

AP Calculus AB Formula and Strategy Guide

Limits, derivatives, applications of the derivative, integrals, and accumulation — the full AP Calculus AB scope, with the moment each rule actually applies. Work a section, then try the matching questions in the practice worksheet.

SECTIONS	5	WORKED EXAMPLES	4	FORMAT	Print friendly
----------	---	-----------------	---	--------	----------------

How to use this guide

A formula you cannot place is not knowledge yet. Work the recall drill below before the questions.

- Name the rule before applying it out loud — 'this is the chain rule because a function is inside another'.
- A derivative answers 'how fast'; an integral answers 'how much total'. Keep that distinction explicit.
- Units matter on the free-response portion of the real exam — practice stating them even here.

1. Limits and continuity

NAME	FORMULA	WHEN TO USE
Limit definition	the value $f(x)$ approaches as x approaches a	Describing behavior near a point, not necessarily at it.
Continuity	$\lim_{x \rightarrow a} f(x) = f(a)$	Confirming no break, jump, or hole at a point.
Limit at infinity	long-run behavior as x grows without bound	Horizontal asymptotes and end behavior.
L'Hopital's rule	$0/0$ or infinity/infinity → take derivatives of top and bottom	A limit gives an indeterminate form.

WORKED EXAMPLE

Find $\lim_{x \rightarrow 2} \frac{(x^2 - 4)}{(x - 2)}$.

- Factor: $(x-2)(x+2)/(x-2)$
- Cancel: $x + 2$
- Substitute $x = 2$: 4

Check: The hole at $x=2$ does not stop the limit from existing.

2. Derivative rules

NAME	FORMULA	WHEN TO USE
Power rule	$d/dx[x^n] = n x^{n-1}$	Differentiating a polynomial term.

NAME	FORMULA	WHEN TO USE
Product rule	$(fg)' = f'g + fg'$	Two functions are multiplied together.
Quotient rule	$(f/g)' = (f'g - fg')/g^2$	One function is divided by another.
Chain rule	$d/dx[f(g(x))] = f'(g(x)) \times g'(x)$	A function is nested inside another.
Derivative of sin/cos	$d/dx[\sin x] = \cos x$, $d/dx[\cos x] = -\sin x$	Differentiating trig functions.
Derivative of e^x and $\ln x$	$d/dx[e^x] = e^x$, $d/dx[\ln x] = 1/x$	Differentiating exponential/log functions.

WORKED EXAMPLE

Differentiate $f(x) = x^2 \sin(x)$.

- Product rule: $f' = (x^2)' \sin(x) + x^2(\sin x)'$
- $= 2x \sin(x) + x^2 \cos(x)$

Check: Two terms are expected from a product of two functions.

3. Applications of the derivative

NAME	FORMULA	WHEN TO USE
Critical points	$f'(x) = 0$ or undefined	Locating potential extrema.
First derivative test	sign change of f' identifies max/min	Classifying a critical point.
Second derivative test	$f''(x) > 0$: local min; $f''(x) < 0$: local max	An alternative way to classify extrema.
Related rates	differentiate a relationship with respect to time	Two changing quantities are linked by an equation.
Optimization	set derivative of the quantity to 0, check endpoints	Finding a maximum or minimum value in context.

WORKED EXAMPLE

Find the critical points of $f(x) = x^3 - 3x$.

- $f'(x) = 3x^2 - 3$
- Set to 0: $3x^2 = 3$, $x^2 = 1$
- $x = 1$ or $x = -1$

Check: f' is a parabola opening up, crossing zero at $x = \pm 1$.

4. Integrals and the Fundamental Theorem

NAME	FORMULA	WHEN TO USE
Power rule for integrals	$\text{INT } x^n \, dx = x^{n+1}/(n+1) + C$	Antidifferentiating a polynomial term.
Fundamental Theorem, part 1	$d/dx \text{ INT}[a \text{ to } x] f(t)dt = f(x)$	A derivative of an accumulation function.
Fundamental Theorem, part 2	$\text{INT}[a \text{ to } b] f(x)dx = F(b) - F(a)$	Evaluating a definite integral.
u-substitution	reverse the chain rule	The integrand contains a composed function and its derivative.
Area between curves	$\text{INT}[a \text{ to } b] (\text{top} - \text{bottom}) \, dx$	Finding area bounded by two functions.

WORKED EXAMPLE

Evaluate $\text{INT}[0 \text{ to } 2] 3x^2 \, dx$.

1. Antiderivative: x^3
2. Evaluate: $2^3 - 0^3$
3. $= 8$

Check: The antiderivative x^3 checks out since $d/dx[x^3] = 3x^2$.

5. Differential equations and motion

NAME	FORMULA	WHEN TO USE
Separable differential equations	separate variables, integrate both sides	dy/dx is a product of a function of x and a function of y .
Position, velocity, acceleration	$v = s', a = v' = s''$	Motion along a line, connecting derivatives.
Average value of a function	$1/(b-a) \times \text{INT}[a \text{ to } b] f(x)dx$	The mean height of a function over an interval.

Notes and tutor hand-off

Bring this page to your next session so the tutor can start from what actually blocked you.

Which derivative rule needs more practice?

One integral technique you keep mixing up:

Worksheet question numbers to review with a tutor:
