



pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics Item and Scoring Sampler



2022–2023
Grade 5

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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.

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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 5.

- 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.

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 5 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 5

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)

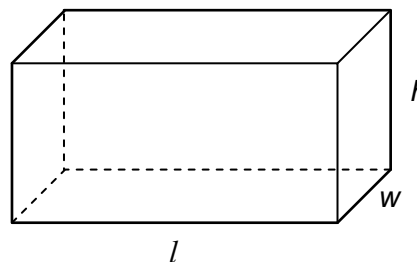
1 kilogram (kg) = 1,000 grams (g)

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)

Rectangular Prism



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

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

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

Volume = area of the base × 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

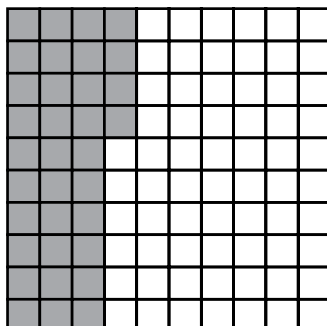
1. Multiply: 372×108

- A. 6,696
- B. 39,666
- C. 40,176
- D. 282,816

Item Information	
Alignment	A-T.2.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	21%
p-value B	11%
p-value C	64% (correct answer)
p-value D	4%
Option Annotations	<ul style="list-style-type: none"> A. aligns partial products incorrectly ($2,976 + 3,720$) B. does not regroup when multiplying ($2,466 + 37,200$) C. Correct: using the standard algorithm, multiplies 372 by 8 and 372 by 100, and then adds the partial products ($2,976 + 37,200$) D. strings products together when multiplying 372 by 8 ($245,616 + 37,200$)

A calculator is permitted for use in solving questions 2–16 in this sampler.

2. The 10-by-10 grid shown below represents one whole.



The decimal number q is represented by the shaded part of the grid. Which statement correctly compares the value of q with two other numbers?

- A. The value of q is greater than 0.1 and less than 0.305.
- B. The value of q is greater than 0.305 and less than 0.35.
- C. The value of q is greater than 0.35 and less than 0.675.
- D. The value of q is greater than 0.675 and less than 3.5.

Item Information	
Alignment	A-T.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	31%
p-value B	39% (correct answer)
p-value C	18%
p-value D	12%
Option Annotations	<p>A. uses 0.34 as the value of q, but thinks $0.34 < 0.305$ because $34 < 305$</p> <p>B. Correct: identifies 0.34 as the value of q since 34 of 100 squares are shaded, compares 0.34 to 0.305 either by comparing the digits in the tenths place ($3 = 3$) and then the digits in the hundredths place ($4 > 0$) OR by expanding 0.34 to 0.340 and then comparing the digits after the decimal point ($340 > 305$), and compares 0.34 to 0.35 either by comparing the digits in the tenths place ($3 = 3$) and then the digits in the hundredths place ($4 < 5$) OR by comparing the digits after the decimal point ($34 < 35$)</p> <p>C. counts unshaded instead of shaded and uses 0.66 as decimal</p> <p>D. interprets shaded as 3.4</p>

3. Four number sentences are shown below, some of which are not true.

$$436.04 = 444.03$$

$$236.76 = 235.84$$

$$505.64 > 505.55$$

$$325.64 > 325.54$$

Each number is rounded to the nearest tenth. The comparison symbol in each number sentence remains the same. Which number sentence is rounded correctly and is true?

- A. The number sentence $436.04 = 444.03$ becomes $440 = 440$.
- B. The number sentence $236.76 = 235.84$ becomes $236.8 = 235.8$.
- C. The number sentence $505.64 > 505.55$ becomes $505.6 > 505.5$.
- D. The number sentence $325.64 > 325.54$ becomes $325.6 > 325.5$.

Item Information	
Alignment	A-T.1.1.5 A-T.1.1.4
Answer Key	D
Depth of Knowledge	2
p-value A	23%
p-value B	17%
p-value C	21%
p-value D	39% (correct answer)
Option Annotations	<p>A. rounds to the nearest ten instead of to the nearest tenth</p> <p>B. after rounding correctly, compares only the digits in the tenths place and does not compare the whole number parts of the numbers</p> <p>C. rounds both numbers down</p> <p>D. Correct: rounds 325.64 down to 325.6 based on the 4 in the hundredths place, rounds 325.54 down to 325.5 based on the 4 in the hundredths place, and then compares 325.6 to 325.5 by comparing the digits in the hundreds place ($3 = 3$), then the digits in the tens place ($2 = 2$), then the digits in the ones place ($5 = 5$), and then the digits in the tenths place ($6 > 5$)</p>

4. Serena has one large and one small beehive. Information about the hives and the bees living in each hive is listed below.
- There are 1,050 bees living in the large hive.
 - The number of bees living in the small hive is 0.7 times the number of bees living in the large hive.
 - The bees living in the small hive visit 2,500 flowers each day.
 - The bees living in the large hive visit 0.8 times the number of flowers visited each day by the bees living in the small hive.

