

Gradient of tangents on curves

Gradient of Tangents on Curves



Key idea

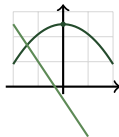
The **gradient** of a curve at a point is the gradient of the **tangent line**. Unlike straight lines, curves have a different gradient at every point.

How to estimate gradient

- Draw the tangent line at the point.
- Pick two grid intersection points on the tangent.
- $m = \frac{\Delta y}{\Delta x}$ (rise over run).
- Horizontal tangent $\Rightarrow m = 0$ (turning point).

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Estimating gradient from a tangent



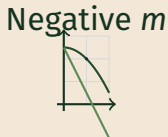
$$\text{Rise} = -4, \text{Run} = 1 \Rightarrow m = -4$$

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Gradient signs



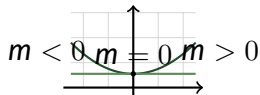
Key idea

A **positive gradient** ($m > 0$) means the curve slopes upward. **Negative** ($m < 0$) means it slopes downward. At a **turning point**, $m = 0$ (horizontal tangent).

Increasing / Decreasing

If $m > 0$, function is **increasing**. If $m < 0$, function is **decreasing**. If $m = 0$, **stationary** (turning point).

Identifying turning points



Gradient changes $- \rightarrow 0 \rightarrow + =$
minimum.

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Stationary point types

Maximum: gradient $+$ $\rightarrow$ 0 $\rightarrow$ $-$
(curve peaks)

Minimum: gradient $-$ $\rightarrow$ 0 $\rightarrow$ $+$
(curve troughs)

Inflection: gradient 0 but sign
unchanged (curve flattens briefly
then continues)

Try these

1. A tangent slopes up 2 for 1 right. What is m ?
2. Gradient is $+$ then 0 then $-$. Max or min?
3. At a turning point, what is the gradient?

Answers: 1. $m = 2$ 2. Max 3. $m = 0$