GRADE 12 MATHEMATICS

Outcomes Comparison for
Principles of Mathematics 12 and Applications of Mathematics 12:
Analysis of Curriculum Changes

BRITISH COLUMBIA

Ministry of Education
Curriculum Branch

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Introduction

This document is intended to be used as a tool to help teachers better identify the mathematical content and pedagogical differences between the previous Applications of Mathematics 12 & Principles of Mathematics 12 courses and the revised Applications of Mathematics 12 & Principles of Mathematics 12 courses. Alignment with the new curriculum is to be completed by 2001/02. The complete Mathematics 10 to 12 IRP can be downloaded from:

http://www.bced.gov.bc.ca/irp/math1012/mathtoc.htm

The prescribed learning outcomes for each curriculum organizer or sub-organizer have been broken down into the following parts:

Identical Outcomes - identifies which outcomes remain the same for each course.

Similar Outcomes - identifies which outcomes address similar concepts but have been altered (e.g., they may include limitations on an old outcome or may emphasize different aspects of an outcome.)

Deleted/Added Outcomes - the first column lists outcomes being deleted from the previous course while the second column lists learning outcomes that are being added to the revised course.

Note: The presentation of these outcomes in no way represents a suggested teaching sequence. The presentation format is intended to assist teachers in identifying and clarifying the changes to British Columbia's secondary mathematics curriculum.

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Problem Solving

Previous Curriculum	Revised Curriculum
It is expected that students will use a variety of methods to solve real-life, practical, technical, and theoretical problems.	It is expected that students will use a variety of methods to solve real-life, practical, technical, and theoretical problems.
It is expected that students will:	*It is expected that students will:*
A 1. solve problems that involve a specific content area	A 1. solve problems that involve a specific content area such as geometry, algebra, trigonometry, statistics, or probability
A 2. solve problems that involve more than one content area	A 2. solve problems that involve more than one content area
A 3. solve problems that involve mathematics within other disciplines	A 3. solve problems that involve mathematics within other disciplines
A 4. analyse problems and identify the significant elements	A 4. analyse problems and identify the significant elements
A 5. develop specific skills in selecting and using an appropriate problem-solving strategy or combination of strategies chosen from, but not restricted to, the following: guess and check look for a pattern make a systematic list make and use a drawing or model eliminate possibilities work backward simplify the original problem develop alternative original approaches analyse keywords	A 5. develop specific skills in selecting and using an appropriate problem-solving strategy or combination of strategies chosen from, but not restricted to, the following: • guess and check • look for a pattern • make a systematic list • make and use a drawing or model • eliminate possibilities • work backward • simplify the original problem • develop alternative original approaches • analyse keywords
A 1. demonstrate the ability to work individually and co-operatively to solve problems	A 6. demonstrate the ability to work individually and co-operatively to solve problems
A 2. determine that their solutions are correct and reasonable	A 7. determine that their solutions are correct and reasonable
A 3. clearly communicate a solution to a problem and the process used to solve it	A 8. clearly communicate a solution to a problem and the process used to solve it
A 4. use appropriate technology to assist in problem solving	A 9. use appropriate technology to assist in problem solving

Number (Number Operations I)

Previous Curriculum	Revised Curriculum
It is expected that students will use matrices and matrix operations to model and solve problems.	It is expected that students will describe and apply operations on matrices to solve problems, using technology as required.

Similar Outcomes

It is expected that students will:	*It is expected that students will:*
B 1. use matrices to represent and organize information for a given problem	B 1. model and solve problems, including those solved previously, using technology to perform matrix operations of addition, subtraction, and scalar multiplication as required
B 2. generate new information about a problem using the following matrix operations, applying technology where appropriate: addition and subtraction scalar multiplication matrix multiplication	
B3. model and solve matrix problems including: • networking and scheduling • long-term trends • consumer problems • maximum and minimum problems • linear programming problems involving no more than three variables in three equations or three inequalities	B 2. model and solve consumer and network problems using technology to perform matrix multiplication as required

Number (Number Operations II)

Previous Curriculum	Revised Curriculum
It is expected that students will make and justify financial decisions.	It is expected that students will design or use a spreadsheet to make and justify financial decisions.

