Overview of Item Samplers

Item samplers are one type of student resource provided to help students and educators prepare for test administration. While standardized tests are familiar to almost all students, each assessment has its own layout and ways students interact with it. The item samplers should be used to familiarize students and educators with how the content is assessed by providing examples of the format and item types students could encounter on the MCA.

Other Resources

While this Teacher Guide provides detailed information about the item samplers, the student tutorial is the resource that should be used to familiarize students and educators with the general functionality of the online test, including navigation, tools, and examples of all item types.

For further information about the student tutorial and using student resources, refer to the Purposes of Student Resources on the Item Samplers page of PearsonAccess Next (PearsonAccess Next > Preparing for Testing > Item Samplers). Please contact mde.testing@state.mn.us for any questions about the MCA or resources for testing.

Contents of this Teacher Guide

The Teacher Guides provide supplementary information for the items in the online item samplers, including:

- An answer key for the online item samplers*
- Item images
- Images of correct answers for technology-enhanced items or items highlighting special functionality
- Rationales for correct and incorrect answer options
- Alignment to the benchmarks from the test specifications
- Cognitive complexity (indicated as Depth of Knowledge or DOK) from the test specifications
- Calculator designation (CL = calculator allowed; NC = no calculator)
- Notes on grade expectations and/or item type information included for some items

For detailed information on benchmarks and cognitive complexity levels, see the test specifications on the MDE website (Districts, Schools and Educators > Statewide Testing > Test Specifications).

*The answer key for paper item samplers (12-point, 18-point, 24-point, and braille test books) is included on the last page of this Teacher Guide. Some items on the paper item samplers appear in the online item sampler and the answer key includes information on where corresponding item information can be found in this guide.

Student Responses

Upon completion of the online item samplers, a report is displayed, which provides student responses for some item types. This report can be printed for use in conjunction with the information in this Teacher’s Guide on how the student responded to those items. The overall score on the report is not a predictor of performance on the MCA; it is simply a total of correct responses. Note: student responses for multiple-choice and multiple-response items will display the student’s response followed by an underscore and additional text (e.g., A_A). Please ignore the information after the underscore.
# Grade 8 Mathematics MCA Item Sampler
## Online Answer Key

### Section 1
9 Questions

<table>
<thead>
<tr>
<th>Item #</th>
<th>Correct Answer</th>
<th>Item Type</th>
<th>Benchmark</th>
<th>Calculator</th>
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</thead>
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<tr>
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<td>MC</td>
<td>8.2.1.4</td>
<td>CL</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>MC</td>
<td>8.2.2.2</td>
<td>CL</td>
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<tr>
<td>3</td>
<td>D</td>
<td>MC</td>
<td>8.2.2.3</td>
<td>CL</td>
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<tr>
<td>4</td>
<td>C</td>
<td>MC</td>
<td>8.2.2.5</td>
<td>CL</td>
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<td>5</td>
<td>C</td>
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<td>CL</td>
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### Section 2
10 Questions

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<td>C</td>
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<td>4</td>
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### Section 3
12 Questions

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</tr>
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<td>MC</td>
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</tr>
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<td>12</td>
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<td>CL</td>
</tr>
<tr>
<td>13</td>
<td>B</td>
<td>MC*</td>
<td>8.4.1.2</td>
<td>CL</td>
</tr>
</tbody>
</table>

*This item demonstrates the straight edge tool that will be available for select items on the MCA in grades 8 and 11.*
Section 1

Question 1

Benchmark: 8.2.1.4
Understand that an arithmetic sequence is a linear function that can be expressed in the form \( f(x) = mx + b \), where \( x = 0, 1, 2, 3, ... \)

*For example:* The arithmetic sequence 3, 7, 11, 15, ..., can be expressed as \( f(x) = 4x + 3 \).

**Item Specifications**
- Vocabulary allowed in items: \( n \)th term, arithmetic sequence, geometric sequence, linear function, non-linear function, progression, common difference, and vocabulary given at previous grades
- Allowable notation: items must specify the domain as \( x = 0, 1, 2, 3, ... \) or \( x = 1, 2, 3, 4, ... \)

DOK: 2
Calculator: CL
Answer: C

<table>
<thead>
<tr>
<th>A</th>
<th>Mixed up arithmetic with geometric. To find the next term in the sequence, multiply by 2.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Arithmetic sequences have the same difference between each consecutive term. This is a growing pattern; the differences are 1, 2, 3, 4, ...</td>
</tr>
<tr>
<td>C</td>
<td>Correct. To find the next term in the sequence, add −13.</td>
</tr>
<tr>
<td>D</td>
<td>This is a two-rule pattern. The odd-numbered terms use the rule: add −10; the even-numbered terms use the rule: add 10.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should be able to determine whether a sequence is arithmetic, geometric, or other by looking at consecutive terms or by finding differences. Student should be able to generate terms of a sequence using the given the domain.
Question 2

Benchmark: 8.2.2.2
Identify graphical properties of linear functions including slopes and intercepts. Know that the slope equals the rate of change, and that the $y$-intercept is zero when the function represents a proportional relationship.

