Chapter 9 Linear and Quadratic Inequalities

9.1 Linear Inequalities in Two Variables

KEY IDEAS

- Recall that to graph a linear equation you can use one of two methods: solve for y or use the intercepts.

Method 1: Solve for y

- Isolate y on one side of the equation to express the equation in the form $y = mx + b$.
- Plot the y-intercept $(0, b)$. Use the slope and the y-intercept to determine another point.
- Draw a line passing through the y-intercept and the second point.

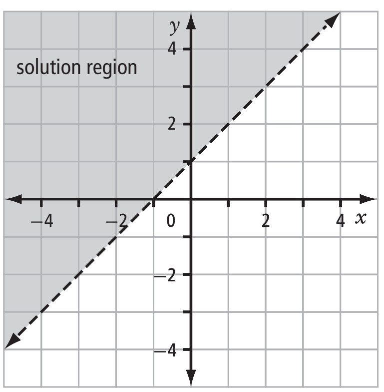
Method 2: Use the Intercepts

- Determine the x-intercept by letting $y = 0$ in the equation and solving for x. The x-intercept will be the point $(x, 0)$.
- Determine the y-intercept by letting $x = 0$ in the equation and solving for y. The y-intercept will be the point $(0, y)$.
- Plot the two intercepts and draw a line passing through them.

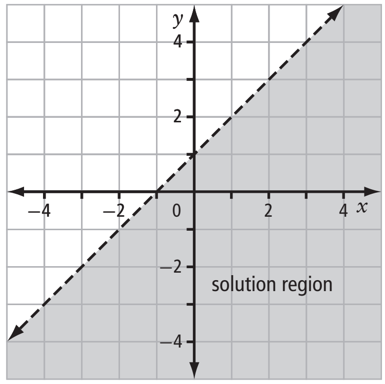
To graph and solve a linear inequality in two variables, isolate y in the inequality.

- Graph the linear equation (boundary) using one of the two methods described above.
- Determine whether the boundary line is solid or dashed:
  - A solid line means that points on the line are part of the solution region. Use a solid line if the inequality involves $\leq$ or $\geq$.
  - A dashed line means that points on the line are *not* part of the solution region. Use a dashed line if the inequality involves $<$ or $>$.
- Select a test point that is not on the boundary line and test it in the original inequality. If the statement is true, shade the region containing the point. If the statement is not true, shade the region that does not contain the point.

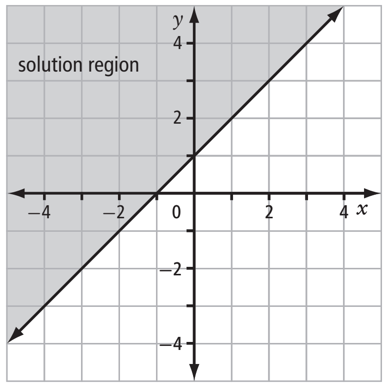
Examples:
$y > x + 1$
The boundary is a *dashed* line.
The test point (0, 0) is not within the solution region because $0 > 0 + 1$ is not a true statement. Therefore, the region *above* the line is shaded.



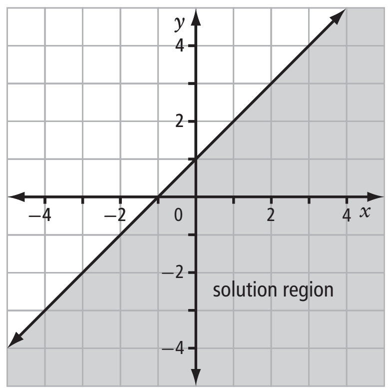
$y < x + 1$
The boundary is a *dashed* line.
The test point (0, 0) is within the solution region because $0 < 0 + 1$ is a true statement. Therefore, the region *below* the line is shaded.



$y \geq x + 1$
The boundary is a *solid* line.
The test point (0, 0) is not within the solution region because $0 \geq 0 + 1$ is not a true statement. Therefore, the region *above* the line is shaded.



$y \leq x + 1$
The boundary is a *solid* line.
The test point (0, 0) is within the solution region because $0 \leq 0 + 1$ is a true statement. Therefore, the region *below* the line is shaded.



- There are an infinite number of solutions to a linear inequality. Solving a linear inequality means determining the *solution region* in the Cartesian plane, rather than determining a point (or points) on a line.

Working Example 1: Graph a Linear Inequality of the Form $Ax + By < C$

Graph and label the linear inequality $4x - 3y < -12$ for the set of real numbers.

Solution

Isolate y on the left side of the inequality symbol.

Remember that if you multiply or divide both sides of an inequality by a negative number, you must reverse the symbol.

Replace the inequality symbol with an equal sign.

The y-intercept is ________. The slope is ________.

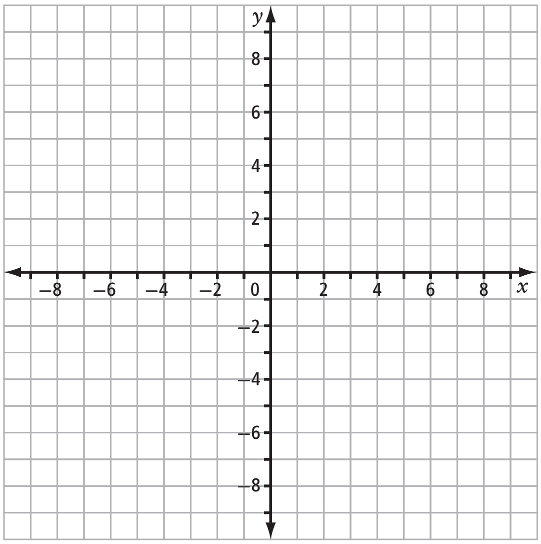
Plot the y-intercept on the grid. Then, using the slope, locate a second point on the boundary line.

From the y-intercept, move ________________ a distance of ________ units.
(*up* or *down*)

Then, move ________ units to the ________________.
(*right* or *left*)

The coordinates of the second point are ________________.

Draw a ________________ line passing through the points.
(*solid* or *dashed*)



Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ________________

Test point below the boundary: ________________

Substitute each point into the inequality.

For the point ________________:

For the point ________________:

The test point ________________ satisfies the inequality.

Shade the area ________________ the boundary to indicate the solution region.
(*above* or *below*)

See page 466 of *Pre-Calculus 11* for a similar example.

Working Example 2: Graph a Linear Inequality of the Form $Ax + By \geq C$

Graph and label the linear inequality $2x - 3y \geq 15$ for the set of real numbers.

Solution

Isolate y on the left side of the inequality sign.

Remember that if you multiply or divide both sides of an inequality by a negative number, you must reverse the symbol.

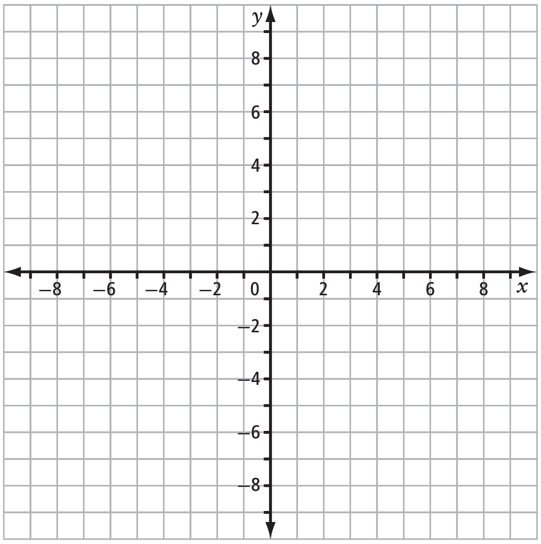
Replace the inequality sign with an equal sign.

The y-intercept is ________.

Determine the x-intercept.

Remember that to determine the x-intercept, let $y = 0$ and solve for x.

Plot the x-intercept and y-intercept on the graph.



Draw a ________________ line through the intercepts
(*solid* or *dashed*)
to indicate the boundary.

Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ________________

Test point below the boundary: ________________

Substitute each point into the inequality.

For the point ________________:

For the point ________________:

The test point ________________ satisfies the inequality.

Shade the area ________________ the boundary to indicate the solution region.
(*above* or *below*)

Working Example 3: Write and Solve a Linear Inequality

A sports equipment manufacturer makes footballs and soccer balls. One football requires 4 min on the cutting machine, while one soccer ball requires only 3 min on the machine. Determine an inequality that would represent this situation. Draw a graph of the inequality to show the number of each type of ball that could be made in 30 min or less.

Solution

Let x represent the number of ________________, requiring ________ min per ball.

Let y represent the number of ________________, requiring ________ min per ball.

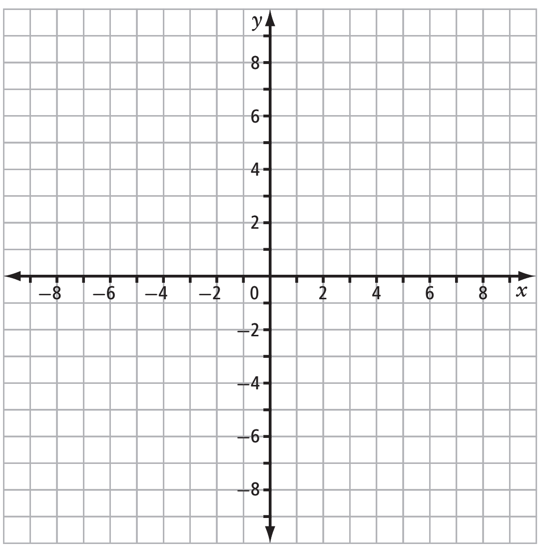
Write the inequality. (Hint: The time it takes to make each type of ball must be included in the inequality, and the total time cannot exceed 30 min.)

________________ + ________________ ≤ ________

Isolate y on the left side of the inequality.

State the equation that is related to the boundary, expressed in slope-intercept form.

Graph the boundary using either the slope and y-intercept or the x-intercept and y-intercept.



Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ______________

Test point below the boundary: ______________

Substitute each point into the inequality.

For the point ______________:

For the point ______________:

The test point ______________ satisfies the inequality.

Shade the area ______________ the boundary to indicate the solution region.
(*above* or *below*)

Select one point in the solution region to answer the question.

For example, select ______________.

You could make _______ footballs and _______ soccer balls.

Check Your Understanding

Practise

1. Which of the ordered pairs are solutions to the given inequality?

a) $4x - 2y \leq -2$

$\{(-1, 4), (0, 0), (4, -3), (3, 7)\}$

b) $-2x + 5y - 8 > 0$

$\{(0, 7), (-2, 5), (3, -1), (-6, 1)\}$

c) $3x < -y - 3$

$\{(0, -3), (-3, -4), (2, -10), (-2, 5)\}$

d) $-2y \geq -2x - 2$

$\{(0, 0), (-2, 5), (-4, -3), (3, 1)\}$

2. Graph each inequality.

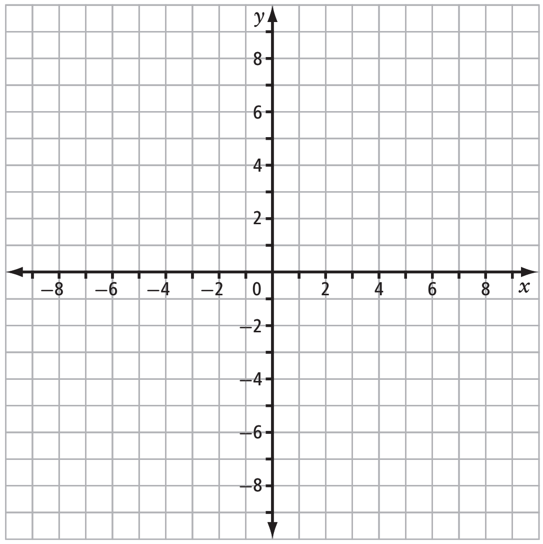
a) $y \leq 3x - 2$

Equation of the boundary: ________________.

y-intercept: ________.

Slope: ________.

Plot the y-intercept on the grid. Then, using the slope, locate a second point on the boundary.



From the y-intercept, move ________________ a distance of ________ units.
(*up* or *down*)

Then, move ________ units to the ______________.
(*right* or *left*)

The coordinates of the second point are ________________.

Draw a ________________ line passing through the points.
(*solid* or *dashed*)

Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ________________

Test point below the boundary: ________________

Substitute each point into the inequality.

For the point ________________:

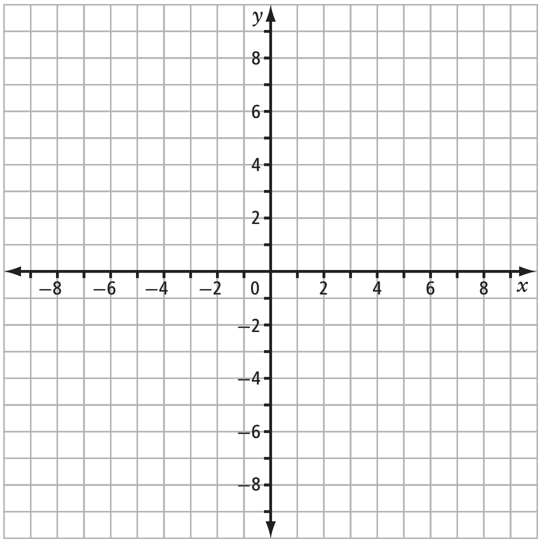
For the point ________________:

The test point ________________ satisfies the inequality.

Shade the area ________________ the boundary to indicate the solution region.
(*above* or *below*)

b) $4x + y \geq 5$

Isolate y on the left side of the inequality sign.



Replace the inequality sign with an equal sign.

The y-intercept is ________.

Determine the x-intercept.

Plot the x-intercept and y-intercept on the graph.

Draw a ________________ line through the intercepts to indicate the boundary.
(*solid* or *dashed*)

Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ________________

Test point below the boundary: ________________

Substitute each point into the inequality.

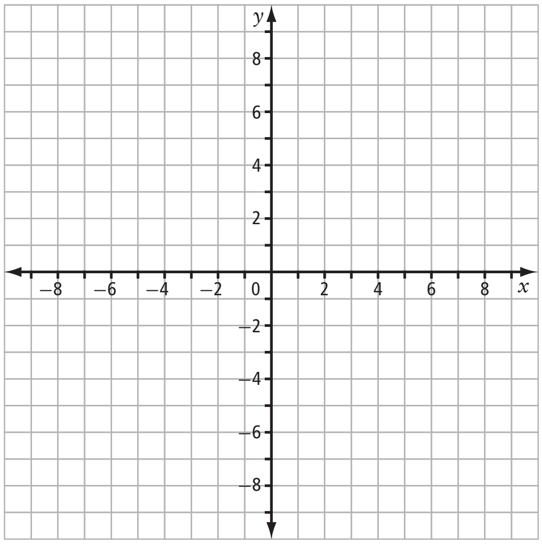
For the point ________________:

For the point ________________:

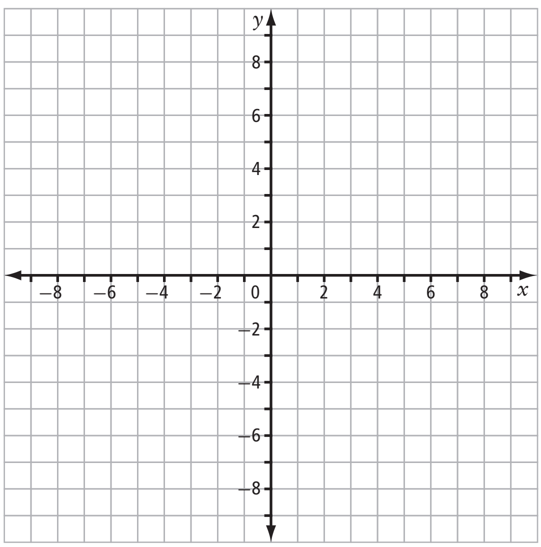
The test point ________________ satisfies the inequality.

Shade the area ________________ the boundary to indicate the solution region.
(*above* or *below*)

c) $3y - 12x < 12$

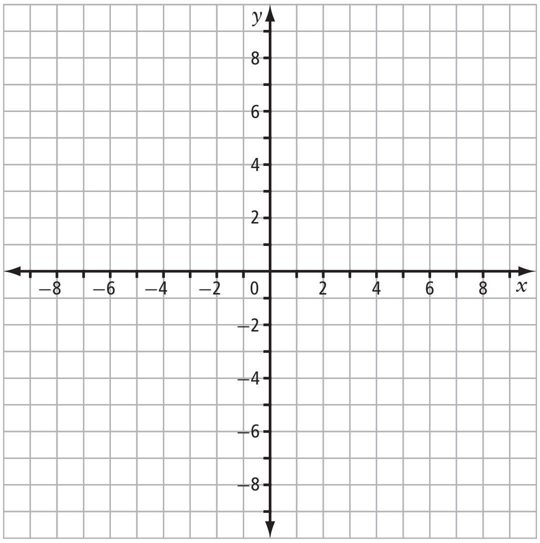


d) $y > 8 - 2x$

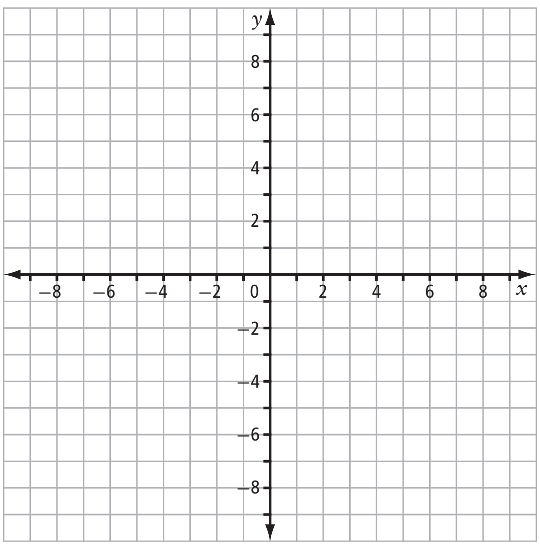


3. Graph each inequality.

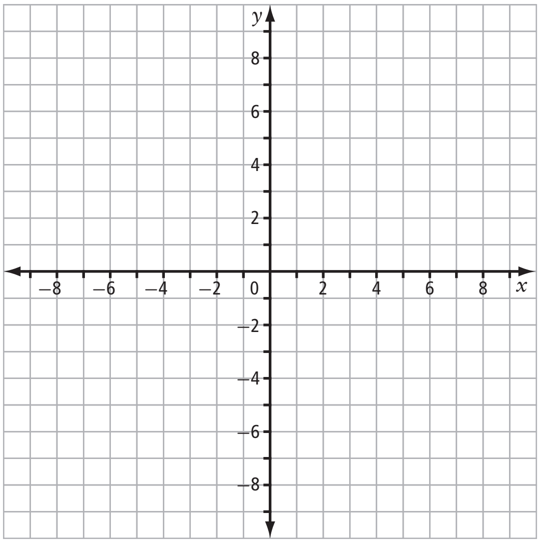
a) $4x - 5y > 20$



b) $2x + y < 8$

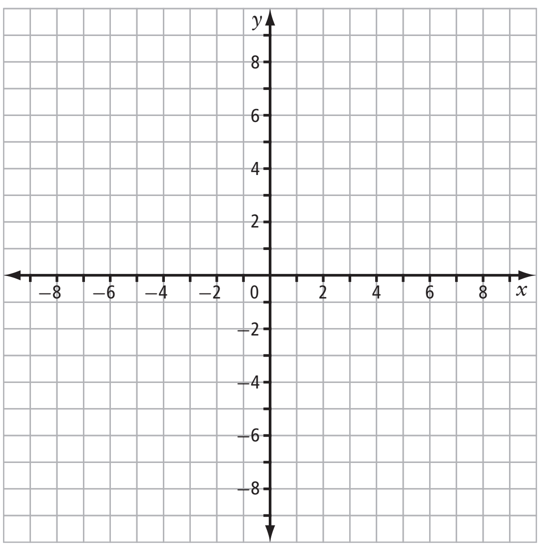


c) $4y - 3x \geq 5$



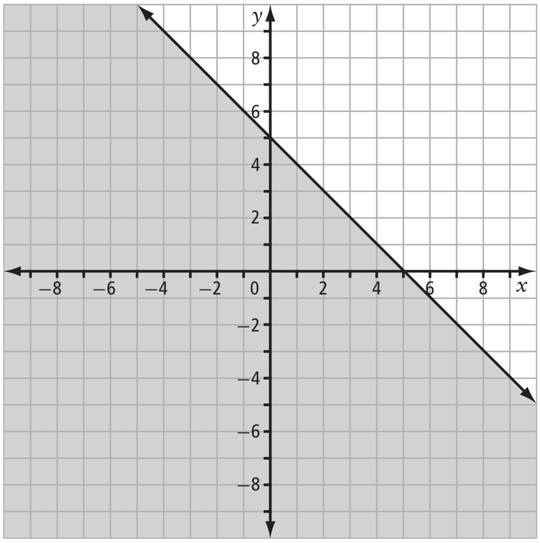
d) $\frac{3}{4}x - \frac{1}{2}y \geq -\frac{3}{2}$

(Hint: Multiply all terms by the lowest common multiple of 2 and 4 to remove the denominator.)



4. Determine the inequality that best describes each of the following graphs.

a)



y-intercept: $b =$ ________

Select one other point on the line.

$x =$ ________; $y =$ ________

Substitute the values for x, y, and b into the equation of the line in slope-intercept form, $y = mx + b$, and solve for m.

$m =$ ________

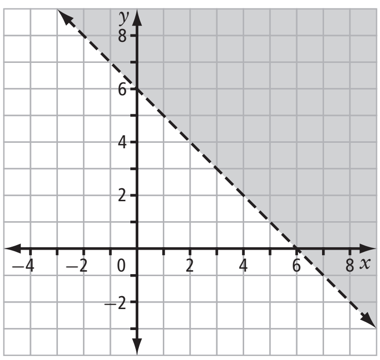
Write the equation of the boundary in slope-intercept form: ________________

Is the boundary line solid or dashed? ________________

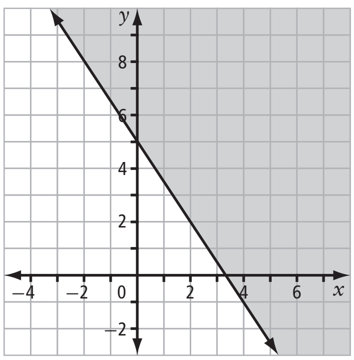
Is the graph shaded above ($>$ or $\geq$) or below ($<$ or $\leq$) the boundary line? __________

Write the equation of the boundary as an inequality: ________________

b)



c)



Apply

5. You want to earn at least $300 in interest annually. You want to do this by investing some of your money in a bond that pays interest at a rate of 4% per annum, and the rest in a guaranteed investment certificate (GIC) that pays interest of 5% per annum. Determine the inequality that represents this scenario. Sketch the graph of the inequality to show the amount you could invest at each rate. Select one possible investment combination and check it in the original inequality.

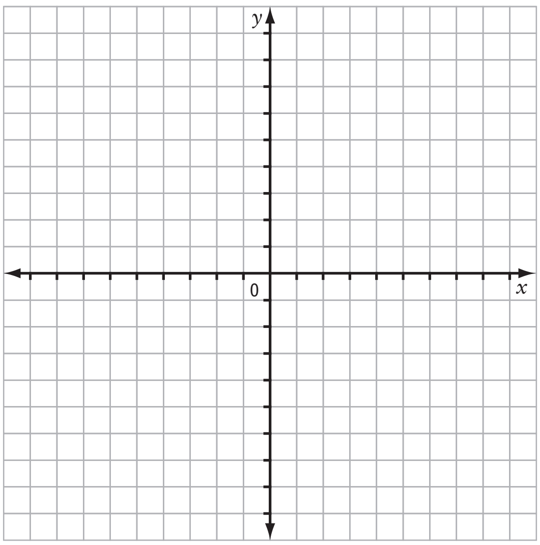
Let x = amount invested in a bond
Let y = amount invested in a GIC

Write the inequality. (Hint: The total interest earned per annum must be greater than or equal to $300.)

________________ + ________________ ≥ ________

Isolate y on the left side of the inequality.

State the equation that is related to the boundary line. ____________________________



Graph the boundary using either the slope and y-intercept or the intercepts.
Select a test point from each region to determine which region contains the solution.

Test point above the boundary: ____________

Test point below the boundary: ____________

Substitute each point into the inequality.

For the point ________________:

For the point ________________:

The test point ________________ satisfies the inequality.

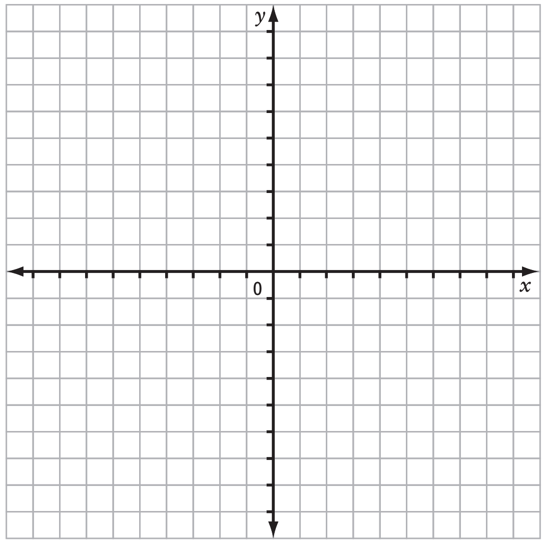
Shade the area ________________ the boundary to indicate the solution region.
(*above* or *below*)

Select one point in the solution region to answer the question.

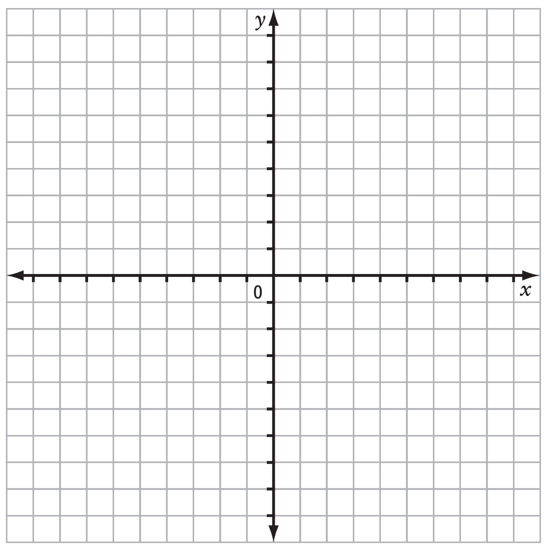
For example, select ________________.

You could invest $ ________ in a bond paying 4% annual interest and $ ________ in a GIC paying 5% annual interest to earn at least $300.

6. A vehicle manufacturer produces cars and trucks. In a given week, the company can make up to 100 vehicles. Sketch a graph to show the number of cars and trucks that could be made in one week. Select one possible solution and check it in the original inequality.

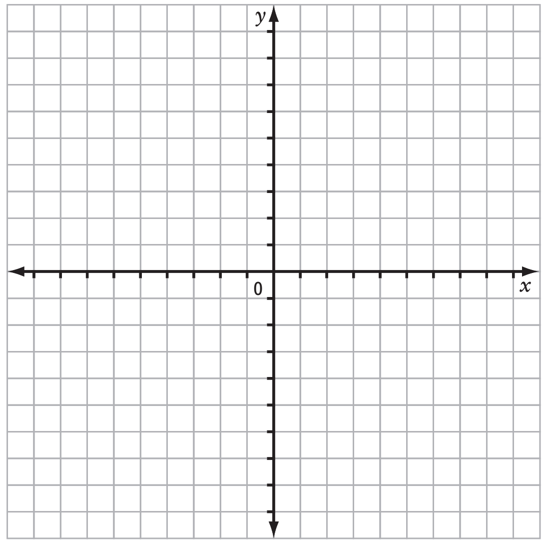


7. Barb has started a new fitness program. She knows she can burn 500 calories per hour jogging and 300 calories per hour walking her dog. Barb wants to do a combination of the two activities and burn at least 3000 calories a week. Draw a graph to show the possible workout combinations she could do in a week. Select one possible combination and check it in the original inequality.



See #15 on page 474 of *Pre-Calculus 11* for a similar question.

8. An airplane can hold up to 1500 kg of luggage. Economy class passengers are allowed to bring 15 kg of luggage. First class passengers are allowed to bring 45 kg of luggage. Assuming that each passenger brings luggage at the maximum allowable weight, draw a graph showing the possible combinations of allowable luggage weight. Select one possible solution and check it in the original inequality.



Connect

9. Use what you learned in Chapter 8 about solving a system of equations graphically to hypothesize what solving a system of inequalities might involve. Include a sketch as part of your explanation.

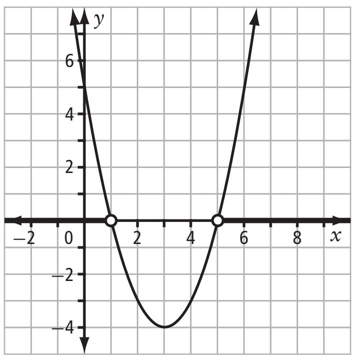
10. Based on your hypothesis in #9, solve the following system of linear inequalities. Pick one possible solution point to check in each of the original inequalities. Compare your solution with that of a classmate.

$y \geq 2x + 6$
$y \leq -\frac{1}{2}x + 2$

9.2 Quadratic Inequalities in One Variable

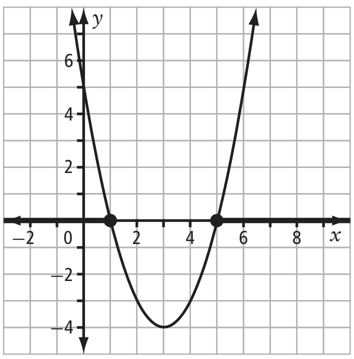
KEY IDEAS

- Solving quadratic equations by graphing can also be used to solve quadratic inequalities in one variable. Instead of stating the x-intercepts as the solution, the graph is used to identify the intervals of x-values where the y-values of the graph are above or below the x-axis.
- A quadratic inequality in one variable can be written in one of four forms. Therefore, there are four possible scenarios when solving quadratic inequalities graphically.



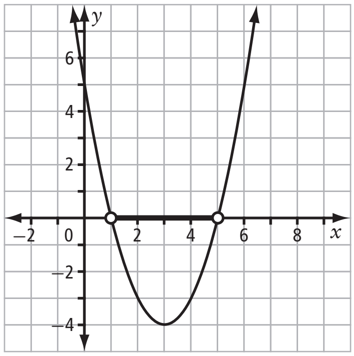
$y > 0$

The solution set is the values of x for which the graph of $f(x)$ lies on or above the x-axis. The solution set does not include the x-intercepts.
Solution set: $\{x \mid x < 1 \text{ or } x > 5, x \in \mathrm{R}\}$



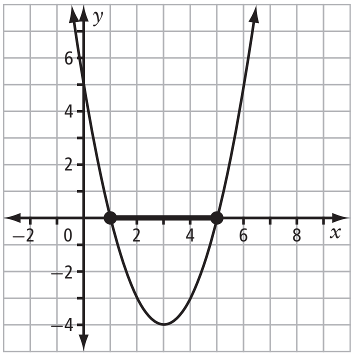
$y \geq 0$

The solution set is the values of x for which the graph of $f(x)$ lies on or above the x-axis. The solution set include the x-intercepts.
Solution set: $\{x \mid x \leq 1 \text{ or } x \geq 5, x \in \mathrm{R}\}$



$y < 0$

The solution set is the values of x for which the graph of $f(x)$ lies on or above the x-axis. The solution set does not include the x-intercepts.
Solution set: $\{x \mid 1 < x < 5, x \in \mathrm{R}\}$



$y \leq 0$

The solution set is the values of x for which the graph of $f(x)$ lies on or above the x-axis. The solution set includes the x-intercepts.
Solution set: $\{x \mid 1 \leq x \leq 5, x \in \mathrm{R}\}$

Working Example 1: Solve a Quadratic Inequality of the Form $ax^2 + bx + c > 0, a > 0$

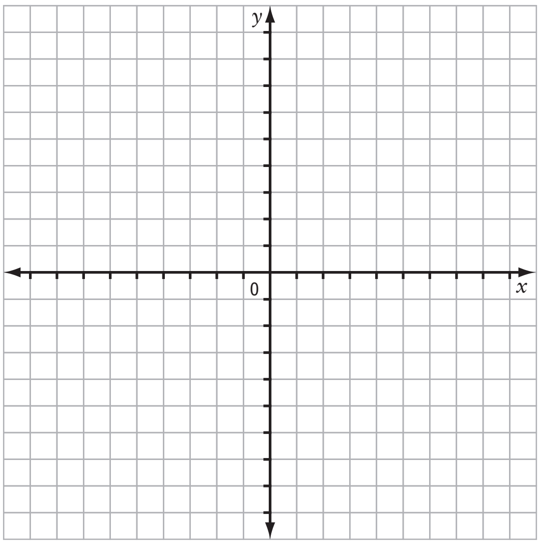
Solve $x^2 + x > 6$ graphically.

Solution

Rewrite the inequality so that the quadratic expression is on the left side and a zero is on the right side.

Sketch the graph of the quadratic, labelling all intercepts and the vertex.

What strategies can you use to sketch the graph of a quadratic function in standard form?



Highlight the section(s) of the x-axis where the y-values of $f(x)$ are above the x-axis ($f(x) > 0$).

Determine if the solution includes the x-intercepts (closed point) or does not include them (open point). Mark the points appropriately on the graph.

Based on the highlighted portion of the graph, state the solution.

Recall that to solve a quadratic equation algebraically means to factor the quadratic, set each factor equal to zero, and solve.

Quadratics that cannot be factored can be solved by completing the square or by using the quadratic formula.

The method of solving quadratic equations by factoring can be applied to solving quadratic inequalities:

- Factor to determine all possible roots and place them on a number line to form intervals (the number of intervals is one more than the number of roots).
- For each interval, select a point that falls within the interval and test it in the original inequality to see if it is true or false.
- If it is true, the solution falls within that interval.

See page 479 of *Pre-Calculus 11* to review the case analysis method for solving quadratic inequalities.

Working Example 2: Solve a Quadratic Inequality of the Form $ax^2 + bx + c \le 0, a > 0$

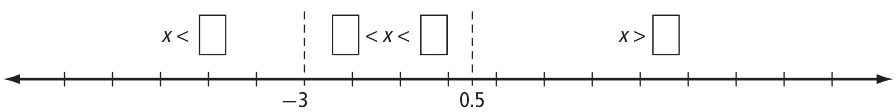
Solve $2x^2 + 5x \le 3$ algebraically using roots and test points.

Solution

Rewrite the inequality so that the quadratic expression is on the left side and a zero is on the right side.

Factor the quadratic to determine all possible roots.

Place each root on a number line to form intervals. Label each interval.



For each interval, choose a point that falls within the interval and test it in the *original* inequality to see if it is true or false.

Does the solution include the roots? Explain.

State the solution.

Working Example 3: Solve a Quadratic Inequality in One Variable

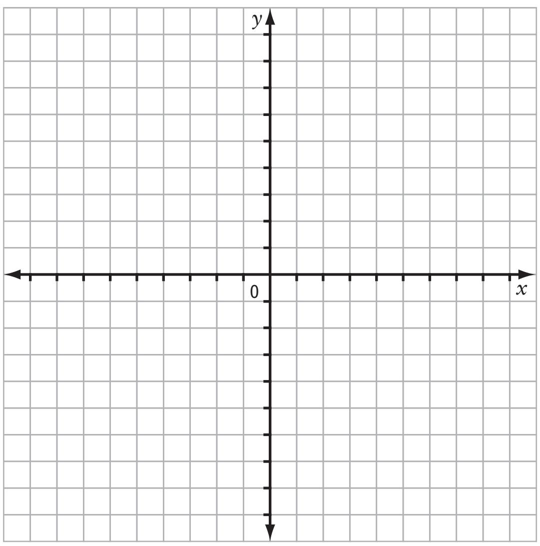
A golfer hits a ball down a fairway. She would like to know the length of time, in seconds, that the ball was at a height of at least 25 m. Solving the inequality $-8x^2 + 40x \geq 25$ will help determine this.

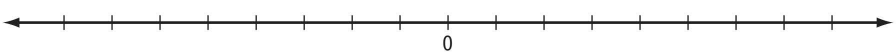
Solution

Rewrite the inequality so that the quadratic expression is on the left side and a zero is on the right side.

Which do you think is the better approach for solving this inequality, solving graphically or solving algebraically? Why?

Solve using your preferred method. If you solve the inequality graphically, include a labelled sketch. If you solve algebraically, include a number line with the test intervals marked.



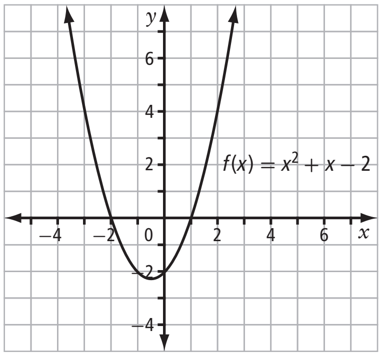


State the solution.

Check Your Understanding

Practise

1. Based on the graph of $f(x) = x^2 + x - 2$, determine the solution to each inequality.



a) $x^2 + x - 2 > 0$

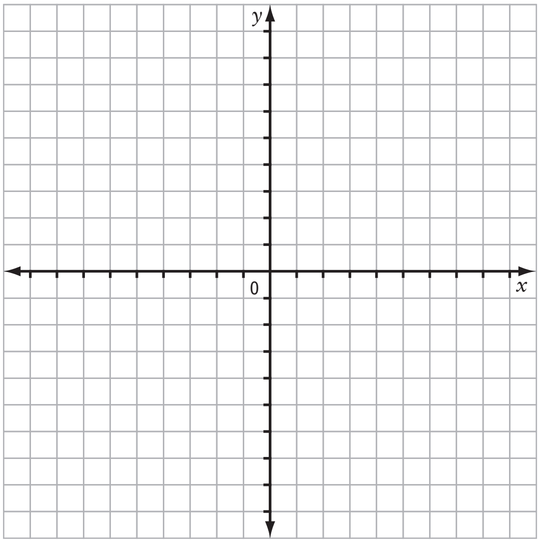
b) $x^2 + x - 2 \leq 0$

c) $x^2 + x - 2 < 0$

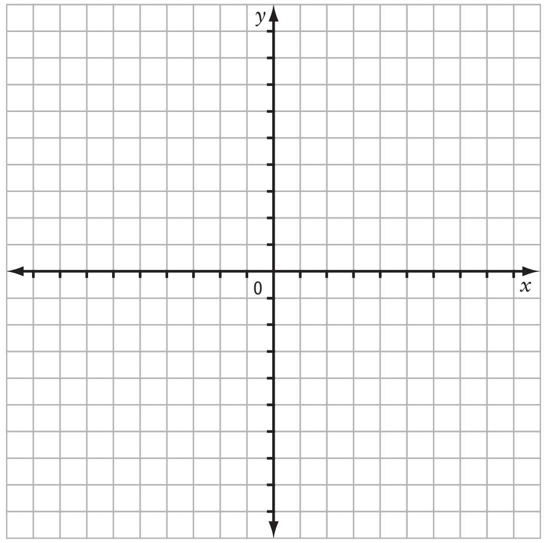
d) $x^2 + x - 2 \geq 0$

2. Solve each inequality graphically.

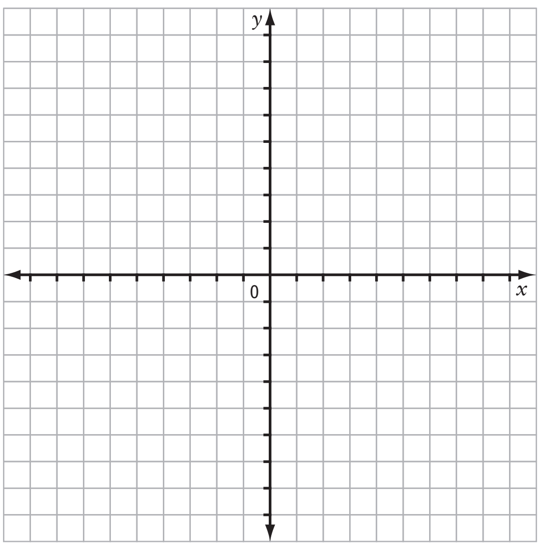
a) $x^2 + x - 2 \geq 0$



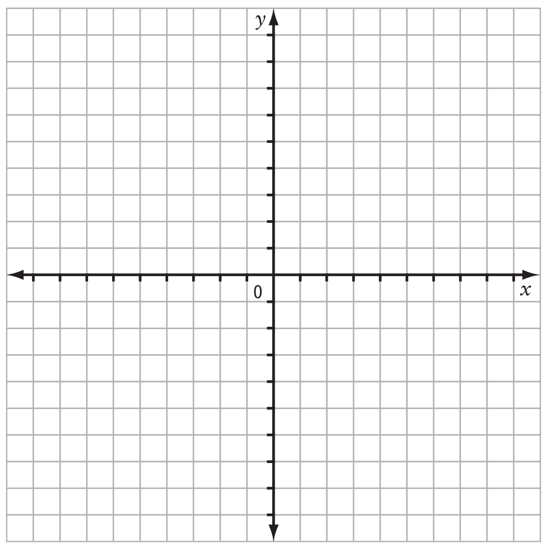
b) $-x^2 + 4x < -5$



c) $2x^2 + 10x + 12 \leq 0$



d) $x^2 - 6x < -9$



3. Solve the following inequalities algebraically. (Hint: Use a number line.)

a) $x^2 < -3x - 2$

b) $4x^2 < 7x - 3$

c) $6x^2 - 1 \geq x$

d) $2x^2 \geq 7x + 4$

Apply

4. In a right triangle, one leg is 10 cm shorter than twice the length of the other leg. If the length of the hypotenuse is at least 8 cm, solving the inequality $x^2 + (2x - 10)^2 \geq 8^2$ will help you determine the possible lengths of the legs. (Hint: The value of x cannot be a number that would result in a side length less than or equal to 0.)

5. A theatre seats 2000 people and charges \$10 per ticket. At this price, all the tickets can be sold. A recent survey indicates that for every \$1 increase in price, the number of tickets sold will decrease by 100. Determine the ticket prices that would result in revenue of at least \$15 000 by using the inequality $x^2 - 10x \leq 50$, where x is the number of \$1 increments in the price of a ticket.

6. A farmer wants to build a rectangular pen that can be divided into four equal compartments by fences that are parallel to the width. If the farmer has only 1000 m of fencing, what dimensions will make the area of the pen at most 15 000 m^2? Solve the inequality $x^2 - 200x \leq -6000$, where x is the width of the pen, in metres, to help you determine the possible measures of x.

7. Determine two numbers whose sum is 30 and whose product is at least 200. (Hint: Use only one variable.)

8. Create an inequality for each of the following solutions.

a) $-\frac{1}{2} < x < 4$

b) $x \leq -\frac{3}{2}$ and $x \geq \frac{1}{4}$

c) $0 \leq x \leq \frac{4}{3}$

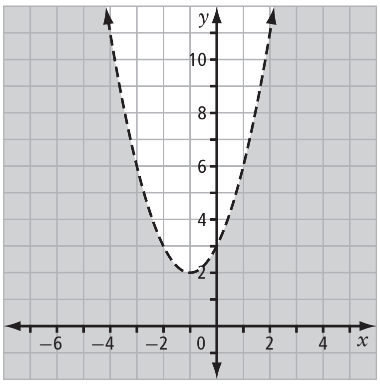
Connect

9. Explain how solving inequalities graphically and algebraically are the same, and how they are different. Which method do you prefer? Why?

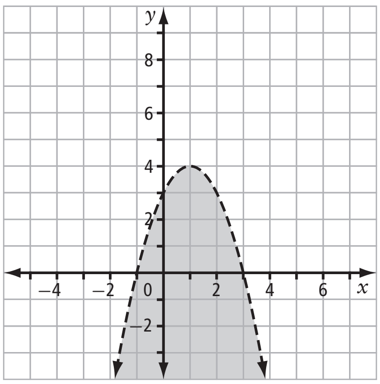
9.3 Quadratic Inequalities in Two Variables

KEY IDEAS

- To solve a quadratic inequality in two variables means to determine the solution region. The solution region may be above the parabola related to the inequality, or it may be below it. In addition, the solution region may or may not include the points on the related quadratic function. Therefore, there are eight possible scenarios when solving quadratic inequalities in two variables. In each scenario, the parabola may open upward or downward.

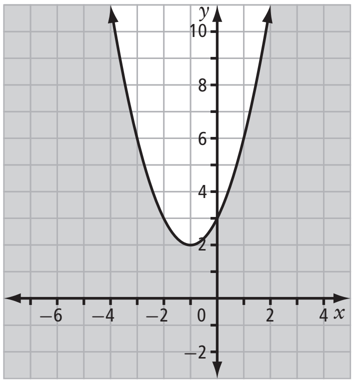


$y < ax^2 + bx + c, a > 0$

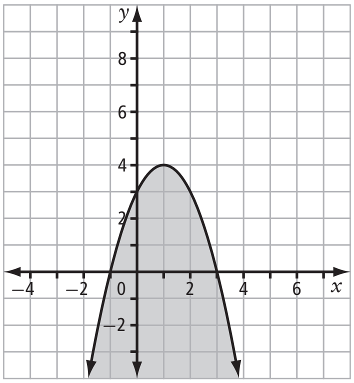


$y < ax^2 + bx + c, a < 0$

The solution region is below the parabola. The solution does not include the points on the parabola of the related quadratic function.

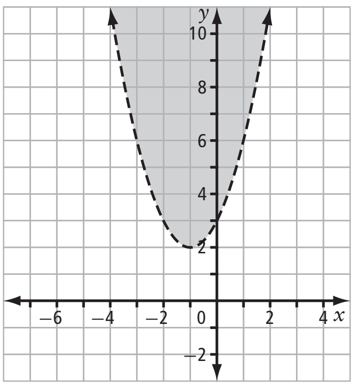


$y \le ax^2 + bx + c, a > 0$

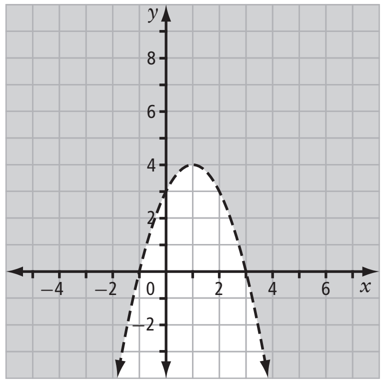


$y \le ax^2 + bx + c, a < 0$

The solution region is below the parabola. The solution includes the points on the parabola of the related quadratic function.

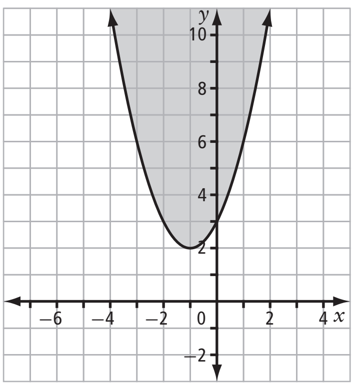


$y > ax^2 + bx + c, a > 0$

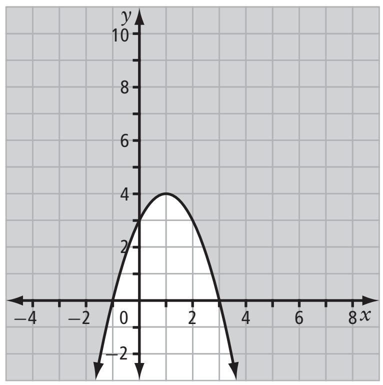


$y > ax^2 + bx + c, a < 0$

The solution region is above the parabola. The solution does not include the points on the parabola of the related quadratic function.



$y \geq ax^2 + bx + c, a > 0$



$y \geq ax^2 + bx + c, a < 0$

The solution region is above the parabola. The solution includes the points on the parabola of the related quadratic function.

- Once you have determined the solution region and shaded it, select a test point in the region area and substitute it into the original inequality to see if it satisfies the inequality. Do not select a point that lies on the boundary.

Working Example 1: Graph a Quadratic Inequality in Two Variables With $a > 0$

Graph $y < 2x^2 + 5x - 3$. Choose a point in the solution region to check in the original inequality.

Solution

Write the related quadratic function in the standard form $y = ax^2 + bx + c$.

____

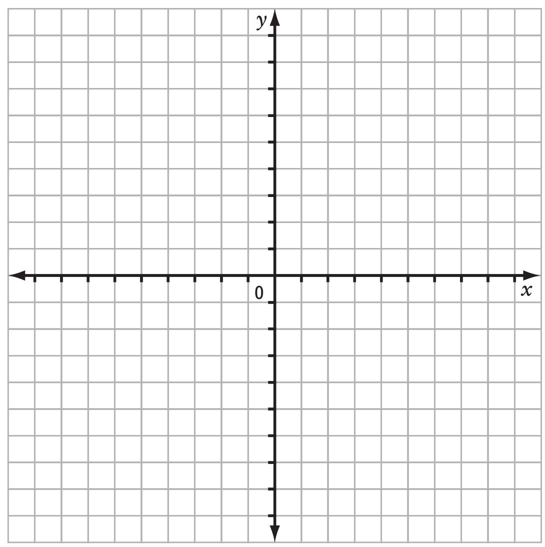
Graph the parabola using a graphing calculator to determine the x-intercepts, y-intercept, and vertex.

The x-intercepts are ________ and ________.

The y-intercept is ________.

The vertex is ________.

Sketch the graph of the related quadratic function, labelling all intercepts and the vertex.



Do you draw the parabola using a solid line or a dashed line? Explain.

Select a test point: ________

Substitute the point into the original inequality to see if it satisfies the inequality.

Is the graph to be shaded above the parabola or below it? Explain.

Shade the solution region.

Working Example 2: Graph a Quadratic Inequality in Two Variables With $a < 0$

Graph $y \leq -x^2 - 6x + 9$. Choose a test point in the solution region to check in the original inequality.

Solution

Write the equation in the standard form $y = ax^2 + bx + c$.

____

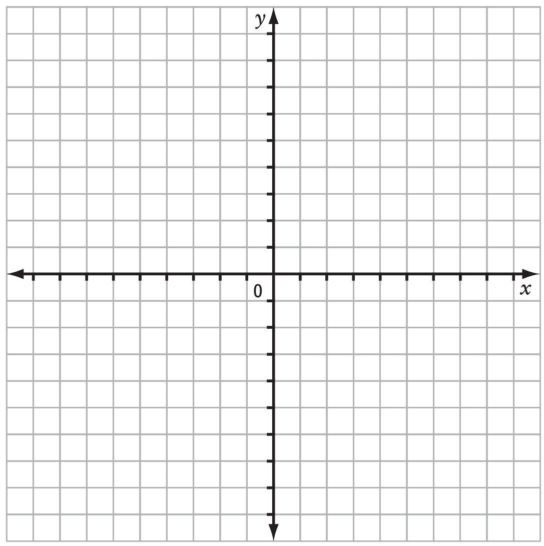
Enter the equation into a graphing calculator to determine the x-intercepts, y-intercept, and vertex.

The x-intercepts are ________ and ________.

The y-intercept is ________.

The vertex is ________.

Sketch the graph of the related quadratic function, labelling all intercepts and the vertex.



Do you draw the parabola using a solid line or a dashed line? Explain.

Select a test point: ________

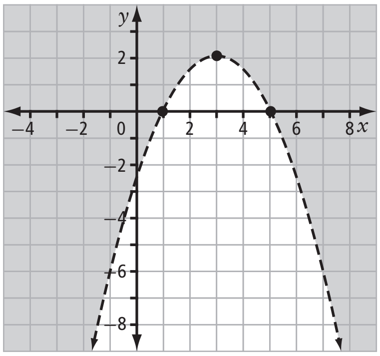
Substitute the point into the original inequality to see if it satisfies the inequality.

Is the graph to be shaded above the parabola or below it? Explain.

Shade the solution region.

Working Example 3: Determine the Quadratic Inequality That Defines a Solution Region

Write an inequality to describe the following graph.



Solution

Identify the vertex: ________

Identify the x-intercepts in the form $(x, 0)$: ________ and ________

Write the equation of the parabola in vertex form, $y = a(x - p)^2 + q$.

Substitute the coordinates of the vertex (p, q) and one of the x-intercepts $(x, 0)$ into the equation to determine the value of a.

Use the values of the parameters a, p, and q to write the equation.

Is the graph shaded above ($>$ or $\geq$) or below ($<$ or $\leq$) the graph of the function?

Is the line solid ($\geq$ or $\leq$) or dashed ($>$ or $<$)?

Write the equation as an inequality using the appropriate sign.

See a similar example on page 493 of *Pre-Calculus 11*.

Check Your Understanding

Practise

1. Circle the ordered pairs that are solutions to the given inequality.

a) $y < 2x^2 + 4x + 3$

$\{(0, 0), (0, 3), (-1, 10), (2, 1)\}$

b) $y \geq 2x^2 + 16x - 34$

$\{(-4, -5), (-2, 10), (6, 5), (8, -6)\}$

c) $y \leq 2x^2 + 16x + 36$

$\{(-2, -10), (-4, 10), (0, 36), (2, -7)\}$

d) $y > x^2 - 2x + 3$

$\{(-1, 17), (0, 3), (1, 9), (-4, -5)\}$

2. Name one point that is a solution to the given inequality and one point that is *not* a solution.

a) $y < 5x^2 + 2x + 1$

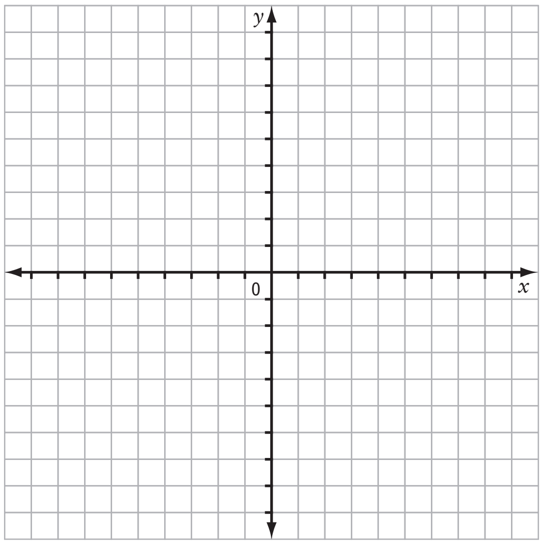
b) $y \geq -4x^2 + 6x - 7$

c) $y \leq 3x^2 + 7x + 12$

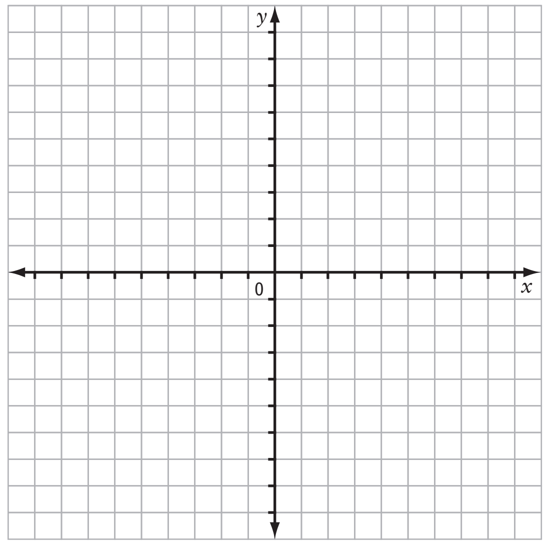
d) $y > -2x^2 - 3x + 5$

3. Graph each quadratic inequality.

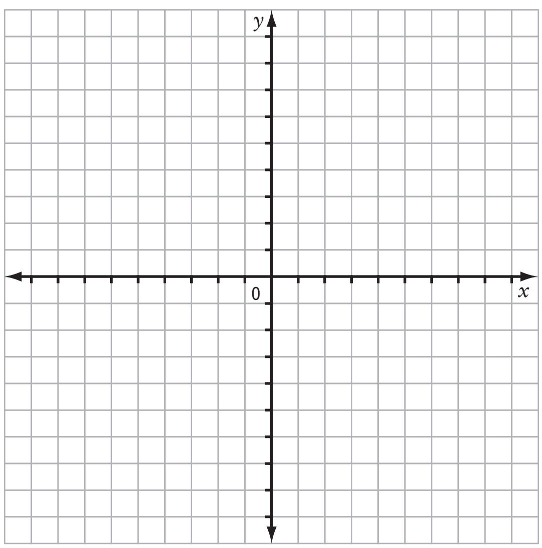
a) $y > x^2 + x - 6$



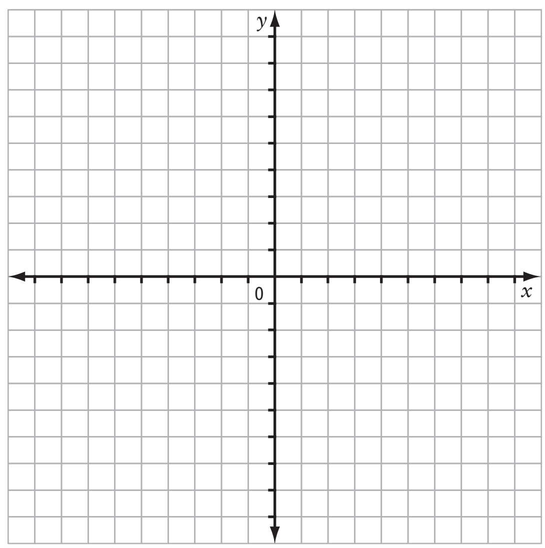
b) $y \leq x^2 - x - 2$



c) $y \geq 2x^2 + 9x + 10$

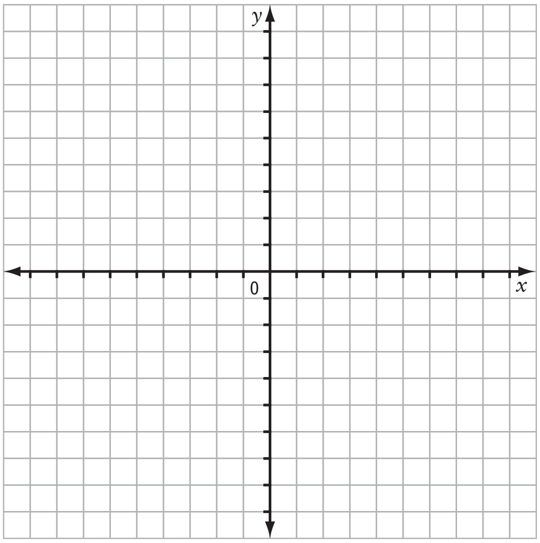


d) $y < 6x^2 - x - 1$

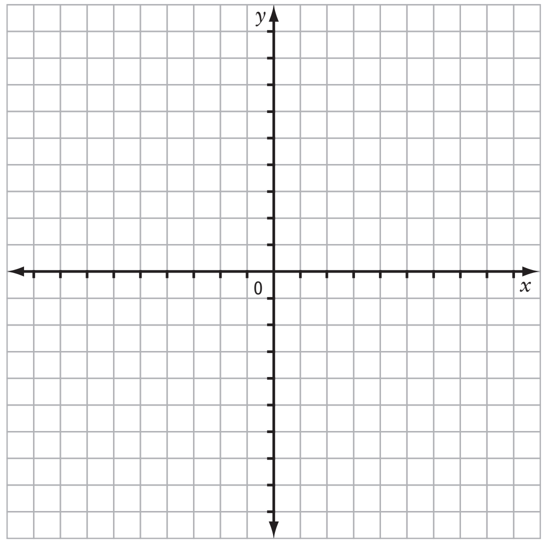


4. Graph each quadratic inequality.

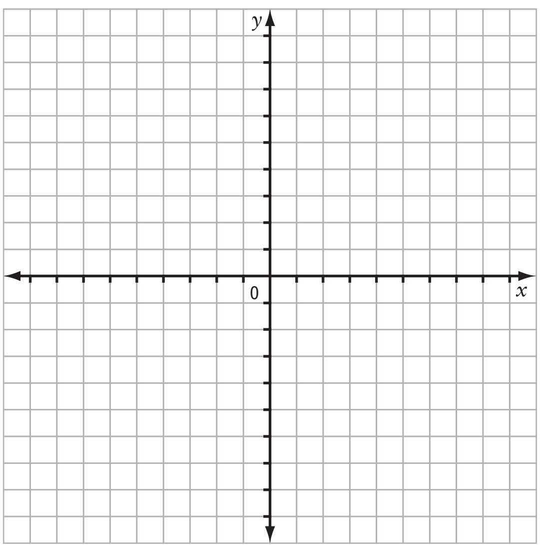
a) $y > (x - 1)^2 + 1$



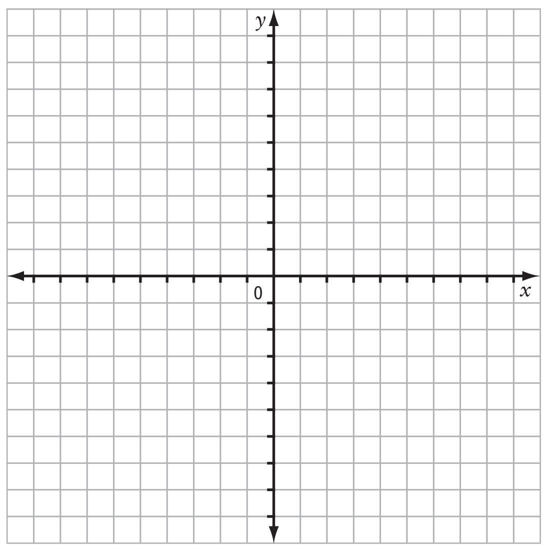
b) $y \leq (x + 2)^2 - 9$



c) $y \geq 2(x - 3)^2 + 8$

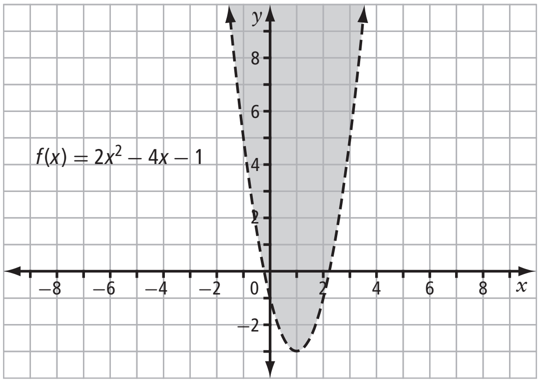


d) $y < (x - 1)^2 + 2$

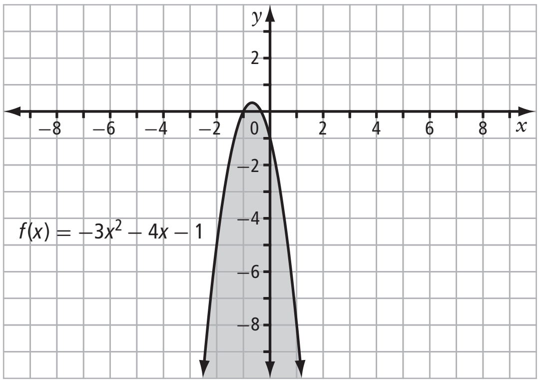


5. Write an inequality to describe each graph given the function that defines the boundary parabola.

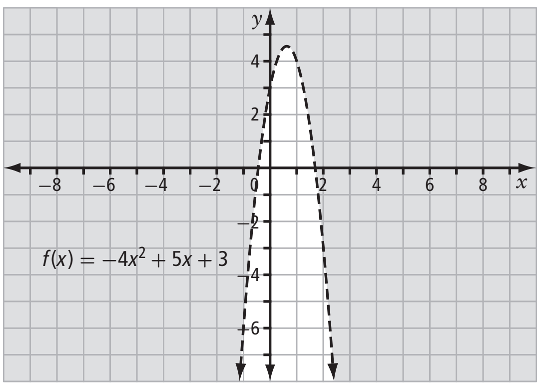
a)



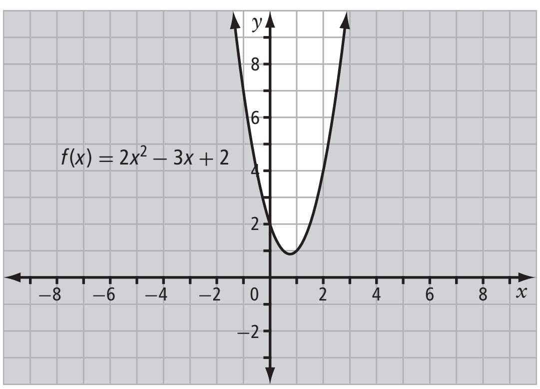
b)



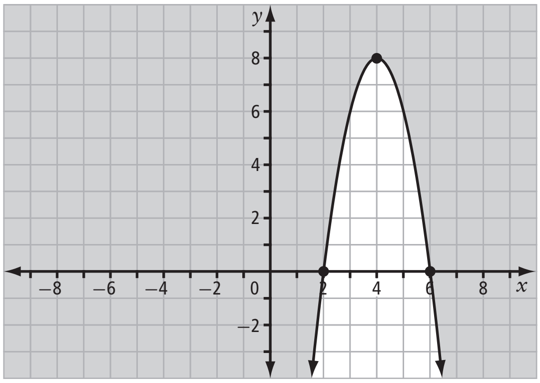
c)

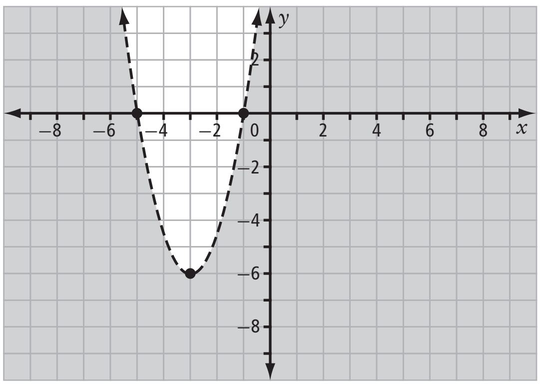


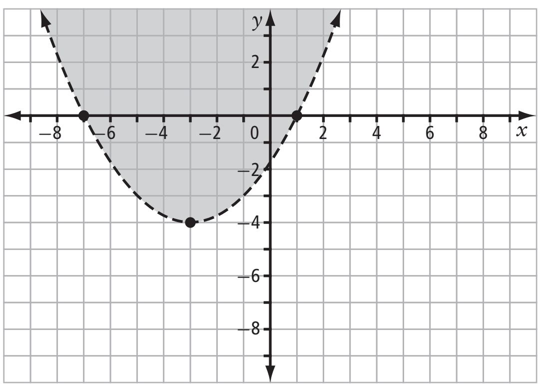
d)

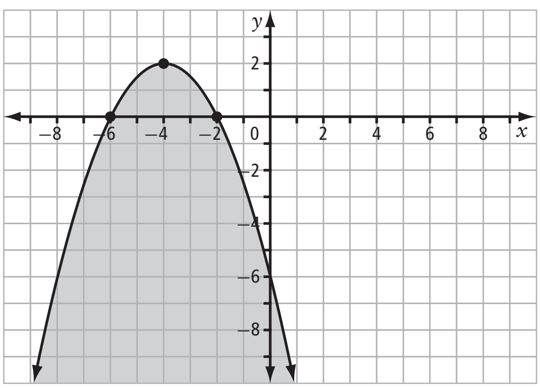


6. Write an inequality for each graph.

a) 

b) 

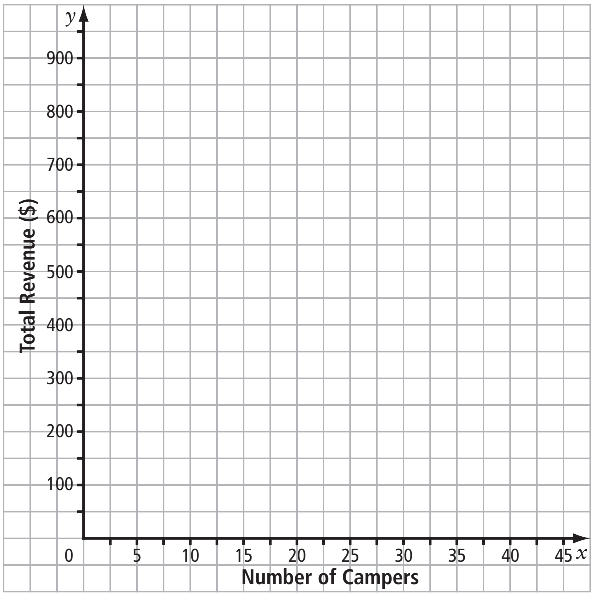
c) 

d) 

Apply

7. In order to get the most revenue from registrations for a camping trip, an adventure company needs to have as many campers as possible at a price per camper that is reasonable. If 15 people sign up, the price per person is \$50. The registration fee is reduced by \$2 for each additional camper beyond 15. The relationship between the number of registrations and revenue is given by $y \le (50 - 2x)(15 + x)$, where x represents the number of campers beyond 15 and y is the total revenue, in dollars.

a) Graph the quadratic inequality.



b) What is the total number of registrations that will generate revenue of at least \$500?

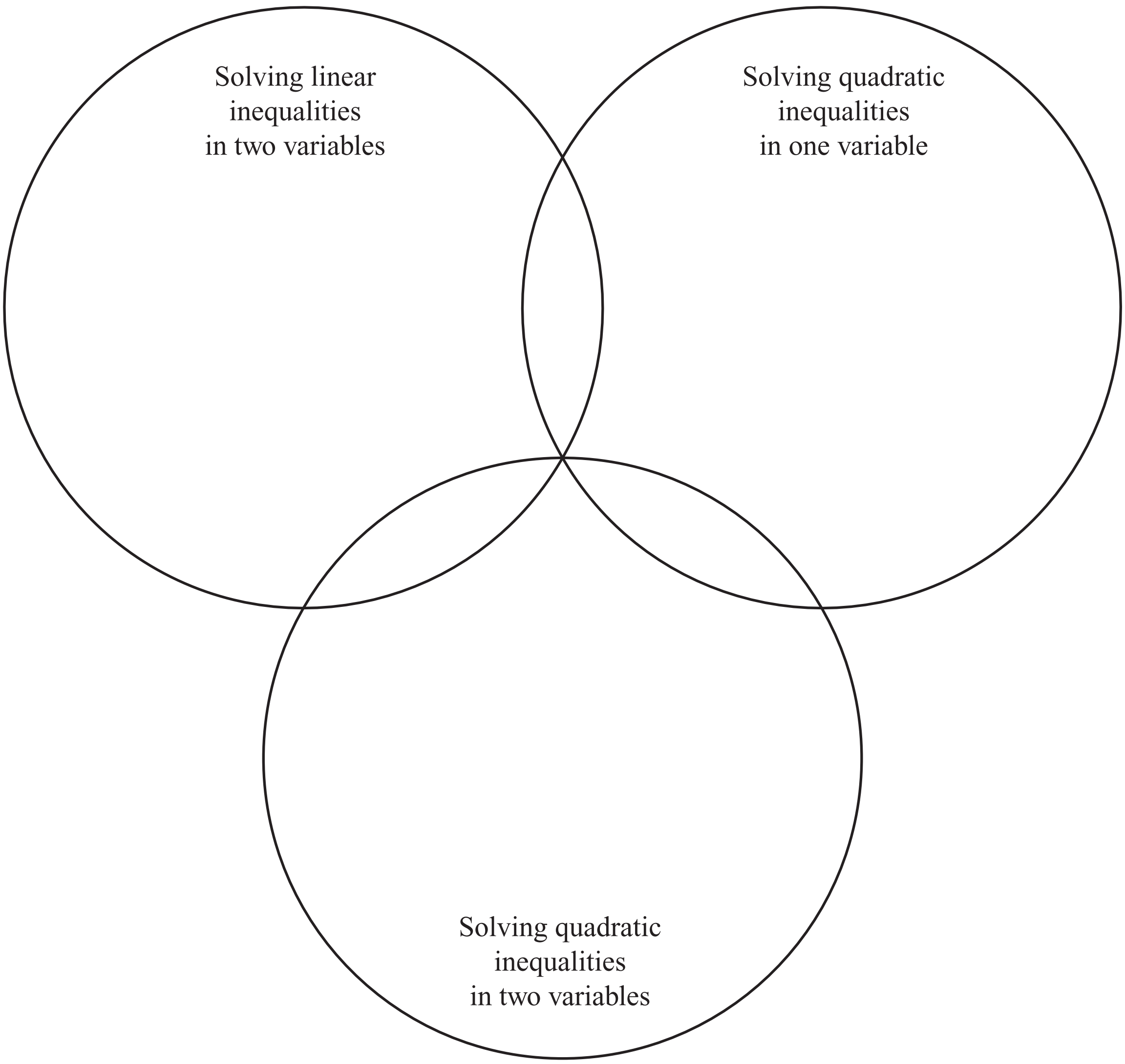
Connect

8. Use what you learned in Chapter 8 about solving a system of equations graphically to hypothesize what solving a system of quadratic inequalities might involve. Include a sketch as part of your explanation.

9. Based on your hypothesis in #8, solve the following system of quadratic inequalities. Choose one possible solution point to check in each of the original inequalities. Compare your solution with that of a classmate.

$y \geq x^2 - 4x - 4$
$y \leq -x^2 - 4x + 4$

10. Based on your work in Chapter 9, complete the Venn diagram. Include notes, diagrams, and examples.



Chapter 9 Review

9.1 Linear Inequalities in Two Variables, pages 362–378

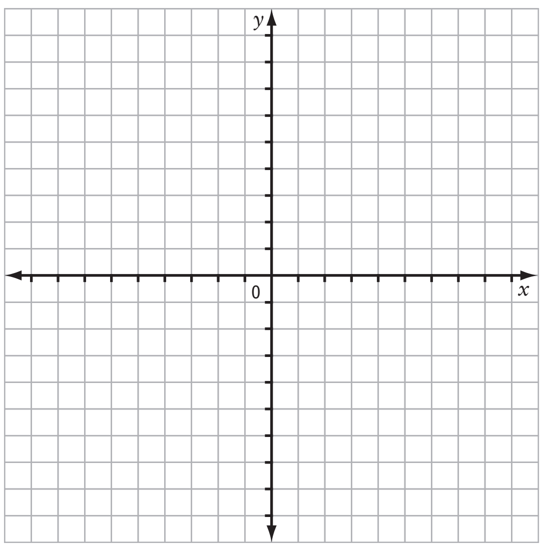
1. Circle the solutions for each inequality.

a) $3x + 2y > 5$
$\{(1, -2), (0, 7), (-3, 4), (5, -3)\}$

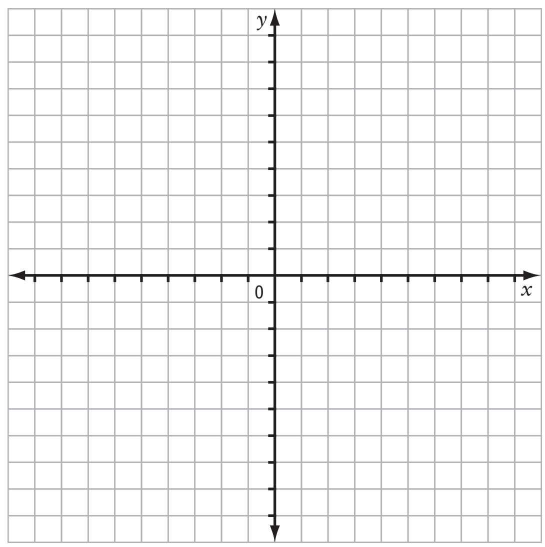
b) $-4x + 5y \leq 25$
$\{(7, 0), (-4, 3), (-3, -4), (5, -1)\}$

2. Graph each inequality.

a) $2x - 3y \geq 12$

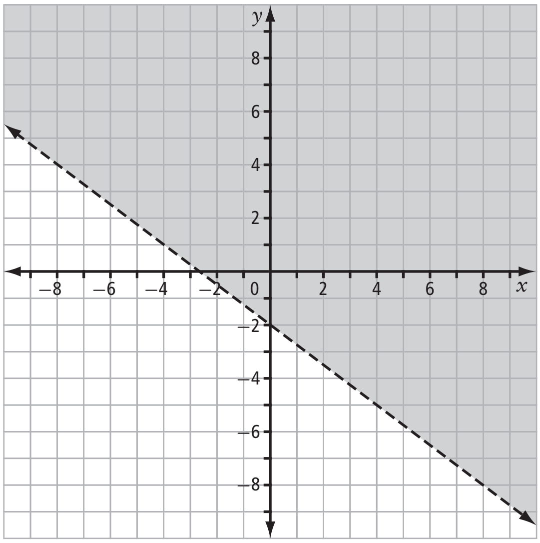


b) $-5x - y < 0$

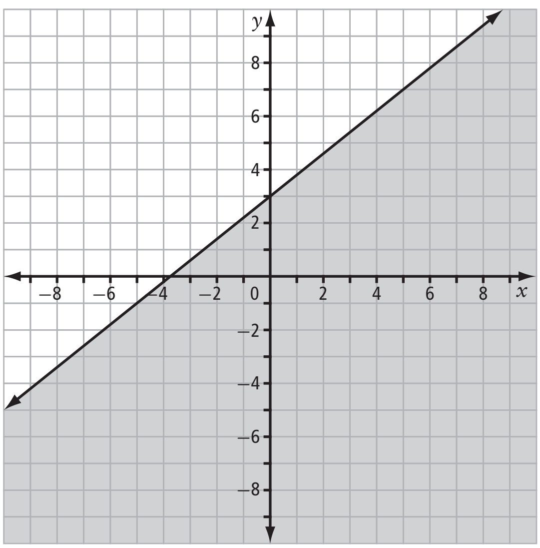


3. Determine the inequality that best describes each graph.

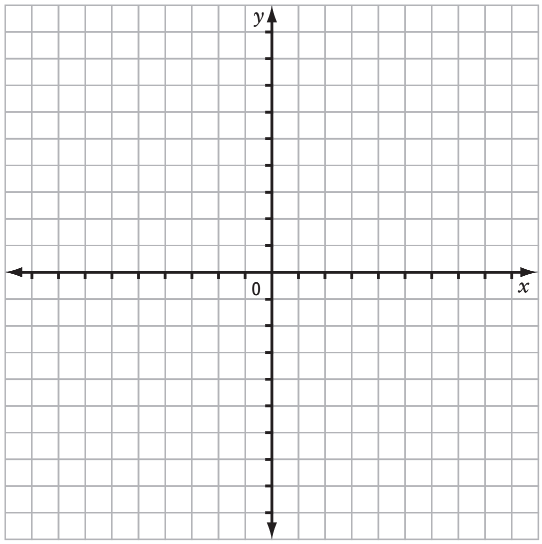
a)



b)

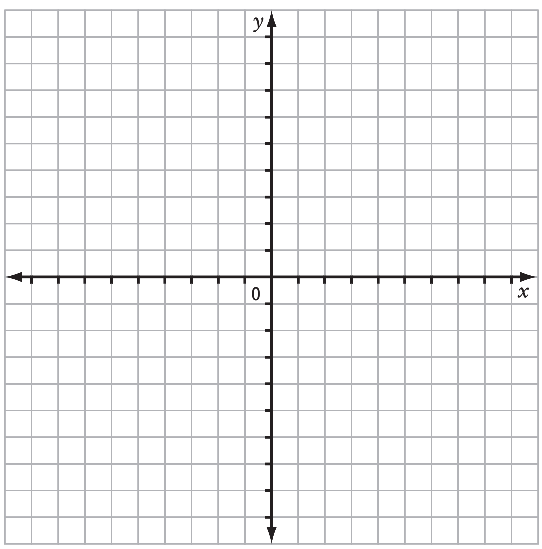


4. Amber is working to earn money for a down payment on a car. She wants to save at least \$1000. Amber makes \$15 per hour at a part-time job and \$10 per hour babysitting. Draw a graph to show some of the possible ways she can work to earn money. Choose one possible solution and check it in the original inequality.

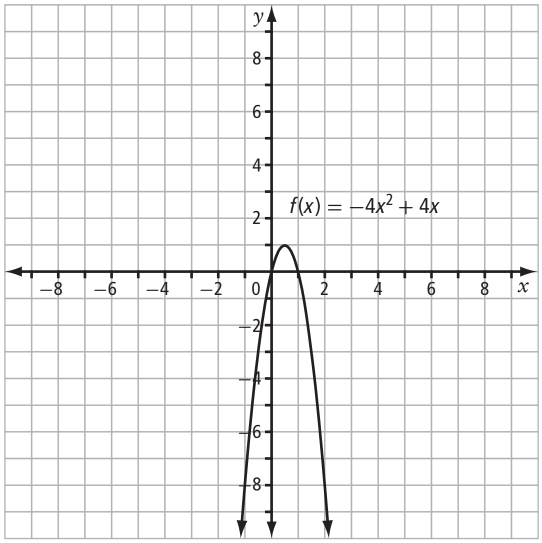


9.2 Quadratic Inequalities in One Variable, pages 379–388

5. Solve $-2x^2 + 3x > -7$ graphically.



6. Based on the graph below, what is the solution to each inequality?



a) $-4x^2 + 4x > 0$

b) $-4x^2 + 4x < 0$

c) $-4x^2 + 4x \leq 0$

d) $-4x^2 + 4x \geq 0$

7. Solve $x^2 - x - 12 \leq 0$ algebraically.

9.3 Quadratic Inequalities in Two Variables, pages 389–400

8. Circle the ordered pairs that are solutions to the given inequality.

a) $y \geq -3x^2 + 2x + 7$

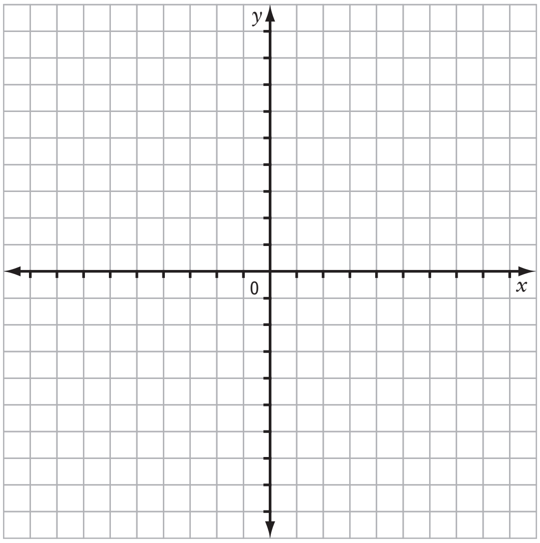
$\{(1, 6), (0, 0), (1, -10), (6, 12)\}$

b) $y < 5x^2 - 10x + 2$

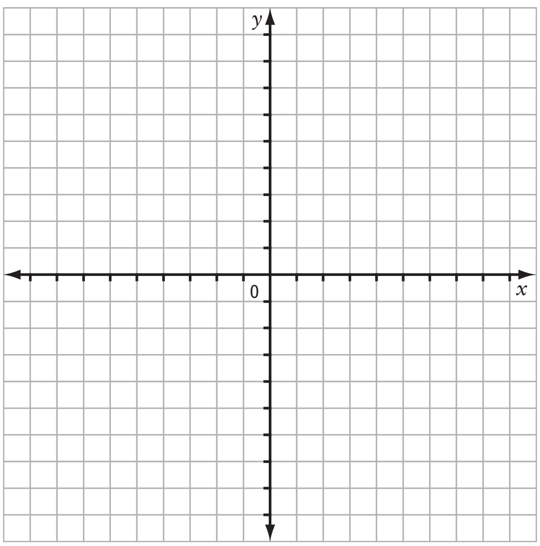
$\{(-1, -2), (3, 4), (2, 5), (0, 3)\}$

9. Graph each quadratic inequality

a) $y > -3x^2 - 3x + 1$

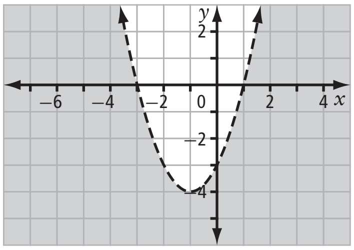


b) $y \leq 0.5x^2 + 4x - 3$

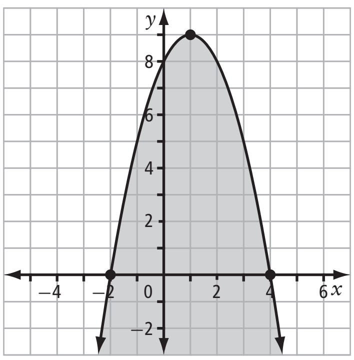


10. Write an inequality to describe each graph.

a)



b)



Chapter 9 Skills Organizer

Complete the table for solving a linear inequality in two variables.

Form of Expression of Inequality	Boundary (Dashed *or* Solid)	How to Solve Graphically or Algebraically	

Complete the table for solving a quadratic inequality in one variable.

Form of Expression of Inequality	Solution Set		How to Solve Graphically or Algebraically		
	Position Relative to x-axis	x-intercept(s) Included?			

Complete the table for solving a quadratic inequality in two variables.

Form of Expression of Inequality	Boundary (Dashed *or* Solid)	Direction of Parabola		How to Solve Graphically or Algebraically	
		$a > 0$	$a < 0$		