Math Booklet of Formulas

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GREEK ALPHABET

Capital	Small	Name
Α	α	Alpha
Β	β	Beta
Γ	γ	Gamma
Δ	δ	Delta
Ε	ε	Epsilon
Ζ	ζ	Zeta
Η	η	Eta
Θ	θ	Theta
Ι	ι	Iota
Κ	κ	Kappa
Λ	λ	Lambda
Μ	μ	Mu
Ν	ν	Nu
Ξ	ξ	Xi
Ο	ο	Omicron
Π	π	Pi
Ρ	ρ	Rho
Σ	σ	Sigma
Τ	τ	Tau
Υ	υ	Upsilon
Φ	φ	Phi
Χ	χ	Chi
Ψ	ψ	Psi
Ω	ω	Omega

ABBREVIATIONS

Length

In.	inch
ft	foot
yd	yard
mile	mi
mm	millimeter
cm	centimeter
dm	decimeter
m	meter
dam	decameter
hm	hectometer
km	kilometer

Volume

pt	pint
gal	gallon
mL	milliliter
cL	centiliter
dL	deciliter
L	liter
daL	dekaliter
hL	hectoliter
kL	kiloliter
cc	cubic centimeter

Weight

mg	milligram
cg	centigram
dg	decigram
g	gram
dag	dekagram
hg	hectogram
kg	kilogram
pond	lb
ounce	oz

RATES OF CONVERSION BETWEEN UNITS

LENGTH

1 mi = 5280 ft

1 mi = 1.609 km

1 mile = 1760 yd

1 in. = 2.54 cm

1 yd = 0.9144 m

1 yd = 3 ft

1 m = 3.281 ft

VOLUME / CAPACITY

1 mile squared = 640 acres

1 cubic foot = 7.481 gal

1 gal = 3.785 L

1 mL = 1cc

MASS / WEIGHT

1 kg = 2.2 lb

1 lb = 16 oz

SUBSETS OF REAL NUMBERS

Natural Numbers $=\{1,2,3,4,...\}$

Whole Numbers $=\{0,1,2,3,4,...\}$

Integers

$=\{...,-3,-2,-1,0,1,2,3,4,...\}$

Rational

$=\{\frac{a}{b} \mid a \text{ and } b \text{ are integers}\}$

with $a \neq 0$

Irrational $=\{x \mid x \text{ in not rational}\}$

PROPERTIES OF REAL NUMBERS

For all real numbers a, b and c we can write

$a+b=b+a$

The addition is commutative

$a \cdot b = b \cdot a$

The multiplication is commutative

$(a+b)+c=a+(b+c)$

The addition is associative

$(a \cdot b)c = a(b \cdot c)$

The multiplication is associative

$a(b+c)=ab+ac$

Distributive property of multiplication over addition

ORDER OF OPERATIONS

First evaluate within the grouping symbols such as parentheses

1. Exponential expressions
2. Multiplication and division
3. Addition and subtraction

ABSOLUTE VALUE

$$|x| = \begin{cases} x & \text{for } x \geq 0 \\ -x & \text{for } x < 0 \end{cases}$$

EXPANDING - FACTORING FORMULAS

$$(x+y)^2 = x^2 + 2xy + y^2$$
$$(x-y)^2 = x^2 - 2xy + y^2$$
$$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$$
$$(x-y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$$
$$(x-y)(x+y) = x^2 - y^2$$

SLOPE OF A LINE

- The slope m of a line through the points (x_1, y_1) and (x_2, y_2) is given by

$$m = \frac{y_2 - y_1}{x_2 - x_1} \text{ when } x_1 \neq x_2$$

- The slope of a horizontal line is equal to zero.
- The slope of a vertical line is undefined.

MIDPOINT AND DISTANCE FORMULAS

The coordinates of the midpoint M of segment PQ where points P (x_1, y_1) and Q (x_2, y_2) are given by

M $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

The distance d(PQ) between points P and Q is given by

d(PQ) = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

QUADRATIC FORMULA

The solutions to the quadratic equation $ax^2 + bx + c = 0$ ($a \neq 0$) are given by

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

If $b^2 - 4ac > 0$, then there are two real solutions.

If $b^2 - 4ac = 0$, then there is one real solutions
(or a repeated solution).

If $b^2 - 4ac < 0$, then there are two complex solutions.