Which statement about the bees is true?

- A. There are 8,400 bees living in the two hives.
- B. There are 1,057 bees living in the small hive.
- C. The bees living in the two hives visit 2,508 flowers each day.
- D. The bees living in the large hive visit 2,000 flowers each day.

Item Information	
Alignment	A-T.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	13%
p-value B	13%
p-value C	16%
p-value D	58% (correct answer)
Option Annotations	A. calculates $1,050 \times 7 + 1,050$ B. calculates $1,050 + 7$ C. calculates $2,500 + 8$ D. Correct: determines the number of flowers the bees living in the large hive visit each day by multiplying the number of flowers the bees living in the small hive visit each day by 0.8 ($2,500 \times 0.8$)

5. Which step should be performed first when subtracting $\frac{1}{5}$ from $\frac{5}{7}$?
- A. Subtract 1 from 5.
 - B. Invert the fraction $\frac{1}{5}$.
 - C. Find a common denominator by adding 5 and 7.
 - D. Find a common denominator by multiplying 5 and 7.

Item Information	
Alignment	A-F.1
Answer Key	D
Depth of Knowledge	1
p-value A	7%
p-value B	9%
p-value C	10%
p-value D	74% (correct answer)
Option Annotations	<ul style="list-style-type: none"> A. subtracts the numerators without finding a common denominator B. confuses the process with division C. adds the given denominators D. Correct: recognizes that fractions cannot be subtracted without first finding a common denominator and that a common denominator can be found by multiplying the two given denominators

6. Aaron's fish bowl contains $2\frac{3}{5}$ gallons of water. Bryan's fish bowl contains $1\frac{7}{8}$ gallons of water. How many more gallons of water does Aaron's fish bowl contain than Bryan's fish bowl?
- A. $\frac{11}{40}$
- B. $\frac{2}{3}$
- C. $\frac{29}{40}$
- D. $\frac{4}{3}$

Item Information	
Alignment	A-F.1.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	12%
p-value B	9%
p-value C	71% (correct answer)
p-value D	8%
Option Annotations	<p>A. subtracts $\frac{3}{5}$ from $\frac{7}{8}$</p> <p>B. changes to improper fractions and subtracts without a common denominator $\left(\frac{15}{8} - \frac{13}{5}\right)$</p> <p>C. Correct: converts $2\frac{3}{5}$ to an improper fraction by multiplying 2 by 5 and then adding 3 for the numerator $\left(2\frac{3}{5} = \frac{2 \times 5 + 3}{5} = \frac{13}{5}\right)$, converts $1\frac{7}{8}$ to an improper fraction by multiplying 1 by 8 and then adding 7 for the numerator $\left(1\frac{7}{8} = \frac{1 \times 8 + 7}{8} = \frac{15}{8}\right)$, multiplies $\frac{13}{5}$ by $\frac{8}{8}$ and multiplies $\frac{15}{8}$ by $\frac{5}{5}$ to get equivalent fractions with a common denominator $\left(\frac{13 \times 8}{5 \times 8} = \frac{104}{40}$ and $\frac{15 \times 5}{8 \times 5} = \frac{75}{40}\right)$, and then subtracts $\frac{75}{40}$ from $\frac{104}{40}$</p> <p>D. calculates $\frac{7-3}{8-5}$</p>

7. Which story matches the expression $(18 - 3 \times 4) \div 2$?
- A. Ed had \$18. He bought a pen for \$3 and 4 pencils for \$2 each.
 - B. Ed had \$18. He bought 3 pens for \$4 each and gave \$2 to his sister.
 - C. Ed had \$18. He gave half the money away and then bought 3 pens for \$4 each.
 - D. Ed had \$18. He bought 3 pens for \$4 each and then shared the rest of the money equally with his sister.

Item Information	
Alignment	B-O.1
Answer Key	D
Depth of Knowledge	2
p-value A	18%
p-value B	19%
p-value C	9%
p-value D	54% (correct answer)
Option Annotations	<p>A. misinterprets the operation of the multiplication and division symbols</p> <p>B. misinterprets the operation of the division symbol</p> <p>C. tries to apply the division symbol first, then the multiplication symbol</p> <p>D. Correct: identifies a story in which 3 is multiplied by 4 (“3 pens for \$4 each”) before subtracting the product from 18 (“Ed had \$18 . . . the rest of the money”), with the difference being divided by 2 (“shared . . . equally with his sister”)</p>

8. When finding the value of the expression $81 - (24 \div 3 \times 2) + 18$, which operation should be completed first?
- A. $81 - 24$
 - B. $24 \div 3$
 - C. 3×2
 - D. $2 + 18$

