A Formulary for Mathematics

A collection of the
Formulas, Facts and Figures
often needed in
mathematics

These are some of the pages of the first rough draft of a booklet which has now been published

It is in a handier A5 size, contains twice as much material as this, and uses a second colour (red) as a help in picking out the salient points on each page.

In addition, there is a set of work-sheets based on the booklet aimed at encouraging familiarity in its use, and developing some mathematical ideas.

Full details can be found at
www.cleavebooks.com

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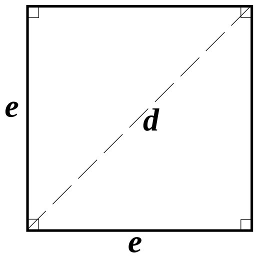
Square



$\boldsymbol{e}$ = **e**dge length
$\boldsymbol{d}$ = **d**iagonal length
$\boldsymbol{P}$ = **p**erimeter length
$\boldsymbol{A}$ = **a**rea

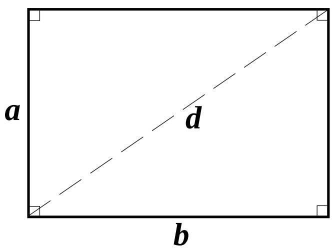
$\boldsymbol{P} = 4 \times e$ $\quad \boldsymbol{P} = 4 \times \sqrt{A}$ $\quad \boldsymbol{P} = 2 \times d \times \sqrt{2}$

$\boldsymbol{A} = e^2$ $\quad \boldsymbol{A} = d^2 \div 2$ $\quad \boldsymbol{A} = P^2 \div 16$

$\boldsymbol{d} = e \times \sqrt{2}$ $\quad \boldsymbol{d} = \sqrt{2 \times A}$ $\quad \boldsymbol{d} = \dfrac{P \times \sqrt{2}}{4}$

$\boldsymbol{e} = \sqrt{A}$ $\quad \boldsymbol{e} = P \div 4$ $\quad \boldsymbol{e} = \dfrac{d \times \sqrt{2}}{2}$

Oblong



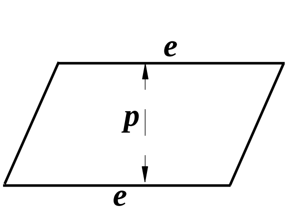
$\boldsymbol{a, b}$ = edge lengths
$\boldsymbol{d}$ = **d**iagonal length
$\boldsymbol{P}$ = **p**erimeter length
$\boldsymbol{A}$ = **a**rea

$\boldsymbol{P} = 2 \times (a + b)$ $\quad \boldsymbol{a} = \dfrac{P}{2} - b$ $\quad \boldsymbol{b} = \dfrac{P}{2} - a$

$\boldsymbol{d} = \sqrt{a^2 + b^2}$ $\quad \boldsymbol{a} = \sqrt{d^2 - b^2}$ $\quad \boldsymbol{b} = \sqrt{d^2 - a^2}$

$\boldsymbol{A} = a \times b$ $\quad \boldsymbol{a} = A \div b$ $\quad \boldsymbol{b} = A \div a$

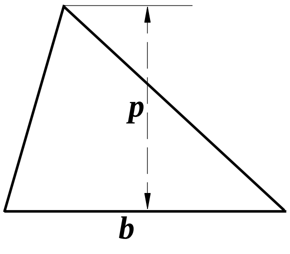
Parallelogram



$\boldsymbol{e}$ = **e**dge lengths of two parallel edges
$\boldsymbol{p}$ = **p**erpendicular distance between them
$\boldsymbol{A}$ = **a**rea

$\boldsymbol{A} = p \times e$

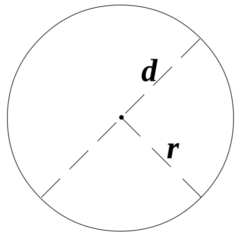
Triangle



$\boldsymbol{b}$ = **b**ase length
$\boldsymbol{p}$ = **p**erpendicular height
$\boldsymbol{A}$ = **a**rea

$\boldsymbol{A} = p \times b \div 2$

Circle



$\boldsymbol{r}$ = **r**adius length
$\boldsymbol{d}$ = **d**iameter length
$\boldsymbol{C}$ = **c**ircumference length
$\boldsymbol{A}$ = **a**rea

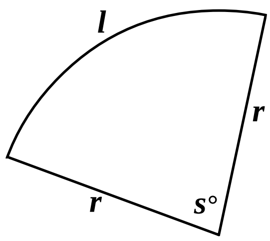
$\boldsymbol{C} = 2 \times \pi \times r$ $\quad \boldsymbol{C} = \pi \times d$ $\quad \boldsymbol{C} = 2 \times \sqrt{A \times \pi}$

$\boldsymbol{A} = \pi \times r^2$ $\quad \boldsymbol{A} = \dfrac{\pi \times d^2}{4}$ $\quad \boldsymbol{A} = \dfrac{C^2}{4 \times \pi}$

$\boldsymbol{d} = 2 \times r$ $\quad \boldsymbol{d} = 2 \times \sqrt{\dfrac{A}{\pi}}$ $\quad \boldsymbol{d} = C \div \pi$

$\boldsymbol{r} = d \div 2$ $\quad \boldsymbol{r} = \sqrt{\dfrac{A}{\pi}}$ $\quad \boldsymbol{r} = \dfrac{C}{2 \times \pi}$

Sector



$\boldsymbol{s}°$ = **s**ector angle *(in degrees)*
$\boldsymbol{l}$ = **l**ength of arc
$\boldsymbol{r}$ = **r**adius of circle
$\boldsymbol{A}$ = **a**rea of sector

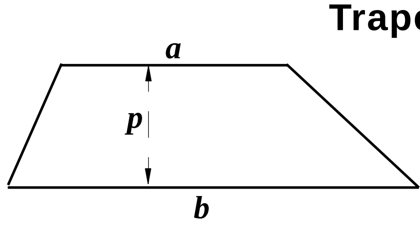
$\boldsymbol{l} = \pi \times r \times s° \div 180$

$\boldsymbol{A} = \pi \times r^2 \times s° \div 360$ $\quad \boldsymbol{A} = r \times l \div 2$

