pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

2021*
Grade 4

* This is a revised version of the 2017 Item and Scoring Sampler.

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—September 2021

TABLE OF CONTENTS

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 Anchor documents, assessment handbooks, and content-based item and scoring samplers. This Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing local instructional programs 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 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 items (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 (items) that have been written to be aligned with the Assessment Anchors, which are aligned to the PCS. The test questions provide an idea of the types of items that will appear on an operational, PCS-based PSSA. Each sample test question has been through a rigorous review process to ensure alignment with the Assessment Anchors.

Typically an item and scoring sampler is released every year to provide students and educators with a resource to assist in delivering focused instructional programs aligned to the PCS. However, due to the cancellation of standardized testing in 2019–2020, the 2021 Item and Scoring Sampler is a revised version of the previously released 2017 Item and Scoring Sampler. This revised version ensures that students and educators have an enhanced item and scoring sampler to use during instruction and/or preparation of students to take the PSSA Exam.

Purpose and Uses

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

Item Format and Scoring Guidelines

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

Each 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.

This sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines may be distributed to students for use during local assessments and may also be used by educators when scoring local assessments.[1]

Item Alignment

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

Testing Time and Mode of Testing Delivery for the PSSA

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

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

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

Mathematics Reporting Categories

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

• A = Numbers and Operations	• C = Geometry
• B = Algebraic Concepts	• D = Data Analysis and Probability

These four classifications are used throughout the grade levels. In addition to these classifications, there are five Reporting Categories for each grade level. The first letter of each Reporting Category represents the classification; the second letter represents the Domain as stated in the Common Core State Standards for Mathematics. Listed below are the Reporting Categories for Grade 4.

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

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

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. 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).....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

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 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, DOK level, and mean student score. Additionally, each of the included item-specific scoring guidelines is combined with sample student responses representing each score point to form a practical, item-specific scoring guide. The *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

Example Multiple-Choice Item Information Table

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

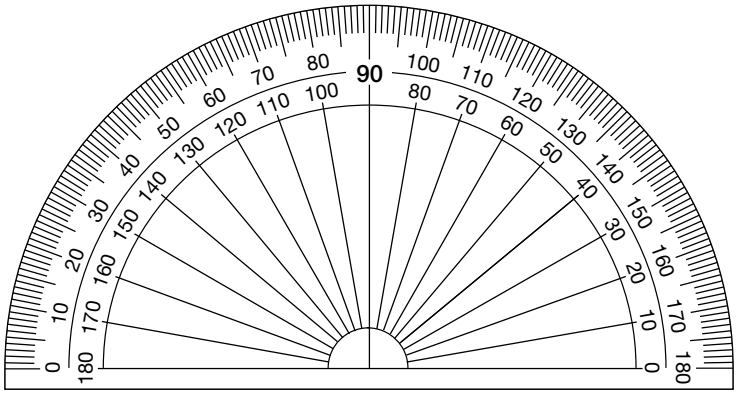
Example Open-Ended Item Information Table

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

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

Grade 4 Protractor

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



Grade 4 Formula Sheet

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

2021
Grade 4

Standard Conversions

1 yard (yd) = 3 feet (ft)
1 foot = 12 inches (in.)

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

1 gallon (gal) = 4 quarts (qt)
1 quart = 2 pints (pt)
1 pint = 2 cups (c)

Metric Conversions

1 kilometer (km) = 1,000 meters (m)
1 meter = 100 centimeters (cm)

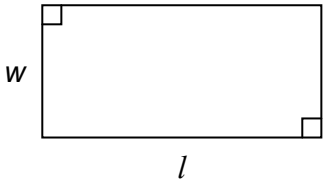
1 kilogram (kg) = 1,000 grams (g)

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

Time Conversions

1 year (yr) = 12 months (mo)
1 year = 52 weeks (wk)
1 year = 365 days
1 week = 7 days
1 day = 24 hours (hr)
1 hour = 60 minutes (min)
1 minute = 60 seconds (sec)

Rectangle



Area = length × width
$A = l \times w$

Perimeter = length + length + width + width
$P = l + l + w + w$

Mathematics Test Directions

On the following pages are the mathematics questions.

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

Directions for Multiple-Choice Questions

Some questions will ask you to select an answer from among four choices.

For the multiple-choice questions:

- First solve the problem on scratch paper.
- Choose the correct answer and record your choice in the answer booklet.
- If none of the choices matches your answer, go back and check your work for possible errors.
- Only one of the answers provided is the correct response.

Directions for Open-Ended Questions

Some questions will require you to write your response.

For the open-ended questions:

- These questions have more than one part. Be sure to read the directions carefully.
- You cannot receive the highest score for an open-ended question without completing all tasks in the question. For example, if the question asks you to show your work or explain your reasoning, be sure to show your work or explain your reasoning in the space provided.
- If the question does **not** ask you to show your work or explain your reasoning, you may use the space provided, but only those parts of your response that the question specifically asks for will be scored.
- Write your response in the appropriate location within the response box in the answer booklet. Some answers may require graphing, plotting, labeling, drawing, or shading. If you use scratch paper, be sure to transfer your final response and any needed work or reasoning to the answer booklet.

THIS PAGE IS INTENTIONALLY BLANK.

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

MULTIPLE-CHOICE ITEMS

1. Add: $6\frac{2}{5} + 3\frac{4}{5}$

A. $4\frac{4}{5}$

B. $9\frac{1}{5}$

C. $10\frac{1}{5}$

D. $21\frac{1}{5}$

Item Information	
Alignment	A-F.2.1.3
Answer Key	C
Depth of Knowledge	1
p-value A	4%
p-value B	37%
p-value C	57% (correct answer)
p-value D	2%
Option Annotations	A. multiplies the whole number by the numerator of each fraction and then adds $\frac{12}{5} + \frac{12}{5}$ B. does not add the additional 1 to the whole number when changing $\frac{6}{5}$ to $\frac{1}{5}$ C. Correct: converts each mixed number to an improper fraction by multiplying the whole part by the denominator (5) and then adding the product to the numerator to get $\frac{32}{5} + \frac{19}{5} = \frac{51}{5}$, and then converts $\frac{51}{5}$ back to a mixed number by dividing 51 by 5 for the whole part and leaving the remainder as the new numerator OR adds the whole parts and the fractional parts separately to get 9 and $\frac{6}{5}$, converts the $\frac{6}{5}$ to $1\frac{1}{5}$, and then adds 9 to $1\frac{1}{5}$ D. solves the problem as $\frac{62}{5} + \frac{34}{5}$ and then incorrectly converts $\frac{96}{5}$ to $21\frac{1}{5}$

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

2. There are 49,528 people living in a city. What is the value of the 4 in the number of people living in the city?

A. two times the two in the tens place

B. twenty times the two in the tens place

C. two hundred times the two in the tens place

D. two thousand times the two in the tens place

Item Information	
Alignment	A-T.1.1.1 A-T.1.1.2
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	A. does not consider place value B. uses concept of “10 times the value” but only for 1 place value C. uses concept of “100 times the value” since there are two digits between the 2 and the 4 D. Correct: identifies the value of the 4 as 40,000, identifies the value of the 2 as 20, and recognizes that 40,000 is 2,000 times 20

3. The average distance from Earth to the moon is 238,855 miles. What is this distance rounded to the nearest thousand?

A. 200,000

B. 238,000

C. 238,900

D. 239,000

Item Information	
Alignment	A-T.1.1.4
Answer Key	D
Depth of Knowledge	1
p-value A	11%
p-value B	10%
p-value C	12%
p-value D	67% (correct answer)
Option Annotations	A. rounds to the highest place value B. rounds down (truncates) C. rounds to the nearest hundred D. Correct: looks at the digit to the right of the thousands place, recognizes it as 5 or greater, and rounds the thousands place up from 8 to 9

4. A theater sold $1,048 worth of tickets on Saturday and $424 worth of tickets on Sunday. Each ticket cost $8. How many tickets were sold altogether on Saturday and Sunday?

A. 53

B. 78

C. 131

D. 184

Item Information	
Alignment	A-T.2.1.3 A-T.2.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	7%
p-value B	8%
p-value C	14%
p-value D	71% (correct answer)
Option Annotations	A. divides $424 by $8 (determines the number of tickets sold on Sunday) B. subtracts $424 from $1,048 and then divides the difference by $8 C. divides $1,048 by $8 (determines the number of tickets sold on Saturday) D. Correct: adds $1,048 to $424 and then divides the sum by $8 OR divides $1,048 by $8, divides $424 by $8, and then adds the quotients

5. Cheryl keeps her marbles in two containers. She has between 177 and 203 marbles in one container. She has between 157 and 163 marbles in the other container. Which estimate could be the total number of marbles Cheryl has in both containers?

A. 300

B. 320

C. 360

D. 400

Item Information	
Alignment	A-T.2.1.4
Answer Key	C
Depth of Knowledge	2
p-value A	10%
p-value B	20%
p-value C	44% (correct answer)
p-value D	26%
Option Annotations	A. rounds the highest numbers down to the nearest hundred and then adds 100 to 200 B. rounds the lowest numbers down to the nearest ten and then adds 170 to 150 C. Correct: determines the lowest possible total by adding 177 and 157, determines the greatest possible total by adding 203 and 163, and selects a number between these two sums OR selects an "easy" number between 177 and 203 (e.g., 200), selects an "easy" number between 157 and 163 (e.g., 160), adds these numbers together, and selects a value close to this sum D. rounds both numbers to the nearest hundred and then adds 200 to 200

6. On a vocabulary list, $\frac{5}{10}$ of the words are nouns and $\frac{6}{12}$ of the words are verbs. Which pair of statements correctly compares the fraction of the words on the vocabulary list that are nouns to the fraction that are verbs?

A. Since $5 < 6$, then $\frac{5}{10} < \frac{6}{12}$.
So, there are fewer nouns than verbs on the vocabulary list.

B. Since $\frac{1}{10} > \frac{1}{12}$, then $\frac{5}{10} > \frac{6}{12}$.
So, there are more nouns than verbs on the vocabulary list.

C. Since $\frac{5}{10} = \frac{7}{12}$ and $7 > 6$, then $\frac{5}{10} > \frac{6}{12}$.
So, there are more nouns than verbs on the vocabulary list.

D. Since $\frac{5}{10} = \frac{1}{2}$ and $\frac{6}{12} = \frac{1}{2}$, then $\frac{5}{10} = \frac{6}{12}$.
So, there are equal numbers of nouns and verbs on the vocabulary list.

