Section 5.3 – Graphing Linear Inequalities in Two Variables

This Booklet Belongs to: _____ **Block:** _____

- The solution of a **linear inequality** is **a section of the coordinate plane** that takes up half of it
- We have to graph the inequality like we would a regular linear equation
- Then when we replace the inequality sign we can determine what side of the line to shade

Graphing a Linear Inequality – The EASY way

Step 1: Graph the linear inequality equation. Use a **solid line for** $\leq$ ***or*** $\geq$**,** and a **dashed line for** $<$ ***or*** $>$

Step 2: We can use either of the equation we have learned to graph the inequality

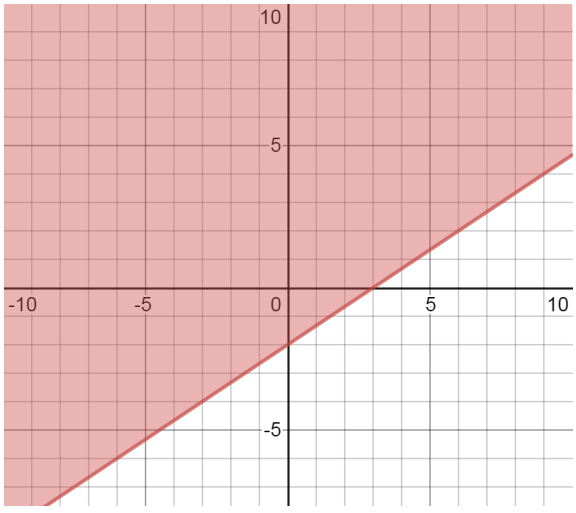
Method 1: $(Ax + By \leq C \text{ or } Ax + By > C)$

Choose a test point **not** on the line and substitute the point into the equation. If the inequality stays true, shade the region including that point. If not true, shade the other region

Method 2: $(y < mx + b \text{ or } y \geq mx + b)$

Look at the inequality equation; if $y \text{ is greater than or equal too}$, graph the upper half of the grid, if $y \text{ is less than}$, graph the lower half.

Example 1: $2x - 3y \leq 6$ or $y \geq \frac{2}{3}x - 2$



Solution 1:

Step 1: Graph the linear equation $2x - 3y = 6$.

Since the inequality $\leq$ includes 'equals', use a solid line

Step 2: **Method 1:**

Test point (0, 0)

$2x - 3y \leq 6$
$2(0) - 3(0) \leq 6$
$0 \leq 6$ True Statement
So, SHADE IN the region with (0, 0)

Method 2: Equation $y \geq \frac{2}{3}x - 2 \text{ is } \geq$, So, shade upper half

Solve Systems of Linear Inequalities

- Steps to follow here are the same as one linear inequality
- The only difference: the solution must be the **intersection of all the inequality equations**
- This is the region where **all points are satisfied** at the same time

Example 1:

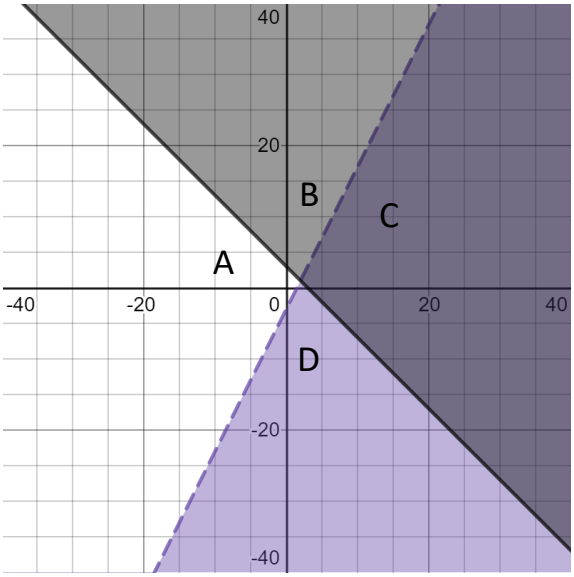
Solve: $2x - y > 3$
$x + y \geq 3$

$2x - y = 3$		$x + y = 3$	
x	y	x	y
0	-3	0	3
1.5	0	3	0
3	3	-2	5

$> \textit{ has a dashed line}$ $\geq \textit{ has a solid line}$

Solution 1: Graph both lines, then test points

Test Point $(0, 0)$ from region A		Test Point $(2, 4)$ from region B	
$2x - y > 3$	NO	$2x - y > 3$	NO
$x + y \geq 3$	NO	$x + y \geq 3$	YES
Test Point $(5, 1)$ from region C		Test Point $(2, -3)$ from region D	
$2x - y > 3$	YES	$2x - y > 3$	YES
$x + y \geq 3$	YES	$x + y \geq 3$	NO



- The only region with a test point that satisfies both inequalities is:

REGION C (SHADE IT IN)

Example 2:

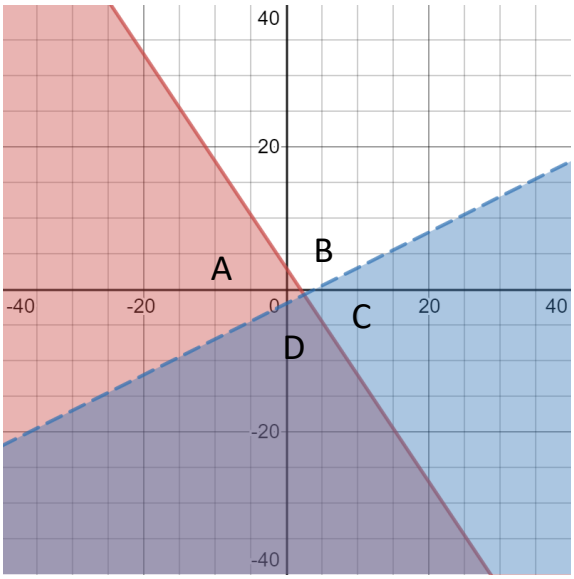
Solve: $3x + 2y \leq 6$
$x - 2y > 4$

$3x + 2y = 6$		$x - 2y = 4$	
x	y	x	y
0	3	0	-2
2	0	4	0
4	-3	-4	-4

$\leq$ *has a solid line* $>$ *has a dashed line*

Solution 2:

Test Point $(0, 0)$ from region A		Test Point $(2, 4)$ from region B	
$3x + 2y \leq 6$	YES	$3x + 2y \leq 6$	NO
$x - 2y > 4$	NO	$x - 2y > 4$	NO
Test Point $(5, -1)$ from region C		Test Point $(2, -3)$ from region D	
$3x + 2y \leq 6$	NO	$3x + 2y \leq 6$	YES
$x - 2y > 4$	YES	$x - 2y > 4$	YES



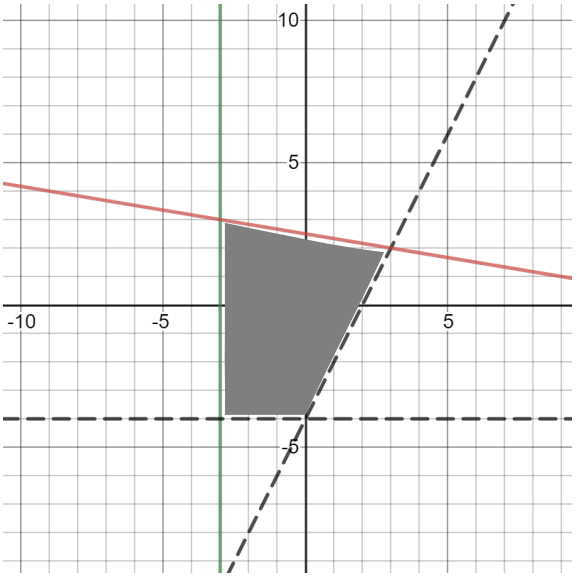
- The only region with a test point that satisfies both inequalities is: **REGION D (SHADE IT IN)**

- The algebra and elimination steps were not included in the notes
- With the test point, remember to plug into the equation for the given (x, y)

Example 3:

Graph the system of linear inequalities:

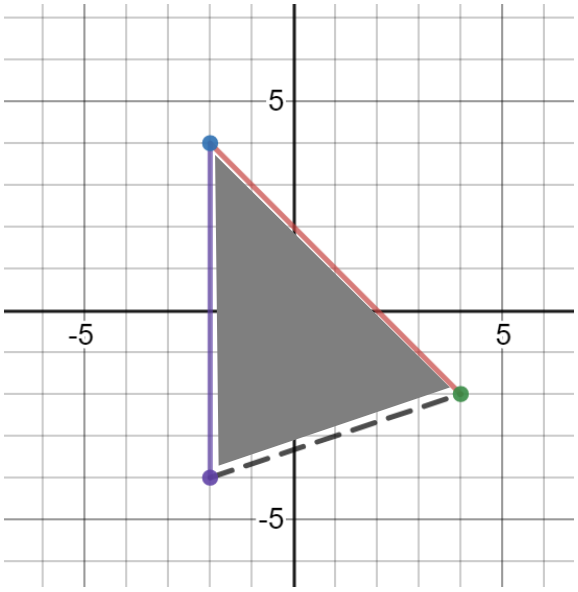
$x \geq -3$
$y \geq -4$
$y > 2x - 4$
$x + 6y \leq 15$



Solution 3:

- For $x \geq 3$ graph solid line $x = 3$, then shade to right
- For $y > -4$ graph line $y = -4$ then shade up
- For $y > 2x - 4$ graph a dashed line $y = 2x - 4$, then shade up
- For $x + 6y \leq 15$ graph a solid line $y \leq -\frac{1}{6}x + \frac{5}{2}$, then shade down

Example 4: Write a system of linear inequalities that has the given graph



Solution 4:

Points of Intersect are: $A\ (-2, 4), B\ (-2, -4), and\ C\ (4, -2)$

Equation of the vertical line is: $\boldsymbol{x \geq -2}$

Equation of dashed line BC has slope:

$m = \frac{-2-(-4)}{4-(-2)} = \frac{2}{6} = \frac{1}{3}, \qquad y = mx + b,$

Using C $(4, -2)$ $\rightarrow -2 = \frac{1}{3}(4) + b$ $\rightarrow$ $b = -\frac{10}{3}$ $\rightarrow$ $\boldsymbol{y > \frac{1}{3}x - \frac{10}{3}}$

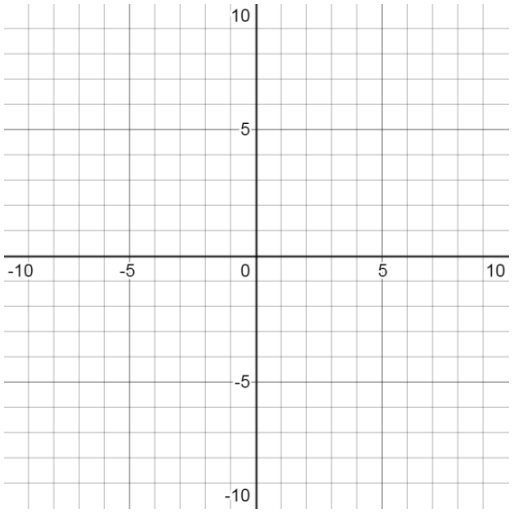
Equation of dashed line AC has slope:

$$m = \frac{4-(-2)}{-2-4} = \frac{6}{-6} = -1, \qquad y - intercept\ is\ (0, 2) \rightarrow \boldsymbol{y \leq -x + 2}$$

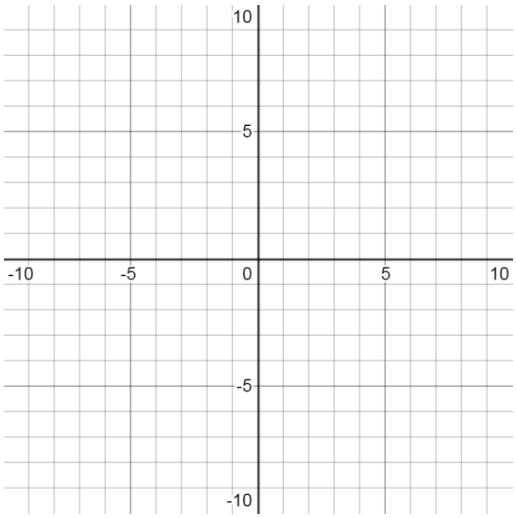
Section 5.3 – Practice Questions

Graph the following inequalities on the grid provided.

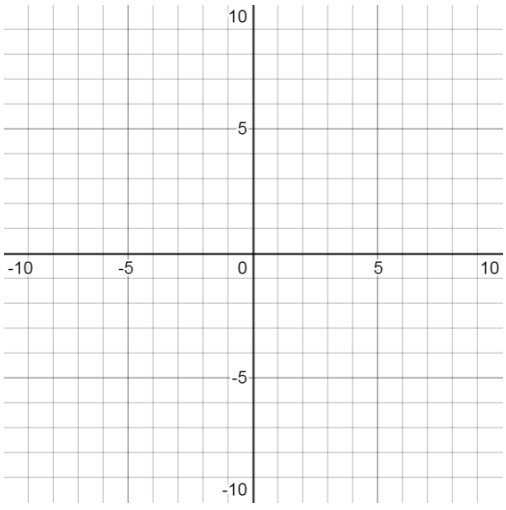
1. $3x + y \geq 6$



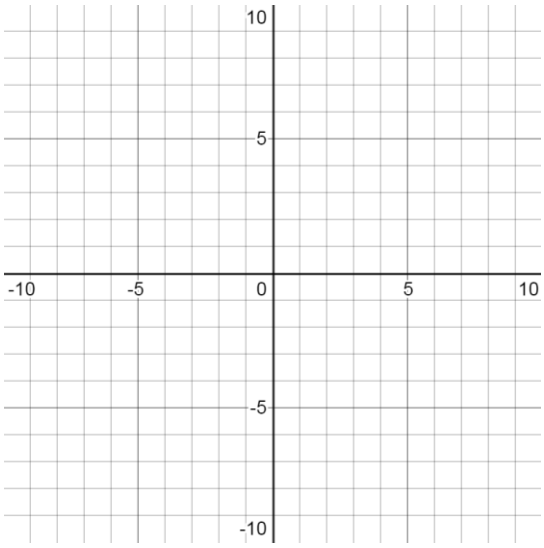
2. $2x - y < 4$



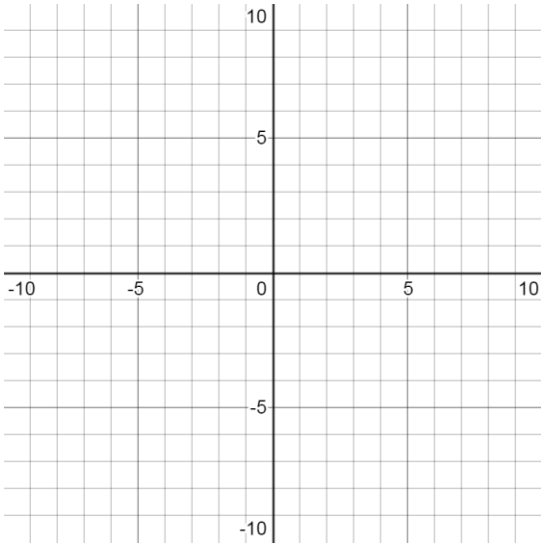
3. $0.4x - \frac{2}{3}y > 2$



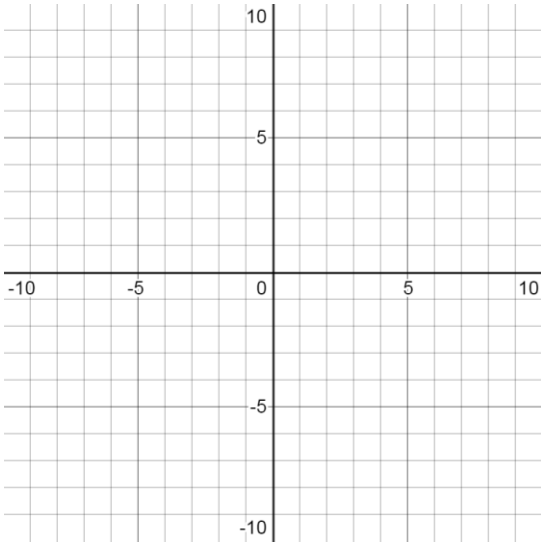
4. $\frac{1}{3}x + \frac{2}{3}y \geq 2$



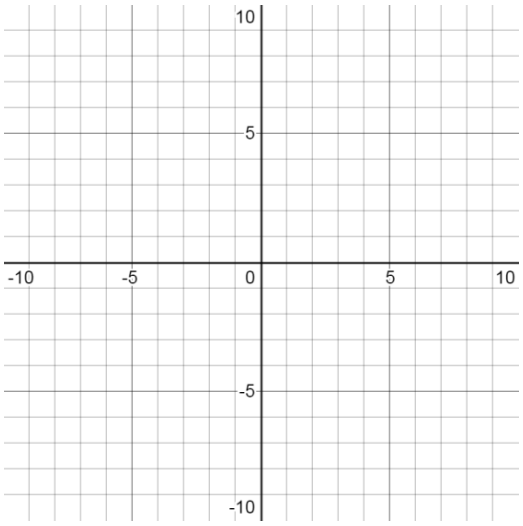
5. $y \geq \frac{1}{2}x + 3$



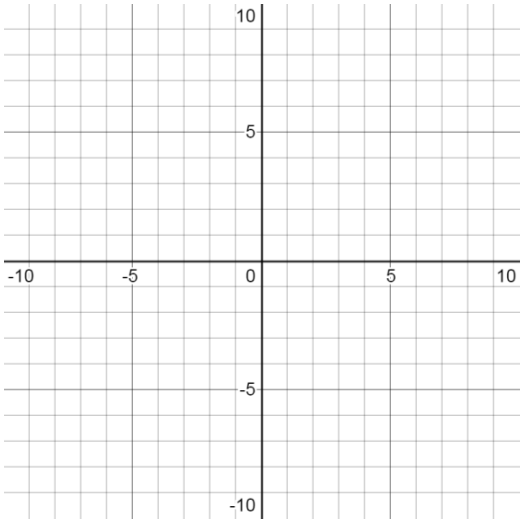
6. $y < -\frac{4}{3}x + 2$



7. $x < 2$

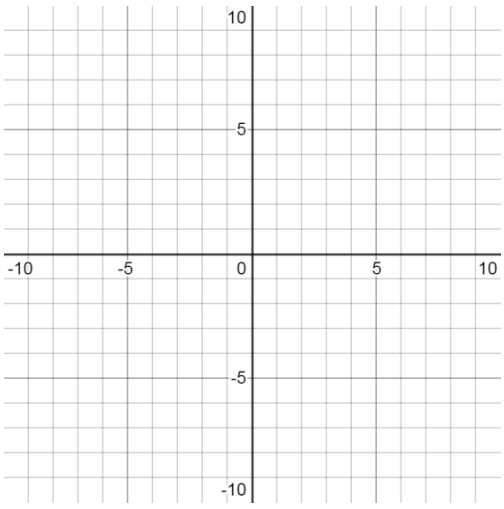


8. $y > -3$

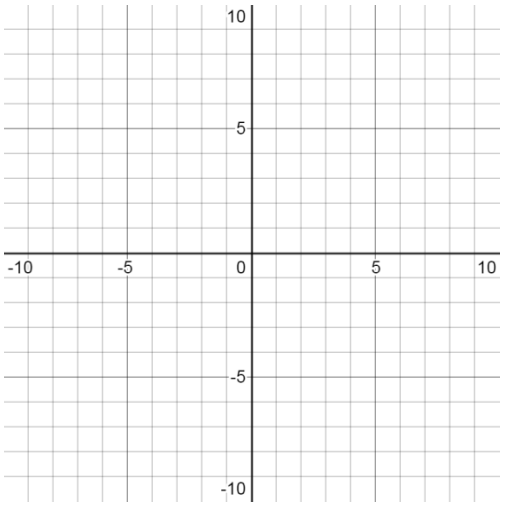


Graph the following inequalities on the grid provided and shade in the solution.

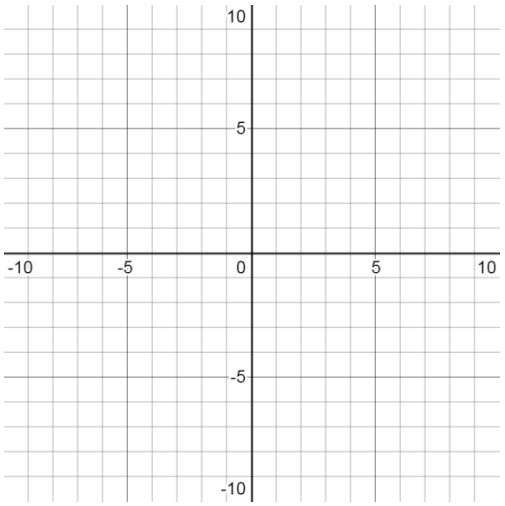
9. $y \geq x$
   $2y < -x + 2$



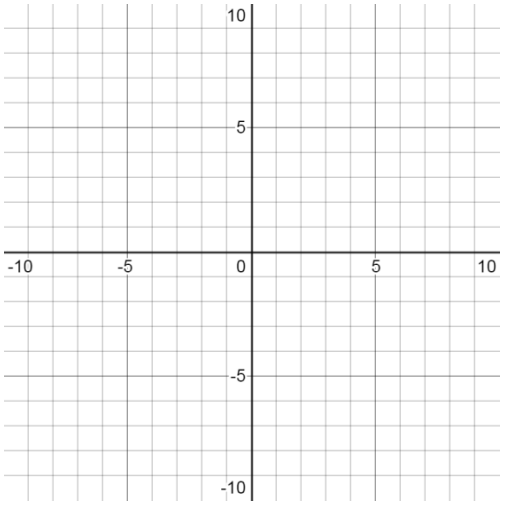
10. $x + 2y > 4$
    $3x - 2y \leq 6$



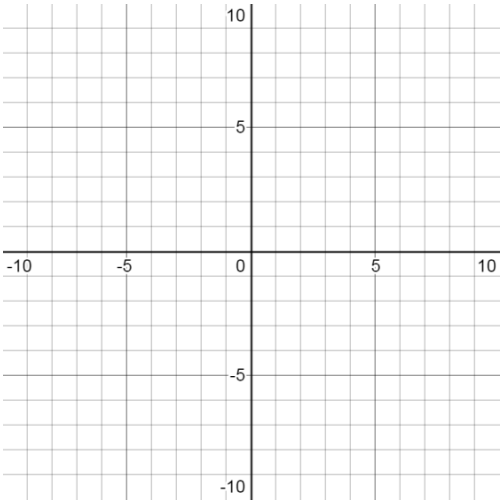
11. $x + y \leq 2$
    $x + y \geq -2$



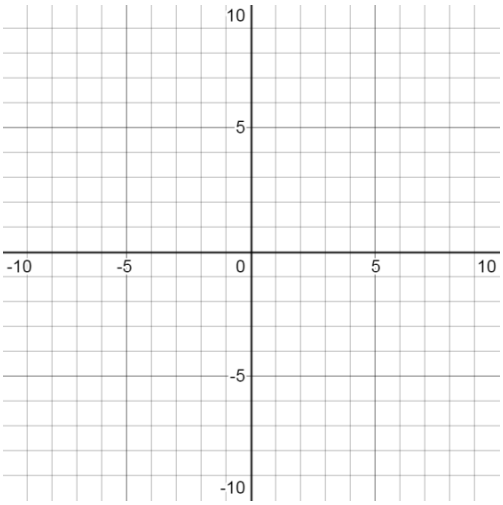
12. $y \leq x + 1$
    $y \geq -x + 1$



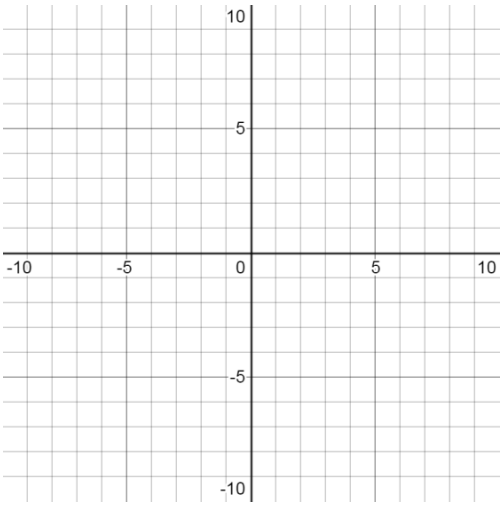
13. $4x + 5y < 20$
$2x - y \leq 4$
$x \geq 0$
$y \geq 0$



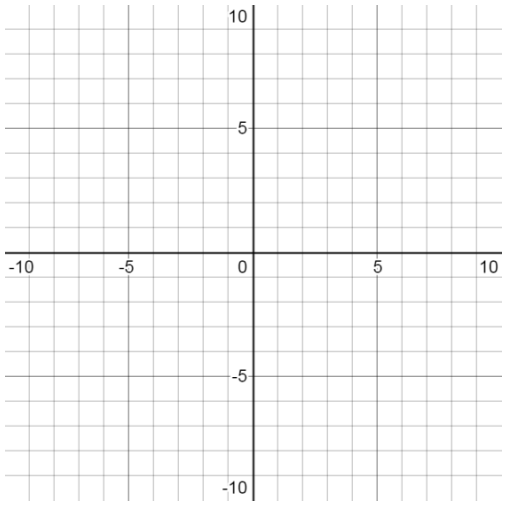
14. $x - y \leq 1$
$x - y \geq -3$
$-1 \leq x \leq 3$



15. $x - y \leq 2$
$x + 2y \leq 4$
$x \leq -1$

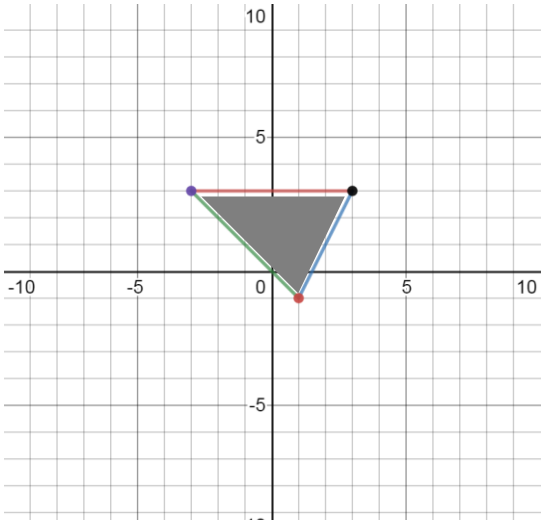


16. $x + y \leq 4$
$2x - y \geq 2$
$x \geq 0$
$y \geq 0$



Write a system of linear inequalities that forms the given graph

17.



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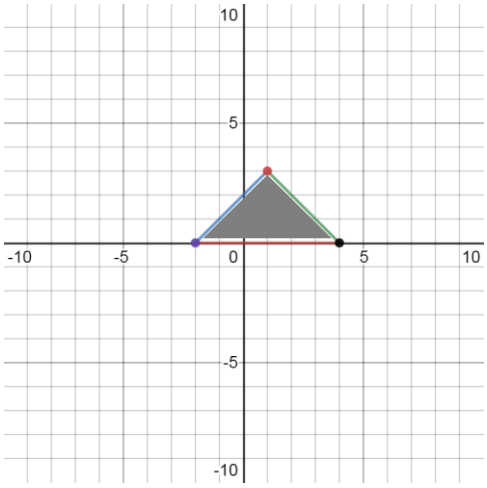

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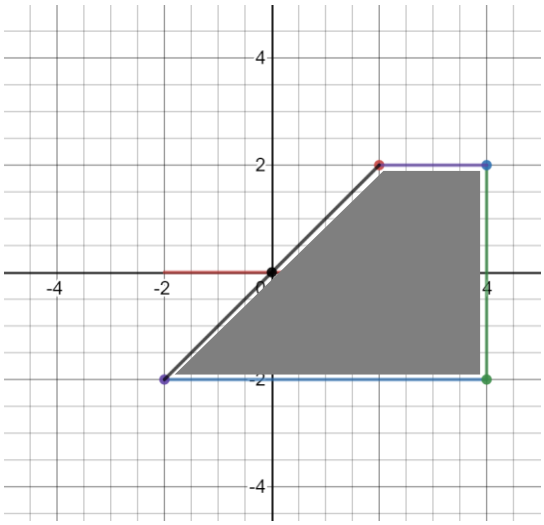

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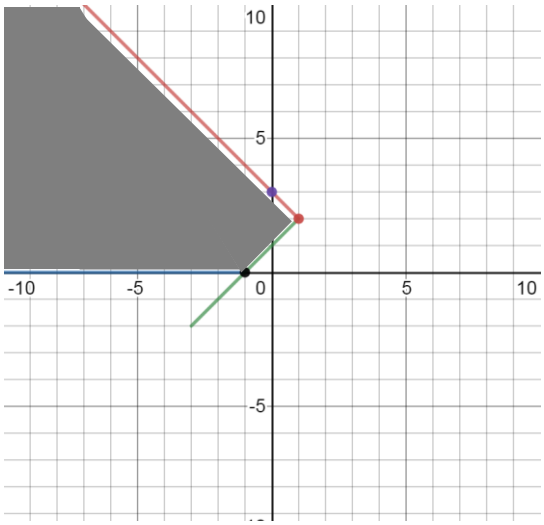