$\boldsymbol{r} = 2 \times A \div l$ $\quad \boldsymbol{l} = 2 \times A \div r$

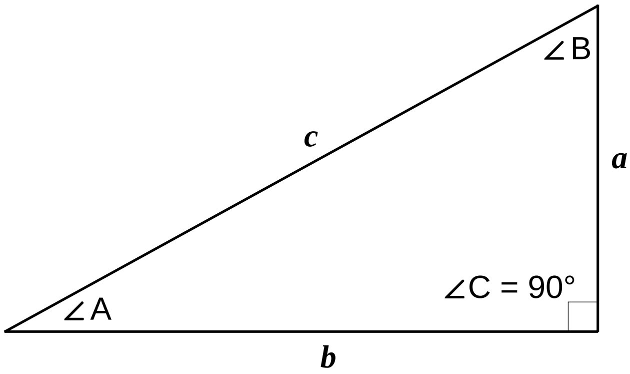
$\boldsymbol{r} = \dfrac{180\, l}{\pi\, s°}$ $\quad \boldsymbol{s}° = \dfrac{180\, l}{\pi\, r}$ $\quad \boldsymbol{s}° = \dfrac{360\, A}{\pi\, r^2}$

Trapezium



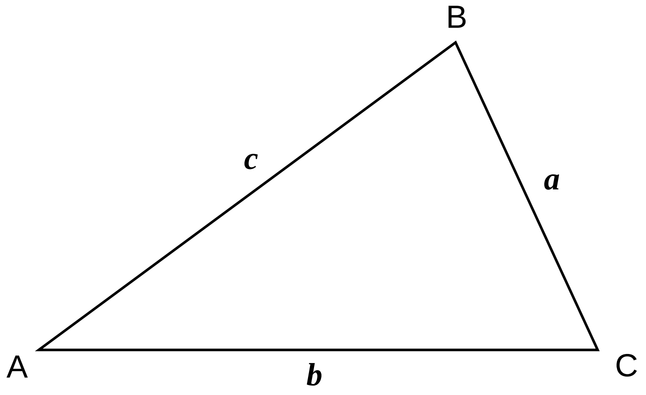
$\boldsymbol{a, b}$ = edge lengths of two parallel edges
$\boldsymbol{p}$ = **p**erpendicular distance between them
$\boldsymbol{A}$ = **a**rea

$\boldsymbol{A} = p \times (a + b) \div 2$



Take care to match given data to the correct letters

Given	Use the formula from the appropriate box below to find				
	$\boldsymbol{a}$	$\boldsymbol{b}$	$\boldsymbol{c}$	∠A	∠B
$\boldsymbol{a}$ $\boldsymbol{b}$			$c = \sqrt{a^2 + b^2}$	tan A $= a \div b$	tan B $= b \div a$
$\boldsymbol{a}$ $\boldsymbol{c}$		$b = \sqrt{c^2 - a^2}$		sin A $= a \div c$	cos B $= a \div c$
$\boldsymbol{b}$ $\boldsymbol{c}$	$a = \sqrt{c^2 - b^2}$			cos A $= b \div c$	sin B $= b \div c$
$\boldsymbol{a}$ ∠A		ê	$c = a \div$ sin A		B = 90° – A
$\boldsymbol{a}$ ∠B		$b = a \times$ tan B	$c = a \div$ cos B	A = 90° – B	
$\boldsymbol{b}$ ∠A	$a = b \times$ tan A		$c = b \div$ cos A		B = 90° – A
$\boldsymbol{b}$ ∠B	$a = b \div$ tan B		$c = b \div$ sin B	A = 90° – B	
$\boldsymbol{c}$ ∠A	$a = c \times$ sin A	$b = c \times$ cos A			B = 90° – A
$\boldsymbol{c}$ ∠B	$a = c \times$ cos B	$b = c \times$ sin B		A = 90° – B	



The semi-perimeter is given by $s = (a + b + c) \div 2$ which is more usually written as

$$s = \frac{a+b+c}{2}$$

Δ is the symbol for **area**

Area = $\frac{1}{2}ab\sin C$ *or* $\frac{1}{2}ac\sin B$ *or* $\frac{1}{2}bc\sin A$ *or* $\sqrt{s(s-a)(s-b)(s-c)}$

Sine Rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule

$a^2 = b^2 + c^2 - 2bc\cos A$ *or* $\cos A = (b^2 + c^2 - a^2) \div 2bc$

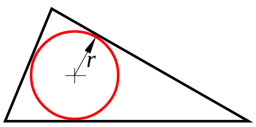
$b^2 = a^2 + c^2 - 2ac\cos B$ *or* $\cos B = (a^2 + c^2 - b^2) \div 2ac$

$c^2 = a^2 + b^2 - 2ab\cos C$ *or* $\cos C = (a^2 + b^2 - c^2) \div 2ab$

Tangent Rule $\tan\dfrac{B-C}{2} = \dfrac{b-c}{b+c}\cot\dfrac{A}{2}$

Half-angle Formulas $\sin\dfrac{A}{2} = \sqrt{\dfrac{(s-b)(s-c)}{bc}}$ $\quad \cos\dfrac{A}{2} = \sqrt{\dfrac{s(s-a)}{bc}}$ $\quad \tan\dfrac{A}{2} = \sqrt{\dfrac{(s-b)(s-c)}{s(s-a)}}$

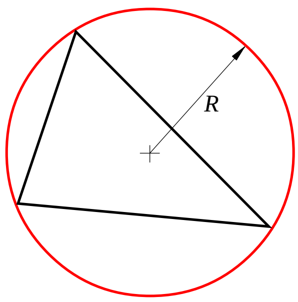
Inscribed Circle



Δ = Area

radius $r = \dfrac{\Delta}{s}$

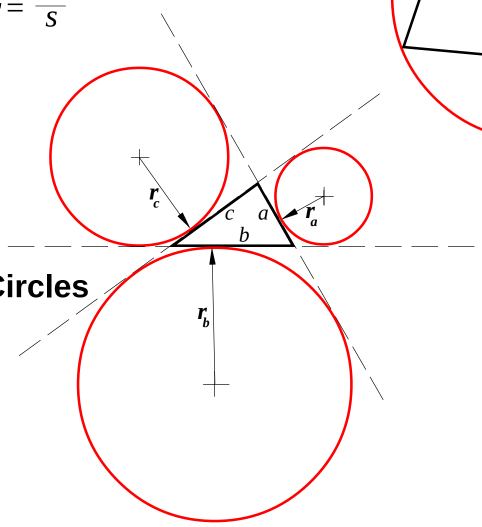
Circumscribed Circle



Radius $R = \dfrac{abc}{4\Delta}$

$R = \dfrac{a}{2\sin A}$ *or* $\dfrac{b}{2\sin B}$ *or* $\dfrac{c}{2\sin C}$

Escribed Circles

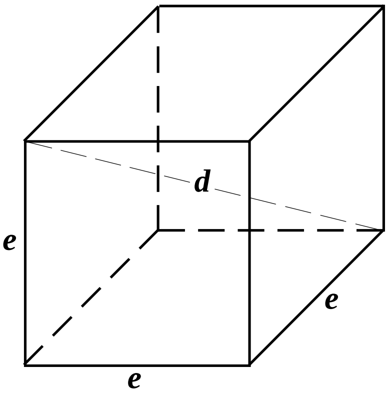


The different radii needed for the three possible escribed circles are identified by the letters of the edge on which each circle is placed $\mathbf{r}_a$ $\mathbf{r}_b$ $\mathbf{r}_c$

$\mathbf{r}_a = \dfrac{\Delta}{s-a}$ $\quad \mathbf{r}_b = \dfrac{\Delta}{s-b}$ $\quad \mathbf{r}_c = \dfrac{\Delta}{s-c}$

All the above formulas are **cyclic**
That is, the six variables (a, b, c, A, B, C) can be changed around as long as the pattern of the formula is kept.
This is best seen in the **Cosine Rule** where all three possible variations are given, and the pattern is clear.

