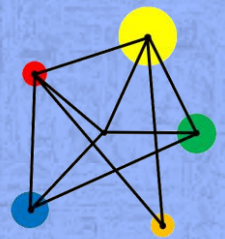
Co-ordinates



Vocabulary

Point
An exact position. Points are often named using a capital letter.

Coordinates
A pair of numbers that give the location of a point such as (2 , 4).

Quadrant
One of the four regions defined by the x axis and y axis.

Midpoint
The point at the middle of a line segment.

Axis
A straight line. The x axis is horizontal, and the y axis is vertical. The plural of axis is *axes.*

Graph
A set of points drawn on axes, usually joined with a line or curve.

Line Segment
A finite straight line with two ends.

1. Use co ordinates to plot points in all four quadrants.

2. Find the midpoint of a line segment.

3. Plot graphs of simple equations.

Key Facts

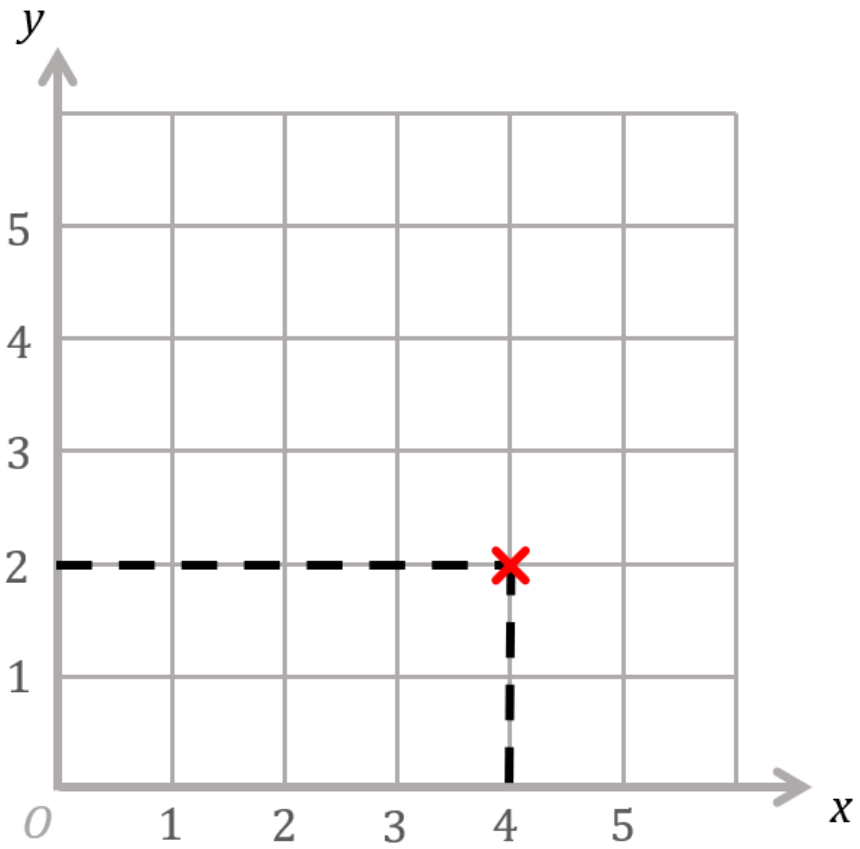
Any point can be described by a pair of numbers called co-ordinates.

The co-ordinates of the red cross are (4 , 2).

The first number is the **x co-ordinate.**

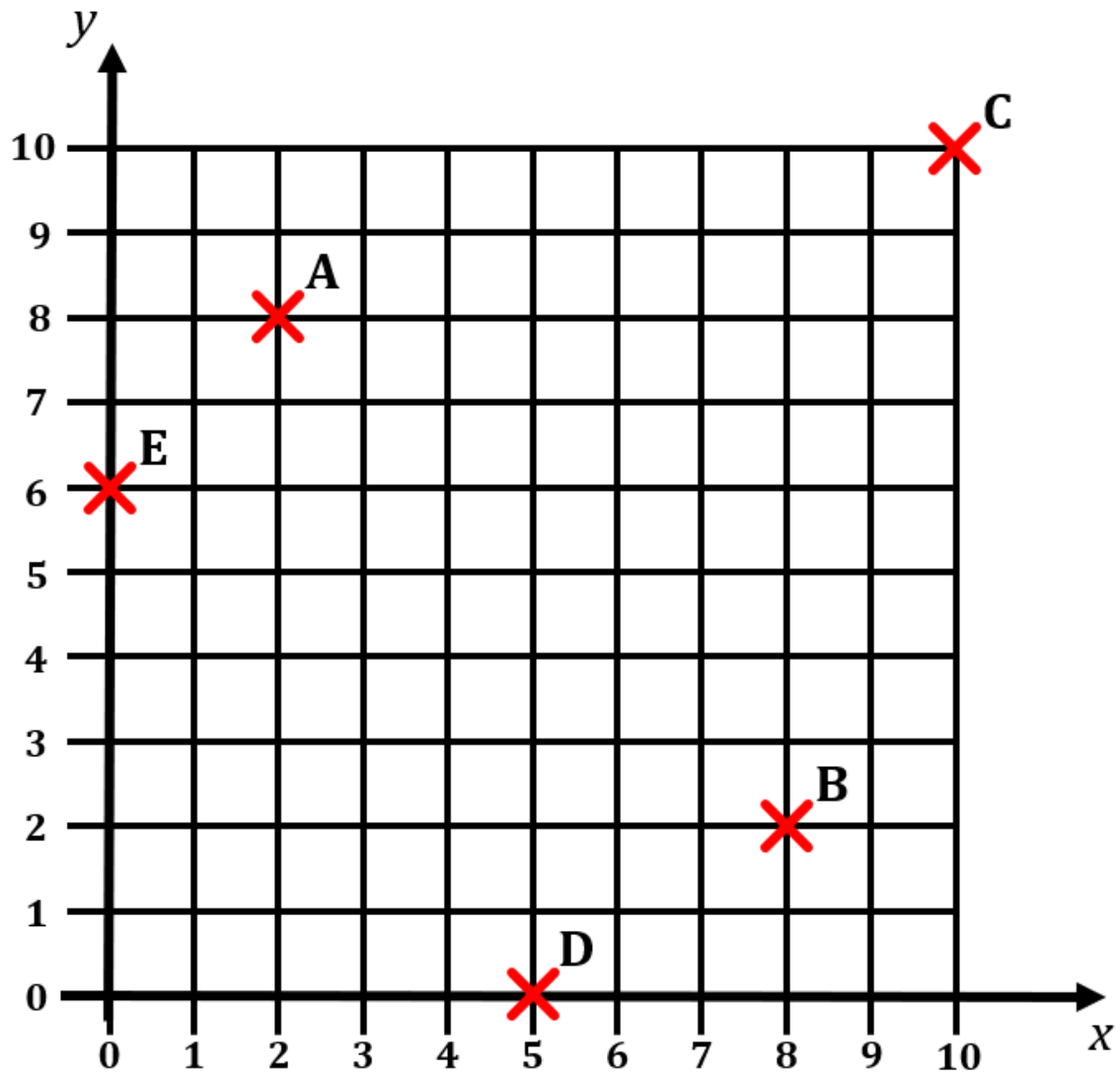
The second number is the **y co-ordinate.**

(x , y)



Example

What are the co-ordinates of the points A , B , C , D & E ?



Solutions

What are the co-ordinates of the points A , B , C , D & E ?

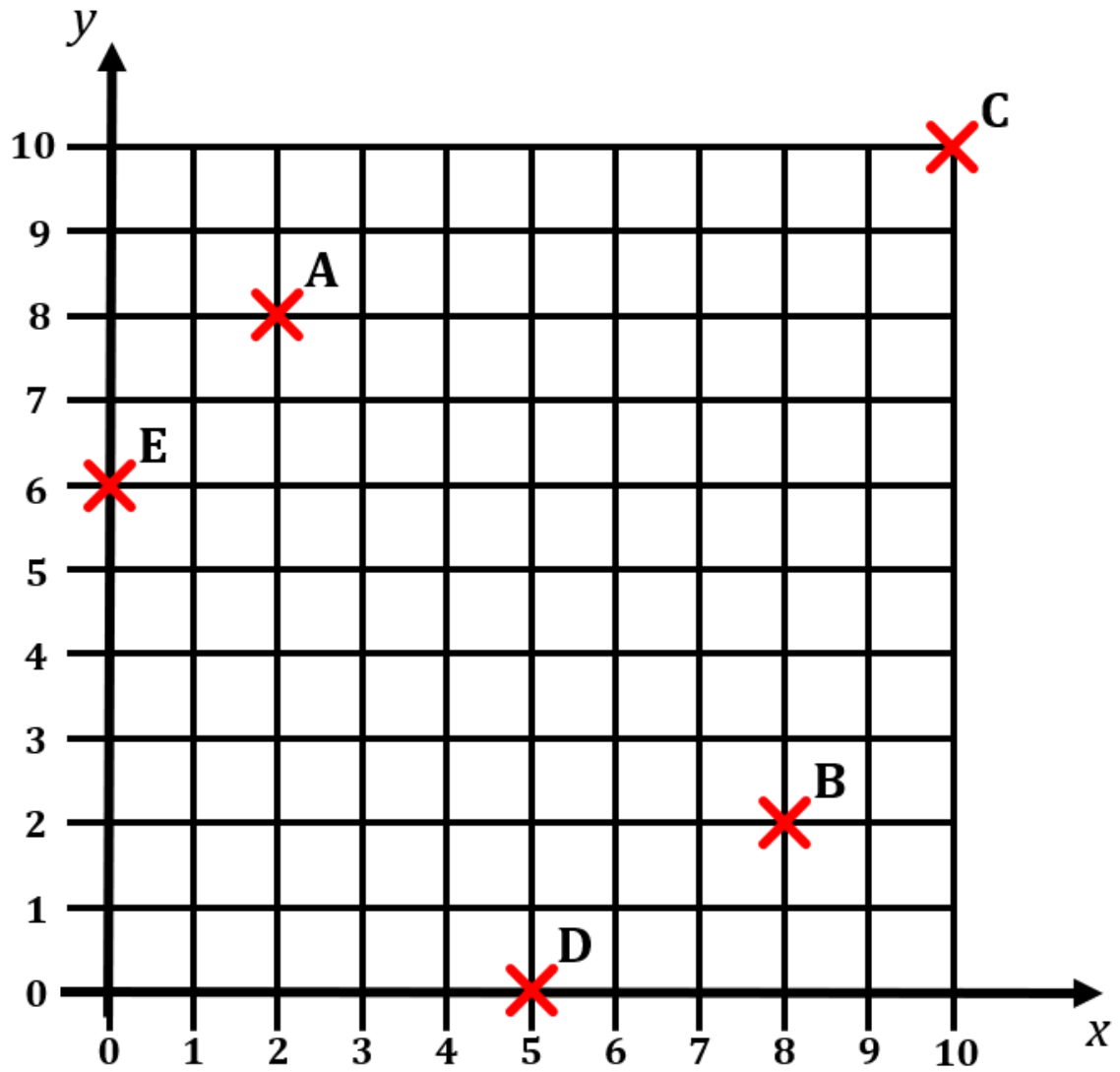
A **(2 , 8)**

B **(8 , 2)**

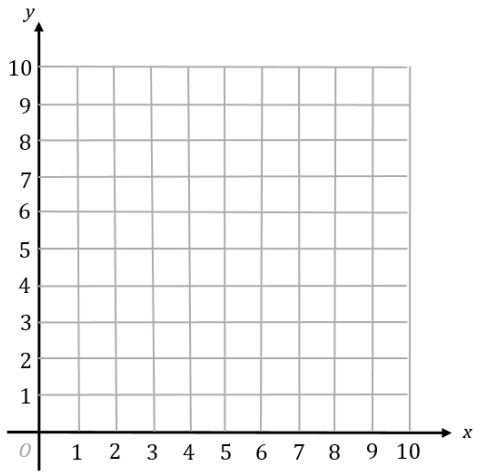
C **(10 , 10)**

D **(5 , 0)**

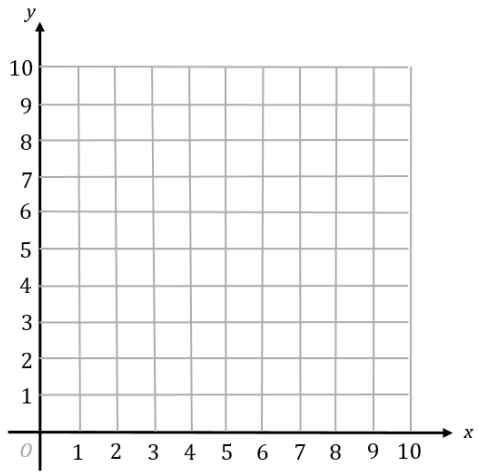
E **(0 , 6)**



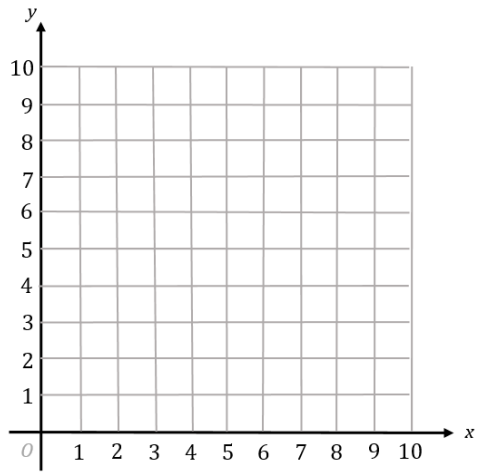
In each diagram, plot the points given by the co-ordinates and join the points with a ruler.
Write down the name of each of the quadrilaterals that you have drawn.



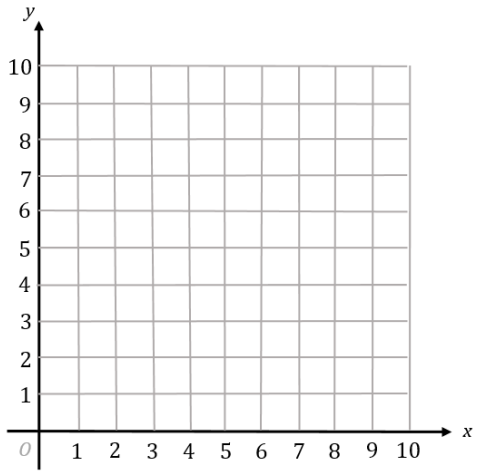
(2 , 2)
(8 , 2)
(8 , 8)
(2 , 8)



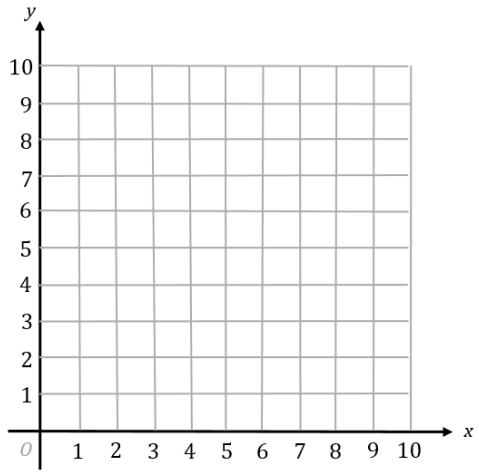
(2 , 3)
(8 , 3)
(8 , 7)
(2 , 7)



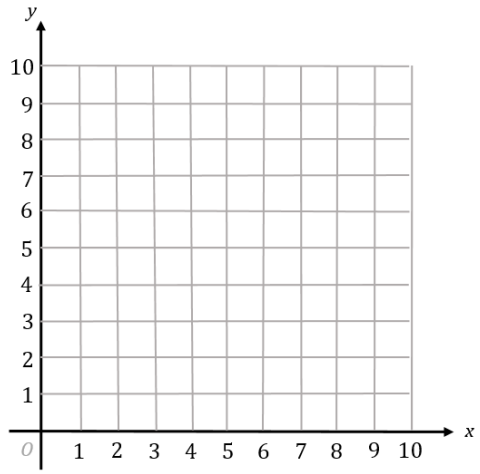
(5 , 2)
(8 , 6)
(5 , 8)
(2 ,6)



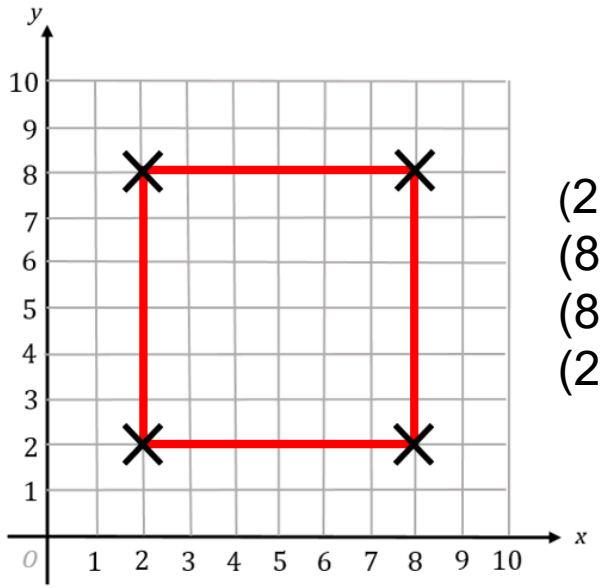
(2 , 2)
(7 , 2)
(9 , 6)
(4 , 6)



(2 , 2)
(8 , 2)
(6 , 6)
(4 , 6)

