



## Graph Drawing

### Section 1 : Coordinates

You will have used coordinates before. In this section, we revisit coordinates before starting work on lines and graphs. Remember that the first number is the x-coordinate (right) and the second number is the y-coordinate (up).

The origin is the centre of the graph at  $(0, 0)$ .

If the x-coordinate is a negative number then the point will be to the left of the origin.

If the y-coordinate is a negative number then the point will be below the origin.

#### Practice Question

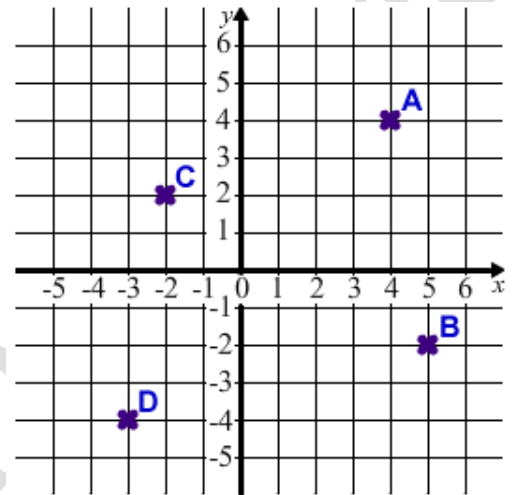
Work out the answer to each of these questions. Look at the coordinate grid below.

What are the coordinates of A?

What are the coordinates of B?

What are the coordinates of C?

What are the coordinates of D?



#### Exercises

Work out the answers to the questions below and fill in the boxes.

#### Question 1

Write down the coordinates of each of the points marked on the following axes:

A( , ); B( , ); C( , )

D( , ); E( , ); F( , )

G( , ); H( , ); I( , )

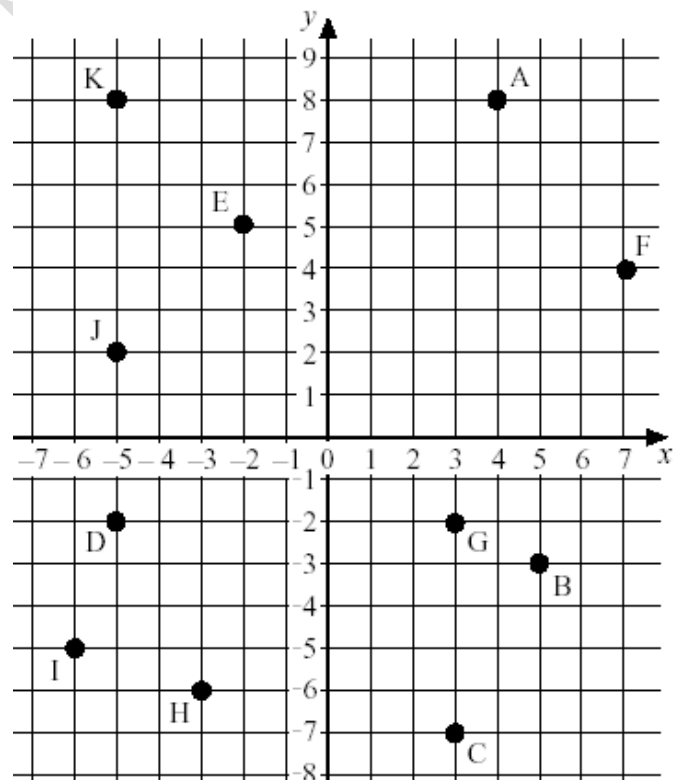
J( , ); K( , )

**NOTE: In the next few questions you need to plot points and draw lines on graphs.**

**Question 2:** (a) Plot these points on the graph below and join them up with straight lines to form a triangle:

$(3, -2)$ ,  $(-1, 6)$  and  $(-5, -2)$

(b) What type of triangle have you drawn?



**Question 3:** (a) Plot these points on the graph below and join them up in order to form a shape:

$(-1, 4)$ ,  $(2, 5)$ ,  $(5, 4)$  and  $(2, -1)$

(b) What is the name of the shape you have drawn?



