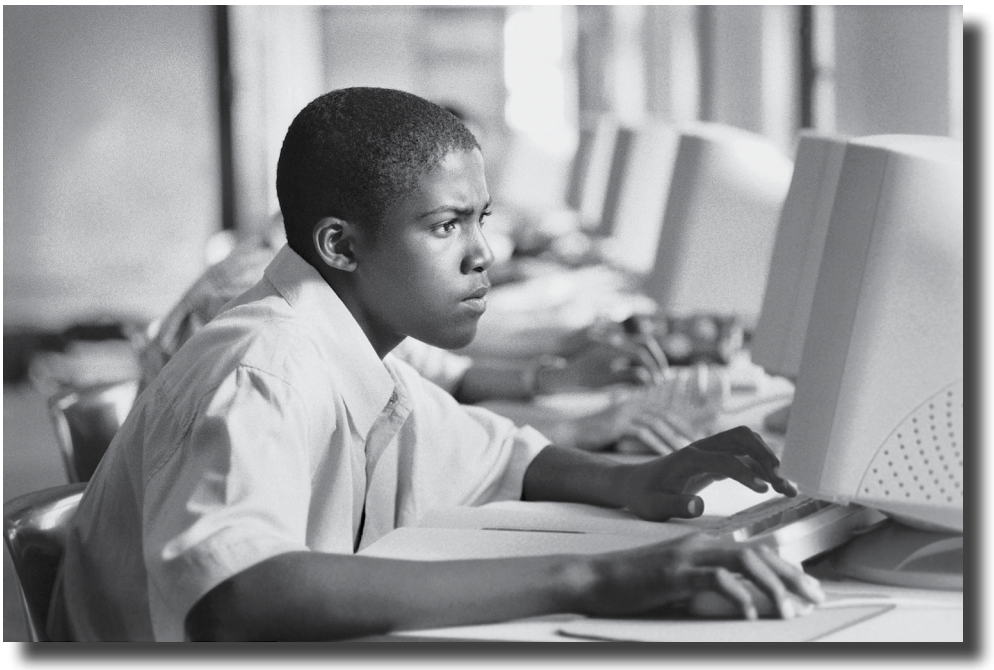
pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler



2024–2025
Grade 7

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—August 2024

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INFORMATION ABOUT MATHEMATICS

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 and Scoring 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 Item and Scoring 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 Item and Scoring 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 (OE) item to demonstrate the range of responses that students provided in response to these items.

Purpose and Uses

The items in this Item and Scoring Sampler may be used[1] as examples for creating assessment items at the classroom level. Classroom teachers may find it beneficial to have students respond to the open-ended item in this Item and Scoring Sampler. Educators may then use the Item and Scoring Sampler as a guide to score the responses either independently or together with colleagues within a school or district. This Item and Scoring Sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines 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 in mathematics is scored using an item-specific scoring guideline based on a 0–4-point scale. In this Item and Scoring 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 Test 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 estimated response time for each item type is listed below.

- **Multiple-Choice:** 2 minutes
- **Open-Ended:** 10 to 15 minutes

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
- B = Algebraic Concepts
- C = Geometry
- D = Data Analysis and Probability

These four classifications are used throughout the grade levels. In addition to these classifications, there are five Reporting Categories for each grade level. The first letter of each Reporting Category represents the classification; the second letter represents the Domain as stated in the Common Core State Standards for Mathematics. Listed below are the Reporting Categories for Grade 7.

- A–N = The Number System
- A–R = Ratios and Proportional Relationships
- B–E = Expressions and Equations
- C–G = Geometry
- D–S = Statistics and Probability

Examples of MC and OE items assessing these categories are included in this Item and Scoring Sampler.

Item and Scoring Sampler Format

This Item and Scoring 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 percentage[2] 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 Questions* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs. 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

Category	Item-Specific 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

Category	Item-Specific Information
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 Questions

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

The response provides correct answer(s) with clear and complete mathematical procedures shown and a correct explanation, as required by the task. 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.

Response may show only information copied from the question.

Special Categories within zero reported separately:

BLK (blank)	Blank, entirely erased, or written refusal to respond
OT	Off task
LOE	Response in a language other than English
IL	Illegible

Grade 7 Formula Sheet

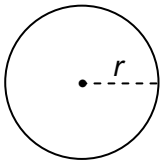
Formulas that you may need on this test are found below.
You may refer back to this page at any time during the mathematics test.
You may use calculator π or the number 3.14 as an approximation of π.

2024
Grade 7

Simple Interest

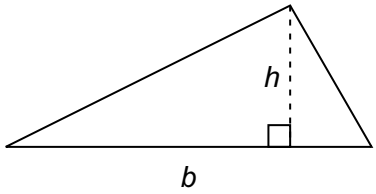
$I = Prt$

Circle



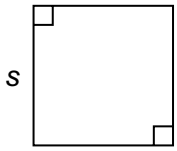
$C = 2\pi r$
$A = \pi r^2$

Triangle



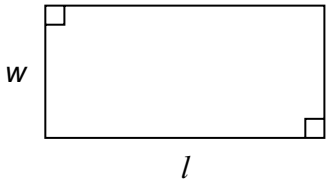
$A = \frac{1}{2} bh$

Square



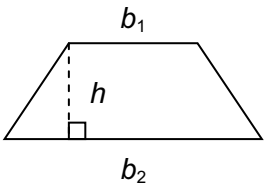
$A = s^2$

Rectangle



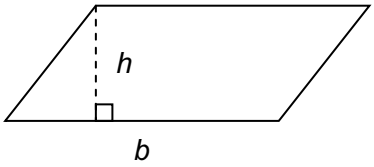
$A = lw$
$P = 2l + 2w$

Trapezoid



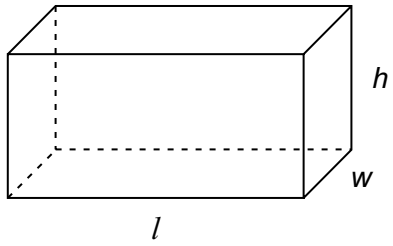
$A = \frac{1}{2} h(b_1 + b_2)$

Parallelogram



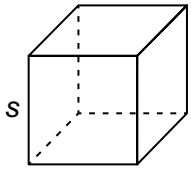
$A = bh$

Rectangular Prism



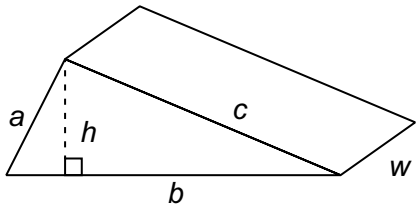
$V = lwh$ $SA = 2lw + 2lh + 2wh$

Cube



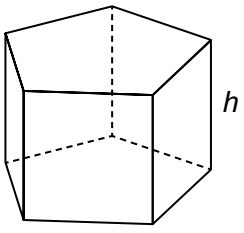
$V = s^3$ $SA = 6s^2$

Triangular Prism



$V = \frac{1}{2} bhw$ $SA = bh + aw + bw + cw$

Polygonal Prism



$V = Bh$, where B = area of the base
$SA = Ph + 2B$, where P = perimeter of base

PSSA MATHEMATICS GRADE 7

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 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 asks you to explain, be sure to use words to 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 Item and Scoring Sampler is to be solved without the use of a calculator.

Multiple-Choice Items

1. Simplify: $-28 + 20 + (-3)$

Ⓐ -51

Ⓑ -11

Ⓒ -9

Ⓓ -5

Category	Item-Specific Information
Alignment	A-N.1.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	20%
p-value B	61% (correct answer)
p-value C	6%
p-value D	13%
Option Annotations	A. first adds as 28 + 20 + 3 and then uses either the sign of the "greatest" number (28) OR the most common sign (two negatives vs. only one positive) B. Correct: either first adds $^{-}28$ to 20, resulting in a sum of $^{-}8$, and then adds the sum to $^{-}3$, resulting in a sum of $^{-}11$ OR reorders the terms of the expression to $20 + {}^{-}28 + {}^{-}3$, rewrites the expression as $20 - 28 + {}^{-}3$ by changing the first "plus a negative" to subtraction, and subtracts 28 from 20 $(20 - 28 = {}^{-}8)$, resulting in $^{-}8 + {}^{-}3$, which has a sum of $^{-}11$ C. determines the difference between 28 and 20 $(28 - 20 = 8)$ and the difference between 20 and 3 $(20 - 3 = 17)$ and then determines the difference between the differences $(8 - 17 = {}^{-}9)$ D. determines the difference between 28 and 20 $(28 - 20 = 8)$ and the difference between 8 and 3 $(8 - 3 = 5)$ and then uses either the sign of the "greatest" number (28) OR the most common sign (two negatives vs. only one positive)

A calculator is permitted for use in solving questions 2–16 in this Item and Scoring Sampler.

