

**A. Lesson Context**

|                           |   |  |  |
|---------------------------|---|--|--|
| BIG PICTURE of this UNIT: | <ul style="list-style-type: none"> <li>• How &amp; why do we build NEW knowledge in Mathematics?</li> <li>• What NEW IDEAS &amp; NEW CONCEPTS can we now explore with specific references to QUADRATIC FUNCTIONS?</li> <li>• How can we extend our knowledge of FUNCTIONS, given our BASIC understanding of Functions?</li> </ul> |  |  |
| CONTEXT of this LESSON:   | <p>Where we've been</p> <p>In Lesson 2, you worked with connected transformed parabolas to the form of quadratics as <math>y = a(x - h)^2 + k</math></p>  | <p>Where we are</p> <p>HOW do we ALGEBRAICALLY work with quadratic models in the vertex form</p> | <p>Where we are heading</p> <p>How do we extend our knowledge &amp; skills of quadratic functions, given the new ideas &amp; concepts we now know about functions.</p> |

**B. Lesson Objectives**

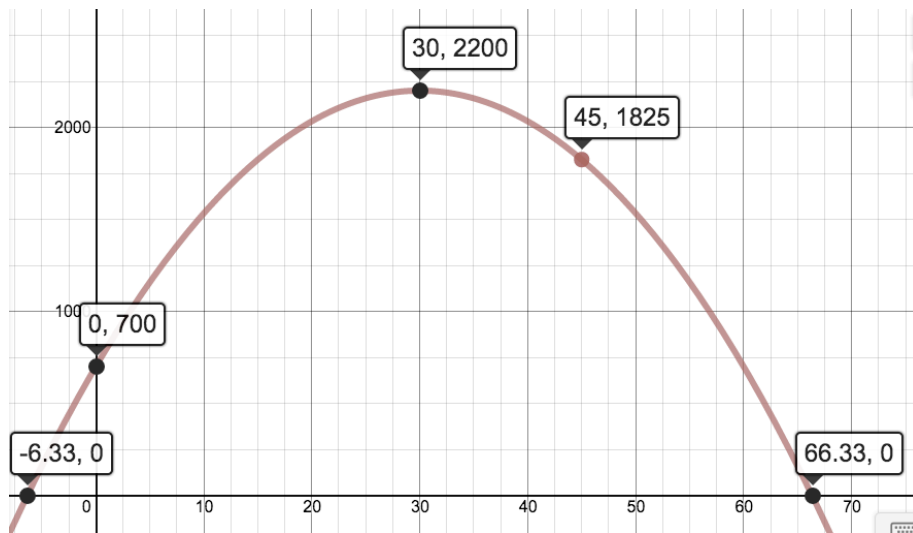
- Graph/Sketch graphs of parabolas when given equations in vertex form
- Evaluate and solve quadratic equations when equations are in vertex form
- Write equations of graphs of parabolas using vertex form
- Apply previous concepts of inverses and transformations to parabolas when written in vertex form

**C. Fast Five** (Skills Review Focus)

|   |   |
|---|---|
| <p>Solve the equation:</p> $0 = (x + 2)^2 - 9$            | <p>Factor <math>3x^2 - x - 2</math> and then solve for x.</p> |
| <p>Expand the expression <math>-2(x + 3)^2 - 7</math></p> | <p>Expand <math>(4 - 3x)^2</math></p>                         |

**D. Modeling with Quadratic Functions (Context)**

Mr S's sister is a motorcycle instructor and runs a training school. Because she works for herself, she can charge any amount (as an hourly charge) that she wishes. She keeps track of her hourly fees and her profits and has prepared a graph showing the relationship between her hourly wages and her profits.



In this relation, the variables:

X represents the hourly fee my sister charges

Y represents the monthly profit she makes

(a) State a reasonable domain and range for this relationship, given the context of the problem

(b) State the coordinates of the vertex and explain its meaning in this context.

(c) State the zero(s) of the relation and explain its meaning in this context.

(e) Evaluate  $P(45)$  and explain its meaning.

