 Non-linear graphs

The parabola

Optional internet activities

Will it hit the hoop?

Go to <http://student.desmos.com>

1. Enter the class code <teacher insert class code> and hit the join button.
2. Hit “Continue without signing in”.
3. Please enter your first name.
4. Work through the activities.

Polygraph: Parabolas Part 2

1. Enter the class code <teacher insert class code>
2. And hit the join button
3. Continue without signing in again
4. Complete the definitions below.

Definitions

Complete the sentences using the following terms: axis of symmetry, concave up, concave down, vertex, x-intercept, y-intercept, intercept, maximum, minimum and turning point

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a parabola is the highest or lowest point.
* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ parabola looks like a smile.
* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ parabola looks like a frown.
* The point where the parabola crosses the axes is called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The point where the parabola crosses the y-axis is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The point(s) where the parabola crosses the x-axis is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cuts the parabola in half.

Positive coefficients of

1. Complete the tables of values and plot points on the opposite page. Use a different colour pen for each graph and clearly label your graph. If you have access to graphing software, you could complete these activities by entering the equations and looking at the graphs.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

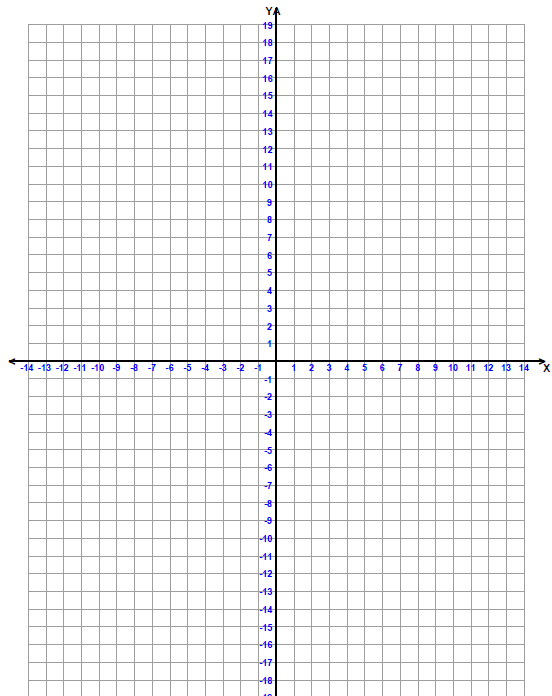
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 0.5 | 1 | 2 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 2 | 4 | 6 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 2 | 4 | 6 |
| y |  |  |  |  |  |  |  |



1. For the graphs you drew:
   1. Which curve appears most wide and flat? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Which curve appears the most narrow and steep? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. What is their common vertex ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Are the curves pointing up or down? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Write a sentence that explains how the graphs change as the co-efficient of changes.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Negative coefficients of

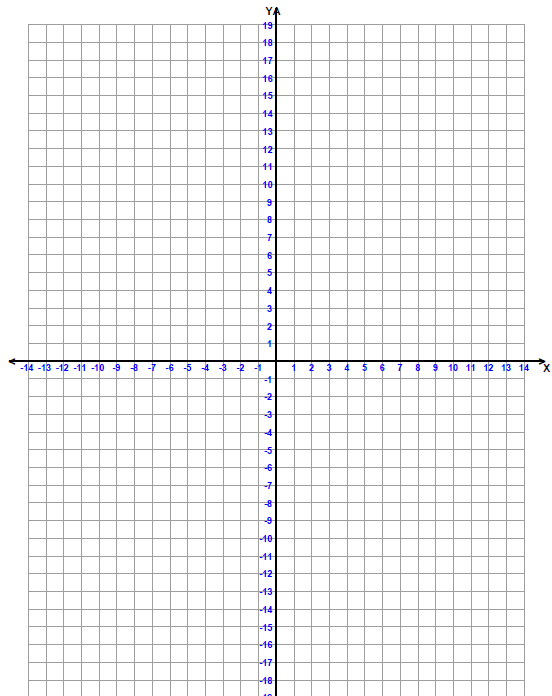
1. Complete the tables of values and plot points on the opposite page. Use a different colour pen for each graph and clearly label your graph.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 0.5 | 1 | 2 |
| y |  |  |  |  |  |  |  |



