



The Mathematics Department

7

Co-ordinates

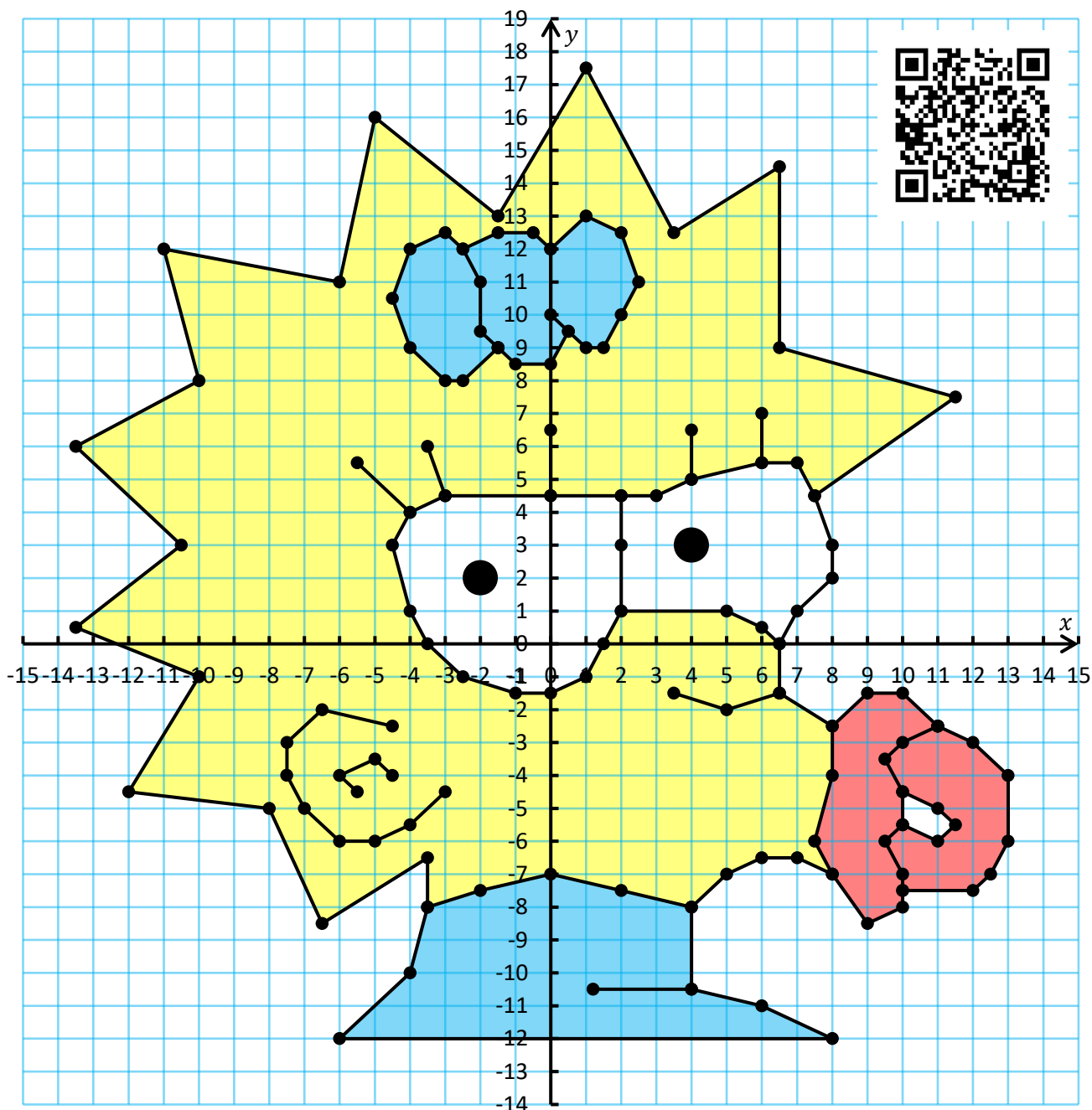
in the Four

Quadrants

Name:

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The First Quadrant

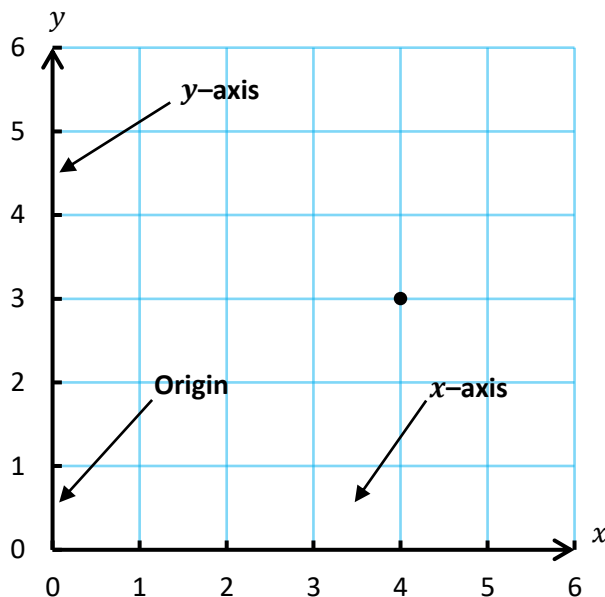
One way of locating a point is to use a pair of **numbered, perpendicular lines**. These lines are called **axes**.

