

Investigating the axis of symmetry of a parabola

The aim of this investigation is to find the equation of the axis of symmetry for the parabola given by:

$$y = ax^2 + bx + c \text{ where } a \neq 0.$$

Recall that the axis of symmetry is a vertical line that takes the form $x = \text{constant}$. You will find the value of the constant in terms of the values of the parameters a , b and /or c .

A: Investigating the effect of changing c

1. Go to Desmos at www.desmos.com/calculator
2. Type in $y = ax^2 + bx + c$, and create sliders for the values of the parameters a , b and c when asked.
3. Set the values of a and b to 1, use the slider to change the value of c .

How does the value of c affect the graph?

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Does the value of c affect the location of the axis of symmetry?

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In the remainder of this investigation, we will only focus on the values of a and b . Why is this a sensible thing to do?

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B: Investigating the effect of changing b when $a = 1$

4. Set the value of a to 1, use the slider to change the value of b as shown in the table below. Write the equation of the axis of symmetry in the form $x = \text{constant}$

Value of b	2	4	6	8	10
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

How does the constant in the equation of the axis of symmetry relate to the value of b ?

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Use this table to test other values of b (keep the value of $a = 1$)

Value of b	-10	-8	3	7
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

Does your initial theory hold? Use this sentence starter to state your initial theory more formally

When $a = 1$,

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C: Investigating the effect of changing b when $a = 2$

5. Set the value of a to 2 and repeat step 4 above. It might be helpful to write the equation for the axis of symmetry in the form $x = a \text{ fraction}$.

Value of b	2	4	6	8	10
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

Is the new value of a changing things? How?

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Use this table to test more values of b when a is 2

Value of b	-10	-8	3	7
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

Write down your theory for the equation of the axis of symmetry.

When $a = 2$,

D: Investigating further

6. Set the value of a to 3 and repeat step 4 above. Choose your own values for b .

Value of b					
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

Does your theory in question 5 for the equation of the axis of symmetry hold? If not, how has it changed?

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7. You may wish to try a few more combinations for the values of a and b to test your theory. Here is a table that you could use for this purpose.

Value of b					
Value of a					
Equation of the axis of symmetry	$x =$	$x =$	$x =$	$x =$	$x =$

8. Can you generalise your findings? Complete the following sentence.

The axis of symmetry for the parabola whose equation $y = ax^2 + bx + c$ where $a \neq 0$, is given by $x =$

Teaching notes:

This investigation uses the free graphing software Desmos but any graphing programme will work as well. If no computers are available, the graphs could be divided among the class to draw and the investigation completed as a group.

The investigation develops students' understanding of the relationship between quadratic graphs and their equations. It has links to the quadratic formula and to completing the square that could be used to further develop their knowledge of this topic.