Lone Star College-CyFair Formula Sheet

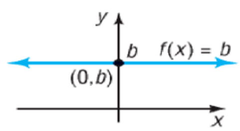
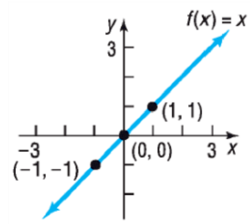
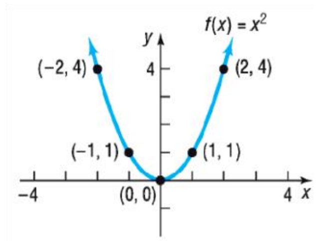
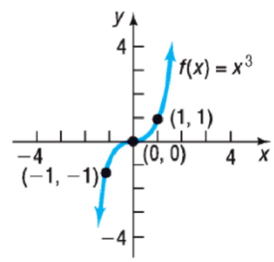
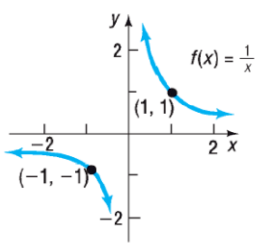
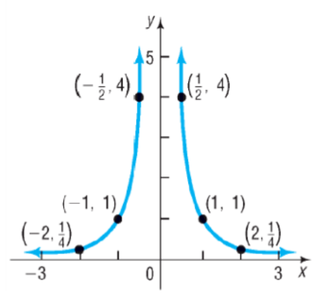
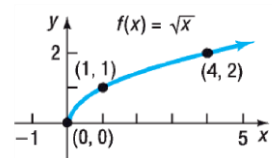
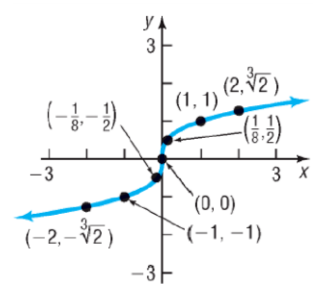
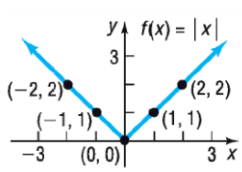
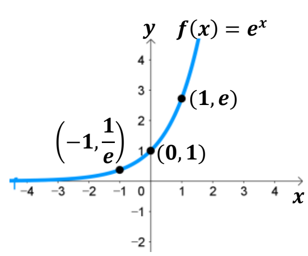
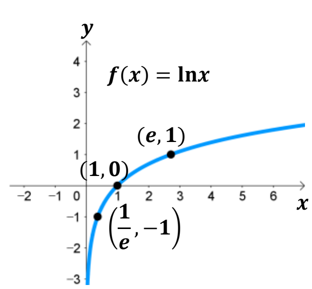
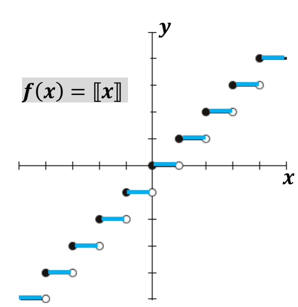
The following formulas are critical for success in the indicated course. Student CANNOT bring these formulas on a formula sheet or card to tests and instructors MUST NOT provide them during the test either on the board or on a handout. They MUST be memorized.

Math 1314 College Algebra

FORMULAS/EQUATIONS

Distance Formula	If $P_1 = (x_1, y_1)$ and $P_2 = (x_2, y_2)$, the distance from P_1 to P_2 is $d(P_1, P_2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Standard Equation Of a Circle	The standard equation of a circle of radius r with center at (h, k) is $(x-h)^2 + (y-k)^2 = r^2$
Slope Formula	The slope m of the line containing the points $P_1 = (x_1, y_1)$ and $P_2 = (x_2, y_2)$ is $m = \frac{y_2 - y_1}{x_2 - x_1}$ if $x_1 \neq x_2$; m is undefined if $x_1 = x_2$
Point-slope Equation of a Line	The equation of a line with slope m containing the points (x_1, y_1) is $y - y_1 = m(x - x_1)$
Slope-Intercept Equation of a Line	The equation of a line with slope m and y-intercept b is $y = mx + b$
Quadratic Formula	The solutions of the equation $ax^2 + bx + c = 0,\ a \neq 0$, are $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

