Appendix 15C: Grade 8 Mathematics Item Descriptions Developed During the TIMSS 2019 Benchmarking

Items at Low International Benchmark (400)	
Number	
M09_01	Recognizes a 7-digit number given in words

Items at Intermediate International Benchmark (475)	
Number	
M01_02A	Solves a word problem involving addition of time
M06_01	Solves a word problem involving subtraction of negative numbers
M07_03	Solves a two-step word problem involving whole numbers
M05_02	Solves a word problem involving subtraction of negative numbers
M04_03	Determines whether a series of decimals are greater than, less than, or equal to fractions (1 of 2 points)
M06_02	Identifies equivalent ratios
M10_05	Given a ratio, represents an equivalent ratio pictorially
Algebra	
M04_07A	Solves a word problem involving an inequality and explains answer
M08_08A	Extends a given geometric pattern to supply the value of the 7th term
Geometry	
M02_10	Determines the value of an angle in an irregular quadrilateral given the values of the other angles

M14_10	Identifies the reflections of irregular shapes
M11_11	Determines the total number of stacked unit cubes
Data and Probability	
M05_12	Finds and compares the unit prices of four objects
M05_14	Identifies the bar graph that matches the information shown in a table
M07_12A	Compares data from two line graphs to solve a problem
M07_12B	Reads data from a line graph
M09_12A	Calculates mean and median for one ordered lists of data (1 of 2 points)
M13_11	Evaluates information given by a time/distance graph
M01_12	Solves a problem given the chance of an outcome
M03_14A	Estimates an expected value given an observed sample

Items at High International Benchmark (550)	
Number	
M03_01	Identifies an expression equivalent to a given division expression
M05_01	Evaluates an expression involving negative whole numbers and parentheses
M05_05A	Solves a word problem involving multiplication and addition of whole numbers
M10_01	Adds two numbers with different exponents and bases
M11_02	Solves a word problem involving division of whole numbers with a remainder

M14_01	Identifies the number with the most factors
M01_03	Understands a property of adding multiples
M01_04	Writes a decimal with three places as a fraction
M03_03	Finds the missing value in an addition problem with both fractions and decimals
M04_03	Determines whether a series of decimals are greater than, less than, or equal to fractions (2 of 2 points)
M05_04	Given the two parts of a whole in a word problem, identifies the fraction which represents one part
M07_04	Determines what fraction of a 10X10 grid is shaded
M13_02	Solves a two-step word problem involving subtraction of whole numbers and multiplication of a fraction
M14_02	Determines the numerator that makes two fractions equivalent
M01_01	Identifies the representation of a fraction equivalent to a given representation of a fraction
M08_02	Adds two decimals represented in words
M11_01	Solves a word problem involving a fraction of a whole
M12_03	Identifies a decimal equivalent to the sum of two fractions with denominators that are powers of ten
M04_04	Solves a word problem involving a fraction of a whole
M02_04	Solves a word problem involving a three-part ratio
M03_04	Shades a percent of a figure
M10_04	Solves a word problem involving ratios
M13_04	Solves a word problem involving ratios and decimals
M14_04A	Determines a ratio to model a situation

M14_04B	Determines a ratio to model a situation
M07_01	In a word problem for dividing a given quantity in a given ratio, determines the quantity of one of the parts.
Algebra	
M01_06	Identifies the equivalent algebraic expression involving exponents and multiplication
M02_07	Solves a word problem involving evaluating a formula with exponents
M10_06	Evaluates an expression with two variables
M10_09	Solves a pair of simultaneous linear equations in two variables
M12_06	Evaluates a formula with an exponent
M12_08	Solves a word problem involving simultaneous linear equations in two variables
M14_05	Identifies an expression that represents a situation
M14_06	Solves a linear equation involving fractions
M14_07	Solves a word problem involving evaluating a formula with two variables
M05_07	Evaluates an algebraic expression involving fractions and integers
M08_05	Evaluates an expression with a square root and two variables with exponents
M08_07	Solves a multi-step word problem involving linear inequalities
M11_06	Identifies an equation that models a situation
M02_05	Evaluates an expression with two variables
M03_07	Identifies an algebraic expression that represents the perimeter of an irregular shape
M04_06	Evaluates an equation with three variables

M07_06	Evaluates the power of an expression given its value
M11_07	Identifies an expression for the area of part of a geometric figure
M13_05	Solves a linear equation in two-variables given the value of one variable
M01_07A	Extends a given geometric pattern to find the value of the 10th term
M03_08	Determines a missing coordinate for a linear relationship given in a table
M04_08A	Extends a given geometric pattern to supply the value of the 10th term
M11_08	Uses values for a linear function to determine an extrapolated value
M13_07	Identifies the true statement about a linear relationship given in a graph
Geometry	
M02_11	Compares properties of two open cylinders made by rolling the same rectangle in different directions
M02_12	Determines the coordinates of a trapezoid's missing vertex given a congruent trapezoid in the Cartesian plane
M03_10	Finds the coordinates of a midpoint given two points in the Cartesian plane
M03_12	Draws rectangle on square grid given area and perimeter (1 of 2 points)
M05_10	Identifies the value of an angle involving properties of corresponding and supplementary angles
M07_10	Solves a problem involving similar triangles
M08_09A	Determines the area of a parallelogram given its base and height
M08_09B	Uses the Pythagorean theorem to solve for a side length of a parallelogram and calculates the perimeter (1 of 2 points)
M08_10	Completes a parallelogram in the Cartesian plane given three of its vertices
M09_09	Recognizes congruent quadrilaterals

