

4 Graphs

This is a key building block in mathematics that is used to illustrate both data and algebraic formulae.

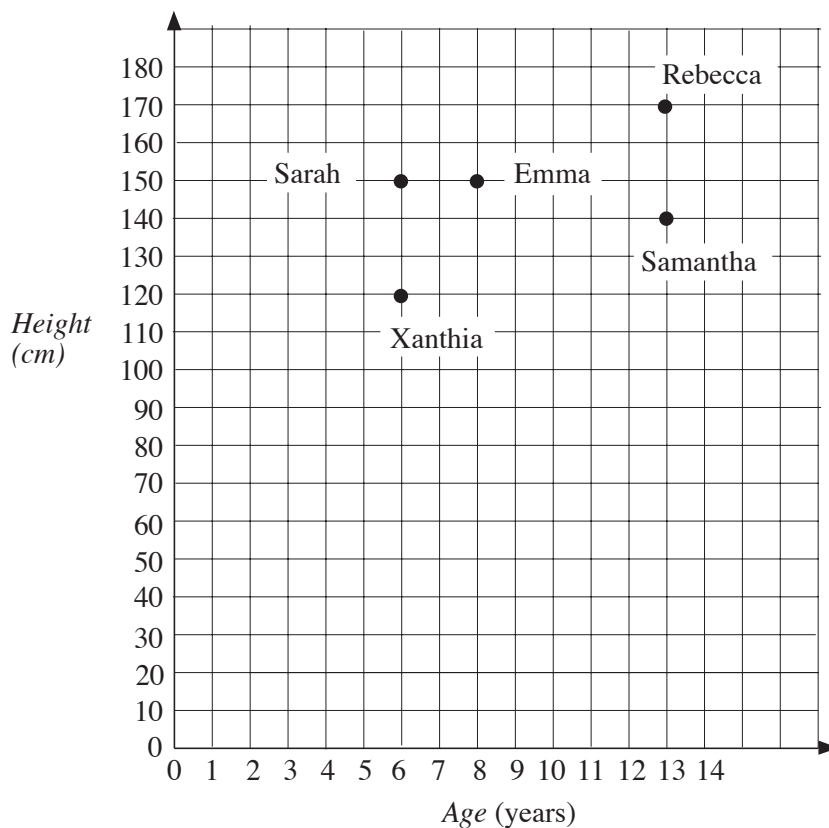
4.1 Scatter Graphs

This is a particularly useful way of illustrating "paired" data - that is, information which has *two* related values e.g. height and weight; price and sales; latitude and longitude; rain and sunshine.



Example

The scatter graph below shows height and age. Information for five girls has been plotted on the graph.



- Who is the tallest and how tall is she?
- Who is the youngest and how old is she?
- How much taller is Rebecca than Emma?
- How much younger is Sarah than Samantha?
- Is it true that older people are taller?



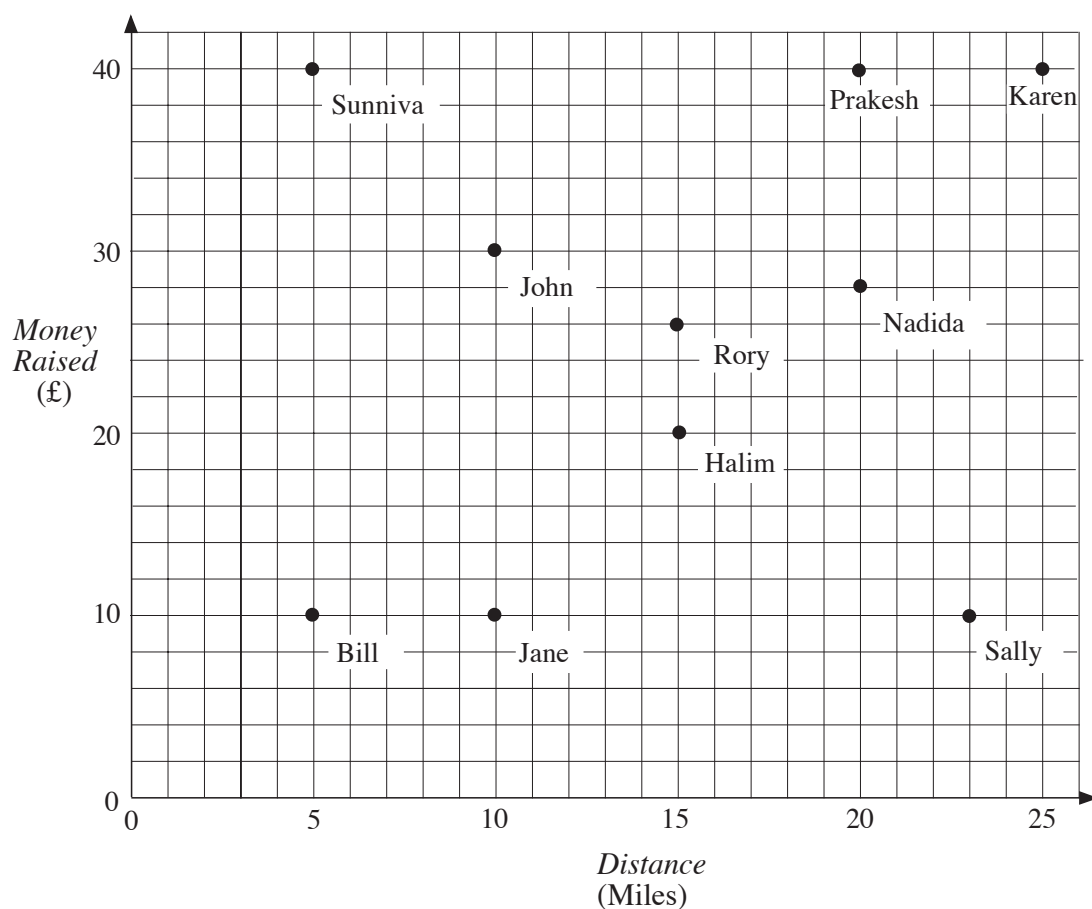
Solution

- (a) Rebecca is the tallest, and her height is 170 cm.
- (b) Sarah and Xanthia are the youngest - they are both 6 years old.
- (c) Emma is 150 cm in height, so Rebecca is
$$170 - 150 = 20 \text{ cm}$$
taller than Emma.
- (d) Samantha is 13 years old, so Sarah is
$$13 - 6 = 7 \text{ years}$$
younger than Samantha.
- (e) There is some evidence from the graph to deduce that older people are usually taller, but it is not true in general for girls less than 14 years old.