LIBRARY OF FUNCTIONS

<table>
<tr><td>Constant Function
$f(x) = b$</td><td>Identity Function
$f(x) = x$</td><td>Square Function
$f(x) = x^2$</td><td>Cube Function
$f(x) = x^3$</td></tr>
<tr><td>
</td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Reciprocal Function
$f(x) = \frac{1}{x}$</td><td>Squared Reciprocal Function
$f(x) = \frac{1}{x^2}$</td><td>Square Root Function
$f(x) = \sqrt{x}$</td><td>Cube Root Function
$f(x) = \sqrt[3]{x}$</td></tr>
<tr><td>
</td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Absolute Function
$f(x) = |x|$</td><td>Exponential Function
$f(x) = e^x$</td><td>Natural Logarithm Function
$f(x) = \ln x$</td><td>Greatest Integer Function
$f(x) = [\![x]\!]$</td></tr>
<tr><td>
</td><td>
</td><td>
</td><td>
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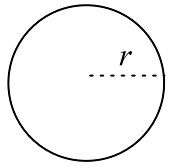
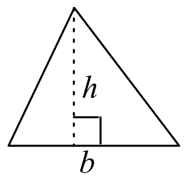
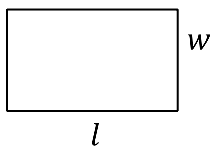
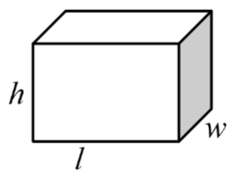
GEOMETRY FOMULAS