Similar Outcomes

It is expected that students will:	*It is expected that students will:*
C 1. design or modify a financial spreadsheet template to allow users to input their own variables	C 1. design a financial spreadsheet template to allow users to input their own variables
C 2. use spreadsheets to compare the financial advantages and disadvantages of: an investment using payback period and return on investment renting or owning an asset whose value is increasing (including a house) leasing or buying an asset whose value is decreasing (including a vehicle) car insurance needs and premiums using the concepts of loss, probability of loss, compulsory coverage, optional coverage, deductible, and driving record	C 2. analyse the costs and benefits of renting or buying an increasing asset, such as land or property, under various circumstances C 3. analyse the costs and benefits of leasing or buying a decreasing asset, such as a vehicle or computer, under various circumstances C 4. analyse an investment portfolio applying such concepts as interest rate, rate of return and total return

Patterns and Relations (Patterns)

Previous Curriculum	Revised Curriculum
It is expected that students will generalize and analyse fractal patterns.	It is expected that students will generate and analyze cyclic, recursive, and fractal patterns

Identical Outcomes

It is expected that students will:	It is expected that students will:
D 1. use technology to generate and graph finite and infinite sequences whose recursive definition may or may not be given D 2. identify sequences and patterns that appear to be: • divergent • convergent • oscillating • static D 3. construct a fractal by repeatedly applying a procedure to a geometric figure D 4. use the concept of self-similarity to compare and predict the perimeters, areas, or volumes of fractal patterns	D 4. use technology to generate and graph sequences that model real-life phenomena D 5. use technology to construct a fractal pattern by repeatedly applying a procedure to a geometric figure D 6. use the concept of self-similarity to compare and/or predict the perimeters, areas and volumes of fractal patterns
G1. construct a periodic graph from cyclic data G2. make predictions from graphs that represent periodic events G3. analyse periodic events (including those described by sinusoidal curves) and use correct terminology when describing them G4. collect sinusoidal data, sketch the graph, and represent the data with an equation of either of the following forms: $y = a \sin(kt) + c$ $y = a \cos(kt) + c$	D 1. describe periodic events, including those represented by sinusoidal curves, using the terms amplitude, period, maximum and minimum values, vertical and horizontal shift D 2. collect sinusoidal data; graph the graph using technology, and, represent the data with a best fit equation of the form: • $y = a \sin(bx + c) + d$ D 3. use best fit sinusoidal equations, and their associated graphs, to make predictions (interpolation, extraction)

Patterns and Relations (Variables and Equations)

Previous Curriculum	Revised Curriculum
It is expected that students will use linear programming to model and solve optimization problems.	

Deleted/Added Outcomes

It is expected that students will: E 1. design and solve linear systems to model problem situations E 2. graphically solve systems of linear inequalities in two variables, using technology when appropriate E 3. identify and calculate the maximum and minimum values in a linear programming model for two variables in up to four inequalities E 4. apply linear programming to find solutions to optimization problems	

Patterns and Relations (Relations and Functions)

Previous Curriculum	Revised Curriculum
It is expected that students will use the characteristics of graphs of non-linear functions to analyse and solve problems. It is expected that students will:	

Deleted/Added Outcomes

F 1. use graphing calculators to plot the following non-linear functions: power exponential reciprocal logarithmic , includes 1nx polynomial F 2. identify different types of patterns and characteristics (domain, range, symmetries, vertices, asymptotes, intercepts, and maximum or minimum values) of the following non-linear functions: power reciprocal exponential logarithmic polynomial F 3. use graphs to model and solve problems involving the following non-linear functions: • power • reciprocal • exponential • logarithmic • polynomial	

Shape and Space (Measurement)

Previous Curriculum	Revised Curriculum
	It is expected that students will analyse objects, shapes and processes to solve cost and design problems.

Deleted/Added Outcomes

	It is expected that students will: E 1. use dimensions and unit prices to solve problems involving perimeter, area and volume E 2. solve problems involving estimation and costing for objects, shapes or processes when a design is given E 3. design an object, shape, layout or process within a specified budget E 4. use simplified models to estimate the solutions to complex measurement problems

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

Previous Curriculum	Revised Curriculum
It is expected that students will apply geometry concepts and reasoning skills to open-ended problems and project design.	It is expected that students will solve problems involving polygons and vectors, including both 3-D and 2-D applications.

Deleted/Added Outcomes

It is expected that students will:	*It is expected that students will:*
H1. use the geometric properties of regular polygons and polyhedra to solve problems	F1. use appropriate terminology to describe: • vectors (i.e., direction, magnitude) • scalar quantities (i.e., magnitude)
H2. use the properties of circles, polygons, and polyhedra to create and conduct design and layout projects	F2. assign meaning to the multiplication of a vector by a scalar
	F3. determine the magnitude and direction of a resultant vector, using triangle or parallelogram methods
	F4. model and solve problems in 2-D and simple 3-D, using vector diagrams and technology

Statistics and Probability (Data Analysis)

Previous Curriculum	Revised Curriculum
It is expected that students will analyse bivariate data.	

