

Fraction Rules

Common Denominators

$$a/b + c/d = ad + bc/bd$$

Multiplication

$$a/b * c/d = ac/bd$$

Reciprocal

$$1/(a/b) = b/a$$

Lines

Given point (c,d) and slope m, the unique line that satisfies this is the set of all points (x,y) such that

$$m = y-d/x-c$$

$$m = y-d/x-c$$

slope is change in y/change in x

Parallel, Perpendicular

$y=2x+4$ and $y=2x+3$ are parallel

$y=2x+4$ and $2y=4x+8$ are same line

$y=2x+4$ and $y = 1/2x+6$ meet perpendicularly

Parallel lines never meet, same slope

Perpendicular lines meet once at right angles and slopes are negative reciprocals

Quadratic Functions: Parabolas

$$f(x) = ax^2 + bx + c$$

Zeros given by the quadratic formula:

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

$$\text{Coordinate point } (-b/2a, (-b^2 + 4ac)/4a)$$

Geometric Equations

Circles: Circumference $2(\pi)r$ Area $(\pi)r^2$

Cylinders: Surface area $2(\pi)r \times h + 2(\pi)r^2$

Volume: $(\pi)r^2h$

Sphere: Surface area $4(\pi)r^2$ Volume $4/3(\pi)r^3$

Geometric Formulas

SOHCAHTOA

$$\text{SOH} = \sin(x) = a/c$$

$$\text{CAH} = \cos(x) = b/c$$

$$\text{TOA} = \tan(x) = a/b$$

$$180 \text{ degrees} = (\pi)\text{rad}$$

Divide arclength by radius to get radian measure

Special Angles

Degree Radian Cosine Sine Tangent

$$0 \ 0 \ 1 \ 0 \ 0$$

$$30 \ (\pi/6) \ \sqrt{3}/2 \ 1/2 \ 1/\sqrt{3}$$

$$45 \ (\pi/4) \ 1/\sqrt{2} \ 1/\sqrt{2} \ 1$$

$$60 \ (\pi/3) \ 1/2 \ \sqrt{3}/2 \ \sqrt{3}$$

$$90 \ (\pi/2) \ 0 \ 1 \ \text{undefined}$$

Theory of Geometric Series

$$S = p + pr + pr^2 + pr^3 + \dots + pr^n$$

$$Sr = p + pr + pr^2 + pr^3 + \dots + pr^n + pr^{n+1}$$

$$S - Sr = p - pr^{n+1}$$

$$S = p - pr^{n+1}/1-r$$

Negative Exponents

$$a^{-m} = 1/a^m$$

$$1/a^{-m} = a^m$$

Multiplication and Scientific Notation

Multiplication and Division:

- Convert into scientific notation

- Add/subtract exponents

- Multiply/divide coefficients

- Convert to scientific notation

$$-2.3E4 \times 9.5E7/1.6E10 = 2.3 \times 9.5/1.6E(4+7-10)$$

Absolute Values

Absolute Values often generate "and" and "or" situations.

Examples:

$$|x| < 1: -1 < x \text{ and } x < 1 \quad -1 < x < 1$$

$$|x| > 1: x > 1 \text{ or } x < -1$$

$$|2x+3| > 1: 2x+3 > 1 \text{ or } -(2x+3) > 1$$

$$x > -1 \text{ or } x < -2$$

Exponential Rules

$$\exp(a)\exp(b) = \exp(a+b)$$

$$[\exp(a)]^b = \exp(ab)$$

$$\exp(-a) = 1/\exp(a)$$

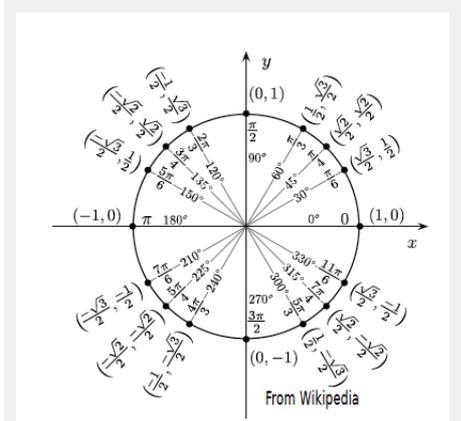
Domain: all real numbers

Range: all positive numbers

Pythagorean Theorem

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

Unit Circle



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Secant, Cosecant, Cotangent

Secant: $1/\cos(x)$
Cosecant = $1/\sin(x)$
Cotangent = $1/\tan(x) = \cos(x)/\sin(x)$

Trigonometric Identities

$\cos^2x + \sin^2x = 1$
 $\tan^{-1}x = \arctan x$
 $\cot(x) = 1/\tan x$
 $e^{i\theta} = \cos x + i\sin x$

Basic Facts

Total human population: 7 billion
USA population: 300 million
Distance from NY to LA: 2500 miles
Distance to the moon: 2.4E5 miles
Distance to the Sun: 1E8 miles
Distance around the equator: 2.5E4 miles
Area of the US: 4E6 square miles
Surface area of the Earth: 2E8 square miles

Distance Between Points

The distance between two points on the plane is based on the Pythagorean Theorem
 $|A-B| = \sqrt{(Xa-Xb)^2 + (Ya - Yb)^2}$
 $A=(Xa, Ya)$ $B=(Xb, Yb)$

Function Variables

Domain = valid inputs to function
Range = what can the function produce
Zeros or Roots = where is $f(x)=0$
Intersections = Where is $f(x) = g(x)$
Local maximum is largest value around itself
Local minimum is smallest value around itself
Global is largest overall

Logarithms

Logarithms are the functional inverses of the exponential
 $y = b^x$ is equivalent to $\log_b(y) = x$
 $\log(mn) = \log(m) + \log(n)$
 $\log(m^n) = n\log(m)$
 $\log(1/m) = -\log(m)$
 $\log_a(m) = \log_b(m)/\log_b(a)$
 $\exp(a)\exp(b) = \exp(ab)$
 $\exp(-a) = 1/\exp(a)$
 $e^{2.3} = 10$, $e^{12} = e^{2.3 \cdot 5.2} = (e^{2.3})^{5.2} = 10^{5.2} = 2E5$

Sine

Sine is the y component as theta spins
Domain is all real numbers
Range $-1 < y < 1$
Maxima at $\pi/2 + 2k\pi$, Minima at $3\pi/2 + 2k\pi$
Zeros at $k\pi$
Period 2π

Cosine

Cosine is the x component as theta spins
Domain is all real numbers
Range is $-1 < y < 1$
Max is $2k\pi$, Minima $(2k + 1)\pi$
Zeros at $\pi/2 + k\pi$
Period is 2π

Tangent

Tangent is the slope of the line with angle theta
Domain is all real numbers except $\pi/2 + k\pi$
Range is all real numbers
No max or min. asymptotes at undefined points
Zeros at $k\pi$
Period is π



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