M13_08A	Solves a word problem involving the length around a hexagonal prism
M13_09	Determines the number of exposed faces for unit-cubes that make up a larger cube (1 of 2 points)
M01_11	Solves a problem involving angles of a triangle
M10_13	Identifies the net of a triangular prism
M11_09	Identifies the reflection of a partly shaded shape
M12_10	Solves a two-step word problem involving volume of a rectangular prism and cost
Data and Probability	
M02_13	Computes the mean of five positive and negative values
M02_14	Identifies an appropriate graph for three different types of data
M06_13A	Computes the mean of four given values
M08_11A	Determines the mean value of data represented by four bars in a bar graph
M10_14	Identifies relevant considerations for systematic data collection
M12_14A	Computes the mean of five six-digit numbers
M14_14	Estimates the value of a bar in a bar graph without a scale given the value of another bar
M01_13B	Uses and interprets data sets in pie charts to solve a problem involving percentages
M08_12	Estimates the probability of an event given an observed sample
M11_14	Draws a spinner that has given probabilities
M12_13	Estimates the probability of an event given an observed sample
M06_12	Estimates the number of objects in a given probability sample

Items at Advanced International Benchmark (625)	
Number	
M02_01	Recognizes true or false statements based on properties of operations
M03_02	Solves a two-step word problem involving whole numbers
M04_01	Identifies numbers that are perfect squares
M04_02	Analyzes truth of statements about the properties of a whole number
M05_05B	Solves a non-routine word problem involving whole numbers
M06_04	Uses four different digits to write two two-digit numbers with the smallest product
M08_01	Justifies that a given number satisfies a condition for its parity and factors
M12_01	Determines two integers that satisfy two conditions involving their sum and product
M07_02	Identifies a prime number
M13_01	Identifies an expression equivalent to a given multiplicative expression
M02_03	Solves a multi-step problem involving addition and subtraction of fractions
M08_03	Determines the missing value in a multiplication sentence involving fractions
M10_02	Determines the location of the product of two fractions on a number line
M12_02	Orders fractions and decimals
M12_04	Determines the denominator that makes the sum of a fraction and a whole number equivalent to a decimal
M14_03	Uses four different digits to write two fractions with the largest product

M02_02	Identifies the location of a fraction on a number line
M01_02B	Solves a word problem involving percentages and elapsed time
M05_03	Solves a two-step word problem involving percentages
M06_03	Determines the dimensions of a rectangle that is similar to a given rectangle
M08_04	Recognizes fractions and decimals equivalent to a given percentage
M09_02	Given the volume of a fraction of a container, determines the total volume for multiple containers of the same size
M09_03	Solves a word problem involving price per unit and explains reasoning
M11_03	Completes a table of equivalent proportions and percentages (2 of 2 points)
M11_03	Partially completes a table of equivalent proportions and percentages (1 of 2 points)
M11_04	Solves a word problem involving ratios
M12_05	Solves a word problem involving ratios
M13_03	Identifies a percentage using a given ratio
M07_05	Identifies a true statement about percentages of given numbers
Algebra	
M02_08	Constructs a linear equation for the perimeter of a triangle and solves for the length of one side
M05_06	Identifies an equivalent algebraic expression
M05_08	Uses a given formula involving fractions to solve a word problem
M06_08	Constructs a linear equation for the perimeter of a rectangle and finds the area (2 of 2 points)
M06_08	Constructs a linear equation for the perimeter of a rectangle and finds the area (1 of 2 points)

M08_06	Identifies an inequality that represents the relationship between the areas of two rectangles
M09_05	Simplifies an algebraic expression
M09_08	Constructs a linear equation for the perimeter of a triangle and solves for the length of one side
M10_07	Adds two expressions with two variables and simplifies the result
M12_07	Identifies a simplified expression equivalent to a given expression with parentheses
M14_08	Identifies a simplified expression equivalent to a given expression with fractions and two variables
M14_09	Identifies a pair of linear equations in two variables that represent a situation
M01_05	Identifies an algebraic expression that represents the area of a given rectangle
M02_06	Identifies an expression with parentheses equivalent to a given expression without parentheses
M04_07B	Identifies an inequality that represents a situation
M06_05	Identifies an expression that represents a situation
M10_08	Solves a word problem involving evaluating a formula with an exponent
M01_08	Identifies the graph of a linear equation
M04_08B	Constructs an expression for the nth term of a geometric pattern
M05_09	Demonstrates an understanding of slope by relating graphs and their equations
M06_06	Constructs a linear equation to represent a situation
M08_08B	Extends a given geometric pattern to supply the value of the 50th term
M09_06	Retrieves coordinate points from a graph of a function
M10_10	Constructs an equation to describe the relationship between two quantities

