4.7 Graphing Systems of Linear Inequalities

Learning Objectives

By the end of this section, you will be able to:

- Determine whether an ordered pair is a solution of a system of linear inequalities
- Solve a system of linear inequalities by graphing
- Solve applications of systems of inequalities

Be Prepared!

Before you get started, take this readiness quiz.

1. Solve the inequality $2a < 5a + 12$.
   If you missed this problem, review **Example 2.52**.
2. Determine whether the ordered pair $\left(3, \frac{1}{2}\right)$ is a solution to the system $y > 2x + 3$.
   If you missed this problem, review **Example 3.34**.

Determine whether an ordered pair is a solution of a system of linear inequalities

The definition of a **system of linear inequalities** is very similar to the definition of a system of linear equations.

System of Linear Inequalities

Two or more linear inequalities grouped together form a system of linear inequalities.

A system of linear inequalities looks like a system of linear equations, but it has inequalities instead of equations. A system of two linear inequalities is shown here.

$$\begin{cases} x + 4y \geq 10 \\ 3x - 2y < 12 \end{cases}$$

To solve a system of linear inequalities, we will find values of the variables that are solutions to both inequalities. We solve the system by using the graphs of each inequality and show the solution as a graph. We will find the region on the plane that contains all ordered pairs (x, y) that make both inequalities true.

Solutions of a System of Linear Inequalities

Solutions of a system of linear inequalities are the values of the variables that make all the inequalities true.

The solution of a system of linear inequalities is shown as a shaded region in the *x, y* coordinate system that includes all the points whose ordered pairs make the inequalities true.

To determine if an ordered pair is a solution to a system of two inequalities, we substitute the values of the variables into each inequality. If the ordered pair makes both inequalities true, it is a solution to the system.

EXAMPLE 4.53

Determine whether the ordered pair is a solution to the system $\begin{cases} x + 4y \geq 10 \\ 3x - 2y < 12 \end{cases}$.

ⓐ $(-2, 4)$ ⓑ $(3, 1)$

Solution

ⓐ Is the ordered pair $(-2, 4)$ a solution?

We substitute $x = -2$ and $y = 4$ into both inequalities.

$x + 4y \geq 10$	$3x - 2y < 12$
$-2 + 4(4) \overset{?}{\geq} 10$	$3(-2) - 2(4) \overset{?}{<} 12$
$14 \geq 10$ true	$-14 < 12$ true

The ordered pair $(-2, 4)$ made both inequalities true. Therefore $(-2, 4)$ is a solution to this system.

ⓑ Is the ordered pair $(3, 1)$ a solution?

We substitute $x = 3$ and $y = 1$ into both inequalities.

$x + 4y \geq 10$	$3x - 2y < 12$
$3 + 4(1) \overset{?}{\geq} 10$	$3(3) - 2(1) \overset{?}{<} 12$
$7 \geq 10$ false	$7 < 12$ true

The ordered pair $(3, 1)$ made one inequality true, but the other one false. Therefore $(3, 1)$ is not a solution to this system.

TRY IT : : 4.105

Determine whether the ordered pair is a solution to the system: $\begin{cases} x - 5y > 10 \\ 2x + 3y > -2 \end{cases}$.

ⓐ $(3, -1)$ ⓑ $(6, -3)$

TRY IT : : 4.106

Determine whether the ordered pair is a solution to the system: $\begin{cases} y > 4x - 2 \\ 4x - y < 20 \end{cases}$.

ⓐ $(-2, 1)$ ⓑ $(4, -1)$

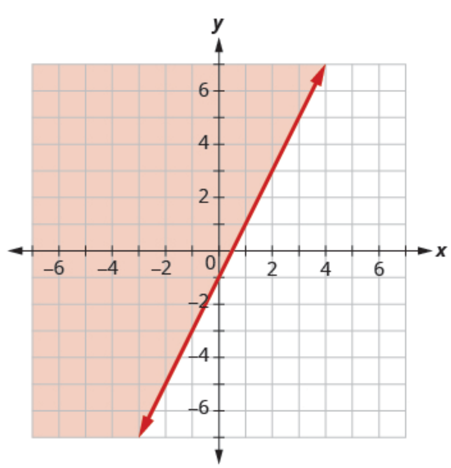
Solve a System of Linear Inequalities by Graphing

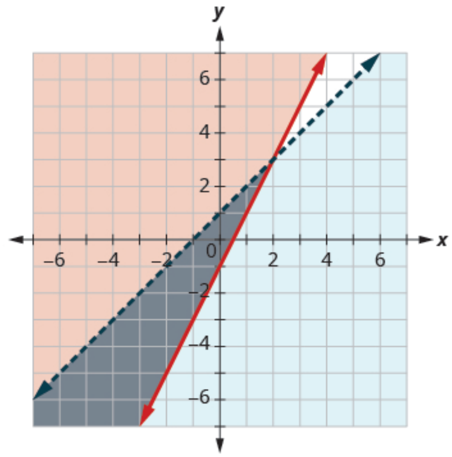
The solution to a single linear inequality is the region on one side of the boundary line that contains all the points that make the inequality true. The solution to a system of two linear inequalities is a region that contains the solutions to both inequalities. To find this region, we will graph each inequality separately and then locate the region where they are both true. The solution is always shown as a graph.