Item Information	
Alignment	A-F.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	25%
p-value B	13%
p-value C	8%
p-value D	54% (correct answer)
Option Annotations	A. only compares numerators and does not consider denominators B. only compares denominators and does not consider numerators C. incorrectly creates an equivalent fraction by adding 2 to both the numerator and denominator of $\frac{5}{10}$ D. Correct: creates equivalent fractions by dividing the numerator and denominator of $\frac{5}{10}$ by 5 and by dividing the numerator and denominator of $\frac{6}{12}$ by 6

7. In September, Mrs. Jones had a full set of pencils. In October, she had $\frac{7}{12}$ of the full set remaining. In November, she gave away $\frac{2}{12}$ of the full set. What fraction of the full set of pencils did Mrs. Jones have remaining at the end of November?

A. $\frac{5}{24}$

B. $\frac{5}{12}$

C. $\frac{5}{6}$

D. $\frac{5}{0}$

Item Information	
Alignment	A-F.2.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	6%
p-value B	86% (correct answer)
p-value C	5%
p-value D	3%
Option Annotations	A. subtracts the numerators but adds the denominators B. Correct: subtracts the numerators while leaving the common denominator C. subtracts the numerators but "reduces" the 12 to 6 by dividing the 12 by 2 D. subtracts the numerators and the denominators

8. Mikalya rode her bike on 4 days last week. She rode her bike a total of $2\frac{2}{3}$ miles. Which equation shows how many miles Mikalya could have ridden her bike each day?

A. $\frac{1}{3} + \frac{1}{3} + 1 + 1 = 2\frac{2}{3}$

B. $\frac{2}{3} + \frac{2}{3} + 1 + 1 = 2\frac{2}{3}$

C. $\frac{1}{3} + \frac{1}{3} + \frac{2}{3} + 1 = 2\frac{2}{3}$

D. $\frac{2}{3} + \frac{2}{3} + \frac{2}{3} + 1 = 2\frac{2}{3}$

Item Information	
Alignment	A-F.2.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	79% (correct answer)
p-value B	7%
p-value C	7%
p-value D	7%
Option Annotations	A. Correct: uses $\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$ to get $\frac{2}{3} + 1 + 1 = 2\frac{2}{3}$ B. adds only one of the $\frac{2}{3}$ fractions to 1 + 1 C. uses $\frac{1}{3} + \frac{1}{3} = 1$ to get $1 + \frac{2}{3} + 1 = 2\frac{2}{3}$ D. uses $\frac{2}{3} + \frac{2}{3} = 1$ to get either $\frac{2}{3} + 1 + 1 = 2\frac{2}{3}$ or $1 + \frac{2}{3} + 1 = 2\frac{2}{3}$

9. In each box of bananas, $\frac{2}{10}$ of the bananas are already ripe. How many bananas are already ripe in a box of 30 bananas?

A. 2

B. 6

C. 12

D. 20

Item Information	
Alignment	A-F.2.1.7 A-F.2.1.6
Answer Key	B
Depth of Knowledge	2
p-value A	9%
p-value B	50% (correct answer)
p-value C	15%
p-value D	26%
Option Annotations	A. uses only the value of the numerator B. Correct: multiplies the numerator by the number of bananas (2×30) and then divides the product by the denominator ($60 \div 10$) OR converts 30 to $\frac{30}{1}$, multiplies $\frac{2}{10}$ by $\frac{30}{1}$ to get $\frac{2 \times 30}{10 \times 1} = \frac{60}{10}$, and then converts $\frac{60}{10}$ to 6 C. adds the numerator to the denominator ($2 + 10$) D. multiplies the numerator by the denominator (2×10) OR subtracts the denominator from the number of bananas ($30 - 10$)

10. Pauline has two sticks. One is $\frac{4}{10}$ meter long. The other is $\frac{9}{100}$ meter long. Which statement correctly compares the two lengths when written as decimals?

A. $0.04 < 0.09$

B. $0.04 < 0.90$

C. $0.90 < 0.40$

D. $0.09 < 0.40$

Item Information	
Alignment	A-F.3.1.2 A-F.3.1.3
Answer Key	D
Depth of Knowledge	1
p-value A	32%
p-value B	17%
p-value C	8%
p-value D	43% (correct answer)
Option Annotations	A. incorrectly converts $\frac{4}{10}$ B. incorrectly converts both fractions C. incorrectly converts $\frac{9}{100}$ and uses the wrong inequality sign for the given decimals D. Correct: converts $\frac{4}{10}$ to 0.4 and includes a 0 placeholder in the hundredths place to get 0.40, converts $\frac{9}{100}$ to 0.09, identifies the comparison symbol as "less than," and orders the decimals by comparing place values OR creates an equivalent fraction of $\frac{4}{10}$ by multiplying the numerator and denominator by 10, converts $\frac{40}{100}$ to 0.40, converts $\frac{9}{100}$ to 0.09, identifies the comparison symbol as "less than," and orders the decimals by comparing place values

11. Jesse has 4 rows of rocks. There are 6 rocks in each row. Which description shows another way Jesse can organize all of his rocks?

