

Day	Date	Assignment (Due the next class meeting)
	SEE TEAMS	Chapter 4 Test Notes 5.1 solving by factoring 5.1 Worksheet <i>Solve quadratic functions by factoring</i>
	SEE TEAMS	5.2 Worksheet <i>Solve many functions by factoring</i>
	SEE TEAMS	5.3 Worksheet <i>Solve functions with more complex factoring</i>
	SEE TEAMS	5.4 Worksheet <i>Solve quadratic functions by using the quadratic formula</i>
	SEE TEAMS	5.5 Worksheet <i>Solve systems involving quadratic functions</i>
	SEE TEAMS	Ch 5 Practice Test
	SEE TEAMS	Ch 5 Test Notes: 6.1 adding, Subtracting, multiplying polynomials 6.1 Worksheet <i>Adding/Subtracting and Multiplying</i>
Friday October 29 th No School – Nevada Day		
Thursday November 11 th No School – Veteran's Day		

- * Be prepared for daily quizzes.
- * Every student is expected to do every assignment for the entire unit.
- * Try www.khanacademy.org if you need help outside of school hours.
- * Students who complete 100% of their homework for the semester will receive a 2% bonus!

5.1: Solving functions by factoring

Work with your partner or group to determine which are solutions to $f(x) = 0$ and $g(x) = 0$.

$$f(x) = x^2 - x - 6$$

x	Solution to $f(x) = 0$?
-3	$(-3)^2 - (-3) - 6 = 9 + 3 - 6 = 6 \neq 0$ NO
-2	$(-2)^2 - (-2) - 6 = 4 + 2 - 6 = 0$ YES
-1	$(-1)^2 - (-1) - 6 = -4$ NO
0	$0^2 - 0 - 6 = -6$ NO
1	$1^2 - 1 - 6 = -6$ NO
2	$2^2 - 2 - 6 = -4$ NO
3	$3^2 - 3 - 6 = 0$ YES

- What do you notice

- Same function/solutions.

Note: The solutions to $f(x) = 0$ and $g(x) = 0$ are also called the “zeroes” or the “roots” of the functions.

x-intercepts

$$g(x) = (x - 3)(x + 2)$$

x	Solution to $g(x) = 0$?
-3	$(-3 - 3)(-3 + 2) = (-6)(-1) = 6 \neq 0$ NO
-2	$(-2 - 3)(-2 + 2) = (-5)(0) = 0$ YES
-1	$(-1 - 3)(-1 + 2) = (-4)(1) = -4 \neq 0$ NO
0	$(0 - 3)(0 + 2) = -6 \neq 0$ NO
1	$(1 - 3)(1 + 2) = (-2)(3) = -6 \neq 0$ NO
2	$(2 - 3)(2 + 2) = (-1)(4) = -4 \neq 0$ NO
3	$(3 - 3)(3 + 2) = 0(5) = 0$ YES

How do you find the y-intercept?

Set $x = 0$

How do you find the x-intercept?

Set $y = 0$

Example 1: Find the solutions to the equation: $f(x) = x^2 + 3x$

x	Solution to $f(x) = 0$?
-3	$(-3)^2 + 3(-3) = 9 - 9 = 0$
-2	$(-2)^2 + 3(-2) = 4 - 6 = -2$
-1	$(-1)^2 + 3(-1) = 1 - 3 = -2$
0	$(0)^2 + 3(0) = 0$
1	$(1)^2 + 3(1) = 1 + 3 = 4$
2	$(2)^2 + 3(2) = 4 + 6 = 10$
3	$3^2 + 3(3) = 9 + 9 = 18$

What are the other ways to describe solutions?

roots, x-intercepts, zeros

Examples -- Find the solutions for the following functions:

2.) $y = 3x^2 - 9x$

$0 = 3x^2 - 9x$

$0 = 3x(x-3)$

$3x = 0$ $x-3 = 0$
 $x = 0$ $+3 \quad +3$

$x = 3$

$x = 0, 3$

3.) $y = 10x^2 - 2x$

$0 = 2x(5x-1)$

$2x = 0$ $5x-1 = 0$

$x = 0$ $5x = 1$
 $x = 1/5$

$x = 0, 1/5$

4.) $y = 12x + 4$

$0 = 4(3x+1)$

$3x+1 = 0$

$3x = -1$

$x = -1/3$

What would the graph of these functions look like?

