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. (CI – ideally) Given that $f(x) = x^2 - 3x + 5$ and that $g(x) = -2x^2 - x + 10$, {1,12,26}
   a. Which value is greater, $f(1)$ or $g(1)$?
   b. Solve $f(x) = g(x)$ and explain what your solution means.
   c. HENCE or otherwise, solve $f(x) > g(x)$ and explain how you can verify that your solution is correct.

2. A motion detector records the height of a baseball, ***h*** in meters, ***t*** seconds after it is hit into the air. The relation is $h(t) = -4.9t^2 + 20.58t + 0.49$. {9,10,15,16}
   a. From what height was the ball hit?
   b. For how long was the ball in flight?
   c. What was the maximum height of the ball?
   d. What is the equation of the inverse & what does the inverse equation represent?

3. For the quadratic function $y(x) = 2(x - 3)^2 - 11$; {10,12}
   a. Find the zeroes by using the square root method.
   b. Expand the equation and then find the zeroes using the QF
   c. Which method is easier? Why?

4. A company prints and sells math textbooks. Their revenues are modelled by the quadratic equation $R(b) = -0.1b^2 + 15b - 120$, where R is revenue in tens of thousands of dollars for the sale and printing of b thousands of textbooks. The expenses for printing and selling the b thousands of textbooks (E, in tens of thousands of dollars) are given by the linear equation $E(b) = 100 + b$. {9,10,15,16}

   a. What is the profit/loss if 30,000 books are printed & sold? If 130,000 books are printed & sold?

   b. How many books must be printed and sold is the profit is to be $1,800,000?

   c. How many books must be printed & sold if the company is to break even?

   d. When does the company achieve its maximum profit? What is the maximum profit?

   e. When does the company lose money? Explain how you know.

5. Go on line and find out what a **DISCRIMINANT** of a quadratic equation refers to. Then, determine the value of the discriminants in: {13}

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

6. Based on the discriminant, indicate how many and what type of solutions there would be given the following equations. Explain what it (number of solutions that is) means. Show a diagram to demonstrate your understanding {13}

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

7. Given the following quadratic equations ➔ $f(x) = 3x^2 - 6x + 4$ and $g(x) = -4x^2 - x + 2$, answer the following analysis questions: {19}

   a. Use your TI-84 GDC to prepare a data table for all x values between x = -1 and x = 7.

   b. Use these values to calculate the **first differences**.

   c. Then, determine the **second differences**. What do you notice?

   d. Double the value of the leading coefficient in both functions and re-determine the first and second differences. What do you notice?

   e. In terms of this idea of "differences", what would you expect for the for the polynomial $h(x) = -2x^3 + x^2 + -3x + 4$. Explain your reasoning.

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

1. Solve the system $\begin{cases} y = x^2 + 4x + 6 \\ y = mx + 5 \end{cases}$ for m such that there exists only one unique solution. The line(s) $y = mx + 5$ are called tangent lines ➔ WHY?

2. Add or subtract the following complex numbers.

   a. (3 + 2i) + (3 + i) b. (4 − 2i) − (3 − 2i) c. (−1 + 3i) + (2 + 2i)

   d. (2 − 5i) − (8 − 2i)

3. Multiply the following complex numbers.

   a. (3 + 2i)(3 + i) b. (4 − 2i)(3 − 2i) c. (−1 + 3i)(2 + 2i)

   d. (2 − 5i)(8 − 3i) e. (2 − i)(3 + 4i)

4. Perform the following divisions:

   a. $\dfrac{2+4i}{i}$ b. $\dfrac{-2+6i}{1+2i}$ c. $\dfrac{1+3i}{2+i}$ d. $\dfrac{3+2i}{3-i}$