

Spilled Milk

Anna brought a 1 gallon jug of milk to school for the class party. She didn't know that the jug of milk got knocked over. The cap was loose, and $\frac{1}{4}$ of the milk spilled out of the jug each hour it was on its side. If the party is in 3 hours and no one notices the spilled milk jug until then, will there be any milk left for the party? Show and explain your math thinking.

Spilled Milk

Suggested Grade Span

Grades 3 – 5

Grade(s) in Which Task Was Piloted

Grade 3

Task

Anna brought a 1 gallon jug of milk to school for the class party. She didn't know that the jug of milk got knocked over. The cap was loose, and $\frac{1}{4}$ of the milk spilled out of the jug each hour it was on its side. If the party is in 3 hours and no one notices the spilled milk jug until then, will there be any milk left for the party? Show and explain your math thinking.

Alternative Versions of Task

More Accessible Version:

Anna brought a 1 gallon jug of milk to school for the class party. She didn't know that the jug of milk got knocked over. The cap was loose, and $\frac{1}{4}$ of the milk spilled out of the jug each hour it was on its side. If the party is in 2 hours and no one notices the spilled milk jug until then, will there be any milk left for the party? Show and explain your math thinking.

More Challenging Version:

Anna brought a 1 gallon jug of milk to school for the class party. She didn't know that the jug of milk got knocked over. The cap was loose, and $\frac{1}{2}$ of the milk spilled out of the jug during the first hour. $\frac{1}{2}$ of the then remaining milk spilled out during the second hour. $\frac{1}{2}$ of the then remaining milk spilled out during the third hour. It was now time for the party. How much milk, if any, is left for the party? Show and explain your math thinking.

NCTM Content Standards and Evidence

Number and Operation Standard for Grades 3–5

Instructional programs from Pre–Kindergarten through grade 12 should enable students to...

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
 - *NCTM Evidence:* Develop an understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers.
- *Exemplars Task Specific Evidence:* This task requires students to understand and apply the concept of $\frac{1}{4}$.

Time/Context/Qualifiers/Tip(s) From Piloting Teacher

This is a short task.

Links

The task would link to other tasks involving parties published in Volumes 7 and 8 of Exemplars.

The task could also link to units on milk, dairy, and farms.

Technology Link: If you go to <http://standards.nctm.org/document/examples/index.htm> you can also find a electronic example of an activity that would complement this task called *Communicating About Mathematics Using Games* that focuses on fractions.

Common Strategies Used to Solve This Task

Most students use a diagram to represent the whole gallon of milk and then break it up into fourths.

Possible Solutions

Original Version:

$\frac{3}{4}$ of the gallon spilled. $\frac{1}{4}$ gallon is left.

More Accessible Version:

$\frac{1}{2}$ of the gallon spilled. $\frac{1}{2}$ gallon is left.

More Challenging Version:

Hour One: $\frac{1}{2}$ of a gallon would be left.

Hour Two: $\frac{1}{2}$ of $\frac{1}{2}$ of a gallon spilled, so $\frac{1}{4}$ of a gallon would be left.

Hour Three: $\frac{1}{2}$ of $\frac{1}{4}$ of a gallon spilled, so $\frac{1}{8}$ of a gallon would be left.

Task Specific Assessment Notes

General Notes: Most students will draw diagrams to solve the task, a concrete way of dealing with the concept of fractions.

Novice: The novice will show no engagement in the task or an approach that will not lead toward a solution. No understanding of $\frac{1}{4}$ is demonstrated.

Apprentice: The apprentice will show some understanding of fractions and of $\frac{1}{4}$ but will achieve an incorrect solution due to a reasoning error.

Practitioner: The practitioner will achieve a correct solution, showing understanding of $\frac{1}{4}$.

Expert: The expert will use formal math language and show a deeper understanding of concepts of fractions and/or measurement.

