Functions, Grade 11 (MCR3U)
Course Description

Course Title: Functions
Course Code: MCR3U
Grade: 11

Course Type: University
Credit Value: 1.0
Prerequisite: MPM2D

- **This course builds on** your knowledge from grade 10 Academic mathematics
- **It leads you to** MHF4U, MCV4U, MDM4U
- **You will also have the option to take** MCT4C, MAP4C

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

This course is divided into four main strands:

Characteristics of Functions

Exponential Functions

Discrete Functions

Trigonometric Functions

Functions, Grade 11 (MCR3U)
Course Description

Characteristics of Functions:

Students will demonstrate an understanding of quadratic functions and their representations and solve problems from real world applications, and will factor and simplify expressions as fractions to solve problems like this:

Drones are not allowed to fly within a certain distance of airports. If the drone comes too close, then the airport will attempt to knock it out of the air using their own drones. This can only happen when the two drones are at the same height. If your drone's height(h) is modelled as a function of time (t) by the equation $h(t) = t + 6$ and the airports drone's height is modelled by $h(t) = -t^2 + 3t + 9$, at what time will your drone be knocked out of the air?

Solution:

Drone 1 ⟶ $h(t) = t + 6$

Drone 2 ⟶ $h(t) = -t^2 + 3t + 9$

Set equal to find intercept(s)

$t + 6 = -t^2 + 3t + 9$

$0 = -t^2 + 2t + 3$

$0 = -(t^2 - 2t - 3)$

$0 = -(t - 3)(t + 1)$

$t = 3$ or ~~$t = -1$~~

∴ the drone will be knocked down at 3 seconds

Functions, Grade 11 (MCR3U)
Course Description

Exponential Functions:

Students will use their knowledge of exponent laws to solve equations with exponents, such as calculating the half-life of radioactive elements (the time taken for the radioactivity of a specified isotope to fall to half its original value.) They will also explore the properties of exponential functions and solve problems arising from real world applications such as:

Problem: A baker has a customer coming to pick up a cake in 15 minutes and it is just coming out of the oven. If the cake is boxed up before it cools down to room temperature (20° C) it will ruin the cake. The baker decided to pull the cake right out of the oven and place it outside where it is -3° C in hopes that it cools down quickly. If the temperature of the cake is modelled by the equation $T(t) = 250\,(0.4)^{t/10} - 3$ where T is the temperature and t is the time in minutes, will the cake be ready to go for the customer when they get to the bakery?

Solution:

$$T(t) = 250\,(0.4)^{\frac{t}{10}} - 3$$

What is T when t = 15 ?

$$T(15) = 250\,(0.4)^{\frac{15}{10}} - 3$$

$$= 250\,(0.4)^{1.5} - 3$$

$$= 63.25 - 3$$

$$= 60.25^{\circ}$$

No, the cake will not be ready to go.

Functions, Grade 11 (MCR3U)
Course Description

Discrete functions:

Students will study numerical patterns based on addition (arithmetic sequences) and multiplication (geometric sequences) and how they can be applied to examples like bank contracts. They will also study lump sum investments and annuities, such as examining an amortized payment schedule for the financing of a new car or problems such as:

Problem: One of your friends started to invest $1000 a year at age 20 into an RRSP that earns 6% per annum, compounded annually. One of your other friends who is the same age says all he has to do is invest $3000 a year into the same RRSP starting when he turns 50 to have the same amount of money at age 65 as the friend who started at age 20. Is he correct in his statement? If not, what is the difference in values of the RRSPs?

Solution:

$$FV = P\left(\frac{(1+r)^n - 1}{r}\right)$$

Friend #1	Friend #2
$P = 1000$	$P = 3000$
$r = 0.06$	$r = 0.06$
$n = 45$	$n = 15$
$FV = 1000\left(\frac{(1+0.06)^{45} - 1}{0.06}\right)$	$FV = 3000\left(\frac{(1+0.06)^{15} - 1}{0.06}\right)$
= \$212 743.51	= \$69 827.91

∴ friend #2 was incorrect and will have $142 915.60 less than friend #1

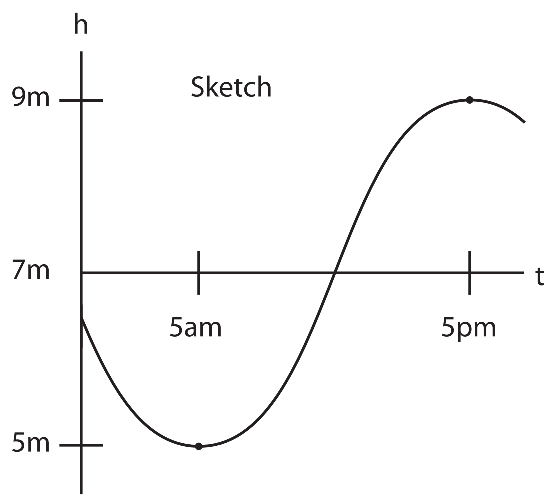
Functions, Grade 11 (MCR3U)
Course Description

Trigonometric Functions:

Students will solve problems using trigonometric laws and identities. They will also explore trigonometric functions, such as modelling the motion of a swinging pendulum in a grandfather clock or determining the rotation time of a blade on a rotating windmill or solving problems using the sinusoidal characteristics of the tides such as:

Problem: The depth of water in a harbour due to tides can be represented by a sinusoidal function. While out boating you want to dock your boat in a harbor but the depth of the water has to be at least 6.5 m deep for your boat to dock safely. In the harbor you want to visit, low tide occurs at 5 a.m. with a water depth of 5.0 m, high tide occurs at 5 p.m. with a water depth of 9.0 m. Will it be safe to dock during the hours of 11 a.m. to 2 p.m.?

Solution:



Determine equation

$h(t) = -a \cos k\,(t - h) + d$

$a = \frac{9 + 5}{2} = 2$ $\qquad k = \frac{360}{24} = 15$

$h = 5$ $\qquad d = 5 + 2 = 7$

$h(t) = -2 \cos 15\,(t - 5) + 7$

Check for t = 11 and t = 14

$h(11) = -2 \cos 15\,(11 - 5) + 7 = 7.0$ m

$h(14) = -2 \cos 15\,(14 - 5) + 7 = 8.414$ m

∴ it is safe to dock