Mathematics

The grade 4 LEAP 21 Mathematics test is composed of sixty multiple-choice and three 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(s) 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 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 in 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 2002 Mathematics Test, Grade 4

Achievement Level	Raw Score Range
Advanced	69 – 72 points
Proficient	63 – 68.5 points
Basic	47 – 62.5 points
Approaching Basic	35.5 – 46.5 points
Unsatisfactory	0 – 35 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—*Approaching Basic, Basic, Proficient,* and *Advanced*. 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 standard 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 strenghts 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.

Achievement Level: *Advanced*

> About how much juice will a one-liter pitcher hold?
>
> A.   1 cup
> B.   1 pint
> *C.   1 quart
> D.   1 gallon

* 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 proficient level of mastery. The content standard for this item is **Measurement**. In solving problems related to this content standard, students demonstrate an understanding of concepts, processes, and real-life applications of measurement.

This item requires 4th-grade students to understand the relative size of units in both metric and English/customary systems. When converting between systems, students are to use intuitive reference points to determine quantities. Although this item does not require complex mathematical procedures, the fact that it is at the *Advanced* level may indicate this Measurement benchmark is not adequately addressed in the mathematics curriculum to which many students are exposed. To correctly respond to this item, students need to understand the approximate equivalence of 1 liter and 1 quart. This item does not require use of a calculator.

Achievement Level: *Proficient*

Tim wants to make 16 cards for his friends. If *t* stands for the time that Tim will spend making each card, which number sentence can you use to find out how long it is going to take Tim to make the 16 cards?

A. $t + 16 = \boxed{}$

B. $t - 16 = \boxed{}$

*C. $t \times 16 = \boxed{}$
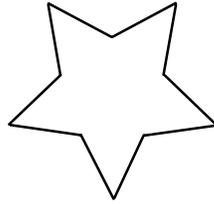
D. $t \div 16 = \boxed{}$

* correct answer

This item would most likely be answered correctly by students who score at the *Proficient* 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. The content standard for this item is **Algebra**. In solving problems related to this content standard, students demonstrate an understanding of concepts and processes that allow them to analyze, represent, and describe relationships among variable quantities and to apply algebraic methods to real-world situations.

This item requires 4th-grade students to use a variable to represent an unknown quantity and then use the variable in a number sentence. Students must understand that the variable *t* can represent any amount of time. They must then decide which operation (multiplication) must be performed to determine the total time Tim spends making cards. Finally, students choose the number sentence C, which can be used to determine this time. This item does not require use of a calculator.

Achievement Level: *Basic*

Use the figure below to answer question X.

Sarah wants to bake a cake with the shape of a 5-pointed star, as shown above. Which two different pans can she use to make her star-shaped cake?
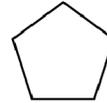

    1   2   3   4

  A.   1 and 2

  B.   1 and 3

  C.   2 and 3

* D.   2 and 4

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* 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. The content standard for this item is **Geometry**. In solving problems related to this content standard, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional figures, and are able to justify their findings.

This item requires 4th-grade students to understand that simpler shapes can be combined and manipulated to form more complex shapes. Although many different shapes could be combined to form the star, the students must first realize that, from the options available, only the pentagon and triangle can be used. The students should also realize that the triangle is used more than once in forming the star. This item does not require use of a calculator.

Achievement Level: *Approaching Basic*

Vanessa's fourth-grade class went to the zoo. They visited some animals and recorded their heights as shown in the chart below.

Zoo Animals

Animal	Height (in centimeters)
Black bear	150
Bobcat	60
Gray wolf	80
Mountain lion	100

The mountain lion is how many centimeters taller than the bobcat?

* A.   40 centimeters
   B.   60 centimeters
   C.   100 centimeters
   D.   160 centimeters

* 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. The content standard for this item is **Data Analysis, Probability, and Discrete Math.** In solving problems related to this content standard, students discover trends, formulate conjectures regarding cause-and-effect relationships, and demonstrate critical-thinking skills in order to make informed decisions.

This item requires 4th-grade students to correctly select data listed in a chart and then use the data in calculations necessary to answer a question. Students must first correctly read the chart and select the height of the mountain lion (100 cm) and the bobcat (60 cm). To determine how many centimeters taller the mountain lion is, they must then find the difference in heights by subtracting (100 − 60). Calculators were not allowed for this 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 measurement is **Patterns, Relations, and Functions.** In solving problems for this content standard, students demonstrate an understanding of the use of patterns, relations, and functions that represent and explain real-world situations.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97				

A. Complete the table for Mary by continuing the pattern.

B. Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ _____

C. Could the following rule be used to find what the fine would be for a movie that is n days overdue? Explain your answer.

