



Exhibit 1.2.3: Summary of TIMSS 2023 International Benchmarks of Mathematics Achievement


Advanced International Benchmark


625 *Students can extend their understanding beyond working with integers alone to solve a variety of problems in novel contexts.* They can interpret relationships among fractions or decimals, negative numbers, or proportions and ratios in multistep problems. They can formulate expressions, solve algebraic equations, and demonstrate an understanding of linear functions. Students can use their knowledge of the properties of geometric figures to find missing measures and identify related shapes. Students can integrate information across data displays to represent data and justify a conclusion. Students can implement their understanding of probabilities to relate problem conditions and likelihood.


High International Benchmark


550 *Students can apply their conceptual understanding in a variety of relatively complex situations.* They can relate magnitudes and differences between positive and negative integers, fractions, and decimals to solve problems. Students demonstrate an understanding of linear equations and can formulate algebraic expressions to represent a problem. They demonstrate a basic understanding of relationships represented as graphs on a Cartesian plane. They can apply basic properties of shapes to solve problems involving triangles, parallel lines, rectangles, and similar figures. Students can interpret data given in a variety of graphical representations to justify conclusions and solve problems involving outcomes and probabilities in familiar contexts.


Intermediate International Benchmark

475 *Students can apply mathematical knowledge in a variety of situations.* They can solve problems across contexts involving whole numbers, negative numbers, fractions, decimals, and proportional relationships. They can interpret relationships given visually or in words to represent them algebraically. Students demonstrate some understanding of angle measures and in relating two-dimensional and three-dimensional shapes. They can read, interpret, and integrate across sources to represent data.


Low International Benchmark

400 *Students have knowledge of integers, basic shapes, and visual representations.* Students can apply basic properties of whole numbers. They demonstrate some knowledge of linear relationships. They can find the lengths of sides in polygons and relate views of solids. Students can read information from graphs and complete data representations.

 Low International Benchmark**400** Summary


Students have knowledge of integers, basic shapes, and visual representations. Students can apply basic properties of whole numbers. They demonstrate some knowledge of linear relationships. They can find the lengths of sides in polygons and relate views of solids. Students can read information from graphs and complete data representations.

Students can relate number properties of integers up to six digits to solve problems, including when given in words. They can order negative numbers and arrange integers in an equation to produce a given product.

Students can identify the line on a grid that represents the greatest increase.

Students can use properties of shapes and measures in polygons to determine the side length of a regular polygon given its perimeter or to identify corresponding angles in rotated polygons. Students can also interpret different views representing a given three-dimensional solid.

Students can interpret data from several representations, including interpolating values in a line graph, labeling the portions of a pie chart, and completing a line graph from data in a table.

Exhibit 1.2.6: Description of the TIMSS 2023 Intermediate International Benchmark (475) of Mathematics Achievement

Intermediate International Benchmark
475 Summary

Students can apply mathematical knowledge in a variety of situations. They can solve problems across contexts involving whole numbers, negative numbers, fractions, decimals, and proportional relationships. They can interpret relationships given visually or in words to represent them algebraically. Students demonstrate some understanding of angle measures and in relating two-dimensional and three-dimensional shapes. They can read, interpret, and integrate across sources to represent data.

Students can determine differences involving a negative integer to solve problems. They can identify equivalent representations of fractions. Students can relate simple fractions and decimals, including solving simple equations with negative decimals. Students can relate representations of ratios, percentages, or fractions and apply and represent a proportional relationship to solve word problems.

Students can represent situations with an expression with two variables and, when given the values to substitute, use the result of expressions to justify a conclusion. They can algebraically represent linear relationships and solve linear equations with an unknown on one side. They can order algebraic expressions involving a variable representing a positive integer, including single-term quadratic and negative terms. Students can interpret linear relationships from a line graph to find a function value and identify a simple quadratic relationship from numbers in a table.

Students can determine supplementary angle measures. They can identify two-dimensional views of a complex three-dimensional shape and relate three-dimensional shapes, including analyzing visualizations of three-dimensional shapes composed of unit cubes.

Students can read data from a table or bar graph and combine data from two sources to solve a problem. They can integrate information to label pie charts or bar graph axes satisfying proportional requirements.

