

Fraction Rules

Common Denominators

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

Multiplication

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

Reciprocal

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

Theory of Geometric Series

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

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

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

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

Lines

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

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

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

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) 0 1 undefined

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

$$4/3(\pi)r^3$$

Negative Exponents

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

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

Trigonometric Identities

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

$$\tan^{-1}x = \arctan x$$

$$\cot(x) = 1/\tan x$$

$$e^{10} = \cos x + i \sin x$$

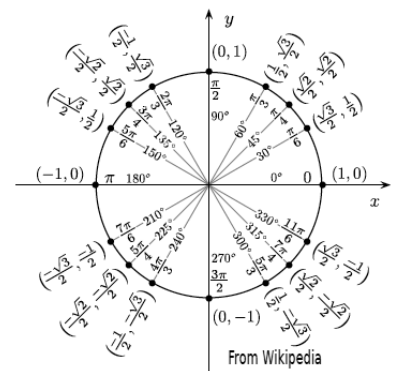
Secant, Cosecant, Cotangent

$$\text{Secant: } 1/\cos(x)$$

$$\text{Cosecant} = 1/\sin(x)$$

$$\text{Cotangent} = 1/\tan(x) = \cos(x)/\sin(x)$$

Unit Circle



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Pythagorean Theorem

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

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

Absolute Values

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

Examples:

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

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

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

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

Multiplication and Scientific Notation

Multiplication and Division:

- Convert into scientific notation

- Add/subtract exponents

- Multiply/divide coefficients

- Convert to scientific notation

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

Logarithms

Logarithms are the functional inverses of the exponential

$$y = b^x \text{ is equivalent to } \log_b(y) = x$$

$$\log(mn) = \log(m) + \log(n)$$

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

$$\log(1/m) = -\log(m)$$

$$\log_a(m) = \log_b(m) / \log_b(a)$$

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

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

$$e^{2.3} = 10, e^{12} = e^{2.3 \times 5.2} = (e^{2.3})^{5.2} = 10^{5.2} = 2E5$$

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

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

Distance Between Points

The distance between two points on the plane is based on the Pythagorean Theorem

$$|A-B| = \sqrt{(X_a - X_b)^2 + (Y_a - Y_b)^2}$$

$$A = (X_a, Y_a) \quad B = (X_b, Y_b)$$

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



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