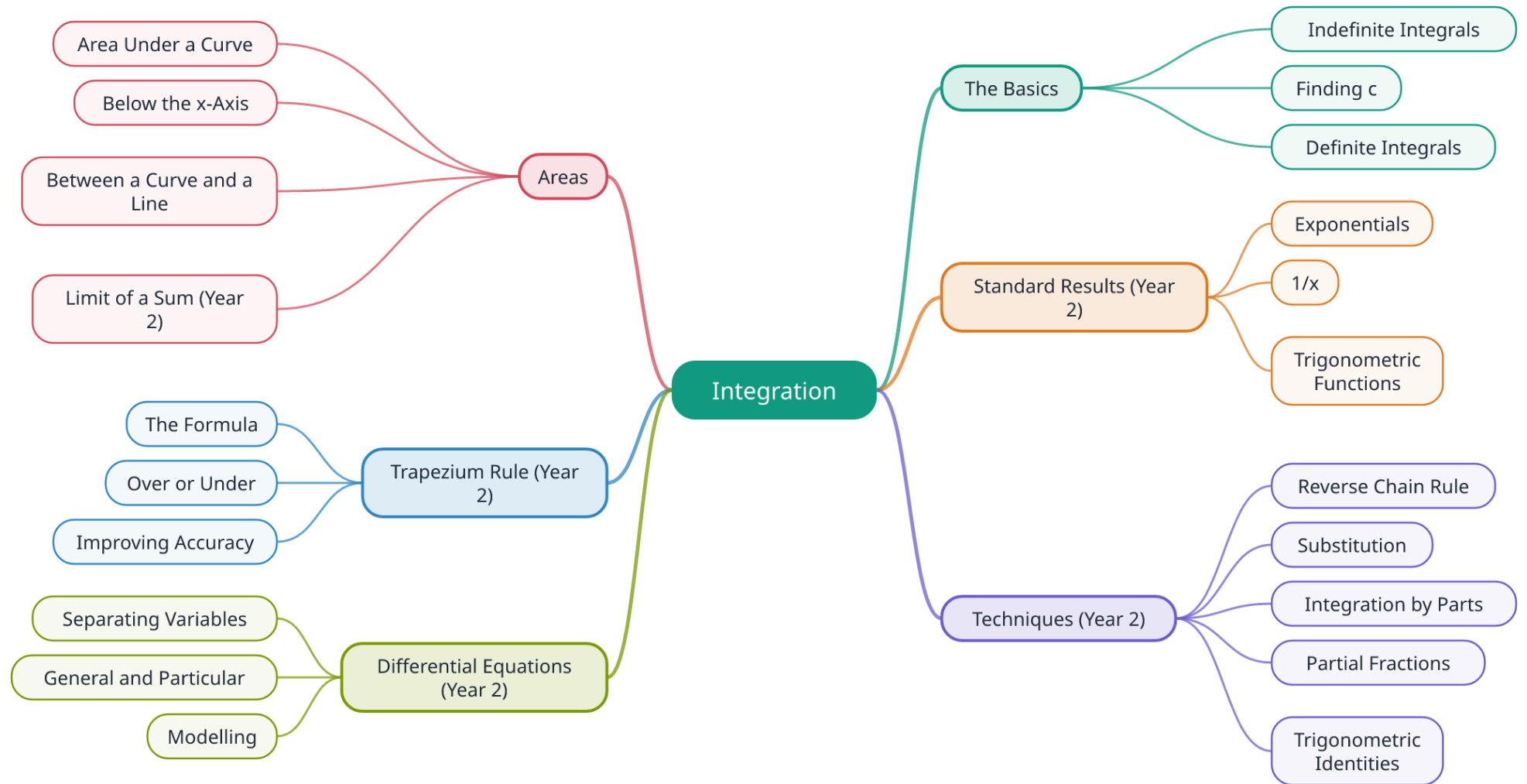


Integration Mind Map (A Level Maths)

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Integration mind map explained

The Basics

Integration is the reverse of differentiation.

Indefinite Integrals

The integral of x^n is $x^{(n+1)} / (n + 1) + c$, for any n except -1 . Always add the constant of integration, c .

Finding c

If you know a point on the curve, substitute it after integrating to find the value of c .

Definite Integrals

Integrate, then substitute the upper limit and subtract the value at the lower limit. No constant is needed.

Standard Results (Year 2)

Learn these alongside the derivatives they reverse.

Exponentials

The integral of $e^{(kx)}$ is $(1/k)e^{(kx)} + c$.

$1/x$

The integral of $1/x$ is $\ln|x| + c$. More generally, $f'(x)/f(x)$ integrates to $\ln|f(x)| + c$.

Trigonometric Functions

- $\sin kx$ integrates to $-(1/k) \cos kx + c$
- $\cos kx$ integrates to $(1/k) \sin kx + c$
- $\sec^2 kx$ integrates to $(1/k) \tan kx + c$

Angles in radians.

Techniques (Year 2)

For integrals that are not standard results.

Reverse Chain Rule

Spot an integral in the form $f'(x) \times g(f(x))$, adjust for the constant, and integrate directly.

Substitution

Replace part of the integrand with u , rewrite dx in terms of du , integrate, then substitute back. For definite integrals, change the limits too.

Integration by Parts

For a product: the integral of $u \, dv/dx \, dx = uv -$ the integral of $v \, du/dx \, dx$. Choose u to be the part that gets simpler when differentiated, such as x (but $\ln x$ is usually u).

Partial Fractions

Split a rational function into simpler fractions, then integrate each one, usually to a $\ln$ term.

Trigonometric Identities

Use identities to rewrite integrals such as $\sin^2 x$ or $\cos^2 x$ in a form you can integrate.

Areas

A definite integral gives the area between a curve and the x -axis.

Area Under a Curve

Integrate between the two x -values. Sketch the curve first.

Below the x -Axis

Areas below the x -axis give negative integrals. Find each region separately and add their sizes.

Between a Curve and a Line

Integrate the upper function minus the lower function, between the points where they meet.

Limit of a Sum (Year 2)

The area is the limit of the sum of the areas of thin rectangles as their width tends to zero.

Trapezium Rule (Year 2)

A numerical method for estimating an area when you cannot integrate exactly.

The Formula

Area is approximately $(h/2)[y_0 + 2(y_1 + y_2 + \dots + y_{n-1}) + y_n]$, where h is the strip width and y_0 to y_n are the heights at each step.

Over or Under

It overestimates the area if the curve is convex (bending upwards) and underestimates if it is concave.

Improving Accuracy

Use more, narrower strips.

Differential Equations (Year 2)

Equations involving a derivative, used to model change.

Separating Variables

Rearrange so all the y terms are with dy and all the x terms with dx , then integrate both sides.

General and Particular

The general solution includes the constant c . A particular solution uses given conditions to find c .

Modelling

For example, $dP/dt = kP$ models growth proportional to size, giving exponential growth or decay. Comment on whether the model is realistic.

How to revise with this mind map

1. Learn the standard results in pairs with their derivatives, so you can check any answer by differentiating it.
2. Practise choosing the method. Ask in order: is it a standard result, a reverse chain rule, a product (by parts), a substitution, or a fraction (partial fractions)?
3. Sketch before finding areas. A quick sketch shows where the curve crosses the x -axis and which regions are below it.
4. Show every step in differential equations: separating, integrating both sides, adding the constant, then using the conditions. Marks follow the working.
5. Make it yours. Build your own integration map in Mindmapi from your notes, and ask the AI about any technique you are unsure of. The answer is saved into that branch's notes for next time.