Solve the system using a graphing calculator.

1. $x - 4y = 9$
   $2x - 3y = 11$

2. $y = 2x$
   $3x + 5y = 0$

3. $x = 2$
   $3x + 2y = 4$

4. $y = -\frac{1}{3}x + 1$
   $2x + 6y = 6$

Warm Up

warm up: can use graphing calculator or desmos

by hand if technology is not available

* practice by hand using
  - graphing
  - elimination
  - Substitution

Graph the function.

1. $f(x) = (x - 5)^2$
   $x^2 - 10x + 25$

2. $g(x) = (x + 1)^2 + 7$

3. $y = -6(x - 4)^2 + 2$

4. $f(x) = -2(x - 1)^2 - 5$

Cumulative Warm Up

* Can use desmos to graph - explain what type of graph

* Use parent function to talk and review transformations.

Essential Question

How can you solve a nonlinear system of equations?

Essential Question

What you will learn:

- Solve systems of nonlinear equations
- Solve Quadratic equations by graphing

Work with a partner. Match each system with its graph. Explain your reasoning. Then solve each system using the graph.

a. $y = x^2$, $y = x + 2$

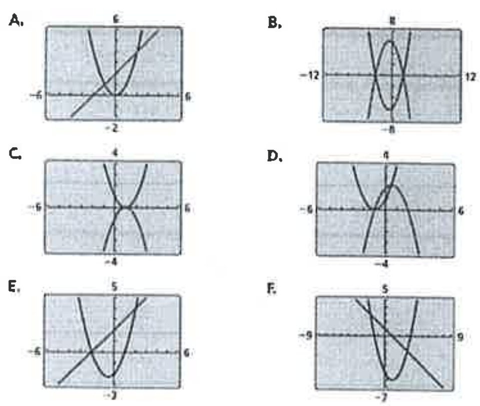
b. $y = x^2 + x - 2$, $y = x + 2$

c. $y = x^2 - 2x - 5$, $y = -x + 1$

d. $y = x^2 + x - 6$, $y = -x^2 - x + 6$

e. $y = x^2 - 2x + 1$, $y = -x^2 + 2x - 1$

f. $y = x^2 + 2x + 1$, $y = -x^2 + x + 2$



Exploration 1

* Work w/ partners to match

* Use graphing technology

* talk about solutions and how they differ when we work with systems.

Work with a partner. Look back at the nonlinear system in Exploration 1(f). Suppose you want a more accurate way to solve the system than using a graphical approach.

a. Show how you could use a *numerical approach* by creating a table. For instance, you might use a spreadsheet to solve the system.

b. Show how you could use an *analytical approach*. For instance, you might try solving the system by substitution or elimination.

a)

x	-1	$-\frac{1}{2}$	0	$\frac{1}{2}$	1
$y=x^2+2x+1$	0	$\frac{1}{4}$	1	$\frac{9}{4}$	4
$y=-x^2+x+2$	0	$\frac{5}{4}$	2	$\frac{9}{4}$	2

Exploration 2

* additional discussion

b) $x^2-2x+1=-x^2+x+2$

$2x^2+x-1=0$

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

$2x-1=0 \qquad x+1=0$

$x=\frac{1}{2} \qquad x=-1$

* Notice where the values of the two equations are equal.

Solve the system by graphing.

$y = x^2 - 2x - 1$ Equation 1

$y = -2x - 1$ Equation 2

graph by hand as well in case tecnology is not available

Example 1

* use graphing technology and look at table values

OR on Desmos

where the two graphs intersect

* discuss how we know solutions, why do they need to be the same?

Solve the system by substitution.

$x^2 + x - y = -1$ Equation 1

$x + y = 4$ Equation 2

$y = -x + 4$

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

$x^2 + x + x - 4 = -1$

$x^2 + 2x - 3 = 0$

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

$x + 3 = 0 \quad x - 1 = 0$

$x = -3 \quad x = 1$

finish by substituting the x values in and solve for y.

which equation will you use? why?

