



FORMULA SHEET · HIGH SCHOOL

AP Calculus AB and BC Formula Sheet

Everything you need to have memorised for AP Calculus AB, with the BC-only topics at the end. There is no formula sheet in the exam, so this is the list to know cold.

AP

01 Limits and continuity

Definition of the derivative – $f'(x) = \lim_{h \rightarrow 0} [f(x+h) - f(x)]/h$

Continuity at a – $f(a)$ exists and $\lim_{x \rightarrow a} f(x) = f(a)$

L'Hôpital's rule – for $0/0$ or ∞/∞ , $\lim f/g = \lim f'/g'$

Key limits – $\sin x/x \rightarrow 1$ and $(1 - \cos x)/x \rightarrow 0$ as $x \rightarrow 0$

02 Derivatives

Basic – $x^n \rightarrow nx^{n-1}$; $e^x \rightarrow e^x$; $a^x \rightarrow a^x \ln a$; $\ln x \rightarrow 1/x$; $\log_a x \rightarrow 1/(x \ln a)$

Trigonometric – $\sin \rightarrow \cos$; $\cos \rightarrow -\sin$; $\tan \rightarrow \sec^2$; $\sec \rightarrow \sec \tan$; $\csc \rightarrow -\csc \cot$; $\cot \rightarrow -\csc^2$

Inverse trig – $\arcsin x \rightarrow 1/\sqrt{1-x^2}$; $\arctan x \rightarrow 1/(1+x^2)$

Rules – product, quotient, chain; implicit differentiation for relations in x and y

Inverse function – $(f^{-1})'(b) = 1/f'(a)$ where $f(a) = b$

03 The big theorems

Intermediate Value Theorem – f continuous on $[a, b]$ takes every value between $f(a)$ and $f(b)$

Extreme Value Theorem – f continuous on $[a, b]$ has an absolute max and min there

Mean Value Theorem – $f'(c) = [f(b) - f(a)]/(b - a)$ for some c in (a, b)

Fundamental Theorem – $d/dx \int_a^x f(t)dt = f(x)$; $\int_a^b f(x)dx = F(b) - F(a)$

04 Using derivatives

Shape – $f' > 0$ increasing; $f'' > 0$ concave up; inflection where f'' changes sign

Extrema – candidates where $f' = 0$ or is undefined, plus the endpoints

Linearisation – $L(x) = f(a) + f'(a)(x - a)$

Motion – $v = x'(t)$, $a = v'(t)$; speeding up when v and a have the same sign; speed = $|v|$

05 Integrals and applications

Average value – $[1/(b-a)] \int_a^b f(x)dx$

Area between curves – $\int (\text{top} - \text{bottom})dx$

Volumes – disc $\pi \int R^2 dx$; washer $\pi \int (R^2 - r^2)dx$; known cross-sections $\int A(x)dx$

Riemann sums – left, right, midpoint; trapezoid $\frac{1}{2}\Delta x [f(x_0) + 2f(x_1) + \dots + 2f(x_{n-1}) + f(x_n)]$

Motion – displacement $\int v dt$; total distance $\int |v| dt$

u-substitution – change the limits when you change the variable

06 Differential equations

Separation of variables – put all y terms with dy , all x terms with dx , integrate

Exponential growth – $dy/dt = ky$ gives $y = Ce^{kt}$

Slope fields – draw short segments with slope dy/dx at each point

07 BC only

Integration – by parts $\int u dv = uv - \int v du$; partial fractions; improper integrals as limits

Euler's method – $y_{n+1} = y_n + h \cdot f(x_n, y_n)$

Logistic growth – $dP/dt = kP(1 - P/L)$; fastest growth at $P = L/2$

Arc length – $\int \sqrt{1 + (dy/dx)^2} dx$

Parametric – $dy/dx = (dy/dt)/(dx/dt)$; speed $\sqrt{(dx/dt)^2 + (dy/dt)^2}$

Polar – area $\frac{1}{2} \int r^2 d\theta$; $x = r \cos \theta$, $y = r \sin \theta$

Series tests – geometric $a/(1-r)$ for $|r| < 1$; n th-term test; p -series converges for $p > 1$; ratio test; alternating series test

Alternating series error – $|\text{error}| \leq \text{first omitted term}$

Maclaurin – $e^x = \sum x^n/n!$; $\sin x = x - x^3/3! + x^5/5! - \dots$; $\cos x = 1 - x^2/2! + x^4/4! - \dots$; $1/(1-x) = \sum x^n$

Lagrange error bound – $|R_n(x)| \leq M|x - a|^{n+1}/(n+1)!$

How to use this sheet

- 1 In free-response answers, write the integral before you evaluate it: setup earns points.
- 2 Justify every conclusion with the theorem's name and its conditions.
- 3 Check the College Board site each year for the current exam format and timing.

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