A. 2 rows with 5 rocks in each row

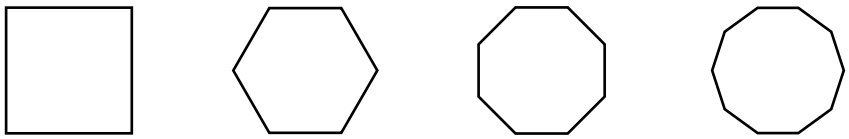
B. 3 rows with 8 rocks in each row

C. 5 rows with 5 rocks in each row

D. 2 rows with 24 rocks in each row

Item Information	
Alignment	B-O.2.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	8%
p-value B	67% (correct answer)
p-value C	11%
p-value D	14%
Option Annotations	A. incorrectly uses 4 + 6 = 10 as the total number of rocks and matches with 2 × 5 = 10 B. Correct: determines 4 × 6 = 24 and recognizes that 3 × 8 also equals 24 C. incorrectly uses 4 × 6 = 25 as the total number of rocks D. uses the total number of rocks (24) as the number of rocks in each row

12. The shapes below show a pattern.



shape 1 shape 2 shape 3 shape 4

The pattern continues. How many sides will shape 10 have?

A. 16

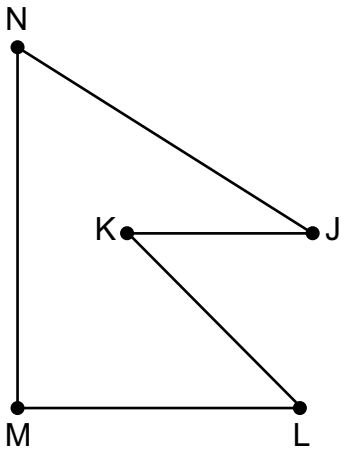
B. 22

C. 30

D. 40

Item Information	
Alignment	B-O.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	18%
p-value B	60% (correct answer)
p-value C	10%
p-value D	12%
Option Annotations	A. adds 6 to the shape number because 4 + 6 = 10 in shape 4 B. Correct: recognizes that each shape has 2 more sides than the previous shape, so extends the pattern by adding 2 each time OR determines the rule to be "multiply the shape number by 2 and then add 2," so multiplies 10 by 2 and then adds 2 to 20 C. multiplies 3 by the shape number because 2 × 3 = 6 in shape 2 D. multiplies 4 by the shape number because 1 × 4 = 4 in shape 1

13. The shape of Nepal's flag is shown below.



Which statement about the shape of Nepal's flag is true?

A. Angle N is a right angle.

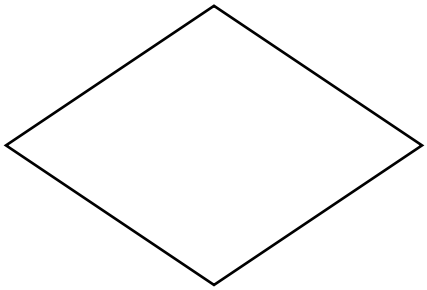
B. Angle J is an obtuse angle.

C. Line segment ML and line segment KJ are parallel.

D. Line segment ML and line segment KL are perpendicular.

Item Information	
Alignment	C-G.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	18%
p-value B	10%
p-value C	52% (correct answer)
p-value D	20%
Option Annotations	A. incorrectly describes the angle (angle is acute, not right) B. incorrectly describes the angle (angle is acute, not obtuse) C. Correct: identifies that line segments ML and KJ are both horizontal, which means they are parallel D. misidentifies angle KLM as a right angle or does not know that perpendicular line segments should form a right angle

14. The shape of a window in Neal's house is shown below.



The opposite sides of the window are parallel. No pair of sides is perpendicular. Which term describes the shape of the window?

A. parallelogram

B. rectangle

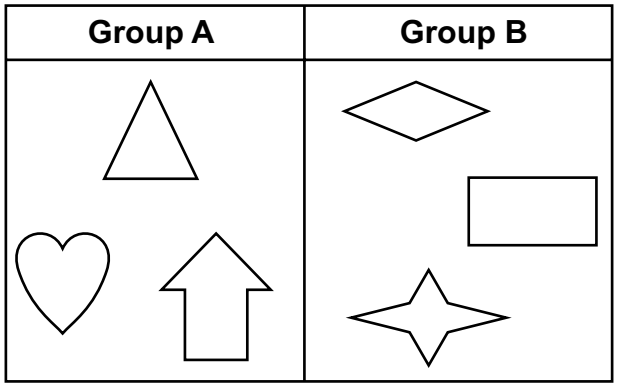
C. square

D. trapezoid

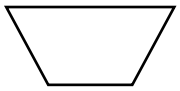
Item Information	
Alignment	C-G.1.1.2
Answer Key	A
Depth of Knowledge	1
p-value A	63% (correct answer)
p-value B	4%
p-value C	15%
p-value D	18%
Option Annotations	A. Correct: identifies a quadrilateral with opposite sides parallel as a parallelogram B. does not associate "perpendicular" with right angles C. thinks parallel sides mean all sides are equal length; does not associate "perpendicular" with right angles D. thinks only one pair of opposite sides are parallel

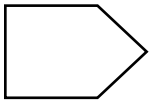
THIS PAGE IS INTENTIONALLY BLANK.

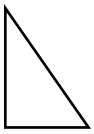
15. Erin sorted some shapes based on the number of lines of symmetry each shape has.

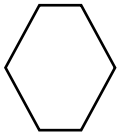


Which shape belongs in Group B?

A. 

B. 

C. 

D. 

Item Information	
Alignment	C-G.1.1.3
Answer Key	D
Depth of Knowledge	2
p-value A	25%
p-value B	12%
p-value C	7%
p-value D	56% (correct answer)
Option Annotations	A. identifies a shape with only one line of symmetry B. identifies a shape with only one line of symmetry C. identifies a shape with no lines of symmetry D. Correct: recognizes that the shapes in Group B each have 2 lines of symmetry, so identifies a shape with 2 lines of symmetry

16. On the street map shown below, Elm Street and Oak Street meet at a right angle.

Which equation shows how to find the measure of the angle formed by Maple Street and Oak Street?

