# Estimating gradients

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.

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## 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 $360°$.

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

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https://undergroundmathematics.org/calculus-trig-log/estimating-gradients