

## Sketching Quadratic Graphs

?

?

**Did you know?**

Quadratic curves are also known as parabolas.

Parabolas are used in many examples of architecture.



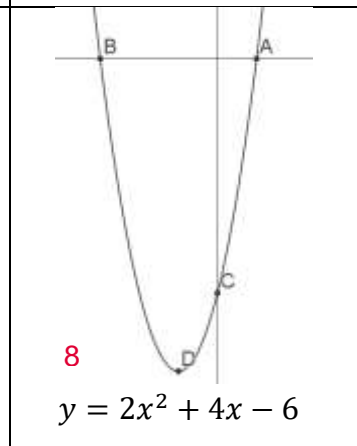
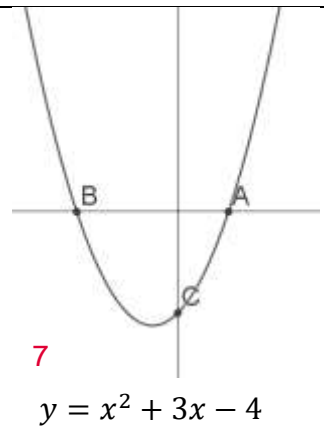
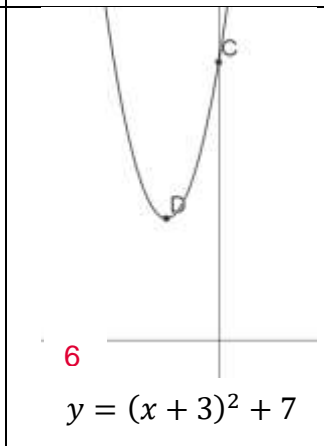
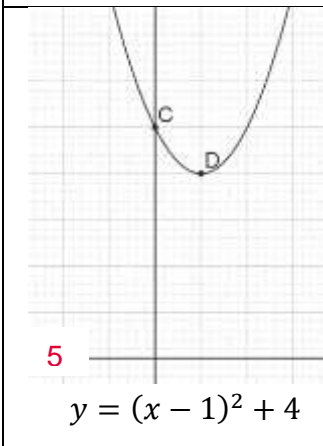
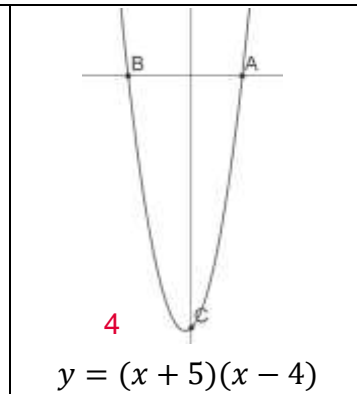
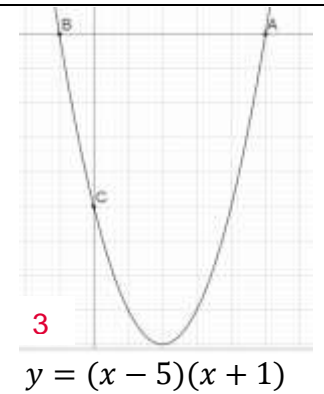
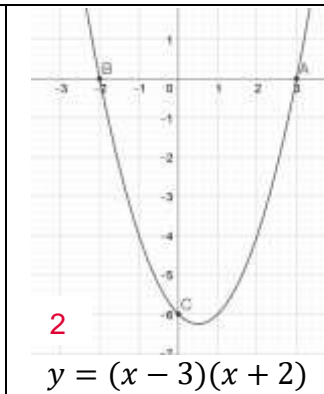
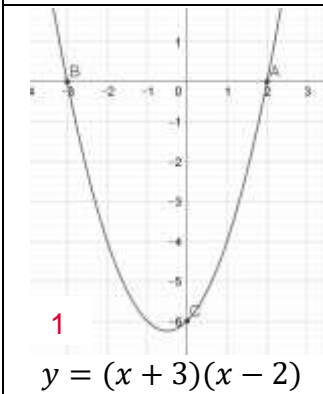
- Do you recognise these landmarks?
- Do you think they are parabolas?
- Can you find any more examples of architecture that use parabolas near where you live?



