GEE 21

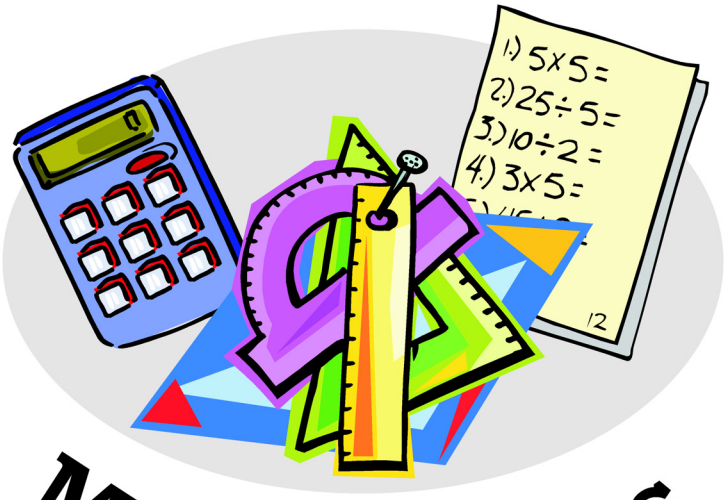
Graduation Exit Examination
for the 21st Century

Released Test Items:

Sample Student Work Illustrating GEE 21
Achievement Levels

July 2004

Grade 10



Mathematics

Louisiana Department of EDUCATION
Reaching For Results

LOUISIANA DEPARTMENT OF EDUCATION

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Louisiana's Graduation Exit Examination for the 21st Century (GEE 21)

GRADE 10 SAMPLE ITEMS AND STUDENT WORK 2003–2004

GEE 21 is an integral part of the Louisiana school and district accountability system passed by the state legislature and signed into law in 1997. The primary purposes of the accountability system are to raise expectations for achievement for all Louisiana public school students and to improve public education in the state.

In March 2004, students in grade 10 took GEE 21 English Language Arts and Mathematics tests. The test scores are combined with other relevant data to create school and district accountability scores, which serve as a means of measuring educational quality and improvement in educational programs over time.

This document is part of a series of materials meant to promote understanding of knowledge and skills students must have and the kinds of work they must produce to be successful on the GEE 21. A list of other documents providing background and further information on the GEE 21 tests can be found on the Louisiana Department of Education Web site at www.louisianaschools.net.

GEE 21 Reports

Louisiana's grade 10 students are tested each year in March. Individual student, school, district, and state test results are released in phases in May and July. School and district accountability results are reported in the fall.

For GEE 21, student scores are reported at five achievement levels: *Advanced, Mastery, Basic, Approaching Basic,* and *Unsatisfactory*. The percentage of students scoring at each level is reported for individual schools, districts, and the state. General definitions for the achievement levels are given on page 2. Specific definitions of achievement levels for the Mathematics test were published in the 1999 Released Items document. The achievement level definitions for all content areas can be found on the Louisiana Department of Education Web site at www.louisianaschools.net. Click on the "Testing" link below the tabs at the top of the page, then on the "Achievement Levels" link at the left of the page.

GEE 21
General Achievement Level Definitions

Achievement Level	Definition
Advanced	A student at this level has demonstrated superior performance beyond the level of mastery.
Mastery	A student at this level has demonstrated competency over challenging subject matter and is well prepared for the next level of schooling.
Basic	A student at this level has demonstrated only the fundamental knowledge and skills needed for the next level of schooling.
Approaching Basic	A student at this level has only partially demonstrated the fundamental knowledge and skills needed for the next level of schooling.
Unsatisfactory	A student at this level has not demonstrated the fundamental knowledge and skills needed for the next level of schooling.

Purpose of This Document

This document presents student work in the Mathematics test, which was completed as part of a GEE 21 assessment. The document includes examples of multiple-choice and constructed-response items that exemplify what students scoring at specified achievement levels should know and be able to do. A discussion of each item highlights knowledge and skills it is intended to measure, as well as strengths and weaknesses in the student work on the item.

As you review the items, it is important to remember that a student's achievement level is based on his or her *total test score* (cumulative score for all questions in the test) in a content area, *not* on one particular item or section, and that sample items included in this report represent a small portion of the body of knowledge and skills measured by the GEE 21 tests. Additional items will be released in future years of the GEE 21.