2. While on a road trip with his family, Tristan records the price of a gallon of gasoline they buy each day. The change in price each day is shown in the table below.

Gallon of Gasoline

Day	Change in Price
Monday	+$0.07
Tuesday	−$0.12
Wednesday	−$0.03
Thursday	+$0.06

Which statement about the average change in price for a gallon of gasoline is true?

Ⓐ The average change in price is negative because the largest amount of change is −$0.12, and that affects the average the most.

Ⓑ The average change in price is positive because the total change is positive, and a positive total change in price divided by 4 days is positive.

Ⓒ The average change in price is negative because the total change is negative, and a negative total change in price divided by 4 days is negative.

Ⓓ The average change in price is positive because change represents subtraction, and when the values are subtracted the result is a positive number.

Category	Item-Specific Information
Alignment	A-N.1
Answer Key	C
Depth of Knowledge	2
p-value A	29%
p-value B	16%
p-value C	39% (correct answer)
p-value D	16%
Option Annotations	A. considers only the largest individual change (in terms of absolute value) without considering the actual sum of all the values divided by 4 B. does not find the sum of the change in price correctly (e.g., may have added the values without considering one or both negative signs) C. Correct: recognizes that, to find the average, the total must first be found, and then either adds the values ($0.07 + {}^{-}0.12 = 0.07 - 0.12 = {}^{-}0.05$, ${}^{-}0.05 + {}^{-}0.03 = {}^{-}0.08$, ${}^{-}0.08 + 0.06 = 0.06 - 0.08 = {}^{-}0.02$) and recognizes that a negative total (${}^{-}0.02$) divided by a positive number (4) would result in a negative quotient, which is the average change in price OR adds the two positive values ($0.07 + 0.06 = 0.13$) and the two negative values (${}^{-}0.12 + {}^{-}0.03 = {}^{-}0.15$), recognizes that the negative sum is farther from 0 than the positive sum, which means the total change in price would be negative, and recognizes that a negative total divided by a positive number would result in a negative quotient, which is the average change in price D. uses subtraction (“change”) rather than addition (“total”), resulting in $0.07 - {}^{-}0.12 - {}^{-}0.03 - 0.06 = 0.07 + 0.12 + 0.03 - 0.06 = 0.22 - 0.06 = 0.16$, and then concludes the average would be positive since a positive number divided by a positive number results in a positive quotient

3. The track at a fitness center is 0.32 kilometer long. Jamie ran around the track $3\frac{1}{2}$ times.

How many kilometers did Jamie run?

Ⓐ 1.12

Ⓑ 1.46

Ⓒ 3.16

Ⓓ 3.82

Category	Item-Specific Information
Alignment	A-N.1.1.3
Answer Key	A
Depth of Knowledge	1
p-value A	74% (correct answer)
p-value B	8%
p-value C	9%
p-value D	9%
Option Annotations	A. Correct: converts $3\frac{1}{2}$ to 3.5 and then multiplies 3.5 by 0.32 B. adds $\frac{1}{2}$ to the product of 3 and 0.32 (i.e., $\frac{1}{2} + 3 \cdot 0.32 = 0.5 + 0.96 = 1.46$) C. adds 3 to the product of $\frac{1}{2}$ and 0.32 (i.e., $3 + \frac{1}{2} \cdot 0.32 = 3 + 0.16 = 3.16$) D. converts $3\frac{1}{2}$ to 3.5 and then adds 3.5 and 0.32

4. Alice buys songs online. The number of songs she buys and the total price to buy those songs are proportional to one another. She determines that the total price to buy 20 songs is d dollars. How could Alice determine the total price, in dollars, to buy 30 songs?

Ⓐ by adding 10 to d because $20 + 10 = 30$

Ⓑ by subtracting 10 from d because $30 - 10 = 20$

Ⓒ by multiplying d by $\frac{2}{3}$ because $30 \cdot \frac{2}{3} = 20$

Ⓓ by multiplying d by 1.5 because $20 \cdot 1.5 = 30$

Category	Item-Specific Information
Alignment	A-R.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	34%
p-value B	14%
p-value C	17%
p-value D	35% (correct answer)
Option Annotations	A. considers a proportional relationship to be additive rather than multiplicative B. considers a proportional relationship to be additive rather than multiplicative and starts with 30 songs rather than 20 songs C. uses the reciprocal of the proportional relationship by starting with 30 songs rather than 20 songs D. Correct: recognizes that a proportional relationship is multiplicative and recognizes that buying 1.5 times as many songs would change the total price by a factor of 1.5

5. Mr. Krenshaw is typing a novel he has written. He types at a constant rate. The numbers of pages he has typed after different amounts of time are shown in the table below.

Mr. Krenshaw's Typed Pages

Time (hours)	Number of Pages
1.5	9
3.5	21
7.5	45
8.5	51

The pattern continues. How many pages does Mr. Krenshaw type each hour?

Ⓐ 6

Ⓑ 7.5

Ⓒ 8.5

Ⓓ 9

Category	Item-Specific Information
Alignment	A-R.1.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	71% (correct answer)
p-value B	10%
p-value C	10%
p-value D	9%
Option Annotations	A. Correct: divides the number of pages for any row of the table by that row's time (e.g., 21 ÷ 3.5 = 6) B. finds the difference between the number of pages and the time in the first row (i.e., 9 − 1.5 = 7.5) C. recognizes that pages typed per hour can be determined when the time is at 1 hour but subtracts 0.5 from the number of pages in the first row (9 − 0.5 = 8.5) since subtracting 0.5 from the time in the first row (1.5 hours) has a difference of 1 hour D. uses the number of pages in the first row (9) without considering that the time in the first row is not 1 hour

6. Ben is making chocolate chip cookies with walnuts in them. The ratio of cups of chocolate chips to cups of walnuts is 4:3. To make his cookies, Ben uses $2\frac{1}{2}$ cups of chocolate chips. Which equation could be used to determine the number of cups of walnuts (x) that Ben needs?

Ⓐ $\frac{x}{2.5} = \frac{4}{3}$

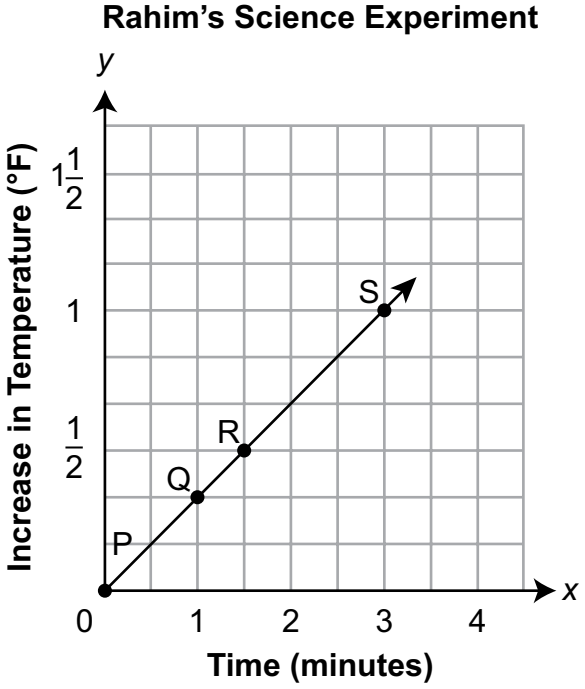
Ⓑ $\frac{2.5}{x} = \frac{4}{3}$

Ⓒ $\frac{2.5}{3} = \frac{4}{x}$

Ⓓ $\frac{2.5}{4} = \frac{3}{x}$

Category	Item-Specific Information
Alignment	A-R.1.1.4
Answer Key	B
Depth of Knowledge	2
p-value A	26%
p-value B	48% (correct answer)
p-value C	13%
p-value D	13%
Option Annotations	A. sets up the first fraction as the cups of walnuts needed (x) divided by the cups of chocolate chips used $\left(2\frac{1}{2}=2.5\right)$ but sets up the second fraction by converting the given ratio $4:3$ to fractional form without considering that this ratio is cups of chocolate chips to cups of walnuts rather than cups of walnuts to cups of chocolate chips B. Correct: sets up each fraction using "chocolate chips" divided by "walnuts" by writing the first fraction as the cups of chocolate chips used $\left(2\frac{1}{2}=2.5\right)$ divided by the cups of walnuts needed (x) and the second fraction by converting the given ratio $4:3$ to fractional form C. sets up each fraction using "chocolate chips" divided by "walnuts," but pairs the cups of chocolate chips used $\left(2\frac{1}{2}=2.5\right)$ with the cups of walnuts from the given ratio (3) and pairs the cups of chocolate chips from the given ratio (4) with the cups of walnuts needed (x) D. sets up the first fraction as the cups of chocolate chips used $\left(2\frac{1}{2}=2.5\right)$ divided by the cups of chocolate chips from the given ratio (4) but then uses the reciprocal of this relationship in the second fraction by setting the cups of walnuts from the given ratio (3) divided by the cups of walnuts needed (x)

7. Rahim measures the temperature of water as it is heated in a science experiment. He makes the graph below to show the relationship between the time (x), in minutes, and the increase in temperature (y), in degrees Fahrenheit.



Which point on the graph represents the change in temperature in degrees Fahrenheit per minute?

Ⓐ point P

Ⓑ point Q

Ⓒ point R

Ⓓ point S

Category	Item-Specific Information
Alignment	A-R.1.1.5
Answer Key	B
Depth of Knowledge	1
p-value A	9%
p-value B	40% (correct answer)
p-value C	13%
p-value D	38%
Option Annotations	A. selects the point at $(0, 0)$ as the point common to all proportional relationships but does not consider that $\frac{0}{0}$ is undefined (i.e., it is the only point on the graph of a proportional relationship that cannot be used to determine the unit rate) B. Correct: recognizes that the point $(1, r)$ of a proportional relationship represents the change in temperature per minute since the *y*-coordinate of this point (*r*) is the unit rate C. selects the first point with a positive *y*-value that is labeled along the *y*-axis D. selects the point with a *y*-coordinate of 1 rather than the point with an *x*-coordinate of 1

8. The table below shows the relationship between a dog's weight, in pounds, and the dog's mass, in kilograms, during three visits to the veterinarian.

Dog Weight and Mass

Visit Number	Weight (pounds)	Mass (kilograms)
1	7	3.18
2	12	5.45
3	15	6.82

During visit 4, the dog's mass is 7.71 kilograms greater than its mass during visit 3. Rounded to the nearest pound, what is the dog's weight during visit 4?

Ⓐ 23

Ⓑ 26

Ⓒ 32

Ⓓ 50

Category	Item-Specific Information
Alignment	A-R.1.1.6
Answer Key	C
Depth of Knowledge	2
p-value A	36%
p-value B	18%
p-value C	37% (correct answer)
p-value D	9%
Option Annotations	A. adds 7.71 to 6.82, resulting in a sum of 14.53, but then divides the sum by 4 (from visit 4), resulting in a quotient of 3.6325, divides the quotient by 0.45 [the approximate ratio of mass (kilograms) to weight (pounds)], resulting in a quotient of 8.07222 . . . , and adds the quotient to 15, resulting in a sum of 23.07222 . . . , which is then rounded to the nearest whole number B. adds 7.71 to 6.82, resulting in a sum of 14.53, but then multiplies the sum by 4 (from visit 4), resulting in a product of 58.12, and multiplies the product by 0.45 [the approximate ratio of mass (kilograms) to weight (pounds)], resulting in a product of 26.154, which is then rounded to the nearest whole number C. Correct: adds 7.71 to the mass during visit 3 (6.82 kilograms) to determine the mass during visit 4 (6.82 + 7.71 = 14.53 kilograms), determines the approximate ratio of weight (pounds) to mass (kilograms) by dividing the weight for any row of the table by that row's mass (e.g., 15 ÷ 6.82 ≈ 2.2), and then multiplies the approximate ratio (2.2) by the mass during visit 4 (14.53 kilograms), resulting in a product of 31.966, which is then rounded to the nearest whole number D. adds 7.71 to 15 (the weight during visit 3 rather than adding to the mass during visit 3), resulting in a sum of 22.71, and divides the sum by 0.45 [the approximate ratio of mass (kilograms) to weight (pounds)], resulting in a quotient of 50.4666 . . . , which is then rounded to the nearest whole number

9. Which expression is equivalent to $2(3p + 72 + 3p)$?

Ⓐ $81p$

Ⓑ $156p$

Ⓒ $12p + 72$

Ⓓ $12p + 144$

Category	Item-Specific Information
Alignment	B-E.1.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	9%
p-value B	19%
p-value C	14%
p-value D	58% (correct answer)
Option Annotations	A. distributes the 2 to the first term only, resulting in $6p + 72 + 3p$, adds the numerals from all three terms (6 + 72 + 3 = 81), and then multiplies the sum by p B. simplifies the second factor by adding the numerals from all three terms (3 + 72 + 3 = 78), multiplies the sum by p, resulting in the product $78p$, and then multiplies the product by 2 C. simplifies the second factor by combining the like terms, resulting in $6p + 72$, but then distributes the 2 to the first term only (i.e., does not multiply the 72 by 2) D. Correct: simplifies the second factor by combining the like terms, resulting in $6p + 72$, and then distributes the 2 by multiplying both the $6p$ and the 72 by 2

10. The price of a pair of pants is $25.50. Mai will use a coupon for 20% off when she buys the pants. Which method can be used to correctly determine the amount of money Mai will save by using her coupon?

Ⓐ Since 10% of $25.50 is $2.55, multiply $2.55 by 2 to get $5.10.

Ⓑ Since $25 is $\frac{1}{4}$ of $100, divide 20 by 4 and then add the extra $0.50 to get $5.50.

Ⓒ Since $25 is $\frac{1}{4}$ of $100, divide 20 by 4 and then subtract the extra $0.50 to get $4.50.

Ⓓ Since 10% of $25.50 is $2.50, multiply $2.50 by 2 and then add another 10% to get $5.10.

Category	Item-Specific Information
Alignment	B-E.2
Answer Key	A
Depth of Knowledge	2
p-value A	53% (correct answer)
p-value B	16%
p-value C	13%
p-value D	18%
Option Annotations	A. Correct: recognizes that 20% can be determined by finding 10% of the original amount (0.10 · $25.50 = $2.55) and multiplying that value by 2 since 20% is 2 · 10% (i.e., since 0.20 = 2 · 0.10, then 0.20 · $25.50 = 2 · 0.10 · $25.50) B. subtracts $0.50 from $25.50, resulting in a difference of $25, represents the $25 as a fraction of 100 and treats the actual percentage (20%) as the number 20, and then adds the $0.50 (which was subtracted from $25.50) to the quotient C. subtracts $0.50 from $25.50, resulting in a difference of $25, represents the $25 as a fraction of 100 and treats the actual percentage (20%) as the number 20, and then subtracts the $0.50 (which was already subtracted from $25.50) from the quotient D. determines an incorrect value for 10% of $25.50 by omitting one of the 5s and then adds “10%” (0.10) to increase the value to the correct solution [Note: Even though this method results in a correct solution for this situation, this method cannot be applied to any dollar amount and is therefore considered an incorrect method.]

11. Ms. Rodriguez buys markers for the students in her class. She buys 3 boxes of markers for every 5 students. She also buys 2 extra boxes of markers. She buys a total of 17 boxes of markers. How many students are in Ms. Rodriguez's class?

Ⓐ 9

Ⓑ 25

Ⓒ 27

Ⓓ 30

Category	Item-Specific Information
Alignment	B-E.2.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	9%
p-value B	56% (correct answer)
p-value C	21%
p-value D	14%
Option Annotations	A. subtracts 2 from 17, resulting in a difference of 15, but then multiplies the difference by the ratio of boxes of markers to students $\left(\frac{3}{5}\right)$ rather than by the ratio of students to boxes of markers $\left(\frac{5}{3}\right)$ B. Correct: subtracts the 2 extra boxes from the total number of boxes (17 − 2 = 15) and then multiplies the difference (15) by the ratio of students to boxes of markers $\left(\frac{5}{3}\right)$, resulting in 25 students C. subtracts the 2 extra boxes from the total number of boxes (17 − 2 = 15), multiplies the difference (15) by the ratio of students to boxes of markers $\left(\frac{5}{3}\right)$, resulting in a product of 25, but then adds the 2 (which was subtracted from the 17) to the product D. sets up the expression 17 · 5 + 2, which simplifies to 87, divides this amount by 3, resulting in a quotient of 29, and then rounds the quotient up to the nearest multiple of 5 since the number of students should be a multiple of 5 (“3 boxes for every 5 students”)

12. A school is collecting donations for a new baseball field. The table below shows the donations received for five months.

