

General and Specific Learning Outcomes by Strand Applied Mathematics

Number

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Develop number sense.	General Learning Outcome Develop number sense.			
Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes		Specific Learning Outcomes
<p>8.N.1. Demonstrate an understanding of perfect squares and square roots, concretely, pictorially, and symbolically (limited to whole numbers). [C, CN, R, V]</p> <p>8.N.2. Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers). [C, CN, ME, R, T]</p> <p>8.N.3. Demonstrate an understanding of percents greater than or equal to 0%. [CN, PS, R, V]</p> <p>8.N.4. Demonstrate an understanding of ratio and rate. [C, CN, V]</p> <p>8.N.5. Solve problems that involve rates, ratios, and proportional reasoning. [C, CN, PS, R]</p>	<p>9.N.1. Demonstrate an understanding of powers with integral bases (excluding base 0) and whole-number exponents by</p> <ul style="list-style-type: none"> ■ representing repeated multiplication using powers ■ using patterns to show that a power with an exponent of zero is equal to one ■ solving problems involving powers <p>[C, CN, ME, PS, R]</p> <p>9.N.2. Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole-number exponents. [C, CN, ME, PS, R, T]</p>	<p>10I.A.1. Demonstrate an understanding of factors of whole numbers by determining</p> <ul style="list-style-type: none"> ■ prime factors ■ greatest common factor ■ least common multiple ■ square root ■ cube root <p>[CN, ME, R]</p> <p>10I.A.2. Demonstrate an understanding of irrational numbers by</p> <ul style="list-style-type: none"> ■ representing, identifying, and simplifying irrational numbers ■ ordering irrational numbers <p>[CN, ME, R, V]</p> <p>10I.A.3. Demonstrate an understanding of powers with integral and rational exponents. [C, CN, PS, R]</p>		<p>12A.FM.1. Solve problems that involve compound interest in financial decision making. [C, CN, PS, T, V]</p> <p>12A.FM.2. Analyze costs and benefits of renting, leasing, and buying. [CN, PS, R, T]</p> <p>12A.FM.3. Analyze an investment portfolio in terms of</p> <ul style="list-style-type: none"> ■ interest rate ■ rate of return ■ total return <p>[ME, PS, R, T]</p> <p>12A.L.1. Analyze puzzles and games that involve numerical and logical reasoning, using problem-solving strategies. [CN, ME, PS, R, T]</p>

Applied Mathematics

Number

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Develop number sense.	General Learning Outcome Develop number sense.			
Specific Learning Outcomes	Specific Learning Outcomes			
<p>8.N.6. Demonstrate an understanding of multiplying and dividing positive fractions and mixed numbers, concretely, pictorially, and symbolically. [C, CN, ME, PS]</p> <p>8.N.7. Demonstrate an understanding of multiplication and division of integers, concretely, pictorially, and symbolically. [C, CN, PS, R, V]</p> <p>8.N.8. Solve problems involving positive rational numbers. [C, CN, ME, PS, R, T, V]</p>	<p>9.N.3. Demonstrate an understanding of rational numbers by</p> <ul style="list-style-type: none"> ■ comparing and ordering rational numbers ■ solving problems that involve arithmetic operations on rational numbers <p>[C, CN, ME, PS, R, T, V]</p> <p>9.N.4. Explain and apply the order of operations, including exponents, with and without technology. [ME, PS, T]</p> <p>9.N.5. Determine the square root of positive rational numbers that are perfect squares. [C, CN, ME, PS, R, T]</p> <p>9.N.6. Determine an approximate square root of positive rational numbers that are non-perfect squares. [C, CN, ME, PS, R, T]</p>			

Applied Mathematics

Patterns and Relations (Patterns)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Use patterns to describe the world and solve problems.	General Learning Outcome Use patterns to describe the world and solve problems.			
Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes
8.PR.1. Graph and analyze two-variable linear equations. [C, ME, PS, R, T, V]	9.PR.1. Generalize a pattern arising from a problem-solving context using linear equations, and verify by substitution. [C, CN, PS, R, V] 9.PR.2. Graph linear relations, analyze the graph, and interpolate or extrapolate to solve problems. [C, CN, ME, PS, R, T, V]	10I.R.1. Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V]	11A.L.1. Analyze and prove conjectures, using inductive and deductive reasoning, to solve problems. [C, CN, PS, R, T]	12A.L.2. Solve problems that involve the application of set theory. [CN, PS, R, T, V] 12A.L.3. Solve problems that involve conditional statements. [C, CN, PS, R, T]