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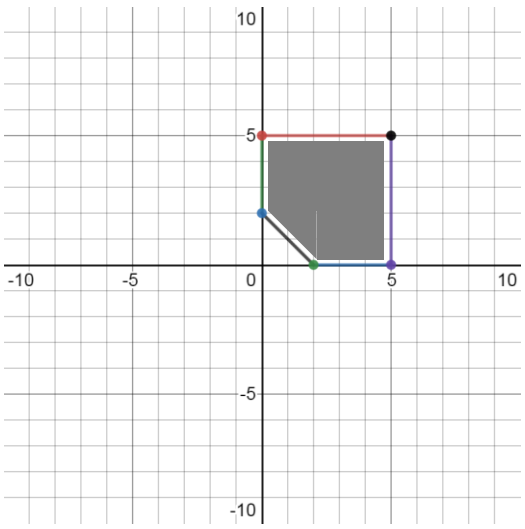

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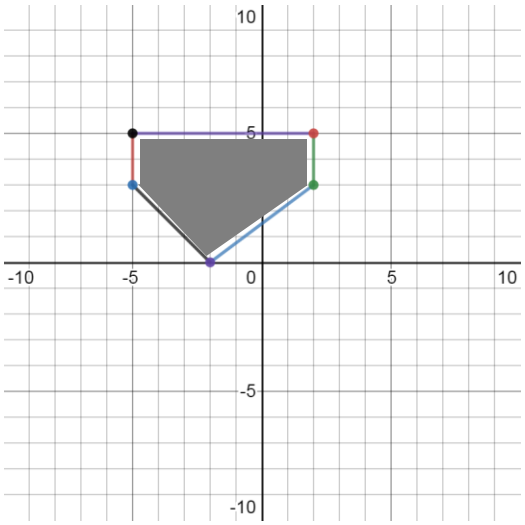

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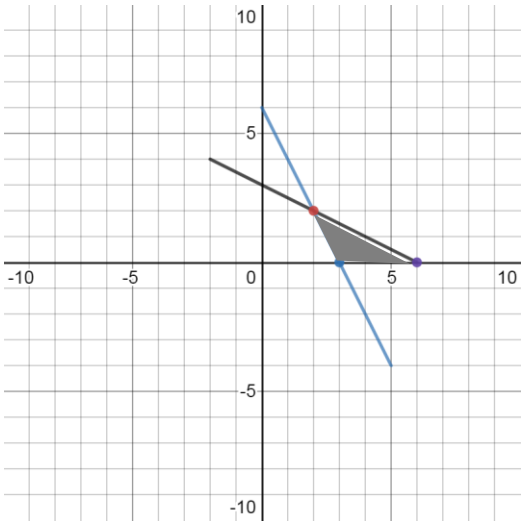

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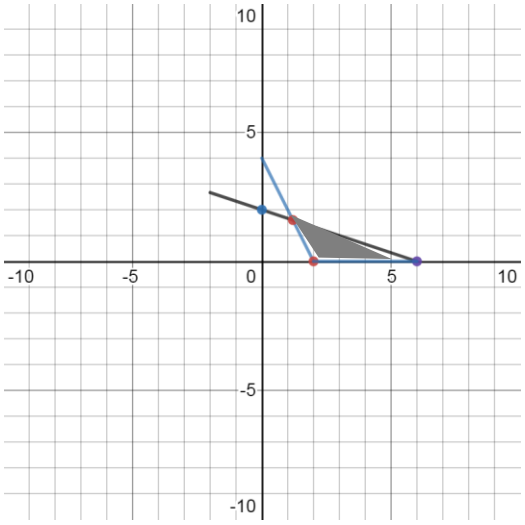

Answer Key – Section 5.3

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3. *See Website*	4. *See Website*
5. *See Website*	6. *See Website*
7. *See Website*	8. *See Website*
9. *See Website*	10. *See Website*
11. *See Website*	12. *See Website*
13. *See Website*	14. *See Website*
15. *See Website*	16. *See Website*
17. $y \leq 3$ $y \geq 2x - 3$ $y \geq -x$	18. $y \leq x + 2$ $y \geq 0$ $y \leq -x + 4$
19. $y \leq x$ $x \leq 4$ $-2 \leq y \leq 2$	20. $y \leq -x + 3$ $y \geq x + 1$ $y \geq 0$
21. $0 \leq y \leq 5$ $y \geq -x + 2$ $0 \leq x \leq 5$	22. $y \leq 5$ $y \geq -x - 2$ $y \geq \frac{3}{4}x + \frac{3}{2}$ $-5 \leq x \leq 2$
23. $y \leq -\frac{1}{2}x + 3$ $y \geq -2x + 6$ $y \geq 0$	24. $y \leq -\frac{1}{3}x + 2$ $y \geq -2x + 4$ $y \geq 0$

Extra Work Space