



Formulae for A-level Mathematics

AS Mathematics (7356)

A-level Mathematics (7357)

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For the specifications first taught from September 2017.

This booklet of formulae is required for all AS and A-level Mathematics exams.

There is a larger booklet of formulae and statistical tables for all AS and A-level Further Mathematics exams.

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Pure mathematics

Binomial expansion

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1}b + \binom{n}{2} a^{n-2}b^2 + \dots + \binom{n}{r} a^{n-r}b^r + \dots + b^n \quad \text{for } n \in \mathbb{N}$$

$$\text{where } \binom{n}{r} = {}^nC_r = \frac{n!}{r!(n-r)!}$$

$$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots \quad \text{for } |x| < 1, n \in \mathbb{Q}$$

Arithmetic series

$$S_n = \frac{1}{2} n(a + l) = \frac{1}{2} n(2a + (n-1)d)$$

Geometric series

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

$$S_\infty = \frac{a}{1 - r} \quad \text{for } |r| < 1$$

Trigonometry: small angles

For small angle θ , measured in radians:

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

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

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

Trigonometric identities

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

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

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

Differentiation

$f(x)$	$f'(x)$
$\tan x$	$\sec^2 x$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$
$\sec x$	$\sec x \tan x$
$\cot x$	$-\operatorname{cosec}^2 x$
$\frac{f(x)}{g(x)}$	$\frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$

Differentiation from first principles

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

Integration

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

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

$f(x)$	$\int f(x) dx$
$\tan x$	$\ln \sec x + c$
$\cot x$	$\ln \sin x + c$

Numerical solution of equations

The Newton-Raphson iteration for solving $f(x) = 0$: $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$

Numerical integration

The trapezium rule: $\int_a^b y dx \approx \frac{1}{2} h ((y_0 + y_n) + 2(y_1 + y_2 + \dots + y_{n-1}))$, where $h = \frac{b-a}{n}$

Mechanics

Constant acceleration

$$s = ut + \frac{1}{2} at^2 \quad \mathbf{s} = \mathbf{u}t + \frac{1}{2} \mathbf{a}t^2$$

$$s = vt - \frac{1}{2} at^2 \quad \mathbf{s} = \mathbf{v}t - \frac{1}{2} \mathbf{a}t^2$$

$$v = u + at \quad \mathbf{v} = \mathbf{u} + \mathbf{a}t$$

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

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

Probability and statistics

Probability

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) \times P(B|A)$$

Standard deviation

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

Discrete distributions

Distribution of X	$P(X = x)$	Mean	Variance
Binomial $B(n, p)$	$\binom{n}{x} p^x (1 - p)^{n-x}$	np	$np(1 - p)$

Sampling distributions

For a random sample of n observations from $N(\mu, \sigma^2)$:

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

End of formulae

