# Mathematics

The grade 4 LEAP 21 Mathematics test is composed of sixty multiple-choice and three constructed-response items. A student earns one 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.<br>• The student completes all important components of the task accurately and communicates ideas effectively.<br>• Where appropriate, the student offers insightful interpretations and/or extensions.<br>• 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.<br>• The student's response demonstrates an understanding of major concepts and/or processes, although less important ideas or details may be overlooked or misunderstood.<br>• The student's logic and reasoning may contain minor flaws. |
| **2** | • The student completes some parts of the task successfully.<br>• 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 LEAP 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 of the constructed-response items.

It is possible for a 4th-grade student to earn a total of 72 points on the LEAP 21 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 raw score range for each achievement level is listed on the next page.

## Spring 2003 Mathematics Test, Grade 4

| Achievement Level | Raw Score Range |
|---|---|
| Advanced | 67.5 – 72 points |
| Mastery | 60 – 67 points |
| Basic | 43 – 59.5 points |
| Approaching Basic | 31.5 – 42.5 points |
| Unsatisfactory | 0 – 31 points |

This document presents four multiple-choice items selected to illustrate results from four of the five achievement levels used to report LEAP 21 results—*Advanced*, *Mastery* (formerly *Proficient*), *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 of 0–4 is included. Each student response is annotated to explain how its score was derived and the strengths and weaknesses of the response.

**Note:** Items may have been reduced in size for this document. Font size on the LEAP 21 assessments is typically 12 points.

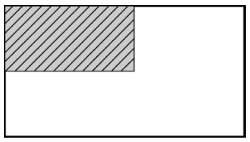
## Grade 4—Mathematics
## Multiple-Choice Items

**Strand:** Geometry

**Benchmark G.3:** Make predictions regarding combinations, subdivisions, and transformations (slides, flips, turns) of simple plane geometric shapes

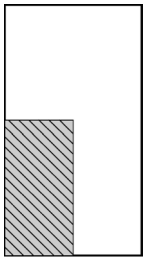
**Achievement Level:** ***Advanced***

Darlene designed the flag below.

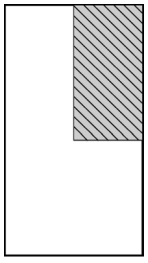


Which of the following shows Darlene's flag turned 90° **counterclockwise**?

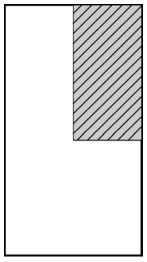
* A.



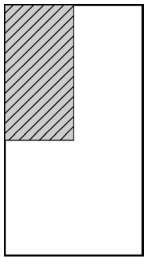
B.



C.



D.



* correct answer

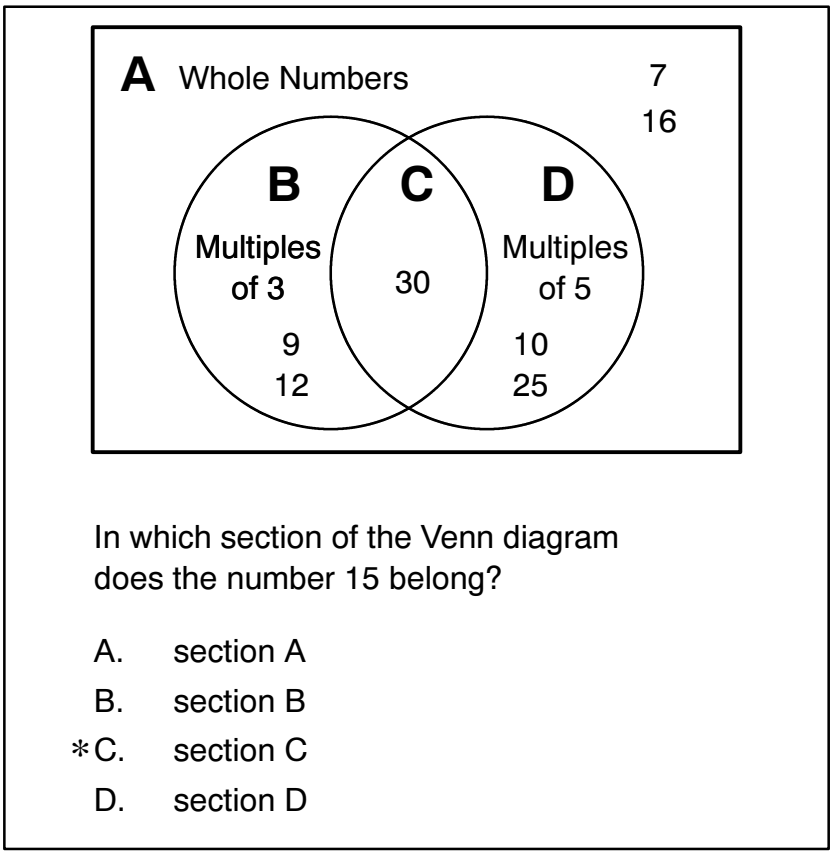
This item would most likely be answered correctly by students who score at the *Advanced* level. A student who scores at this level demonstrates superior performance beyond the level of mastery.

