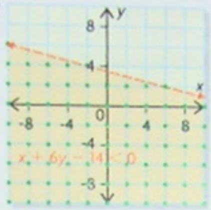
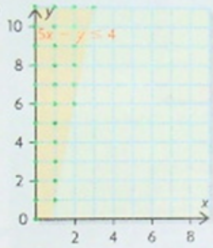
SOLUTIONS...

6. a) no solution

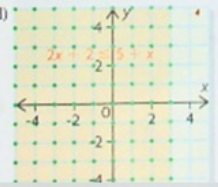
b)



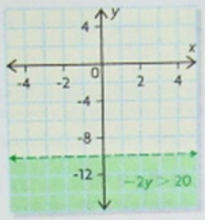
c)



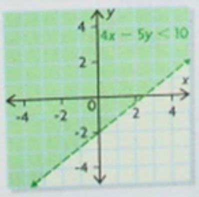
d)



e)



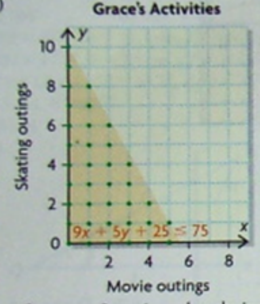
f)



7. a) Let x represent the number of movies Grace sees. Let y represent the number of times Grace goes skating.
$\{(x, y) \mid 9x + 5y + 25 \leq 75, x \in W, y \in W\}$

b) The variables must be whole numbers. $x \in W, y \in W$

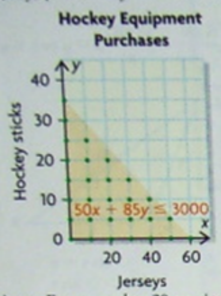
c)



i) e.g., see 3 movies and go skating 4 times
ii) e.g., see 5 movies and go skating once
iii) e.g., see 3 movies and go skating 6 times

8. a) Let x represent the number of jerseys. Let y represent the number of sticks.
$\{(x, y) \mid 50x + 85y \leq 3000, x \in W, y \in W\}$

b)

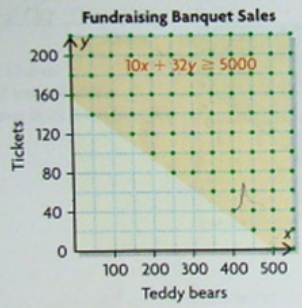


c) e.g., Eamon can buy 20 practice jerseys and 20 sticks for his team for \$2700. It's reasonable to have a few extra jerseys and a few extra sticks.

9. a) Let x represent the number of teddy bears sold. Let y represent the number of tickets sold.
$\{(x, y) \mid 10x + 32y \geq 5000, x \in W, y \in W\}$

b) The variables must be whole numbers. $x \in W, y \in W$

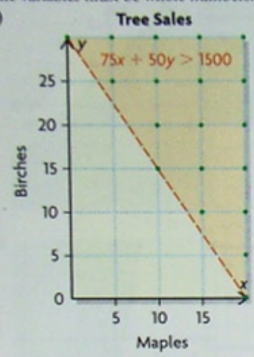
c)



i) not a solution
ii) Yes, this is a solution.
iii) not a solution

10. a) Let x represent the number of maple trees sold. Let y represent the number of birch trees sold.
$\{(x, y) \mid 75x + 50y > 1500, x \in W, y \in W\}$
The variables must be whole numbers. $x \in W, y \in W$

b)



c) i) Yes, because (13, 13) is in the solution region.
ii) No, because (14, 9) lies on the dashed boundary and is not included in the shaded region; the point (9, 14) is also not in the solution region.

HOMEWORK Questions...

8. Eamon coaches a hockey team of 18 players. He plans to buy new practice jerseys and hockey sticks for the team. The supplier sells practice jerseys for \$50 each and hockey sticks for \$85 each. Eamon can spend no more than \$3000 in total. He wants to know how many jerseys and sticks he should buy.

a) Write a linear inequality to represent the situation.

b) Use your inequality to model the situation graphically.

c) Determine a reasonable solution to meet the needs of the team, and provide your reasoning.