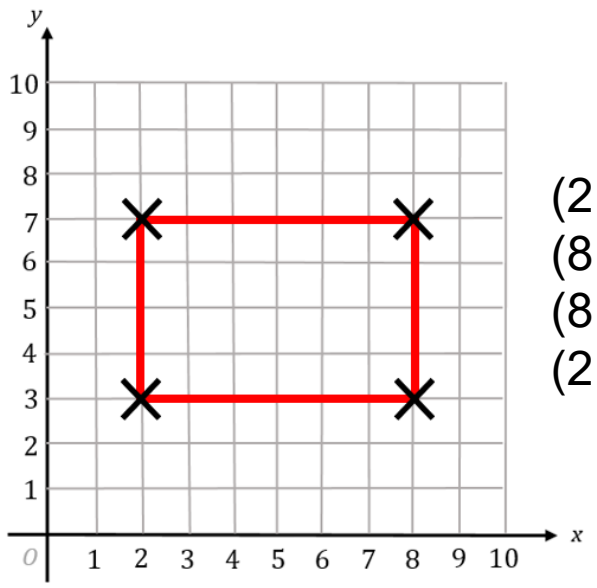


(5 , 2)
(9 , 5)
(5 , 8)
(1 , 5)



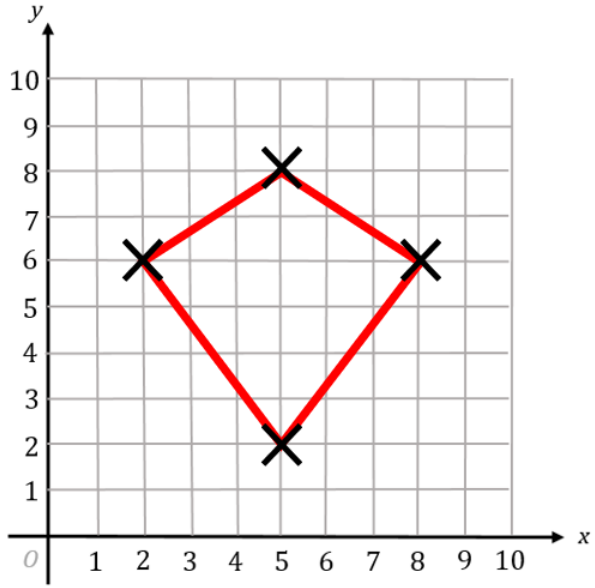
(2 , 2)
(8 , 2)
(8 , 8)
(2 , 8)

Square



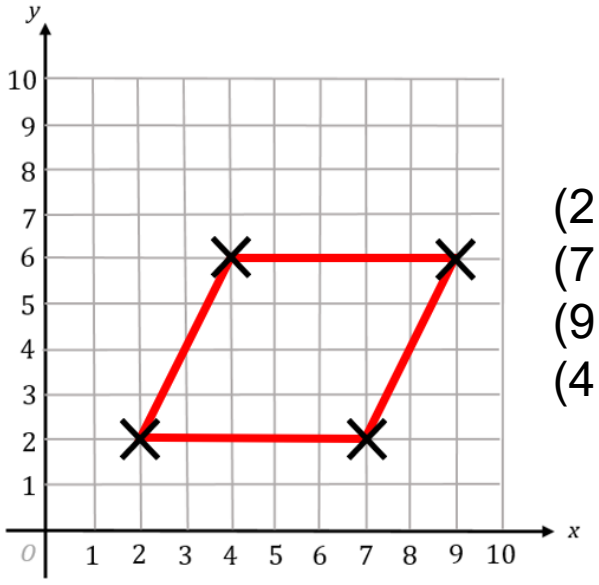
(2 , 3)
(8 , 3)
(8 , 7)
(2 , 7)

Rectangle



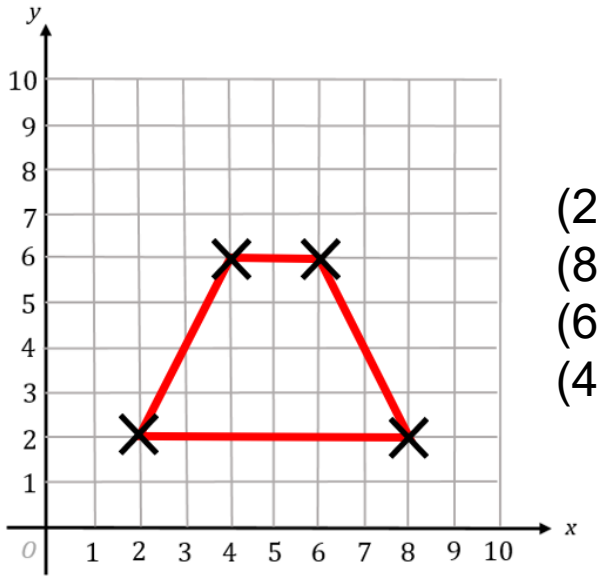
(5 , 2)
(8 , 6)
(5 , 8)
(2 , 6)

Kite



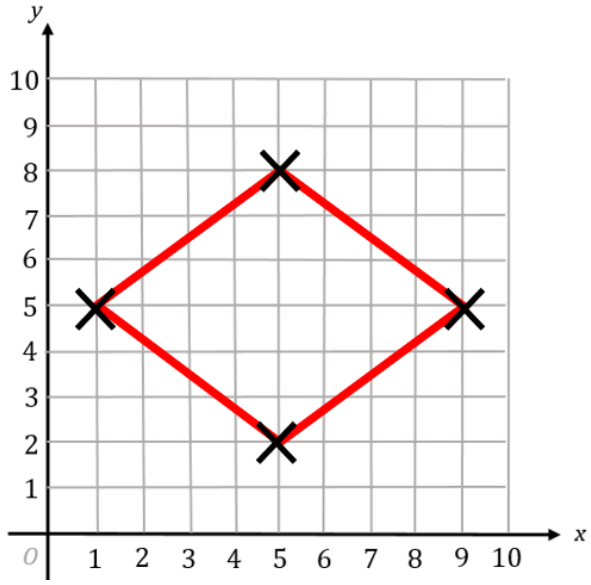
(2 , 2)
(7 , 2)
(9 , 6)
(4 , 6)

Parallelogram



(2 , 2)
(8 , 2)
(6 , 6)
(4 , 6)

Trapezium



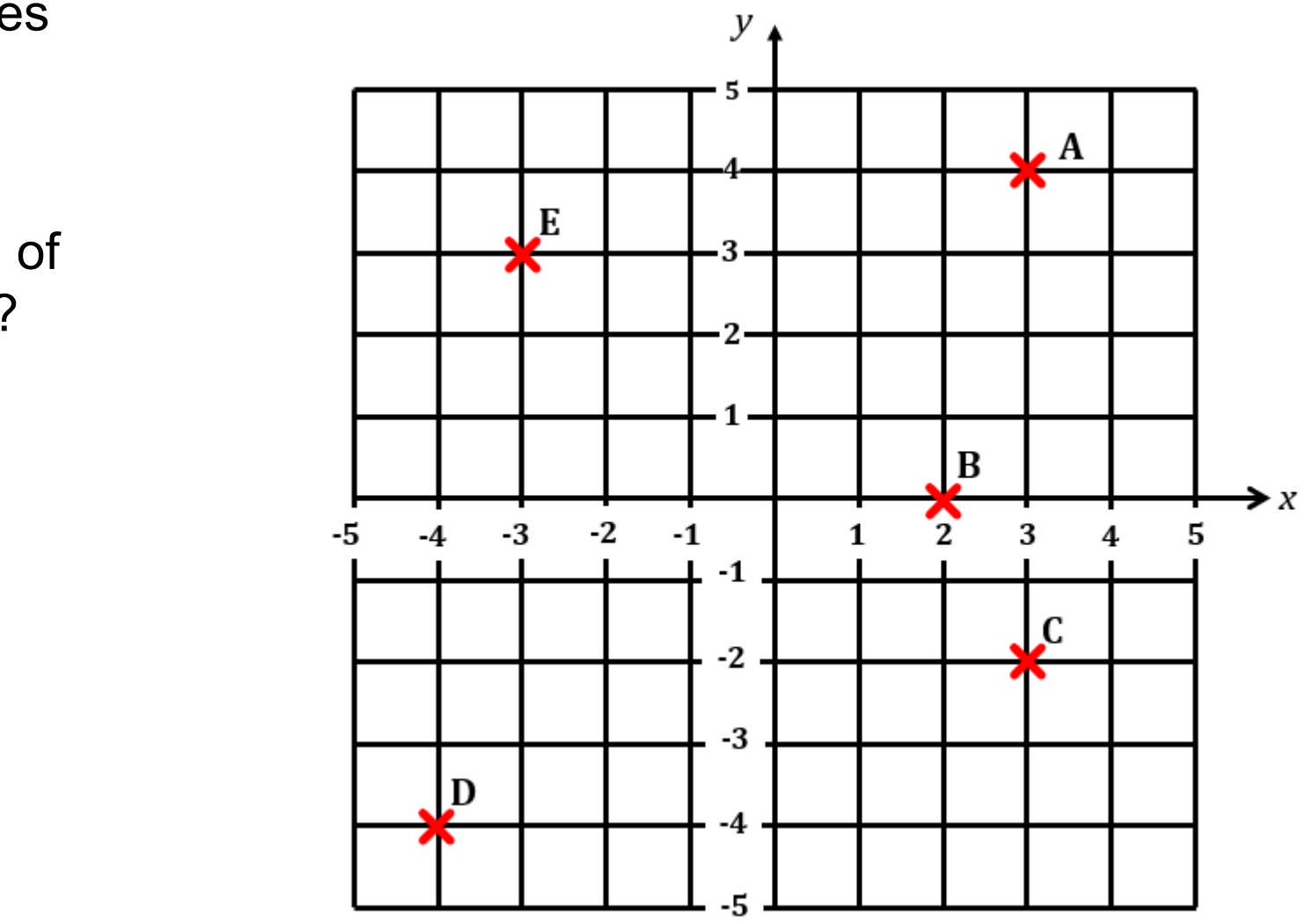
(5 , 2)
(9 , 5)
(5 , 8)
(1 , 5)

Rhombus

Question

We can extend co-ordinates to negative numbers.

What are the co-ordinates of the points A , B , C , D , E?



Solution

We can extend co-ordinates to negative numbers.

What are the co-ordinates of the points A , B , C , D , E?

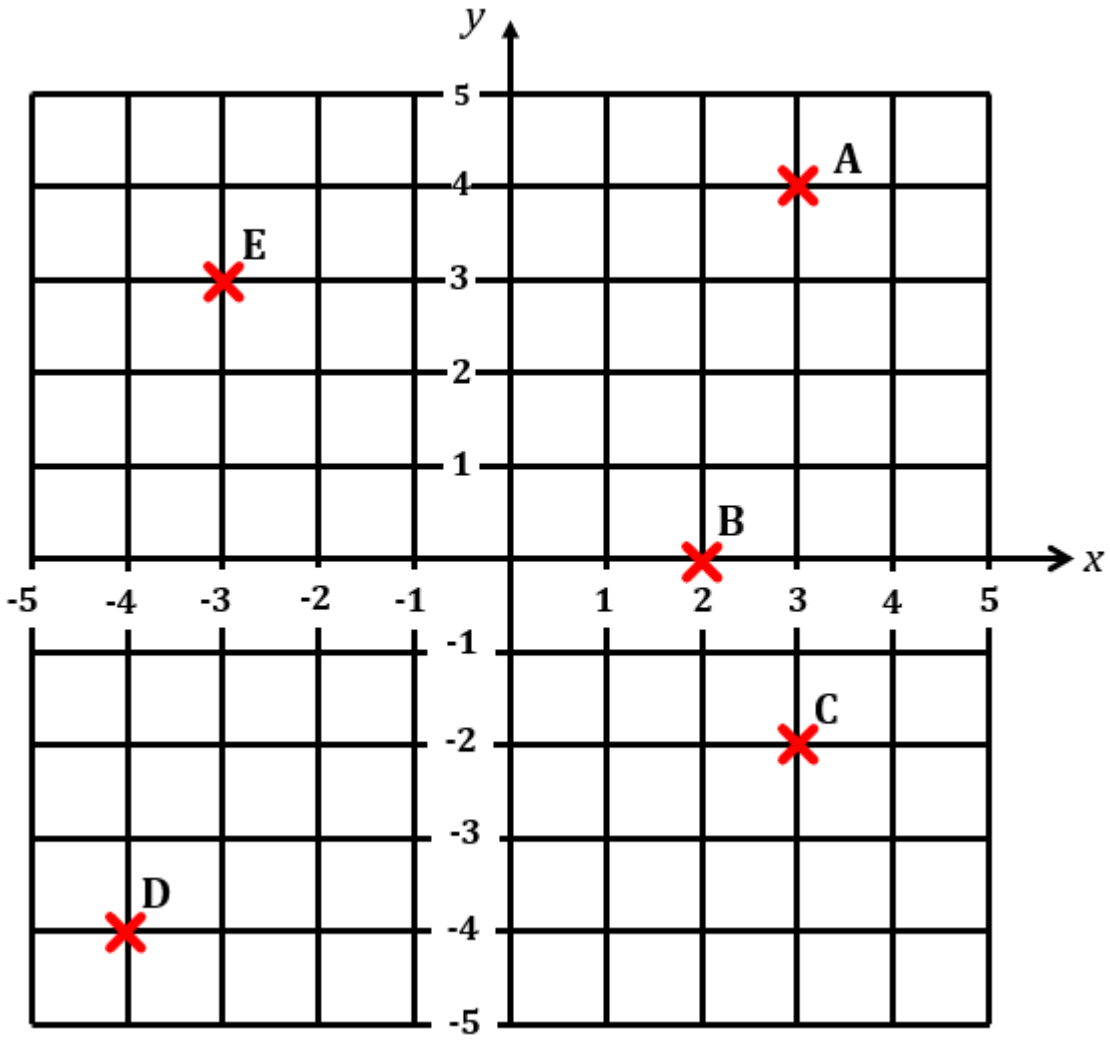
A **(4 , 4)**

B **(2 , 0)**

C **(3 , - 2)**

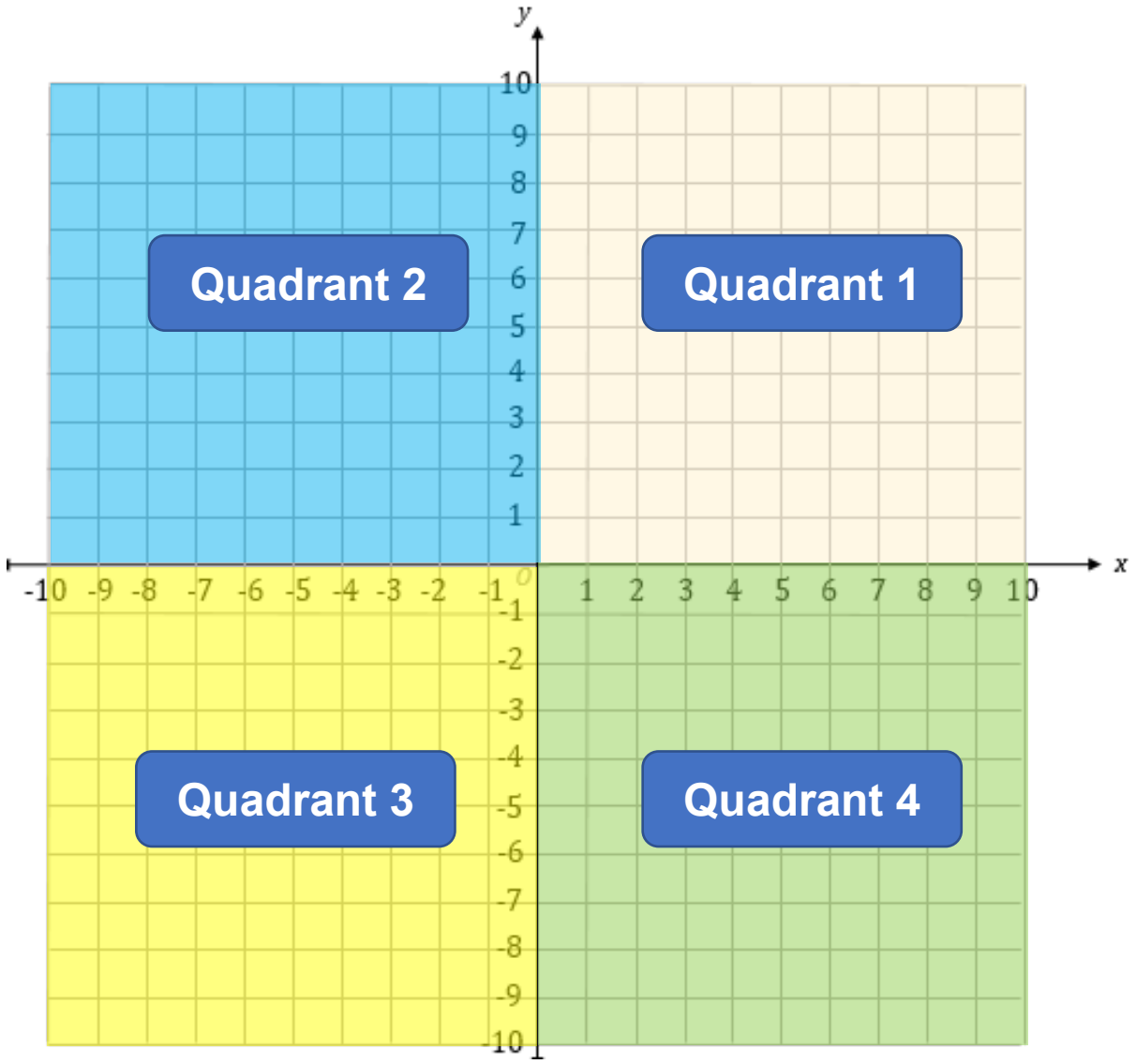
D **(- 4 , - 4)**

E **(- 3 , 3)**



Key Fact

The x axis and y axis divide the co ordinate grid into four **quadrants**.



