Math 30-1
Course Outline
Fall 2022
Mr. K. Hovey

Classroom Hours: I am available at any time for lunch hour and after school tutoring sessions. Please see me for an appointment

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Course Background

This course sequence is designed to provide students with the mathematical understandings and critical-thinking skills identified for entry **into post-secondary programs that require the study of calculus.**

Topics include algebra and number theory; measurement; relations and functions; trigonometry; and permutations, combinations and binomial theorem.

Philosophy

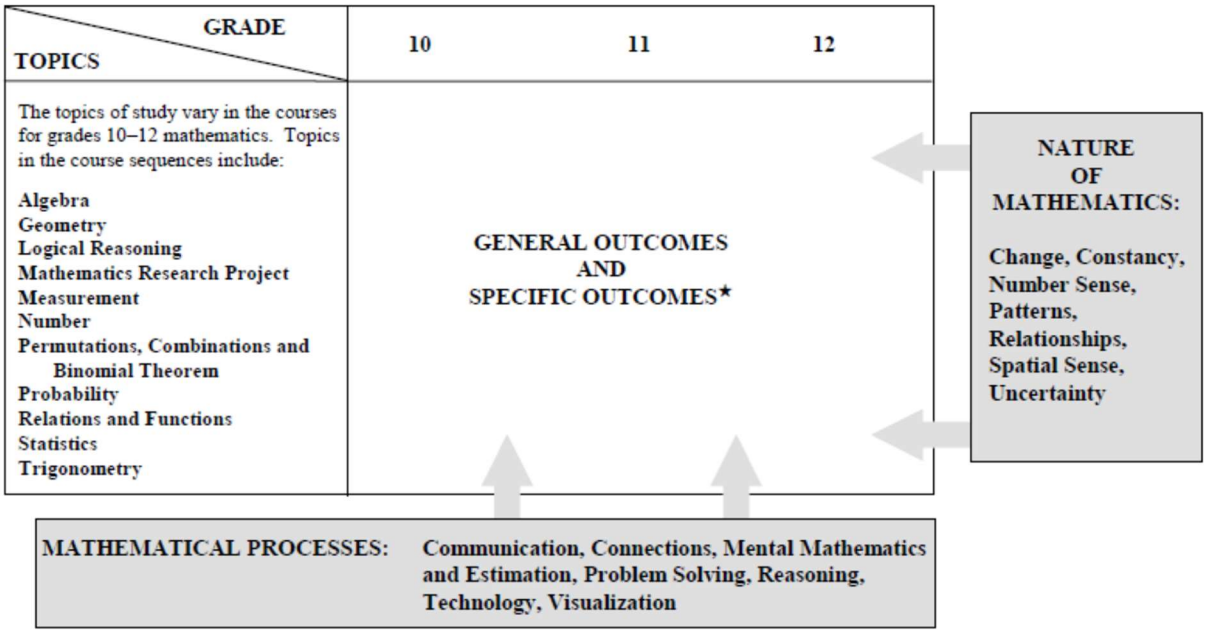
Students construct their understanding of mathematics by developing meaning based on a variety of learning experiences. The use of manipulatives, visuals and a variety of pedagogical approaches can address the diversity of learning styles and the developmental stages of students.

I will provide experiences in the classroom which may increase each student's chance for success and to allow individual progress to take place. However, I also expect each student to accept responsibility for his/her own learning. This includes completing assigned tasks to the best of their ability, participating in classroom discussions and activities, and conducting themselves in a manner that will enhance the learning process.

The diploma in recent years have tested the curriculum in a manner that relies heavily on problem solving, so the course will also attempt to develop your abilities in this area.

CONCEPTUAL FRAMEWORK FOR GRADES 10–12 MATHEMATICS

The chart below provides an overview of how mathematical processes and the nature of mathematics influence learning outcomes.



Mathematical Processes

The seven mathematical processes are critical aspects of learning, doing and understanding mathematics. Students must encounter these processes regularly in a mathematics program in order to achieve the goals of mathematics education.
This program of studies incorporates the following interrelated mathematical processes. They are to permeate the teaching and learning of mathematics.
Students are expected to:

Communication [C]	use *communication* in order to learn and express their understanding
Connections [CN]	make connections among mathematical ideas, other concepts in mathematics, everyday experiences and other disciplines
Mental Mathematics Estimation [ME]	demonstrate fluency with *mental mathematics and estimation*
Problem Solving [PS]	develop and apply new mathematical knowledge through *problem solving*
Reasoning [R]	develop mathematical *reasoning*
Technology [T]	select and use *technology* as a tool for learning and for solving problems
Visualization [V]	develop *visualization* skills to assist in processing information, making connections and solving problems.