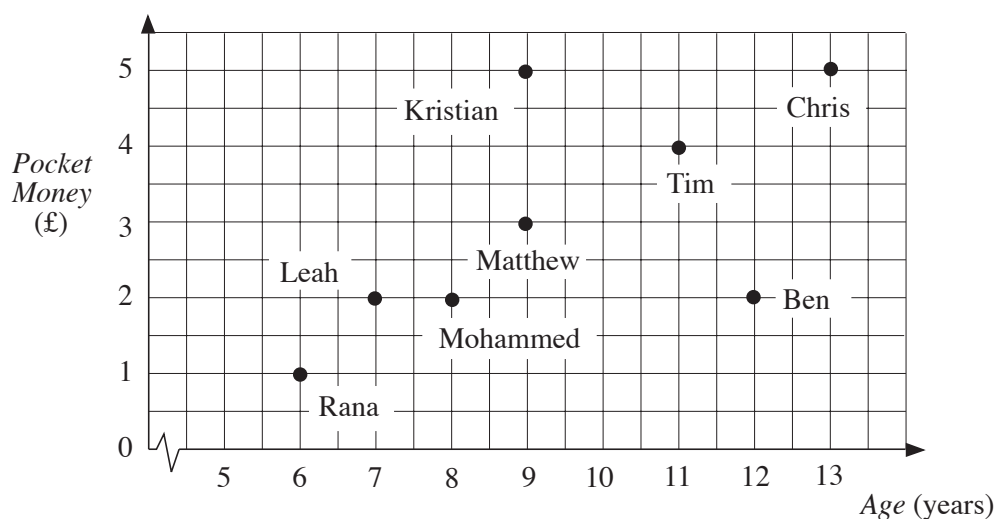


Exercises

1. Ten children took part in a sponsored walk. The scatter plot below shows how much money they raised and how far they walked.
 - (a) (i) How far did Karen walk?
 - (ii) How much money did she raise?
 - (b) Two children walked 15 miles. What are their names?
 - (c) Who walked 20 miles and raised £40?
 - (d) Explain how to work out how much Bill was sponsored for each mile.
 - (e) How much was Sunniva sponsored for each mile?
 - (f) How much money did Rory raise?
 - (g) How far did Sally walk?
 - (h) Generally, was more money raised by walking further?



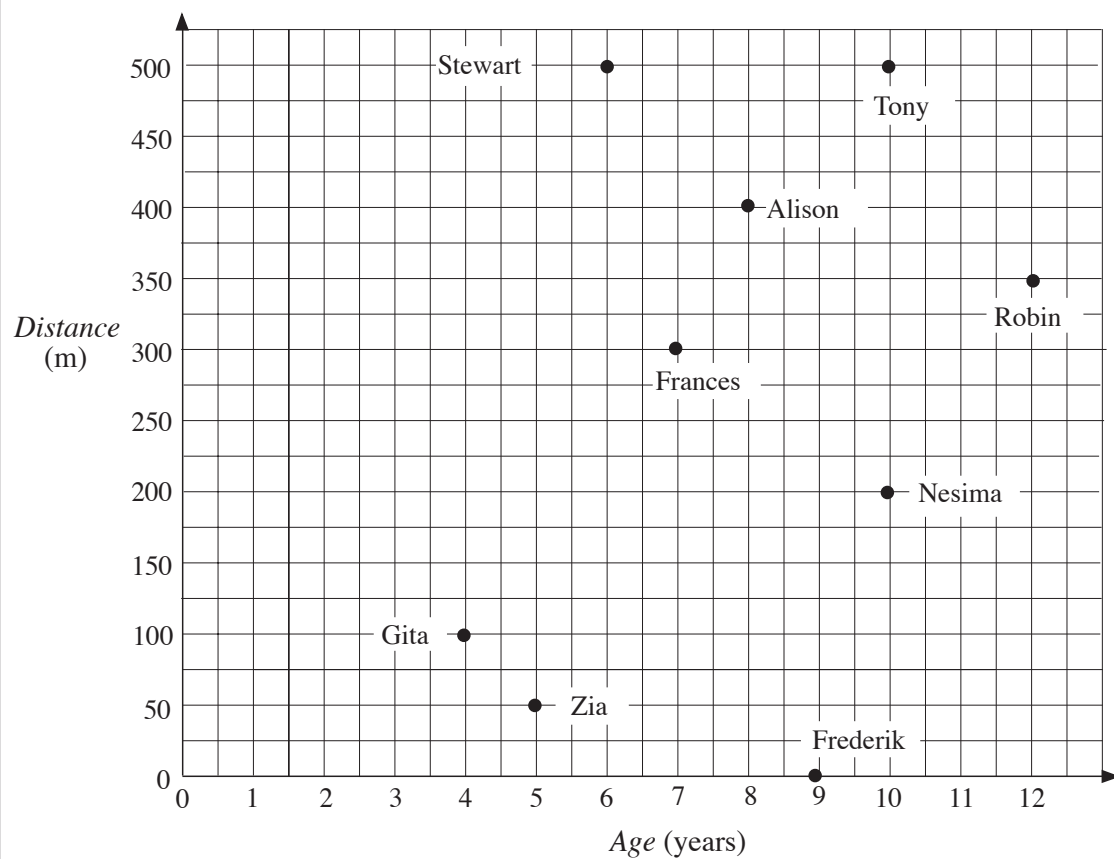
2. The scatter plot below shows the ages of the children who live in one street and how much pocket money they get each week.



