Now Revise

Routine – Non Calculator

Quadratics

Relationships 1.2 and 1.3

1

Given that

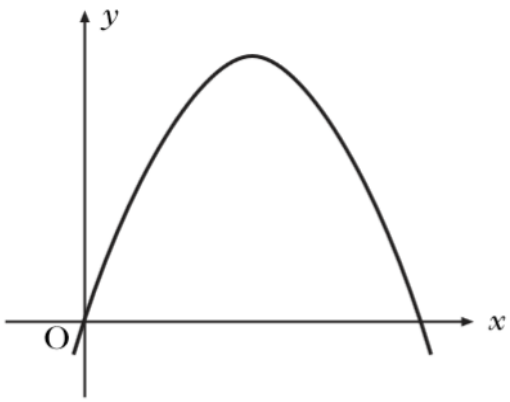
$$f(x) = x^2 + 3,$$

(*a*) evaluate $f(-4)$

(*b*) find t when $f(t) = 52$.

2

The graph shown below is part of the parabola with equation $y = 8x - x^2$.



(*a*) By factorising $8x - x^2$, find the roots of the equation

$$8x - x^2 = 0.$$

(*b*) State the equation of the axis of symmetry of the parabola.

(*c*) Find the coordinates of the turning point.

3

Given that $f(x) = 5 - x^2$, evaluate $f(-3)$.

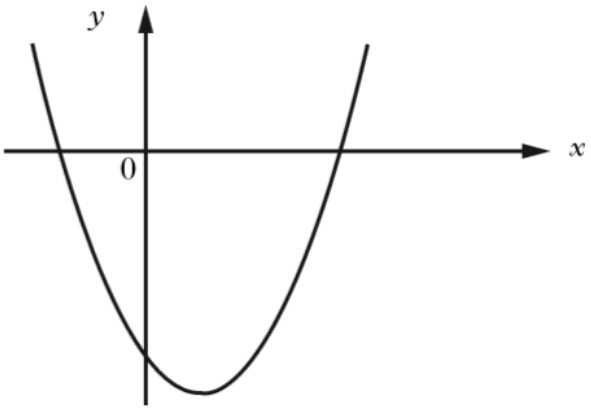
4

(*a*) Factorise $x^2 - 4x - 21$.

(*b*) Hence write down the roots of the equation

$$x^2 - 4x - 21 = 0.$$

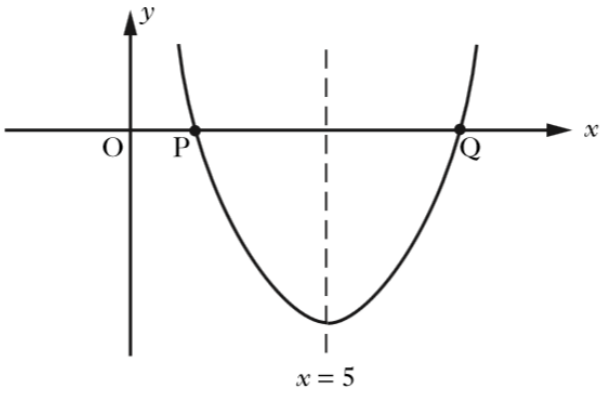
(*c*) The graph of $y = x^2 - 4x - 21$ is shown in the diagram.



Find the coordinates of the turning point.

5

The graph below shows part of a parabola with equation of the form $y = (x + a)^2 + b$.



The equation of the axis of symmetry of the parabola is $x = 5$.

(*a*) State the value of a.

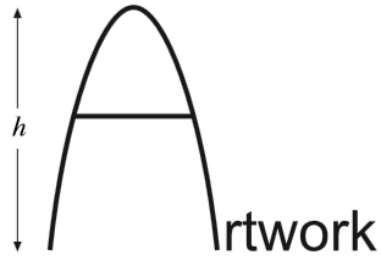
(*b*) P is the point (2, 0). State the coordinates of Q.