Baseball Field Donations

Month	Donations Received (dollars)
1	3,085
2	3,849
3	2,930
4	3,548
5	3,333

Which method gives the **most** accurate estimate of the sum of the donations the school has received in five months?

Ⓐ rounding each monthly donation value to 3,000 and then adding

Ⓑ rounding each monthly donation value to the nearest 1,000 and then adding

Ⓒ rounding each monthly donation value up to the nearest 1,000 and then adding

Ⓓ rounding each monthly donation value down to the nearest 1,000 and then adding

Category	Item-Specific Information
Alignment	B-E.2.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	19%
p-value B	51% (correct answer)
p-value C	19%
p-value D	11%
Option Annotations	A. notices that the only number to not start with a 3 would round to 3,000, so thinks that this method would be the most accurate B. Correct: recognizes that, since each monthly donation amount is a 4-digit number, rounding to the nearest thousand would be more accurate than rounding every value up to the next thousand, rounding (i.e., truncating) every value down to the previous thousand, or rounding to a specific dollar amount in the thousands C. rounds up rather than to the closest thousand (i.e., may have thought that an overestimate would be the most accurate since money is involved but confuses estimation strategies for "money collected" and "budget") D. rounds down rather than to the closest thousand (i.e., may have thought that an underestimate would be the most accurate since money collected is involved)

13. Victoria makes a triangular shelf for her room. The shelf has side lengths of 9 inches, 12 inches, and 15 inches. The largest angle is 90°. Which description of the shape of the shelf is accurate?

Ⓐ an acute equilateral triangle

Ⓑ an acute scalene triangle

Ⓒ a right isosceles triangle

Ⓓ a right scalene triangle

Category	Item-Specific Information
Alignment	C-G.1.1.2
Answer Key	D
Depth of Knowledge	1
p-value A	11%
p-value B	17%
p-value C	29%
p-value D	43% (correct answer)
Option Annotations	A. thinks that a triangle with a 90° angle is an acute triangle (may have considered that the other two angles must be acute angles) and that a triangle with three sides of different lengths is an equilateral triangle (may have confused all equal sides and no equal sides) B. recognizes that a triangle with three sides of different lengths is a scalene triangle but thinks that a triangle with a 90° angle is an acute triangle (may have considered that the other two angles must be acute angles) C. recognizes that a triangle with a 90° angle is a right triangle but thinks that a triangle with three sides of different lengths is an isosceles triangle (may have confused two equal sides and no equal sides) D. Correct: recognizes that a triangle with a 90° angle is a right triangle and that a triangle with three sides of different lengths is a scalene triangle

14. Daria is trying to make a triangular brace from three metal rods. The metal rods have lengths of 3 inches, 7 inches, and 11 inches. Daria cannot cut or bend the metal rods. Which statement explains whether Daria can make a triangular brace from the three metal rods?

Ⓐ Because 11 is less than the double of 7, Daria can make a triangular brace from the three metal rods.

Ⓑ Because 11 is greater than the double of 3, Daria cannot make a triangular brace from the three metal rods.

Ⓒ Because the sum of 3 and 7 is less than 11, Daria cannot make a triangular brace from the three metal rods.

Ⓓ Because the product of 3 and 7 is greater than 11, Daria can make a triangular brace from the three metal rods.

Category	Item-Specific Information
Alignment	C-G.1.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	13%
p-value B	14%
p-value C	62% (correct answer)
p-value D	11%
Option Annotations	A. thinks that a triangle can be formed only when the longest side is less than twice the longer of the two shorter sides (i.e., considers the shortest side length to be irrelevant when determining whether a triangle can be formed) B. thinks that a triangle can be formed only when the longest side is less than twice the shortest side (i.e., considers the middle side length to be irrelevant when determining whether a triangle can be formed) C. Correct: applies the triangle inequality theorem, which states that the sum of the lengths of any two sides of a triangle is greater than the length of the third side, and compares the sum of the shorter two side lengths (3 + 7 = 10) to the longest side length (11) D. uses the product of the two shortest sides (3 · 7 = 21) rather than the sum (3 + 7 = 10) when comparing to the longest side (11)

15. A shipping company has two different sizes of boxes. Both boxes are cubes. The first box has a side length of 4 inches. The second box has a side length of 6 inches. Hannah claims that the volume of the second box is 8 cubic inches greater than the volume of the first box because the difference in side lengths is 2 inches and $2^3 = 8$. Which statement could be used to show that Hannah's claim is **not** correct?

Ⓐ The value of 2^3 is 6, not 8.

Ⓑ The value of $(6 - 4)^3$ is equal to $6^3 - 4^3$, not 2^3.

Ⓒ The difference in the volumes is actually $6^3 - 4^3$, which is 152 and not 8.

Ⓓ The difference in the volumes is actually $6 \cdot 6^2 - 6 \cdot 4^2$, which is 120 and not 8.

Category	Item-Specific Information
Alignment	C-G.2.2.2
Answer Key	C
Depth of Knowledge	2
p-value A	23%
p-value B	17%
p-value C	42% (correct answer)
p-value D	18%
Option Annotations	A. considers 2^3 to be another way to represent $2 \cdot 3$ B. thinks that distributing should always be the first step but does not consider that distributing is a possible first step only when a grouped expression is being multiplied by another expression rather than being raised to an exponent C. Correct: recognizes that each volume should be determined individually by raising each side length to the power of 3 (6^3 and 4^3) before finding the difference D. uses the surface area formula for a cube ($SA = 6s^2$) rather than the volume formula for a cube ($V = s^3$)

Open-Ended Item

16. Some students want to learn about the exercise habits of the students at their middle school.

Three students conducted the surveys described below.

- Kari surveyed the girls at her lunch table.
- Mandy surveyed every 10th student who entered the school building.
- Lea surveyed all the members of the girls' and boys' soccer teams.

A. Explain why Mandy's survey is the best representation of a random sample to learn about the exercise habits of the students at the middle school. As part of your explanation, state why the other two surveys do not represent random samples.

Go to the next page to finish question 16.

GO ON

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

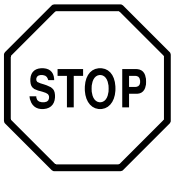
A school-wide survey was conducted to find out how many students ride a bike for exercise. Nick conducted a survey of a sample of 75 students to find out how many students ride a bike for exercise. The results of both surveys are shown in the table below.

Riding a Bike for Exercise

	Number Who Ride a Bike	**Number Surveyed**
School Population	490	875
Nick's Sample Population	26	75

B. Based on the information in the table, why is it likely that Nick's sample is **not** random? State how many students from Nick's sample would have been expected to ride a bike for exercise had his sample been truly random.

After you have finished your work, close this booklet so your teacher will know you are finished.



Item-Specific Scoring Guideline

#16 Item Information

Category	Item-Specific Information
Alignment	D-S.1
Depth of Knowledge	2
Mean Score	1.28

Assessment Anchor this item will be reported under:

M07.D-S.1 Use random sampling to draw inferences about a population.

Specific Anchor Descriptor addressed by this item:

M07.D-S.1.1 Use random samples.

Item-Specific Scoring Guideline

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

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of how to use random sampling to draw inferences about a population.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (2 points):

1 point for correct and complete response

OR 1/2 point for correct but incomplete response

1 point for correct and complete explanation

OR 1/2 point for correct but incomplete explanation

What?

Sample Response:

Kari's survey is not random because it only considers her friends.

OR equivalent

AND

Lea's survey is not random because it only considers students who play a sport.

OR equivalent

Why?

Sample Explanation:

Mandy has the best survey because every 10th student is randomly selected as they enter the building in the morning, so it is truly a random sample.

OR equivalent

Part B (2 points):

1 point for correct answer

1 point for correct and complete explanation

OR 1/2 point for correct but incomplete explanation

What?

Answers may vary. Accept any response from 38–45.

Sample Response:

42 (students)

Why?

Sample Explanation:

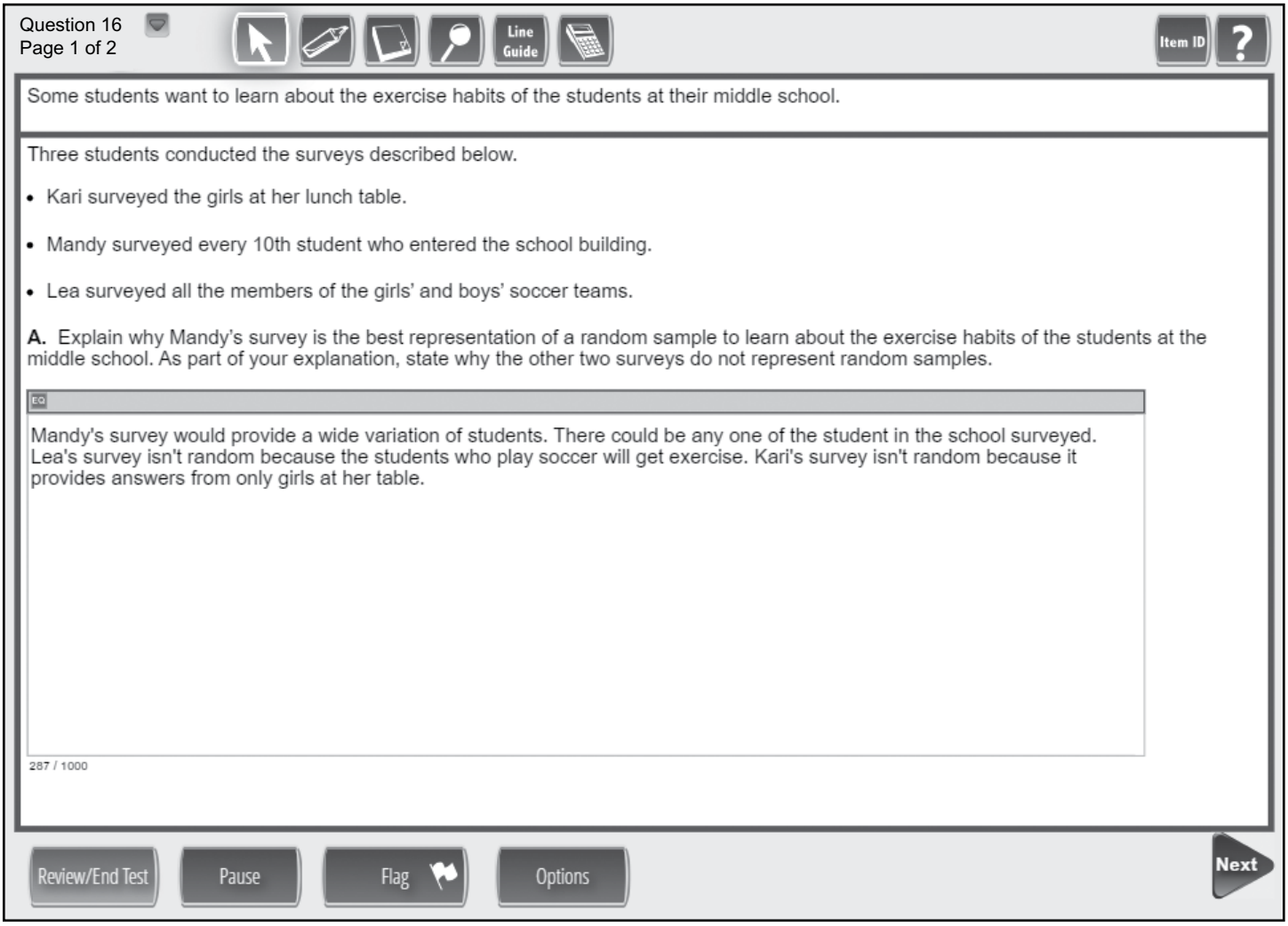
It does not seem likely that Nick chose a random sample because approximately 35% of the students in his sample reported biking for exercise; however, 56% of the entire school population reported this. If Nick's sample had been truly random, his numbers should have been closer to 56% of 75, which is 42.

OR equivalent

STUDENT RESPONSE

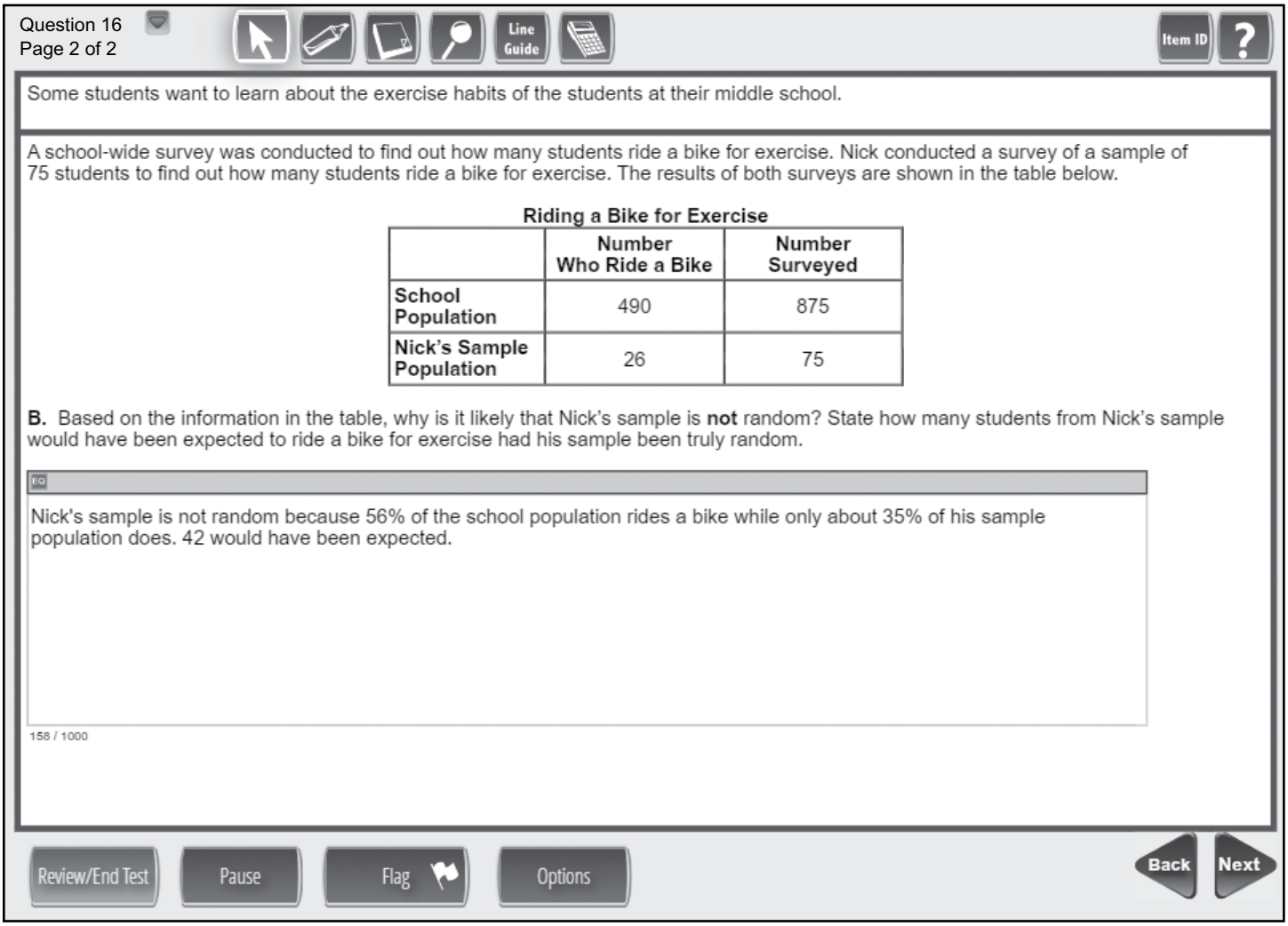
Computer Response Score: 4 points

PART A



Part A: The student provided a correct explanation as to why Mandy's survey is the best representation of a random sample (*Mandy's survey would provide a wide variation of students*). The student also provided a correct response as to why the other two surveys do not represent random samples (*Lea's survey isn't random because the students who play soccer will get exercise. Kari's . . . provides answers from only girls at her table*). [2 points]

PART B



Part B: The student provided a correct and complete explanation as to why it is likely Nick's sample was not random (*because 56% of the school population rides a bike while only about 35% of his sample population does*) along with a correct answer (*42*). While support (work or explanation) for the answer is not required for Part B, the student likely calculated 56% by dividing 490 by 875, resulting in 0.56, and then determined 56% of Nick's sample population by multiplying 75 by 0.56, resulting in a product of 42. [2 points]

STUDENT RESPONSE

Response Score: 3 points

16. Some students want to learn about the exercise habits of the students at their middle school.

Three students conducted the surveys described below.

