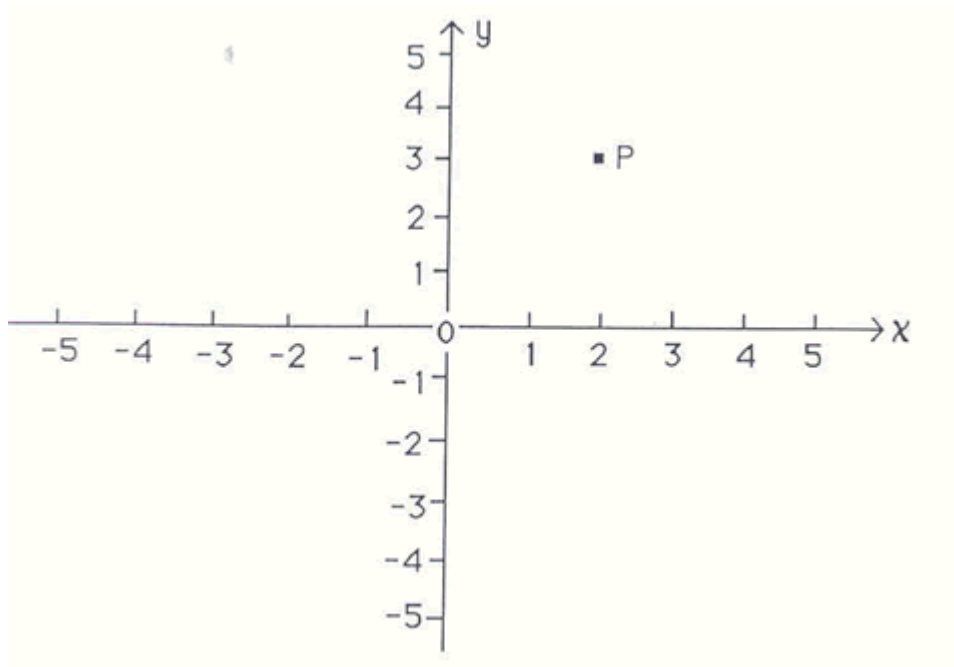Learning
Development

University of
Northampton

STRAIGHT LINE GRAPHS

THE COORDINATES OF A POINT

The coordinates of any point are written as an ordered pair (x, y)

Point P in the diagram has coordinates (2, 3).

Its **horizontal** distance along the x axis from the origin 0 is 2 units so the x coordinate is 2. Its **vertical** distance along the y axis from the origin is 3 units so the y coordinate is 3.

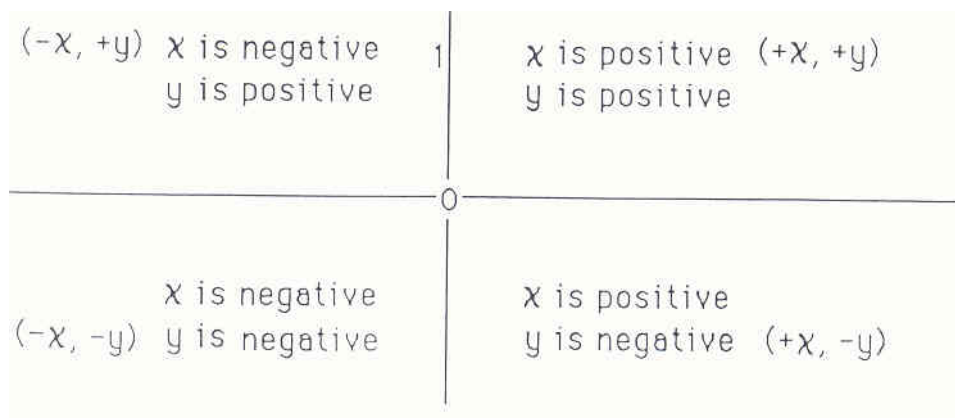**REMEMBER** – The x coordinate is always written first.

Often points have one or both coordinates which are negative.

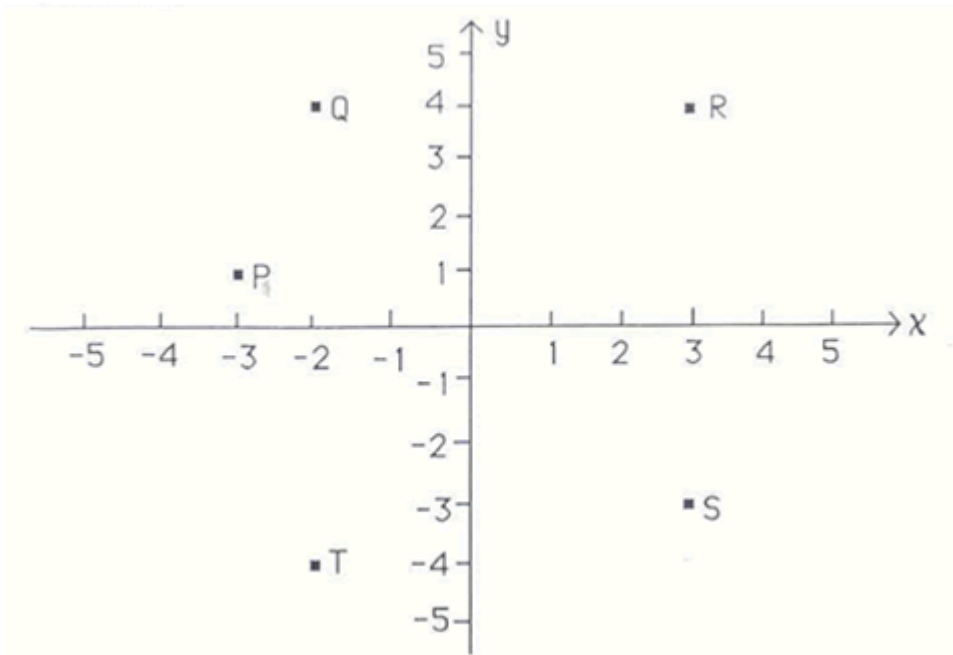**Positive** values of x are to the **right** of the origin.

Negative values of x are to the **left** of the origin.

Positive values of y are **upwards** from the origin.

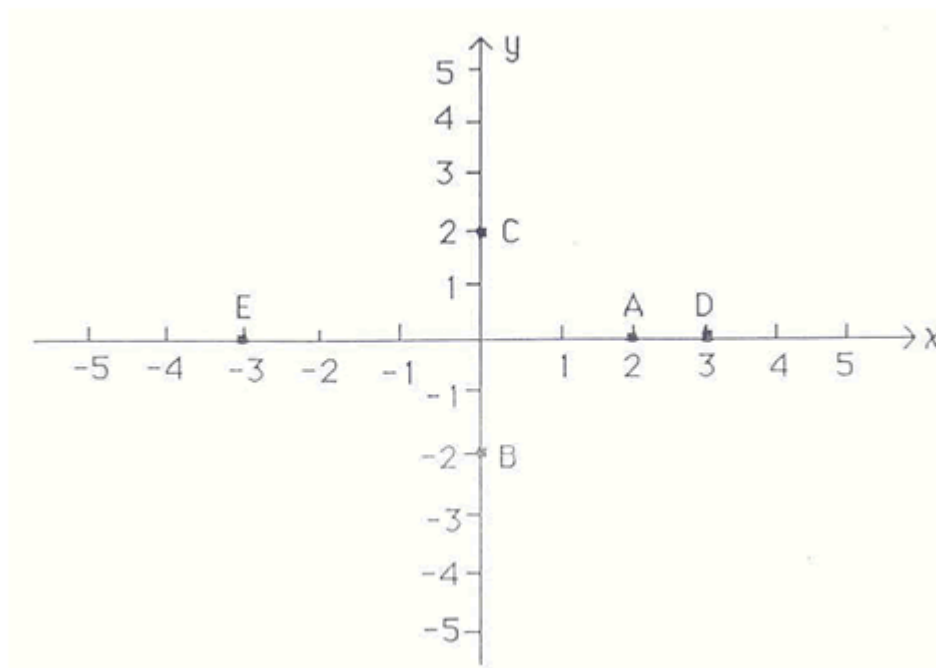**Negative** values of y are **downwards** from the origin.