Variables $x \to$ # of jerseys

$y \to$ # of sticks

Restrictions $x \in W$

$y \in W$

a) $50x + 85y \leq 3000$

$50x + 85y = 3000$

x int

$\frac{50x + \cancel{85(0)}}{50} = \frac{3000}{50}$

$x = 60$

$(60, 0)$

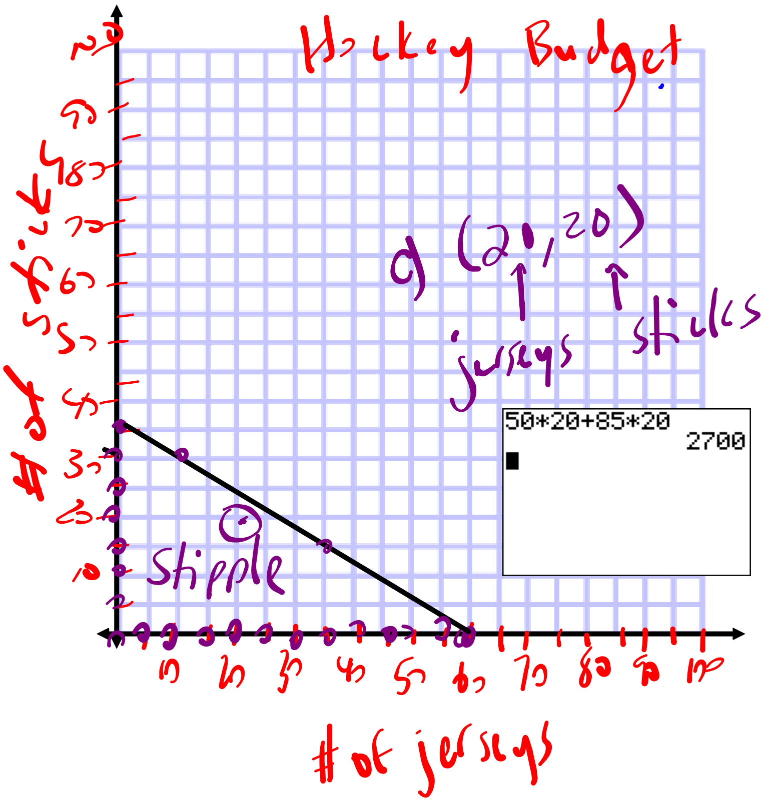
y int

$\frac{\cancel{50(0)} + 85y}{85} = \frac{3000}{85}$

$y = 35.2$

$(0, 35.2)$

b)



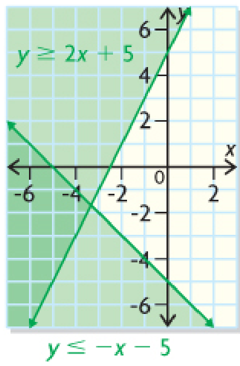
5.3 Graphing to Solve Systems of Linear Inequalities

GOAL

Solve problems by modelling systems of linear inequalities.

system of linear inequalities

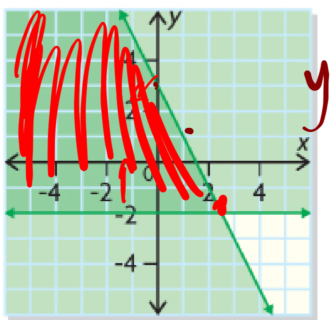
A set of two or more linear inequalities that are graphed on the same coordinate plane; the intersection of their solution regions represents the solution set for the system.



EXPLORE...

- What conclusions can you make about the system of linear inequalities graphed below?

$x \in R \quad y \in R$



$y \leq -2x + 3$

$y \geq -2$

SAMPLE ANSWER

Any or all of the following solutions are acceptable:

- It represents a system of two linear inequalities, each with a straight boundary and a solution region.
- One linear inequality is $y \leq -2x + 3$, and the horizontal inequality is $y \geq -2$. I determined $y \leq -2x + 3$ using the slope and y-intercept and the form $y = mx + b$, and I was able to identify $y \geq -2$ because it's a horizontal line through -2 on the y-axis.
- Both inequalities include the possibility of equality because the boundaries are solid.
- The solution set of the system is represented by the overlapping region because it's where the solution regions for the two linear inequalities overlap. The solution set includes points along the boundaries of the overlap.
- The domain and range are from the set of real numbers because the solution region is green and not stippled.
- All four quadrants are included so there are no restrictions on the set of real numbers.

