

# Exemplar Grade 5 Mathematics Test Questions



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# Introduction

This booklet explains ACT<sup>®</sup> Aspire<sup>®</sup> Grade 5 Mathematics test questions by presenting, with their answer keys, sample questions aligned to each reporting category on the test. A key includes the question's depth-of-knowledge (DOK) level,<sup>1</sup> an explanation of the task posed by each question, a thorough explanation of correct responses, ideas for improvement, and more. The exemplar test questions included here are representative of the range of content and types of questions found on the ACT Aspire Grade 5 Mathematics test. Educators can use this resource in several ways:

- Become familiar with ACT Aspire question types.
- See what typical questions in each ACT Aspire reporting category look like.
- Help reinforce or adjust teaching and learning objectives.
- Learn how ACT Aspire improvement idea statements can help students identify key skills they have not yet mastered.

ACT Aspire Mathematics tests provide a picture of the whole of a student's mathematical development, including a look at the concepts and skills new to the grade level as well as whether the student has continued to strengthen, integrate, and apply mathematics from earlier grades. These components are important in judging how a student is progressing and what next steps are appropriate.

## Reporting Categories

The following ACT Aspire reporting categories help to provide this picture.

### Grade Level Progress

The Grade Level Progress reporting category represents a student's achievement related to the mathematical topics new to the grade. To allow for an analysis of student strengths, the category also includes a reporting category for each of the grade-level domains that constitute Grade Level Progress for that grade.

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<sup>1</sup> Norman L. Webb, "Depth-of-Knowledge Levels for Four Content Areas," last modified March 28, 2002, <http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.doc>.

## Integrating Essential Skills

The Integrating Essential Skills reporting category looks at the mathematical growth of the student with topics learned in previous grades. This mathematics should not be static, but should be strengthened as the student progresses through the grades. Students should integrate and become more fluent in these topics, using them flexibly as needed to solve problems, give explanations, and accomplish tasks of greater complexity that reflect grade-level expectations for mathematical practice.

Together, the Grade Level Progress and Integrating Essential Skills categories make up the entirety of the ACT Aspire Mathematics test. Two other reporting categories, Modeling and Justification and Explanation, pull out information that crosses the other reporting categories.

## Modeling

The Modeling reporting category highlights questions that assess understanding of mathematical models and their creation, interpretation, evaluation, and improvement. Modeling is closely tied to problem solving, and because models are frequently used to teach mathematics—especially in the early grades—modeling is also closely tied to learning mathematics. Modeling expectations increase from one grade to the next. To ensure that the Modeling reporting category provides a better indication of being on track, some modeling skills are a part of the reporting category in lower grades but not in upper grades.

## Justification and Explanation

The Justification and Explanation (JE) category focuses on giving reasons for why things work as they do, where students create a mathematical argument to justify. The evidence is collected through constructed-response tasks designed around a progression of justification skills connecting Grades 3 and up.

## Structure of the Mathematics Test

The structure of the ACT Aspire Mathematics test is the same from Grade 3 through early high school (Grades 9 and 10), assessing new topics for the grade and whether students continue to strengthen their mathematical core. (For the Early High School test, Grade 8 topics are included in the Grade Level Progress component to keep together formal algebra, functions, and geometry topics. This makes Grade Level Progress and its subcategories more coherent.) Within this structure of content comes a level of rigor represented in part by a distribution of depth of knowledge through Webb's level 3. The Integrating Essential Skills component includes only DOK level 2 and level 3 because that component is about assessing how well students have continued to strengthen their mathematical core. Across all parts of the test, students can apply Mathematical Practices to help them demonstrate their mathematical achievement.

Mathematical justification is a way of knowing. In theory, students will be able to learn new mathematics more reliably if they have a strong framework to build upon. Mathematical justification is glue for that framework. The Common Core State Standards for Mathematics (CCSSM) recognizes this in its Mathematical Practice 3 (MP3): “Create viable arguments and critique the reasoning of others.” The ACT Aspire Mathematics test focuses attention on student justification.

Students respond to JE tasks with a grade-level-appropriate mathematical argument. These tasks utilize a constructed-response format, allowing students flexibility in the way they shape their arguments. Each response is evaluated on the basis of demonstrated evidence of particular skills associated with mathematical justification. These JE skills include stating relevant properties and definitions that support the justification, constructing an argument that includes reasons for claims, and demonstrating indirect proof or command of counterexample.

The JE skills identified in table 1 are arranged in a progression from Grade 3 through EHS. At each grade, the JE skills are divided into three levels. Trained scorers weigh evidence and then make an overall determination about the evidence for or against each skill level. Demonstrating JE skills at one level is evidence of having learned the skills in previous levels. In addition to looking at the JE skills, each response is rated according to how successful the student was in completing the task assigned; this is the Progress rating. A full-credit response shows evidence of the required level of JE skills needed to solve the problem and applies these skills to complete the task.

For each of the JE tasks, evidence for and against each of the JE levels is combined with the Progress rating and mapped to a 0–4 scale. These task scores contribute to the JE reporting category and to the total Mathematics score. Some of the tasks contribute to the Grade Level Progress reporting category, and the others contribute to the Integrating Essential Skills reporting category.

Level 1 JE skills are those where students should have a fluent command, and Level 2 JE skills are those most closely aligned with grade-level focus. Level 3 JE skills are more advanced. As the research base increases for this progression, the list will grow and become more refined. Note that there are two JE statements for evidence of misconceptions. These are marked with asterisks in table 1.

As students progress from grade to grade, expectations increase according to which JE skill belongs to which level. Some level 3 JE skills will become level 2, and some level 2 will become level 1.

**Table 1. Justification and Explanation Skills Progression**

Justification statement	JE level at grade:				
	3–4	5	6–7	8	10
<b>EXA</b> Provide an example.	1	1	1	1	1
<b>DEF</b> State a definition, theorem, formula, or axiom.	1	1	1	1	1
<b>PRT</b> State a property or classification of an object.	1	1	1	1	1
<b>REL</b> State a relationship between two or more objects.	1	1	1	1	1
<b>PRO1</b> State one or more steps in a procedure.	1	1	1	1	1
<b>VIS1</b> Provide a visual representation.	1	1	1	1	1
<b>CMP1</b> Provide a computation.	1	1	1	1	1
<b>LFD1</b> Use a Specific Statement to draw a Conclusion or Provide Specific Support for a Statement.	1	1	1	1	1
<b>CMP2</b> Use a computation to Support a Statement or Conclusion.	2	1	1	1	1
<b>PAT1</b> Generate a sequence from a rule OR explain a pattern using words, algebraic expressions, or numeric operations.	2	1	1	1	1
<b>LFD2</b> Use two or more Specific Statements to draw a Conclusion.	2	1	1	1	1
<b>ERR1</b> Indicate an error occurred.	2	1	1	1	1
<b>PRO2</b> Explain why a step in a procedure is necessary.	2	2	2	1	1
<b>CON1</b> Make a conditional statement (e.g. If-Then, When-Then, etc.).	2	2	2	1	1
<b>VIS2</b> Draw and label a visual representation that illustrates a mathematical concept, property, or relationship.	2	2	2	1	1
<b>PAT2</b> Use a pattern or sequence to support a Statement or Conclusion.	2	2	2	1	1
<b>CNE1</b> Provide a counterexample of a conditional statement.	2	2	2	2	2
<b>LFD3</b> Use a General Statement to draw a Conclusion or Provide General Support for a Statement.	2	2	2	2	2
<b>LFD4</b> Use a Claim to draw a Conclusion and provide Specific Support for the Claim.	2	2	2	2	2
<b>LFD5</b> Use a Claim to draw a Conclusion and provide General Support for the Claim.	3	3	2	2	2
<b>LFD6</b> Use a Specific Statement and a General Statement to draw a Conclusion.	3	3	2	2	2
<b>VIS3</b> Draw and label a visual representation that illustrates a mathematical concept, property, or relationship and use the labeling in one's prose to clarify an argument.	3	3	3	2	2
<b>N-EXA</b> Use proof by example.	3	3	3	2	2
<b>CON2</b> Conclude from a conditional statement.	3	3	3	2	2
<b>ERR2</b> Indicate an error and use a mathematical concept (definition, theorem, or axiom) to explain why an error occurred.	3	3	3	3	2
<b>CNE2</b> Provide a counterexample and verify that the conditional conclusion does not hold for the example.	3	3	3	3	2

Table 1 (continued)

Justification statement	JE level at grade:				
	3–4	5	6–7	8	10
<b>CNV</b> Understand that a statement can be true and its converse or inverse can be false.	3	3	3	3	2
<b>N-CNV</b> States that the converse or inverse of a conditional statement is true because the original statement is true.	3	3	3	3	2
<b>CLA1</b> State that an object belongs (or does not belong) to a class, state at least one of the common characteristics of the class, and state that the object has (or does not have) those characteristics.	3	3	3	3	2
<b>LFD7</b> Use two or more Specific Statements to draw a Conclusion and provide Specific Support for at least one of the Statements.	3	3	3	3	2
<b>LFD8</b> Use two General Statements to draw a Conclusion.	3	3	3	3	2
<b>PAT3</b> Introduce a pattern or sequence and use it to support a Statement or Conclusion.	3	3	3	3	3
<b>CNE3</b> Provide a counterexample and verify that the conditional hypotheses do hold for the example, while the conditional conclusion does not.	3	3	3	3	3
<b>CON3</b> Conclude from a conditional statement and verify that the statement's hypotheses hold.	3	3	3	3	3
<b>CAS</b> Use cases in a proof.	3	3	3	3	3
<b>IND</b> Use indirect proof (e.g. proof by contradiction).	3	3	3	3	3
<b>LFD9</b> Use two or more Claims to draw a Conclusion and provide Support for at least one Claim—at least one Claim or Support must be General.	3	3	3	3	3
<b>CLA2</b> State what is required to be a member of a class, verify that an object meets all of those requirements, and then state that the object belongs to that class.	3	3	3	3	3

## Improvement Ideas

ACT Aspire includes simple improvement ideas at the reporting category (skill) level on student and parent reports. These improvement ideas are provided for the lowest performing skill for each subject tested. The skills are always ordered from highest performing to lowest performing based on the percentage of points correct. If the percentages for two or more skills are tied, the skill with the lower number of total points is displayed first.

Keep in mind that the order of skills listed on reports may not always be exemplary of where to focus learning. For example, the skills in which a student performed within the ACT Readiness Range may not always be listed first, and the skills in which a student did not perform within the ACT Readiness Range may not always be listed last. Also, keep in mind the total number of points possible in each skill when interpreting the percentage correct.

There are two levels of improvement idea statements (low and high) for ACT Aspire summative reporting. Low statements are given on the report if the student's lowest skill score is below the ACT Readiness Range for that particular skill. High statements are given on the report if the student's lowest skill score is at or above the ACT Readiness Range for that particular skill.

# Answer Key

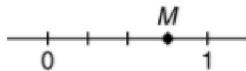
This section presents the grade, question type, DOK level, alignment to the ACT Aspire reporting categories, and correct response for each of several test questions. Each question is also accompanied by an explanation of the question and by the correct response as well as improvement idea statements for ACT Aspire Mathematics.

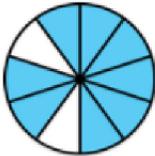
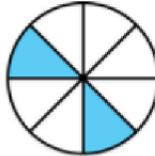
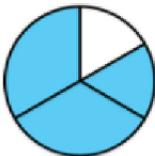
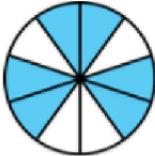
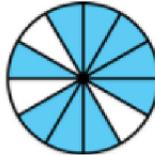
Some test questions are appropriate at several grades: as a part of Grade Level Progress when the topic is new to the grade and then in later grades as a part of Integrating Essential Skills (as long as the question is at least DOK level 2 for that grade).