**Question 4:** The coordinates of 3 corners of a square are:  $(3, 1)$ ,  $(-1, 1)$  and  $(3, -3)$ .  
What are the coordinates of the other corner?

**Question 5:** The coordinates of 3 corners of a rectangle are:  $(-1, 6)$ ,  $(-4, 6)$  and  $(-4, -5)$ .  
What are the coordinates of the other corner?

**Question 6:** A shape has corners at the points with coordinates:  $(3, -2)$ ,  $(6, 2)$ ,  $(-2, 2)$  and  $(-5, -2)$ .  
(a) Plot the points on the graph below and join them in order.  
(b) What is the name of the shape?

**Question 7:** A shape has corners at the points with coordinates:  $(3, 3)$ ,  $(1, -1)$ ,  $(3, -5)$  and  $(5, -1)$ .  
(a) Plot the points on the graph below and join them in order.  
(b) What is the name of the shape?

## Section 2 : Plotting Points on Straight Lines

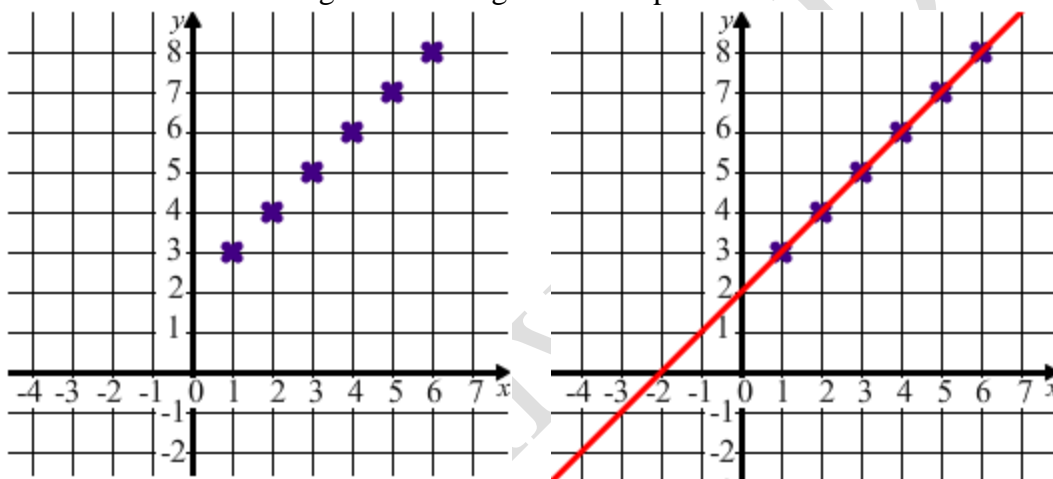
In this section we will be plotting points that lie on a straight line.

We will then look for relationships between the  $x$  and  $y$  coordinates of the points on the line.

### Example

Below is a graph showing the points  $(1, 3)$ ,  $(2, 4)$ ,  $(3, 5)$ ,  $(4, 6)$ ,  $(5, 7)$

We can then draw a straight line through all of the points:



### Equation of a line

We can find an equation which describes the relationship between the  $x$  and  $y$  coordinates on the graph. Looking at the pairs of coordinates, we can see that the  $y$ -value is always two more than the  $x$ -value.

The equation to represent this is:

$$y = x + 2 \quad (\text{the } y\text{-coordinate can always be found by adding 2 to the } x\text{-coordinate})$$

Note that this works for every point on the line, even with negative numbers and decimals.

Examples of other points on this line are:  $(0, 2)$ ,  $(-1, 1)$ ,  $(-4, -2)$  and  $(2.5, 4.5)$



### Practice Question

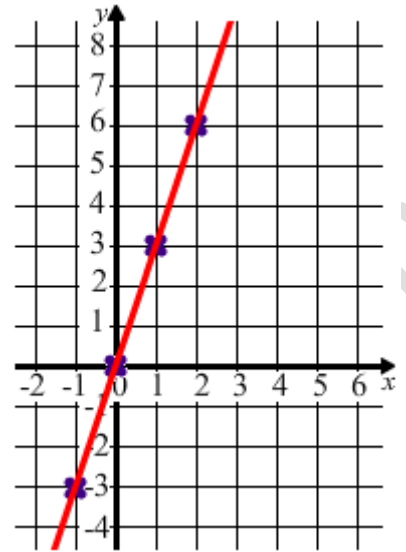
Work out the answer to the question

The points  $(-1, -3)$ ,  $(0, 0)$ ,  $(1, 3)$  and  $(2, 6)$  have been plotted.

A straight line has been drawn through the four points.

How are the  $x$  and  $y$  coordinates of the points on the line related?

What is the equation of the line?



### Exercises

Work out the answers to the questions below and fill in the boxes.

**NOTE:** In these questions you need to plot points and draw lines on graphs.

#### Question 1

(a) Plot these points on the graph and draw a straight line through them:

$(0, 4)$ ,  $(1, 5)$ ,  $(3, 7)$ ,  $(4, 8)$

(b) Below are the coordinates of three other points on the line. Fill in the gaps:

$(2, \quad)$ ;  $(-2, \quad)$ ;  $(\quad, 9)$

#### Question 2

(a) Plot these points on the graph and draw a straight line through them:

$(0, 6)$ ,  $(2, 4)$ ,  $(3, 3)$ ,  $(5, 1)$

(b) Now plot these points on the graph and draw another line through them:

$(1, 8)$ ,  $(2, 7)$ ,  $(5, 4)$ ,  $(7, 2)$

(c) These two lines are.....

#### Question 3

(a) Plot these points on the graph and draw a straight line through them:

$(2, 6)$ ,  $(3, 5)$ ,  $(4, 4)$ ,  $(7, 1)$

(b) Now plot these points on the graph and draw another line through them:

$(0, 1)$ ,  $(1, 2)$ ,  $(3, 4)$ ,  $(5, 6)$

(c) These two lines are.....

#### Question 4

(a) Plot these points on the graph and draw a straight line through them:

$(1, 1)$ ,  $(2, 2)$ ,  $(4, 4)$ ,  $(5, 5)$

(a) Below are the coordinates of two other points on the line.

(b) Fill in the gaps:  $(3, \quad)$ ;  $(\quad, 7)$

(c) Complete the equation of the line:  $y =$

#### Question 5

(a) Plot these points on the graph and draw a straight line through them:

$(1, 3)$ ,  $(2, 4)$ ,  $(3, 5)$ ,  $(5, 7)$

(b) Below are the coordinates of three other points on the line.

(c) Fill in the gaps:  $(0, \quad)$ ;  $(-1, \quad)$ ;  $(\quad, 8)$

(d) Complete the equation of the line:  $y =$

### Section 3 : Plotting Graphs Given Their Equations



In this section we introduce the idea of the *gradient* of a line, which is a measure of how steep it is. We will also see how to plot the graph of a straight line using the *equation* of the line. There is a link between the *equation* of a line and its *gradient*, which you should see by the end of the section.

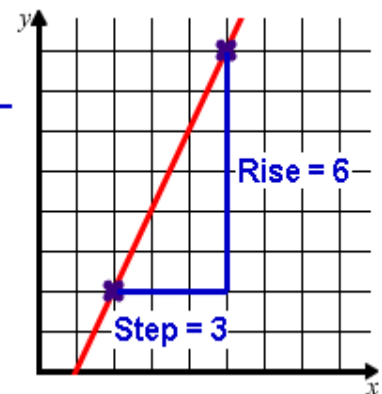
### Gradient of a line

The *gradient* of a line is found as shown in the diagram below:

### Steps to find the gradient

1. Mark two points on the line, as far apart as possible
2. Connect the two points with one horizontal line and one vertical line to form a triangle
3. Measure the *step* - how far the line has gone to the right on the horizontal line
4. Measure the *rise* - how far the line has gone up (or down) on the vertical line
5. Divide the *rise* by the *step* to get the *gradient*

$$\begin{aligned}\text{Gradient} &= \frac{\text{Rise}}{\text{Step}} \\ &= \frac{6}{3} \\ &= 2\end{aligned}$$



