Take your time

$(x+h)^2 = x^2 + 2hx + h^2$

$(x+h)^3 = x^3 + 3hx^2 + 3h^2x + h^3$

horiz scaling: $\frac{1}{a}$, inside

vert ref = x-axis ref

$Log(x)$ $x > 0$

$\sqrt{x} \rightarrow x \geq 0$

$\frac{1}{x} \rightarrow x \neq 0$

Eq → Diagnose transformati

Reflect, Scale, Shift

Alphabetical order

Graph → Diagnose → Eq is opposite order

horiz reflect = y-axis reflect

When in doubt, plot points

Even f(x)	Odd f(x)
$f(-x) = f(x)$	$f(-x) = -f(x)$
y-axis symmetry	origin symmetry
$(x,y) \rightarrow (-x,y)$	$(x,y) \rightarrow (-x,-y)$

jointly

Direct Variation $y = kx$ or $\frac{y}{x} = k$

Inverse Variation $y = k/x$ or $xy = k$

$f(x) = [\![x]\!]$ = biggest int. ≤ to the input

$\frac{-b}{2a} = \text{LOS}$

$\left(\frac{b}{2}\right)^2$ for complete the square

Remainder theorem: $\frac{P(x)}{x-k} \rightarrow P(k)$ remainder

$(x-k)\,q(x) + \underbrace{r}_{\text{remainder}}$

$P(k) = r$

i^1	$\sqrt{-1}$	look at last 2 digits of exponent
i^2	-1	
i^3	$-\sqrt{-1}$	$12i^{37610}$
i^4	$+1$	$= -12$

Curves + 1 = degree

bowl

n degrees → n complex solutions

possible rational roots: $\pm\frac{p}{q}$ or $\pm\frac{z}{a}$ ← constant

Slant asympt exists when: $m = n + 1$

horiz asymp.

$y = \frac{ax^m + c_1}{bx^n + c_2}$

$m < n$ $y = 0$

$m = n$ $y = a/b$

$m > n$ none

1 | 2 -3 3

$\boxed{2 \quad -1}$ 2

Slant asympt.

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$y = ab^x$

$0 < b < 1$ decay

$b > 1$ growth

$y = Pe^{rt}$

$y = P\left(1 + \frac{r}{n}\right)^{nt}$

$\log_b(b^n) = n$

$\log_b k = x \rightarrow b^x = k$

$\log(a) + \log(b) = \log(a \cdot b)$

$\log(x^n) = n\log(x)$

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

$\log_b(x) = \frac{\log x}{\log b}$

	Input	Output
Linear	x	y
Expon.	x	$\ln(y)$
Logarith	$\ln(x)$	y
Power f(x)	$\ln(x)$	$\ln(y)$

Amt Rem. = Init. Amnt $\ast (0.5)^{t/h}$

t → # of yrs of decay

h → half life

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

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

$\frac{op}{hy} = \text{sine}$

$\frac{hy}{op} = \text{csc}$

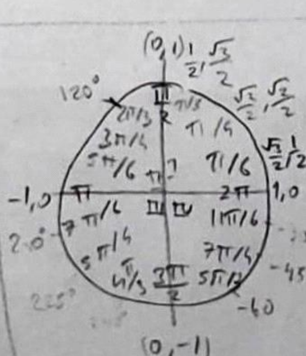
$y = a\sin(b(x-c)) + d$

period: $2\pi/b$ or π/b tan

max-min

amplitude = $|a|$

sin start = 0, cos start = max



$\cos^{-1}$ I, II

rest is I, IV

$\csc^{-1}$ I, IV

rest is I, II

Mode

$\omega = 2\pi \cdot \frac{rot}{min} = \frac{rad}{min}$

angular

$v = 2\pi r \cdot \frac{rot}{min} = \frac{in}{min}$

linear

$\frac{in}{rot}$

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

$2\pi r$ circumference πr^2 Area

$\sin(-x) = -\sin x$
$\cos(-x) = \cos x$
$\tan(-x) = -\tan x$
even odd iden.