Mathematics

The GEE 21 Mathematics test is composed of sixty multiple-choice and four constructed-response items. A student earns 1 point for each correct answer to a multiple-choice item and from 0 to 4 points for the answer and work shown for each constructed-response item.

The general scoring rubric for constructed-response items is:

Score	Description
4	• The student's response demonstrates in-depth understanding of the relevant content and/or procedures. • The student completes all important components of the task accurately and communicates ideas effectively. • Where appropriate, the student offers insightful interpretations and/or extensions. • Where appropriate, the student uses more sophisticated reasoning and/or efficient procedures.
3	• The student completes most important aspects of the task accurately and communicates clearly. • The student's response demonstrates an understanding of major concepts and/or processes, although less important ideas or details may be overlooked or misunderstood. • The student's logic and reasoning may contain minor flaws.
2	• The student completes some parts of the task successfully. • The student's response demonstrates gaps in conceptual understanding.
1	• The student completes only a small portion of the task and/or shows minimal understanding of the concepts and/or processes.
0	• The student's response is incorrect, irrelevant, too brief to evaluate, or blank.

Note: It is important to recognize that score points for constructed-response items and GEE 21 achievement levels do not share a one-to-one correspondence. For example, it should *not* be assumed that a student who scores at the *Advanced* level in the assessment has earned a score of 4 on each constructed-response item.

It is possible for a GEE 21 student to earn a total of 76 points on the Mathematics test. The number of raw score points that a student would have to achieve to reach each achievement level may change slightly from year to year, given the difficulty of that particular form of the test. The spring 2004 raw score range for each achievement level is listed on the next page.

Spring 2004 GEE 21 Mathematics Test

Achievement Level	Raw Score Range
Advanced	65 – 76 points
Mastery	55.5 – 64.5 points
Basic	39 – 55 points
Approaching Basic	32.5 – 38.5 points
Unsatisfactory	0 – 32 points

This document presents four multiple-choice items selected to illustrate results from four of the five achievement levels used to report GEE 21 results—*Advanced, Mastery, Basic* and *Approaching Basic.* Examples of *Unsatisfactory* work are not included; by definition, work classified as *Unsatisfactory* exhibits a narrower range of knowledge and skills than work classified as *Approaching Basic*. Information shown for each item includes

- the correct answer,
- the achievement level,
- the strand and benchmark each item measures, and
- commentary on the skills/knowledge measured by the item.

In addition, one constructed-response item with its scoring rubric and sample student responses at scores 0–4 are included. Each student response is annotated to explain how its score was derived and the strengths and weaknesses of the response.

Note: Test items may have been reduced in size for this document. Font size on the GEE 21 test is typically 12 point.

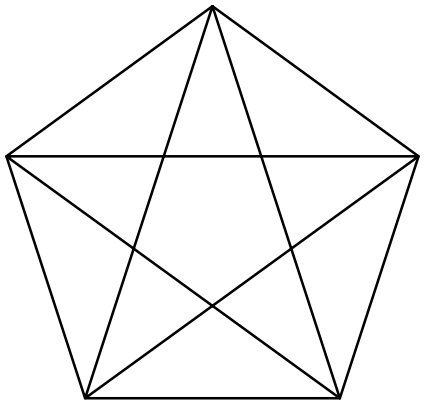
GEE 21—Mathematics
Multiple-Choice Items

Strand: Data Analysis, Probability, and Discrete Math

Benchmark D.9: Using discrete math to model real-life situations (e.g., fair games or elections, map coloring)

Achievement Level: ***Advanced***

Use the map below to answer question X.



What is the smallest number of colors needed to color the map so that no two regions that share more than one point as a boundary are the same color?