- Kari surveyed the girls at her lunch table.
- Mandy surveyed every 10th student who entered the school building.
- Lea surveyed all the members of the girls' and boys' soccer teams.

A. Explain why Mandy's survey is the best representation of a random sample to learn about the exercise habits of the students at the middle school. As part of your explanation, state why the other two surveys do not represent random samples.

Mandy's survey was the best because she did all different people so not all the people were the same. The other two did not represent random because Kari did everyone at her own lunch table and Lea did all the soccer members that run a lot.

Go to the next page to finish question 16.

GO ON

Part A: The student provided a correct explanation as to why Mandy's survey is the best representation of a random sample (*because she did all different people so not all the people were the same*). The student also provided a correct but incomplete response as to why the other two surveys do not represent random samples (*Kari did everyone at her own lunch table and Lea did all the soccer members that run a lot*). This response does not fully explain why these other two surveys were not random. [1.5 points]

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

A school-wide survey was conducted to find out how many students ride a bike for exercise. Nick conducted a survey of a sample of 75 students to find out how many students ride a bike for exercise. The results of both surveys are shown in the table below.

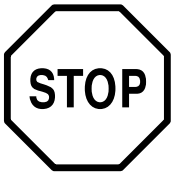
Riding a Bike for Exercise

	Number Who Ride a Bike	**Number Surveyed**
School Population	490	875
Nick's Sample Population	26	75

B. Based on the information in the table, why is it likely that Nick's sample is **not** random? State how many students from Nick's sample would have been expected to ride a bike for exercise had his sample been truly random.

It is likely that Nick's sample was not random because at least half of his school rode a bike for exercise. For Nick's sample to have been truly random 42 students would have been expected to ride a bike.

After you have finished your work, close this booklet so your teacher will know you are finished.

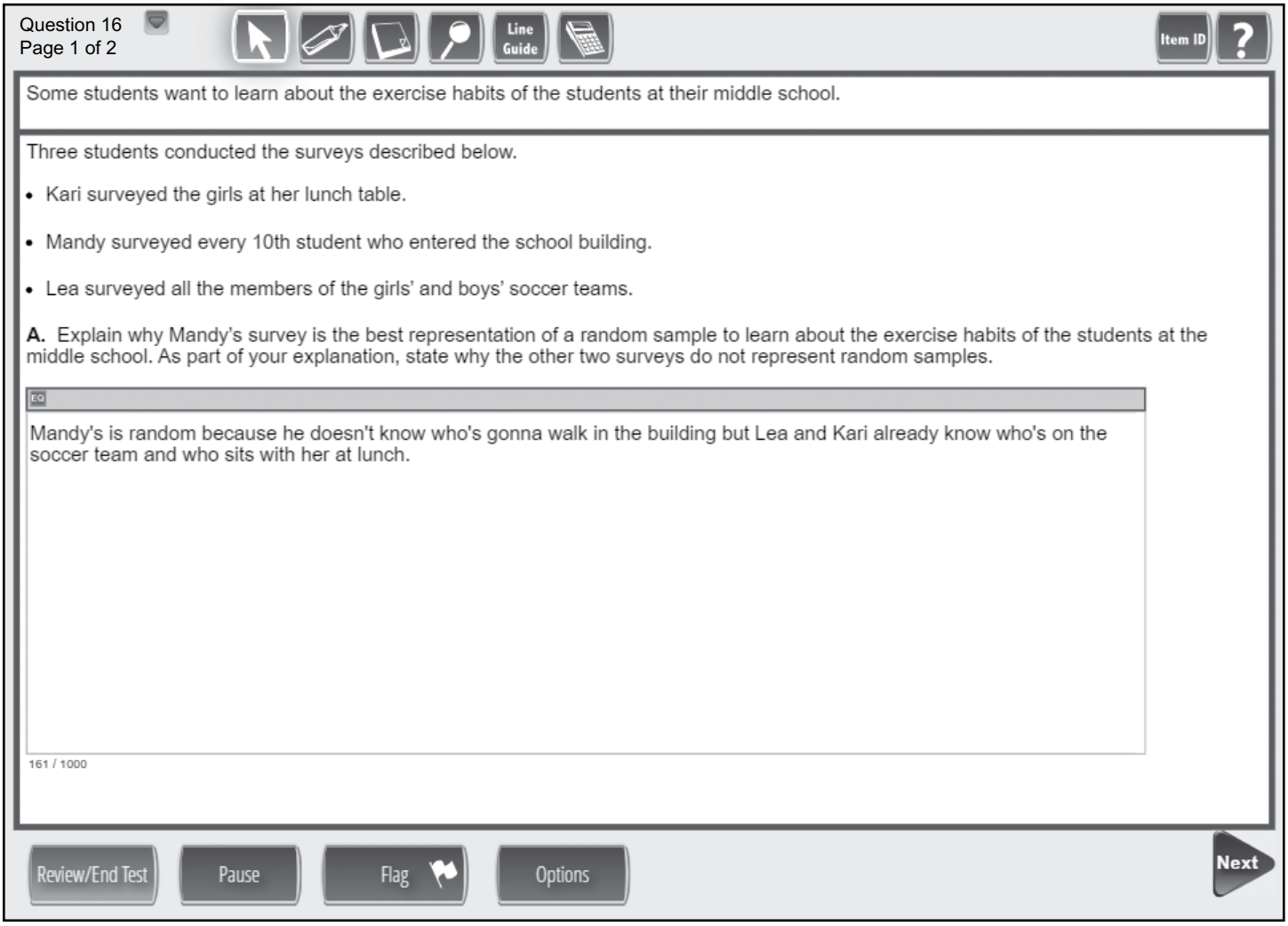


Part B: The student provided a correct but incomplete explanation as to why it is likely Nick's sample was not random (*because at least half of his school rode a bike*), which does not explain Nick's sample being significantly less than the school-wide survey. The student also provided a correct answer (*42*). While support (work or explanation) for the answer is not required for Part B, the student likely calculated 56% by dividing 490 by 875, resulting in 0.56, and then determined 56% of Nick's sample population by multiplying 75 by 0.56, resulting in a product of 42. [1.5 points]

