



# The Pennsylvania System of School Assessment

## Mathematics Item and Scoring Sampler

# SUPPLEMENT

2009–2010  
Grade 8

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# MATHEMATICS

## ***INTRODUCTION***

The 2009–2010 Mathematics Item and Scoring Sampler Supplement displays released items from the 2009 PSSA operational test. The sampler supplement is to be used in conjunction with the previous year’s item sampler. The 2008–2009 Mathematics Item and Scoring Sampler can be found on the Pennsylvania Department of Education website at <http://www.pde.state.pa.us/>. Select the “Pre K–12 Schools” tab at the top of the page. Then select “Assessment” in the “Learn About” column to the left. Select “Resource Materials” in the “Learn About” column of the next page, and then scroll down to find the appropriate sampler. Alternately, you may type in or click this link to reach the location of the item samplers:

[http://www.pde.state.pa.us/a\\_and\\_t/cwp/view.asp?a=108&Q=73314&a\\_and\\_tNav=|680|&a\\_and\\_tNav=|](http://www.pde.state.pa.us/a_and_t/cwp/view.asp?a=108&Q=73314&a_and_tNav=|680|&a_and_tNav=|)

This item and scoring sampler supplement contains 16 mathematics multiple-choice items and 1 open-ended item. Each item is preceded by the Assessment Anchor and Eligible Content coding. The majority of multiple-choice answer options are followed by a brief analysis or rationale. The correct answer is indicated by an asterisk. The table following each multiple-choice item displays the percentages of students who chose each answer option. The correct answer is also shaded in these tables. The table following the open-ended item indicates the students’ performance for each scorepoint. Sample student responses for each of the scoring levels are also included for the open-ended item.

# MATHEMATICS

## MULTIPLE-CHOICE ITEMS

Note: All percentages listed in the tables below the items have been rounded.

### A.1.1.1

1. The distance between Duncan's house and his grandparents' house is 3,400 miles. What is this distance written in scientific notation?

- A  $3.4 \times 10^{-2}$  *used 2 for 2 zeros; moved left so used negative*
- B  $3.4 \times 10^{-3}$  *moved left so used negative*
- C  $3.4 \times 10^2$  *used 2 for 2 zeros*
- D  $3.4 \times 10^3$  \*

A	B	C	D
2%	5%	17%	76%

### A.2.1.1

During an assessment, students would not be permitted to use a calculator on item 2.

- Use the expression below to answer question 2.

$$(15 - 7)^2 + (2 \cdot 2)^2 - (4 + 3)$$

2. What is the value of the expression?

- A 17 *simplified  $8^2$  to be 16 and  $4^2$  to be 8, so  $16 + 8 - 7 = 17$*
- B 73 \*
- C 79 *simplified correctly until end; subtracted 4 from 80 then added 3*
- D 137 *added  $8 + 4$ , then squared 12 and subtracted 7*

A	B	C	D
9%	79%	10%	3%

# MATHEMATICS

## A.2.2.2

During an assessment, formulas will be provided on a reference sheet.

3. Abner walks 3 miles per hour. At this rate, how long will it take him to walk  $7\frac{1}{2}$  miles?

- A  $2\frac{1}{2}$  hours \*
- B  $4\frac{1}{2}$  hours *subtracted*
- C  $10\frac{1}{2}$  hours *added*
- D  $22\frac{1}{2}$  hours *multiplied*

A	B	C	D
69%	11%	5%	15%

## A.3.1.2

4. For which of these is an exact amount needed?

- A the amount of water in a quart  
\*
- B the amount of water in a swimming pool  
*an estimate is appropriate*
- C the amount of water a person drinks in a day  
*an estimate is appropriate*
- D the amount of milk added to a bowl of cereal  
*an estimate is appropriate*

A	B	C	D
77%	8%	12%	3%

# MATHEMATICS

## A.3.2.1

During an assessment, students would not be permitted to use a calculator on item 5.

5. Sheldon's restaurant bill is \$37.56. He plans to leave a 15% tip. Which is **closest** to the amount of money Sheldon plans to leave for a tip?

A \$3

*divided 40 by 15 and then rounded up*

B \$4

*found 10% and rounded up*

C \$6

\*

D \$8

*about 20%*

A	B	C	D
12%	18%	61%	9%

## B.1.1.1

6. Lavasha's backpack holds up to 14.75 kilograms. What is this mass expressed in grams?

A 0.01475

*thinks kilogram is 1/1000 of a gram*

B 1.475

*thinks 1 kilogram is 1/10 of a gram*

C 1,475

*thinks 100 grams is 1 kilogram*

D 14,750

\*

A	B	C	D
22%	15%	17%	45%

## B.2.1.1

7. Claire uses 5 straws as the sides of a regular polygon. Each straw is used as one side of the polygon. What is the sum of the measures of the interior angles of the polygon?

