Defining a Region using Multiple Inequalities

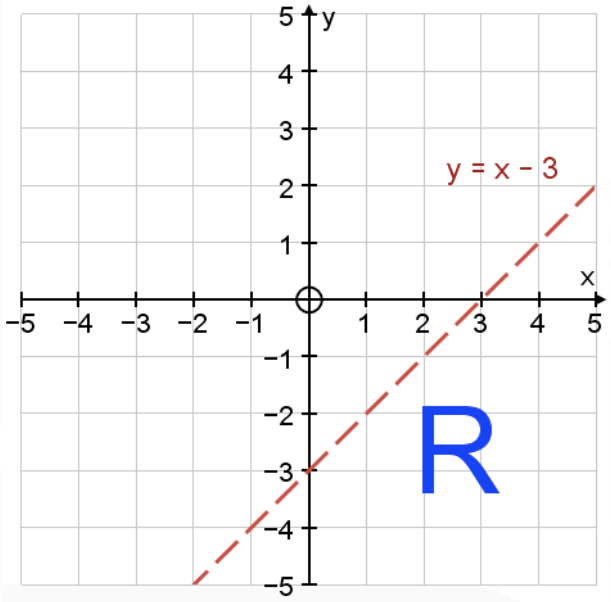
Starter

1. **(Review of last lesson)** Label the region R defined by the inequality $y < x - 3$.

Working: Draw the line $y = x - 3$
Let $x = 0, y = -3 \Rightarrow$ plot $(0, -3)$
Let $x = 3, y = 3 - 3 = 0 \Rightarrow$ plot $(3, 0)$
To check: Let $x = -1, y = -1 - 3 = -4 \Rightarrow$ plot $(-1, -4)$
Draw a ***dotted*** line since the inequality is $<$.

Choose the point $(0, 0)$ as it is not on the line.
Substitute into $y < x - 3$: $0 < 0 - 3$ False
$(0, 0)$ is not in the required region.

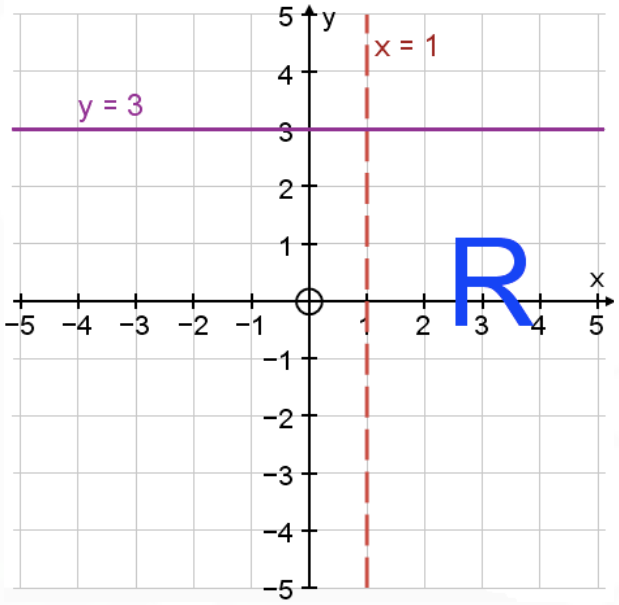
Write an R on the other side of the line to where $(0, 0)$ is.



2. (a) On the same set of axes draw the lines $x = 1$ and $y = 3$.
(b) Hence label the region R that satisfies the inequalities $x > 1$ ***and*** $y \leq 3$.

Working: (a) $x = 1$ is a vertical line passing through 1 on the $x-$axis
$y = 3$ is a horizontal line passing through 3 on the $y-$axis

(b) $x = 1$ is dotted but $y = 3$ is solid
From $x > 1$, the required region is to the right of the line $x = 1$.
From $y \leq 3$, the required region is below the line $y = 3$.

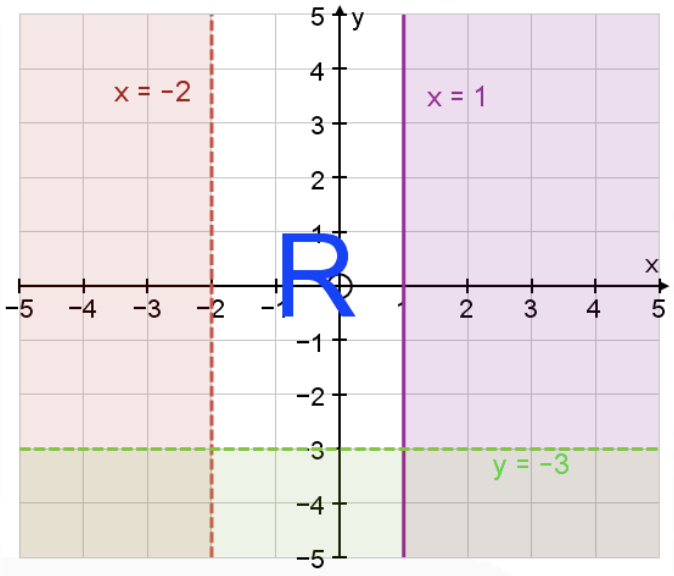


E.g. 1 Label the region R that satisfies the inequalities $-2 < x \leq 1, y > -3$.

