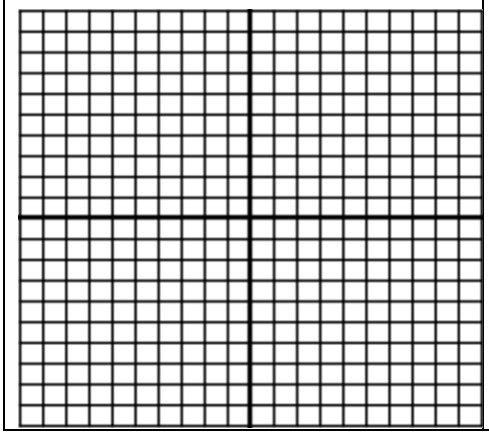
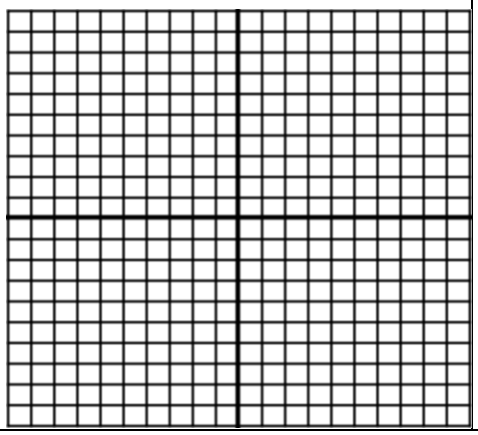
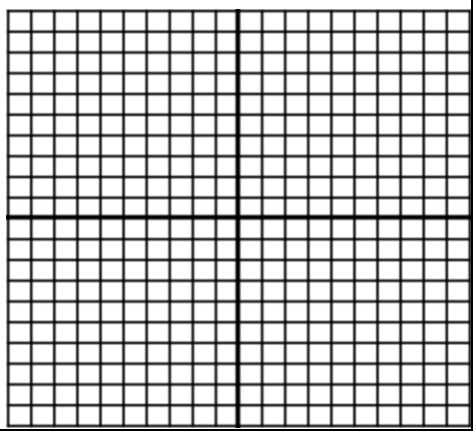
Module 3: Quadratic Functions

Lesson 1: Graphing Quadratic Functions

* Graph each. Identify Coordinates of the Vertex (min or max?), the equation of the Axis of Symmetry and the Domain/Range.

2. $f(x) = (x-5)^2$	3. $g(x) = 2x^2 + 3$	4. $h(x) = -(x+1)^2$
		

Vertex or Graphing Form	Standard Form
$y = a(x-h)^2 + k$	$y = ax^2 + bx + c$

Module 3: Lesson 1 – Example 3

Use Quadratic Functions

SKIING A ski resort has extended hours on one holiday weekend per year. Last year, the resort sold 680 ski passes at $120 per holiday weekend pass. This year, the resort is considering a price increase. They estimate that for each $5 increase, they will sell 20 fewer holiday weekend passes.

Module 3: Lesson 1 – Extra Example 2

Compare Quadratic Functions

Compare $f(x) = -2x^2 + 8x - 4$ to the quadratic function $g(x)$ shown in the table. Which function has a greater maximum?

x	$g(x)$
0	–5
1	4
2	7
3	4
4	–5

Module 3: Lesson 1 – Example 4

Find Average Rate of Change from an Equation

Determine the average rate of change of $f(x) = -x^2 + 2x - 1$ over the interval $[-4, 4]$.

