

3.4 Differentiation

Name: _____ Class: _____ Date: _____

KEY WORDS derivative

<!-- Session 2 native-skill companion -->

Objective

Practise differentiation within the labelled native lessons. Public original tasks; locally authored answer guidance.

1 Key knowledge and worked examples

■ Derivatives and stationary points · Higher

For a polynomial term ax^n with nonnegative integer n , the gradient term is anx^{n-1} . Add the differentiated terms. A stationary point has zero gradient.

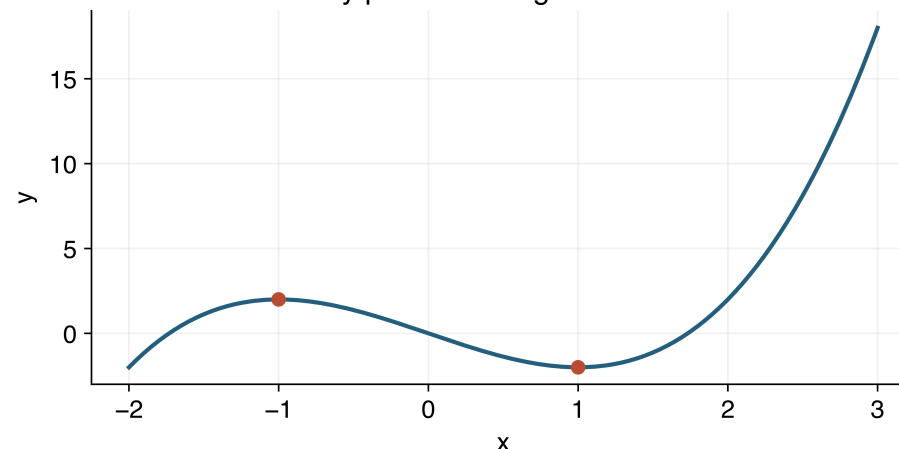
$$\frac{d}{dx}(ax^n) = anx^{n-1}, \quad f'(x) = 0$$

For $y=x^3-3x$, $dy/dx=3x^2-3$. At $x=1$, the gradient is 0 and $y=-2$. The gradient $3x^2-3$ changes from negative to positive at $x=1$, so this is a local minimum. At $x=-1$, $y=2$ and the gradient changes from positive to negative, giving a local maximum. Use gradient signs and the graph shape, within this specification.

A zero derivative does not always mean a maximum or minimum: $y=x^3$ is stationary at 0 but continues increasing. An endpoint can also produce an extreme value on a restricted domain.

This advanced-tier IGCSE lesson is limited to polynomial differentiation, tangent gradients and stationary points. Chain, product, quotient and implicit differentiation are excluded.

Stationary points and signed accumulation



Original native-lesson illustration; labels belong to its worked example.

2 Practice

2.1 (Higher) For $y=x^3-3x$, find dy/dx at $x=2$.

2.2 (Higher) Find the y-coordinate of the stationary point at $x=1$.

2.3 (Higher) For $y=4x^3$, find dy/dx at $x=2$.

3 Exam-style questions

3.1 Decide whether this claim is true. Justify with a concrete calculation or counterexample: Every point with zero derivative is a local maximum or minimum.

Solutions

2.1 $dy/dx=3x^2-3$. At $x=2$ it is $12-3=9$.

2.2 Substitute into the original curve: $y(1)=1-3=-2$.

2.3 The derivative is $12x^2$; at 2 it is $12 \times 4=48$.

3.1 False. For $f(x)=x^3$, $f'(0)=0$ but x^3 is increasing on both sides of zero. This stationary point is not a local extremum; inspect the gradient sign change.

Local review guidance: show the chosen method; give the checked result; explain the condition or failed shortcut. This is authored classroom guidance.