Working: $x = -2$ is a vertical line passing through -2 on the $x-$axis
$x = 1$ is a vertical line passing through 1 on the $x-$axis
$y = -3$ is a horizontal line passing through -3 on the $y-$axis

$x = -2$ and $y = -3$ are dotted but $x = 1$ is solid.

From $-2 < x \leq 1$, the required region is between lines so shade the unwanted region.
From $y > -3$, the required region is above the line $y = -3$ so shade the unwanted area below the line.
Put an R in the unshaded region.



E.g. 2 On a graph, label the region R defined by the inequalities $y < x, x < 3$ and $x + y \geq 2$.

Working:

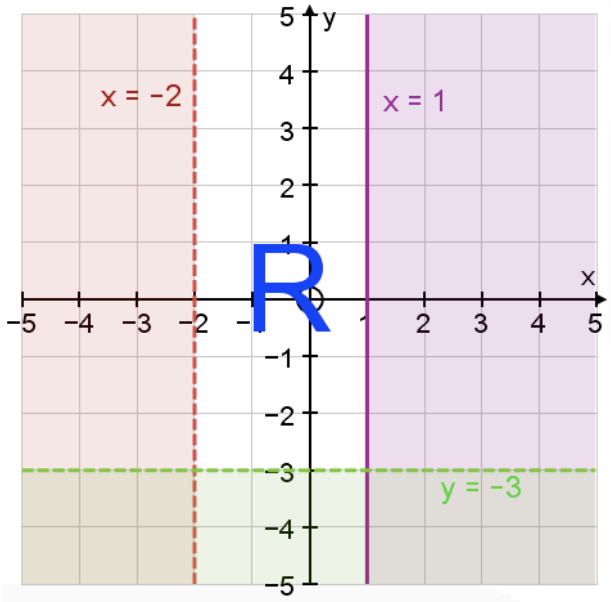
Draw the line $y = x$
Let $x = 0, y = 0 \quad \Rightarrow \quad$ plot $(0, 0)$
Let $x = 2, y = 2 \quad \Rightarrow \quad$ plot $(2, 2)$
To check: Let $x = -2, y = -2 \Rightarrow$ plot $(-2, -2)$
Draw a ***dotted*** line since the inequality is $<$.
Choose the point $(0, 1)$ as it is not on the line.
Substitute into $y < x$: $\quad 1 < 0$ False
$(0, 1)$ is not in the required region so shade its side of the line.

$x = 3$ is a vertical line passing through 3 on the $x-$axis
Draw a ***dotted*** line since the inequality is $<$.
From $x < 3$, the required region is to the left of the line so shade the unwanted region to the right of the line.

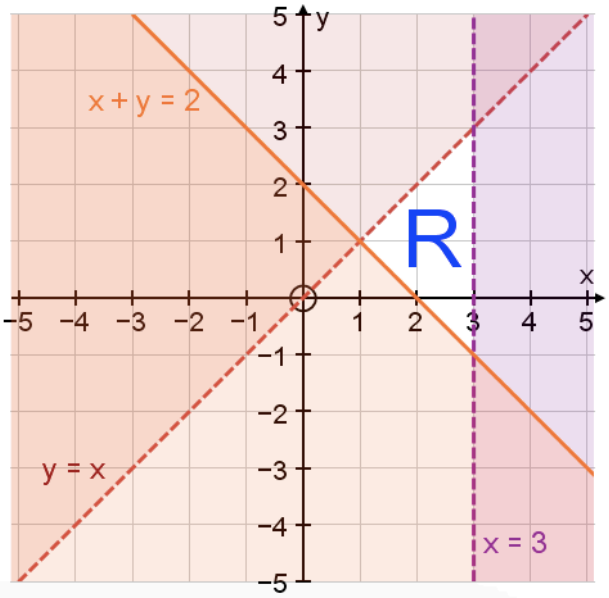
Draw the line $x + y = 2$
The line $x + y = 2$ goes through the points $(0, 2)$ and $(2, 0)$
To check: Let $x = 1, y = 1 \Rightarrow$ plot $(1, 1)$
Draw a ***solid*** line since the inequality is $\geq$.
Choose the point $(0, 0)$ as it is not on the line.
Substitute into $x + y \geq 2$: $\quad 0 + 0 \geq 2$ $\quad$ False
$(0, 0)$ is not in the required region so shade its side of the line.

Write an R in the unshaded region.

E.g. 1



E.g. 2



Video: Inequalities and regions

Solutions to Starter and E.g.s

Exercise

9-1 class textbook:	p513 E16.2 Qu 4, 5, 6ace…, 7*, 8*
A*-G class textbook:	p468 M16.3 Qu 4, 5, 6ace…, 7*

9-1 homework book: p173 E16.2 Qu 2, 4-6, 7*
A*-G homework book: p130 M16.3 Qu 2, 4-6

Summary
Multiple inequalities:

1. Draw the line corresponding to the first inequality
2. Shade the side of the line that is not in the required region
3. Repeat steps 1 and 2 for each inequality
4. The required region R, will be the area that is left unshaded

Homework book answers (only available during a lockdown)