Calcpad

Version 6.0 quick reference guide

ПРОЕКТСОФТ®
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How it works?

1. **Enter** text and formulas into the "**Code**" box on the left.
2. Press **F5** or click ▶ to **calculate**. The results will appear in the "**Output**" box on the right as a professionally formatted Html **report**.
3. Click 🖶 to **print** or 📄 to **copy** the output.
   You can also **export** it to **Html** 💾, **PDF** 📕 or **MS Word** 📝 document.

The language

The Calcpad language includes the following elements:

- Real numbers: digits "**0**" - "**9**" and decimal point "**.**";
- Complex numbers: **re** ± **im***i* (e.g. **3** - **2***i*);
- Variables:
  - Latin letters: "*a*" - "*z*", "*A*" - "*Z*";
  - Greek letters: "*α*" - "*ω*", "*A*" - "*Ω*";
  - digits: "**0**" - "**9**";
  - comma: " **,** ";
  - prime symbols: " **′** ", " **″** ", " **‴** ", " **⁗** ";
  - special symbols: " **ø** ", "**Ø**", " **°** ", "**∡**";
  - "_" for subscript;

  A variable name must start with a letter. Names are case sensitive.
- Constants: π, e, φ, γ, g, G, M_E, M_S, c, h, μ_0, ε_0, k_e, e, m_e, m_p, m_n, N_A, σ, k_B, R, F, γ_c, γ_s, γ_a, γ_g, γ_w
- Operators:
  "**!**" - factorial;
  "**^**" - exponent;
  "**/**" - division;
  "**÷**" - force division bar;
  "****" - division;
  "**⊘**" - modulo (reminder);
  "*****" - multiplication;
  "**-**" - minus;
  "**+**" - plus;
  "**≡**" - equal to;
  "**≠**" - not equal to;
  "**<**" - less than;
  "**>**" - greater than;
  "**≤**" - less or equal;
  "**≥**" - greater or equal;
  "**∧**" - logical “and”;

"∨" - logical “or”;

"⊕" - logical “xor”;

"=" - assignment;

- Custom functions of type $f(x; y; z; ...)$;
- Built-in functions:
  - Trigonometric:

    sin(x) - sine;

    cos(x) - cosine;

    tan(x) - tangent;

    csc(x) - cosecant;

    sec(x) - secant;

    cot(x) - cotangent;
  - Hyperbolic:

    sinh(x) - hyperbolic sine;

    cosh(x) - hyperbolic cosine;

    tanh(x) - hyperbolic tangent;

    csch(x) - hyperbolic cosecant;

    sech(x) - hyperbolic secant;

    coth(x) - hyperbolic cotangent;
  - Inverse trigonometric:

    asin(x) - inverse sine;

    acos(x) - inverse cosine;

    atan(x) - inverse tangent;

    atan2$(x; y)$ - the angle whose tangent is the quotient of y and x;

    acsc(x) - inverse cosecant;

    asec(x) - inverse secant;

    acot(x) - inverse cotangent;
  - Inverse hyperbolic:

    asinh(x) inverse hyperbolic sine;

    acosh(x) - inverse hyperbolic cosine;

    atanh(x) - inverse hyperbolic tangent;

    acsch(x) - inverse hyperbolic cosecant;

    asech(x) - inverse hyperbolic secant;

    acoth(x) - inverse hyperbolic cotangent;
  - Logarithmic, exponential and roots:

    log(x) - decimal logarithm;

    ln(x) - natural logarithm;

    log_2(x) - binary logarithm;

    exp(x) – exponential function;

sqr(*x*) or **sqrt**(*x*) - square root;

cbrt(*x*) - cubic root;

root(*x*; *n*) - n-th root;

◦ Rounding:

round(*x*) - round to the nearest integer;

floor(*x*) - round to the lower integer;

ceiling(*x*) - round to the greater integer;

trunc(*x*) - round to the nearest integer towards zero;

◦ Integer:

mod(*x*; *y*) - the reminder of an integer division;

gcd(*x*; *y*) - the greatest common divisor of two integers;

lcm(*x*; *y*) - the least common multiple of two integers;

◦ Complex:

abs(*x*) - absolute value/magnitude;

re(*x*) - the real part of a complex number;

im(*x*) - the imaginary part of a complex number;

phase(*x*) - the phase of a complex number;

◦ Aggregate and interpolation:

min(*x*; *y*; *z*...) - minimum of multiple values;

max(*x*; *y*; *z*...) - maximum of multiple values;

sum(*x*; *y*; *z*...) - sum of multiple values = $x + y + z$...;

sumsq(*x*; *y*; *z*...) - sum of squares = $x^2 + y^2 + z^2$...;

srss(*x*; *y*; *z*...) - square root of sum of squares = **sqrt**($x^2 + y^2 + z^2$...);

average(*x*; *y*; *z*...) - average of multiple values = $(x + y + z...)/n$;

product(*x*; *y*; *z*...) - product of multiple values = $x \cdot y \cdot z$...;

mean(*x*; *y*; *z*...) - geometric mean = **n-th root**($x \cdot y \cdot z$...);

take(*n*; *a*; *b*; *c*...) - returns the n-th element from the list;

line(*x*; *a*; *b*; *c*...) - linear interpolation;

spline(*x*; *a*; *b*; *c*...) - Hermite spline interpolation;

◦ Conditional and logical:

if(*cond*; *value-if-true*; *value-if-false*) - conditional evaluation;

switch(*cond1*; *value1*; *cond2*; *value2*; ...; *default*) - selective evaluation;

not(*x*) - logical "not";

and(*x*; *y*; *z*...) - logical "and";

or(*x*; *y*; *z*...) - logical "or";

xor(*x*; *y*; *z*...) - logical "xor";

◦ Other:

sign(*x*) - sign of a number;

random(*x*) - random number between 0 and *x*.

- Comments: **"Title"** or **'text'** in double or single quotes, respectively. **HTML**, **CSS**, **JS** and **SVG** are allowed.
- Graphing and plotting:

  $Plot { $f(x)$ @ $x = a : b$ } - simple plot;

  $Plot { $x(t)$ | $y(t)$ @ $t = a : b$ } - parametric;

  $Plot { $f_1(x)$ & $f_2(x)$ & ... @ $x = a : b$ } - multiple;

  $Plot { $x_1(t)$ | $y_1(t)$ & $x_2(t)$ | $y_2(t)$ & ... @ $x = a : b$ } - multiple parametric;

  $Map { $f(x; y)$ @ $x = a : b$ & $y = c : d$ } - 2D color map of a 3D surface;

  PlotHeight - height of plot area in pixels;

  PlotWidth - width of plot area in pixels;

  PlotStep - grid size for map plotting.
- Iterative and numerical methods:

  $Root { $f(x) = const$ @ $x = a : b$ } - root finding for $f(x) = const$;

  $Root { $f(x)$ @ $x = a : b$ } - root finding for $f(x) = 0$;

  $Find { $f(x)$ @ $x = a : b$ } similar to above, but x is not required to be a precise solution;

  $Sup { $f(x)$ @ $x = a : b$ } - local maximum of a function;

  $Inf { $f(x)$ @ $x = a : b$ } - local minimum of a function;

  $Area { $f(x)$ @ $x = a : b$ } - adaptive Gauss-Lobatto numerical integration;

  $Integral { $f(x)$ @ $x = a : b$ } – Tanh-Sinh numerical integration;

  $Slope { $f(x)$ @ $x = a$ } - numerical differentiation;

  $Sum { $f(x)$ @ $k = a : b$ } - iterative sum;

  $Product { $f(k)$ @ $k = a : b$ } - iterative product;

  $Repeat { $f(k)$ @ $k = a : b$ } - general inline iterative procedure;

  Precision - relative precision for numerical methods [10^{-2}; 10^{-16}] (default is 10^{-12})
- Program flow control:

  Simple:

  ```
  #if condition
      your code goes here
  #end if
  ```

  Alternative:

  ```
  #if condition
      your code goes here
  #else
      some other code
  #end if
  ```

  Complete:

  ```
  #if condition1
      your code goes here
  #else if condition2
  ```

```
    your code goes here
#else
    some other code
#end if
```