Item Specifications
• Coordinates used for determining slope must contain integer values
• Vocabulary allowed in items: linear function, intercept, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>The weight of each marble is the slope, not the $y$-intercept.</td>
</tr>
<tr>
<td>B</td>
<td>Correct. The $y$-intercept represents the weight of the jar with 0 marbles in it.</td>
</tr>
<tr>
<td>C</td>
<td>The $x$-intercept—not the $y$-intercept—is where the weight equals 0. In this situation, when the $x$-intercept is 0, the $y$-value is negative. A negative number of marbles is not possible.</td>
</tr>
<tr>
<td>D</td>
<td>Mixed up $x$- and $y$-axes. The $y$-intercept represents the weight of the jar with 0 marbles in it, not with 10 marbles in it.</td>
</tr>
</tbody>
</table>
Notes on grade expectations: Student should be able to interpret the meaning of points, slope and y-intercept for linear functions in terms of the context.
Question 3

An equation is shown.

\[ m = 4p + 3 \]

When \( p \) is increased by 2, how much does \( m \) increase?

- A. 2
- B. 4
- C. 7
- D. 8

Benchmark: 8.2.2.3
Identify how coefficient changes in the equation \( f(x) = mx + b \) affect the graphs of linear functions. Know how to use graphing technology to examine these effects.

Item Specifications
- Vocabulary allowed in items: linear function, intercept, coefficient, constant, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: D

A Did not multiply the change by 4.
B Used coefficient of 4 from equation.
C Added 4 + 3 from equation.
D Correct. Since \( p \) is multiplied by 4, when \( p \) increases by 2, \( m \) would increase by \( 2 \times 4 = 8 \).

Notes on grade expectations: Student should be able to describe the effect on the dependent variable given a change to the independent variable.
Question 4

A sequence is shown.  

1.5 4.5 13.5 40.5 ....

What is the seventh term in the sequence?

- A. 121.5
- B. 364.5
- C. 1,063.5
- D. 3,280.5

**Benchmark: 8.2.2.5**
Represent geometric sequences using equations, tables, graphs and verbal descriptions, and use them to solve problems. 
*For example:* If a girl invests $100 at 10% annual interest, she will have $100(1.1)^x$ dollars after $x$ years.

**Item Specifications**
- Vocabulary allowed in items: $n^{th}$ term, arithmetic sequence, geometric sequence, linear function, non-linear function, progression, and vocabulary given at previous grades
- DOK: 2
- Calculator: CL
- Answer: C

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Found the next term ($5^{th}$) instead of the $7^{th}$.</td>
</tr>
<tr>
<td>B</td>
<td>Found the $6^{th}$ term instead of the $7^{th}$.</td>
</tr>
<tr>
<td>C</td>
<td>Correct. Since the rule is $\times 3$, multiply 40.5 by 3 three times; $40.5(3)^3$.</td>
</tr>
<tr>
<td>D</td>
<td>Found the $8^{th}$ term instead of the $7^{th}$.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Given consecutive terms of a geometric sequence, student should be able to determine the rule and generate additional terms. Find the common ratio by dividing each term by the previous term.
Question 5

Benchmark: 8.2.3.2
Justify steps in generating equivalent expressions by identifying the properties used, including the properties of algebra. Properties include the associative, commutative and distributive laws, and the order of operations, including grouping symbols.

Item Specifications
• Items must not have context
• Vocabulary allowed in items: associative, commutative, distributive, identity, property, order of operations, and vocabulary given at previous grades

DOK: 1
Calculator: CL
Answer: C

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Chose incorrect property.</td>
</tr>
<tr>
<td>B</td>
<td>Chose incorrect property.</td>
</tr>
<tr>
<td>C</td>
<td>Correct. The Distributive Property is shown.</td>
</tr>
<tr>
<td>D</td>
<td>Chose incorrect property.</td>
</tr>
</tbody>
</table>
Question 6

Which is the equation of the same line as $y = 3x - 8$?

- A. $3x - 2y = 8$
- B. $-3x - 2y = -8$
- C. $6x - y = 16$
- D. $6x - 2y = 16$

Benchmark: 8.2.4.3
Express linear equations in slope-intercept, point-slope and standard forms, and convert between these forms. Given sufficient information, find an equation of a line.

For example: Determine an equation of the line through the points $(-1,6)$ and $\left(\frac{2}{3}, -\frac{3}{4}\right)$.

**Item Specifications**
- Items must not have context
- Vocabulary allowed in items: slope-intercept form, point-slope form, standard form, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: D

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Multiplied $y$ by 2 without multiplying any other terms by 2.</td>
</tr>
<tr>
<td>B</td>
<td>Multiplied $y$ by $-2$ without multiplying any other terms by $-2$.</td>
</tr>
<tr>
<td>C</td>
<td>Did not multiply $y$ by 2.</td>
</tr>
<tr>
<td>D</td>
<td>Correct.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should be able to compare equations in different forms to determine equivalence.
Question 7

Benchmark: 8.2.4.6
Represent relationships in various contexts with equations and inequalities involving the absolute value of a linear expression. Solve such equations and inequalities and graph the solutions on a number line.
For example: A cylindrical machine part is manufactured with a radius of 2.1 cm, with a tolerance of $\frac{1}{100}$ cm. The radius $r$ satisfies the inequality
$|r - 2.1| \leq 0.01$.

Item Specifications
• Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must type the correct answer in the box in order to receive 1 point.

Notes on grade expectations: Solve $2x - 4 = 6$ to get $x = 5$. Solve $2x - 4 = -6$ to get $x = -1$.

Note: The allowable characters that can be entered in the answer box are digits 0-9, fraction bar (/), decimal point (.), and negative sign (-). Students cannot enter a comma in numbers with more than 3 digits. Familiarity with calculators will help the students with this concept.
Question 8

Benchmark: 8.2.4.7
Represent relationships in various contexts using systems of linear equations. Solve systems of linear equations in two variables symbolically, graphically and numerically. For example: Marty’s cell phone company charges $15 per month plus $0.04 per minute for each call. Jeannine’s company charges $0.25 per minute. Use a system of equations to determine the advantages of each plan based on the number of minutes used.

Item Specifications
• Vocabulary allowed in items: system of equations, undefined, infinite, intersecting, identical, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B

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<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Top equation has $x$ and $y$ mixed up.</td>
</tr>
<tr>
<td>B</td>
<td>Correct.</td>
</tr>
<tr>
<td>C</td>
<td>Top equation has $x$ and $y$ mixed up. Bottom equation should be $x + y = 40$.</td>
</tr>
<tr>
<td>D</td>
<td>Bottom equation should be $x + y = 40$.</td>
</tr>
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</table>
Question 9

What is the distance between (4, 7) and (−3, 9) on a coordinate grid?

- A. \( \sqrt{5} \)
- B. \( \sqrt{45} \)
- C. \( \sqrt{53} \)
- D. \( \sqrt{305} \)

Benchmark: 8.3.1.2
Determine the distance between two points on a horizontal or vertical line in a coordinate system. Use the Pythagorean Theorem to find the distance between any two points in a coordinate system.

Item Specifications
- Graphs are not provided when finding horizontal or vertical distance
- Vocabulary allowed in items: Pythagorean Theorem and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: C

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<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Found square root of ([ (7 - 9) + (4 - -3) ] = \sqrt{5} ) but did not square the parentheses.</td>
</tr>
<tr>
<td>B</td>
<td>Subtracted the squares instead of adding; square root of ([(-3 - 4)^2 - (9 - 7)^2] = \sqrt{45} )</td>
</tr>
<tr>
<td>C</td>
<td>Correct. Square root of ([(-3 - 4)^2 + (9 - 7)^2] = \sqrt{53} )</td>
</tr>
<tr>
<td>D</td>
<td>Added ( y_1 ) and ( y_2 ) instead of subtracting; square root of ([(-3 - 4)^2 + (9 + 7)^2] = \sqrt{305} ).</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should be able to find the distance between two points on a coordinate plane using the distance formula, \( d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \), or the Pythagorean Theorem. Both formulas are on the grade 8 formula sheet.
Section 2

Question 1

Which expression results in a rational number?

- A. $1.5 + \sqrt{1.5}$
- B. $12 - \sqrt{12}$
- C. $\frac{3}{4} \cdot \sqrt{\frac{3}{4}}$
- D. $25 \div \sqrt{25}$

Benchmark: 8.1.1.1
Classify real numbers as rational or irrational. Know that when a square root of a positive integer is not an integer, then it is irrational. Know that the sum of a rational number and an irrational number is irrational, and the product of a non-zero rational number and an irrational number is irrational.
For example: Classify the following numbers as whole numbers, integers, rational numbers, irrational numbers, recognizing that some numbers belong in more than one category: $\frac{6}{3}$, $\pi$, $\sqrt{2}$, $\sqrt{4}$, $\sqrt{10}$, $-6.7$.

Item Specifications
- Allowable notation: $\sqrt{18}$
- Vocabulary allowed in items: irrational, real, square root, radical, and vocabulary given at previous grades

DOK: 1
Calculator: NC
Answer: D

<table>
<thead>
<tr>
<th>Answer</th>
<th>Correct. The square root of 25 simplifies to 5; $25/5 = 5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The number is not rational because the square root of 1.5 is an irrational number and the sum of a rational number and an irrational number is an irrational number.</td>
</tr>
<tr>
<td>B</td>
<td>The number is not rational because the square root of 12 is an irrational number and the difference of a rational number and an irrational number is an irrational number.</td>
</tr>
<tr>
<td>C</td>
<td>The number is not rational because the square root of $\frac{3}{4}$ is an irrational number and the product of a rational number and an irrational number is an irrational number.</td>
</tr>
</tbody>
</table>

A  The number is not rational because the square root of 1.5 is an irrational number and the sum of a rational number and an irrational number is an irrational number.
Question 2

Benchmark: 8.1.1.2
Compare real numbers; locate real numbers on a number line. Identify the square root of a positive integer as an integer, or if it is not an integer, locate it as a real number between two consecutive positive integers.

For example: Put the following numbers in order from smallest to largest:
2, $\sqrt{3}$, $-4$, $-6.8$, $-\sqrt{37}$.

Another example: $\sqrt{68}$ is an irrational number between 8 and 9.

Item Specifications
• Allowable notation:
• Vocabulary allowed in items: square root, radical, consecutive, and vocabulary given at previous grades

DOK: 1
Calculator: NC
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must select both points on the number line in order to receive 1 point.