Cube



e = **e**dge length
d = **d**iagonal length
S = **s**urface area
V = **v**olume

$S = 6 \times e^2$ $\quad V = e^3$ $\quad d = e \times \sqrt{3}$

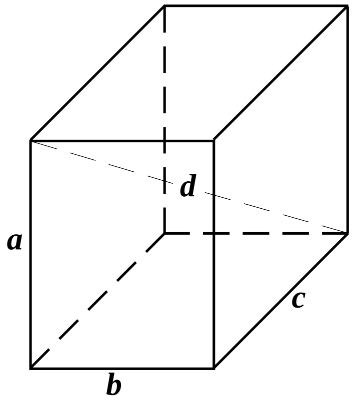
$e = \sqrt{\dfrac{S}{6}}$ $\quad e = \sqrt[3]{V}$ $\quad e = d \div \sqrt{3}$

$S = 6 \times \sqrt[3]{V^2}$ $\quad S = 2 \times d^2$

$V = \sqrt{\dfrac{S^3}{216}}$ $\quad V = \dfrac{d^3 \times \sqrt{3}}{9}$

$d = e\sqrt{\dfrac{S}{2}}$

Cuboid



a, b, c = edge lengths
d = **d**iagonal length
S = **s**urface area
V = **v**olume

$V = a \times b \times c$

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

$S = 2 \times (ab + bc + bc)$

$a = \dfrac{V}{bc}$ $\quad b = \dfrac{V}{ac}$ $\quad c = \dfrac{V}{ab}$

Regular Polyhedrons

Associated with any regular convex polyhedron are two particular spheres.
A **circumsphere** is the sphere drawn around the *outside* of a regular convex polyhedron so as as to touch every vertex of that polyhedron.
An **insphere** is the sphere drawn around the *inside* of a regular convex polyhedron so as as to touch every face of that polyhedron.
If the edge length of the polyhedron is ***e*** then

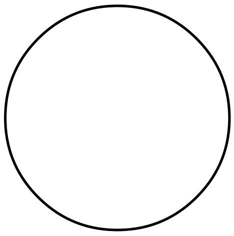
- **area** of the surface of the **polyhedron** is given by $e^2 \times$ A-factor
- **volume** of the **polyhedron** is given by $e^3 \times$ V-factor
- **radius** of the **circumsphere** is given by $e \times$ C-factor
- **radius** of the **insphere** is given by $e \times$ I-factor

The necessary factors are to be found in the table below.
The size of the dihedral angle (in degrees) between faces is also given

No. of faces	Name	A-factor	V-factor	C-factor	I-factor	Dihedral Angle
4	tetrahedron	1.73205	0.117851	0.612372	0.204124	70.5333
6	cube	6	1	0.866025	0.5	90
8	octahedron	3.46410	0.471405	0.707107	0.408248	109.467
12	dodecahedron	20.6458	7.66312	1.40126	1.11352	116.565
20	icosahedron	8.66025	2.18170	0.951057	0.755761	138.190

Except for values which are exact, all others are given to 6 significant figures.

Sphere



r = **r**adius
d = **d**iameter
C = **c**ircumference
A = **a**rea of surface
V = **v**olume

$$C = 2 \times \pi \times r \quad or \quad \pi \times d$$

$$A = 4 \times \pi \times r^2 \quad or \quad \pi \times d^2$$

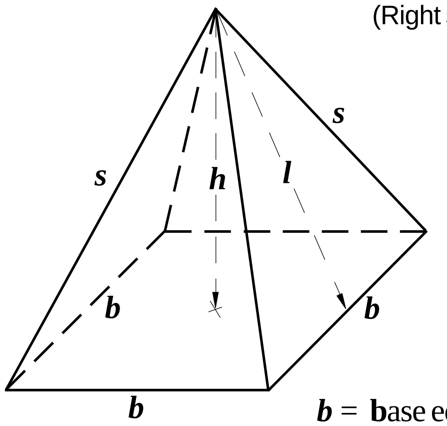
$$V = 4 \times \pi \times r^3 \div 3 \quad or \quad \pi \times d^3 \div 6$$

$$d = 2 \times r \quad or \quad \sqrt{\frac{A}{\pi}} \quad or \quad \sqrt[3]{\frac{6V}{\pi}}$$

$$r = d \div 2 \quad or \quad \frac{1}{2}\sqrt{\frac{A}{\pi}} \quad or \quad \sqrt[3]{\frac{3V}{4\pi}}$$

Pyramid

(Right square-based)



b = **b**ase edge length
s = **s**lant edge length
h = perpendicular **h**eight
l = s**l**ant height
V = **v**olume

$$V = b^2 \times h \div 3$$

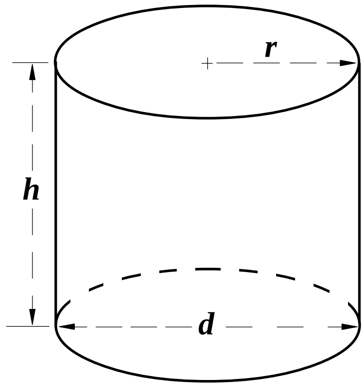
$$h = 3 \times V \div b^2 \qquad b = \sqrt{\frac{3V}{h}}$$

$$s = \sqrt{h^2 + \frac{b^2}{2}} \qquad b = \sqrt{2(s^2 - h^2)}$$

$$h = \sqrt{s^2 - \frac{b^2}{2}} \qquad b = 2\sqrt{(l^2 - h^2)}$$

$$l = \sqrt{h^2 + \frac{b^2}{4}} \qquad h = \sqrt{l^2 - \frac{b^2}{4}}$$

Cylinder



r = **r**adius
d = **d**iameter
h = **h**eight
C = **c**urved area *(without ends)*
T = **t**otal area *(with ends)*
V = **v**olume