STUDENT RESPONSE

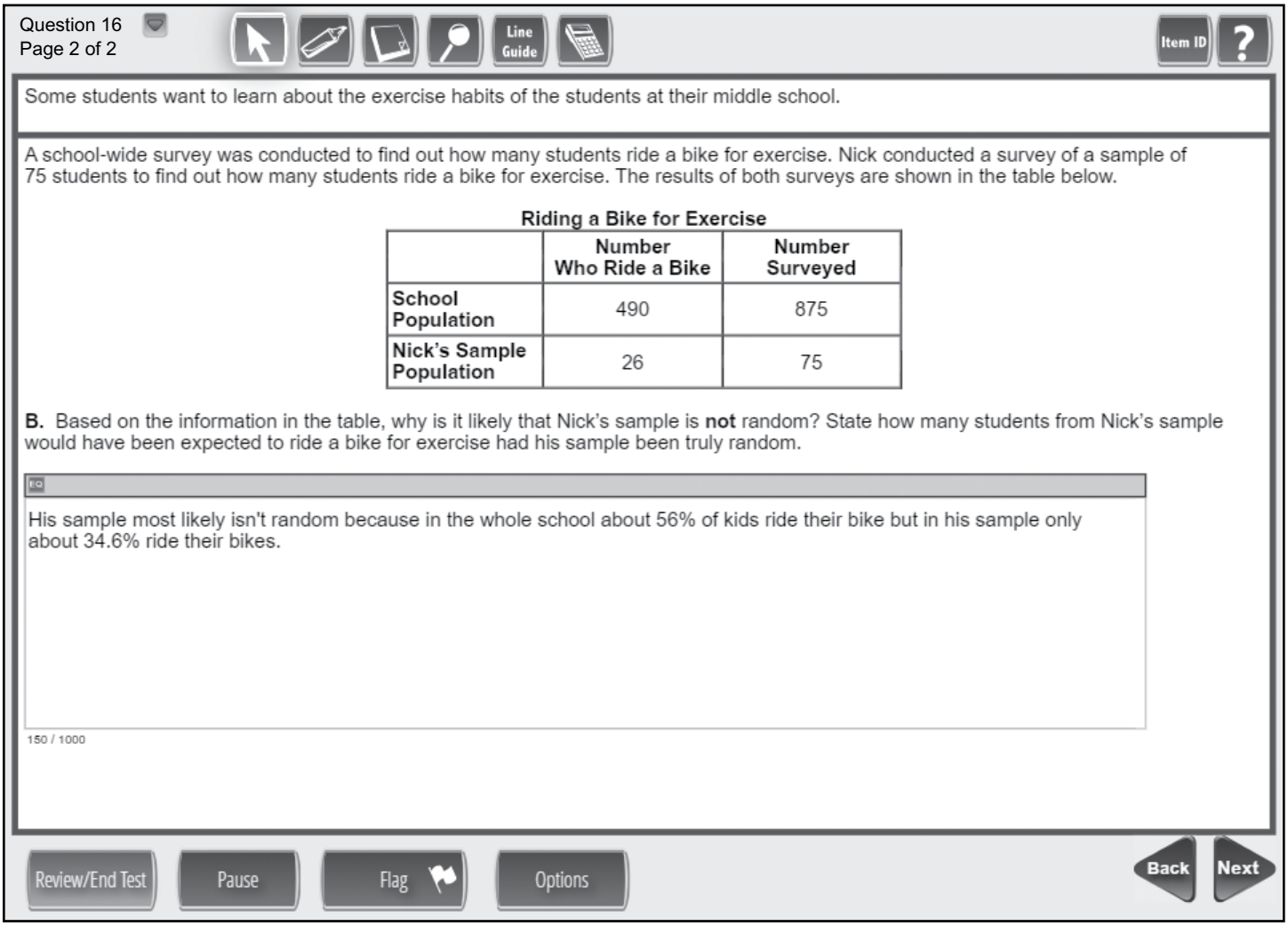
Computer Response Score: 2 points

PART A



Part A: The student provided a correct explanation as to why Mandy's survey is the best representation of a random sample (*Mandy's is random because he doesn't know who's gonna walk in the building*). The student provided an incorrect response as to why the other two surveys do not represent random samples (*Lea and Kari already know who's on the soccer team and who sits with her at lunch*). This response does not explain why these two surveys were not random. [1 point]

PART B



Part B: The student provided a correct and complete explanation as to why it is likely Nick's sample was not random by comparing the 56% and the 34.6% (*in the whole school about 56% of kids ride their bike but in his sample only about 34.6% ride their bikes*). The student did not provide a numerical answer for how many students from Nick's sample would have been expected to ride a bike. [1 point]

STUDENT RESPONSE

Response Score: 1 point

16. Some students want to learn about the exercise habits of the students at their middle school.

Three students conducted the surveys described below.

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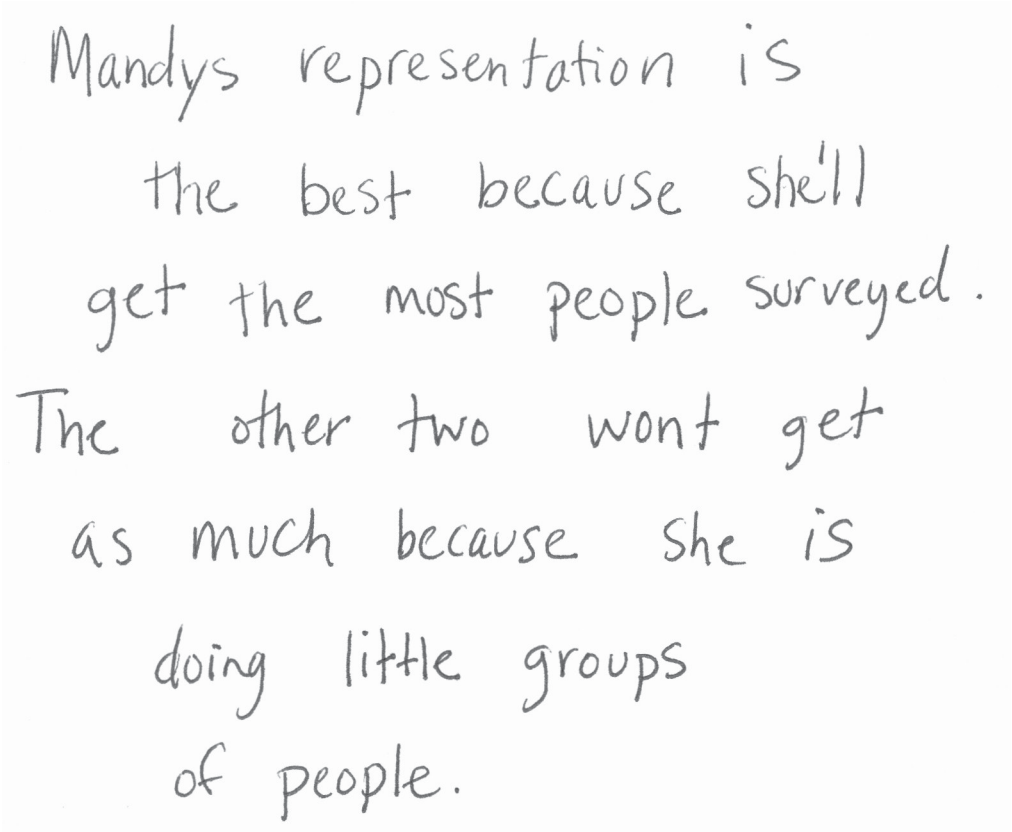
- Mandy surveyed every 10th student who entered the school building.
- Lea surveyed all the members of the girls' and boys' soccer teams.

A. Explain why Mandy's survey is the best representation of a random sample to learn about the exercise habits of the students at the middle school. As part of your explanation, state why the other two surveys do not represent random samples.



Go to the next page to finish question 16.

GO ON

Part A: The student provided an incorrect explanation as to why Mandy's survey is the best representation of a random sample (*Mandys representation is the best because she'll get the most people surveyed*). The student focused on the number of people surveyed rather than how the students were selected. The student also provided an incorrect response as to why the other two surveys do not represent random samples (*The other two wont get as much because she is doing little groups of people*). Again, the student focused on the number of people surveyed rather than how the students were selected. [0 points]

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

A school-wide survey was conducted to find out how many students ride a bike for exercise. Nick conducted a survey of a sample of 75 students to find out how many students ride a bike for exercise. The results of both surveys are shown in the table below.