Question

In which quadrant do the following points lie?

a) (- 1 , 5)

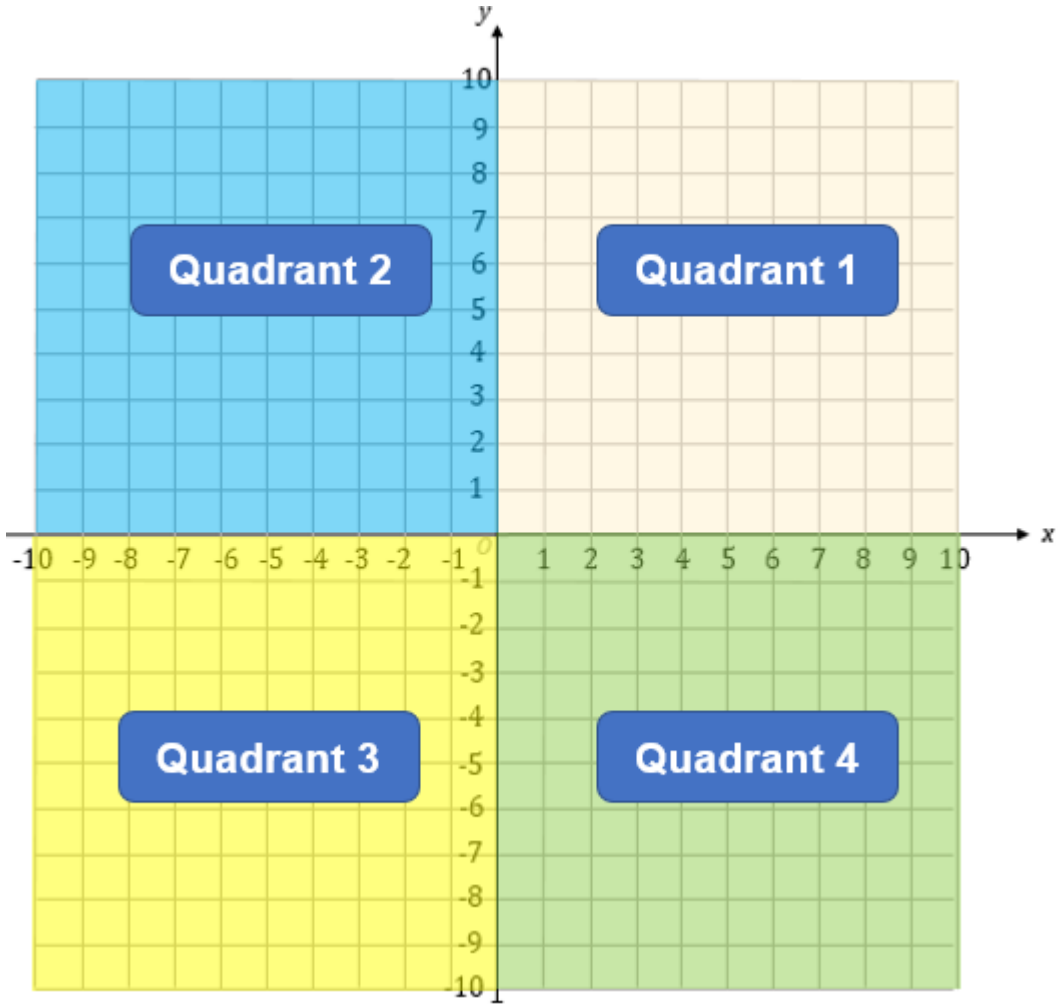
b) (3 , 3)

c) (- 2 , - 4)

d) (4 , - 3)

e) (0 , 0)

f) (- 7 , 0)



Solution

a) (- 1 , 5) **2nd Quadrant**

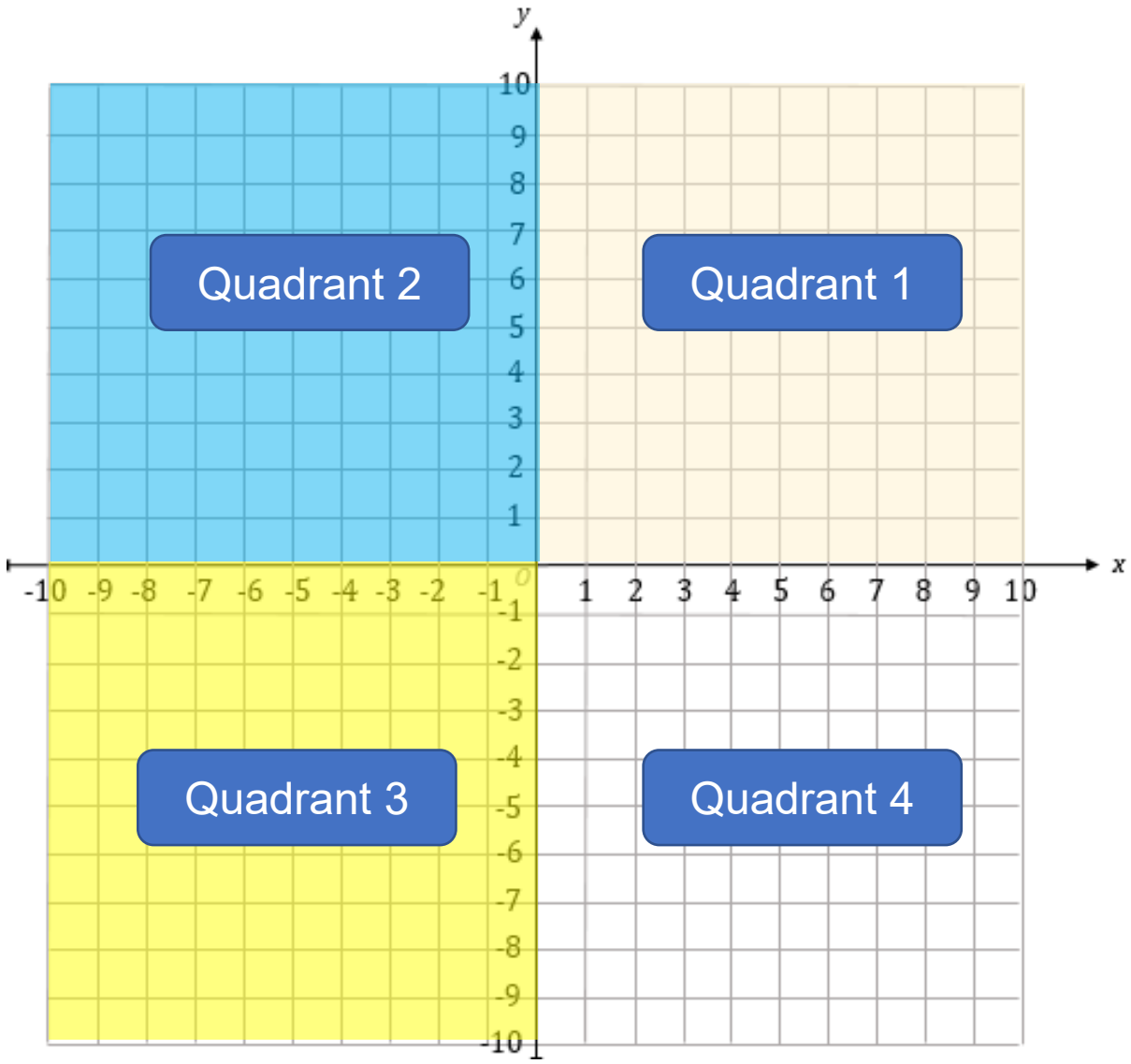
b) (3 , 3) **1st Quadrant**

c) (- 2 , - 4) **3rd Quadrant**

d) (4 , - 3) **4th Quadrant**

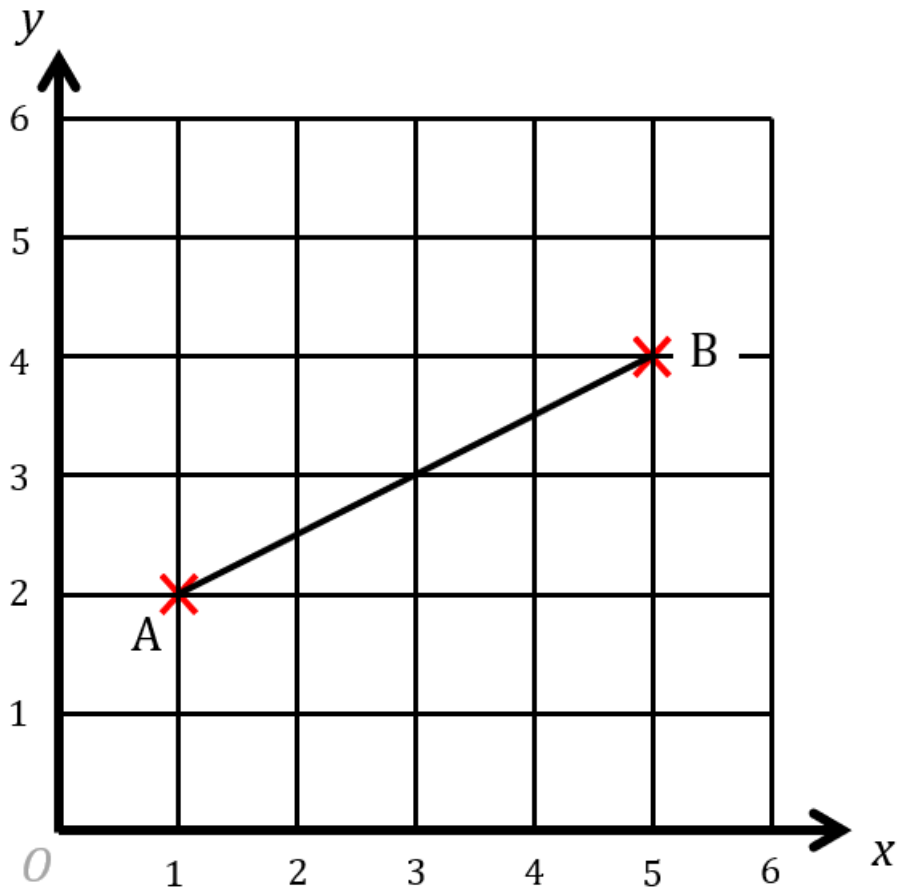
e) (0 , 0) **All 4 Quadrants**

f) (- 7 , 0) **Quadrants 2 & 3**



Question

Where is the midpoint of the line segment AB?

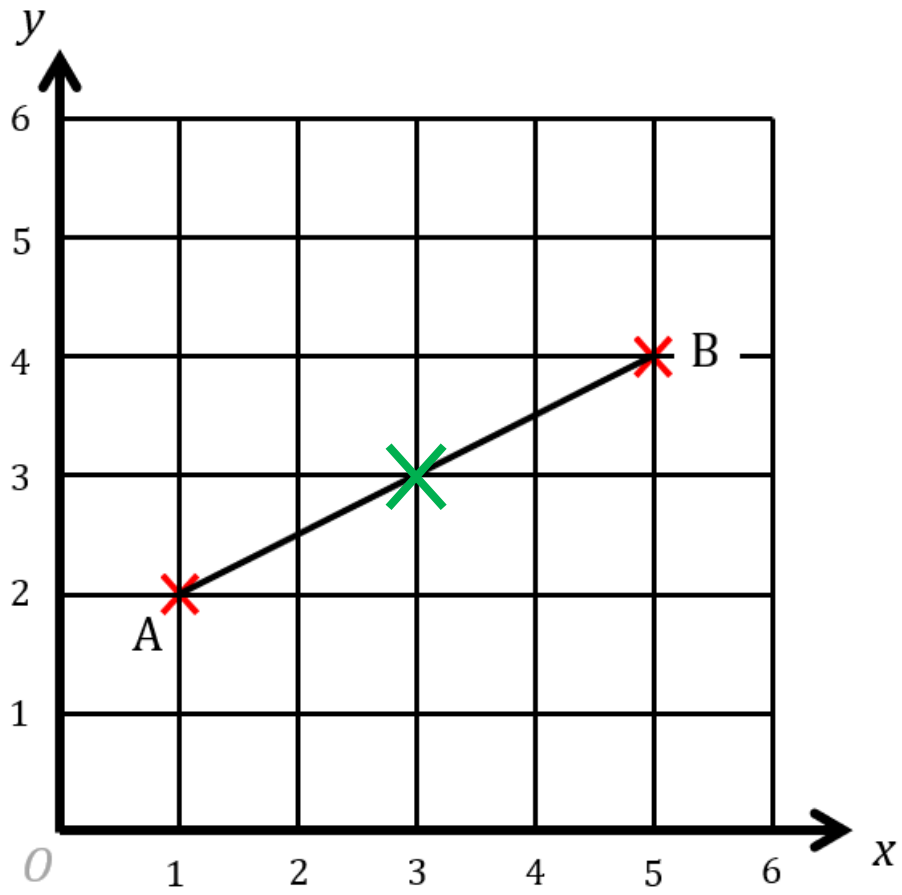


Solution

A (1 , 5)

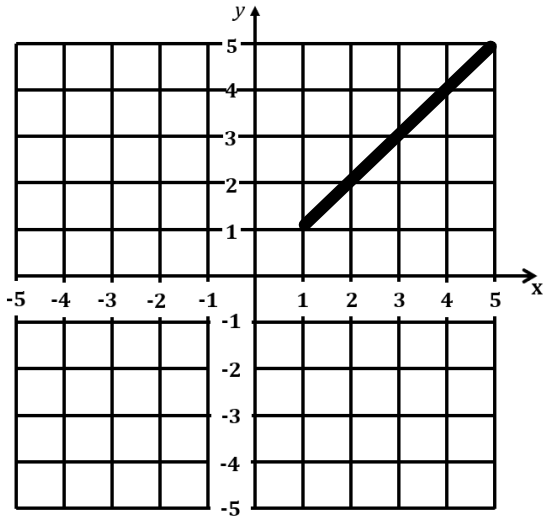
B (3 , 3)

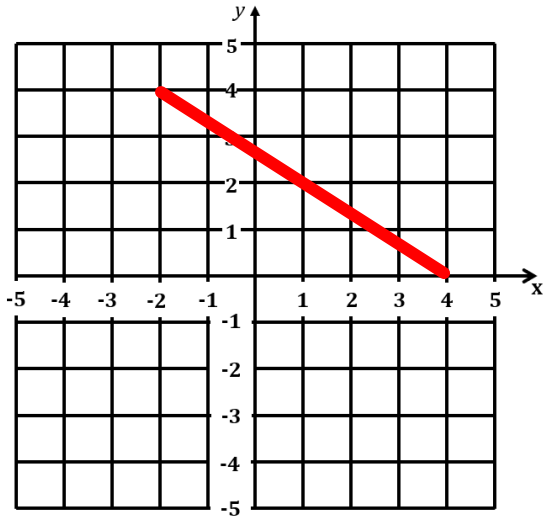
The midpoint is at **(3 , 3)**.

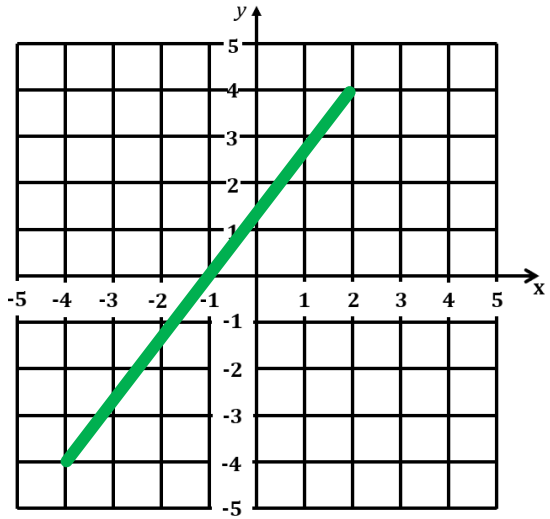


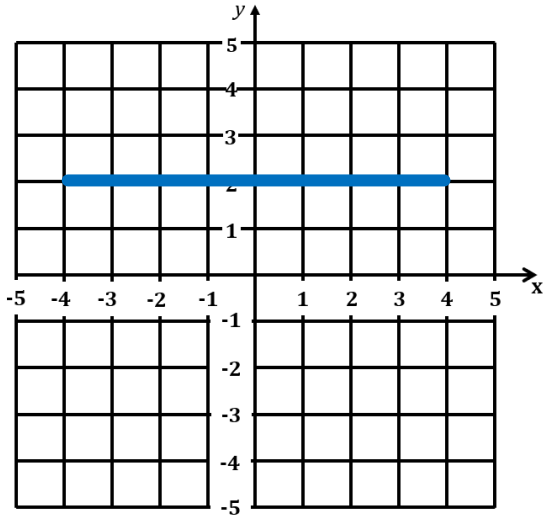
Exercise

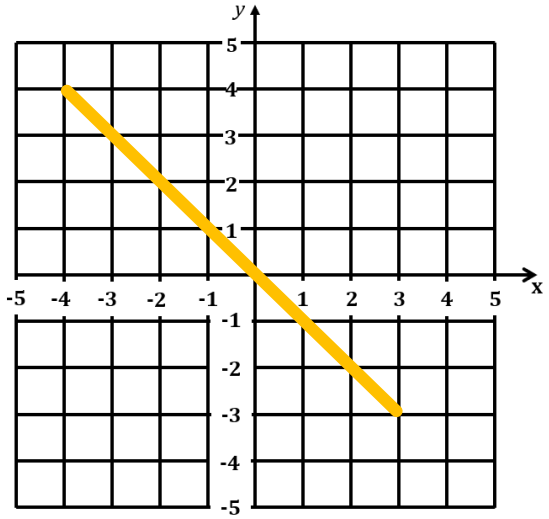
Find the midpoint of each line segment.