(d) HENCE, write the equation in FACTORED form.

(f) Evaluate  $P(15)$  and explain your thinking.

(g) Determine the equation for this relation in VERTEX form. Show your work

(h) My sister would like to know what hourly fee OPTIMIZES her profits?

**E. Quadratic Algebra: Working with Vertex Form (Example #1)**

To sketch the parabola defined by  $f(x) = -2(x + 3)^2 + 12$ :

(i) State the equation of the axis of symmetry.

(ii) State the location of the vertex.

(iii) Evaluate  $f(0)$

(iv) Evaluate  $f(-7)$

(v) State the location of a point “symmetrically opposite” to the y-intercept

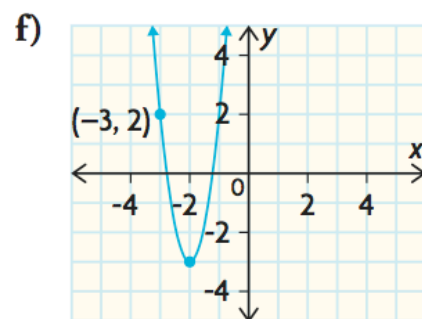
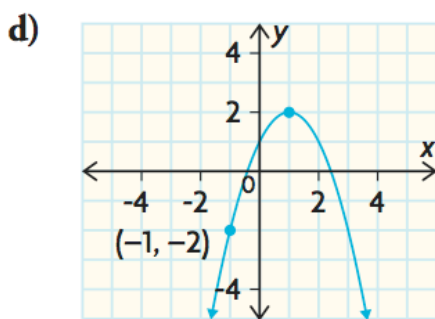
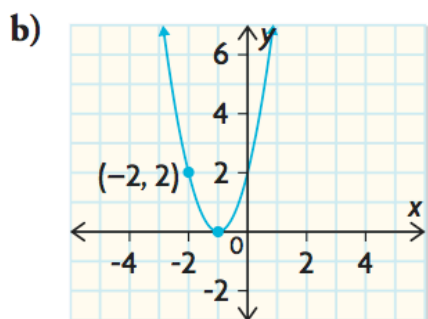
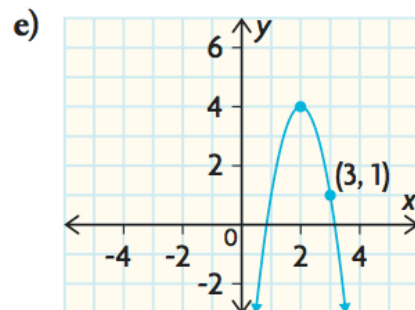
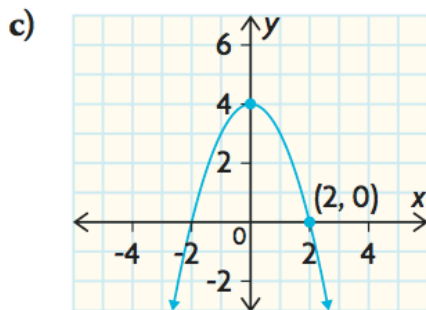
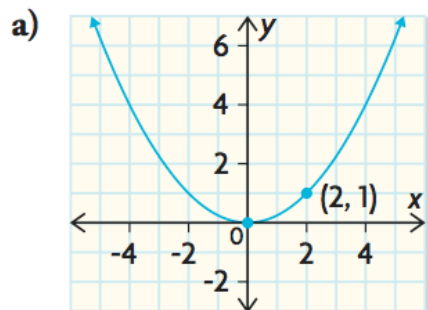
(vi) Solve for  $x$  if  $f(x) = 0$ . Round your answer(s) to two decimal places

(vii) Solve  $f(x) = -60$

(viii) Write the equation of the INVERSE function of  $f(x)$  and write it in  $f^{-1}(x)$  notation.

**F. Quadratic Algebra: Working with Vertex Form: Equation Writing (Example #2)**

Write the equation of each parabola in vertex form.