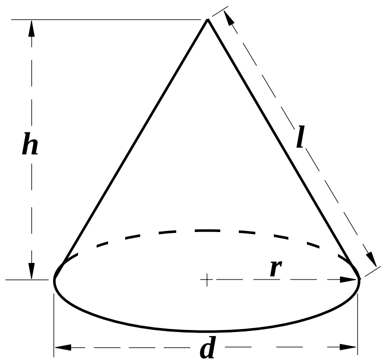
$$V = \pi \times r^2 \times h \quad or \quad \pi \times d^2 \times h \div 4 \quad or \quad \frac{C \times r}{2}$$

$$C = 2 \times \pi \times r \times h \quad or \quad \pi \times d \times h \quad or \quad \frac{2 \times V}{r}$$

$$T = 2 \times \pi \times r \times (r + h)$$

Cone

(Right circular)



r = **r**adius of base circle
d = **d**iameter of base
h = perpendicular **h**eight
l = s**l**ant height
C = **c**urved area *(without base)*
V = **v**olume

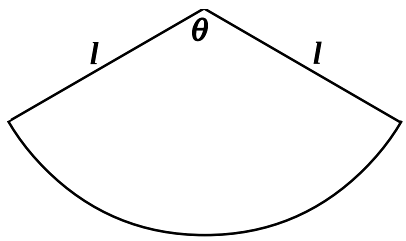
$$r = d \div 2$$

$$l = \sqrt{r^2 + h^2} \qquad h = \sqrt{l^2 - r^2} \qquad r = \sqrt{l^2 - h^2}$$

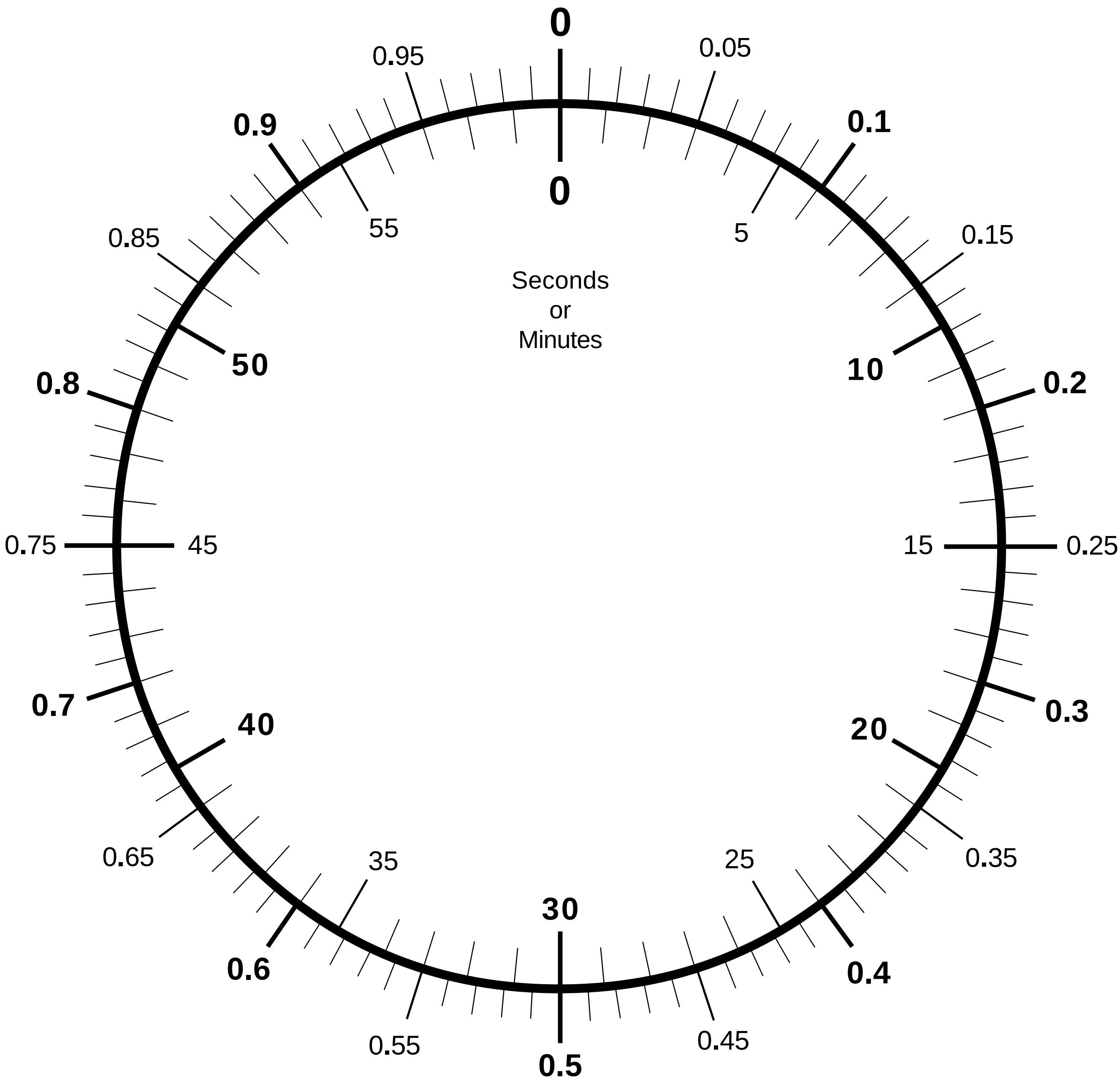
$$V = \pi \times r^2 \times h \div 3 \quad or \quad \pi \times d^2 \times h \div 12$$

$$C = \pi \times r \times l \qquad r = \sqrt{\frac{3V}{\pi h}} \qquad h = \frac{3V}{\pi r^2}$$

The sector needed to make a cone having a base radius of r and slant height of l can be cut from a circle with a radius of l and a sector angle of $\theta°$ where $\theta° = \frac{360\,r}{l}$



The equivalent values of
seconds or minutes
(of time or angle)
&
a decimal fraction of a
minute, hour or degree