## Question 1

Juliana divided the part of a number line from 0 to 1 into sections of equal length. She plotted point  $M$  on the number line, as shown below.

One of the following circles is shaded to represent a fraction that is equivalent to the number represented by point  $M$ . Which one?



- A. 
- B. 
- C. 
- D. 
- E. 

Question type	CCSSM topic	Correct response
Selected Response	3.NF.A, MP4, Recognize equivalent fractions and fractions in lowest terms (N 13–15)	E

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
3	Grade Level Progress > Number and Operations—Fractions	Yes	3
4–5	Integrating Essential Skills	Yes	3
6–EHS	Integrating Essential Skills	Yes	2

In this selected-response (multiple-choice) question, students must analyze the number line given and determine what fraction is being represented (CCSSM.3.NF.A.3). Because this question requires students to analyze the situation and connect different representations, it is a DOK level 3 question for the Grades 3, 4, and 5 tests. For all other ACT Aspire tests, it is a DOK level 2 question. Because students are interpreting models, this question is a part of the Modeling reporting category (MP4).

## Correct Response

After determining that the fraction at point  $M$  is  $\frac{3}{4}$ , students must then determine which of the circles provided has  $\frac{3}{4}$  of its area shaded. The circle in answer option E has 9 out of 12 equally sized sections shaded, and  $\frac{9}{12}$  is equivalent to  $\frac{3}{4}$ .

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Integrating Essential Skills	5	Continue to strengthen your skills by using the mathematics you learned in previous grades.	Before you solve a math problem, predict how the solution will go and what method(s) will work.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

## Question 2

A school club used  $\frac{1}{15}$  of its budget to buy 9 T-shirts. The price of each T-shirt was the same. What fraction of the club's budget was used to buy 1 T-shirt?

- A  $\frac{3}{5}$
- B  $\frac{14}{15}$
- C  $\frac{1}{24}$
- D  $\frac{1}{135}$
- E  $\frac{8}{135}$

Question type	CCSSM topic	Correct response
Selected Response	5.NF.B.7.c, MP2, Solve routine one-step arithmetic problems using positive rational numbers, such as single-step percent (AF 16–19)	D

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
5	Grade Level Progress > Numbers and Operations—Fractions	Yes	3
6, 7	Integrating Essential Skills	Yes	2

This question assesses a student's understanding of when and how to divide unit fractions by a nonzero whole number in the process of solving a real world problem (CCSSM.5.NF.B.7.c). A student must make sense of quantities and their relationships in solving this problem (MP2).

This question is mapped to the Number and Operations—Fractions reporting category within the Grade Level Progress reporting category for a Grade 5 test. As fraction arithmetic continues to be explored in Grades 6 and 7, this question is mapped to the Integrating Essential Skills reporting category for the Grades 6 and 7 tests. Given that the abstraction of quantities to solve problems is anything but rote for students at each of these grades, the question is assigned a DOK level of 2. When appearing on any of these tests, the item contributes to the Modeling reporting category.

### Correct Response

The fraction of the budget,  $\frac{1}{15}$ , used to buy the 9 T-shirts is equally allotted to each T-shirt, as the price of each T-shirt is the same amount. Dividing  $\frac{1}{15}$  by 9 is equivalent to multiplying  $\frac{1}{15}$  by  $\frac{1}{9}$ , which is equal to  $\frac{1}{135}$ . Therefore, option D is the correct response.

Some incorrect answers reveal misconceptions students may have. For example, students who interpret the operation to be multiplication because of the phrase “ $\frac{1}{15}$  of” may select option A because  $\frac{1}{15}$  multiplied by 9 is  $\frac{3}{5}$ .

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Number and Operations—Fractions	5	Work on adding and subtracting fractions with unlike denominators. Can you explain the connection between fractional representations and division?	Draw a picture that represents how to multiply and divide fractions. Explain your picture to a friend.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

### Question 3

Consider the numbers 607.05 and 1,805.67.

Which of the statements below is(are) true?

1. The value of the 5 in 607.05 is  $\frac{1}{100}$  times the value of the 5 in 1,805.67.
2. The value of the 6 in 607.05 is 1,000 times the value of the 6 in 1,805.67.
3. The value of the 7 in 607.05 is 1,000 times the value of the 7 in 1,805.67.

- A 1 only
- B 2 only
- C 3 only
- D 1 and 2 only
- E 2 and 3 only

Question type	CCSSM topic	Correct response
Selected Response	5.NBT.A.1, MP1, MP2, MP7, Identify a digit's place value (N 16–19)	D

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
5	Grade Level Progress > Number and Operations in Base Ten	No	3
6, 7	Integrating Essential Skills	No	2

This question assesses a student's understanding of the relationship between values of digits in a multidigit number (CCSSM.5.NBT.A.1). A student must evaluate the truth value of each given statement (MP1), reason abstractly about the value of the digits in each number (MP2), and make use of the structure of our place value system (MP7).

This question is mapped to the Number and Operations in Base Ten reporting category within the Grade Level Progress reporting category for a Grade 5 test. Given that the student must make decisions about each statement using knowledge of the place value system, the question is assigned a DOK level of 3. The item is not in the Modeling reporting category.

### Correct Response

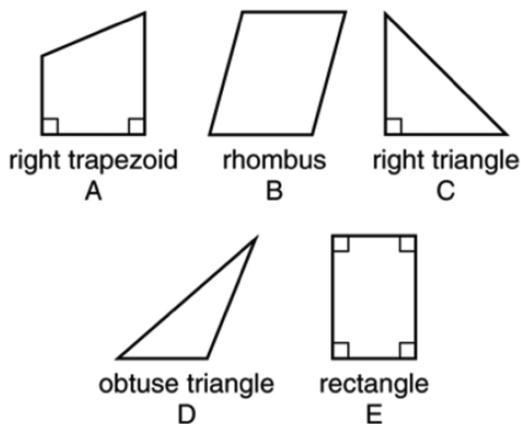
In statement 1, the student must recognize that the 5 in 607.05 is two places to the right of the 5 in 1,805.67, making it  $(\frac{1}{10}) \times (\frac{1}{10}) = (\frac{1}{100})$  times the value. This statement is true. In statement 2, the student must recognize that the 6 in 607.05 is 3 places to the left of the 6 in 1,805.67, making it  $10 \times 10 \times 10 = 1,000$  times the value. This statement is also true. In statement 3, the student must recognize that the 7 in 607.05 is 2 places to the left of the 7 in 1,805.67, making it  $10 \times 10 = 100$  times the value, not 1,000 times the value. Statement 3 is false. Option D is the correct response.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Number and Operations in Base 10	5	Work on explaining the patterns when multiplying by a power of 10.	Explain to your teacher your strategy for multiplying and dividing decimal numbers.