* A. 2 colors

B. 3 colors

C. 4 colors

D. 5 colors

* correct answer

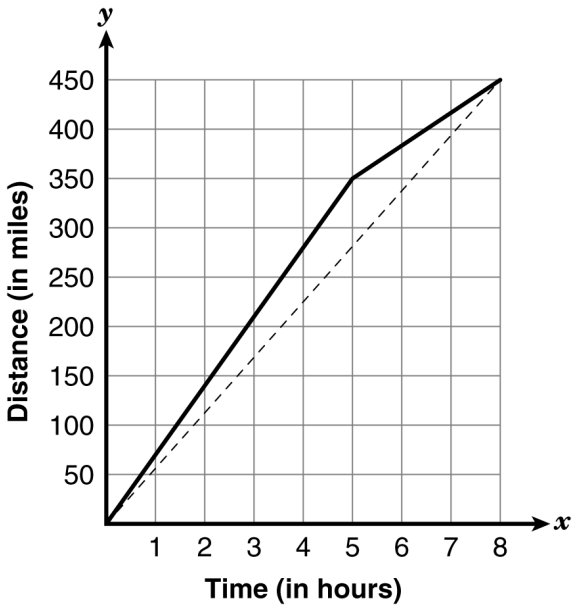
This item would most likely be answered correctly by students who score at the *Advanced* level. The item requires 10th-grade students to apply discrete mathematics skills to establish a procedure for determining the minimum number of colors needed to color the map. They must first recognize regions that share more than one point as a boundary are also the regions that share a common line segment as a border. To determine the number of colors, the students may begin by selecting any single region, giving it a color, and then determining the number of different colors necessary to color all regions with which it shares a boundary. Regardless of which region they select, they will find that exactly one additional color is necessary. As they continue to use this procedure until all eleven regions are accounted for, the students will find that the same two colors may be used and that no more than these two different colors will ever be needed. The correct response is A. This item is a variation of a well known mathematics problem called the four color problem. This item does not require the use of a calculator.

Strand: Algebra

Benchmark A.1: Demonstrating the ability to translate real-world situations (e.g., distance versus time relationships, population growth, growth functions for diseases, growth of minimum wage, auto insurance tables) into algebraic expressions, equations, and inequalities and vice versa

Achievement Level: ***Mastery***

The solid lines in the graph below show how much time it took Sally to drive 450 miles.



She traveled the first 5 hours at one rate of speed. She traveled at a second rate of speed for the last 3 hours. She could have traveled the same distance in 8 hours at a constant rate of speed, as indicated by the dotted line in the graph. Which of the following equations shows the correct relationship between the distance (D) and the time (t) for the dotted line?

A. $D = 50.60t$

B. $D = 55t$

* C. $D = 56.25t$

D. $D = 58.45t$

* correct answer

This item would most likely be answered correctly by students who score at the *Mastery* level or above. The item requires 10th-grade students to translate the information on the graph into an algebraic equation. Students may use one of two strategies to answer this question. As one strategy, they may recognize this as a rate-time-distance problem and use the associated equation (Distance = Rate $\times$ Time). From the graph, students would find the rate by dividing the distance traveled (450 miles) by the time spent traveling (8 hours). The resulting rate is 56.25 miles per hour. As a second strategy, students would algebraically represent the graph by using the slope-intercept form of its equation. By choosing any two points on the dotted line, students must determine that the slope is 56.25. Since the graph passes through the origin (0, 0), the y-intercept is 0. By using either of these strategies, the same algebraic representation ($D = 56.25t$) is found. The correct response is C. The use of a calculator is allowed for this item.

Strand: Measurement

Benchmark M.3: Estimating, computing, and applying physical measurement using suitable units (e.g., calculate perimeter and area of plane figures, surface area and volume of solids presented in real-world situations)

Achievement Level: ***Basic***

Moses and Amalia want to install a rectangular solar panel on their roof. They need to know the weight of the panel per square foot. The panel is 62.5 inches long and 31.1 inches wide, and weighs 34 pounds. About how much does the solar panel weigh per square foot?

A. about $\frac{1}{2}$ pound

B. about 1 pound

* C. about $2\frac{1}{2}$ pounds

D. about 5 pounds

* correct answer

This item would most likely be answered correctly by students who score at the *Basic* level or above. The item requires 10th-grade students to apply the concepts of area and rate. To answer the question, the students must first determine the area of the solar panel. They must then find the weight per square inch. This value is a rate. The area of the rectangular panel is found by multiplying the length and width. There are several methods that students can use when estimating values. Since the answer is requested in weight per square foot, either the length and width must be changed to feet (approximately 5.2 feet and 2.6 feet), or the area in square inches must be divided by 144 (number of square inches in one square foot). With either method, the area is about 13.5 square feet. Finally, students must divide the total weight, 34 pounds, by the area, 13.5 square feet, to determine the weight per square foot. The answer will be about 2.5 or $2\frac{1}{2}$ pounds per square foot. The correct response is C. The use of a calculator is not allowed on this item.