Notes on grade expectations: Student can use knowledge of perfect squares to estimate the value of $\sqrt{3}$. Knowing that $\sqrt{3}$ falls between $\sqrt{1}$ and $\sqrt{4}$, and that 1 and 4 are perfect squares, then $\sqrt{1} = 1$ and $\sqrt{4} = 2$, so the value of $\sqrt{3}$ must be between 1 and 2.
Question 3

Simplify.

\[(4x)^2 - 4x^3\]

A. \(x^{-1}\)
B. \(12x^{-1}\)
C. \(16x^2 - 4x^3\)
D. \(16x^2 - 64x^3\)

Benchmark: 8.1.1.4
Know and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions.

For example: \(3^2 \times 3^{-5} = 3^{(-1)} = \left(\frac{1}{3}\right)^3 = \frac{1}{27}\).

Item Specifications
• Allowable notation: \(-x^2, (-x)^2, -3^2, (-3)^2\)
• Expressions may be numeric or algebraic
• Vocabulary allowed in items: vocabulary given at previous grades

DOK: 1
Calculator: NC
Answer: C

<table>
<thead>
<tr>
<th>Option</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Did not square the 4 in parentheses and used division instead of subtraction; (\frac{4x^2}{4x^3}).</td>
</tr>
<tr>
<td>B</td>
<td>Subtracted unlike terms to get (16 - 4 = 12). Divided (x^2) by (x^3) instead of subtracting.</td>
</tr>
<tr>
<td>C</td>
<td>Correct.</td>
</tr>
<tr>
<td>D</td>
<td>Cubed the 4 that is not in parentheses; Found ((4x)^2 - (4x)^2) instead of ((4x)^2 - 4x^2).</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know how to combine like terms and how to use the order of operations from grade 7.
Question 4

Benchmark: 8.1.1.5
Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are involved. For example: \((4.2 \times 10^4) \times (8.25 \times 10^3) = 3.465 \times 10^8\), but if these numbers represent physical measurements, the answer should be expressed as \(3.5 \times 10^8\) because the first factor, \(4.2 \times 10^4\), only has two significant digits.

Item Specifications
- Vocabulary allowed in items: scientific notation, significant digits, standard form, and vocabulary given at previous grades

DOK: 2
Calculator: NC
Answer: D

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Found exponent using (-6 + 4) instead of (-6 - 4). Did not adjust exponent of 10 after rewriting 0.25 as 2.5.</td>
</tr>
<tr>
<td>B</td>
<td>Found (0.25 \times 10^{-10}), but did not rewrite as (2.5 \times 10^{-11}). Added 1 to exponent of (-10) instead of subtracting 1.</td>
</tr>
<tr>
<td>C</td>
<td>Found (0.25 \times 10^{-10}), but did not rewrite as (2.5 \times 10^{-11}).</td>
</tr>
<tr>
<td>D</td>
<td>Correct.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know that in scientific notation, \(a \times 10^b\), the absolute value of \(a\) must be greater than or equal to 1 and less than 10.
Question 5

Which table of values does not represent a function?

A. \[
\begin{array}{c|c}
  x & y \\
  \hline
  -1 & 0 \\
  0 & 0 \\
  1 & 2 \\
\end{array}
\]

B. \[
\begin{array}{c|c}
  x & y \\
  \hline
  -1 & -2 \\
  0 & 0 \\
  1 & 2 \\
\end{array}
\]

C. \[
\begin{array}{c|c}
  x & y \\
  \hline
  -1 & -2 \\
  0 & 0 \\
  0 & 2 \\
\end{array}
\]

D. \[
\begin{array}{c|c}
  x & y \\
  \hline
  -1 & -1 \\
  0 & 0 \\
  1 & 1 \\
\end{array}
\]

Benchmark: 8.2.1.1
Understand that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable. Use functional notation, such as \( f(x) \), to represent such relationships.

For example: The relationship between the area of a square and the side length can be expressed as \( f(x) = x^2 \). In this case, \( f(5) = 25 \), which represents the fact that a square of side length 5 units has area 25 units squared.

Item Specifications
- Vocabulary allowed in items: independent, dependent, constant, coefficient, and vocabulary given at previous grades

DOK: 1
Calculator: NC
Answer: C

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>For each x-value, there is only 1 y-value.</td>
</tr>
<tr>
<td>B</td>
<td>For each x-value, there is only 1 y-value.</td>
</tr>
<tr>
<td>C</td>
<td>Correct. For the x-value of 0, there is more than 1 y-value.</td>
</tr>
<tr>
<td>D</td>
<td>For each x-value, there is only 1 y-value.</td>
</tr>
</tbody>
</table>
Notes on grade expectations: Student should know that in a function, there is exactly 1
y-value for every x-value. Student should know that the vertical line test may be used to
determine if a graph is a function.
Question 6

The number of cakes needed for a party, c, is dependent upon the number of guests at the party, g. Which equation shows the number of cakes as a function of the number of guests?

- A. \( f(c) = \frac{g}{12} \)
- B. \( f(g) = \frac{g}{12} \)
- C. \( f(c) = \frac{c}{12} \)
- D. \( f(g) = \frac{c}{12} \)

**Benchmark: 8.2.1.2**

Use linear functions to represent relationships in which changing the input variable by some amount leads to a change in the output variable that is a constant times that amount.

*For example:* Uncle Jim gave Emily $50 on the day she was born and $25 on each birthday after that. The function \( f(x) = 50 + 25x \) represents the amount of money Jim has given after \( x \) years. The rate of change is $25 per year.

**Item Specifications**

- Vocabulary allowed in items: independent, dependent, constant, coefficient, and vocabulary given at previous grades
- DOK: 1
- Calculator: NC
- Answer: B

<table>
<thead>
<tr>
<th>Option</th>
<th>Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Used ( f(c) ) instead of ( f(g) ). A function of ( g ) uses ( f(g) ).</td>
</tr>
<tr>
<td>B</td>
<td>Correct.</td>
</tr>
<tr>
<td>C</td>
<td>Used ( c ) instead of ( g ) as the independent variable, and ( f(c) ) instead of ( f(g) ) as the dependent variable.</td>
</tr>
<tr>
<td>D</td>
<td>Used ( c ) instead of ( g ) as the independent variable.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know that in a function, the dependent variable is determined by the independent variable. Using function notation, if the independent variable is \( t \), then the dependent variable is \( f(t) \).
Question 7

Benchmark: 8.2.2.1
Represent linear functions with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another.

Item Specifications

- Vocabulary allowed in items: linear function, and vocabulary given at previous grades

DOK: 2
Calculator: NC
Answer: C

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<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Used (2, 10) and interpreted y-axis as rate instead of cost.</td>
</tr>
<tr>
<td>B</td>
<td>Interpreted axes correctly, but used the point (8, 60) instead of (8, 40).</td>
</tr>
<tr>
<td>C</td>
<td>Correct. The graph has a slope of 5. ((30 - 0)/(6 - 0) = 30/6 = 5)</td>
</tr>
<tr>
<td>D</td>
<td>Thought 40 was the y-intercept.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should be able to interpret the meaning of points, slope, and y-intercept in linear function in terms of the context.
Question 8

What integer value of \( x \) makes \( \sqrt{85} < x < \sqrt{120} \) true?

Enter your answer in the box.

Benchmark: 8.1.1.3

Determine rational approximations for solutions to problems involving real numbers.

*For example:* A calculator can be used to determine that \( \sqrt{7} \) is approximately 2.65.

*Another example:* To check that \( \frac{5}{12} \) is slightly bigger than \( \sqrt{2} \), do the calculation

\[
\left( \frac{5}{12} \right)^2 = \left( \frac{17}{12} \right) \times \left( \frac{17}{12} \right) = \frac{289}{144} = 2 \frac{1}{144}.
\]

*Another example:* Knowing that \( \sqrt{10} \) is between 3 and 4, try squaring numbers like 3.5, 3.3, 3.1 to determine that 3.1 is a reasonable rational approximation of \( \sqrt{10} \).

Item Specifications

- Allowable notation: \( \sqrt{18} \)
- Vocabulary allowed in items: square root, radical, consecutive, and vocabulary given at previous grades

DOK: 2

Calculator: NC

Answer:

This is a technology-enhanced item. The correct answer is shown. A student must type the correct answer in the box to receive 1 point.

What integer value of \( x \) makes \( \sqrt{85} < x < \sqrt{120} \) true?

Enter your answer in the box.

10

Notes on grade expectations: Student can use knowledge of perfect squares. Since \( \sqrt{81} = 9 \) and \( \sqrt{121} = 11 \), 10 is the only integer between 9 and 11.

Note: The allowable characters that can be entered in the answer box are digits 0-9, fraction bar (/), decimal point (.), and negative sign (-). Students cannot enter a comma in numbers with more than 3 digits. Familiarity with calculators will help the students with this concept.
Question 9

Benchmark: 8.3.2.1
Understand and apply the relationships between the slopes of parallel lines and between the slopes of perpendicular lines. Dynamic graphing software may be used to examine these relationships.

Item Specifications
• Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: NC
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must select both of the correct equations in order to receive 1 point.

Notes on grade expectations: Student should know that perpendicular lines have opposite reciprocal slopes. In this situation, since the slope of the given line is $\frac{1}{2}$, select equations with slope of $-2$. 
Question 10

A rectangle is drawn on a coordinate grid. The equation for 1 side of the rectangle is $3x - 2y = 12$. Which could be an equation for another side of the rectangle?

- A. $y = \frac{3}{2}x + 5$
- B. $y = 3x + 12$
- C. $y = -\frac{3}{2}x - 12$
- D. $y = 2x - 5$

**Benchmark: 8.3.2.2**
Analyze polygons on a coordinate system by determining the slopes of their sides. For example: Given the coordinates of four points, determine whether the corresponding quadrilateral is a parallelogram.

**Item Specifications**
- Vocabulary allowed in items: vocabulary given at previous grades
- DOK: 3
- Calculator: NC
- Answer: A

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<table>
<thead>
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<tbody>
<tr>
<td>A</td>
<td>Correct. The slope of the given line is $\frac{3}{2}$, so the other sides must have the same slope (parallel sides) or the opposite reciprocal slope, $-\frac{2}{3}$ (perpendicular sides).</td>
</tr>
<tr>
<td>B</td>
<td>Has slope of 3 instead of $\frac{3}{2}$ or $-\frac{2}{3}$.</td>
</tr>
<tr>
<td>C</td>
<td>Has slope of $-\frac{3}{2}$ instead of $\frac{2}{3}$ or $-\frac{2}{3}$.</td>
</tr>
<tr>
<td>D</td>
<td>Has slope of 2 instead of $\frac{2}{3}$ or $-\frac{2}{3}$.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know definitions of polygons from previous grades. Rectangles have 2 sets of parallel sides. Since rectangles have 4 right angles, the sets of sides are perpendicular to each other. Student should know that parallel lines have equivalent slopes and perpendicular lines have opposite reciprocal slopes.

