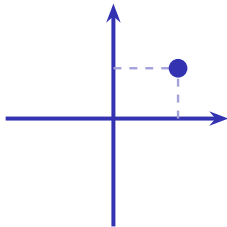


Coordinate Geometry

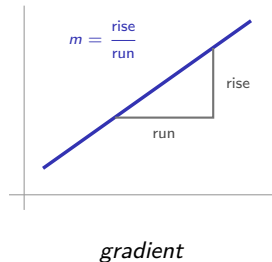
IGCSE Mathematics ■ Topic 3

IGCSE Mathematics



What we will cover

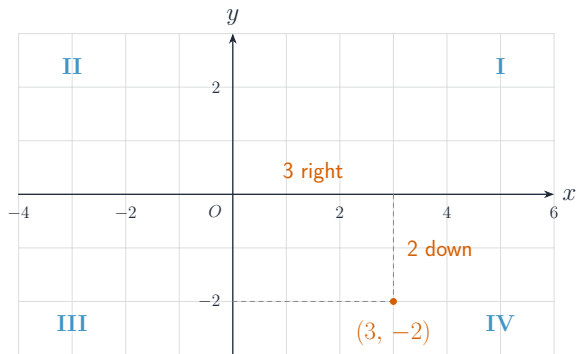
- 1 Coordinates & axes
- 2 The line $y = mx + c$
- 3 Gradient
- 4 Length & midpoint
- 5 Parallel & perpendicular



1

Lines

Coordinates and axes



- The two number lines are the **axes** 坐标轴: the **horizontal** 水平 x -axis and the **vertical** 竖直 y -axis.
- They cross at the **origin** 原点, the point $(0, 0)$.
- The axes split the grid into four **quadrants** 象限.

Coordinates, and the perpendicular results

coordinates 坐标

a point is written (x, y) – across first, then up. Sometimes called Cartesian coordinates

a small table of values 数值表

choose two or three x -values, work out y , and plot – enough for a straight line

the gradient

$$m = \frac{y_2 - y_1}{x_2 - x_1} \text{ – rise over run}$$

parallel lines

have the **same** gradient

perpendicular lines

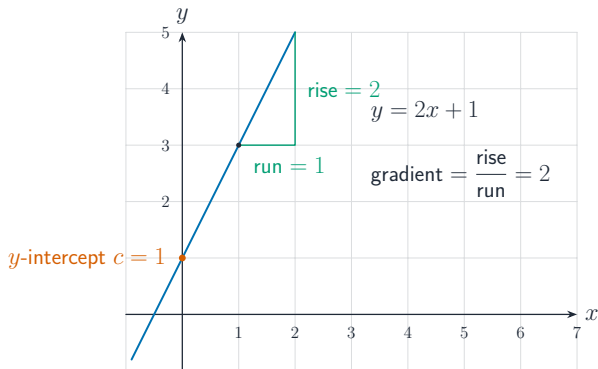
gradients multiply to -1 , so $m_2 = -\frac{1}{m_1}$ – they meet at a **right angle** 直角

the perpendicular bisector 垂直平分线

passes through the **midpoint** of a segment at right angles to it

The perpendicular bisector needs both results at once: the midpoint for a point on the line, and the negative reciprocal for its gradient.

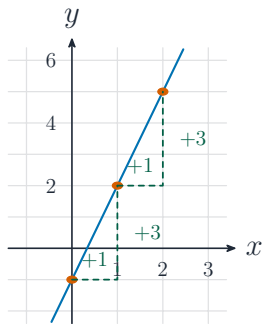
The line $y = mx + c$



$y = mx + c$: m is the **gradient** 斜率, c is the **intercept** 截距 (where it crosses the y-axis).

Rearrange $ax + by = c$ into $y = mx + c$ to read off m & c .

Drawing a line fast



drawing $y = 3x - 1$:

1. mark the intercept $c = -1$
2. gradient 3: step 1 right, 3 up, again and again
3. join the points

check with a table: $x = 0, 1, 2 \rightarrow y = -1, 2, 5$

Drawing a line fast: mark the intercept, then use the gradient to step to new points

Gradient



$$m = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{rise}}{\text{run}}$$

Through (1, 2) and (4, 11)

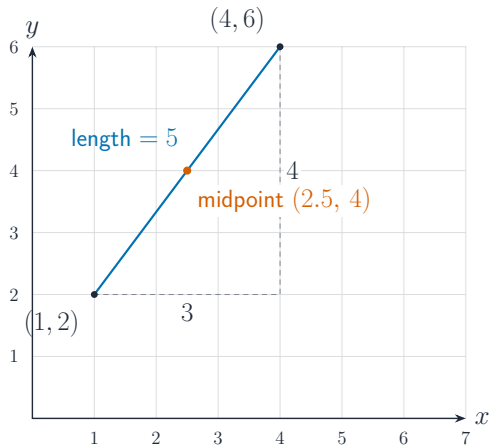
$$m = \frac{11 - 2}{4 - 1} = \frac{9}{3} = \mathbf{3}$$

A steep mountain road: gradient measures steepness as rise over run.