A. $90° - 50° = 40°$

B. $180° - 50° = 130°$

C. $90° + 50° = 140°$

D. $180° + 50° = 230°$

Item Information	
Alignment	D-M.3.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	63% (correct answer)
p-value B	14%
p-value C	17%
p-value D	6%
Option Annotations	A. Correct: recognizes that a right angle is 90° and uses subtraction since the unknown angle and the labeled angle form the right angle B. uses 180° as the sum of the two angles (straight angle) instead of 90° (right angle) C. uses addition instead of subtraction D. uses 180° instead of 90° and uses addition instead of subtraction

THIS PAGE IS INTENTIONALLY BLANK.

OPEN-ENDED QUESTION

17. A construction crew is paving a highway.

One morning, the crew starts work at 10 minutes past 6 A.M. and finishes at 20 minutes to noon.

A. How many hours and minutes does the crew work in the morning?

The crew can extend the length of the highway by 200 feet each hour.

B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.

Go to the next page to finish question 17.

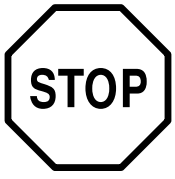
GO ON

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

After lunch, the crew will extend the length of the highway by another 300 **yards**. They will start at 1:30 P.M.

C. At what time will they complete the 300 **yards**?

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



Item-Specific Scoring Guideline

#17 Item Information

Alignment	D-M.1	Depth of Knowledge	2	Mean Score	0.74

Assessment Anchor this item will be reported under:

M04.D-M.1—Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

Specific Anchor Descriptor addressed by this item:

M04.D-M.1.1—Solve problems involving length, weight (mass), liquid volume, time, area, and perimeter.

Scoring Guide

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

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3 points.
2	Student earns 2 points.
1	Student earns 1 point. OR Student demonstrates minimal understanding of solving problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
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?
5 hours and 30 minutes	

Part B (2 points):

1 point for correct answer

1 point for complete support

What?	Why?
1,100 (feet) [Note: Carry over any error from Part A]	**Sample Work:** 5 hours and 30 minutes = 5.5 hours 5.5 × 200 = 1,100 **OR** **Sample Explanation:** The crew can cover 200 feet each hour, so they can cover 100 feet in a half-hour. In 5 hours, they can cover 5 × 200 = 1,000 feet. In the other half-hour, they can cover 100 feet. So they cover 1,000 + 100 = 1,100 feet in all.

Part C (1 point):

1 point for correct answer

What?	Why?
6:00 (P.M.)	

STUDENT RESPONSE

Response Score: 4 points

17. A construction crew is paving a highway.

One morning, the crew starts work at 10 minutes past 6 A.M. and finishes at 20 minutes to noon.

A. How many hours and minutes does the crew work in the morning?

5 hours and 30 minutes

The student has given the correct answer (*5 hours and 30 minutes*) by correctly calculating the time difference between 6:10 a.m. and 11:40 a.m. [1 point]

The crew can extend the length of the highway by 200 feet each hour.

B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.

1,100 feet

200 × 5 = 1,000 feet in 5 hours

2) 200 = 100

1,000 + 100 = 1,100

The student has given the correct answer (*1,100 feet*) with complete support. The student first multiplies 200 (*feet*) by 5 (*hours*) to find that the crew completed *1,000 feet in 5 hours*. To find how many feet the crew completed in 30 minutes, the student took the number of feet completed in one hour and divided by 2 (*200 ÷ 2 = 100*). The student then added 1,000 and 100 to find the complete length of highway completed (*1,100 feet*). [2 points]

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

After lunch, the crew will extend the length of the highway by another 300 **yards**. They will start at 1:30 P.M.

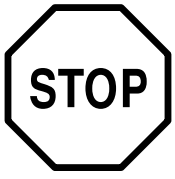
C. At what time will they complete the 300 **yards**?

6:00

They will get done at 6:00

The student has given the correct answer (*6:00*). The student most likely converted from yards to feet by multiplying 300 by 3 to get 900 feet, divided 900 by 200 (the number of feet the crew can complete each hour) to get 4.5 hours, and then added 4.5 hours to 1:30 p.m. to get a finish time of 6:00. [1 point]