## Question 4

Two of the shapes below are quadrilaterals that each have at least 1 acute angle and at least 1 obtuse angle. Which two?



- A Shapes A and B
- B Shapes A and E
- C Shapes B and D
- D Shapes B and E
- E Shapes C and D

Question type	CCSSM topic	Correct response	
Selected Response	5.G.B.4, MP1, MP3, Exhibit knowledge of basic angle properties and special sums of angle measures (G 20–23)	A	
Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
5	Grade Level Progress > Geometry	No	2

This question assesses a student's understanding of identifying two-dimensional figures given specific properties (CCSSM.5.G.B.4). A student must consider each given shape and determine whether it fits the required criteria (MP1), so the item has a DOK level of 2 when appearing on a Grade 5 test. This question is mapped to the Geometry reporting category within the Grade Level Progress reporting category for a Grade 5 test. The item is not in the Modeling reporting category.

## Correct Response

The student must consider each shape and determine which ones are quadrilaterals with at least one acute angle and at least one obtuse angle. Shapes C and D are not quadrilaterals, so those shapes are eliminated. Shape E, the rectangle, although a quadrilateral, has four right angles; it has neither acute nor obtuse angles. Shape E is eliminated. Shapes A and B are both quadrilaterals, each having at least one acute and one obtuse angle, making option A the correct response.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Geometry	5	Work on graphing points in the first quadrant and classifying two-dimensional figures into categories that have a hierarchy.	Find real-world data that occurs in ordered pairs and graph that data in the standard coordinate plane. What characteristics of the graph do you observe?

## Question 5

After Cammy gets out of bed in the morning, she completes several activities to get ready for school. The list below shows the numbers of minutes she needs to complete each of these activities.

- 30 minutes: brush teeth, shower, and get dressed
- 10 minutes: eat breakfast
- 30 minutes: car ride to school

Cammy must be at school by 8:00 a.m. What is the **latest** time Cammy can get out of bed, complete all her activities, and still get to school on time? Explain why your answer is correct.

1000

Question type	CCSSM topic	Correct response		
Justification and Explanation (Constructed Response)	3.MD.A, MP1, MP3	See explanation.		

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	JE level	Modeling	DOK level
3	Grade Level Progress	3	Yes	3
4–6	Integrating Essential Skills	3	No	3

This Justification and Explanation task asks students not just to find a solution, but to explain the procedure that leads to that solution. Successful students will explain how they solved the problem and give reasons why their solution is correct. Procedure, computation, and logical flow justification are a few of the justification skills this task elicits. The content here is addition and subtraction of time intervals (CCSSM.3.MD.A). This problem enables students to relate the mathematics they learn in the classroom to their everyday experience. A successful student will make sense of the problem and persevere in solving it (MP1). Students are doing modeling by simulating the events and connecting them to the time each takes. This level of modeling is a part of the Modeling reporting category for Grade 3 but not for higher grades.

For Grade 3 students, this task would be a part of the Grade Level Progress reporting category. This task would also be appropriate for the Grades 4, 5, or 6 tests. However, it would be a part of the Integrating Essential Skills reporting category for those tests. At these grade levels, this task requires JE level 3 reasoning and is part of the JE reporting category; the task also is a DOK level 3 task.

### Response 1

A student could receive full credit for the following response:

$$30 + 10 + 30 = 70 \text{ min}$$

$$70 - 60 = 10$$

$$70 \text{ min} = 1 \text{ hr } 10 \text{ min}$$

$$8 \text{ a.m.} - 1 \text{ hr } 10 \text{ min} = 6:50 \text{ a.m.}$$

Cammy must wake up at 6:50 a.m. so she is not late for school. I know my answer is correct because Cammy has to be at school at 8 and you need to figure how much time it takes to get ready and get to school. I added the times for dressing, eating, and driving to school to get 70 minutes. Then, I subtracted the time needed from the school's start time to find when Cammy needs to get up.

Describing the computational procedure and its results can make an argument more clear, so ACT Aspire captures when students use those types of justification techniques. The main JE statements captured in this response are “Use a computation to Support a Statement or Conclusion,” “Explain why a step in a procedure is necessary,” and “Use two or more Specific Statements to draw a Conclusion and provide Specific Support for at least one of the Statements.” The response also provides direct evidence of “Provide a computation,” “State a relationship between two or more objects,” and “State one or more steps in a procedure.” A response of this type demonstrates direct evidence for all three levels of justification at Grade 5.

This response successfully completes the assigned task by finding the time that Cammy has to wake up and by thoroughly supporting that answer. The response demonstrates understanding of the given information and the goal. The student's calculations are evidence that the student understands a procedure required to complete the task successfully, and the explanation is presented clearly and is well organized. This response would be given a Progress score of 3.

With Level 3 justification and a Progress score of 3, this response would be given 4 points.

## Response 2

$$8 \text{ a.m.} - 30 \text{ min} = 7:30 \text{ a.m.}$$

$$7:30 \text{ a.m.} - 30 \text{ min} = 7 \text{ a.m.}$$

$$7 \text{ a.m.} - 10 \text{ min} = 6:50 \text{ a.m.}$$

Cammy should get up at 6:50 a.m.