Module 3: Lesson 1 – Example 5

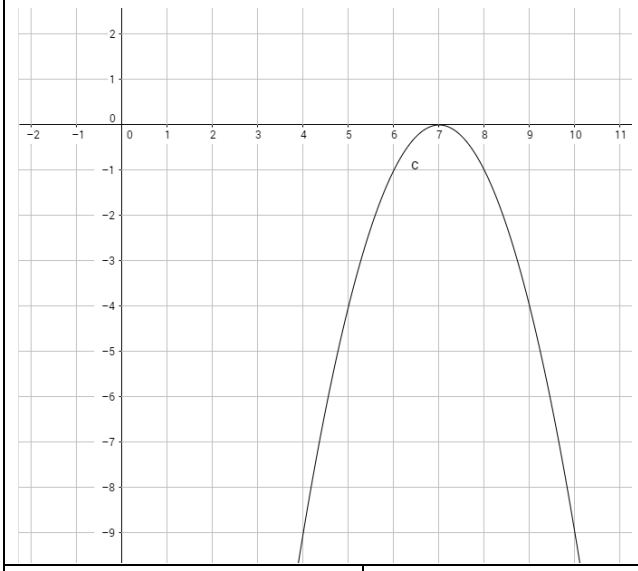
Find Average Rate of Change from a Table

Determine the average rate of change of $f(x)$ over the interval $[-3, 3]$.

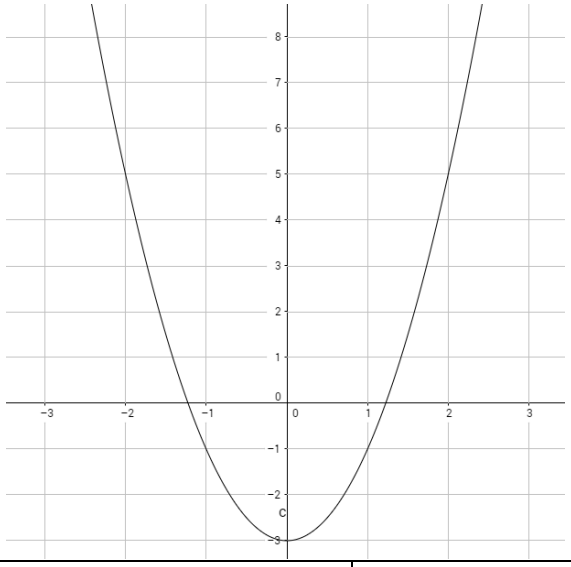
x	$f(x)$
–3	48
–2	21
–1	0
0	–15
1	–24
2	–27
3	–24

* Given the graph, table, or coordinate pairs of a quadratic function, write the equation for the function.

1.



2.



3.

x	y
-5	0
-4	-3
-3	-4
-2	-3
-1	0
0	5
1	12

4.

x	y
2	-8
3	-4.5
4	-2
5	$-\frac{1}{2}$
6	0
7	$-\frac{1}{2}$
8	-2

5.

Vertex $(0, 5)$, point $(1, 6)$

6.

Vertex $(1, 2)$, point $(2, -5)$

Work/Note Space:

*Write each function in Standard Form.

7. $f(x) = (x-5)^2 + 2$	8. $h(x) = -(x+1)^2 + 1$
9. $p(x) = -3(x-2)^2$	10. $q(x) = \frac{1}{2}(x+4)^2 - 1$

When in Standard Form, you can determine the x-coordinate of the vertex using the formula: $x = \frac{-b}{2a}$.
Once you have this $x - value$, you can plug this into the equation to determine the $y - value$ of the vertex.

*From Standard Form, determine the coordinates of the vertex. Then rewrite the function in vertex form.

11. $f(x) = x^2 - 10x + 27$	12. $y = -x^2 - 2x$
13. $y = -3x^2 + 12x - 12$	14. $f(x) = \frac{1}{2}x^2 + 4x + 7$

Compare your answers in 7-10 with your answers from 11-14. What is the connection?

