IM2 Problem Set 6.1 - Working with Quadratic Functions

BIG PICTURE of this UNIT:	• How do we analyze and then work with a data set that shows both increase and decrease • What is a parabola and what key features do they have that makes them useful in modeling applications • How do I use graphs, data tables and algebra to analyze quadratic functions? • How can I use graphs and equations of quadratic relations to make predictions from data sets & their models

1. (CI) Simplify the following polynomial expressions:

    a. $2x(3x + 1) + 5(3x + 1)$
    b. $x(x + 5) - 6(x + 5)$
    c. $3(2x^2 - 1) + 6(2x - 3) - (2x^2 - 5x)$

2. (CI) Given the pattern …..2,4,8,14,22,32,44, ….

    a. How do you know the pattern is NOT linear?
    b. How do you know the pattern is NOT exponential?
    c. What are the next three terms of the sequence
    d. What are the 3 terms that came **before** 2?

3. (CA) Use your calculator and a standard view window to graph and analyze the following functions: (Your analysis will include the domain, range, asymptotes (if any), and x- and y-intercepts (if any))

    a. $f(x) = x - 4$ b. $f(x) = 2^x - 4$ c. $f(x) = x^2 - 4$

4. (CA) In a football game, Youssef tries kicking the football and the path that the ball travels can be modeled by the function $h(x) = x - \frac{1}{10}x^2$, where h is the height above the ground, in meters, and x is the horizontal distance travelled, in meters, by the ball.

    a. Evaluate $h(2)$ and explain what this means in the context of the problem.
    b. Graph the function on your calculator. Write down the window settings that allow you to see the important details of the function.
    c. When does the ball reach its maximum height? What is the maximum height of the ball?
    d. How far forward does the ball travel?
    e. What would the domain and range for this function in this context be?

5. (CI) For the following equations, find the value of x that makes the equation true.

a. (i) $2x - 4 = 0$ (ii) $\frac{1}{2}x - 4 = 0$ (iii) $2^x - 4 = 0$ (iv) $2^x + 4 = 0$
b. (i) $x^2 - 4 = 0$ (ii) $x^2 - x - 2 = 0$ (iii) $x^2 - 2x - 8 = 0$

6. (CI) Apply the distributive property to simplify the following polynomial expressions:

a. $(x + 3)(2x + 4)$ b. $(y + 2)(y - 1)$ c. $(2x + 3)(3x - 5)$

7. (CI) For the function $f(x) = x^2$, prepare a data table and then graph the data and draw a smooth curve through the data points you have generated from the function.

x	-4	-3	-2	-1	0	1	2	3	4
$f(x)$									

Then determine:

a. the domain and the range of $f(x)$;
b. the vertex of the curve;
c. is the curve symmetrical? Where might the axis of symmetry be?

8. (CA) You are provided with data showing the population of Namibia since 1950. NOTE #1: we are using $t = 0$ to represent the year 1950. NOTE #2: population values are in thousands.

year, t	0	5	10	15	20	25	30	35	40	45	50
population	511	561	625	704	800	921	1018	1142	1409	1646	1894

a. Graph the scatter plot on your calculator. Record your window settings.
b. Find a quadratic regression equation for the population data.
c. Then, estimate the population of Namibia in the years 1940, 1997 and 2005. NOTE: population values are in thousands.
d. Find an exponential regression equation for the data as well and compare the "fit" of the two models. Which model seems to be a 'better fit"?

9. (CA) For the following quadratic functions, (i) $f(x) = (x + 2)(x + 6)$ and $g(x) = -2(x – 5)(x + 7)$

a. Graph them on your calculator.
b. Find the vertex
c. Find the x-intercepts
d. Explain why we call this form of a quadratic equation "factored form" or "intercept form."

EXTENSION PROBLEMS

10. **Graphs of Quadratic Functions – Geogebra and translation vectors**

    a. Use GEOGEBRA to graph the function $f(x) = x^2$.

    b. Create a vector.

    c. Now use the "translate by vector" tool and apply it to the function $f(x)$. Describe what happens to the quadratic function.

    d. Now let's all create the translation vector and apply it to $f(x)$.

       i. State the coordinates of the vertex ==> is there a connection to translation vector?
       ii. State the domain and range of the function è is there a connection to translation vector?
       iii. Is the parabola symmetrical? If so, where is the line of symmetry? è is their a connection to translation vector?

    e. ***KEY POINT***: Write down the new "equation" of this quadratic function and explain how the equation of the quadratic function is related to the translation vector.

11. https://nrich.maths.org/773

12. https://brilliant.org/daily-problems/cross-square/