

Defining a Region using an Inequality

Starter

Remember: **Vertical lines** are of the form $x = \text{"a number"}$
Horizontal lines are of the form $y = \text{"a number"}$

1. Draw the line $x = 2$. Hence label the region R described by the inequality $x \leq 2$.
2. Draw the line $y = -1$. Hence label the region R described by the inequality $y > -1$.
3. How will we be able to distinguish between $<$ OR $>$ and \leq OR \geq ?
4. Draw the lines $x = -3$ and $x = 1$. Hence label the region R described by the inequality $-3 < x \leq 1$.

Notes

Some questions require us to "shade the region", while others say "leave the region unshaded". The examining board we follow, OCR, tend to say "label the region" but the textbook states "shade the region".

Similar to loci:

Solid lines \Rightarrow line **is included** in the required region

Dotted lines \Rightarrow line **is not included** in the required region

To draw the correct line, simply **replace the inequality symbol by an "=" sign**.

For example, for $x + y \leq 3$, draw the line $x + y = 3$.

Success Criteria – drawing diagonal straight lines

We need two points to define a straight line and a third point to check that the first two are correct.

1. Choose an x -value
2. Substitute the x -value into the equation of the line and solve to find the y -value
3. Plot the point
4. Repeat steps 1-3 twice more so that in total 3 points are plotted.
5. Draw a straight line through the 3 points – if the points do not lie in a line, find a 4th point.

E.g. 1 Draw the line $y = x + 2$.

N.B. The straight line $x + y = k$ passes through $(k, 0)$ and $(0, k)$. For example, the line $x + y = 5$ passes through the points $(5, 0)$ and $(0, 5)$.

Success Criteria – deciding which side of a diagonal line should be labelled R

1. Choose any point that is not on the line – usually $(0, 0)$
2. Substitute the coordinates into the inequality
3. Do the coordinates satisfy the inequality?
Yes \Rightarrow the point is in required region \Rightarrow write R in the region where the point is
No \Rightarrow the point is not in required region \Rightarrow write R on the opposite side of the line

E.g. 2 Decide whether the given point satisfies the inequality:

- | | | | | | |
|-----|---------|-----------------|-----|----------|-----------------|
| (a) | (3, 2) | $x + y < 6$ | (b) | (1, 5) | $y < 3x - 1$ |
| (c) | (-4, 3) | $y \geq 1 - 2x$ | (d) | (2, 6) | $x + y \leq 8$ |
| (e) | (0, 0) | $2x - 5y > 7$ | (f) | (-1, -8) | $y \leq 3x - 5$ |

Working: (a) Substitute (3, 2) into $x + y < 6$: $3 + 2 < 6$ True
Yes, (3, 2) does satisfy the inequality.

N.B. It is usually easiest to choose the point (0, 0) as long as it is not on the line.

E.g. 3 Using your graph from **E.g. 1**, label the region R described by the inequality $y \geq x + 2$.

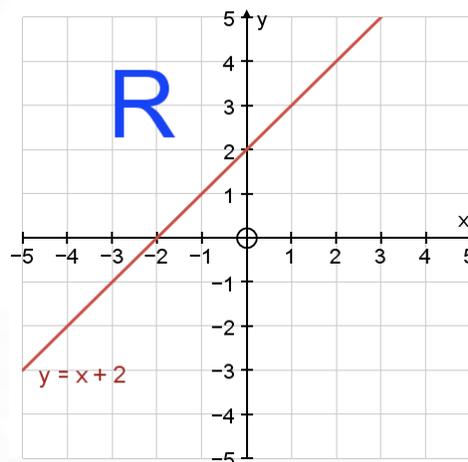
Working: Choose the point (0, 0) as it is not on the line.

Substitute into $y \geq x + 2$:
 $0 \geq 0 + 2$ False

(0, 0) is not in the required region

Write an R on the other side of the line.

N.B. Notice that it is a solid line because the inequality is \geq .



E.g. 4 Label the region R defined by the inequality:

- | | | | |
|-----|----------------|-----|--------------|
| (a) | $x + y \leq 3$ | (b) | $y > 2x + 3$ |
|-----|----------------|-----|--------------|

Success Criteria – inequalities in 2-D

1. Replace the inequality symbol with an = sign and draw the line
2. Choose any point that is not on the line
3. Substitute the coordinates into the inequality
4. Do the coordinates satisfy the inequality?
True \Rightarrow the point is in required region \Rightarrow write R in the region where the point is
False \Rightarrow the point is not in required region \Rightarrow write R on opposite side of line

Video: [Regions and inequalities - horizontal and vertical lines](#)

Video: [Regions and inequalities - diagonal lines](#)

[Solutions to Starter and E.g.s](#)

Exercise

- | | | |
|----------------------|---|---------------------------|
| 9-1 class textbook: | p512 E16.2 Qu 1, 2 (axes from -5 to 5), 3 | Label the region R |
| A*-G class textbook: | p468 M16.3 Qu 1, 2 (axes from -5 to 5), 3 | Label the region R |
| 9-1 homework book: | p173 E16.2 Qu 1, 3 | Label the region R |
| A*-G homework book: | p129 M16.3 Qu 1, 3 | Label the region R |

Summary

Solid lines \Rightarrow line **is included** in the required region

Dotted lines \Rightarrow line **is not included** in the required region

To draw the correct line, simply **replace the inequality symbol by an “=” sign**.

The straight line $x + y = k$ passes through $(k, 0)$ and $(0, k)$. For example, the line $x + y = 5$ passes through the points $(5, 0)$ and $(0, 5)$.

Drawing inequalities in 2-D

1. Replace the inequality symbol with an = sign and draw the line
2. Choose any point that is not on the line — usually $(0, 0)$
3. Substitute the coordinates into the inequality
4. Do the coordinates satisfy the inequality?
True \Rightarrow the point is in required region \Rightarrow write R in the region where the point is
False \Rightarrow the point is not in required region \Rightarrow write R on opposite side of line

Homework book answers (only available during a lockdown)