

Teacher notes

# Why use this resource?

Students are asked to estimate the gradient of three points on a sine graph, without being given a scale. They should find that they have to decide between using degrees or radians on the *x*-axis. This gives an opportunity to discuss what the gradient function of  $\sin x$  is, and why it will be different depending on the units of *x*. This can help to explain why we use radians when doing calculus.

# Preparation

Students should have a copy of the sine graph with points A, B and C marked on, to use for their estimations. You can download a printable page with the graphs on here.

If students are not familiar with the idea of sketching the gradient function of a graph, you may want to use one or two of the cards from Gradient match to introduce the idea with more straightforward graphs.

# Possible approach

You may want students to estimate the gradients by themselves initially, as their differing approaches could lead to a rich discussion about which methods are more appropriate and perhaps more accurate. Some students may not make a conscious decision to use radians or degrees and so sharing students' results should draw out the problem of not having a scale on the axes. Once it is understood there are two possibilities, students should be asked to sketch the gradient function in degrees and in radians, and compare the results.

#### Key questions

- How can we estimate the gradient of a curve?
- What scale have you used for the *x*-axis?
- Can you sketch the gradient of  $\sin x$  in radians? In degrees?

# Possible support

Students might try and estimate the gradients by measuring distances on the graph. To help them see why this might be incorrect and suggest a different method, you could ask them to label any values on the axes that they know.

# Possible extension

The derivative of  $\sin x$  when x is in degrees is  $a \cos x$ . Students could try to work out what the value of a is. They may want to consider how you would transform a sine graph with a period of  $2\pi$  to one with a period of  $360^{\circ}$ .

- What is the scale factor that is involved?
- How does that impact the gradient?