**Exhibit 1.2.6a: TIMSS 2023 Intermediate International Benchmark (475) of Mathematics Achievement –
Example Item 1****Content Domain:** Algebra**Cognitive Domain:** Reasoning**Description:** Solves a word problem involving an inequality and explains answer

Eric has 50 minutes to make as many model planes as he can.
It takes Eric 5 minutes to make Model A and 3 minutes to make Model B.

A. Eric wants to make 5 of Model A and 10 of Model B.

Explain why he will **not** have enough time to complete these models.

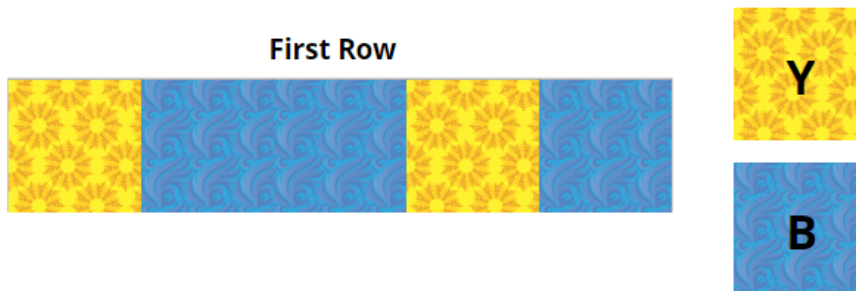
it will take him 55 minutes

The answer shown illustrates one type of response that would receive full credit.
Other types of correct responses are possible as defined by the item's unique scoring guide.


Exhibit 1.2.6b: TIMSS 2023 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 2**Content Domain:** Number**Cognitive Domain:** Applying**Description:** Given a ratio, represents an equivalent ratio pictorially

There are 5 squares in the first row of a quilt. The ratio of yellow (Y) to blue (B) squares is equivalent to 4:6.

Drag squares to the row to show a ratio equivalent to 4:6.



The answer shown illustrates one possible arrangement of 3 blue and 2 yellow squares that would receive full credit.


 High International Benchmark

550 Summary

Students can apply their conceptual understanding in a variety of relatively complex situations. They can relate magnitudes and differences between positive and negative integers, fractions, and decimals to solve problems. Students demonstrate an understanding of linear equations and can formulate algebraic expressions to represent a problem. They demonstrate a basic understanding of relationships represented as graphs on a Cartesian plane. They can apply basic properties of shapes to solve problems involving triangles, parallel lines, rectangles, and similar figures. Students can interpret data given in a variety of graphical representations to justify conclusions and solve problems involving outcomes and probabilities in familiar contexts.

Students can solve problems across contexts involving number properties. They can add two numbers in exponential form and determine a number between a positive and negative number on a number line. Students demonstrate conceptual understanding of fractions to make multiple comparisons with fractions and simple decimals, relate decimals and integers on a number line, and find values to make fractions equivalent. Students can add fractions with different denominators and order them. They can apply ratios and percentages to determine a quantity, both with increases and decreases. Students can represent parts of a whole using percentages, represent sets of quantities with ratios, and identify equivalent ratios.

Students can evaluate algebraic expressions, including those with up to three variables, products of variables, or quadratic terms given the values to substitute. They can identify and formulate algebraic expressions to represent real-world situations. Students can solve linear equations and verify solutions to simultaneous linear equations. Students can analyze and verify properties of functions represented on a Cartesian plane, including representing a non-linear relationship in a graph and interpreting the intersection point of two lines in the context of a problem. They can identify similarities among numbers to generate the next term in a multiplicative pattern or extrapolate a relationship from numbers in a table.

Students can integrate properties of a two-dimensional shape to recreate it on a grid or to estimate or calculate angle measures. They can determine the coordinates of points on a Cartesian plane, translate a point, and identify reflected shapes over an axis. They can calculate the area of a parallelogram given its base and height. Students can apply properties of similar triangles to determine lengths or use properties of a right triangle, including the Pythagorean theorem, to solve a problem. They can relate properties and representations of two- and three-dimensional shapes to solve problems.

Students can integrate data from multiple representations to complete tables and graphs, including interpreting a line graph to justify a conclusion and determining the best representation to display results. Students can calculate the mean of data in a list or from a bar graph. They can determine the probability of a simple event and apply their understanding of probability to represent scenarios meeting a probability condition or estimate an empirical probability given experimental outcomes.

