Systems of Linear Inequalities in Two Variables

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What is a System of Linear Inequalities?

A system of linear inequalities in two variables consists of at least two linear inequalities in the same variables.

Examples and Non-Examples of Systems of Linear Inequalities in Two Variables

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Non-Examples

$$x + y > 6$$

$$\begin{cases} x \leq 1 \\ x + y > 2 \end{cases}$$

$$\begin{cases} x + 2y \leq 3 \\ x + 3y = 2 \end{cases}$$

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$$x + y > 6$$

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$$\begin{cases} x + 2y \leq 3 \\ x + 3y = 2 \end{cases}$$

$$\begin{cases} x + y \geq 1 \\ x + y - z < 4 \end{cases}$$

Example

Write Yes if the given is a system of linear inequalities in two variables or No if it is not.

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$$\begin{cases} 2x \geq y + 1 \\ 3x < 2y \end{cases}$$

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Yes

$$\begin{cases} x > 3y \\ y \leq 2 \end{cases}$$

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Write Yes if the given is a system of linear inequalities in two variables or No if it is not.

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$$\begin{cases} y > 3x - 1 \\ y = x - 1 \end{cases}$$ No

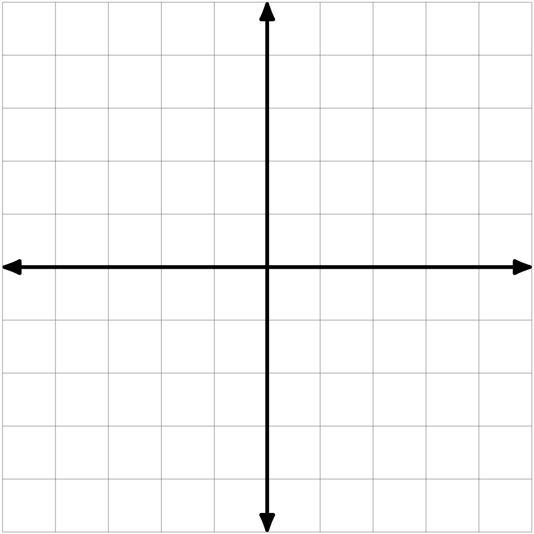
$$\begin{cases} 2x \geq y + 1 \\ 3x < 2y \end{cases}$$ Yes

$$\begin{cases} x > 3y \\ y \leq 2 \end{cases}$$ No

What is the Graph of a System of Linear Inequalities?

The graph of a system of linear inequalities is the graph of all solutions of the system.

Example 1



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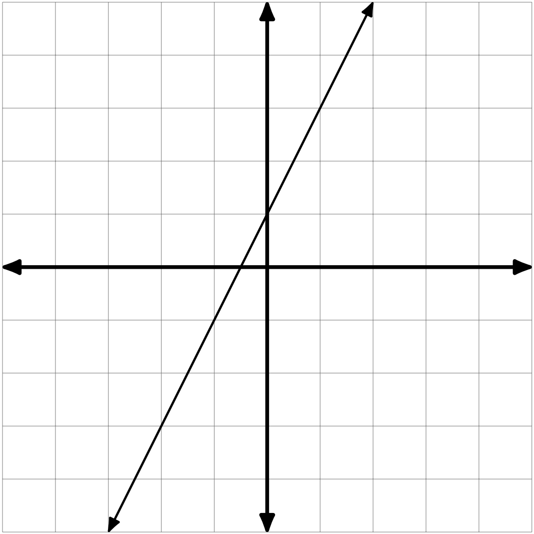

