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3-3 Study Guide and Intervention

Solving Systems of Inequalities by Graphing

Systems of Inequalities To solve a system of inequalities, graph the inequalities in the same coordinate plane. The solution of the system is the region shaded for all of the inequalities.

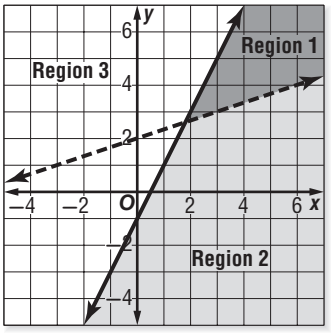
Example **Solve the system of inequalities.**

$y \leq 2x - 1$ and $y > \frac{x}{3} + 2$

The solution of $y \leq 2x - 1$ is Regions 1 and 2.

The solution of $y > \frac{x}{3} + 2$ is Regions 1 and 3.

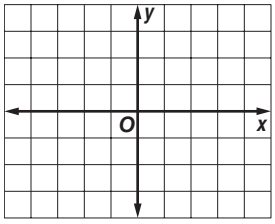
The intersection of these regions is Region 1, which is the solution set of the system of inequalities.



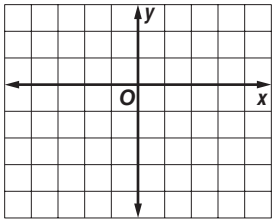
Exercises

Solve each system of inequalities by graphing.

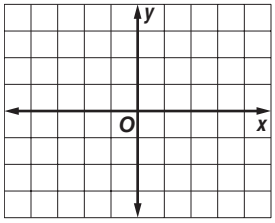
1. $x - y \leq 2$
$x + 2y \geq 1$



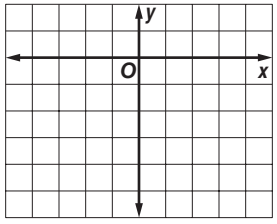
2. $3x - 2y \leq -1$
$x + 4y \geq -12$



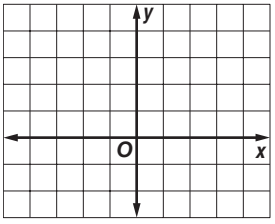
3. $|y| \leq 1$
$x > 2$



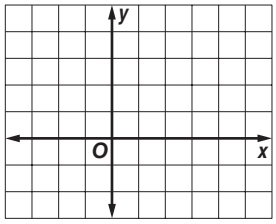
4. $y \geq \frac{x}{2} - 3$
$y < 2x$



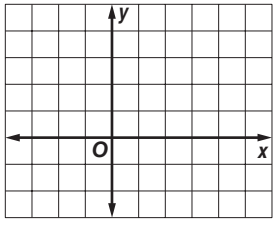
5. $y < \frac{x}{3} + 2$
$y < -2x + 1$



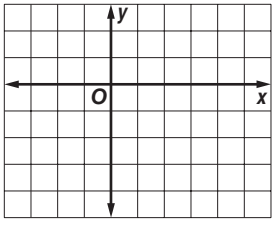
6. $y \geq -\frac{x}{4} + 1$
$y < 3x - 1$



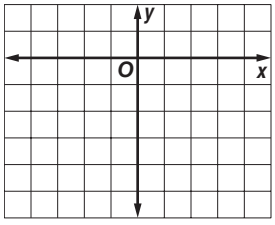
7. $x + y \geq 4$
$2x - y > 2$



8. $x + 3y < 3$
$x - 2y \geq 4$



9. $x - 2y > 6$
$x + 4y < -4$



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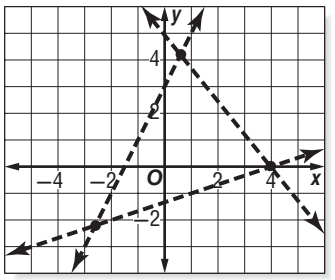
3-3 Study Guide and Intervention *(continued)*

Solving Systems of Inequalities by Graphing

Find Vertices of an Enclosed Region Sometimes the graph of a system of inequalities produces an enclosed region in the form of a polygon. You can find the vertices of the region by a combination of the methods used earlier in this chapter: graphing, substitution, and/or elimination.

Example **Find the coordinates of the vertices of the triangle formed by $5x + 4y < 20$, $y < 2x + 3$, and $x - 3y < 4$.**



Graph each inequality. The intersections of the boundary lines are the vertices of a triangle.

The vertex (4, 0) can be determined from the graph. To find the coordinates of the second and third vertices, solve the two systems of equations

$$\begin{aligned} y &= 2x + 3 \\ 5x + 4y &= 20 \end{aligned} \quad \text{and} \quad \begin{aligned} y &= 2x + 3 \\ x - 3y &= 4 \end{aligned}$$

For the first system of equations, rewrite the first equation in standard form as $2x - y = -3$. Then multiply that equation by 4 and add to the second equation.

$$\begin{array}{rl} 2x - y = -3 & \text{Multiply by 4.} \\ 5x + 4y = 20 & \end{array} \qquad \begin{array}{rrr} 8x - 4y &= & -12 \\ (+)\ 5x + 4y &= & 20 \\ \hline 13x & = & 8 \\ x & = & \frac{8}{13} \end{array}$$

Then substitute $x = \frac{8}{13}$ in one of the original equations and solve for y.

$$\begin{aligned} 2\left(\frac{8}{13}\right) - y &= -3 \\ \frac{16}{13} - y &= -3 \\ y &= \frac{55}{13} \end{aligned}$$

The coordinates of the second vertex are $\left(\frac{8}{13}, 4\frac{3}{13}\right)$.

For the second system of equations, use substitution. Substitute 2x + 3 for y in the second equation to get

$$\begin{aligned} x - 3(2x + 3) &= 4 \\ x - 6x - 9 &= 4 \\ -5x &= 13 \\ x &= -\frac{13}{5} \end{aligned}$$

Then substitute $x = -\frac{13}{5}$ in the first equation to solve for y.

$$y = 2\left(-\frac{13}{5}\right) + 3$$

$$y = -\frac{26}{5} + 3$$

$$y = -\frac{11}{5}$$

The coordinates of the third vertex are $\left(-2\frac{3}{5}, -2\frac{1}{5}\right)$.

Thus, the coordinates of the three vertices are (4, 0), $\left(\frac{8}{13}, 4\frac{3}{13}\right)$ and $\left(-2\frac{3}{5}, -2\frac{1}{5}\right)$.

Exercises

Find the coordinates of the vertices of the triangle formed by each system of inequalities.

1. $y \leq -3x + 7$
$y < \frac{1}{2}x$
$y > -2$

2. $x > -3$
$y < -\frac{1}{3}x + 3$
$y > x - 1$

3. $y < -\frac{1}{2}x + 3$
$y > \frac{1}{2}x + 1$
$y < 3x + 10$