1. For the graphs you drew:
   1. Which curve appears most wide and flat? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Which curve appears the most narrow and steep? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. What is their common vertex ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Are the curves pointing up or down? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Write a sentence explaining how the graph changes when the coefficient is a negative number.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Adding a constant term

1. Complete the tables of values and plot points on the opposite page. Use a different colour pen for each graph and clearly label your graph.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

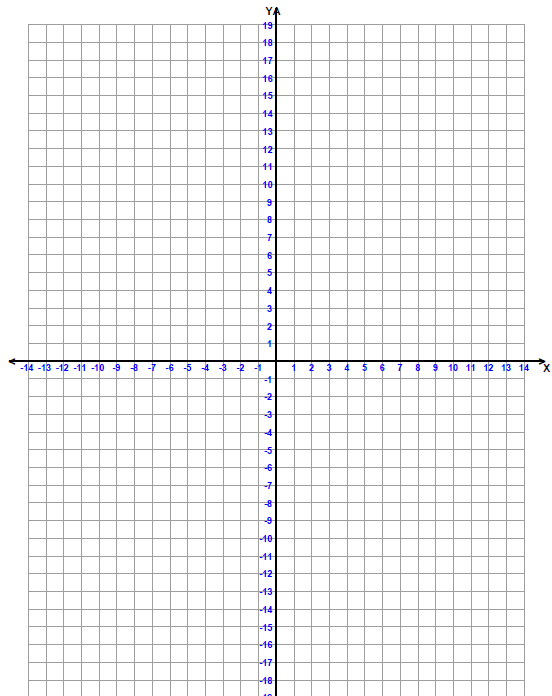
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x |  |  |  | 0 | 1 | 2 | 3 |
| y |  |  |  |  |  |  |  |



1. Write a description to explain what the graphs have in common.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How are the graphs different?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write a sentence to describe the effect of the constant term on the shape and position of the parabola.

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\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definition

Use Google or a dictionary to find a mathematical definition for:

Translation

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Optional internet activities

Polygraph: Parabolas

1. Go to <http://student.desmos.com>
2. Enter the class code <teacher insert class code> and hit the join button.
3. Hit “Continue without signing in”.
4. Please enter your first name.
5. Use your new terminology to play this game with your friends.

Mixed questions

1) Write the missing features for each graph.

|  |  |  |  |
| --- | --- | --- | --- |
| a) | x and y axes to plot graphs on | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| b) | concave up parabola with vertex at (2, -5.4) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |  |
| --- | --- | --- | --- |
| c) | concave down parabol with vertex at (2,0) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| d) | concave up parabola with vertex at (2,5) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |  |
| --- | --- | --- | --- |
| e) | concave up parabola with vertex at (-3, 0) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |  |
| --- | --- | --- | --- |
| f) | concave up parabola with vertex at (2, -2) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |  |
| --- | --- | --- | --- |
| g) | concave down with vertext at (0.3) | (i) | The parabola has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turning point. |
|  |  | (ii) | The co-ordinates of the vertex are \_\_\_\_\_\_\_\_\_\_. |
|  |  | (iii) | The *y*-intercept is |
|  |  | (iv) | The *x*-intercepts are and |
|  |  | (v) | The axis of symmetry has equation \_\_\_\_\_\_\_\_\_\_\_\_\_ |

The cubic function

Sketching cubics

1. Complete the tables of values and plot points on the opposite page. Use a different colour pen for each graph and clearly label your graph.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