Course Evaluation

One the marking scheme used for this course, all evaluations in a chapter are calculated separately according to the following marks breakdown.

Course Evaluation

Term Work

Chapter Exams	75%
Quizzes and Assignments	25%

Final Evaluation

Term Work	70%
Diploma Exam	30%

Each unit is assigned a percentage of the course based on the learner outcomes and information regarding the Diploma Exam marking scheme.

Chapter	Tentative Exam Date	Percent of Course Mark
Transformations of Functions and Function Operations	September 24th	18%
Polynomial and Rational Functions	October 22nd	16%
Trigonometric Functions and Graphs	November 12th	14%
Trigonometric Equations and Identities	December 3rd	15%
Permutations, Combinations and the Binomial Theorem	December 17th	16%
Exponential and Logarithmic Functions	January 14th	21%

The percentages assigned above are based on the percentages of the Diploma Exam blueprint supplied by Alberta Education.

Diploma Breakdown	Course Units	Percentages
Relations and Functions	Transformations of Functions and Function Operations Polynomial Functions Exponential and Logarithmic Functions	55%
Trigonometry	Trigonometric Functions and Graphs Trigonometric Equations and Identities	29%
Permutations, Combinations and the Binomial Theorem	Permutations, Combinations and the Binomial Theorem	16%

Performance Standards

Acceptable Standard

Students who attain the acceptable standard but not the standard of excellence will receive a final course mark between 50 percent and 79 percent, inclusive. Typically, these students have gained new skills and a basic knowledge of the concepts and procedures relative to the general and specific outcomes defined for Mathematics 30–1 in the program of studies. They demonstrate mathematical skills as well as conceptual understanding, and they can apply their knowledge to familiar problem contexts.

Standard of Excellence

Students who attain the standard of excellence will receive a final course mark of 80 percent or higher. Typically, these students have gained a breadth and depth of understanding regarding the concepts and procedures, as well as the ability to apply this knowledge and conceptual understanding to a broad range of familiar and unfamiliar problem contexts.

Most of this course will be evaluated with using quizzes and unit exams.
I will be assigning multiple choice questions from the review packages. I will not be marking these questions, but I highly recommend that you attempt these questions. One of the largest difficulties that my students have faced in the past is the inability to apply their knowledge to the diploma style multiple choice and numerical response questions. I have included as many of the newer questions that rely heavily on problem solving to allow you to be more familiar with this style of questions also.
By increasing your familiarity with these types, you will increase the likelihood of success on exams.
The daily homework is essential to your successfully completing this course. Failure to diligently complete the homework will cause you to fail to understand the material.

The quizzes within the units will be written response, where you will have to show your work for full marks.

The unit exams will be 75% multiple choice and 25% written response. The written response questions will be modelled on the exam questions that I have access to.

The diploma exam will consist of 32 multiple choice and numerical response questions and 3 written response questions.

Learner Outcomes

Trigonometry

General Outcome – Develop Trigonometric Reasoning

Specific Outcomes

1. Demonstrate an understanding of angles in standard position, expressed in degrees and radians. [CN, ME, R, V]
2. Develop and apply the equation of the unit circle. [CN, R, V]
3. Solve problems, using the six trigonometric ratios for angles expressed in radians and degrees. [ME, PS, R, T, V]
4. Graph and analyze the trigonometric functions sine, cosine and tangent to solve problems. [CN, PS, T, V]
5. Solve, algebraically and graphically, first and second degree trigonometric equations with the domain expressed in degrees and radians. [CN, PS, R, T, V]
6. Prove trigonometric identities, using:
    - reciprocal identities
    - quotient identities
    - Pythagorean identities
    - sum or difference identities (restricted to sine, cosine and tangent)
    - double-angle identities (restricted to sine, cosine and tangent).

    [R, T, V]

Acceptable Standard	Standard of Excellence
The student can:	The student can also:
• demonstrate an understanding of the radian measure of an angle as a ratio of the subtended arc to the radius of a circle	
• convert from radians to degrees and vice versa	
• solve problems involving arc length, radius, and angle measure in either radians or degrees	• solve multi-step problems based on the relationship $\theta = \frac{a}{r}$ (angle conversion is not considered a step)
• determine the measures, in degrees or radians, of all angles that are co-terminal with a given angle in standard position, within a specified domain	
• determine the missing coordinate of a point $P(x, y)$ that lies on the unit circle	
• find the approximate values of trigonometric ratios of angles, θ, where $\theta \in R$	
• find the exact values of trigonometric ratios of special angles, θ, where $\theta \in R$	
• determine the exact values of all the trigonometric ratios, given the value of one trigonometric ratio in a restricted domain or the coordinates of a point on the terminal arm of an angle in standard position	
• determine the measures of the angles, θ, in degrees or radians, given the value of a trigonometric ratio, where $0 \leq \theta < 2\pi$ or $0° \leq \theta < 360°$, or given a point on the terminal arm of an angle in standard position	
• sketch the graphs of $y = \sin x$, $y = \cos x$, and $y = \tan x$, and analyze the characteristics of the graph	
• describe the characteristics of sinusoidal functions of the form $y = a\sin[b(x - c)] + d$ and $y = a\cos[b(x - c)] + d$, and sketch the graph	• describe the characteristics of sinusoidal functions where the parameter b must be factored, and sketch the graph

- give partial explanations of the relationships between equation parameters and transformations of sinusoidal functions
- determine a partial equation for a sinusoidal curve given the graph, the characteristics, or a real-world situation
- provide a partial explanation of how the characteristics of the graph of a trigonometric function relate to the conditions in a contextual situation
- given a trigonometric equation, identify restrictions on the variable in the domain $0 \leq \theta < 2\pi$ or $0° \leq \theta < 360°$
- determine, in a restricted domain, the graphical solution for any trigonometric equation
- algebraically determine the solution set of first-degree trigonometric equations within a restricted domain or the general solution
- in a restricted domain within $0 \leq \theta < 2\pi$ or $0° \leq \theta < 360°$, algebraically determine the solution set of second-degree trigonometric equations
- explain the difference between a trigonometric identity and a trigonometric equation

- give full explanations of the relationships between equation parameters and transformations of sinusoidal functions
- determine the complete equation, finding all 4 parameters, for a sinusoidal curve given the graph, the characteristics, or a real-world situation
- provide a complete explanation of how the characteristics of the graph of a trigonometric function relate to the conditions in a contextual situation
- given a trigonometric equation, identify restrictions on the variable in the domain $\theta \in R$
- in a restricted domain outside $0 \leq \theta < 2\pi$ or $0° \leq \theta < 360°$, algebraically determine the solution set of second-degree trigonometric equations
- algebraically determine, in a restricted domain, the solution set of trigonometric equations involving sum and difference, double-angle, or Pythagorean trigonometric identity substitutions
- determine the general solution of
  - second-degree trigonometric equations
  - trigonometric equations involving sum and difference, double-angle, or Pythagorean trigonometric identity substitutions

• explain the difference between verifying for a given value and proving an identity for all permissible values	
• verify a trigonometric identity graphically or numerically for a given value	• determine the non-permissible values of a trigonometric identity
• algebraically simplify and prove simple identities, and recognize that there may be non-permissible values	• algebraically simplify and prove more-difficult identities which include sum and difference identities, double-angle identities, conjugates, or the extensive use of rational operations
• determine the exact value of a trigonometric ratio using the sum, difference, and double-angle identities of sine and cosine	• determine the exact value of a trigonometric ratio using the sum, difference, and double-angle identities of a tangent
• participate in and contribute to the problem-solving process for problems that require analysis of trigonometry studied in Mathematics 30–1	• complete the solutions to problems that require the analysis of trigonometry studied in Mathematics 30–1

Permutations, Combinations and Binomial Theorem

General Outcome-- Develop algebraic and numeric reasoning that involves combinatorics.