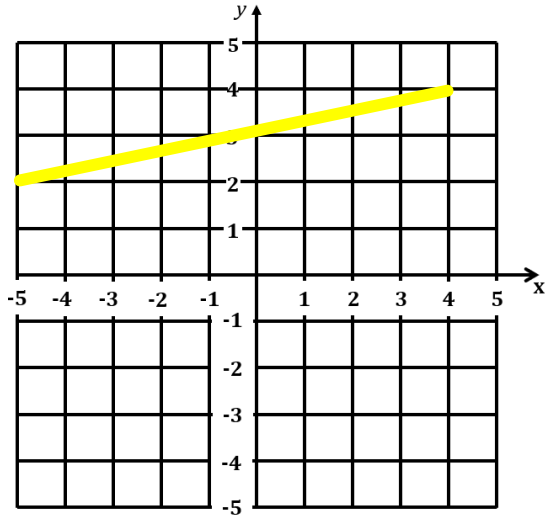






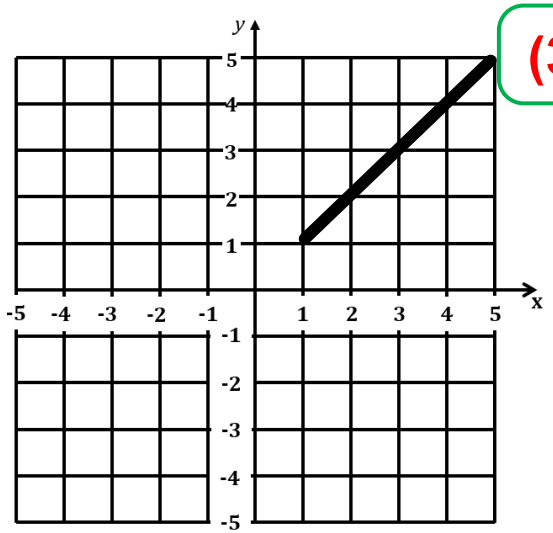




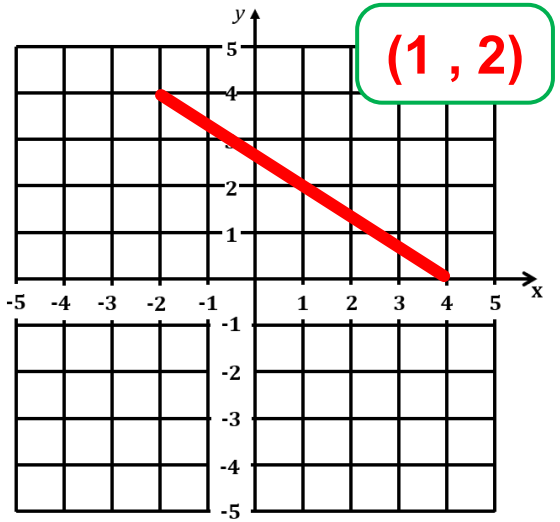


Solutions

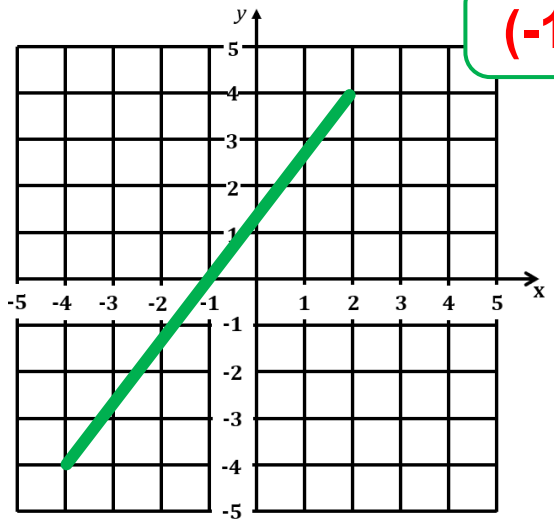
Find the midpoint of each line segment.



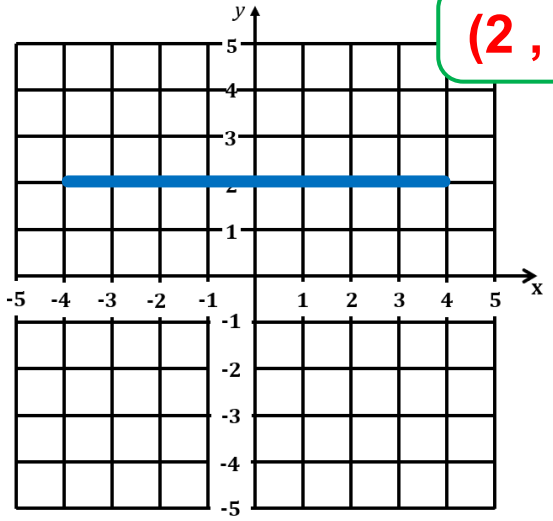
(3 , 3)



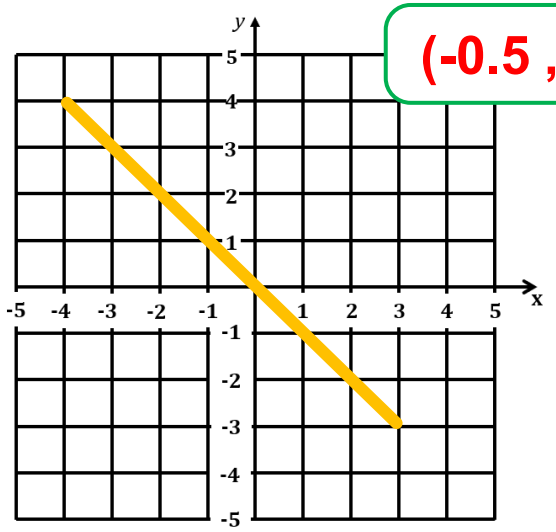
(1 , 2)



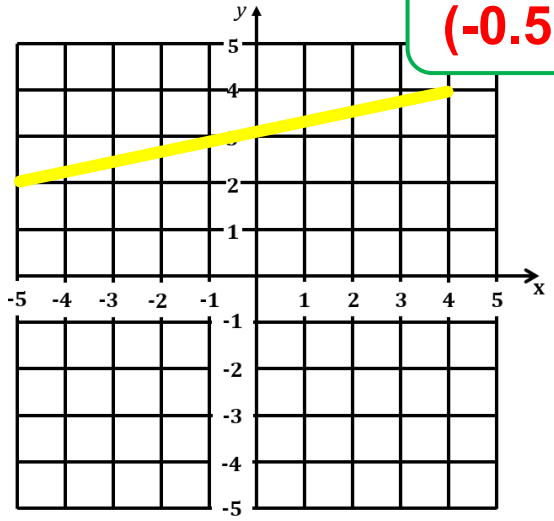
(-1 , 0)



(2 , 0)



(-0.5 , 0.5)



(-0.5 , 3)

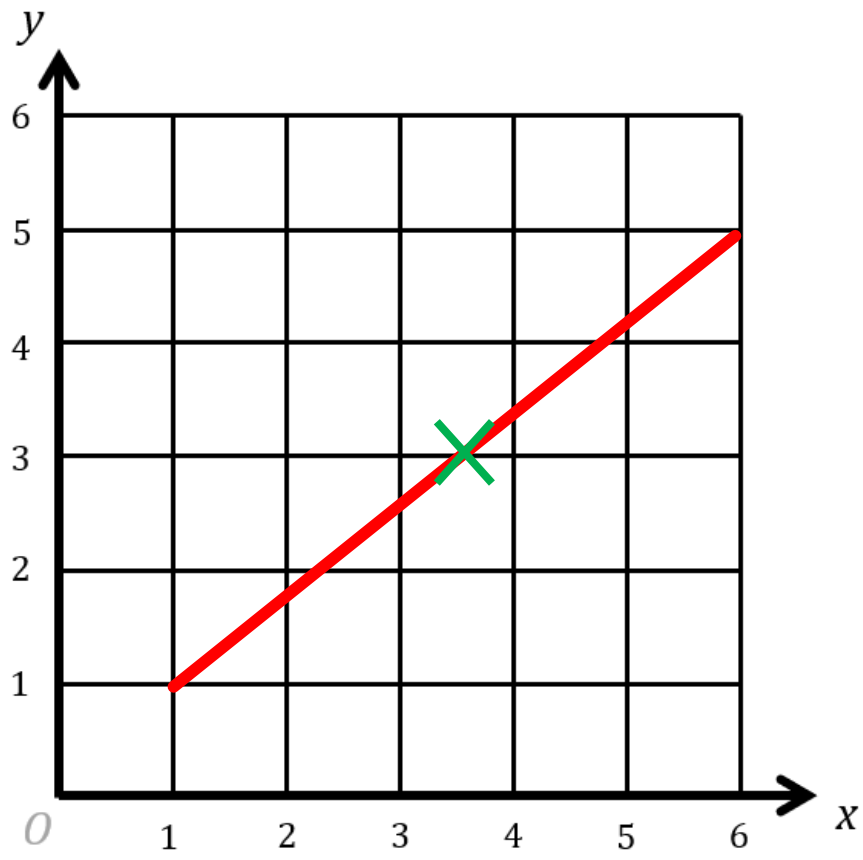
Key Fact

You can find the midpoint of a line segment as follows:

Midpoint of (1 , 1) and (6 , 5)

$$= \left(\frac{1+6}{2}, \frac{1+5}{2}\right)$$

$$= \underline{(3.5, 3)}$$



Exercise

Find the midpoint of the line segment joining each pair of points?

a) (1 , 1) and (5 , 5)

b) (2 , 6) and (8 , 12)

c) (0 , 0) and (3 , 6)

d) (1 , 1) and (5 , 5)

e) (- 4 , 8) and (8 , 4)

f) (- 1 , - 1) and (4 , 5)

g) (- 4 , - 2) and (- 2 , - 4)

h) (1.5 , - 3) and (4 , 0)

i) $(1\frac{3}{4}, 3\frac{1}{2})$ and $(4\frac{1}{2}, -1)$

Solutions

Find the midpoint of the line segment joining each pair of points?

a) (1 , 1) and (5 , 5)

(3 , 3)

b) (2 , 6) and (8 , 12)

(5 , 9)

c) (0 , 0) and (3 , 6)

(1.5 , 3)

d) (1 , 1) and (5 , 5)

(2 , 2)

e) (- 4 , 8) and (8 , 4)

(2 , 6)

f) (- 1 , - 1) and (4 , 5)

(1.5 , 2)

g) (- 4 , - 2) and (- 2 , - 4)

(-3 , -3)

h) (1.5 , - 3) and (4 , 0)

(2.75 , -1.5)

i) $(1\frac{3}{4}, 3\frac{1}{2})$ and $(4\frac{1}{2}, -1)$

$(3\frac{1}{8}, 1\frac{1}{4})$

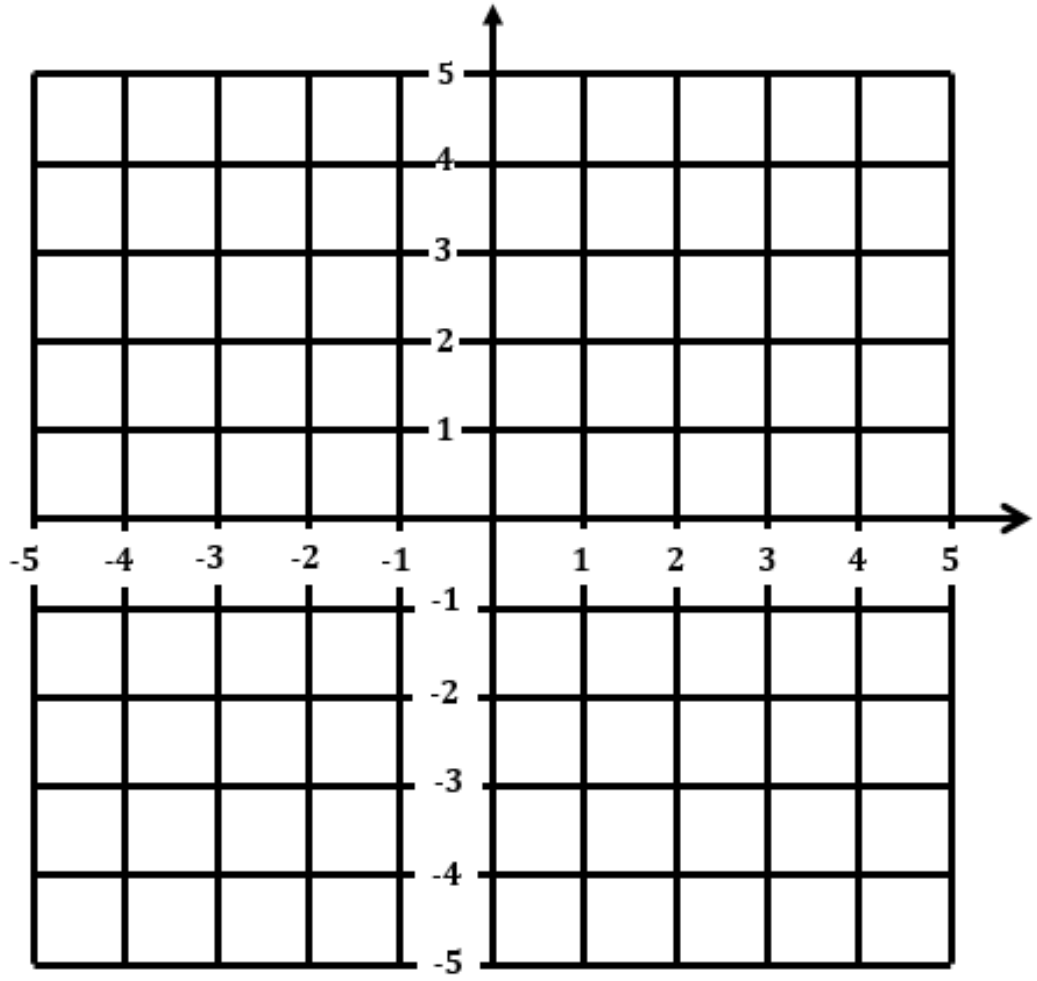
Straight Line Graphs

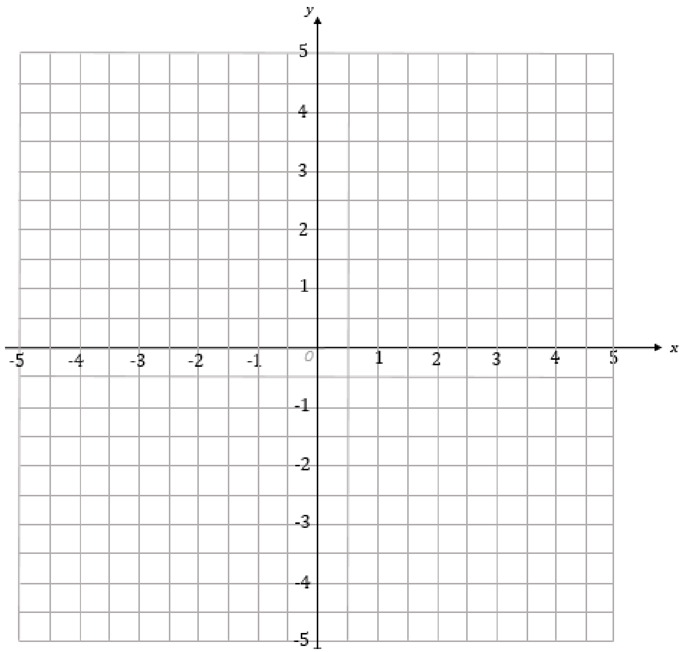
Plot these points on a co-ordinate grid.