Deleted/Added Outcomes

It is expected that students will: I1. differentiate between discrete and continuous data I2. determine the equation of the line of best fit using: • median-median method • least squares method with technology I3. use appropriate technology to calculate the correlation coefficient r I4. interpret the correlation coefficient r and its limitations with respect to the data set and relevant scatter plot	

Statistics and Probability (Chance and Uncertainty)

Previous Curriculum	Revised Curriculum
It is expected that students will use the normal probability distribution to solve problems involving uncertainty.	It is expected that students will: • use normal and binomial probability distributions to solve problems involving uncertainty. • solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. • model the probability of a compound event, and solve problems based on the combining of simpler probabilities..

Similar Outcomes

It is expected that students will:	*It is expected that students will:*
J1. use the fundamental counting principle to determine the number of ways of performing operations in sequence given a set of constraints including AND and OR, AT LEAST and AT MOST, MORE THAN and LESS THAN	G1. find the population standard deviation of a data set or a probability distribution, using technology
J2. interpret and apply the constraints to solve a pathway problem	G2. use z-scores and the normal distribution to solve problems
J3. calculate the population mean and standard deviation of grouped and ungrouped data	G3. use the normal approximation to the binomial distribution to solve problems involving probability calculations for large samples (where $npq > 10$)
J4. calculate the mean and standard deviation of a probability distribution	G4. solve pathway problems, interpreting and applying any constraints
J5. use calculated z-scores and z-score tables to solve problems involving normally distributed data	G5. use the fundamental counting principle to determine the number of different ways to perform multistep operations
J6. use the normal distribution and the normal approximation to the binomial distribution to solve problems involving confidence intervals for large samples	G6. construct a sample space for two or three events
J7. simulate random outcomes in an experiment and use probability distributions, tables, and graphs to summarize the results	G7. classify events as independent or dependent
	G8. solve problems, using the probabilities of mutually exclusive and complementary events

Principles of Mathematics 12

Problem Solving

Previous Curriculum	Revised Curriculum
It is expected that students will use a variety of methods to solve all forms of problems (that is, real-life, practical, technical, theoretical).	It is expected that students will use a variety of methods to solve real-life, practical, technical, and theoretical problems.
It is expected that students will:	*It is expected that students will:*
A 1. solve problems that involve one and more than one content area	A 1. solve problems that involve a specific content area such as geometry, algebra, trigonometry, statistics, or probability
	A 2. solve problems that involve more than one content area
A 2. solve problems that involve mathematics within other disciplines	A 3. solve problems that involve mathematics within other disciplines
A 3. analyse a problem and identify the significant elements	A 4. analyse problems and identify the significant elements
A 4. develop specific skills in selecting and using an appropriate problem-solving strategy or combination of strategies chosen from, but not restricted to, the following: • guess and check • look for a pattern • make a systematic list • make and use a drawing or model • eliminate possibilities • work backward • simplify the original problem • develop alternative original approaches • analyse key words	A 5. develop specific skills in selecting and using an appropriate problem-solving strategy or combination of strategies chosen from, but not restricted to, the following: • guess and check • look for a pattern • make a systematic list • make and use a drawing or model • eliminate possibilities • work backward • simplify the original problem • develop alternative original approaches • analyse keywords
A 5. demonstrate the ability to work individually and co-operatively to solve problems	A 6. demonstrate the ability to work individually and co-operatively to solve problems
A 6. determine that their solutions are correct and reasonable, and clearly communicate the process used to solve the problem	A 7. determine that their solutions are correct and reasonable
	A 8. clearly communicate a solution to a problem and the process used to solve it
A 7. use appropriate technology to assist in problem solving	A 9. use appropriate technology to assist in problem solving

Patterns and Relations (Patterns)

Previous Curriculum	Revised Curriculum
It is expected that students will use patterns (sequences and series) to describe real-world phenomena and solve problems.	It is expected that students will generate and analyze exponential patterns.