Item Information	
Alignment	B-O.1.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	9%
p-value B	61% (correct answer)
p-value C	27%
p-value D	3%
Option Annotations	<p>A. performs the operations from left to right and does not consider the grouping symbols</p> <p>B. Correct: recognizes that the operations inside the grouping symbols should be completed first, identifies that division and multiplication are equal in the order of operations, and performs the operations from left to right within the grouping symbols, starting with division</p> <p>C. incorrectly considers that multiplication should be performed prior to division</p> <p>D. reverses the order of operations (adds/subtracts first) and does not consider the grouping symbols</p>

9. Andrew has $3\frac{1}{2}$ liters of juice. For a party, he needs $1\frac{1}{2}$ times the amount of juice he has already. The expression shown below represents the total amount of juice, in liters, Andrew needs, but one number is missing.

$$\left(3 + \frac{1}{2}\right)\left(\square + \frac{1}{2}\right)$$

What number should go into the box so the expression represents the total amount of juice, in liters, Andrew needs?

- A. $\frac{1}{4}$
- B. 1
- C. $1\frac{1}{2}$
- D. 3

Item Information	
Alignment	B-O.1.1.2
Answer Key	B
Depth of Knowledge	1
p-value A	8%
p-value B	68% (correct answer)
p-value C	13%
p-value D	11%
Option Annotations	<p>A. finds the product of the two fractional parts of the mixed numbers</p> <p>B. Correct: recognizes that a mixed number is the sum of the whole part and the fractional part, identifying the second factor as $1 + \frac{1}{2}$</p> <p>C. does not notice that the $3\frac{1}{2}$ has been rewritten as a sum and selects the other mixed number</p> <p>D. sees the two $\frac{1}{2}$s and thinks there should be two 3s as well</p>

10. The first five values in a number pattern are represented by the expressions below.

$$4 \times 1 \quad 4 \times 2 \quad 4 \times 3 \quad 4 \times 4 \quad 4 \times 5$$

The pattern continues. How many values in the pattern are **less** than 100?

- A. 19
- B. 24
- C. 25
- D. 99

Item Information	
Alignment	B-O.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	16%
p-value B	51% (correct answer)
p-value C	23%
p-value D	10%
Option Annotations	<p>A. focuses on 4×5 in last expression and uses “the term number times 5” rather than “4 times the term number,” identifies the value of the 20th term as $20 \times 5 = 100$, and determines that 19 values in the pattern are less than 100</p> <p>B. Correct: recognizes that each term is 4 times the term number, identifies the value of the 25th term as $4 \times 25 = 100$, and determines that 24 values in the pattern are less than 100</p> <p>C. identifies the value of the 25th term as $4 \times 25 = 100$ but does not consider “less than 100”</p> <p>D. recognizes that 99 values from 1–99 are less than 100 and does not consider the pattern expressions and focuses on term 1, term 2, term 3, etc.</p>

11. Julian has 4 videos. Each video is the same length. The total time for all of the videos is 300 **seconds**. How many **minutes** long is each video?
- A. 0.8 minute
 - B. 1.25 minutes
 - C. 20 minutes
 - D. 75 minutes

Item Information	
Alignment	D-M.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	6%
p-value B	36% (correct answer)
p-value C	23%
p-value D	35%
Option Annotations	<p>A. calculates $4 \times 60 \div 300$</p> <p>B. Correct: determines the number of seconds per video by dividing the total time by the number of videos ($300 \div 4 = 75$) and then converts from seconds to minutes by dividing the time per video by 60 ($75 \div 60 = 1.25$) OR converts the total time from seconds to minutes by dividing the number of seconds by 60 ($300 \div 60 = 5$) and then determines the number of minutes per video by dividing the converted time by the number of videos ($5 \div 4 = 1.25$)</p> <p>C. calculates $4 \times 300 \div 60$</p> <p>D. divides 300 by 4 but does not convert from seconds to minutes</p>

12. A runner drinks $\frac{1}{2}$ pint of water during a race. How many gallons of water does the runner drink during the race?
- A. $\frac{1}{16}$ gallon
 - B. $\frac{1}{10}$ gallon
 - C. $\frac{1}{8}$ gallon
 - D. $\frac{1}{4}$ gallon