A  $360^\circ$

$2 \times 180$

B  $540^\circ$

\*

C  $720^\circ$

$4 \times 180$

D  $900^\circ$

$5 \times 180$

A	B	C	D
18%	65%	8%	9%

# MATHEMATICS

## B.2.2.2

8. A pool in the shape of a rectangular prism has a width of  $8\frac{1}{2}$  feet (ft), a length of 12 ft, and a depth of 8 ft. What is the volume of the pool?

A 102 ft<sup>3</sup>  $12 \times 8.5$ ; found area

B 532 ft<sup>3</sup>  $8^3 + 12 + 8$

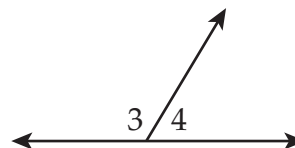
C 816 ft<sup>3</sup> \*

D 1,728 ft<sup>3</sup>  $12^3$ ; thought all sides had same length

A	B	C	D
9%	5%	84%	2%

## C.1.1.2

9. Harriet drew the figure below on a piece of paper.



Which describes a relationship between  $\angle 3$  and  $\angle 4$  in the figure?

A complementary angles

*confused supplementary and complementary*

B obtuse angles

*saw that angle 3 is obtuse*

C supplementary angles

\*

D vertical angles

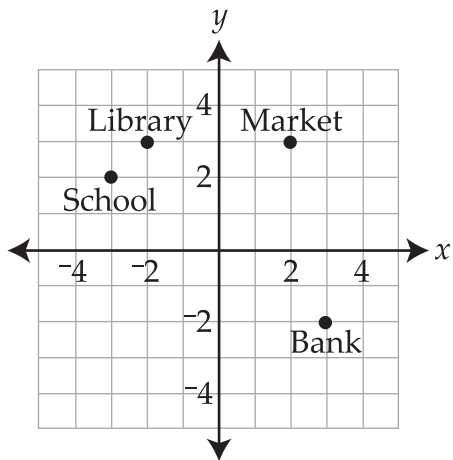
*confused supplementary and vertical*

A	B	C	D
24%	7%	59%	10%

# MATHEMATICS

## C.3.1.1

Use the figure below to answer question 10.



10. Which building is located at  $(-2, 3)$ ?

- A School
- B Library
- C Market
- D Bank

A	B	C	D
2%	85%	2%	10%

## D.2.1.1

11. What is the solution of  $\frac{x}{3} > -3$ ?

- A  $x < -1$
- B  $x > -1$
- C  $x < -9$
- D  $x > -9$

A	B	C	D
13%	23%	19%	45%



# MATHEMATICS

## D.2.2.2

12. The violin section makes up  $\frac{3}{5}$  of a school orchestra. The equation below is used to determine the total number of musicians ( $m$ ) in the orchestra.

$$\frac{3}{5}m = 60$$

What is the total number of musicians in the orchestra?

- A 36  $60 \times 3/5$
- B 100 \*
- C 195  $(60 + 5) \times 3$
- D 297  $60 \times 5 - 3$

A	B	C	D
16%	76%	5%	2%

## D.4.1.3

13. The table below shows a relationship between the values of  $x$  and  $y$ .

$x$	$y$
-7	-10
-2	-5
3	0
8	5

Which equation describes the relationship?

- A  $y = x - 3$  \*
- B  $y = x + 3$  *added 3 instead of subtracted*
- C  $y = -x - 3$  *used negative coefficient*
- D  $y = -x + 3$  *added 3 instead of subtracted; used negative coefficient*

A	B	C	D
74%	10%	9%	6%

# MATHEMATICS

## E.1.1.1

14. The student council needs to make a budget that shows the percent of money it will spend on each item during the school year. Which type of graph would **best** represent the budget?

- A circle graph \*
- B double bar graph  
*would use to compare budgets*
- C histogram  
*would not be the best way to display percents of a whole*
- D double line graph  
*budget items are discrete*

A	B	C	D
69%	13%	8%	9%

## E.3.2.1

15. Olivia is creating a 3-letter code using the letters A, B, and C. She has decided that each letter will only be used once in the code. How many different 3-letter codes can Olivia create?

