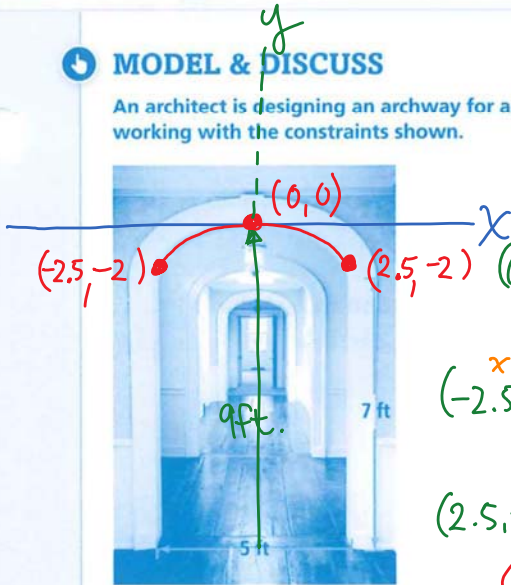


**MODEL & DISCUSS**

An architect is designing an archway for a building that has a 9 ft ceiling. She is working with the constraints shown.



A. Find a quadratic model for the arches if the highest point of the arch touches the ceiling.

$$y = ax^2 + bx + c$$

$$(0,0): 0 = a(0)^2 + b(0) + c$$

$$0 = c$$

$$(-2.5, -2): -2 = a(-2.5)^2 + b(-2.5) + c$$

$$* -2 = 6.25a - 2.5b$$

$$(2.5, -2): -2 = a(2.5)^2 + b(2.5) + c$$

$$* -2 = 6.25a + 2.5b$$

elimination (add)

$$\begin{array}{r} -4 = 12.5a \\ \underline{12.5} \quad \underline{12.5} \end{array}$$

$$-0.32 = a$$

$$-2 = 6.25(-0.32) - 2.5b$$

$$-2 = -2 - 2.5b$$

$$\begin{array}{r} +2 \quad +2 \\ \hline 0 = -2.5b \\ \underline{-2.5} \quad \underline{-2.5} \end{array}$$

$$0 = b$$

$$y = -0.32x^2 + 0x + 0$$

$$y = -0.32x^2$$

B. Use Structure Describe how to change the model so that the highest point of the arch does not touch the ceiling. © MP7

$$y = -0.32x^2 + 0$$

c: negative #

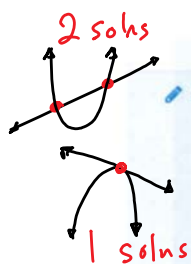
**HABITS OF MIND**

**Look for Relationships** How is finding the model above like solving a system of linear equations? How is it different. © MP5

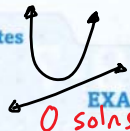
Solving for a, b, & c

**9-7**  
Solving Systems of Linear and Quadratic Equations  
PearsonRealize.com

# Lines & Parabolas



Notes



EXAMPLE 1

**Try It!** Understand Linear-Quadratic Systems of Equations

1. How many solutions does the system of equations at the right have? Explain.

- graphing, substitution, elimination

2, 1, or 0

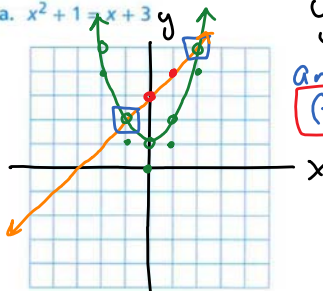
$y = x$  line  
 $y = x^2$  parabola

EXAMPLE 2

**Try It!** Solve a Linear-Quadratic Equation by Graphing

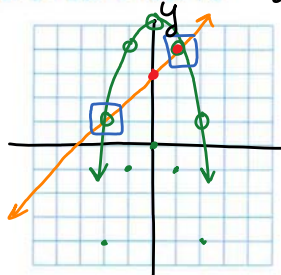
2. What are the solutions of each of the equations? Rewrite each as a system of equations and graph to solve.