Strand: Number and Number Relations

Benchmark N.2: Demonstrating that a number can be expressed in many forms, and selecting an appropriate form for a given situation (e.g., fractions, decimals, percents, and scientific notation)

Achievement Level: ***Approaching Basic***

There were 24 French Club members last year. If this year's membership is 150% of last year's, how many members are in the French Club this year?

A. 16
B. 20
C. 30
* D. 36

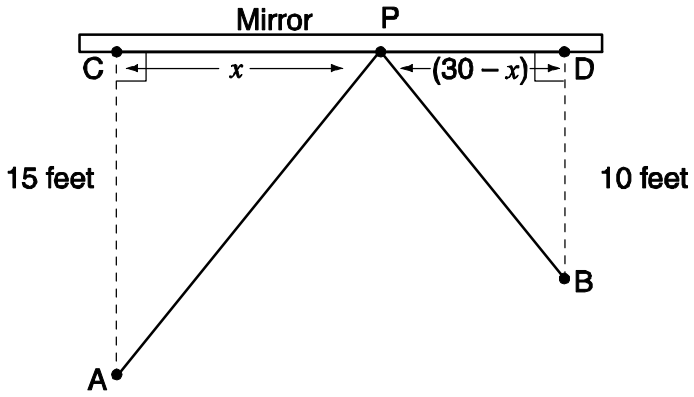
* correct answer

This item would most likely be answered correctly by students who score at the *Approaching Basic* level or above. The item requires 10th-grade students to determine a percentage. To find the percentage, the students must multiply the number of members in the French club last year (24) by either the decimal equivalent (1.5) or the fraction equivalent ($\frac{3}{2}$) of the percent, 150%. As an alternative, students may multiply the number of members (24) by either the decimal equivalent or the fraction equivalent of 50%. This product (12) is then added to the original number of members. With the use of either method, students will find that there are 36 members in the French club this year. The correct response is D. The use of a calculator is not allowed on this item.

Grade 10 Mathematics—Scoring Rubric
Constructed-Response Item

The following pages present a mathematics constructed-response item, a scoring rubric, and examples of student work at scores of 0–4. The original item is shown below, and the scoring rubric is on page 11. The content standard for this item is **Geometry.** In solving problems for this content standard, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional geometry, and justify their findings.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that $\triangle ACP$ is similar to $\triangle BDP$.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

B. Solve the proportion from part A and find the length CP. Show all of your work.

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer.

Scoring Rubric

Score	Description
4	5 points
3	4 points **OR** correct answers to all 3 parts
2	2 or 3 points
1	1 point **OR** minimal understanding of proportions, similar figures, and/or the Pythagorean theorem
0	Response is incorrect, irrelevant to the skill or concept being measured, or blank.

Points assigned:

Part A: 1 point

- 1 point for a correct proportion [$\frac{15}{x} = \frac{10}{(30 - x)}$, or equivalent]

Part B: 2 points

- 2 points for correctly solving the proportion [x = CP = 18 (ft.), or correct solution of incorrect proportion in part A] with work shown indicating correct strategy

  OR

- 1 point for a correct strategy for solving the proportion with arithmetic or minor procedural error (e.g., missing or switching a negative sign) OR correct answer with incomplete or no work shown

Part C: 2 points

- 2 points for a correct answer with work or explanation indicating a correct strategy. [≈39 (ft.) or correct answer based on an incorrect proportion in part A and/or incorrect answer in part B; if the student is unable to find a numeric answer in part B, a complete expression involving variables and employing the Pythagorean Theorem to find the total distance would be sufficient to earn 2 points in this part]

  OR

- 1 point for a correct answer with incomplete or no work shown OR correct strategy with minor computation error(s) or failure to add two segments

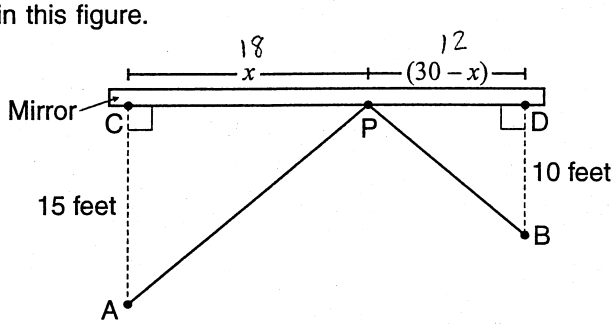
Note:

- Do not penalize for omitting units in either part. If incorrect units are given, do not award a score of 4. Otherwise, do not penalize.

Score 4

Below is the work of a 10th-grade student who received a score of 4 for his or her response. A score of 4 is given when a student completes all important components of the task and communicates his or her ideas effectively. The response should demonstrate in-depth understanding of content area, and all important components of the task should be complete.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that ΔACP is similar to ΔBDP.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

$\frac{10}{15} = \frac{(30-x)}{x}$

B. Solve the proportion from part A and find the length CP. Show all of your work.

CP = 18 feet

$10x = 15(30-x)$

$10x = 450 - 15x$

$+15x \quad +15x$

$\frac{25x}{25} = \frac{450}{25}$

$x = 18$

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer. 39 ft.

$18^2 + 15^2 = c^2$

$\sqrt{549} = \sqrt{c^2}$

$c \approx 23$

$12^2 + 10^2 = c^2$

$\sqrt{244} = \sqrt{c^2}$

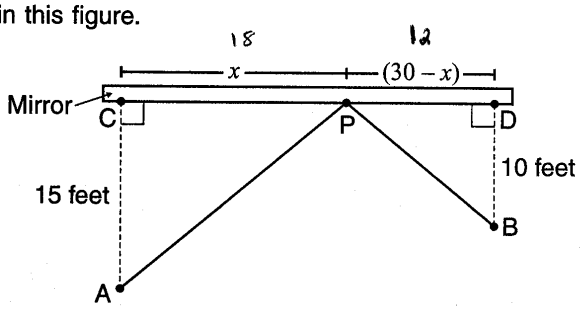
$c \approx 16$

This response demonstrates the mathematical skills required to answer all parts of the question correctly, with appropriate justification in each part. The student writes a correct proportion in part A, and provides the correct answer to both parts B and C with work shown demonstrating an appropriate strategy. The response is correct and complete and earns a total of 5 points for a score of 4.

Score 3

Below is the work of a 10th-grade student who received a score of 3 for his or her response. A score of 3 is given when a student completes the most important aspects of the required task and communicates his or her ideas clearly. The response should demonstrate the student's understanding of major concepts and/or processes, although the student may have overlooked or misunderstood one part of the problem.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that ΔACP is similar to ΔBDP.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

$\frac{15}{x} = \frac{10}{30-x}$

CP = 18 feet

B. Solve the proportion from part A and find the length CP. Show all of your work.

$\frac{15}{x} = \frac{10}{30-x}$

$10x = 450 - 15x$

$+15x \quad +15x$

$\frac{25x}{25} = \frac{450}{25}$

$x = 18$

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer.

It traveled about 39 feet.

A to P

$15^2 + 18^2 = 549$

P to B

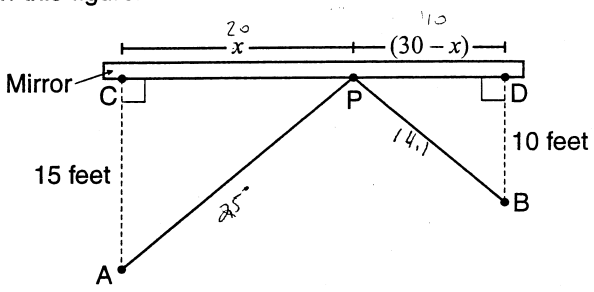
$10^2 + 12^2 = 244$

This response demonstrates the mathematical skills required to answer all parts of the question correctly, but the support provided in part C is incomplete. The student writes a correct proportion in part A and provides the correct answer to both parts B and C. In part B, correct work is shown demonstrating the appropriate strategy for solving the proportion. In part C, however, only one part of the procedure necessary for determining the correct answer is shown. The response therefore is correct, but not complete, and earns a total of 4 points (1 in part A, 2 in part B, and 1 in part C) for a score of 3.

Score 2

Below is the work of a 10th-grade student who received a score of 2 for his or her response. A score of 2 is given when a student completes some parts of the task successfully. The student's response demonstrates gaps in his or her conceptual understanding.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that ΔACP is similar to ΔBDP.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

$\frac{2}{3} = \frac{x}{30-x}$

B. Solve the proportion from part A and find the length CP. Show all of your work.

$\frac{2}{3} = \frac{x}{30-x}$ $\quad \frac{60-x}{3-x} = \frac{3x}{3}$ $\quad 20-x = x$

$20 = x$

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer.