Applied Mathematics

Patterns and Relations (Variables and Equations)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Represent algebraic expressions in multiple ways.	General Learning Outcome Represent algebraic expressions in multiple ways.			
Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	
<p>8.PR.2. Model and solve problems using linear equations of the form</p> <ul style="list-style-type: none"> ■ $ax = b$ ■ $\frac{x}{a} = b, a \neq 0$ ■ $ax + b = c$ ■ $\frac{x}{a} + b = c, a \neq 0$ ■ $a(x + b) = c$ <p>concretely, pictorially, and symbolically, where $a, b,$ and c are integers. [C, CN, PS, V]</p>	<p>9.PR.3. Model and solve problems using linear equations of the form</p> <ul style="list-style-type: none"> ■ $ax = b$ ■ $ax + b = c$ ■ $ax = b + cx$ ■ $a(x + b) = c$ ■ $ax + b = cx + d$ ■ $a(bx + c) = d(ex + f)$ ■ $\frac{a}{x} = b, x \neq 0$ <p>where $a, b, c, d, e,$ and f are rational numbers. [C, CN, ME, PS, V]</p> <p>9.PR.4. Explain and illustrate strategies to solve single variable linear inequalities with rational number coefficients within a problem-solving context. [C, CN, ME, PS, R, V]</p> <p>9.PR.5. Demonstrate an understanding of polynomials (limited to polynomials of degree less than or equal to 2). [C, CN, R, V]</p>	<p>10I.A.3. Demonstrate an understanding of powers with integral and rational exponents. [C, CN, PS, R]</p> <p>10I.A.4. Demonstrate an understanding of the multiplication of polynomial expressions (limited to monomials, binomials, and trinomials), concretely, pictorially, and symbolically. [C, CN, R, V]</p> <p>10I.A.5. Demonstrate an understanding of common factors and trinomial factoring, concretely, pictorially, and symbolically. [C, CN, R, V]</p>	<p>11A.M.1. Solve problems that involve the application of rates. [CN, PS, R, T]</p>	

Applied Mathematics

Patterns and Relations (Variables and Equations) *(continued)*

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
	General Learning Outcome Represent algebraic expressions in multiple ways.			
	Specific Learning Outcomes			
	9.PR.6. Model, record, and explain the operations of addition and subtraction of polynomial expressions, concretely, pictorially, and symbolically (limited to polynomials of degree less than or equal to 2). [C, CN, ME, PS, R, V]			
	9.PR.7. Model, record, and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials, concretely, pictorially, and symbolically. [C, CN, R, V]			

Applied Mathematics

Patterns and Relations (Relations and Functions)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
		Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes
		10I.R.1. Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V] 10I.R.2. Demonstrate an understanding of relations and functions. [C, R, V] 10I.R.3. Demonstrate an understanding of slope with respect to <ul style="list-style-type: none"> ■ rise and run ■ line segments and lines ■ rate of change ■ parallel lines ■ perpendicular lines [PS, R, V]	11A.R.1. Model and solve problems that involve systems of linear inequalities in two variables. [CN, PS, T, V] 11A.R.2. Demonstrate an understanding of the characteristics of quadratic functions, including <ul style="list-style-type: none"> ■ vertex ■ intercepts ■ domain and range ■ axis of symmetry [CN, PS, T, V]	12A.R.1. Represent data, using polynomial functions (of degree ≤ 3), to solve problems. [C, CN, PS, T, V] 12A.R.2. Represent data, using exponential and logarithmic functions, to solve problems. [C, CN, PS, T, V] 12A.R.3. Represent data, using sinusoidal functions, to solve problems. [C, CN, PS, T, V]

Applied Mathematics

Patterns and Relations (Relations and Functions) *(continued)*

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
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Specific Learning Outcomes

10I.R.4. Describe and represent linear relations, using

- words
- ordered pairs
- tables of values
- graphs
- equations

[C, CN, R, V]

10I.R.5. Determine the characteristics of the graphs of linear relations, including the

- intercepts
- slope
- domain
- range

[CN, PS, R, T, V]