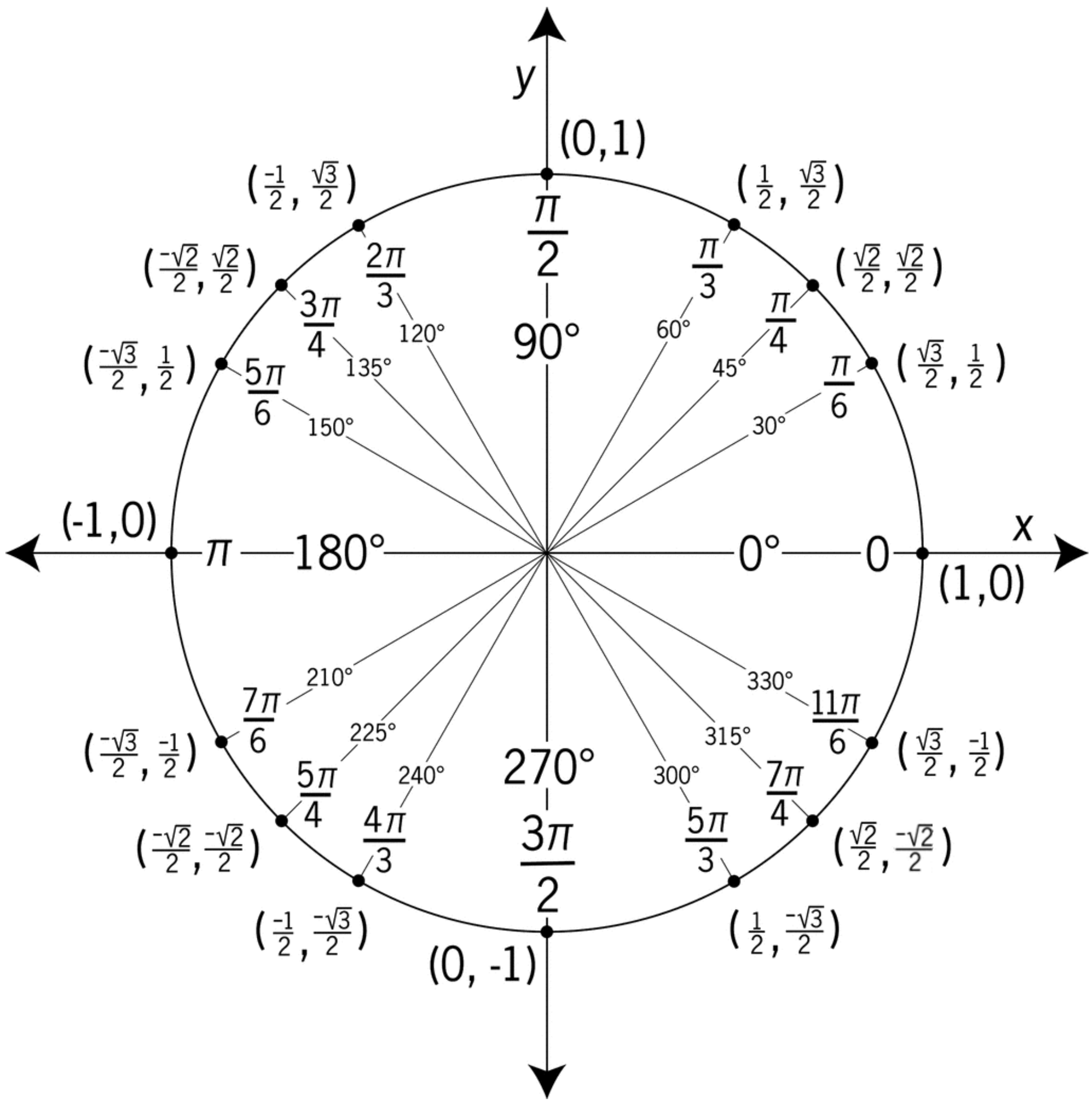
Circle		r = Radius, A = Area, C = Circumference $\boldsymbol{A = \pi r^2}$ $\boldsymbol{C = 2\pi r}$
Triangle		b = Base, h = Altitude(Height), A = Area $\boldsymbol{A = \frac{1}{2}bh}$
Rectangle		l = Length, w = Width, A = Area, P = Perimeter $\boldsymbol{A = lw}$ $\boldsymbol{P = 2l + 2w}$
Rectangular Box		l = Length, w = Width, h = Height, V = Volume, S = Surface Area $\boldsymbol{V = lwh}$ $\boldsymbol{S = 2lw + 2lh + 2wh}$

PROPERTIES OF LOGARITHMS

- $\log_a(MN) = \log_a M + \log_a N$
- $\log_a\left(\frac{M}{N}\right) = \log_a M - \log_a N$
- $\log_a M^r = r\log_a M$
- $\log_a M = \frac{\log M}{\log a} = \frac{\ln M}{\ln a}$
- $a^x = e^{x\ln a}$

Math 1316 Trigonometry

Students in Trigonometry should know all the formulas from Math 1314 College Algebra plus the following.



Unit Circle $x^2 + y^2 = 1$

TRIGONOMETRIC FUNCTIONS

Of an Acute Angle

$\sin\theta = \frac{b}{c} = \frac{\text{Opposite}}{\text{Hypotenuse}}$

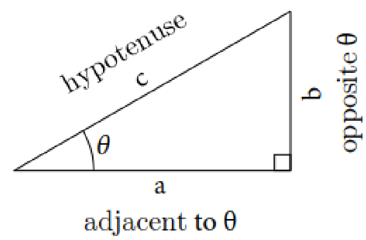
$\cos\theta = \frac{a}{c} = \frac{\text{Adjacent}}{\text{Hypotenuse}}$