EXAMPLE 4.54 HOW TO SOLVE A SYSTEM OF LINEAR INEQUALITIES BY GRAPHING

Solve the system by graphing: $\begin{cases} y \geq 2x - 1 \\ y < x + 1 \end{cases}$.

Solution

Step 1. Graph the first inequality. • Graph the boundary line. • Shade in the side of the boundary line where the inequality is true.	We will graph $y \geq 2x - 1$. We graph the line $y = 2x - 1$. It is a solid line because the inequality sign is $\geq$. We choose (0, 0) as a test point. It is a solution to $y \geq 2x - 1$, so we shade in above the boundary line.	$\begin{cases} y \geq 2x - 1 \\ y < x + 1 \end{cases}$ 

Step 2. On the same grid, graph the second inequality. • Graph the boundary line. • Shade in the side of that boundary line where the inequality is true.	We will graph $y < x + 1$ on the same grid. We graph the line $y = x + 1$. It is a dashed line because the inequality sign is <. Again, we use (0, 0) as a test point. It is a solution so we shade in that side of the line $y = x + 1$.	
Step 3. The solution is the region where the shading overlaps.	The point where the boundary lines intersect is not a solution because it is not a solution to $y < x + 1$.	The solution is all points in the area shaded twice—which appears as the darkest shaded region.
Step 4. Check by choosing a test point.	We'll use (–1, –1) as a test point.	Is (–1, –1) a solution to $y \geq 2x - 1$? $-1 \overset{?}{\geq} 2(-1) - 1$ $-1 \geq -3$ true Is (–1, –1) a solution to $y < x + 1$? $-1 \overset{?}{<} -1 + 1$ $-1 < 0$ true The region containing (–1, –1) is the solution to this system.

TRY IT : : 4.107

Solve the system by graphing: $\begin{cases} y < 3x + 2 \\ y > -x - 1 \end{cases}$.

TRY IT : : 4.108

Solve the system by graphing: $\begin{cases} y < -\frac{1}{2}x + 3 \\ y < 3x - 4 \end{cases}$.

HOW TO : : SOLVE A SYSTEM OF LINEAR INEQUALITIES BY GRAPHING.

Step 1. Graph the first inequality.
- Graph the boundary line.
- Shade in the side of the boundary line where the inequality is true.

Step 2. On the same grid, graph the second inequality.
- Graph the boundary line.
- Shade in the side of that boundary line where the inequality is true.

Step 3. The solution is the region where the shading overlaps.

Step 4. Check by choosing a test point.

EXAMPLE 4.55

Solve the system by graphing: $\begin{cases} x - y > 3 \\ y < -\frac{1}{5}x + 4 \end{cases}$.

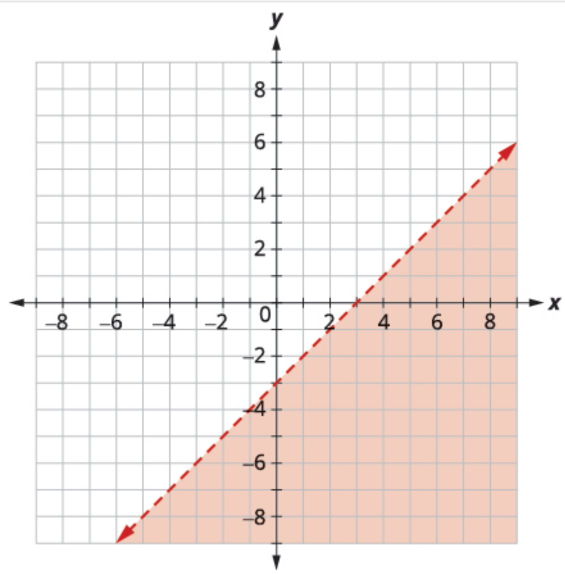
Solution

$$\begin{cases} x - y > 3 \\ y < -\frac{1}{5}x + 4 \end{cases}$$

Graph $x - y > 3$, by graphing $x - y = 3$ and testing a point.

The intercepts are $x = 3$ and $y = -3$ and the boundary line will be dashed.

Test (0, 0) which makes the inequality false so shade (red) the side that does not contain (0, 0).

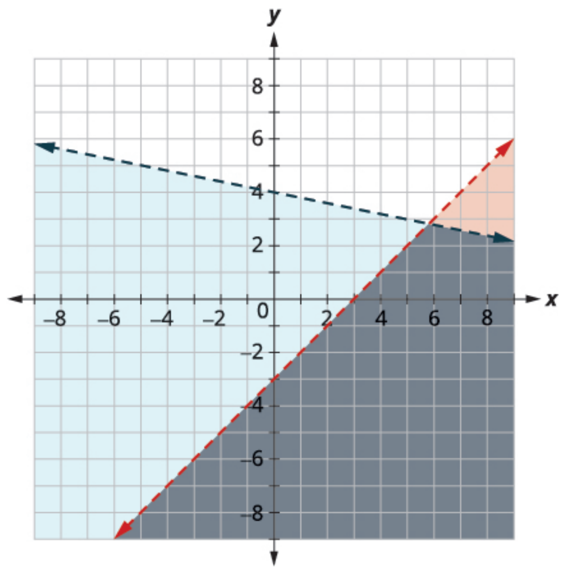


Graph $y < -\frac{1}{5}x + 4$ by graphing $y = -\frac{1}{5}x + 4$ using the slope $m = -\frac{1}{5}$ and *y*-intercept *b* = 4.

The boundary line will be dashed

Test (0, 0) which makes the inequality true, so shade (blue) the side that contains (0, 0).

Choose a test point in the solution and verify that it is a solution to both inequalties.



The point of intersection of the two lines is not included as both boundary lines were dashed. The solution is the area shaded twice—which appears as the darkest shaded region.

TRY IT : : 4.109

Solve the system by graphing: $\begin{cases} x + y \leq 2 \\ y \geq \frac{2}{3}x - 1 \end{cases}$.

TRY IT : : 4.110

Solve the system by graphing: $\begin{cases} 3x - 2y \leq 6 \\ y > -\frac{1}{4}x + 5 \end{cases}$.

EXAMPLE 4.56

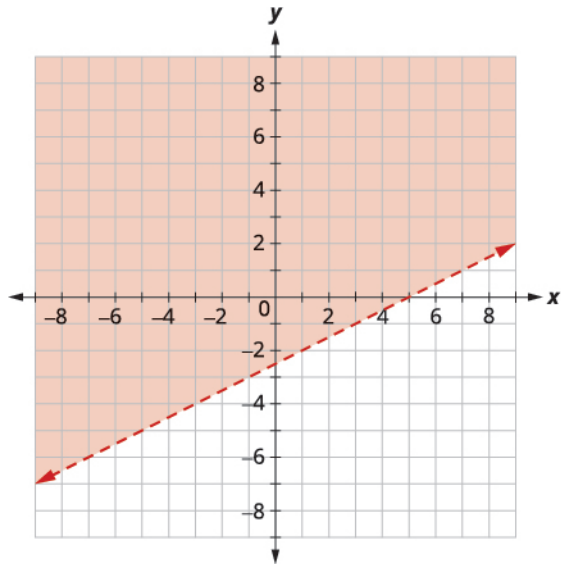
Solve the system by graphing: $\begin{cases} x - 2y < 5 \\ y > -4 \end{cases}$.

Solution

$$\begin{cases} x - 2y < 5 \\ y > -4 \end{cases}$$

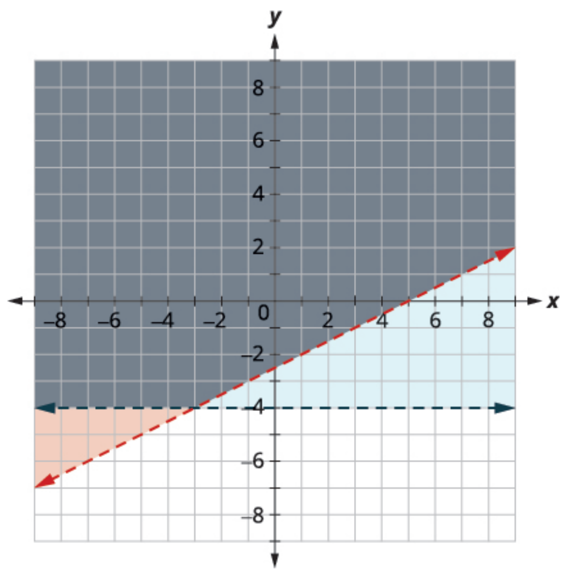
Graph $x - 2y < 5,$ by graphing $x - 2y = 5$ and testing a point. The intercepts are $x = 5$ and $y = -2.5$ and the boundary line will be dashed.

Test (0, 0) which makes the inequality true, so shade (red) the side that contains (0, 0).



Graph $y > -4,$ by graphing $y = -4$ and recognizing that it is a horizontal line through $y = -4.$ The boundary line will be dashed.

Test (0, 0) which makes the inequality true so shade (blue) the side that contains (0, 0).



The point $(0, 0)$ is in the solution and we have already found it to be a solution of each inequality. The point of intersection of the two lines is not included as both boundary lines were dashed.

The solution is the area shaded twice—which appears as the darkest shaded region.

TRY IT : : 4.111 Solve the system by graphing: $\begin{cases} y \geq 3x - 2 \\ y < -1 \end{cases}.$

TRY IT : : 4.112 Solve the system by graphing: $\begin{cases} x > -4 \\ x - 2y \geq -4 \end{cases}.$

Systems of linear inequalities where the boundary lines are parallel might have no solution. We'll see this in the next example.

EXAMPLE 4.57

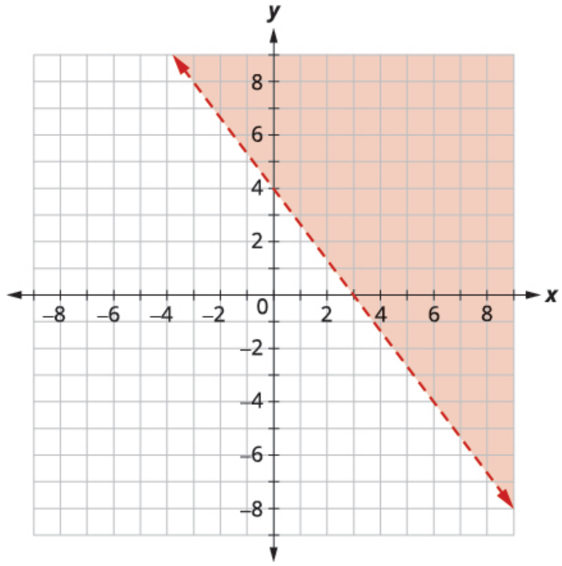
Solve the system by graphing: $\begin{cases} 4x + 3y \geq 12 \\ y < -\frac{4}{3}x + 1 \end{cases}$.

Solution

$$\begin{cases} 4x + 3y \geq 12 \\ y < -\frac{4}{3}x + 1 \end{cases}$$

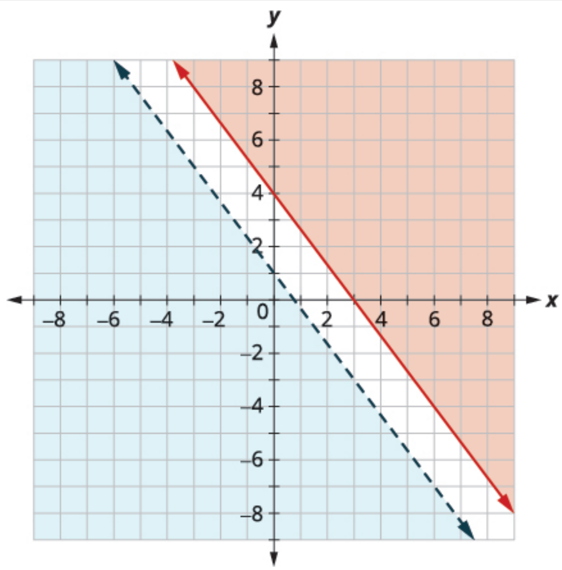
Graph $4x + 3y \geq 12$, by graphing $4x + 3y = 12$ and testing a point. The intercepts are $x = 3$ and $y = 4$ and the boundary line will be solid.

Test (0, 0) which makes the inequality false, so shade (red) the side that does not contain (0, 0).



Graph $y < -\frac{4}{3}x + 1$ by graphing $y = -\frac{4}{3}x + 1$ using the slope $m = -\frac{4}{3}$ and y-intercept $b = 1$. The boundary line will be dashed.

Test (0, 0) which makes the inequality true, so shade (blue) the side that contains (0, 0).



There is no point in both shaded regions, so the system has no solution.

TRY IT : : 4.113 Solve the system by graphing: $\begin{cases} 3x - 2y \geq 12 \\ y \geq \frac{3}{2}x + 1 \end{cases}$.

TRY IT : : 4.114 Solve the system by graphing: $\begin{cases} x + 3y > 8 \\ y < -\frac{1}{3}x - 2 \end{cases}$.

Some systems of linear inequalities where the boundary lines are parallel will have a solution. We'll see this in the next example.

EXAMPLE 4.58

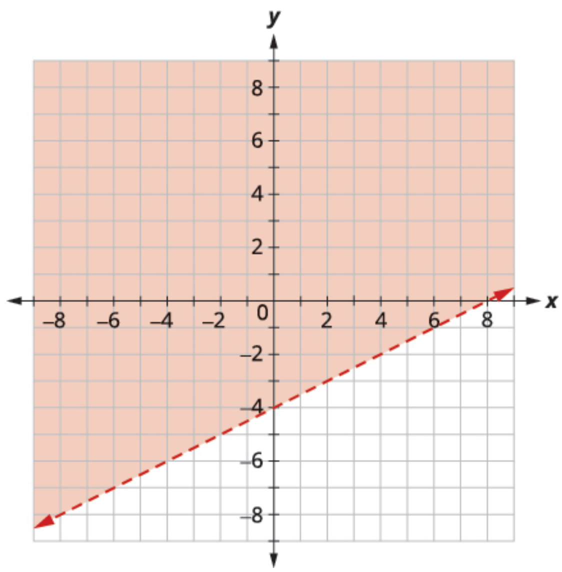
Solve the system by graphing: $\begin{cases} y > \frac{1}{2}x - 4 \\ x - 2y < -4 \end{cases}$.

