1. Equation of a Straight Line

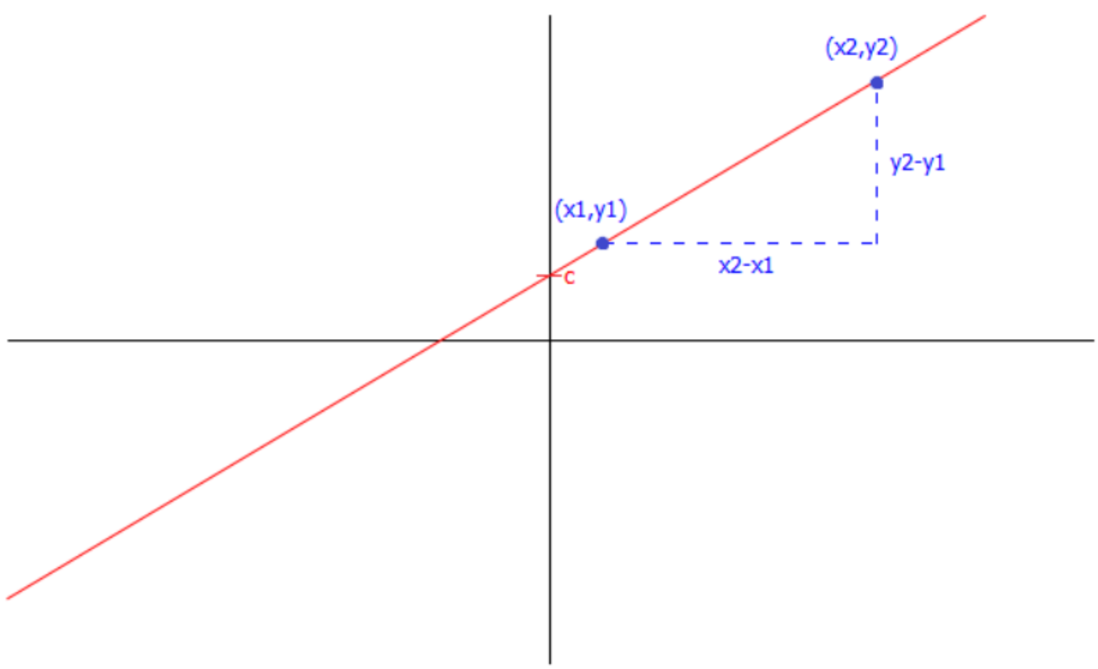
The equation of a straight line is

$$y = mx + c$$

m is the gradient and c is the height at which the line crosses the y-axis, also known as the y-intercept.

The gradient m is the slope of the line - the amount by which the y-coordinate increases in proportion to the x-coordinate. If you have points (x1, y1) and (x2, y2) on the line, the gradient is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



If you know one point (x1, y1) on the line as well as its gradient m, the equation of the line is

$$(y - y_1) = m(x - x_1)$$

Example 1: ***Find the equation of the line with gradient −2 that passes through the point (3, −4).***

Solution:

Put $m = -2$, $x_1 = 3$ and $y_1 = -4$ straight into the formula $y - y_1 = m(x - x_1)$.

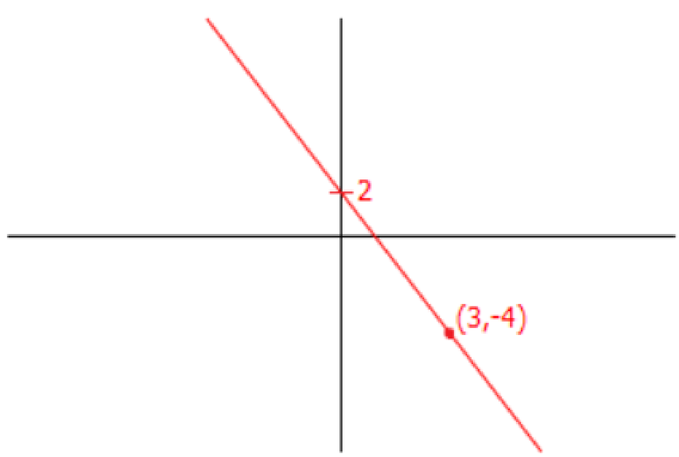
$$y - y_1 = m(x - x_1)$$

$$y + 4 = -2(x - 3)$$

Expand the brackets and simplify.

$$y + 4 = -2x + 6$$

$$y = -2x + 2$$



Example 2: ***Find the equation of the straight line through the points (-5, 7) and (1, 3)***

Solution:

First, find the gradient by substituting the coordinates $x_1 = -5$, $y_1 = 7$, $x_2 = 1$ and $y_2 = 3$ into the formula for the gradient:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{3-7}{1-(-5)}$$

$$= \frac{-4}{6}$$

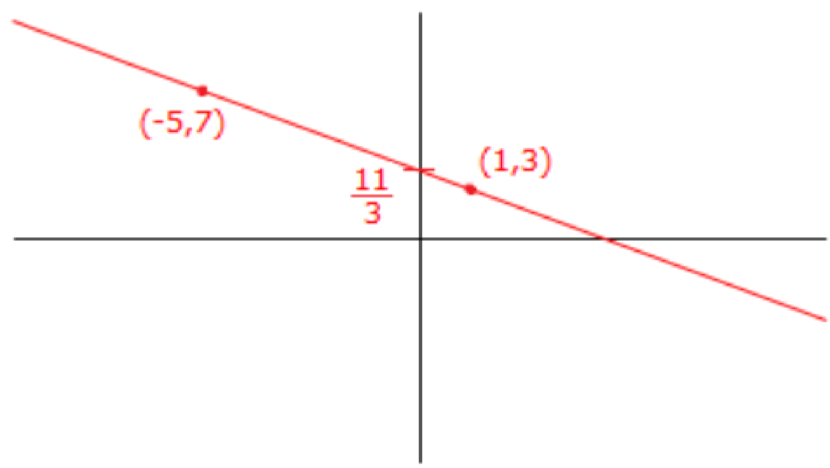
$$= -\frac{2}{3}$$

Choose either point and put into the formula $y - y_1 = m(x - x_1)$:

$$y - y_1 = m(x - x_1)$$
$$y - 7 = -\frac{2}{3}(x - (-5))$$

Expand the brackets and simplify.

$$y - 7 = -\frac{2}{3}x - \frac{10}{3}$$
$$y = -\frac{2}{3}x + \frac{11}{3}$$



2. Trigonometric Functions

There are six basic trigonometric functions used in Trigonometry. These functions are trigonometric ratios. The six basic trigonometric functions are **sine function, cosine function, secant function, co-secant function, tangent function, and co-tangent** function.

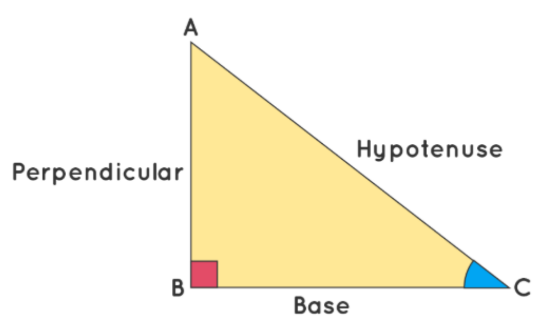
sin θ = Perpendicular/Hypotenuse

cos θ = Base/Hypotenuse

tan θ = Perpendicular/Base

sec θ = Hypotenuse/Base

cosec θ = Hypotenuse/Perpendicular



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The six trig functions and how they relate to each other.

$$\cos(x) \qquad\qquad \sin(x)$$

$$\tan(x) = \frac{\sin(x)}{\cos(x)} \qquad \cot(x) = \frac{\cos(x)}{\sin(x)} = \frac{1}{\tan(x)}$$

$$\sec(x) = \frac{1}{\cos(x)} \qquad \csc(x) = \frac{1}{\sin(x)}$$

The trigonometric functions have a domain θ, which is in degrees or radians. Some of the principal values of θ for the different trigonometric functions are presented below in a table.

θ	0°	30°	45°	60°	90°	180°	270°	360°
sin θ	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	0	-1	0
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	-1	0	1
tan θ	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not Defined	0	Not Defined	0
cosec θ	Not Defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1	Not Defined	-1	Not Defined
sec θ	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not Defined	-1	Not Defined	1
cot θ	Not Defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	Not Defined	0	Not Defined

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3. Domain and Range

One of the more important ideas about functions is that of the domain and range of a function. for the domain we need to avoid division by zero, square roots of negative numbers, logarithms of zero and logarithms of negative numbers. The range of a function is simply the set of all possible values that a function can take.

Example: ***Find the domain and range of each of the following functions.***

(a) $f(x) = 5x - 3$

(b) $g(t) = \sqrt{4 - 7t}$

(c) $h(x) = -2x^2 + 12x + 5$

(d) $f(z) = |z - 6| - 3$

(e) $g(x) = 8$

Solution:

(a) $f(x) = 5x - 3$

Range : $(-\infty, \infty)$

Domain : $-\infty < x < \infty$ or $(-\infty, \infty)$

(b) $g(t) = \sqrt{4-7t}$

Range : $[0, \infty)$

$$4 - 7t \geq 0$$
$$4 \geq 7t$$
$$\frac{4}{7} \geq t \qquad \Rightarrow \qquad t \leq \frac{4}{7}$$

The domain is then,

Domain : $t \leq \frac{4}{7}$ or $\left(-\infty, \frac{4}{7}\right]$

(c) $h(x) = -2x^2 + 12x + 5$

Domain : $-\infty < x < \infty$ or $(-\infty, \infty)$

$$x = -\frac{12}{2(-2)} = 3 \qquad y = h(3) = -2(3)^2 + 12(3) + 5 = 23$$

Range : $(-\infty, 23]$

(d) $f(z) = |z-6| - 3$

Range : $[-3, \infty)$

Domain : $-\infty < z < \infty$ or $(-\infty, \infty)$

(e) $g\left(x\right) = 8$

Range : 8

Domain : $-\infty < x < \infty$ or $(-\infty, \infty)$

H.W

Find the domain of each of the following functions.

(a) $f\left(x\right) = \dfrac{x-4}{x^2 - 2x - 15}$

(b) $g\left(t\right) = \sqrt{6 + t - t^2}$

(c) $h\left(x\right) = \dfrac{x}{\sqrt{x^2 - 9}}$
