Solving and Graphing Inequalities

Graphing Simple Inequalities: $x > 3$

When finding the solution for an equation we get one answer for x. (There is only one number that satisfies the equation.) For 3x – 5 = 16, the only solution is x = 7. When we have an inequality to solve (greater than, less than, greater than or equal to, or less than or equal to) **we have a range of numbers that can be a solution**. *In that range there is an* **infinite amount of possible numbers that make the inequality true.**

Example: $x > 3$

We know 4 is greater than 3. So is 5. So is 6. So is 7. Also 3.1 works. So does 3.01 and 3.001. So would 3.12 and 3.13… you start to get the picture that it would be impossible to list all the possible solutions (all the possible numbers that make the inequality "true". Since we cannot list all the answers, we express the solution set by graphing on a number line.

$x > 3$ **$x < 3$**

$x \geq 3$ **$x \leq 3$**

To graph an inequality, you must do two things:

First you must put a circle on the number (in this case, 3).

Second, you must shade to the side of the circle that contains the solution set.

Circle:

$>$ and $<$ get an *open circle*.

$\geq$ and $\leq$ get a *closed circle*.

Shade:

Less than (and $\leq$) → Left (think L, L)

Greater than (and $\geq$) → Right

Graph the inequality:

1) $x < -5$

2) $x \leq 2$

3) $x > 3$

4) $x \geq -1$

Solving and Graphing: Do all the same steps as solving equations to get the x by itself. When the x is by itself, then you can graph the solution set.

5) $3x - 4 < 2$

6) $\frac{1}{2}x - 7 > -8$

7) $2(5x - 3) \geq 14$

8) $8 - 3x \leq 17$

THE ONE DIFFERENCE BETWEEN SOVING EQUATIONS AND INEQUALITIES

When you *multiply or divide on both sides by a negative number, you must turn the inequality around.*

$8 - 3x < 17$
$\underline{-8 \qquad\quad -8}$
$\underline{-3x} < \underline{9}$
$-3 \qquad -3$
$x > -3$

* Dividing both sides by -3, you must turn the inequality around. It changes from < to >.

Solve and Graph:

9) $12 - \frac{2}{3}x > 6$

10) $12x - 6 \geq 14x - 2$

11) $3(5x + 7) \geq 81$

12) $11 > 4x + 31$

13) $7(5 - 8x) \geq 147$

14) $3(4x + 1) < -27$

Solve and Graph:

1) $\frac{3}{5}x + 9 \leq 12$

2) $4(2-3x) < 32$

3) $-172 \leq 7x - 144$

4) $5x - 2 < 7x - 8$

5) $11x - 5 \geq 15x + 3$

6) $8x + 3 > 12x + 13$

7) $24 - (5/6)x \leq 34$

8) $8(11-2x) \leq 24$

9) $10 \geq 8 - \frac{2}{3}x$

10) $5(3x + 1) < -70$

11) $15 - \frac{5}{8}x \geq 10$

12) $24x - 32 < 8(5x - 12)$

Answer Key to pgs. 3 and 4 (1-12):

1) $x \leq 5$	*2)* $x > -2$	*3)* $x \geq -4$
4) $x > 3$	*5)* $x \leq -2$	*6)* $x < -2.5$
7) $x \geq -12$	*8)* $x \geq 4$	*9)* $x \geq -3$
10) $x < -5$	*11)* $x \leq 8$	*12)* $x > 4$

Q4 Quiz 2 Review: Simple Inequalities

1) $12x - 17 > 19$

2) $41 - \frac{3}{4}x \leq 53$

3) $14x - 2 > 20x + 10$

4) $8(5x - 4) - 6(3x + 5) \leq -7$

5) $6(4x - 2) \geq 5(7x + 2)$

6) $16 \leq 5x - 4$

7) $6(6x - 3) + 4(7 - 12x) > 28$

8) $-24 < 26 - \frac{5}{8}x$

9) $8(7x + 5) > 5(4x + 8)$

10) $4(7x + 3) - (16x - 13) > 17$

11) $7(6x - 4) \leq 4(3x - 7)$

12) $(15x - 8) - (19x + 8) \leq -14$

Compound Inequalities

Compound inequalities are problems that have more than one inequality that have to be graphed together. There are two different types we need to understand. AND ($\cap$) problems and OR ($\cup$) problems.

When graphing a compound in equality, graph each inequality separately and then follow the rules for AND and OR problems.

AND:

- both must be true (for the number to be a part of the solution set, it must satisfy both parts of the compound inequality).
- "Graph both and keep the INTERSECTION."

OR:

- one must be true. (If the number satisfies either part of the compound inequality, or both parts, it is part of the solution set).
- "Graph both and leave it alone."

Example:

$x < 2$ and $x \geq -3$

($x < 2$ and $x \leq -3$ can also be written as $-3 \leq x < 2$)

$x \leq -3$ or $x > 4$

Do Now:

1) $3x - 5 > -11 \cap 5 - \frac{1}{2}x \leq 1$

2) $12 - 4x > 20 \cup 5x - 7 \geq 18$

3) $12x - 17 > -17 \cup 12 - \frac{5}{8}x \geq 17$

4) $-12 \leq 7x + 2 < 23$

5) $-3x + 5 > 17 \cap 2x - 5 > 6$

6) $3x - 4 > -7$ or $4 - 11x \leq -51$

Extra Practice:

1) $2x - 5 > 3$ U $11 - 3x \geq -2$

2) $2 < 5x + 7 \leq 32$

3) $10 - 2x > 3 \cap 7 - \frac{1}{4}x \leq 7$

4) $6(3x - 1) < -96$ U $2 \leq 7x - 5$

5) $16 - 5x < 31 \cap 8x - 7 > 1$

6) $11 - \frac{1}{2}x > 9$ U $8x + 6 \geq -6$

7) $26 - 3x < 17 \cap 9x + 7 < -29$

8) $-20 \leq 9x - 2 \leq -20$

9) $\frac{1}{2}x + 11 > 13 \cap 15 - 4x > 23$

10) $11 - \frac{3}{5}x < 8 \ \text{U} \ 11x + 6 \geq 6$

11) $15 - 9x > 42 \cap 7x + 2 < 16$

12) $13 - \frac{2}{3}x \geq 15 \cap 8x - 11 \geq -35$

Graphing Inequalities

When we solved and graphed inequalities with only one variable (ex: $x \geq 3$), we moved on to compound inequalities (AND/OR). We would graph both inequalities on the same number line and decide what to keep based on whether it was an AND or an OR problem. When we graphed linear equations on the coordinate plane we moved on to solving systems of equations graphically.

When we graph inequalities in two variables on the coordinate plane, we do not graph compound inequalities. We move on to solving systems of inequalities. It takes a little from both inequalities with one variable and solving systems graphically.

Graph the Inequality:

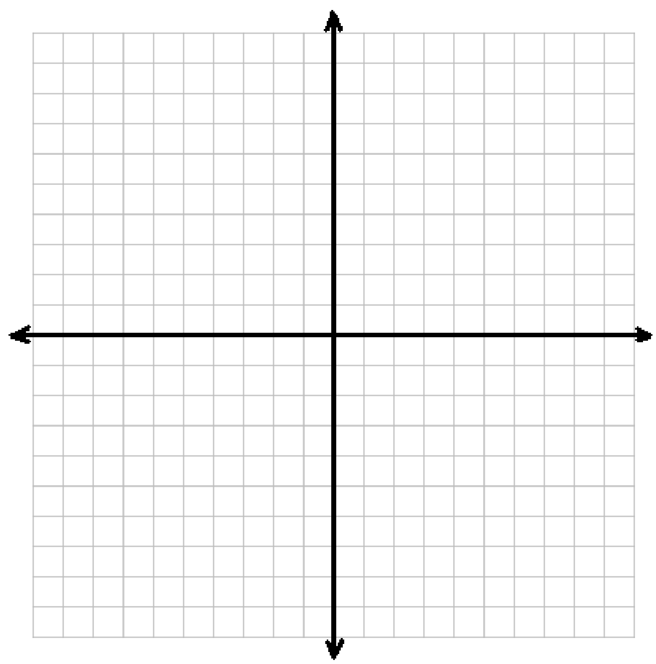
$y > \frac{1}{4}x + 3$

Step 1: Graph the line.

$y > \frac{1}{4}x + 3$

$m = \frac{1}{4} = \frac{\Delta y}{\Delta x} = \frac{\text{up } 1}{\text{r } 4}$

y-int= (0,3)



Step 2: Test a point [we like (0,0)]

(0, 0)

$(0) > \frac{1}{4}(0)+3$

$0 > 3$

FALSE

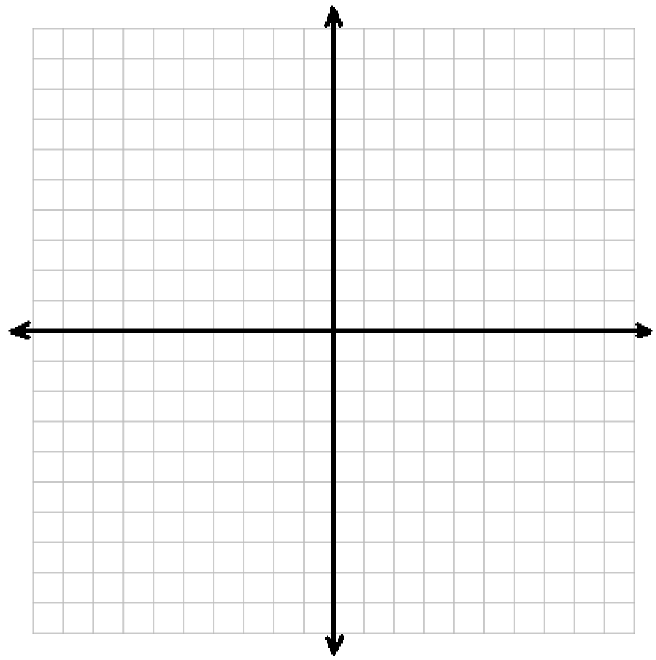
Step 3: Picking which side to "shade":

Since the test for (0,0) came up false, (0,0) is not part of the solution set. So we shade AWAY from (0,0).

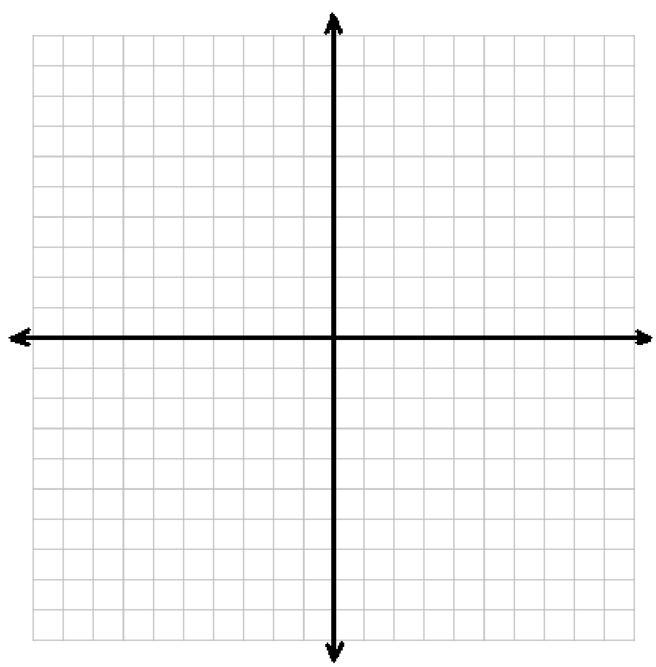
When you "test", you must do it in the original inequality!

When you do step 2 (testing a point) you don't have to use the point (0,0). It usually makes the math easy, though. If the y-intercept is (0,0) you need to pick another point.

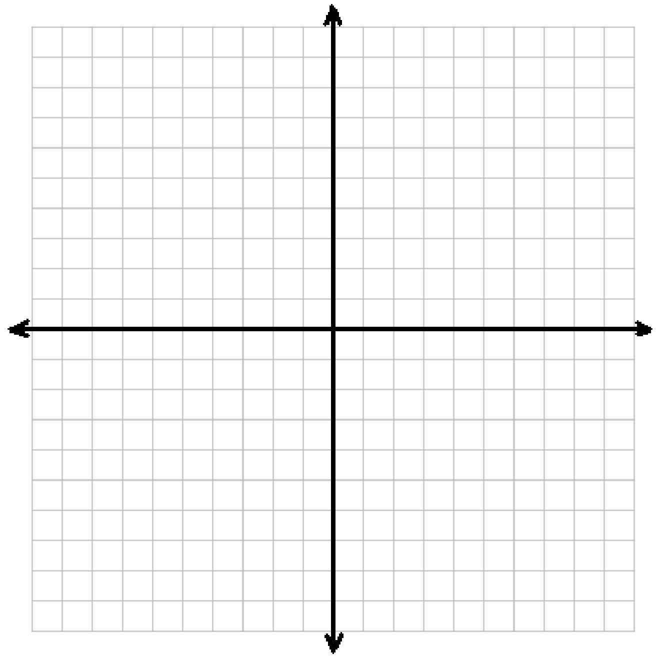
1) $6x - 9y \geq 36$



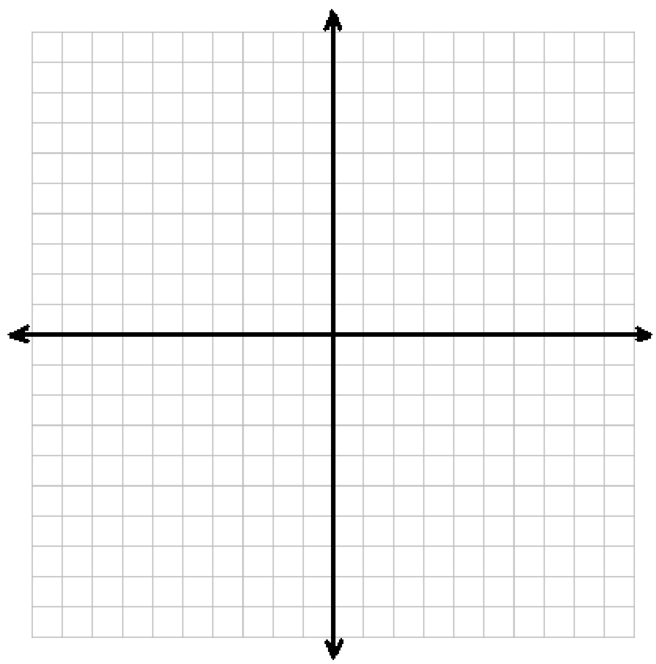
2) $y - 3 > -2(x + 1)$



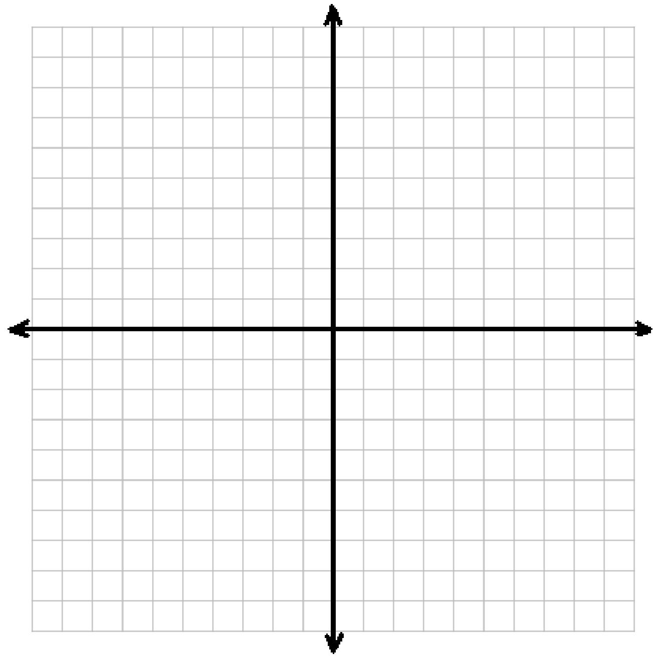
3) $12x + 9y < 27$



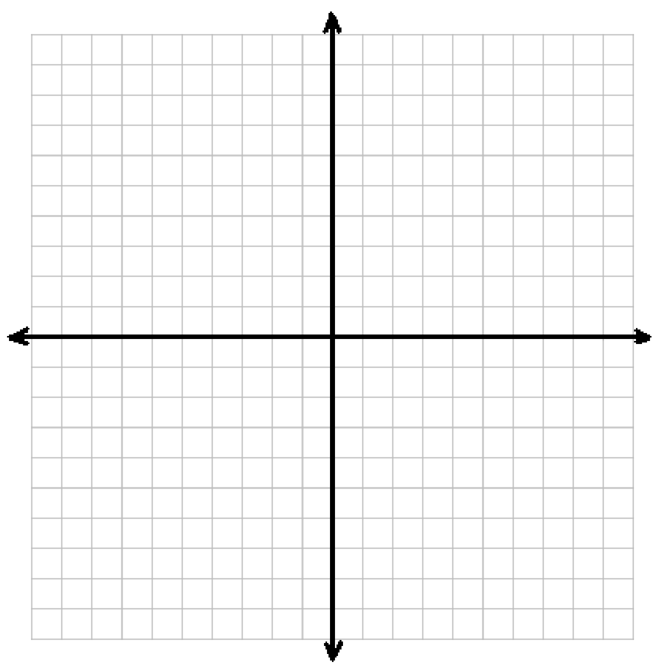
4) $y + 4 \geq -3(x - 3)$



5) $y \geq 4$

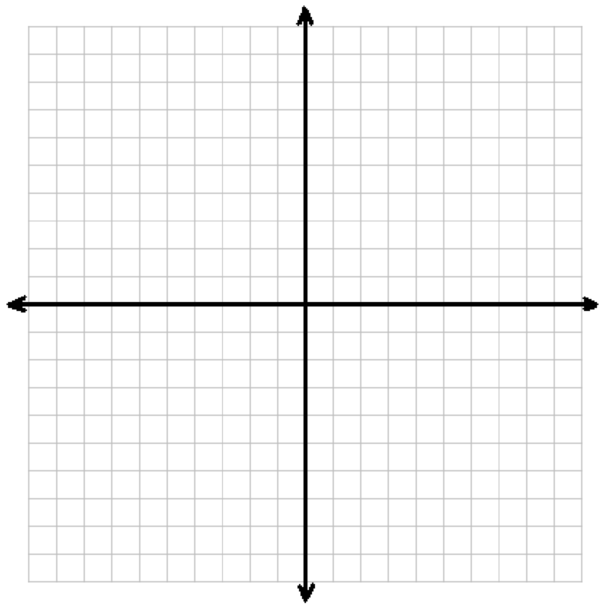


6) $x < -6$

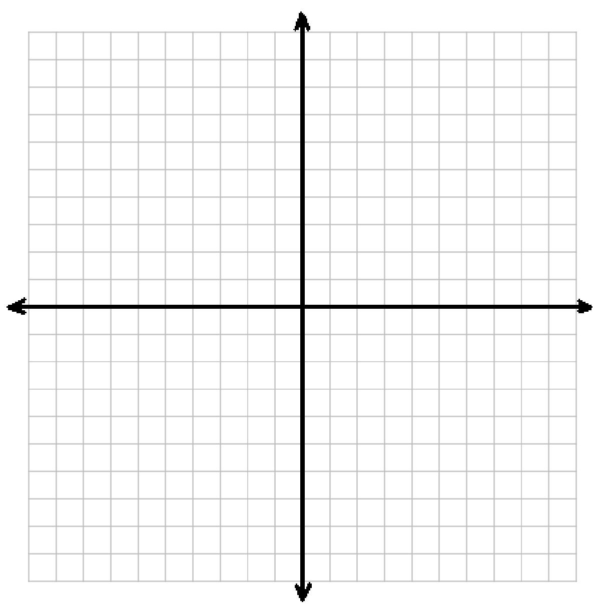


Q4 Quiz 3 Review

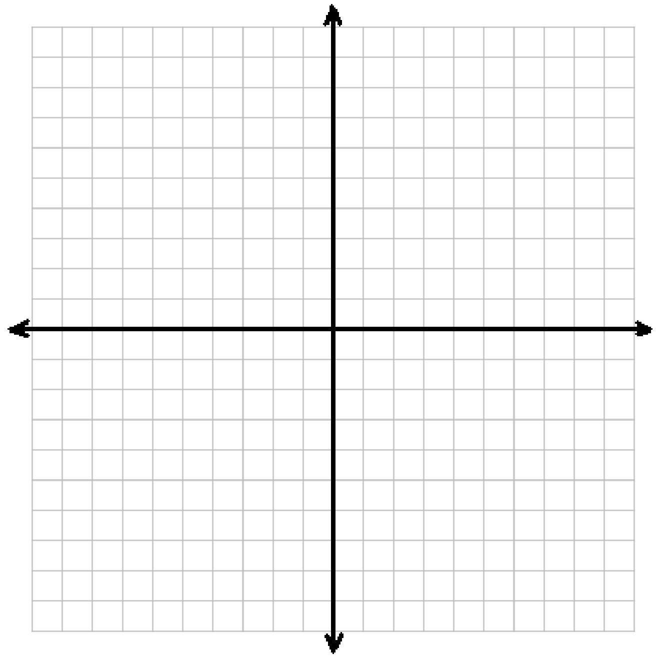
1) $72x - 216y < -432$



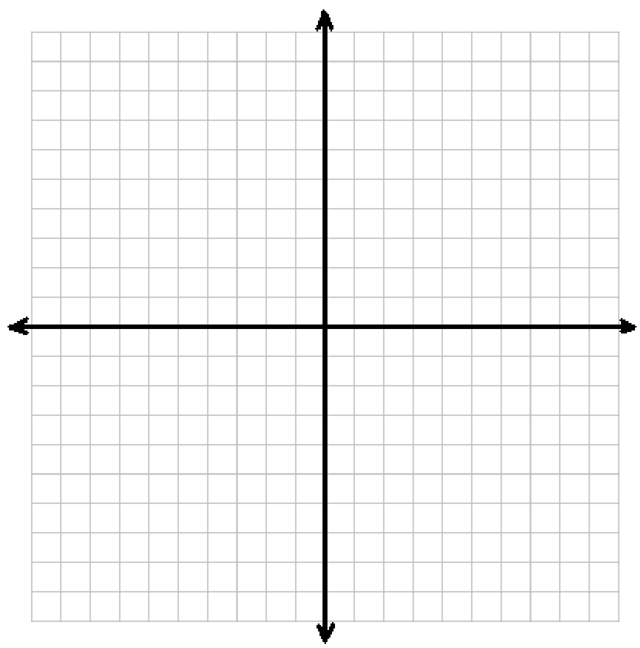
2) $y + 1 \geq \frac{2}{5}(x + 10)$



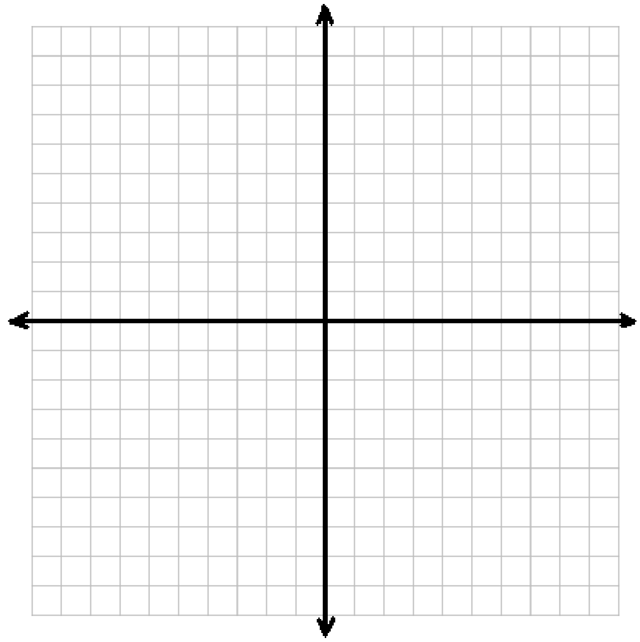
3) $y - 5 < -\frac{1}{2}(x + 10)$



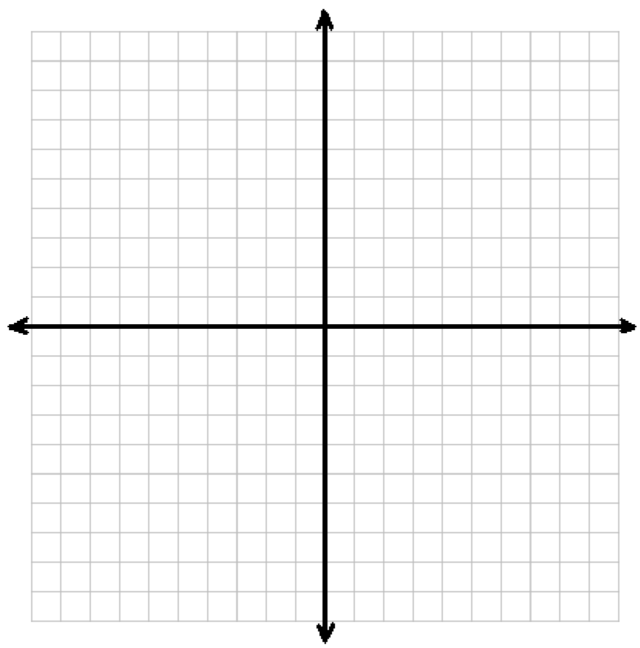
4) $48x + 12y \le -48$



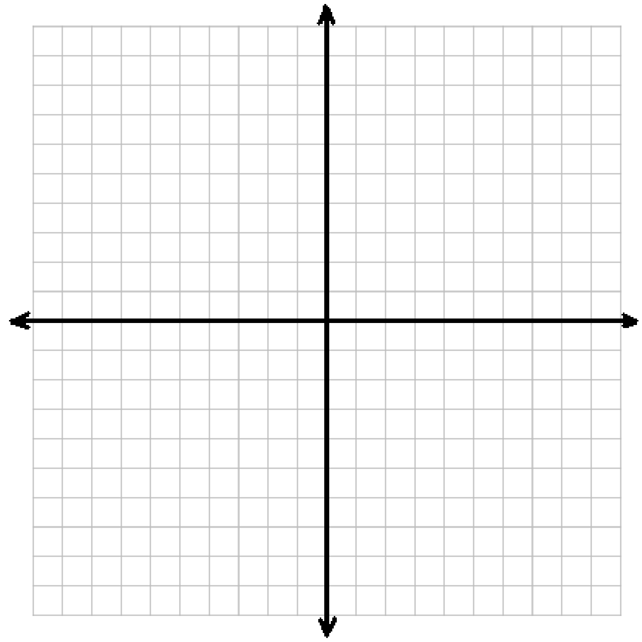
5) $x > 7$



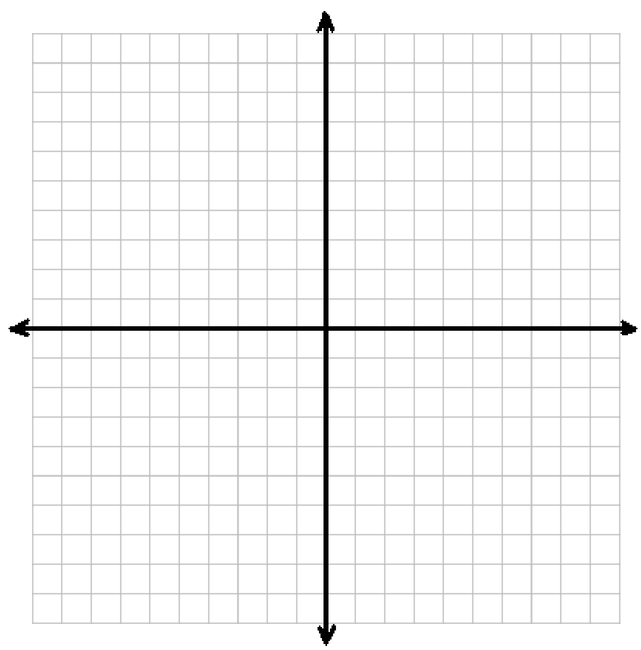
6) $y < -2$



7) x < -4



8) y > 6



Graphing Systems of Inequalities

Solve the system of inequalities graphically: $y > \frac{1}{4}x + 3$
$y \leq 3x - 5$

Step 1: Graph the 1st inequality

$y > \frac{1}{4}x + 3$
$m = \frac{1}{4} =$
y-int= (0,3)

Test (0,0)
$y > \frac{1}{4}x + 3$
$(0) > \frac{1}{4}(0) + 3$
$0 > 0 + 3$
$0 > 3$

False!!

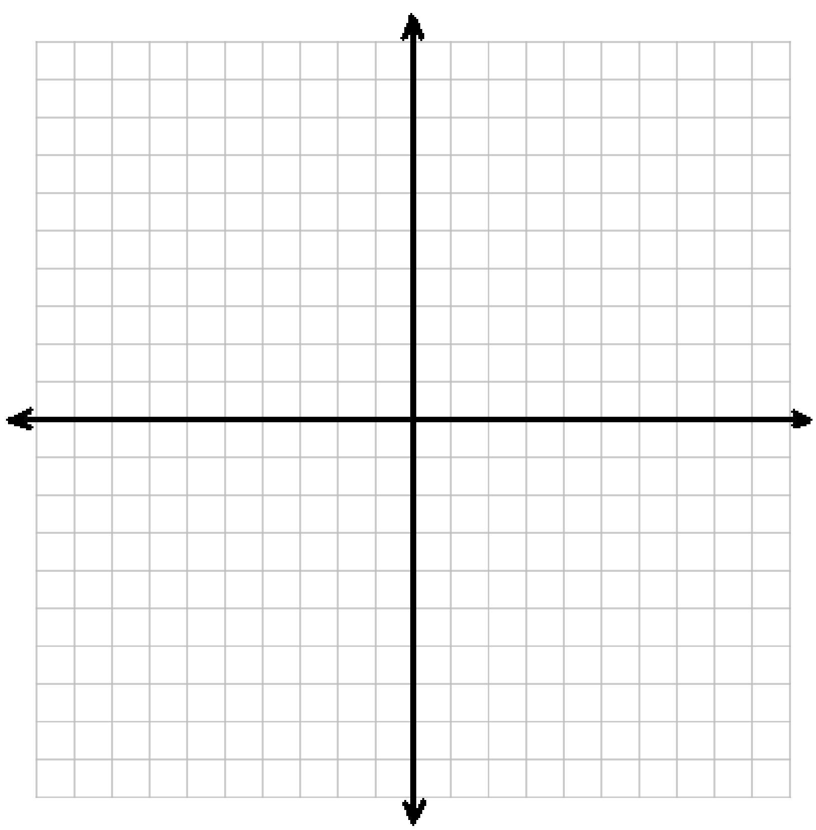
Step 2: Graph the 2nd inequality

$y \leq 3x - 5$
$m = 3/1 =$
y-int.= (0,-5)

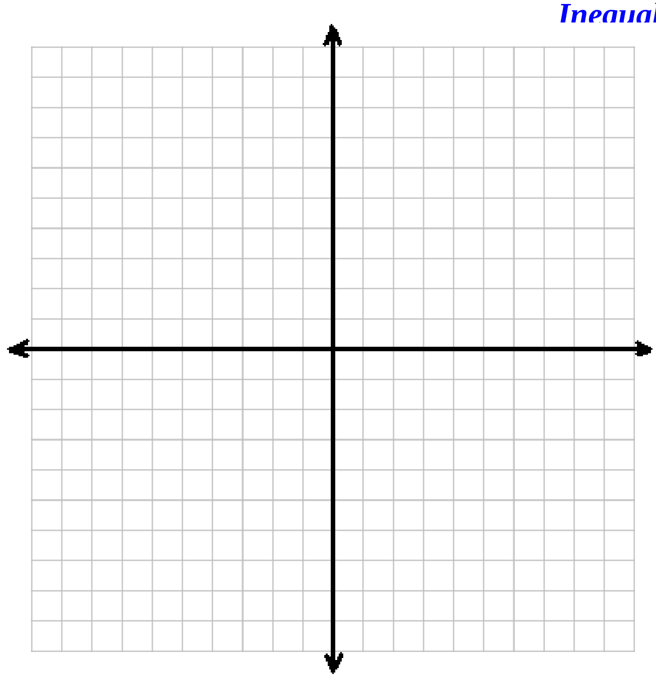
Test (0,0)
$y \leq 3x - 5$
$(0) \leq 3(0) - 5$
$0 \leq 0 - 5$
$0 \leq -5$

False!!

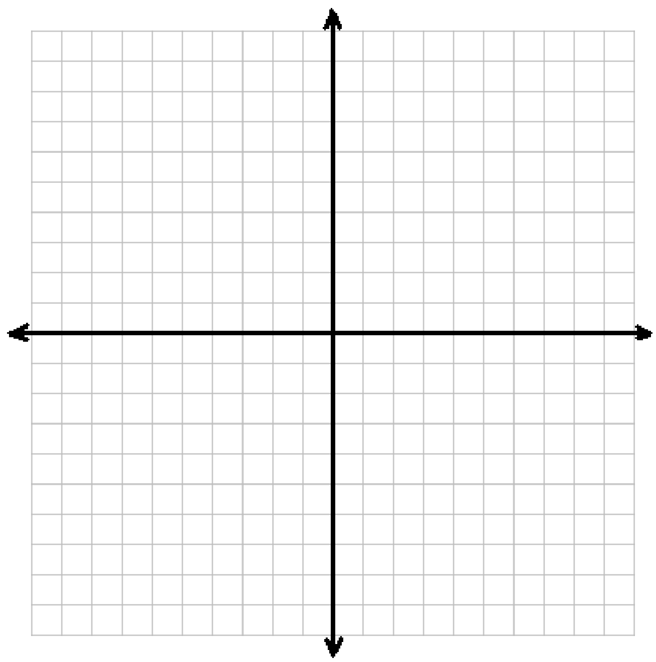
Step 3: Label the area where the shading intersects with an “S”



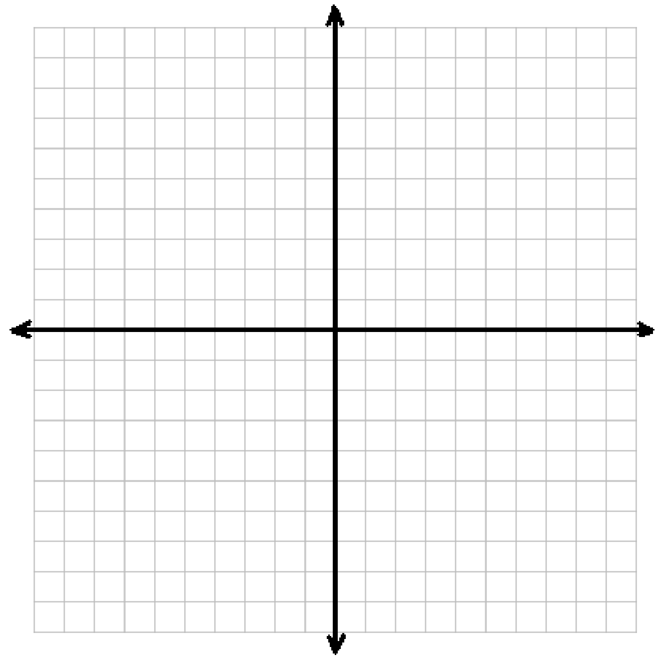
2) $y - 3 < -\frac{1}{3}(x - 6)$
$12x - 6y \geq -12$



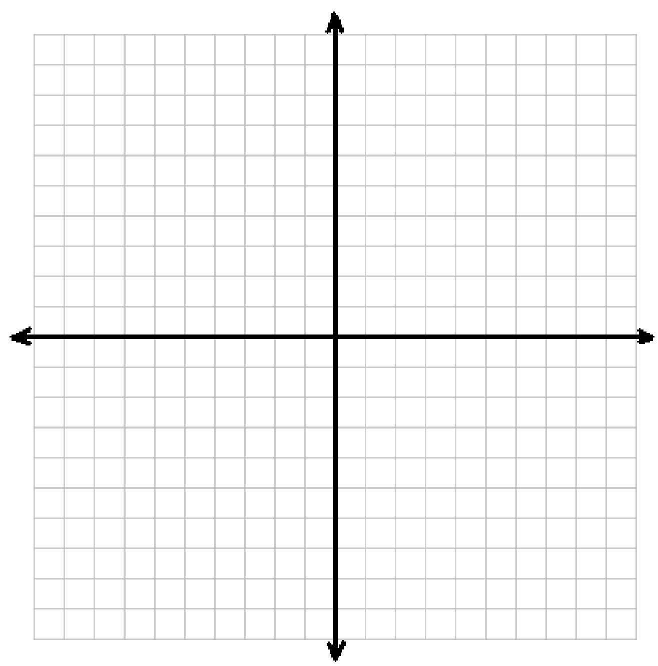
3) $x > 4$
$y \leq -5$



4) $24x + 6y > -6$
$y \geq 2$

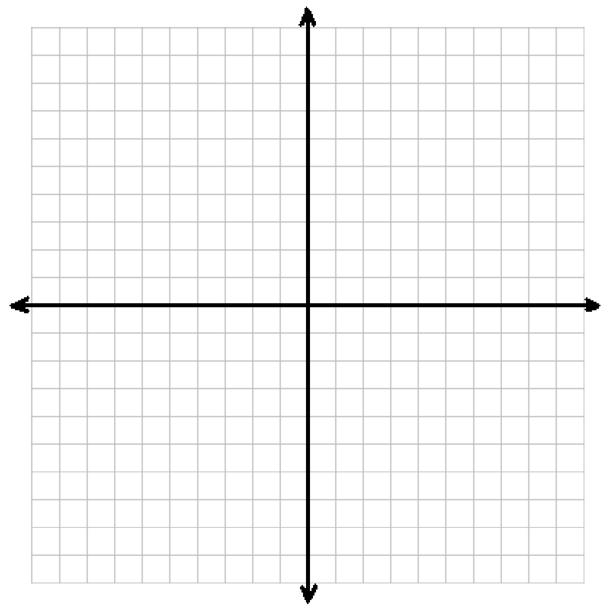


5) $y - 6 < \frac{2}{3}(x - 9)$
$x < -3$

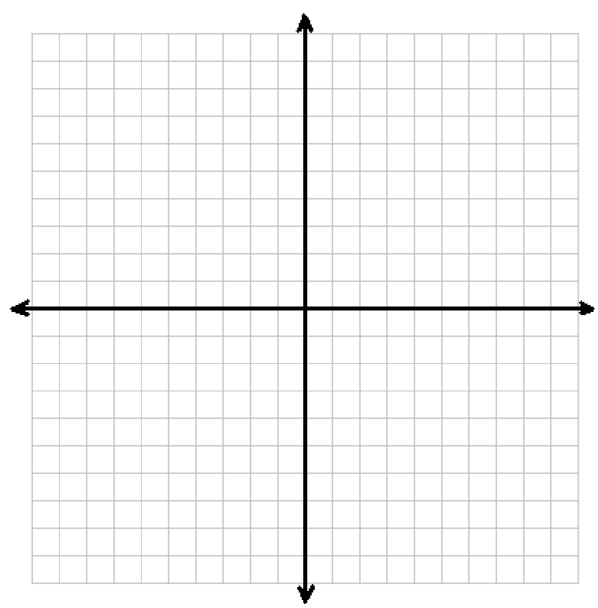


Q4 Quiz 4 Review

1) $y > 5$
   $3x - y \geq -3$

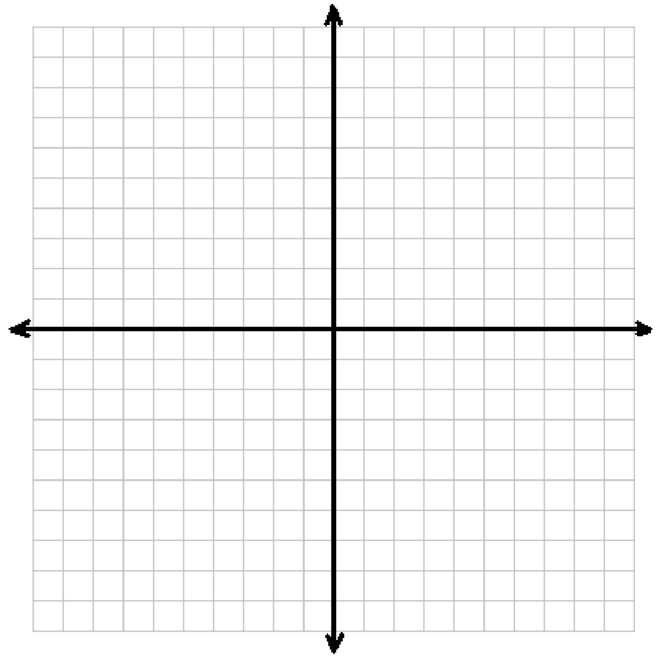


2) $y + 6 \geq -\frac{1}{2}(x - 8)$
   $y - 4 \geq 2(x - 2)$



3) $15x - 45y < 90$

$x \geq 3$



4) $21x - 7y \geq 14$

$y - 3 > -\frac{1}{4}(x + 12)$