LESSON 3. 5

Solving Systems of Nonlinear Equations

Today you will:

- Solve systems of nonlinear equations

Core Vocabulary:

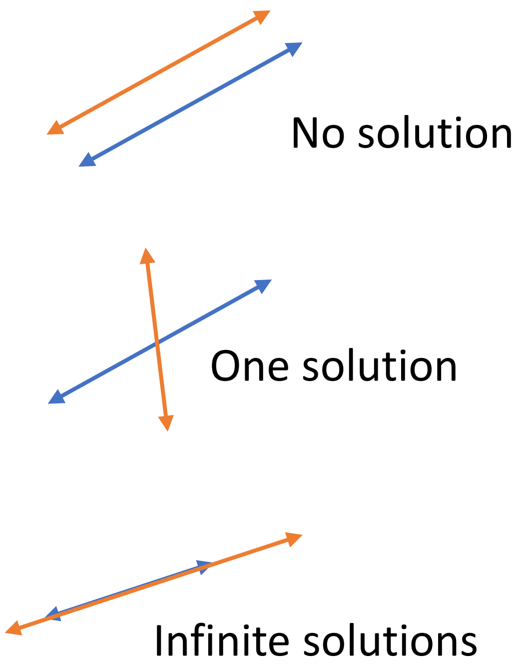
- System of nonlinear equations, p. 132

What does it mean to solve a system of equations?

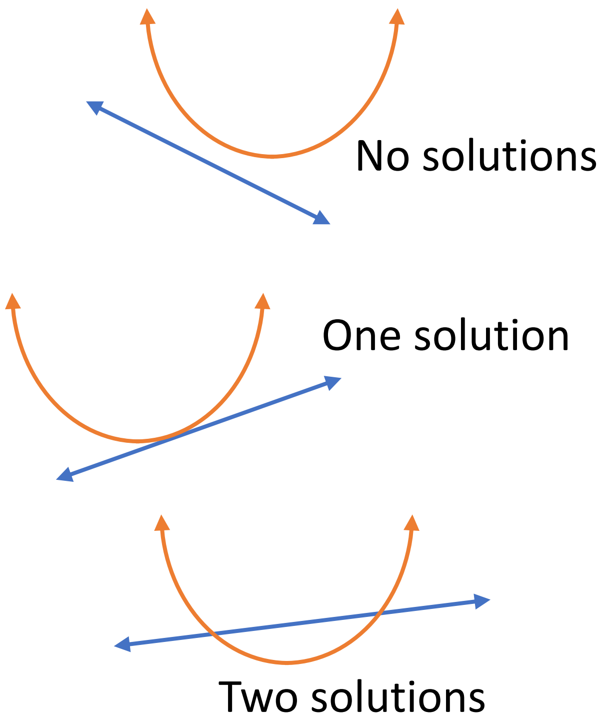
Find all the points (ordered pairs) that are solutions for all equations in the system.

Find all the points of intersection for the equations in the system.

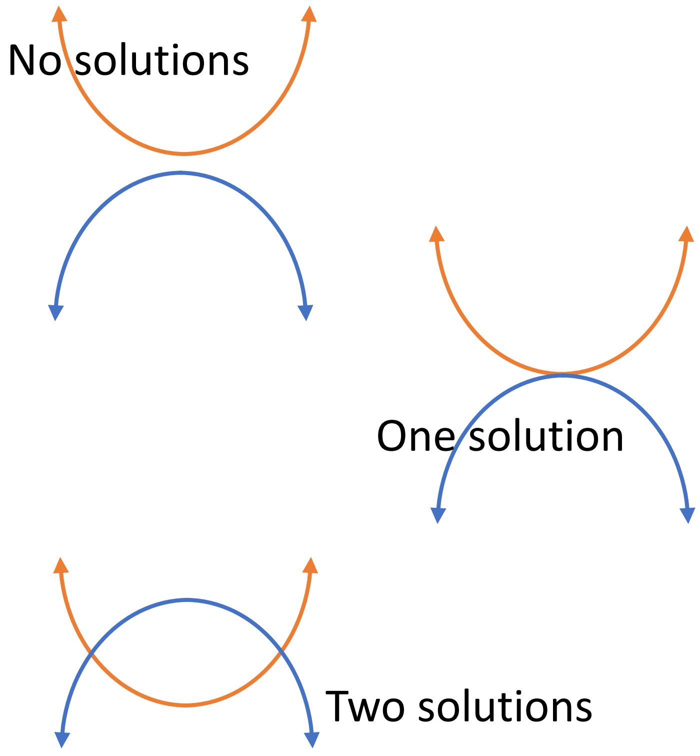
System of 2 lines



System of a parabola and a line



System of two parabolas



What methods do we know for solving a system of equations?