$x + y = 4 \qquad x + y = 4$

$-3 + y = 4 \qquad 1 + y = 4$

$y = 7 \qquad y = 3$

$(-3, 7) \qquad (1, 3)$

* check work on graphing technology.

Example 2

Solve the system by elimination.

$2x^2 - 5x - y = -2$ Equation 1

$x^2 + 2x + y = 0$ Equation 2

$3x^2 - 3x = -2$

$3x^2 - 3x + 2 = 0$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(3)(2)}}{2(3)}$$

$$x = \frac{3 \pm \sqrt{-15}}{6}$$

discriminant -> the value under the radical

b/c the discriminant is negative, the equation has no real solution

Check this using graphing technology. Do the graph intersect?

Example 3

* Student practice

Solve the system using any method. Explain your choice of method.

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

   $(2, 0)$

2. $x^2 + 3x + y = 0$
   $2x + y = 5$

   no solution

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

   $\left(-\frac{4}{3}, \frac{2}{9}\right)$ and $(0, 2)$

Monitoring Progress 1-3

Check work through graphing technology

Check the point where the line and the circle intersect.

Solve the system by substitution.

$x^2 + y^2 = 10$ Equation 1

$y = -3x + 10$ Equation 2

Substitute

$x^2 + y^2 = 10$

$x^2 + (-3x + 10)^2 = 10$

$x^2 + 9x^2 - 60x + 100 = 10$

$\frac{10x^2}{10} - \frac{60x}{10} + \frac{90}{10} = \frac{0}{10}$

$x^2 - 6x + 9 = 0$

$(x - 3)^2 = 0$

$x = 3$

$y = -3(3) + 10$

$y = -9 + 10$

$y = 1$

Solution $(3, 1)$

Example 4

Solve the system.

4. $x^2 + y^2 = 16$
   $y = -x + 4$

   (0,4) and (4,0)

5. $x^2 + y^2 = 4$
   $y = x + 4$

   no solution

6. $x^2 + y^2 = 1$
   $y = \frac{1}{2}x + \frac{1}{2}$

   $\left(\frac{3}{5}, \frac{4}{5}\right)$ and $(-1, 0)$

Monitoring Progress 4-6

* Student practice
* do by hand then check w/ technology
* don't depend on technology *

Core Concept

Solving Equations by Graphing

Step 1 To solve the equation $f(x) = g(x)$, write a system of two equations, $y = f(x)$ and $y = g(x)$.

Step 2 Graph the system of equations $y = f(x)$ and $y = g(x)$. The x-value of each solution of the system is a solution of the equation $f(x) = g(x)$.

Core Concept

Solve (a) $3x^2 + 5x - 1 = -x^2 + 2x + 1$ and
(b) $-(x - 1.5)^2 + 2.25 = 2x(x + 1.5)$ by graphing.

a) $y = 3x^2 + 5x - 1$
$y = -x^2 + 2x + 1$

* use graphing calculator to graph system and find intersecting point(s)

($x \approx -1.18$ and $x \approx 0.43$)

b) $y = -(x-1.5)^2 + 2.25$
$y = 2x(x+1.5)$

* use graphing calculator to solve

$x = 0$

Remember $f(x) = g(x)$

Write two equations as $y =$

Example 5

Solve the equation by graphing.

7. $x^2 - 6x + 15 = -(x - 3)^2 + 6$

$y = x^2 - 6x + 15$
$y = -(x-3)^2 + 6$

$x = 3$

8. $(x + 4)(x - 1) = -x^2 + 3x + 4$

$y = (x+4)(x-1)$
$y = -x^2 + 3x + 4$

$x = -2$ and $x = 2$

* Student practice
* use technology

Monitoring Progress 7-8

I Used to Think ... But Now I Know: Take time for students to reflect on their current understanding of solving a nonlinear system.

Closure