- (a)
 - (i) How old is Tim?
 - (ii) How much pocket money does he get?
- (b) Which children are older than Tim?
- (c) Who gets more pocket money than Tim?

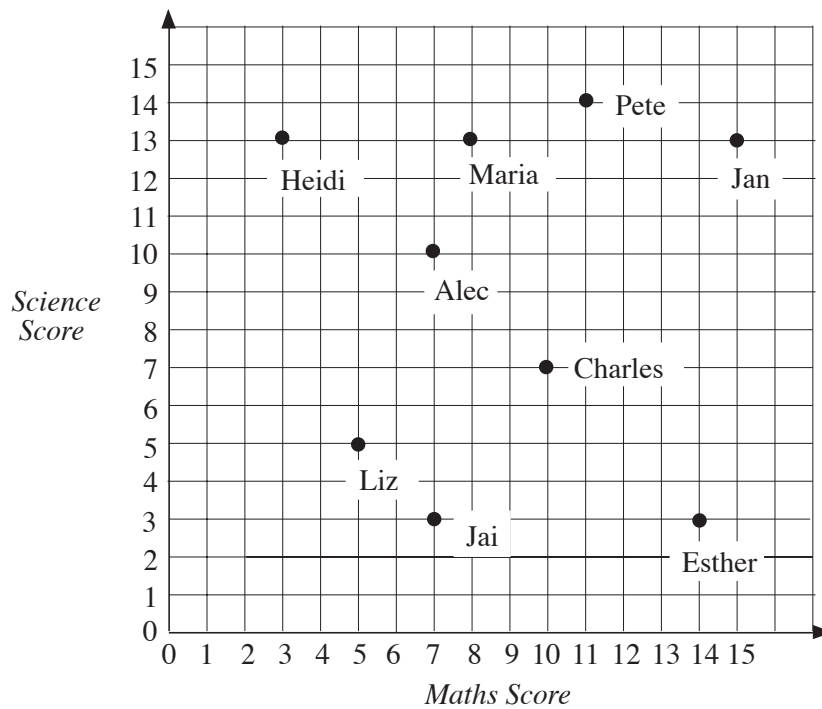
- (d) Who is 9 and gets £ 3 pocket money?
- (e) Who gets the same amount of pocket money as Kristian?
- (f) Who is the same age as Kristian?
- (g) Who gets twice as much pocket money as Ben?
- (h) Who gets half the pocket money Ben gets?
- (i) Ben is trying to persuade his parents to give him more pocket money. How would Ben use this graph to support his claim?
What would be a reasonable amount for Ben to have?

3. The scatter plot shows the ages of some children and the greatest distance they can swim.



- (a) Who is the youngest person that can swim 500 m?
- (b) Who cannot swim at all?
- (c) Who is 8 and can swim 400 m?
- (d) Who is 12 and can swim 350 m?
- (e) Who can swim the furthest?
- (f) Who is the youngest child?
- (g) Who can swim further than Robin?

4. The maths and science teachers at a school gave the Year 7 pupils two tests. The results for 9 pupils are shown on the scatter plot.



- (a) Who had the highest score in science?
- (b) Who had the highest score in maths?
- (c) Who is good at science and poor at maths?
- (d) Who is good at maths and poor at science?

The two test scores are added together.

- (e) Who has the highest total?
- (f) Who has the lowest total?

The results for six other pupils are given in the table below.

Copy the set of axes used above. Draw a scatter plot for these pupils.

<i>Name</i>	<i>Maths Score</i>	<i>Science Score</i>
Rola Reesh	10	8
Karen Eccles	5	14
Jenny Sharp	15	13
Zia Uddin	7	4
Adrian Smith	8	6
Wendy Maull	5	9

5. In a gymnastics competition the performance of each competitor is given a mark out of 10 by two different judges. The results for a competition are given below.

<i>Competitor</i>	<i>Judge 1</i>	<i>Judge 2</i>
Jane	4	5
Nishi	6	3
Julie	8	9
Andrea	2	1
Veronica	5	4
Chiori	3	2

Plot the scores in a scatter plot.

The two scores are added together to give a total.

Use your scatter plot to find:

- Who has the highest total?
- Who is second in the competition?

6. In a sponsored swim, the children raised the money listed in the table below.

<i>Name</i>	<i>Distance (m)</i>	<i>Money Raised</i>
Mark	300	£12
Kingsley	500	£20
Caroline	200	£4
Kevin	400	£10
Pushpa	300	£8
Alex	250	£15
Jai	300	£20
Zahra	50	£10
Lynda	450	£18

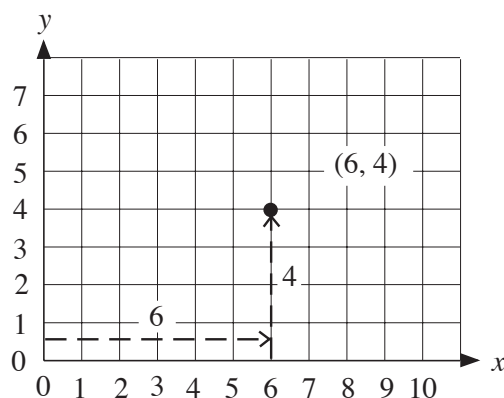
- (a) Draw a scatter plot for the distance and the money raised.
 (b) Copy and complete this sentence using one of these words

"more" "less" "no"

The children who swam the furthest raised money.

4.2 Plotting Points

We will now see how to plot points on a graph.



The x number comes first then the y number:

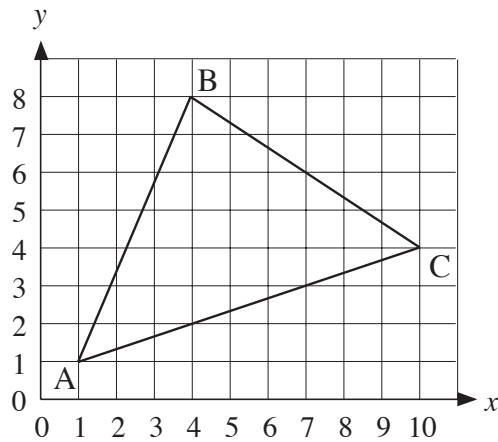
(x, y)

These number are called coordinates.

