# T&T3 3.6

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PROJECT MATHS

Text & Tests

Leaving 3 Certificate

chapter 3

# Coordinate Geometry – The Line

*Key words*

Cartesian plane origin axis quadrant vertex horizontal
vertical slope parallel perpendicular positive negative
linear equation area translation intersection collinear

## Section 3.6 The equation $y = mx + c$

Notes

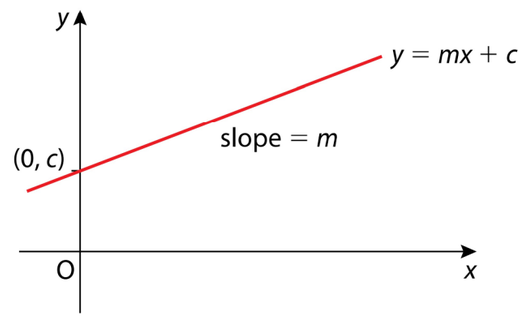
## Section 3.6 The equation $y = mx + c$

If the equation of a line is in the form

$$y = mx + c, \quad \text{then}$$

(i) the slope is $m$

(ii) the line intersects the $y$-axis at $(0, c)$.




The point $(0, c)$ is called the ***y*-intercept**.

If a line is in the form $3x + 2y - 8 = 0$, change the equation to the form $y = mx + c$.

The slope is the value of $m$.



## Example 1

Find the slope of the line $3x - 2y - 9 = 0$.

We write the equation in the form $y = mx + c$.

$$3x - 2y - 9 = 0$$

$\Rightarrow \quad -2y = -3x + 9 \ldots$ leave the $y$ term only on left-hand side

$\Rightarrow \quad 2y = 3x - 9 \ldots$ multiply each term by $-1$

$\Rightarrow \quad y = \frac{3}{2}x - \frac{9}{2} \ldots$ divide each term by 2

$\therefore$ the slope of the line is $\frac{3}{2}$

## Example 2

$\ell$ is the line $2x - 3y + 6 = 0$ and $m$ is the line $3x + 2y - 4 = 0$.
Show that $\ell$ is perpendicular to $m$.

Slope of $\ell$:

$$2x - 3y + 6 = 0$$
$$\Rightarrow \quad -3y = -2x - 6$$
$$\Rightarrow \quad 3y = 2x + 6$$
$$\Rightarrow \quad y = \frac{2}{3}x + 2$$
$$\Rightarrow \quad \text{slope of } \ell = \frac{2}{3}$$

Slope of $m$:

$$3x + 2y - 4 = 0$$
$$\Rightarrow \quad 2y = -3x + 4$$
$$\Rightarrow \quad y = -\frac{3}{2}x + 2$$
$$\Rightarrow \quad \text{slope of } m = -\frac{3}{2}$$

$$\text{Slope of } \ell \times \text{slope of } m = \frac{2}{3} \times \left(-\frac{3}{2}\right)$$
$$= \frac{-6}{6} = -1$$

Since the product of the two slopes $= -1$, the lines are perpendicular.



## Exercise 3.6

$y = mx + c$

**1.** Express each of the following lines in the form $y = mx + c$ and hence write down the slope of the line:

(i) $x + y - 4 = 0$
(ii) $3x + y - 5 = 0$
(iii) $2x + 3y - 7 = 0$
(iv) $5x - 2y + 3 = 0$
(v) $3x + 4y - 2 = 0$
(vi) $3x - 4y + 6 = 0$.

**2.** Express the line $\ell$: $2x + 3y - 7 = 0$ in the form $y = mx + c$.

(i) Write down the slope of $\ell$.

(ii) What is the slope of any line parallel to $\ell$?

(iii) What is the slope of any line perpendicular to $\ell$?





**3.** Show that the lines $x - 2y + 1 = 0$ and $3x - 6y - 7 = 0$ are parallel.
What is the slope of any line perpendicular to these lines?

$x - 2y + 1 = 0$

$+2y \quad x + 1 = 2y \quad +2y$

$\div 2 \quad \frac{1x+1}{2} = y \quad \div 2$

$= \frac{1}{2}$

$3x - 6y - 7 = 0$

$+6y \quad 3x - 7 = 6y \quad +6y$

$\div 6 \quad \frac{3x-7}{6} = y \quad \div 6$

$\frac{3}{6} = \frac{1}{2}$

$\frac{1}{2} \parallel \frac{1}{2}$ parallel.