Solving Systems of Linear Inequalities

A **system of linear inequalities** is an extension of a system of linear equations and consists of two (or more) linear inequalities that have the same variables. For example, $2x + 3y < 4$ and $3x + 4y < 5$ constitute a system of inequalities if x represents the same item in both equations, y represents the same item in both equations, and both equations describe the same context.

Example #1:

Graph the following system and determine a possible solution

$$\{(x,y) \mid y \le 3x - 1, x\varepsilon R, y\varepsilon R\}$$

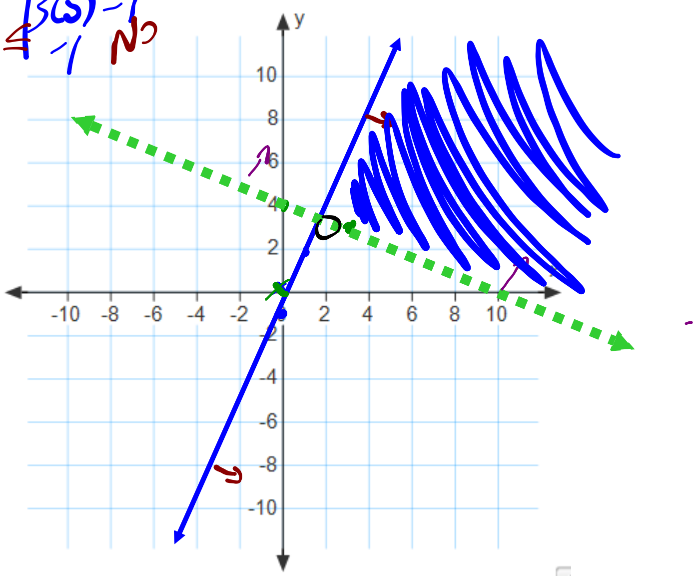
$$\left\{(x,y) \mid y > -\frac{1}{3}x + 4, x\varepsilon R, y\varepsilon R\right\}$$

LS ≤ RS

LS	RS
0	$3(0)-1$
≤	-1 No

LS > RS

LS	RS
0	$-\frac{1}{3}(0)+4$
>	4 No



EXAMPLE #2...

Graph the solution set for the following system of inequalities. Choose two possible solutions from the set.

$3x + 2y > -6$

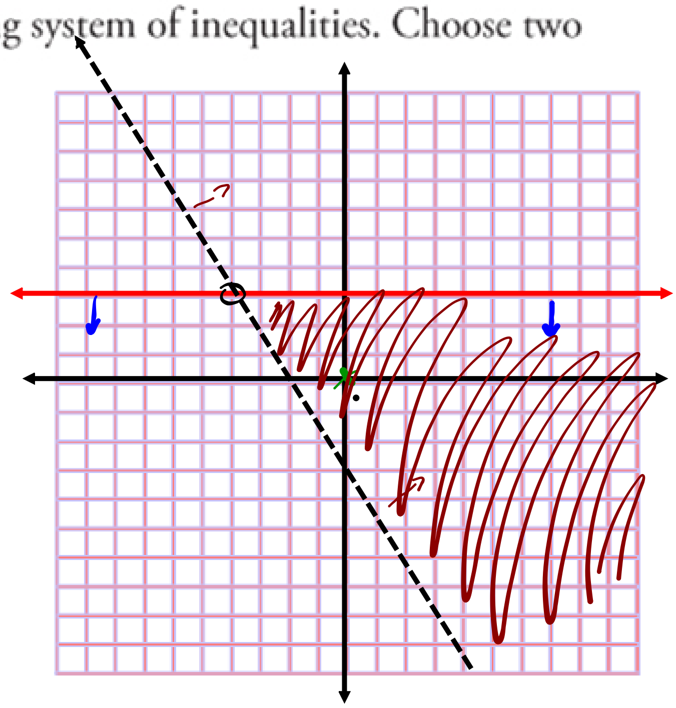
$y \leq 3$

$3x + 2y = -6$

$\frac{\cancel{2}y}{\cancel{2}} = \frac{-3}{2}x - \frac{6}{2}$

$y = \frac{-3}{2}x - 3$

$y = 3$



LS	> RS
0	> -6

APPLY the Math

Can be found on p.230

EXAMPLE 2 Solving graphically a system of two linear inequalities with continuous variables

Graph the solution set for the following system of inequalities. Choose two possible solutions from the set.