This item requires 4th-grade students to perform a geometric transformation. The transformation requires the students to choose both the angle through which the flag is turned and the direction in which the flag is turned. The students must picture the image of the flag after it has been turned 90° in a counterclockwise direction. The point about which the flag is turned will not affect the answer. The students could actually turn the entire page to help picture the transformation. As students progress in mathematics, the word "rotation" rather than "turn" may be used to describe this type of transformation. This item does not require use of a calculator.

**Strand:** Data Analysis, Probability, and Discrete Math

**Benchmark D.3:** Formulating and solving problems that involve the use of data

**Achievement Level:** ***Mastery*** **(formerly** ***Proficient*****)**




In which section of the Venn diagram does the number 15 belong?

A. section A
B. section B
*C. section C
D. section D

* correct answer

This item would most likely be answered correctly by students who score at the *Mastery* level or above. A student who scores at this level demonstrates competency over challenging subject matter and is well prepared for the next level of schooling.

This item requires 4th-grade students to solve a problem by using data represented in a Venn diagram. It is necessary that the students interpret the diagram, but it is not necessary that the students know this diagram is called a "Venn diagram." The students must recognize that the sections in the diagram represent four categories of whole numbers: A—numbers that are not multiples of 3 or multiples of 5, B—numbers that are multiples of 3, C—numbers that are multiples of both 3 and 5, D—numbers that are multiples of 5. Since the number 15 is both a multiple of 3 and a multiple of 5, the students must conclude that it is properly placed in section C. The use of a calculator is not allowed on this item.

**Strand:** Patterns, Relations, and Functions

**Benchmark P.2:** Representing and describing mathematical relationships using tables, variables, open sentences, and graphs

**Achievement Level:** ***Basic***

Mariah is selling marbles for 8¢ each. Which price list is correct?

A.

| Number of Marbles | Total Cost of Marbles |
|---|---|
| 2 | 8¢ |
| 3 | 24¢ |
| 6 | 32¢ |

B.

| Number of Marbles | Total Cost of Marbles |
|---|---|
| 2 | 16¢ |
| 3 | 24¢ |
| 6 | 40¢ |

C.

| Number of Marbles | Total Cost of Marbles |
|---|---|
| 2 | 8¢ |
| 3 | 16¢ |
| 6 | 32¢ |

*D.

| Number of Marbles | Total Cost of Marbles |
|---|---|
| 2 | 16¢ |
| 3 | 24¢ |
| 6 | 48¢ |

* correct answer

This item would most likely be answered correctly by students who score at the *Basic* level or above. A student who scores at this level demonstrates only fundamental knowledge and skills needed for the next level of schooling.

