BIG PICTURE of this UNIT:	• How do we WORK WITH & EXTEND the concept of "functions" • Why are quadratic equations written in different forms? • How do we EXTEND and APPLY our knowledge of quadratic functions, beyond the basics of IM2?

This lesson will be based upon a STUDENT DIRECTED DISCUSSION model ….. in your groups, you should be having DISCUSSIONS about how to think and work through and then present the solutions to the following questions. So, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for DISCUSSIONS !!!! If your group has (i) multiple solutions that lead to the same answers OR (ii) same/different solutions that lead to different answers, present them ANYWAY!!

1. Write the equations of the following parabolas: {18}
   a. It has a vertex at (4, −3) and passes through (2, −15).
   b. It has a y – intercept of –2 and passes through the points (1, 0) and (−2,12).

2. (CI) Find the roots of the quadratic equations: {9,10}
   a. $f(x) = 2x^2 + 13x + 15$ b. $f(x) = 3x^2 - 11x + 10$ c. $f(x) = 3x^2 – 7x – 6$

3. (CI) Solve the quadratic equations: {9,10}
   a. $0 = 6x^2 + 23x + 7$ b. $0 = -36x^2 – 39x + 35$

4. Factor the following quadratic expressions: {7,8}
   a. $6x^2 + 11x – 10$ b. $8x^2 - 18x - 5$ c. $9x^2 + 101x + 22$

5. Use a GRAPH to help you factor the following quadratic functions. Include an explanation as to WHY and HOW a graph can help you write an equation in factored form. {4,7,8}
   a. $2x^2 + 13x + 15$ b. $3x^2 - 11x + 10$ c. $3x^2 – 7x – 6$

6. (CI) Find the roots of $9(x-3)^2 - 16(x+1)^2 = 0$ {7,8}

7. Mr. S. is given the equation $\frac{1}{x-3} + \frac{1}{x+1} = 1$ and is being asked to solve for *x*; {7,8}

   a. Graph the system $f(x) = \frac{1}{x-3} + \frac{1}{x+1}$ and $g(x) = 1$ and find the intersection point(s).

   b. Explain WHY Mr S uses this **system** to solve the original equation.

   c. Graph the parabola $k(x) = x^2 - 4x - 1$ and find the zeroes. What do you notice, given your work in the previous parts of this question?

   Mr. S now has NO calculator, so must provide an algebra based solution for this problem. He carries out the following steps:

$$\frac{1}{x-3} + \frac{1}{x+1} = 1$$
$$(x+1) + (x-3) = 1(x-3)(x+1)$$
$$2x - 2 = x^2 - 2x - 3$$
$$0 = x^2 - 4x - 1$$

   d. Explain what Mr. S. did to get the second line of his solution.

   e. Given the work & explanations, solve the following:

   i. $\frac{1}{x+3} + \frac{1}{x-3} = 1$ ii. $\frac{1}{x} + \frac{1}{x+1} = \frac{5}{6}$

8. Determine the value of the discriminants in: {13}

   a. $f(x) = x^2 + 3x - 4$ b. $f(x) = x^2 + 3x + 2.25$ c. $f(x) = x^2 + 3x + 5$

9. Based on the discriminant, indicate how many and what type of solutions there would be given the following equations: {13}

   a. $3x^2 + x + 10 = 0$ b. $f(x) = x^2 - 8x + 16$ c. $f(x) = 3x^2 + 7x + 2$

10.

Lila is creating dog runs for her dog kennel. She can afford 30 m of chain-link fence to surround four dog runs. The runs will be attached to a wall, as shown in the diagram. To achieve the maximum area, what dimensions should Lila use for each run and for the combined enclosure?

{15,17,18]

a. Show that the equation that should be used to model this problem is A(w) = (30-5w)w.

b. Find the dimensions of the enclosure that should be used to maximize the area of the combined enclosure.

11. You will find a picture of my friend who visited Arches National Park a couple of years ago. She is 5 foot 6 inches tall. Determine an equation you can use to model the arch under which she is standing {15,17,18]

Higher Level Questions for More Complex Concepts OR an EXTENSION of basic concepts involved with Quadratic Functions.

1. Graph the following complex numbers:
   a. $z = 3 + 2i$
   b. $z = -5 + 4i$
   c. $z = -6 - 3i$
   d. $z = 2i$
   e. $z = 5$

2. Show a graphic representation of vector addition wherein you work with $z_1 = 3 + 5i$ and $z_2 = -4 - 2i$. Then show the result of $z_1 + z_2$. How about vector subtraction ➔ try $z_1 - z_2$ and then $z_2 - z_1$

3. Here is a link to an animation showing a new definition of a parabola ➔ a locus definition of a parabola. Adjust the slider to "p" and a set of points will be produced, forming the shape of a parabola.

   https://www.geogebra.org/m/B8FNy9v5 and then this video https://www.youtube.com/watch?v=Ct-AoSbvPQY

   a. Define the terms: (i) locus, (ii) focus, (iii) directrix
   b. Determine the equations of these parabolas, given the following conditions:
      i. The focus is at (0,-3) and the vertex is at the origin.
      ii. The directrix is the line $2x + 10 = 0$ and the vertex is at the origin.
      iii. The focus is on the x-axis, the parabola goes through the point (5,2) and the vertex is at the origin.
      iv. The directrix is the line $x = -3$, the focus is at (7,2) and the parabola goes through the point (9,10).

4. Find all values for m for which the roots of $2x^2 - mx - 8 = 0$ differ by $m - 1$.