

1 Given in Your Exam

These formulas are in the Edexcel "Mathematical Formulae and Statistical Tables" booklet. You don't need to memorise them, but you do need to know when and how to use each one. It also includes tables: binomial cumulative probabilities, percentage points of the normal distribution, critical values for correlation coefficients and random numbers.

PURE



Sphere and Cone

Surface area of a sphere = $4\pi r^2$

Curved surface area of a cone = $\pi r \times \text{slant height}$



Arithmetic Series

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

a is the first term, l the last term, d the common difference

Binomial Series

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

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

For positive whole numbers n



General Binomial Expansion

$$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots$$

Valid for $|x| < 1$ when n is negative or a fraction

Logarithms and Exponentials

$$\log_a x = \frac{\log_b x}{\log_b a}$$

$$e^{x \ln a} = a^x$$

Change of base

Geometric Series

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

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

a is the first term, r the common ratio

Compound Angle Formulae

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

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

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

Sum-to-Product Formulae

$$\sin A + \sin B = 2 \sin \frac{A+B}{2} \cos \frac{A-B}{2}$$

$$\sin A - \sin B = 2 \cos \frac{A+B}{2} \sin \frac{A-B}{2}$$

$$\cos A + \cos B = 2 \cos \frac{A+B}{2} \cos \frac{A-B}{2}$$

$$\cos A - \cos B = -2 \sin \frac{A+B}{2} \sin \frac{A-B}{2}$$

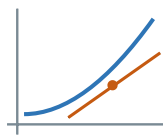
Small Angle Approximations

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

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

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

θ in radians



Differentiation From First Principles

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

Derivatives of Trig Functions

$$\tan kx \rightarrow k \sec^2 kx$$

$$\sec kx \rightarrow k \sec kx \tan kx$$

$$\cot kx \rightarrow -k \operatorname{cosec}^2 kx$$

$$\operatorname{cosec} kx \rightarrow -k \operatorname{cosec} kx \cot kx$$

$$f(x) \rightarrow f'(x)$$

Quotient Rule

$$y = \frac{u}{v} \Rightarrow \frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

Standard Integrals

$$\sec^2 kx \rightarrow \frac{1}{k} \tan kx$$

$$\tan kx \rightarrow \frac{1}{k} \ln |\sec kx|$$

$$\cot kx \rightarrow \frac{1}{k} \ln |\sin kx|$$

$$\operatorname{cosec} kx \rightarrow -\frac{1}{k} \ln |\operatorname{cosec} kx + \cot kx|$$

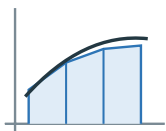
$$\sec kx \rightarrow \frac{1}{k} \ln |\sec kx + \tan kx|$$

Add + c to each

Integration by Parts

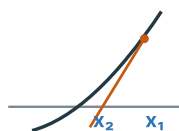
$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

The Trapezium Rule



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

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



Newton-Raphson Method

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

MECHANICS

Constant Acceleration (suvat)

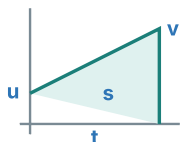
$$v = u + at$$

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

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

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

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



Motion in a straight line with constant acceleration

STATISTICS

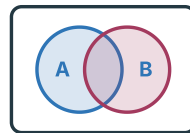
Probability

$$P(A') = 1 - P(A)$$

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

$$P(A|B) = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A')P(A')}$$

$$\text{Independent: } P(A \cap B) = P(A)P(B)$$



Probability: A or B

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

Standard Deviation and IQR

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

$$\sigma = \sqrt{\frac{S_{xx}}{n}} \text{ or } \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

$$\text{IQR} = Q_3 - Q_1$$

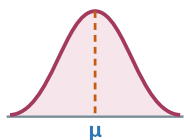
The Binomial Distribution

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

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

$$\text{Mean} = np$$

$$\text{Variance} = np(1 - p)$$



Sample Mean From a Normal Distribution

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

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

Used in hypothesis tests for the mean

2 Learn These by Heart

These are **not** given in the exam. Students lose marks on them every year, so learn them until you can write them from memory.