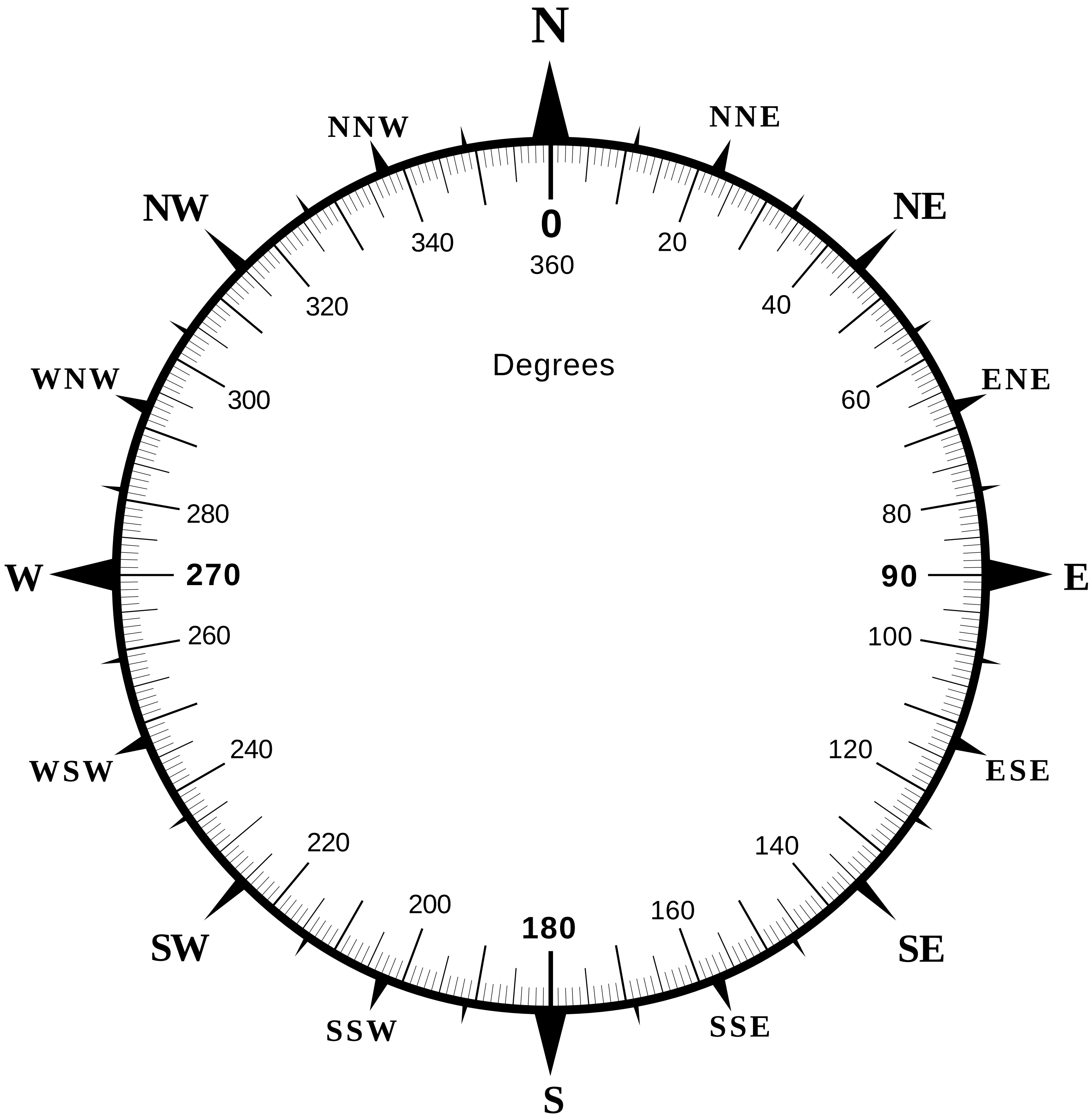


Decimal Fraction of Minute, Hour or Degree

Time			**Angle**		
60 seconds	=	1 minute	60 seconds	=	1 minute
60 minutes	=	1 hour	60 minutes	=	1 degree

Time is written in the form hh:mm:ss *example* 12:34:06
Angle is written in the form d° m' s'' *example* 123° 4' 56''

The equivalent values of
degrees
&
the points of the compass



Quadratic Equations

If $ax^2 + bx + c = 0$ then

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

If $b^2 - 4ac > 0$ there are two, real, different roots.
If $b^2 - 4ac = 0$ there is only one root.
If $b^2 - 4ac < 0$ the roots are complex.

Indices

$$a^m \times a^n = a^{m+n}$$
$$a^m \div a^n = a^{m-n}$$
$$(a^m)^n = a^{m \times n}$$
$$\sqrt[n]{a^m} = a^{m \div n}$$
$$\sqrt[n]{a} = a^{\frac{1}{n}}$$
$$a^{-n} = \frac{1}{a^n}$$
$$a^0 = 1$$
$$(a \times b)^n = a^n \times b^n$$
$$(a \div b)^n = a^n \div b^n$$

Expansions & Factorisations

$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a-b)^2 = a^2 - 2ab + b^2$$
$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$
$$(a+b)^3 = a^3 + b^3 + 3ab\,(a+b)$$
$$(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$
$$(a-b)^3 = a^3 - b^3 - 3ab\,(a-b)$$
$$a^2 - b^2 = (a+b)(a-b)$$
$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$
$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$
$$a^4 - b^4 = (a+b)(a^3 - a^2b + ab^2 - b^3)$$
$$a^4 - b^4 = (a-b)(a^3 + a^2b + ab^2 + b^3)$$

$a^n + b^n$ is divisible by $(a+b)$ when n is odd
but by $(a-b)$ never
$a^n - b^n$ is divisible by $(a+b)$ when n is even
and by $(a-b)$ always

Logarithms

If $N = a^x$ then $\log_a N = x$ and $N = a^{\log_a N}$

$$\log(a \times b) = \log a + \log b$$
$$\log(a \div b) = \log a - \log b$$
$$\log a^n = n \log a$$
$$\log \sqrt[n]{a} = \frac{1}{n}\log a$$
$$\log_a N = \frac{\log_b N}{\log_b a}$$
$$\log_e N = 2.3026 \times \log_{10} N$$
$$\log_a 1 = 0$$

Arithmetic Progressions

The general form of an AP is
$a,\ a+d,\ a+2d,\ a+3d,\ a+4d,\ \ldots\ldots\ a+(n-1)d$
where
a = the first term
d = the common difference
n = the number of terms
the last term is
$l = a + (n - l)d$
the total sum of n terms is
$S_n = n(a+1) \div 2$ *or* $n[2a + (n-1)d] \div 2$

Geometic Progressions

The general form of a GP is
$a,\ ar,\ ar^2,\ ar^3,\ ar^4,\ ar^5,\ \ldots\ldots\ ar^{n-1}$
where
a = the first term
r = the common ratio *or* multiplier
n = the number of terms
the total sum of n terms is
$S_n = a(1-r^n) \div (1-r)$ if $r < 1$
or
$S_n = a(r^n - 1) \div (r-1)$ if $r > 1$
if n is infinity and $r^2 < 1$ then
$S_\infty = a \div (1-r)$
The geometric mean of two numbers a and b = $\sqrt{ab}$

Sums of Powers of Natural Numbers

The first n natural numbers are
$1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ \ldots\ldots\ n$
Their sum when each has been raised to the power r is
$\Sigma n^r = 1^r + 2^r + 3^r + 4^r + 5^r + 6^r + \ldots\ldots + n^r$
For any given value of r there is a formula for Σn^r
The first six are

