Algebra

$$(x+k)(x-k) = x^2 - k^2$$
$$(x+k)^2 = x^2 + 2kx + k^2$$
$$(x-k)^2 = x^2 - 2kx + k^2$$
$$x^3 \pm k^3 = (x \pm k)(x^2 \mp kx + k^2)$$

Formula for solving a quadratic equation:

if $ax^2 + bx + c = 0$ then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Laws of Indices

$$a^m a^n = a^{m+n} \qquad \frac{a^m}{a^n} = a^{m-n} \qquad (a^m)^n = a^{mn}$$

$$a^0 = 1 \qquad a^{-m} = \frac{1}{a^m} \qquad a^{1/n} = \sqrt[n]{a} \qquad a^{\frac{m}{n}} = (\sqrt[n]{a})^m$$

Laws of Logarithms

For any positive base b (with $b \neq 1$)

$$\log_b A = c \quad \text{means} \quad A = b^c$$

$$\log_b A + \log_b B = \log_b AB, \qquad \log_b A - \log_b B = \log_b \frac{A}{B},$$
$$n \log_b A = \log_b A^n, \qquad \log_b 1 = 0, \qquad \log_b b = 1$$

Formula for change of base: $\log_a x = \frac{\log_b x}{\log_b a}$

Logarithms to base e, denoted $\log_{\mathrm{e}}$ or alternatively $\ln$ are called *natural logarithms*. The letter e stands for the exponential constant which is approximately 2.718.

Partial fractions

For *proper fractions* $\frac{P(x)}{Q(x)}$ where P and Q are polynomials with the degree of P less than the degree of Q:

a *linear factor* $ax+b$ in the denominator produces a partial fraction of the form $\frac{A}{ax+b}$

repeated linear factors $(ax+b)^2$ in the denominator produce partial fractions of the form $\frac{A}{ax+b}+\frac{B}{(ax+b)^2}$

a *quadratic factor* ax^2+bx+c in the denominator produces a partial fraction of the form $\frac{Ax+B}{ax^2+bx+c}$

Improper fractions require an additional term which is a polynomial of degree $n-d$ where n is the degree of the numerator and d is the degree of the denominator.

Inequalities:

$a > b$ means a is greater than b

$a < b$ means a is less than b

$a \geqslant b$ means a is greater than or equal to b

$a \leqslant b$ means a is less than or equal to b