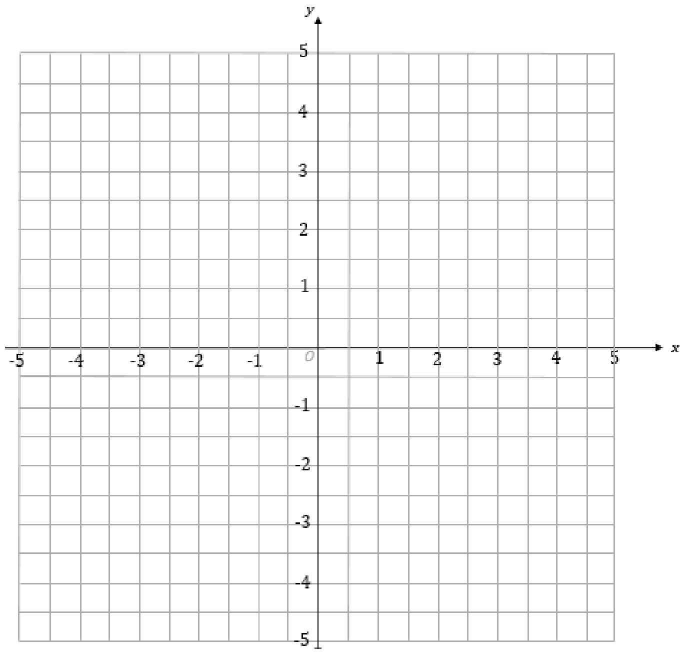
(- 5 , 3) (- 3 , 3) (0 , 3)

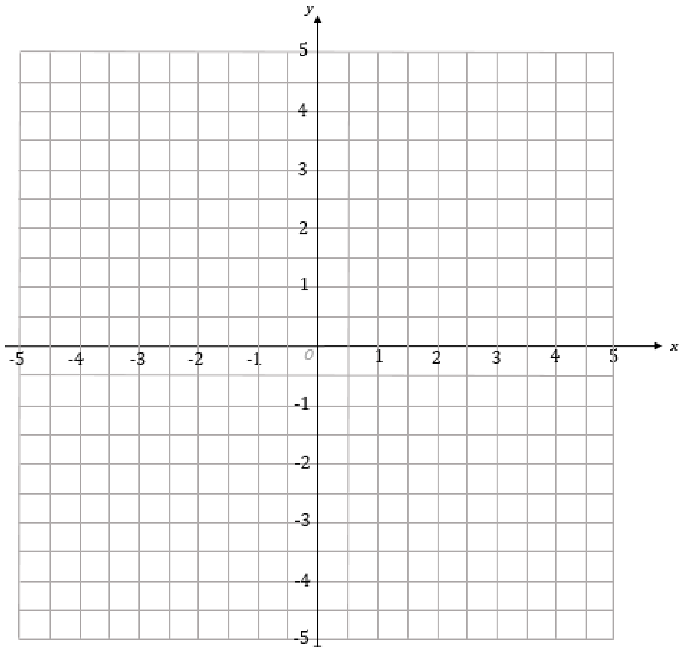
(2 , 3) (4 , 3)

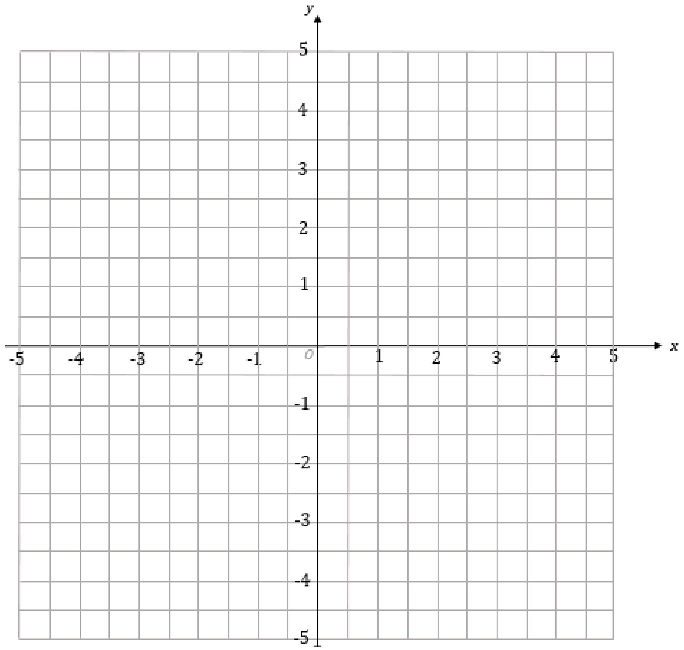
What do you notice about the points that you have plotted?

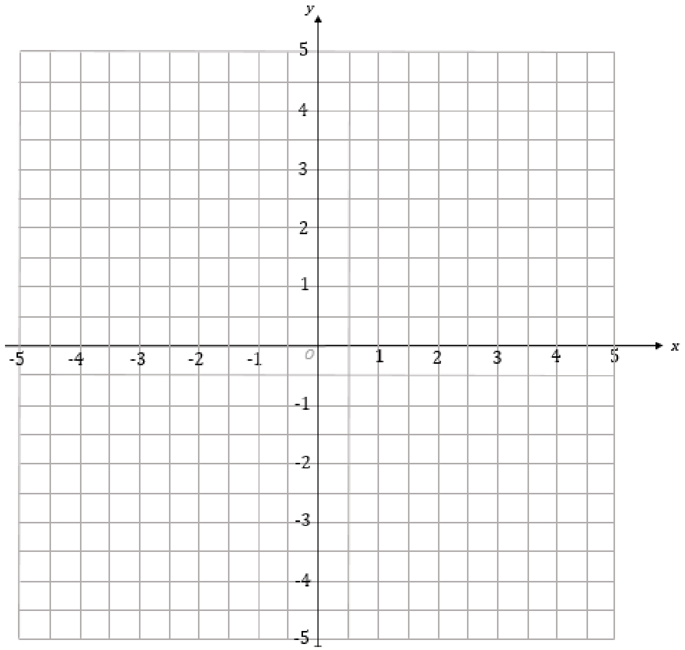


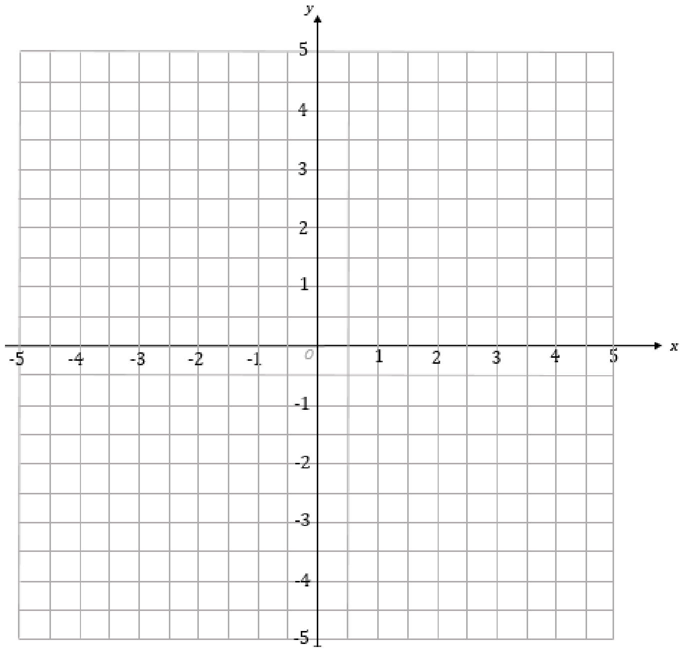

y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5

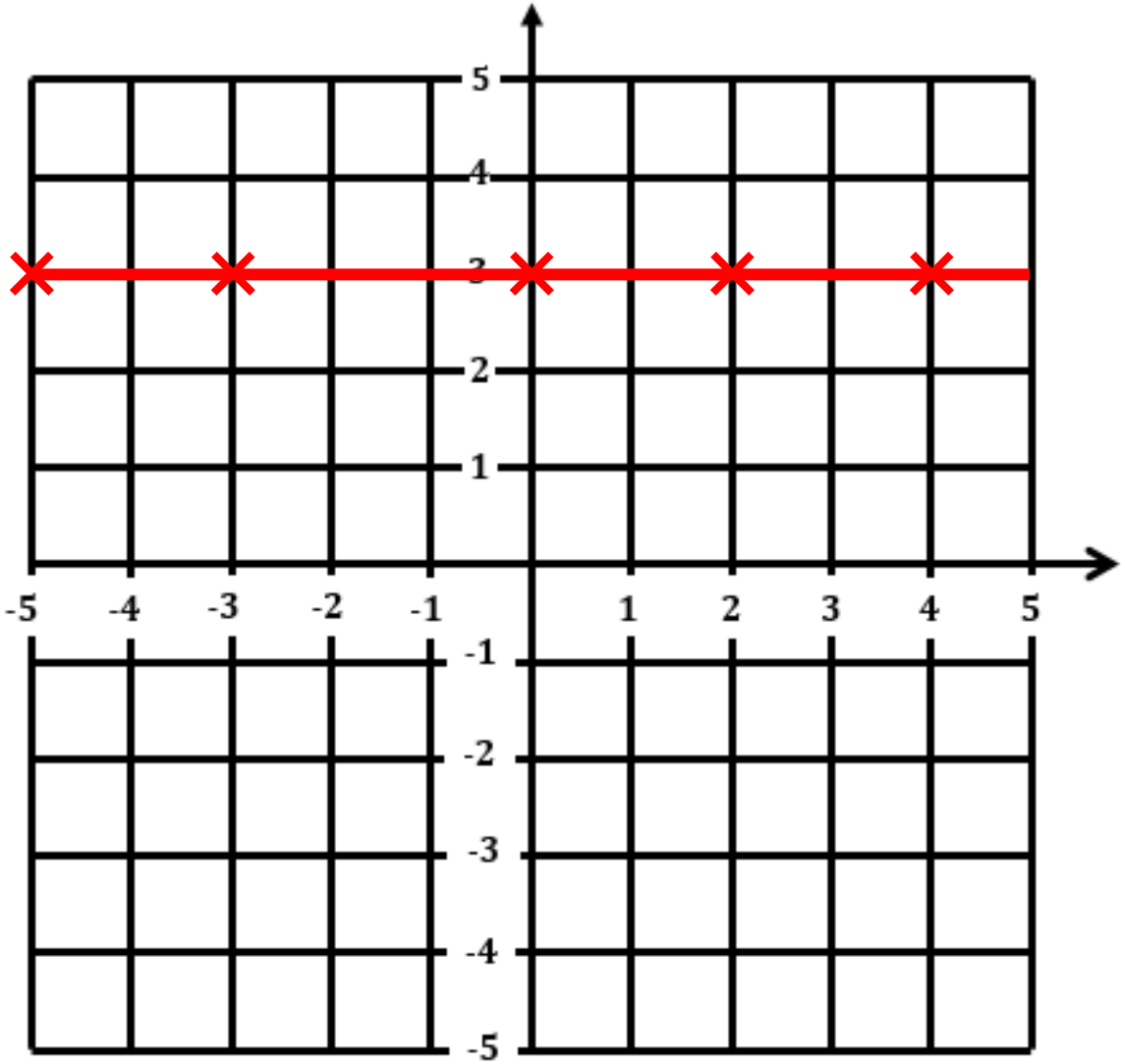
Straight Line Graphs

(- 5 , 3) (- 3 , 3) (0 , 3)

(2 , 3) (4 , 3)

The points all lie on a straight line.

This **graph** is called y = 3.



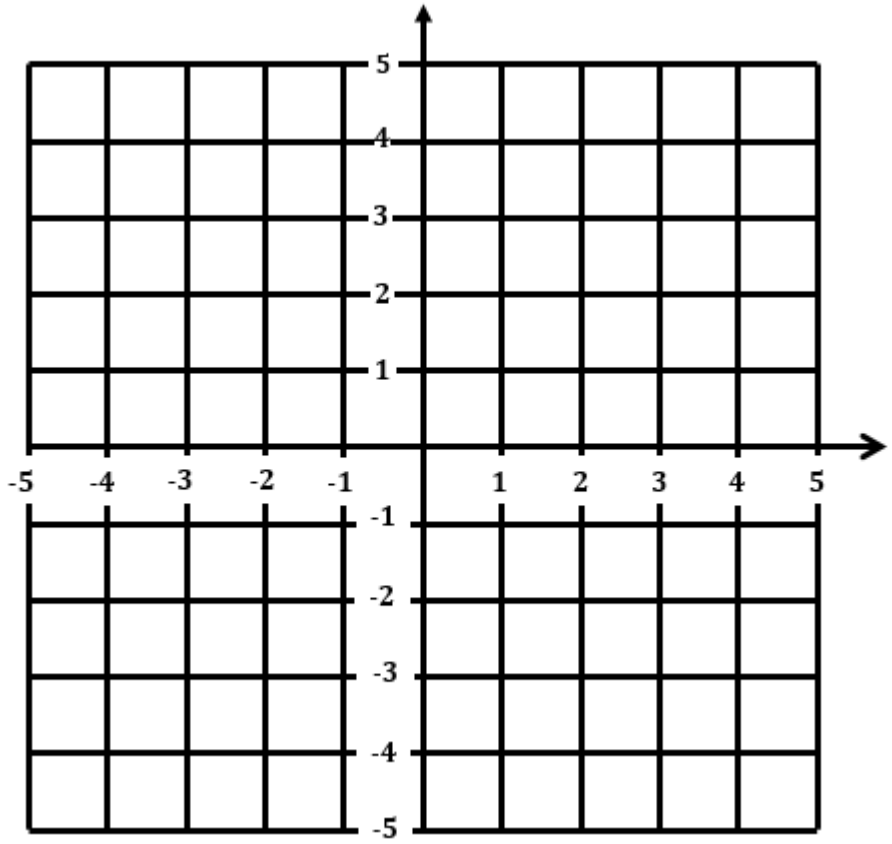
Exercise

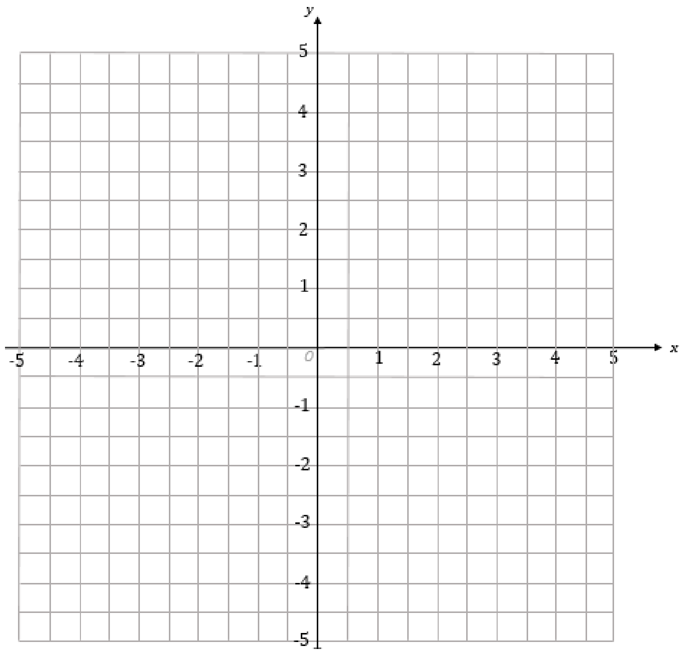
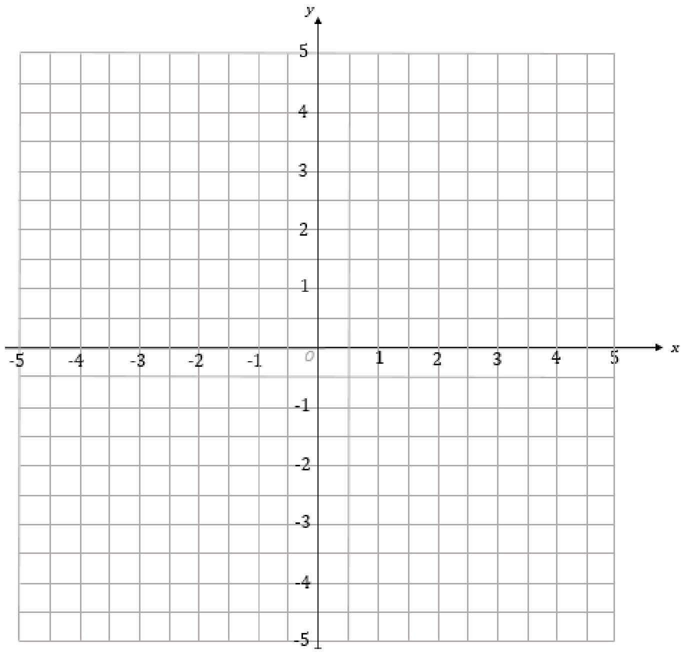
Draw the graphs of these equations.

y = 1 y = - 4

x = 5 x = 0

Challenge : Draw the graph of x + y = 4




y
x
5
4
3
2
1
0
-1
-2
-3
-4
-5
-5
-4
-3
-2
-1
1
2
3
4
5

y
x
5
4
3
2
1
0
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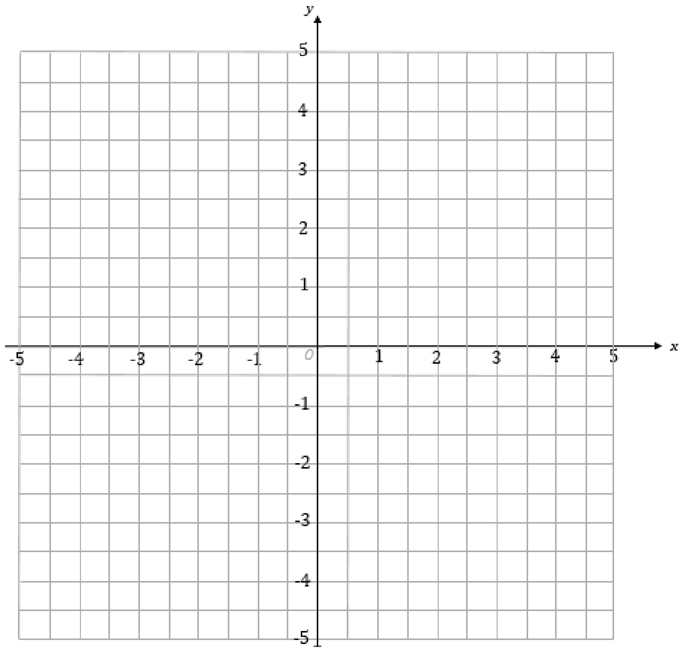
-2
-3
-4
-5
-5
-4
-3
-2
-1
1
2
3
4
5