($r = 1$) $\Sigma n = n(n+1) \div 2$
($r = 2$) $\Sigma n^2 = n(n+1)(2n+1) \div 6$
($r = 3$) $\Sigma n^3 = n^2(n+1)^2 \div 4$ *or* $(\Sigma n)^2$
($r = 4$) $\Sigma n^4 = n(n+1)(2n+1)(3n^2 + 3n - 1) \div 30$
($r = 5$) $\Sigma n^5 = n^2(n+1)^2(2n^2 + 2n - 1) \div 12$
($r = 6$) $\Sigma n^6 = n(n+1)(2n+1)(3n^4 + 6n^3 - 3n + 1) \div 42$

Combinations

Given ***n*** different objects and required to choose ***r*** at a time, this formula gives the number of ways in which it can be done, neglecting the order in which they are chosen.

$$^n\mathbf{C}_r = \frac{n!}{(n-r)!\,r!}$$

Given the importance of these numbers in the Binomial Theorem below, they are also known as the **Binomial Coefficients**. (*see Table of Values at the back*)

Binomial Theorem

$$(a+b)^n = a^n + {}^nC_1 a^{n-1}b + {}^nC_2 a^{n-2}b^2 + {}^nC_3 a^{n-3}b^3 + \ldots$$
$$\ldots + {}^nC_r a^{n-r}b^r + \ldots\ldots + b^n$$

function $f(x)$ or $y = f(x)$	(1st) **derivative** $f'(x)$ or $\frac{d}{dx}f(x)$ or $\frac{dy}{dx}$	**integral** $\int f(x)\,dx$ or $\int y\,dx$
x^n	nx^{n-1}	$\frac{1}{n+1}x^{n+1}$
e^x	e^x	e^x
e^{ax}	ae^{ax}	$\frac{1}{a}e^{ax}$
a^x	$a^x \log_e a$	$\frac{1}{\log_e a}a^x$
$\log_e x$	$\frac{1}{x}$	$x\log_e x - x$
$\frac{1}{x}$	$-\frac{1}{x^2}$	$\log_e\lvert x\rvert$
$\frac{1}{a^2+x^2}$		$\frac{1}{a}\tan^{-1}\frac{x}{a}$
$\frac{1}{a^2-x^2}$		$\frac{1}{a}\tanh^{-1}\frac{x}{a}$
$\frac{1}{x^2-a^2}$		$-\frac{1}{a}\coth^{-1}\frac{x}{a}$
$\frac{1}{\sqrt{a^2+x^2}}$		$\sinh^{-1}\frac{x}{a}$
$\frac{1}{\sqrt{x^2-a^2}}$		$\cosh^{-1}\frac{x}{a}$
$\sin x$	$\cos x$	$-\cos x$
$\cos x$	$-\sin x$	$\sin x$
$\tan x$	$\sec^2 x$	$\log_e\lvert\sec x\rvert$
$\sin^{-1} x$	$\frac{1}{\sqrt{1-x^2}}$	
$\cos^{-1} x$	$-\frac{1}{\sqrt{1-x^2}}$	
$\tan^{-1} x$	$\frac{1}{1+x^2}$	

constants of integration have not been shown

Given that u and v are both functions of x

Product rule

if $y = u \times v$ then $\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$

Quotient rule

if $y = u \div v$ then $\frac{dy}{dx} = \left(v\frac{du}{dx} - u\frac{dv}{dx}\right) \div v^2$

Chain rule

if y is a function of u then $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

In statistics, when the data content is numerical, it is usual to use the symbol x to represent the general case, and individual pieces of data as $x_1\ x_2\ x_3\ x_4\ x_5\ x_6\ x_7\ \dots\ x_n$

Another commonly used symbol is **Σ** *(Greek sigma)* which means "find the sum of". So a formula containing Σx would mean "add up all the x-numbers", and Σx^2 would mean "square all the x-numbers and add up all those values". The number of pieces of data is given by n.

If the data is grouped, then f is used to refer to the frequency of the data in each group and that would require a change to some of the formulas given here.

Arithmetic Mean

Generally this is referred to simply as the mean.

Symbol is $\bar{x}$

This may be found by

Adding up the values of all the data
Dividing by the number of pieces of data

Expressed as a formula it is $\bar{x} = \dfrac{\sum x}{n}$

Range

is the absolute value of the difference between the greatest and least values of the data.

Expressed as a formula it is

range $= |x_{\max} - x_{\min}|$

Root Mean Square Value

is given by $\sqrt{\dfrac{\sum x^2}{n}}$

Standard Deviation

This may be found by

Squaring the values of all the data
Adding them all up
Dividing by how many there are
Subtracting the square of the mean value
Taking the square root.

Symbol is σ

Expressed as a formula it is $\sigma = \sqrt{\dfrac{\sum x^2}{n} - \bar{x}^2}$

Variance

is the square of the Standard Deviation

$= \sigma^2$

χ^2 (chi-squared) Test

For any particular piece of data, if

O is its **O**bserved frequency

and

E is its **E**xpected frequency

then

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

which is the summation carried out over all the groups of the data

Correlation Coefficient

More precisely it is

Pearson's product moment correlation coefficient

Symbol is r

When the data is in the form of ordered pairs of numbers such as (x, y) and there are n such pairs, then the amount of correlation between them can be determined by

A. Multiplying the matching x and y values together, adding them all up and multiplying the total by n

B. Adding up all x-values; adding up all y-values; and multiplying the two results together.

C. Subtracting the result of **B** from **A** *(It might be negative)*

D. Squaring all x-values, adding them up, multiplying the total by n. Repeating for y-values.

E. Adding together all x-values, and squaring the total. Repeating for y-values.

F. Subtracting the x-result in **E** from that in **D** and repeating that for y-result.

G. Multiplying the two answers from **F** together and taking the square root.

Then r = result from **C** ÷ result from **G**

Expressed as a formula it is

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}$$

Straight Line Formula

When the data is in the form of ordered pairs of numbers such as (x, y) and there is a good degree of correlation between them (*as determined above*) then it is possible, as well as useful, to draw a straight line which can serve as the basis of further calculations.

The equation for this line will be of the form

$$y = \mathrm{m}x + \mathrm{c}$$

The necessary values of 'm' and 'c' can be found from

$$\mathbf{m} = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2}$$

and

$$\mathbf{c} = \frac{\sum y - \mathrm{m}\sum x}{n}$$

Rank Order Correlation Coefficient

More precisely it is

Spearman's rank order correlation coefficient

Symbol is ρ

When two sets of data have been ranked in order by some criteria or other, this coefficient is used to determine how closely the two lists agree (or differ).