$\tan\theta = \frac{b}{a} = \frac{\text{Opposite}}{\text{Adjacent}}$

$\csc\theta = \frac{c}{b} = \frac{\text{Hypotenuse}}{\text{Opposite}}$

$\sec\theta = \frac{c}{a} = \frac{\text{Hypotenuse}}{\text{Adjacent}}$

$\cot\theta = \frac{a}{b} = \frac{\text{Adjacent}}{\text{Opposite}}$



Of a General Angle

$\sin\theta = \frac{b}{r}$

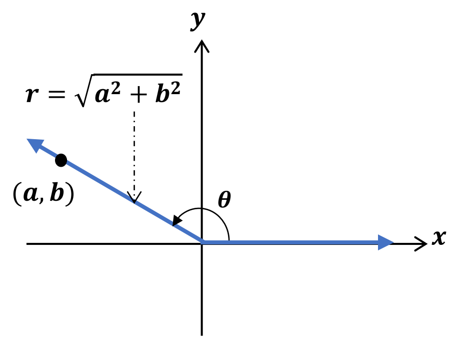
$\cos\theta = \frac{a}{r}$

$\tan\theta = \frac{b}{a}\ ,\ a \neq 0$

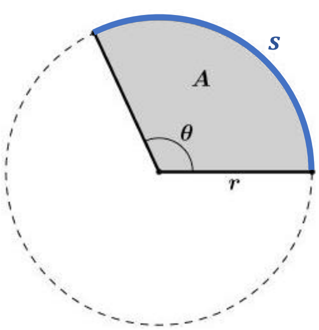
$\csc\theta = \frac{r}{b}\ ,\ b \neq 0$

$\sec\theta = \frac{r}{a}\ ,\ a \neq 0$

$\cot\theta = \frac{a}{b}\ ,\ b \neq 0$



APPLICATIONS



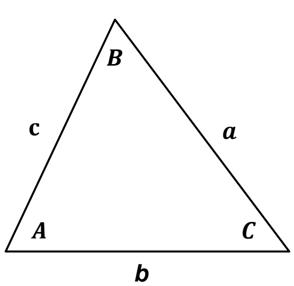
Arc Length: $s = r\theta,\ \theta$ in radians

Area of Sector: $A = \frac{1}{2}r^2\theta,\ \theta$ in radians

Angular Speed: $\omega = \frac{\theta}{t},\ \theta$ in radians

Linear Speed: $v = \frac{s}{t},\ \ v = \omega r$

SOLVING TRIANGLES



Law of Sine: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Law of Cosine: $a^2 = b^2 + c^2 - 2bc\cos A$

$b^2 = a^2 + c^2 - 2ac\cos A$

$c^2 = a^2 + b^2 - 2ab\cos A$

TRIGONOMETRIC IDENTITIES

Fundamental Identities

$\tan\theta = \frac{\sin\theta}{\cos\theta}$ $\cot\theta = \frac{\cos\theta}{\sin\theta}$

$\csc\theta = \frac{1}{\sin\theta}$ $\sec\theta = \frac{1}{\cos\theta}$ $\cot\theta = \frac{1}{\tan\theta}$

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

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

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

Even-Odd Identities

$\sin(-\theta) = -\sin\theta$ $\csc(-\theta) = -\csc\theta$

$\cos(-\theta) = \cos\theta$ $\sec(-\theta) = \sec\theta$

$\tan(-\theta) = -\tan\theta$ $\cot(-\theta) = -\cot\theta$

Cofunction Identities

$\cos(90° - \theta) = \sin\theta$

$\sin(90° - \theta) = \cos\theta$

$\tan(90° - \theta) = \tan\theta$

Sum and Difference Formulas

$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$

$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$

$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$

$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$$

$$\tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

Double-Angle Formulas

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

$$\cos(2\theta) = \cos^2\theta - \sin^2\theta$$
$$= 2\cos^2\theta - 1$$
$$= 1 - 2\sin^2\theta$$

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

LIBRARY OF TRIGONOMETRIC FUNCTIONS

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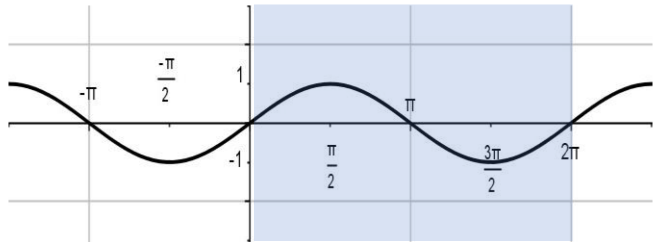
<tr><td>Sine Function

$f(x) = \sin x$</td><td>
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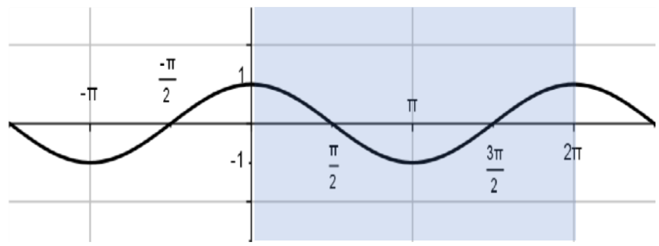
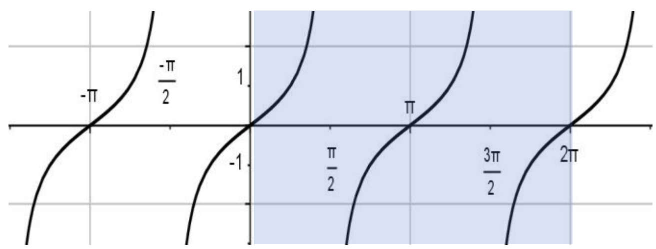
<tr><td>Cosine Function

$f(x) = \cos x$</td><td>
</td></tr>
<tr><td>Tangent Function

$f(x) = \tan x$</td><td>
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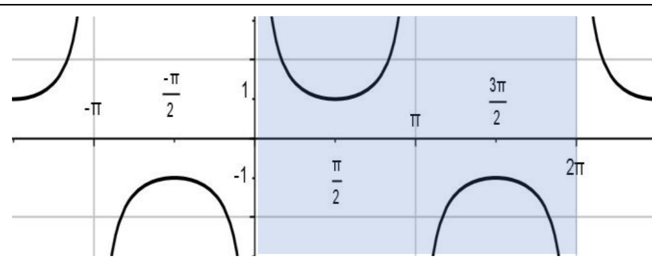
<tr><td>Secant Function

$f(x) = \sec x$</td><td>
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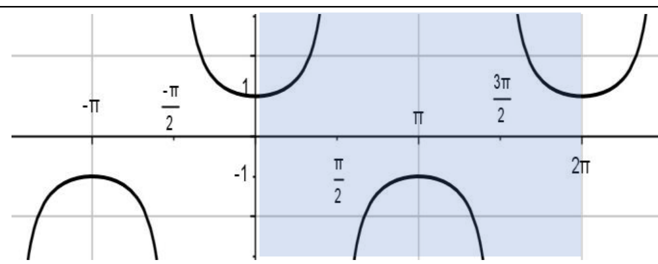
<tr><td>Cosecant Function

$f(x) = \csc x$</td><td>
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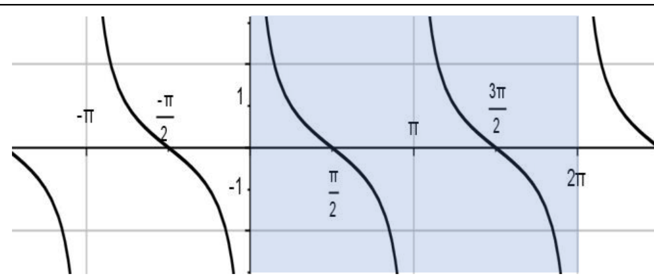
<tr><td>Cotangent Function

$f(x) = \cot x$</td><td>
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Math 2412 Precalculus

Students in Precalculus should know all the formulas from Math 1314 College Algebra and Math 1316 Trigonometry plus the following.