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x
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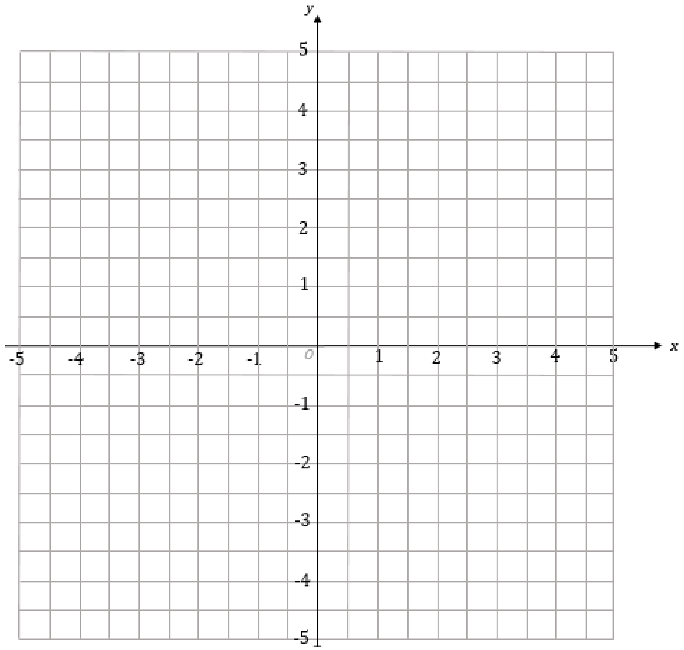
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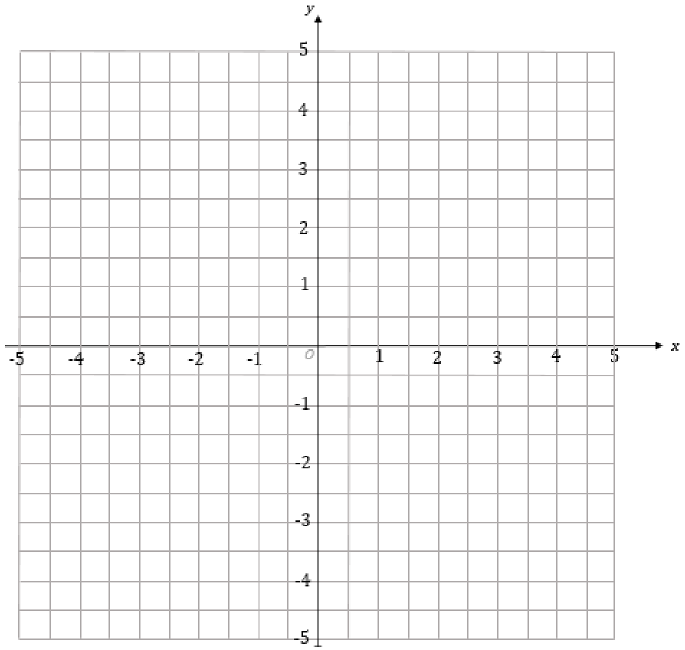
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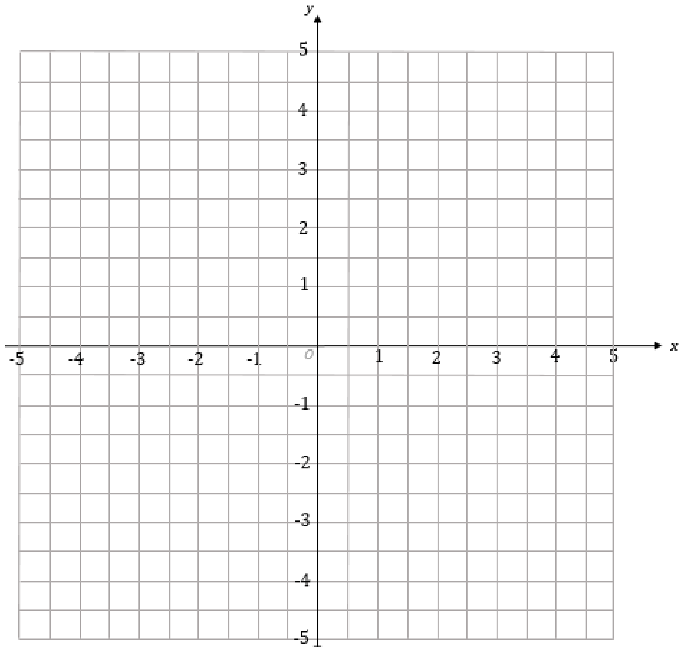
y
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-1
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-3
-4
-5
-5
-4
-3
-2
-1
1
2
3
4
5

Solutions

Draw the graphs of these equations.

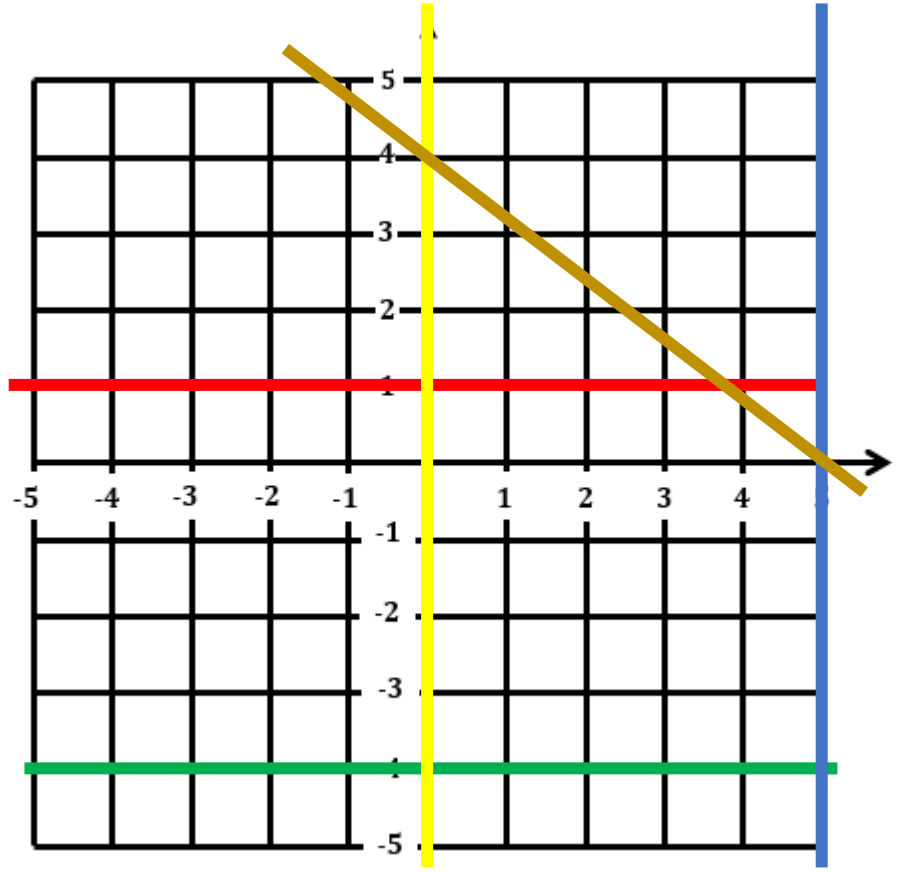
y = 1

y = - 4

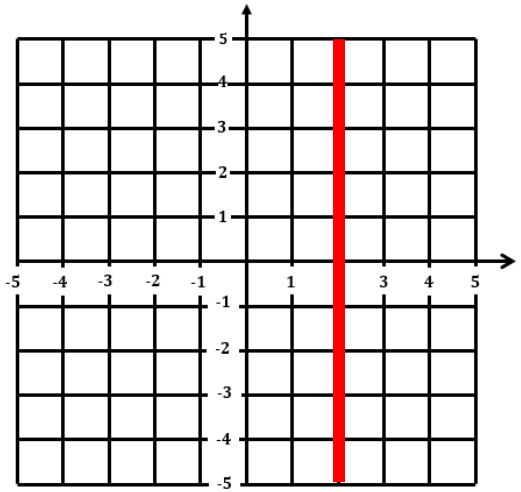
x = 5

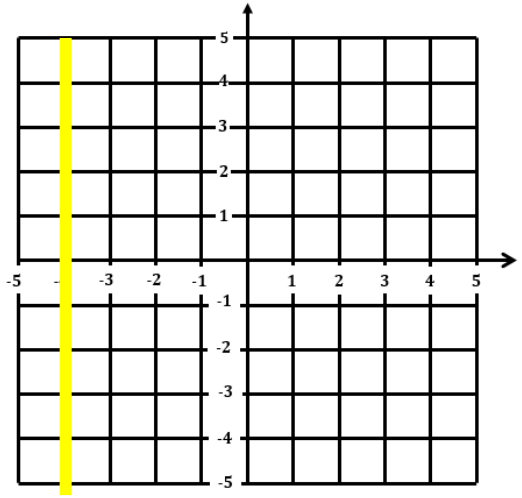
x = 0

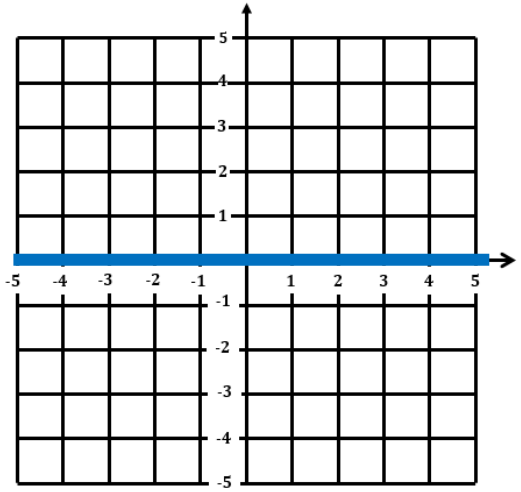
Challenge: Draw the graph of x + y = 4

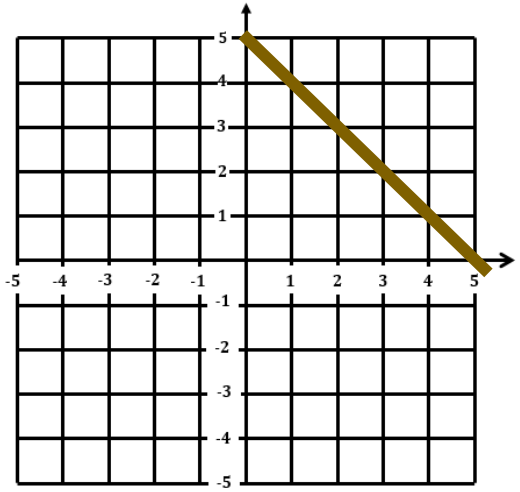


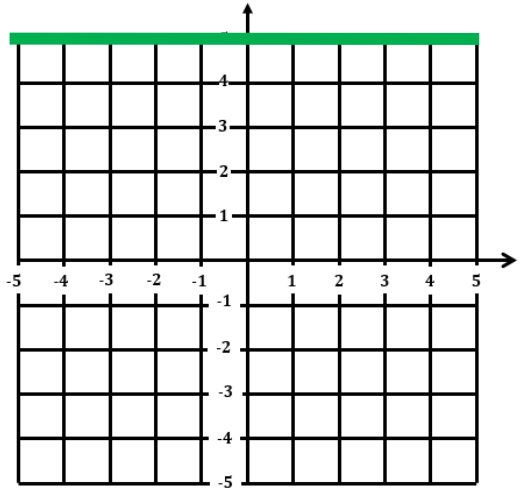
Match the graphs with their equations











y = 5

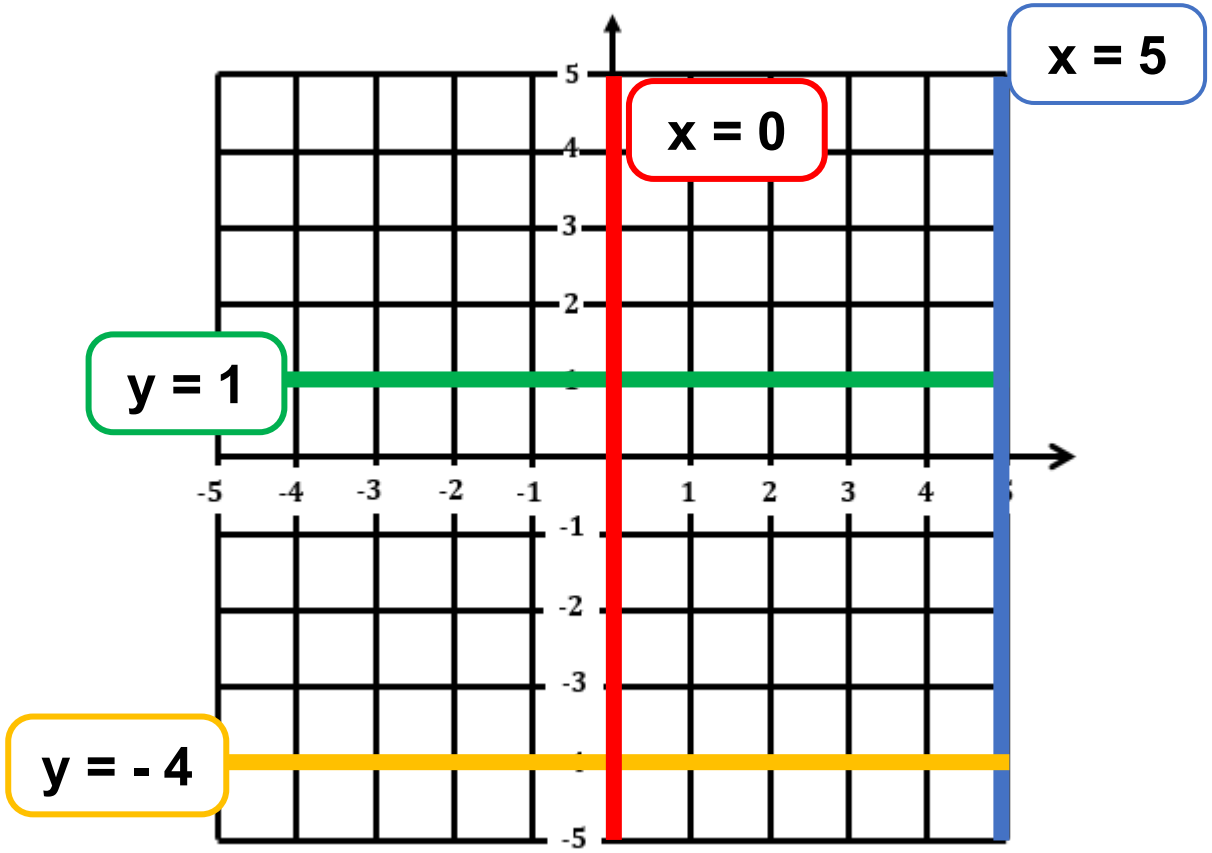
x + y = 5

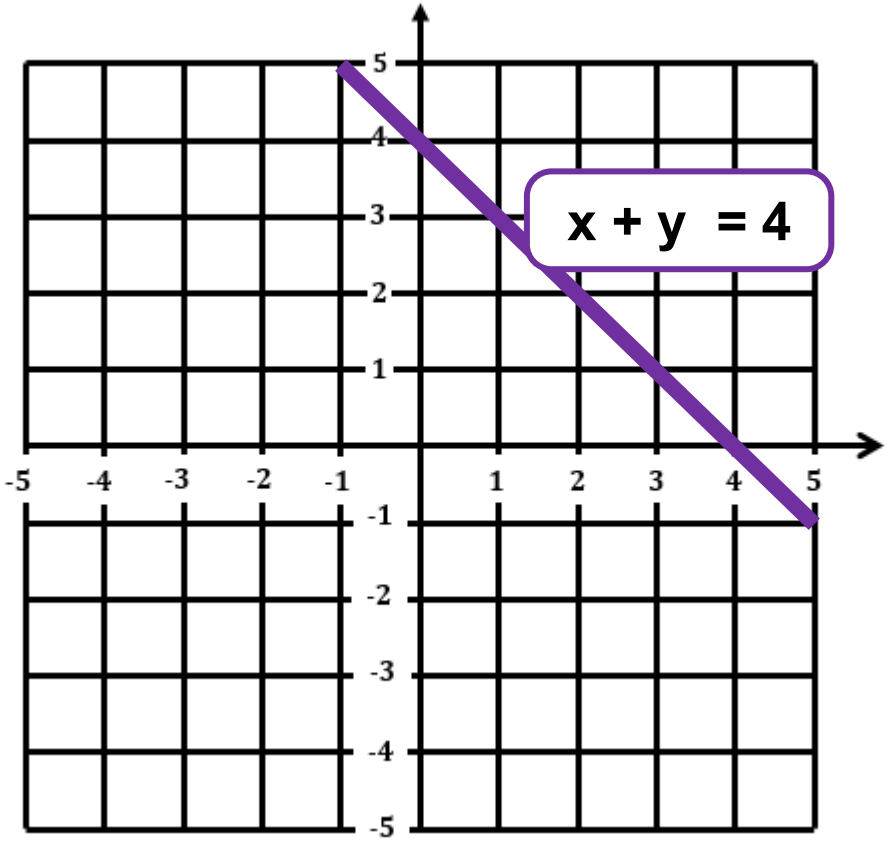
x = - 4

x = 2

y = 0

Solutions





x + y = 4 passes through
(0 , 4) , (1 , 3) , (2 , 2) …

Other Straight Line Graphs

Plot these points on a co-ordinate grid.