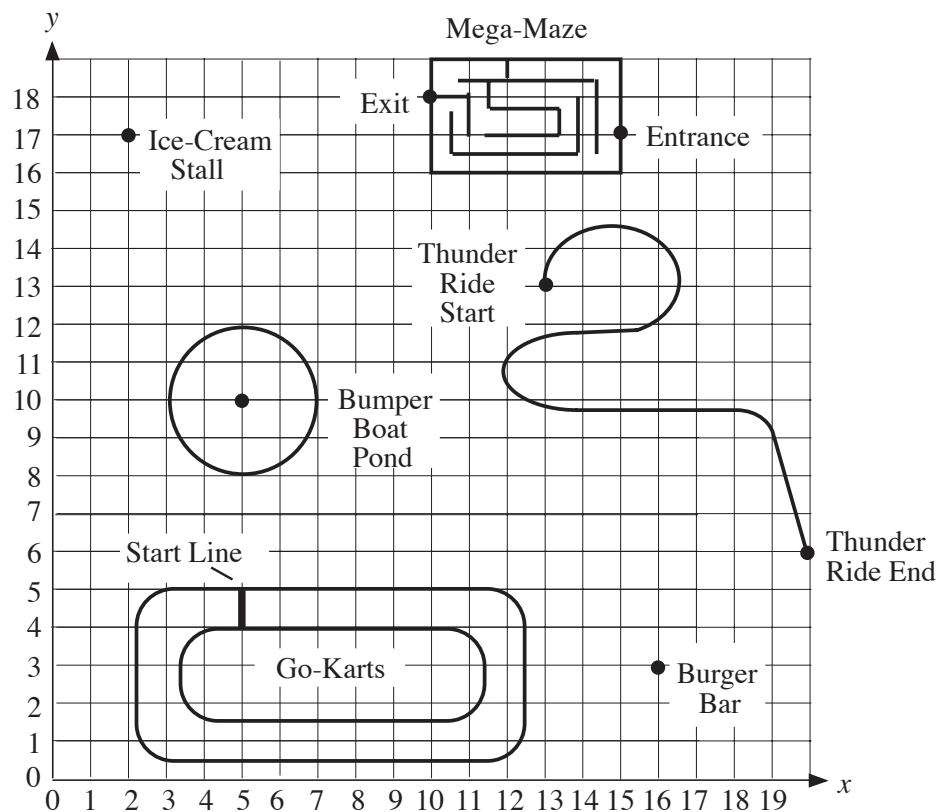


Exercises

- Write down the coordinates of the three corners of this triangle.



- The diagram shows a map of a theme park drawn on a set of axes.



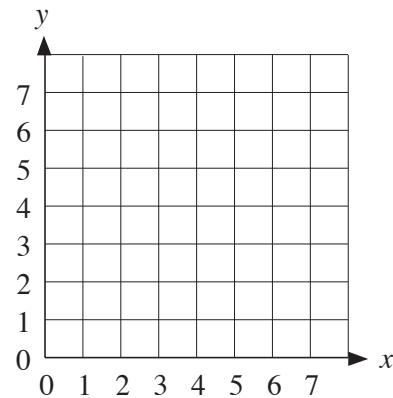
Write down the coordinates of:

- the Burger Bar
- the start of the Thunder Ride
- the end of the Thunder Ride
- the centre of the Bumper Boat Pond

- (e) the Ice Cream Stall
- (f) the Mega-Maze entrance
- (g) the Mega-Maze exit
- (h) both ends of the Go-Karts start line.

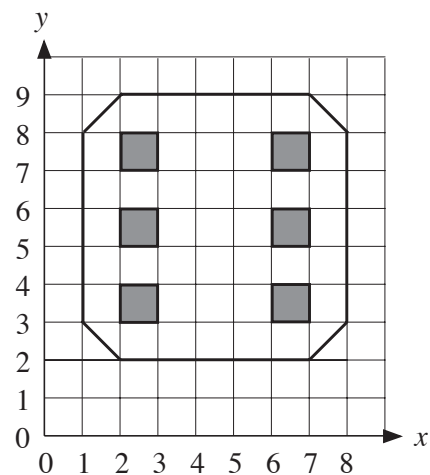
3. Draw a grid like this one.

- (a) Join the points with coordinates $(0, 3)$, $(5, 6)$ and $(5, 0)$ to draw a triangle.
- (b) On the same diagram join the points with coordinates $(2, 0)$, $(2, 6)$ and $(7, 3)$ to draw a second triangle.
- (c) Describe the shape you have now drawn.

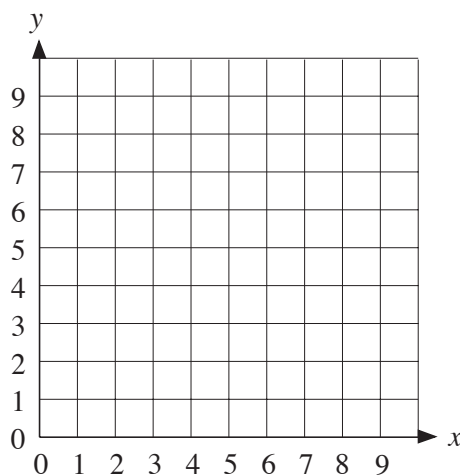


4. The diagram shows the face of a dice showing a 6.

Write a set of instructions that would give the face of the dice that shows a 1.



