

OCR A Level Maths Formula Mat Formulae and Identities You Need to Know

Laws of Indices

$$a^m a^n \equiv a^{m+n}$$

$$\frac{a^m}{a^n} \equiv a^{m-n}$$

$$(a^m)^n \equiv a^{mn}$$

Laws of Logarithms

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

$$\log_a x + \log_a y \equiv \log_a (xy)$$

$$\log_a x - \log_a y \equiv \log_a \left(\frac{x}{y}\right)$$

$$\log_a a \equiv \log_a (a^1)$$

Coordinate Geometry

A straight line, gradient m , through (x_1, y_1) has equation $y - y_1 = m(x - x_1)$.

Straight lines with gradient m_1 and m_2 are perpendicular when $m_1 m_2 = -1$.

Sequences

Arithmetic progression:

$$u_n = a + (n-1)d$$

Geometric progression:

$$u_n = ar^{n-1}$$

Trigonometry

$$\text{Sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Cosine rule: } a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area: area} = \frac{1}{2} ab \sin C$$

$$\tan A = \frac{\sin A}{\cos A}$$

$$\sec A = \frac{1}{\cos A}$$

$$\csc A = \frac{1}{\sin A}$$

$$\cot A = \frac{1}{\tan A}$$

$$\cos^2 A + \sin^2 A \equiv 1$$

$$\sec^2 A \equiv 1 + \tan^2 A$$

$$\csc^2 A \equiv 1 + \cot^2 A$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Mechanics

$$\text{weight} = mg$$

$$F = pR$$

$$F = ma$$

$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt}$$

$$a = \frac{d^2x}{dt^2}$$

$$v = \int a \, dt$$

Perimeter, Area and Volume

For a circle radius r and diameter d :

$$C = 2\pi r = \pi d$$

$$A = \pi r^2$$

For a trapezium with parallel sides a and b and height h :

$$\text{Area} = \frac{1}{2}(a+b)h$$

For a sector radius r , angle θ (in radians) and arc length s :

$$s = r\theta$$

$$A = \frac{1}{2}r^2\theta$$

Integration

Function	Integral
$\sin bx$	$-\frac{1}{b} \cos(bx) + c$
$\cos bx$	$\frac{1}{b} \sin(bx) + c$
e^{ax}	$\frac{1}{a} e^{ax} + c$
$\frac{1}{x}$	$\ln x + c, x \neq 0$

Reverse Chain rule:

$$\int f(g(x))g'(x) \, dx = f(g(x)) + c$$

Differentiation

Function	Derivative
$\sin x$	$\cos(x)$
$\cos x$	$-\sin(x)$
e^x	e^x
$\ln x$	$\frac{1}{x}$

Chain rule:

$$\text{If } y = f(g(x)), \frac{dy}{dx} = f'(g(x)) \frac{dg}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

Product rule:

The derivative of $y = f(x)g(x)$:

$$\frac{dy}{dx} = f(x)g'(x) + f'(x)g(x)$$

$$\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

Statistics

The mean of a set of data:

$$\bar{x} = \frac{\sum x}{n} = \frac{\sum fx}{\sum f}$$

The standard Normal variable:

$$Z = \frac{x - \mu}{\sigma} \text{ where } Z \sim N(0, 1)$$

Vectors

$$|a + b + c| = \sqrt{a^2 + b^2 + c^2}$$

OCR A Level Maths Formula Mat Formulae and Identities You Will be Given

Trigonometric Identities

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B} \quad (A \pm B \neq (2k + \frac{1}{2})\pi)$$

Numerical Methods

Trapezium rule:

$$\int_a^b f(x) \, dx \approx \frac{1}{2}h(y_0 + y_1) + 2(y_1 + y_2 + \dots + y_{n-1})$$

where $h = \frac{b-a}{n}$

Newton-Raphson method:

$$f(x) = 0; x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

Standard Deviation

$$\sqrt{\frac{\sum(x-\bar{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2} \quad \text{or} \quad \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n}} = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

The Binomial Distribution

If $X \sim B(n, p)$ then:

$$P(X=x) = \binom{n}{x} p^x (1-p)^{n-x}$$

Mean of $X = np$

Variance of $X = np(1-p)$

The Normal Distribution

If $X \sim N(\mu, \sigma^2)$ then:

$$X \sim N\left(\mu, \frac{\sigma^2}{n}\right)$$

$$\frac{X - \mu}{\sigma} \sim N(0, 1)$$

Small Angle Approximations

Where θ is measured in radians and small:

$$\sin \theta \approx \theta$$

$$\cos \theta \approx 1 - \frac{1}{2}\theta^2$$

$$\tan \theta \approx \theta$$

Kinematics

Motion in a straight line:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \frac{1}{2}(u+v)t$$

$$s = \frac{1}{2}at^2 + vt$$

Motion in two dimensions:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \frac{1}{2}(u+v)t$$

Differentiation

Function	Derivative
$\tan x$	$\sec^2 x$
$\sec x$	$\sec x \tan x$
$\cot x$	$-\csc^2 x$
$\csc x$	$-\csc x \cot x$

First principles:

$$f'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$$

Quotient rule:

$$f' = \frac{u}{v}, \quad \frac{df}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

Integration

$$\int \frac{f'(x)}{f(x)} \, dx = \ln|f(x)| + c$$

$$\int f(x)g(x) \, dx = \frac{1}{n+1}f(x)g(x)^{n+1} + c$$

Integration by parts:

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

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Paul Sanders



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