

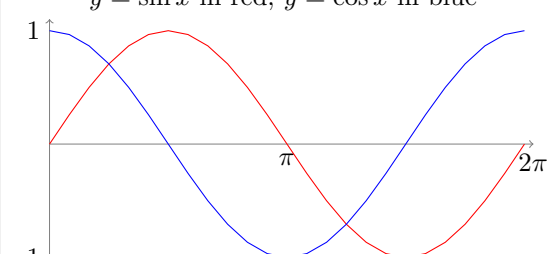
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| Positive Trigonometric Functions I-All pos. II-sin III-tan IV-cos | Law of Cosines $a^2 = b^2 + c^2 - 2bc \cdot \cos A$ | Difference of Cubes $a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$ | Arc Length $s = r\theta$ |
| Heron's Formula $A = \sqrt{s(s-a)(s-b)(s-c)}$ | Change of Base $\log_b m = \frac{\log m}{\log b}$ | Choose Formula $C(x, y) = \binom{x}{y} = \frac{x!}{y!(x-y)!}$ | Law of Sines $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ |
| Degrees to Radians $\frac{A \cdot \pi}{180} = \theta$ | Sector Area $A = \frac{1}{2}r^2\theta$ | Area of Δ $Area = ab \cdot \frac{1}{2} \sin C$ | Polar to (x, y) $r^2 = x^2 + y^2$ $\tan \theta = \frac{y}{x}$ |
| | | | $(\log_a b)(\log_c d) = (\log_a d)(\log_c b)$ |
| $z = \frac{a+bi}{ z } = \frac{a+bi}{\sqrt{a^2+b^2}}$ | $z = r \operatorname{cis} \theta$ $z^n = r^n \operatorname{cis}(n\theta)$ | n th roots of $z = r \operatorname{cis} \theta$ $w_k = r^{1/n} \operatorname{cis} \left(\frac{\theta + 2k\pi}{n} \right)$ | $z_1 z_2 = r_1 r_2 \operatorname{cis}(\theta_1 + \theta_2)$ $\frac{z_1}{z_2} = \frac{r_1}{r_2} \operatorname{cis}(\theta_1 - \theta_2)$ |
| | | | $\vec{v} = \langle a, b \rangle = a\hat{i} + b\hat{j}$ $ \vec{v} = \sqrt{a^2 + b^2}$ |
| | | | $ c\vec{u} = c \vec{u} $ |
| Dot Product $\vec{u} \cdot \vec{v} = a_1 a_2 + b_1 b_2$ | Dot Product Theorem $\vec{u} \cdot \vec{v} = \vec{u} \vec{v} \cos \theta$ | θ between \vec{u} & \vec{v} $\cos \theta = \frac{ \vec{u} \cdot \vec{v} }{ \vec{u} \vec{v} }$ | \vec{u} and \vec{v} are perpendicular $\vec{u} \cdot \vec{v} = 0$ |
| | | | Component of \vec{u} along \vec{v} $(\vec{u} \cdot \vec{v})/ \vec{v} $ |
| | | | $\operatorname{proj}_{\vec{v}} \vec{u} = \left(\frac{\vec{u} \cdot \vec{v}}{ \vec{v} ^2} \right) \vec{v}$ |
| | | | Work $W = \vec{F} \cdot \vec{D}$ |
| Trig Identities | | | |
| $\sin^2 + \cos^2 = 1$ | $\tan^2 + 1 = \sec^2$ | $1 + \cot^2 = \csc^2$ | $2 \sin u \cos u = \sin(2u)$ |
| | | | $\cos^2 u - \sin^2 u = \cos(2u)$ |
| | | | $\frac{2 \tan u}{1 - \tan^2 u} = \tan(2u)$ |
| $\sin u \cos v \pm \cos u \sin v = \sin(u \pm v)$ | | $\cos u \cos v \mp \sin u \sin v = \cos(u \pm v)$ | |
| | | $\frac{\tan u \pm \tan v}{1 \mp \tan u \tan v} = \tan(u \pm v)$ | |
| | | $\cot = \frac{1}{\tan}$ | |
| $\csc = \frac{1}{\sin}$ | $\sec = \frac{1}{\cos}$ | $\sin\left(\frac{\pi}{2} - u\right) = \cos u$ | $\tan\left(\frac{\pi}{2} - u\right) = \cot u$ |
| | | $\sec\left(\frac{\pi}{2} - u\right) = \csc u$ | $\cos\left(\frac{\pi}{2} - u\right) = \sin u$ |
| $\cot\left(\frac{\pi}{2} - u\right) = \tan u$ | $\csc\left(\frac{\pi}{2} - u\right) = \sec u$ | $\frac{1 - \cos 2x}{2} = \sin^2 x$ | $\frac{1 + \cos 2x}{2} = \cos^2 x$ |
| | | $\frac{1 - \cos 2x}{1 + \cos 2x} = \tan^2 x$ | $\pm \sqrt{\frac{1 - \cos u}{2}} = \sin \frac{u}{2}$ |
| $\pm \sqrt{\frac{1 + \cos u}{2}} = \cos \frac{u}{2}$ | | $\frac{1 - \cos u}{\sin u} = \frac{\sin u}{1 + \cos u} = \tan \frac{u}{2}$ | $2 \sin \frac{x \pm y}{2} \cos \frac{x \mp y}{2} = \sin x \pm \sin y$ |
| $2 \cos \frac{x + y}{2} \cos \frac{x - y}{2} = \cos x + \cos y$ | | $-2 \sin \frac{x + y}{2} \sin \frac{x - y}{2} = \cos x - \cos y$ | |