Exercise 1

Complete this list:-
P is (-3, 1)   Q is (,)
R is (,)   S is (,)
T is (,)

REMEMBER – If the Point is on the x axis, the y coordinate is 0
              If the Point is on the y axis, the x coordinate is 0
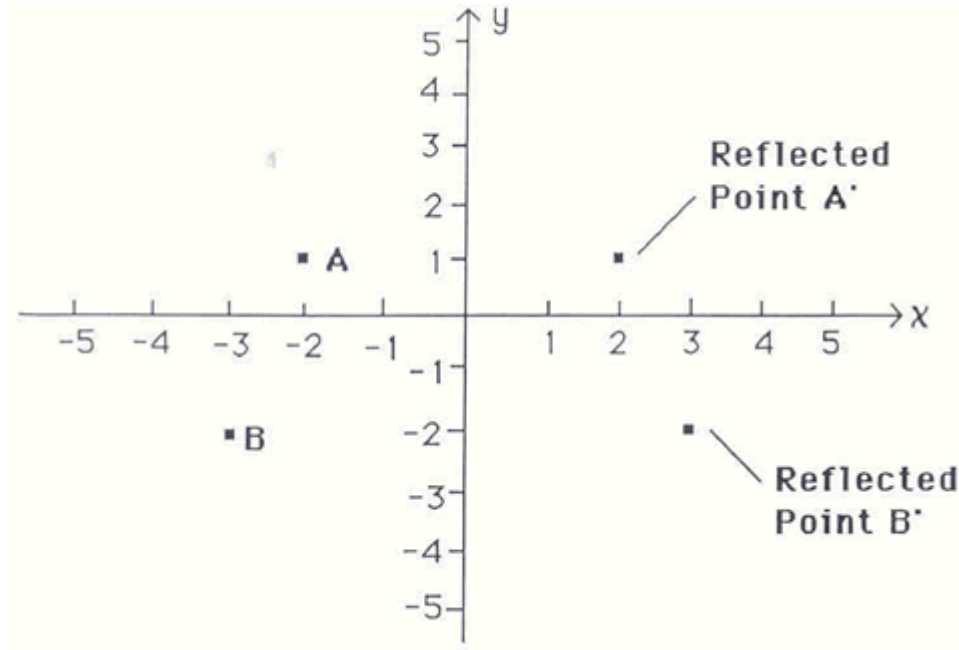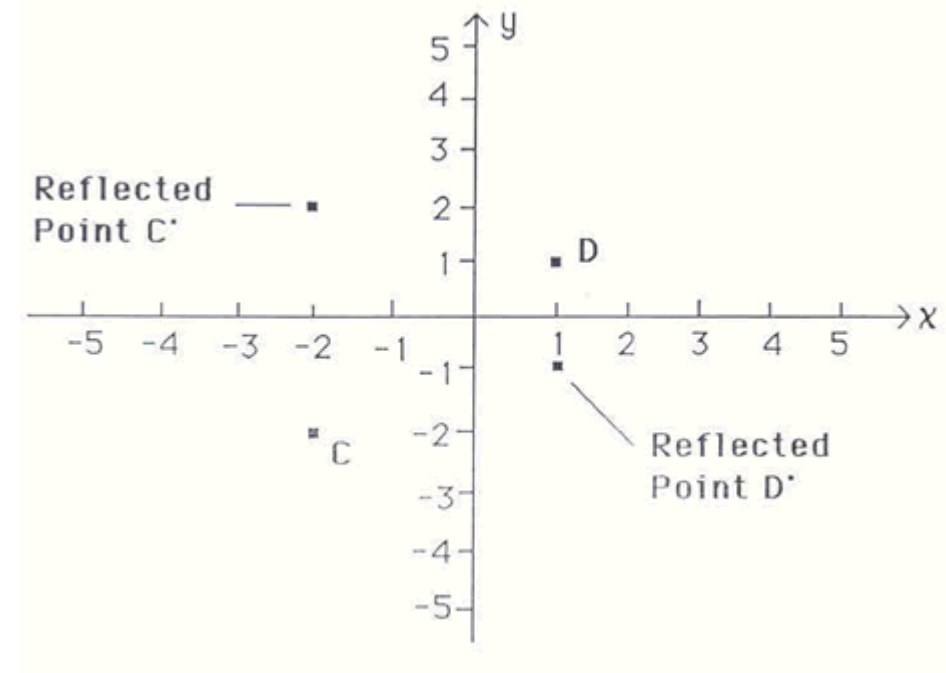
Exercise 2

Complete this list:-
A is (2,0)   B is (0,-2)
C is (,)   D is (,)
E is (,)

REFLECTION OF A POINT

We can imagine that the x axis or the y axis act like a 'mirror' and reflect a point on to a different quadrant of the diagram.
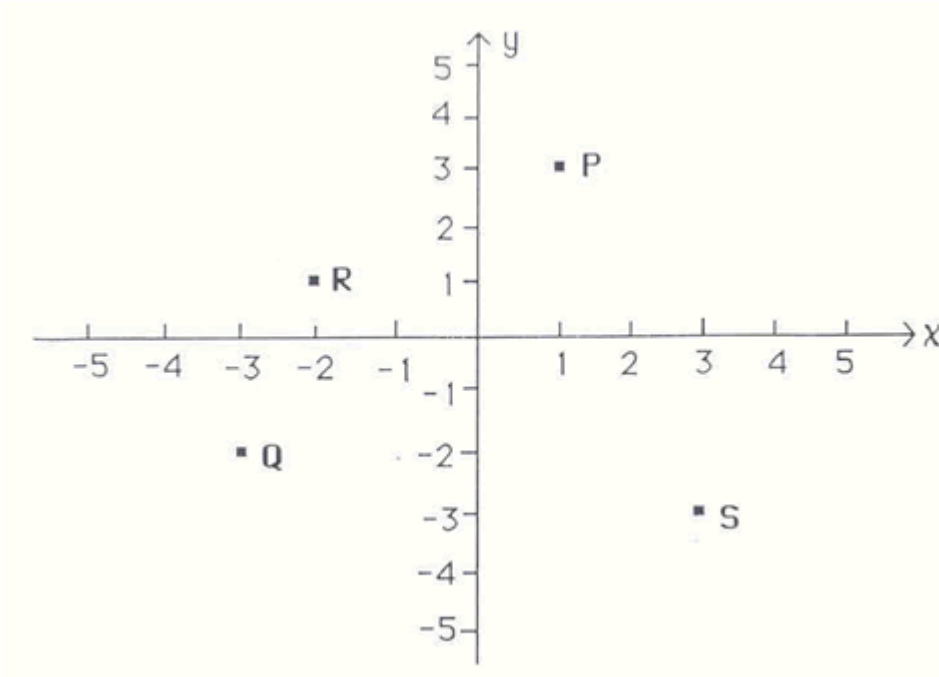

Here the y axis is the 'mirror' and is reflecting the points A and B giving the reflected points A' and B'.
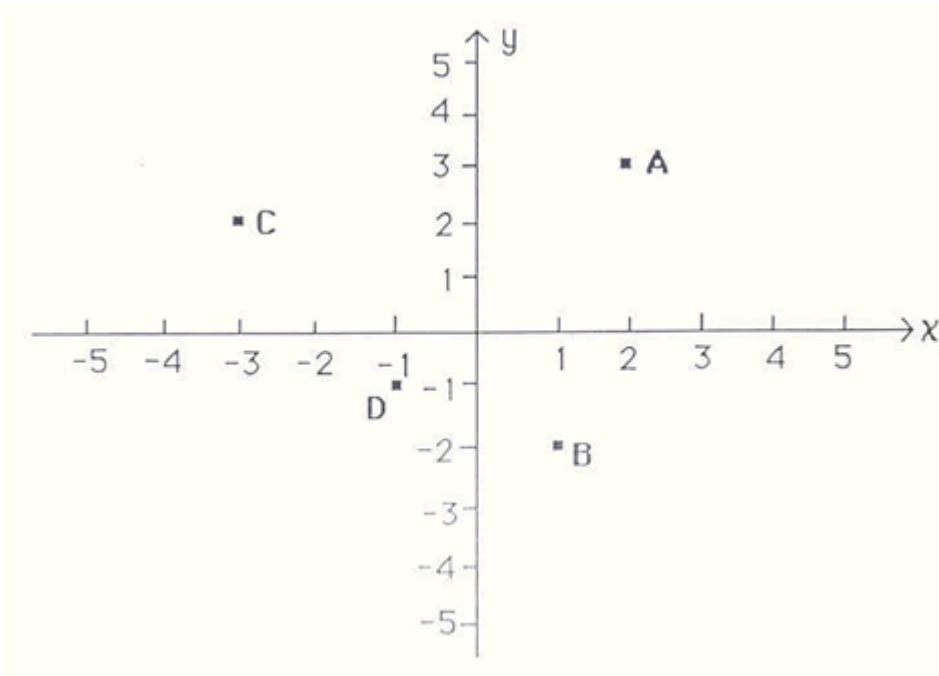

In this diagram the x axis is the 'mirror' and is reflecting the points C and D, giving C' and D'.