# Quadratic Graphs 1



Find the coordinates of A, B and C on each graph

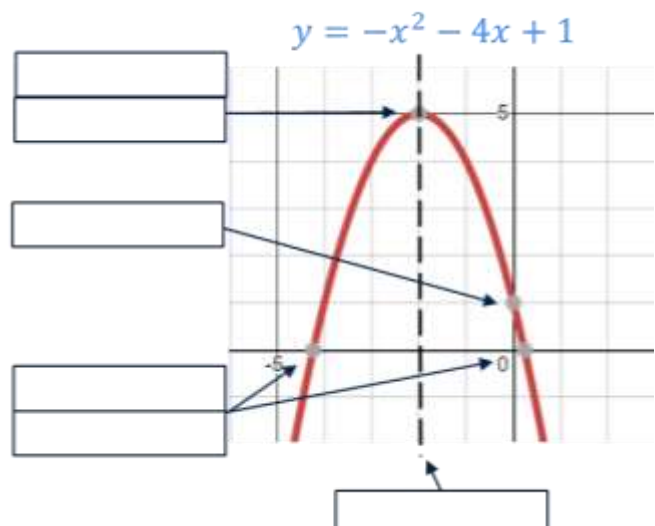
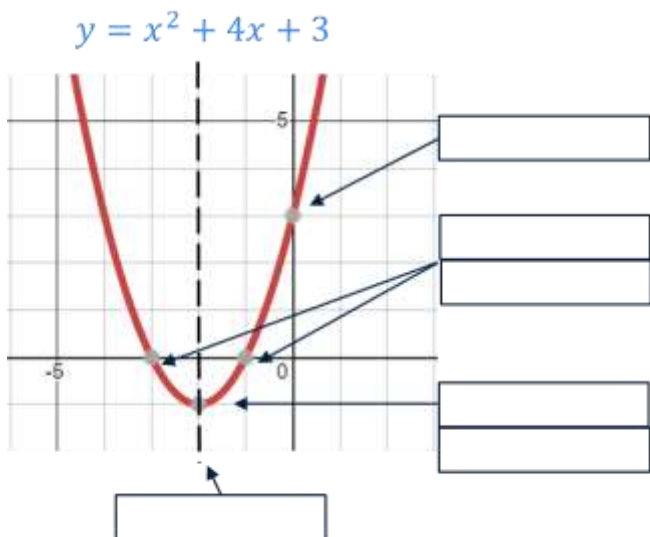


## What is a sketch?



In mathematics a sketch does not need to be a completely accurate drawing, but it should **“illustrate all the significant features of the graph/shape”**

These diagrams show the key features of a quadratic graph



Put the words below into the boxes above so that the quadratic graphs are labelled correctly. Some words may be used more than once.

x intercepts

minimum

roots

turning point

maximum

axis of symmetry

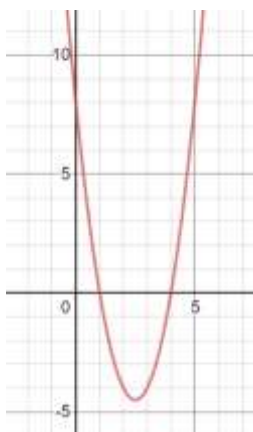
y intercept



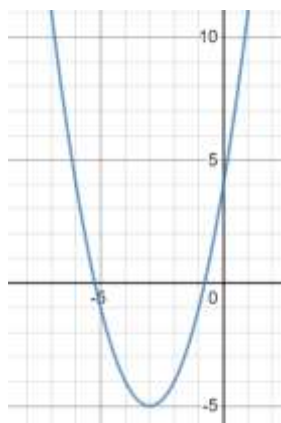
## Identification Parade

Which of the graphs below is  $y = x^2 - 5x + 4$ ?

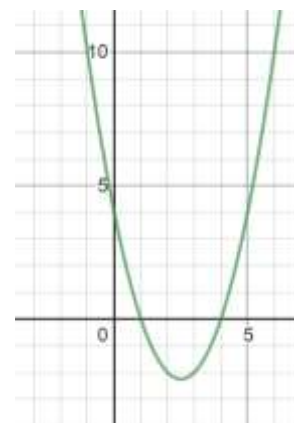
A



B



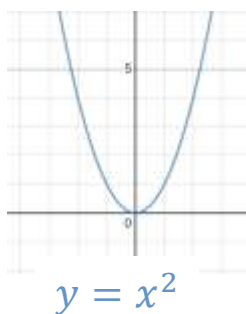
C



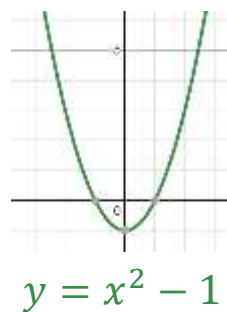
## Move it!

- Can you describe how to move Graph A onto Graph B?

GRAPH A

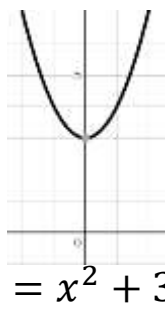


GRAPH B

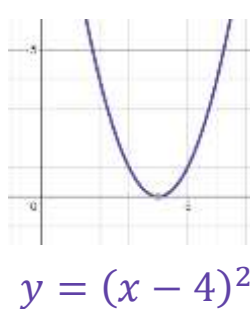


- Which transformations would take GRAPH A onto each of the graphs below?

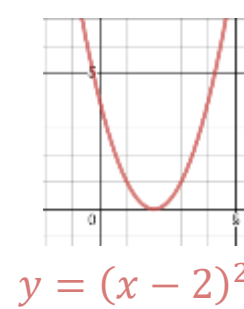
GRAPH C



GRAPH D

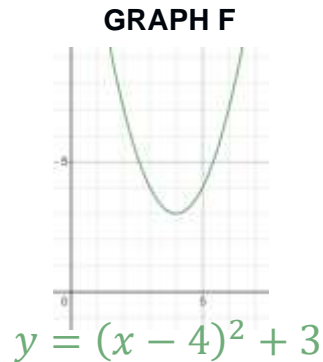
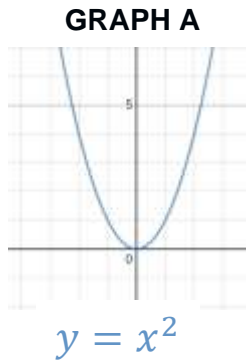


GRAPH E



## Move it again!

- Can you describe how to move Graph A onto Graph F?



- Can you see how that links to the equation of the graph?



## Complete the square to get sorted!

Below are ten quadratic equations.

$$y = x^2 - 4x + 7$$

$$y = x^2 + 2x + 5$$

$$y = x^2 - 6x + 16$$

$$y = x^2 - 6x + 25$$

$$y = x^2 - 2x + 5$$

$$y = x^2 + 8x + 20$$

$$y = x^2 - 6x + 11$$

$$y = x^2 - 8x + 21$$

$$y = x^2 + 6x + 10$$

$$y = x^2 - 10x + 29$$

Your task is to place **nine** of them into a 3 by 3 grid according to the rules on these cards

All of the equations in the top row have a turning point on the line  $y = 4$

One of the equations in the left hand column has its turning point at  $(-4, 4)$

The equation with a turning point at  $(-1, 4)$  is not on the top row

The equations in the top left and centre right square both have the same  $y$  coordinate for their turning point

All of the coordinates of the turning points are at integer values of  $x$  and  $y$ . None of the turning points are on either axis.

All three of the equations with a turning point on the line  $x = 3$  are on the bottom row

All of the equations in the centre column have turning points on the line  $y = 5 - x$

All of the turning points for the equations in the centre column are in the first quadrant

$y = x^2 + 6x + 10$  is in the square in the left hand column directly above  $y = x^2 - 6x + 16$

The turning point of the equation  $y = (x + a)^2 + b$  is at  $(-a, b)$

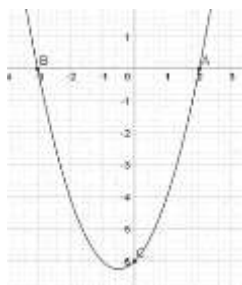


## Quadratic Graphs 2

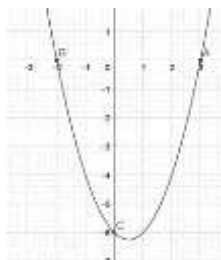


1. What are the  $x$  intercepts of  $y=(2x+3)(x+4)$ ?

2. What are the  $x$  and  $y$  intercepts of this graph.



3. Write the equation of the graph in the form  $ax^2 + bx + c$



4. What are the  $x$  intercepts of the graph of  $y = 6x^2 + x - 2$ ?

5. What does the  $c$  part of the equation in  $y = ax^2 + bx + c$  represent on a graph?

6. Sketch the graph of  $y = 3x^2 - 2x - 8$   
Label the  $x$  and  $y$  intercepts

7. What are the coordinates of the points marked on the diagram of the equation  $y = x^2 + 6x + 16$ ?



8. Which of these statements about the graph  $y = x^2 - 4x + 8$  are true

Has a minimum point at  $(2, 4)$

Will not cross the  $x$  axis twice

Can be factorised



## How High?



The height of a ball thrown up from the ground into the air at time,  $t$ , is given by:

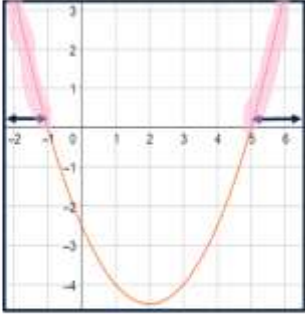
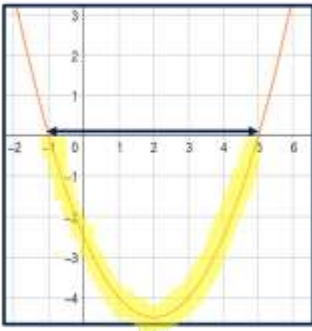
$$h = 20t - 10t^2$$

- Find when the ball hits the ground
- How long is the ball more than 5m above the ground?
- Find the maximum height reached by the ball





## Inequalities reminder

<p>Solve the inequality <math>x^2 - 4x - 5 \geq 0</math></p> <p>Rearrange into factorised form... <math>(x - 5)(x + 1) \geq 0</math></p> <p>...now you can sketch the graph</p>  <p>When <math>x &lt; -1</math> and <math>x &gt; 5</math> the curve is above the <math>x</math> axis.</p> <p>This is where <math>x^2 - 4x - 5 \geq 0</math></p> <p>These are two regions, so are represented by two inequalities <math>x &lt; -1</math> and <math>x &gt; 5</math></p>	<p>Solve the inequality <math>x^2 - 4x - 5 &lt; 0</math></p> <p>Rearrange into factorised form... <math>(x - 5)(x + 1) &lt; 0</math></p> <p>...now you can sketch the graph</p>  <p>When <math>x &gt; -1</math> and <math>x &lt; 5</math> the curve is below the <math>x</math> axis.</p> <p>This is where <math>x^2 - 4x - 5 &lt; 0</math></p> <p>This is one region, so can be represented by one inequality <math>-1 &lt; x &lt; 5</math></p>
--	---



## Quadratic Inequalities

- Use a sketch to help you solve the following inequalities

1.  $(x - 2)(x + 3) < 0$

3.  $x^2 + 7x + 12 \geq 0$

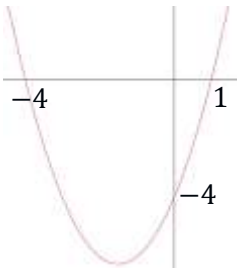
2.  $(4 + x)(2 - x) < 0$

4.  $36 \geq (x + 2)^2$



## Fill the table

- Complete the rows in the table with the information that you have been given

Sketch	Equation	$x$ intercept	$y$ intercept	Minimum point
				
		$(5, 0) (-2, 0)$	$(0, -10)$	
				$(-5, 6)$
	$y = x^2 + 6x + 8$		$(0, 8)$	



## Catching Stars

Go to [Student.Desmos.com](https://student.desmos.com) (use classroom code: **E96QV4**) to try a Quadratic Marbleslides Challenge.

You will be investigating the features of quadratic graphs whilst trying to catch as many stars as possible.

You can join the activity without signing in or entering your real name.