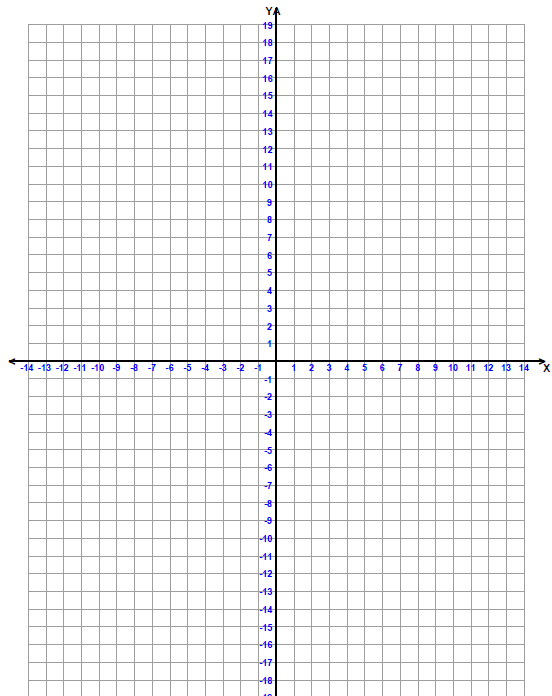
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



Optional internet activities

Polygraph cubics

1. Go to <http://student.desmos.com>
2. Enter the class code <teacher to enter the class code>and hit the join button.
3. Hit “Continue without signing in”.
4. Please enter your first name.
5. Complete the questions.

The exponential function

Polygraph: Exponentials

1. Go to <http://student.desmos.com>
2. Enter the class code <teacher to insert class code>and hit the join button.
3. Hit “Continue without signing in”.
4. Please enter your first name.
5. Complete the questions.

Evaluating exponential expressions

1. Evaluate:
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   9. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   10. \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sketching exponential functions

Complete the tables of values and plot points on the opposite page. Use a different colour pen for each graph and clearly label your graph.

a)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

b)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

c)

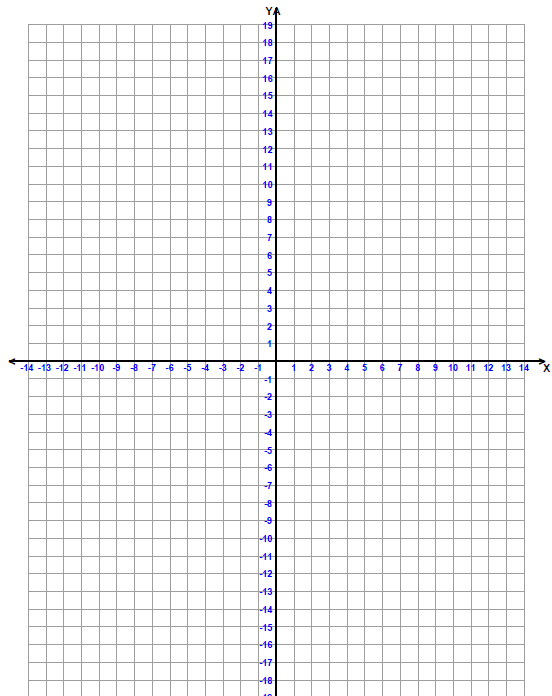
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

d)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |

e)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x |  |  | 0 | 1 | 2 |
| y |  |  |  |  |  |



Extension

Now that you have explored the graphs of above. Apply similar principles to investigate the graphs mentioned below. Use desmos.com to draw graphs of the following:

Absolute Value

Try investigating expressions of the following form:

* Multiplying the absolute value by a number eg
* Adding a number to the absolute value expression eg and
* Adding a number within the absolute value expression eg .

What effect do these have on the graph?

Circle

Try investigating expressions of the following form:

* Try using different numbers to replace the 1
* Try putting numbers in a bracket with the x eg
* Similarly, try putting numbers in a bracket with the y.

What effect do these numbers have on your circle?

Trigonometry graphs

Try investigating expressions of the following form:

* Try putting numbers in front of the sin, cos or tan eg
* Try adding or subtracting numbers on the end, after the , or   
  eg

What effect do these have on the graph?

Outcomes

* MA5.2-1WM selects appropriate notations and conventions to communicate mathematical ideas and solutions
* MA5.2-3WM constructs arguments to prove and justify results
* MA5.2-10NA connects algebraic and graphical representations of simple non-linear relationships
* MA5.3-1WM uses and interprets formal definitions and generalisations when explaining solutions and/or conjectures
* MA5.3-3WM uses deductive reasoning in presenting arguments and formal proofs
* MA5.3-9NA sketches and interprets a variety of non-linear relationships