Exercise 3

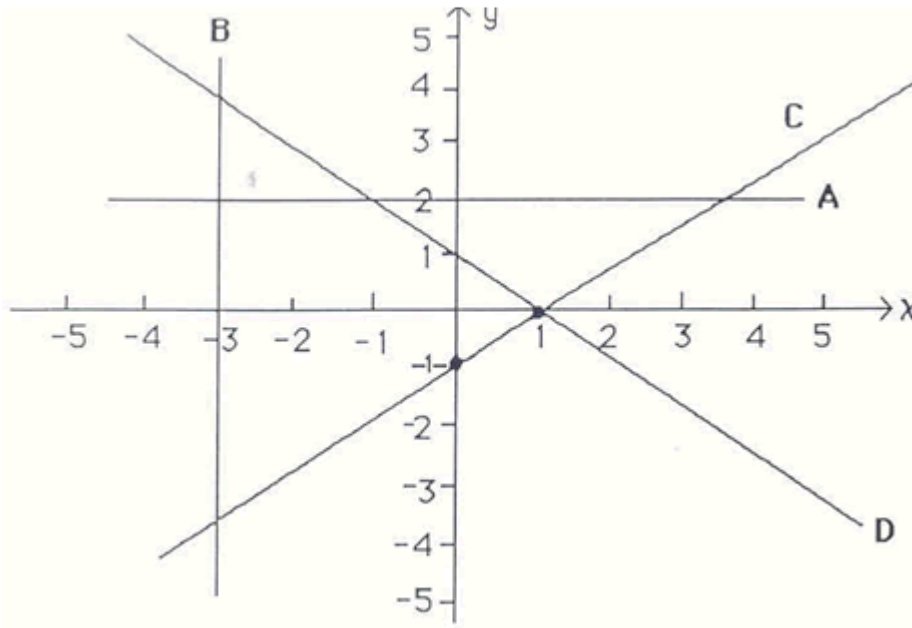Plot the reflection on the y axis of the points P, Q, R and S.

Exercise 4

Plot the reflections in the x axis of the points A, B, C and D.

INTRODUCTION TO STRAIGHT LINE GRAPHS

All straight line graphs can be given a name or 'title'. Later in this pack you will learn to draw the graphs.


Line A is y = 2	Line B is x = -3
Line C is y = x – 1	Line D is y = - x + 1

At this stage do not worry why the lines have different numbers or signs in them.
However, notice that:

(i)   the name is always an equation
(ii)   the **equation is linear** – i.e. – the x and y are only single powers, they are not x^2, y^2, x^3, etc.

Here are some more straight lines. They are all parallel to the x axis.
Another name for the x axis is the line y = 0.
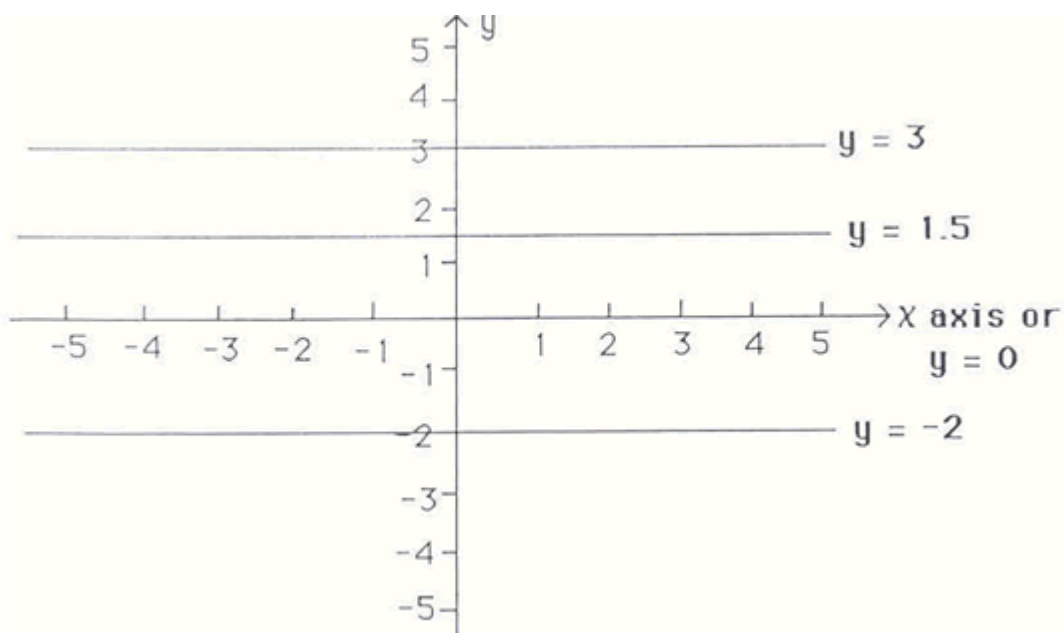
Any straight line parallel to the x axis is given the name y = a where a is the value where the line cuts the y axis. Notice that all points on such a line have the same y coordinate.

