4.3: Systems of Linear Inequalities

ADP Content Standards:

- ***E1: Linear equations and inequalities***
  c. Solve systems of linear inequalities in two variables and graph the solution set.
  d. Recognize and solve problems that can be represented by single variable linear equations or inequalities or systems of linear equations or inequalities involving two or more variables. Interpret the solution(s) in terms of the context of the problem.

CCSS for High School Mathematics:

- ***A.REI.12: Represent and solve equations and inequalities graphically***
  Graph the solutions to linear inequality in two variables as a half-plane (excluding boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Objective: To graph, write, and use a system of linear inequalities.

System of Linear Inequalities

A ***system of linear inequalities*** are two or more inequalities that use the same variables.

E.g., $x + y \leq 2$ Inequality 1
$4x - y > 3$ Inequality 2

The ***solution of a system of linear inequalities*** is the ordered pairs that make both the inequalities true statements.

Example 1: Check Solutions of Inequalities

Check whether (5, -1) is a solution of the system of inequalities.

a.) ① $x + y < 5$ (x, y)
② $x - y \geq -3$

① $5 + (-1) < 5$
$4 < 5$ ✓

② $5 - (-1) \geq -3$
$6 \geq -3$ ✓

Yes, it is a solution

b.) ① $x - 2y \leq 3$
② $y < -2$

① $5 - 2(-1) \leq 3$
$7 \leq 3$ ✗

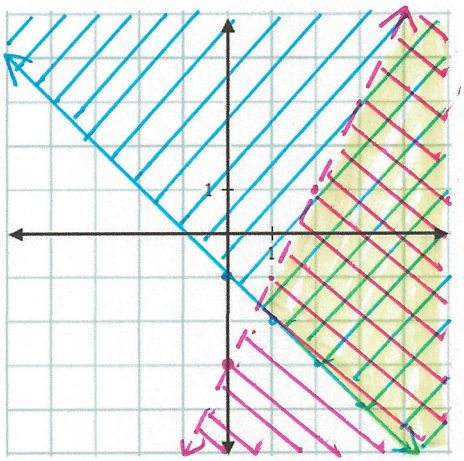
② $-1 < -2$ ✗

No, it is not a solution

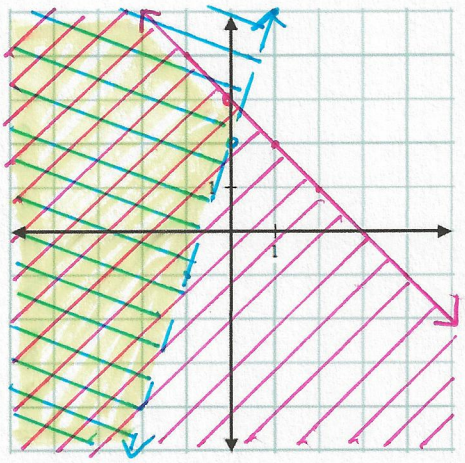
Example 2: Graph a System of Two Inequalities

Graph the system.

a.) $y < 2x - 3$ ★
$y \geq -x - 1$ ★

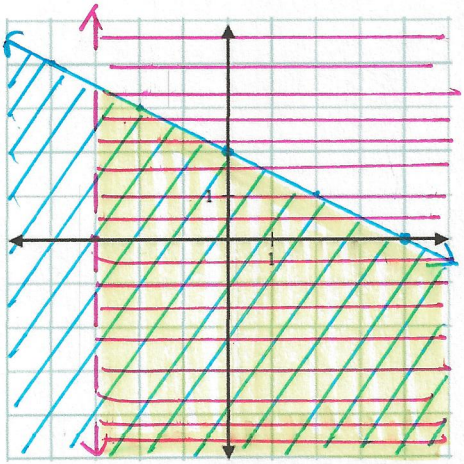


b.) $y \leq -x + 3$ ★
$y > 3x + 2$ ★



c.) $x > -3$ ★
$x + 2y \leq 4$ ★

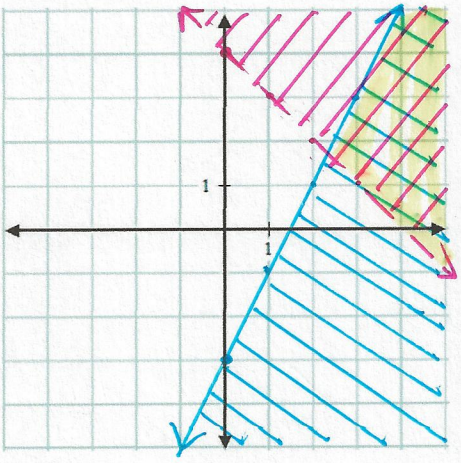
$x + 2y \leq 4$
$-x \quad -x$
$\frac{2y}{2} \leq \frac{-x}{2} + \frac{4}{2}$
$y \leq -\frac{1}{2}x + 2$



d.) $x + y > 4$ ★
$2x - y \geq 3$ ★

$x + y > 4$
$-x \quad -x$
$y > -x + 4$

$2x - y \geq 3$
$-2x \quad -2x$
$\frac{-y}{-1} \geq \frac{-2x}{-1} + \frac{3}{-1}$
$y \leq 2x - 3$

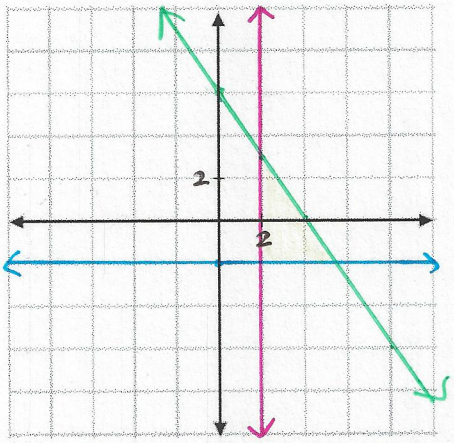


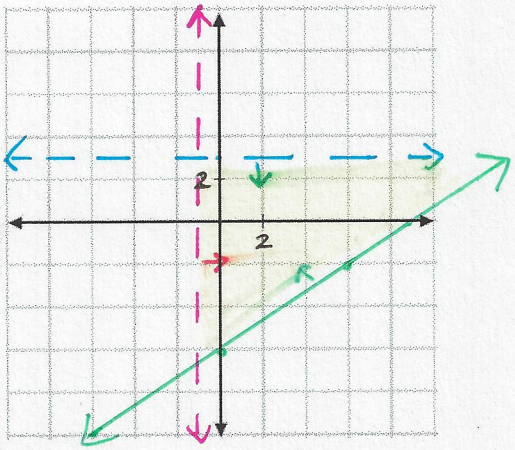
Example 3: Graph a System of Three Inequalities

Graph the system.

a.) $x \geq 2$ ★
$y \geq -2$ ★
$3x + 2y \leq 12$ ★

$3x + 2y \leq 12$
$-3x \quad -3x$
$\frac{2y}{2} \leq \frac{-3x}{2} + \frac{12}{2}$
$y \leq -\frac{3}{2}x + 6$



b.) $x > -1$ ★
$y < 3$ ★
$2x - 3y \leq 18$ ★

$2x - 3y \leq 18$
$-2x \quad -2x$
$\frac{-3y}{-3} \leq \frac{-2x}{-3} + \frac{18}{-3}$
$y \geq \frac{2}{3}x - 6$