$20^2 + 15^2 = c^2$

$15\ 625 = 25$ $\quad 25 + 14.1 = 39.1$ ft

$10^2 + 10^2$

$100 + 100 = 200$

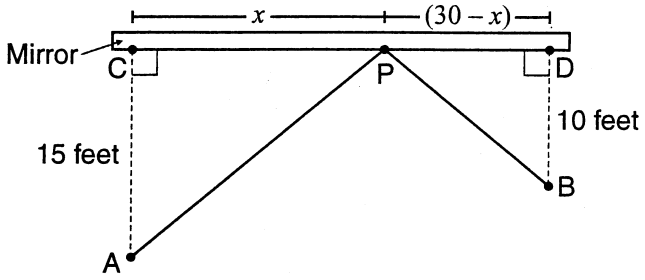
$\sqrt{200} = 14.1$

This response demonstrates an understanding of the relevant concepts in only one part of the question, but this part is complete and correct. The proportion given in part A is incorrect, and the work shown in part B does not demonstrate a correct strategy for solving the proportion to find the correct length. However, the student's work that is shown in part C does demonstrate an understanding of the correct strategy for this part with an answer that is consistent with the incorrect value of x found in part B. The response receives a total of 2 points (for part C) for a score of 2.

Score 1

Below is the work of a 10th-grade student who received a score of 1 for his or her response. A score of 1 is given when a student completes only a small portion of the task, or when the student's response demonstrates minimal understanding of the concepts and/or processes.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that ΔACP is similar to ΔBDP.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

$\frac{15}{10} = \frac{x}{30-x}$

B. Solve the proportion from part A and find the length CP. Show all of your work.

$\frac{15}{10} = \frac{x}{30-x} = \frac{1x}{20}$

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer.

$15x + (30 - x) + 10$

$15x + 29 + 10$

$-10 \quad -10$

$\frac{15x}{15} \quad \frac{39}{15}$

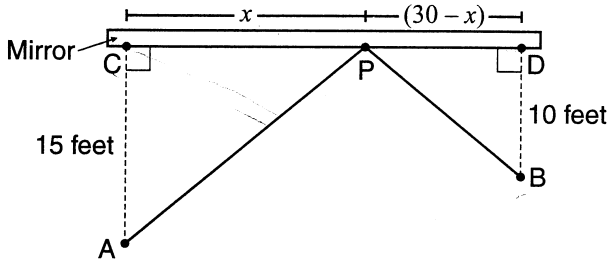
$x = 2.6$ feet

The response demonstrates a minimal understanding of proportions. The student provides a correct proportion in part A with incorrect answers and incorrect work shown in both parts B and C. The response earns a total of 1 point (in part A) for a score of 1.

Score 0

Below is the work of a 10th-grade student who received a score of 0 for his or her response. A score of 0 is given when a student's response is incorrect, irrelevant, too brief to evaluate, or blank.

A scientist is conducting an experiment with laser beams. The laser is located at point A in the figure below. The scientist wishes to reflect the beam off a mirror so that it is directed to point B, as shown in this figure.



In this figure, AC = 15 feet, BD = 10 feet, and CD = 30 feet. Based on the law of reflections, the scientist knows that ΔACP is similar to ΔBDP.

A. Use the values x and $30 - x$ to write a proportion based on the similar triangles ACP and BDP that will help you find the length CP.

17

B. Solve the proportion from part A and find the length CP. Show all of your work.

A to C = 15
C to P = 17

15
- 17

2 is the difference in the point

C. In the figure, $\overline{AC}$ and $\overline{BD}$ are both perpendicular to the mirror. Find the total distance that the laser beam travels from A to P to B. Show or explain how you found your answer.

A to p = 18 p to B = 15

18
+ 15
33

The response is incorrect and does not demonstrate a minimal understanding of proportions, similar figures, or the Pythagorean theorem. The answers to all parts are incorrect, and the work shown does not demonstrate an understanding of an appropriate strategy in any part.

GEE 21

Graduation Exit Examination
for the 21st Century

Spring 2004

Louisiana Department of Education
Office of Student and School Performance
Division of Student Standards and Assessments