The main JE statements captured in this response are “Provide a computation” and “Use a computation to Support a Statement or Conclusion.” While the computations are important to the student's approach, the argument could be strengthened by explaining why the computations are being done. A response of this type demonstrates evidence of the first level of justification at Grade 5.

This response arrives at the correct conclusion. The calculations are evidence that the student understands the procedure, that subtraction is required to complete the task successfully, and that the student approached the task correctly. However, the response fails to explain why the answer is correct or why the subtractions were done to arrive at the answer. The student demonstrates a successful approach to the problem, but some evidence is implicit. Because of the strong approach to the task, this response would be given a Progress score of 2.

With Level 1 Justification and a Progress score of 2, this response would be given 2 out of the 4 points possible for this task.

## Response 3

The latest time Cammy can get up is 6:50 a.m.

Since this response is only the answer to the task's question, there is no evidence of justification present.

This response arrives at the correct conclusion and demonstrates a developing understanding of the goal. However, the response fails to provide the steps or calculations used to arrive at the conclusion; while the answer is correct, the response does not address the “Explain why your answer is correct” portion of the task.” Since there is some evidence of understanding, this response would be given a Progress score of 1.

With no justification and a Progress score of 1, this response would be given 1 out of the 4 points possible for this task.

## Response 4

$$8 \text{ a.m.} + 30 \text{ min} + 30 \text{ min} + 10 \text{ min} = 9:10 \text{ a.m.}$$

The main JE statement captured in this response is “Provide a computation.” Adding reasons for doing the computations and a more formal explanation of the student’s reasoning would increase the justification evidence present and also add to the clarity of the response. A response of this type demonstrates only the first level of justification.

This response doesn’t include a clear answer to the task’s question. By using an incorrect approach, the response demonstrates a lack of understanding of how to achieve the goal. Further, no logical reason for the calculation is provided. Since the response has little evidence of understanding the task, a Progress score of 0 would be given.

With Level 1 justification and a Progress score of 0, this response would be given 1 out of the 4 points possible for this task.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Justification and Explanation	5	Work on identifying reasons for mathematical steps. Explain how to solve a problem from your homework to someone at home. Understand how someone else solves the same problem and discuss the differences.	On one or two of your homework problems each day, put in steps to better show what you were thinking, and add justifications for each step.
Integrating Essential Skills	5	Continue to strengthen your skills by using the mathematics you learned in previous grades.	Before you solve a math problem, predict how the solution will go and what method(s) will work.

## Question 6

Explain what a line of symmetry is.

Explain why the dashed line drawn in the figure below is NOT a line of symmetry for the figure.



Question type	CCSSM topic	Correct response
Justification and Explanation (Constructed Response)	4.G.A, MP4	See explanation.

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Integrating Essential Skills and Grade Level Progress		
		JE level	Modeling	DOK level
4	Grade Level Progress	3	Yes	3
5–8	Integrating Essential Skills	3	Yes	3
EHS	Integrating Essential Skills	2	Yes	3

This Justification and Explanation task elicits an explanation of why something is not true.

The task is crafted carefully so that successful students must give a definition and tie it to their explanation—an important way of reasoning in mathematics and in many areas of life. The context here is symmetry, a topic from Grade 4 (CCSSM.4.G.A.3, “Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry”). A response that successfully justifies the result will contain a general definition of a line of symmetry and show why that definition does not fit the specific situation shown by the drawing. This is JE level 3 reasoning for Grade 4 students and would be a part of the Grade Level Progress reporting category. The task is also a part of the JE reporting category. This task would also be appropriate for the Grades 5, 6, 7, 8, and Early High School tests where it would be a part of the Integrating Essential Skills and the JE reporting categories. While most students at these higher grades are easily able to recognize lines of symmetry, this task still requires students to use definitions and create a cohesive explanation—valuable skills to measure even if the content isn’t advanced. The reasoning skills assessed by this task are at JE level 3 for Grades 4–8 and JE level 2 for EHS. At all grades, this is a task at DOK level 3.

The figure is a possible model for the definition of a line of symmetry, and the student must judge whether the model fits, so this question contributes to the Modeling reporting category (MP4).

## Response 1

A student could receive full credit for the following sample response:

A line of symmetry is a line that divides a figure into two equal parts where you can fold along the line and make the edges match up. Folding along the given line will not make the edges match up because it does not divide the picture into two equal parts, so the dashed line is not a line of symmetry.

The primary justification skills in this response are captured by the JE statements “State that an object belongs (or does not belong) to a class, state at least one of the common characteristics of the class, and state that the object has (or does not have) those characteristics” and “Use a Specific Statement and a General Statement to draw a Conclusion.” The response also demonstrates direct evidence of “State a property or classification of an object” and “State a definition, theorem, formula, or axiom.” A response of this type demonstrates evidence of all three levels of justification at Grade 5.

This response successfully completes the assigned task by stating the definition of a line of symmetry and using that definition to conclude that the line in question was not, in fact, a line of symmetry. In addition to successfully completing the task, the response also shows understanding of the given information and the required goal, and it expresses the argument in a clear and organized manner. This response would be given a Progress score of 3. Note that the definition provided in this response may not be adequate for higher grade levels.

With Level 3 justification and a Progress score of 3, this response would be given 4 points.

## Response 2

A line of symmetry is a line that divides a figure into two equal parts where you can fold along the line and make the edges match. So the dashed line is not a line of symmetry.

This response’s justification is captured by the JE statements “State a definition, theorem, formula, or axiom” and “Use a General Statement to draw a Conclusion or Provide General Support for a Statement,” which provide evidence of the first two levels of justification at Grade 5.

This response provides a general definition of a line of symmetry and uses this general statement to arrive at the conclusion. The definition is evidence that the student understands the concept of a line of symmetry. However, explaining how the definition is connected to the given figure would have been a more thorough response. Though the correct definition was employed, the lack of thoroughness means that this response would be given a Progress score of 2.

Since this is a JE Level 3 task at Grade 5, Level 2 justification and a Progress score of 2 would give this response 2 out of the 4 points possible for this task.