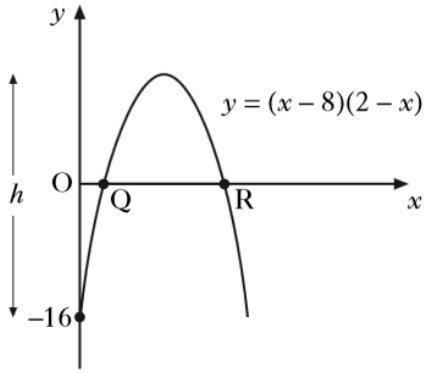
(*c*) Calculate the value of b.

8. The curved part of the letter A in the *Artwork* logo is in the shape of a parabola.

The equation of this parabola is $y = (x - 8)(2 - x)$.

6





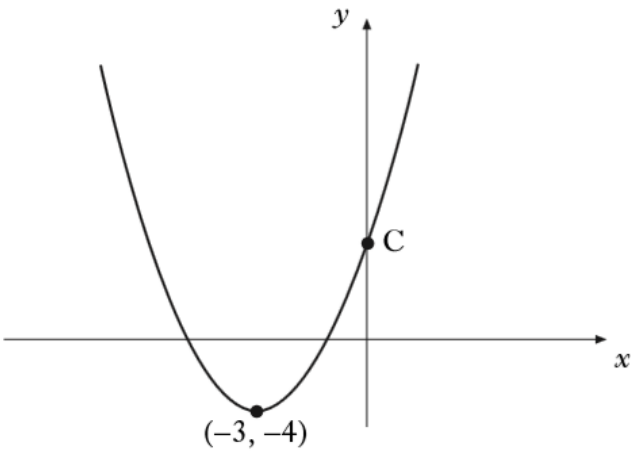
(*a*) Write down the coordinates of Q and R.

(*b*) Calculate the height, h, of the letter A.

7

The diagram below shows part of a parabola with equation of the form

$$y = (x + a)^2 + b.$$

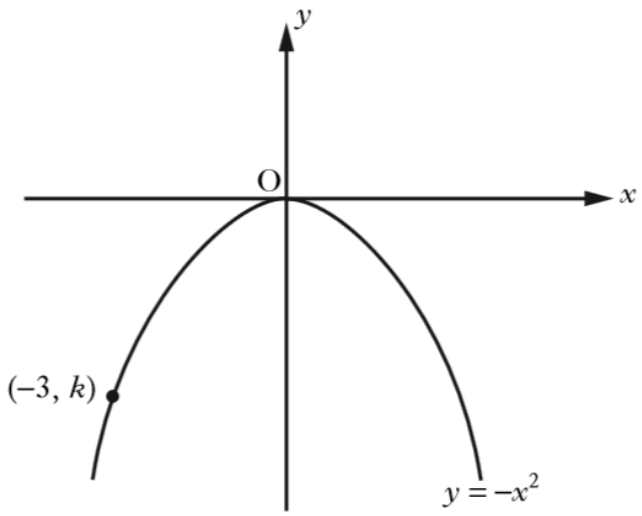


(*a*) Write down the equation of the axis of symmetry of the graph.

(*b*) Write down the equation of the parabola.

(*c*) Find the coordinates of C.

8 The diagram below shows the graph of $y = -x^2$.



The point $(-3, k)$ lies on the graph.

Find the value of k.

9 Two functions are given below.

$$f(x) = x^2 - 4x$$

$$g(x) = 2x + 7$$

(*a*) If $f(x) = g(x)$, show that $x^2 - 6x - 7 = 0$.

(*b*) Hence find **algebraically** the values of x for which $f(x) = g(x)$.

