

ALGEBRAIC PROPERTIES AND FORMULAS

● Properties of Inequalities

If $a < b$, then $a + c < b + c$

If $a < b$ and $b < c$, then $a < c$

If $a < b$ and $c > 0$, then $ac < bc$

If $a < b$ and $c < 0$, then $ac > bc$

If $ab > 0$ and $a < b$, then $\frac{1}{a} > \frac{1}{b}$

● Properties of Absolute Value

$|a| = a$ if $a \geq 0$

$|a| = -a$ if $a < 0$

$|-a| = |a|$

$|ab| = |a||b|$

$|a + b| \leq |a| + |b|$

$|a|^2 = a^2$

● Properties of Exponents

$a \neq 0$ and m and n are integers

$a^n = \underbrace{a \cdot a \cdot a \cdot \dots \cdot a}_{n \text{ factors}}$ if $n > 0$

$a^{1/n}$ = the n^{th} root of a

$a^{-n} = \frac{1}{a^n}$

$a^{m/n} = (a^{1/n})^m$

If p and q are positive rational numbers

$(a^p)^q = a^{p \cdot q} = (a^{1/p})^q$

$a^{p/q} = (a^{1/q})^p$

$a^p a^q = a^{p+q}$

$\frac{a^p}{a^q} = a^{p-q}$

$(ab)^p = a^p b^p$

$\left(\frac{a}{b}\right)^p = \frac{a^p}{b^p}$

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

● Properties of Polynomials

$(x + y)^2 = x^2 + 2xy + y^2$

$(x - y)^2 = x^2 - 2xy + y^2$

$(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$

$(x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$

$x^2 - y^2 = (x + y)(x - y)$

$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$

● Properties of Logarithms

Suppose $a \neq 1$, $a > 0$, $x > 0$, and $w > 0$.

$a^{\log_a x} = x$

$\log_a a^x = x$

$\log_a a = 1$

$\log_a 1 = 0$

$\log_a xw = \log_a x + \log_a w$

$\log_a x^r = r \log_a x$

$\log_a \frac{x}{w} = \log_a x - \log_a w$

$\log x = \log_{10} x$

$\ln x = \log_e x$

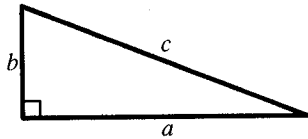
● The Quadratic Formula

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ are the solutions to $ax^2 + bx + c = 0$

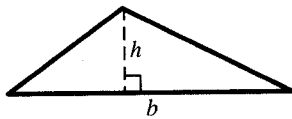
● The Binomial Formula

$(x + y)^n = x^n + \binom{n}{1}x^{n-1}y + \binom{n}{2}x^{n-2}y^2$
 $+ \dots + \binom{n}{j}x^{n-j}y^j + \dots +$
 $\binom{n}{n-1}xy^{n-1} + y^n$

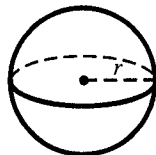
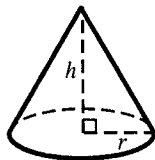
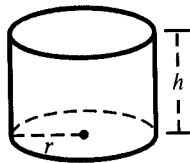
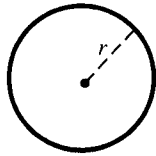
GEOMETRIC FORMULAS



Right Triangle



Any Triangle



● Triangles

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

Area $A = \frac{1}{2}bh$

● Circles

Area $A = \pi r^2$

Circumference $C = 2\pi r$

● Cylinders

Surface Area $S = 2\pi r^2 + 2\pi rh$

Volume $V = \pi r^2 h$

● Cones

Surface Area $S = \pi r^2 + \pi r \sqrt{r^2 + h^2}$

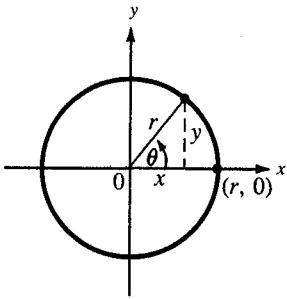
Volume $V = \frac{1}{3}\pi r^2 h$

● Spheres

Surface Area $S = 4\pi r^2$

Volume $V = \frac{4}{3}\pi r^3$

TRIGONOMETRIC FUNCTIONS AND LAWS



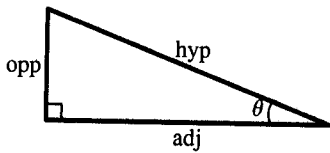
- Definitions Based on the Circle

$$\cos \theta = \frac{x}{r} \qquad \sec \theta = \frac{r}{x}$$

$$\sin \theta = \frac{y}{r} \qquad \csc \theta = \frac{r}{y}$$

$$\tan \theta = \frac{y}{x} \qquad \cot \theta = \frac{x}{y}$$

For the unit circle, $r = 1$

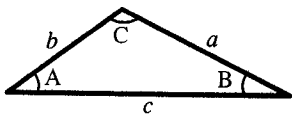


- Definitions Based on the Right Triangle

$$\cos \theta = \frac{\text{adj}}{\text{hyp}} \qquad \sec \theta = \frac{\text{hyp}}{\text{adj}}$$

$$\sin \theta = \frac{\text{opp}}{\text{hyp}} \qquad \csc \theta = \frac{\text{hyp}}{\text{opp}}$$

$$\tan \theta = \frac{\text{opp}}{\text{adj}} \qquad \cot \theta = \frac{\text{adj}}{\text{opp}}$$



- Law of Sines

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

- Law of Cosines

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

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