Show key steps of your solutions:

(a)

(b)

(c)

(d)

(e)

(f)

**G. Quadratic Algebra: Converting between Vertex Form & Standard Form (Example #3)**

(a) TASK A: Convert between forms of equations:

(b) TASK B: Write the equation of the INVERSE RELATION of each parabola in the left column. Graph it on DESMOS

Vertex to Standard

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

Standard to Vertex (HINT:  $x = -b/2a$ )

$$y = x^2 + 4x - 12$$

$$y = -3(x + 4)^2 + 24$$

$$y = 2x^2 - 20x - 80$$

$$y = -\frac{1}{2}(x + 10)^2 - 22$$

$$y = 4x^2 + 20x + 25$$

**H. Quadratic Algebra: Fitting Data (Example #4)**

Mr S's sister is a motorcycle instructor and runs a training school. Because she works for herself, she can charge any amount (as an hourly charge) that she wishes. She keeps track of her hourly fees and her profits and has prepared a DATA TABLE showing the relationship between her hourly wages and her profits.

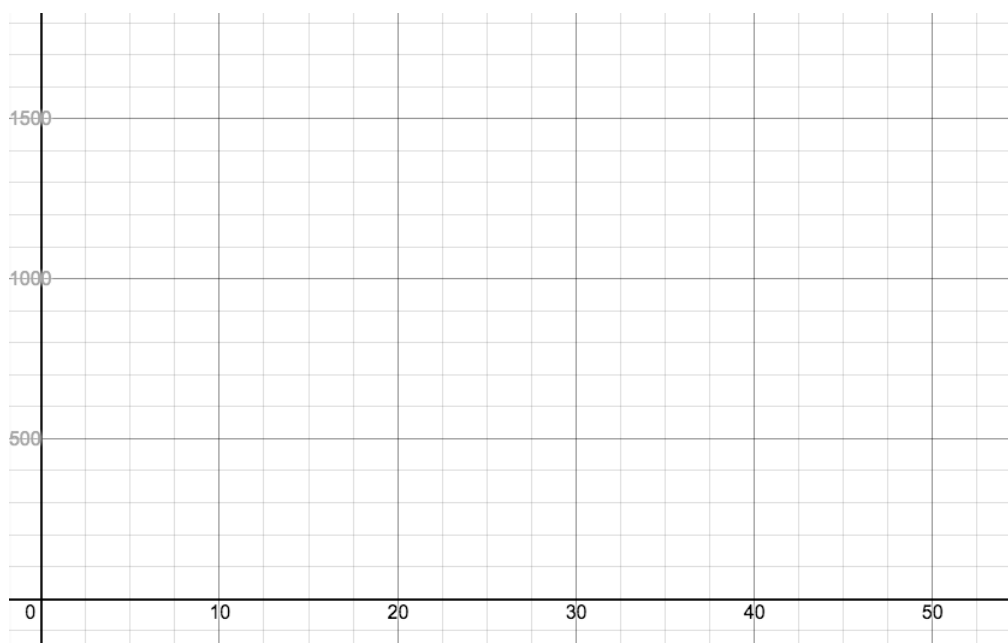
Here is her data set

|            |      |      |      |      |     |     |      |
|------------|------|------|------|------|-----|-----|------|
| Hourly fee | 10   | 22   | 31   | 17   | 45  | 51  | 38   |
| profit     | 1300 | 1750 | 1700 | 1600 | 950 | 400 | 1400 |

In this relation, the variables:

X represents the hourly fee my sister charges

Y represents the monthly profit she makes



(a) Graph the data points

(b) Draw the parabola that best fits the data set as well as you can.

**I. Quadratic Algebra: CONSOLIDATION (Example #5)**

- Determine the equation of a parabola whose vertex is at  $(-4, 12)$  and goes through the point  $(2, -6)$ . Write the equation in vertex & in standard form
- Determine the y-intercept of this parabola.
- Determine 2 other points of the parabola (HINT: its easy to use symmetry).
- Explain how the parent function  $y = x^2$  was transformed.
- Find the zeroes of the parabola and HENCE write the equation in factored form.
- Sketch the parabola, labelling the points you determined in previous questions.