10 Given $2x^2 - 2x - 1 = 0$, show that

$$x = \frac{1 \pm \sqrt{3}}{2}$$

11 Given that

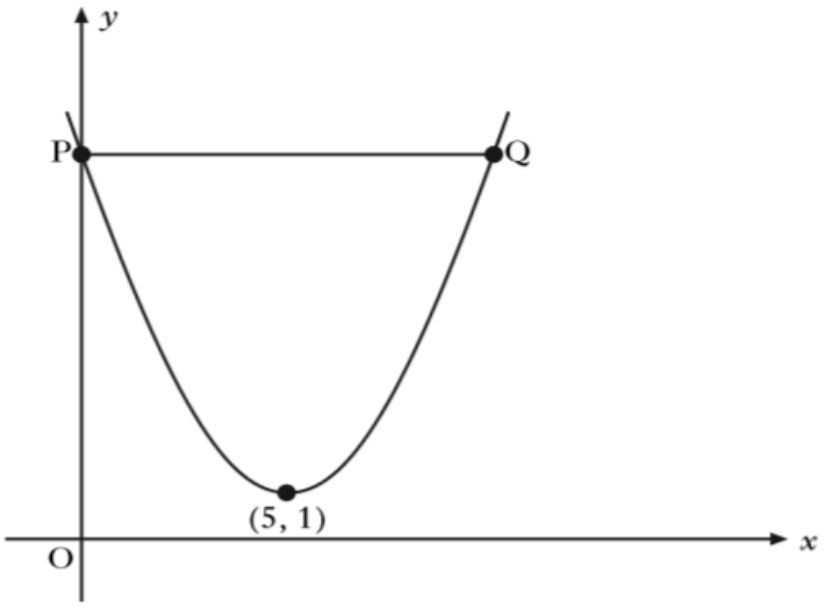
$$x^2 - 10x + 18 = (x - a)^2 + b,$$

find the values of a and b.

12

The graph below shows part of a parabola with equation of the form

$$y = (x + a)^2 + b.$$



(*a*) State the values of a and b.

(*b*) State the equation of the axis of symmetry of the parabola.

(*c*) The line PQ is parallel to the x-axis.
Find the coordinates of points P and Q.

13

Maria has been asked to find the roots of the equation

$$x^2 + 3x + 5 = 0.$$

She decides to use the quadratic formula

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}.$$

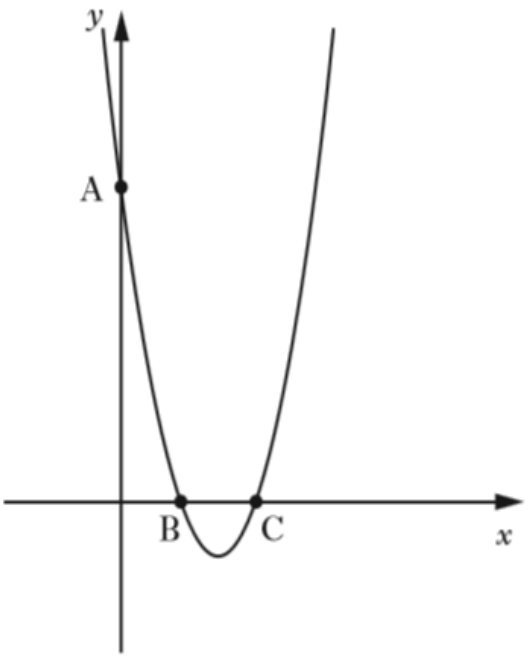
(*a*) Calculate the value of $b^2 - 4ac$.

(*b*) Now explain why Maria cannot find the roots.

14 The equation $x^2 - 6x + 8 = 0$ can also be written as $(x - 2)(x - 4) = 0$.

(*a*) Write down the roots of the equation $x^2 - 6x + 8 = 0$.

Part of the graph of $y = x^2 - 6x + 8$ is shown below.



(*b*) State the coordinates of the points A, B and C.

(*c*) What is the equation of the axis of symmetry of this graph?

15 A parabola has equation $y = x^2 - 8x + 19$.

(a) Write the equation in the form $y = (x - p)^2 + q$.

(b) Sketch the graph of $y = x^2 - 8x + 19$, showing the coordinates of the turning point and the point of intersection with the y-axis.

Now Revise

Routine – Calculator

Quadratics

Relationships 1.2 and 1.3

16

Solve the equation

$$3x^2 - 2x - 10 = 0.$$

Give your answer **correct to 2 significant figures**.

17

Solve the quadratic equation $x^2 - 4x - 6 = 0$.

Give your answers **correct to 1 decimal place**.

18

Solve the equation

$$2x^2 + 3x - 7 = 0.$$

Give your answers **correct to 2 significant figures**.

19

Solve the equation

$$2x^2 - 6x - 5 = 0,$$

giving the roots correct to one decimal place.

20

Solve the equation

$$5x^2 + 4x - 2 = 0,$$

giving the roots correct to 2 decimal places.

21 Solve the equation

$$x^2 + 5x + 3 = 0,$$

giving the roots correct to one decimal place.

22 Solve the equation

$$4x^2 - 7x + 1 = 0,$$

giving the roots correct to 1 decimal place.

23 Use the quadratic formula to solve the equation,

$$3x^2 + 5x - 7 = 0.$$

Give your answers correct to **1 decimal place**.

24 Solve the equation

$$3x^2 + 7x - 5 = 0,$$

giving the roots correct to one decimal place.

Now Revise

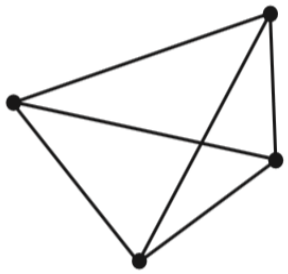
Unseen and Non Routine

Quadratics

Relationships 1.2 and 1.3

25

The minimum number of roads joining 4 towns to each other is 6 as shown.



The minimum number of roads, r, joining n towns to each other is given by the formula

$$r = \tfrac{1}{2}n(n-1).$$

(*a*) State the minimum number of roads needed to join 7 towns to each other.

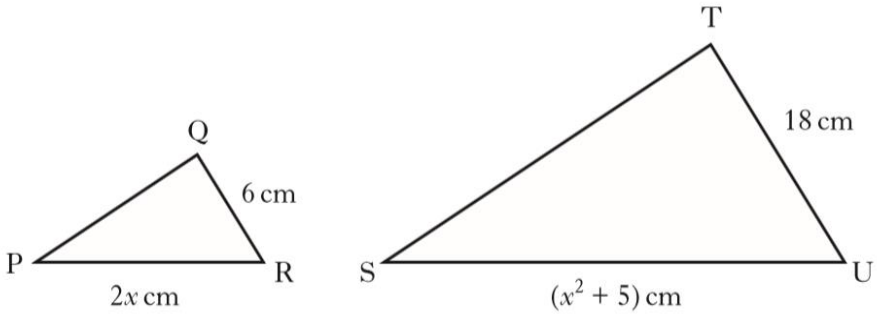
(*b*) When $r = 55$, show that $n^2 - n - 110 = 0$.

(*c*) Hence find **algebraically** the value of n.

26

Triangles PQR and STU are mathematically similar.

The scale factor is 3 and PR corresponds to SU.



(*a*) Show that $x^2 - 6x + 5 = 0$.

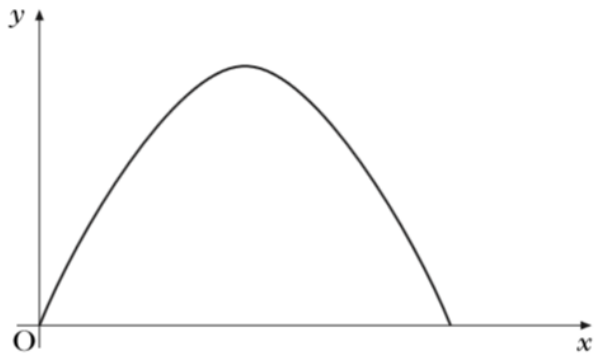
(*b*) Given QR is the shortest side of triangle PQR, find the value of x.

27 The profit made by a publishing company of a magazine is calculated by the formula

$$y = 4x(140 - x),$$

where y is the profit (in pounds) and x is the selling price (in pence) of the magazine.

The graph below represents the profit y against the selling price x.



Find the maximum profit the company can make from the sale of the magazine.

28 The diagram below represents a rectangular garden with length $(x + 7)$ metres and breadth $(x + 3)$ metres.

(*a*) Show that the area, A square metres, of the garden is given by

$$A = x^2 + 10x + 21.$$

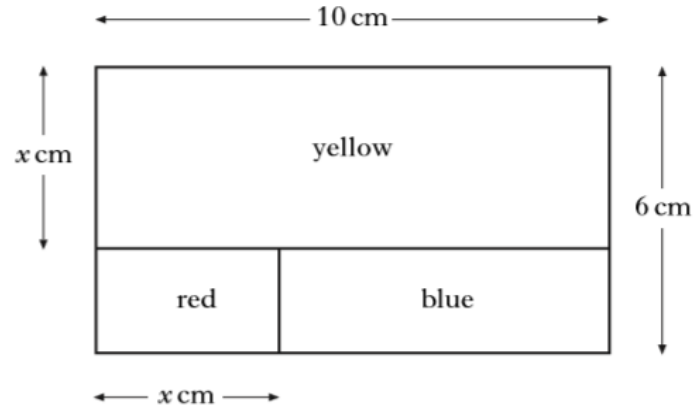
(*b*) The area of the garden is 45 square metres. Find x.