Exercise 5
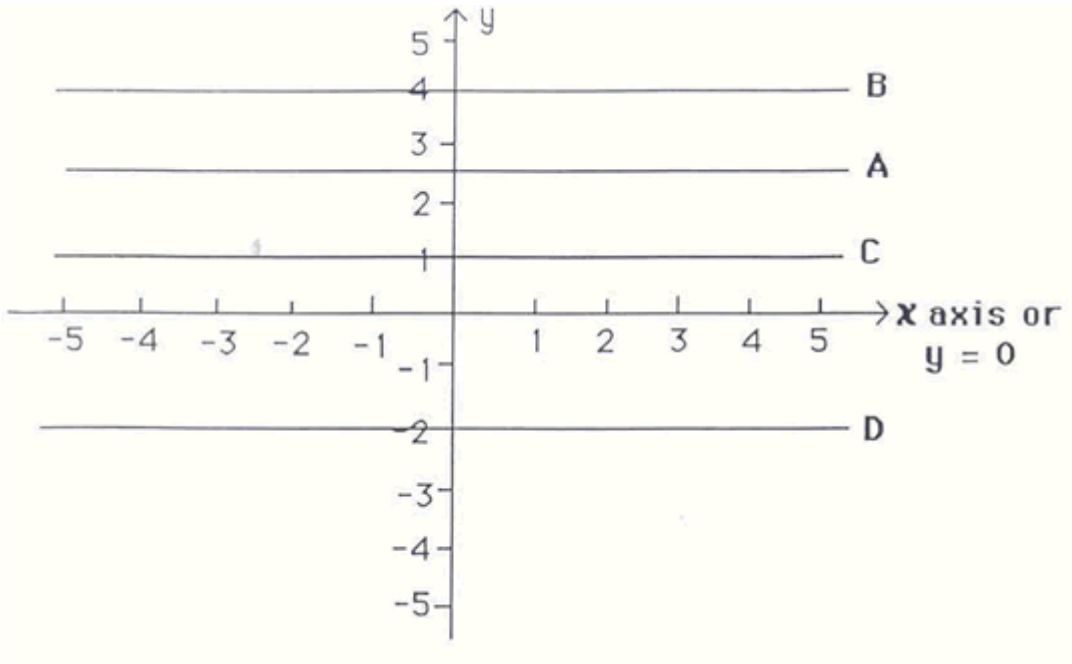
Name these lines:-

A is   B is
C is   D is

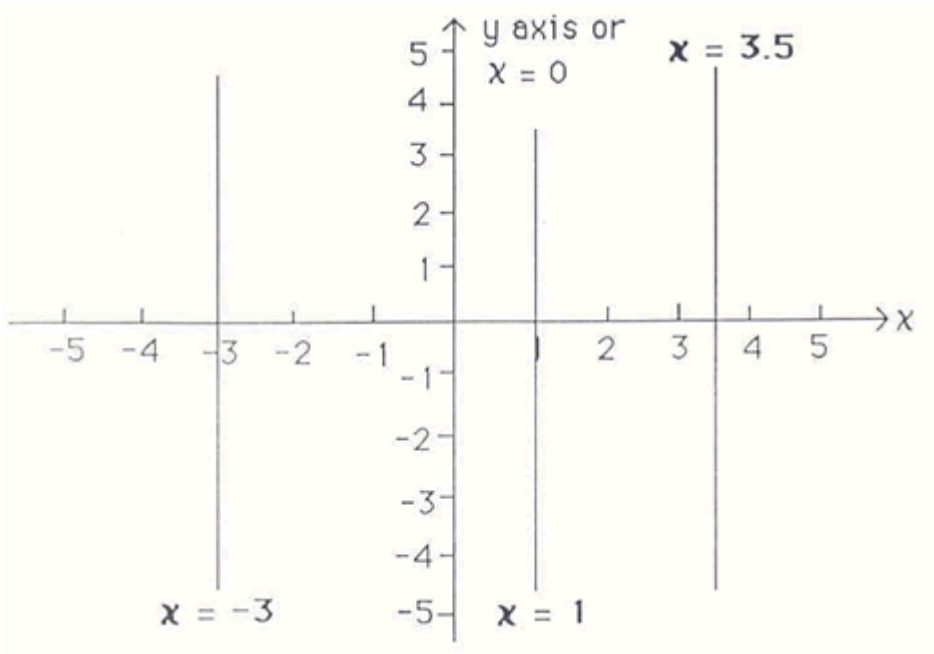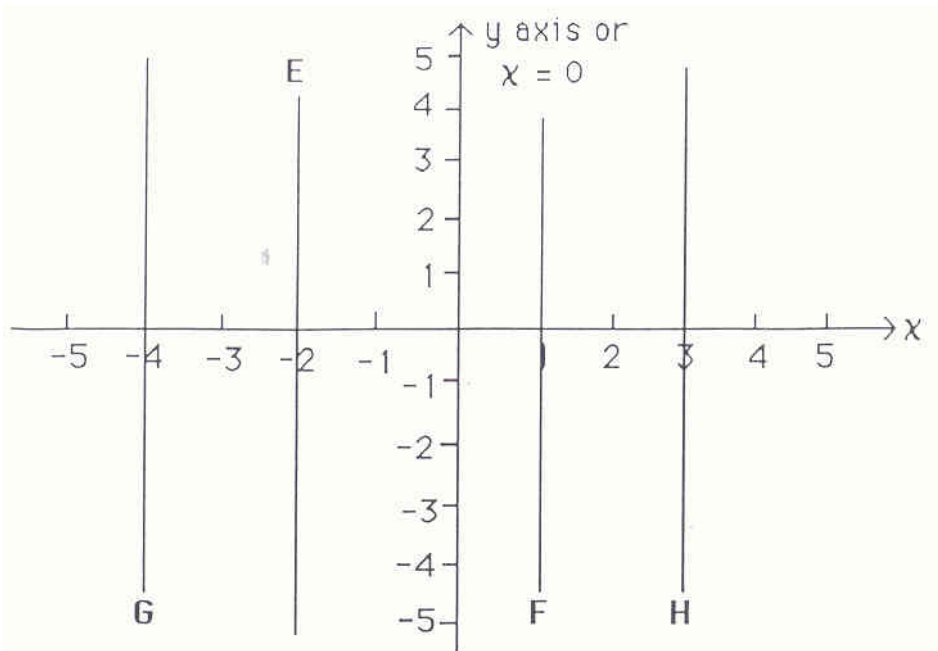Here is another set of straight line graphs. These are parallel to the y axis.

Another name for the y axis is the line $x = 0$.

Any straight line parallel to the y axis is given the name $x = b$ where b is the value where the line cuts the x axis.

Exercise 6

Name these lines

Line E is   Line F is

Line G is   Line H is

REMEMBER :
- The x axis is the line y = 0 because all points on it have y coordinate zero.
- The y axis is the line x = 0 because all points on it have x coordinate zero.

Earlier in this pack you learnt that a point could be reflected in the x or y axis. Now we are going to reflect points in lines parallel to the x or y axis.
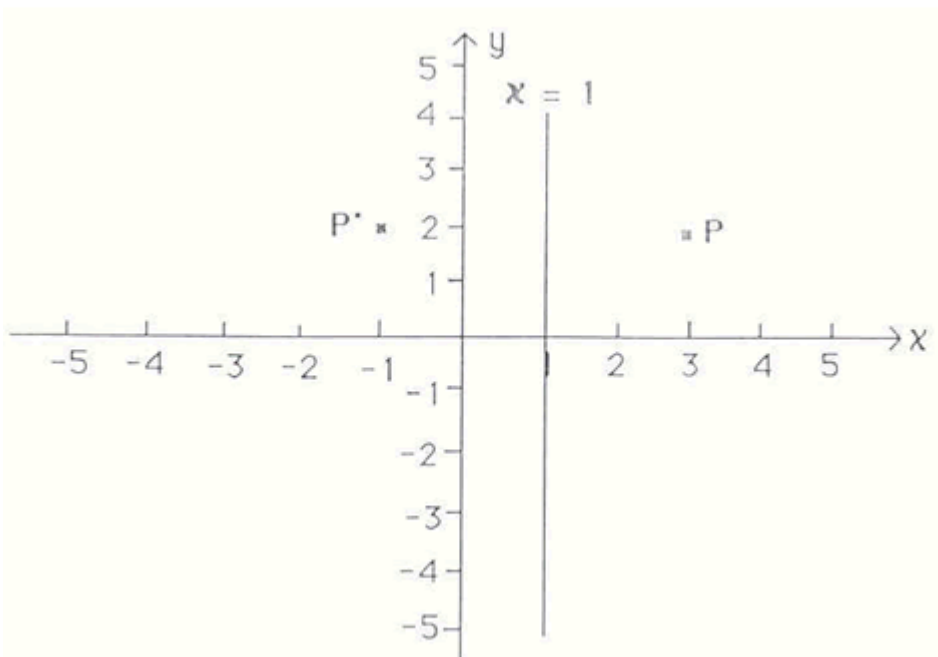
Here the point P has been reflected in the line x = 1.
P is 2 units from the line so P' must be 2 units from the line on the other side.
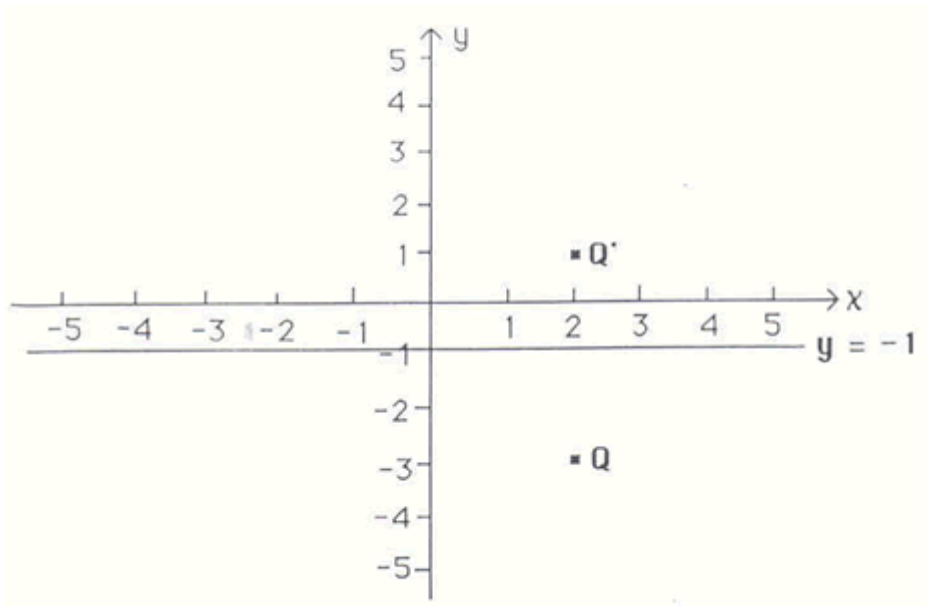
In this example Q has been reflected in the line y = -1.
Q is 2 units from the line, so Q' must be 2 units from the line on the other side.

Exercise 7

a)

Draw the line $x = -1$ on the diagram. Reflect the points A, B and C on the line $x=-1$

b)

Draw the line y = 2 on the diagram. Reflect points D, E and F in the line y = 2.
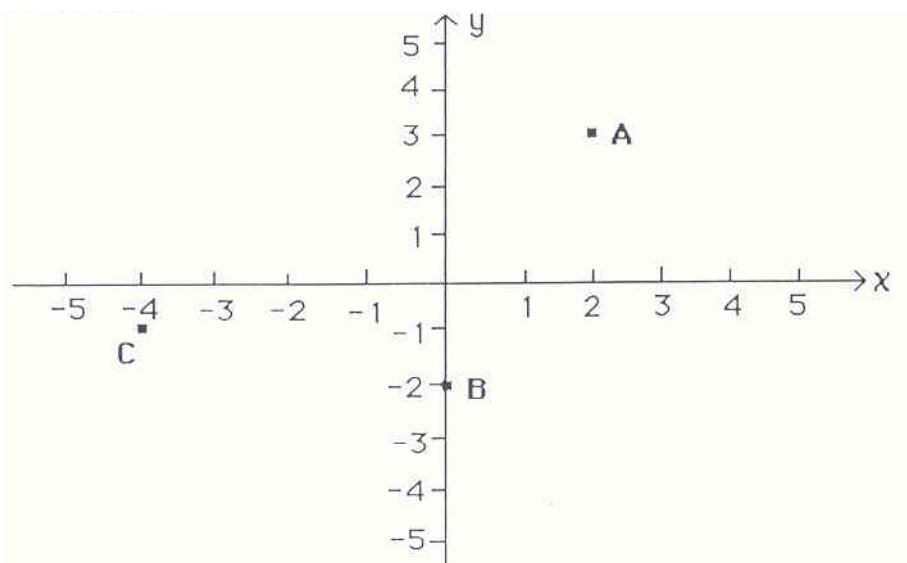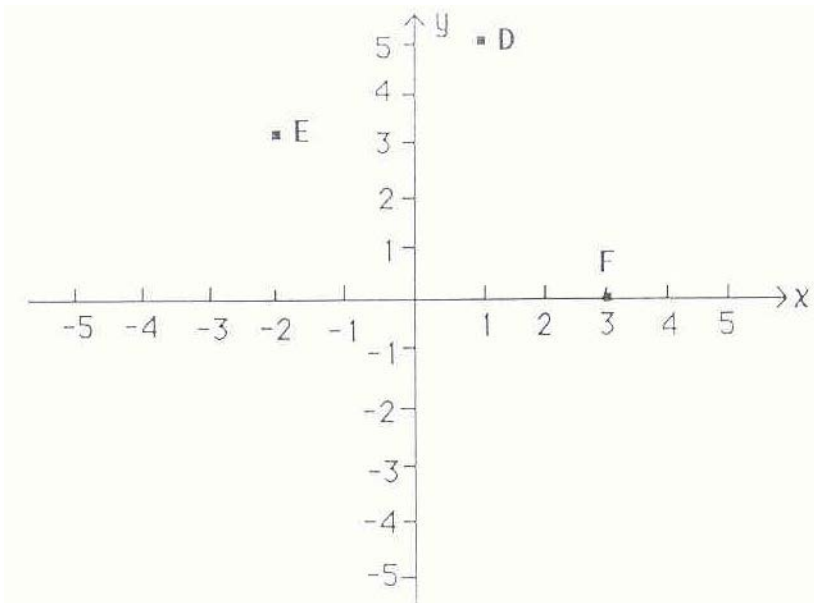
If we are given a rule connecting x and y (and possibly some numbers) we can draw a graph to represent this equation.

For example, suppose we are given the rule y = x. First we try to write down some pairs of values for x and y which fit the rule e.g.

If $x = 2$	then y = 2
If $x = 4$	then y = 4
If $x = -3$	then y = -3

We could go on for ever choosing values for x and finding matching values of y.

It is useful to put the results in a table showing a selection of values.

x	-3	-2	-1	0	1	2	3
y	-3	-2	-1	0	1	2	3

We may now plot the pairs of coordinates (-3, -3) (-2, -2) on a piece of graph paper and we find that they line up in a definite pattern.
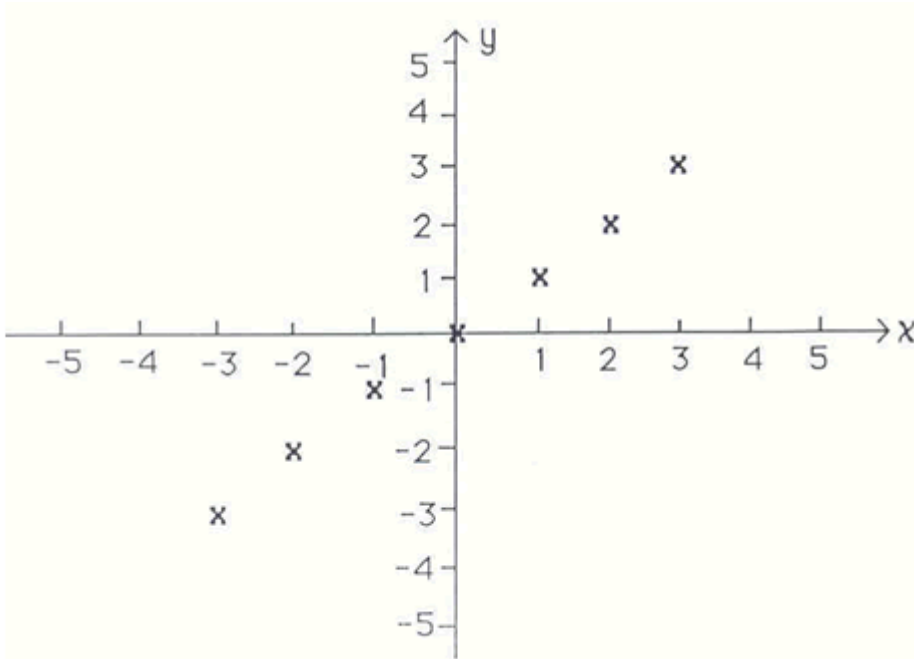
We may "join the crosses" to make the straight line pattern clear and label the line with the rule y = x

PLOTTING STRAIGHT LINE GRAPHS FROM AN EQUATION

If we are given a linear equation, such as y = 2x – 3 we can draw the graph of this equation and it will be a straight line (linear).

Any values of x can be chosen to draw the graph but it is best to choose x values not too large nor too small. In this case we will choose values from x is -3 to x is +3. In exams you will usually be given these values.

First we make a table of values as shown below to calculate y.

| x	-3	-2	-1	0	1	2	3
2x	-6	-4	-2	0	2	4	6
-3	-3	-3	-3	-3	-3	-3	-3
y	-9	-7	-5	-3	-1	1	3

These are added to give each value of y.

The graph can now be plotted using the coordinates (values of x and y) obtained from the table i.e. plot the coordinates (-3, -9) (-2, -7) (-1, -5) (0, -3) (1, -1) (2, 1) (3, 3) on a piece of graph paper.

Useful hints on drawing graphs.

1. Draw two straight lines in pencil, intersecting at right angles to form the axes. Remember to put arrow heads on the axes.
2. Choose a suitable scale which produces a graph to fill most of the graph paper. Choose a scale which is easy to sub-divide.
3. Label each axis to indicate briefly what information is being represented, i.e. rainfall in inches, number of students, etc.
4. Plot the points from the data or from the table of values which has been calculated. Then with a ruler draw a line through the points.
5. Give the graph a title or label the line.

