Greek Characters

Name	Symbol	Typical use(s)
alpha	α	angle, constant
beta	β	angle, constant
gamma	γ	angle, constant
epsilon	ϵ or ε	angle, constant
theta	θ or ϑ	angle, constant
pi	π or ϖ	circular constant
phi	ϕ or φ	angle, constant

Named Sets

empty set	$\varnothing$
real numbers	$\mathbf{R}$
ordered pairs of reals	$\mathbf{R}^2$
integers	$\mathbf{Z}$
positive integers	$\mathbf{Z}_{>0}$
positive real numbers	$\mathbf{R}_{>0}$

Set Symbols

Meaning	Symbol
is a member	$\in$
subset	$\subset$
intersection	$\cap$
union	$\cup$

Intervals

For numbers a and b, we define the intervals:

$$(a,b) = \{x \in \mathbf{R} \mid a < x < b\}$$

$$[a,b) = \{x \in \mathbf{R} \mid a \le x < b\}$$

$$(a,b] = \{x \in \mathbf{R} \mid a < x \le b\}$$

$$[a,b] = \{x \in \mathbf{R} \mid a \le x \le b\}$$

Logic Symbols

Meaning	Symbol
negation	$\neg$
and	$\wedge$
or	$\vee$
implies	$\implies$
equivalent	$\equiv$
for all	$\forall$
there exists	$\exists$

Exponents

For $a, b > 0$ and m, n real:

$$a^0 = 1, \qquad 0^a = 0$$

$$1^a = 1, \qquad a^n a^m = a^{n+m}$$

$$a^n/a^m = a^{n-m}, \qquad (a^n)^m = a^{n\cdot m}$$

$$a^{-m} = 1/a^m, \qquad (a/b)^m = a^m/b^m$$

Polar to Cartesian

$$x = r\cos(\theta)$$

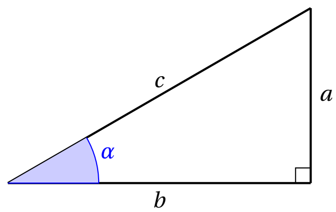
$$y = r\sin(\theta)$$

For $r > 0$ and $0 \le \theta < 2\pi$

$$r = \sqrt{x^2+y^2}$$

$$\theta = \begin{cases} 2\pi - \arccos(x/r) & \text{if } y < 0 \\ \arccos(x/r) & \text{if } y \ge 0 \end{cases}$$

Right Triangle Trigonometry



$\sin(\alpha) = a/c$ $\quad\cos(\alpha) = b/c$ $\quad\tan(\alpha) = a/b$

$\csc(\alpha) = c/a$ $\quad\sec(\alpha) = c/b$ $\quad\cot(\alpha) = b/a$

Trigonometric Identities

$$\sin^2(x) + \cos^2(x) = 1$$

$$2\cos^2(x) = 1 + \cos(2x)$$

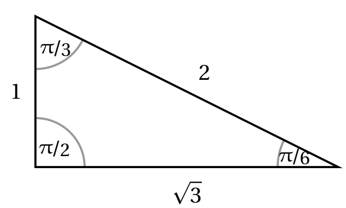
$$2\sin^2(x) = 1 - \cos(2x)$$

$$\sin\left(x+y\right) = \sin(x)\cos(y) + \cos(x)\sin(y)$$

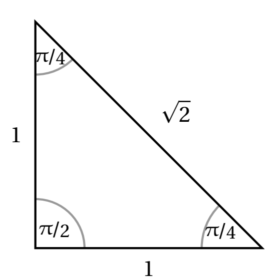
$$\cos\left(x+y\right) = \cos(x)\cos(y) - \sin(x)\sin(y)$$