### Example Question

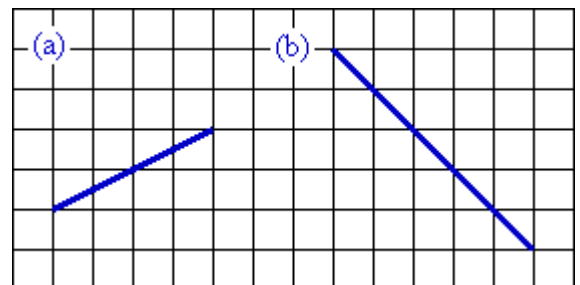
Look at the two lines on the diagram below.  
Work out the gradient of each line.

In (a) the step is 4 and the rise is 2, so we divide 2 by 4 to find the gradient.

The gradient is 0.5

In (b) the step is 5 and the rise is  $-5$  (because the line goes downwards), so the gradient is found by dividing  $-5$  by 5.

The gradient is  $-1$



**NOTE:** Looking from left to right, lines which go upwards have positive gradients and lines which go downwards have negative gradients. A horizontal line has a rise of zero, so the gradient will also be zero.

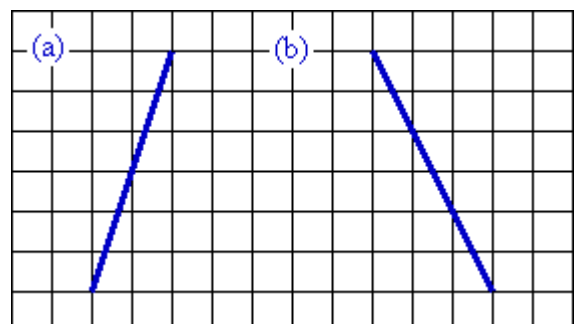
### Practice Question

Look at the two lines on the diagram below.

Work out the answer to each of these questions

What is the gradient of line (a)?

What is the gradient of line (b)?



### Plotting a graph from its equation



The *equation* of a line (e.g.  $y = x + 3$ ) usually tells us how to find a *y-coordinate* using an *x-coordinate*.

We can find the coordinates of several points on a line by picking *x* values and working out *y* values.

### Example Question

A line has equation  $y = 2x + 1$ .

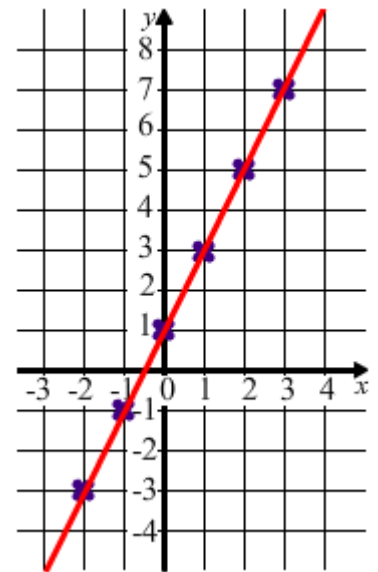
Using *x* values from  $-2$  to  $+3$ , plot the graph of this equation.

The first stage is to draw up a table of *x* values and work out the *y* values using the equation:

<i>x</i>	-2	-1	0	1	2	3
$y = 2x + 1$	-3	-1	1	3	5	7

Next, each pair of *x* and *y* values can be plotted on the graph as coordinates. In this case the coordinates are:  $(-2, -3)$ ,  $(-1, -1)$ ,  $(0, 1)$ ,  $(1, 3)$ ,  $(2, 5)$  and  $(3, 7)$ .