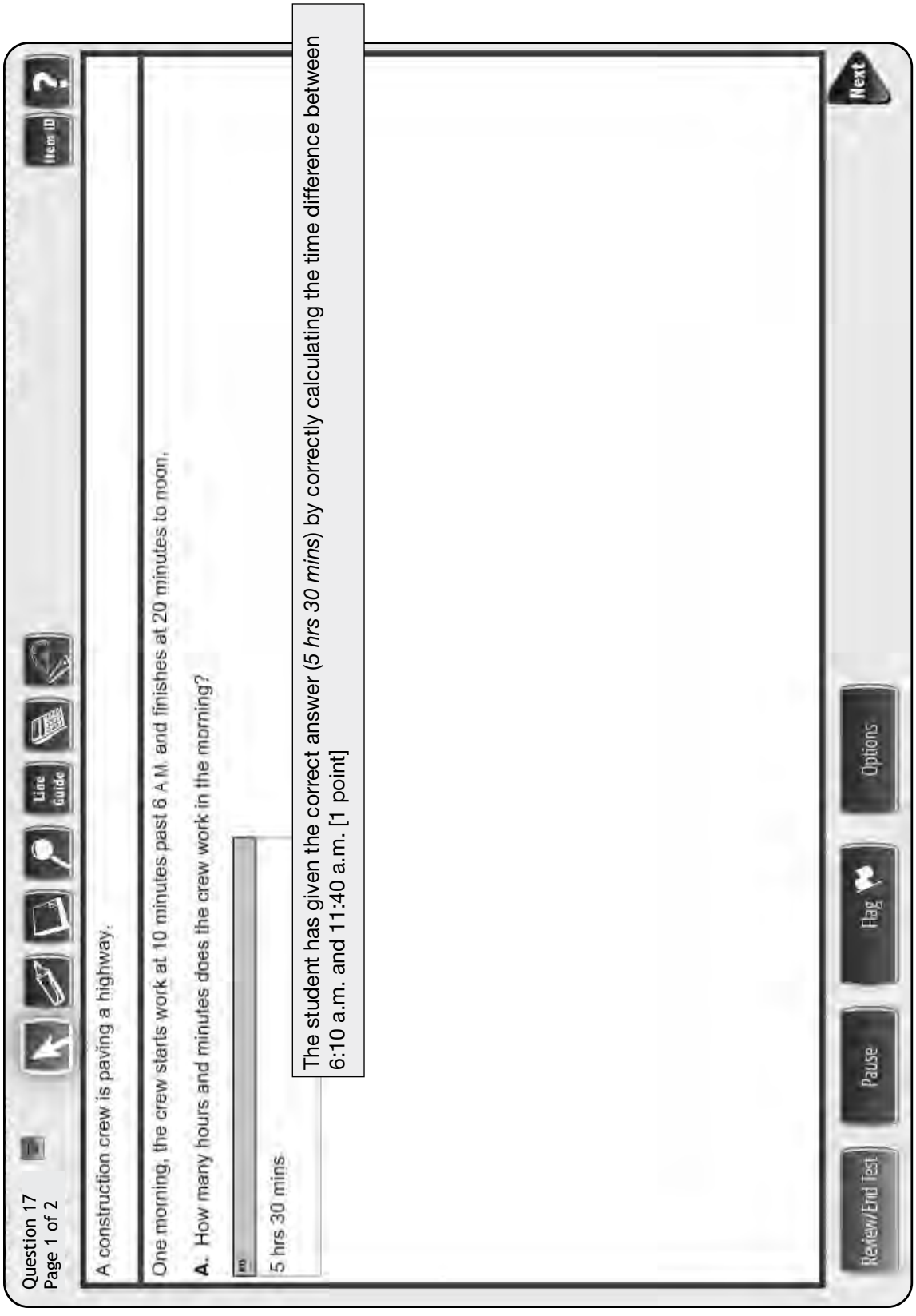
After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.



STUDENT RESPONSE

Response Score: 3 points

PART A



The student has given the correct answer (*5 hrs 30 mins*) by correctly calculating the time difference between 6:10 a.m. and 11:40 a.m. [1 point]

PART B

Question 17
Page 2 of 2
Line Guide
Item ID
A construction crew is paving a highway.
The crew can extend the length of the highway by 200 feet each hour.
B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.
EQ
5 hrs 30 mins - how long they worked
5 × 200 = 1000 - number of hrs times number of feet per hour.
plus 100 feet because they only worked another 30 mins.
Answer - 1100 feet
169 / 1000
The student has given the correct answer (1100 feet) with complete support. The student first multiplies 5 and 200 = 1000, which is the number of hrs times number of feet per hour to find the total length completed in 5 hours. The student then performs mental math to figure out that the crew can do 100 feet in 30 minutes (plus 100 feet because they only worked another 30 mins). The student then added 1,000 and 100 (1000 . . . plus 100) to find the complete length of highway completed (1100 feet). [2 points]
After lunch, the crew will extend the length of the highway by another 300 yards. They will start at 1:30 P.M.
C. At what time will they complete the 300 yards?
EQ
The crew will stop at 4:10
The student has given an incorrect answer (The crew will stop at 4:10). It is unclear how the student derived this answer since no support (work or explanation) is required. [0 points]
Review/End Test
Pause
Flag
Options
Back
Next

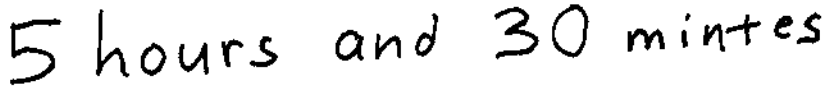
STUDENT RESPONSE

Response Score: 2 points

17. A construction crew is paving a highway.

One morning, the crew starts work at 10 minutes past 6 A.M. and finishes at 20 minutes to noon.