Given that there are n items listed, it is found by

Finding the difference in value (by their list order) of each corresponding pair of rankings.
Squaring all the differences.
Adding the squared values together and multiplying by 6
Dividing the previous result by $(n^3 - n)$
Subtracting that from 1

$= \rho$

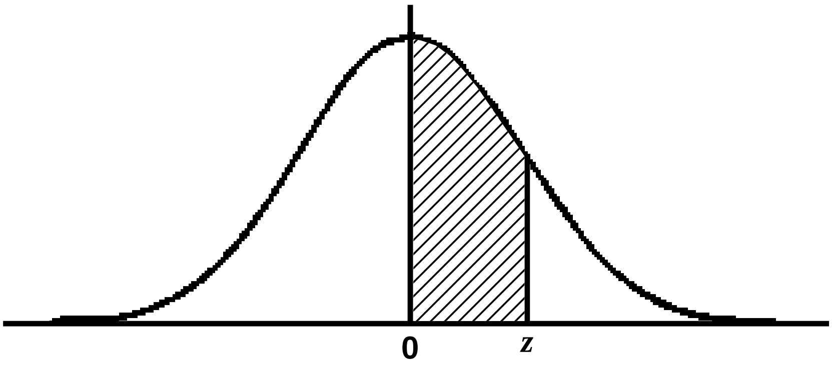
Values of ${}^{n}C_r$

$${}^{n}\mathbf{C}_r = \frac{n!}{(n-r)!\,r!}$$

$n\downarrow$	$r\rightarrow$ 2	3	4	5	6	7	8	9	10	11	$n\downarrow$
1											**1**
2	1										**2**
3	3	1									**3**
4	6	4	1								**4**
5	10	10	5	1							**5**
6	15	20	15	6	1						**6**
7	21	35	35	21	7	1					**7**
8	28	56	70	56	28	8	1				**8**
9	36	84	126	126	84	36	9	1			**9**
10	45	120	210	252	210	120	45	10	1		**10**
11	55	165	330	462	462	330	165	55	11	1	**11**
12	66	220	495	792	924	792	495	220	66	12	**12**
13	78	286	715	1 287	1 716	1 716	1 287	715	286	78	**13**
14	91	364	1 001	2 002	3 003	3 432	3 003	2 002	1 001	364	**14**
15	105	455	1 365	3 003	5 005	6 435	6 435	5 005	3 003	1 365	**15**
16	120	560	1 820	4 368	8 008	11 440	12 870	11 440	8 008	4 368	**16**
17	136	680	2 380	6 188	12 376	19 448	24 310	24 310	19 448	12 376	**17**
18	153	816	3 060	8 568	18 564	31 824	43 758	48 620	43 758	31 824	**18**
19	171	969	3 876	11 628	27 132	50 388	75 582	92 378	92 378	75 582	**19**
20	190	1 140	4 845	15 504	38 760	77 520	125 970	167 960	184 756	167 960	**20**
21	210	1 330	5 985	20 349	54 264	116 280	203 490	293 930	352 716	352 716	**21**
22	231	1 540	7 315	26 334	74 613	170 544	319 770	497 420	646 646	705 432	**22**
23	253	1 771	8 855	33 649	100 947	245 157	490 314	817 190	1 144 066	1 352 078	**23**
24	276	2 024	10 626	42 504	134 596	346 104	735 471	1 307 504	1 961 256	2 496 144	**24**
25	300	2 300	12 650	53 130	177 100	480 700	1 081 575	2 042 975	3 268 760	4 457 400	**25**
26	325	2 600	14 950	65 780	230 230	657 800	1 562 275	3 124 550	5 311 735	7 726 160	**26**
27	351	2 925	17 550	80 730	296 010	888 030	2 220 075	4 686 825	8 436 285	13 037 895	**27**
28	378	3 276	20 475	98 280	376 740	1 184 040	3 108 105	6 906 900	13 123 110	21 474 180	**28**
29	406	3 654	23 751	118 755	475 020	1 560 780	4 292 145	10 015 005	20 030 010	34 597 290	**29**
30	435	4 060	27 405	142 506	593 775	2 035 800	5 852 925	14 307 150	30 045 015	54 627 300	**30**
31	465	4 495	31 465	169 911	736 281	2 629 575	7 888 725	20 160 075	44 352 165	84 672 315	**31**
32	496	4 960	35 960	201 376	906 192	3 365 856	10 518 300	28 048 800	64 512 240	129 024 480	**32**
33	528	5 456	40 920	237 336	1 107 568	4 272 048	13 884 156	38 567 100	92 561 040	193 536 720	**33**
34	561	5 984	46 376	278 256	1 344 904	5 379 616	18 156 204	52 451 256	131 128 140	286 097 760	**34**
35	595	6 545	52 360	324 632	1 623 160	6 724 520	23 535 820	70 607 460	183 579 396	417 225 900	**35**
36	630	7 140	58 905	376 992	1 947 792	8 347 680	30 260 340	94 143 280	254 186 856	600 805 296	**36**
37	666	7 770	66 045	435 897	2 324 784	10 295 472	38 608 020	124 403 620	348 330 136	854 992 152	**37**
38	703	8 436	73 815	501 942	2 760 681	12 620 256	48 903 492	163 011 640	472 733 756	1 203 322 288	**38**
39	741	9 139	82 251	575 757	3 262 623	15 380 937	61 523 748	211 915 132	635 745 396	1 676 056 044	**39**
40	780	9 880	91 390	658 008	3 838 380	18 643 560	76 904 685	273 438 880	847 660 528	2 311 801 440	**40**

