



The Mathematics Department

7

Co-ordinates

in the Four

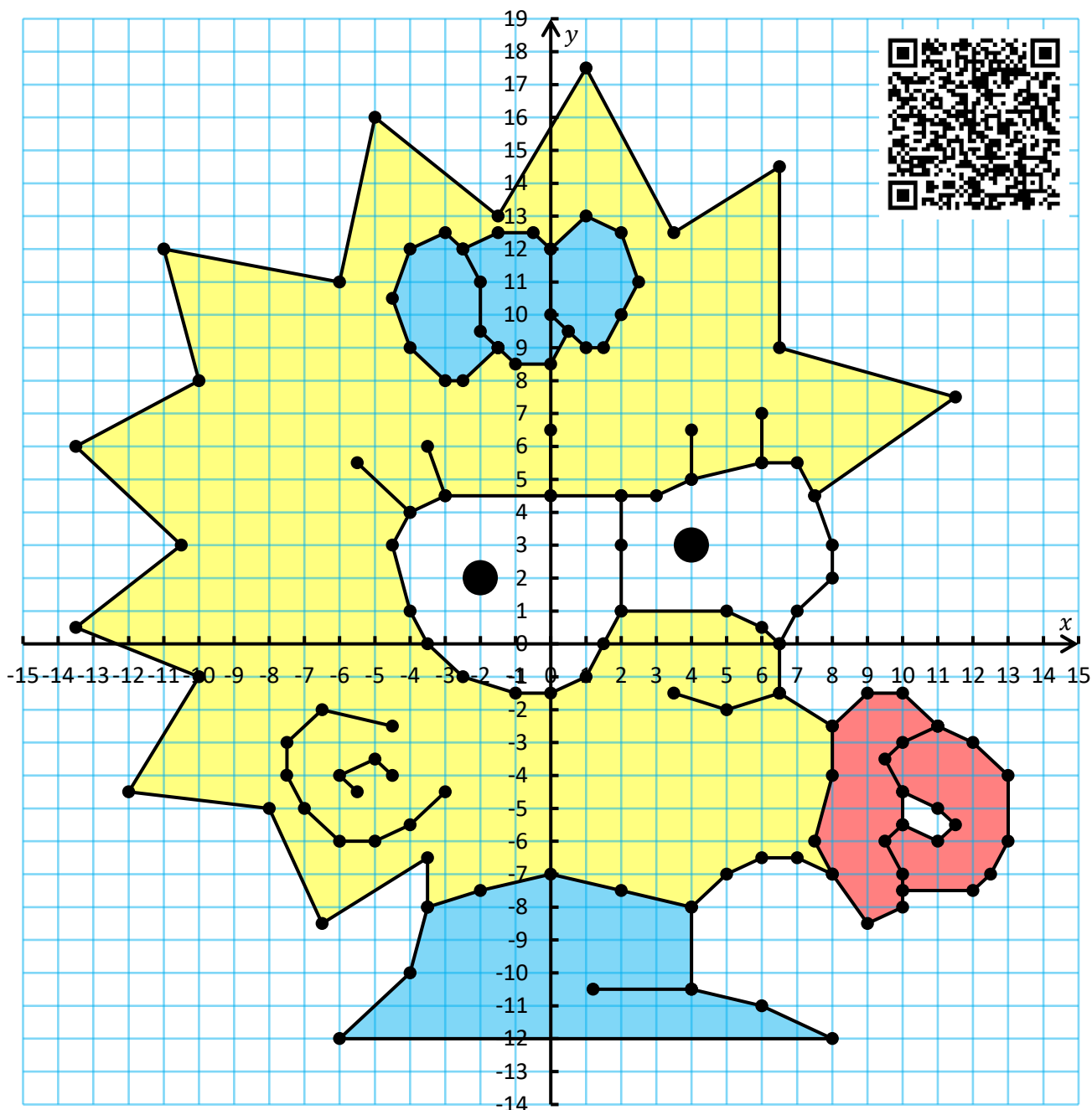
Quadrants

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Name:

# Contents

Chapter	Mathematics	Page Number
The First Quadrant	Plotting co-ordinates in the first quadrant.	3
The Four Quadrants	The four quadrants. Plotting co-ordinates in the four quadrants.	7
Mid-point of a Line	The first quadrant. Adding with negative numbers. The four quadrants.	11
Using Co-ordinates	Missing co-ordinates. Translations.	14



# The First Quadrant

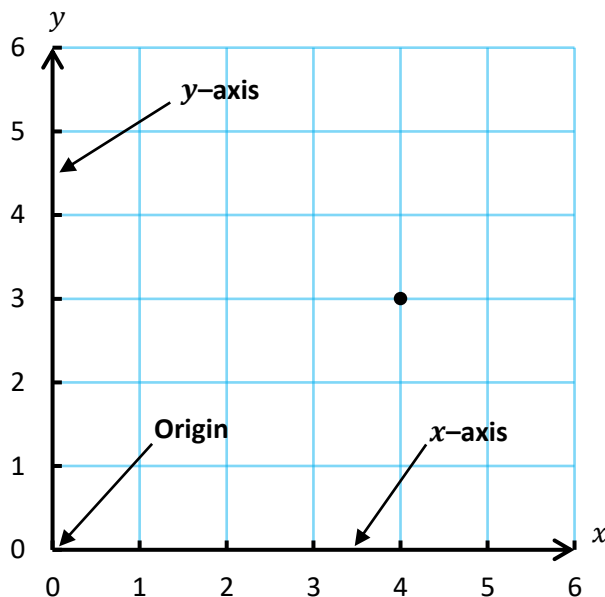
One way of locating a point is to use a pair of **numbered, perpendicular lines**. These lines are called **axes**.

- The **horizontal axis** is the **x-axis**.
- The **vertical axis** is the **y-axis**.
- The **origin** is the point where the two axes **meet**.
- To **plot a point** on the axes:
  - Start at the origin.
  - Move **across** to begin with.
  - Then move **up**.



We use **co-ordinates** to represent points on a set of axes. The co-ordinate (4, 3) is shown on the axes to the right. For this particular co-ordinate,