Riding a Bike for Exercise

	Number Who Ride a Bike	Number Surveyed
School Population	490	875
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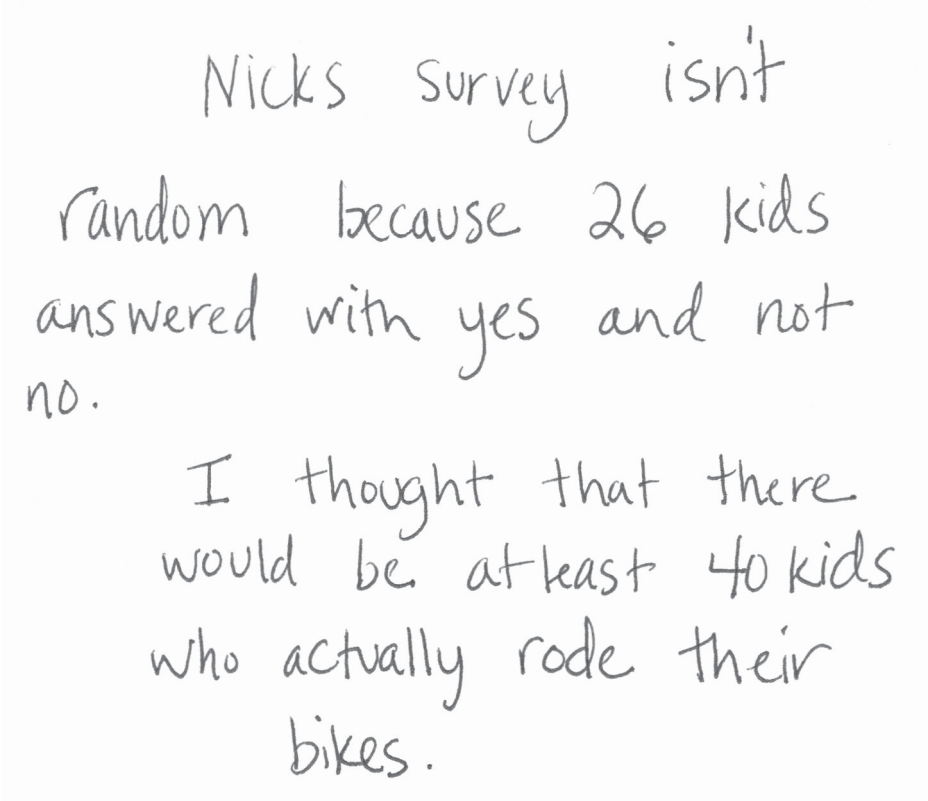
B. Based on the information in the table, why is it likely that Nick's sample is **not** random? State how many students from Nick's sample would have been expected to ride a bike for exercise had his sample been truly random.



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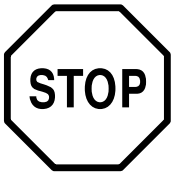


Part B: The student provided an incorrect explanation as to why it is likely Nick's sample was not random (*because 26 kids answered with yes and not no*). Although the student identified the number of students who ride a bike for exercise from Nick's sample population, the student does not compare this value to any other value in the table. The student also provided a correct answer (*40*). While support (work or explanation) for the answer is not required for Part B, the student likely divided 875 by 75, resulting in a quotient of approximately 11.666, which the student then rounded to 12, and then, using the same ratio, the student divided 490 by 12, resulting in a quotient of approximately 40.833, which the student truncated to 40. [1 point]

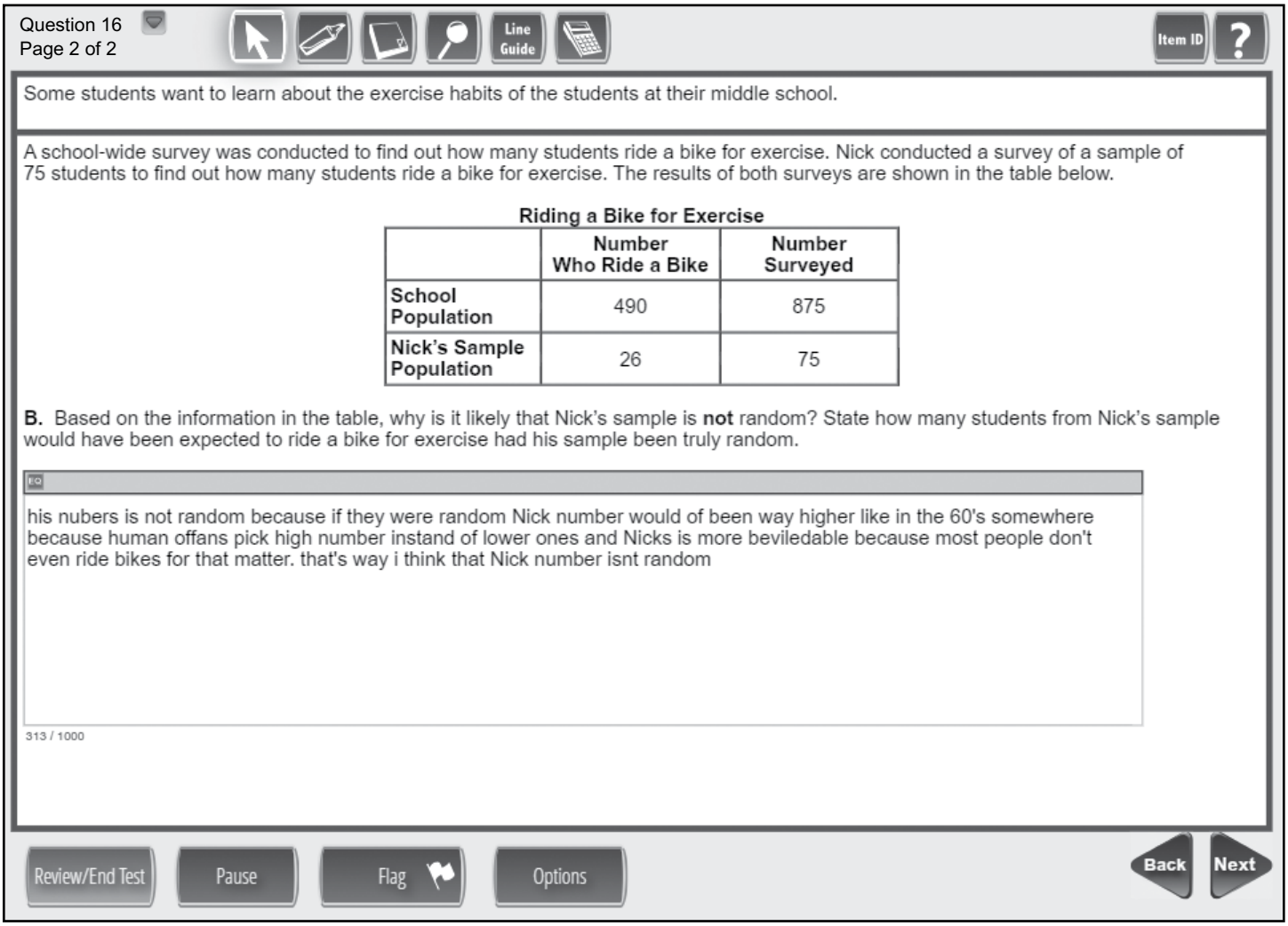
STUDENT RESPONSE

Computer Response Score: 0 points

PART A

Part A: The student provided an incorrect explanation as to why Mandy's survey is the best representation of a random sample (*Mandy's the best survey because it's Realistic and very consisted* [consistent] *. . . that means it's more people she surveying*). The student focused on the number of people surveyed rather than how the students were selected. The student also provided an incorrect response as to why the other two surveys do not represent random samples (*Kari survey is not consisted of not narly enogh people to survey for this topci. Lea survey is way! better than Kari but still not enogh poeple*). Again, the student focused on the number of people surveyed rather than how the students were selected. [0 points]

PART B



Part B: The student provided an incorrect explanation as to why it is likely Nick's sample was not random (*because if they were random Nick number would of been way higher . . . human offans pick high number instand* [instead] *of lower ones and Nicks is more beviledable* [believable] *because most people don't even ride bikes for that matter*). The student attempted to relate Nick's results to personal experience rather than using the information in the table. The student also provided an incorrect answer (*in the 60's somewhere*). No support (work or explanation) is required, so it is unclear where an error was made. [0 points]

Mathematics—Summary Data

Multiple-Choice

An asterisk (*) indicates the key.

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	A-N.1.1.1	B	1	20%	61%*	6%	13%
2	A-N.1	C	2	29%	16%	39%*	16%
3	A-N.1.1.3	A	1	74%*	8%	9%	9%
4	A-R.1.1	D	2	34%	14%	17%	35%*
5	A-R.1.1.3	A	2	71%*	10%	10%	9%
6	A-R.1.1.4	B	2	26%	48%*	13%	13%
7	A-R.1.1.5	B	1	9%	40%*	13%	38%
8	A-R.1.1.6	C	2	36%	18%	37%*	9%
9	B-E.1.1.1	D	1	9%	19%	14%	58%*
10	B-E.2	A	2	53%*	16%	13%	18%
11	B-E.2.2.1	B	2	9%	56%*	21%	14%
12	B-E.2.3.1	B	2	19%	51%*	19%	11%
13	C-G.1.1.2	D	1	11%	17%	29%	43%*
14	C-G.1.1.3	C	2	13%	14%	62%*	11%
15	C-G.2.2.2	C	2	23%	17%	42%*	18%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
16	D-S.1	4	2	1.28

PSSA Grade 7 Mathematics
Item and Scoring Sampler