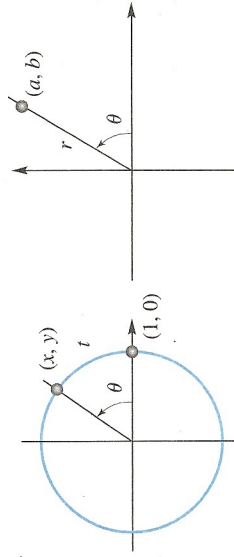


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TRIGONOMETRY



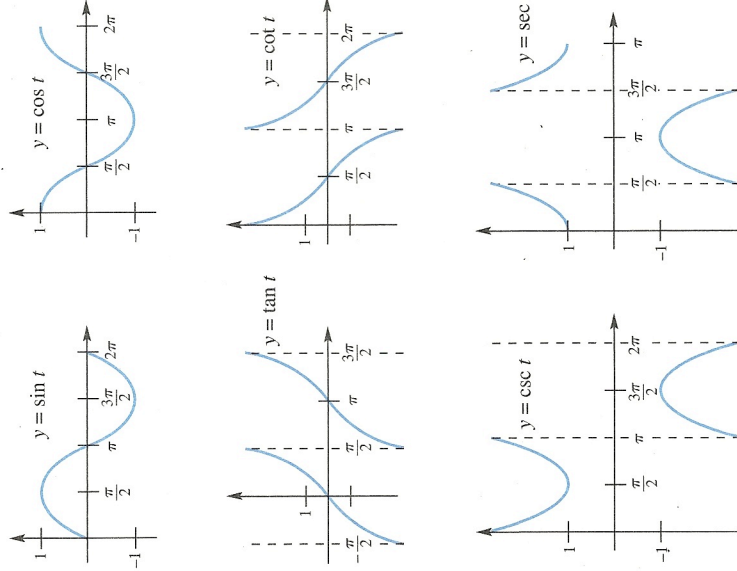
$$\sin t = \sin \theta = \frac{y}{r}$$

$$\cos t = \cos \theta = \frac{x}{r}$$

$$\tan t = \tan \theta = \frac{y}{x} = \frac{b}{a}$$

$$\cot t = \cot \theta = \frac{x}{y} = \frac{a}{b}$$

Graphs



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Basic Identities

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

$$\cot t = \frac{\cos t}{\sin t}$$

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

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

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

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

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

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

Cofunction Identities

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

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

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

Odd-even Identities

$$\sin(-t) = -\sin t$$

$$\cos(-t) = \cos t$$

$$\tan(-t) = -\tan t$$

Addition Formulas

$$\sin(s + t) = \sin s \cos t + \cos s \sin t$$

$$\sin(s - t) = \sin s \cos t - \cos s \sin t$$

$$\cos(s + t) = \cos s \cos t - \sin s \sin t$$

$$\cos(s - t) = \cos s \cos t + \sin s \sin t$$

$$\tan(s + t) = \frac{\tan s + \tan t}{1 - \tan s \tan t}$$

$$\tan(s - t) = \frac{\tan s - \tan t}{1 + \tan s \tan t}$$

Double Angle Formulas

$$\sin 2t = 2 \sin t \cos t$$

$$\cos 2t = \cos^2 t - \sin^2 t = 1 - 2 \sin^2 t = 2 \cos^2 t - 1$$

$$\tan 2t = \frac{2 \tan t}{1 - \tan^2 t}$$

Half Angle Formulas

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

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

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

Product Formulas

$$2 \sin s \cos t = \sin(s + t) + \sin(s - t)$$

$$2 \cos s \cos t = \cos(s + t) + \cos(s - t)$$

$$2 \cos s \sin t = \sin(s + t) - \sin(s - t)$$

$$2 \sin s \sin t = \cos(s - t) - \cos(s + t)$$

Factoring Formulas

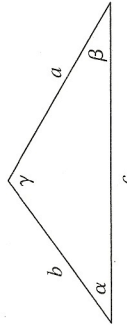
$$\sin s + \sin t = 2 \cos \frac{s-t}{2} \sin \frac{s+t}{2}$$

$$\cos s + \cos t = 2 \cos \frac{s+t}{2} \cos \frac{s-t}{2}$$

$$\sin s - \sin t = 2 \cos \frac{s+t}{2} \sin \frac{s-t}{2}$$

$$\cos s - \cos t = -2 \sin \frac{s+t}{2} \sin \frac{s-t}{2}$$

Laws of Sines and Cosines



$$\frac{\sin \alpha}{a} = \frac{\sin \beta}{b} = \frac{\sin \gamma}{c}$$

$$a^2 = b^2 + c^2 - 2bc \cos \alpha$$

Inverse Trigonometric Functions

$$y = \sin^{-1} x \Leftrightarrow x = \sin y, -\pi/2 \leq y \leq \pi/2$$

$$y = \cos^{-1} x \Leftrightarrow x = \cos y, 0 \leq y \leq \pi$$

$$y = \tan^{-1} x \Leftrightarrow x = \tan y, -\pi/2 < y < \pi/2$$

$$y = \sec^{-1} x \Leftrightarrow x = \sec y, 0 \leq y \leq \pi, y \neq \pi/2$$

$$\sec^{-1} x = \cos^{-1}(1/x)$$

Hyperbolic Functions

$$\sinh x = \frac{1}{2}(e^x - e^{-x})$$

$$\cosh x = \frac{1}{2}(e^x + e^{-x})$$

$$\tanh x = \frac{\sinh x}{\cosh x}$$

$$\coth x = \frac{\cosh x}{\sinh x}$$

$$\operatorname{sech} x = \frac{1}{\cosh x}$$

$$\operatorname{csch} x = \frac{1}{\sinh x}$$

Series

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \dots, -1 < x < 1$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots, -1 < x \leq 1$$

$$\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots, -1 \leq x \leq 1$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$$

$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \dots$$

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \dots$$

$$(1+x)^p = 1 + \binom{p}{1}x + \binom{p}{2}x^2 + \binom{p}{3}x^3 + \dots, -1 < x < 1$$

$$\binom{p}{k} = \frac{p(p-1)(p-2)\dots(p-k+1)}{k!}$$