Similar Outcomes

It is expected that students will:	*It is expected that students will:*
B 2. generate a sequence from a verbal or algebraic description, including recursive definition of a sequence	B 1. derive and apply expressions to represent general terms and sums for geometric growth and to solve problems.
B 3. describe a given sequence algebraically	B 2. connect geometric sequences to exponential functions over the natural numbers.
B 4. develop and use formulae for arithmetic and geometric sequences and series (including infinite geometric series)	B 3. estimate values of expressions for infinite geometric processes.
B 5. demonstrate an understanding of what arithmetic and geometric means	
B 6. demonstrate an understanding of summation (sigma) notation for series	

Deleted/Added Outcomes

B 1. define the terms *sequence, series, arithmetic sequence, arithmetic series, geometric sequence, geometric series, infinite geometric series,* and *recursive definition of a sequence*	
B 1. use sequences and series to solve practical and theoretical problems	

Patterns and Relations (Variables and Equations)

Previous Curriculum	Revised Curriculum
It is expected that students will demonstrate an understanding of polynomial functions, equations, and inequalities, as part of representing algebraic expressions in multiple ways.	It is expected that students will solve exponential, logarithmic and trigonometric equations and identities.

Similar Outcomes

It is expected that students will:	*It is expected that students will*
G1. convert radians to degrees and vice versa	C 1. solve exponential equations having bases that are powers of one another
D 5. simplify expressions and solve equations involving exponential and logarithmic expressions using the following rules: multiplication division powers roots change of base	C 2. solve and verify exponential and logarithmic equations and identities
G3. evaluate expressions and solve equations using radian measure	C 3. distinguish between degree and radian measure, and solve problems using both
G9. solve conditional equations using trigonometric identities	C 4. solve first and second degree trigonometric equations over a domain of length 2π • algebraically • graphically
	C 5. determine the general solutions to trigonometric equations where the domain is the set of real numbers
G7. recognize and use the following trigonometric identities: reciprocal Pythagorean sum and difference double angle	C 6. analyse trigonometric identities: graphically algebraically for general cases
G8. determine equivalent expressions using trigonometric identities	C 7. use sum, difference, and double angle identities for sine and cosine to verify and simplify trigonometric expressions

Previous Curriculum	Revised Curriculum
Deleted/Added Outcomes	
C 1. graph and analyse polynomial functions for the following: • relationship between degree of equation (with its coefficients) and shape of curve • number of zeros, including multiple roots (e.g., double roots, triple roots) • y-intercept • domain and range C 2. approximate real roots of a polynomial equation by graphing its corresponding function C 3. divide a polynomial by a polynomial (using long or synthetic division) C 4. demonstrate an understanding of the factor and remainder theorems C 5. list the possible rational roots of a polynomial equation with integral coefficients C 6. solve for the real roots of polynomial equations C 7. construct a polynomial equation for a function given: • roots of the equation • zeros of the function • zeros and a point on the function C 8. solve problems which are applications of polynomial equations or functions C 9. solve polynomial inequalities	C 4. determine the exact and the approximate values of trigonometric ratios for any multiples of 0°, 30°, 45°, 60° and 90° and 0, $\frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$

Patterns and Relations (Relations and Functions)

Previous Curriculum	Revised Curriculum
It is expected that students will: demonstrate an understanding of exponential and logarithmic functions as part of using algebraic and graphical models to generalize patterns, make predictions, and solve problems. solve systems of quadratic equations and demonstrate understanding of absolute value, as part of using algebraic and graphical models to generalize patterns, make predictions, and solve problems.	It is expected that students will represent and analyze exponential and logarithmic functions, using technology as appropriate.

Similar Outcomes

It is expected that students will:	*It is expected that students will:*
D 1. determine and graph the inverse of a given function	D 1. model, graph, and apply exponential functions to solve problems
D 2. graph and analyse exponential and logarithmic functions	D 2. change functions from exponential form to logarithmic form and vice versa
D 3. use exponential functions to model problems involving growth and decay	D 3. model, graph, and apply logarithmic functions to solve problems
D 4. describe the inverse relationship between logarithmic and exponential functions and convert between logarithmic and exponential form	D 4. explain the relationship between the laws of logarithms and the laws of exponents
D 6. solve problems that are applications of exponential or logarithmic relationships	
G4. graph sine, cosine, and tangent functions over the domain of real numbers (radians) G5. determine the period, amplitude, domain, range, and phase shift of sine, cosine, and tangent functions from the equation or the graph	D 5. draw (using technology), sketch, and analyse the graphs of sine, cosine, and tangent functions, for: • amplitude, if defined • period • domain and range • asymptotes, if any • behavior under transformations
G10. solve applied problems involving radian measure using trigonometric functions	D 6. use trigonometric functions to model and solve problems