Specific Outcomes

1. Apply the fundamental counting principle to solve problems. [C, PS, R, V]
2. Determine the number of permutations of n elements taken r at a time to solve problems. [C, PS, R, V]
3. Determine the number of combinations of n different elements taken r at a time to solve problems. [C, PS, R, V]
4. Expand powers of a binomial in a variety of ways, including using the binomial theorem (restricted to exponents that are natural numbers). [CN, R, V]

Acceptable Standard	Standard of Excellence
The student can:	The student can also:
• apply the fundamental counting principle to various problems involving at most two cases or constraints	• apply the fundamental counting principle to various problems involving three or more cases or constraints
• understand and use factorial notation	
• recognize and address problems involving the terms *and* or *or*	• recognize and address problems involving the terms *at least* or *at most*
	• recognize and address scenarios involving cases where items *cannot be together*
• solve problems involving permutations or combinations	• solve problems involving both permutations and combinations
• solve problems involving permutations when two or more elements are identical (repetitions), with at most one constraint	• solve problems involving permutations when two or more elements are identical (repetitions), with more than one constraint
• solve for n in equations involving one occurrence of ${}_nP_r$ or ${}_nC_r$ given r, where $r \leq 3$, and identify extraneous solutions	
• obtain solutions to problems involving at most two cases or constraints	• obtain solutions to problems involving three or more cases or constraints
• demonstrate an understanding of patterns that exist in the binomial expansion	
• expand $(x + y)^n$ or determine a specified term in the expansion of a binomial with linear terms	• expand $(x + y)^n$ or determine a specified term in the expansion of a binomial with non-linear terms
	• determine an unknown value in $(x + y)^n$ given a specified term in its expansion
• provide a partial solution and explain simple mathematical strategies in a problem-solving context involving combinatorics studied in Mathematics 30-1	• provide a complete solution and explain complex mathematical strategies in a problem-solving context involving combinatorics studied in Mathematics 30-1

Relations and Functions

General Outcome- Develop algebraic and graphical reasoning through the study of relations.

Specific Outcomes

1. Demonstrate an understanding of operations on, and compositions of, functions. [CN, R, T, V]
2. Demonstrate an understanding of the effects of horizontal and vertical translations on the graphs of functions and their related equations.[C, CN, R, V]
3. Demonstrate an understanding of the effects of horizontal and vertical stretches on the graphs of functions and their related equations.[C, CN, R, V]
4. Apply translations and stretches to the graphs and equations of functions. [C, CN, R, V]
5. Demonstrate an understanding of the effects of reflections on the graphs of functions and their related equations, including reflections through the:
    - x-axis
    - y-axis
    - line $y = x$.

    [C, CN, R, V]
6. Demonstrate an understanding of inverses of relations. [C, CN, R, V]
7. Demonstrate an understanding of logarithms. [CN, ME, R]
8. Demonstrate an understanding of the product, quotient and power laws of logarithms. [C, CN, ME, R, T]
9. Graph and analyze exponential and logarithmic functions. [C, CN, T, V]
10. Solve problems that involve exponential and logarithmic equations. [C, CN, PS, R]
11. Demonstrate an understanding of factoring polynomials of degree greater than 2 (limited to polynomials of degree 5 or less with integral coefficients).[C, CN, ME]
12. Graph and analyze polynomial functions (limited to polynomial functions of degree 5 or less). [C, CN, T, V]
13. Graph and analyze radical functions (limited to functions involving one radical). [CN, R, T, V]
14. Graph and analyze rational functions (limited to numerators and denominators that are monomials, binomials or trinomials). [CN, R, T, V]

Acceptable Standard

The student can:

- given their equations, sketch the graph of a function that is the sum, difference, product, quotient, or composition of two functions
- given their graphs, sketch the graph of a function that is the sum, difference, or product of two functions
- write a function, $h(x)$, as:
  - the sum or difference of two or more functions
  - the product or quotient of two functions
  - a single composition

    E.g., $h(x) = f\big(f(x)\big)$

    $h(x) = f\big(g(x)\big)$
- determine the domain and range of a function which results from the operation of two functions (i.e. sum, difference, product, or quotient)
- determine the value of operations or compositions of functions at a point

  E.g., $h(a) = (f \bullet g)(a)$

  $h(a) = f\big(f(a)\big)$

  $h(a) = (f \circ g)(a)$

  $h(a) = f\Big(g\big(h(a)\big)\Big)$

  $h(a) = g(a) + f\big(g(a)\big)$

Standard of Excellence

The student can also:

- given their graphs, sketch the graph of a function that is the quotient of two functions
- write a function, $h(x)$, as:
  - the product or quotient of three functions
  - the composition of functions involving two compositions

    E.g., $j(x) = (f \circ g \circ h)(x)$

    $h(x) = f\Big(g\big(f(x)\big)\Big)$
- write a function, $h(x)$, combining two or more functions through operations on, and/or compositions of, functions, limited to two operations

  E.g., $h(x) = g(x) + f\big(g(x)\big)$

  $h(x) = (f \bullet g)(x) - k(x)$
- determine the domain of a function that is the composition of two functions

- perform, analyze, and describe graphically or algebraically:
  - a combination of transformations involving stretches and/or translations
  - a combination of transformations involving reflections and/or translations
  - a combination of transformations involving reflections and/or stretches
  - a horizontal stretch and/or reflection in the y-axis and a translation where the parameter b is removed through factoring

  given the function in equation or graphical form or mapping notation
- perform, analyze, and describe a reflection in the line $y = x$, given the function or relation in graphical form
- determine the equation of the inverse of a linear, quadratic, exponential, or logarithmic function and analyze its graph
- determine an unknown parameter in a function, given information relating to one point on the graph of the function
- determine, without technology, the exact values of simple logarithmic expressions
- estimate the value of a logarithmic expression using benchmarks
- convert between $y = b^x$ and $\log_b y = x$
- simplify and/or expand logarithmic expressions using the laws of logarithms
- sketch and analyze (domain, range, intercepts, asymptote) the graphs of exponential or logarithmic functions and their transformations
- solve exponential equations that:
  - can be simplified to a common base
  - cannot be simplified to a common base and whose exponents are monomials

- perform, analyze, and describe graphically or algebraically:
  - a horizontal stretch and/or reflection in the y-axis and translation where the parameter b is not removed through factoring
  - a combination of transformations involving at least a reflection, a stretch, and a translation

  given the function in equation or graphical form or mapping notation
- determine restrictions on the domain of a function in order for its inverse to be a function, given the graph or equation
- convert between exponential and logarithmic forms involving more than two steps
- solve exponential equations that cannot be simplified to a common base, where the exponents are not monomials, or where there is a numerical coefficient

• solve logarithmic equations but cannot recognize when a solution is extraneous	• solve logarithmic equations and recognize when a solution is extraneous
• solve exponential and logarithmic real-world application problems	
• solve for a value, such as an earthquake intensity, in comparison problems	• solve for an exponent in comparison problems
• identify whether a binomial is a factor of a given polynomial	
• completely factor a polynomial of degree 3, 4, or 5	
• identify and explain whether a given function is a polynomial function	
• find the zeros of a polynomial function and explain their relationship to the x-intercepts of the graph and the roots of an equation	
• sketch and analyze polynomial functions (in terms of multiplicities, y-intercept, domain and range, etc.)	
• provide a partial solution to solve a problem by modelling a given situation with a polynomial function	• provide a complete solution to a problem by modelling a given situation with a polynomial function
• determine the equation of a polynomial function in factored form, given its graph and/or key characteristics	
• sketch and analyze (in terms of domain, range, invariant points, x- and y-intercepts) $y = \sqrt{f(x)}$ given the graph or equation of $y = f(x)$	
• find the zeros of a radical function graphically and explain their relationship to the x-intercepts of the graph and the roots of an equation	
• determine the equation of a radical function given its graph and/or key characteristics	• determine the equation of a radical function involving all three types of transformations: reflection, stretch, and translation, given its graph and/or key characteristics

- sketch and analyze rational functions (in terms of vertical asymptotes, horizontal asymptote, x-coordinate of a point of discontinuity, domain, range, x- and y-intercepts)
- find the zeros of a rational function graphically and explain their relationship to the x-intercepts of the graph and the roots of an equation
- determine the equation of a rational function given its graph and/or key characteristics
- participate in and contribute toward the problem-solving process for problems involving relations and functions studied in Mathematics 30-1

- determine the y-coordinate of a point of discontinuity of a rational function
- determine the equation of a rational function containing a point of discontinuity, given its graph and/or key characteristics
- complete the solution to problems involving relations and functions studied in Mathematics 30-1