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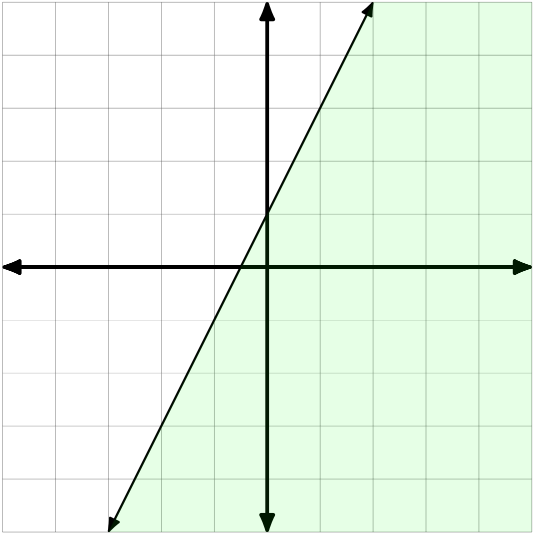

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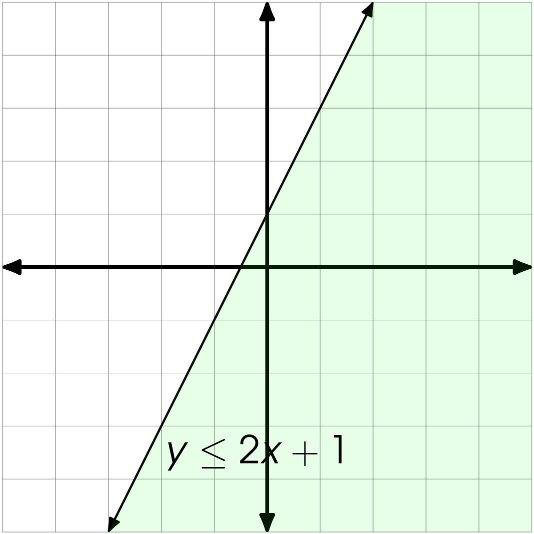

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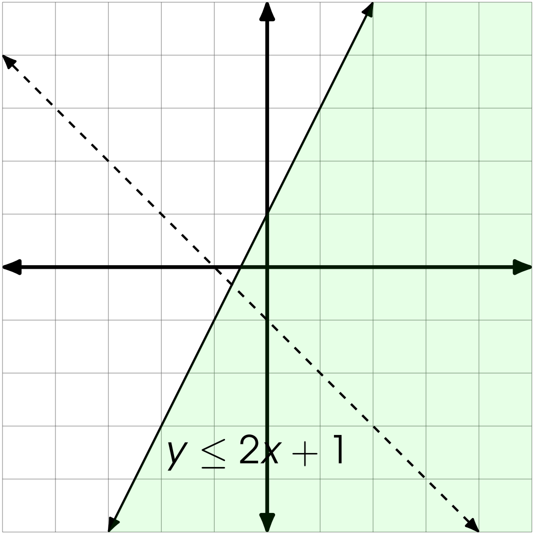

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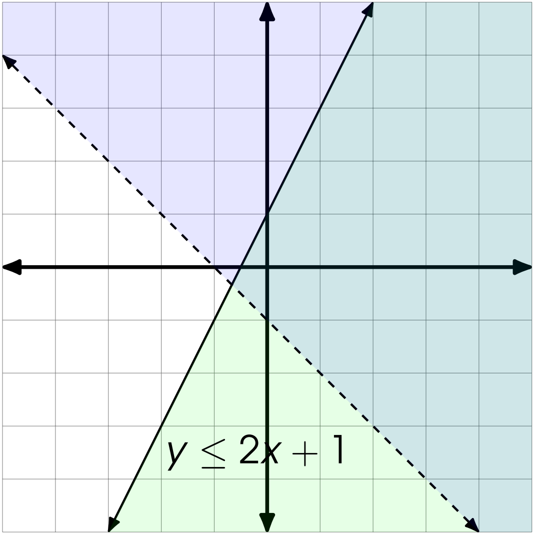