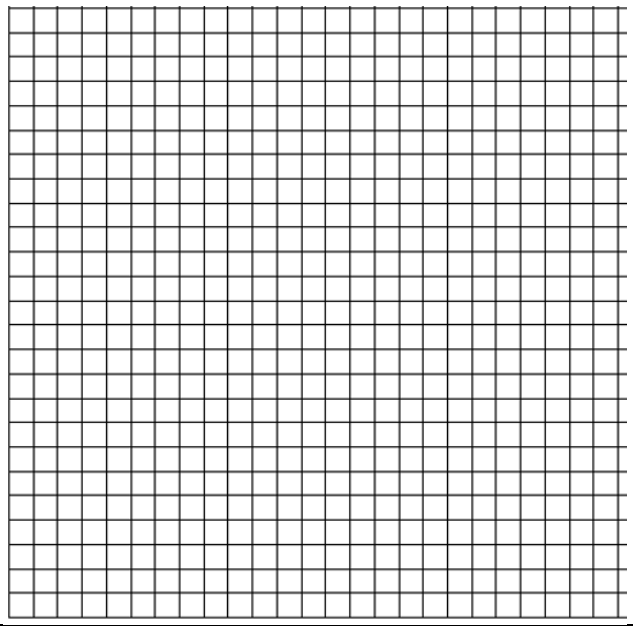
*Identify the vertex, the axis of symmetry, the maximum or minimum value, and the domain and range of each parabola. You may use graph paper to assist you in answering these questions.

15. $y = x^2 + 2x + 1$	16. $y = -2x^2 - 3x + 4$
17. $y = 3x^2 - 4x - 2$	18. $y = -x^2 - x$
19. $y = 3x^2 - 12x + 10$	20. $y = \frac{1}{2}x^2 + 2x - 8$

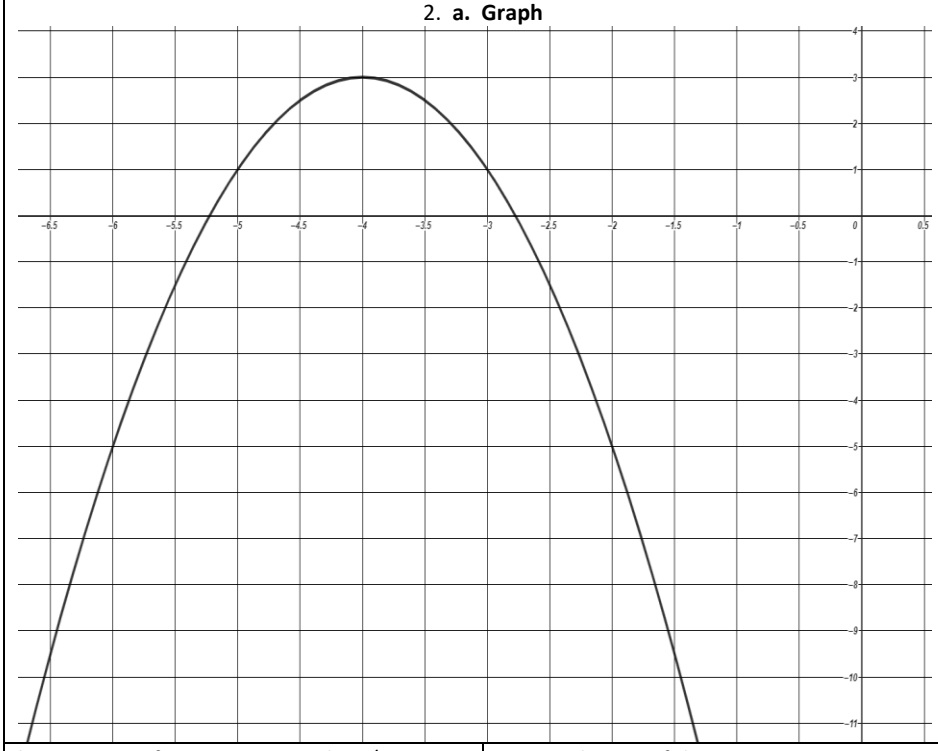
* Use either a regression or a matrix to write the quadratic function for the parabola with the given points in standard form. If you are using a matrix, show your matrix setup and result.