(-5 , -5)

(-3 , -3)

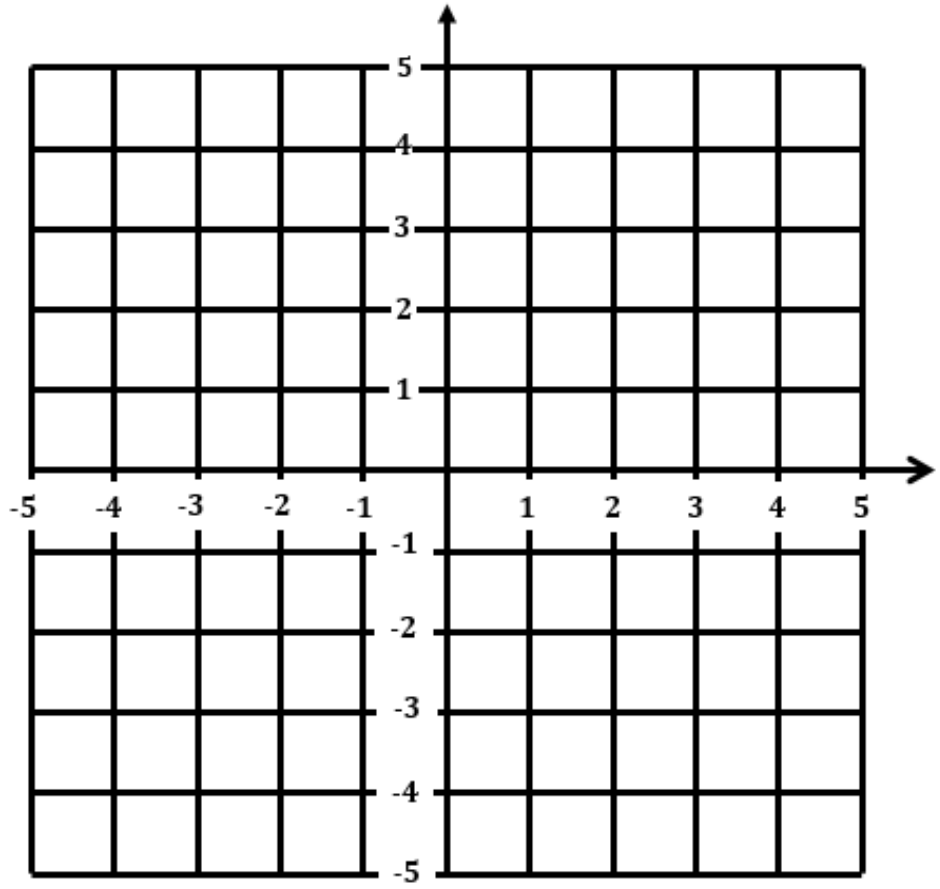
(0 , 0)

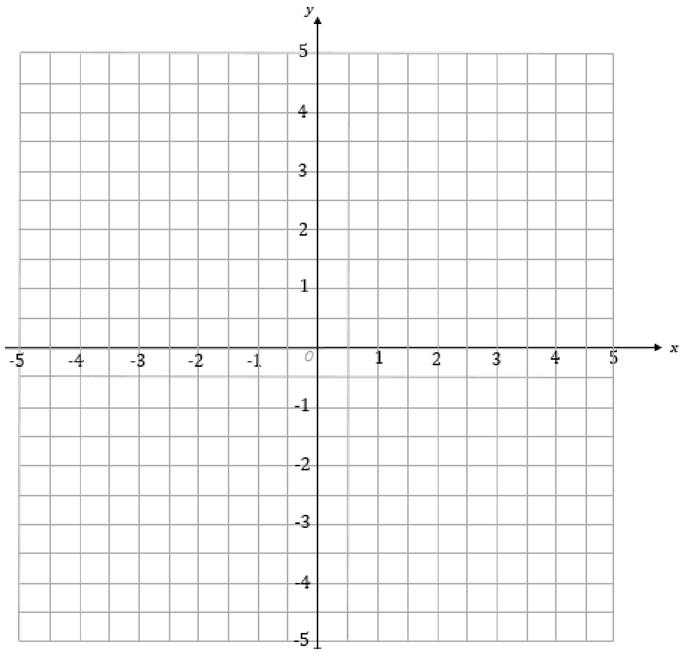
(2 , 2)

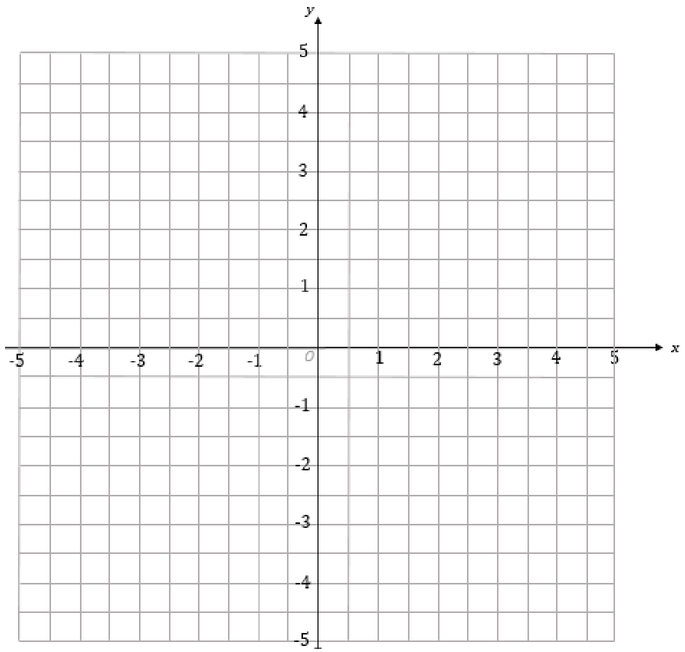
(1 , 1)

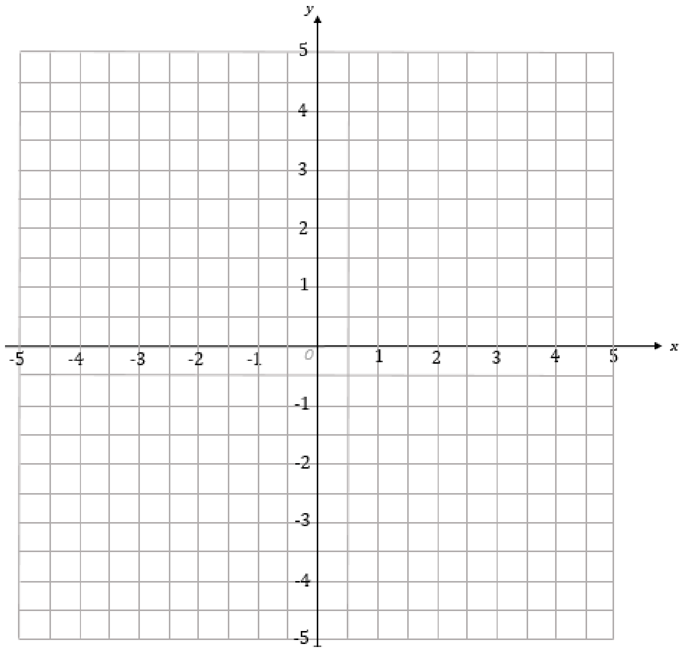
(5 , 5)

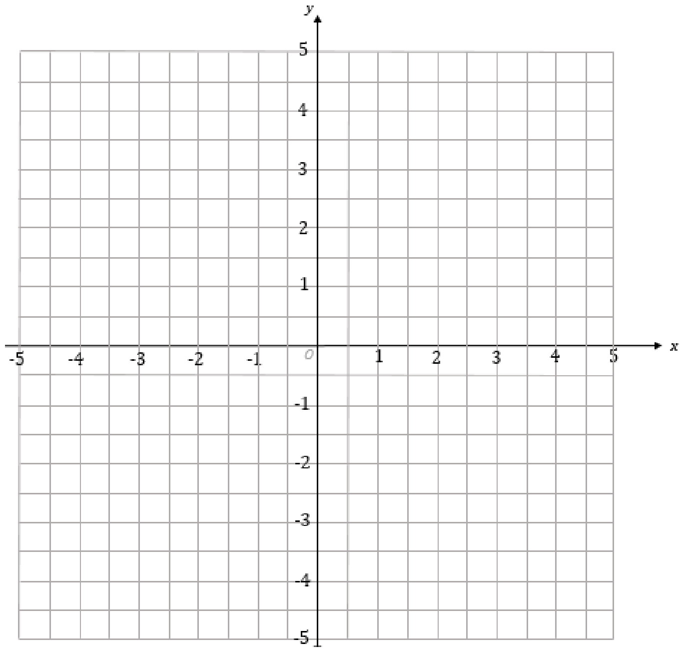
What do you notice about the points that you have plotted?

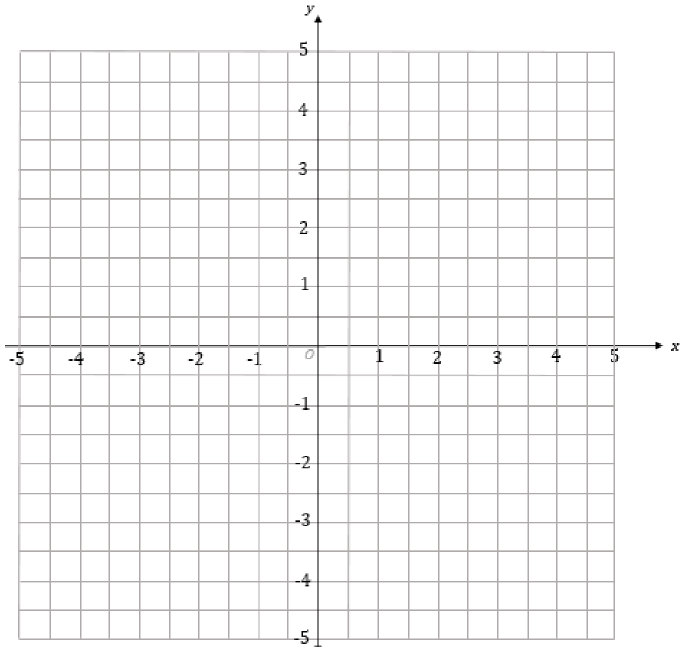


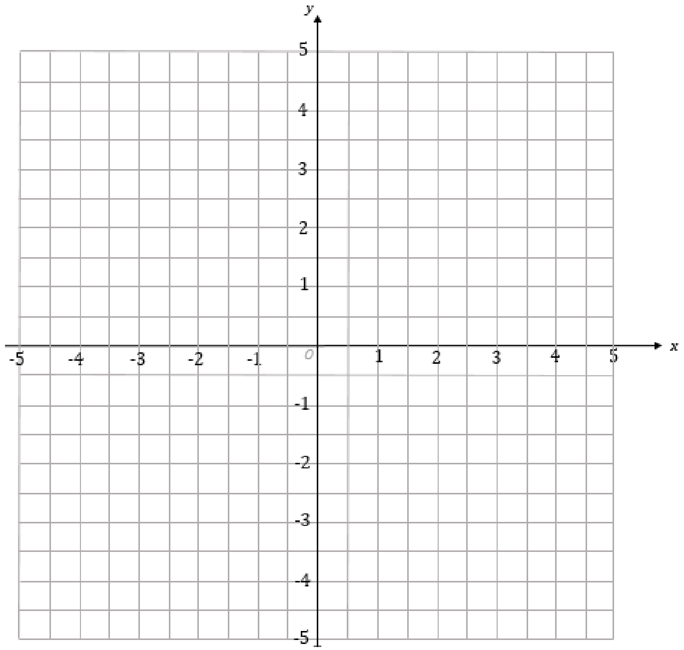

y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5


y
x
5 4 3 2 1 -1 -2 -3 -4 -5
-5 -4 -3 -2 -1 0 1 2 3 4 5

Solutions

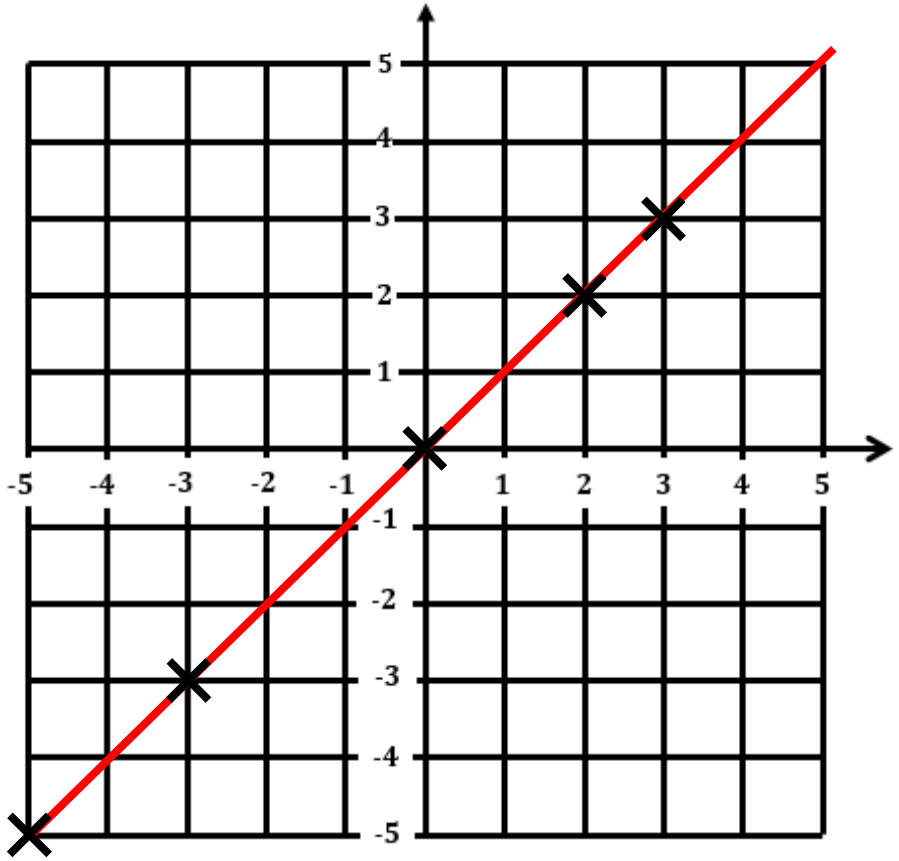
The points all lie on a straight line.

(-5 , -5) (-3 , -3)

(0 , 0) (2 , 2)

(4 , 4)

This line is the graph of y = x



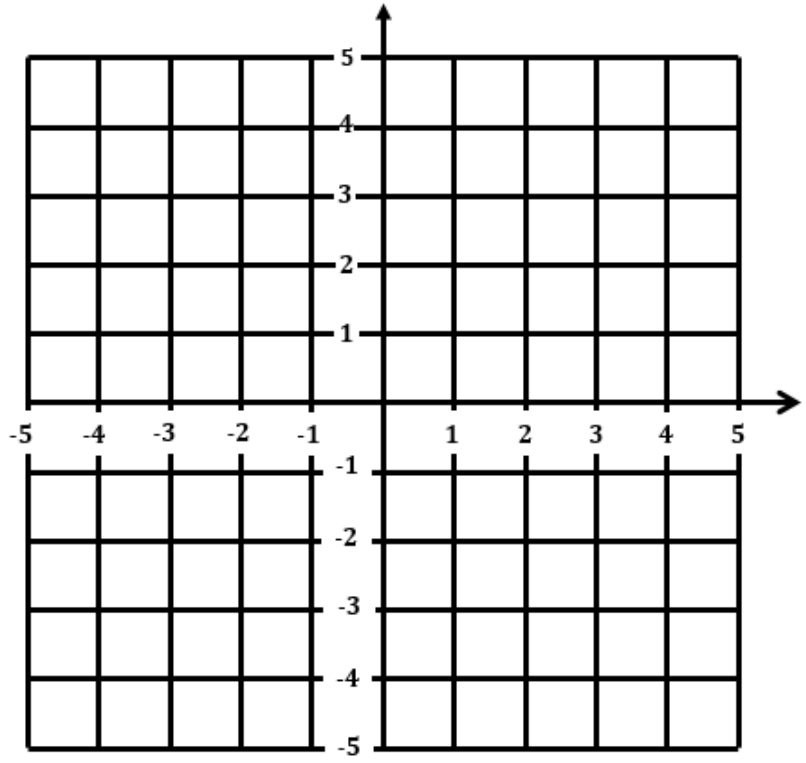
Exercise

Draw the graphs of these equations on separate axes.

a) $y = x + 1$

b) $y = x - 2$

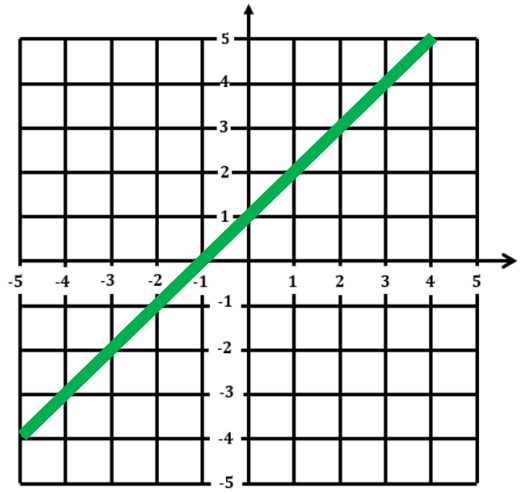
c) $y = -x$



Challenge: Draw the graph of $y = x^2$

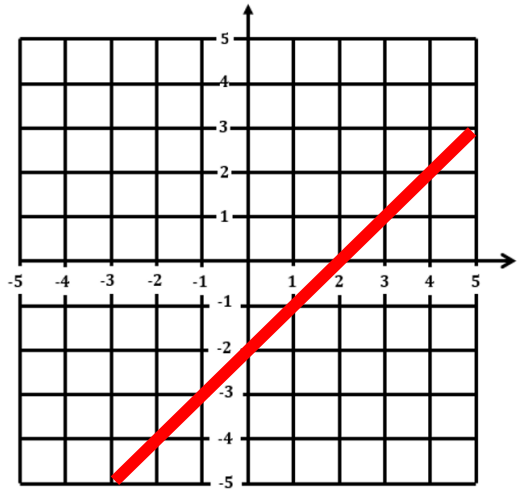
Solutions

a)



