TRIG IDENTITIES:

→ **RECIPROCAL**

$\csc\theta = \frac{1}{\sin\theta}$ $\sec\theta = \frac{1}{\cos\theta}$

$\cot\theta = \frac{1}{\tan\theta}$

→ **QUOTIENT**

$\tan\theta = \frac{\sin\theta}{\cos\theta}$ $\cot\theta = \frac{\cos\theta}{\sin\theta}$

$\tan\theta = \frac{\sec\theta}{\csc\theta}$ $\cot\theta = \frac{\csc\theta}{\sec\theta}$

→ **PYTHAGOREAN**

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

$1 + \cot^2\theta = \csc^2\theta$

$\tan^2\theta + 1 = \sec^2\theta$

→ **DOUBLE ANGLE ARGUMENT**

$\sin(2A) = 2\sin A\cos A$

$\cos(2A) = \cos^2 A - \sin^2 A$

RULES OF RADICALS: $\sqrt[n]{x} = x^{1/n}$, $\sqrt[n]{x^a} = x^{a/n}$

RULES OF EXPONENTS: $x^a x^b = x^{a+b}$, $(x^a)^b = x^{ab}$, $x^a/x^b = x^{a-b}$, $x^{-n} = \frac{1}{x^n}$

RULES OF LOGS: $\log_a x + \log_a y = \log_a(xy)$, $\log_a x - \log_a y = \log_a \frac{x}{y}$, $\log_a x^n = n\log_a x$

EXTRA FACTS:

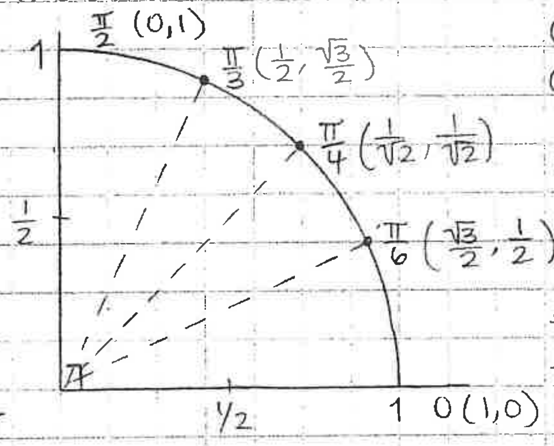
$\ln 1 = 0$

$\ln e = 1$

$\ln e^u = u$

$e^{\ln u} = u$

THE UNIT CIRCLE:



KEY SPECIFIC VALUES:

$\cos(x) = 0 \to x = \frac{\pi}{2} \pm \pi n$

$\cos(x) = 1 \to x = 0 \pm 2\pi n$

$\cos(x) = -1 \to x = \pi \pm 2\pi n$

$\sin(x) = 0 \to x = 0 \pm \pi n$

$\sin(x) = 1 \to x = \frac{\pi}{2} \pm 2\pi n$

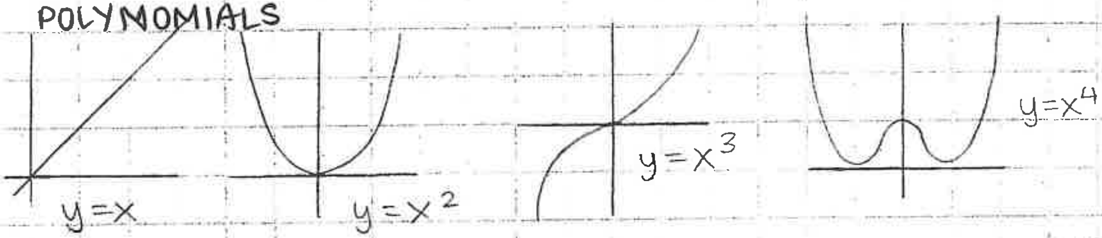
$\sin(x) = -1 \to x = -\frac{\pi}{2} \pm 2\pi n$

$\tan(x) = 0 \to x = 0 \pm \pi n$

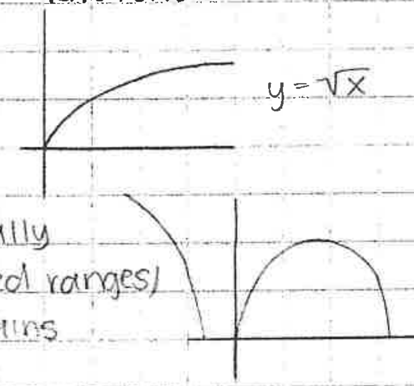
$\tan(x) = 1 \to x = \frac{\pi}{4} \pm \pi n$

WHAT THE GRAPHS LOOK LIKE:

POLYNOMIALS



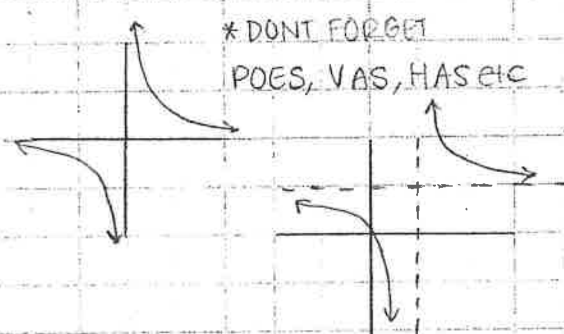
RADICALS



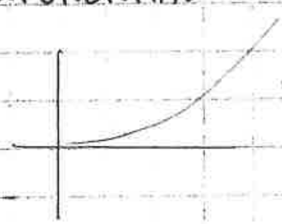
* usually limited ranges/domains

RATIONALS

* DONT FORGET POES, VAS, HAS etc

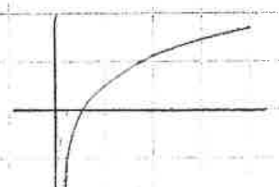


EXPONENTIAL



inverse

LOGARITHMIC



RANGES FOR TRIG^{-1}

$y = \cos^{-1}x$ $0 \le y \le \pi$

$y = \sin^{-1}x$ $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$

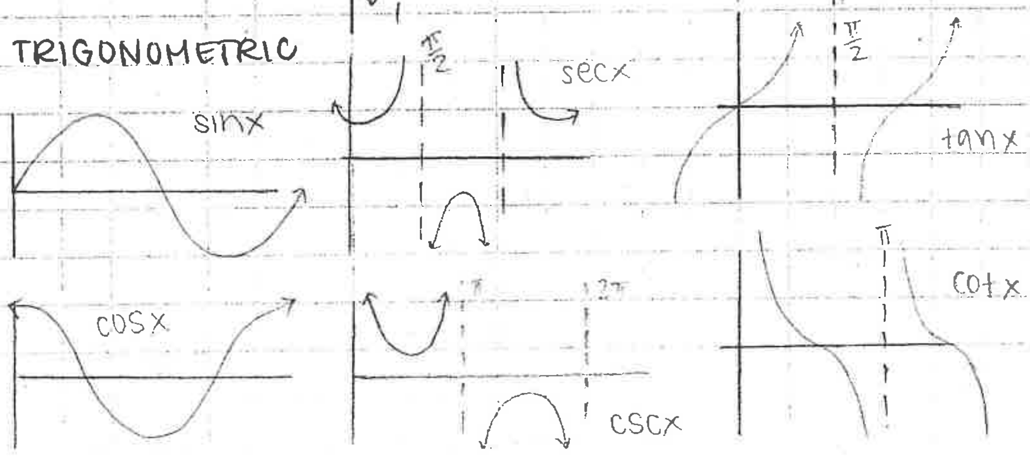
$y = \tan^{-1}x$ $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$

$y = \cot^{-1}x$ $0 \le y \le \pi$

$y = \sec^{-1}x$ $0 \le y \le \pi$

$y = \csc^{-1}x$ $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$

TRIGONOMETRIC



DERIVATIVE RULES:

$\frac{d}{dx} au = a\frac{du}{dx}$

$\frac{d}{dx} u^n = nu^{n-1} \cdot \frac{du}{dx}$

$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

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

$\frac{d}{dx}(u+v) = \frac{du}{dx} + \frac{dv}{dx}$

$\frac{d}{dx} a = 0$

$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

$\frac{d}{dx}\sin u = \cos u \frac{du}{dx}$

$\frac{d}{dx}\cos u = -\sin u \frac{du}{dx}$

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

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

$\frac{d}{dx}\sec u = \sec u \tan u \frac{du}{dx}$

$\frac{d}{dx}\csc u = -\csc u \cot u \frac{du}{dx}$

$\frac{d}{dx}\ln u = \frac{1}{u}\frac{du}{dx}$

$\frac{d}{dx} a^u = a^u \ln a \frac{du}{dx}$

$\frac{d}{dx} e^u = e^u \frac{du}{dx}$

$\frac{d}{dx}\sin^{-1}u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$

$\frac{d}{dx}\cos^{-1}u = \frac{-1}{\sqrt{1-u^2}}\frac{du}{dx}$

$\frac{d}{dx}\tan^{-1}u = \frac{1}{1+u^2}\frac{du}{dx}$

$\frac{d}{dx}\cot^{-1}u = \frac{-1}{1+u^2}\frac{du}{dx}$

$\frac{d}{dx}\sec^{-1}u = \frac{1}{|u|\sqrt{u^2-1}}\frac{du}{dx}$

$\frac{d}{dx}\csc^{-1}u = \frac{-1}{|u|\sqrt{u^2-1}}\frac{du}{dx}$

INTEGRAL RULES:

$\int u^n du = \frac{u^{n+1}}{n+1} + C \quad n \neq -1$

$\int \frac{1}{u} du = \ln|u| + C$ $\rightarrow e^C = K$

$\int e^u du = e^u + C$

$\int a^u du = \frac{a^u}{\ln a} + C \quad a>0, a\neq 1$

$\int \sin u\, du = -\cos u + C$

$\int \cos u\, du = \sin u + C$

$\int \sec^2 u\, du = \tan u + C$

$\int \csc^2 u\, du = -\cot u + C$

$\int \sec u \tan u\, du = \sec u + C$

$\int \csc u \cot u\, du = -\csc u + C$

$\int \sec u\, du = \ln|\sec u + \tan u| + C$

$\int \tan u\, du = \ln|\sec u| + C$

$\int \csc u\, du = -\ln|\csc u + \cot u| + C$

$\int \cot u\, du = \ln|\sin u| + C$

$\int \sin^2 u\, du = \frac{1}{2}u - \frac{1}{4}\sin 2u + C$

$\int \cos^2 u\, du = \frac{1}{2}u + \frac{1}{4}\sin 2u + C$

$\int \frac{du}{\sqrt{a^2-u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + C$

$\int \frac{du}{a^2+u^2} = \frac{1}{a}\tan^{-1}\left(\frac{u}{a}\right) + C$

$\int \frac{du}{u\sqrt{u^2-a^2}} = \frac{1}{a}\sec^{-1}\left|\frac{u}{a}\right| + C$

BOUNDARY RULES:

$\int_a^a f(x)dx = 0$

$\int_a^b f(x)dx = -\int_b^a f(x)dx$

$\int_a^b f(x)dx + \int_b^c f(x)dx = \int_a^c f(x)dx$

if $f(x) \leq g(x)$ on $[a,b]$ then:

$\int_a^b f(x)dx \leq \int_a^b g(x)dx$

FUNDAMENTAL THEOREM

① $\frac{d}{dx}\int_c^x f(t)dt = f(x)$

$\frac{d}{dx}\int_c^u f(t)dt = f(u)\frac{du}{dx}$

② if $F'(x) = f(x)$ then

$\int_a^b f(x)dx = F(b) - F(a)$

AVG VALUE:

$f_{avg} = \frac{1}{b-a}\int_a^b f(x)dx$

DISPLACEMENT:

$\int_a^b v(t)dt$

DISTANCE:

$\int_a^b |v(t)|\,dt$

MOTION:

$x(t) \rightarrow x'(t) = v(t) \rightarrow x''(t) = v'(t) = a(t)$

WASHER METHOD:

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

outer inner

DISK METHOD:

$V = \pi\int_a^b R^2 dx$

LIMITS RULES:

$\lim_{x\to-\infty} e^x = 0$, $\lim_{x\to\infty} e^x = \infty$

$\lim_{x\to-\infty} e^{-x} = \infty$, $\lim_{x\to\infty} e^{-x} = 0$

$\lim_{x\to-\infty} \tan^{-1}x = -\frac{\pi}{2}$, $\lim_{x\to\infty} \tan^{-1}x = \frac{\pi}{2}$

$\lim_{x\to-\infty} \cot^{-1}x = \pi$, $\lim_{x\to\infty} \cot^{-1}x = 0$

MEAN VALUE THEOREM:

if a function f is continuous on $[a,b]$ and differentiable on (a,b), then there is at least 1 number c such that $f'(c) = \frac{f(b)-f(a)}{b-a}$

like avg rate of change but not

ROLLE'S THEOREM:

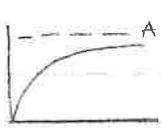
MVT and $f(a) = f(b)$

then one # c such that $f'(c) = 0$

MODELS OF GROWTH + DECAY

$\frac{dy}{dt} = ky$

exponential



$\frac{dy}{dt} = k(A-y)$

simple bounded

$\frac{dy}{dt} = ky\left(1-\frac{y}{A}\right)$

logistic

EXTREME VALUE THEOREM:

if f is cont. on closed $[a,b]$, then $f(x)$ has at least 1 max and 1 min

INTERMEDIATE VALUE THEOREM:

continuous, then $f(x)$ obtains every value between $f(a)$ and $f(b)$