Plot the coordinates
(-3, -9) (-2, -7) (-1, -5) (0, -3) (1, -1) (2, 1) (3, 3) on a piece of graph paper.
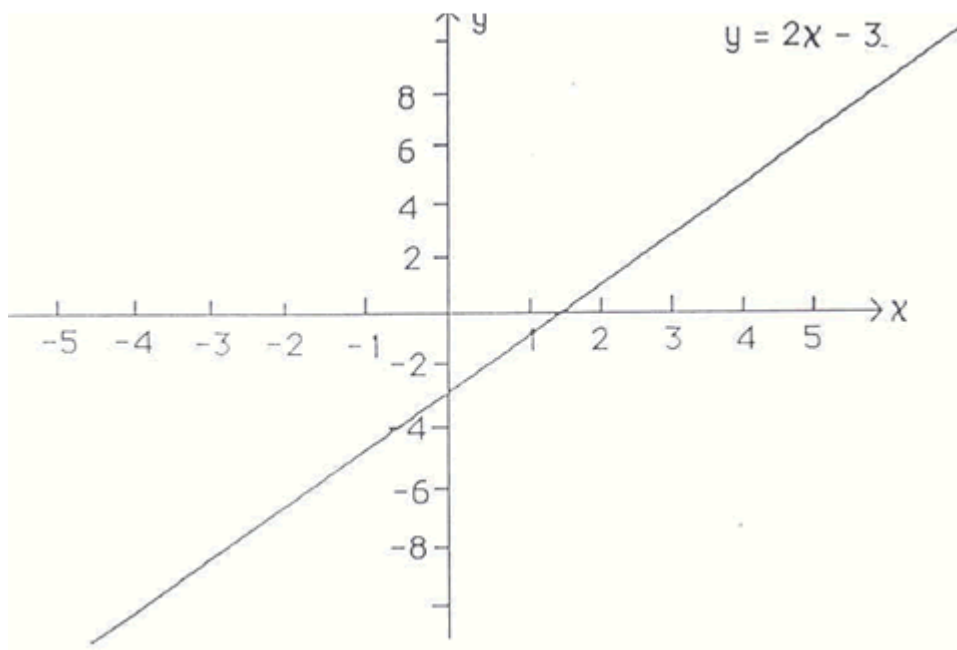
NB The 'marks' on the axis must be the **same distance apart.** The scale on the x and y axes do not need to be the same. Above we have used 1 cm = 1 unit on the x axis and 1 cm = 2 units on the y axis.
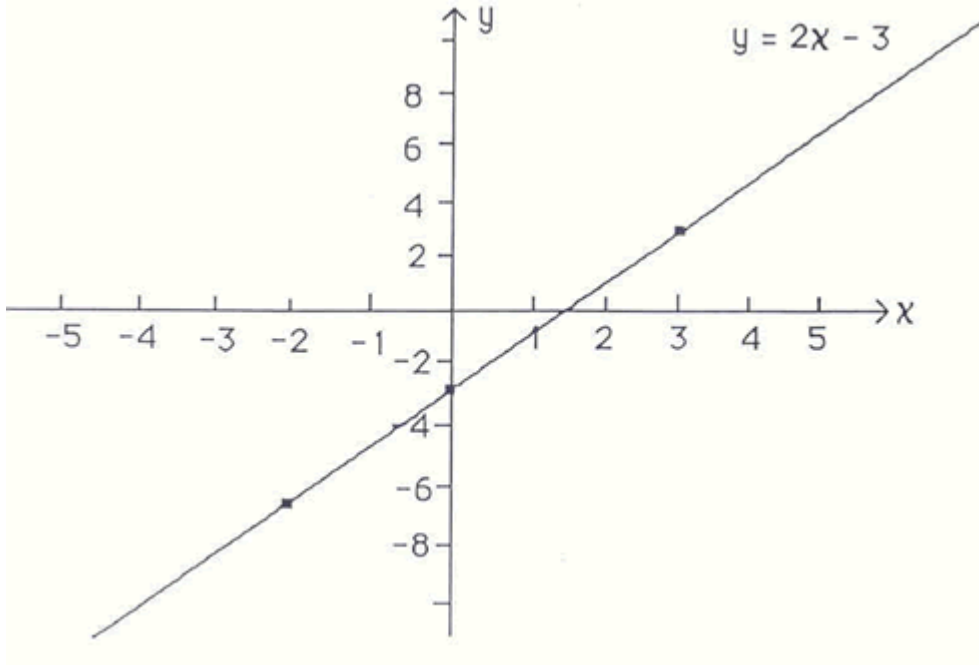
NB When drawing a straight line, it is possible to choose just two values for x, but choose a third as a check as shown below and then make a table of values to help calculate y.

i)

x	-2	0	3
2x	-4	0	6
-3	-3	-3	-3
y	-7	-3	3

ii)   Now plot each pair of (x, y) values or coordinates, then with a ruler draw a line through all 3
points i.e. Plot (-2, -7) (0, -3) (3, 3).

iii)   Make sure both axes and the line are labelled.

Note how the line cuts the y axis at -3 and the equation of the line is $y = 2x$ -3.
We call -3 the **intercept** of the line on the y axis. The coordinates at the intercept point are (0, -3).

Exercise 8

Complete the tables of values for the following equations. Draw their graphs. State their intercept and
the coordinates of the intercept point.

1. $y = 3x + 1$

x	-2	0	2
3x		0	6
+1		1	
y	-5		

Note be careful!! 3 x 0 = 0 **not** 3. This is a common error.

2. $y = -x + 4$

x	-3	1	5
$-x$	+3		
+4	1	+4	
y			-1

When $x = -3$
$x = -(-3)$
$x = +3$

3. $y = \dfrac{1}{2}x - 1$

x	-4	0	6
$\frac{1}{2}x$	-2		
-1		-1	
y		-1	

From the graphs of the above questions, you should observe that:-

When the x term is positive, the line slopes /.
When the x term is negative, the line slopes \.

Remember The **intercept** is the value of y where the line crosses the y axis when the axes cross at the origin.

y = 2x -3	Intercept -3	Coordinates of the intercept (0, -3)
y = 3x +1	Intercept +1	Coordinates of the intercept (0, 1)
y = - x + 4	Intercept +4	Coordinates of the intercept (0, 4)
y = $\dfrac{1}{2}x$ -1	Intercept +4	Coordinates of the intercept (0, -1)

TIME-SERIES GRAPHS

These are often used to illustrate information collected over a period of time such as the profits of a business year by year; the sales of new cars month by month.

In time-series graphs one of the variables is time (years, days, etc) and the other the variable that is being studied (profits, births, accidents, sales etc.)

Remember

1.   Always use the horizontal axis to represent time and the vertical axis the other   variable.
2.   The scales on the two should be chosen so that the best use is made of the space available on the graph paper (the graph fills the space as nearly as possible) and so that they are easy to read (a large square would coincide with common multiples such as five or ten or hundred).
3.   Two variables may be shown as two separate lines on the same diagram for the purpose of comparison (e.g. the sales of British cars and the sales of foreign cars).

   ALWAYS

1.   Give a title.
2.   Label both axes. State **what** is measured and the **units** used. For example – sales (£1000s) – population (millions) – temperature (^{0}C).
3.   Join points on the graph by straight lines.
4.   Show zero on the vertical scale. If it is more convenient to start the scale from a point above zero, the break in the scale must be clearly shown as in solutions 2 and 3.
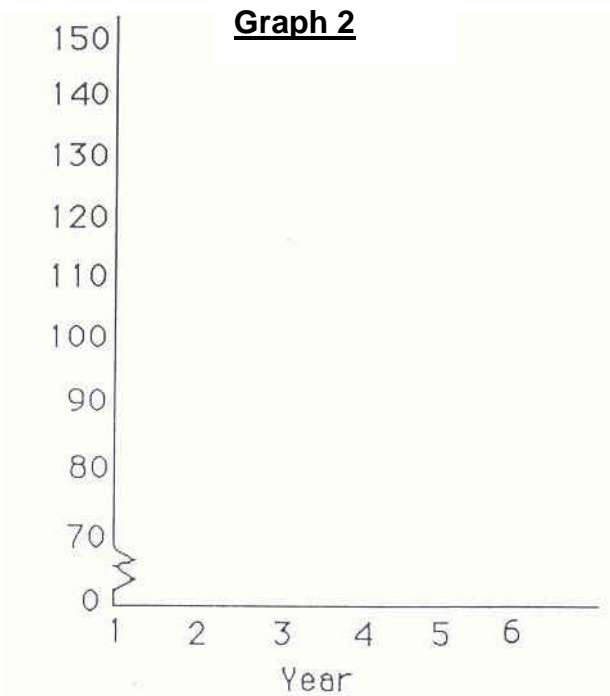
Example

Year	Students entering GCSE Exams (Thousands)
1	76.9
2	83.7
3	91.0
4	114.3
5	130.6
6	142.2

Draw graphs from this information on each of the three sets of axes provided (on the following page). Comment on your results.
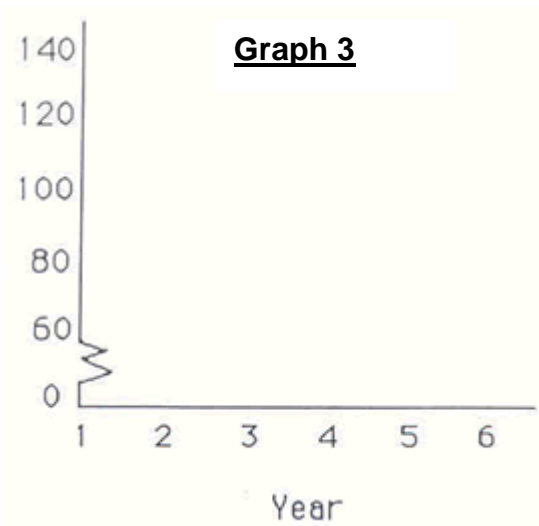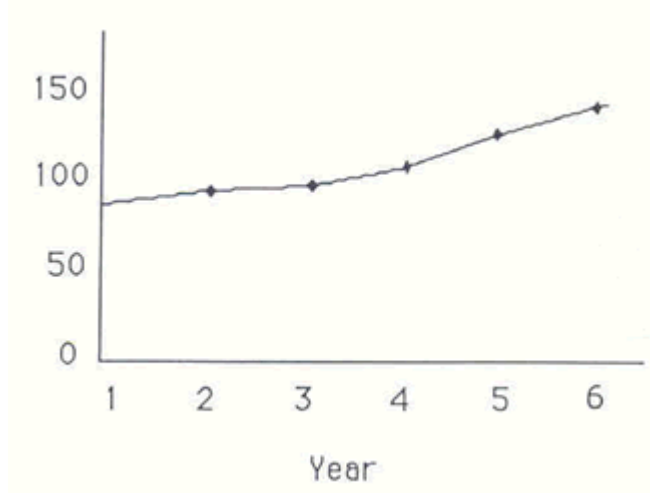
Graph 1
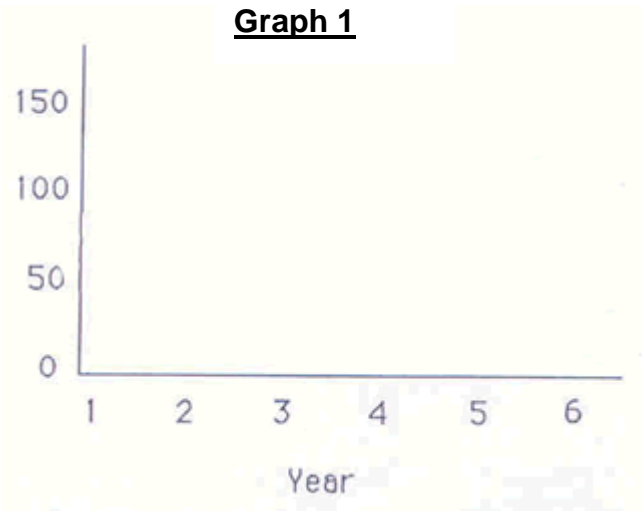
Graph 2
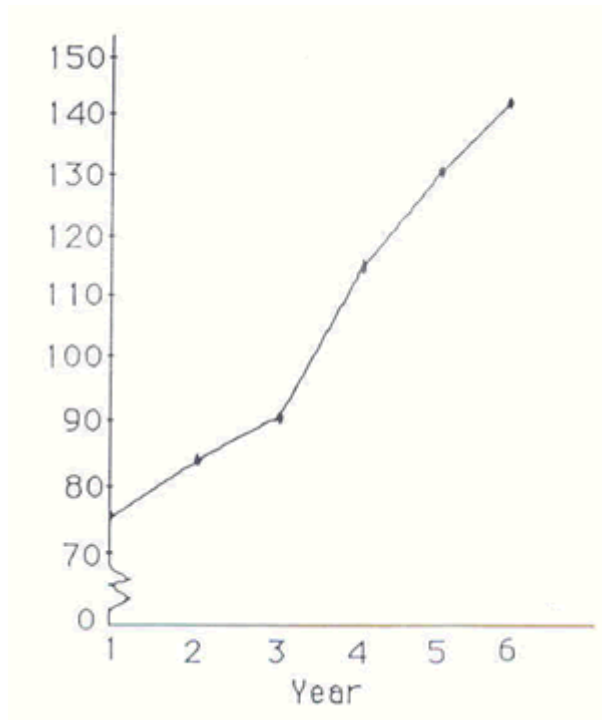

Graph 3
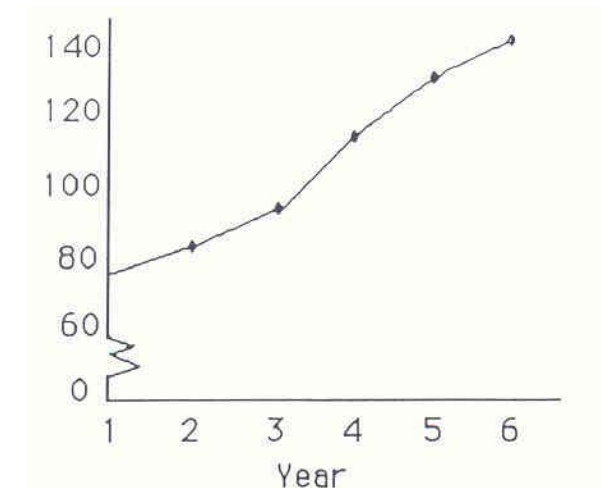

Check your answer on the next page.

Solution 1

This type of vertical scale suggests a gradual increase

Solution 2

With this type of scale the graph appears to rise very steeply

Solution 3

Exercise 9

The data below shows the sales made by a company in the first eight months of 1984. Draw a suitable graph to illustrate this information.

Month	1	2	3	4	5	6	7	8
Sales (£000's)	301	341	334	312	357	372	326	309

ANSWERS

Exercise 1

P (-3, 1)   Q (-2, 4)   R (3, 4)
S (3, -3)   T (-2, -4)
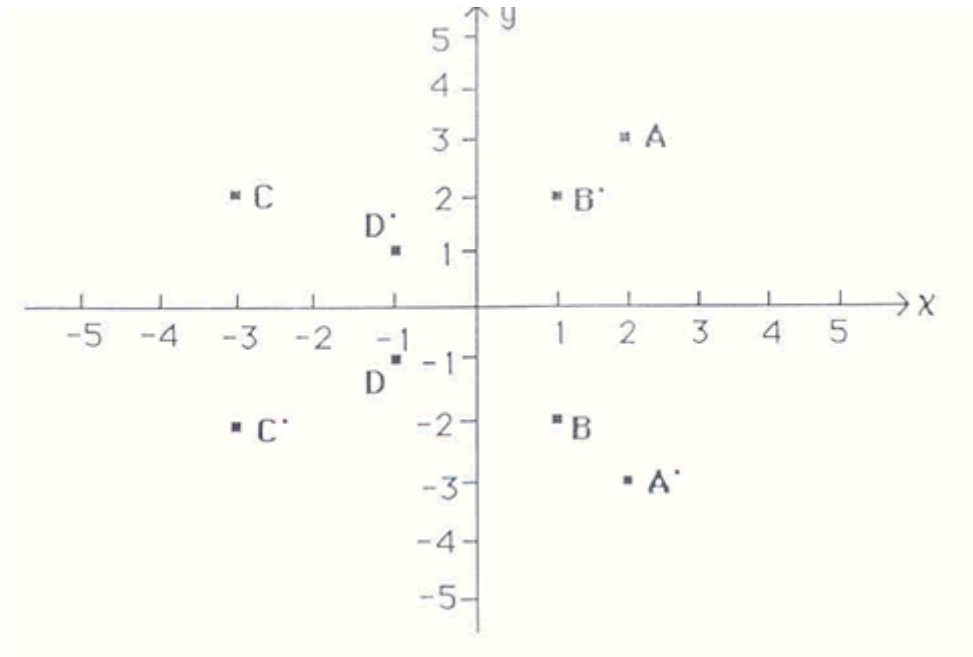
Exercise 2