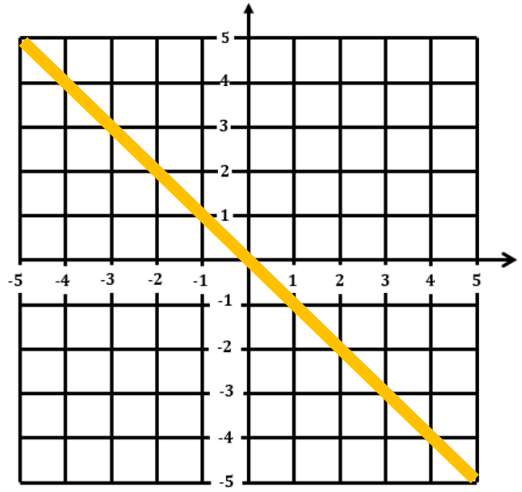
$y = x + 1$

b)



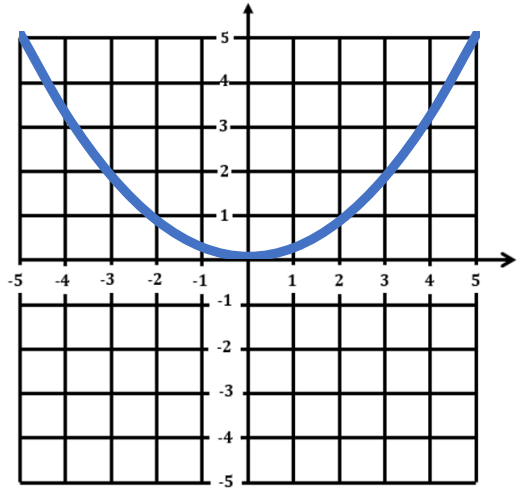
$y = x - 2$

c)



$y = -x$

d)

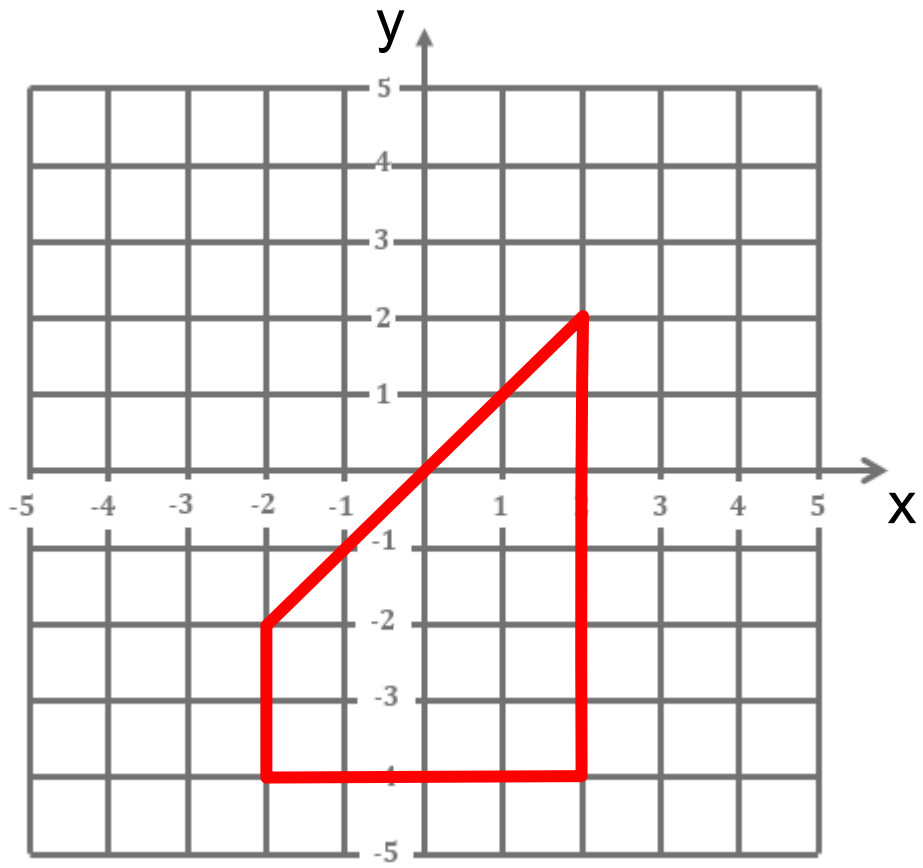


$y = x^2$

Extension

Write down the equations of each side of the hexagon?

Write down the midpoints of each side?



Exam Style Question

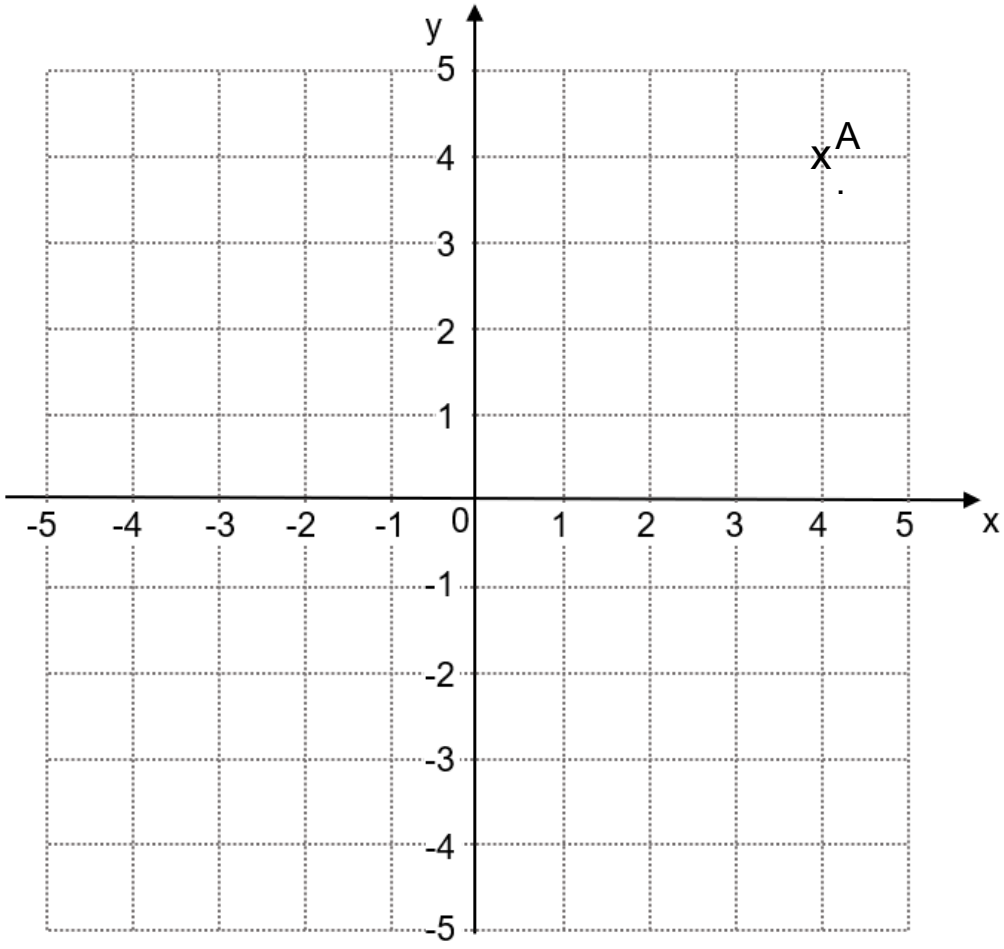
Point A is plotted at (3 , 4) on this centimetre square grid.

Point A is the corner of a square with area 25cm^2.

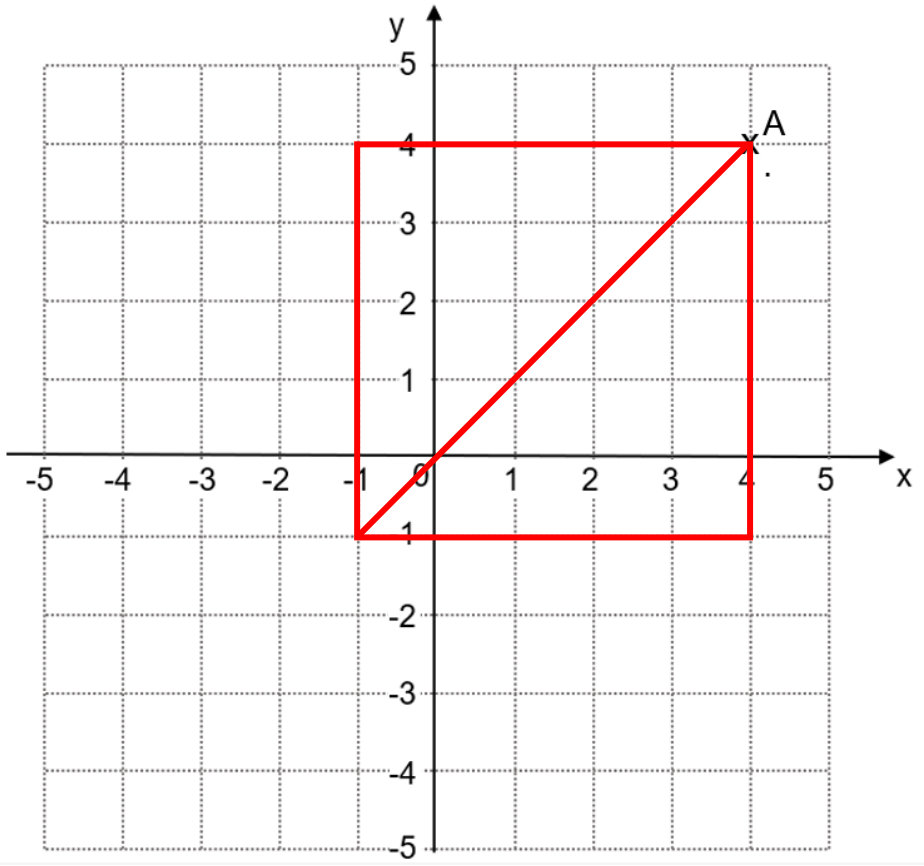
The other corners of the square have integer coordinates and lie on the grid.

a) Find the coordinates of the corner of the square that is diagonally opposite point A.

b) Find the coordinates of the midpoint of the diagonal of the square.



Solution



a) Find the coordinates of the corner of the square that is diagonally opposite point A.

A(-1 , -1)

b) Find the coordinates of the midpoint of the diagonal of the square.

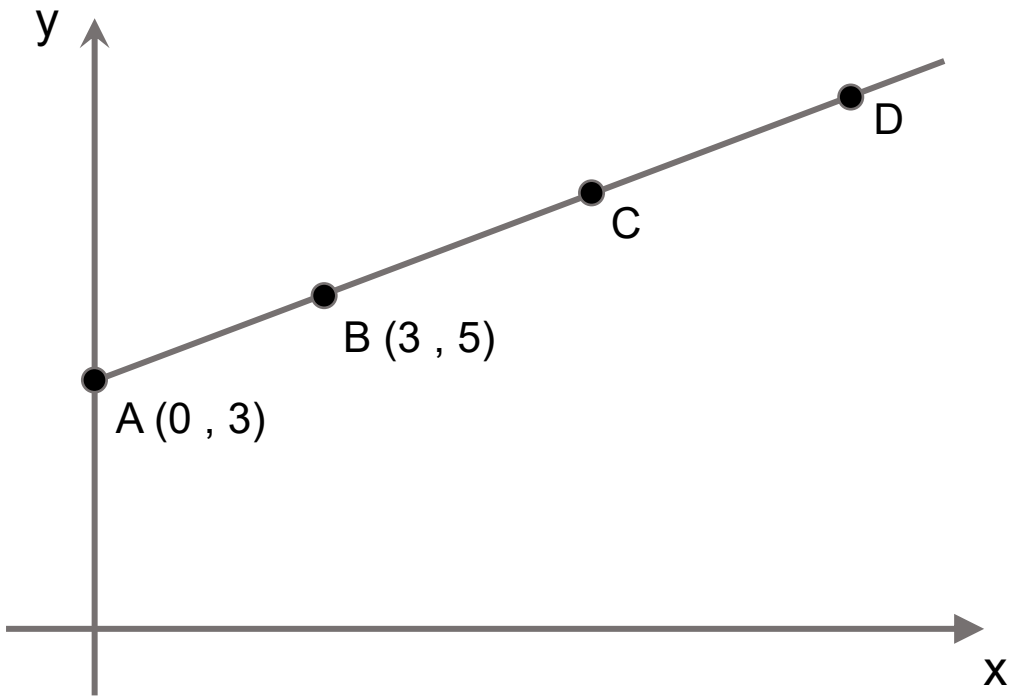
Midpoint is at the point with co-ordinates:

$$\left(\frac{-1+4}{2}, \frac{-1+4}{2}\right)$$

= (1.5 , 1.5)

Exam Style Question

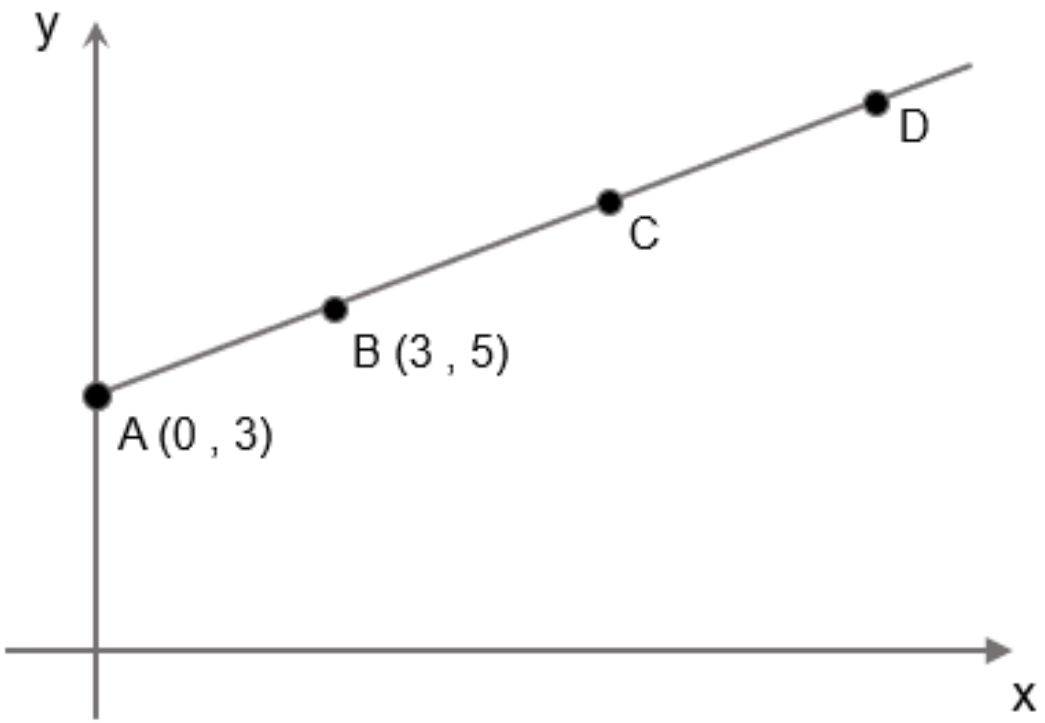
A (0 , 3) and B (6 , 5) are points on the straight line ABCD



AB = BC = CD

Work out the coordinates of D

Solution



Work out the coordinates of D.

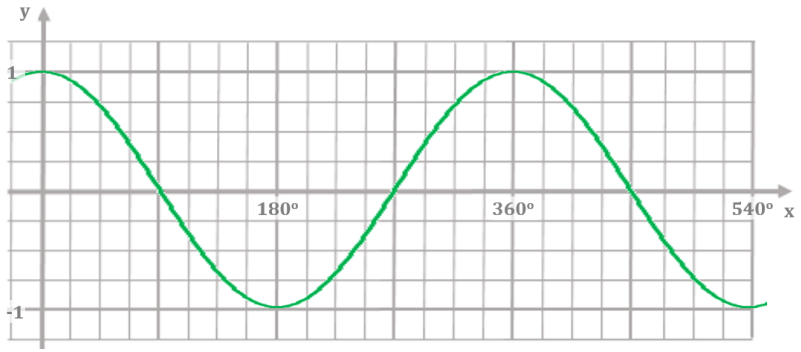
$D = (3 + 3 + 3, 5 + 2 + 2))$

$D = (9, 9)$

Where next?

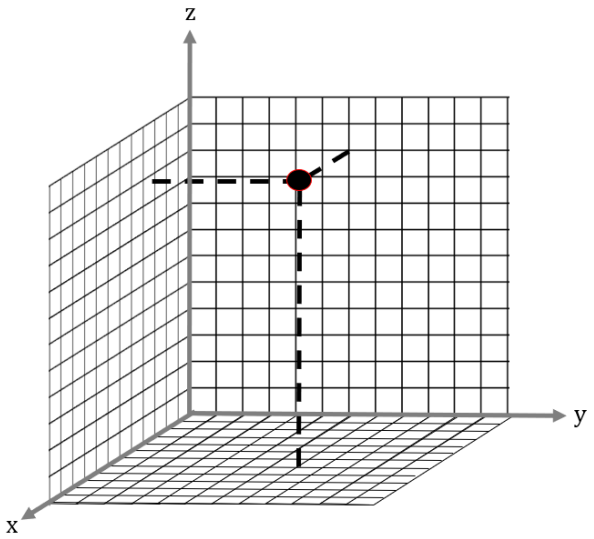
More complex graphs

In your GCSE studies you will meet many types of graphs including quadratic, cubic, exponential and trigonometrical graphs



3D coordinates

The world we live in is three dimensional. In order to study properties of the real world, we learn how to deal with co ordinates in three dimensions. To help us study co ordinates in three dimensions, we need an x axis, a y axis and also a z axis.



Historical links

The x-y plane is called the Cartesian plane in honour of René Descartes, a French mathematician who lived between 1596 and 1650.

Descartes was one of the first people to represent algebraic relationships using graphs that we recognize today. This paved the way for the invention of calculus – one of the most important discoveries ever made in mathematics.