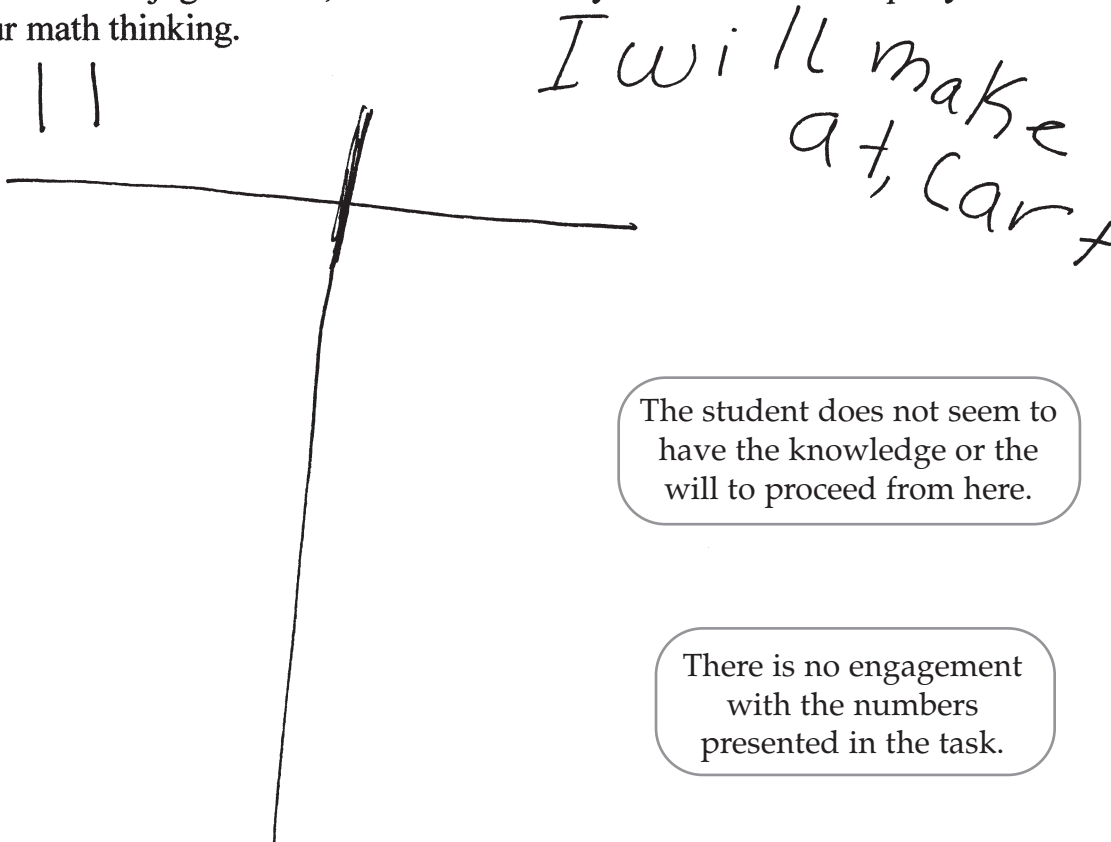
Author

This task was written by **Deb Armitage**, K–8 Mathematics Assessment Consultant at the Vermont Department of Education. The task was piloted by teachers and students in Vermont.

Novice

Spilled Milk!

Anna brought a 1 gallon jug of milk to school for the class party. She didn't know that the jug of milk got knocked over. The cap is loose and $\frac{1}{4}$ of the milk will spill each hour it is on its side. If the party is in three hours and no one sees the jug of milk, will there be any milk left for the party? Show your math thinking.



The student does not seem to have the knowledge or the will to proceed from here.

There is no engagement with the numbers presented in the task.

A minimal attempt is made to create a math representation.

Apprentice

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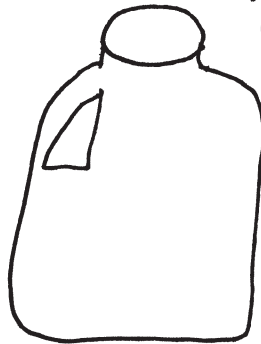
hour	# 1	# 2	# 3
milk	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$

An incorrect answer is achieved.

Some formal math language is used.

Math representations are used to communicate problem solving.

all gone



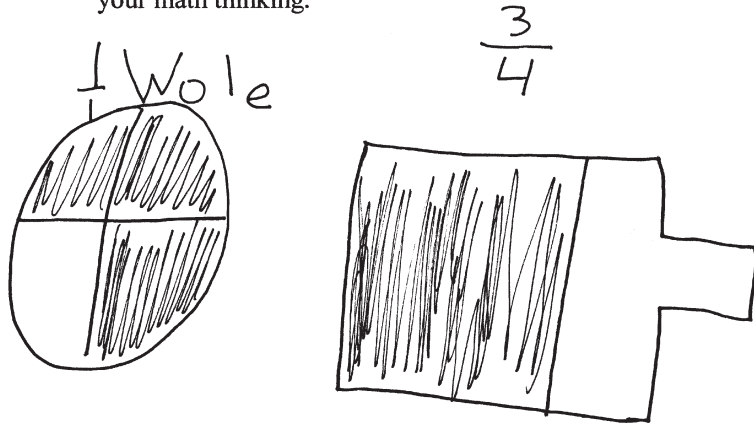
There is evidence of the student drawing on some previous knowledge of fractions.

Practitioner

Spilled Milk!

got Milk

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I need to find out if there will be enough for the party

I hottest

$$\frac{1}{4} + \frac{1}{4} + \frac{1}{4} =$$

$\frac{3}{4}$ and that how much milk came out will make a fraction.

$\frac{1}{4}$ is left

The student clarifies the task.

Formal math language is used.

A correct strategy of using a diagram works for solving the problem.

A correct answer is achieved.

Mathematical representations are constructed to solve the problem and to portray a solution.

Expert

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Milk	hours
$\frac{1}{4}$	1
$\frac{2}{4}$	2
$\frac{3}{4}$	3

Language of fractions and measurement is used to communicate.

An efficient strategy of creating a chart is used.

A correct answer is achieved.

The answer is left $\frac{1}{4}$

I noticed that $\frac{1}{4}$ gallon is 1 quart left

I noticed that each hour $\frac{1}{4}$ spilt and if there was another hour the milk would be gone.

I need to find out if there is any more milk left. I will make a chart.

A sense of audience and purpose is conveyed in the student's commentary.

The student uses prior knowledge of measurement to comment on the amount of milk left.