Previous Curriculum	Revised Curriculum
Deleted/Added Outcomes	
F 1. sketch the graphs of quadratic systems (equations or inequalities) and determine real solutions for the following systems: • linear/linear • linear/quadratic • quadratic/quadratic F 2. use algebraic techniques to find real solutions for systems of quadratic equations F 3. solve problems which are applications of quadratic systems F 4. solve one-variable absolute-value equations and inequalities, and express solutions algebraically and graphically on the number line F 5. use absolute-value sentences to describe intervals on the number line	D 5. describe the three primary trigonometric functions as circular functions with reference to the unit circle and an angle in standard position

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

Previous Curriculum	Revised Curriculum
It is expected that students will: demonstrate an understanding of coordinate geometry and conic sections as part of using algebraic and graphical models to generalize patterns, make predictions, and solve problems. (formerly in Relations & Function II) demonstrate an understanding of the geometric properties of lines, angles, polygons, and circles and their applications in solving applied and theoretical problems, as part of describing the characteristics of 3-D objects and 2-D shapes and analysing the relationships among them.	It is expected that students will classify conic sections, using their shapes and equations.

Identical Outcomes

It is expected that students will:	It is expected that students will:
E 6. transform two-variable quadratic equations from general to standard form and vice versa	E 3. convert a given equation of a conic section from general to standard form and vice versa

Similar Outcomes

E 4. derive an equation for a set of points satisfying certain geometric conditions including: lines (including parallel and perpendicular) circle ellipse parabola hyperbola	E 1. classify conic sections according to shape. E 2. classify conic sections according to a given equation in general or standard (completed square) form (vertical or horizontal axis of symmetry only).

Previous Curriculum	Revised Curriculum
Deleted/Added Outcomes	
E 1. determine the distance between two points E 2. determine the coordinates of the midpoint of a line segment E 3. apply the concepts of midpoint and distance to solve problems E 4. graph and analyse quadratic relations given their equations (circle, ellipse, parabola, hyperbola) E 5. use two-variable quadratic equations to solve applied problems H 1. recall the properties of parallel lines, similar and congruent figures, polygons, angle relationships, angle measurement, basic compass and straightedge constructions, and circle properties H 2. make and justify conjectures regarding the relationships between parts of a geometric figure and its properties H 3. demonstrate the use of auxiliary lines in solving problems H 4. solve problems using a variety of circle properties and provide a deductive justification for the solution	

Shape and Space (Transformations)

Previous Curriculum	Revised Curriculum
Taken from various organizers	Perform, analyze and create transformations of functions and relations that are described by equations or graphs.

Similar Outcomes

	F 1. describe how various translations of functions affect graphs and their related equations: • $y = f(x - h)$ • $y - k = f(x)$.
	F 2. describe how various stretches of functions (compressions and expansions) affect graphs and their related equations: • $y = af(x)$ • $y = f(kc)$.
G2. define and evaluate reciprocal trigonometric ratios	F 3. describe how reflections of functions in both axes and in the line $y = x$ affect graphs and their related equations: • $y = f(-x)$ • $y = -f(x)$ • $y = f^{-1}(x)$
	F 4. using the graph and/or the equation of $f(x)$, describe and sketch $1/f(x)$.
	F 5. using the graph and/or the equation of $f(x)$, describe and sketch $\|f(x)\|$.
G6. graph transformed equations of the sine and cosine functions	F 6. describe and perform single transformations and combinations of transformation on functions and relations.

Statistics and Probability (Chance and Uncertainty)

Previous Curriculum	Revised Curriculum
	It is expected that students will use normal and binomial probability distributions to solve problems involving uncertainty. solve problems based on the counting of sets, using techniques such as the fundamental counting principles, permutations and combinations model the probability of a compound event, and solve problems based on the combining of simpler probabilities

Deleted/Added Outcomes

	It is expected that students will: G1. find the standard deviation of a data set or a probability distribution, using technology. G2. use *z*-scores and the normal distribution to solve problems. G3. use the normal approximation to the binomial distribution to solve problems involving probability calculations for large samples (where npq>10). G4. solve pathway problems, interpreting and applying any constraints. G5. use the fundamental counting principle to determine the number of different ways to perform multistep operations. G6. determine the number of permutations of *n* different objects taken *r* at a time, and use this to solve problems. G7. determine the number of combinations of *n* different objects taken *r* at a time, and use this to solve problems. G8. solve problems, using the binomial theorem where *N* belongs to the set of natural numbers. G9. construct a sample space for two or three events. G10. classify events as independent or dependent. G11. solve problems, using the probabilities of mutually exclusive and complementary events. G12. determine the conditional probability of two events. G13. solve probability problems involving permutations, combinations and conditional probability.