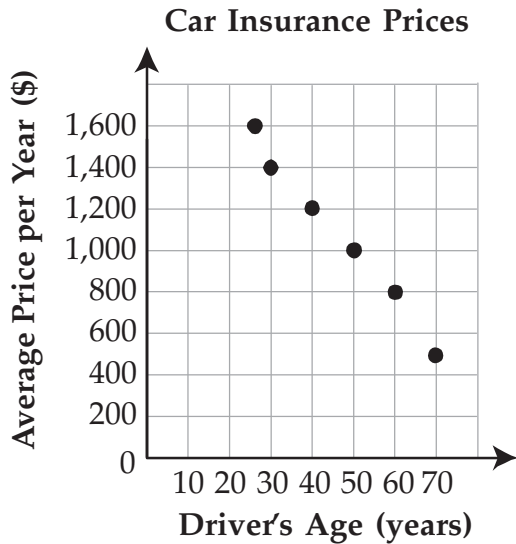
- A 3 *3 letters*
- B 6 \*
- C 9  $3 \times 3$
- D 12  $3 \times 4$

A	B	C	D
7%	70%	20%	3%

# MATHEMATICS

## E.4.1.1

16. The scatter plot below shows the average price of car insurance for drivers of different ages.



Which type of correlation **best** describes the relationship between a driver's age and the average price of that driver's car insurance?

- A weak negative *points close together*
- B strong negative \*
- C weak positive *points close together and line decreases*
- D strong positive *line decreases*

A	B	C	D
15%	59%	12%	14%

# MATHEMATICS

## OPEN-ENDED ITEM

D.1

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24			42

A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

# MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

Score Point 4	Score Point 3	Score Point 2	Score Point 1	Score Point 0
31%	20%	20%	16%	13%

# MATHEMATICS

## ITEM-SPECIFIC SCORING GUIDELINE

### Item #17

This item is reported under Category D, Algebraic Concepts.

#### Assessment Anchor:

D.1– Demonstrate an understanding of patterns, relations and functions.

#### Specific Eligible Content addressed by this item:

D.1.1.1– Continue a numeric or algebraic pattern (pattern must show 3 repetition—may include up to 2 operations, squares and square roots).

D.1.1.2– Find missing elements in numeric or geometric patterns and/or functions (may be given a table or rule—pattern must show 3 repetitions).

D.1.1.3– Determine the rule of a function (given elements in an input-output table, chart or list—limit to linear functions).

#### Scoring Guide:

Score	In response to this item, the student—
4	demonstrates a <i>thorough</i> understanding of continuing a numeric or algebraic pattern, finding missing elements in numeric or geometric patterns or functions, and determining the rule of a function by correctly solving problems and clearly explaining procedures.
3	demonstrates a <i>general</i> understanding of continuing a numeric or algebraic pattern, finding missing elements in numeric or geometric patterns or functions, and determining the rule of a function by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	demonstrates a <i>partial</i> understanding of continuing a numeric or algebraic pattern, finding missing elements in numeric or geometric patterns or functions, and determining the rule of a function by correctly performing a significant portion of the required task.
1	demonstrates <i>minimal</i> understanding of continuing a numeric or algebraic pattern, finding missing elements in numeric or geometric patterns or functions, and determining the rule of a function.
0	The response has given no correct answer and <i>insufficient</i> evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.
Non-scorable	BLK – Blank, entirely erased, or written refusal to respond OT – Off Task IL – Illegible LOE – Response in a language other than English

# MATHEMATICS

Item #17

Top Scoring Response:

Part A Answers	
10	12
<b>30</b>	<b>36</b>

(1 score point)

0.5 point for each correct answer

Part B Answer
$w = 3m$ <b>OR</b> equivalent

(1 score point)

1 point for correct equation

Part C Explanation
The amount of water will be 6 times the amount of mix. <b>OR</b> The $3m$ becomes $6m$ in the equation in A <b>OR</b> equivalent

(1 score point)

1 point for correct answer and complete explanation (.5 points for correct answer with incomplete or no explanation)

Part D Answer
108

(1 score point)

1 point for correct answer

# MATHEMATICS

## OPEN-ENDED ITEM RESPONSES

### D.1 Response Score: 4

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24			42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

mix	10	12
water	30	36

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$m = \text{cups of mix}$$
$$w = \text{cups of water}$$
$$w = 3m$$

The student has given a correct equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.



## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

Instead of the amount of water being equal to 3 times the amount of mix It would now have to equal 3 times the amount of mix then multiply it by 2. It could also be 6 times the amount of mix.

$$W = 6m$$

The student has given a correct answer and complete explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

$$W = 6m$$

$$W = 6m \cdot 18$$

$$W = 108 \text{ cups of water}$$

She would need 108 cups of water.

The student has given a correct answer.

# MATHEMATICS

## D.1 Response Score: 3

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	36	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$W = 3m$$

The student has given a correct equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

The equation would be  $w = 6m$  because his sister doubled the amount of water from 3 to 6. So, the variable "m" will be doubled

The student has given a correct answer and complete explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

Rodney's sister would use 54 cups of water.

