Square Roots
$\sqrt{x^6} = |x^3|$
$\sqrt{x^8} = x^4$
$\sqrt{x^7} = x^3\sqrt{x}$

Absolute Value Inequalities
$|x| < c \qquad -c < x < c$
$|x| > c \qquad x < -c$ or $c < x$

Distance Formula
$A(x_1, y_2)$ and $B(x_2, y_2)$
$d(A, B) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Midpoint Formula
$A(x_1, y_2)$ and $B(x_2, y_2)$
$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Equation of a Circle
$(x-h)^2+(y-k)^2 = r^2$

Point-Slope Form
$y-y_1 = m(x-x_1)$

Standard Form
$Ax+By+C = 0$

Positive Trigonometric Functions
I–All II–sin III–tan IV–cos

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

Joint Variation
If z is varies jointly as x and y,
$z = kxy$

Perpendicular Lines
$m_2 = -\frac{1}{m_1}$

Average Rate of Change
$\text{ARoC} = \frac{\text{y change}}{\text{x change}} = \frac{f(x_2) - f(x_1)}{x_2 - x_1}$

Difference of Cubes
$a^3+b^3 = (a+b)(a^2-ab+b^2)$
$a^3-b^3 = (a-b)(a^2+ab+b^2)$

Standard Form of a Quadratic Function
$f(x) = a(x-h)^2 + k$

Vertical Shifts of Graphs
Suppose $c > 0$.
Graph $y = f(x) + c$ by shifting $y = f(x)$ up c.
Graph $y = f(x) - c$ by shifting $y = f(x)$ down c.

Horizonal Shifts of Graphs
Suppose $c > 0$.
Graph $y = f(x-c)$ by shifting $y = f(x)$ right c.
Graph $y = f(x+c)$ by shifting $y = f(x)$ left c.

Definition of Log
if $a^x = y$,
$\log_a y = x$

Arc Length
$s = r\theta$

Reflecting Graphs
Graph $y = -f(x)$ by reflecting $y = f(x)$ in the x-axis.
Graph $y = f(-x)$ by reflecting $y = f(x)$ in the y-axis.

Vertical Stretching of Graphs
To graph $y = cf(x)$, graph $y = f(x)$, then
if $c > 1$ strech vertically a by factor of c
if $0 < c < 1$ shrink vertically a by factor of c

Inverse Variation
If y is inversly proportional to x,
$y = \frac{k}{x}$

Horizontal Stretching of Graphs
To graph $y = f(cx)$, graph $y = f(x)$, then
if $c > 1$ shrink horizontally by a factor of $\frac{1}{c}$
if $0 < c < 1$ stretch horizontally by a factor of $\frac{1}{c}$

Even and Odd Functions
if $f(-x) = f(x)$ $\quad f(x)$ is even
if $f(-x) = -f(x)$ $\quad f(x)$ is odd

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

Min or Max of a Quadratic Function
$f(x) = x(x-h)^2 + k \quad f(h) = k$
$f(x) = ax^2 + bx + c \quad f(-\frac{b}{2a})$

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

Completing the Square
With a quadratic in form $ax^2 + bx = c$
$(\frac{1}{2} \cdot b)^2 = c$

Hidden quadratic 1
$x^{-3/2}+2x^{-1/2}+x^{1/2}$
$x^{-3/2}(1 + 2x + x^2)$
$x^{-3/2}(1+x)^2$

Hidden quadratic 2
$e^{2x} + 2e^x + 1$
$(e^x + 1)^2$

Permutations
$p(x, y) = \frac{x!}{(x-y)!}$

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
$\frac{A \cdot \pi}{180} = \theta$

Remainder Theorem
If $P(x) \div (x-c)$, the remainder $= P(c)$.