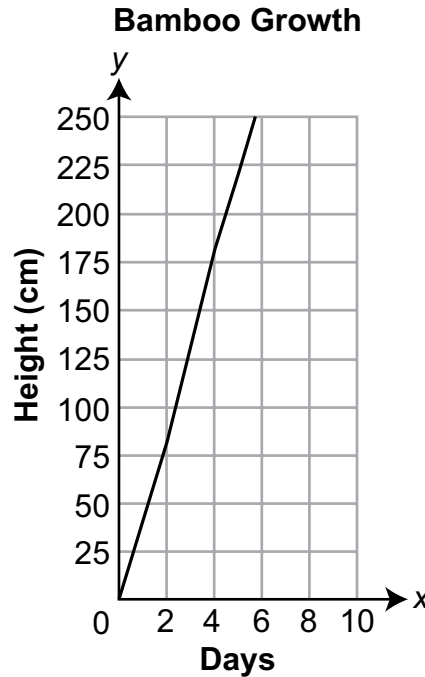
Item Information	
Alignment	D-M.1.1.1
Answer Key	A
Depth of Knowledge	1
p-value A	34% (correct answer)
p-value B	8%
p-value C	29%
p-value D	29%
Option Annotations	<p>A. Correct: converts the amount of water from pints to quarts by dividing the number of pints by 2 ($\frac{1}{2} \div 2 = \frac{1}{4}$) and then converts the amount of water from quarts to gallons by dividing the number of quarts by 4 ($\frac{1}{4} \div 4 = \frac{1}{16}$) OR uses the reference sheet to identify that 2 pints = 1 quart and 4 quarts = 1 gallon to determine that 8 pints = 1 gallon and then converts the amount of water from pints to gallons by dividing the number of pints by 8 ($\frac{1}{2} \div 8 = \frac{1}{16}$)</p> <p>B. determines that 8 pints = 1 gallon, which means 1 pint = $\frac{1}{8}$ gallon, but converts from pints to gallons by adding the denominators ($\frac{1}{2} + \frac{1}{8} = \frac{1}{2+8}$)</p> <p>C. divides by 4 (converts from quarts to gallons or converts using $\frac{1}{2}$ for each conversion)</p> <p>D. divides by 2 (converts from pints to quarts)</p>

13. The table below shows the recorded height of a bamboo plant after several days of growth.

Bamboo Growth

Days	2	4	6	8	10
Height (cm)	82	181	264	318	348

The line graph below was made to display the data from the table, but not all the data fit on the graph.



Which change would allow all the data from the table to fit on the graph without changing the size of the grid?

- A. for the x-axis, using a scale of 1 instead of a scale of 2
- B. for the x-axis, using a scale of 3 instead of a scale of 2
- C. for the y-axis, using a scale of 15 instead of a scale of 25
- D. for the y-axis, using a scale of 35 instead of a scale of 25

Item Information	
Alignment	D-M.2.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	15%
p-value B	17%
p-value C	20%
p-value D	48% (correct answer)
Option Annotations	<p>A. does not realize that less of the data would be displayed (the graph would not extend past day 5)</p> <p>B. does not realize that this would not change the amount of data displayed on the graph (the graph would extend to day 15, which is not necessary)</p> <p>C. recognizes that the y-axis should change but does not realize that less of the data would be displayed</p> <p>D. Correct: recognizes that using a scale of 35 for the y-axis would change the values from 0, 25, 50, . . . , 250 to 0, 35, 70, . . . , 350, which would allow the greatest height from the table (348 cm) to be displayed on the graph without changing the size of the grid</p>




14. The table below shows the number of pizzas served during lunch at a school cafeteria over three days.

Pizzas Served in Cafeteria

Day	Number of Pizzas Served
Wednesday	$2\frac{1}{2}$
Thursday	3
Friday	6




Which pictograph represents the data shown in the table?

A. Pizzas Served in Cafeteria

Day	Number of Pizzas Served
Wednesday	
Thursday	
Friday	




Key:  = 2 pizzas

B. Pizzas Served in Cafeteria

Day	Number of Pizzas Served
Wednesday	
Thursday	
Friday	




Key:  = 2 pizzas

C. Pizzas Served in Cafeteria

Day	Number of Pizzas Served
Wednesday	
Thursday	
Friday	

Key:  = 2 pizzas

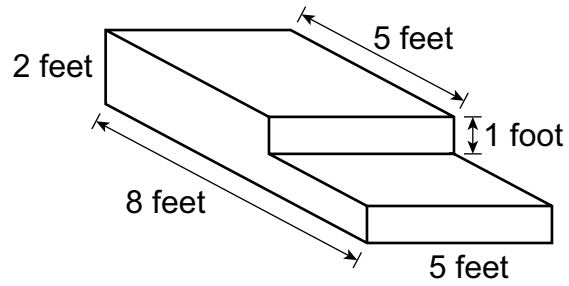
D. Pizzas Served in Cafeteria

Day	Number of Pizzas Served
Wednesday	
Thursday	
Friday	

Key:  = 2 pizzas

Item Information	
Alignment	D-M.2.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	28%
p-value B	8%
p-value C	18%
p-value D	46% (correct answer)
Option Annotations	<p>A. does not apply the key (uses 1 “pizza” = 1 pizza)</p> <p>B. uses a half “pizza” for both the odd number of pizzas (3) and the half pizza $\left(2 \frac{1}{2}\right)$</p> <p>C. switches the number of pizzas for Wednesday and Thursday</p> <p>D. Correct: applies the key to each value in the table, using a half “pizza” for the odd number of pizzas (3) and a quarter “pizza” for the half pizza $\left(2 \frac{1}{2}\right)$</p>

