

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. (CA) A ball is thrown from the rooftop of a building and the relationship between its height (in meters) and time of flight (in seconds) is modeled by the equation $h(t) = -5t^2 + 5t + 30$. Graph the function on your TI-84 and use the TI-84 to answer the following questions: {4,5,6,15,16}

- a. State your Window Settings from the TI-84
- b. How tall is the building?
- c. When will the ball hit the ground?
- d. the domain and range (in context)
- e. When does the ball reach its highest point? How high?
- f. Sketch the function
- g. Factor the equation $h(t) = -5t^2 + 5t + 30$ and HENCE explain how you could use algebraic skills to perform the SAME analysis

2. Expand and simplify the following binomial products: {7,8}

- | | | | |
|---------------------|-----------------------|--------------------------------|------------------------|
| a. $(x + 8)(x + 4)$ | b. $-(a - 8)(2a + 3)$ | c. $\frac{1}{2}(x + 8)(x - 6)$ | d. $(2x - 5)^2$ |
| e. $(x - 6)(x + 6)$ | f. $5(t - 9)(6 - t)$ | g. $-5(t - 13)(3t + 2)$ | h. $(2x - 1)(x - 4)^2$ |

3. Factor the following trinomials: {7,8}

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|-------------------|---------------------|--------------------|---------------------|
| a. $x^2 + 5x + 4$ | b. $x^2 + 15x + 50$ | c. $x^2 + 5x - 24$ | d. $x^2 + 6x - 72$ |
| e. $x^2 - 6x + 9$ | f. $x^2 - 36$ | g. $x^2 + x - 72$ | h. $x^2 - 10x + 24$ |

4. (CA) Use your TI-84 to graph $f(x) = -2x^2 + 6x + 10$ in an appropriate view window and then use the TI-84 to determine the following. Finally, sketch the parabola, labeling the key points/features; {3,4,6}
- | | | |
|------------------------------|-----------------|------------------------|
| (i) Window Settings on TI-84 | (ii) Zeroes | (iii) Axis of Symmetry |
| (iv) Optimal point | (v) y-intercept | (vi) Sketch |
5. (CA) Use your TI-84 to graph $f(x) = \frac{1}{2}(x - 4)(x + 10)$ in an appropriate view window and then use the TI-84 to determine the following. Finally, sketch the parabola, labeling the key points/features; {3,4,6}
- | | | |
|------------------------------|-----------------|------------------------|
| (i) Window Settings on TI-84 | (ii) Zeroes | (iii) Axis of Symmetry |
| (iv) Optimal point | (v) y-intercept | (vi) Sketch |
6. (CA) Use your TI-84 to graph $f(x) = 2(x + 4)^2 - 18$ in an appropriate view window and then use the TI-84 to determine the following. Finally, sketch the parabola, labeling the key points/features; {3,4,6}
- | | | |
|------------------------------|-----------------|------------------------|
| (i) Window Settings on TI-84 | (ii) Zeroes | (iii) Axis of Symmetry |
| (iv) Optimal point | (v) y-intercept | (vi) Sketch |
7. (CA) The profits of a company in its first 13 months of operations are modelled by the quadratic function $P(m) = -\frac{1}{4}(m - 6)^2 + 4$ where m is the number of months (and $m = 1$ represents January 1st) and $P(m)$ is measured in billions of pesos. {7,9,15,16}
- Explain why the domain of the function is $\left\{m \in \mathbb{Z}^+ \mid 0 \leq m \leq 13\right\}$.
 - Determine when the company “breaks even”.
 - Determine in which month the company maximizes its profits.
 - What are the company’s maximum profits?
 - Solve and interpret $P(m) < 0$ given that the domain is $\left\{m \in \mathbb{Z}^+ \mid 0 \leq m \leq 13\right\}$
 - For what values of m are the profits DECREASING? Explain how you determined your answer.
 - Solve $P(m) = -12$ and interpret



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

1. Mr. S. can sell 500 apples per week when he charges 50 cents per apple. Through market research, his wife (being smarter than Mr. S of course) knows that for every price increase of 2 cents per apple, he will sell 10 less apples. {7,9,15,16}
 - a. Determine an equation that can you used to model Mr. S.'s expected revenues.
 - b. What price should he charge to maximize his revenues?
 - c. What is his maximum revenue?
 - d. How many price increments are required such that his business has NO revenue?

2. 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 $E(b) = 100 + b$. {7,9,15,16}
 - 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.

3. A selection of contest questions from the Canadian Mathematics Competition:
 - a. If $f(x) = x^2 - 7x + k$ and $f(k) = -9$, then find the value of $f(-1)$
 - b. Find the shortest distance between the parabola $f(x) = 4x^2 + 2$ and $g(x) = -3x^2 - 4$
 - c. Find the minimum value of the function $f(x) = 2^{x^2-2x}$.
 - d. Given that m and n are the roots of the equation $7x^2 + 9x + 21 = 0$, find the numerical value of $(m + 7)(n + 7)$.