2

Make the Best of It

Optimization

MATERIALS

None

Lesson Overview

Students move from solving systems of equations to solving systems of inequalities. They model problems in context requiring several inequalities to be graphed on the same coordinate plane. Students recognize that the solution to a system of inequalities is the intersection of the solutions to each inequality. Then, through a context, they are introduced to linear programming as a process to determine the optimal solution to a system of linear inequalities. Students use linear programming to solve problems and explain the difference between the solution to a system of linear inequalities and the solution to an equation calculated by linear programming.

Algebra 2

Systems of equations and inequalities

(3) The student applies mathematical processes to formulate systems of equations and inequalities, uses a variety of methods to solve, and analyzes reasonableness of solutions. The student is expected to:

(A) formulate systems of equations, including systems consisting of three linear equations in three variables and systems consisting of two equations, the first linear and the second quadratic.

(E) formulate systems of at least two linear inequalities in two variables.

(F) solve systems of two or more linear inequalities in two variables.

(G) determine possible solutions in the solution set of systems of two or more linear inequalities in two variables.

ELPS

1.A, 1.C, 1.E, 1.F, 1.G, 2.C, 2.E, 2.I 3.D, 3.E, 4.B, 4.C, 5.B, 5.F, 5.G

Essential Ideas

- The solution of a system of inequalities is the intersection of the solutions to each inequality. Every point in the intersection satisfies all inequalities in the system.
- The optimal solution to a system of inequalities can be determined through a process called *linear programming*.

- In linear programming, the vertices of the solution region of the system of linear inequalities are substituted into a given equation to determine the optimal solution.
- Systems of equations can be used to model real-world problems.

Lesson Structure and Pacing: 2 Days

Day 1

Engage

Getting Started: She Works Hard for the Money

Students write a linear inequality in two variables to model a problem situation, graph the inequality on a coordinate plane, and interpret solutions in the context of the problem. They then write additional inequalities to model the fact that the variables in the problem must represent non-negative numbers.

Develop

Activity 2.1: Systems of Linear Inequalities

Students write a linear inequality in two variables to represent an additional constraint on the problem situation from the Getting Started. They then write a system of inequalities and determine solutions that satisfy all constraints. A *solution of a system of inequalities* is defined. Students analyze the solutions to a system of inequalities and conclude that it is possible to have no solution. They then solve a problem in context that can be modeled by a system of linear inequalities.

Day 2

Activity 2.2: Linear Programming

Students write a system of inequalities to represent the constraints of a problem situation, graph the system on the coordinate plane, and shade the region that represents the solution set. The term *linear programming* is defined as a process to determine the optimal solution to a system of inequalities. They use linear programming to optimize the results for two given scenarios.

Demonstrate

Talk the Talk: Making Bling for Cha-Ching

Students write a system of inequalities to represent the constraints of a problem situation and use linear programming to determine a maximum value for a profit equation. They then describe the difference between a solution to a system of linear inequalities and a solution to an equation calculated by linear programming.

Getting Started: She Works Hard for the Money

ENGAGE

Facilitation Notes

In this activity, students write a linear inequality in two variables to model a problem situation, graph the inequality on a coordinate plane, and interpret solutions in the context of the problem. They then write additional inequalities to model the fact that the variables in the problem must represent non-negative numbers.

Have students work with a partner or in a group to complete Question 1. Share responses as a class.

As students work, look for

How they assign the variables in part (a). While it makes no difference which variable is the independent variable and which variable is the dependent variable, suggest students refer to the labeled axes on the coordinate plane in part (b) when defining their variables.

Misconception

Students may base their decision on which half plane to shade based on the $\geq$ symbol within the inequality $10x + 7.5y \geq 90$. While this yields the correct inequality symbol in this case, their rule does not hold up in cases where the coefficient of y is negative. Use the inequality $x - y \geq 90$ to prove this point. Suggest students base their decision on the inequality symbol when y is isolated on the left side of the inequality. Another method to determine which half plane to shade is to test a point on the graph in the inequality.

Questions to ask

- Why is an inequality rather than an equation required for this context?
- Why do you need two different variables for your inequality?
- What variable did you use for the independent variable? Does it matter in this case?
- How did you determine what inequality symbol to use?
- Is your line solid or dotted? Why?
- How did you decide whether to shade above or below the line?
- Did you use the graph or the inequality to test Colton's advice? Explain your process.
- If you graph the two inequalities that bound the graph to the first quadrant, what polygon is formed?

Summary

The solution to a linear inequality in two variables is any ordered pair whose *x*- and *y*-values make the inequality a true statement.

DEVELOP

Activity 2.1

Systems of Linear Inequalities

Facilitation Notes

In this activity, students write a linear inequality in two variables to represent an additional constraint on the problem situation from the Getting Started. They then write a system of inequalities and determine solutions that satisfy all constraints. A *solution of a system of inequalities* is defined. Students analyze the solutions to a system of inequalities and conclude that it is possible to have no solution. They then solve a problem in context that can be modeled by a system of linear inequalities.

Have students work with a partner or in a group to complete Question 1. Share responses as a class.

Differentiation strategies

To scaffold support when graphing more than one inequality on the same coordinate plane,

- Suggest that they shade the portion of the graph that represents the solution to each inequality and interpret the intersection of the shaded portions as the solution to the entire system. This method reduces the memory load required to shade the solution only, reduces the number of errors, and makes it easier to identify and correct mistakes.
- Have them used colored pencils for their lines and the shading that corresponds to their lines to distinguish among them.

Questions to ask

- How does your inequality address the fact that Janice could work less that 20 hours per week?
- What do each of your inequalities represent?
- Did you shade above or below the line $x + y = 20$? Why?
- How do you know what portion of the graph represents the solution?
- What is meant by Janice's *earnings requirement*?
- How could you use the graph to determine how many hours Janice must work at the ice cream shop to meet her earning requirement?

- How could you use algebra to determine how many hours Janice must work at the ice cream shop to meet her earning requirement?
- What does the vertical line both points lie on represent?
- What other number of hours could Erin suggest?
- How can you use an inequality to express all possible suggestions Erin has made?

Have students work with a partner or in a group to read the information following Question 1 and complete Questions 2 through 6. Share responses as a class.

Differentiation strategy

To scaffold support for interpreting a pre-shaded graph, suggest they use one of the coordinate planes in Question 4 to graph each inequality in the system of equations themselves. They then can compare their solution to those of Serena and Adam.

Questions to ask

- To verify that a point is a solution to a system of inequalities, how many inequalities must result in a true statement?
- To verify that a point is not a solution, how many of the inequalities must result in a false statement?
- How could you modify the system of inequalities so that it does have a solution?

Have students work with a partner or in a group to complete Question 7. Share responses as a class.

As students work, look for

Whether or not they include $x \geq 0$ and $y \geq 0$ as part of their system of inequalities.

Differentiation strategy

To support students who struggle determining the equations, suggest that they use the units to inform their work. In this case, the inequality $2x + 1.25y \geq 100$ includes values with the unit of dollars.

Questions to ask

- Explain what each inequality represents in the context of the problem.
- How can you use the graph to identify solutions?
- How can you use algebra to verify your solution?

Summary

The solution of a system of inequalities is the intersection of the solutions to each inequality. Every point in the intersection satisfies all inequalities in the system.

Activity 2.2
Linear Programming

Facilitation Notes

In this activity, students write a system of inequalities to represent the constraints of a problem situation, graph the system on the coordinate plane, and shade the region that represents the solution set. The term *linear programming* is defined as a process to determine the optimal solution to a system of inequalities. They use linear programming to optimize the results for two given scenarios.

Have students work with a partner or in a group to complete Questions 1 and 2. Share responses as a class.

As students work, look for

Whether they expressed the number of hours using a compact inequality, $3 \le x \le 6$, or as two separate inequalities, $x \ge 3$ and $x \le 6$.

Misconception

Similar to an instance in the previous lesson, students may misinterpret *as least twice as much time running (x) as to strength training (y)* as $2x \ge y$. Suggest students substitute values in the equation to demonstrate the error in their thinking. Once students realize the correct inequality is $x \ge 2y$, discuss how to rewrite the inequality as $y \le \frac{1}{2}x$ to graph it.

Questions to ask

- Explain what each inequality represents in the context of the problem.
- How did you graph the lines that pertain to running only? Why are they vertical lines?
- How did you know whether to shade above or below $y \le \frac{1}{2}x$?
- If you tested points to determine the solution set, did you need to test a point in every region formed by the lines? Explain your thinking.

Ask a student to read the information following Question 2 aloud. Discuss as a class.

Have students work with a partner or in a group to complete Questions 3 through 5. Share responses as a class.

Differentiation strategies

To scaffold support,

- Guide them through the process of identifying the coordinates of the vertices that are non-integer values. For example:

- Have students identify the equations of the two lines that create the intersection point.

$$x + y = 8$$
$$y = \frac{1}{2}x$$

- Instruct students to solve the system.

$$\begin{aligned} x + y &= 8 \\ x + \tfrac{1}{2}x &= 8 \\ \tfrac{3}{2}x &= 8 \\ x &= \tfrac{16}{3} = 5\tfrac{1}{3} \end{aligned} \qquad \begin{aligned} y &= \tfrac{1}{2}x \\ y &= \tfrac{1}{2}\left(\tfrac{16}{3}\right) \\ y &= \tfrac{16}{6} = 2\tfrac{2}{3} \end{aligned}$$

- Write the solution as the coordinate pair $(5\frac{1}{3}, 2\frac{2}{3})$.

• Provide a template to determine the optimal solution

Vertices	$600x + 250y = W$	W
(3, 0)	$600(3) + 250(0) = W$	1800
(6, 0)		
(3, 1.5)		
$(5\frac{1}{3}, 2\frac{2}{3})$		
(6, 2)		

Questions to ask

• What polygon is formed by the shaded region? How many vertices does it have?
• How did you identify the coordinates of the vertices that are non-integer values?
• Why do you think the vertices are the only solutions that need to be checked for the optimal solution?
• What type of value are you looking for when substituting the coordinates of the vertices into the equation? How do you know?
• How many calories will Brad burn if he follows the optimal plan?
• Does this optimal plan fall within Brad's workout constraints? How do you know?

Have students work with a partner or in a group to complete Question 6. Share responses as a class.

Questions to ask

• Why isn't it necessary to change your graph?
• What equation represents this advertising context?
• Explain your steps to determine the optimal combination of running and strength training for Brad to earn the most money.

- How much money will Brad burn if he follows the optimal plan?
- Will you always be looking for the maximum value when determining the optimal solution? Why or why not?

Summary

In linear programming, the vertices of the solution region of the system of linear inequalities are substituted into a given equation to find the maximum or minimum value.

DEMONSTRATE

Talk the Talk: Making Bling for Cha-Ching

Facilitation Notes

In this activity, students write a system of inequalities to represent the constraints of a problem situation and use linear programming to determine a maximum value for a profit equation. They then describe the difference between a solution to a system of linear inequalities and a solution to an equation calculated by linear programming.

Have students work with a partner or in a group to complete Questions 1 and 2. Share responses as a class.

Misconception

Students may attempt to graph the optimization equation. If this occurs, remind them that the optimization equation is only considered once the solution set of the system is determined.

Questions to ask

- What portion of the context does each of your inequalities address?
- What polygon is formed by the shaded region? How many vertices does it have?
- What is your optimization equation?
- What are the coordinate pairs you need to substitute into your optimization equation?
- What type of value are you looking for when substituting the coordinate pairs into the optimization equation? How do you know?
- What is the maximum profit Christy can earn?
- How is linear programming related to solving a system of linear equations?

Summary

Systems of inequalities can model real-world problems with optimal solutions.

Make the Best of It

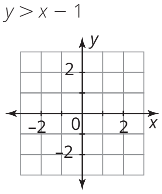
2

Optimization

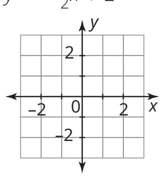
Warm Up

Graph each linear inequality.

1. $y > x - 1$



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



Learning Goals

- Write systems of linear inequalities in two variables.
- Solve systems of two or more linear inequalities in two variables.
- Determine possible solutions in the solution set of systems of two or more linear inequalities in two variables.
- Determine constraints from a problem situation.
- Use the vertices of a solution region to calculate maximum or minimum values.

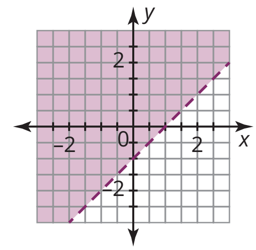
Key Terms

- solution of a system of inequalities
- linear programming

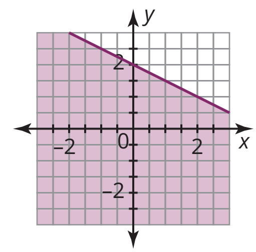
You have used the intersection of linear equations on a coordinate plane to solve a system of linear equations. How can you use the intersection of linear inequalities on a coordinate plane to determine the greatest or least values that a function can take?

Warm Up Answers

1.



2.

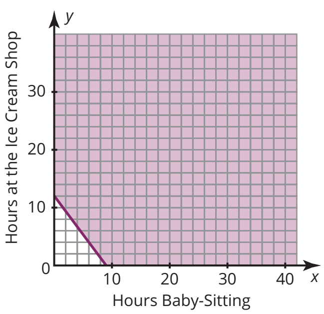


Answers

1a. $10x + 7.5y \geq 90$

Let x equal the number of hours Janice works at her baby-sitting job, and y equal the number of hours Janice works at the ice cream shop.

1b.



GETTING STARTED

Remember:

A boundary line, determined by the inequality, divides the plane into two half-planes, and the inequality symbol indicates which half-plane contains all the solutions.

She Works Hard for the Money

Recall that you can graph a linear inequality in two variables on a coordinate plane by determining the boundary line and shading the appropriate half-plane.

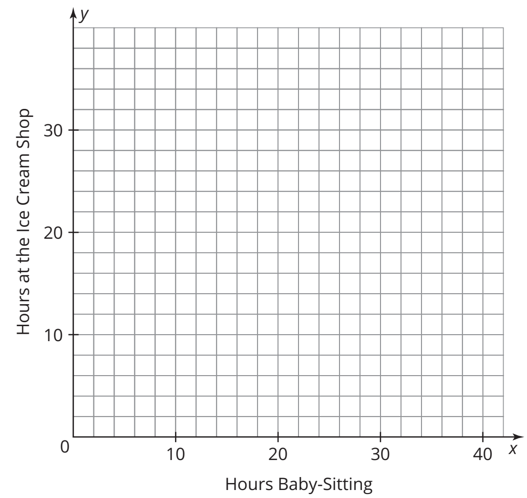
1. Janice works two jobs and is trying to maximize her weekly earnings. Her baby-sitting job pays \$10 per hour, and her job at an ice cream shop pays \$7.50 per hour. Suppose she needs to earn at least \$90 to cover her weekly expenses.

a. Write a linear inequality to represent the total amount of money Janice needs to earn at her jobs. Be sure to define your variables.

Think about:

Will the boundary line be a solid or a dashed line?

b. Graph the linear inequality on the coordinate plane.



c. **Janice's friend Colton suggests that she work 18 hours at her baby-sitting job and 12 hours at the ice cream shop. If Janice follows Colton's advice, will she earn enough to cover her weekly expenses? Explain your reasoning.**

d. **Write this solution as an ordered pair. Where does it fall on the graph?**

e. **Determine another possible solution to this problem situation. Justify your reasoning.**

f. **Why is the graph restricted to the first quadrant?**

g. **Write two inequalities that represent this restriction.**

Think about:

Which values are reasonable for the variables in the problem situation?

Answers

1c. Yes. If Janice spends 18 hours baby-sitting and 12 hours at the ice cream shop, then $x = 18$ and $y = 12$. The ordered pair satisfies the linear inequality.

$10(18) + 7.5(12) \geq 90$

$180 + 90 \geq 90$

$270 \geq 90$ ✔

1d. The ordered pair is (18, 12). It falls within the shaded region on the graph.

1e. Sample answer. The ordered pair (14, 0) is another possible solution to the problem situation.

$10(14) + 7.5(0) \geq 90$

$140 + 0 \geq 90$

$140 \geq 90$ ✔

1f. The graph is restricted to the first quadrant because the variables represent the number of hours Janice works at each job, and the number of hours cannot be negative.

1g. $x \geq 0, y \geq 0$

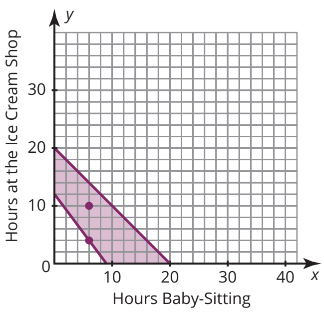
Answers

1a. $x + y \leq 20$

1b. Colton's suggestion is not reasonable. While she will make enough money to cover her weekly expenses, 18 hours of baby-sitting and 12 hours at the ice cream shop exceed 20 total hours.

1c. $$\begin{cases} x + y \leq 20 \\ 10x + 7.5y \geq 90 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

1d.



1e. Janice must work 4 hours at the ice cream shop to meet her earnings requirement.

$$10(6) + 7.5y = 90$$
$$60 + 7.5y = 90$$
$$7.5y = 30$$
$$y = 4$$

ACTIVITY **2.1** Systems of Linear Inequalities

The three inequalities you wrote to represent the possible number of hours Janice can work at her two jobs make up a system of linear inequalities. How does adding another inequality to the system affect the solution?

1. Suppose that Janice can work a maximum of 20 total hours per week.

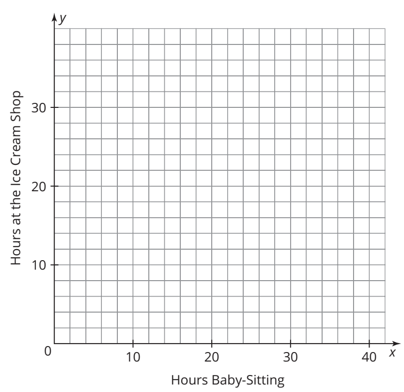
a. Write a linear inequality to represent the total number of hours that Janice could work per week.

Remember:

In a system of linear inequalities, the inequalities are known as constraints because the values of the expressions are "constrained" to lie within a certain region on the graph.

b. Is Colton's suggestion of 18 hours at her baby-sitting job and 12 hours at the ice cream shop still reasonable? Justify your reasoning.

c. Write the four linear inequalities that you have written into a system of inequalities that represents Janice's problem situation.



d. Graph the system of linear inequalities on one coordinate plane.

e. Suppose that Janice is only able to baby-sit for 6 hours. How many hours must she work at the ice cream shop in order to meet her earnings requirement? Justify your reasoning.

ELL Tip

To further help students understand the meaning of the term *constraint*, connect its mathematical meaning to its everyday use. A *constraint* is a *limitation or restriction*. For example, seatbelts are often referred to as safety *constraints*.

f. **Write your solution as an ordered pair, and plot it on the graph in part (d). Where does it fall?**

g. **Erin suggests that Janice also work 10 hours at the ice cream shop. Is this solution reasonable? How does it compare to your answer in part (e)?**

h. **Write Erin's solution as an ordered pair and plot it on the graph in part (d). Where does it fall?**

i. **Compare these solutions with the ordered pair (18, 12) suggested by Colton in part (b). What do you notice?**

The **solution of a system of inequalities** is the intersection of the solutions to each inequality. Every point in the intersection satisfies all inequalities in the system.

2. **Select one ordered pair that represents a point inside the overlapping region. Verify that it is a solution to the system of linear inequalities.**

3. **Select one ordered pair that represents a point outside the overlapping region. Verify that it is not a solution to the system of linear inequalities.**

Answers

1f. See graph in Question 1, part (d).
The ordered pair is (6, 4). It falls on the border of the shaded region of the graph.

1g. The solution (6, 10) is reasonable. It satisfies all inequalities in the system.
This solution falls within the shaded region whereas the solution in part (e) falls on the border of the shaded region. The solution to part (e) is the minimum value to satisfy the earnings requirement.

1h. See graph in Question 1, part (d).
The ordered pair is (6, 10). It falls within the shaded region of all four inequalities.

1i. The solutions in parts (f) and (h) satisfy all four linear inequalities and fall within the shaded region that overlaps. The solution suggested by Colton only satisfied some of the linear inequalities, and it did not fall within the overlapping shaded region.

2. Sample answer.
The point (16, 2) is a solution to the system. It falls within the overlapping shaded region and satisfies all inequalities in the system.

$16 + 2 \leq 20$

$18 \leq 20$ ✔

$10(16) + 7.5(2) \geq 90$

$160 + 15 \geq 90$

$175 \geq 90$ ✔

$16 \geq 0$ ✔

$2 \geq 0$ ✔

3. Sample answer.
The point (6, 3) is not a solution to the system. It does not fall within the overlapping shaded region and does not satisfy all inequalities in the system.

$6 + 3 \leq 20$

$9 \leq 20$ ✔

$10(6) + 7.5(3) \geq 90$

$60 + 22.5 \geq 90$

$82.5 \geq 90$ ✗

$6 \geq 0$ ✔

$3 \geq 0$ ✔

Answers

4a. Serena is correct. She shaded the region above the graph of the line $y > -3x + 5$ and shaded below the graph of the line $y < -3x - 2$.

4b. Sample answer.
Below both lines:
Check (−2, 0).

$0 > -3(-2) + 5$

$0 > 11$ ✗

$0 < -3(-2) - 2$

$0 < 4$ ✔

Between the two lines:

Check (0, 0).

$0 > -3(0) + 5$

$0 > 5$ ✗

$0 < -3(0) - 2$

$0 < -2$ ✗

Above both lines:
Check (6, 0).

$0 > -3(6) + 5$

$0 > -13$ ✔

$0 < -3(6) - 2$

$0 < -20$ ✗

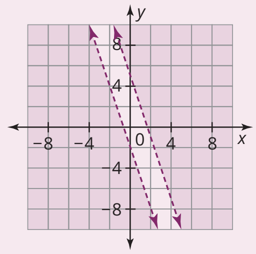
The system has no solution. Serena is correct.

5. The lines in Question 4 are dashed because the expressions $-3x + 5$ and $-3x - 2$ in the inequalities are less than or greater than y, but not equal to y. This means that any point that falls on either of these lines are not part of the solution set.

4. Serena and Adam were each asked to graph the system of linear inequalities shown.

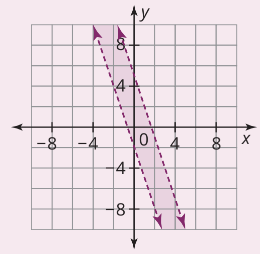
$$\begin{cases} y > -3x + 5 \\ y < -3x - 2 \end{cases}$$

Serena



The two inequalities do not overlap, and therefore the system has no solution.

Adam



The solution to the system of inequalities falls in between the two lines.

a. Who is correct? Justify your reasoning.

b. Select an ordered pair from each region of the graph to verify your response.

5. Why are the lines in Question 4 dashed?

6. Will two parallel lines always produce a system of linear inequalities with no solution?

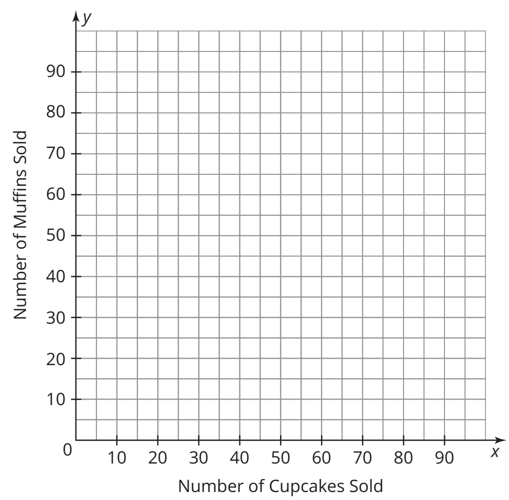
6 • TOPIC 1: Extending Linear Relationships

6. No. A system of linear inequalities will have no solution if the shaded regions do not overlap. The system could have a solution set represented by points that fall in between the two lines.

7. **The Whistling Baker is a bakery that specializes in cupcakes and muffins. They sell cupcakes for \$2.00 each and muffins for \$1.25 each. The Whistling Baker can bake a total of 8 dozen treats each day and needs to make \$100 per day.**

   a. **Write a system of linear inequalities to represent this problem situation. Be sure to define your variables.**

   b. **Graph the system of linear inequalities on the coordinate plane.**



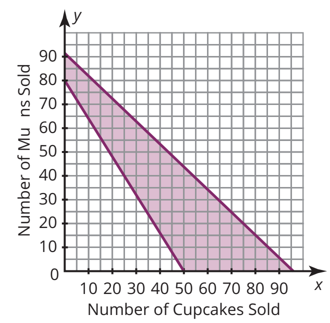
   c. **Identify one possible solution. Is this reasonable within the context of the problem situation?**

Answers

7a. Let x = the number of cupcakes that they bake, and y = the number of muffins that they bake.

$$\begin{cases} 2x + 1.25y \geq 100 \\ x + y \leq 96 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

7b.



7c. Sample answer.
A possible solution is to sell 50 cupcakes and 20 muffins.

$50 + 20 \leq 96$

$70 \leq 96$ ✔

$2(50) + 1.25(20) \geq 100$

$100 + 25 \geq 100$

$125 \geq 100$ ✔

$50 \geq 0$ ✔

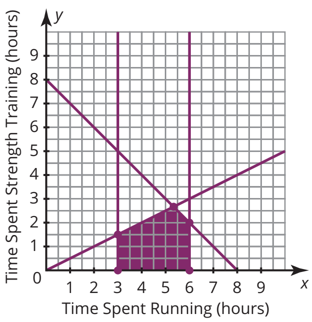
$20 \geq 0$ ✔

Answers

1. Let x = the number of hours spent running per week.
   Let y = the number of hours spent strength training per week.

$$\begin{cases} 3 \le x \le 6 \\ y \le \frac{1}{2}x \\ x + y \le 8 \\ x \ge 0 \\ y \ge 0 \end{cases}$$

2.



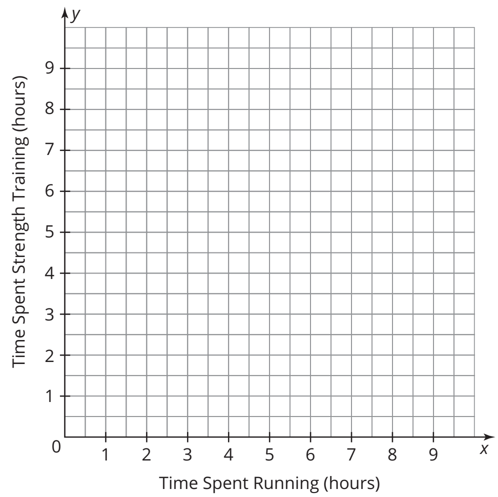
ACTIVITY
2.2

Linear Programming

Brad is a distance runner who wants to design the most effective workout plan to prepare for his next race. To adequately prepare for the race, Brad plans to do a combination of running and strength training. He must run between 3 and 6 hours per week, and wants to devote at least twice as much time to running as to strength training. Brad can spend no more than 8 hours working out each week.

1. Write a system of inequalities to represent the constraints of this problem situation. Be sure to define your unknowns.

2. Graph the system of inequalities on the coordinate plane shown. Shade the region that represents the solution set.



You can use the intersection points to determine the optimal solution to a system of inequalities through a process called *linear programming*.

In **linear programming**, the vertices of the solution region of the system of linear inequalities are substituted into a given equation to determine the maximum or minimum value.

3. Label the vertices of the shaded region.

4. Running burns 600 calories per hour, while strength training burns 250 calories per hour. Write an equation to represent this relationship. Be sure to define your variables.

5. Use the vertices of the solution region to determine how many hours Brad should devote to each type of exercise in order to maximize the number of calories burned.

6. A sponsor wants Brad to advertise their company by wearing its brand name on his workout gear. They will pay him $15 for each hour he wears the brand name while running, and $20 for each hour he wears the brand name while strength training. Determine how many hours Brad should devote to each type of exercise in order to maximize his earnings.

ELL Tip

Define the term *optimal* as the *best or most favorable*. Explain that when solving a system of inequalities, there are many solutions. Now, students will be using a process called *linear programming* to find the *optimal* solution out of the entire solution set.

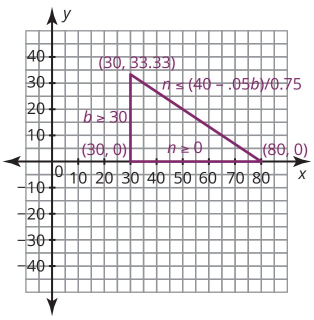
Answers

3. The vertices of the shaded region are (3, 0), (6, 0), (3, 1.5), $(5\frac{1}{3}, 2\frac{2}{3})$ and (6, 2).
4. Let x = the number of hours that Brad runs and y = the number of hours that Brad strength trains.
   $600x + 250y = W$
5. Brad should devote 6 hours to running and 2 hours to strength training each week to maximize his workout.
   $600x + 250y = W$
   $600(3) + 250(0) = 1800$
   $600(6) + 250(0) = 3600$
   $600(3) + 250(1.5) = 2175$
   $600(5.33) + 250(2.67) = 3865.5$
   $600(6) + 250(2) = 4100$
6. Brad should devote $5\frac{1}{3}$ hours to running and $2\frac{2}{3}$ hours to strength training each week to maximize his earnings.
   $15x + 20y = E$
   $15(3) + 20(0) = 45$
   $15(6) + 20(0) = 90$
   $15(3) + 20(1.5) = 75$
   $15(5.33) + 20(2.67) = 133.35$
   $15(6) + 20(2) = 130$

Answers

1. Christy should make 30 bracelets and 33 necklaces.
   Let b represent the number of bracelets.
   Let n represent the number of necklaces.

   $$\begin{cases} 0.5b + 0.75n \leq 40 \\ b \geq 30 \\ n \geq 0 \end{cases}$$

   $P = 10b + 18n$

   $P = 10(30) + 18(33)$
   $= 894$

   $P = 10(80) + 18(0)$
   $= 800$

   $P = 10(30) + 18(0)$
   $= 300$

   The solution that maximizes the profit is (30, 33).

2. The solution of a system of linear inequalities is any ordered pair that satisfies each of the inequalities in the system. The solution to an equation calculated by linear programming is a single ordered pair that is also a solution of a system of linear inequalities that results in a maximum or minimum value for the equation.

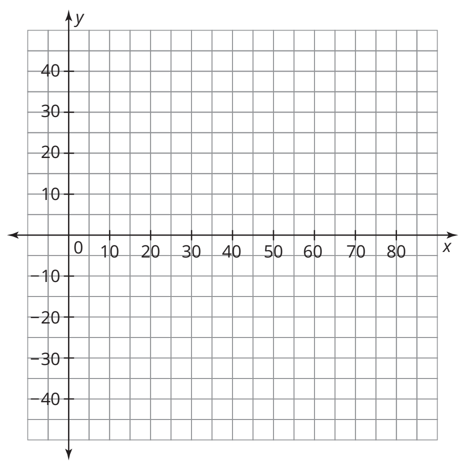
NOTES

TALK the TALK

Making Bling for Cha-Ching

You can write a system of inequalities in two variables to model the constraints in a problem situation and then use linear programming to compute optimal results.

1. Christy uses glass beads to make bracelets and necklaces. It takes her 30 minutes to make a bracelet and 45 minutes to make a necklace. She works at most 40 hours a week. She wants to make at least 30 bracelets. The profit from a bracelet is $10, and the profit from a necklace is $18. Determine the number of bracelets and necklaces Christy should make to maximize her profit. Show your work.



2. Compare the solution of a system of linear inequalities and the solution to an equation calculated by linear programming.

10 • TOPIC 1: Extending Linear Relationships