28. $(4, 1), (7, 4), (3, 4)$	29. $(1, -2), (2, -4), (3, -4)$	30. $(-8,7), (-6, 1), (0, 7)$
31. $(1, 1), (-1, -3), (-3, 1)$	32. $(2, 0), (1, -3), (3, -3)$	33. $(-2, 9), (-4, 5), (1, 0)$

Die-Roll Meeting

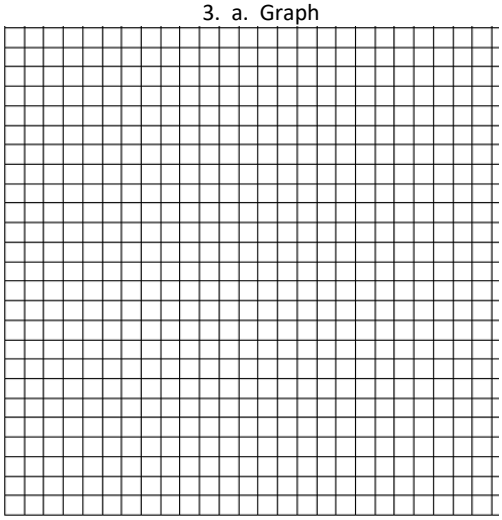
1. a. Graph 	b. Equation of Function in Graphing/Vertex Form	g. Domain
	c. Equation of Function in Standard Form $y = 2x^2 - 11x - 13$	h. Range
	d. Equation for the Axis of Symmetry	i. Coordinates of the x-intercepts
	e. Coordinates of the Vertex	j. Three Ordered Pairs/Solutions for the Quadratic Function
	f. Coordinates of the y-intercept	k. Average Rate of Change over the interval [-3, 4].

2. **a. Graph**

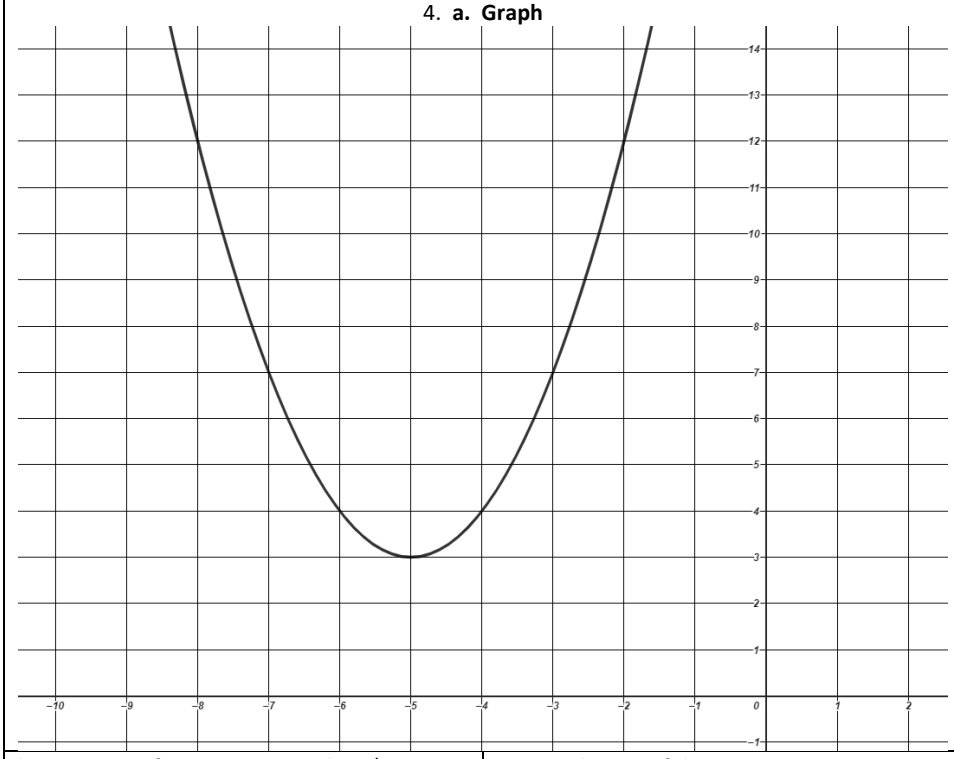


b. Equation of Function in Graphing/Vertex Form	e. Coordinates of the Vertex	i. Coordinates of the x-intercepts
c. Equation of Function in Standard Form	f. Coordinates of the y-intercept	j. Three Ordered Pairs/Solutions for the Quadratic Function
d. Equation for the Axis of Symmetry	g.h. Domain/Range	k. Average Rate of Change over the interval [1, 4].