15. A set of stairs is being made from concrete. A picture of the stairs is shown below.



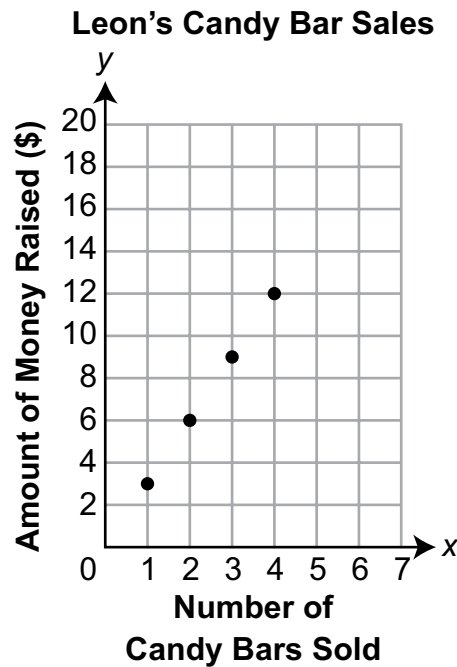
What is the volume, in cubic feet, of the set of stairs?

- A. 21
- B. 65
- C. 80
- D. 120

Item Information	
Alignment	D-M.3.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	29%
p-value B	36% (correct answer)
p-value C	22%
p-value D	13%
Option Annotations	<p>A. finds the sum of the numbers shown</p> <p>B. Correct: separates the figure into a 2-by-5-by-5 rectangular prism and a 1-by-3-by-5 rectangular prism, determines the partial volumes to be $2 \times 5 \times 5 = 50$ cubic feet and $1 \times 3 \times 5 = 15$ cubic feet, and then adds the partial volumes OR separates the figure into a 1-by-5-by-5 rectangular prism and a 1-by-8-by-5 rectangular prism, determines the partial volumes to be $1 \times 5 \times 5 = 25$ cubic feet and $1 \times 8 \times 5 = 40$ cubic feet, and then adds the partial volumes OR determines the volume of the “greater” rectangular prism to be $2 \times 8 \times 5 = 80$ cubic feet and then subtracts the volume of the upper-right 1-by-3-by-5 “missing” rectangular prism ($1 \times 3 \times 5 = 15$ cubic feet)</p> <p>C. determines the volume of the “greater” rectangular prism ($2 \times 8 \times 5$)</p> <p>D. calculates $(8 \times 2 \times 5) + (8 \times 1 \times 5)$, using 8 as the length for both parts</p>

OPEN-ENDED QUESTION

16. Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.



The pattern continues.

- A.** Which axis represents the number of candy bars sold?

- B.** Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(_____, _____)

Go to the next page to finish question 16.



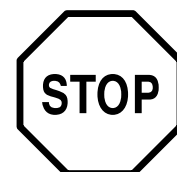
16. **Continued.** Please refer to the previous page for task explanation.

- C. Explain why it is **not** possible for any of the points on the graph to have a y -coordinate of 77.

Last year, Leon raised a total of \$240 from his candy bar sales. This year, his goal is to raise at least 2.5 times that amount.

- D. What is the **fewest** candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.

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

#16 Item Information

Alignment	C-G.1.1 A-T.2.1.3 D-M.2.1	Depth of Knowledge	2	Mean Score	1.36
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Assessment Anchor this item will be reported under:

M05.C-G.1 – Graph points on the coordinate plane to solve real-world and mathematical problems.

Specific Anchor Descriptor addressed by this item:

M05.C-G.1.1 – Identify parts of a coordinate grid and describe or interpret points given an ordered pair.

M05.A-T.2.1 – Use whole numbers and decimals to compute accurately (straight computation or word problems).

M05.D-M.2.1 – Organize, display, and answer questions based on data.

Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of how to graph points on the coordinate plane to solve real-world and mathematical problems by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to graph points on the coordinate plane to solve real-world and mathematical problems by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to graph points on the coordinate plane to solve real-world and mathematical problems by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to graph points on the coordinate plane to solve real-world and mathematical problems.
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 how to graph points on the coordinate plane to solve real-world and mathematical problems.
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?
x-axis OR x OR horizontal	

Part B (1 point):

1 point for correct answer

What?	Why?
(6, 18)	

Part C (1 point):

1 point for correct and complete explanation

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

What?	Why?
	<p>Sample Explanation: Since Leon raises \$3 for each candy bar he sells, the amount of money he raises must be a multiple of \$3. However, \$77 is not a multiple of \$3, so none of the points on the graph will have 77 as a y-coordinate.</p> <p>OR equivalent</p>

Part D (1 point):