## Response 3

You fold along the line to check for symmetry. The dashed line is not a line of symmetry.

This response’s justification is captured by the JE statements “State one or more steps in a procedure,” “Explain why a step in a procedure is necessary,” and “Use a Specific Statement to draw a Conclusion or Provide Specific Support for a Statement,” which provide evidence for the first two levels of justification at Grade 5. The argument could have been strengthened by explaining how folding along the line is related to being or not being a line of symmetry. This could be done, for example, by giving the definition of a line of symmetry.

This response uses a specific statement about the procedure required to test the line of symmetry of the given figure in order to arrive at the correct conclusion. The response demonstrates a developing understanding of the goal. However, the student failed to provide an explanation of a line of symmetry. Since some understanding of lines of symmetry is demonstrated, this response would be given a Progress score of 1.

With Level 2 justification and a Progress score of 1, this response would be given 2 out of the 4 points possible for this task.

## Response 4

The line is not a line of symmetry because it does not divide the heart into 2 sections of equal area. If you move the line down a little, then the areas will be the same, so it will be a line of symmetry.

This response's justification is captured by the JE statements "State a property or classification of an object," "Make a conditional statement (e.g. If-Then, When-Then, etc.)," and "Use two or more Specific Statements to draw a Conclusion and provide Specific Support for at least one of the Statements," which is evidence of all three levels of justification at Grade 5. It is important to note that even though the definition given was incorrect, this does not affect the justification evidence that is present.

Even though this response gives the correct conclusion, it shows a misconception of the definition of a line of symmetry. With little else present except the misconception, this response would be given a Progress score of 0.

Even though this response would be given a Progress score of 0, the evidence of high-level justification would give this response 2 out of the 4 points possible for this task.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Justification and Explanation	5	Work on identifying reasons for mathematical steps. Explain how to solve a problem from your homework to someone at home. Understand how someone else solves the same problem and discuss the differences.	On one or two of your homework problems each day, put in steps to better show what you were thinking, and add justifications for each step.
Integrating Essential Skills	5	Continue to strengthen your skills by using the mathematics you learned in previous grades.	Before you solve a math problem, predict how the solution will go and what method(s) will work.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

## Question 7

Which of the following amounts of time is the same as  $5\frac{3}{4}$  hours?

- A. 5 hours 15 minutes
- B. 5 hours 35 minutes
- C. 5 hours 40 minutes
- D. 5 hours 45 minutes
- E. 5 hours 75 minutes

Question type	CCSSM topic	Correct response
Selected Response	5.MD.A, MP2, MP4	D

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
5	Grade Level Progress > Measurement and Data	Yes	1

This selected-response question provides evidence that the student has developed the skill of converting units within a measurement system (CCSSM.5.MD.A). The student must demonstrate quantitative reasoning skills by considering the units involved (MP2) and converting to the appropriate measure.

Converting between units of time is considered to be a routine concept for Grade 5 and is therefore considered to be DOK level 1. This question is part of the Measurement and Data reporting category within the Grade Level Progress reporting category for the Grade 5 test, and since it is DOK level 1, this particular question would not appear as Integrating Essential Skills on any other grade level test (the skill may be a part of what is required for a deeper question). For Grade 5, the numerical model that students use to make the computation is counted as a part of the Modeling reporting category.

### Correct Response

The student must translate  $\frac{3}{4}$  of an hour to  $\frac{3}{4}$  of 60 minutes, obtaining answer option D.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Measurement and Data	5	Work on converting measurements within a given system and relating volume to multiplication and addition.	In terms of some small object (like grapes or marshmallows), determine the volume of at least 3 containers in your home by filling them with those objects.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

## Question 8

Mario and Jenna each drew a circle. Mario divided his circle in half. Jenna divided her circle into twice as many equal sections as Mario's circle. Select the word below that names the fraction Jenna divided her circle into, and select **all** of the figures below that could represent Jenna's circle.

thirds

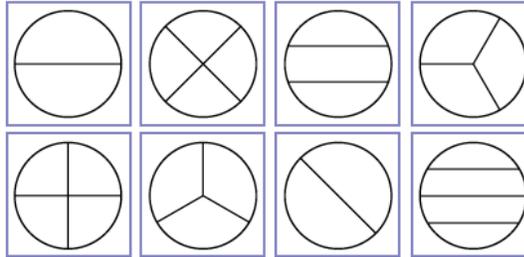
halves

three

four

two

fourths



Question type

CCSSM topic

Correct response

Technology Enhanced

2.G.A, MP4

thirds

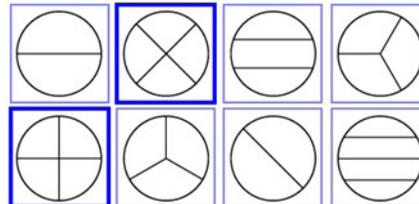
halves

three

four

two

fourths



Appropriate grade level(s)

Integrating Essential Skills and Grade Level Progress reporting categories

Modeling

DOK level

3–6

Integrating Essential Skills

Yes

2

This technology-enhanced question involves partitioning circles and using correct terms to describe that partitioning (CCSSM.2.G.A.3). This problem is part of the Integrating Essential Skills reporting category for the Grades 3, 4, 5, and 6 tests, and it assesses DOK level 2 skills on each of those tests. Students must judge the appropriateness of each shape as a model for the situation. This problem is a part of the Modeling reporting category.

## Correct Response

Students must translate the description given in the problem and connect that to mathematical words and figures. Students who do this correctly will find that Jenna divided her circle into fourths.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Integrating Essential Skills	5	Continue to strengthen your skills by using the mathematics you learned in previous grades.	Before you solve a math problem, predict how the solution will go and what method(s) will work.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

## Question 9

Liam is making chocolate chip cookies. The recipe calls for 1 cup of sugar for every 3 cups of flour. Liam has only 2 cups of flour.

- How much sugar should Liam use?
- Explain why your answer is correct.

Question type	CCSSM topic	Correct response
Justification and Explanation (Constructed Response)	5.NF.B, MP3, MP4	See explanation.