3. a. Graph



b. Equation of Function in Graphing/Vertex Form	g. Domain
c. Equation of Function in Standard Form	h. Range
d. Equation for the Axis of Symmetry	i. Coordinates of the x-intercepts
e. Coordinates of the Vertex $(4, -7)$	**j. Three Ordered Pairs/Solutions for the Quadratic Function** $(7, 2)$, _____, _____
f. Coordinates of the y-intercept	k. Average Rate of Change over the interval [-3, 0].

4. **a. Graph** 		
b. Equation of Function in Graphing/Vertex Form	e. Coordinates of the Vertex	i. Coordinates of the x-intercepts
c. Equation of Function in Standard Form	f. Coordinates of the y-intercept	j. Three Ordered Pairs/Solutions for the Quadratic Function
d. Equation for the Axis of Symmetry	g.h. Domain/Range	k. Average Rate of Change over the interval $[-2, 1]$.

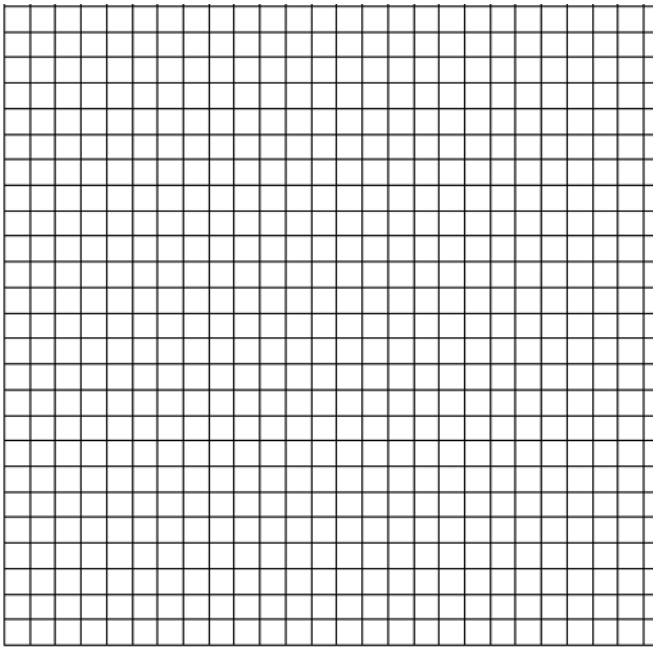
Lesson 2: Solving Quadratic Equations by Graphing

Discussion on Number of Possible Solutions based on Intersections

Module 3: Lesson 2 – Example 1

One Real Solution

Solve $10 - x^2 = 4x + 14$ by graphing.



Module 3: Lesson 2 – Example 2

Two Real Solutions

Use a quadratic equation to find two real numbers with a sum of 24 and a product of 143.

Module 3: Lesson 2 – Extra Example 2

Two Real Solutions

NUMBER THEORY Use a quadratic equation to find two real numbers with a sum of 11 and a product of –126.

–21	–18	–7	–6	6	7	18	21

Module 3: Lesson 2 – Extra Example 3

Solve $-x^2 + 4x - 1 = 0$ by graphing. If the exact roots cannot be found, state the consecutive integers between which the roots are located. Select all correct answers.