This item is DOK 3 because several decisions are required before proceeding. Students must understand the relationships between the slopes of the sides of a rectangle. Students must be able to determine the slope of the line represented by the given equation; this most likely requires changing the equation into slope-intercept form ($y = mx + b$). Then students will determine what the slopes of the parallel and perpendicular lines could be and find an equation containing those.
Section 3

Question 1

Benchmark: 8.2.1.3
Understand that a function is linear if it can be expressed in the form $f(x) = mx + b$ or if its graph is a straight line.
For example: The function $f(x) = x^2$ is not a linear function because its graph contains the points $(1, 1), (-1, 1)$ and $(0, 0)$, which are not on a straight line.

Item Specifications
• Vocabulary allowed in items: linear, constant, coefficient, and vocabulary given at previous grades

DOK: 1
Calculator: CL
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must place each relationship into the correct box in order to receive 1 point.
Notes on grade expectations:
A relationship is linear if:
- the equation can be expressed in the form: \( f(x) = mx + b \), or
- the graph is a straight line, or
- the greatest exponent of the independent variable in the equation is 1

A relationship is nonlinear if:
- the equation can be expressed in a form other than \( f(x) = mx + b \), or
- the graph is not a straight line, or
- the greatest exponent of the independent variable in the equation is greater than 1
Question 2

Which function forms a geometric sequence when \( x = 1, 2, 3, \ldots \)?

- A. \( f(x) = x + 2 \)
- B. \( f(x) = x^2 \)
- C. \( f(x) = x^2 + 2 \)
- D. \( f(x) = 2^x \)

Benchmark: 8.2.1.5
Understand that a geometric sequence is a non-linear function that can be expressed in the form \( f(x) = ab^x \), where \( x = 0, 1, 2, 3, \ldots \).

For example: The geometric sequence 6, 12, 24, 48, \ldots, can be expressed in the form \( f(x) = 6(2^x) \).

Item Specifications
- Vocabulary allowed in items: \( n \)th term, arithmetic sequence, geometric sequence, linear function, non-linear function, exponential, progression, common ratio, and vocabulary given at previous grades
- Allowable notation: items must specify the domain as \( x = 0, 1, 2, 3, \ldots \) or \( x = 1, 2, 3, 4, \ldots \)

DOK: 2
Calculator: CL
Answer: D

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<tbody>
<tr>
<td>A</td>
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<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

A. Equation is not in the form \( f(x) = ab^x \). The terms 3, 4, 5, \ldots have a common difference (arithmetic sequence), not a common ratio.

B. Confused \( x^2 \) with \( 2^x \). There is no common ratio between the terms 1, 4, 9, \ldots.

C. Confused \( x^2 \) with \( 2^x \). There is no common ratio between the terms 3, 6, 11, \ldots.

D. Correct. Equation is in the form \( f(x) = ab^x \). The terms in the sequence, 2, 4, 8, 16, 32, 64 \ldots can be generated using a common ratio of 2 (i.e., \( 2 \times 2 = 4, 4 \times 2 = 8, 8 \times 2 = 16, \) etc.).

Notes on grade expectations: Student should be able to determine whether a sequence is arithmetic, geometric, or other by looking at the equation or consecutive terms in the sequence. A geometric sequence has a common ratio between consecutive terms.
Question 3

A sequence is shown.

\[ \begin{array}{cccc}
-1 & -7 & -13 & -19 & -25 \\
\end{array} \]

What is the function rule for the sequence?

- A. \( f(x) = x - 6 \)
- B. \( f(x) = -6x \)
- C. \( f(x) = 5x - 6 \)
- D. \( f(x) = -6x + 5 \)

**Benchmark: 8.2.2.4**

Represent arithmetic sequences using equations, tables, graphs and verbal descriptions, and use them to solve problems.

*For example:* If a girl starts with \$100\ in savings and adds \$10\ at the end of each month, she will have \(100 + 10x\) dollars after \(x\) months.

**Item Specifications**

- Vocabulary allowed in items: \(n\)th term, arithmetic sequence, geometric sequence, linear function, non-linear function, progression, and vocabulary given at previous grades

**DOK:** 2

**Calculator:** CL

**Answer:** D

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Found constant difference of (-6), then attempted to write as a recursive formula.</td>
</tr>
<tr>
<td>B</td>
<td>Ignored initial term in sequence; only used change (slope).</td>
</tr>
<tr>
<td>C</td>
<td>Mixed up slope and (y)-intercept.</td>
</tr>
<tr>
<td>D</td>
<td>Correct. Constant difference of (-6) equals slope; use (y = mx + b) or find 0th term to find (y)-intercept of 5.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should be able to determine whether a sequence is arithmetic, geometric, or other by looking at consecutive terms or by finding differences. Student should be able to write a function rule for the sequence.
Question 4

What is the value of \(-3|2x - y|\) when \(x = -4\) and \(y = 5\)?