| $\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$ | | $\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$ | |
| $\cos u \cos v = \frac{1}{2}[\cos(u + v) + \cos(u - v)]$ | | $\sin u \sin v = \frac{1}{2}[\cos(u + v) - \cos(u - v)]$ | |
| Row-Echelon Form $\begin{bmatrix} 1 & 2 & -1 & 1 \\ 0 & 1 & 4 & -7 \\ 0 & 0 & 1 & -2 \end{bmatrix}$ | Reduced Row-Echelon Form $\begin{bmatrix} 1 & 0 & 0 & -3 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & -2 \end{bmatrix}$ | Using matrix inverses ($AX = B \Rightarrow X = A^{-1}B$) $\begin{bmatrix} 2 & -5 \\ 3 & -6 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 15 \\ 36 \end{bmatrix} \Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -2 & \frac{5}{3} \\ -1 & \frac{2}{3} \end{bmatrix} \begin{bmatrix} 15 \\ 36 \end{bmatrix} = \begin{bmatrix} 30 \\ 9 \end{bmatrix}$ | |
| Matrix Multiplication! | | | |
| $\begin{bmatrix} 1 & 3 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} -1 & 5 & 2 \\ 0 & 4 & 7 \end{bmatrix} = \begin{bmatrix} 1 \cdot (-1) + 3 \cdot 0 & 1 \cdot 5 + 3 \cdot 4 & 1 \cdot 2 + 3 \cdot 7 \\ (-1) \cdot (-1) + 0 \cdot 0 & (-1) \cdot 5 + 0 \cdot 4 & (-1) \cdot 2 + 0 \cdot 7 \end{bmatrix} = \begin{bmatrix} -1 & 17 & 23 \\ 1 & -5 & -2 \end{bmatrix}$ | | | |
| 2 \times 2 Matrix Inverse If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ | | $n \times n$ Matrix Inverse $\left[\begin{array}{ccc ccc} 1 & -2 & -4 & 1 & 0 & 0 \\ 2 & -3 & -6 & 0 & 1 & 0 \\ -3 & 6 & 15 & 0 & 0 & 1 \end{array} \right] \rightarrow \left[\begin{array}{ccc ccc} 1 & 0 & 0 & -3 & 2 & 0 \\ 0 & 1 & 0 & -4 & 1 & -\frac{2}{3} \\ 0 & 0 & 1 & 1 & 0 & \frac{1}{2} \end{array} \right]$ | |
| 2 \times 2 Matrix Determinant $\det(A) = A = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$ | Minor M_{ij} : Take the matrix and delete the i th row and the j th column. Find the determinant | | Cofactor A_{ij} $(-1)^{i+j} M_{ij}$ |
| $n \times n$ Matrix Determinant (can move along any row/column) $\det(A) = A = \begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{vmatrix} = a_{11}A_{11} + a_{12}A_{12} + \cdots + a_{1n}A_{1n}$ | | Common Sums $\sum_{k=1}^n c = nc$ $\sum_{k=1}^n k = \frac{n(n+1)}{2}$ $\sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}$ $\sum_{k=1}^n k^3 = \frac{n^2(n+1)^2}{4}$ | |

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| <p>Algebra of Functions</p> <p>Let f and g be functions with domains A and B.</p> <p>$(f + g)(x) = f(x) + g(x)$ Domain $A \cap B$</p> <p>$(f - g)(x) = f(x) - g(x)$ Domain $A \cap B$</p> <p>$(fg)(x) = f(x)g(x)$ Domain $A \cap B$</p> <p>$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$ Domain $\{x \in A \cap B \mid g(x) \neq 0\}$</p> <p>$(f \circ g)(x) = f(g(x))$ Domain $\{x \in B \mid g(x) \in A\}$</p> | <p>Polynomial Synthetic Division</p> $(x^3 + x^2 - 1) \div (x + 2)$ $\begin{array}{r rrrr} -2 & 1 & 1 & 0 & -1 \\ & & -2 & 2 & -4 \\ \hline & 1 & -1 & 2 & -5 \end{array}$ <p>Result is $x^2 - x + 2 - \frac{5}{x+2}$</p> | <p>Polynomial Long Division</p> $\begin{array}{r} x^2 - x + 2 \\ x+2 \overline{) x^3 + x^2 - 1} \\ \underline{-x^3 - 2x^2} \\ -x^2 \\ \underline{x^2 + 2x} \\ 2x - 1 \end{array}$ |