ALGEBRA AND FUNCTIONS



The Quadratic Formula

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

Laws of Indices

$$a^x \times a^y = a^{x+y}$$

$$a^x \div a^y = a^{x-y}$$

$$(a^x)^y = a^{xy}$$

Laws of Logarithms

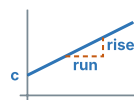
$$x = a^n \Leftrightarrow n = \log_a x$$

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

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

$$k \log_a x = \log_a (x^k)$$

$$a > 0, x > 0$$



Straight Lines

$$y - y_1 = m(x - x_1)$$

$$\text{Perpendicular: } m_1 m_2 = -1$$

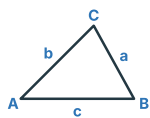
nth Terms of Sequences

$$\text{Arithmetic: } u_n = a + (n - 1)d$$

$$\text{Geometric: } u_n = ar^{n-1}$$

TRIGONOMETRY

Sine Rule, Cosine Rule and Area



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

$$a^2 = b^2 + c^2 - 2bc \cos A$$

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

Pythagorean Identities

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

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

$$\operatorname{cosec}^2 A \equiv 1 + \cot^2 A$$

Double Angle Formulae

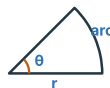
$$\sin 2A \equiv 2 \sin A \cos A$$

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

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

$\cos 2A$ can also be written as $2\cos^2 A - 1$ or $1 - 2\sin^2 A$

Arc Length and Sector Area



$$s = r\theta$$

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

θ in radians

MENSURATION

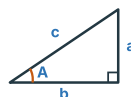
Circles



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

$$A = \pi r^2$$

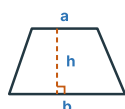
Pythagoras' Theorem



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

c is the hypotenuse

Trapezium and Prism



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

$$\text{Volume of a prism} = \text{area of cross-section} \times \text{length}$$

CALCULUS AND VECTORS

Standard Derivatives

$$x^n \rightarrow nx^{n-1}$$

$$\sin kx \rightarrow k \cos kx$$

$$\cos kx \rightarrow -k \sin kx$$

$$e^{kx} \rightarrow ke^{kx}$$

$$\ln x \rightarrow \frac{1}{x}$$

$$f(x) \rightarrow f'(x)$$

Product and Chain Rules

$$(fg)' = f'g + fg'$$

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

Standard Integrals

$$x^n \rightarrow \frac{x^{n+1}}{n+1} \quad (n \neq -1)$$

$$\cos kx \rightarrow \frac{1}{k} \sin kx$$

$$\sin kx \rightarrow -\frac{1}{k} \cos kx$$

$$e^{kx} \rightarrow \frac{1}{k} e^{kx}$$

$$\frac{1}{x} \rightarrow \ln|x|$$

Add $+ c$ to each

Reverse Chain Rule and Area

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

$$\text{Area under a curve} = \int_a^b y dx \quad (y \geq 0)$$

Magnitude of a Vector

$$|xi + yj + zk| = \sqrt{x^2 + y^2 + z^2}$$

MECHANICS

Forces and Newton's Second Law

$$\text{Weight} = mg$$

$$\text{Friction: } F \leq \mu R$$

$$F = ma$$

Use $g = 9.8 \text{ m s}^{-2}$ unless told otherwise

Variable Acceleration

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

$$a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$$

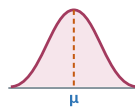
$$r = \int v \, dt$$

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

STATISTICS

Mean

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



Standardising a Normal Variable

$$Z = \frac{X - \mu}{\sigma}, \text{ where } X \sim N(\mu, \sigma^2)$$

Write It First

Write the formula down before you substitute. You can earn a method mark even if the answer goes wrong.

Check the Units

Make sure every length is in the same unit before you use a formula.

Test Yourself

Cover the right-hand side of each card and try to write the formula from memory.

Need Help Using These Formulas?

Book a free 90-minute lesson and I'll show your child exactly when and how to use each one.

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