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	JE level	Modeling	DOK level
5	Grade Level Progress	3	Yes	3
6–8	Integrating Essential Skills	3	No	3
EHS	Integrating Essential Skills	2	No	3

This question prompts students to explain their reasoning and tie it to a real-world problem. Logical flow, number sense, and computation are key justification elements in this question. A successful student will make sense of the real-world problem involving fractions (CCSSM.5.NF.B) and provide appropriate justification and explanation (MP3).

For Grade 5 students, this task would be a part of the Grade Level Progress reporting category. This task would also be appropriate for the Grades 6, 7, 8, and Early High School tests; it would be a part of the Integrating Essential Skills reporting category for those grades. The task is part of the JE reporting category. The reasoning required is at JE level 3 for Grades 5–8. That same reasoning is JE level 2 for the Early High School test. It is a DOK level 3 task at all grade levels.

For Grade 5, this task contributes to the Modeling reporting category. Students produce a numerical model and provide an interpretation. In higher grades this should be automatic, so this question does not contribute to the Modeling reporting category for the Grade 6 through Early High School tests.

## Response 1

A student could receive full credit for the following sample response:

Liam has 2 cups of flour, which is  $\frac{2}{3}$  of the 3 cups of flour that the recipe talks about. So he should use  $\frac{2}{3}$  of the 1 cup of sugar that the recipe talks about.  $\frac{2}{3}$  of 1 cup is  $\frac{2}{3}$  cup. Liam should use  $\frac{2}{3}$  cup of sugar.

The JE statement “Use two or more Specific Statements to draw a Conclusion and provide Specific Support for at least one of the Statements” captures the complexity of the argument. This response also uses “State one or more steps in a procedure,” “Explain why a step in a procedure is necessary,” and “State a relationship between two or more objects.” A response of this type demonstrates evidence of all three levels of justification at Grade 5.

The response successfully completes the task assigned by giving the correct amount of sugar that Liam should use and thoroughly explaining why that amount is correct. The response demonstrates one successful pathway and presents a cohesive and well-organized argument, which would give this response a Progress score of 3.

With Level 3 justification and a Progress score of 3, this response would be given 4 points.

## Response 2

Liam must use  $\frac{2}{3}$  cup of sugar. The recipe has a fixed proportion of flour and sugar. Liam does not have enough flour for the recipe, so he will have to reduce the amount of sugar to make up for that.

The primary justification skills appearing in the response are captured by the JE statements “State a property or classification of an object,” “State one or more steps in a procedure,” “Explain why a step in a procedure is necessary,” and “Use two or more Specific Statements to draw a Conclusion and provide Specific Support for at least one of the Statements.” As such, this response demonstrates evidence of the first three levels of justification at Grade 5.

The response gives the correct amount of sugar, but it does not elaborate on why  $\frac{2}{3}$  is the correct value. However, it does give some reasoning as to why the amount is reduced. Elaborating further would strengthen the response. This response would be given a Progress score of 2.

With Level 3 Justification and a Progress score of 2, this response would be given 3 out of the 4 points possible for this task.

## Response 3

Liam does not have enough flour for the recipe. He should use less sugar to account for less flour. Liam should put in half a cup of sugar.

The argument structure for this response is “Use two or more Specific Statements to draw a Conclusion.” There is also evidence related to stating properties and explaining procedures present in the response. Overall, there is evidence of the first two levels of justification at Grade 5.

The response shows some understanding of Liam’s issue with trying to make cookies, but it does not have a correct amount of sugar or a fully developed explanation, resulting in a Progress score of 1.

With Level 2 justification and a Progress score of 1, this response would be given 2 out of the 4 points possible for this task.

## Response 4

Liam should still use 1 cup of sugar. The amount of sugar doesn’t change with 2 cups of flour.

The response fails to show understanding of fractions, which would result in a Progress score of 0; however, it still receives credit for justification being present. The argument structure is “Use a Specific Statement to draw a Conclusion or Provide Specific Support for a Statement,” which is evidence of just the first level of justification.

With Level 1 justification and a Progress score of 0, this response would be given 1 out of the 4 points possible for this task.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Justification and Explanation	5	Work on identifying reasons for mathematical steps. Explain how to solve a problem from your homework to someone at home. Understand how someone else solves the same problem and discuss the differences.	On one or two of your homework problems each day, put in steps to better show what you were thinking, and add justifications for each step.
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Modeling	5	Work on creating picture representations of numerical statements and use the pictures to solve problems.	Find a real-world situation and create a model to describe and predict information.

## Question 10

A pattern exists among the units digits of the powers of 7, as shown below. What is the units digit of  $7^{50}$  ?

$$7^0 = 1 \quad 7^3 = 343 \quad 7^6 = 117,649$$

$$7^1 = 7 \quad 7^4 = 2,401 \quad 7^7 = 823,543$$

$$7^2 = 49 \quad 7^5 = 16,807 \quad 7^8 = 5,764,801$$

(Note: The units digit of 2,401 is 1.)

- A. 1
- B. 3
- C. 4
- D. 7
- E. 9

Question type	CCSSM topic	Correct response
Selected Response	5.OA.B, MP1, MP7, Exhibit knowledge of elementary number concepts such as rounding, the ordering of decimals, pattern identification, primes, and greatest common factor (N 20–23)	E

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	Modeling	DOK level
5	Grade Level Progress > Operations and Algebraic Thinking	No	3
6–EHS	Integrating Essential Skills	No	3

Mathematics is sometimes described as a study of patterns. The word “pattern” is found throughout the CCSSM. This exemplar assesses a student’s ability to recognize a pattern and use the pattern to solve a problem, a part of CCSSM Mathematical Practice 7 (MP7): “Look for and make use of structure.” The question is based on content from CCSSM cluster 5.OA.B. The question involves a relatively high level of competence with Mathematical Practice 1 (MP1): “Make sense of problems and persevere in solving them.” Understanding the place-value structure of whole numbers and operations on whole numbers, as well as more advanced relationships involving factors, multiples, and remainders are useful for finding the solution. The question is at a DOK level of 3—students must make decisions on to how to approach finding a solution.