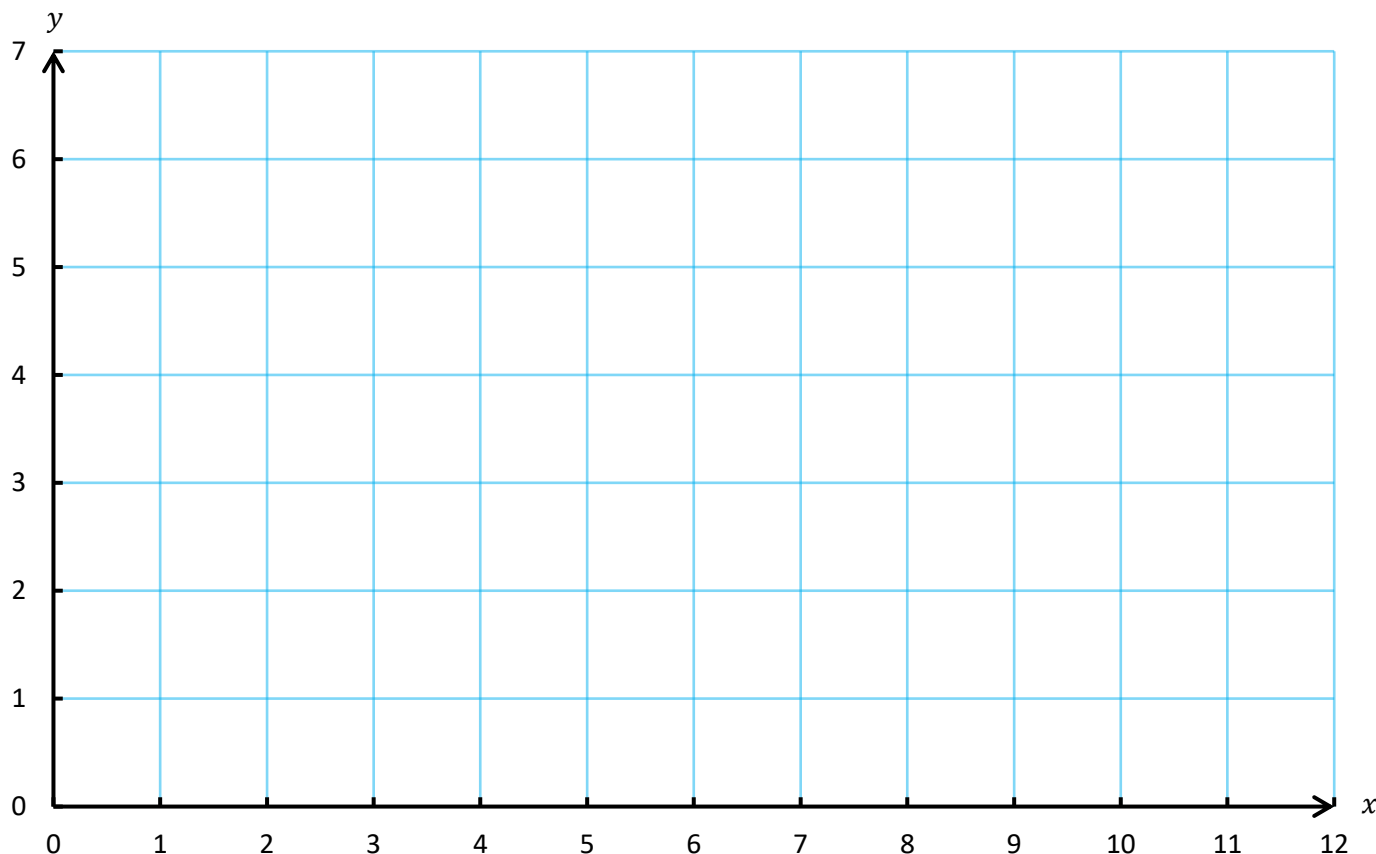
- The **x-coordinate** is 4. This is the distance we move **across**.
- The **y-coordinate** is 3. This is the distance we move **up**.



### Exercise 1

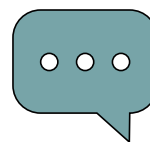
Plot the following points on the axes shown below.

- |            |            |             |              |                |
|------------|------------|-------------|--------------|----------------|
| (a) (4, 5) | (b) (8, 1) | (c) (11, 4) | (d) (1, 5)   | (e) (6, 2)     |
| (f) (9, 2) | (g) (0, 4) | (h) (6, 0)  | (i) (2.5, 3) | (j) (6.5, 4.5) |

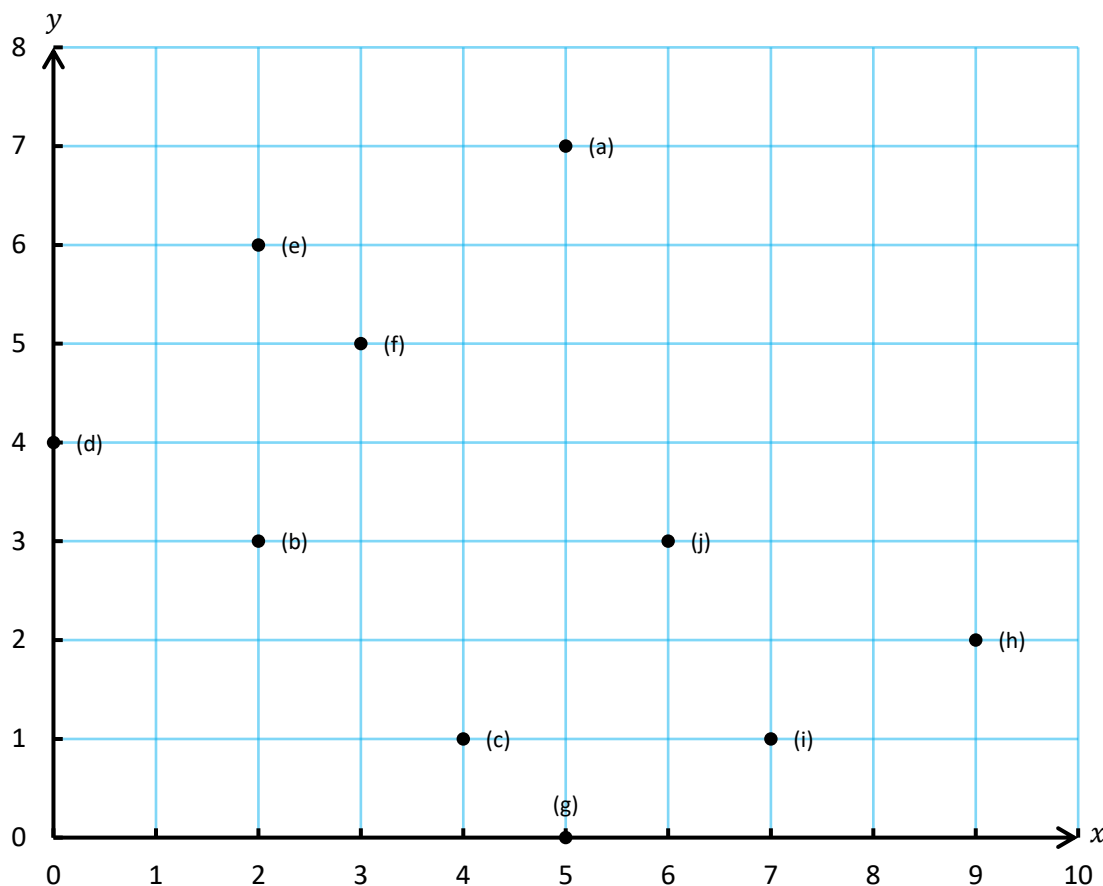


**Exercise 2**

Write down the co-ordinates of each of the points (a), (b), ..., (j) on the axes shown below.



2



- (a) .....
- (b) .....
- (c) .....
- (d) .....
- (e) .....
- (f) .....
- (g) .....
- (h) .....
- (i) .....
- (j) .....

**Exercise 3**

Plot the following co-ordinates on the next page to draw the **face of a famous person**...

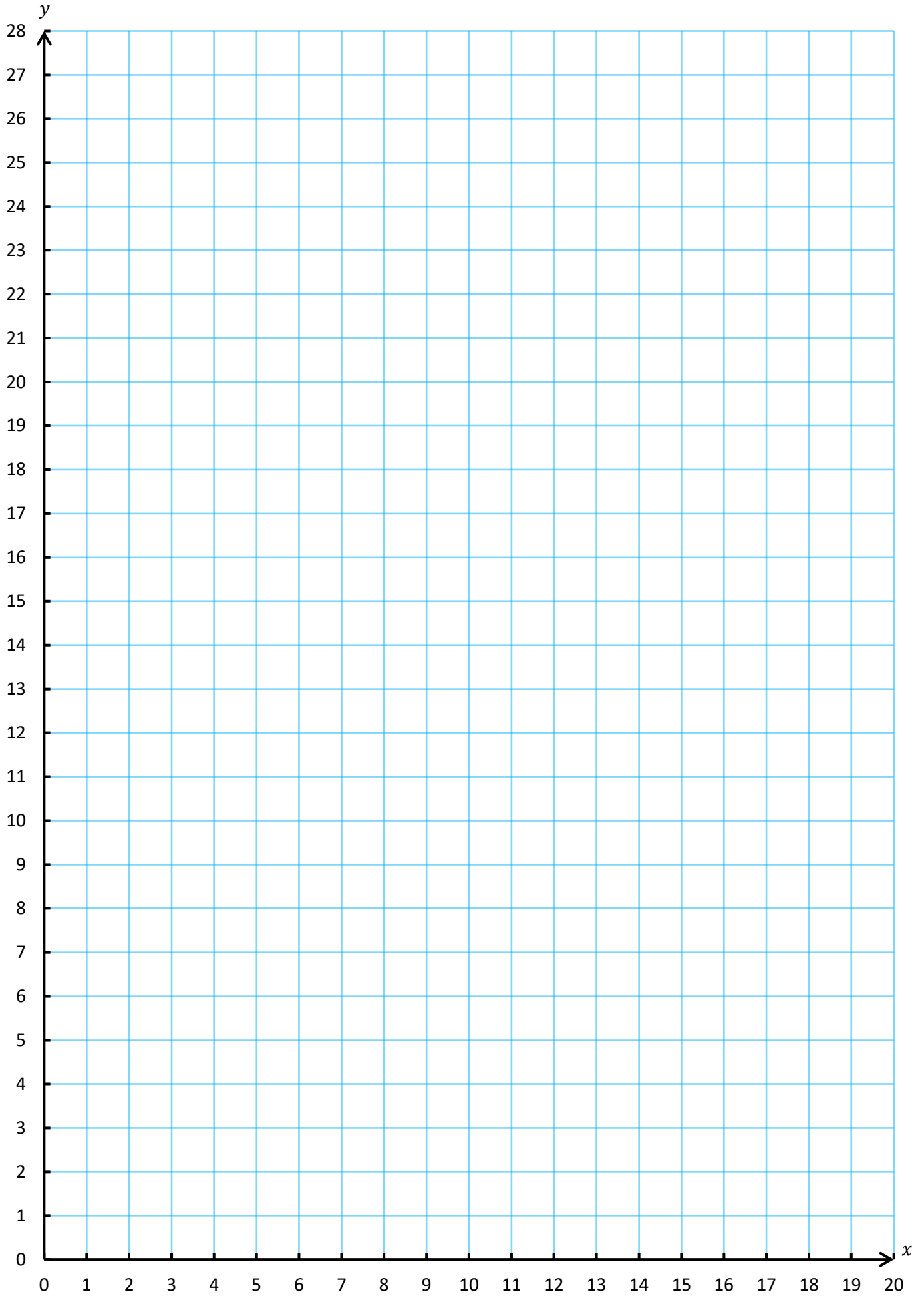


Connect the co-ordinates as you go on, starting a new line for each new bullet point.

For the **red** co-ordinates, you must **double** the numbers to arrive at the correct co-ordinate. For example, if you see the co-ordinate (5, 8), then you must plot the point (10, 16).

For the **blue** co-ordinates, you must **subtract three** from the numbers to arrive at the correct co-ordinate. For example, if you see the co-ordinate (7, 11), then you must plot the point (4, 8).

- **Face:** (10, 0), (13, 6), (8, 3), (6, 5), (2, 5), (1, 6), (2, 6), (2, 11), (1, 12), (1, 16), (2, 17), (2, 26), (3, 25), (2, 13), (5, 25), (6, 26), (10, 28), (8, 26), (9, 25), (10, 26), (11, 25), (12, 26), (13, 25), (7, 13), (15, 25), (16, 26), (17, 25), (18, 26), (18, 15), (17, 4), (16, 3), (19, 3)
- **Right Eye:** (8, 11), (6, 13), (6, 16), (7, 18), (12, 22), (11, 19), (13, 18), (7, 8), (13, 12), (10, 11), (9, 11)
- **Nose:** (6, 9), (5, 8), (4, 8), (3, 9), (3, 10), (7, 14), (5, 11), (3, 6), (7, 12)
- **Eyebrow:** (6, 17), (5, 18), (2, 9), (2, 17)
- **Left Eye:** (3, 11), (5, 14)
- **Mouth:** (7, 5), (13, 8), (11, 6), (13, 6), (14, 5)
- **Mouth:** (13, 7), (13, 6)
- **Ear:** (17, 11), (9, 6), (19, 11), (19, 9), (9, 4), (17, 8), (16, 9)
- **Place a Big Dot at (4, 15) and at (14, 18)**

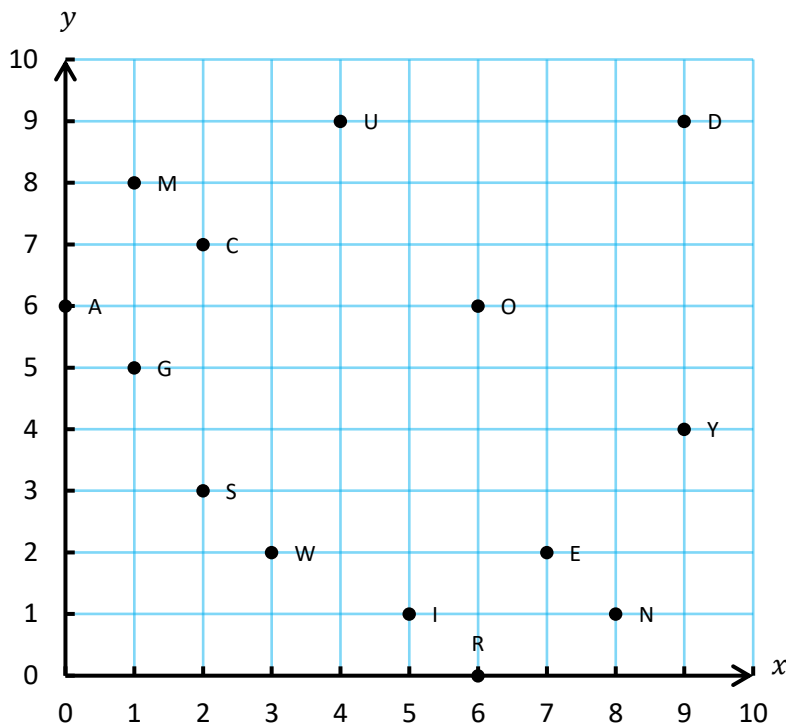


**Exercise 4**

2

Write down the letter that is next to each of the following points. After you finish, you should have a Welsh sentence. What is the sentence?

- (4, 9) (8, 1)
- (2, 7) (0, 6) (1, 8) (1, 5) (9, 4) (1, 8)
- (7, 2) (6, 0) (5, 1) (0, 6) (9, 9)
- (3, 2) (8, 1) (0, 6)
- (8, 1) (7, 2) (1, 5) (7, 2) (2, 3)
- (3, 2) (5, 1) (6, 0) (5, 1) (6, 6) (8, 1)



**Exercise 5 (Revision)**

Draw  $x$  and  $y$  axes on a piece of squared paper. Number the axes from 0 to 18. Plot the following points, connecting them with straight lines as you go on. (Work row-by-row.)

- (4, 8), (6, 7), (8, 7), (9, 6), (8, 5), (6, 5), (5, 4),
- (5, 3), (6, 3), (6, 4), (9, 4), (10, 5), (13, 4), (14, 2),
- (13, 1), (13, 0), (14, 0), (14, 1), (15, 2), (14, 5), (13, 5),
- (13, 7), (12, 9), (17, 8), (14, 9), (17, 9), (14, 10), (17, 11),
- (15, 11), (17, 12), (13, 11), (12, 9), (10, 9), (8, 11), (8, 12),
- (5, 15), (4, 15), (3, 16), (3, 15), (1, 13), (1, 12), (2, 12),
- (4, 13), (5, 11), (4, 10), (2, 11), (0, 9), (0, 8), (1, 8),
- (1, 9), (2, 10), (3, 9), (2, 7), (4, 5), (5, 5), (5, 6),
- (4, 6), (3, 7), (4, 8).

**Evaluation**

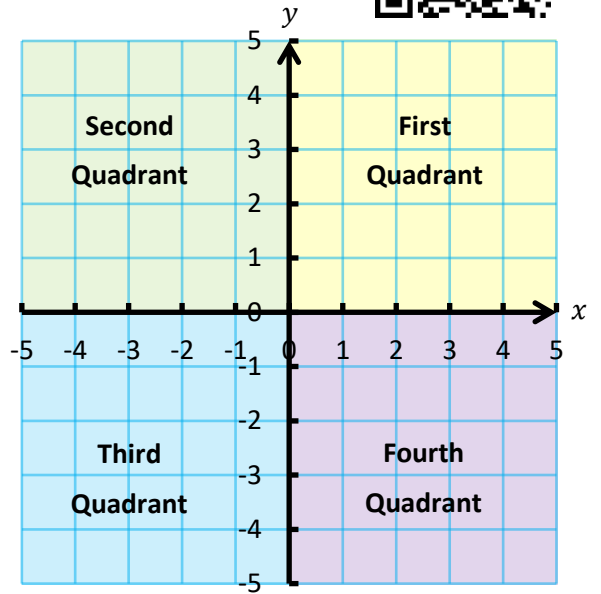
Key Words	Corrections	I am happy with...	I need to revise...



# The Four Quadrants



In the previous chapter, only co-ordinates with **positive** numbers were used. To plot co-ordinates that use **negative** numbers, we must extend the  $x$ -axis to the left and the  $y$ -axis downwards. By doing this, the  $x$  and  $y$  axes divide the **plane** into **four quadrants**. These quadrants are numbered in an anti-clockwise direction, as shown in the diagram on the right.



## Exercise 6



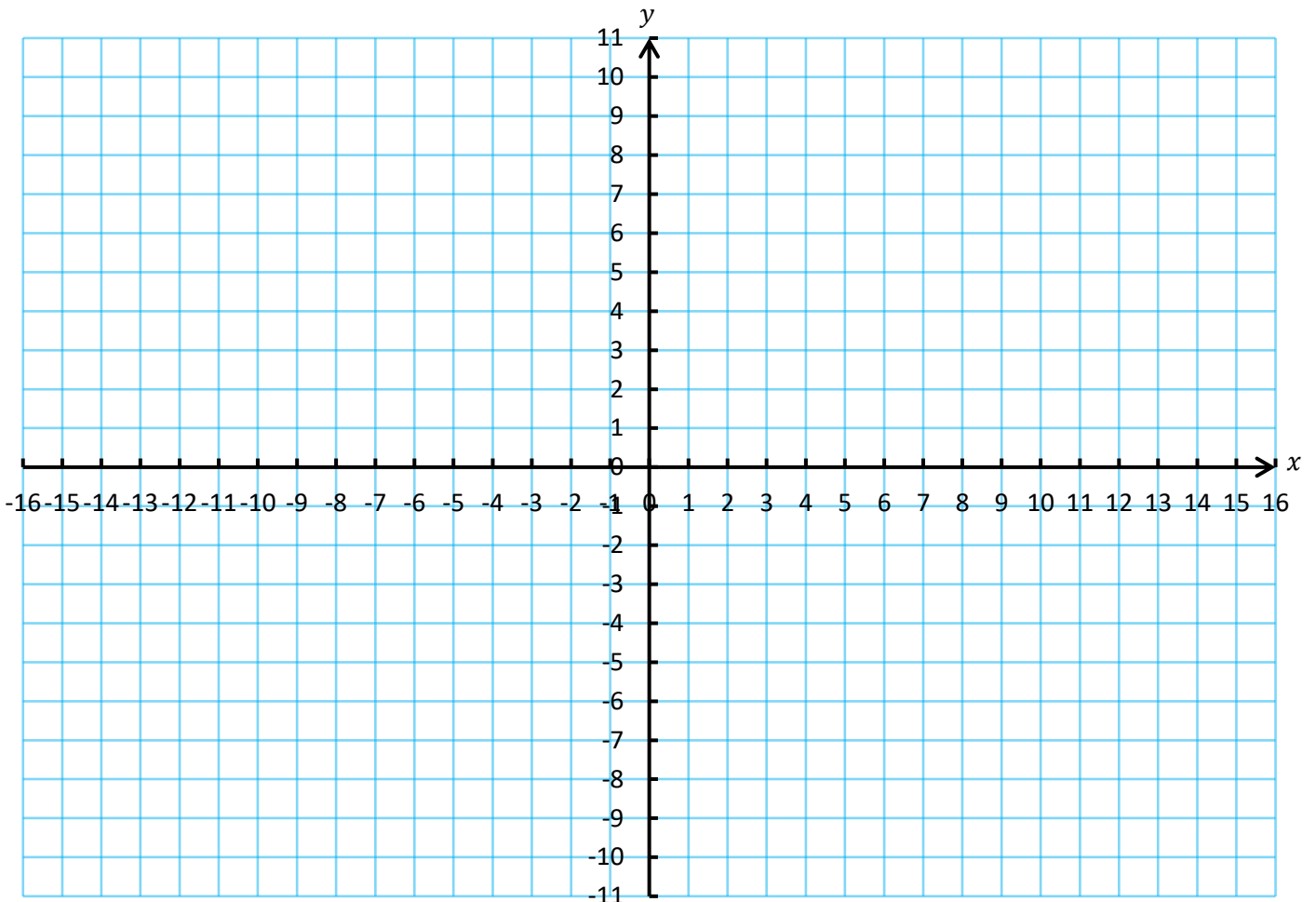
In which quadrant do the following points appear?

- (a) (2, 5)      (b) (-2, 3)      (c) (4, -2)      (d) (-4, 1)
- (e) (-4, -3)    (f) (2, 8)      (g) (1, -6)      (h) (-2, 4.5)
- (i) (5, 0)      (j) (-9, -2)    (k) (-4, 3)      (l) (5, -1)
- (m) (0, -2)    (n) (-3.5, -1.5) (o) (0, 0)      (p) (-0.5, 3.25)

## Exercise 7

Plot the following points on the axes shown below.

- (a) (13, 7)      (b) (-3, 5)      (c) (8, -2)      (d) (-10, -4)    (e) (-14, 7)      (f) (6, -3)      (g) (0, -6)
- (h) (13, 10)    (i) (4.5, 8)      (j) (-5.5, 3)    (k) (4.5, -10)    (l) (-7.5, 0)      (m) (-11.5, -6.5) (n) (14.5, -3)



## Exercise 8

2

(a) Write down the letter that is next to each of the following points. After you finish, you should have a Welsh sentence. What is the sentence?

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

(4, 5), (7, -1)

(6, 5)

(-4, -6), (6, 5), (3, 3), (-2, -2), (0, -4), (-4, 0),

(-4, 0), (7, 5), (1, 5)

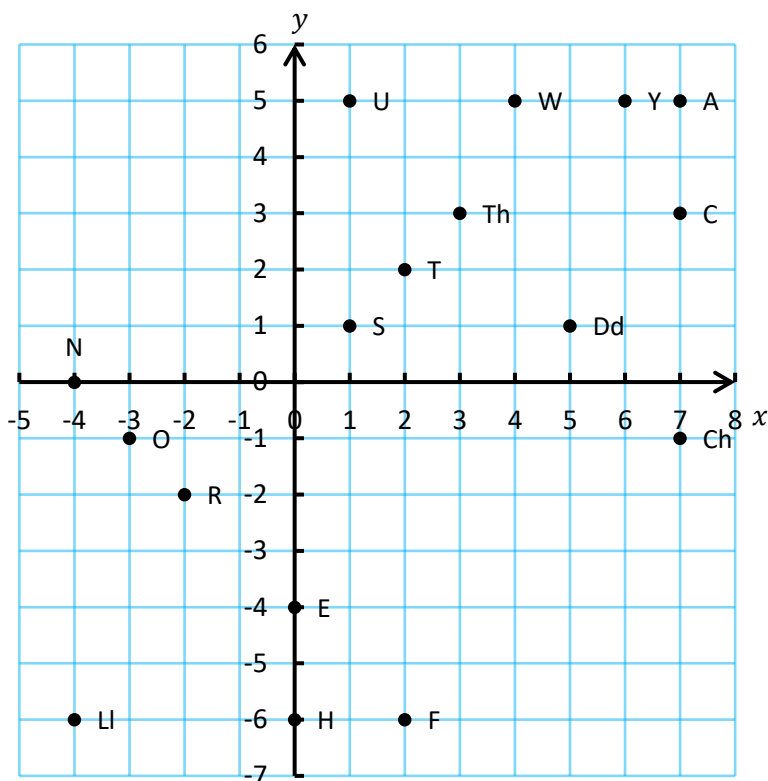
(6, 5), (-4, 0)

(-4, 0), (0, -6), (-2, -2), (0, -4), (2, -6), (-4, 0)

(6, 5), (-2, -2)

(4, 5), (6, 5), (5, 1), (-3, -1), (-2, -2)

(b) Do what is asked of you in part (a). What is the result?



## Exercise 9

Plot the following co-ordinates on the next page to draw the **face of a famous person**...



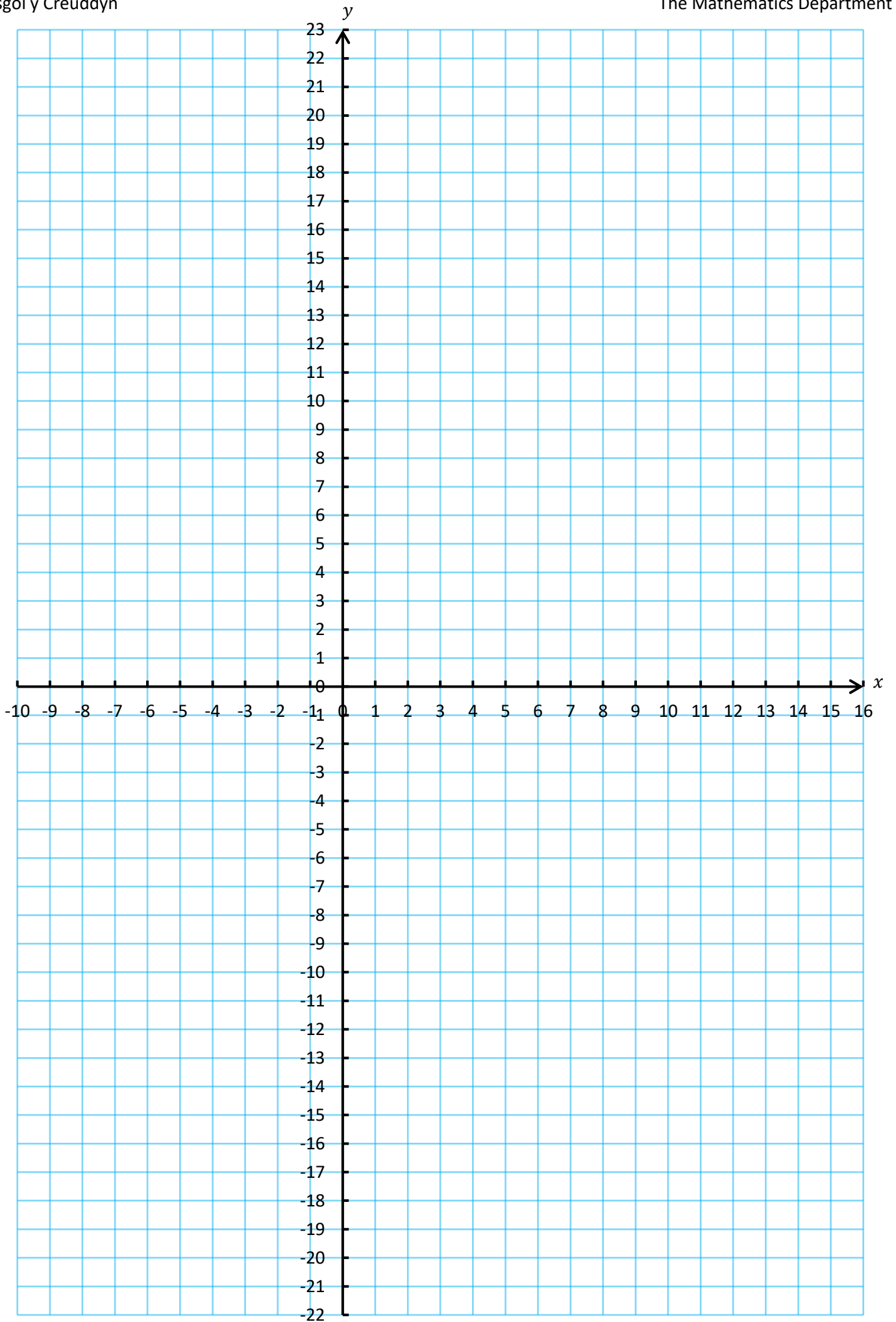
Connect the co-ordinates as you go on, starting a new line for each new bullet point.

For the **red** co-ordinates, you must **halve** the numbers to arrive at the correct co-ordinate. For example, if you see the co-ordinate (8, 10), then you must plot the point (4, 5).

For the **blue** co-ordinates, you must **add four** to the numbers to arrive at the correct co-ordinate. For example, if you see the co-ordinate (2, 5), then you must plot the point (6, 9).

- **Mouth:** (11, -11), (11, -12), (9, -14), (5, -16), (3, -16), (0, -15), (-2, -11), (-2, -9), (-1, -7), (2, -4), (4, -3), (12, -3), (14, -4), (15, -6), (15, -9), (11, -11), (8, -12), (5, -11), (2, -10)
- **Lips:** (0, -11), (4, -9)
- **Neck:** (-9, -20), (-7, -12), (-5, -7), (-7, -7), (-9, -5), (-9, -4), (-8, -3), (-6, -2), (-5, -3)
- **Ear:** (-7, -5), (-7, -4), (-6, -4)
- **Neck:** (8, -21), (7, -19), (7, -17), (8, -15), (9, -14)
- **Hair:** (-9, -3), (-9, 3), (-7, -2), (-6, 3), (-4, -2)
- **Left Eye:** (12, -3), (13, -2), (14, 0), (12, 1), (6, 1), (4, 0), (3, -1), (1, -1), (-1, 0), (-2, 1), (-3, 4), (-1, 7), (4, 16), (4, 8), (2, 2), (7, 4), (6, 1)
- **Right Eye:** (12, 1), (13, 2), (10, 0), (13, 6), (24, 14), (9, 8), (7, 7), (6, 6)
- **Head:** (-7, 0), (-9, 6), (-9, 12), (-8, 15), (-6, 17), (-3, 19), (0, 20), (2, 20), (1, 15), (7, 17), (9, 15), (20, 26), (11, 11), (11, 9), (9, 5), (12, 7)
- **Hair:** (-8, 12), (-9, 15), (-8, 18), (-6, 20), (-4, 20), (-3, 19)
- **Hair:** (-6, 14), (-7, 17), (-6, 20), (-4, 22), (-1, 22), (1, 21), (2, 20)
- **Place a Big Dot at (0, 3) and at (20, 6).**





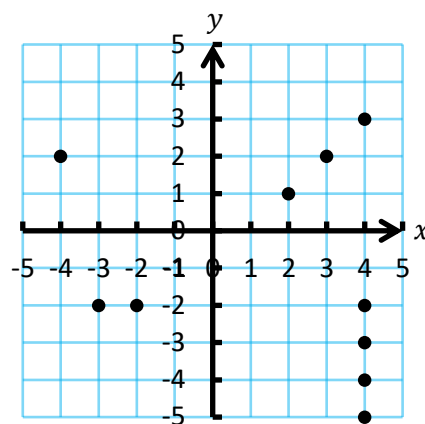
### Battleships (a game for two players)



Each player will need the worksheet for the game.

Place the following ships on your graph without the other player seeing:

**1 submarine** (1 dot); **1 destroyer** (2 dots); **1 cruiser** (3 dots); **1 battleship** (4 dots). An example is shown to the right.



Each player names a co-ordinate in turn. The other player announces “hit” or “miss”. When each of the dots representing a ship have been hit, the opponent announces, “ship destroyed”. The first player to lose **all** of his/her ships is the loser.

### Exercise 10 (Revision)

2

Draw  $x$  and  $y$  axes on a piece of squared paper. Number the  $x$ -axis from  $-18$  to  $18$ , and the  $y$ -axis from  $-26$  to  $16$ . Plot the following points, connecting them with straight lines as you go on. (Work row-by-row.)

- |            |            |                                      |           |           |           |           |
|------------|------------|--------------------------------------|-----------|-----------|-----------|-----------|
| (-13, -25) | (-11, -22) | (-8, -18)                            | (-6, -15) | (-5, -12) | (-5, -11) | (-6, -10) |
| (-7, -10)  | (-8, -9)   | (-7, -7)                             | (-6, -7)  | (-5, -8)  | STOP      | (-7, -9)  |
| (-6, -8)   | STOP       | (-6.5, -8.5)                         | (-5, -10) | STOP      | (-7, -25) | (-6, -23) |
| (-4, -21)  | STOP       | (-5, -22)                            | (-3, -23) | (1, -23)  | (4, -21)  | STOP      |
| (6, -25)   | (4, -21)   | (4, -17)                             | (5, -14)  | (7, -13)  | (10, -12) | (13, -10) |
| (13, -9)   | (11, -6)   | STOP                                 | (-2, -11) | (2, -13)  | (7, -13)  | STOP      |
| (-3, -12)  | (-1, -10)  | STOP                                 | (6, -6)   | (10, -6)  | (11, -7)  | (11, -8)  |
| (10, -9)   | (8, -9)    | STOP                                 | (6, -2)   | (7, -1)   | (9, 0)    | (11, 0)   |
| (13, -2)   | (13, -4)   | (12, -6)                             | (11, -6)  | STOP      | (4, -8)   | (0, -8)   |
| (-2, -6)   | (-2, -4)   | (-1, -2)                             | (2, 0)    | (4, 0)    | (6, -2)   | (7, -4)   |
| (6, -6)    | (4, -8)    | STOP                                 | (-2, -5)  | (-4, -4)  | STOP      | (-1, -2)  |
| (-3, 0)    | STOP       | (2, 0)                               | (1, 2)    | STOP      | (4, 0)    | (5, 2)    |
| STOP       | (9, 0)     | (8, 2)                               | STOP      | (11, 0)   | (12, 2)   | STOP      |
| (12, -1)   | (14, 0)    | STOP                                 | (13, -3)  | (15, -2)  | STOP      | (-5, -12) |
| (-9, -13)  | (-10, -9)  | (-14, -8)                            | (-11, -4) | (-15, -1) | (-10, 2)  | (-12, 7)  |
| (-6, 7)    | (-3, 13)   | (1, 9)                               | (6, 14)   | (8, 9)    | (14, 10)  | (12, 4)   |
| (17, 2)    | (13, -2)   | A big dot at (1, -6) and at (9, -5). |           |           |           |           |

## Evaluation

Key Words	Corrections	I am happy with...	I need to revise...



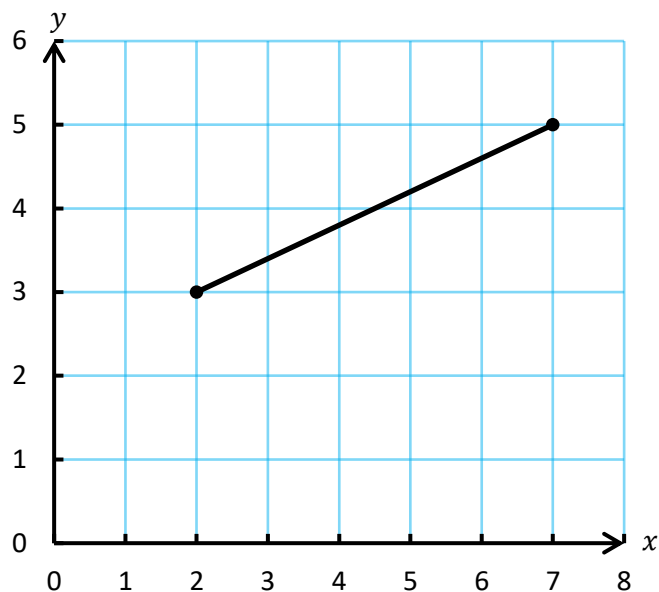
## Mid-point of a Line

It is possible to use a straight line to connect any two different co-ordinates. What is the **mid-point** of a straight line of this type?

### Example

Let us consider the two coordinates (2, 3) and (7, 5), as shown in the graph on the right.

We can see from the graph that the mid-point of the line joining (2, 3) to (7, 5) is (4.5, 4), but it is possible to calculate this *without* using the graph. To do this, we use the **mean** of the *x*-coordinates and the mean of the *y*-coordinates.



- The *x*-coordinates are 2 and 7. The total of 2 and 7 is 9, so the **mean of the *x*-coordinates** is  $9 \div 2 = 4.5$ .
- The *y*-coordinates are 3 and 5. The total of 3 and 5 is 8, so the **mean of the *y*-coordinates** is  $8 \div 2 = 4$ .
- It follows that the mid-point of the line joining (2, 3) to (7, 5) is (4.5, 4).

### Exercise 11

Find the mid-point of the straight line joining the following pairs of co-ordinates.

- |                         |                           |                           |                           |
|-------------------------|---------------------------|---------------------------|---------------------------|
| (a) (2, 6) and (8, 2)   | (b) (4, 5) and (2, 3)     | (c) (9, 6) and (3, 10)    | (d) (11, 7) and (9, 1)    |
| (e) (2, 4) and (3, 8)   | (f) (4, 1) and (10, 6)    | (g) (1, 2) and (2, 1)     | (h) (10, 4) and (5, 12)   |
| (i) (1, 6) and (12, 12) | (j) (24, 10) and (14, 18) | (k) (34, 2) and (26, 5)   | (l) (0, 4) and (6, 4)     |
| (m) (9, 9) and (8, 8)   | (n) (18, 4) and (20, 0)   | (o) (13, 17) and (14, 16) | (p) (45, 67) and (83, 24) |



### Adding Negative Numbers

In Exercise 11, the co-ordinates all came from the first quadrant. To find the mid-point of lines joining co-ordinates in other quadrants, we must first learn how to work with addition sums that contain negative numbers.

### Two Sided Counters

Two sided counters have a **yellow** face and a **red** face. The **yellow** face represents +1 (positive one) and the **red** face represents -1 (negative one).



### Example

+3	-4	0	+3
● ● ●	● ● ● ●	● ●	● ● ● ●
		● ●	● ●

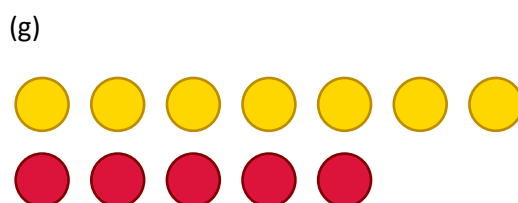
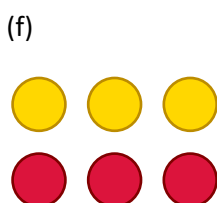
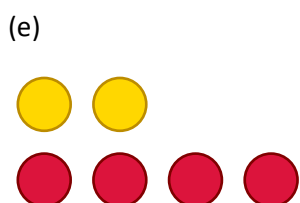
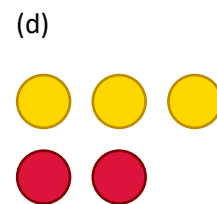
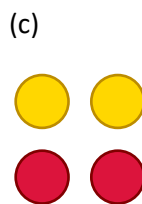
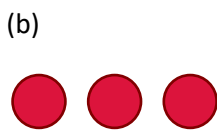
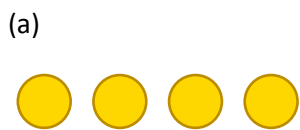
One yellow counter and one red counter gives a **zero pair**. It is possible to remove or add zero pairs to any set of counters without affecting the value of the counters.



**Exercise 12**



Which numbers are shown below?



It is possible to use two sided counters to find the answer to addition sums that contain negative numbers.

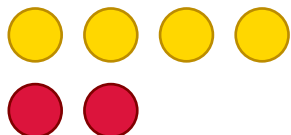
**Example**

$4 + -2$

Start with 4 yellow counters



Add 2 red counters



Remove any zero pairs



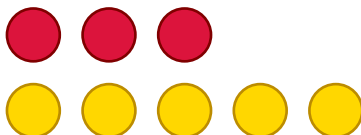
Count what is left: **2**

$-3 + 5$

Start with 3 red counters



Add 5 yellow counters



Remove any zero pairs



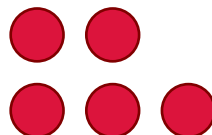
Count what is left: **2**

$-2 + -3$

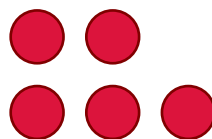
Start with 2 red counters



Add 3 red counters



Remove any zero pairs



Count what is left: **-5**



**Exercise 13**



Use two sided counters to calculate the answer to the following sums.