- 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,

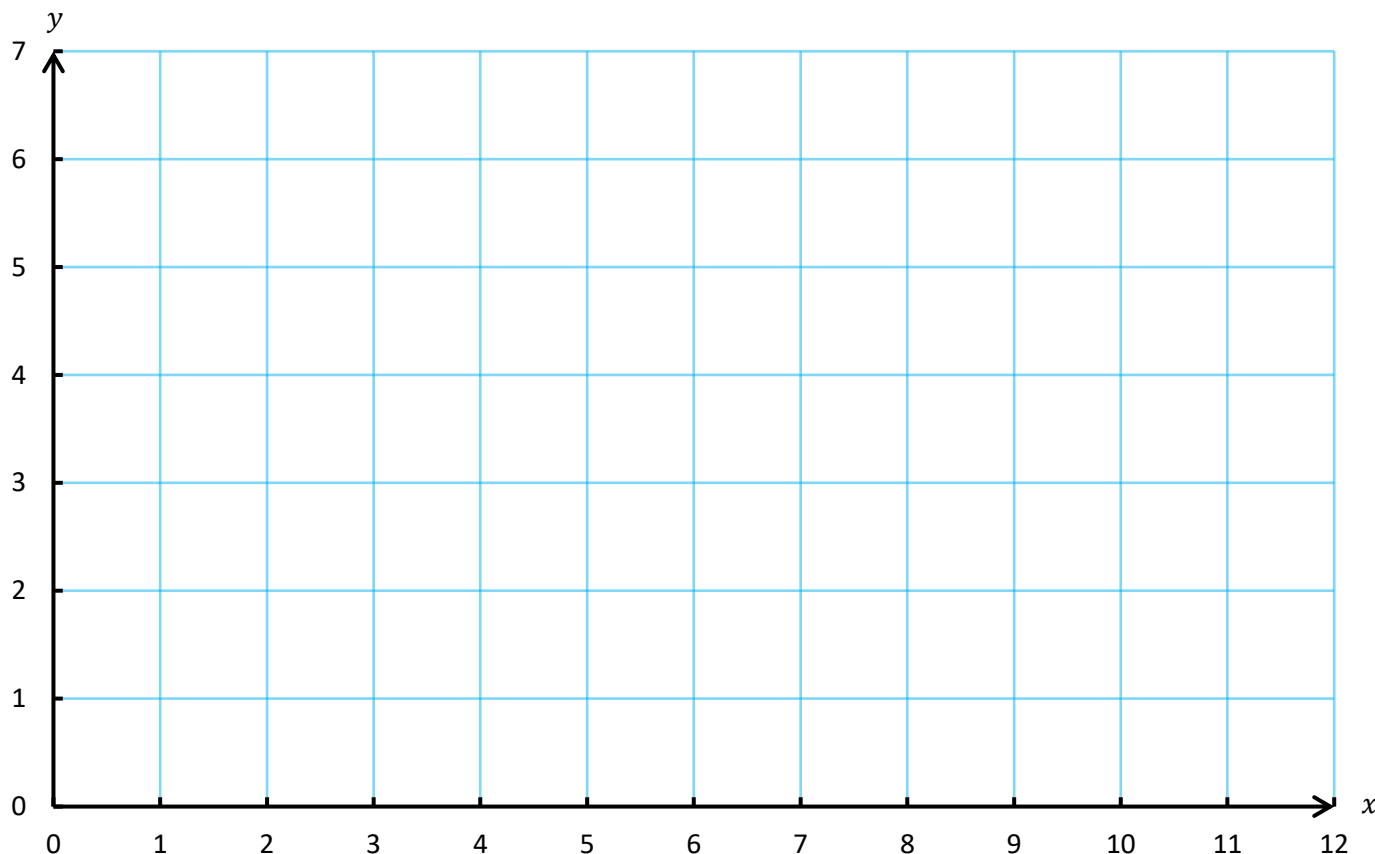
- The **x-coordinate** is 4. This is the distance we move **across**.
- The **y-coordinate** is 3. This is the distance we move **up**.



Exercise 1

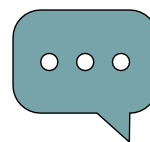
Plot the following points on the axes shown below.

- | | | | | |
|------------|------------|-------------|--------------|----------------|
| (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) |

