Grade 9 Specific Curriculum Outcomes (SCOs) and Performance Indicators

Specific curriculum outcomes (SCOs) are statements that identify the specific conceptual understanding, related skills, and knowledge students are expected to attain by the end of a given grade.

Performance indicators are statements that identify specific expectations of the depth, breadth, and expectations for the outcome. Teachers use performance indicators to determine whether students have achieved the corresponding SCO.

Process Standards Key

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

NUMBER (N)

N01 Students will be expected to demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by

- **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**

[C, CN, PS, R]

Performance Indicators

N01.01 Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2.

N01.02 Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged.

N01.03 Express a given power as a repeated multiplication.

N01.04 Express a given repeated multiplication as a power.

N01.05 Explain the role of parentheses in powers by evaluating a given set of powers.

N01.06 Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$).

N01.07 Evaluate powers with integral bases (excluding base 0) and whole number exponents.

N02 Students will be expected to demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents:

- $\left(a^m\right)\left(a^n\right) = a^{m+n}$
- $a^m \div a^n = a^{m-n}$, $m > n$
- $(a^m)^n = a^{mn}$
- $(ab)^m = a^m b^m$
- $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$, $b \neq 0$

[C, CN, PS, R, T]

Performance Indicators

N02.01 Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents.

N02.02 Evaluate a given expression by applying the exponent laws.

N02.03 Determine the sum of two given powers and record the process.

N02.04 Determine the difference of two given powers and record the process.

N02.05 Identify the error(s) in a given simplification of an expression involving powers.

N03 Students will be expected to demonstrate an understanding of rational numbers by comparing and ordering rational numbers and solving problems that involve arithmetic operations on rational numbers. [C, CN, PS, R, T, V]

Performance Indicators

N03.01 Order a given set of rational numbers in fraction and decimal form by placing them on a number line.
N03.02 Identify a rational number that is between two given rational numbers.
N03.03 Solve a given problem involving operations on rational numbers in fraction or decimal form.

N04 Students will be expected to explain and apply the order of operations, including exponents, with and without technology. [PS, T]

Performance Indicators

N04.01 Solve a given problem by applying the order of operations without the use of technology.
N04.02 Solve a given problem by applying the order of operations with the use of technology.
N04.03 Identify the error in applying the order of operations in a given incorrect solution.

N05 Students will be expected to determine the exact square root of positive rational numbers. [C, CN, PS, R, T]

Performance Indicators

N05.01 Determine whether or not a given rational number is a square number and explain the reasoning.
N05.02 Determine the square root of a given positive rational number that is a perfect square.
N05.03 Identify the error made in a given calculation of a square root (e.g., is 3.2 the square root of 6.4)?
N05.04 Determine a positive rational number, given the square root of that positive rational number.

N06 Students will be expected to determine an approximate square root of positive rational numbers. [C, CN, PS, R, T]

Performance Indicators

N06.01 Estimate the square root of a given rational number that is not a perfect square, using the roots of perfect squares as benchmarks.
N06.02 Determine an approximate square root of a given rational number that is not a perfect square, using technology (e.g., a calculator, a computer).
N06.03 Explain why the square root of a given rational number as shown on a calculator may be an approximation.
N06.04 Identify a number with a square root that is between two given numbers.

PATTERNS AND RELATIONS (PR)

PR01 Students will be expected to generalize a pattern arising from a problem-solving context using a linear equation and verify by substitution. [C, CN, PS, R, V]

Performance Indicators

PR01.01 Write an expression representing a given concrete, pictorial, oral, and/or written pattern.
PR01.02 Write a linear equation to represent a given context.
PR01.03 Describe a context for a given linear equation.
PR01.04 Solve, using a linear equation, a given problem that involves concrete, pictorial, oral, and/or written linear patterns.
PR01.05 Write a linear equation representing the pattern in a given table of values, and verify the equation by substituting values from the table.

PR02 Students will be expected to graph a linear relation, analyze the graph, and interpolate or extrapolate to solve problems. [C, CN, PS, R, T, V]

Performance Indicators

PR02.01 Describe the pattern found in a given graph.
PR02.02 Graph a given linear relation, including horizontal and vertical lines.
PR02.03 Match given equations of linear relations with their corresponding graphs.
PR02.04 Extend a given graph (extrapolate) to determine the value of an unknown element.
PR02.05 Interpolate the approximate value of one variable on a given graph, given the value of the other variable.
PR02.06 Extrapolate the approximate value of one variable from a given graph, given the value of the other variable.
PR02.07 Solve a given problem by graphing a linear relation and analyzing the graph.

