# Quadrare

## Quadrare

Is a Latin word meaning 'to make square', it's where the words **quad**ratics, **quad**rangle, **quad**rilateral, **quad**riceps... come from.

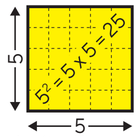
**Can you think of any more quad words?**

## Not everything is perfect

Just like in the real world, not everything in maths can be perfect - although much of maths is pretty good! There are lots of expressions that cannot be written as a perfect square

## Make a square

When we square a number we can show this in a picture, it makes a square!



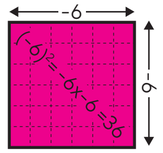

## Squaring a number

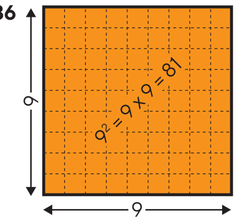
When we square a number, we multiplying by itself.

**5 x 5 = 25** or **9 x 9 = 81** or **-6 x -6 = 36**

We use a superscript 2 to be the symbol for this operation. René Descartes developed this notation.

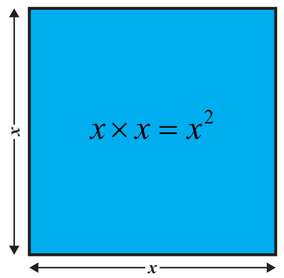
**$5^2 = 25$** or **$9^2 = 81$** or **$(-6)^2 = 36$**



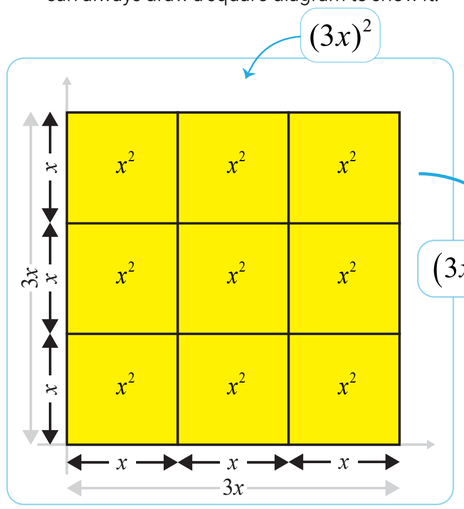

## Squaring an unknown

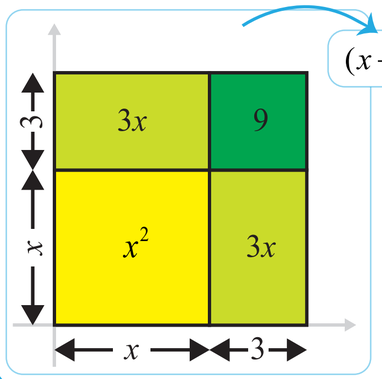
When we square a number, we don't know yet we use a letter to represent this number. It could be any letter from any alphabet, quite often it's $x$, thanks to Descartes again for this!

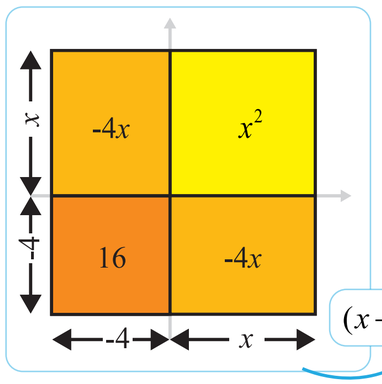



## Squaring an expression

Pretty much anything can be squared. And we can always draw a square diagram to show it.

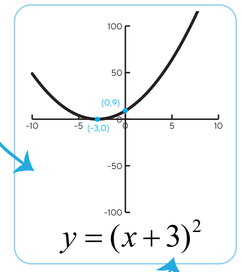



## Translations #1

When the graph of a perfect square quadratic function is drawn, it is a translation in the $x$ direction.




The curve touches the $x$ axis at -3. Can you think why?

## Completing the square

When an expression can't be written as a perfect square

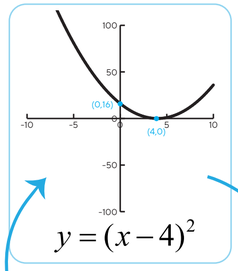
$(x-4)^2 \square = x^2 - 8x + 17$

This expression is almost a **perfect square**, but we need to add 1 to the left side of expression for it to be identical.

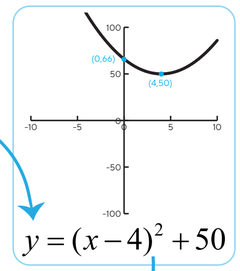
$(x-4)^2 + 1 = x^2 - 8x + 17$

When we can take a quadratic expression and write it in this form, we call it **completing the square**.

$(x+p)^2 + q$




What's **different**? Why?
What's the **same**? Why?




$(x-4)^2 = x^2 - 8x + 16$

## Perfectly Square

Anything that can be written as something squared is called a **perfect square**. All of these are **perfect squares**:

$(x+3)^2 \quad (3x)^2 \quad (x-4)^2$

$7^2 \quad (x+y+12-5z)^2$

## Quadratics!

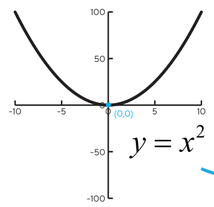
An expression which has unknowns to a highest power of 2, and maybe some unknowns and possibly a constant, is called a Quadratic. No other powers allowed. These are all quadratic expressions:

$(x+3)^2 \qquad 12 - r^2 + 3r \qquad x^2 + 42$

$(t-10)^2 - 5 \qquad x^2 \qquad p^2 + p - 12$

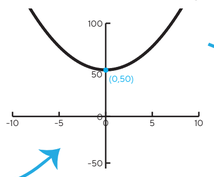
## Plot it!

Plotting the simplest quadratic...




## Huh?

What's **different**? Why?
What's the **same**? Why?

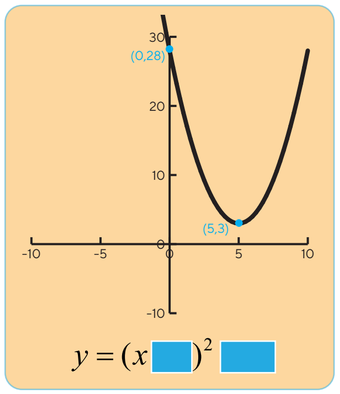



## Translations #2

What has caused the vertical translation in the $y$ direction? Can you see?

## What is it?

By looking at the graph to the right, can you determine it's equation. What goes in the blue boxes below?




Answer $y = (x-5)^2 + 3$

There is more to Mathematics than you think.... visit furthermaths.wales to find out more.
Level 2 Additional Maths can be studied during key stage four.
In key stage five A Level Mathematics is the most popular[1] A-level and A Level Further Mathematics is the perfect accompaniment.

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[1] https://www.wjec.co.uk/media/invh1fni/gce-a-level-provisional-results-june-2022.pdf

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