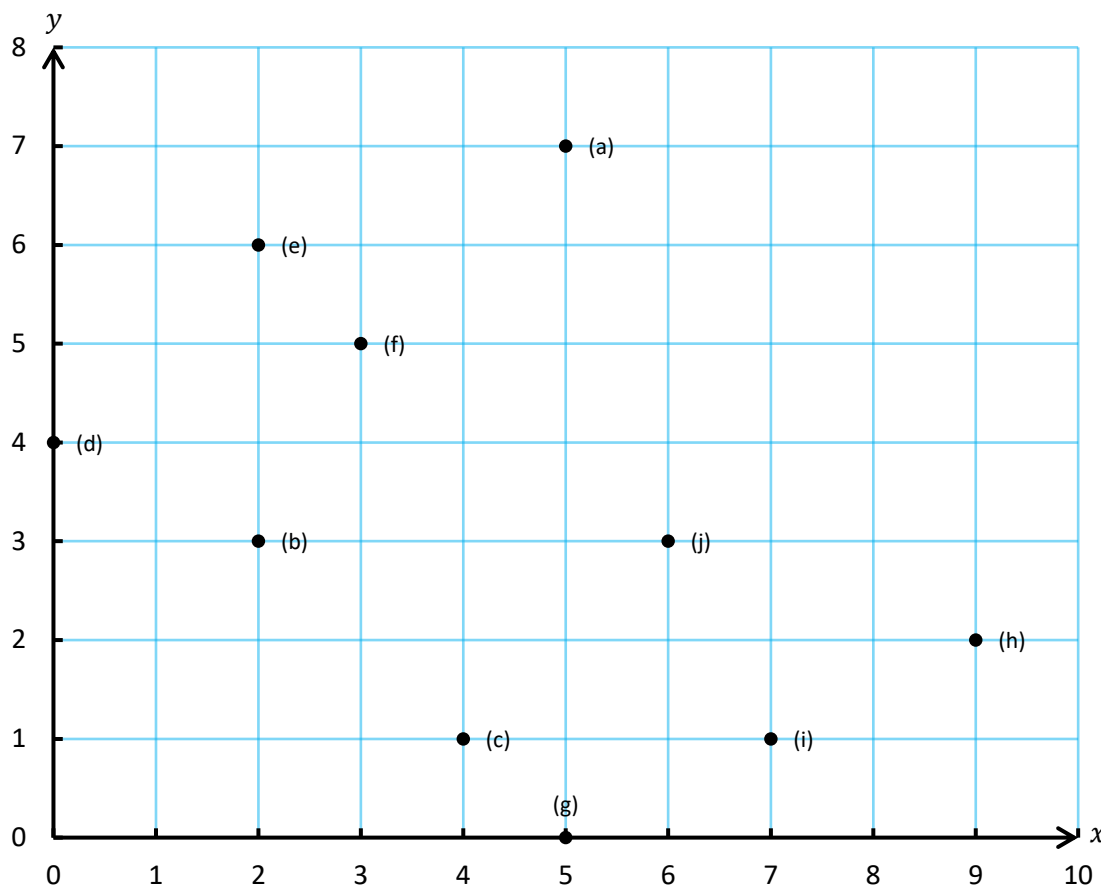


Exercise 2

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



4



- (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**...

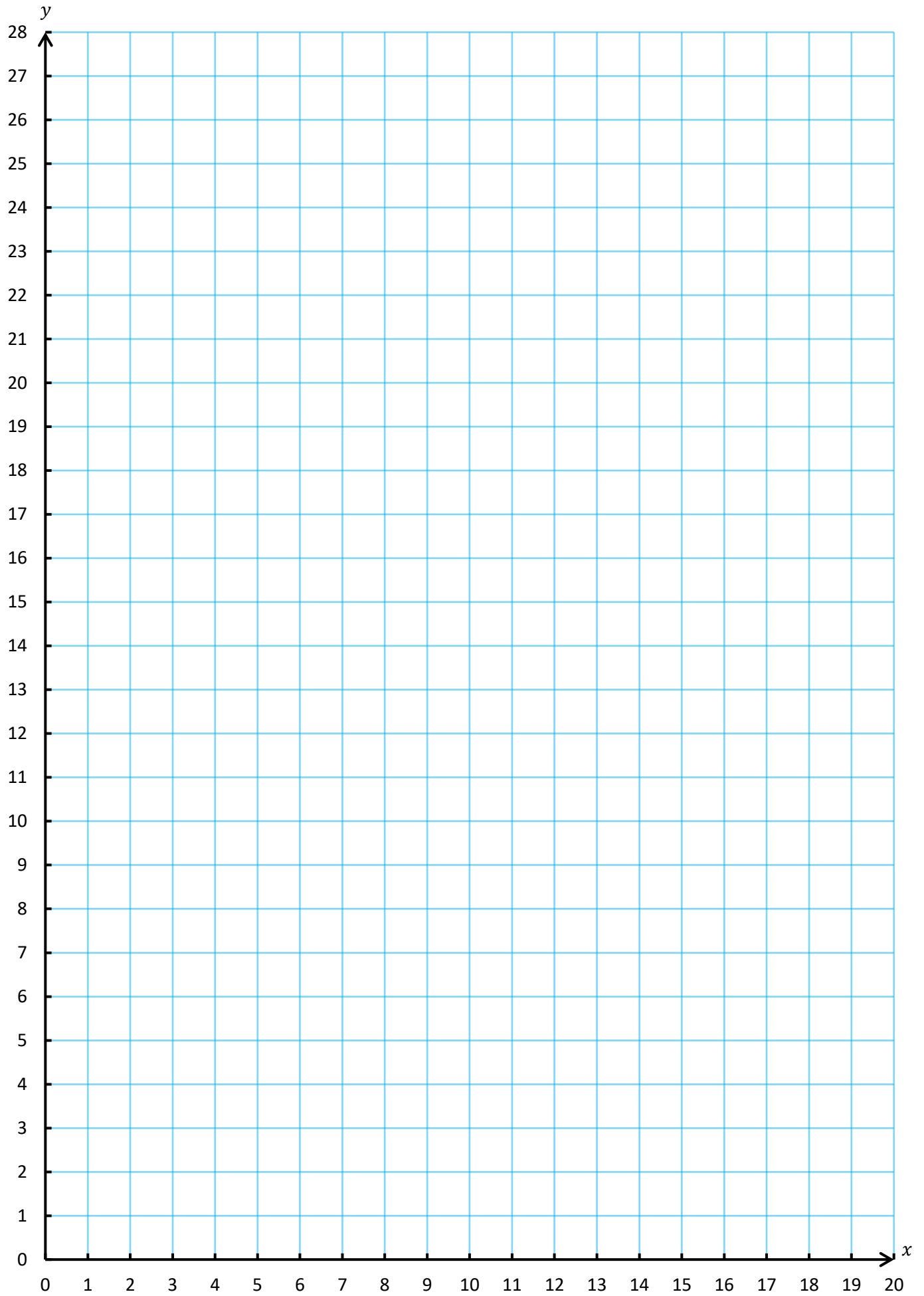


Connect the co-ordinates as you go on, starting a new line for each new bullet point.

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)**

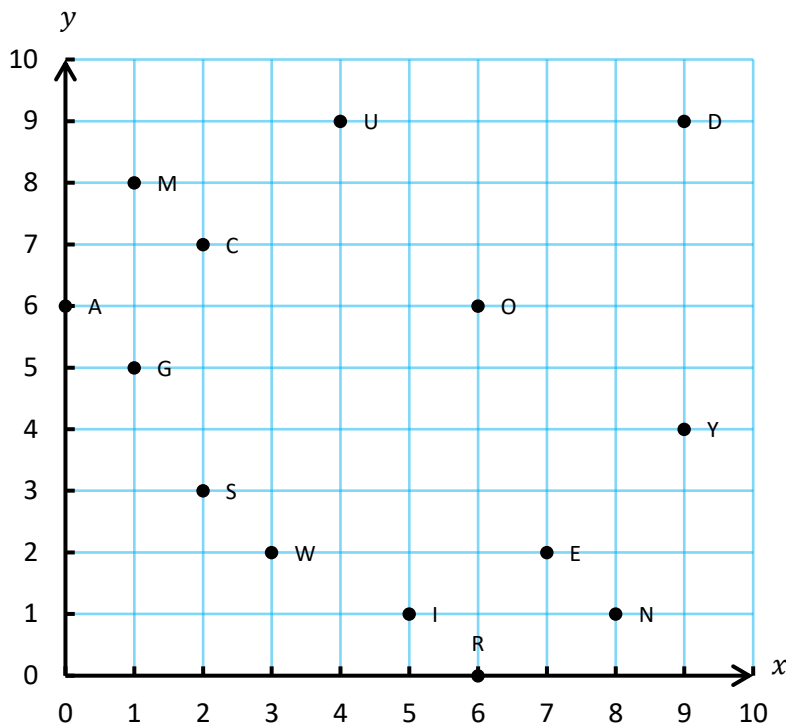


Exercise 4

4

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).



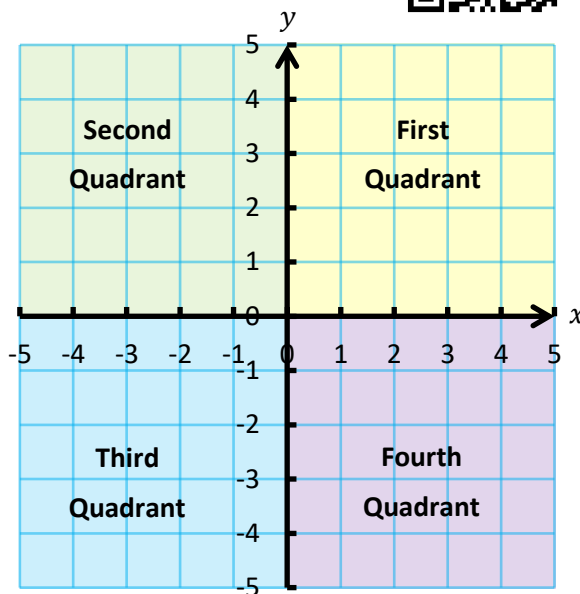
Key Words	Corrections	I am happy with...	I need to revise...



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.



6 Skill

Exercise 6

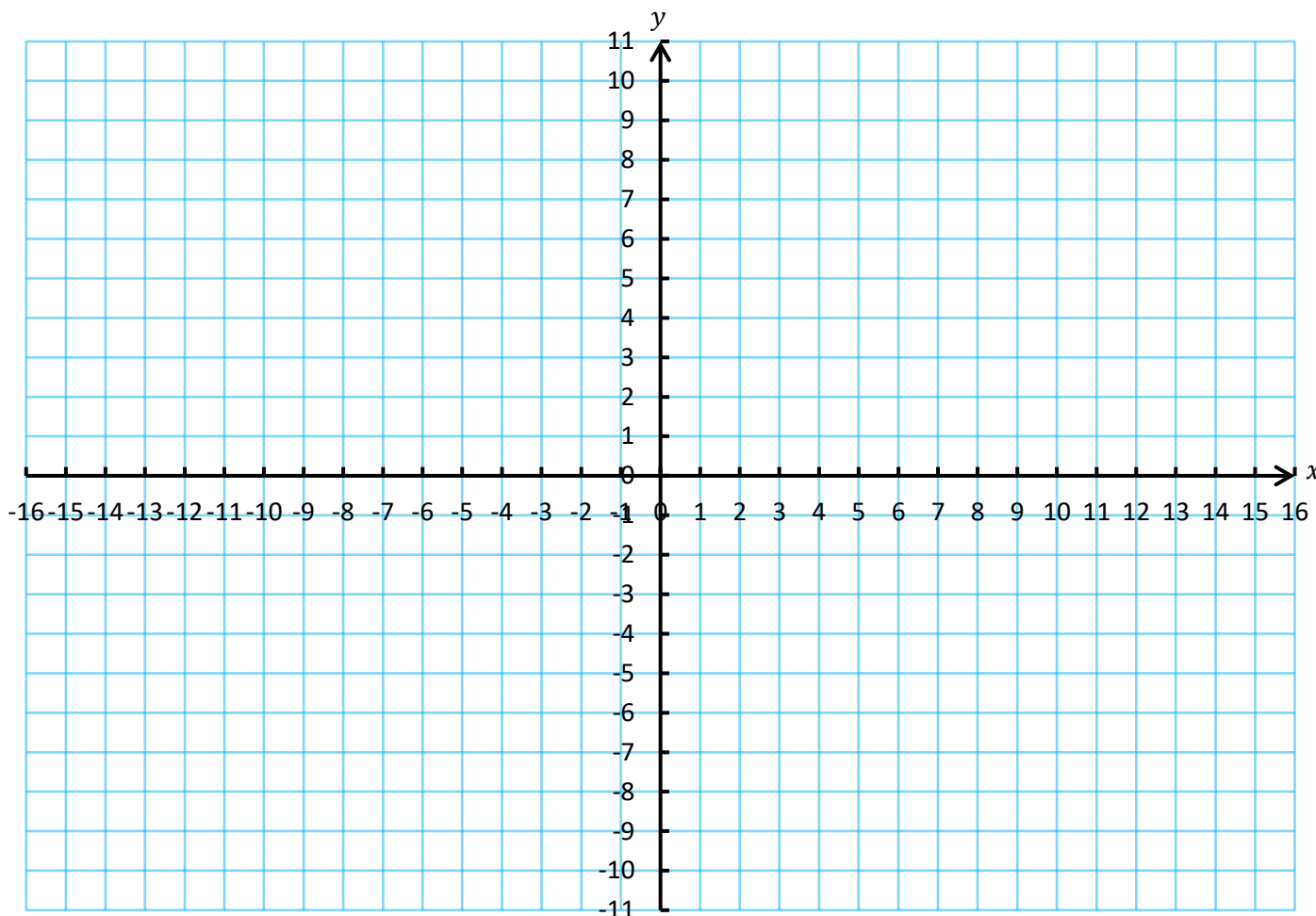
In which quadrant do the following points appear?

- | | | | |
|--------------|------------------|-------------|------------------|
| (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

6

(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)

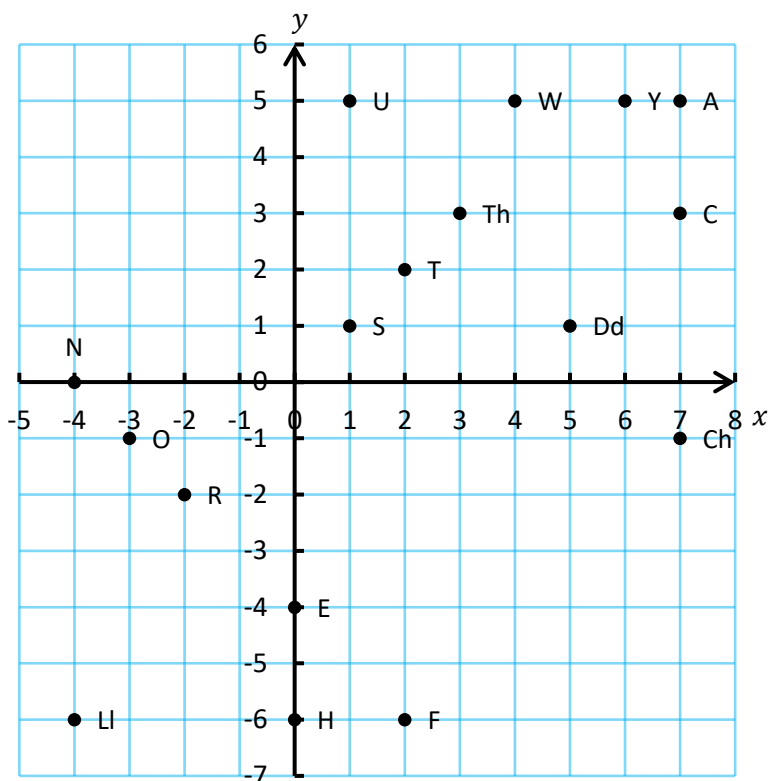
(6, 5), (-4, 0)

(-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**...



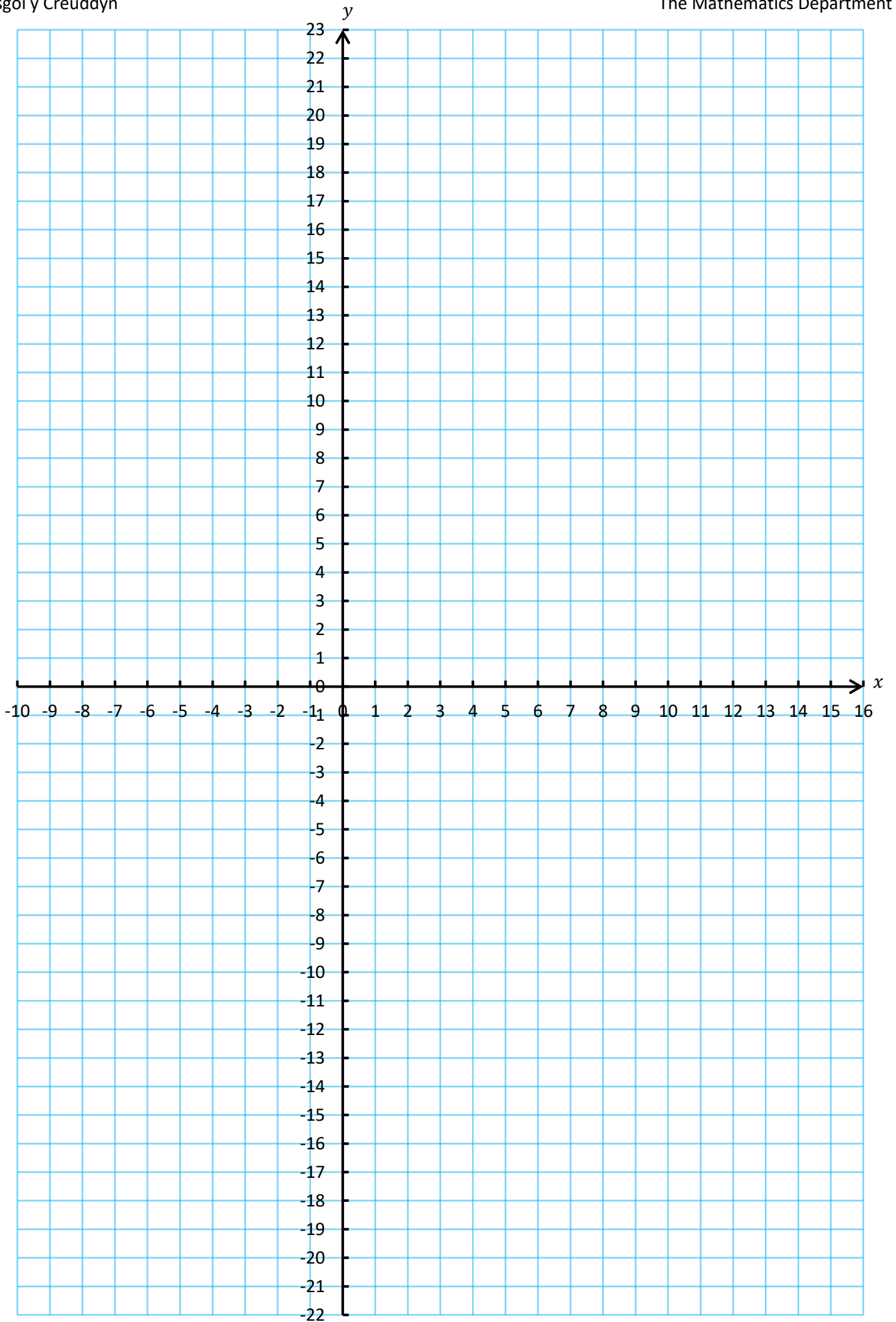
Connect the co-ordinates as you go on, starting a new line for each new bullet point.

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).**





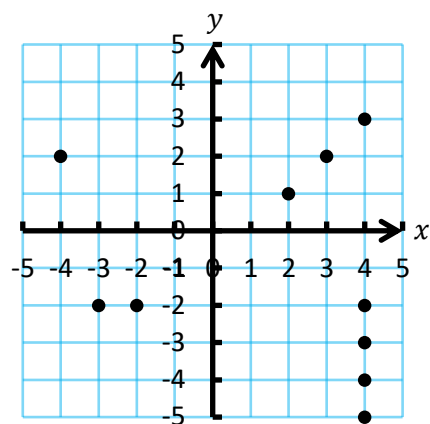
Battleships (a game for two players)



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)

6

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...



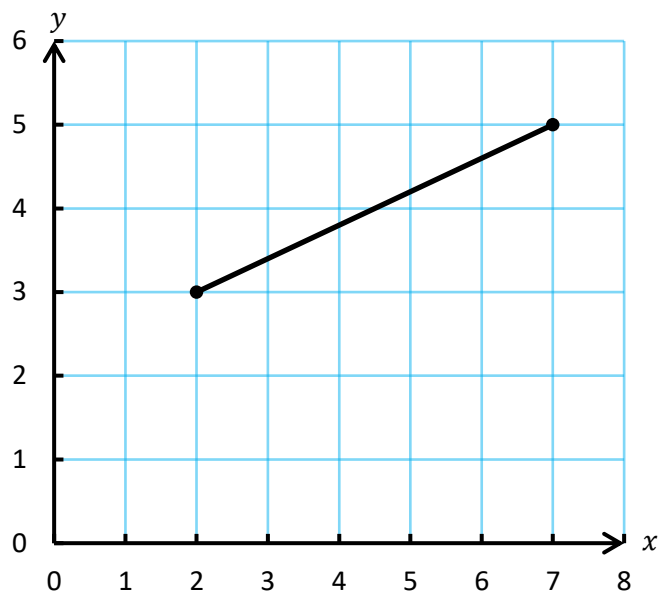
Mid-point of a Line

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) |

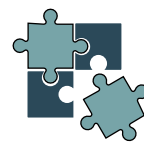


Adding Negative Numbers

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?

(a)	(b)	(c)	(d)
(e)	(f)	(g)	

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

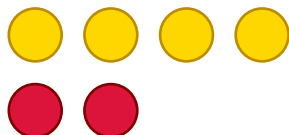
Example

$4 + -2$

Start with 4 yellow counters



Add 2 red counters



Remove any zero pairs



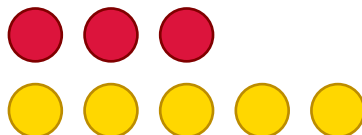
Count what is left: **2**

$-3 + 5$

Start with 3 red counters



Add 5 yellow counters



Remove any zero pairs



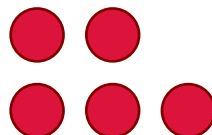
Count what is left: **2**

$-2 + -3$

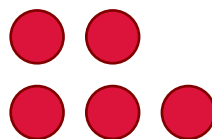
Start with 2 red counters



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.

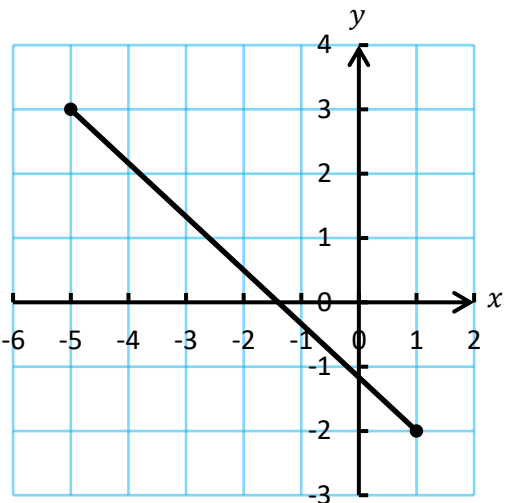
- | | | | |
|---------------|--------------|---------------|---------------|
| (a) $5 + 2$ | (b) $5 + -2$ | (c) $-5 + 2$ | (d) $-5 + -2$ |
| (e) $6 + -1$ | (f) $-1 + 6$ | (g) $-6 + 1$ | (h) $1 + -6$ |
| (i) $7 + -3$ | (j) $3 + -7$ | (k) $-3 + -7$ | (l) $-7 + 3$ |
| (m) $3 + -6$ | (n) $-6 + 3$ | (o) $-3 + -6$ | (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

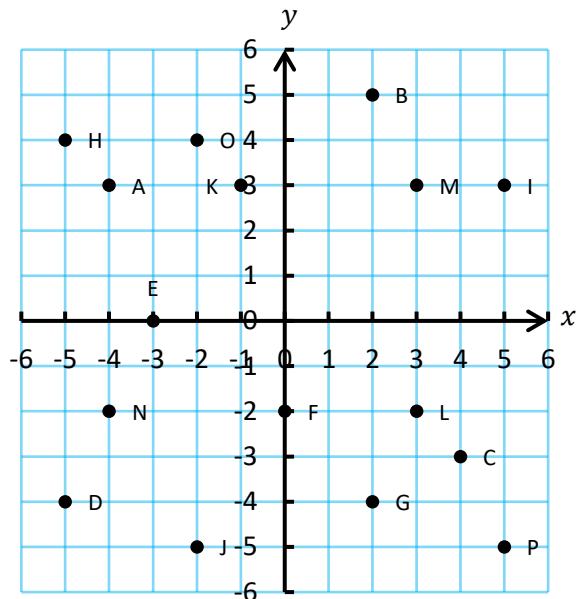
Find the mid-point of the straight line joining the following pairs of co-ordinates.

- (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

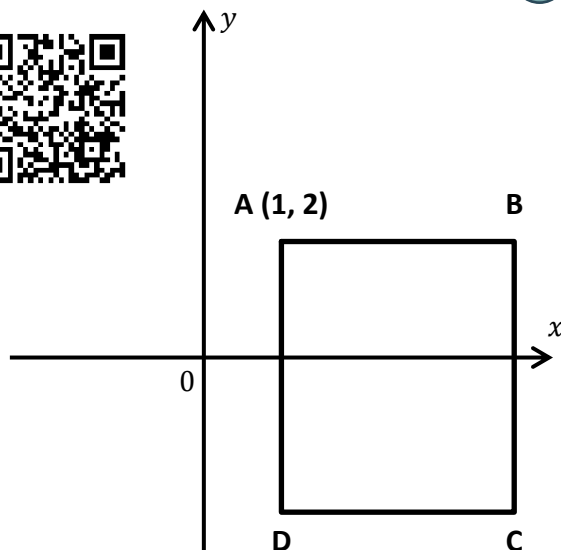
Applying 6

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

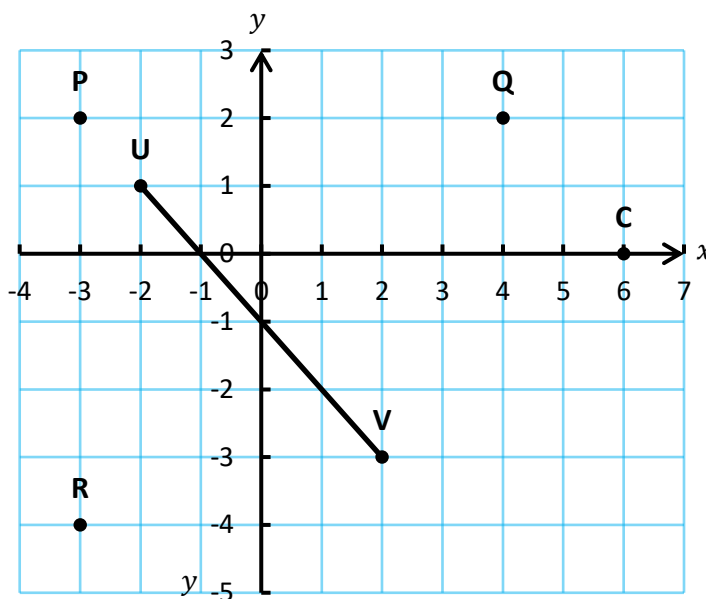
Hayley plots a square on graph paper. The co-ordinates of three of the corners are $(-4, 4)$, $(-1, 4)$ and $(-4, 1)$. What is the co-ordinate of the **fourth corner** of the square?