**4.** Show that the lines $2x + 3y - 4 = 0$ and $3x - 2y + 1 = 0$ are perpendicular to each other.

$2x+3y-4=0$

$-2x$ | $3y-4=-2x$ | $-2x$

$+4$ | $3y=-2x+4$ | $+4$

$\div 3$ | $y=\frac{-2x+4}{3}$ | $\div 3$

$3x-2y+1=0$

$+2y$ | $3x+1=2y$ | $+2y$

$\div 2$ | $\frac{3x+1}{2}=y$ | $\div 2$

$\frac{-2}{3}$ $\qquad$ $\frac{3}{2}$

$\perp$

$\frac{-2}{3} \times \frac{3}{2} = \frac{-6}{6} = -1$





HW

**5.** If the equation of the line $\ell$ is $y = 3x - 4$, write down the equation of any line, in the form $y = mx + c$, that is

(i) parallel to $\ell$

(ii) perpendicular to $\ell$.

HW

**6.** Investigate if the lines $y = \frac{2}{3}x + 4$ and $2x - 3y - 5 = 0$ are parallel.





HW

The equation of the line $m$ is $y = 3x - 2$.

Find (i) the slope of $m$

(ii) the point at which $m$ intersects the $y$-axis.



H

**8.** The equations of six lines are given below:

a: $y = 2x - 3$ c: $y = x + 3$ e: $y = -\frac{1}{2}x + 4$

b: $y = \frac{1}{2}x + 5$ d: $y = -2x - 4$ f: $y = 2x - 2$

(i) Name a pair of parallel lines.

(ii) Name a pair of perpendicular lines.

(iii) Which line crosses the $y$-axis at $(0, 4)$?

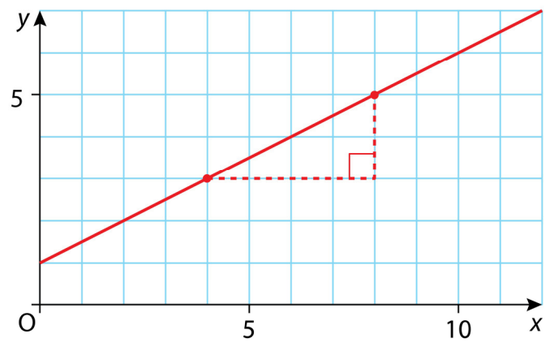
(iv) Which line crosses the $y$-axis at $(0, -3)$?



Exercise 3.6

$y = mx + c$

**9.** By finding the slope and $y$-intercept, write down the equation of the given line.



**10.** If the line $x + 2y - 6 = 0$ is parallel to the line $2x + ky - 5 = 0$, find the value of $k$.





**11.** If the line $2x - 3y + 7 = 0$ is perpendicular to the line $3x + ky - 4 = 0$, find the value of $k$.

**12.** For what value of $k$ is the line $2x + ky - 4 = 0$ parallel to the line $x + 3y + 7 = 0$?



## Exercise 3.6 Answers

**1.** (i) $y = -x + 4; -1$ (ii) $y = -3x + 5; -3$
(iii) $y = -\frac{2}{3}x + \frac{7}{3}; -\frac{2}{3}$ (iv) $y = \frac{5}{2}x + \frac{3}{2}; \frac{5}{2}$
(v) $y = -\frac{3}{4}x + \frac{1}{2}; -\frac{3}{4}$ (vi) $y = \frac{3}{4}x + \frac{3}{2}; \frac{3}{4}$

**2.** $y = -\frac{2}{3}x + \frac{7}{3}$;
(i) $-\frac{2}{3}$ (ii) $-\frac{2}{3}$ (iii) $\frac{3}{2}$

**3.** $-2$

**5.** (i) $y = 3x + 6$ (ii) $y = -\frac{1}{3}x + 11$

**6.** Yes; parallel

**7.** (i) 3 (ii) $(0, -2)$

**8.** (i) $a + f$ (ii) $a + e$ or $b + d$
(iii) e (iv) a

**9.** $x - 2y + 2 = 0$ or $y = \frac{1}{2}x + 1$

**10.** $k = 4$ **11.** $k = 2$ **12.** $k = 6$