AB Calc Memorization Sheet

Derivatives

Prod. $\frac{d}{dx}(uv) = uv' + vu'$

Quot. $\frac{d}{dx}\frac{t}{b} = \frac{bt' - tb'}{b^2}$

Chain $\frac{d}{dx} f(u) = f'(u)\,u'$

or

$\frac{d}{dx} f(g(x)) = f'(g(x))\,g'(x)$

$\frac{d}{dx} x^n = nx^{n-1}$

$\frac{d}{dx}\ln x = \frac{1}{x}$, $\frac{d}{dx}\ln u = \frac{u'}{u}$

$\frac{d}{dx}\log_a x = \frac{1}{x\ln a}$

$\frac{d}{dx}e^x = e^x$, $\frac{d}{dx}a^x = a^x \ln a$

$\frac{d}{dx}\sin x = \cos x$

$\frac{d}{dx}\cos x = -\sin x$

$\frac{d}{dx}\tan x = \sec^2 x$

$\frac{d}{dx}\cot x = -\csc^2 x$

$\frac{d}{dx}\sec x = \sec x \tan x$

$\frac{d}{dx}\csc x = -\csc x \cot x$

$\frac{d}{dx}\arcsin x = \frac{1}{\sqrt{1-x^2}}$

$\frac{d}{dx}\arctan x = \frac{1}{1+x^2}$

$f'(x) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$

$f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$

Integrals

$\int x^n dx = \frac{x^{n+1}}{n+1} + C$, $n \neq -1$

$\int \frac{1}{x} dx = \ln|x| + C$

$\int \frac{u'}{u} dx = \ln|u| + C$

$\int e^x dx = e^x + C$

$\int a^x dx = \frac{a^x}{\ln a} + C$

$\int \cos x\, dx = \sin x + C$

$\int \sin x\, dx = -\cos x + C$

$\int \sec^2 x\, dx = \tan x + C$

$\int \tan x\, dx = -\ln|\cos x| + C$

$\int \cot x\, dx = \ln|\sin x| + C$

$\int \sec x \tan x\, dx = \sec x + C$

$\int \csc^2 x\, dx = -\cot x + C$

$\int \csc x \cot x\, dx = -\csc x + C$

$\int \frac{u'}{a^2+u^2} du = \frac{1}{a}\arctan\frac{u}{a} + C$

$\int \frac{u'}{\sqrt{a^2-u^2}} du = \arcsin\frac{u}{a} + C$

Trig Identities

$\tan x = \frac{\sin x}{\cos x}$

$\sin^2 x + \cos^2 x = 1$

$\tan^2 x = \sec^2 x - 1$

Volume

Disc

$V = \pi\int_a^b r^2\, dx$

Washer

$V = \pi\int_a^b (R^2 - r^2)\, dx$

Cross Section

$V = \int_a^b A\, dx$

Position – Velocity – Acceleration

s(t) v(t) a(t)

$\frac{d}{dt}s(t) = v(t)$ $\int a(t)dt = v(t) + C$

$\frac{d}{dt}v(t) = a(t)$ $\int v(t)dt = s(t) + C$

$v(t) = 0$ implies particle at rest.
$v(t) > 0$ implies particle moving to right.
$v(t) < 0$ implies particle moving to left.
Speed = $|v(t)|$

Total Distance Traveled = $\int_a^b |v(t)|\, dt$

Area of Trapezoid $A = \frac{1}{2}w(h_1 + h_2)$

Trapezoidal Rule

$A \approx \frac{1}{2}w(h_1 + 2h_2 + 2h_3 + ... + 2h_n + h_{n+1})$

Riemann Sum (add areas of rectangles)

Second Fundamental Theorem

$\frac{d}{dx}\int_u^v f(t)\,dt = f(v)v' - f(u)u'$

Average Rate of Change: $\text{AROC} = \frac{f(b) - f(a)}{b - a}$ (slope between two points)

Inst. Rate of Change: $\text{IROC} = f'(c)$ (slope at a single point)

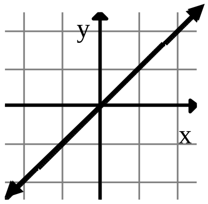
Mean Value Theorem: $f'(c) = \frac{f(b) - f(a)}{b - a}$ (find c where $m_{\sec} = m_{\tan}$)

Average Value of a Function: $f_{avg} = \frac{\int_a^b f(x)dx}{b - a}$ $\left(\text{avg. height} = \frac{\text{area}}{\text{width}}\right)$

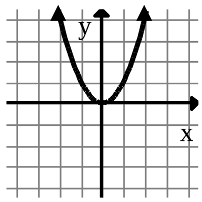
Intermediate Value Theorem: A function f that is continuous on $[a,b]$ takes on every y-value between $f(a)$ and $f(b)$.

