**A11** IDENTIFY AND INTERPRET ROOT, INTERCEPTS AND TURNING POINTS OF QUADRATIC FUNCTIONS GRAPHICALLY; DEDUCE ROOTS ALGEBRAICALLY(foundation and higher tier)

You should already be able to draw a graph of a quadratic equation.

You also need to be able to identify the intercepts and turning points of quadratic graphs.

**Please note: function notation is not required nor tested in Foundation Tier therefore graph equation would be of a form ‘*y* = ‘ rather than ‘f(*x*) =’ .**

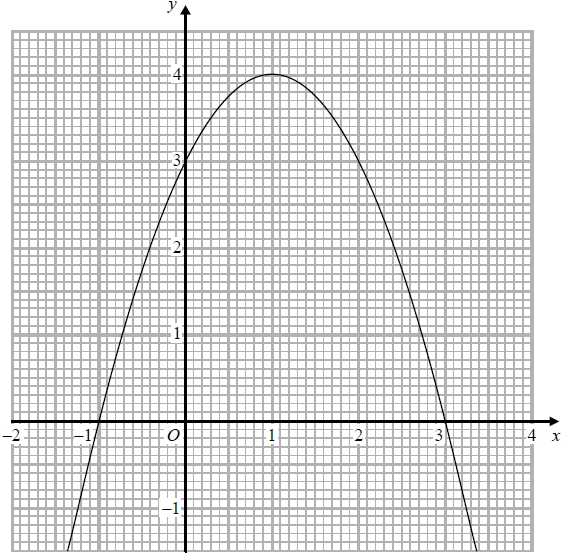
**EXAMPLE 1**

The graph of *y* = f(*x*) is drawn on the grid.

(i) Write down the coordinates of the *y*-intercept.

(ii) Use your graph to find the coordinates of the points where the f(*x*) = 0

(iii) Find the maximum value of f(*x*).



(i) (0, 3) This is where the graph cuts the *y*-axis

(ii) (−1, 0) and (3, 0) This is where the graph cuts the *x*-axis

(iii) The maximum value is 4 The maximum value is the greatest value of *y*

**NOTE:** If you were asked for the maximum point then the answer would be: (1, 4).

**EXAMPLE 2**

The graph shows the curve f(*x*) = *x*2 − 3*x* − 1 for values of *x* between −3 and 6.

(i) Write down the coordinates of the *y*-intercept.

(ii) Use your graph to find estimates of the roots of the equation *x*2 − 3*x* − 1 = 0

(iii) Write down the coordinates of the turning point of f(*x*).

(iv) Use your graph to estimate the values of *x* when *x*2 − 3*x* − 1 = 2

*y*

1

2

3

4

-1

-2

-3

-4

1

2

3

4

5

6

-1

-2

-3

0

*x*

(i) (0, −1) This is where the graph cuts the *y*-axis

(ii) *x* = −0.3 or *x* = 3.3 This means find the value(s) of *x*

where the graph cuts the *x*-axis

(iii) (1.5, −3.25) The turning point is where the curve turns.

(iv) Instead of *x*2 − 3*x* − 1 = *y* we have *x*2 − 3*x* − 1 = 2 so we need to draw the line *y* = 2

and find the corresponding values of *x*. **(S**ee blue lines on graph.)

*x* = −0.8 or *x* = 3.8

**NOTE:** The **ROOTS** of an equation in *x* means you need to solve the equation to find

the values of *x*. If you have a graph, you can find estimates of *x* by looking

to see where the graph cuts the *x*-axis.

If you are asked to deduce the roots of a quadratic equation **algebraically** it means you have to use algebraic methods to solve the quadratic equation such as factorising, etc.

**EXERCISE:**

**1.** For each of the following quadratic graphs:

(i) Write down the coordinates of the *y*-intercept.

(ii) Use your graph to find the coordinates of the points where the f(*x*) = 0

(iii) Find the maximum or minimum value of f(*x*).

2

4

-2

-4

-6

1

2

3

4

-1

-2

0

*x*

1

2

3

4

-1

-2

-3

-4

1

2

3

4

-1

-2

0

*x*

1. *y* (b) *y*

1

2

3

4

-1

1

2

-1

-2

-3

0

*x*

(c) *y* (d) *y*

1

2

3

-1

-2

-3

1

2

3

4

5

-1

-2

0

*x*

**2.** For each of the following quadratic graphs:

(i) Write down the coordinates of the *y*-intercept.

(ii) Use your graph to find estimates of the roots of the equation of f(*x*) = 0

(iii) Write down the coordinates of the turning point of the curve *y* = f(*x*).

2

-2

-4

-6

-8

2

4

-2

0

*x*

(a) *y*

2

4

-2

1

2

3

4

5

-1

0

*x*

(b) *y*

**3.** The graph shows the curve f(*x*) = 2*x*2 − 3*x* − 7 for values of *x* between − 2 and 4.

1

2

3

4

-1

-2

-3

-4

-5

-6

-7

-8

-9

1

2

3

4

5

-1

-2

-3

0

*x*

*y*

(a) Write down the coordinates of the *y*-intercept.

(b) Use your graph to find estimates of the roots of the equation 2*x*2 − 3*x* −7 = 0

(c) Write down the coordinates of the turning point of the curve *y* = f(*x*).

(d) Use your graph to estimate the values of *x* when 2*x*2 − 3*x* − 7 = −4

(e) Use your graph to estimate the values of *x* when f(*x*) = 2

**4.** The graph shows the curve f(*x*) = 6 + *x* − 2*x*2 for values of *x* between − 3 and 3.

2

4

6

8

-2

-4

-6

-8

-10

-12

-14

-16

1

2

3

-1

-2

-3

0

*x*

*y*

(a) Write down the coordinates of the points where the curve cuts the axes.

(b) Use your graph to find estimates of the roots of the equation 6 + *x* − 2*x*2 = 0

(c) Write down the coordinates of the turning point of f(*x*).

(d) Use your graph to estimate the values of *x* when f(*x*) = − 6

(e) Use your graph to estimate the values of *x* when 6 + *x* − 2*x*2 = 4

**ANSWERS:**

1. (a)(i) (0, −4) (ii) (−1.2, 0), (3.2, 0) (iii) Minimum = −5

(b)(i) (0, 2) (ii) (−0.8, 0), (2.8, 0) (iii) Maximum = 3

(c)(i) (0, 0) (ii) (0, 0), (3, 0) (iii) Maximum = 2.25

(d)(i) (0, 0) (ii) (0, 0), (−1, 0) (iii) Minimum = −0.25

2. (a)(i) (0, 1) (ii) (−0.4, 0), (2.4, 0) (iii) (1, 2)

(b)(i) (0, 2) (ii) (0.6, 0), (3.4, 0) (iii) (2, −2)

3. (a) (0, −7)

(b) (−1.27, 0), (2.76, 0) accept answers ±0.1

(c) (0.75, −8.125) accept answers ±0.1

(d) *x* = −0.7 or *x* = 2.2

(e) *x* = −1.5 or *x* = 3

4. (a) (0, 6)

(b) (−1.5, 0), (2, 0)

(c) (0.25, 6.1)

(d) *x* = −2.2 or *x* = 2.7

(e) *x* = −0.8 or *x* = 1.3