



Mathematics

Formula Sheet

Differentiation

y	$\frac{dy}{dx}$
a (any constant)	0
ax	a
ax^n	$n \times ax^{n-1}$
ae^{nx}	$n \times ae^{nx}$
$a \ln(nx)$	$\frac{a}{x}$
$a \sin(nx)$	$n \times a \cos(nx)$
$a \cos(nx)$	$-n \times a \sin(nx)$
$a \sinh(nx)$	$n \times a \cosh(nx)$
$a \cosh(nx)$	$n \times a \sinh(nx)$

Product Rule

$$\text{If } y = uv \quad \text{then} \quad \frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

Quotient Rule

$$\text{If } y = \frac{u}{v} \quad \text{then} \quad \frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

Chain Rule

$$\text{If } y = f(u) \text{ and } u = g(x) \quad \text{then} \quad \frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

Integration by Parts

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

Integration

y	$\int y \, dx$
a (any constant)	$ax + C$
ax^n	$\frac{ax^{n+1}}{n+1} + C \quad (n \neq -1)$
ae^{nx}	$\frac{ae^{nx}}{n} + C$
$\frac{a}{x}$	$a \ln x + C$
$\frac{a}{nx+b}$	$\frac{a \ln(nx+b)}{n} + C$
$a \sin(nx)$	$\frac{-a \cos(nx)}{n} + C$
$a \cos(nx)$	$\frac{a \sin(nx)}{n} + C$
$a \sinh(nx)$	$\frac{a \cosh(nx)}{n} + C$
$a \cosh(nx)$	$\frac{a \sinh(nx)}{n} + C$

The Quadratic Equation

For the quadratic equation $ax^2 + bx + c = 0$:

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

Completing the Square

For the quadratic equation $ax^2 + bx + c = 0$, where $a = 1$:

$$\left(x + \frac{b}{2}\right)^2 + c - \left(\frac{b}{2}\right)^2$$

Modulus and Argument

Given a complex number in the form $z = x + jb$, the modulus, r , and argument, θ can be determined by:

$$r = \sqrt{x^2 + y^2} \quad \theta = \tan^{-1} \left(\frac{y}{x} \right)$$

Volume of Revolution

$$V = \int_a^b \pi y^2 \, dx$$

Vector Analysis

Given the matrix:

$$\underline{A} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

then the determinant:

$$\det \underline{A} = |\underline{A}| = ad - bc$$

and the inverse:

$$\text{inv} \underline{A} = \underline{A}^{-1} = \frac{1}{|\underline{A}|} \times \text{adj} \underline{A} = \frac{1}{|\underline{A}|} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$

Rules of Indices

$$a^m \times a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^m \div a^n = a^{m-n}$$

$$\frac{A}{a^n} = Aa^{-n}$$

$$a^0 = 1$$

$$a^1 = a$$

$$\sqrt[n]{a} = a^{\frac{1}{n}}$$

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

$$(a^m)^n = a^{m \times n}$$

Rules for Fractions

Multiplying Fractions

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

Dividing Fractions

$$\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$$

Triange Geometry

Right angled triangles

Pythagoras' theorem:

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

where a is the hypotenuse and b, c are the other two sides.

General rules for triangles

Sine rule:

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

Cosine rule:

$$a^2 = b^2 + c^2 - 2bc \cos(A) \quad \text{or} \quad \cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$$

Numerical Prefixes

Prefix	Symbol	Meaning
Giga	G	$\times 10^9$
Mega	M	$\times 10^6$
Kilo	k	$\times 10^3$
Milli	m	$\times 10^{-3}$
Micro	μ	$\times 10^{-6}$
Nano	n	$\times 10^{-9}$