1. Substitution

2. Elimination

Solve the system by substitution. $x^2 + x - y = -1$ Equation 1

$x + y = 4$ Equation 2

SOLUTION

Begin by solving for y in Equation 2.

$y = -x + 4$ Solve for y in Equation 2.

Next, substitute $-x + 4$ for y in Equation 1 and solve for x.

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

$x^2 + x - (-x + 4) = -1$ Substitute $-x + 4$ for y.

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

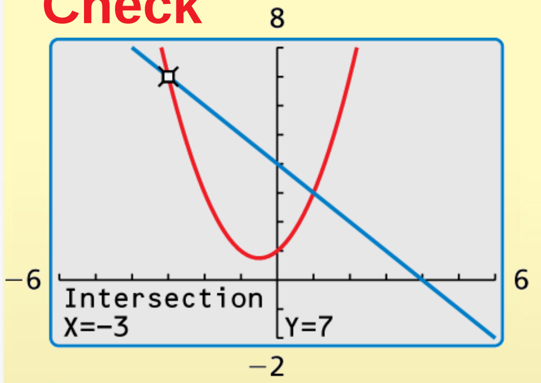
$x^2 + 2x - 3 = 0$ Write in standard form.

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

$x + 3 = 0$ or $x - 1 = 0$ Zero-Product Property.

$x = -3$ or $x = 1$ Solve for x.

Check



To solve for y, substitute $x = -3$ and $x = 1$ into the equation $y = -x + 4$.

$y = -x + 4 = -(-3) + 4 = 7$ Substitute −3 for x.

$y = -x + 4 = -1 + 4 = 3$ Substitute 1 for x.

The solutions are (−3, 7) and (1, 3).

Do pg 136 #18, 19 – solve by substitution

18. $x = 3$

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

19. $2x^2 + 4x - y = -3$

$-2x + y = -4$

18. $(3, -23)$

19. no solution

Solve the system by elimination.

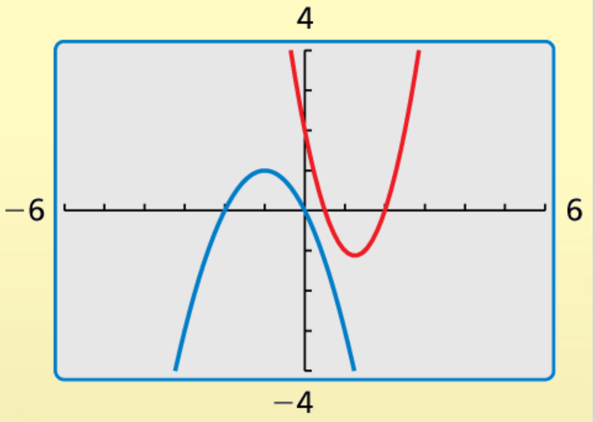
$2x^2 - 5x - y = -2$ Equation 1

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

SOLUTION

Add the equations to eliminate the *y*-term and obtain a quadratic equation in *x*.

Check



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

Add the equations.

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

Write in standard form.

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

Use the Quadratic Formula.

Because the discriminant is negative, the equation $3x^2 - 3x + 2 = 0$ has no real solution. So, the original system has no real solution.

