

Linear equation in two variable

A **linear equation in two variables** has the standard form **$ax + by = c$** , where a and b are not both zero. Its graph is always **a straight line**, and every point **(x, y)** on that line is a solution to the equation. On the SAT, this topic covers slope, graphing, writing equations, and comparing two lines at once.

1 What this topic actually tests

The SAT almost never just says “graph this line”. It usually hides a linear equation inside a word problem, a table of values, or a comparison between two lines and checks one of four skills:

Reading Lines – pulling slope and intercepts out of an equation, a graph, or a table.

Writing a line – building an equation from a rate, a starting value or two given points.

Comparing two lines – describe whether a system has one, zero, or infinitely many solutions.

Intercept in context – explaining what the slope or an intercept means in the situation described.

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Key vocabulary and definitions.

Solution (order pair)

A pair (x, y) that makes the equation true. It lies on the line.

Slope (m)

The rate of change of y with respect to x

Y intercept

The point where the line crosses the Y axis, where $X = 0$.

X intercept

The point where the line crosses the x-axis where $y = \text{zero}$

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Three key forms of a line

- **Standard form**

$Ax + By = c$. Best for quickly finding both intercepts.

- **Slope intercept form**

$y = mx + b$ best for reading slope (m) and y intercept (b) directly.

- **Point slope form**

$y - y_1 = m(x - x_1)$ best when you know the slope and one point at a line.

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Slope: formula and meaning

- Slope measures steepness and direction. Given two points on the line, it's the change in y divided by the change in x.

$$\text{Slope (m)} = (y_2 - y_1) / (x_2 - x_1)$$

Positive Slope ($m > 0$)

Line rises left to right as x increases y also increases.

Negative Slope ($m < 0$)

Lines falls left to right. As x increases, y decreases.

Zero Slope

Horizontal Line. Y- value never changes.
 $Y = k$ (constant)

Undefined Slope

Vertical line. X - value never changes.
 $X = k$ (constant)

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Parallel and perpendicular lines

Parallel Line

Same slope, different y-intercepts.
The lines never intersect. $m_1 = m_2$

Perpendicular lines

Slopes are negative reciprocals of each other. The lines cross at a right angle.

$$m_1 = -1/m_2$$

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Systems of two linear equations

Two linear equations together form a system. Graphically, this means comparing two lines - and the number of solutions depends entirely on their slopes and intercepts.

- **One Solution**

Different slopes. The lines cross at exactly one point
 $m_1 \neq m_2$

- **No solution**

Same slope, different y-intercepts. The lines are parallel and never meet
 $m_1 = m_2, b_1 \neq b_2$

- **Infinitely many solutions**

Same slope and same y-intercept - two equations describe the identical line, so every point on it is a shared solution
 $m_1 = m_2$ and $b_1 = b_2$.