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. A chain of ice cream stores sells $840 of ice cream per day. Each ice cream costs $3.50. Market research shows the following trend in revenue as the price of an ice cream cone is reduced. {18,19,20}

Price ($)	3.50	3.00	2.50	2.00	1.50	1.00	0.50
Revenue ($)	840	2520	3600	4080	3960	3240	1920

   a. Create a scatter plot and draw the curve of best fit

   b. Calculate the **second differences** in this data set. What do you notice?

   c. Determine an equation in vertex form to model this relation.

   d. Use your model to predict the revenue if the price of an ice cream cone is reduced to $2.25.

   e. To maximize the revenue, what should an ice cream cone cost?

   f. Check the accuracy of your model using quadratic regression.

2. Use the quadratic formula to solve the following quadratric equations. Round all final answers to 2 decimal places. Verify your answers using POLYSMLT2 on your TI-84 GDCs as well as verifying on DESMOS. {10}

   a. $x^2 - 4x - 1 = 0$

   b. $6x^2 - x - 15 = 0$

   c. $-3x^2 + 12x + 7 = 0$

   d. $3x(x - 4) = (4x - 1)^2$

3. Expand the following {7}

   a. $(x - 5)(x + 5)$
   b. $(4 - 3x)(4 + 3x)$
   c. $4(x + 3)(x - 3)$
   d. $(2x - 3y)(2x + 3y)$
   e. $(e^x - \sqrt{3})(e^x + \sqrt{3})$
   f. $(2x - y - 3)(2x + y + 3)$

4. Factor the following expressions: {7,8,14}

   a. $x^2 - 16$
   b. $4x^2 - 1$
   c. $121 - 16x^2$
   d. $x^4 - 16$
   e. $16x^2 - \frac{1}{9}$
   f. $\frac{1}{25}x^2 - 3$

5. Solve the following "diffference of squares" quadratic equations, given your work in Q2. {9,11,12,14}

   a. $x^2 - 16 = 0$
   b. $4x^2 - 1 = 0$
   c. $121 - 16x^2 = 0$
   d. $x^4 - 16 = 0$
   e. $16x^2 - \frac{1}{9} = 0$
   f. $\frac{1}{25}x^2 - 3 = 0$

6. The graphs of the quadratic equations given in Q4 & Q5 all have the same "one thing" in common. What is it and how did you figure it out?

7. Write an equation of a parabola that has zeroes at $x = -3$ and $x = 2$ and passes through the point (4,5). Write your final answers using ALL THREE FORMS of quadratic equations. {8,18}

8. Sasha wants to build a walkway of uniform width around a rectangular flower bed that measures 20m x 30m. Her budget is $6000 and it will cost her $10/m² to construct the path. {16,17}

   a. To help understand the problem, start by drawing a diagram, showing the path and the flower bed.

   b. Show that the quadratic equation $A(x) = (30 + 2x)(20 + 2x) – 600$ can be used to model the area of the walkway around her garden.

   c. How wide will the walkway be?

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

Nottingham Castle below is a daunting castle to attack. It has enormous 50 meter high walls that are 10 meters thick. There are archers on the castle walls firing arrows to stop the rescue attempt of Maid Marion. You must therefore be no closer to the castle than 100 meters. Your target is the Sheriff of Nottingham. He is in his parlor 20 meters inside the walls of the castle, sitting 10 meters above the ground.

Q1: Using any suitable strategy, find an equation that models a reasonable flight path of a successful projectile that is catapaulted over the castle walls – the aim is to hit the sheriff. VERIFY that your model "works"

Q2: Explain how your model would change if the wall were 75 meters high and the archers could only fire to a distance of 50 meters from the wall.

Sketch of what's happening: