

AP Calculus BC Formula and Strategy Guide

Everything in AP Calculus AB, plus the BC-only material: advanced integration techniques, parametric and polar functions, and sequences, series, and Taylor polynomials. Work a section, then try the matching questions in the practice worksheet.

SECTIONS	5	WORKED EXAMPLES	3	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.

- BC adds breadth, not just difficulty — know which convergence test to reach for before you start one.
- Parametric and polar problems reward drawing the curve first; the algebra makes more sense once you can see it.
- A series question always starts with the same move: identify the series type before choosing a test.

1. Advanced integration

NAME	FORMULA	WHEN TO USE
Integration by parts	$\text{INT } u \, dv = uv - \text{INT } v \, du$	The integrand is a product that substitution can't handle.
Partial fractions	split a rational function into simpler fractions	Integrating a rational function with factorable denominator.
Improper integrals	replace infinity with a limit	The interval or the integrand is unbounded.
Arc length	$\text{INT } \sqrt{1 + (f'(x))^2} \, dx$	Finding the length of a curve.

WORKED EXAMPLE

Evaluate $\text{INT } x e^x \, dx$ using integration by parts.

- Let $u = x$, $dv = e^x \, dx$, so $du = dx$, $v = e^x$
- $uv - \text{INT } v \, du = x e^x - \text{INT } e^x \, dx$
- $= x e^x - e^x + C$

Check: Differentiating $x e^x - e^x + C$ gives back $x e^x$ by the product rule.

2. Parametric, vector, and polar functions

NAME	FORMULA	WHEN TO USE
Parametric derivative	$dy/dx = (dy/dt)/(dx/dt)$	A curve is defined by $x(t)$ and $y(t)$.
Parametric arc length	$\text{INT } \sqrt{(dx/dt)^2 + (dy/dt)^2} \, dt$	Finding the length of a parametric curve.

NAME	FORMULA	WHEN TO USE
Polar area	$\frac{1}{2} \int r^2 d(\theta)$	Finding area enclosed by a polar curve.
Velocity vector	$\langle x'(t), y'(t) \rangle$	Motion described by parametric position functions.
Speed	$\sqrt{(x'(t))^2 + (y'(t))^2}$	The magnitude of the velocity vector.

WORKED EXAMPLE

Find dy/dx for $x(t) = t^2$, $y(t) = t^3$.

- $dx/dt = 2t$, $dy/dt = 3t^2$
- $dy/dx = 3t^2/2t$
- $= 3t/2$

Check: The result still depends on t , as expected for a parametric curve.

3. Sequences and series

NAME	FORMULA	WHEN TO USE
Geometric series convergence	converges if $ r < 1$, sum $= a/(1-r)$	A series with a constant ratio between terms.
nth term test	if $\lim a_n \neq 0$, the series diverges	A quick first check before a harder test.
Ratio test	$\lim a_{n+1}/a_n < 1$ converges	Terms involve factorials or exponentials.
Alternating series test	terms decrease to 0 and alternate sign	A series alternates positive and negative terms.
p-series	$\sum 1/n^p$ converges if $p > 1$	A series of the form $1/n^p$.

WORKED EXAMPLE

Does the series $\sum (1/2)^n$ from $n=1$ to infinity converge, and if so, to what?

- Geometric series with $r = 1/2$, $|r| < 1$, so it converges
- Sum $= a/(1-r)$ where $a = 1/2$
- $= (1/2)/(1/2) = 1$

Check: A geometric series with first term $1/2$ and ratio $1/2$ sums to 1.

4. Taylor and Maclaurin polynomials

NAME	FORMULA	WHEN TO USE
Taylor polynomial	$f(a) + f'(a)(x-a) + f''(a)(x-a)^2/2! + \dots$	Approximating a function near $x = a$.
Maclaurin polynomial	a Taylor polynomial centered at $a = 0$	Approximating a function near $x = 0$.

NAME	FORMULA	WHEN TO USE
Common Maclaurin series	e^x, $\sin x$, $\cos x$ have standard expansions	Recognizing a series as a known function.
Lagrange error bound	bounds the difference between $f(x)$ and its Taylor approximation	Estimating how good a Taylor approximation is.

5. Differential equations and logistic growth

NAME	FORMULA	WHEN TO USE
Euler's method	$y_{n+1} = y_n + h \times f(x_n, y_n)$	Approximating a solution to a differential equation numerically.
Logistic growth	$dP/dt = kP(1 - P/L)$	Growth that slows as it approaches a carrying capacity L .
Slope fields	short line segments showing dy/dx at grid points	Visualizing solutions to a differential equation.

Notes and tutor hand-off

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

Which convergence test do you reach for too quickly, before checking if it applies?

One BC-only topic (parametric, polar, or series) that needs another pass:

Worksheet question numbers to review with a tutor:
