QUADRATIC FORMULA

If $a \neq 0$, the roots of $ax^2 + bx + c = 0$ are

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

SPECIAL PRODUCT FORMULAS

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

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

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

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

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

SPECIAL FACTORING FORMULAS

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

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

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

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

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

EXPONENTS AND RADICALS

$$a^m a^n = a^{m+n} \qquad a^{1/n} = \sqrt[n]{a}$$

$$(a^m)^n = a^{mn} \qquad a^{m/n} = \sqrt[n]{a^m}$$

$$(ab)^n = a^n b^n \qquad a^{m/n} = \left(\sqrt[n]{a}\right)^m$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \qquad \sqrt[n]{ab} = \sqrt[n]{a}\,\sqrt[n]{b}$$

$$\frac{a^m}{a^n} = a^{m-n} \qquad \sqrt{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$$a^{-n} = \frac{1}{a^n} \qquad \sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$$

BINOMIAL THEOREM

$$(x + y)^n = x^n + \binom{n}{1}x^{n-1}y + \binom{n}{2}x^{n-2}y^2 + \cdots + \binom{n}{k}x^{n-k}y^k + \cdots + y^n,$$

where $$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

INEQUALITIES

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

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

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

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

ABSOLUTE VALUE ($d > 0$)

$|x| < d$ if and only if

$$-d < x < d$$

$|x| > d$ if and only if either

$$x > d \quad \text{or} \quad x < -d$$

MEANS

Arithmetic mean A of n numbers

$$A = \frac{a_1 + a_2 + \cdots + a_n}{n}$$

Geometric mean G of n numbers

$$G = (a_1 a_2 \cdots a_n)^{1/n},\ a_k > 0$$

SEQUENCES

nth term of an arithmetic sequence with first term a_1 and common difference d

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

Sum S_n of the first n terms of an arithmetic sequence

$$S_n = \frac{n}{2}(a_1 + a_n)$$

or $$S_n = \frac{n}{2}[2a_1 + (n - 1)d]$$

nth term of a geometric sequence with first term a_1 and common ratio r

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

Sum S_n of the first n terms of a geometric sequence

$$S_n = \frac{a_1(1 - r^n)}{1 - r}$$

EXPONENTIALS AND LOGARITHMS

$y = \log_a x$ means $a^y = x$

$$\log_a xy = \log_a x + \log_a y$$

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

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

$$a^{\log_a x} = x$$

$$\log_a a^x = x$$

$$\log_a 1 = 0$$

$$\log_a a = 1$$

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

$$\ln x = \log_e x$$

$$\log_b u = \frac{\log_a u}{\log_a b}$$