Solution

$$\begin{cases} y > \frac{1}{2}x - 4 \\ x - 2y < -4 \end{cases}$$

Graph $y > \frac{1}{2}x - 4$ by graphing $y = \frac{1}{2}x - 4$ using the slope $m = \frac{1}{2}$ and the intercept $b = -4$. The boundary line will be dashed.

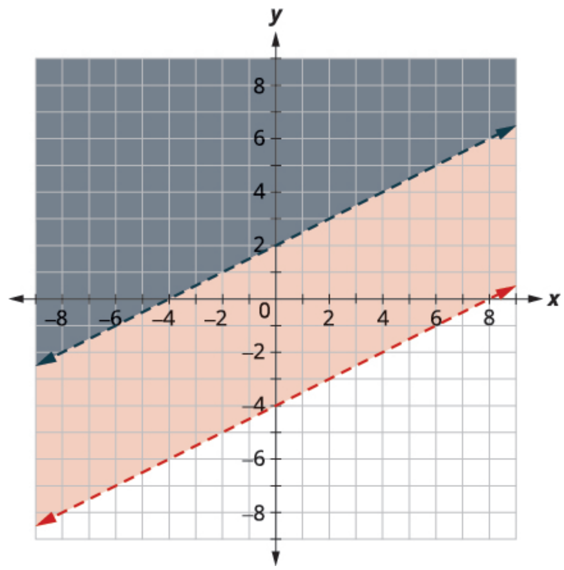
Test (0, 0) which makes the inequality true, so shade (red) the side that contains (0, 0).



Graph $x - 2y < -4$ by graphing $x - 2y = -4$ and testing a point. The intercepts are $x = -4$ and $y = 2$ and the boundary line will be dashed.

Choose a test point in the solution and verify that it is a solution to both inequalties.

Test (0, 0) which makes the inequality false, so shade (blue) the side that does not contain (0, 0).



No point on the boundary lines is included in the solution as both lines are dashed.

The solution is the region that is shaded twice which is also the solution to $x - 2y < -4$.

TRY IT : : 4.115 Solve the system by graphing: $\begin{cases} y \geq 3x + 1 \\ -3x + y \geq -4 \end{cases}$.

TRY IT : : 4.116 Solve the system by graphing: $\begin{cases} y \leq -\frac{1}{4}x + 2 \\ x + 4y \leq 4 \end{cases}$.

Solve Applications of Systems of Inequalities

The first thing we'll need to do to solve applications of systems of inequalities is to translate each condition into an inequality. Then we graph the system, as we did above, to see the region that contains the solutions. Many situations will be realistic only if both variables are positive, so we add inequalities to the system as additional requirements.

EXAMPLE 4.59

Christy sells her photographs at a booth at a street fair. At the start of the day, she wants to have at least 25 photos to display at her booth. Each small photo she displays costs her $4 and each large photo costs her $10. She doesn't want to spend more than $200 on photos to display.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could she display 10 small and 20 large photos?

ⓓ Could she display 20 large and 10 small photos?

Solution

ⓐ

$$\begin{aligned} \text{Let } x &= \text{the number of small photos.} \\ y &= \text{the number of large photos} \end{aligned}$$

To find the system of equations translate the information.

She wants to have at least 25 photos.

The number of small plus the number of large should be at least 25.

$$x + y \geq 25$$

\$4 for each small and \$10 for each large must be no more than \$200

$$4x + 10y \leq 200$$

The number of small photos must be greater than or equal to 0.

$$x \geq 0$$

The number of large photos must be greater than or equal to 0.

$$y \geq 0$$

We have our system of equations.

$$\begin{cases} x + y \geq 25 \\ 4x + 10y \leq 200 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

ⓑ

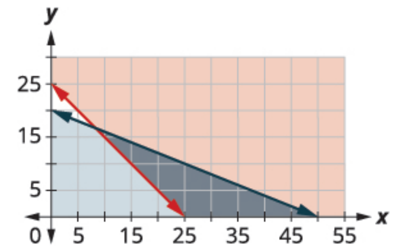
Since $x \geq 0$ and $y \geq 0$ (both are greater than or equal to) all solutions will be in the first quadrant. As a result, our graph shows only quadrant one.

To graph $x + y \geq 25$, graph $x + y = 25$ as a solid line.

Choose (0, 0) as a test point. Since it does not make the inequality true, shade (red) the side that does not include the point (0, 0).

To graph $4x + 10y \leq 200$, graph $4x + 10y = 200$ as a solid line.

Choose (0, 0) as a test point. Since it does make the inequality true, shade (blue) the side that include the point (0, 0).



The solution of the system is the region of the graph that is shaded the darkest. The boundary line sections that border the darkly-shaded section are included in the solution as are the points on the *x*-axis from (25, 0) to (55, 0).

ⓒ To determine if 10 small and 20 large photos would work, we look at the graph to see if the point (10, 20) is in the solution region. We could also test the point to see if it is a solution of both equations.

It is not, Christy would not display 10 small and 20 large photos.

ⓓ To determine if 20 small and 10 large photos would work, we look at the graph to see if the point (20, 10) is in the solution region. We could also test the point to see if it is a solution of both equations.

It is, so Christy could choose to display 20 small and 10 large photos.

Notice that we could also test the possible solutions by substituting the values into each inequality.

TRY IT : : 4.117

A trailer can carry a maximum weight of 160 pounds and a maximum volume of 15 cubic feet. A microwave oven weighs 30 pounds and has 2 cubic feet of volume, while a printer weighs 20 pounds and has 3 cubic feet of space.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could 4 microwaves and 2 printers be carried on this trailer?

ⓓ Could 7 microwaves and 3 printers be carried on this trailer?

TRY IT : : 4.118

Mary needs to purchase supplies of answer sheets and pencils for a standardized test to be given to the juniors at her high school. The number of the answer sheets needed is at least 5 more than the number of pencils. The pencils cost \$2 and the answer sheets cost \$1. Mary's budget for these supplies allows for a maximum cost of \$400.

ⓐ Write a system of inequalities to model this situation.
ⓑ Graph the system.
ⓒ Could Mary purchase 100 pencils and 100 answer sheets?
ⓓ Could Mary purchase 150 pencils and 150 answer sheets?

When we use variables other than *x* and *y* to define an unknown quantity, we must change the names of the axes of the graph as well.

EXAMPLE 4.60

Omar needs to eat at least 800 calories before going to his team practice. All he wants is hamburgers and cookies, and he doesn't want to spend more than \$5. At the hamburger restaurant near his college, each hamburger has 240 calories and costs \$1.40. Each cookie has 160 calories and costs \$0.50.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could he eat 3 hamburgers and 1 cookie?

ⓓ Could he eat 2 hamburgers and 4 cookies?

Solution

ⓐ

Let $h =$ the number of hamburgers.
$c =$ the number of cookies

To find the system of equations translate the information.

The calories from hamburgers at 240 calories each, plus the calories from cookies at 160 calories each must be more that 800.

$$240h + 160c \geq 800$$

The amount spent on hamburgers at \$1.40 each, plus the amount spent on cookies at \$0.50 each must be no more than \$5.00.

$$1.40h + 0.50c \leq 5$$

The number of hamburgers must be greater than or equal to 0.

$$h \geq 0$$

The number of cookies must be greater than or equal to 0.

$$c \geq 0$$

We have our system of equations.

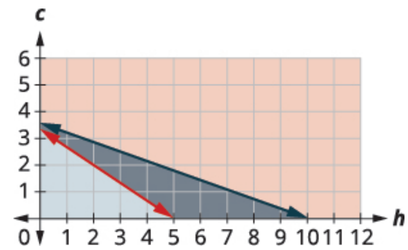
$$\begin{cases} 240h + 160c \geq 800 \\ 1.40h + 0.50c \leq 5 \\ h \geq 0 \\ c \geq 0 \end{cases}$$

ⓑ

Since $h > \ = 0$ and $c > \ = 0$ (both are greater than or equal to) all solutions will be in the first quadrant. As a result, our graph shows only quadrant one.

To graph $240h + 160c \geq 800,$ graph $240h + 160c = 800$ as a solid line.

Choose (0, 0) as a test point. Since it does not make the inequality true, shade (red) the side that does not include the point (0, 0).



Graph $1.40h + 0.50c \leq 5.$ The boundary line is $1.40h + 0.50c = 5.$ We test (0, 0) and it makes the inequality true. We shade the side of the line that includes (0, 0).

The solution of the system is the region of the graph that is shaded the darkest. The boundary line sections that border the darkly shaded section are included in the solution as are the points on the *x*-axis from (5, 0) to (10, 0).

ⓒ To determine if 3 hamburgers and 2 cookies would meet Omar's criteria, we see if the point (3, 2) is in the solution region. It is, so Omar might choose to eat 3 hamburgers and 2 cookies.

ⓓ To determine if 2 hamburgers and 4 cookies would meet Omar's criteria, we see if the point (2, 4) is in the solution region. It is, Omar might choose to eat 2 hamburgers and 4 cookies.

We could also test the possible solutions by substituting the values into each inequality.

TRY IT : : 4.119

Tension needs to eat at least an extra 1,000 calories a day to prepare for running a marathon. He has only $25 to spend on the extra food he needs and will spend it on $0.75 donuts which have 360 calories each and $2 energy drinks which have 110 calories.