The student has given an incorrect answer.

# MATHEMATICS

## D.1 Response Score: 3

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	36	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$w = m \cdot 3$$

The student has given a correct equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

$$W = M \cdot 3 \cdot 2$$

The student has given a correct answer with no explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

108

The student has given a correct answer. Based on PSSA scoring rules,  $3\frac{1}{2}$  points count as 3 points.

# MATHEMATICS

## D.1 Response Score: 2

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	36	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$w = 3(m)$$

The student has given a correct equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

$2w = 3(m)$   
the water is doubled so the  
water timesed by 2.

The student has given an incorrect answer and explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

$2w = 3(18) = 54$   
 $w = 27$  cups  
she would need 27 cups  
of water.

The student has given an incorrect answer.

# MATHEMATICS

## D.1 Response Score: 2

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	30	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$w = 3m$$

The student has given a correct equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.



## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

$$W = 6m$$

The student has given a correct answer with no explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

$$\begin{array}{r} 18 \\ \times 3 \\ \hline 54 \end{array}$$

54  
Rodney's sister would mix 54 cups of water with the 18 cups of mix to make her lemonade.

The student has given an incorrect answer. Based on PSSA scoring rules, 2½ points count as 2 points.

# MATHEMATICS

## D.1 Response Score: 1

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	36	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$\begin{aligned}1 \times 3 &= 3 \\2 \times 6 &= 12 \\3 \times 9 &= 27 \\4 \times 12 &= 48 \\8 \times 24 &= 192 \\10 \times 30 &= 300 \\12 \times 36 &= 436 \\14 \times 42 &= 588\end{aligned}$$

The student has given incorrect equations.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

cups of m	1	2	3	8	10	12	14
cups of w	6	12	18	48	60	72	84

The student has given a partially correct answer but incomplete explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

she would need 88 cups  
of water.

The student has given an incorrect answer. Based on PSSA scoring rules,  $1\frac{1}{2}$  points count as 1 point.

# MATHEMATICS

## D.1 Response Score: 1

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	30	36	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two correct answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

$$N \times M = A$$

The student has given an incorrect equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

$$W^2 \times M = a$$

The student has given an incorrect answer and no explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

36 cups of water.

The student has given an incorrect answer.

# MATHEMATICS

## D.1 Response Score: 0

17. The table below shows the numbers of cups of mix and water Rodney uses to make different amounts of lemonade.

Lemonade Batches

Cups of Mix ( $m$ )	1	2	3	4	8	10	12	14
Cups of Water ( $w$ )	3	6	9	12	24	27	33	42

- A. Complete the table with the missing cups of water Rodney uses to make the lemonade.

The student has given two incorrect answers.

- B. Write an equation to describe the relationship between the amount of mix ( $m$ ) and water ( $w$ ) Rodney uses to make lemonade.

The equation that I used was  $m \times 3w$   
Because every cup of mix takes  
3 cups of water that's how I got  
my numbers -

The student has given an incorrect equation.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.

## MATHEMATICS

17. *Continued.* Please refer to the previous page for task explanation.

Rodney's sister thinks the lemonade made with the amounts in the table is too strong. She doubles the amount of water in every batch.

- C. Explain how the equation written in part B should change to show the relationship between the amounts of mix and water Rodney's sister uses to make lemonade.

Rodney's sister puts a little more water and less sugar to make it less strong

The student has given an incorrect answer and explanation.

- D. How many cups of water would Rodney's sister mix with 18 cups of mix to make lemonade?

Rodney's sister would mix about 25 cups of water. to her lemonade

The student has given an incorrect answer.

# MATHEMATICS

## SUMMATIVE DATA TABLE

### Multiple-Choice Items

Sampler Sequence	A	B	C	D
1	2%	5%	17%	76%
2	9%	79%	10%	3%
3	69%	11%	5%	15%
4	77%	8%	12%	3%
5	12%	18%	61%	9%
6	22%	15%	17%	45%
7	18%	65%	8%	9%
8	9%	5%	84%	2%
9	24%	7%	59%	10%
10	2%	85%	2%	10%
11	13%	23%	19%	45%
12	16%	76%	5%	2%
13	74%	10%	9%	6%
14	69%	13%	8%	9%
15	7%	70%	20%	3%
16	15%	59%	12%	14%

### Open-Ended Item

Sampler Sequence	Score Point 4	Score Point 3	Score Point 2	Score Point 1	Score Point 0
17	31%	20%	20%	16%	13%



**Mathematics**  
**Grade 8**  
**Item and Scoring Sampler Supplement**

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