- parabolas & a line (#4)

Intercept Form: $f(x) = a(x - \text{root})(x - \text{root})$

Examples -- Find the solutions (roots, zeroes) for the following functions:

5.) $y = 3x^2 - 2x$

$0 = x(3x-2)$

$x = 0$ $3x-2 = 0$
 $3x = 2$
 $x = 2/3$

6.) $y = 12x^2 + 9x$

$0 = 3x(4x+3)$

$3x = 0$ $4x+3 = 0$

$x = 0$ $4x = -3$

$x = -3/4$

What are the solutions to the following functions?

7.) $y = 2(x+3)^2 + 8$

$0 = 2(x+3)^2 + 8$

$-8 = 2(x+3)^2$

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

$\pm 2i = x+3$

$x = -3 \pm 2i$

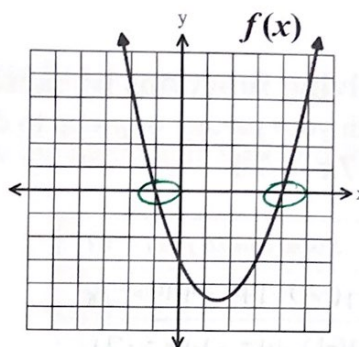
Example 8.)

What are the solutions to $f(x) = 0$?

$$x = -1, 4$$

What is a possible equation for $f(x)$ in factored form?

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



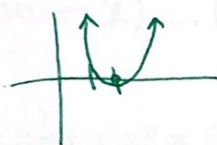
Examples -- Find the solutions for the following functions and sketch graphs by using the x-intercepts (and estimating the vertex).

9) $y = x^2 - 4x + 4$

$$0 = (x-2)(x-2)$$

$$x-2=0$$

$$x=2$$

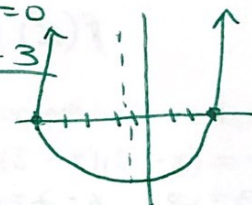


10.) $y = x^2 + 2x - 15$

$$0 = (x+5)(x-3)$$

$$\begin{array}{l} x+5=0 \\ x=-5 \end{array}$$

$$\begin{array}{l} x-3=0 \\ x=3 \end{array}$$



Examples—Solve:

11.) $x^2 - 4x = 12$

$$x^2 - 4x - 12 = 0$$

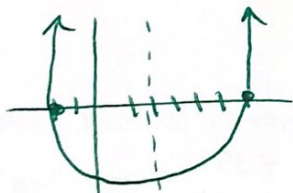
$$(x-6)(x+2) = 0$$

$$x-6=0$$

$$x+2=0$$

$$x=6$$

$$x=-2$$



12.) $-x^2 = x - 42$

$$0 = x^2 + x - 42$$

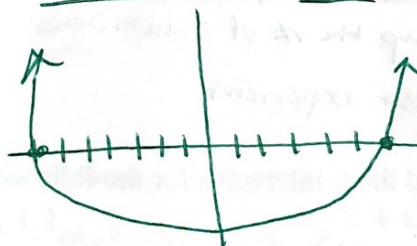
$$0 = (x+7)(x-6)$$

$$x+7=0$$

$$x-6=0$$

$$x=-7$$

$$x=6$$



5.2: More solving functions by factoring

Work with your partner or group to determine the solutions to $f(x) = 0$ and $g(x) = 0$.

$$f(x) = 7x - 14$$

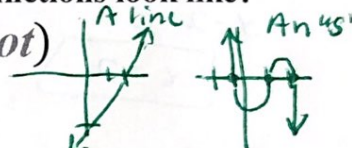
$$g(x) = (x - 1)(x + 1)(x - 2)$$

x	Solution to $f(x) = 0$?
-2	$7(-2) - 14 = -14 - 14 = -28$
-1	$7(-1) - 14 = -7 - 14 = -21$
0	$7(0) - 14 = -14$
1	$7 - 14 = -7$
2	$7(2) - 14 = 0$

x	Solution to $g(x) = 0$?
-2	$(-2-1)(-2+1)(-2-2) = (-3)(-1)(-4) = -12$
-1	$(-2)(0)(-3) = 0$
0	$(-1)(1)(-2) = 2$
1	$(0)(2)(-1) = 0$
2	$(1)(3)(0) = 0$

What would the graph of these functions look like?