ARITHMETIC AND GEOMATRIC SEQUENCES

The n th term of an arithmetic sequence with first term a_1 and common difference d is given by

$$a_n = a_1 + (n-1)d$$

The sum S_n of the first n terms of an arithmetic sequence is given by

$$S_n = \frac{n}{2}(a_1 + a_n)$$

The n th term of a geometric sequence with first term a_1 and common ratio r is given by

$$a_n = a_1 r^{n-1}$$

The sum S_n of the first n terms of a geometric sequence is given by

$$S_n = \frac{a_1(1-r^n)}{(1-r)}$$

The sum S of an infinite geometric sequence with $|r| < 1$ is given by

$$S = \frac{a_1}{(1-r)}$$

EXPONENTAILS AND LOGARITHMS

$y = \log_b(x)$ if and only if $b^y = x$

$$\log_b(xy) = \log_b(x) + \log_b(y)$$
$$\log_b\left(\frac{x}{y}\right) = \log_b(x) - \log_b(y)$$
$$\log_b x^r = r\log_b(x)$$
$$b^{\log_b(x)} = x$$
$$\log_b(b^x) = x$$
$$\log_b(1) = 0$$
$$\log_b(b) = 1$$
$$\log_b(x) = \frac{\log_a(x)}{\log_a(b)}$$

BINOMIAL THEOREM

$$(x+y)^n = x^n + {}_nC_1 x^{n-1}y + {}_nC_2 x^{n-2}y^2 + \ldots + {}_nC_r x^{n-r}y^r + \ldots + y^n$$

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

EXPONENTS AND RADICALS

$$x^0 = 1$$
$$x^{-r} = \frac{1}{x^r} = \left(\frac{1}{x}\right)^r$$
$$\frac{1}{x^{-r}} = x^r$$
$$x^r x^s = x^{r+s}$$
$$(x^r)^s = x^{rs}$$
$$\left(\frac{x}{y}\right)^r = \frac{x^r}{y^r}$$
$$\frac{x^r}{y^s} = y^{r-s}$$
$$(xy)^r = x^r y^r$$
$$\left(\frac{x}{y}\right)^{-r} = \left(\frac{y}{x}\right)^r$$
$$x^{1/n} = \sqrt[n]{x}$$
$$\sqrt[n]{xy} = \sqrt[n]{x}\sqrt[n]{y}$$
$$x^{n/m} = (\sqrt[m]{x})^n$$
$$\sqrt[n]{\frac{x}{y}} = \frac{\sqrt[n]{x}}{\sqrt[n]{y}}$$

INEQUALITIES

If $a > b$ and $b > c$ then $a > c$

If $a > b$, then $a + c > b + c$

If $a > b$ and $c > 0$, then $ac > bc$

If $a > b$ and $c < 0$, then $ac < bc$

ABSOLUTE VALUE INEQUALITIES

If $|x| \le b$ if and only if $-b \le x \le b$

If $|x| \ge b$ if and only if $x \ge b$ or $x \le -b$

LINEAR FUNCTION

Function f of the form $f(x) = ax + b$ with $a \ne 0$ is called a linear function because its graph is a line that has a slope equal to a and b is the y intercept of the line.

Domain: $(-\infty, +\infty)$

Range: $(-\infty, +\infty)$

QUADRATIC FUNCTION

Function f of the form $f(x) = ax^2 + bx + c$ with $a \ne 0$ is called a quadratic function. Its graph is a parabola that has a vertex.

The coordinates (h, k) of the vertex are given by

$$h = \frac{-b}{2a} \quad \text{and} \quad k = f(h)$$

if $a > 0$, the graph opens upward and the vertex is a minimum point. The range of f is given by the interval $[k, +\infty)$

if $a < 0$, the graph opens downward and the vertex is a maximum point. The range of f is given by the interval $(-\infty, k]$

Domain of given by $(-\infty, +\infty)$

Function f may also be written in vertex form as follows

$$f(x) = a(x-h)^2 + k$$

GROWTH AND DECAY EXPONENTIAL FUNCTIONS

Assuming that *P* is positive

$f(x) = Pe^{kx}$ is increasing if $k > 0$, growth function.

$f(x) = Pe^{kx}$ is decreasing if $k < 0$, decay function.

COMPOUND INTEREST FORMULA

If r is the rate of interest and the principal (the amount you begin with) *P* is compounded n times per year then after t years the total amount *A* is given by

$$A(t) = P\left(1 + \frac{r}{n}\right)^{nt}$$

FRACTIONS AND RATIONAL EXPRESSIONS

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

$$\frac{a}{b} - \frac{c}{b} = \frac{a-c}{b}$$

$$\frac{a}{b} + \frac{c}{d} = \frac{ad+cb}{bd}$$

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

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

$$\frac{ac}{bc} = \frac{a}{b}$$

RECTANGULAR EQUATIONS FOR CONIC SECTIONS

Circle of center (h, k) and radius r

$$(x-h)^2 + (y-k)^2 = r^2$$

Ellipse of center (h, k)

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

Parabola of vertex (h, k) - Axis parallel to y axis

$$(x-h)^2 = 4p(y-k)$$

Parabola of vertex (h, k) - Axis parallel to x axis

$$(y-k)^2 = 4p(x-h)$$

Hyperbola of center (h, k) - Axis parallel to x axis

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

Hyperbola of center (h, k) - Axis parallel to y axis

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$