- ☐ **A** between –4 and –5
- ☐ **B** between –3 and –4
- ☐ **C** between –1 and 0
- ☐ **D** between 0 and 1
- ☐ **E** between 3 and 4
- ☐ **F** between 4 and 5

Module 3: Lesson 2 – Example 4

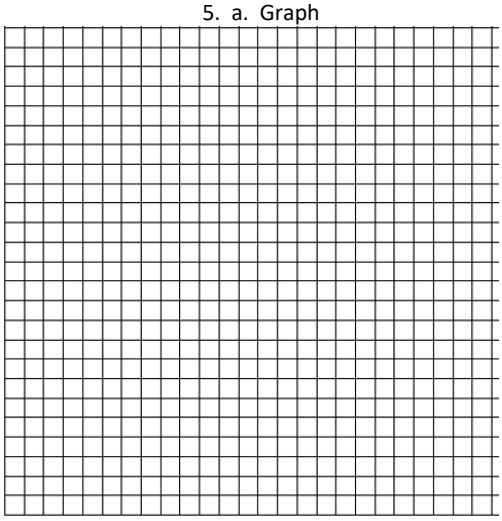
Solve by Using a Table

Use a table to solve $-x^2 + 5x - 1 = 0$.

Module 3: Lesson 2 – Example 5

Solve by Using a Calculator

FOOTBALL A kicker punts a football. The height of the ball after t seconds is given by $h(t) = -16t^2 + 50t + h_0$, where h_0 is the initial height. If the ball is 1.5 feet above the ground when the punter's foot meets the ball, how long will it take the ball to hit the ground?

5. a. Graph 	b. Equation of Function in Graphing/Vertex Form	g. Domain
	c. Equation of Function in Standard Form	h. Range
	d. Equation for the Axis of Symmetry	**i. Coordinates of the x-intercepts** $(\mathbf{3}, \mathbf{0}), (\mathbf{-6}, \mathbf{0})$
	e. Coordinates of the Vertex	j. Three Ordered Pairs/Solutions for the Quadratic Function
	f. Coordinates of the y-intercept $(\mathbf{0}, \mathbf{-36})$	k. Average Rate of Change over the interval [-6, 3].

Module 3: Lesson 3

Complex Number Discussion

Module 3: Lesson 4 – Solving a Quadratic by Factoring

You are solving quadratic equations by factoring each week on your Basic Skills Quizzes. Here are some special Cases.

Module 3: Lesson 4 – Example 5

Factor a Difference of Squares

Solve $81 = x^2$ by factoring. Check your solution.

Module 3: Lesson 4 – Example 7

Complex Solutions

Solve $x^2 = -144$ by factoring. Check your solution.

Module 3: Lesson 4 – Extra Example 7

Complex Solutions

Solve $x^2 = -49$ by factoring. Check your solution.

- A $x = -7, 7$
- B $x = -7i, 7i$
- C $x = 7$
- D $x = -7i$

Module 3: Lesson 5 – Solving a Quadratic Using Square Root Property and by Completing the Square

You are solving quadratic equations by CTS as an option each week on your Basic Skills Quizzes. Here are some other examples.

Module 3: Lesson 5 – Example 1

Solve a Quadratic Equation with Rational Roots

Solve $x^2 - 4x + 4 = 25$ by using the Square Root Property.

Module 3: Lesson 5 – Extra Example 1

Solve a Quadratic Equation with Rational Roots

Solve $x^2 + 14x + 49 = 169$ by using the Square Root Property.

Solve by Completing the Square $x^2 - 9x = -18$	Module 3: Lesson 5 – Extra Example 7 

Lesson 6: The Quadratic Formula and the Discriminant

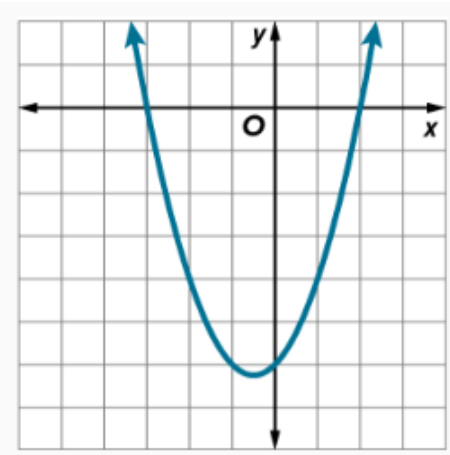
Revisit Previous Example to discuss.

