Functions and Applications, Grade 11 (MCF3M)
Course Description

Course Title: Functions and Applications
Course Code: MCF3M
Grade: 11

Course Type: University/College
Credit Value: 1.0
Prerequisite: MPM2D or MFM2P

- **This course builds on** your knowledge from grade 10 Applied or Academic mathematics
- **It leads you to** MDM4U, MCT4C
- **You will also have the option to take** MAP4C
- **This can lead you to many careers such as:** Architectural Technician, Biomedical Engineer, Satellite Image Analyst, Urban Planner, Web Developer

Official Ontario Ministry of Education secondary curriculum available here:
http://www.edu.gov.on.ca/eng/curriculum/secondary/math.html

This course focuses on three main strands:

Quadratic Functions

Exponential Functions

Trigonometric Functions

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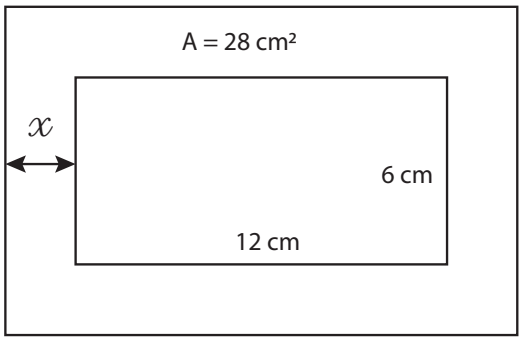
Quadratics Functions

Students will manipulate and gather information from quadratic functions to solve a variety of real-world problems, such as how to determine the initial speed a rocket will need at take-off in order to achieve a certain height, and the total distance it will travel at that speed or designing and building products such as:

Problem: You have decided to make a picture frame out of a sheet of aluminum. The frame will be cut out of a singular sheet and the final area of the frame is to be 28 cm^2. The inside of the frame has to be 12 cm by 6 cm. What should the width, x, of the frame be?



Solution:

$$\begin{aligned}\text{Area} &= (12 + 2x) \times (6 + 2x)\\ &= 72 + 24x + 12x + 4x^2\\ &= 4x^2 + 36x + 72\end{aligned}$$

Subtract the cut-out part of 12×6

$$\begin{aligned}\text{Area} &= 4x^2 + 36x + 72 - 72\\ &= 4x^2 + 36x\end{aligned}$$

Desired area is 28

$$\begin{aligned}28 &= 4x^2 + 36x\\ 0 &= 4x^2 + 36x - 28\end{aligned}$$

Solve with

$$x = \frac{-36 \pm \sqrt{36^2 - 4(4)(-28)}}{2(4)}$$

$x = 0.72$ $\quad$ ~~$x = -9.72$~~

$\therefore$ the width of x is approximately 0.72 cm

Functions and Applications, Grade 11 (MCF3M)
Course Description

Exponential functions:

Students will solve problems using their knowledge of exponent laws and explore the graphical representation of exponential functions, such as modelling the growth of an investment or debt.

$$A = P(1 + i)^n$$

Where:
- A = final amount
- P = starting amount or principal
- i = the interest rate as a decimal
- n = the number of compounding periods

Problem: One day you made an impulse buy on a $1 500 new computer and put it on your credit card. The credit card has an interest rate of 20% per annum compounded monthly. How much money will the computer end up costing if you don't pay off your credit card until 2 years from now?

Solution:

$A = P(1 + i)^n$

$A = ?$

$P = 1500$

$i = \frac{0.20}{12}$

$n = 2 \times 12$
$= 24$

$A = 1500\left(1 + \frac{0.2}{12}\right)^{24}$

$= \$2\,230.37$

$\therefore$ the computer will end up costing $2 230.37

Functions and Applications, Grade 11 (MCF3M)
Course Description

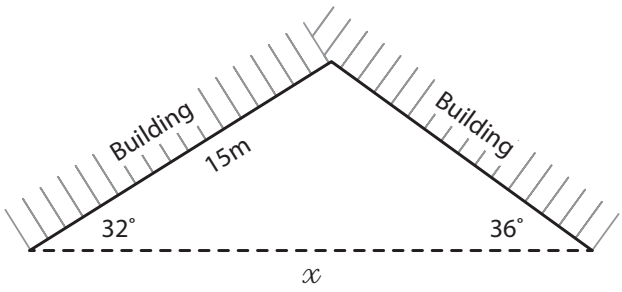
Trigonometric Functions:

Students will solve problems using triangles and trigonometry laws such as understanding changes to a staircase's angle of incline. They will also learn the graphical and algebraic representations of periodic and trigonometric functions used in investigating the periodic nature of the tides or other applications such as how a landscaper might use trigonometry to build a fence around a property.

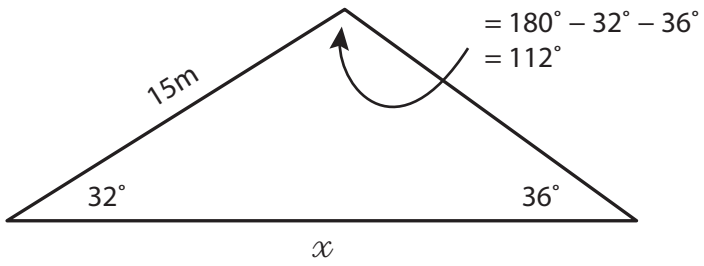
Uses of Trigonometry

Music Theory	Audio Synthesis	Acoustics	Optics
Financial Markets	Electronics	Probability	Statistics
Biology	Medical Imaging	Pharmacy	Chemistry
Seismology	Meteorology	Oceanography	and Many More

Problem: A landscaper is building a garden for a customer. The customer has asked for a fence to be built connecting two existing walls so that animals will be not be able to enter the garden. The following diagram shows the scenario and the data collected by the landscaper. How long is the fence going to have to be if built in the indicated location, x?



Solution: The landscaper recognizes that they have a non-right angle triangle with a corresponding side and angle and that sine law can be used to solve for the unknown side. Use the Trigonemetric Table provided.



$= 180^\circ - 32^\circ - 36^\circ$
$= 112^\circ$

$$\frac{x}{\sin 112} = \frac{15}{\sin 36}$$

$$x = \frac{\sin(112)15}{\sin 36}$$

$$= 23.7$$

$\therefore$ the fence needs to be 23.7 m long

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Trigonometric Table

Angle in degrees	Angle in Radians	Sine	Cosine	Tangent
36˚	0.628	0.588	0.809	0.727
37˚	0.646	0.602	0.799	0.754
38˚	0.663	0.616	0.788	0.781
39˚	0.681	0.629	0.777	0.810
40˚	0.698	0.643	0.766	0.839
41˚	0.716	0.656	0.755	0.869
42˚	0.733	0.669	0.743	0.900
43˚	0.750	0.682	0.731	0.933
44˚	0.768	0.695	0.719	0.966
45˚	0.785	0.707	0.707	1.000

Angle in degrees	Angle in Radians	Sine	Cosine	Tangent
81˚	1.414	0.988	0.156	6.314
82˚	1.431	0.990	0.139	7.115
83˚	1.449	0.993	0.122	8.144
84˚	1.466	0.995	0.105	9.514
85˚	1.484	0.996	0.087	11.43
86˚	1.501	0.998	0.070	14.301
87˚	1.518	0.999	0.052	19.081
88˚	1.536	0.999	0.035	28.636
89˚	1.553	1.000	0.017	57.290
90˚	1.571	1.000	0.000	∞