$$f(x) = a(x - \text{root})(x - \text{root}) \dots (x - \text{root})$$



Examples -- Find the zeroes for the following functions:

1.) $y = (x + 3)(x - 2)(x + 5)$

$$\begin{array}{l} x+3=0 \quad x-2=0 \quad x+5=0 \\ \underline{x=-3} \quad \underline{x=2} \quad \underline{x=-5} \end{array}$$

2.) $f(x) = 3x(x + \frac{1}{2})(5x - 2)$

$$\begin{array}{l} 3x=0 \quad x+\frac{1}{2}=0 \quad 5x-2=0 \\ \underline{x=0} \quad \underline{x=-\frac{1}{2}} \quad \underline{x=\frac{2}{5}} \end{array}$$

Examples -- Find the solutions for the following functions:

3.) $y = 3x^2(x - 2)(x + 5)$

$$\begin{array}{l} 3x^2=0 \quad x-2=0 \quad x+5=0 \\ \underline{x=0} \quad \underline{x=2} \quad \underline{x=-5} \end{array}$$

4.) $f(x) = (x + 5)^3$

$$\begin{array}{l} x+5=0 \\ \underline{x=-5} \end{array}$$

Degree of a function vs. # of solutions:

Degree = up to the # of solutions
 \rightarrow largest exponent

Examples -- Find the x-intercepts for the following functions:

5.) $y = 3x^2 + 6x + 3$

$$\begin{array}{l} 0 = 3(x^2 + 2x + 1) \\ 0 = 3(x+1)(x+1) \\ x+1=0 \\ \underline{x=-1} \end{array}$$

6.) $f(x) = -x^2 + 2x + 35$

$$\begin{array}{l} 0 = -(x^2 - 2x - 35) \\ 0 = -(x-7)(x+5) \\ x-7=0 \quad x+5=0 \\ \underline{x=7} \quad \underline{x=-5} \end{array}$$

Examples -- Find the zeroes for the following functions:

7.) $f(x) = -2x^4 + 14x^3 - 24x^2$

$$\begin{array}{l} 0 = -2x^2(x^2 - 7x + 12) \\ 0 = -2x^2(x-3)(x-4) \\ -2x^2=0 \quad x-3=0 \quad x-4=0 \\ \underline{x=0} \quad \underline{x=3} \quad \underline{x=4} \end{array}$$

8.) $5x^4 - 15x^2 = 0$

$$\begin{array}{l} 5x^2(x^2 - 3) = 0 \\ 5x^2=0 \quad x^2-3=0 \\ \underline{x=0} \quad \underline{x=\pm\sqrt{3}} \end{array}$$

5.3: Solving functions by more complex factoring

Work with your partner or group to simplify and write the function in standard form.

1) $f(x) = (3x + 5)(x + 1)$

$$0 = (3x + 5)(x + 1)$$

$$\begin{array}{l} 3x + 5 = 0 \\ 3x = -5 \\ x = -\frac{5}{3} \end{array} \quad \begin{array}{l} x + 1 = 0 \\ x = -1 \end{array}$$

2) $g(x) = (5x + 7)(5x - 7)$

$$0 = (5x + 7)(5x - 7)$$

$$\begin{array}{l} 0 = 5x + 7 \\ -7 = 5x \\ -\frac{7}{5} = x \end{array} \quad \begin{array}{l} 0 = 5x - 7 \\ 7 = 5x \\ \frac{7}{5} = x \end{array}$$

Examples -- Find the solutions for $f(x) = 0$ in the following functions:

3) $f(x) = 2x^2 + 9x - 5$

$$0 = (2x - 1)(x + 5)$$

$$\begin{array}{l} 2x - 1 = 0 \\ 2x = 1 \\ x = \frac{1}{2} \end{array} \quad \begin{array}{l} x + 5 = 0 \\ x = -5 \end{array}$$

4) $f(x) = 6x^2 + 11x + 3$

$$0 = (2x + 3)(3x + 1)$$

$$\begin{array}{l} 2x + 3 = 0 \\ 2x = -3 \\ x = -\frac{3}{2} \end{array} \quad \begin{array}{l} 3x + 1 = 0 \\ 3x = -1 \\ x = -\frac{1}{3} \end{array}$$