This item requires 4th-grade students to use a table to describe the relationship between the number of marbles and the total cost of the marbles. Each marble sells for 8¢. From this information, the students must conclude that the cost of the marbles is always 8 times the number of marbles. The table represented in option D is the only choice in which the cost is always 8 times the number of marbles. The use of a calculator is allowed on this item.

**Strand:** Number and Number Relations

**Benchmark N.2:** Demonstrating number sense and estimation skills, giving particular attention to common equivalent reference points (i.e., $\frac{1}{4}$ = 25% = .25; $\frac{1}{2}$ = 50% = .5; $1 = 100%, etc.)

**Achievement Level:** ***Approaching Basic***

Bobby mowed 18 lawns in April, 21 lawns in May, and 23 lawns in June. Which of the following expressions should he use to estimate how many lawns he mowed during these three months?

A. 10 + 20 + 20
* B. 20 + 20 + 20
C. 20 + 20 + 30
D. 20 + 30 + 30

* correct answer

This item would most likely be answered correctly by students who score at the *Approaching Basic* level or above. A student who scores at this level only partially demonstrates fundamental knowledge and skills needed for the next level of schooling.

This item requires 4th-grade students to use number sense and estimation skills to determine approximately how many lawns were mowed in three months. The students must estimate the number of lawns mowed each month by rounding to the nearest multiple of 10. By rounding to the nearest 10, the estimate of the number of lawns mowed each month is 20. The estimate of the total number of lawns mowed is found by adding the three monthly estimates as shown in choice B. The use of a calculator is not allowed on this item.

## Grade 4 Mathematics—Scoring Rubric
## Constructed-Response Item

The work presented in this section contains examples of student work at each score point for a mathematics constructed-response item. The content standard for this item is **Measurement.** In solving problems for this content standard, students demonstrate an understanding of the concepts, processes, and real-life applications of measurement.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

_____

**b.** What time was Marie's mother finished decorating the cake? Show your work.

_____

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

Number of quarts of milk _____

## Scoring Rubric

| Score | Description |
|---|---|
| **4** | The student earns 4 points. |
| **3** | The student earns 3 or $3\frac{1}{2}$ points. |
| **2** | The student earns 2 or $2\frac{1}{2}$ points. |
| **1** | The student earns $\frac{1}{2}$ to $1\frac{1}{2}$ points<br>or<br>The student demonstrates minimal understanding of the use of units of measurement of time or capacity. |
| **0** | The student's response is incorrect or irrelevant to the skill being measured, or blank. |

## Points Assigned

### Part A: (1 point)

- 1 point for giving the correct answer of **105 minutes** or **1 hour and 45 minutes** and showing the correct process **(40 minutes + 30 minutes + 35 minutes = 105 minutes)**
  **OR**
- $\frac{1}{2}$ point for correct process with incorrect answer resulting from an arithmetic error **or** correct answer with no work shown

### Part B: (1 point)

- 1 point for giving the correct answer of **11:30 A.M.** and showing the correct process (**9:45 A.M. + 1 hour 45 minutes = 11:30 A.M.**) **OR** correct process with incorrect time (based on incorrect answer from part A)
  **OR**
- $\frac{1}{2}$ point for correct answer with no work shown **OR** correct process with incorrect time resulting from an arithmetic error **OR** for an answer correctly based on an incorrect answer from part A with no work shown

**Part C: (2 points)**

- 2 points for giving the correct answer of **2 quarts** and for showing correct process of **4 cakes multiplied by 2 cups of milk equals 8 cups of milk; 8 cups = 2 quarts**
  **OR**
- 1 point for giving the equivalent of **8 cups OR 2 quarts** only with no work shown **OR** for giving an incorrect answer using the correct process containing an arithmetic error
  **OR**
- $\frac{1}{2}$ point for the correct process for the number of cups, with no units ($4 \times 2 = 8$)

## Score 4

Below is the work of a 4th-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 ideas effectively. The student demonstrates in-depth understanding of the content area and completes all of the important components of the task.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

1hr 45min

40
30
+35
105 = 1hr 45 min

105
- 60 = 1 hr, 45 min
45

**b.** What time was Marie's mother finished decorating the cake? Show your work.

11:30 A.M.