Double Angle

$\sin(2x) = 2\sin x \cos x$
$\cos 2x = \cos^2 x - \sin^2 x$
$\tan 2x = (2\tan x)/(1-\tan^2 x)$

Addition + Subtraction identities

$\sin(a+b) = \sin(a)\cos(b) + \cos(a)\sin(b)$
$\sin(a-b) = \sin(a)\cos(b) - \cos(a)\sin(b)$
$\cos(a+b) = \cos(a)\cos(b) - \sin(a)\sin(b)$
$\cos(a-b) = \cos(a)\cos(b) + \sin(a)\sin(b)$

$$\tan(a+b) = \frac{\tan(a)+\tan(b)}{1-\tan(a)\tan(b)}$$

$$\tan(a-b) = \frac{\tan(a)-\tan(b)}{1+\tan(a)\tan(b)}$$

$\cos\left(\frac{\pi}{2}-x\right) = \sin x$ $\sec\left(\frac{\pi}{2}-x\right) = \csc x$
$\sin\left(\frac{\pi}{2}-x\right) = \cos x$ $\csc\left(\frac{\pi}{2}-x\right) = \sec x$
$\tan\left(\frac{\pi}{2}-x\right) = \cot x$ $\cot\left(\frac{\pi}{2}-x\right) = \tan x$

cofunction identities

Check your mode!

Basic

$1+\tan^2 x = \sec^2 x$
$1+\cot^2 x = \csc^2 x$

Law of Sines

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

SSA → 2 sol

$\text{Area} = \frac{1}{2}ab\sin C$

Law of Cosines

$a^2 = b^2 + c^2 - 2bc(\cos A)$

$$\cos A = \frac{b^2+c^2-a^2}{2bc}$$

SAS, SSS

Half angle identities

$$\sin\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1-\cos x}{2}}$$

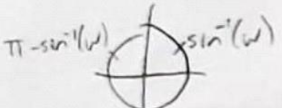
$$\cos\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1+\cos x}{2}}$$

$$\tan\left(\frac{x}{2}\right) = \frac{\sin x}{1+\cos x} = \frac{1-\cos x}{\sin x}$$

$S = (a+b+c)/2$
$\text{Area} = \sqrt{S(S-a)(S-b)(S-c)}$ (for non included angles) SSS triangle

To find the other angle that gives same result:

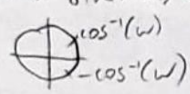
$x = \pi - \sin^{-1}(w)$



$x = 2\pi - \underbrace{\cos^{-1}(w)}_{\theta}$

to keep in range

already other angle



$x = \tan^{-1}(w) + \pi$
(when w in quad 3)

Component form

$\langle a, b\rangle$

magnitude: $\sqrt{a^2+b^2}$

$\theta = \tan^{-1}\left(\frac{b}{a}\right)$

$180 - \theta$ for QII
$180 + \theta$ for QIII
check coord pos

$$\cos\theta = \frac{u \cdot v}{\|u\|\|v\|}$$

$u \cdot u = (\|u\|)^2$

$(u_a \cdot v_a) + (u_b \cdot v_b)$

$W = F \cdot d$

Trig/polar form:

$\text{mag}(\cos\theta + i\sin\theta)$

exponential form:

$re^{i\theta}$ $\boxed{\theta + \frac{2\pi k}{n}}$ $r = \text{mag}$

Euler's formula:

$e^{i\pi} + 1 = 0$

De moive's theorem:

$[r(\cos\theta + i\sin\theta)]^n$
$= r^n(\cos(n\theta) + i\sin(n\theta))$
$(re^{i\theta})^5 = r^5 \cdot e^{i5\theta}$

Finding n^{th} roots:

$k = 0$ to $n-1$

$$z_k = \sqrt[n]{r}\left(\cos\frac{\theta+2\pi k}{n} + i\sin\frac{\theta+2\pi k}{n}\right)$$

Polar coords → rectangular

$(r, \theta) \to (r\cos\theta, r\sin\theta)$

$x = r\cos\theta$
$y = r\sin\theta$ converting to rectangular
$x^2+y^2 = r^2$

$r = \sqrt{x^2+y^2}$
$\theta = \tan^{-1}\left(\frac{y}{x}\right)$ converting to polar

vert parabola:

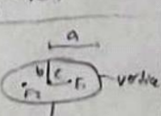
$y - k = \frac{1}{4p}(x-h)^2$

horiz parabola:

$x - h = \frac{1}{4p}(y-k)^2$

ellipse:

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

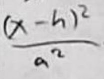


$a^2 - b^2 = c^2$ $e = \frac{c}{a}$

hyperbolas:

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

(horiz)



$a^2 + b^2 = c^2$

(vert)

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

Slope of tan for any x

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

derivative

Dist. between F_1 and point

$F_1P + F_2P = 2a$ ellipse

| sum is area | abs val | hyperbola

Limits

$\lim_{x\to 2^+}$ $x > 2$ only coming from right

$x \to 2^-$ $x < 2$ only coming from left

$$\lim_{x\to h}\frac{f(x)-f(h)}{x-h}$$ slope of tan