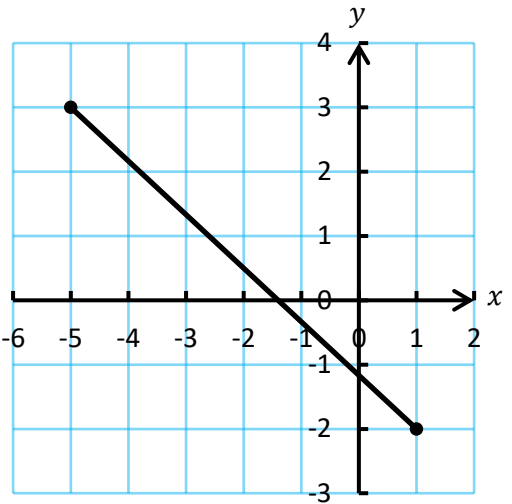
- |               |              |               |               |
|---------------|--------------|---------------|---------------|
| (a) $5 + 2$   | (b) $5 + -2$ | (c) $-5 + 2$  | (d) $-5 + -2$ |
| (e) $6 + -1$  | (f) $-1 + 6$ | (g) $-6 + 1$  | (h) $1 + -6$  |
| (i) $7 + -3$  | (j) $3 + -7$ | (k) $-3 + -7$ | (l) $-7 + 3$  |
| (m) $3 + -6$  | (n) $-6 + 3$ | (o) $-3 + -6$ | (p) $6 + -3$  |
| (q) $9 + -2$  | (r) $7 + -6$ | (s) $-2 + -6$ | (t) $-3 + -4$ |
| (u) $-3 + 7$  | (v) $-4 + 2$ | (w) $4 + -8$  | (x) $2 + -2$  |
| (y) $3 + -10$ | (z) $-4 + 6$ | (α) $-2 + -3$ | (β) $12 + -3$ |



### Mid-point of Lines in the Four Quadrants

Let us consider the two co-ordinates (1, -2) and (-5, 3), as shown in the graph on the right.

We can see from the graph that the mid-point of the line joining (1, -2) to (-5, 3) is (-2, 0.5), but it is possible to calculate this *without* using the graph. To do this, we use (as before) the **mean** of the *x*-coordinates and the mean of the *y*-coordinates.



- The *x*-coordinates are 1 and -5.  
The total of 1 and -5 is  $1 + -5 = -4$ ,  
so the **mean of the *x*-coordinates** is  $-4 \div 2 = -2$ .
- The *y*-coordinates are -2 and 3. The total of -2 and 3 is  $-2 + 3 = 1$ , so the **mean of the *y*-coordinates** is  $1 \div 2 = 0.5$ .
- It follows that the mid-point of the line joining (1, -2) to (-5, 3) is (-2, 0.5).

### Exercise 14



Find the mid-point of the straight line joining the following pairs of co-ordinates.

- (a) (4, -2) and (2, 8)    (b) (8, 4) and (-2, 6)    (c) (9, -4) and (5, 2)    (d) (-4, -6) and (10, 12)  
 (e) (4, 2) and (-10, -6)    (f) (-8, 5) and (1, 3)    (g) (-6, -2) and (11, 15)    (h) (34, -5) and (-4, 10)  
 (i) (-8, 14) and (2, -6)    (j) (-4, -6) and (-2, -4)    (k) (-5, 4) and (-7, -12)    (l) (-14, 0) and (-6, -8)  
 (m) (15, 13) and (11, -1)    (n) (-25, -20) and (7, -4)    (o) (-1, 0) and (0, -1)    (p) (-12.5, -3.5) and (0.5, -1.5)



### Exercise 15

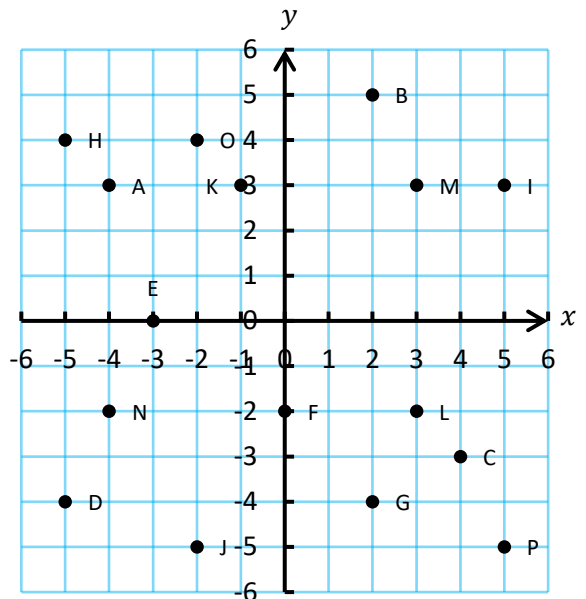
Find the mid-point of the straight line joining the following pairs of co-ordinates.

- (a) A and B                      (b) C and D  
 (c) E and F                      (d) G and H  
 (e) I and J                        (f) K and L  
 (g) M and N                      (h) O and P

### Exercise 16 (Revision)

Find the mid-point of the straight line joining the following pairs of co-ordinates.

- (a) (9, 3) and (1, 9)                      (b) (9, -3) and (1, 9)  
 (c) (-9, 3) and (1, 9)                      (d) (-9, -3) and (-1, -9)



Key Words	Corrections	I am happy with...	I need to revise...

Using Co-ordinates

Applying

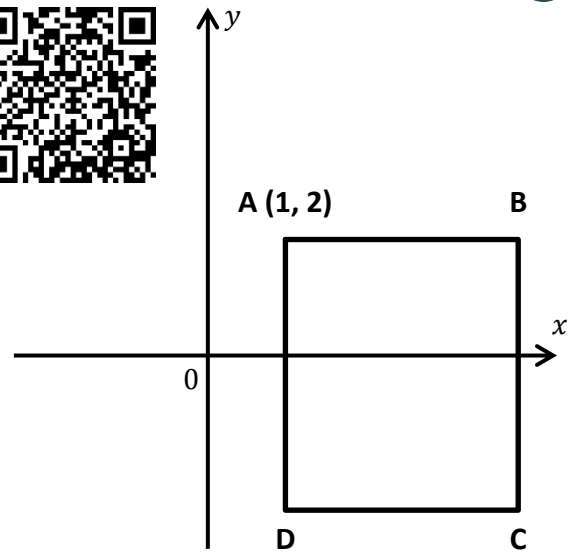
2

Missing Co-ordinates



Exercise 17

In the diagram on the right, the length of the sides of the square **ABCD** is 6 units. Find the co-ordinates of the points **B**, **C** and **D**.



Exercise 18

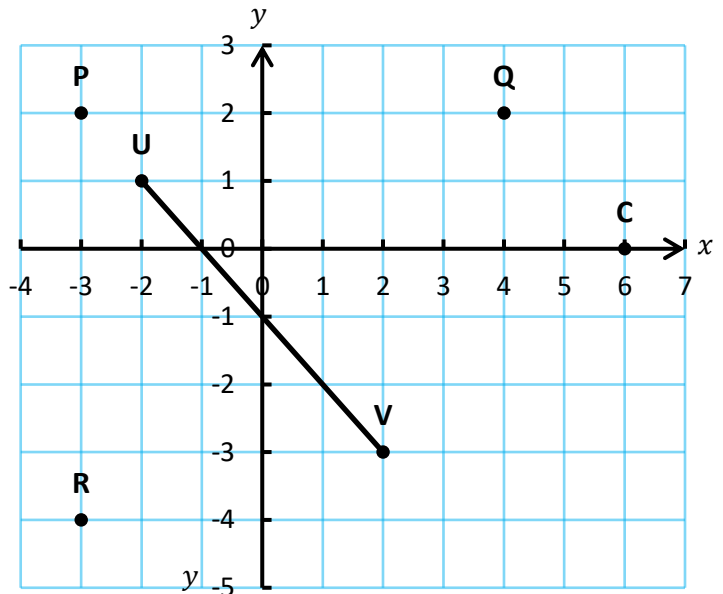
Hayley plots a square on graph paper. The co-ordinates of three of the corners are  $(-4, 4)$ ,  $(-1, 4)$  and  $(-4, 1)$ . What is the co-ordinate of the **fourth corner** of the square?