## Correct Response

A student solution involves recognizing that the number pattern of the units digit generated by the powers of 7 repeats every 4 terms. Using that structure, the student can figure out where the 50th term fits into the pattern, which can be connected to the remainder when 50 is divided by 4.

Answer option E is the correct answer.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.
Operations and Algebraic Thinking	5	Work on graphing ordered pairs of corresponding terms from two different patterns and use that to compare the patterns. Can you interpret the numerical expressions to predict something about values without actually finding values?	Record the calculations needed for 2 homework problems each day during 1 week and explain why you used those calculations.

## Question 11

A student thinks that the sum of 4.3 and 8.4 is 12.7 because  $4 + 8 = 12$  and  $3 + 4 = 7$ . The student then adds 3.7 and 2.6 and gets 5.13 because  $3 + 2 = 5$  and  $6 + 7 = 13$ . Identify the mistake in the student's procedure, and explain why this procedure won't always work.

1200

Question type	CCSSM topic	Correct response		
Justification and Explanation (Constructed Response)	5.NBT.B, MP3, Perform one-operation computation with whole numbers and decimals (N 13–15)	See explanation.		

Appropriate grade level(s)	Integrating Essential Skills and Grade Level Progress reporting categories	JE level	Modeling	DOK level
5	Grade Level Progress	3	No	3
6–8	Integrating Essential Skills	3	No	3
EHS	Integrating Essential Skills	2	No	3

This task elicits an explanation of why a procedure is not always effective. When learning about decimals, students often make the mistake of just adding the digits instead of adding the value of the numbers. This task is crafted carefully so that successful students must identify the misconception and explain why it is incorrect by appealing to a general mathematical concept. The content here is place value, a topic from CCSSM Grade 5 (5.NBT.B.7). The focus is on mathematical justification, captured by CCSSM in MP3: “Create viable arguments and critique the reasoning of others.”

For Grade 5 students, this task would be a part of the Grade Level Progress reporting category. This task would also be appropriate for the Grades 6, 7, 8, and Early High School tests as a part of the Integrating Essential Skills reporting category. At Grades 5–8, this task is a part of the Justification and Explanation reporting category, requires JE level 3 reasoning, and is DOK level 3. For the Early High School test, this would be considered JE level 2.

### Response 1

A student could receive full credit for the following sample response:

The student didn't pay attention to place value and added the tenths place wrong.  $0.6 + 0.7 = 1.3$ .

The student's procedure won't always work because if you add numbers by place value and get a number greater than 9, you must carry to the next largest place value.

The heart of the justification in this response is captured by the JE statements “Indicate an error occurred” and “Indicate an error and use a mathematical concept (definition, theorem, or axiom) to explain why an error occurred.” The student uses a general mathematical concept in the response (“if you add numbers by place value and get a number greater than 9, you must carry to the next largest place value”), a skill captured by the JE statement “State a definition, theorem, formula, or

axiom.” This response also provides direct evidence of “Provide a computation,” “State a relationship between two or more objects,” and “Use a General Statement to draw a Conclusion or Provide General Support for a Statement.” A response of this type demonstrates evidence of all three levels of justification at Grade 5.

The response successfully completes the task assigned, telling why the student in the problem is incorrect and thoroughly explaining why the procedure won’t always work. The response demonstrates understanding of the given information, uses logically consistent reasons to support mathematical claims, and expresses the argument in a clear, organized manner, which would give this response a Progress score of 3.

With Level 3 justification and a Progress score of 3, this response would be given 4 points.

## Response 2

The student is wrong.  $3.7 + 2.6 = 6.3$ . They made a mistake adding the tenths place values.

There are several JE statements present in the response: “Indicate an error occurred,” “Provide a computation,” “State a relationship between two or more objects,” and “Use two or more Specific Statements to draw a Conclusion.” This response demonstrates evidence of the first level of justification. A more general explanation of the properties of place value and how they apply to the error in question would have been stronger justification.

The response shows a clear understanding of how adding decimals works because it provides the correct answer. However, it would be strengthened by a more in-depth explanation of what place value error is occurring and how it can be corrected. This response would be given a Progress score of 2.

With Level 1 justification and a Progress score of 2, this response would be given 2 out of the 4 points possible for this task.

## Response 3

$3.7 + 2.6 = 6.3$ , not 5.13.

The response provides a correct answer but no explanation, which gives this response a Progress score of 1. However, it does have evidence of the justification statements “Indicate an error occurred,” “Provide a computation,” and “State a relationship between two or more objects,” all of which are Level 1 statements for Grade 5.

With Level 1 justification and a Progress score of 1, this response would be given 1 out of the 4 points possible for this task.

## Response 4

The student started out okay but then messed up.  $6 + 7 = 13$ . Since  $6 + 7$  is bigger than 9, you have to carry the 1. You have to add that 1 to the 3, as in  $1 + 3 = 4$ .  $3.7 + 2.6 = 5.4$ .

The response indicates awareness of an error in adding, but the response’s explanation of the error shows a lack of understanding for how carrying should work when adding decimals. Therefore, the response would be given a Progress score of 0. However, the response does use justification that is captured by the JE statements “Indicate an error occurred,” “Provide a computation,” “State a relationship between two or more objects,” and “Explain why a step in a procedure is necessary,” which is evidence of the first two levels of justification at Grade 5.

With Level 2 justification and a Progress score of 0, this response would be given 1 point out of the 4 points possible for this task.

## Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Justification and Explanation	5	Work on identifying reasons for mathematical steps. Explain how to solve a problem from your homework to someone at home. Understand how someone else solves the same problem and discuss the differences.	On one or two of your homework problems each day, put in steps to better show what you were thinking, and add justifications for each step.
Grade Level Progress	5	Complete your homework when assigned. Meet with a friend and quiz each other on the concepts learned each day.	Help a friend in your class who is struggling with a math assignment.