## Introduction

Straight line graphs arise in many engineering applications. This leaflet discusses the mathematical equation which describes a straight line and explains the terms 'gradient' and 'intercept'.

## 1. The equation of a straight line

Any equation of the form

$$
y=m x+c
$$

where $m$ and $c$ are fixed numbers, (i.e. constants), has a graph which is a straight line.
For example,

$$
y=3 x+5, \quad y=\frac{2}{3} x+8 \quad \text { and } \quad y=-3 x-7
$$

all have graphs which are straight lines, but

$$
y=3 x^{2}+4, \quad y=\frac{2}{3 x}-7, \quad \text { and } \quad y=-14 \sqrt{x}
$$

have graphs which are not straight lines. The essential feature of a straight line equation is that $x$ and $y$ occur only to the power 1 .

## 2. The straight line graph

Any straight line graph can be plotted very simply by finding just two points which lie on the line and joining them. It is a good idea to find a third point just as a check.

## Example

Plot a graph of the straight line with equation $y=5 x+4$.

## Solution

From the equation, note that when $x=0$, the value of $y$ is 4 . Similarly when $x=3, y=19$. So the points $(0,4)$ and $(3,19)$ lie on the graph. These points are plotted and joined together to form the straight line graph.


## 3. The gradient and intercept of a straight line

In the equation $y=m x+c$ the value of $m$ is called the gradient of the line. It can be positive, negative or zero. Lines with a positive gradient slope upwards, from left to right. Lines with a negative gradient slope downwards from left to right. Lines with a zero gradient are horizontal.
this line has a positive gradient this line has a negative gradient the gradient of this line is zero




The value of $c$ is called the vertical intercept of the line. It is the value of $y$ when $x=0$. When drawing a line, $c$ gives the position where the line cuts the vertical axis.


## Example

Determine the gradient and vertical intercept of each line.
a) $y=12 x-6$,
b) $y=5-2 x$,
c) $4 x-y+13=0$,
d) $y=8$,
e) $y=4 x$.

## Solution

a) Comparing $y=12 x-6$ with $y=m x+c$ we see that $m=12$, so the gradient of the line is 12. The fact that this is positive means that the line slopes upwards as we move from left to right. The vertical intercept is -6 . This line cuts the vertical axis below the horizontal axis.
b) Comparing $y=5-2 x$ with $y=m x+c$ we see that $m=-2$, so the gradient is -2 . The line slopes downwards as we move from left to right. The vertical intercept is 5 .
c) We write $4 x-y+13=0$ in standard form as $y=4 x+13$ and note that $m=4, c=13$.
d) Comparing $y=8$ with $y=m x+c$ we see that $m=0$ and $c=8$. This line is horizontal.
e) Comparing $y=4 x$ with $y=m x+c$ we see that $m=4$ and $c=0$.

## Exercises

1. State the gradient and intercept of each of the following lines.
a) $y=5 x+6$,
b) $y=3 x-11$,
c) $y=-2 x+7$,
d) $y=9$,
e) $y=7-x$

## Answers

1. a) gradient 5 , intercept 6
b) $3,-11$,
c) $-2,7$,
d) 0,9 ,
e) $-1,7$.