SOH-CAH-TOA
$\sin = \frac{\text{opp}}{\text{hyp}} \quad \cos = \frac{\text{adj}}{\text{hyp}} \quad \tan = \frac{\text{opp}}{\text{adj}}$

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

Direct Variation
If y is directly proportional to x,
$y = kx$

Population Growth
n is population size, r is relative growth rate, t is time
$n = n_0e^{rt}$

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

Properties of logs
$(\log_a b)(\log_c d) = (\log_a d)(\log_c b)$
$\log m + \log n = \log mn$
$\log m - \log n = \log \frac{m}{n}$
$m \log n = \log n^m$

Two-intercept form
$\frac{x}{a} + \frac{y}{b} = 1$

Quadratic Formula
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Slope-Intercept Form
$y = mx + b$

i raised to a power
$i^1 = i$
$i^2 = -1$
$i^3 = -i$
$i^4 = 1$
...

Complex numbers
$\overline{a+bi} = a - bi$
$|a+bi| = \sqrt{(a+bi)(a-bi)}$

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

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

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

Result is $x^2 - x + 2 - \frac{5}{x+2}$

Polynomial Long Division

$$\begin{array}{r|l} & \quad x^2 \quad - x + 2 \\ \hline x+2) & x^3 + x^2 \qquad -1 \\ & -x^3 - 2x^2 \\ \hline & \qquad -x^2 \\ & \qquad x^2 + 2x \\ \hline & \qquad\qquad 2x - 1 \end{array}$$

Rational Roots Theorem

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

$\pm 1, \pm 2 \qquad \pm 1, \pm 2, \pm 3, \pm 6$

Possible rational roots:

$\pm 1, \pm \frac{1}{2}, \pm 2, \pm 3, \pm \frac{3}{2}, \pm 6$

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

When degree of numerator is same as degree of denominator

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

If degree of denominator is greater, 0

Slant Asymptotes

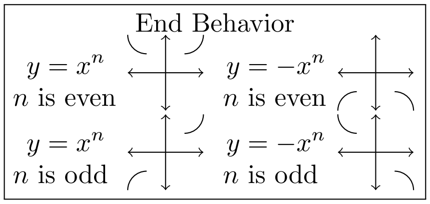
When degree of numerator is one greater than degree of denominator

$y = \dfrac{x^2 - 4x - 5}{x - 3}$	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



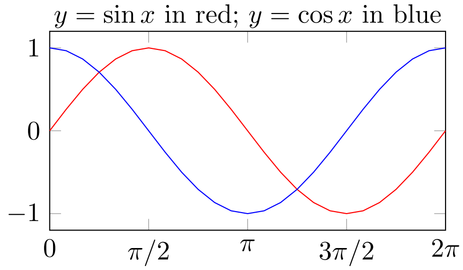
Trig Identities

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

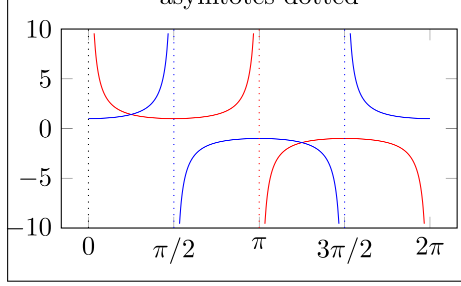
$$\tan^2 + 1 = \sec^2$$

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

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



$y = \csc x$ in red; $y = \sec x$ in blue, asymtotes dotted



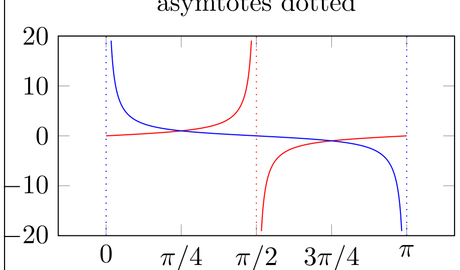
sin/cos/csc/sec Graph Properties

If in form:

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

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

$y = \tan x$ in red; $y = \cot x$ in blue, asymtotes dotted



tan/cot Graph Properties

If in form:

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

amplitude $|a|$, period π/k, phase shift b