5) $y = 3x^2 - 7x - 20$

$$0 = (3x + 5)(x - 4)$$

$$\begin{array}{l} 3x + 5 = 0 \\ 3x = -5 \\ x = -\frac{5}{3} \end{array} \quad \begin{array}{l} x - 4 = 0 \\ x = 4 \end{array}$$

6) $f(x) = -10x^2 + 18x + 4$

$$0 = -2(5x^2 - 9x - 2)$$

$$0 = -2(5x + 1)(x - 2)$$

$$\begin{array}{l} 5x + 1 = 0 \\ 5x = -1 \\ x = -\frac{1}{5} \end{array} \quad \begin{array}{l} x - 2 = 0 \\ x = 2 \end{array}$$

Examples -- Find the solutions for the following functions:

7) $y = 4x^2 - 25$

$$0 = (2x + 5)(2x - 5)$$

$$\begin{array}{l} \downarrow \quad \downarrow \\ -5/2 \quad 5/2 \end{array}$$

8) $36x^2 - 50 = -1$

$$36x^2 = 49$$

$$x^2 = \frac{49}{36}$$

$$x = \pm \frac{7}{6}$$

$$9) f(x) = -16x^5 + 9x^3$$

$$0 = -x^3(16x^2 - 9)$$

$$\begin{array}{ccc} \downarrow & (4x+3)(4x-3) & \\ 0 & \neq & \downarrow \\ & -3/4 & 3/4 \end{array}$$

Examples -- Find the solutions for the following functions:

$$10) y = x^4 - 5x^2 + 4$$

$$0 = (x^2 - 4)(x^2 - 1)$$

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

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow \\ -2 & 2 & -1 & 1 \end{array}$$

$$11) 2x^4 - 36x^2 + 162 = f(x)$$

$$2(x^4 - 18x^2 + 81)$$

$$2(x^2 - 9)(x^2 - 9)$$

$$2(x+3)^2(x-3)^2$$

$$\begin{array}{cc} \downarrow & \downarrow \\ -3 & 3 \end{array}$$

$$12) y = x^4 - 29x^2 + 100$$

$$0 = (x^2 - 25)(x^2 - 4)$$

$$\begin{array}{cc} \downarrow & \downarrow \\ \pm 5 & \pm 2 \end{array}$$

$$13) -x^3 - 25x = 0$$

$$-x(x^2 + 25) = 0$$

$$\begin{array}{cc} \downarrow & \sqrt{x^2} = \sqrt{25} \\ 0 & x = \pm 5i \end{array}$$

$$14) x^4 - 36 = 0$$

$$(x^2 + 6)(x^2 - 6) = 0$$

$$x^2 = -6 \quad x^2 = 6$$

$$x = \pm i\sqrt{6} \quad x = \pm \sqrt{6}$$

5.4 Notes: Solving Quadratics using the Quadratic Formula

A quadratic equation in general form: $ax^2 + bx + c = 0$. Let a , b , and c be real numbers such that $a \neq 0$.

The Quadratic Formula:
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solve using the Quadratic Formula

1) $x^2 + 7x = -6$

$x^2 + 7x + 6 = 0$
 $a = 1$ $b = 7$ $c = 6$

$x = \frac{-7 \pm \sqrt{49 - 4(1)(6)}}{2}$

$= \frac{-7 \pm \sqrt{25}}{2}$ $\frac{-7+5}{2} = -1$

$= \frac{-7-5}{2} = -6$

$x = -1 \text{ \& } -6$

3) $x^2 + 3x = 8 + 4x$

$a = 1$ $b = -1$ $c = -8$

$x = \frac{1 \pm \sqrt{1 - 4(1)(-8)}}{2}$

$= \frac{1 \pm \sqrt{33}}{2}$

↑
decimals

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

$a = -1$ $b = 2$ $c = -5$

$x = \frac{-2 \pm \sqrt{4 - 4(-1)(-5)}}{2}$

$= \frac{-2 \pm \sqrt{4 - 20}}{2} = \frac{-2 \pm \sqrt{-16}}{2}$

$= \frac{-2 \pm \sqrt{-16}}{2} = \frac{-2 \pm 4i}{2}$

$= \frac{-2 \pm 4i}{2}$

4) $3x^2 - 8 = 0$

$a = 3$ $b = 0$ $c = -8$

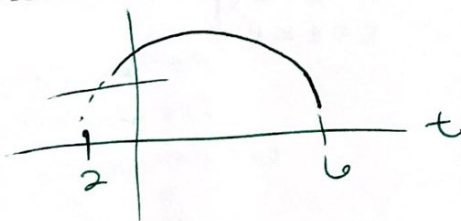
$x = \frac{0 \pm \sqrt{0 - 4(3)(-8)}}{6}$