9:45 to 10:45 = 1
10:45 to 11:30 = 45 min

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

2

2 cups = 1 pt.
x 4
8 cups = 4 pts.
4 pts. = 2 qt.

Number of quarts of milk 2 qt.

This response demonstrates the mathematical skills required to answer all parts of the question correctly, with complete work shown for each part. The student provides the correct answer to parts A, B, and C, and the work shown clearly demonstrates how the answers were derived. The response is complete and correct and earns a total of 4 points for a score of 4.

**Score 3**

Below is the work of a 4th-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 less important ideas.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

40+30+35=105 min.

**b.** What time was Marie's mother finished decorating the cake? Show your work.

9:45
+1:05
10:50 AM.

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

×2 ÷8
4 ÷4
8 2

Number of quarts of milk 2 quarts of milk

This response demonstrates the mathematical skills required to answer most of the question correctly, with a minor error in part B. The student provides the correct answer to parts A and C, with work shown that clearly demonstrates how the answer was derived in these two parts. In part B, the student incorrectly converts 105 minutes to 1 hour and 5 minutes, but does correctly add 1 hour and 5 minutes to 9:45 A.M. The student shows the correct process for part B, but gives the incorrect time because he or she incorrectly converted 105 minutes to 1 hour and 5 minutes. The student earns a total of $3\frac{1}{2}$ points (1 point for part A, $\frac{1}{2}$ point for part B, and 2 points for part C) for a score of 3.

**Score 2**

Below is the work of a 4th-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 conceptual understanding.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

40
30
+35
105

one hour and five minutes

**b.** What time was Marie's mother finished decorating the cake? Show your work.

1
9:45 A.M.
1:05
10,50

She finished at 10:50

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

4
x2
8

Number of quarts of milk 8

This response demonstrates the mathematical skills required to answer one part of the question correctly (part B is correct based upon an incorrect answer to part A), with some correct work shown in the other two parts. The student shows correct process for part A, but the answer is incorrect because the student incorrectly converted 105 minutes to 1 hour and 5 minutes. In part B, the student shows the correct process and correctly calculates the time based on the answer to part A. In part C, the student shows the correct process for determining the number of cups, but does not provide units. The student earns a total of 2 points ($\frac{1}{2}$ point for part A, 1 point for part B, and $\frac{1}{2}$ point for part C) for a score of 2.

**Score 1**

Below is the work of a 4th-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.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

40+30+35=105 min.

**b.** What time was Marie's mother finished decorating the cake? Show your work.

1 hour and 5 min

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

Number of quarts of milk She put about $\frac{3}{4}$

This response demonstrates the mathematical skills necessary to answer one part of the question correctly, with no correct work shown in the other parts. The student provides a correct answer to part A, with work shown that clearly demonstrates how the answer was derived. The answers to both parts B and C are incorrect, and there is no work shown in these parts that demonstrates correct process. The student earns 1 point for a score of 1.

## Score 0

Below is the work of a 4th-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.

Marie's mother made a cake. She put the cake in the oven at 9:45 A.M. The cake took 40 minutes to bake, 30 minutes to cool, and 35 minutes to decorate.

**a.** How many minutes in all did it take Marie's mother to bake, cool, and decorate the cake? Show your work.

IT TOOK 90 Minutes to cook

**b.** What time was Marie's mother finished decorating the cake? Show your work.

She finished a 9:55

**c.** Marie's mother made 4 cakes in all. She put 2 cups of milk in each cake. How many **quarts** of milk did she use? Show how you got your answer.

Number of quarts of milk She use 6 quarts

The response is incorrect and does not demonstrate minimal understanding of the use of units of measurement of time and capacity. The student does not answer any part of the question correctly and does not show work demonstrating correct procedures for any part.