the map.

A. List three roads that form a right triangle.

olive st.
franklin Ln.
Lincoln Ave.

The student provided a correct combination of three named roads on the map that form the three sides of a right triangle (*Olive St.*, *Lincoln Ave.*, *franklin Ln.*). [1 point]

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Leman st. fram st.

The student provided an incorrect answer (*Lemon st.* and *fram st.*). These two roads run perpendicular to Troy Ln., not parallel. The incorrect spelling of "Farm St." is acceptable. [0 points]

Go to the next page to finish question 17.



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

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

Lincoln Ave.

The student provided a correct answer (*Lincoln Ave.*) that proves Jack's claim is not correct, since Lincoln Ave. intersects Farm St. and is not perpendicular to it. [1 point]

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

Because Lincoln Ave. is going across the Mirdden of it But it is not touching the conerners.

The explanation provided (*Because Lincoln Ave. is going across the Mirdden [middle] of it But it is not touching the conerners [corners]*) is incorrect and does not explain why the map does not have a line of symmetry. [0 points]

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



STUDENT RESPONSE

Response Score: 1 point



PARTS A and B

Question 17
Page 1 of 2

Item ID

?

There are right triangles shown on the map.

A. List three roads that form a right triangle.

Franklin Ln.
Troy Ln.
Olive St.

The three-road combination provided by the student (*Franklin Ln., Troy Ln., Olive St.*) does not form the three sides of a right triangle. Additionally, Franklin Ln. and Troy Ln. are parallel to each other and could not be two of three sides of a right triangle. [0 points]

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Marlin Ln.
Franklin Ln.

The student provided a partially correct answer of two of the three roads that run parallel to Troy Ln. (*Marlin Ln., Franklin Ln.*), without including any incorrect roads. The student did not include Benson Ln., which is needed for full credit. [0.5 points]

A map is shown below.

Line Guide

←

↶

↷

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↺

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↻

↺

Options

Flag

Pause

Review/End Test

Next

PARTS C and D

Question 17
Page 2 of 2

Item ID ?

Line Guide

Calculator

Ruler

Eraser

Highlighter

Flag

Pause

Review/End Test

A map is shown below.

Options

Flag

Pause

Review/End Test

Back

Next

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

Olive St does because it is stright Up and down

The student provided an incorrect answer (Olive St). Although Olive St. is not perpendicular to Farm St., it does not intersect Farm St., which neither supports Jack's claim nor proves it is not correct. [0 points]

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

Because all the roads are facing a different way.

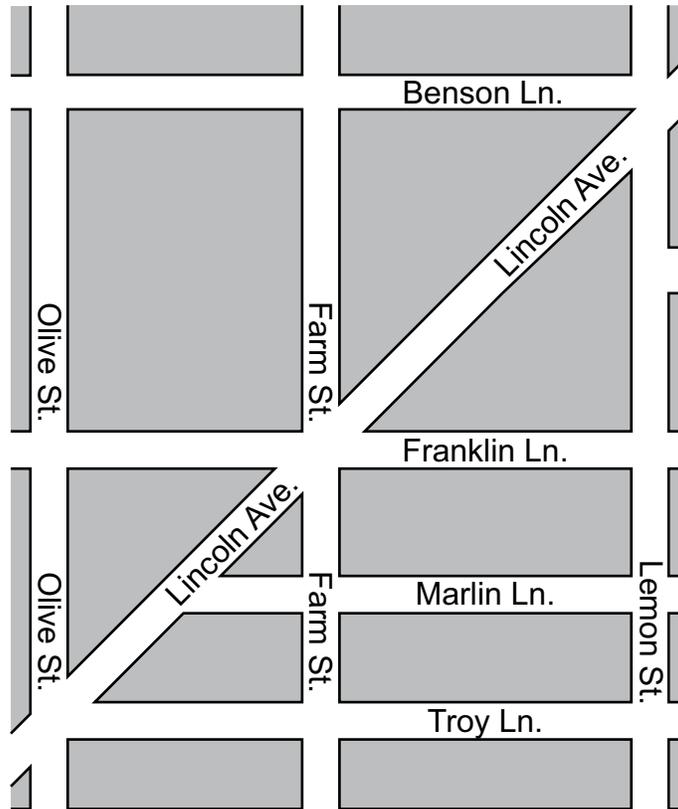
The explanation provided (Because all the roads are facing a different way) is incorrect and does not explain why the map does not have a line of symmetry. [0 points]

48 / 1000

STUDENT RESPONSE

Response Score: 0 points

17. A map is shown below.



There are right triangles shown on the map.

A. List three roads that form a right triangle.

farm st. Troy Ln. Lemon st.

The three-road combination provided by the student (*farm St., Troy Ln., Lemon St.*) does not form the three sides of a right triangle. While Farm St. and Troy Ln. form a right angle, Lemon St. is not a road that would form a right triangle with these two roads. Similarly, Lemon St. and Troy Ln. form a right angle, but Farm St. is not a road that would form a right triangle with these two roads. [0 points]

There are roads that run parallel to Troy Ln. shown on the map.

B. List all the roads that run parallel to Troy Ln.

Lincoln Ave. Franklin Ln. Olive st

The student's answer provided only one correct road (*Franklin Ln.*) with two incorrect roads (*Lincoln Ave., Olive St*). An answer with incorrect roads does not earn any credit. [0 points]

Go to the next page to finish question 17.



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

Jack claims that Farm St. is perpendicular to every road it intersects on the map.

C. Which road proves that Jack's claim is **not** correct?

Farm. St. in intersects
with troy Ln.

The student provided an incorrect answer (*troy Ln.*). Although Troy Ln. intersects Farm St., it is perpendicular to Farm St., which supports Jack's claim as opposed to identifying a road that would prove Jack's claim is not correct. [0 points]

D. Explain why the map does not have a line of symmetry even though it is in the shape of a rectangle.

becace a rectangle
can have a line of
siymmetry

The explanation provided (*becace a rectangle can have a line of siymmetry*) is incorrect and does not explain why the map does not have a line of symmetry. [0 points]

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



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-F.2.1.3	B	1	5%	89%	3%	3%
2	A-T.1.1.1 A-T.1.1.2	C	2	24%	24%	33%	19%
3	A-T.1.1.3 A-T.2.1.1	B	2	11%	61%	19%	9%
4	A-T.2.1	D	1	34%	5%	8%	53%
5	A-T.2.1.2 D-M.2.1	A	2	65%	10%	15%	10%
6	A-F.1.1	C	2	32%	20%	37%	11%
7	A-F.1.1.1	B	2	14%	52%	14%	20%
8	A-F.2.1.2 A-F.1.1.1	B	2	22%	49%	16%	13%
9	A-F.3.1	D	1	7%	10%	12%	71%
10	B-O.1.1.4 A-F.3.1.3	C	1	20%	24%	35%	21%
11	B-O.3.1	B	2	14%	47%	17%	22%
12	D-M.1.1 A-F.2.1.3	C	2	14%	8%	73%	5%
13	D-M.1.1.2 D-M.1.1.4	B	1	21%	65%	8%	6%
14	D-M.2.1.1 A-F.1.1.1	C	2	8%	19%	46%	27%
15	D-M.3	C	2	6%	6%	84%	4%
16	D-M.3.1.1 C-G.1.1.1	D	1	15%	13%	17%	55%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	C-G.1.1.1 C-G.1.1.2 C-G.1.1.3	4	2	1.81

PSSA Grade 4 Mathematics Item and Scoring Sampler

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