PR03 Students will be expected to model and solve problems, where *a*, *b, c, d, e,* and *f* are rational numbers, using linear equations of the form

- $ax = b$
- $\frac{x}{a} = c,\ a \neq 0$
- $ax + b = c$
- $\frac{x}{a} + b = c,\ a \neq 0$
- $ax = b + cx$
- $a(x + b) = c$
- $ax + b = cx + d$
- $a(bx + c) = d(ex + f)$
- $\frac{a}{x} = b,\ x \neq 0$

[C, CN, PS, V]

Performance Indicators

PR03.01 Solve the given linear equation, using concrete and pictorial representations, and record this process symbolically.
PR03.02 Verify by substitution whether a given rational number is a solution to a given linear equation.
PR03.03 Solve a given linear equation symbolically.
PR03.04 Identify and correct an error in a given incorrect solution of a linear equation.
PR03.05 Represent a given problem, using a linear equation.
PR03.06 Solve a given problem, using a linear equation, and record the process.

PR04 Students will be expected to explain and illustrate strategies to solve single variable linear inequalities with rational coefficients within a problem-solving context. [C, CN, PS, R, V]

Performance Indicators

PR04.01 Translate a given problem into a single variable linear inequality, using the symbols ≥, >, <, or ≤.
PR04.02 Determine if a given rational number is a possible solution of a given linear inequality.
PR04.03 Generalize and apply a rule for adding or subtracting a positive or negative number to determine the solution of a given inequality.
PR04.04 Generalize and apply a rule for multiplying or dividing by a positive or negative number to determine the solution of a given inequality.
PR04.05 Solve a given linear inequality algebraically, and explain the process orally or in written form.
PR04.06 Compare and explain the process for solving a given linear equation to the process for solving a given linear inequality.
PR04.07 Graph the solution of a given linear inequality on a number line.
PR04.08 Compare and explain the solution of a given linear equation to the solution of a given linear inequality.
PR04.09 Verify the solution of a given linear inequality, using substitution for multiple elements in the solution.

PR04.10 Solve a given problem involving a single variable linear inequality, and graph the solution.

PR05 Students will be expected to demonstrate an understanding of polynomials (limited to polynomials of degree less than or equal to 2). [C, CN, R, V]

Performance Indicators

PR05.01 Create a concrete model and/or a pictorial representation for a given polynomial expression.
PR05.02 Write the expression for a given model of a polynomial.
PR05.03 Identify the variables, degree, and number of terms and coefficients, including the constant term, of a given simplified polynomial expression.
PR05.04 Describe a situation for a given first-degree polynomial expression.
PR05.05 Match equivalent polynomial expressions given in simplified form.

PR06 Students will be expected to 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, PS, R, V]

Performance Indicators

PR06.01 Model addition of two given polynomial expressions, concretely and/or pictorially, and record the process symbolically.
PR06.02 Model subtraction of two given polynomial expressions, concretely and/or pictorially, and record the process symbolically.
PR06.03 Identify like terms in a given polynomial expression.
PR06.04 Apply a personal strategy for addition or subtraction of two given polynomial expressions, and record the process symbolically.
PR06.05 Identify equivalent polynomial expressions from a given set of polynomial expressions, including pictorial and symbolic representations.
PR06.06 Identify the error(s) in a given simplification of a given polynomial expression.

PR07 Students will be expected to 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]

Performance Indicators

PR07.01 Model multiplication of a given polynomial expression by a given monomial, concretely or pictorially, and record the process symbolically.
PR07.02 Model division of a given polynomial expression by a given monomial, concretely or pictorially, and record the process symbolically.
PR07.03 Apply a personal strategy for multiplication and division of a given polynomial expression by a given monomial.
PR07.04 Provide examples of equivalent polynomial expressions.
PR07.05 Identify the error(s) in a given simplification of a given polynomial expression.

MEASUREMENT (M)

M01 Students will be expected to solve problems and justify the solution strategy, using the following circle properties:

- **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.**

[C, CN, PS, R, T, V]

M01.01 Demonstrate that

- 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

M01.02 Solve a given problem involving application of one or more of the circle properties.

M01.03 Determine the measure of a given angle inscribed in a semicircle, using the circle properties.

M01.04 Explain the relationship among the centre of a circle, a chord, and the perpendicular bisector of the chord.

GEOMETRY (G)

G01 Students will be expected to determine the surface area of composite 3-D objects to solve problems. [C, CN, PS, R, V]

Performance Indicators

G01.01 Determine the area of overlap in a given composite 3-D object, and explain the effect on determining the surface area (limited to right cylinders, right rectangular prisms, and right triangular prisms).