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

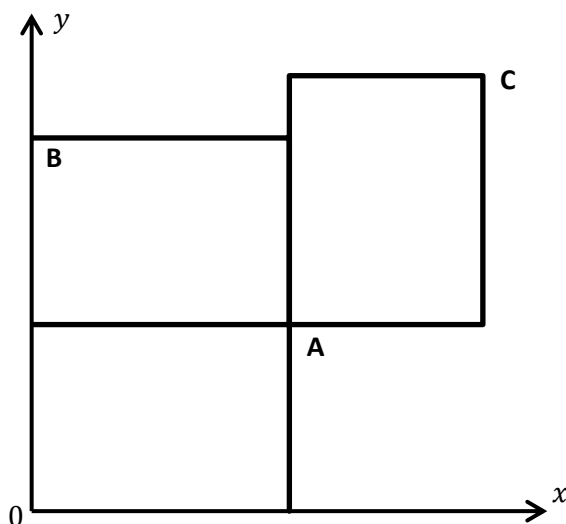
- (a) Write down the co-ordinates of the point **P**.
- (b) The point **W** lies on the line **UV**. The y -coordinate of **W** is -2 . What is **W**'s x -coordinate?
- (c) What are the co-ordinates of the mid-point of the line **UV**?
- (d) The co-ordinates of the point $(1, 3)$ add to 4. What number 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**?

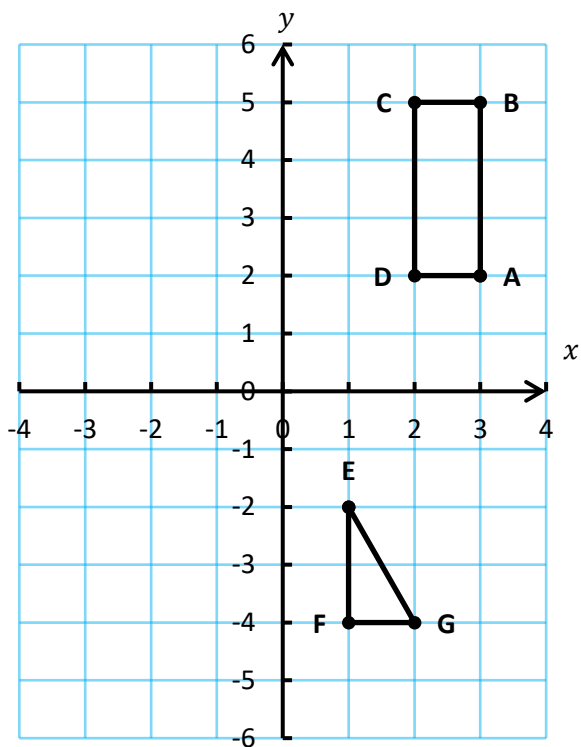


Translation Using a Vector Column

6

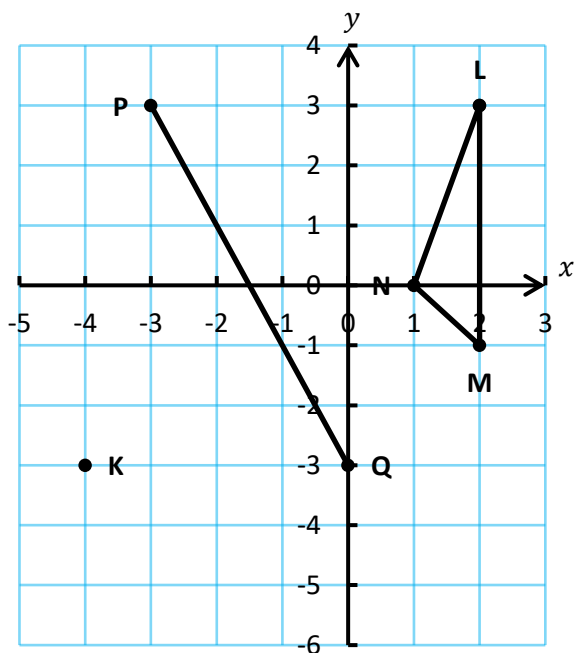
Exercise 22

- (a) The rectangle **ABCD** is translated using the vector column $\begin{pmatrix} -4 \\ 0 \end{pmatrix}$. Write down the co-ordinates of the new vertices.
- (b) The rectangle **ABCD** is translated using the vector column $\begin{pmatrix} 1 \\ -7 \end{pmatrix}$. 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 using the vector column $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$. Write down the co-ordinates of the new vertices.



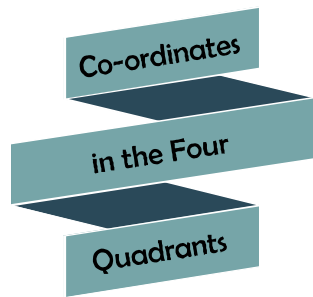
Exercise 23 (Revision)

- (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 using the vector column $\begin{pmatrix} -4 \\ -5 \end{pmatrix}$. 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 plot co-ordinates in the first quadrant , e.g. (5, 2).			2	
I know how to recognise co-ordinates that have been plotted in the first quadrant .			1	
I know what the co-ordinate of the origin is.			5	
Given a co-ordinate such as (7, 3), I know what the x-coordinate is and what the y-coordinate is.			3, 4	
I know how to plot co-ordinates in all four quadrants , e.g. (-7, 3).			7	
I know how to recognise co-ordinates that have been plotted in all four quadrants .			11	
I know how to recognise in which quadrant a given co-ordinate appears.			8	
I know how to add a negative number , e.g. $5 + -2$.			6	
I can find the mid-point of a straight line that connects a pair of co-ordinates.			9, 11	
I can find missing co-ordinates in diagrams.			11	
I can write co-ordinates for translations that use vector columns .			10	