This is the second video in a group of five, talking about the Mathematical Methods problem-solving or modelling task for Unit 4. And I'm just going to go through what we need to do in this video.

We need to state questions of interest and related analysis. I've already talked about what the hyperbola is I'm looking at. What happens when the hyperbola xy is one is translated, reflected or dilated? What happens to the rule of the function? The question does the graph have stationary points or points of inflection? I think it's worth your students looking at that but you'll find that they don't exist. What is the behaviour of tangents and perpendicular lines to the graph? What is the area under the graph? And what is the maximum or minimum distance from a certain point to the graph? So the relevant content is transformations and mapping. Varying parameters. Looking at whether there are any stationary points or points of inflection. Tangents and perpendicular lines. Area under the graph over an interval. Distance from a certain point or a range of points to the graph. And any maxima or minima.

So the task is, the question is, first of all, the rectangular hyperbola of the form xy is one or y is one on x has two asymptotes: x equals nought, y equals nought, which are perpendicular to each other. I'm going to talk about the hyperbola having two symmetric branches or we could say opposite branches that in this simplest form are reflected over the line y equals -x. But obviously, when it's translated, it will be reflected over a different line. And you will find that the students could discover that it has no stationary points or points of inflection, which makes it interesting when we talk about the vertex of the hyperbola.

There's the simplest graph of y equals one on x where can you see the reflection line would be y equals -x, and we've got two symmetric branches and we have two asymptotes, x is nought, y is nought with the centre of the hyperbola being at the point nought, nought. So that's the starting point for the students.

Then we look at number cases. Instead of y equals 2x plus 1 over 2x plus 3 and re-express, draw its graph, stating the domain and range and identifying any key features. Then similarly analyse the graph of y equal 2x plus 3 on 2x plus 1. As I said in the introductory part, let's flip the numerator and the denominator and see what happens to these graphs. So we're starting off in simple, numeric form where we can look at what happens to the graphs purely by flipping the numerator and the denominator. So this is y equals 2x plus 1 on 2x plus 3. Students ought to be able to identify that we have a vertical asymptote where the denominator would be zero. So the vertical asymptote is at x is -1.5 and the horizontal asymptote is at y equals one. And the new centre of the graph is the point -1.5, 1.

Now, the next thing is to compare and contrast these graphs together. What happens when I flip the numerator and the denominator? There's a lot in there that students could compare. And then what's very interesting is that when you actually divide these on your calculator, you'll find you'll have b, c up on the numerator and you'll have certain relationships where it's worth considering what happens when b is greater than c? What happens when b is less than c? And what happens when b equals c?

These are the two graphs. Immediately you can see the difference where I flip the numerator and the denominator. Notice that in this case, we still have the coefficient of x being the same and in fact, two. But in this case, the opposing sections or the symmetric sections look like their opposite. So that's a very interesting relationship just straightaway where we look at our vertical asymptotes and our horizontal asymptotes.

So when we start these tasks, we like the students to start with numbers. So this is a graph with numbers in it where we can look at patterns. What we're doing here is we're looking at graphs and identification of key features of graphs and in this case, it's power functions of y equals x to the n where n are rationals and in this case, the n will be -1. Then we look at transformations from y is f of x to its fully transformed case where f could be any of the functions where we move and change a, n, b, c. We vary parameters. Algebraic fractions are involved and what is interesting is we then start to look at discontinuities of the graph. Where the asymptotes exist, where is the graph discontinuous? So that's the end of video two where we've introduced the first part.

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