Lesson 7: Solving Quadratic Inequalities

Module 3: Lesson 7 – Example 3

Solve a Quadratic Inequality (< or ≤) by Graphing

Solve $x^2 + x - 6 < 0$ by graphing.

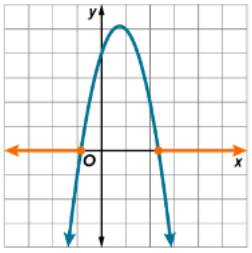


Module 3: Lesson 7 – Extra Example 3

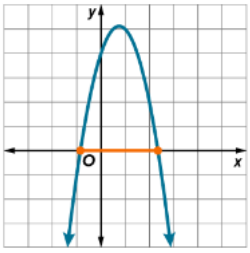
Solve a Quadratic Inequality (< or ≤) by Graphing

Solve $-2x^2 + 3x + 4 \leq 0$ by graphing. Select the correct graph and solution set.

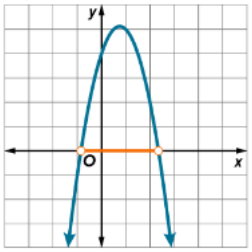
○ A $\{x \mid -0.85 \leq \text{ or } x \geq 2.35\}$



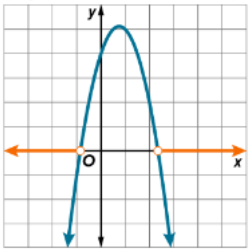
○ B $\{x \mid -0.85 \leq x \leq 2.35\}$



○ C $\{x \mid -0.85 < x < 2.35\}$

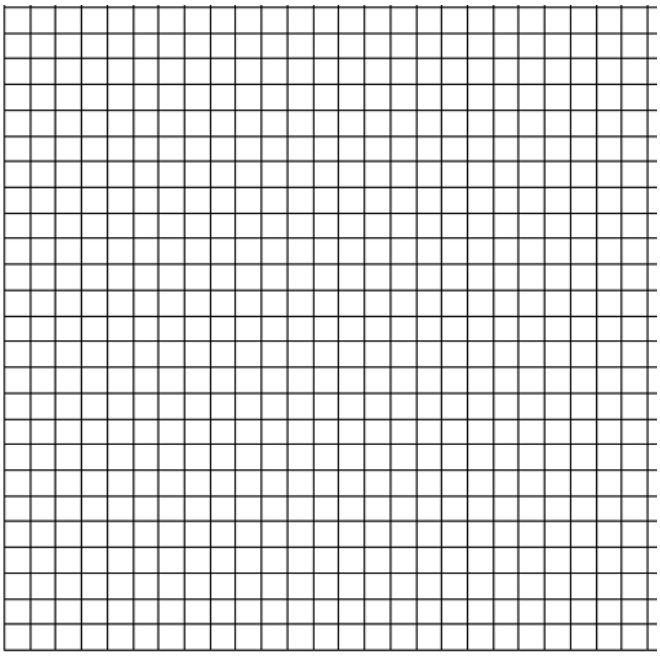


○ D $\{x \mid x < -0.85 \text{ or } x > 2.35\}$



Repeat the previous 2 examples and solve Algebraically.

6. Graph the function $h(x) = -2(x - 0)^2 + 4$



7. Given the table of a quadratic function, write an equation for the function.

x	y
-3	66
-2	39
-1	18
0	3
1	-6
2	-9
3	-6

8. Write each function in Standard Form.

$$g(x) = 2(x + 1)^2 + 4$$

9. From Standard Form, determine the coordinates of the vertex. Then rewrite the function in vertex form.

$$y = -3x^2 + 12x + 5$$

10. A model for a company's revenue from selling a software package is $R = -2.3p^2 + 500p$, where p is the price in dollars of the software. What price will maximize revenue? Find the maximum revenue.

11. Find the dimensions of the rectangle with maximum area that can be enclosed with 90 feet of fence.