5. Draw a grid like this.

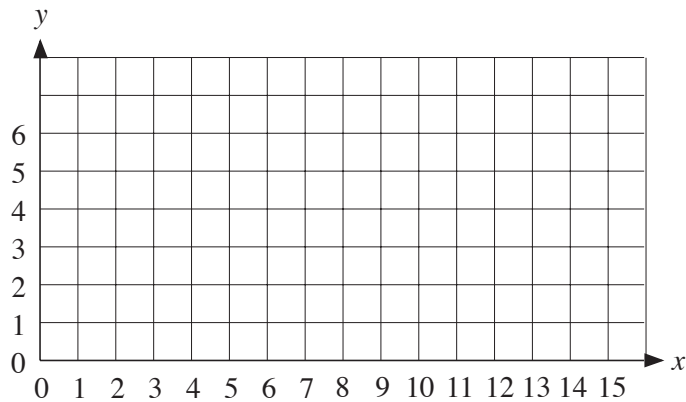


Join these points in order.

Use the same grid for all four parts.

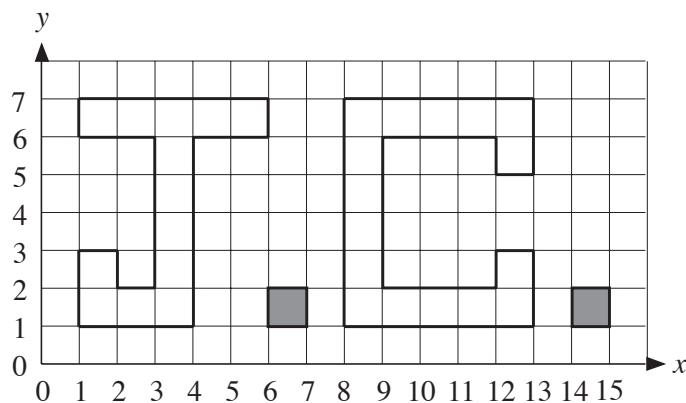
- (a) $(4, 6)$, $(5, 7)$, $(6, 6)$, $(4, 6)$.
- (b) $(5, 8)$, $(4, 8)$, $(4, 7)$, $(5, 8)$, $(6, 8)$, $(6, 7)$, $(5, 8)$.
- (c) $(4, 5)$, $(5, 4)$, $(6, 5)$, $(5, 3)$, $(4, 5)$.
- (d) $(5, 2)$, $(3, 4)$, $(3, 5)$, $(2, 5)$, $(2, 8)$, $(3, 8)$, $(3, 9)$, $(7, 9)$, $(7, 8)$, $(8, 8)$, $(8, 5)$, $(7, 5)$, $(7, 4)$, $(5, 2)$.

6. For this question you will need a grid like the one below.



Join each set of points in order to discover a message.

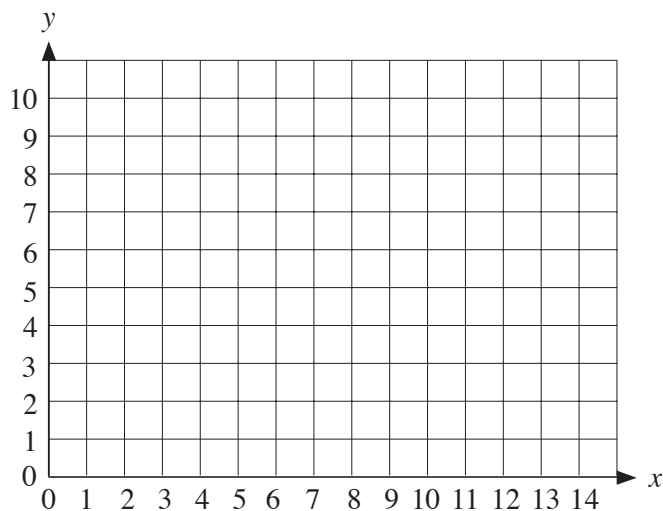
- (a) (14, 4), (14, 5), (15, 5), (15, 4), (14, 4)
 - (b) (5, 1), (5, 6), (8, 6), (8, 5), (6, 5), (6, 4), (8, 4), (8, 3), (6, 3), (6, 2), (8, 2), (8, 1), (5, 1)
 - (c) (9, 6), (10, 6), (10, 2), (12, 2), (12, 1), (9, 1), (9, 6)
 - (d) (14, 1), (14, 3), (16, 3), (16, 6), (13, 6), (13, 1), (14, 1)
 - (e) (4, 6), (3, 6), (3, 4), (2, 4), (2, 6), (1, 6), (1, 1), (2, 1), (2, 3), (3, 3), (3, 1), (4, 1), (4, 6)
7. The picture shows a set of initials.



- (a) Write out a set of instructions to draw these initials.
- (b) Draw your initials on a grid in a similar way.

Write out a set of instructions. Give the instructions to a friend and see if they can use them to draw your initials.

8. Answer this question on a copy of this grid.



- (a) Shade in the square with corners at the points with coordinates (5, 3), (5, 4), (6, 4), (6, 3).
 - (b) Join these points in order: (2, 4), (4, 8), (6, 9).
 - (c) Join these points in order: (6, 4), (7, 5), (8, 5), (9, 4), (9, 3), (8, 2), (7, 2) and (6, 3).
 - (d) Complete the picture to show a pair of glasses and write down the coordinates of the extra points that you use.
9. Draw a picture on a grid. Write a set of instructions using the coordinates so that a friend can draw the picture.

4.3 Coordinates

With the introduction of negative numbers, we can bring in coordinate axes with positive and negative numbers.

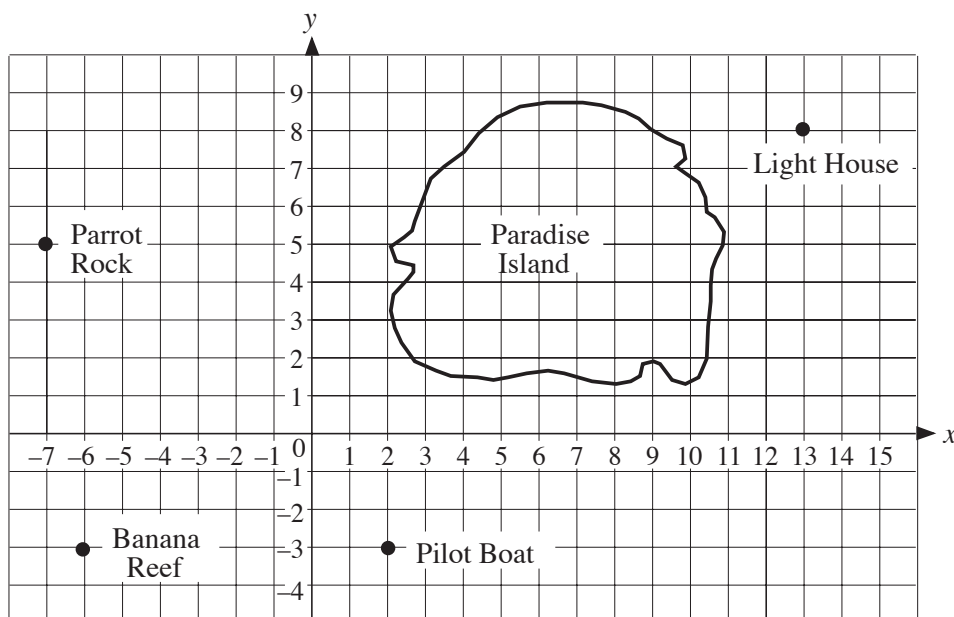


Example

A map of Paradise Island is drawn on the following grid.

What are the coordinates of;

- (a) the Lighthouse
- (b) the Pilot Boat
- (c) Parrot Rock
- (d) Banana Reef?



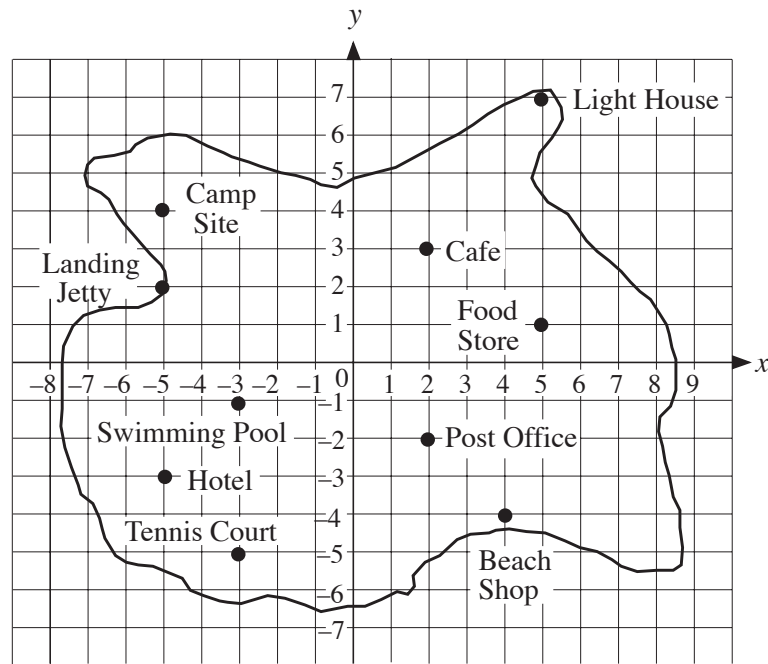
Solution

- (a) $x = 13, y = 8$ which is written as $(13, 8)$
- (b) $(2, -3)$
- (c) $(-7, 5)$
- (d) $(-6, -3)$

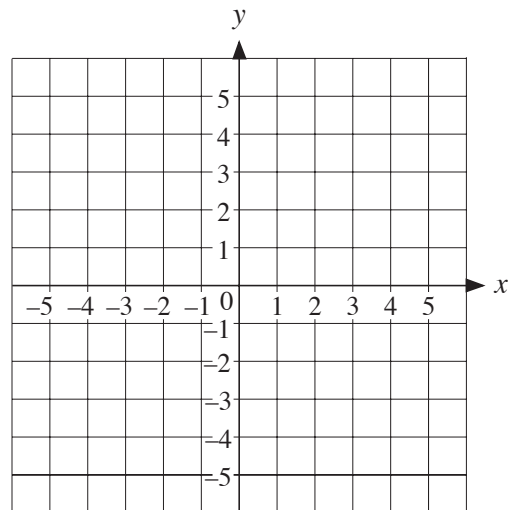


Exercises

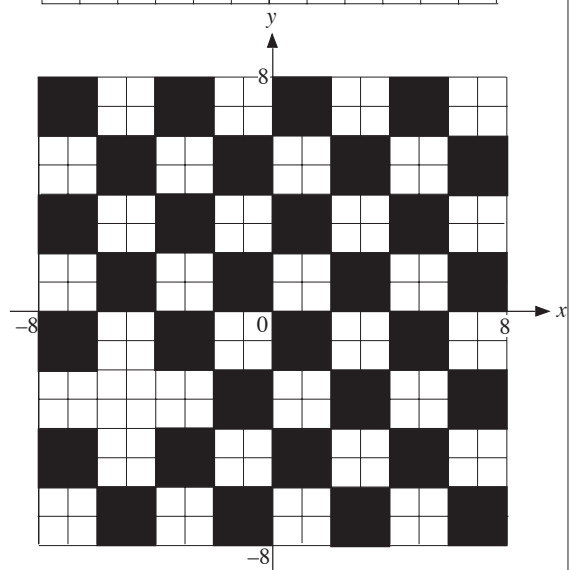
1. The following map shows a small island.
 - (a) What are the coordinates of;
 - (i) the cafe
 - (ii) the beach shop
 - (iii) the hotel
 - (iv) the campsite
 - (v) the swimming pool?
 - (b) Nisha moves from the place with coordinates $(-3, -5)$ to the place with coordinates $(-5, 4)$.
Where did she start?
Where did she finish?
 - (c) Explain why Jacob cannot walk in a straight line from the place with coordinates $(5, 7)$ to the place with coordinates $(-5, 4)$.