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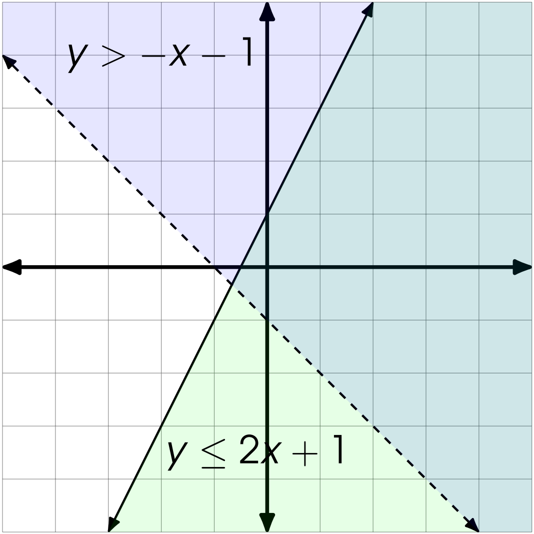

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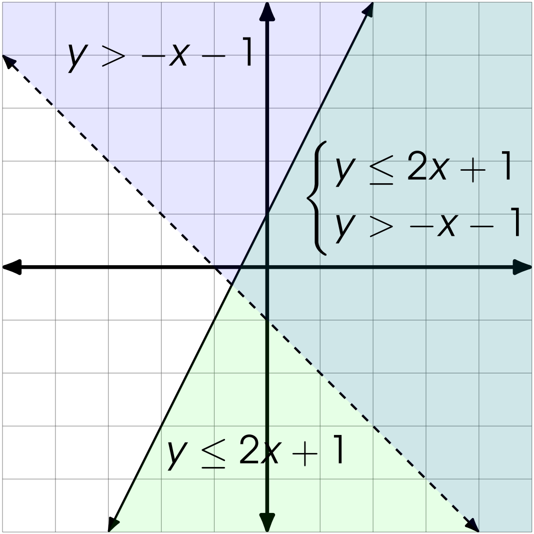

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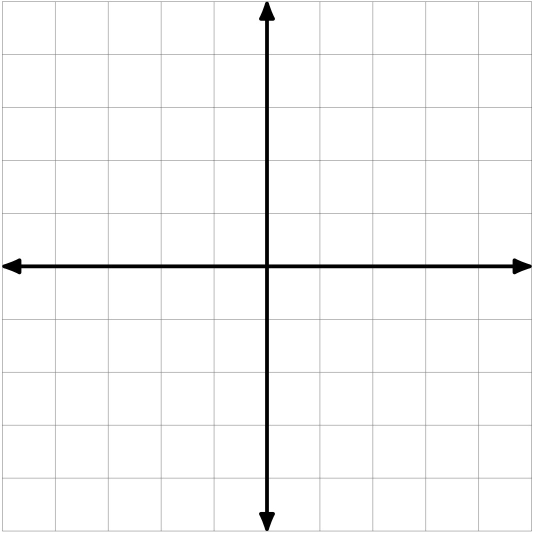
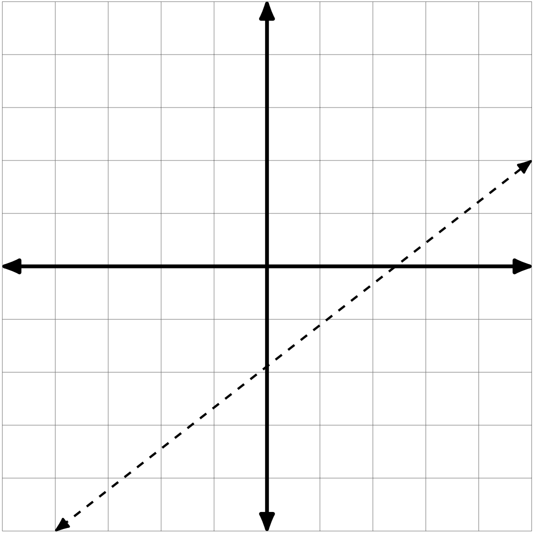