G01.02 Determine the surface area of a given composite 3-D object (limited to right cylinders, right rectangular prisms, and right triangular prisms).

G01.03 Solve a given problem involving surface area.

G02 Students will be expected to demonstrate an understanding of similarity of polygons. [C, CN, PS, R, V]

Performance Indicators

G02.01 Determine if the polygons in a given presorted set are similar, and explain the reasoning.

G02.02 Model and draw a polygon similar to a given polygon, and explain why the two are similar.

G02.03 Solve a given problem using the properties of similar polygons.

G03 Students will be expected to draw and interpret scale diagrams of 2-D shapes. [CN, R, T, V]

Performance Indicators

G03.01 Identify an example of a scale diagram in print and electronic media.

G03.02 Draw a diagram to scale that represents an enlargement or a reduction of a given 2-D shape.

G03.03 Determine the scale factor for a given diagram drawn to scale.

G03.04 Determine if a given diagram is proportional to the original 2-D shape, and if it is, state the scale factor.

G03.05 Solve a given problem that involves the properties of similar triangles.

G04 Students will be expected to demonstrate an understanding of line and rotation symmetry. [C, CN, PS, V]

Performance Indicators

G04.01 Classify a given set of 2-D shapes or designs according to the number of lines of symmetry.

G04.02 Complete a 2-D shape or design, given one half of the shape or design and a line of symmetry.

G04.03 Determine if a given 2-D shape or design has rotation symmetry about the point at its centre, and if it does, state the order and angle of rotation.

G04.04 Rotate a given 2-D shape about a vertex, and draw the resulting image.

G04.05 Identify the type of symmetry that arises from a given transformation on a Cartesian plane.

G04.06 Complete, concretely or pictorially, a given transformation of a 2-D shape on a Cartesian plane, record the coordinates, and describe the type of symmetry that results.

G04.07 Identify and describe the types of symmetry created in a given piece of artwork.

G04.08 Determine whether or not two given 2-D shapes on a Cartesian plane are related by either rotation or line symmetry.

G04.09 Draw, on a Cartesian plane, the translation image of a given shape using a given translation rule such as R2, U3, or → →, ↑↑↑; label each vertex and its corresponding ordered pair; and describe why the translation does not result in line or rotation symmetry.

G04.10 Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation.

STATISTICS AND PROBABILITY (SP)

SP01 Students will be expected to describe the effect on the collection of data of bias, use of language, ethics, cost, time and timing, privacy, and cultural sensitivity. [C, CN, R, T]

Performance Indicators

SP01.01 Analyze a given case study of data collection; and identify potential problems related to bias, use of language, ethics, cost, time and timing, privacy, or cultural sensitivity.

SP01.02 Provide examples to illustrate how bias, use of language, ethics, cost, time and timing, privacy, or cultural sensitivity may influence data.

SP02 Students will be expected to select and defend the choice of using either a population or a sample of a population to answer a question. [C, CN, PS, R]

Performance Indicators

SP02.01 Identify whether a given situation represents the use of a sample or a population.

SP02.02 Provide an example of a situation in which a population may be used to answer a question, and justify the choice.

SP02.03 Provide an example of a question where a limitation precludes the use of a population, and describe the limitation.

SP02.04 Identify and critique a given example in which a generalization from a sample of a population may or may not be valid for the population.

SP02.05 Provide an example to demonstrate the significance of sample size in interpreting data.

SP03 Students will be expected to develop and implement a project plan for the collection, display, and analysis of data by

- **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**

[C, PS, R, T, V]

Performance Indicators

SP03.01 Create a rubric to assess a project that includes the assessment of

- a question for investigation
- the choice of a data collection method that includes social considerations
- the selection of a population or a sample and the justification for the selection
- the display of collected data
- the conclusions to answer the question

SP03.02 Develop a project plan that describes

- a question for investigation
- the method of data collection that includes social considerations

- the method for selecting a population or a sample
- the methods for display and analysis of data

SP03.03 Complete the project according to the plan, draw conclusions, and communicate findings to an audience.
SP03.04 Self-assess the completed project by applying the rubric.

SP04 Students will be expected to demonstrate an understanding of the role of probability in society.
[C, CN, R, T]

Performance Indicators
SP04.01 Provide an example from print and electronic media where probability is used.
SP04.02 Identify the assumptions associated with a given probability, and explain the limitations of each assumption.
SP04.03 Explain how a single probability can be used to support opposing positions.
SP04.04 Explain, using examples, how decisions may be based on a combination of theoretical probability, experimental probability, and subjective judgment.