ⓐ Write a system of inequalities that models this situation.
ⓑ Graph the system.
ⓒ Can he buy 8 donuts and 4 energy drinks and satisfy his caloric needs?
ⓓ Can he buy 1 donut and 3 energy drinks and satisfy his caloric needs?

TRY IT : : 4.120

Philip's doctor tells him he should add at least 1,000 more calories per day to his usual diet. Philip wants to buy protein bars that cost $1.80 each and have 140 calories and juice that costs $1.25 per bottle and have 125 calories. He doesn't want to spend more than $12.

ⓐ Write a system of inequalities that models this situation.
ⓑ Graph the system.
ⓒ Can he buy 3 protein bars and 5 bottles of juice?
ⓓ Can he buy 5 protein bars and 3 bottles of juice?

MEDIA : :

Access these online resources for additional instruction and practice with solving systems of linear inequalities by graphing.

- Solving Systems of Linear Inequalities by Graphing (https://openstax.org/l/37sysineqgraph)
- Systems of Linear Inequalities (https://openstax.org/l/37sysineqgraph2)

4.7 EXERCISES

Practice Makes Perfect

Determine Whether an Ordered Pair is a Solution of a System of Linear Inequalities

In the following exercises, determine whether each ordered pair is a solution to the system.

280. $\begin{cases} 3x + y > 5 \\ 2x - y \leq 10 \end{cases}$

ⓐ $(3, -3)$

ⓑ $(7, 1)$

281. $\begin{cases} 4x - y < 10 \\ -2x + 2y > -8 \end{cases}$

ⓐ $(5, -2)$

ⓑ $(-1, 3)$

282. $\begin{cases} y > \frac{2}{3}x - 5 \\ x + \frac{1}{2}y \leq 4 \end{cases}$

ⓐ $(6, -4)$

ⓑ $(3, 0)$

283. $\begin{cases} y < \frac{3}{2}x + 3 \\ \frac{3}{4}x - 2y < 5 \end{cases}$

ⓐ $(-4, -1)$

ⓑ $(8, 3)$

284. $\begin{cases} 7x + 2y > 14 \\ 5x - y \leq 8 \end{cases}$

ⓐ $(2, 3)$

ⓑ $(7, -1)$

285. $\begin{cases} 6x - 5y < 20 \\ -2x + 7y > -8 \end{cases}$

ⓐ $(1, -3)$

ⓑ $(-4, 4)$

Solve a System of Linear Inequalities by Graphing

In the following exercises, solve each system by graphing.