2. (a) Draw a set of axes like those in the diagram.
- (b) Mark the points with coordinates $(4, 0)$, $(-4, 0)$, $(0, 4)$, $(0, -4)$, $(1, 2)$, $(1, -2)$, $(3, 3)$, $(3, -3)$, $(2, 1)$, $(2, -1)$, $(-1, 2)$, $(-1, -2)$, $(-3, 3)$, $(-3, -3)$, $(-2, 1)$, $(-2, -1)$.
- (c) Join the points to form an 8 pointed star.



3. The picture shows a giant chess board that has been drawn on the surface of a playground.
- (a) What are the coordinates of the corners of the square that is the wrong colour?
- (b) John always looks in the direction of the y-axis. When he starts at the point with the coordinates $(0, 7)$, he has one foot on a black square and one foot on a white square.

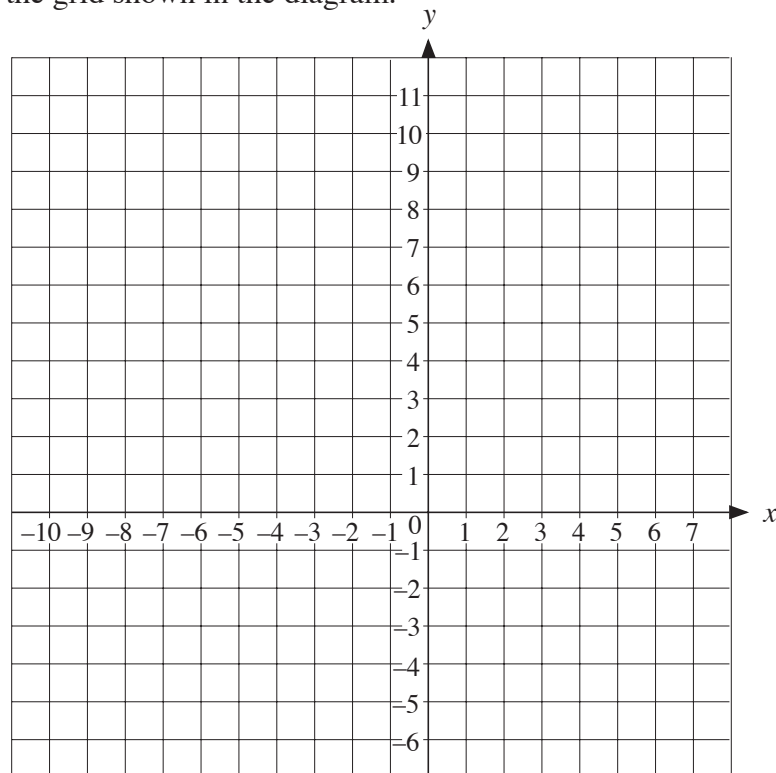


Is his left foot on the black square or the white square?

Describe where his feet are if he starts at;

- (i) $(2, 5)$
- (ii) $(-5, 3)$
- (iii) $(6, -3)$
- (iv) $(-8, -1)$
- (v) $(-2, 3)$

4. Draw the grid shown in the diagram.



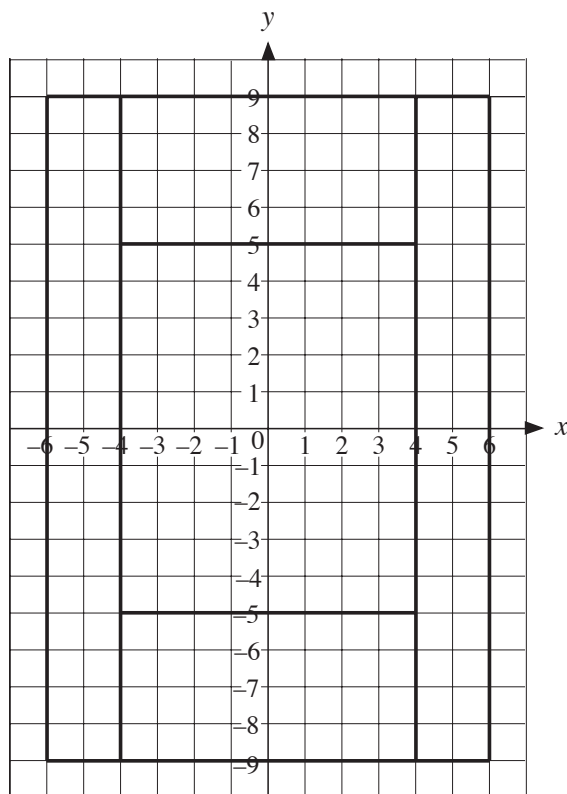
On the grid plot the points below joining each point to the next point.

$(0, 0)$, $(2, -2)$, $(0, -5)$, $(-2, -5)$, $(0, -2)$, $(-2, 0)$, $(-4, -2)$, $(-8, -5)$,
 $(-10, -5)$, $(-6, -2)$, $(-4, 0)$, $(-2, 6)$, $(-5, 5)$, $(-7, 3)$, $(-7, 4)$,
 $(-5, 6)$, $(-2, 7)$, $(-1, 7)$, $(-1, 8)$, $(-2, 9)$, $(-2, 10)$, $(-1, 11)$, $(1, 11)$,
 $(2, 10)$, $(2, 9)$, $(1, 8)$, $(1, 7)$, $(2, 7)$, $(4, 5)$, $(6, 5)$, $(6, 4)$, $(4, 4)$, $(2, 6)$,
 $(0, 0)$.