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| <p>Rational Roots Theorem</p> $2x^3 + 2x^2 - 3x - 6$ <p>$\pm 1, \pm 2$ $\pm 1, \pm 2, \pm 3, \pm 6$</p> <p>Possible rational roots:</p> <p>$\pm 1, \pm \frac{1}{2}, \pm 2, \pm 3, \pm \frac{3}{2}, \pm 6$</p> | <p>Decartes' Rule of Signs</p> <p>Count num. of sign changes</p> $P(x) = 3x^6 + 4x^5 + 3x^3 - x - 3$ <p>1 positive real root</p> $P(-x) = 3x^6 - 4x^5 - 3x^3 + x - 3$ <p>1 or 3 negative real roots</p> | <p>Logarithm Formulas</p> <p>$\log(m \cdot n) = \log m + \log n$</p> <p>$\log\left(\frac{m}{n}\right) = \log m - \log n$</p> <p>$\log(m^n) = n \cdot \log m$</p> <p>$\log_b b^x = x = b^{\log_b x}$</p> | <p>Trigonometric Reciprocals</p> <p>$\cot = \frac{1}{\tan}$</p> <p>$\csc = \frac{1}{\sin}$</p> <p>$\sec = \frac{1}{\cos}$</p> |
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| <p>Horizontal Asymptotes</p> $y = \frac{2x^2 - 4x + 5}{x^2 - 2x + 1}$ <p>Original Equation</p> $= \frac{2x^2}{x^2}$ <p>$x \rightarrow \infty$, other terms \rightarrow tiny</p> $= 2$ <p>Cancel, horizontal asymptote</p> | <p>Slant Asymptotes</p> $y = \frac{x^2 - 4x - 5}{x - 3}$ <p>Original Equation</p> $= x - 1 - \frac{8}{x - 3}$ <p>Divide</p> $= x - 1$ <p>$x \rightarrow \infty$, other terms \rightarrow tiny</p> |
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| <p>Vertical Asymptotes</p> $y = \frac{2x^2 - 4x + 5}{x^2 - 2x + 1}$ <p>Original Equation</p> $= \frac{2x^2 - 4x + 5}{(2x - 1)(x + 2)}$ <p>Factor demoniator</p> $x = \frac{1}{2} \text{ or } x = -2$ <p>Impossible</p> | <p>End Behavior</p> <p>$y = x^n$ $y = -x^n$</p> <p>n is even n is even</p> <p>$y = x^n$ $y = -x^n$</p> <p>n is odd n is odd</p> | <p>$m \times n$ matrix</p> $\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$ |
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| <p>$y = \sin x$ in red; $y = \cos x$ in blue</p>  | <p>sin/cos Graph Properties</p> <p>If in form:</p> $y = a \sin k(x - b)$ <p>amplitude a, period $2\pi/k$, phase shift b</p> | <p>Allowed row operations</p> <ol style="list-style-type: none"> 1. Add a multiple of one row to another 2. Multiply a row by a nonzero constant 3. Interchange two rows |
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| <p>If $\begin{cases} ax + by = r \\ cx + dy = s \end{cases}$, then $x = \frac{\begin{vmatrix} r & b \\ s & d \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}$ and $y = \frac{\begin{vmatrix} a & r \\ c & s \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}$</p> | <p>Parabola</p> $x^2 = 4py$ <p>$V(0, 0)$, $F(0, p)$, directrix $y = -p$</p> | <p>Ellipse</p> $\frac{x^2}{(a \text{ or } b)^2} + \frac{y^2}{(a \text{ or } b)^2} = 1$ $c^2 = a^2 - b^2$ | <p>Eccentricity</p> $e = \frac{c}{a}$ |
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| <p>Hyperbola</p> $\frac{x^2}{ab^2} - \frac{y^2}{b^2} = 1$ $c^2 = a^2 + b^2$ | <p>General Conic</p> $\frac{d(P, F)}{d(P, l)} = e$ | <p>Polar Conics</p> $r = \frac{ed}{1 \pm e(\cos \text{ or } \sin)\theta}$ | <p>Derivative Formula</p> $f^{-1}(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$ | <p>Area</p> $A = \lim_{n \rightarrow \infty} \sum_{k=1}^n f(x_k) \Delta x$ $\Delta x = \frac{b - a}{n}$ $x_k = a + \frac{k}{n} \Delta x$ |
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