- A. -27
- B. -9
- C. 9
- D. 27

Benchmark: 8.2.3.1
Evaluate algebraic expressions, including expressions containing radicals and absolute values, at specified values of their variables.

For example: Evaluate \(\pi r^2 h\) when \(r = 3\) and \(h = 0.5\), and then use an approximation of \(\pi\) to obtain an approximate answer.

Item Specifications
- Items must not have context
- Directives may include: simplify, evaluate
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>May have ignored (-2) and calculated (-3</td>
</tr>
<tr>
<td>B</td>
<td>Correct. (-3</td>
</tr>
<tr>
<td>C</td>
<td>Mixed up ++/− sign.</td>
</tr>
<tr>
<td>D</td>
<td>May have ignored (-2) and absolute value signs calculating (-3(-4 - 5)).</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know the order of operations from previous grades.
Question 5

Leon plants 3 rows of tomatoes with $n$ plants in each row. He also plants 1 row of beans with 5 plants in the row. Which equation can be used to find $t$, the total number of plants Leon planted?

- A. $t = n + 8$
- B. $t = 3n + 1$
- C. $t = 3n + 5$
- D. $t = 5n + 3$

Benchmark: 8.2.4.1
Use linear equations to represent situations involving a constant rate of change, including proportional and non-proportional relationships.

For example: For a cylinder with fixed radius of length 5, the surface area $A = 2\pi(5)h + 2\pi(5)^2 = 10\pi h + 50\pi$, is a linear function of the height $h$, but the surface area is not proportional to the height.

Item Specifications
- Vocabulary allowed in items: vocabulary given at previous grades
- DOK: 2
- Calculator: CL
- Answer: C

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<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Combined $3n + 5$ as $3 + n + 5 = n + 8$.</td>
</tr>
<tr>
<td>B</td>
<td>For beans, used 1 row instead of 1 row $\times$ 5 plants.</td>
</tr>
<tr>
<td>C</td>
<td>Correct.</td>
</tr>
<tr>
<td>D</td>
<td>Thought there were 5 rows of $n$ tomatoes and 1 row of beans with 3 plants in each row.</td>
</tr>
</tbody>
</table>
Question 6

![Image of a question asking for the value of p when \(2p + 10 = 24\).

Benchmark: 8.2.4.2
Solve multi-step equations in one variable. Solve for one variable in a multi-variable equation in terms of the other variables. Justify the steps by identifying the properties of equalities used.

For example: The equation \(10x + 17 = 3x\) can be changed to \(7x + 17 = 0\), and then to \(7x = -17\) by adding/subtracting the same quantities to both sides. These changes do not change the solution of the equation.

Another example: Using the formula for the perimeter of a rectangle, solve for the base in terms of the height and perimeter.

Item Specifications
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: A

<table>
<thead>
<tr>
<th>Option</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Correct. (2p + 10 = 24; 2p = 14; p = 7)</td>
</tr>
<tr>
<td>B</td>
<td>Subtracted 2 from both sides instead of dividing by 2; treated (2p) as (2 + p).</td>
</tr>
<tr>
<td>C</td>
<td>Added 10 to both sides instead of subtracting.</td>
</tr>
<tr>
<td>D</td>
<td>Multiplied both sides by 2 instead of dividing by 2.</td>
</tr>
</tbody>
</table>
Question 7

Benchmark: 8.2.4.5
Solve linear inequalities using properties of inequalities. Graph the solutions on a number line.

For example: The inequality $-3x < 6$ is equivalent to $x > -2$, which can be represented on the number line by shading in the interval to the right of $-2$.

Item Specifications
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Reversed inequality symbols.</td>
</tr>
<tr>
<td>B</td>
<td>Correct. Equivalent to $-4 &lt; x &lt; -2$ (multiplied by $-2$).</td>
</tr>
<tr>
<td>C</td>
<td>Did not reverse inequality symbols when multiplying by negative number.</td>
</tr>
<tr>
<td>D</td>
<td>Reversed inequality symbols.</td>
</tr>
</tbody>
</table>
Question 8

Benchmark: 8.3.1.1
Use the Pythagorean Theorem to solve problems involving right triangles.
For example: Determine the perimeter of a right triangle, given the lengths of two of its sides.
Another example: Show that a triangle with side lengths 4, 5 and 6 is not a right triangle.

Item Specifications
• Congruent angle marks may be used
• Vocabulary allowed in items: Pythagorean Theorem and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must type the correct answer in the box in order to receive 1 point.
Notes on grade expectations: Student finds the hypotenuse using the Pythagorean Theorem: \( \sqrt{6^2 + 5^2} = \sqrt{36 + 25} = \sqrt{61} \approx 7.8102 \)

Note: The allowable characters that can be entered in the answer box are digits 0-9, fraction bar (/), decimal point (.), and negative sign (-). Students cannot enter a comma in numbers with more than 3 digits. Familiarity with calculators will help the students with this concept.
Question 9

Benchmark: 8.3.2.3
Given a line on a coordinate system and the coordinates of a point not on the line, find lines through that point that are parallel and perpendicular to the given line, symbolically and graphically.