Content Domain: Algebra**Cognitive Domain:** Applying**Description:** Solves a pair of simultaneous linear equations in two variables

$$3x + 4y = 13$$

$$2x - y = 5$$

Find the values of x and y that make both equations true.

$$x = \boxed{3}$$

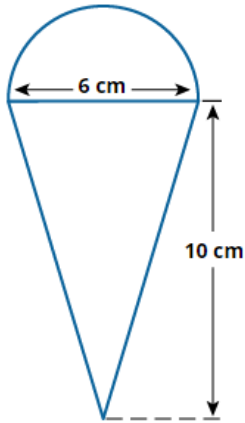
$$y = \boxed{1}$$

Content Domain: Geometry and Measurement

Cognitive Domain: Applying

Description: Solves a word problem involving circles and similar triangles


- The design for an ice cream shop's logo is a semicircle on top of an isosceles triangle with the dimensions shown below.



The shop wants to make a larger version of the logo using a similar triangle with a height of 250 cm.

What will be the diameter of the semicircle for the larger version?

Answer: cm

Exhibit 1.2.8: Description of the TIMSS 2023 Advanced International Benchmark (625) of Mathematics Achievement

Advanced International Benchmark
625 Summary

Students can extend their understanding beyond working with integers alone to solve a variety of problems in novel contexts. They can interpret relationships among fractions or decimals, negative numbers, or proportions and ratios in multistep problems. They can formulate expressions, solve algebraic equations, and demonstrate an understanding of linear functions. Students can use their knowledge of the properties of geometric figures to find missing measures and identify related shapes. Students can integrate information across data displays to represent data and justify a conclusion. Students can implement their understanding of probabilities to relate problem conditions and likelihood.

Students can interpret relationships among number properties to solve a problem or justify a conclusion, including with negative numbers, decimals, and fractions. They can extend their arithmetic knowledge to algebraic representations to apply a rule involving negative numbers or decompose multiplication as a sum of products. Students can apply their understanding of computations with fractions and decimals to solve a two-step word problem. They can analyze and integrate information across different sources to support calculations with integers and relate percentages with fractions, decimals, and ratios. Students demonstrate understanding of proportional reasoning and can apply a ratio to solve a word problem or determine the ratio in the simplest form given a representation.

Students can formulate and solve equations involving fractions and evaluate an expression with one or two variables involving an exponent, fractions, or a square root. They can identify simultaneous equations representing a situation given in words. Students can represent a relationship as an algebraic inequality with up to two variables and integrate two inequalities given as a visual representation to solve a problem. Students can simplify an algebraic expression involving fractions and two variables and formulate a pattern using an algebraic expression. Students demonstrate understanding of linear relationships, including estimating the slope of the graph of a linear function and extrapolating a linear function to estimate a value.

Students can apply the properties of two-dimensional shapes, including circles, triangles, and unfamiliar polygons, to solve a variety of problems. They can relate the dimensions of these shapes and use the area of triangles, the Pythagorean theorem, and parallel lines to find missing measures of lengths and angles. They can translate shapes on the Cartesian plane and determine the number of faces in a complex three-dimensional solid. Students can integrate properties of three-dimensional figures to solve problems involving volume and surface area.

Students can integrate data from multiple representations to solve word problems. They can apply an understanding of the mean of data in a table to justify a claim. Students demonstrate a conceptual understanding of probabilities of simple events to determine conditions resulting in the greatest probability of an event or to determine the probability of a complementary event.

Exhibit 1.2.8a: TIMSS 2023 Advanced International Benchmark (625) of Mathematics Achievement –
Example Item 1**Content Domain:** Data and Probability**Cognitive Domain:** Knowing**Description:** Computes the probability of an event given the number of each type of object in a set

Jenny has a bag of marbles with:

- 50 red
- 50 yellow
- 40 blue
- 60 green

She picks one marble out of the bag at random.

A. What is the probability Jenny will pick a marble that is **not** green?

Answer:

$\frac{7}{10}$

Exhibit 1.2.8b: TIMSS 2023 Advanced International Benchmark (625) of Mathematics Achievement –
Example Item 2

Content Domain: Number

Cognitive Domain: Applying

Description: Given a ratio in a table, completes two equivalent ratios with one part missing in each

The value of x is **proportional** to the value of y .

Complete the table.

x	y
6	4
3	2
12	8