Do pg 137 #29, 30 – solve by elimination

29. $-3x^2 + y = -18x + 29$

$-3x^2 - y = 18x - 25$

30. $y = -x^2 - 6x - 10$

$y = 3x^2 + 18x + 22$

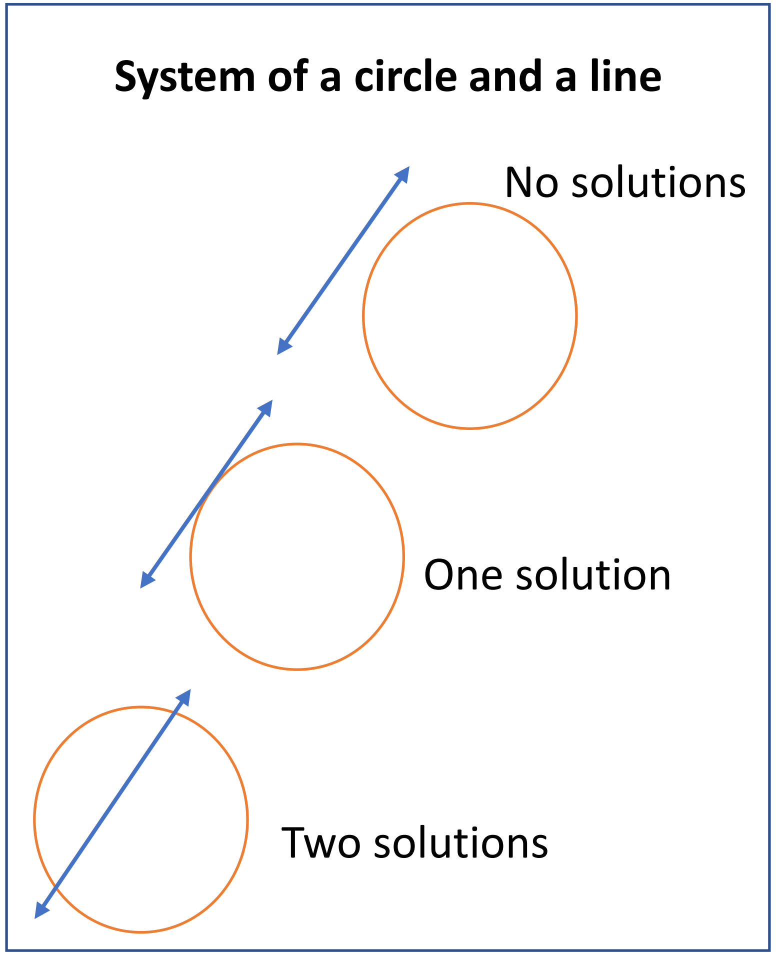
29. no solution

30. $(-2, -2)$ and $(-4, -2)$

What kind of equation is $x^2 + y^2 = 25$?

It is a circle with radius 5 and center at (0, 0).

General equation for a circle: $x^2 + y^2 = r^2$ where r is the radius and the center is at (0, 0).



Solve the system by substitution.

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

$y = -3x + 10$ Equation 2

SOLUTION

Substitute $-3x + 10$ for y in Equation 1 and solve for x.

$x^2 + y^2 = 10$	Write Equation 1.
$x^2 + (-3x + 10)^2 = 10$	Substitute $-3x + 10$ for y.
$x^2 + 9x^2 - 60x + 100 = 10$	Expand the power.
$10x^2 - 60x + 90 = 0$	Write in standard form.
$x^2 - 6x + 9 = 0$	Divide each side by 10.
$(x - 3)^2 = 0$	Perfect Square Trinomial Pattern
$x = 3$	Zero-Product Property

COMMON ERROR

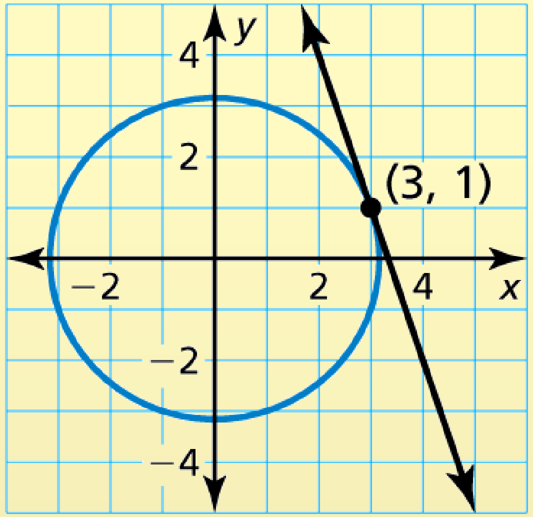
You can also substitute $x = 3$ in Equation 1 to find y. This yields two *apparent* solutions, (3,1) and (3, −1). However, (3, −1) is *not* a solution because it does not satisfy Equation 2. You can also see (3, −1) is not a solution from the graph.

To find the y-coordinate of the solution, substitute $x = 3$ in Equation 2.

$y = -3(3) + 10 = 1$

The solution is (3, 1).

Check



Do pg 137 #42 – solve using any method and explain your choice

42. $-x^2 + y^2 = 100$

$y = -x + 14$

42. about (3.43, 10.57); *Sample answer:* substitution because the second equation can be substituted into the first equation

Homework

Pg 136 #15-24, 27-35, 37-40