*Item Specifications*
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Slope is correct, but this line does not go through the point ((3, -1)).</td>
</tr>
<tr>
<td>B</td>
<td>Correct. Found opposite reciprocal of slope, (-\frac{3}{2}), then used (y = mx + b) to find (y)-intercept.</td>
</tr>
<tr>
<td>C</td>
<td>Used reciprocal of slope, but did not use the opposite sign.</td>
</tr>
<tr>
<td>D</td>
<td>Used reciprocal of slope, but did not use the opposite sign.</td>
</tr>
</tbody>
</table>

Notes on grade expectations: Student should know from previous grades that perpendicular lines have opposite reciprocal slopes.
Question 10

Benchmark: 8.4.1.2
Use a line of best fit to make statements about approximate rate of change and to make predictions about values not in the original data set.
For example: Given a scatterplot relating student heights to shoe sizes, predict the shoe size of a 5'4" student, even if the data does not contain information for a student of that height.

Item Specifications
• Vocabulary allowed in items: scatterplot, line of best fit, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The scatterplot does not list all Ferris wheels; this statement cannot be confirmed.</td>
</tr>
<tr>
<td>B</td>
<td>Correct. Slope of line confirms $25 \text{ m}$ per 10 years or $2.5 \text{ m/yr}$.</td>
</tr>
<tr>
<td>C</td>
<td>Only some, not all, of the newer Ferris wheels were taller.</td>
</tr>
<tr>
<td>D</td>
<td>The number of data points per year does not perpetually increase.</td>
</tr>
</tbody>
</table>
Notes on grade expectations: Student should be able to interpret a scatterplot and the line of best fit in terms of the context.
Question 11

Ben’s school is having a carnival. It costs $3 to enter and $0.75 for each game ticket. Ben has $16. Show an inequality that represents the number of tickets, \( t \), Ben can buy.

Drag the numbers and symbol into the boxes.

[Image of inequality symbols and numbers]

Benchmark: 8.2.4.4
Use linear inequalities to represent relationships in various contexts.
For example: A gas station charges $0.10 less per gallon of gasoline if a customer also gets a car wash. Without the car wash, gas costs $2.79 per gallon. The car wash is $8.95. What are the possible amounts (in gallons) of gasoline that you can buy if you also get a car wash and can spend at most $35?

Item Specifications
• Inequalities contain no more than 1 variable
• Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must drag each number and the symbol into the correct boxes in order to receive 1 point.

[Image of inequality symbols and numbers]

Notes on grade level expectations: The entrance fee is a fixed cost and 0.75 represents the price per ticket, \( t \). The less than or equal to symbol (\( \leq \)) shows Ben spends no more than $16 on the entry fee and tickets for games.
Question 12

Benchmark: 8.2.4.5
Solve linear inequalities using properties of inequalities. Graph the solutions on a number line.

For example: The inequality $-3x < 6$ is equivalent to $x > -2$, which can be represented on the number line by shading in the interval to the right of $-2$.

Item Specifications
• Vocabulary allowed in items: vocabulary given at previous grades

DOK: 3
Calculator: CL
Answer:

This is a technology-enhanced item. The correct answer is shown. A student must correctly graph the entire solution set in order to receive 1 point.
Solve:

\[ |x| > 4 \]

Graph the solution on the number line.
Select the type of solution. Drag the endpoints to the correct position.
A class calculated the average temperature and the average amount of precipitation for each month in St. Paul.

Using the line of best fit, what would be the precipitation in St. Paul if the average temperature is 85 degrees?
(Sampler Hint: Use the straightedge tool)

- A. 4 inches
- B. 4.5 inches
- C. 5 inches
- D. 5.5 inches

**Benchmark: 8.4.1.2**

Use a line of best fit to make statements about approximate rate of change and to make predictions about values not in the original data set.

*For example:* Given a scatterplot relating student heights to shoe sizes, predict the shoe size of a 5'4" student, even if the data does not contain information for a student of that height.

**Item Specifications**
- Vocabulary allowed in items: scatterplot, line of best fit, and vocabulary given at previous grades

DOK: 2
Calculator: CL
Answer: B
<table>
<thead>
<tr>
<th>Option</th>
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<tbody>
<tr>
<td>A</td>
<td>Precipitation at 75 degrees.</td>
</tr>
<tr>
<td>B</td>
<td>Correct ((y = 0.055x - 0.13))</td>
</tr>
<tr>
<td>C</td>
<td>Drew the line of best fit using the points (20, 1.1), and (33, 1.9).</td>
</tr>
<tr>
<td>D</td>
<td>Drew the line of best fit using the points (20, 1.1), (33, 1.9) and (69, 4.7).</td>
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Note: This item demonstrates the straight edge tool that will be available for select items on the MCA in grades 8 and 11. Select the straight edge from the tools above the item. See image below.

![Graph showing the relationship between average temperature and precipitation in St. Paul.](image)

Using the line of best fit, what would be the precipitation in St. Paul if the average temperature is 85 degrees?
(Sampler Hint: Use the straightedge tool.)

- A. 4 inches
- B. 4.5 inches
- C. 5 inches
- D. 5.5 inches

Notes on grade expectations: Student should be able to interpret a scatterplot and the line of best fit in terms of the context.
### Segment 1
8 Questions

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### Segment 2
18 Questions

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