Example 2



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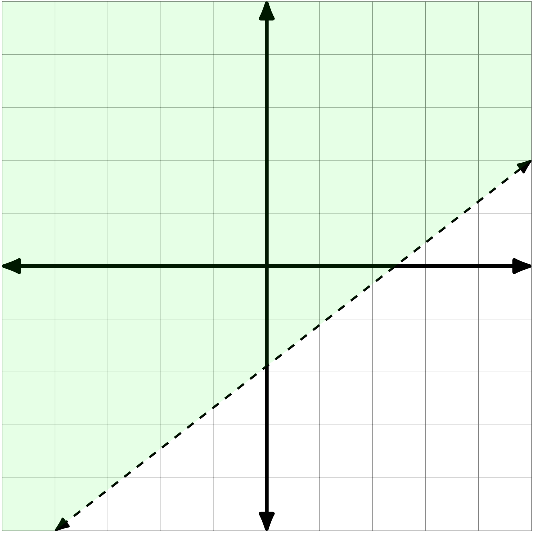

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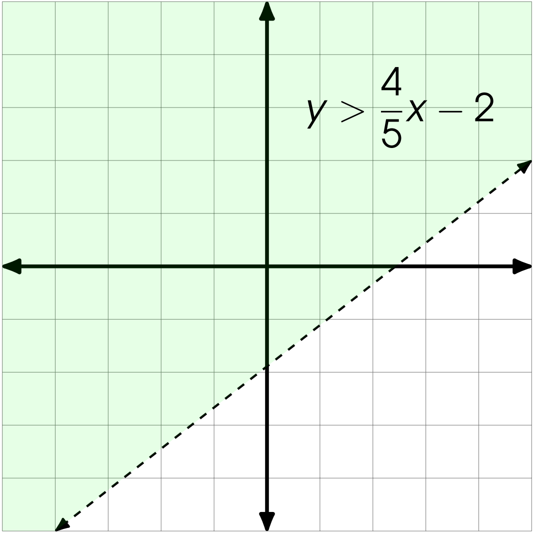

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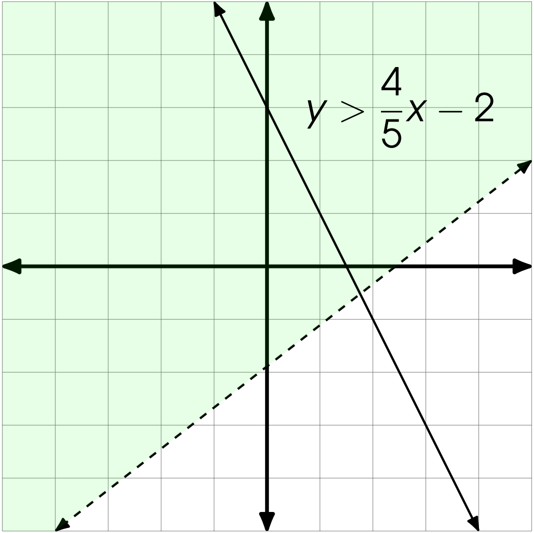

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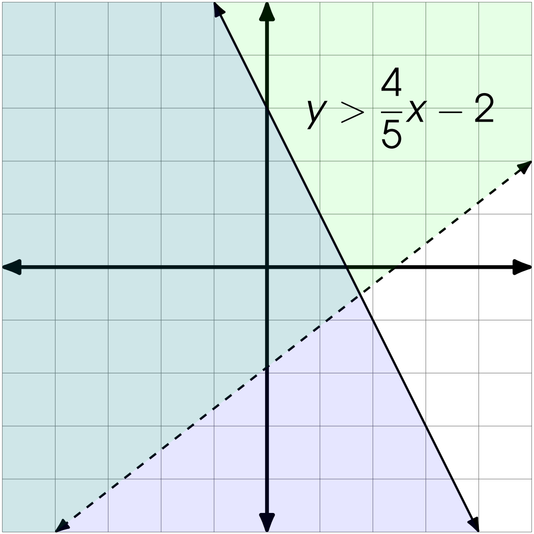