Fine = $2.99 + n

Answer: _____

Explanation: _____

_____

_____

_____

Scoring Rubric

Score	Description
4	Student correctly answers all parts.
3	Student correctly answers three parts (but does not give a complete explanation for part C). **OR** Student correctly answers either part A or part B and correctly answers part C and includes a complete explanation for this part.
2	Student correctly answers parts A and B. **OR** Student correctly answers part C and gives a complete explanation. **OR** Student correctly answers part A or part B and correctly answers part C (no valid explanation is given).
1	Student correctly answers part A or part B. **OR** Student makes an error in the chart in part A, but all other answers are correct based on this error.
0	Incorrect or irrelevant response, or blank.

Exemplary Responses:

Part A

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97	$11.96	$14.95	$17.94	$20.93

Part B: $18.90

Part C: No
Rule does not work: 2.99 + 2 = 4.99, not 5.98.
(Other examples are acceptable.)

Note: If a student incorrectly answers parts A and B, but answers "No" for part C without an explanation, no points are given.

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.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97	$11.96	$14.95	$17.94	$20.93

A.   Complete the table for Mary by continuing the pattern.

B.   Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ _18.90_____

C.   Could the following rule be used to find what the fine would be for a movie that is n days overdue? Explain your answer.

Fine = $2.99 + n

Answer: _no_____

Explanation: _No because $2.99 would have to be multiplied by the number of days it is overdue to get the fine._

This response demonstrates the mathematical skills required to correctly solve all parts of the question. The student demonstrates an understanding of the pattern of overdue fines by correctly filling in the missing values on the table. The student gives a correct answer to part B and in part C provides the correct answer with a complete explanation. All parts of the question are complete and correct.

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.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (*n*) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97	$11.96	$14.95	$17.94	$20.93

A. Complete the table for Mary by continuing the pattern.

B. Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ _18.90_

C. Could the following rule be used to find what the fine would be for a movie that is *n* days overdue? Explain your answer.

Fine = $2.99 + *n*

Answer: _No_

Explanation: _I think no is the answer because you do not add the no. of days the video was overdue_

This response demonstrates the mathematical skills required to answer all parts of the question correctly, but the explanation given in part C is incomplete. The student demonstrates understanding of the pattern of overdue fines by correctly filling in missing values on the table and provides a correct answer to part B. In part C, the student gives the correct answer but does not provide enough support for why this rule does not work and does not describe what the correct rule would be.

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.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97	11.96	14.95	17.94	20.93

A. Complete the table for Mary by continuing the pattern.

B. Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ __14.95__

C. Could the following rule be used to find what the fine would be for a movie that is n days overdue? Explain your answer.

Fine = $2.99 + n

Answer: __NO__

Explanation: __I said no because you don't know how many days its overdue that is how I got my answer.__

This response demonstrates the mathematical skills required to complete some parts of the question correctly. The student demonstrates understanding of the pattern of overdue fines by correctly filling in the missing values on the table, and does provide a correct answer to part C. However, the answer to part B is incorrect, and the explanation given in part C is not valid.

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. The student's response demonstrates minimal understanding of concepts and/or processes.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97	$11.96	$14.95	$17.94	$20.93

A. Complete the table for Mary by continuing the pattern.

B. Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ _14.95_

C. Could the following rule be used to find what the fine would be for a movie that is n days overdue? Explain your answer.

Fine = $2.99 + n

Answer: ___n___

Explanation: _I put 2 because they have $2.99 and the fine of the day is 1 day overdue._

This response demonstrates the mathematical skills required to correctly answer only one part of the question. The student demonstrates understanding of the pattern of overdue fines by correctly filling in the missing values on the table. The answers to parts B and C are incorrect, and the explanation given in part C is not valid.

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.

Mary works at a video rental store. She is making a table to show the fines for one overdue movie.

OVERDUE MOVIE FINES

Number (n) of Days	1	2	3	4	5	6	7
Amount of Fine	$2.99	$5.98	$8.97				

A. Complete the table for Mary by continuing the pattern.

B. Joe rented a movie for $3.95. If he returned the movie 5 days overdue, how much did he spend in total for the movie rental?

Answer: $ __6.95__

C. Could the following rule be used to find what the fine would be for a movie that is n days overdue? Explain your answer.

Fine = $2.99 + n

Answer: __NO__

Explanation: __No, because the chart of overdue Movie fines, goes up to seven there is now a n in the chart.__

This response is incorrect and does not demonstrate understanding of the mathematical skills required to solve any part of the question correctly. The student does not attempt to complete the table and provides an incorrect answer to part B. Since no correct work is shown in parts A and B, an answer of "NO" in part C, without a valid explanation, does not receive any credit.