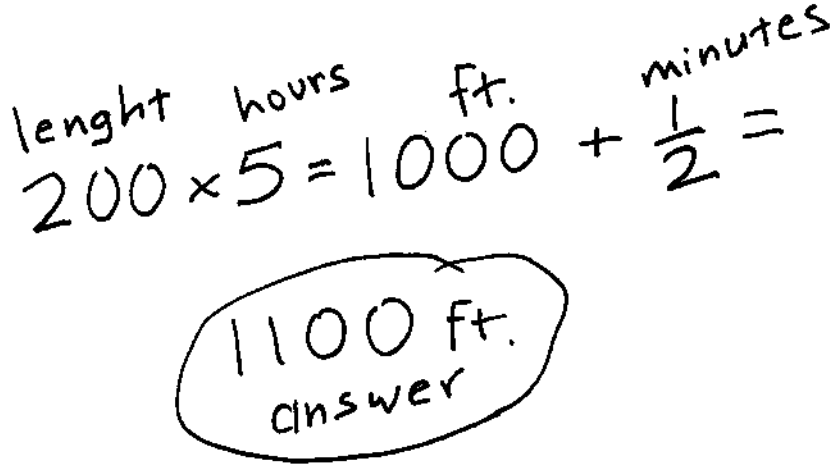
A. How many hours and minutes does the crew work in the morning?



The student has given the correct answer (*5 hours and 30 mintes*) by correctly calculating the time difference between 6:10 a.m. and 11:40 a.m. [1 point]

The crew can extend the length of the highway by 200 feet each hour.

B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.



The student has given the correct answer (*1100 ft.*) but the support is incorrect. While the student starts out with calculating the length of the highway completed in 5 hours (*200 [lenght] × 5 [hours] = 1000 [ft.]*), the second part of the support given is unclear (+ $\frac{1}{2}$ *[minutes]*). There is no support showing how the student calculated the length for the remaining 30 minutes of work. Students must show correct support for both hours and minutes for credit. The support is both incorrect and written as a run-on equation; either results in no credit for the support. [1 point]

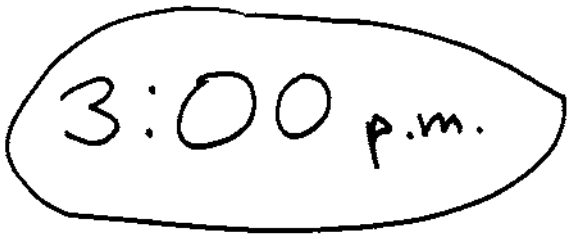
Go to the next page to finish question 17.

GO ON

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

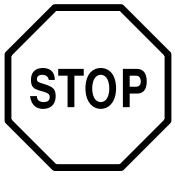
After lunch, the crew will extend the length of the highway by another 300 **yards**. They will start at 1:30 P.M.

C. At what time will they complete the 300 **yards**?



The student has given an incorrect answer (*3:00 p.m.*). It is unclear how the student derived this answer since no support (work or explanation) is required. The student may not have converted the 300 yards to feet and then proceeded to divide 300 by 200 to get 1.5 hours and add 1.5 hours to 1:30 p.m. [0 points]

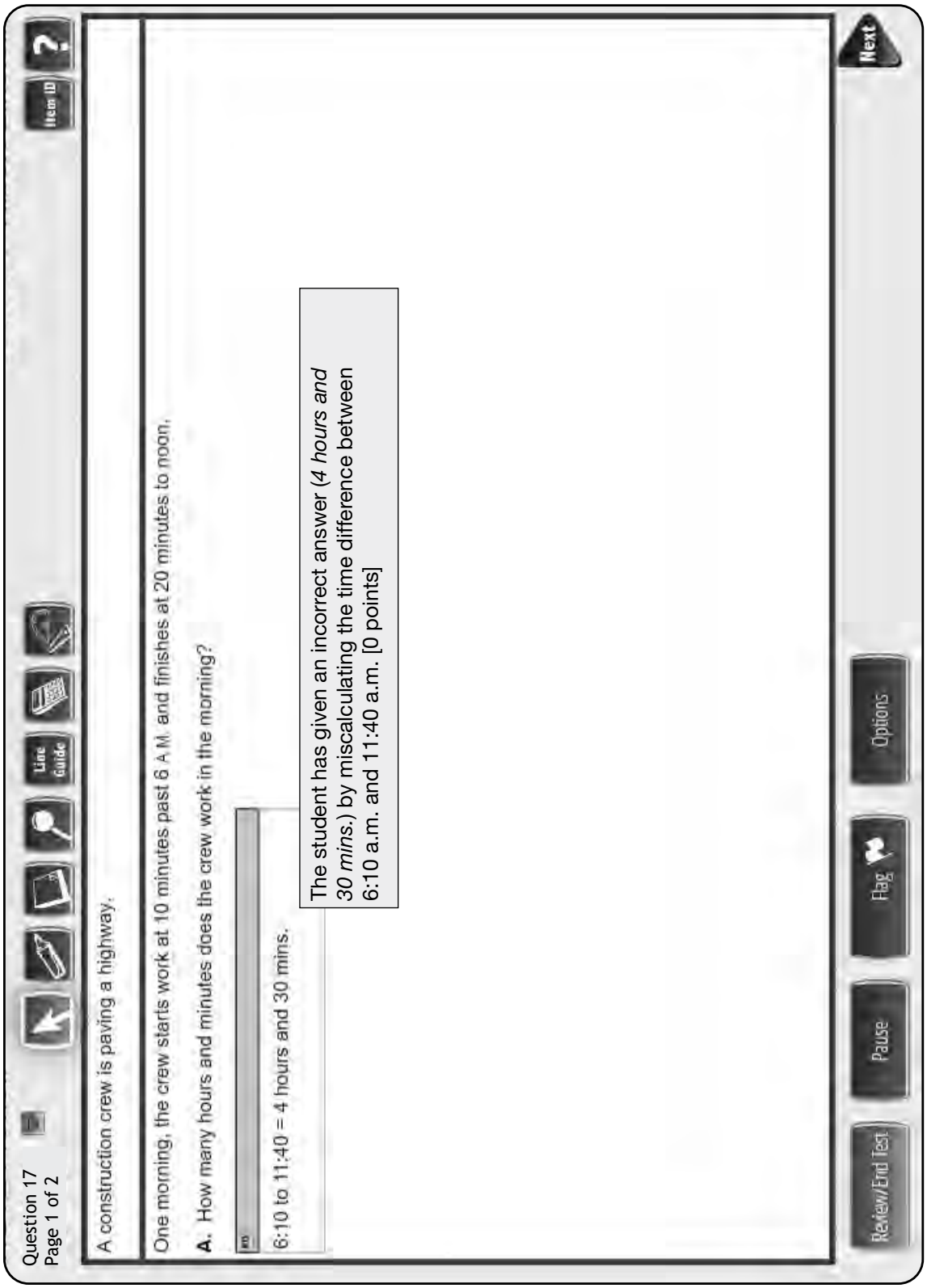
After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.