Famous Triangles

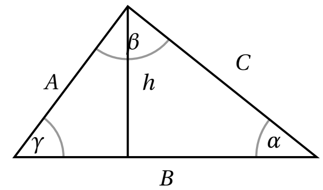
The 30-60-90 triangle



The 45-45-90 triangle



Laws of Cosine & Sine



Law of cosines

$$C^2 = A^2 + B^2 - 2AB\cos(\gamma)$$

Law of sines

$$\frac{\sin\alpha}{A} = \frac{\sin\beta}{B} = \frac{\sin\gamma}{C}$$

Area

$$\text{Area} = hB/2 = AB\sin(\gamma)/2$$

Solution of Equations

Algebraic

$$\left[ab = 0\right] \equiv \left[a = 0 \textbf{ or } b = 0\right]$$

$$\left[a^2 = b^2\right] \equiv \left[a = b \textbf{ or } a = -b\right]$$

$$\left[\frac{a}{b} = 0\right] \equiv \left[a = 0 \textbf{ and } b \ne 0\right]$$

$$\left[\frac{a}{b} = \frac{c}{d}\right] \equiv \left[ad = bc \textbf{ and } b \ne 0 \textbf{ and } d \ne 0\right]$$

$$\left[|a| = |b|\right] \equiv \left[a = b \textbf{ or } a = -b\right]$$

$$\left[\sqrt{a} = b\right] \equiv \left[a = b^2 \textbf{ and } b \ge 0\right]$$

For $a \ne 0$,

$$\left[ax^2 + bx + c = 0\right] \equiv \left[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right]$$

Trig

$$\left[\cos(a) = 0\right] \equiv \left[a = (k - 1/2)\pi, k \in \mathbf{Z}\right]$$

$$\left[\sin(a) = 0\right] \equiv \left[a = k\pi, k \in \mathbf{Z}\right]$$

$$\left[\tan(a) = 0\right] \equiv \left[a = k\pi, k \in \mathbf{Z}\right]$$

$$\left[\cos(a) = b\right] \equiv \left[a = \pm\arccos(b) + 2k\pi, k \in \mathbf{Z}\right]$$

$$\left[\sin(a) = b\right] \equiv \left[a = \arcsin(b) + 2k\pi, k \in \mathbf{Z} \text{ or } a = -\arcsin(b) + (2k+1)\pi, k \in \mathbf{Z}\right]$$

$$\left[\tan(a) = b\right] \equiv \left[a = \arctan(b) + k\pi, k \in \mathbf{Z}\right]$$

Vectors

Dot product: $\langle x_1, y_1\rangle \cdot \langle x_2, y_2\rangle = x_1x_2 + y_1y_2$

Length: $\|\langle x, y\rangle\| = \sqrt{x^2+y^2}$

Unit Vectors: $\mathbf{i} = \langle 1, 0\rangle, \quad \mathbf{j} = \langle 0, 1\rangle$

Angle: $\mathbf{a}\cdot\mathbf{b} = \|\mathbf{a}\|\|\mathbf{b}\|\cos(\vartheta)$, where (ϑ) is the acute angle between $\mathbf{a}$ and $\mathbf{b}$.

Graphs

Cosine, sine, and tangent

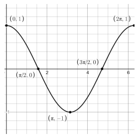


Figure 1: Graph of $y = \cos(x)$ on $[0, 2\pi]$.

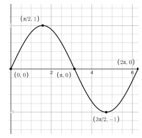


Figure 2: Graph of $y = \sin(x)$ on $[0, 2\pi]$.

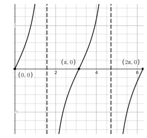


Figure 3: Graph of $y = \tan(x)$ on $[0, 2\pi]$.

Arccosine, arcsine, and arctangent

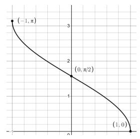


Figure 4: Graph of $y = \arccos(x)$ on $[-1, 1]$.

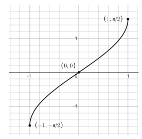


Figure 5: Graph of $y = \arcsin(x)$ on $[-1, 1]$.

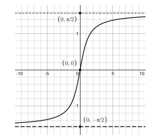


Figure 6: Graph of $y = \arctan(x)$ on $[-10, 10]$.

Unit Circle