Applied Mathematics

Patterns and Relations (Relations and Functions) *(continued)*

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
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Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
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Specific Learning Outcomes

- 10I.R.6. Relate linear relations expressed in
- slope–intercept form ($y = mx + b$)
 - general form ($Ax + By + c = 0$)
 - slope–point form ($y - y^1 = m(x - x^1)$)
- to their graphs.
[C, CN, R, T, V]
- 10I.R.7. Determine the equation of a linear relation, given
- a graph
 - a point and the slope
 - two points
 - a point and the equation of a parallel or perpendicular line
 - a scatterplot
- [C, CN, PS, R, T, V]
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Applied Mathematics

Patterns and Relations (Relations and Functions) *(continued)*

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
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Specific Learning Outcomes

- 10I.R.8. Represent a linear function, using function notation.
[CN, ME, V]
 - 10I.R.9. Solve problems that involve systems of linear equations in two variables, graphically and algebraically.
[CN, PS, R, T, V]
 - 10I.R.10. Solve problems that involve the distance between two points and the midpoint of a line segment.
[C, CN, PS, V]
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Applied Mathematics

Shape and Space (Measurement)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Use direct or indirect measurement to solve problems.	General Learning Outcome Use direct or indirect measurement to solve problems.			
Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes		Specific Learning Outcomes
<p>8.SS.1. Develop and apply the Pythagorean theorem to solve problems. [CN, PS, R, T, V]</p> <p>8.SS.2. Draw and construct nets for 3-D objects. [C, CN, PS, V]</p> <p>8.SS.3. Determine the surface area of</p> <ul style="list-style-type: none"> ■ right rectangular prisms ■ right triangular prisms ■ right cylinders <p>to solve problems. [C, CN, PS, R, V]</p> <p>8.SS.4. Develop and apply formulas for determining the volume of right prisms and right cylinders. [C, CN, PS, R, V]</p>	<p>9.SS.1. Solve problems and justify the solution strategy using circle properties, including</p> <ul style="list-style-type: none"> ■ the perpendicular from the centre of a circle to a chord bisects the chord ■ the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc ■ the inscribed angles subtended by the same arc are congruent ■ a tangent to a circle is perpendicular to the radius at the point of tangency <p>[C, CN, PS, R, T, V]</p>	<p>10I.M.1. Solve problems that involve linear measurement, using</p> <ul style="list-style-type: none"> ■ SI and imperial units of measure ■ estimation strategies ■ measurement strategies <p>[ME, PS, V]</p> <p>10I.M.2. Apply proportional reasoning to problems that involve conversions between SI and imperial units of measure. [C, ME, PS, T]</p>		<p>12A.D.1. Analyze objects, shapes, and processes to solve cost and design problems. [C, CN, ME, PS, R, T, V]</p>

Applied Mathematics

Shape and Space (3-D Objects and 2-D Shapes)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
<p>General Learning Outcome Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.</p>	<p>General Learning Outcome Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.</p>			
Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes	Specific Learning Outcomes
<p>8.SS.5. Draw and interpret top, front, and side views of 3-D objects composed of right rectangular prisms. [C, CN, R, T, V]</p>	<p>9.SS.2. Determine the surface area of composite 3-D objects to solve problems. [C, CN, ME, PS, R, V]</p> <p>9.SS.3. Demonstrate an understanding of similarity of polygons. [C, CN, PS, R, T, V]</p>	<p>10I.M.3. Solve problems, using SI and imperial units, that involve the surface area and volume of 3-D objects, including</p> <ul style="list-style-type: none"> ■ right cones ■ right cylinders ■ right prisms ■ right pyramids ■ spheres <p>[CN, PS, R, T, V]</p> <p>10I.M.4. Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V]</p>	<p>11A.M.2. Solve problems that involve scale diagrams, using proportional reasoning. [CN, PS, R, T, V]</p> <p>11A.M.3. Demonstrate an understanding of the relationships among scale factors, areas, surface areas, and volumes of similar 2-D shapes and 3-D objects. [C, CN, PS, R, T, V]</p> <p>11A.G.1. Derive proofs that involve the properties of angles and triangles. [CN, R, T, V]</p> <p>11A.G.2. Solve problems that involve the properties of angles and triangles. [CN, PS, T, V]</p> <p>11A.G.3. Solve problems that involve the cosine law and the sine law, including the ambiguous case. [CN, PS, R, T]</p>	<p>12A.D.1. Analyze objects, shapes, and processes to solve cost and design problems. [C, CN, ME, PS, R, T, V]</p>