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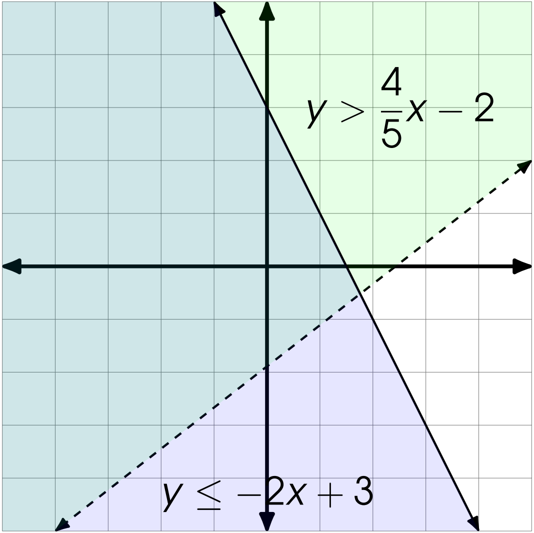

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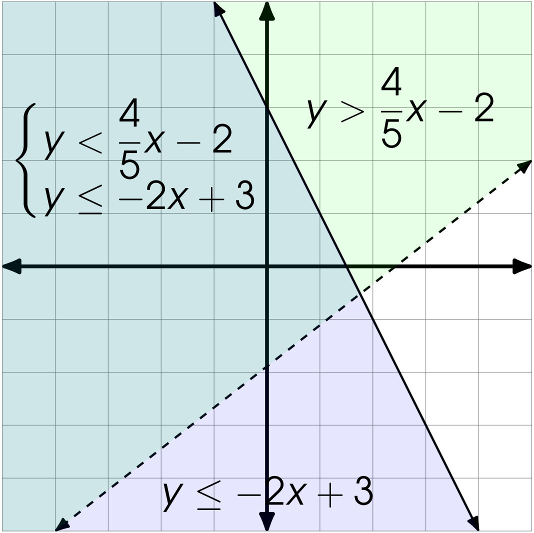
$\begin{cases} y < \frac{4}{5}x - 2 \\ y \leq -2x + 3 \end{cases}$
$y > \frac{4}{5}x - 2$
$y \leq -2x + 3$

What is a Solution of a System of Linear Inequalities?

The solution of a linear inequality is the ordered pair that is a solution to all inequalities in the system.

How to Check Whether an Ordered Pair is a Solution to a System of Linear Inequalities?

1. Replace x and y with the given values in both inequalities.

How to Check Whether an Ordered Pair is a Solution to a System of Linear Inequalities?

1. Replace x and y with the given values in both inequalities.
2. Simplify. Check if the ordered pair satisfies both inequalities.

Example 1

Is the ordered pair (2, 1) a solution to the system $\begin{cases} x - y \leq 1 \\ x + y < 4 \end{cases}$?

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Step 1: Replace x and y with the given values in both inequalities.

Given: $x = 2,$

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$x - y \leq 1$

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$x - y \leq 1$

$2 - 1 \leq 1$

Example 1

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x - y \leq 1$

$2 - 1 \leq 1$ Substitution Property

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Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x - y \leq 1$

$2 - 1 \leq 1$ Substitution Property

$1 \leq 1$

Example 1

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x - y \leq 1$

$2 - 1 \leq 1$ Substitution Property

$1 \leq 1$ Simplification

Example 1

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x - y \leq 1$

$2 - 1 \leq 1$ Substitution Property

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$\therefore$ the ordered pair (2, 1) satisfies the inequality $x - y \leq 1$.

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Given: $x = 2, \quad y = 1$

$x + y < 4$

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$x + y < 4$

$2 + 1 < 4$ Substitution Property

Example 1

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x + y < 4$

$2 + 1 < 4$ Substitution Property

$3 < 4$

Example 1

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = 1$

$x + y < 4$

$2 + 1 < 4$ Substitution Property

$3 < 4$ Simplification

$\therefore$ the ordered pair (2, 1) satisfies the inequality $x + y < 4$.

