All Students Take Calculus
I–All pos. II–sin III–tan IV–cos

Law of Cosines
$a^2 = b^2 + c^2 - 2bc \cdot \cos A$

Difference of Cubes
$a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$

Arc Length
$s = r\theta$

Heron's Formula
$A = \sqrt{s(s-a)(s-b)(s-c)}$

Change of Base
$\log_b m = \dfrac{\log m}{\log b}$

Choose Formula
$C(x, y) = \binom{x}{y} = \dfrac{x!}{y!(x-y)!}$

Law of Sines
$\dfrac{\sin A}{a} = \dfrac{\sin B}{b} = \dfrac{\sin C}{c}$

Degrees to Radians
$\dfrac{A \cdot \pi}{180} = \theta$

Sector Area
$A = \dfrac{1}{2} r^2 \theta$

Area of Δ
$Area = ab \cdot \dfrac{1}{2} \sin C$

$(\log_a b)(\log_c d) = (\log_a d)(\log_c b)$

Trig Identities

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

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

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

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

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

$\frac{2 \tan u}{1 - \tan^2 u} = \tan(2u)$

$\sin u \cos v \pm \cos u \sin v = \sin(u \pm v)$

$\cos u \cos v \mp \sin u \sin v = \cos(u \pm v)$

$\frac{\tan u \pm \tan v}{1 \mp \tan u \tan v} = \tan(u \pm v)$

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

$\csc = \frac{1}{\sin}$

$\sec = \frac{1}{\cos}$

$\sin\left(\frac{\pi}{2} - u\right) = \cos u$

$\tan\left(\frac{\pi}{2} - u\right) = \cot u$

$\sec\left(\frac{\pi}{2} - u\right) = \csc u$

$\cos\left(\frac{\pi}{2} - u\right) = \sin u$

$\cot\left(\frac{\pi}{2} - u\right) = \tan u$

$\csc\left(\frac{\pi}{2} - u\right) = \sec u$

$\frac{1 - \cos 2x}{2} = \sin^2 x$

$\frac{1 + \cos 2x}{2} = \cos^2 x$

$\frac{1 - \cos 2x}{1 + \cos 2x} = \tan^2 x$

$\pm\sqrt{\frac{1 - \cos u}{2}} = \sin \frac{u}{2}$

$\pm\sqrt{\frac{1 + \cos u}{2}} = \cos \frac{u}{2}$

$\frac{1 - \cos u}{\sin u} = \frac{\sin u}{1 + \cos u} = \tan \frac{u}{2}$

$2 \sin \frac{x \pm y}{2} \cos \frac{x \mp y}{2} = \sin x \pm \sin y$

$2 \cos \frac{x + y}{2} \cos \frac{x - y}{2} = \cos x + \cos y$

$-2 \sin \frac{x + y}{2} \sin \frac{x - y}{2} = \cos x - \cos y$

$\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$

$\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$

$\cos u \cos v = \frac{1}{2}[\cos(u + v) + \cos(u - v)]$

$\sin u \sin v = \frac{1}{2}[\cos(u + v) - \cos(u - v)]$

Algebra of Functions

Let f and g be functions with domains A and B.

$(f+g)(x) = f(x) + g(x)$	Domain $A \cap B$
$(f-g)(x) = f(x) - g(x)$	Domain $A \cap B$
$(fg)(x) = f(x)g(x)$	Domain $A \cap B$
$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$	Domain $\{x \in A \cap B \mid g(x) \neq 0\}$
$(f \circ g)(x) = f(g(x))$	Domain $\{x \in B \mid g(x) \in A\}$

Polynomial Synthetic Division

$(x^3 + x^2 - 1) \div (x + 2)$

$$\begin{array}{r|rrrr} -2 & 1 & 1 & 0 & -1 \\ & & -2 & 2 & -4 \\ \hline & 1 & -1 & 2 & -5 \end{array}$$

Polynomial Long Division

$$\begin{array}{rrrr} & x^2 & -x+2 & \\ \cline{2-4} x+2) & x^3 & +x^2 & -1 \\ & -x^3 & -2x^2 & \\ \cline{2-3} & & -x^2 & \\ & & x^2+2x & \\ \cline{3-3} & & & 2x-1 \end{array}$$

Rational Roots Theorem

$2x^3 + 2x^2 - 3x - 6$

$\pm1, \pm2 \qquad \pm1, \pm2, \pm3, \pm6$

Possible rational roots:

$\pm1, \pm\frac{1}{2}, \pm2, \pm3, \pm\frac{3}{2}, \pm6$

Decartes' Rule of Signs

Count num. of sign changes

$P(x) = 3x^6 + 4x^5 + 3x^3 - x - 3$

1 positive real root

$P(-x) = 3x^6 - 4x^5 - 3x^3 + x - 3$

1 or 3 negative real roots

Logarithm Formulas

$$\log(m \cdot n) = \log m + \log n$$

$$\log\left(\frac{m}{n}\right) = \log m - \log n$$

$$\log(m^n) = n \cdot \log m$$

$$\log_b b^x = x = b^{\log_b x}$$

Other trig stuff

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

$$\csc = \frac{1}{\sin}$$

$$\sec = \frac{1}{\cos}$$

Horizontal Asymptotes

$y = \dfrac{2x^2 - 4x + 5}{x^2 - 2x + 1}$	Original Equation
$= \dfrac{2x^2}{x^2}$	$x \to \infty$, other terms $\to$ tiny
$= 2$	Cancel, horizontal asymptote

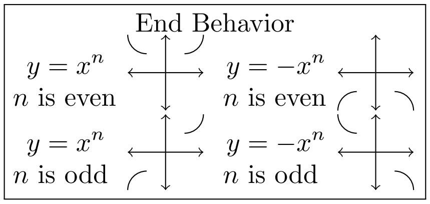
Slant Asymptotes

$y = \dfrac{x^2 - 4x - 5}{x - 3}$	Original Equation
$= x - 1 - \dfrac{8}{x - 3}$	Divide
$= x - 1$	$x \to \infty$, other terms $\to$ tiny

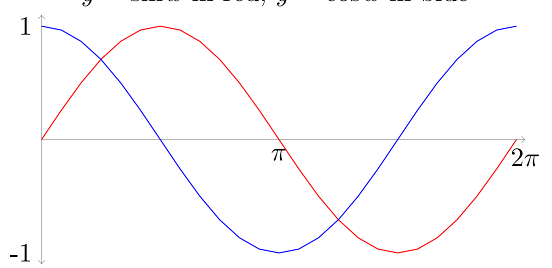
Vertical Asymptotes

$y = \dfrac{2x^2 - 4x + 5}{x^2 - 2x + 1}$	Original Equation
$= \dfrac{2x^2 - 4 + 5}{(2x - 1)(x + 2)}$	Factor demoniator
$x = \dfrac{1}{2}$ or $x = -2$	Impossible

End Behavior



$y = \sin x$ in red; $y = \cos x$ in blue



sin/cos Graph Properties

If in form:

$$y = a \sin k(x - b)$$

amplitude $|a|$, period $2\pi/k$, phase shift b