M12_09A	Extends a given geometric pattern to supply the value of the 5th term
M12_09B	Constructs an expression for the nth term of a geometric pattern
M13_06	Identifies the slope of a line given its equation
M02_09	Identifies a point that is collinear with three given collinear points
M03_06	Identifies a line with positive slope
Geometry	
M01_10	Determines the surface area of a prism given the dimensions of its net
M03_09	Uses properties of triangles and quadrilaterals to solve for an angle
M03_12	Draws rectangle on square grid given area and perimeter (2 of 2 points)
M04_09	Draws the image of a triangle translated horizontally and vertically on in the Cartesian plane
M04_10	Solves a two-step problem involving the area of a triangle inscribed in a square (2 of 2 points)
M04_10	Solves a two-step problem involving the area of a triangle inscribed in a square (1 of 2 points)
M05_11	Draws an angle of a given measure on a square grid
M06_10	Finds vertices of triangles created from trapezoids in the Cartesian plane (1 of 2 points)
M06_11	Uses properties of supplementary angles to solve for an angle
M07_09	Draws all lines of symmetry on a regular polygon
M10_11	Determines the area of a square given the side length of a regular hexagon with the same perimeter
M10_12	Solves a word problem involving circles and similar triangles
M11_10	Determines the number of faces of a solid with unit cubes removed

M12_11	Solves for a missing side length given two similar triangles in context
M13_08B	Solves a word problem involving the lateral surface area of a hexagonal prism
M13_10	Solves a word problem involving the Pythagorean theorem
M14_11	Uses properties of corresponding and supplementary angles to solve for an angle in a geometric figure
M14_12	Justifies that a right triangle and obtuse triangle with the same base and height have the same area
M14_13	Determines the surface area of a rectangular prism given its length, width, and height
M09_10	Finds the coordinates of a vertex of a rectangle given the other three vertices
Data and Probability	
M01_13A	Uses and interprets data sets in pie charts to solve a problem involving percentages
M04_11	Identifies relevant considerations for systematic data collection
M06_13B	Determines the change in a mean given changes in individual scores
M07_14	Justifies a conclusion resulting from comparing two distributions
M09_12A	Calculates mean and median for two ordered list of data (2 of 2 points)
M14_16	Explains the change in a mean given changes in individual values
M07_13	Interprets data in a pictograph to solve a multi-step problem
M11_13	Interprets a histogram to identify a proportion
M14_15	Identifies the optimal data display to answer a given question
M03_14B	Compares observed and expected values
M04_12A	Computes the probability of an event given the number of each type of object in a set

M04_12B	Computes the probability of an event given the number of each type of object in a set
M09_13	Solves a multi-step problem involving probability
M13_13	Identifies the conditional probability of an event

Items Above Advanced International Benchmark (625)	
Number	
M02_01	Recognizes equivalent expressions based on properties of operations (2 of 2 points)
M09_04	Given four different containers, identifies the container with the greatest fraction filled
M04_05	Given a ratio in a table, completes two equivalent ratios with one part missing in each
Algebra	
M03_05	Identifies the equivalent form of a linear inequality in one variable
M07_07	Identifies an algebraic expression involving parentheses and negative terms
M07_08	Solves a pair of simultaneous linear equations
M11_05	Identifies equivalent rational expressions
M01_07B	Gives a rule for the nth term of a geometric pattern
M08_08C	Constructs an expression for the nth term of a geometric pattern
M09_07	Determines a collinear point given another point on the line and the slope

Geometry	
M01_09	Identifies the image of a shape after rotation and reflection
M03_11	Solves for a missing side length given two similar triangles
M06_09	Estimates area of an irregular shape on a square grid
M06_10	Finds the coordinates of the vertices of triangles created from trapezoids in the Cartesian plane
M07_11	Solves a multi-step word problem involving ratios between volumes
M08_09B	Uses the Pythagorean theorem to solve for a side length of a parallelogram and calculates the perimeter (2 of 2 points)
M09_11	Explains why two shaded areas of overlapping congruent triangles are equal
M12_12	Solves a word problem involving a quarter of the circumference of a circle (2 of 2 points)
M12_12	Solves a word problem involving a quarter of the circumference of a circle (1 of 2 points)
M13_09	Determines the number of exposed faces for unit-cubes that make up a larger cube (2 of 2 points)
Data and Probability	
M02_15	Explains why a statement about data in a bar graph with a y-axis scale that does not start at 0 is incorrect
M03_13	Compares characteristics of two dot plots to justify a conclusion
M05_13	Explains why a data representation could be misleading
M08_11B	Converts the value of a bar in a bar graph to a percent
M10_15	Compares data in two pie charts with different totals to refute a conclusion
M11_12	Solves a word problem involving averages