

Calculus · supported focus

Supported focus · SL

## Supported scope

- Supported SL focus. First assessment 2021; current through 2028. First-assessment-2029 course is separate.. Remaining guide, assessment and practical requirements retain their recorded holds.
- State model conditions and distinguish fictional data from measurements.

# Differentiation · 1.1

## Reasoning

A curved road has different slopes at different positions. An average gradient cannot describe every point. This lesson studies derivative : The instantaneous rate of change, also the gradient of a tangent.

# Differentiation · 2.1

## Reasoning

For  $y = ax^n$ ,  $dy/dx = anx^{n-1}$ . A stationary point satisfies  $dy/dx = 0$ . Check the sign change of the derivative, or the second derivative when it is nonzero, to classify it. State the allowed inputs and units before calculating. An equation should express the relationship, not just record a calculator entry.

# Differentiation · 3.1

## Reasoning

Use the displayed relationship within its stated domain.

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

## Differentiation · 3.2

### Reasoning

Check the result against the starting quantities. Substitute into the original relation, or compare the graph and numerical answer where appropriate.

## Differentiation · 3.3

### Reasoning

For  $y=x^3-3x$ ,  $dy/dx=3x^2-3$ . At  $x=1$ , the gradient is 0 and  $y=-2$ . The second derivative is  $6x$ , positive at  $x=1$ , so this is a local minimum. At  $x=-1$ ,  $y=2$  and the second derivative is negative, giving a local maximum.

# Differentiation · 4.1

## Reasoning

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. When a shortcut fails, identify the assumption it breaks. Keep an exact value until the requested final rounding.

## Differentiation · 4.2

### Reasoning

Every point with zero derivative is a local maximum or minimum. This claim is false. Explain which definition or assumption it violates.

# Differentiation · 5.1

## Reasoning

At GCSE/IGCSE use only the polynomial scope allowed by the tier; do not add chain, product or quotient rules there. At advanced level, connect the derivative to rates and optimization with a valid domain. A complete solution gives the mathematical result and explains what it means. Check that it is possible in the stated context.

# Differentiation · 6.1

## Reasoning

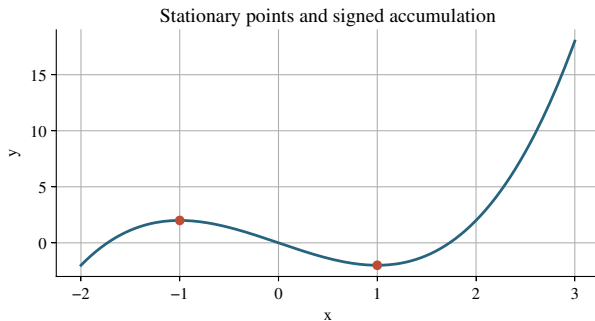
Current first-assessment-2021 Analysis and Approaches SL. This is authored concept support; the full guide is needed to certify every objective. Give the method before the final answer, and use the paper's calculator and formula rules. Review a wrong answer by locating the first invalid step.

# Differentiation · 6.2

## Reasoning

The instantaneous rate of change, also the gradient of a tangent. Choose the relationship, show the method, check its assumptions and interpret the result.

## Differentiation · diagram



- Original teaching diagram: Derivatives and stationary points
- Use the labels and the stated model together.

## Differentiation · original transfer

## Your turn

For  $y=x^3-3x$  on  $[-2, 2]$ , find the absolute maximum and minimum, including all candidates.

# Differentiation · transfer reasoning

## Method and interpretation

Derivative  $3x^2 - 3 = 0$  at  $\pm 1$ . Values  $y(-2) = -2$ ,  $y(-1) = 2$ ,  $y(1) = -2$ ,  $y(2) = 2$ .

Maximum 2 at  $-1, 2$ ; minimum  $-2$  at  $-2, 1$ . Checking only stationary points misses endpoint ties.

# Integration · 1.1

## Reasoning

A velocity graph tells us motion at an instant. How can we recover the displacement accumulated over time? This lesson studies antiderivative : A function whose derivative equals the given integrand.

# Integration · 2.1

## Reasoning

For  $n \neq -1$ , the integral of  $ax^n$  is  $ax^{n+1}/(n+1) + C$ . A definite integral is signed accumulation. Split at sign changes when total area or distance is required. State the allowed inputs and units before calculating. An equation should express the relationship, not just record a calculator entry.

## Integration · 3.1

## Reasoning

Use the displayed relationship within its stated domain.

$$\int ax^n dx = \frac{ax^{n+1}}{n+1} + C \quad (n \neq -1)$$

# Integration · 3.2

## Reasoning

Check the result against the starting quantities. Substitute into the original relation, or compare the graph and numerical answer where appropriate.

## Integration · 3.3

## Reasoning

For  $v(t)=3t^2-3$  over  $0 \leq t \leq 2$ , displacement  $= [t^3-3t]_0^2 = 2$ . Since  $v$  changes sign at  $t=1$ , distance  $= -[t^3-3t]_0^1 + [t^3-3t]_1^2 = 2+4=6$ . The constants cancel only for a definite integral.

# Integration · 4.1

## Reasoning

The integral of  $1/x$  is  $\ln|x|+C$ , not the power rule with  $n=-1$ . Signed area can be zero even when the total enclosed area is positive. When a shortcut fails, identify the assumption it breaks. Keep an exact value until the requested final rounding.

# Integration · 4.2

## Reasoning

A definite integral always equals the total positive area, even when the graph crosses the axis. This claim is false. Explain which definition or assumption it violates.

# Integration · 5.1

## Reasoning

Identify what the integral means and include the correct units. A rate measured per second integrates to the underlying quantity, not to another rate. Differentiate an antiderivative to check it. A complete solution gives the mathematical result and explains what it means. Check that it is possible in the stated context.

# Integration · 6.1

## Reasoning

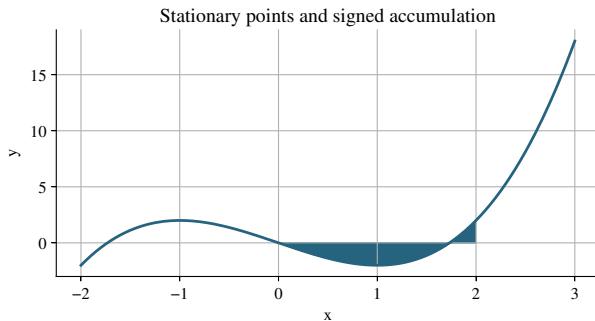
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# Integration · 6.2

## Reasoning

A function whose derivative equals the given integrand. Choose the relationship, show the method, check its assumptions and interpret the result.

# Integration · diagram



- Original teaching diagram: Integrals, area and accumulation
- Use the labels and the stated model together.

# Integration · original transfer

## Your turn

For velocity  $v=t-2$  on  $0 \leq t \leq 5$ , find displacement and total distance and explain the distinction.

# Integration · transfer reasoning

## Method and interpretation

$\text{Integral}[t^2/2 - 2t]_0^5 = 2.5$ . Sign changes at 2; signed integrals are  $-2$  then  $4.5$ , so distance  $6.5$ . Units follow velocity/time units. Distance integrates  $|v|$ .

## Check yourself

- Explain derivative using the stated model.
- Explain antiderivative using the stated model.
- Change one value in the original transfer; explain which assumption still matters.