MCF3MI **Unit 3 Day 4** **Solving a Quadratic Equation by Graphing**

Quadratic Function

A quadratic function:
- Is a *function* with a squared variable
- There are two variables or function notation
- To solve it, write the corresponding equation and solve it.
- On a graph, the solution are the *zeros*

Quadratic Equation

A quadratic equation:
- Is an *equation* with a squared variable.
- There is only one variable in the equation.
- To SOLVE it, you need to find the VALUE for the VARIABLE that makes the equation true.
- In an equation the solution is the *roots*.

Investigate the Math:

A model rocket is launched from the roof of a building. The height, $h(t)$, in metres, at any time, t, in seconds, is modelled by the function $h(t) = -5t^2 + 15t + 20$

1. Use Desmos to graph the height of the function. Determine the following properties of the function:
   a. Zeros: $x = -1, 4$
   b. Axis of Symmetry: $x = 1.5$
   c. Vertex: $(1.5, 31.25)$

2. What is the rocket's height when it hits the ground? Use this value to write a quadratic equation you could use to determine when the rocket hits the ground.

$h = 0$

3. Substitute one of the zeros you determined in #1 into the quadratic equation you wrote in #2. Repeat this for the other zero. What do you notice?

$h(-1) = -5(-1)^2 + 15(-1) + 20$
$= 0$

4. What are the *roots* of the equation you wrote in #2 $t = -1, t = 4$

5. State the domain and range of the function in the context of the question.

D: $t \in R, 0 \le t \le 4$
R: $h \in R, 0 \le h \le 31.25$

6. What is the starting height of the rocket? Where is it on the graph? Where is it in the function?

↳ 20m ↳ y intercept ↳ $h(0)$

7. When will the rocket hit the ground?

$t = 4$ seconds.

To SOLVE a quadratic equation by graphing…

1. Rewrite the equation as a function in standard form ($ax^2 + bx + c = 0$).
2. Graph the function using technology.
3. Determine the zeros of the function. These are the mathematical solutions that solve the equation (the roots of the equation).
4. If a word problem, interpret the solutions in the context of the question. It may be that both zeros don't make sense – only one does!

Example 1: Solve each of the following by graphing using Desmos.

a) $-3 = x^2 + 2x - 8$

$0 = x^2 + 2x - 8 + 3$

$0 = x^2 + 2x - 5$

$x = -3.45, 1.45$

(b) $0 = 0.5x^2 + x - 5$

$x = -4.32$

$x = 2.32$

Example 2:

The population of an Ontario city is modelled by the function $P(t) = 0.5t^2 + 10t + 300$, where $P(t)$ is the population in thousands and t is the time in years. Note: $t = 0$ corresponds to the year 2010.

a) What was the population in 2010?

$P(0) = 0.5(0)^2 + 10(0) + 300$

$= 300$

∴ the population is 300 000

b) What will the population be in 2020?

$P(10) = 0.5(10)^2 + 10(10) + 300$

$= 0.5(100) + 100 + 300$

$= 450$

∴ the population is 450 000.

c) When is the population expected to be 1 050 000?

$1050 = 0.5t^2 + 10t + 300$ P(t)

$0 = 0.5t^2 + 10t + 300 - 1050$

$0 = 0.5t^2 + 10t - 750$

$t = -50$ $t = 30$

∴ in 2040 it will exceed 1 050 000.

*Use DESMOS for all graphing! Pg. 149 #2, 3, 4, 5 . Pg. 150 #6, 7

Prepare for Quiz next class: p. 155 #1, 2, 3