A (2, 0)   B (0, -2)   C (0, 2)
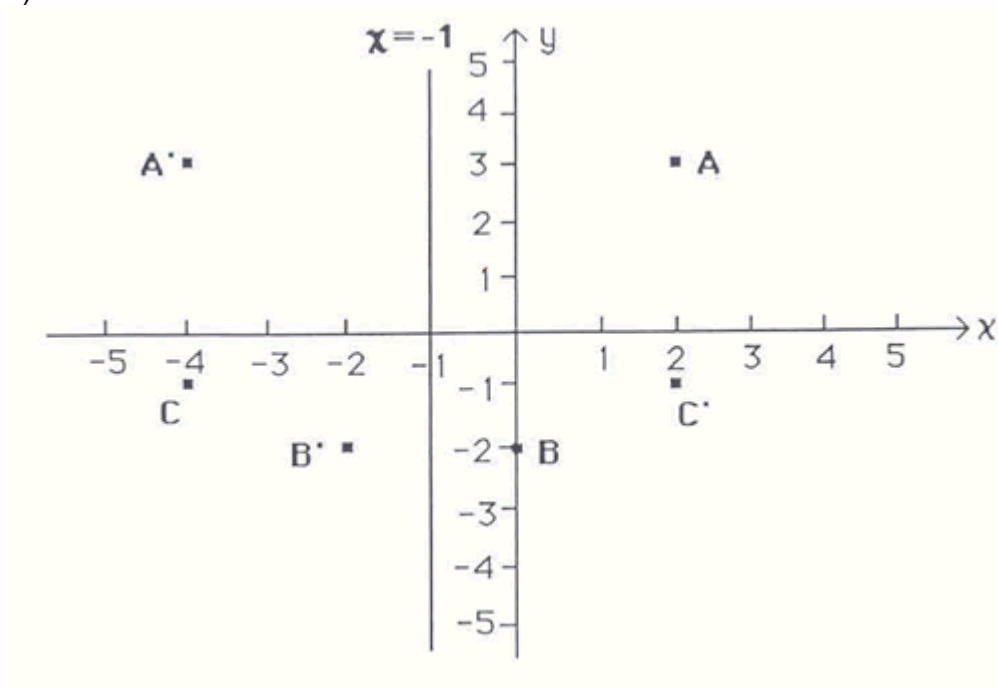D (3, 0)   E (-3, 0)

Exercise 3
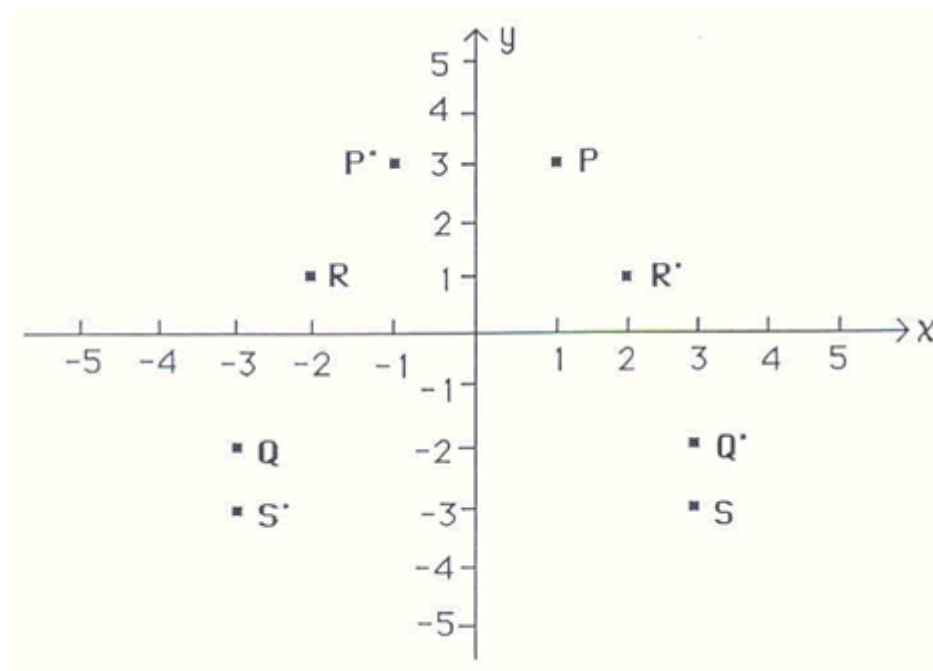
Exercise 4

Exercise 5

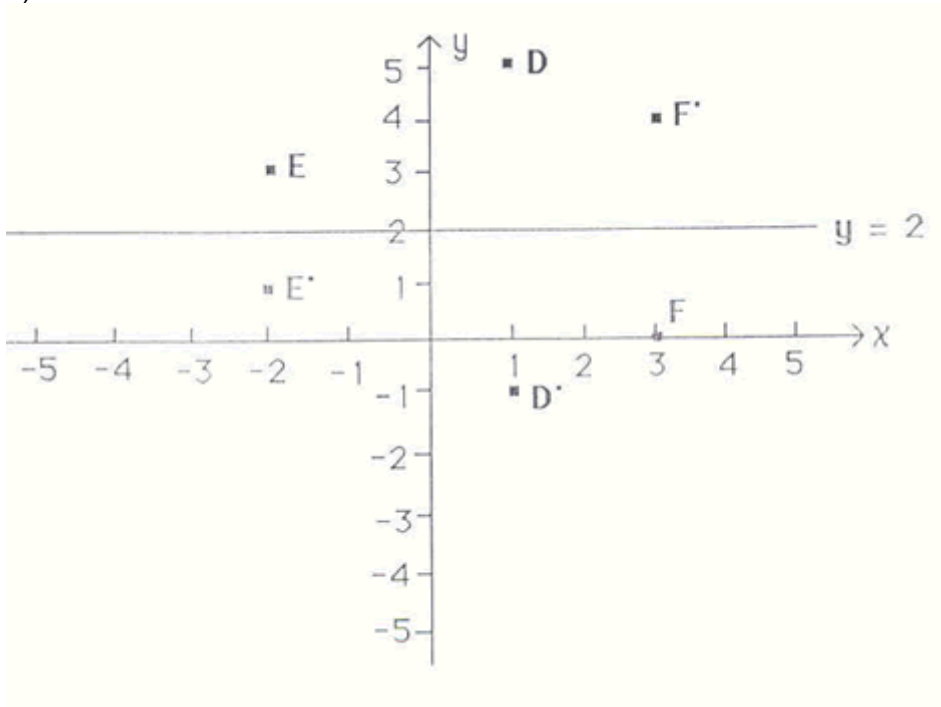A y = 2.5 B y = 4 C y = 1 D y = -2

Exercise 6

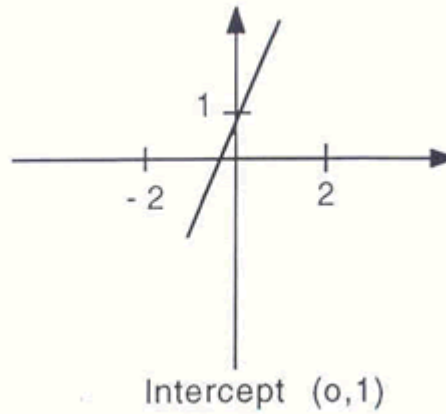E $x = -2$ F $x = 1$ G $x = -4$ H $x = 3$

Exercise 7

a)

b)

Exercise 8

1. $y = 3x + 1$

x	-2	0	2
3x	-6	0	6
+1	+1	+1	+1
y	-5	1	7

Intercept (o,1)

2. $y = -x + 4$

x	-3	1	5
-x	+3	-1	-5
+4	+4	+4	+4
y	7	3	-1

Intercept (0,4)
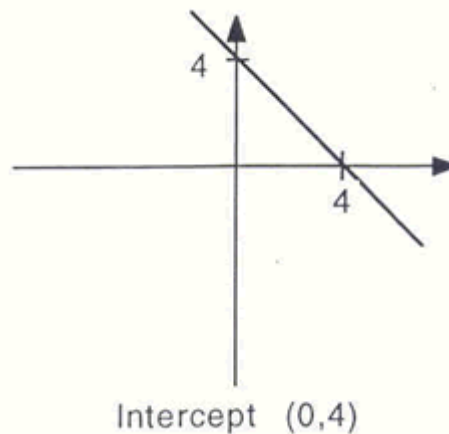
3. $y = \dfrac{1}{2}x - 1$

x	-4	0	6
$\frac{1}{2}x$	-2	0	3
-1	-1	-1	-1
y	-3	-1	2

Intercept (0,-1)

Exercise 9