a.  $x^2 + 1 = x + 3$



$y = x + 3$   $\&$   $y = x^2 + 1$   
ans:  $(-1, 2)$  &  $(2, 5)$   
k: 1 up

b.  $5 - 0.5x^2 = 0.5x + 2$



$5 - x^2 = x + 3$   
 $y = 5 - x^2$   $\&$   $y = x + 3$   
 $y = -x^2 + 5$   
Vert refl.  
ans:  $(-2, 1)$  &  $(1, 4)$   
k: 5 up

## HABITS OF MIND

**Communicate Precisely** How could you use a table to solve a system of linear and quadratic equations? When does it make sense to use this method? Explain. © MP.6

*u*

**EXAMPLE 3** Try It! Solve Systems of Equations Using Elimination

3. Use elimination to solve each system of equations.



line  
parabola

a.  $y = -x + 4$   
 $y = (x^2 - 2)$  } subtract  
→ eliminate "y"

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

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

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

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

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

zero prod prop

$$x - 2 = 0 \quad \text{or} \quad x + 3 = 0$$

$$\begin{array}{r} x - 2 = 0 \\ +2 \quad +2 \\ \hline x = 2 \end{array} \quad \text{or} \quad \begin{array}{r} x + 3 = 0 \\ -3 \quad -3 \\ \hline x = -3 \end{array}$$

$x^2$	
	$-6$

$-1, 6$   
 $-2, 3$   
 $-3, 2$   
 $-6, 1$

b.  $y = -x^2 + 4x + 2$   
 $y = (2 - x)$  } elimination  
• subtract

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

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

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

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

zero prod prop

$$x = 0 \quad \text{or} \quad x - 5 = 0$$

$$\begin{array}{r} x - 5 = 0 \\ +5 \quad +5 \\ \hline x = 5 \end{array}$$

Factor...

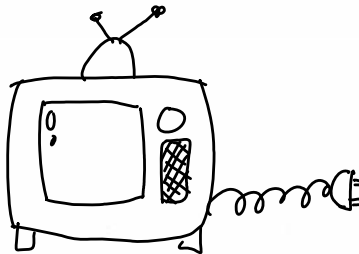
$$0 = x^2 - 5x$$

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

zero prod prop

**EXAMPLE 4** Try It! Solve Systems Using Substitution

4. Could you have used elimination or graphing to solve this linear-quadratic system of equations? Explain.



**HABITS OF MIND**

**Construct Arguments** Explain when a solution to a linear-quadratic system of equations is not included as part of the solution to a problem. © MP.3

**Do You UNDERSTAND?**

1. **ESSENTIAL QUESTION** How is solving linear-quadratic systems of equations similar to and different from solving systems of linear equations?

2. **Error Analysis** A student claims that a linear-quadratic system of equations has three solutions. Explain the error the student made. **MP3**

3. **Vocabulary** What are the characteristics of a linear-quadratic system of equations?

4. **Reason** What system of equations could you use to solve the equation  $x^2 - 3 = 7$ ? Explain. **MP2**

**Do You KNOW HOW?**

Rewrite each equation as a system of equations.

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

6.  $x = x^2 - 5$   
 $y = x$   
 $y = x^2 - 5$

7.  $2x^2 - 5 = x + 7$   
 $y = 2x^2 - 5$   
 $y = x + 7$

8.  $x^2 - 2x + 3 = x + 4$   
 $y = x^2 - 2x + 3$   
 $y = x + 4$

Find the solution of each system of equations.

9.  $\begin{cases} y = x^2 + 3x + 1 \\ y = -x + 1 \end{cases}$   
 Subst  $\frac{x^2 + 3x + 1 = -x + 1}{+x \quad -1 \quad +x \quad -1}$   
 $x^2 + 4x = 0$   
 $x(x + 4) = 0$   
 $x = 0 \mid x + 4 = 0 \rightarrow x = 0, -4$

10.  $\begin{cases} y = x^2 + 1 \\ y = -2x \end{cases}$   
 elim  $\begin{aligned} 0 &= x^2 + 1 - (-2x) \\ 0 &= x^2 + 1 + 2x \\ 0 &= x^2 + 2x + 1 \end{aligned}$   
 $(x + 1)(x + 1) = 0$   
 $x + 1 = 0$   
 $x = -1$