STUDENT RESPONSE

Response Score: 1 point

PART A



PART B

Question 17
Page 2 of 2
Line Guide
Item ID
A construction crew is paving a highway.
The crew can extend the length of the highway by 200 feet each hour.
B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.
EQ
4 hours × 200 feet = 800 feet
There would be 800 feet of the new part of the highway in length.
92 / 1000
The student has given an incorrect answer (There would be 800 feet of the new part of the highway in length) and incorrect support (4 hours × 200 feet = 800 feet). The student has only carried over part of the answer from Part A (4 hours), and without addressing both the hours and minutes from Part A in Part B, no credit is given for the support. [0 points]
After lunch, the crew will extend the length of the highway by another 300 yards. They will start at 1:30 P.M.
C. At what time will they complete the 300 yards?
EQ
6:00 is when they finish.
The student has given the correct answer (6:00 is when they finish). The student most likely converted from yards to feet by multiplying 300 by 3 to get 900 feet, divided 900 by 200 (the number of feet the crew can complete each hour) to get 4.5 hours, and then added 4.5 hours to 1:30 p.m. to get a finish time of 6:00. [1 point]
Review/End Test
Pause
Flag
Options
Back
Next

STUDENT RESPONSE

Response Score: 0 points

17. A construction crew is paving a highway.

One morning, the crew starts work at 10 minutes past 6 A.M. and finishes at 20 minutes to noon.

A. How many hours and minutes does the crew work in the morning?

They work 6 hours and 10 minutes

The student has given an incorrect answer (*They work 6 hours and 10 minutes*) by miscalculating the time difference between 6:10 a.m. and 11:40 a.m. [0 points]

The crew can extend the length of the highway by 200 feet each hour.

B. What is the length, in feet, of the new part of the highway when the crew finishes working in the morning? Show or explain all your work.

1,200 feet

200 ← feet
× 6 ← hours
1,200
feet

The student has given an incorrect answer (*1,200 feet*) and incorrect support (*200 feet × 6 hours = 1,200 feet*). The student has only carried over part of the answer from Part A (*6 hours*), and without addressing both the hours and minutes from Part A in Part B, no credit is given for the support. [0 points]

Go to the next page to finish question 17.

GO ON

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

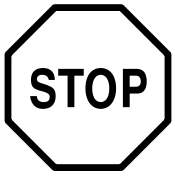
After lunch, the crew will extend the length of the highway by another 300 **yards**. They will start at 1:30 P.M.

C. At what time will they complete the 300 **yards**?

they will complete 300 Yards at 2:10

The student has given an incorrect answer (*they will complete 300 Yards at 2:10*). It is unclear how the student derived this answer since no support (work or explanation) is required. The student may not have converted the 300 yards to feet and then proceeded to divide 200 by 300 to get $\frac{2}{3}$ hour, convert $\frac{2}{3}$ hour to 40 minutes, and add 40 minutes to 1:30 p.m. [0 points]

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



MATHEMATICS—SUMMARY DATA

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	A-F.2.1.3	C	1	4%	37%	57%	2%
2	A-T.1.1.1 A-T.1.1.2	D	2	15%	17%	20%	48%
3	A-T.1.1.4	D	1	11%	10%	12%	67%
4	A-T.2.1.3 A-T.2.1.1	D	2	7%	8%	14%	71%
5	A-T.2.1.4	C	2	10%	20%	44%	26%
6	A-F.1.1	D	1	25%	13%	8%	54%
7	A-F.2.1.1	B	1	6%	86%	5%	3%
8	A-F.2.1.2	A	2	79%	7%	7%	7%
9	A-F.2.1.7 A-F.2.1.6	B	2	9%	50%	15%	26%
10	A-F.3.1.2 A-F.3.1.3	D	1	32%	17%	8%	43%
11	B-O.2.1.1	B	2	8%	67%	11%	14%
12	B-O.3.1	B	2	18%	60%	10%	12%
13	C-G.1.1.1	C	2	18%	10%	52%	20%
14	C-G.1.1.2	A	1	63%	4%	15%	18%
15	C-G.1.1.3	D	2	25%	12%	7%	56%
16	D-M.3.1.2	A	2	63%	14%	17%	6%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	D-M.1	4	2	0.74

PSSA Grade 4 Mathematics
Item and Scoring Sampler