Finally the points are joined with a straight line running all the way across the graph:

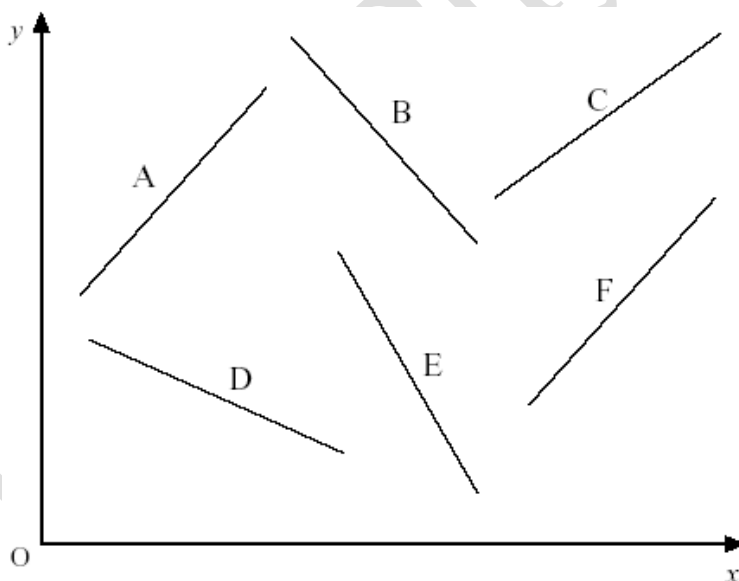


### Practice Question

A line has equation  $y = x - 3$ . Using *x* values from  $-1$  to  $+4$ , find *y* values then plot them.

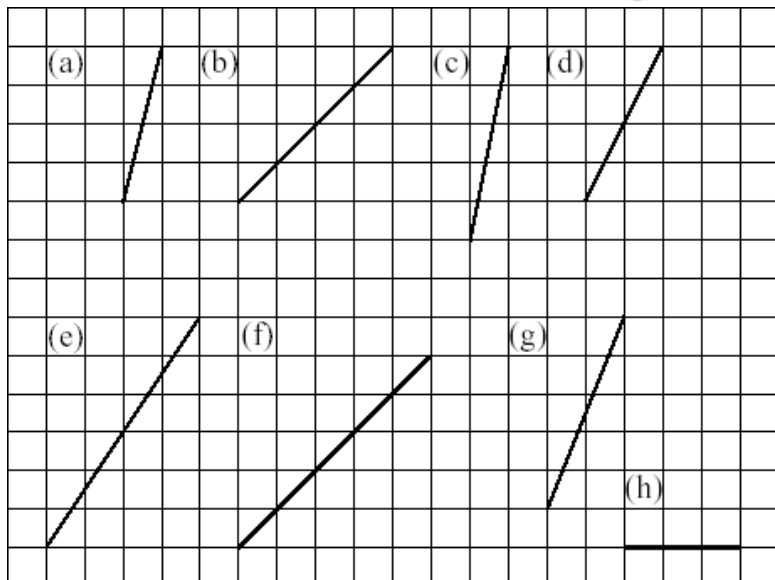
### Question 1

For each of the lines below, decide if the gradient is *positive* or *negative*:



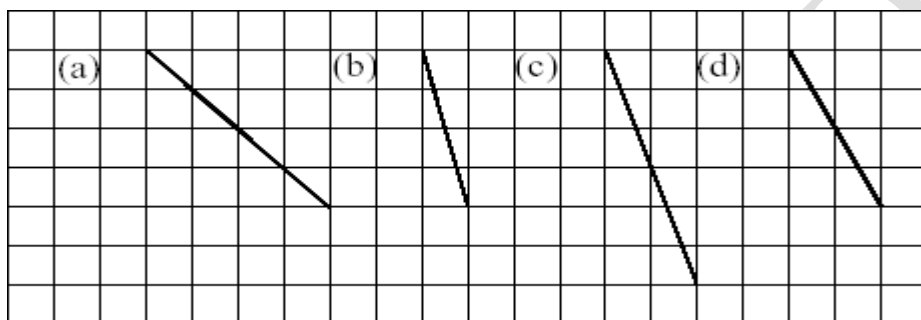
### Question 2

Calculate the gradient of each of the lines below, giving your answer as a decimal where necessary:



### Question 3

Determine the gradient of each of the following lines:



### Question 4

A line has equation  $y = 2x - 2$

(a) Complete the following table

$x$	-1	0	1	2	3	4
$y = 2x - 2$	<input type="text"/>	<input type="text"/>	<input type="text"/>	2	<input type="text"/>	<input type="text"/>

(b) Plot the six points on the graph and draw a line through them.

(c) What is the gradient of the line?