Show clearly all your working.

29

(*a*) A decorator's logo is rectangular and measures 10 centimetres by 6 centimetres.

It consists of three rectangles: one red, one yellow and one blue.



The yellow rectangle measures 10 centimetres by x centimetres.

The width of the red rectangle is x centimetres.

Show that the area, A, of the blue rectangle is given by the expression

$$A = x^2 - 16x + 60.$$

(*b*) The area of the blue rectangle is equal to $\frac{1}{5}$ of the total area of the logo.

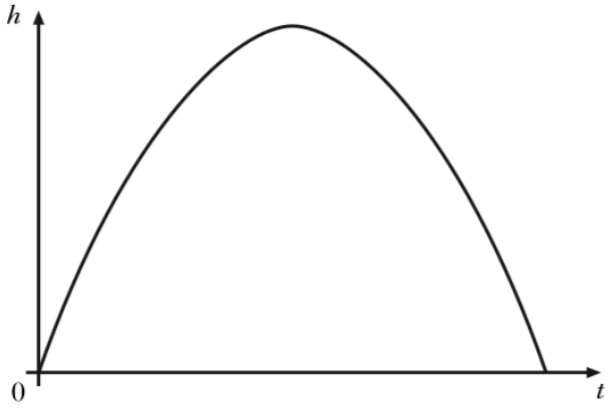
Calculate the value of x.

30

The diagram below shows the path of a rocket which is fired into the air.

The height, h metres, of the rocket after t seconds is given by

$$h(t) = -2t(t - 14).$$



(*a*) For how many seconds is the rocket in flight?

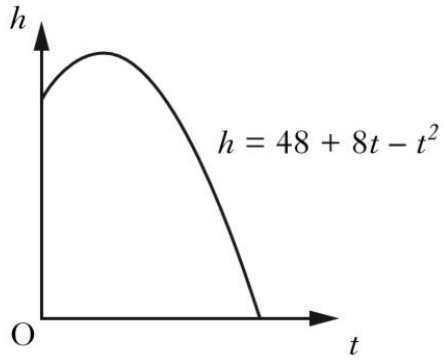
(*b*) What is the maximum height reached by the rocket?

31

The diagram shows the path of a flare after it is fired.

The height, h metres above sea level, of the flare is given by

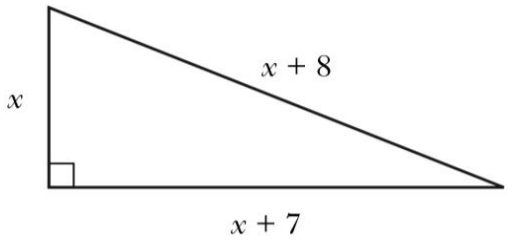
$h = 48 + 8t - t^2$ where t is the number of seconds after firing.



Calculate, **algebraically**, the time taken for the flare to enter the sea.

32

A right-angled triangle has dimensions, in centimetres, as shown.



Calculate the value of x.

33

The weight, W kilograms, of a giraffe is related to its age, M months, by the formula

$$W = \tfrac{1}{4}\left(M^2 - 4M + 272\right).$$

At what age will a giraffe weigh 83 kilograms?

34. Assume $px^2 + 6x + 1 = 0$ has 1 root.

Find p.

35. $ax^2 + 4x - 2 = 0$ has equal roots.

Find a.

36. $x^2 + bx + 25 = 0$ has 1 root.

Find 2 values for b.

37. $px^2 + 8x - 2 = 0$ has 2 real roots.

Set up an inequality in p, and solve for p.

38. $mx^2 + 6x + m = 0$ has equal roots.

Find m.

39. $x^2 + x - t = 0$ has no real roots.

Solve for t