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2.6 Linear Inequalities & Systems of Inequalities Notes

Linear Inequalities

A linear inequality is similar to a linear equation, but it has an inequality symbol and an *infinite* number of solutions.

Given $y \geq -2x + 9$, determine which points satisfy the inequality:

a) $(-1, 3)$ b) $(10, -5)$

$3 \geq -2(-1) + 9$ $-5 \geq -2(10) + 9$
 $3 \geq 2 + 9$ $-5 \geq -20 + 9$
 $3 \geq 11$ $-5 \geq -11$ ✓

$(-1, 3)$ is not a solution $(10, -5)$ is a solution

Graphing Linear Inequalities

- Put the inequality in slope-intercept form. Flip the inequality symbol when multiplying or dividing by a negative.
- Graph the line. Use a dashed line for $<$ and $>$ and a solid line for \leq and \geq .
- Test a point $(0,0)$ by substituting it into the inequality. If it makes it true, shade over the point. If not, shade on the opposite side of the line. Do not use a point to test if it is on the line.

For linear systems this means: Shade above the line for $>$ or \geq and below the line for $<$ or \leq .

Ex1: $5x + 3y \leq 12$

$\frac{3y}{3} \leq \frac{-5x}{3} + \frac{12}{3}$

$y \leq -\frac{5}{3}x + 4$

solid line

Test $(0,0)$
 $5(0) + 3(0) \leq 12$
 $0 \leq 12$
 True
 Shade over $(0,0)$

Ex2: $x - 6y < -12$

$\frac{-6y}{-6} < \frac{-x}{-6} - \frac{12}{-6}$

$y > \frac{1}{6}x + 2$

Flip. Divided by (-6)

All the points (x, y) in the shaded region and on the line are solutions.

System of Linear Inequalities

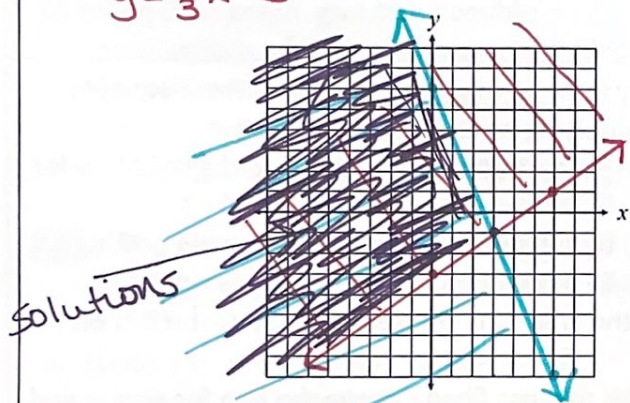
The solution to a system of linear inequalities is the set of ordered pairs that satisfy **ALL** the linear inequalities in the system.

The solution is shown by graphing.

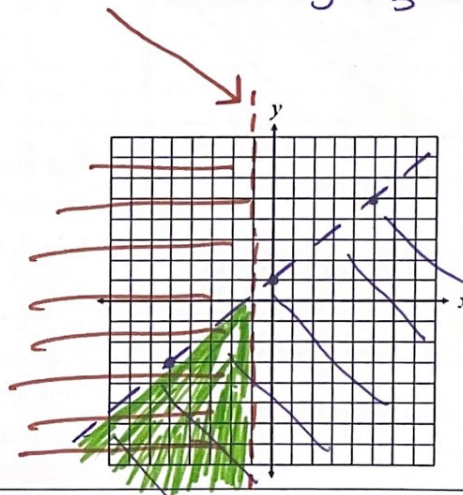
- 1) Graph and shade each linear inequality.
- 2) The solution to the system is where the shading overlaps.

Ex3: $7x + 3y \leq 18 \rightarrow 3y \leq -7x + 18$
 $2x - 3y \leq 9$
 $-3y \leq -2x + 9$
 $y \geq \frac{2}{3}x - 3$

$y \leq -\frac{7}{3}x + 6$

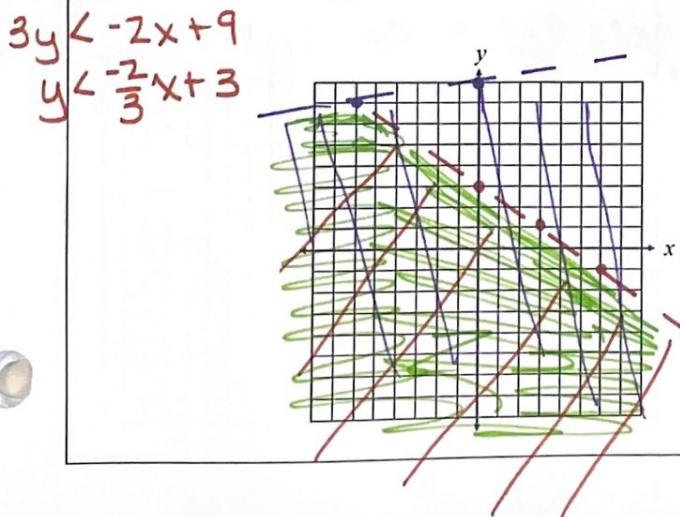


Ex4: $4x - 5y > -5 \rightarrow -5y > -4x - 5$
 $x < -1$
 $y < \frac{4}{5}x + 1$



Ex5: $x - 6y > -48 \rightarrow -6y > -x - 48$
 $2x + 3y < 9$
 $y < \frac{1}{6}x + 8$

$3y < -2x + 9$
 $y < -\frac{2}{3}x + 3$



Ex6: Which points are solutions to the system in Ex5? The solutions are in shaded region and not on dashed line.

(1,1) solution

(9,-2) NO

(3,4) NO

(-2,6) NO

(-8,-3) solution

(4,-7) solution

Also substituted into both inequalities will determine if they are solutions.

Ex7: To raise money to attend Boy Scout camp, Alex is selling popcorn. Small bags of popcorn sell for \$4 each and large bags sell for \$6 each. He needs to earn at least \$300 to attend camp. He will also earn a badge if he sells at least 60 bags total of any combination.

a) Write a system of linear inequalities to represent this situation, then graph it.

x: # of small bags
y: # of large bags

$$x + y \geq 60 \rightarrow y \geq -x + 60$$

$$4x + 6y \geq 300$$

$$\downarrow$$

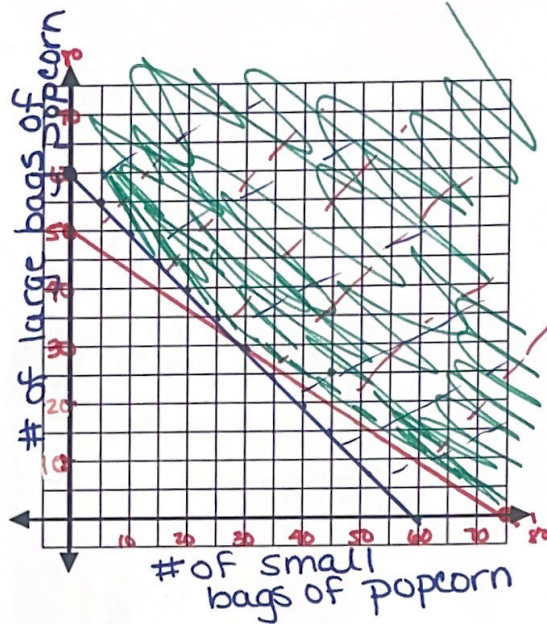
$$6y \geq -4x + 300$$

$$y \geq -\frac{2}{3}x + 50$$

OR
Find x + y intercepts
(0, 50)
(75, 0)

b) Using your graph, give two possible combinations of bags of popcorn that Alec can sell to attend camp and earn his badge. (30, 50)

30 small and 50 lg bags
(45, 25) 45 small and 25 lg



Ex8: Greg needs at least \$1.60 in stamps to return his Amazon order via mail. He has 28¢ and 4¢ stamps. He can use no more than twenty 4¢ stamps as he only has one book left.

a) Write a system of linear inequalities to represent this situation, then graph it.

x: number of 28¢ stamps
y: number of 4¢ stamps

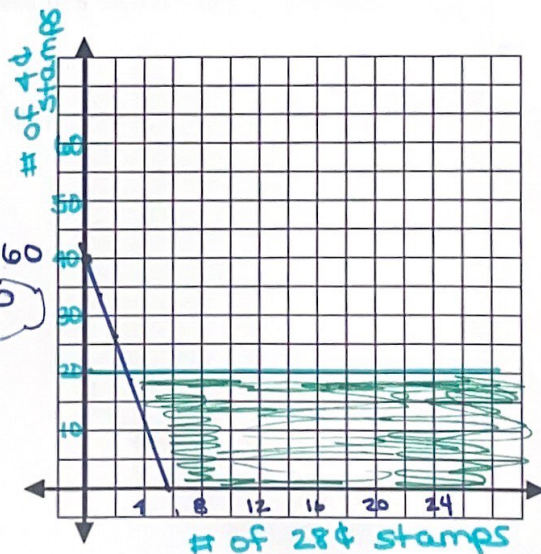
$$.28x + 0.04y \geq 1.60$$

$$28x + 4y \geq 160 \rightarrow 4y \geq -28x + 160$$

$$y \leq 20$$

$$y \geq -7x + 40$$

b) Using your graph, give two possible combinations of stamps that Greg can use to ensure he mails his package with the correct postage.



$x \geq 0$
 $y \geq 0$ are part of the system. In these situations negative x or y does not make sense.