N	N^2	N^3	N^4	N^5	N^6
1	1	1	1	1	1
2	4	8	16	32	64
3	9	27	81	243	729
4	16	64	256	1 024	4 096
5	25	125	625	3 125	15 625
6	36	216	1 296	7 776	46 656
7	49	343	2 401	16 807	117 649
8	64	512	4 096	32 768	262 144
9	81	729	6 561	59 049	531 441
10	100	1 000	10 000	100 000	1 000 000
11	121	1 331	14 641	161 051	1 771 561
12	144	1 728	20 736	248 832	2 985 984
13	169	2 197	28 561	371 293	4 826 809
14	196	2 744	38 416	537 824	7 529 536
15	225	3 375	50 625	759 375	11 390 625
16	256	4 096	65 536	1 048 576	16 777 216
17	289	4 913	83 521	1 419 857	24 137 569
18	324	5 832	104 976	1 889 568	34 012 224
19	361	6 859	130 321	2 476 099	47 045 881
20	400	8 000	160 000	3 200 000	64 000 000
21	441	9 261	194 481	4 084 101	85 766 121
22	484	10 648	234 256	5 153 632	113 379 904
23	529	12 167	279 841	6 436 343	148 035 889
24	576	13 824	331 776	7 962 624	191 102 976
25	625	15 625	390 625	9 765 625	244 140 625
26	676	17 576	456 976	11 881 376	308 915 776
27	729	19 683	531 441	14 348 907	387 420 489
28	784	21 952	614 656	17 210 368	481 890 304
29	841	24 389	707 281	20 511 149	594 823 321
30	900	27 000	810 000	24 300 000	729 000 000
31	961	29 791	923 521	28 629 151	887 503 681
32	1 024	32 768	1 048 576	33 554 432	1 073 741 824
33	1 089	35 937	1 185 921	39 135 393	1 291 467 969
34	1 156	39 304	1 336 336	45 435 424	1 544 804 416
35	1 225	42 875	1 500 625	52 521 875	1 838 265 625
36	1 296	46 656	1 679 616	60 466 176	2 176 782 336
37	1 369	50 653	1 874 161	69 343 957	2 565 726 409
38	1 444	54 872	2 085 136	79 235 168	3 010 936 384
39	1 521	59 319	2 313 441	90 224 199	3 518 743 761
40	1 600	64 000	2 560 000	102 400 000	4 096 000 000
41	1 681	68 921	2 825 761	115 856 201	4 750 104 241
42	1 764	74 088	3 111 696	130 691 232	5 489 031 744
43	1 849	79 507	3 418 801	147 008 443	6 321 363 049
44	1 936	85 184	3 748 096	164 916 224	7 256 313 856
45	2 025	91 125	4 100 625	184 528 125	8 303 765 625
46	2 116	97 336	4 477 456	205 962 976	9 474 296 896
47	2 209	103 823	4 879 681	229 345 007	10 779 215 329
48	2 304	110 592	5 308 416	254 803 968	12 230 590 464
49	2 401	117 649	5 764 801	282 475 249	13 841 287 201
50	2 500	125 000	6 250 000	312 500 000	15 625 000 000

Areas under Curve of Normal Distribution



The table gives the fraction of the total area under the curve for the shaded area shown, which lies between the middle ordinate (*the mean*) and the ordinate at ***z*** for values of ***z*** from 0.00 to 3.99
(All values rounded to 4 decimal places)

↓z→	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0754
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2258	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2996	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

Symbols and Abbreviations

Mathematics uses many symbols and abbreviations to represent instructions, or numbers, in a more concise form. Here, with a brief note as to their meaning, are the ones most commonly used.
see also The Greek Alphabet

+	add *or* plus *or* positive
−	minus *or* subtract *or* negative
~	find the absolute difference of
×	times *or* multiplied by
*	times *or* multiplied by
÷	divided by
/	divided by
±	add or subtract plus or minus positive or negative
=	equals *or* is equal to
≠	does not equal *or* is not equal to
≈	is approximately equal to
≡	is equivalent to *or* has the same value as is identically equal to is congruent to
$<$	is less than
$\leqslant$	is less than or equal to
$>$	is greater than
$\geqslant$	is greater than or equal to
∝	varies as *or* is proportional to
:	proportion
.	decimal (*or* fraction) point
,	decimal marker
%	per cent *or* out of a hundred
‰	per mil *or* out of a thousand
( )	brackets *or* parentheses
⟨ ⟩	angle brackets
[ ]	square brackets
{ }	curly brackets *or* braces also used to enclose a set
$[x]$	the largest whole number which is not greater than x
$\lvert x\rvert$	the absolute value of x
x^2	x squared
x^3	x cubed
x^n	x to the nth power
$\sqrt{x}$	the square root of x
$\sqrt[3]{x}$	the cube root of x
∠	angle
∥	is parallel to
∦	is not parallel to
⊥	is perpendicular to
°	degrees
′	minutes
″	seconds

ℕ	the set of **natural** numbers
ℤ	the set of **whole** numbers
ℚ	the set of **rational** numbers
ℝ	the set of **real** numbers
ℂ	the set of **complex** numbers
∈	is a member of
∉	is not a member of
⊂	is a subset of
⊄	is not a subset of
⊃	includes
∪	union
∩	intersection
∅	null *or* empty set
⇒	implies
⇐	is implied by
⇔	implies and is implied by
∴	therefore
∞	infinity
$n!$	factorial n
$!n$	sub-factorial *or* derangements of n
i	square root of $^-1$
e	≈ 2.71828 …
π	≈ 3.14159 …
f(x)	function of x
f′(x)	first derivative of f(x)
∫	integral *or* anti-derivative
&	hexadecimal number follows

AP	arithmetic progression
APR	annual percentage rate
cu	cubic *(referring to units of volume)*
dp	decimal places
g c d	greatest common denominator
h c f	highest common factor
l c d	lowest common denominator
l c m	lowest common multiple
m	gradient of a line
mod	modulus
QED	which was to be proved
s f	significant figures
sq	square *(referring to units of area)*
UT	Universal Time *(Greenwich Mean Time)*

The Greek alphabet is a rich source of symbols used in both mathematics and science, to the extent that nearly every one of them (both capitals and lower case) is used in some way or other. Some of them appear more than once to represent different things. Below is the full alphabet, and the names of the various symbols. The capital form of the letter is given in the first column, followed by the lower case version and its name. Then some of the more commonly seen meanings of usage are given.

Α	α	alpha	α β γ are often used to identify angles in plane figures.
Β	β	beta	
Γ	γ	gamma	
Δ	δ	delta	Δ is sometimes used to represent the area of a plane figure. δ is used (in calculus) to show that a small amount is considered.
Ε	ε	epsilon	
Ζ	ζ	zeta	
Η	η	eta	
Θ	θ	theta	θ is used to indicate a general angle
Ι	ι	iota	
Κ	κ	kappa	
Λ	λ	lambda	λ is used to represent a scalar in vector work
Μ	μ	mu	μ is used (in the SI system) to represent the prefix *micro* μ is sometimes used to represent the arithmetic mean
Ν	ν	nu	
Ξ	ξ	xi	ξ is sometimes used as the symbol for the universal set
Ο	ο	omicron	
Π	π	pi	Π is used to show that a continued product is needed π is used to represent the value of the irrational number 3.14159 … $\pi(n)$ means the number of primes less than, or equal to n
Ρ	ρ	rho	
Σ	σ	sigma	Σ is used to show that the sum of a series is to be found σ is used to represent the standard deviation of a population
Τ	τ	tau	τ is used to represent the golden ratio 1.6180 … (see also phi)
Υ	υ	upsilon	
Φ	φ	phi	Φ is sometimes used as the symbol for the empty set ϕ is used to represent the golden ratio 1.6180 … (see also tau) $\phi(n)$ means the number of positive integers less than, and relatively prime to, n
Χ	χ	chi	χ is used in statistics in reference to the chi-squared test
Ψ	ψ	psi	
Ω	ω	omega	