2

Segments

Length and midpoint



A **line segment** 线段 is the straight piece between two points.

To find the **length** 长度 of the segment between (x_1, y_1) and (x_2, y_2) , use **Pythagoras' theorem** 勾股定理 on the horizontal and vertical gaps:

$$\text{length} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

For the **midpoint** 中点, average the coordinates.

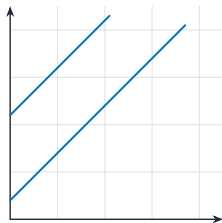
Parallel and perpendicular

■ **parallel** 平行 – same gradient

■ **perpendicular** 垂直 – $m_1 \times m_2 = -1$

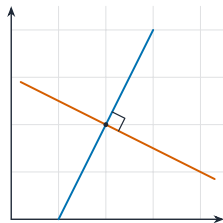
So flip the fraction & change the sign.

Parallel



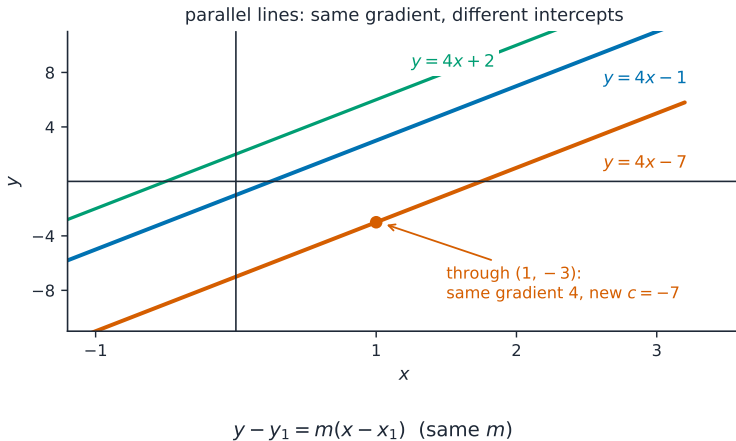
same gradient
(never meet)

Perpendicular



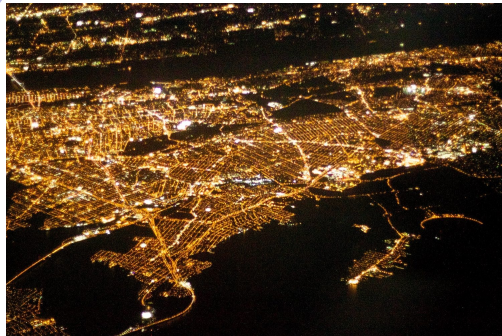
gradients 2 and $-\frac{1}{2}$
(product -1)

Parallel lines



Parallel lines: same gradient, different intercepts

Coordinates



A city street grid: every place is fixed by its coordinates.

Exam tips

- The straight line is $y = mx + c$: m is the **gradient** and c is where the line crosses the y -axis.
- Gradient = (change in y) $\div$ (change in x). Keep the two coordinates in the same order on the top and the bottom.
- **Parallel** lines have the *same* gradient; **perpendicular** lines have gradients that multiply to -1 (the negative reciprocal).
- The midpoint is the average of the coordinates; the distance between two points comes from Pythagoras on the differences.

3

Recap

Topic 3 – key takeaways

1

Line

$y = mx + c$: gradient m , intercept c

2

Gradient

rise over run

3

Length

Pythagoras on the gaps; midpoint averages

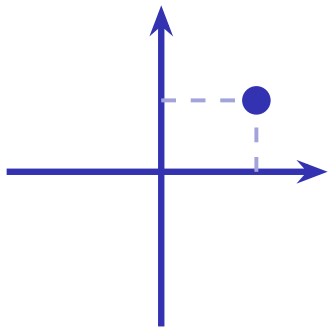
4

Lines

parallel: same m ; perpendicular:
 $m_1 m_2 = -1$

Check yourself

- 1 In $y = 4x - 1$, what is the gradient?
- 2 Find the gradient through $(1, 2)$ and $(4, 11)$.
- 3 What is the midpoint of $(1, 2)$ and $(4, 6)$?
- 4 What do perpendicular gradients multiply to?



Answers 1. 4 2. 3 3. $(2.5, 4)$ 4. -1