Half Angle Formulas

$$\sin\theta = \pm\sqrt{\frac{1-\cos 2\theta}{2}} \qquad \cos\theta = \pm\sqrt{\frac{1+\cos 2\theta}{2}} \qquad \tan\theta = \frac{1-\cos 2\theta}{\sin 2\theta}$$

Products and Quotients of Complex Numbers in Polar Form

Let $z_1 = r_1(\cos\theta_1 + i\sin\theta_1)$ and $z_2 = r_2(\cos\theta_2 + i\sin\theta_2)$.

Then $z_1 z_2 = r_1 r_2[\cos(\theta_1+\theta_2) + i\sin(\theta_1+\theta_2)]$

and, if $z_2 \neq 0$,

$$\frac{z_1}{z_2} = \frac{r_1}{r_2}[\cos(\theta_1-\theta_2) + i\sin(\theta_1-\theta_2)].$$

DeMoivre’s Theorem

If $z = r(\cos\theta + i\sin\theta)$ and n is a positive integer,

$$z^n = r^n[\cos(n\theta) + i\sin(n\theta)].$$

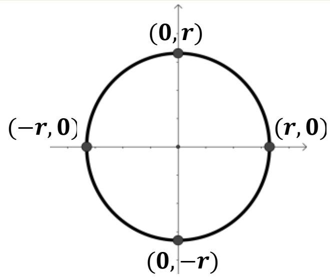
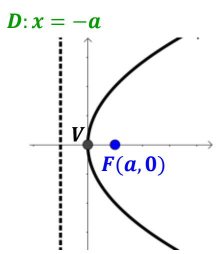
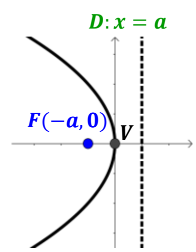
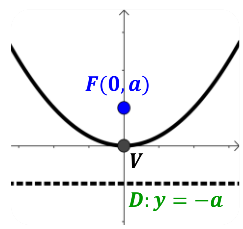
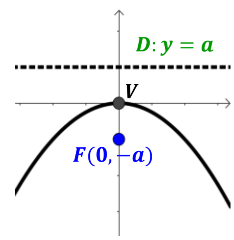
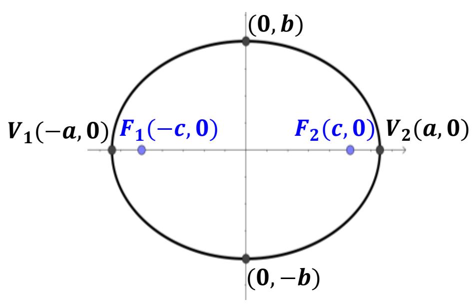
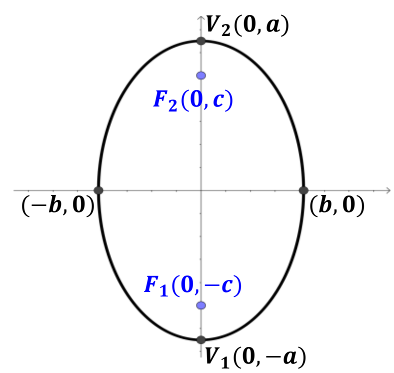
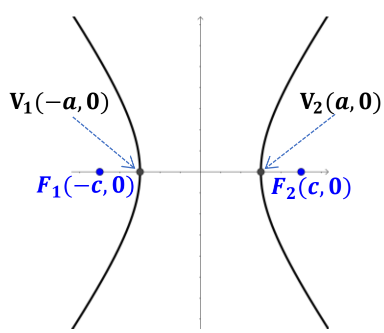
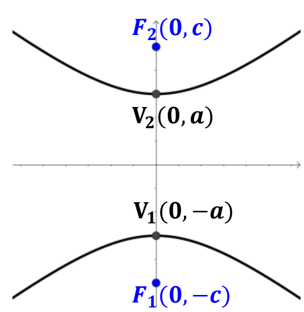
Complex Roots

Let $w = r(\cos\theta_0 + i\sin\theta_0)$ be a complex number and let $n\geq 2$be an integer. If $w \neq 0$, there are n distinct complex nth roots of w, given by the formula

$$z_k = \sqrt[n]{r}\left[\cos\left(\frac{\theta_0}{n} + \frac{2k\pi}{n}\right) + i\sin\left(\frac{\theta_0}{n} + \frac{2k\pi}{n}\right)\right].$$

Where $k = 0, 1, 2, \cdots, n-1$.

CONICS

Circle	$x^2 + y^2 = 1$			
				
Parabola	$y^2 = 4ax$	$y^2 = -4ax$	$x^2 = 4ay$	$x^2 = -4ay$
				
Ellipse	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1,\ a > b,\ c^2 = a^2 - b^2$		$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1,\ a > b,\ c^2 = a^2 - b^2$	
				
Hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1,\ c^2 = a^2 + b^2$ Asymptote: $y = \frac{b}{a}x,\ y = -\frac{b}{a}x$		$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1,\ c^2 = a^2 + b^2$ Asymptote: $y = \frac{a}{b}x,\ y = -\frac{a}{b}x$	
				

POLAR EQUATIONS OF CONICS(Focus at the Pole, Eccentricity e)

Equation	Description
$r = \dfrac{ep}{1 - e\cos\theta}$	Directrix is perpendicular to the polar axis at a distance p units to the left of the pole: $x = -p$
$r = \dfrac{ep}{1 + e\cos\theta}$	Directrix is perpendicular to the polar axis at a distance p units to the right of the pole: $x = p$
$r = \dfrac{ep}{1 + e\sin\theta}$	Directrix is parallel to the polar axis at a distance p units above the pole: $y = p$
$r = \dfrac{ep}{1 - e\sin\theta}$	Directrix is parallel to the polar axis at a distance p units below the pole: $y = -p$
Eccentricity If $e = 1$, the conic is a parabola; the axis of symmetry is perpendicular to the directrix. If $0 < e < 1$, the conic is an ellipse; the major axis is perpendicular to the directrix. If $e > 1$, the conic is a hyperbola; the transverse axis is perpendicular to the directrix.	

ARITHMETIC SEQUENCE

$$a_n = a_1 + (n-1)d$$

$$\begin{aligned} S_n &= a_1 + (a_1 + d) + (a_1 + 2d) + \cdots + [a_1 + (n-1)d] \\ &= \tfrac{n}{2}[2a_1 + (n-1)d] \\ &= \tfrac{n}{2}[a_1 + a_n] \end{aligned}$$

GEOMETRIC SEQUENCE

$$a_n = a_1 r^{n-1}$$

$$\begin{aligned} S_n &= a_1 + a_1 r + a_1 r^2 + \cdots + a_1 r^{n-1} \\ &= \frac{a_1(1-r^{n})}{1-r} \end{aligned}$$

GEOMETRIC SERIES

If $|r| < 1$,

$$a_1 + a_1 r + a_1 r^2 + \cdots = \sum_{k=1}^{\infty} a_1 r^{k-1} = \frac{a_1}{1-r}$$

If $|r| \geq 1$,

the infinite geometric series does not have a sum.

PERMUTATIONS/COMBINATIONS

$0! = 1$

$1! = 1$

$n! = n(n-1) \cdot \cdots \cdot (3)(2)(1)$

$P(n, r) = \dfrac{n!}{(n-r)!}$

$\mathrm{C(n, r)} = \dbinom{n}{r} = \dfrac{n!}{(n-r)!\, r!}$

BINOMIAL THEOREM

$$(a+b)^n = a^n + \binom{n}{1} b a^{n-1} + \binom{n}{2} b^2 a^{n-2} + \cdots + \binom{n}{n-1} b^{n-1} a + b^n$$