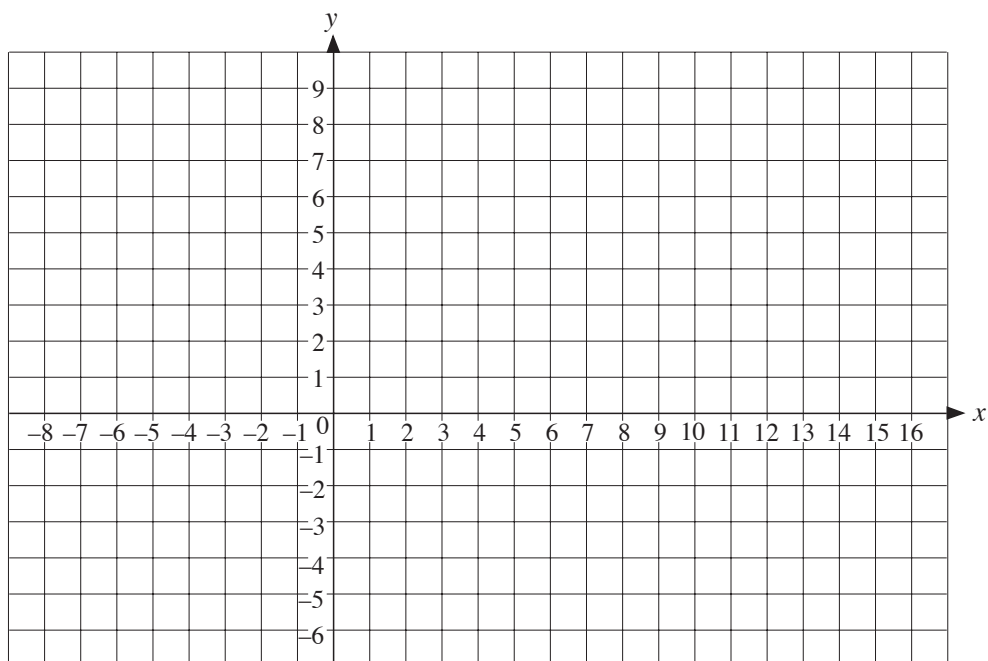
5. The diagram shows a tennis court drawn on a set of axes. The position of the ball is directly above the coordinates given.

The ball is served at $(1, 9)$ and hit at $(-3, -7)$. It travels back over the net and is hit again at $(-3, 8)$. The ball bounces next at $(6, -9)$.

Draw the path of the tennis ball on a copy of this diagram.



6. (a) Draw a copy of this grid.



- (b) On the grid draw the rectangles with corners at the following points with coordinates;
- (i) $(-6, 6)$, $(-5, 6)$, $(-5, 4)$, $(-6, 4)$
 - (ii) $(-2, 1)$, $(-3, 1)$, $(-3, 3)$, $(-2, 3)$
 - (iii) $(3, 1)$, $(3, 3)$, $(4, 3)$, $(4, 1)$
 - (iv) $(10, 1)$, $(10, 3)$, $(9, 3)$, $(9, 1)$
 - (v) $(12, 4)$, $(13, 4)$, $(13, 6)$, $(12, 6)$

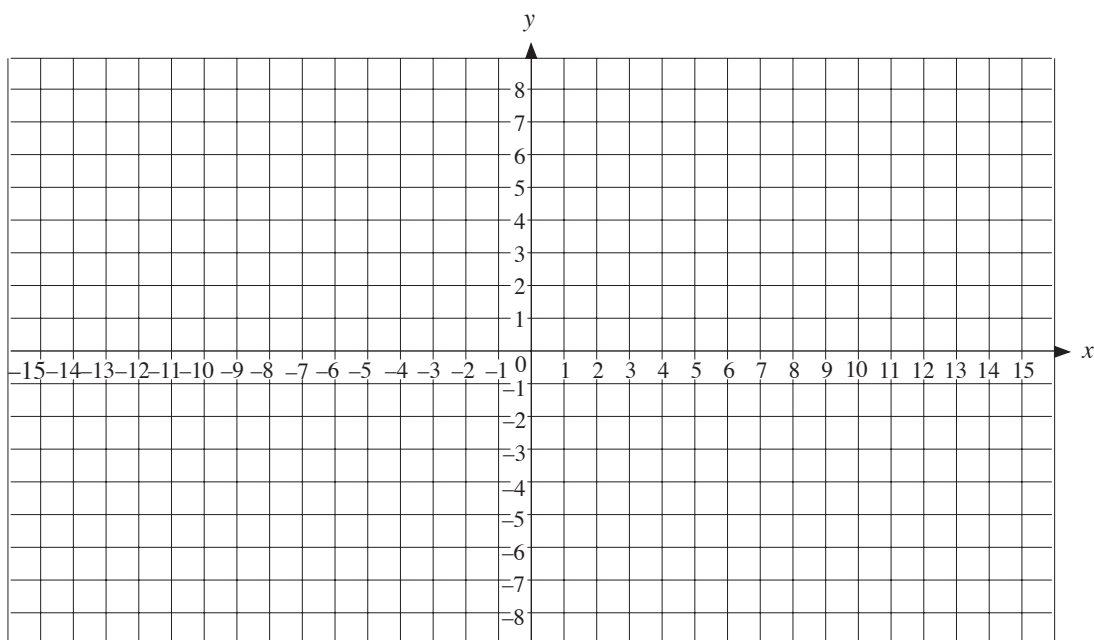
- (c) Join the points with coordinates

$(1, -5), (1, -1), (2, 0), (5, 0), (6, -1), (6, -5)$

- (d) Join the points with coordinates

$(-7, -5), (-7, 5), (-8, 7), (-8, 9), (-7, 9), (-7, 8), (-6, 8),$
 $(-6, 9), (-5, 9), (-5, 8), (-4, 8), (-4, 9), (-3, 9), (-3, 7),$
 $(-4, 5), (-3, 5), (-3, 4), (-2, 4), (-2, 5), (-1, 5), (-1, 4), (0, 4),$
 $(0, 5), (1, 5), (1, 4), (2, 4), (2, 5), (3, 5), (3, 4), (4, 4), (4, 5),$
 $(5, 5), (5, 4), (6, 4), (6, 5), (7, 5), (7, 4), (8, 4), (8, 5), (9, 5),$
 $(9, 4), (10, 4), (10, 5), (11, 5), (10, 7), (10, 9), (11, 9), (11, 8),$
 $(12, 8), (12, 9), (13, 9), (13, 8), (14, 8), (14, 9), (15, 9), (15, 7),$
 $(14, 5), (14, -5), (-7, -5).$

7. (a) Draw a picture of your own on a copy of the axes below.



- (b) Write a set of instructions and give them to a friend, so they can draw your picture.