$3x + 2y > -6$

$y \leq 3$

Peter's Solution: Using graph paper

$x \in R, y \in R$

I assumed both x and y are in the set of real numbers because restrictions on the domain and range were not stated. I knew the graph would have a continuous solution region and could be in all four quadrants.

$3x + 2y > -6$

x-intercept:	y-intercept:
$3x + 2(0) = -6$	$3(0) + 2y = -6$
$\frac{3x}{3} = -\frac{6}{3}$	$\frac{2y}{2} = -\frac{6}{2}$
$x = -2$	$y = -3$
$(-2, 0)$	$(0, -3)$

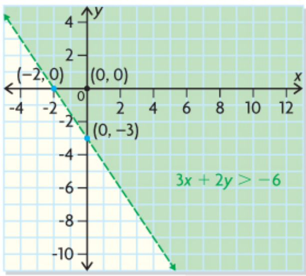
To graph $3x + 2y > -6$, I identified the x- and y-intercepts of the linear equation of the boundary $3x + 2y = -6$.

Test (0, 0) in $3x + 2y > -6$.

LS	RS
$3x + 2y$	-6
$3(0) + 2(0)$	
0	

Since $0 > -6$,
(0, 0) is in the solution region.

I used the test point (0, 0) to determine which region to shade.

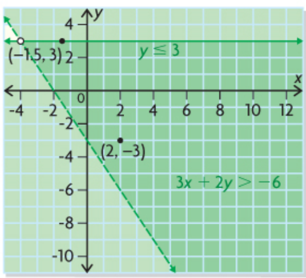


I drew a dashed green line for the boundary since the > sign does not include the possibility of equality and the solution set is continuous.

I shaded the half plane that included (0, 0), since (0, 0) is a solution to the linear inequality. I used green shading to show a continuous solution region.

$y \leq 3$

I knew that I should draw a solid horizontal green boundary because the inequality has one variable, y, the sign is $\leq$ and the solution set is continuous.



I shaded the half plane below the boundary, since all the points in this region have y-coordinates that are less than 3.

Where the solid and dashed boundaries intersect, I drew an open dot to show that this point is not part of the solution region. It made sense that the intersection point is not included because none of the points on the boundary of $3x + 2y > -6$ are included in its solution region.

I knew that all the points in the overlapping solution region, which included points along its solid boundary, represented the solution set, because x and y are in the set of real numbers.

The overlapping solution region represents the solution set of the system of linear inequalities. Therefore, $(2, -3)$ and $(-1.5, 3)$ are two possible solutions.

Any point in the solution region is a possible solution.

Your Turn

How would the solution region change if $x \in I$ and $y \in I$? How would it stay the same?

In Summary

Key Ideas

- When graphing a system of linear inequalities, the boundaries of its solution region may or may not be included, depending on the types of linear inequalities ($\geq$, $\leq$, $<$, or $>$) in the system.
- Most systems of linear inequalities representing real-world situations are restricted to the first quadrant because the values of the variables in the system must be positive.

Need to Know

- Any point in the solution region for a system is a valid solution, but some solutions may make more sense than others depending on the context of the problem.
- You can validate a possible solution from the solution region by checking to see if it satisfies each linear inequality in the system.
  For example, to validate if (2, 2) is a solution to the system:
  $x + y \geq 1$
  $2 > x - 2y$

  Validating (2, 2) for $x + y \geq 1$:

LS	RS
$x + y$	1
$2 + 2$	
4	
$4 \geq 1$	valid

  Validating (2, 2) for $2 > x - 2y$:

LS	RS
2	$x - 2y$
	$2 - 2(2)$
	-2
$2 > -2$	valid

- Use an open dot to show that an intersection point of a system's boundaries is excluded from the solution set. An intersection point is excluded when a dashed line intersects either a dashed or solid line.
- Use a solid dot to show that an intersection point of a system's boundaries is included in the solution set. This occurs when both boundary lines are solid.

HOMEWORK...

Puzzle Worksheet - Systems of Linear Inequations.docx

Worksheet - Systems of Linear Inequations.docx

Attachments

6Ws3e2.mp4

Puzzle Worksheet - Systems of Linear Inequations.docx

Worksheet - Systems of Linear Inequations.docx