(A) Lesson Context

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 equations?		
CONTEXT of this LESSON:	Where we've been In Lesson 3, you investigated the main features of the graphs of parabolas and how to find these features using a graph or graphing calculator	Where we are How can we use the equation & algebra to help find the special features of the graphs of quadratic relations – so is there a graph & algebra connection	Where we are heading How can I use graphs of quadratic relations to make predictions from quadratic data sets & quadratic models and quadratic equations

(A) Lesson Objectives

a. Introduce the factored form of the equation of a quadratic relation by means of investigations
b. Determine how to calculate the key features of a parabola from its equation in factored form
c. Present real world applications involving zeroes or parabola

(B) Investigation – Investigating the Graphs of Quadratic Functions & Factored Form

QUESTION ➔ All of the quadratics you will graph are presented in the form of $y = \boldsymbol{a}(x - \boldsymbol{s})(x - \boldsymbol{t})$. How do the values of $\boldsymbol{a}, \boldsymbol{s}, \boldsymbol{t}$ affect the graph?

To record your groups findings & ideas ➔ open a google doc & share it with your group members & with me

1. Use a graphing calculator (or use www.desmos.com) to graph $y = \boldsymbol{a}(x - 2)(x + 6)$ when $\boldsymbol{a} = 3$. Describe what happens to the graph as you change the value of $\boldsymbol{a}$ to 2, 1, ½, ¼ , 0, -1, -2, -3. Include sketches. Where is the axis of symmetry in each parabola?

2. Graph $y = 2(x - \boldsymbol{s})(x + 5)$ when $\boldsymbol{s} = 3$. Describe what happens to the graph as you change the value of $\boldsymbol{s}$ to 2, 1, 0, -1, -2, -3. Include sketches.

3. Find the axis of symmetry of each parabola you investigated in Q2.

4. Which of the quantities $\boldsymbol{a}$, $\boldsymbol{s}$, or $\boldsymbol{t}$ affects whether the graph has a maximum or a minimum value? How can you PREDICT where a parabola has a maximum or minimum?

5. Which of the quantities $\boldsymbol{a}$, $\boldsymbol{s}$, or $\boldsymbol{t}$ affects where the graph has a zeroes? How can you PREDICT where a parabola has its zeroes?

(C) Consolidation of Investigations ➔ Key Points

a. Equations in the form of y = ***a***(x – ***s***)(x – ***t***) are_____, provided that _____.

b. The equation written the form y = ***a***(x – ***s***)(x – ***t***) is said to be in _____.

c. If a > 0, the parabola opens _____and has _____.

d. If a < 0, the parabola opens _____and has _____.

e. The zeroes of the quadratic can be determined by setting _____and solving_____.

The zeroes are then located _____.

f. If the zeroes are known, then the axis of symmetry can be found ➔_____.

g. Once the axis of symmetry is known, the optimal value can be found ➔_____.

h. The value of ***a*** can be determined IF_____. All known values are substituted

into y = ***a***(x – ***s***)(x – ***t***) and then solve for ***a***.

*(D)**Examples***

a. Ex 1 ➔ For the quadratic relation y = (x + 3)(x – 4), determine:

- ***i.*** The direction of opening.
- ***ii.*** The zeroes
- ***iii.*** The optimal point.
- ***iv.*** The y-intercept.
- ***v.*** Sketch the parabola.

b. Ex 2 ➔ The zeroes of a parabola are -3 and 5. The graph crosses the y-axis at -75. Determine:

- ***i.*** if the relation have a maximum or minimum value?
- ***ii.*** the equation of the quadratic relation.
- ***iii.*** the co-ordinates of the vertex.
- ***iv.*** Sketch the parabola.

c.

5. For each relation, state

i. the x-intercepts

ii. the equation of the axis of symmetry

iii. the coordinates of the vertex

(a) $y = (x + 4)(x + 2)$

(b) $y = (x + 5)(2 - x)$

(c) $y = (4 + x)(1 + x)$

(d) $y = (1 - x)(3 + x)$

(e) $y = (x - 3)(2 - x)$

(f) $y = (x + 1)(x - 4)$

(g) $y = 3(x + 1)(x - 3)$

(h) $y = -2(x + 3)(x - 3)$

d.

7. Sketch a graph for each relation. Do not make a table of values or use graphing technology.

(a) $y = (x + 3)(x + 5)$

(b) $y = (x - 3)(x - 5)$

(c) $y = (x - 6)(x - 2)$

(d) $y = -(x - 1)(x - 2)$

(e) $y = 3(x - 5)(x + 1)$

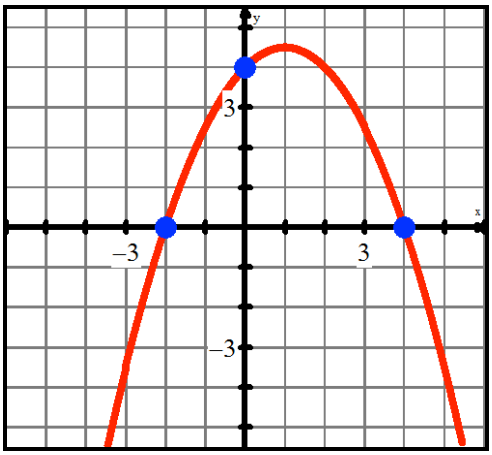
(f) $y = -2(x + 2)(x + 1)$

(g) $y = \frac{1}{2}(x - 4)(x - 2)$

(h) $y = -2(3 - x)(5 - x)$

(i) $y = 10(x - 1)(x + 6)$

e. Determine the equation of the parabola graphed below



(E) Application/Context Problems

a. Ex 1 ➔ Mr. S throws a ball upward from the roof of the building that is 25m tall. The ball reaches a height of 45m above the ground after 2s and hits the ground 5s after being thrown.

- ***i.*** Draw an accurate graph of the height of ball and the time in flight.
- ***ii.*** What are the zeroes of the relation?
- ***iii.*** What are the co-ordinates of the vertex?
- ***iv.*** Determine an equation that models this situation.
- ***v.*** What is the meaning of each zero?

b. Ex 2 ➔ a company called SAMSOONG introduces a new cellphone and its PROFITS are modelled by the equation $P(m) = -5m^2 + 80m - 100$ where m is time in months and P(m) is the profit in millions of dollars. The cellphone is sold for a period of 2 years.

- ***i.*** Graph the profit function on your TI-84.
- ***ii.*** Calculate the zeroes of the quadratic and interpret what they mean.
- ***iii.*** Write the equation in factored form, given your work in (ii).
- ***iv.*** Calculate the co-ordinates of the vertex and interpret.
- ***v.*** Evaluate P(5) and interpret.
- ***vi.*** Solve P(m) = -25 and interpret
- ***vii.*** Solve P(m) < 0 and interpret
- ***viii.*** For what values of m are the profits DECREASING? Explain how you determined your answer.