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

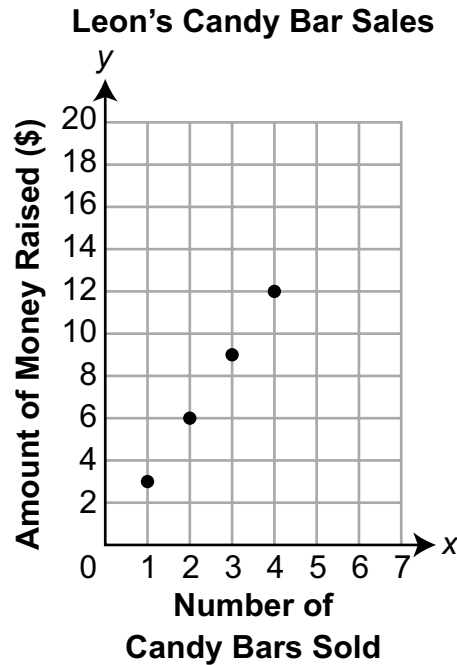
$\frac{1}{2}$ point for correct and complete support

What?	Why?
200 (candy bars)	<p>Sample Work: $2.5 \times 240 = 600$</p> <p>$600 \div 3 = 200$</p> <p>OR</p> <p>Sample Explanation: I multiplied his total from last year (\$240) by 2.5 to find his goal for this year (\$600). To reach this goal, Leon would need to sell $600 \div 3 = 200$ candy bars.</p> <p>OR equivalent</p>

STUDENT RESPONSE

Response Score: 4 points

16. Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.



The pattern continues.

- A. Which axis represents the number of candy bars sold?

The x axis

The student correctly identified *The x axis* as the axis representing the number of candy bars sold. [1 point]

- B. Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(6 , 18)

The student provided a correct ordered pair (6, 18) by correctly interpreting the graph as each candy bar sold raised \$3 and associating the x-coordinate of 6 with the corresponding y-coordinate of 18. [1 point]

Go to

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

- C. Explain why it is **not** possible for any of the points on the graph to have a y -coordinate of 77.

77 is not divisible by 3 so you can't sell any candy bars for \$3 and get to 77.

The student provided a correct and complete explanation for why none of the coordinates on the graph can have a y -coordinate of 77 (*77 is not divisible by 3*). Since each candy bar sold raised \$3, all y -coordinates must be divisible by three. [1 point]

Last year, Leon raised a total of \$240 from his candy bar sales. This year, his goal is to raise at least 2.5 times that amount.

- D. What is the **fewest** candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.

$$\begin{array}{r} 240.0 \\ \times 2.5 \\ \hline \$600 \end{array}$$

His goal is 240×2.5 which is 600. Since each candy bar is \$3, all you have to do is $600 \div 3$. The lowest amount of candy bars Leon could sell to reach his goal is 200.

The student provided the correct answer (200) with correct and complete support. The student first multiplied 240.0 [dollars] by 2.5 to find Leon's goal of \$600. The student further explained *since each candy bar is \$3, all you have to do is $600 \div 3$* . The result of $600 \div 3$ is 200, which the student clearly identifies as the answer (*The lowest amount of candy bars Leon could sell to reach his goal is 200*). [1 point]

After y
and tes

STUDENT RESPONSE

Response Score: 3 points



PARTS A and B

Question 16
Page 1 of 2

Item ID ?

Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.

Leon's Candy Bar Sales

The pattern continues.

A. Which axis represents the number of candy bars sold?
 the x axis

The student correctly identified the x axis as the axis representing the number of candy bars sold. [1 point]

B. Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(,)

The student provided a correct ordered pair (6,18) by correctly interpreting the graph as each candy bar sold raised \$3 and associating the x-coordinate of 6 with the corresponding y-coordinate of 18. [1 point]

Review/End Test

Pause

Flag

Options

Next ▶

PARTS C and D

Question 16
Page 2 of 2

Item ID ?

Calculator

Live Guide

C. Explain why it is **not** possible for any of the points on the graph to have a y -coordinate of 77.

77 is not divisible by 3

The student provided a correct and complete explanation for why none of the coordinates on the graph can have a y -coordinate of 77 (77 is not divisible by 3). Since each candy bar sold raised \$3, the y -coordinates must be divisible by three. [1 point]

Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.

Leon's Candy Bar Sales

Number of Candy Bars Sold	Amount of Money Raised (\$)
1	3
2	6
3	9
4	12
5	15

The pattern continues.

D. What is the **fewest** candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.

$240 \times 2.5 = 600$

The student provided an incorrect answer (600) with incomplete work ($240 \times 2.5 = 600$). While $240 \times 2.5 = 600$ is a correct first step to find Leon's goal of \$600, the rest of the work needed ($600 \div 3$) is not provided, and the response does not earn any credit for the work shown. [0 points]

Review/End Test

Pause

Flag

Options

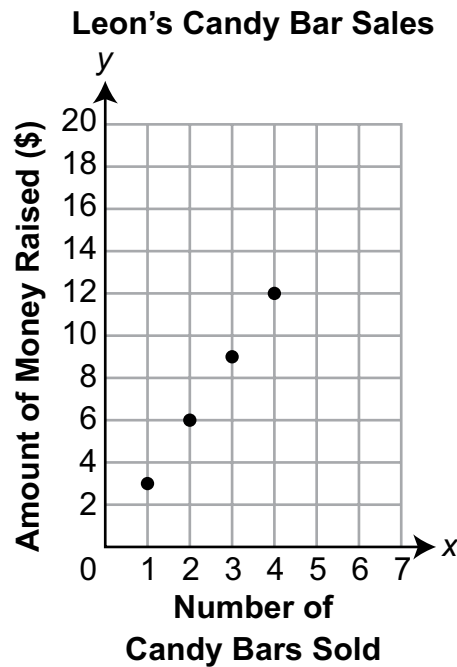
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STUDENT RESPONSE

Response Score: 2 points

16. Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.



The pattern continues.

- A.** Which axis represents the number of candy bars sold?

The x-axis

The student correctly identified *The x-axis* as being the axis representing the number of candy bars sold. [1 point]

- B.** Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(6 , 15)

The student provided an incorrect answer $(6, 15)$. While the x -coordinate is correct (6), the y -coordinate of 15 is incorrect. The y -coordinate of 15 corresponds to an x value of 5 $(5, 15)$. [0 points]

Go to

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

C. Explain why it is **not** possible for any of the points on the graph to have a y-coordinate of 77.

It is not possible because the y-coordinate is counting by twos and 77 is not in that number line (76, 78)

The student provided an incorrect explanation for why none of the coordinates on the graph can have a y-coordinate of 77 (*It is not possible because the y-coordinate is counting by twos and 77 is not in that number line (76,78)*). Each candy bar sold raised \$3, so the y-coordinates increase by three for each candy bar sold, not two. [0 points]

Last year, Leon raised a total of \$240 from his candy bar sales. This year, his goal is to raise at least 2.5 times that amount.

D. What is the **fewest** candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.

200 candy bars

$$\begin{array}{r} 1.240 \\ \times 2.5 \\ \hline 6200 \\ + 24800 \\ \hline 31200 \end{array}$$

$$\begin{array}{r} 2.3 \overline{)600} \\ - 600 \\ \hline 000 \end{array}$$

To get the fewest candy bars Leon needs to sell first, I did 240×2.5 to see what Leon's goal was. I got \$600 and used the \$600 to divide by three because that's how much 1 candy bar is sold for. I got 200 which became my final answer.

After y
and tes

The student provided the correct answer (*200 candy bars*) with correct and complete support. The student first multiplied 240 [dollars] by 2.5 to find Leon's goal of \$600. The student then divided 600 by 3 to find 200 *candy bars* as the number of candy bars Leon needs to sell to reach his goal. The student also correctly explained each step (*first, I did 240×2.5 to see what Leon's goal was. I got \$600 and used the \$600 to divide by three because that's how much 1 candy bar is sold for. I got 200*). Either the work shown or the explanation provided is considered as correct and complete support. [1 point]

STUDENT RESPONSE

Response Score: 1 point



PARTS A and B

Question 16
Page 1 of 2

Item ID ?

Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.

Number of Candy Bars Sold	Amount of Money Raised (\$)
1	3
2	6
3	9
4	12
5	15

The pattern continues.

A. Which axis represents the number of candy bars sold?

The y axis

The student provided an incorrect answer (The y axis). The y-axis represents the amount of money raised, not the number of candy bars sold. [0 points]

B. Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(,)

The student provided an incorrect answer (2, 6). The student has misinterpreted the graph as the y-axis being the number of candy bars sold, so the answer provided shows a y-coordinate of 6 and the corresponding x-coordinate of 2. [0 points]

Review/End Test

Pause

Flag

Options

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PARTS C and D

Question 16
Page 2 of 2

Item ID ?

Calculator

Live Guide

Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.

Number of Candy Bars Sold	Amount of Money Raised (\$)
1	3
2	6
3	9
4	12
5	15

The pattern continues.

Options

Flag

Pause

Review/End Test

C. Explain why it is **not possible for any of the points on the graph to have a y-coordinate of 77.**

It is not possible to have 77 on any of the points because 77 is not a multiple of 3. Like all the other numbers on the graph that are marked, are multiples of 3. And if 77 was to be on one of the points, you would have to put 7 on a point and 7 is not on a point. Therefore, 77 cannot be placed on one of the points on this graph, but on another graph.

The student provided a correct and complete explanation for why none of the coordinates on the graph can have a y-coordinate of 77 (77 is not a multiple of 3... all the other numbers on the graph that are marked, are multiples of 3). Since each candy bar sold raised \$3, the y-coordinates must be divisible by three. [1 point]

D. What is the **fewest candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.**

The fewest candy bars Leon needs to sell would be 300 candy bars. It would be 300 because if he sells candy bars and gets \$3 every time he sells one, he would soon have a total of \$600 which is 240×2.5 . Therefore, he will need to sell 300 candy bars.

The student provided an incorrect answer (300 candy bars) with incomplete work (\$600 which is 240×2.5). While $240 \times 2.5 = 600$ is a correct first step to find Leon's goal of \$600, the rest of the work needed ($600 \div 3$) is not provided, and the response does not earn any credit for the work shown. [0 points]

Review/End Test

Pause

Flag

Options

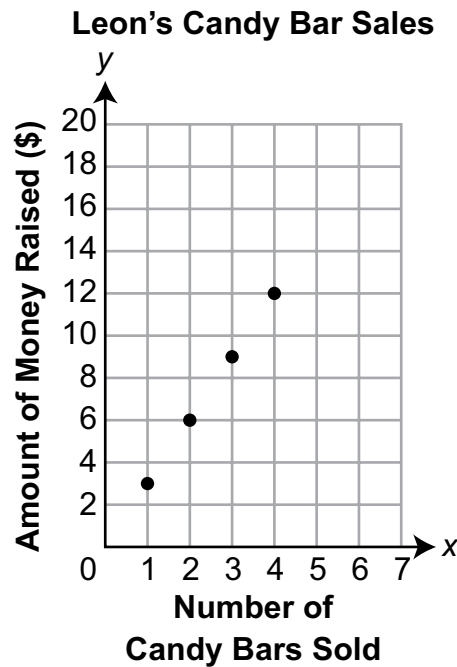
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STUDENT RESPONSE

Response Score: 0 points

16. Leon is selling candy bars for a school fundraiser. He raises \$3.00 for each candy bar he sells. The graph shown below represents the total amount of money, in dollars, Leon has raised based on the number of candy bars he has sold.



The pattern continues.

- A.** Which axis represents the number of candy bars sold?

(4, 12)

The student provided an incorrect answer [ordered pair (4, 12)]. The answer provided is a plotted coordinate on the graph; however, the x-axis is not identified as the axis representing the number of candy bars sold. [0 points]

- B.** Write the ordered pair that represents the amount of money Leon raises for selling 6 candy bars.

(6 , 16)

The student provided an incorrect answer (6, 16). While the x-coordinate is correct (6), the y-coordinate of 16 is incorrect. The y-coordinate is 18 for an x-coordinate of 6. [0 points]

Go to

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

- C. Explain why it is **not** possible for any of the points on the graph to have a y-coordinate of 77.

77 should not be on the y-coordinate because all the numbers are even, but 77 is not even so it can't go on the y-coordinate.

The student provided an incorrect explanation for why none of the coordinates on the graph can have a y-coordinate of 77 (*all the numbers are even, but 77 is not even so it can't go on the y-coordinate*). Each candy bar sold raised \$3, so the y-coordinates increase by three for each candy bar sold, not solely even numbers. [0 points]

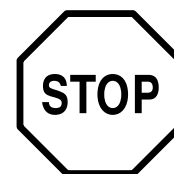
Last year, Leon raised a total of \$240 from his candy bar sales. This year, his goal is to raise at least 2.5 times that amount.

- D. What is the **fewest** candy bars Leon needs to sell to reach his goal for this year? Show or explain all your work.

The fewest amount is 96 candybars because $\$240 \div 2.5 = 96$ so the fewest amount of candybars Leon needs to sell is 96 candybars.

The student provided an incorrect answer (*96 candybars*) with incorrect work ($\$240 \div 2.5 = 96$). The \$240 should have been multiplied by 2.5, not divided by 2.5. Additionally, the step ($600 \div 3$) is not provided. [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-T.2.1.1	C	1	21%	11%	64%	4%
2	A-T.1.1	B	2	31%	39%	18%	12%
3	A-T.1.1.5 A-T.1.1.4	D	2	23%	17%	21%	39%
4	A-T.2.1	D	2	13%	13%	16%	58%
5	A-F.1	D	1	7%	9%	10%	74%
6	A-F.1.1.1	C	1	12%	9%	71%	8%
7	B-O.1	D	2	18%	19%	9%	54%
8	B-O.1.1.1	B	1	9%	61%	27%	3%
9	B-O.1.1.2	B	1	8%	68%	13%	11%
10	B-O.2.1	B	2	16%	51%	23%	10%
11	D-M.1.1.1	B	2	6%	36%	23%	35%
12	D-M.1.1.1	A	1	34%	8%	29%	29%
13	D-M.2.1.2	D	2	15%	17%	20%	48%
14	D-M.2.1.2	D	2	28%	8%	18%	46%
15	D-M.3.1.2	B	2	29%	36%	22%	13%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
16	C-G.1.1 A-T.2.1.3 D-M.2.1	4	2	1.36

PSSA Grade 5 Mathematics Item and Scoring Sampler

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