286. $\begin{cases} y \leq 3x + 2 \\ y > x - 1 \end{cases}$

287. $\begin{cases} y < -2x + 2 \\ y \geq -x - 1 \end{cases}$

288. $\begin{cases} y < 2x - 1 \\ y \leq -\frac{1}{2}x + 4 \end{cases}$

289. $\begin{cases} y \geq -\frac{2}{3}x + 2 \\ y > 2x - 3 \end{cases}$

290. $\begin{cases} x - y > 1 \\ y < -\frac{1}{4}x + 3 \end{cases}$

291. $\begin{cases} x + 2y < 4 \\ y < x - 2 \end{cases}$

292. $\begin{cases} 3x - y \geq 6 \\ y \geq -\frac{1}{2}x \end{cases}$

293. $\begin{cases} 2x + 4y \geq 8 \\ y \leq \frac{3}{4}x \end{cases}$

294. $\begin{cases} 2x - 5y < 10 \\ 3x + 4y \geq 12 \end{cases}$

295. $\begin{cases} 3x - 2y \leq 6 \\ -4x - 2y > 8 \end{cases}$

296. $\begin{cases} 2x + 2y > -4 \\ -x + 3y \geq 9 \end{cases}$

297. $\begin{cases} 2x + y > -6 \\ -x + 2y \geq -4 \end{cases}$

298. $\begin{cases} x - 2y < 3 \\ y \leq 1 \end{cases}$

299. $\begin{cases} x - 3y > 4 \\ y \leq -1 \end{cases}$

300. $\begin{cases} y \geq -\frac{1}{2}x - 3 \\ x \leq 2 \end{cases}$

301. $\begin{cases} y \leq -\frac{2}{3}x + 5 \\ x \geq 3 \end{cases}$

302. $\begin{cases} y \geq \frac{3}{4}x - 2 \\ y < 2 \end{cases}$

303. $\begin{cases} y \leq -\frac{1}{2}x + 3 \\ y < 1 \end{cases}$

304. $\begin{cases} 3x - 4y < 8 \\ x < 1 \end{cases}$

305. $\begin{cases} -3x + 5y > 10 \\ x > -1 \end{cases}$

306. $\begin{cases} x \geq 3 \\ y \leq 2 \end{cases}$

307. $\begin{cases} x \le -1 \\ y \ge 3 \end{cases}$

308. $\begin{cases} 2x + 4y > 4 \\ y \le -\frac{1}{2}x - 2 \end{cases}$

309. $\begin{cases} x - 3y \ge 6 \\ y > \frac{1}{3}x + 1 \end{cases}$

310. $\begin{cases} -2x + 6y < 0 \\ 6y > 2x + 4 \end{cases}$

311. $\begin{cases} -3x + 6y > 12 \\ 4y \le 2x - 4 \end{cases}$

312. $\begin{cases} y \ge -3x + 2 \\ 3x + y > 5 \end{cases}$

313. $\begin{cases} y \ge \frac{1}{2}x - 1 \\ -2x + 4y \ge 4 \end{cases}$

314. $\begin{cases} y \le -\frac{1}{4}x - 2 \\ x + 4y < 6 \end{cases}$

315. $\begin{cases} y \ge 3x - 1 \\ -3x + y > -4 \end{cases}$

316. $\begin{cases} 3y > x + 2 \\ -2x + 6y > 8 \end{cases}$

317. $\begin{cases} y < \frac{3}{4}x - 2 \\ -3x + 4y < 7 \end{cases}$

Solve Applications of Systems of Inequalities

In the following exercises, translate to a system of inequalities and solve.

318. Caitlyn sells her drawings at the county fair. She wants to sell at least 60 drawings and has portraits and landscapes. She sells the portraits for \$15 and the landscapes for \$10. She needs to sell at least \$800 worth of drawings in order to earn a profit.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Will she make a profit if she sells 20 portraits and 35 landscapes?

ⓓ Will she make a profit if she sells 50 portraits and 20 landscapes?

319. Jake does not want to spend more than \$50 on bags of fertilizer and peat moss for his garden. Fertilizer costs \$2 a bag and peat moss costs \$5 a bag. Jake's van can hold at most 20 bags.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Can he buy 15 bags of fertilizer and 4 bags of peat moss?

ⓓ Can he buy 10 bags of fertilizer and 10 bags of peat moss?

320. Reiko needs to mail her Christmas cards and packages and wants to keep her mailing costs to no more than \$500. The number of cards is at least 4 more than twice the number of packages. The cost of mailing a card (with pictures enclosed) is \$3 and for a package the cost is \$7.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Can she mail 60 cards and 26 packages?

ⓓ Can she mail 90 cards and 40 packages?

321. Juan is studying for his final exams in chemistry and algebra. he knows he only has 24 hours to study, and it will take him at least three times as long to study for algebra than chemistry.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Can he spend 4 hours on chemistry and 20 hours on algebra?

ⓓ Can he spend 6 hours on chemistry and 18 hours on algebra?

322. Jocelyn is pregnant and so she needs to eat at least 500 more calories a day than usual. When buying groceries one day with a budget of \$15 for the extra food, she buys bananas that have 90 calories each and chocolate granola bars that have 150 calories each. The bananas cost \$0.35 each and the granola bars cost \$2.50 each.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could she buy 5 bananas and 6 granola bars?

ⓓ Could she buy 3 bananas and 4 granola bars?

323. Mark is attempting to build muscle mass and so he needs to eat more than an additional 80 grams of protein a day. A bottle of protein water costs \$3.20 and a protein bar costs \$1.75. The protein water supplies 27 grams of protein and the bar supplies 16 gram. If he has \$10 dollars to spend

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could he buy 3 bottles of protein water and 1 protein bar?

ⓓ Could he buy no bottles of protein water and 5 protein bars?

324. Jocelyn desires to increase both her protein consumption and caloric intake. She desires to have at least 35 more grams of protein each day and no more than an additional 200 calories daily. An ounce of cheddar cheese has 7 grams of protein and 110 calories. An ounce of parmesan cheese has 11 grams of protein and 22 calories.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could she eat 1 ounce of cheddar cheese and 3 ounces of parmesan cheese?

ⓓ Could she eat 2 ounces of cheddar cheese and 1 ounce of parmesan cheese?

325. Mark is increasing his exercise routine by running and walking at least 4 miles each day. His goal is to burn a minimum of 1500 calories from this exercise. Walking burns 270 calories/mile and running burns 650 calories.

ⓐ Write a system of inequalities to model this situation.

ⓑ Graph the system.

ⓒ Could he meet his goal by walking 3 miles and running 1 mile?

ⓓ Could he his goal by walking 2 miles and running 2 mile

Writing Exercises

326. Graph the inequality $x - y \geq 3$. How do you know which side of the line $x - y = 3$ should be shaded?

327. Graph the system $\begin{cases} x + 2y \leq 6 \\ y \geq -\frac{1}{2}x - 4 \end{cases}$. What does the solution mean?

Self Check

ⓐ *After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.*

I can...	Confidently	With some help	No-I don't get it!
determine whether an ordered pair is a solution of a system of linear inequalities.			
solve a system of linear inequalities by graphing.			
solve applications of systems of inequalities.			

ⓑ *What does this checklist tell you about your mastery of this section? What steps will you take to improve?*