(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 & 4, you looked at and analyzed for key features of graphs of parabolas	Where we are Equations for quadratic relations can be written in three forms and each form communicates key information about the features of a parabola	Where we are heading How can I use graphs and equations to make predictions from quadratic data sets & quadratic models and quadratic equations

(B) Lesson Objectives:

a. Understand the connection between the standard form of a quadratic equation and the y-intercept of a parabola
b. Understand the connection between the factored form of a quadratic equation and the zeroes of a parabola
c. Understand the connection between the vertex form of a quadratic equation and the maximums/minimums of a parabola
d. Start to see how additional features of a parabola can be determined from an equation (i.e how can an axis of symmetry be predicted from factored form? How can the zeroes be predicted from vertex form?)

(C) Algebra Skills – REVIEW

a. Expanding →

http://mrsantowski.tripod.com/2014IntegratedMath2/Homework/Distribution_WS.pdf

b. *Factoring →*

http://mrsantowski.tripod.com/2014IntegratedMath2/Homework/GCF_Factoring.pdf

(C) STANDARD FORM:

Use DESMOS to complete the observation table below:

EQN	y-int	x-int (zeroes)	vertex	axis of symmetry
$y = x^2 + 4x - 12$				
$y = x^2 - 5x + 6$				
$y = x^2 - 5x$				
$y = x^2 + 12x$				
$y = x^2 + 3x - 8$				
$y = x^2 + 8x + 16$				
$y = x^2 + 2x + 3$				
$y = x^2 + 4x - 12$				
$y = 2x^2 + 4x - 12$				
$y = 4x^2 + 4x - 12$				

Which feature is EASIEST TO PREDICT given the form of the equation?

How can you PREDICT where the ***axis of symmetry*** is FROM THE EQUATION?

(D) FACTORED FORM:

Use DESMOS to complete the observation table below:

EQN	y-int	x-int (zeroes)	vertex	axis of symmetry
$y=(x+3)(x-5)$				
$y=(x-2)(x-6)$				
$y=x(x-7)$				
$y=(x-3)^2$				
$y=(x-4)(x-2)$				
$y=2(x-4)(x-2)$				
$y=-3(x-4)(x-2)$				
$y=(4-x)(x-2)$				
$y=(2x-2)\left(\frac{1}{2}x-4\right)$				
$y=(3x-2)(3x-4)$				

Which feature is EASIEST TO PREDICT given the form of the equation? How?

How can you PREDICT where the axis of symmetry is FROM THE EQUATION?

(E) VERTEX FORM:

EQN	y-int	x-int (zeroes)	vertex	axis of symmetry
$y=(x-1)^2-4$				
$y=(x+1)^2-9$				
$y=(x+4)^2+6$				
$y=(x-3)^2$				
$y=-(x-4)^2+4$				
$y=-(x+2)^2-1$				
$y=-\left(x-\frac{1}{2}\right)^2+2$				
$y=\frac{1}{2}(x+4)^2-2$				
$y=2(x+5)^2-8$				
$y=(3x-2)^2-9$				

Which feature is EASIEST TO PREDICT given the form of the equation?

How can you PREDICT where the zeroes are FROM THE EQUATION?

(F) SUMMARY OF KEY POINTS OF LESSON 5:

EQUATION FORM	EQUATION	KEY FEATURE	EXTENSION ➔ ADDITIONAL FEATURE:
(1) Standard Form			
(2) Factored Form			
(3) Vertex Form			

Example ➔ Mr. S throws a ball upward from the roof of the building that is 32m tall. The ball reaches a maximum height of 50m above the ground after 3s and hits the ground 8s after being thrown.

a. Draw an accurate graph of the height of ball and the time in flight.
b. What are the zeroes of the relation?
c. What are the co-ordinates of the vertex?
d. Determine an equation that models this situation.
e. What is the meaning of each zero?

(D)<u>Consolidation of Investigation with VERTEX FORM ➔ Key Points</u>

a. Equations in the form of $y = \boldsymbol{a}(x - \boldsymbol{h})^2 + \boldsymbol{k}$ are______________________, provided that ____________.

b. The equation written the form $y = \boldsymbol{a}(x - \boldsymbol{h})^2 + \boldsymbol{k}$ 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 vertex of the quadratic is located at _________________________________.

f. The axis of symmetry can be found ➔ ______________________________.

g. The optimal value can be found ➔ ___________________________.

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

into $y = \boldsymbol{a}(x - \boldsymbol{h})^2 + \boldsymbol{k}$ and then solve for ***a***.

i. The zeroes of the quadratic can be determined by setting __________and solving___________________.

The zeroes are then located _________________________________.

*(E) **Examples***

a. Ex 1 ➔ For the quadratic relation $y = 2(x + 3)^2 - 8$, determine:

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

b. Ex 2 ➔ The vertex of a parabola is at (-3,5). The graph crosses the y-axis at 23. Determine:

- ***i.*** if the relation has a maximum or minimum value?
- ***ii.*** the co-ordinates of the vertex.
- ***iii.*** the equation of the quadratic relation.
- iv. The co-ordinates of the point opposite the y-intercept
- ***v.*** Sketch the parabola.

c. Ex 3 ➔ Mr. S throws a ball upward from the roof of the building that is 32m tall. The ball reaches a maximum height of 48m above the ground after 3s.

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