Example 1

$\therefore$ since the ordered pair $(2, 1)$ satisfies both the inequalities $x - y \leq 1$ and $x + y < 4$, it is a solution to the system $\begin{cases} x - y \leq 1 \\ x + y < 4 \end{cases}$.

Example 2

Is the ordered pair $(-1, 1)$ a solution to the system $\begin{cases} x & \geq -y \\ 2x + y > 1 \end{cases}$?

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Given: $x = -1$,

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$x \geq -y$

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Given: $x = -1, \quad y = 1$

$x \geq -y$

$-1 \geq -(1)$

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$-1 \geq -(1)$ Substitution Property

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$-1 \geq -(1)$ Substitution Property

$-1 \geq -1$ Simplification

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Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = -1, \quad y = 1$

$x \geq -y$

$-1 \geq -(1)$ Substitution Property

$-1 \geq -1$ Simplification

$\therefore$ the ordered pair $(-1, 1)$ satisfies the inequality $x \geq -y$.

Example 2

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$2x + y > 1$

$2(-1) + 1 > 1$

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Given: $x = -1, \quad y = 1$

$2x + y > 1$

$2(-1) + 1 > 1$ Substitution Property

$-1 > 1$ Simplification

Example 2

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = -1, \quad y = 1$

$2x + y > 1$

$2(-1) + 1 > 1$ Substitution Property

$-1 > 1$ Simplification

$\therefore$ the ordered pair $(-1, 1)$ does not satisfy the inequality $2x + y > 1$.

Example 2

$\therefore$ since the ordered pair $(-1, 1)$ does not satisfy the inequality $2x + y > 1$, it is not a solution to the system $\begin{cases} x & \geq -y \\ 2x + y > 1 \end{cases}$.

Example 3

Is the ordered pair $(2, -1)$ a solution to the system $\begin{cases} x - 2y \leq 4 \\ x + 2y \geq 0 \end{cases}$?

Example 3

Step 1: Replace x and y with the given values in both inequalities.

Given: $x = 2$,

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Given: $x = 2, \quad y = -1$

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Given: $x = 2, \quad y = -1$

$x - 2y \leq 4$

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Given: $x = 2, \quad y = -1$

$x - 2y \leq 4$

$2 - 2(-1) \leq 4$

Example 3

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = -1$

$x - 2y \leq 4$

$2 - 2(-1) \leq 4$ Substitution Property

Example 3

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = -1$

$x - 2y \leq 4$

$2 - 2(-1) \leq 4$ Substitution Property

$4 \leq 4$

Example 3

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = -1$

$x - 2y \leq 4$

$2 - 2(-1) \leq 4$ Substitution Property

$4 \leq 4$ Simplification

$\therefore$ the ordered pair $(2, -1)$ satisfies the inequality $x - 2y \leq 4$.

Example 3

Step 1: Replace x and y with the given values in both inequalities.

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$x + 2y \geq 0$

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Given: $x = 2, \quad y = -1$

$x + 2y \geq 0$

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Given: $x = 2, \quad y = -1$

$x + 2y \geq 0$

$2 + 2(-1) \geq 0$ Substitution Property

$0 \geq 0$

Example 3

Step 2: Simplify. Check if the ordered pair satisfies both inequalities.

Given: $x = 2, \quad y = -1$

$x + 2y \geq 0$

$2 + 2(-1) \geq 0$ Substitution Property

$0 \geq 0$ Simplification

$\therefore$ the ordered pair $(2, -1)$ satisfies the inequality $x + 2y \geq 0$.

Example 3

$\therefore$ since the ordered pair $(2, -1)$ satisfies both the inequalities $x - 2y \leq 4$ and $x + 2y \geq 0$, it is a solution to the system $\begin{cases} x - 2y \leq 4 \\ x + 2y \geq 0 \end{cases}$.

Thank you for watching.