Exercise 19

Guto plots a rectangle on graph paper. The co-ordinates of three of the corners are  $(2, -1)$ ,  $(5, -1)$  and  $(5, -5)$ . What is the co-ordinate of the **fourth corner** of the rectangle?

Exercise 20

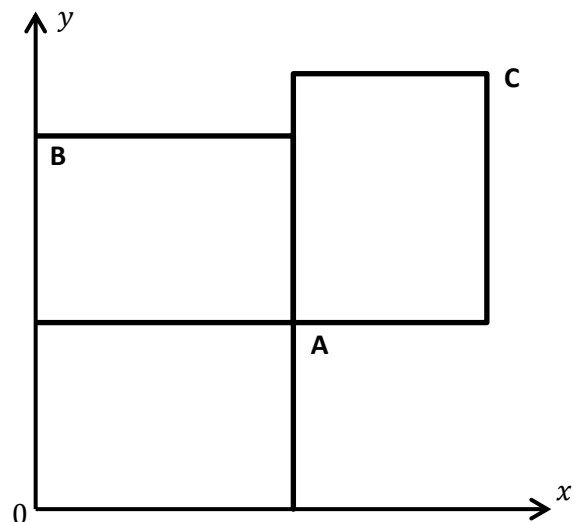
- (a) Write down the co-ordinates of the point **P**.
- (b) The point **W** lies on the line **UV**. The  $y$ -coordinate of **W** is  $-2$ . What is **W**'s  $x$ -coordinate?
- (c) What are the co-ordinates of the mid-point of the line **UV**?
- (d) The co-ordinates of the point  $(1, 3)$  add to 4. What number do you get if you add the co-ordinates of any point on the line **UV**?
- (e) Write down the co-ordinates of the point **S** so that **PQRS** forms a rectangle.
- (f) **CD** is a vertical line. What would be the co-ordinates of the point **D** if **CD** was 4 units in length and in the fourth quadrant?



Exercise 21

The diagram on the right shows 3 rectangles, each of them 4 units by 3 units.

- (a) Find the co-ordinates of the points **A**, **B** and **C**.
- (b) What would be the co-ordinates of the mid-point of the line joining **A** to **B**?
- (c) What would be the co-ordinates of the mid-point of the line joining **A** to **C**?

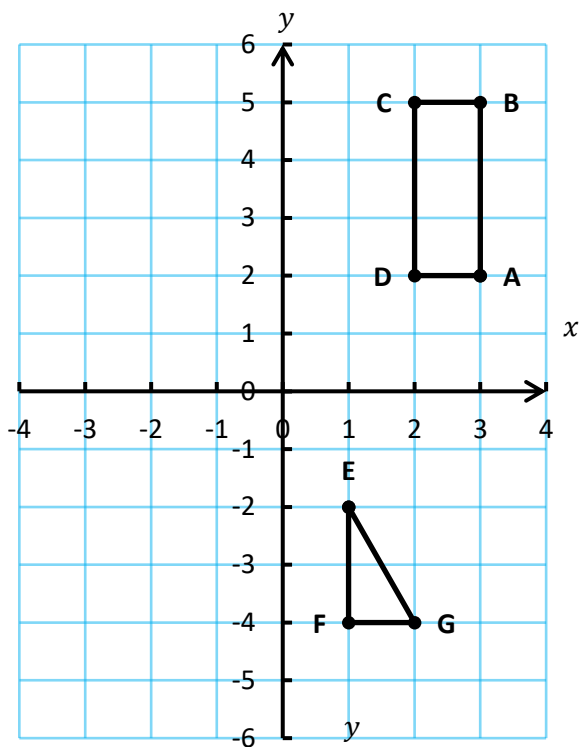


**Translation**

2

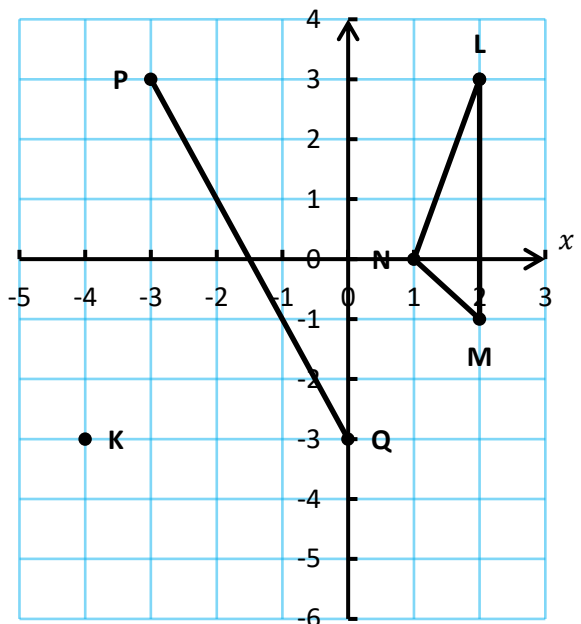
**Exercise 22**

- (a) The rectangle **ABCD** is translated 4 units to the left. Write down the co-ordinates of the new vertices.
- (b) The rectangle **ABCD** is translated 1 unit to the right and 7 units down. Write down the co-ordinates of the new vertices.
- (c) The rectangle **ABCD** is translated so that its vertices move to the co-ordinates (0, 1), (1, 1), (1, 4), (0, 4). What vector column represents this translation?
- (d) The triangle **EFG** is translated 3 units to the left and 2 units up. Write down the co-ordinates of the new vertices.



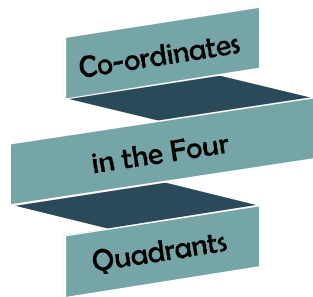
**Exercise 23 (Revision)**

- (a) Write down the co-ordinates of the point **K**.
- (b) The point **R** lies on the line **PQ**. The *y*-coordinate of **R** is 1. What is the *x*-coordinate of **R**?
- (c) What are the co-ordinates of the mid-point of the line **PQ**?
- (d) The shape **LMN** is translated 4 units to the left and 5 units down. Write down the co-ordinates of the new vertices.
- (e) The line **PQ** forms one side of a square. What could be the co-ordinates of the other two corners?



**Evaluation**



Key Words	Corrections	I am happy with...	I need to revise...



# Reflection Sheet

Name: .....

Percentage in the test: .....

	I know this. 	I need to revise this. 	Question in the test:	Correct in the test?
I know how to <b>plot co-ordinates in the first quadrant</b> , e.g. (5, 2).			2	
I know how to <b>recognise co-ordinates</b> that have been plotted in the <b>first quadrant</b> .			1	
I know what the co-ordinate of the <b>origin</b> is.			5	
Given a co-ordinate such as (7, 3), I know what the <b>x-coordinate</b> is and what the <b>y-coordinate</b> is.			3, 4	
I know how to <b>plot co-ordinates in all four quadrants</b> , e.g. (-7, 3).			7	
I know how to <b>recognise co-ordinates</b> that have been plotted in <b>all four quadrants</b> .			11	
I know how to recognise <b>in which quadrant</b> a given co-ordinate appears.			8	
I know how to <b>add a negative number</b> , e.g. $5 + -2$ .			6	
I can find the <b>mid-point of a straight line</b> that connects a pair of co-ordinates.			9, 11	
I can find <b>missing co-ordinates</b> in diagrams.			11	
I can <b>translate</b> co-ordinates.			10	