Parent Graphs

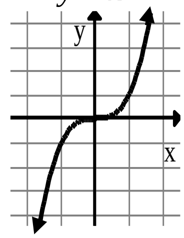
$y = x$



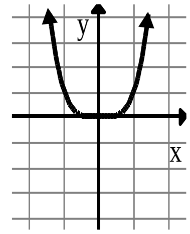
$y = x^2$



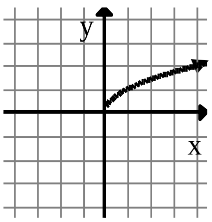
$y = x^3$



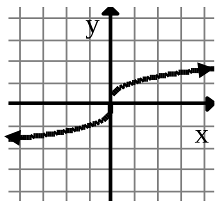
$y = x^4$



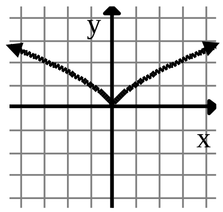
$y = \sqrt{x}$



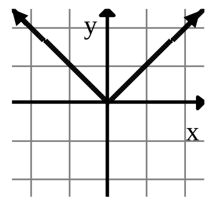
$y = \sqrt[3]{x}$



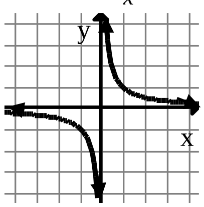
$y = x^{\frac{2}{3}}$



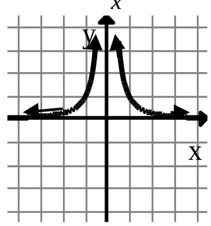
$y = |x|$



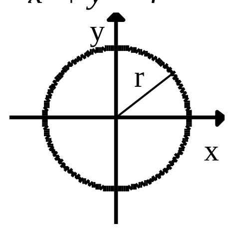
$y = \frac{1}{x}$



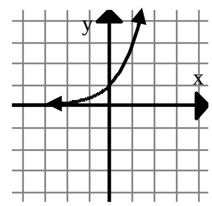
$y = \frac{1}{x^2}$



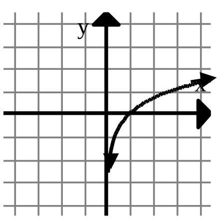
$x^2 + y^2 = r^2$



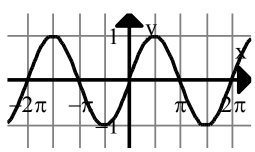
$y = e^x$



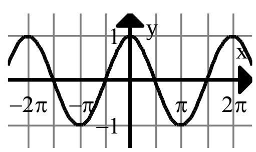
$y = \ln x$



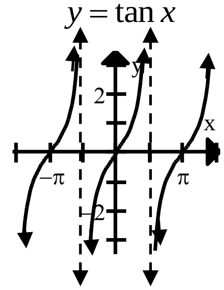
$y = \sin x$



$y = \cos x$



$y = \tan x$



Tangent – Normal Lines

Tangent: $y - y_1 = m(x - x_1)$ use the derivative to find m

Normal: $y - y_1 = \frac{-1}{m}(x - x_1)$

Curve Sketching

Max. or Min. Points: Relative: $f'(x) = 0$ or $f'(x)$ undefined.

Absolute: At relative extrema **or endpoints** of a closed interval.

Points of Inflection: $f''(x) = 0$ or $f''(x)$ undefined

Make an f' number line: increasing: $f'(x) > 0$ decreasing: $f'(x) < 0$

Make an f'' number line: concave upward: $f''(x) > 0$ concave downward: $f''(x) < 0$