Applied Mathematics

Shape and Space (Transformations)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
General Learning Outcome Describe and analyze position and motion of objects and shapes.	General Learning Outcome Describe and analyze position and motion of objects and shapes.			
Specific Learning Outcomes	Specific Learning Outcomes		Specific Learning Outcomes	
8.SS.6. Demonstrate an understanding of tessellation by <ul style="list-style-type: none"> ■ explaining the properties of shapes that make tessellating possible ■ creating tessellations ■ identifying tessellations in the environment [C, CN, PS, T, V] 	9.SS.4. Draw and interpret scale diagrams of 2-D shapes. [CN, R, T, V] 9.SS.5. Demonstrate an understanding of line and rotation symmetry. [C, CN, PS, V]		11A.L.2. Analyze puzzles and games that involve spatial reasoning, using problem-solving strategies. [CN, PS, R, T, V]	

Applied Mathematics

Statistics and Probability (Data Analysis)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
<p>General Learning Outcome Collect, display, and analyze data to solve problems.</p> <p>Specific Learning Outcomes</p> <p>8.SP.1. Critique ways in which data are presented. [C, R, T, V]</p>	<p>General Learning Outcome Collect, display, and analyze data to solve problems.</p> <p>Specific Learning Outcomes</p> <p>9.SP.1. Describe the effect of</p> <ul style="list-style-type: none"> ■ bias ■ use of language ■ ethics ■ cost ■ time and timing ■ privacy ■ cultural sensitivity <p>on the collection of data. [C, CN, R, T]</p> <p>9.SP.2. Select and defend the choice of using either a population or a sample of a population to answer a question. [C, CN, PS, R]</p>		<p>Specific Learning Outcomes</p> <p>11A.S.1. Demonstrate an understanding of normal distribution, including</p> <ul style="list-style-type: none"> ■ standard deviation ■ z-scores <p>[CN, PS, T, V]</p> <p>11A.S.2. Interpret statistical data, using</p> <ul style="list-style-type: none"> ■ confidence intervals ■ confidence levels ■ margin of error <p>[C, CN, R, T]</p> <p>11A.RP.1. Research and give a presentation on a historical event or an area of interest that involves mathematics. [C, CN, ME, PS, R, T, V]</p>	<p>Specific Learning Outcomes</p> <p>12A.RP.1. Research and give a presentation on a current event or an area of interest that involves mathematics. [C, CN, ME, PS, R, T, V]</p>

Applied Mathematics

Statistics and Probability (Data Analysis) *(continued)*

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
<p>General Learning Outcome Collect, display, and analyze data to solve problems.</p>				
<p>Specific Learning Outcomes</p>				
<p>9.SP.3. Develop and implement a project plan for the collection, display, and analysis of data by</p> <ul style="list-style-type: none"> ■ formulating a question for investigation ■ choosing a data collection method that includes social considerations ■ selecting a population or a sample ■ collecting the data ■ displaying the collected data in an appropriate manner ■ drawing conclusions to answer the question <p>[C, PS, R, T, V]</p>				

Applied Mathematics

Statistics and Probability (Chance and Uncertainty)

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
<p>General Learning Outcome Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.</p>	<p>General Learning Outcome Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.</p>			
Specific Learning Outcomes	Specific Learning Outcomes			Specific Learning Outcomes
<p>8.SP.2. Solve problems involving the probability of independent events. [C, CN, PS, T]</p>	<p>9.SP.4. Demonstrate an understanding of the role of probability in society. [C, CN, R, T]</p>			<p>12A.P.1. Interpret and assess the validity of odds and probability statements. [C, CN, ME, T]</p> <p>12A.P.2. Solve problems that involve the probability of mutually exclusive and non-mutually exclusive events. [CN, PS, R, T, V]</p> <p>12A.P.3. Solve problems that involve the probability of independent and dependent events. [CN, PS, R, T]</p> <p>12A.P.4. Solve problems that involve the fundamental counting principle. [PS, R, T, V]</p> <p>12A.P.5. Solve problems that involve permutations. [ME, PS, R, T, V]</p> <p>12A.P.6. Solve problems that involve combinations. [ME, PS, R, T, V]</p>