$= \pm \frac{\sqrt{96}}{6}$

$= \pm \frac{4\sqrt{6}}{6}$

$= \pm \frac{2\sqrt{6}}{3}$

Example 5) A rocket is launched off a platform with an initial velocity of 19.6 meters per second. The path of the rocket can be modeled by the equation $h = -4.9t^2 + 19.6t + 58.8$, where h is the height of the rocket, and t is the time in seconds. After how many seconds will the rocket hit the ground?



$h = -4.9t^2 + 19.6t + 58.8$

$= -4.9(t^2 - 4t - 12)$

$= -4.9(t-6)(t+2)$

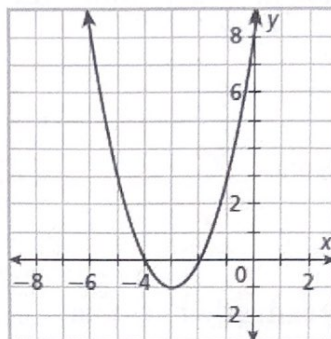
$= 0 \text{ \& } -2$

6 seconds

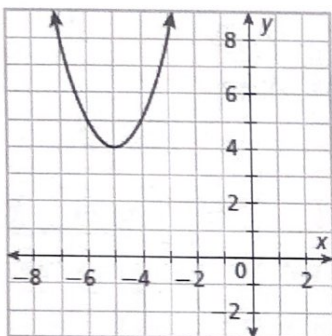
Recall what solutions to functions look like on a graph:

Example 6) What are the solutions to $f(x) = 0$?

$$-2 \text{ \& } -4$$



Example 7) What are the solutions to $g(x) = 0$?



Hint: What is an equation for $g(x)$ in vertex form?

$$y = (x + 5)^2 + 4$$

$$y - 4 = (x + 5)^2$$

$$\pm 2i = x + 5$$

$$-5 \pm 2i = x$$

5.5 Notes: Systems of Linear and Quadratic Equations

Essential Question: How can you solve a system of equations when one equation is linear and the other is quadratic?

Exploration: Find the solutions to the given equation.

Given $f(x) = 3x^2 - 6x + 5$ and $g(x) = -3x + 23$, complete the tables below to find the x -values where $f(x) = g(x)$.

$f(x) = 3x^2 - 6x + 5$	
x	$f(x)$
-3	50
* -2	29
-1	14
0	5
1	2
2	5
* 3	14
4	29
5	50
6	77
7	110

$g(x) = -3x + 23$	
x	$g(x)$
-3	32
* -2	29
-1	26
0	23
1	20
2	17
* 3	14
4	11
5	8
6	5
7	2

Graph both equations on the graphing calculator. What do you notice?

The graphs intersect twice at the points $(-2, 29)$ and $(3, 14)$.
 Example 1: First solve the system of equations by graphing on your graphing calculator. Then, solve by using algebra.

$$\begin{cases} y = -x^2 + 9 \\ y = x + 3 \end{cases}$$

$$x + 3 = -x^2 + 9$$

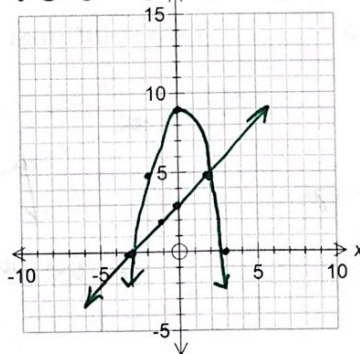
$$x^2 + x - 6 = 0$$

$$(x+3)(x-2) = 0$$

$$\begin{matrix} x & & x \\ -3 & & 2 \end{matrix}$$

$$\text{if } x = -3 \quad \text{if } x = 2 \quad (-3, 0)$$

$$y = 0 \quad y = 5 \quad (2, 5)$$



Example 2: Solve by using algebra.

$$\begin{cases} f(x) = 4x^2 + 5x - 4 \\ g(x) = -3x - 4 \end{cases}$$

$$4x^2 + 5x - 4 = -3x - 4$$

$$4x^2 + 8x = 0$$

$$4x(x+2) = 0$$

$$\downarrow \quad \downarrow$$

$$0 \quad -2$$

$$\text{if } x = 0$$

$$3(0) - 4$$

$$-4$$

$$(0, -4)$$

$$\text{if } x = -2$$

$$-3(-2) - 4$$

$$6 - 4$$

$$2$$

$$(-2, 2)$$

3) Solve the system: $\begin{cases} x^2 + 14x + 3y + 1 = 10 \\ 3x + y = -5 \end{cases}$

$$y = -3x - 5$$

$$x^2 + 14x + 3(-3x - 5) + 1 = 10$$

$$x^2 + 14x - 9x - 15 - 9 = 0$$

$$x^2 + 5x - 24 = 0$$

$$(x+8)(x-3) = 0$$

$$\downarrow \quad \downarrow$$

$$-8 \quad 3$$

$$\text{if } x = -8$$

$$y = -3(-8) - 5$$

$$= 24 - 5$$

$$= 19$$

$$(-8, 19)$$

$$\text{if } x = 3$$

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

$$= -9 - 5$$

$$= -14$$

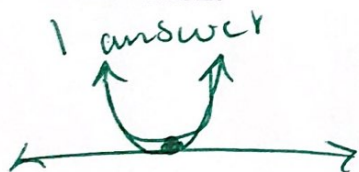
$$(3, -14)$$

What are the 2 algebraic ways to solve systems of quadratic and linear functions?

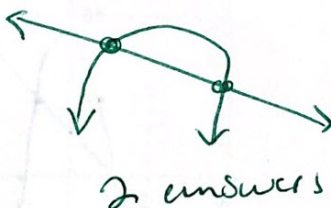
Elimination
Substitution

How many answers will you get for these types of systems? 3 different situations:

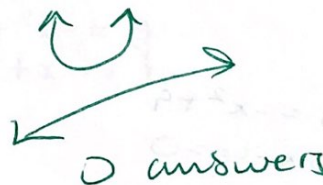
One solution:



Two solutions:



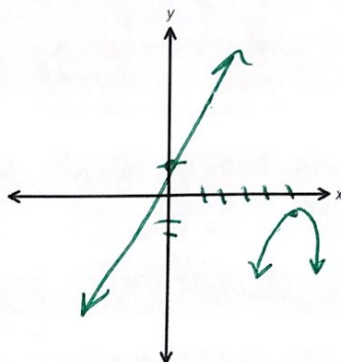
No solutions:



Example 4: Use a graphing calculator to solve this system of equations by graphing.

$$\begin{cases} f(x) = 2x + 1 \\ g(x) = -(x - 5)^2 - 2 \end{cases}$$

NO
Solution



5)

Which of the following systems of equations could a student use to write a quadratic function in standard form for the parabola passing through the points $(1, -3)$, $(4, 6)$, and $(5, 9)$?

A. $\begin{cases} x^2 - 3x + c = y \\ 4x^2 + 6x + c = y \\ 5x^2 + 9x + c = y \end{cases}$

C. $\begin{cases} a - 3b + c = y \\ 16a + 6b + c = y \\ 25a + 9b + c = y \end{cases}$

B. $\begin{cases} 2a + b + c = -3 \\ 8a + 4b + c = 6 \\ 10a + 5b + c = 9 \end{cases}$

D. $\begin{cases} a + b + c = -3 \\ 16a + 4b + c = 6 \\ 25a + 5b + c = 9 \end{cases}$

6)

A parabola has x -intercepts at 2 and 6 and goes through the point $(8, 4)$. What other point is on the parabola?

A. $(-2, -2)$

B. $(4, -2)$

C. $(-3, 15)$

D. $(1, 15)$

$$4 = a(8-2)(8-6)$$

$$4 = a(6)(2)$$

$$a = \frac{1}{3} \quad \text{vertex @ } (4,)$$

$$y = \frac{1}{3}(x-2)(x-6)$$

$$-2 = \frac{1}{3}(-2-2)(-2-6)$$

$$15 = \frac{1}{3}(-3-2)(-3-6)$$

$$-2 = \frac{1}{3}(4-2)(4-6)$$

$$15 = \frac{1}{3}(1-2)(1-6)$$

$$-2 = \frac{1}{3}(2)(-2)$$