

Why use this resource?

Based on the idea of looking for similarities and differences between functions, this resource aims to help students make links between properties of functions composed from other functions, using features of their formulae, graphs and derivatives.

The warm-up asks students to give reasons why each one of three functions could be the odd one out, thinking about a range of reasons relating to formulae, graphs and derivatives. Many of these ideas can be used in the main problem, in which students are presented with a 3×3 grid of functions composed from other functions. Students are asked to explain why each function could be the 'odd one out' in its row and column.

Preparation

A larger version of the [table of functions](#) is available for printing so that students can record ideas and any sketches. Mini-whiteboards could help to encourage students to sketch graphs. An alternative [table with graphs and derivatives](#) is also available.

Possible approach

Students should work in pairs or small groups. There many ways to tackle these problems, so group discussion will be important.

For the warm-up, ask what's the same and what's different about the functions. Students may start with algebraic features, but encourage them to think about properties of functions and their graphs too. It would be helpful to record these ideas to support thinking about the main problem.

To introduce the main problem, you may prefer to ask for "the" odd one out in each row. It can then emerge through discussion that each function could be the odd one out. The challenge is then to find a reason why every function is an odd one out in its row and column.

There are many reasons why functions are odd ones out, so encourage students to record their ideas. Part-way through the task, ask students to share ideas by suggesting a common property or feature they've used, or by handing their table to another group.

Key questions

To help students to think about functions as a composition of functions

- What could “ u ” be for these functions?
- Could you draw a function diagram for y ?

To help expand the range of properties or features of the functions

- What does $\frac{dy}{dx}$ tell you about the function and its graph?
- How would you start to sketch the graph of this function?
- What features do the formulae for y and $\frac{dy}{dx}$ have?

Possible support

The suggestions for things think about in the warm-up could help to support discussion of the many reasons why each function could be the odd one out.

You could start the main problem by folding or cutting the table so that students only look at one row at a time. Alternatively, students could be asked to look at the whole table, but start by picking out two functions which share a feature and then one that doesn't share it.

Access to graphing software such as [Desmos](#) may help students if they are struggling to sketch or visualise the graphs. Alternatively, you could give students the [table with graphs and derivatives](#).

Possible extension

Is there an over-arching property that all three functions in the row or column share?

Can you add a function to a row or column that either

- shares a property with two functions but not the third, or
- shares a property with the odd one out, or
- shares a property with all three functions.