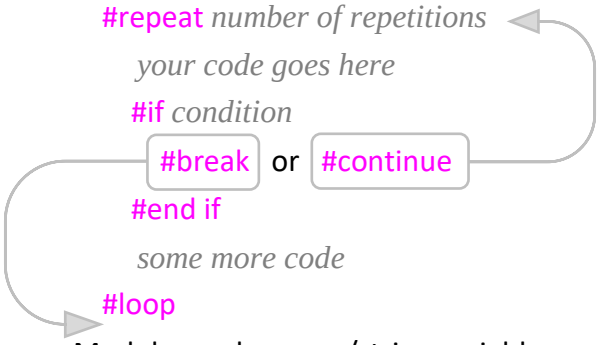
You can add as many "#else if"s as needed, but only one "#else". You can omit any of them.

- Iteration blocks:

  Simple:

```
#repeat number of repetitions
    your code goes here
#loop
```

  With conditional break/continue:



- Modules and macros/string variables:

  Modules:

  #include *filename* - include external file (module);

  #local - start local section (not to be included);

  #global - start global section (to be included);

  Inline string variable:

```
#def variable_name$ = content
```

  Multiline string variable:

```
#def variable_name$
    content line 1
    content line 2
    ...
#end def
```

  Inline string macro:

```
#def macro_name$(param1$; param2$; ...) = content
```

  Multiline string macro:

```
#def macro_name$(param1$; param2$; ...)
    content line 1
    content line 2
    ...
#end def
```

- Output control:
  #hide - hide the report contents;
  #show - always show the contents (default);
  #pre - show the next contents only before calculations;
  #post - show the next contents only after calculations;
  #val - show only the final result, without the equation;
  #equ - show complete equations and results (default);
  #noc - show only equations without results (no calculations);
  #round *n* - rounds the output to *n* digits after the decimal point.
  Each of the above commands is effective after the current line until the end of the report or another command that overwrites it.
- Breakpoints for step-by-step execution:
  #pause - calculates down to the current line and waits for the user to resume manually;
  #input - renders an input form to the current line and waits for user input.
- Units for trigonometric functions: #deg - degrees, #rad - radians, #gra – grades;
- Separator for target units: |;
- Return angles with units: *ReturnAngleUnits* = 1;
- Dimensionless units: *%*, *‰*;
- Angle units *°*, *′*, *″*, *deg*, *rad*, *grad*, *rev*;
- Metric units (SI and compatible):
  Mass: *g*, *hg*, *kg*, *t*, *kt*, *Mt*, *Gt*, *dg*, *cg*, *mg*, *µg*, *Da*, *u*;
  Length: *m*, *km*, *dm*, *cm*, *mm*, *µm*, *nm*, *pm*, *AU*, *ly*;
  Time: *s*, *ms*, *µs*, *ns*, *ps*, *min*, *h*, *d*;
  Frequency: *Hz*, *kHz*, *MHz*, *GHz*, *THz*, *mHz*, *µHz*, *nHz*, *pHz*, *rpm*;
  Speed: *kmh*;
  Electric current: *A*, *kA*, *MA*, *GA*, *TA*, *mA*, *µA*, *nA*, *pA*;
  Temperature: *℃*, *Δ℃*, *K*;
  Amount of substance: *mol*;
  Luminous intensity: *cd*;
  Area: *a*, *daa*, *ha*;
  Volume: *L*, *mL*, *cL*, *dL*, *hL*;
  Force: *dyn N*, *daN*, *hN*, *kN*, *MN*, *GN*, *TN*, *gf*, *kgf*, *tf*;
  Moment: *Nm*, *kNm*;
  Pressure: *Pa*, *daPa*, *hPa*, *kPa*, *MPa*, *GPa*, *TPa*,
  dPa, *cPa*, *mPa*, *µPa*, *nPa*, *pPa*,
  bar, *mbar*, *µbar*, *atm*, *at*, *Torr*, *mmHg*;
  Viscosity: *P*, *cP*, *St*, *cSt*;
  Energy work: *J*, *kJ*, *MJ*, *GJ*, *TJ*, *mJ*, *µJ*, *nJ*, *pJ*,
  Wh, *kWh*, *MWh*, *GWh*, *TWh*, *cal*, *kcal*, *erg*,
  eV, *keV*, *MeV*, *GeV*, *TeV*, *PeV*, *EeV*;

Power: W, kW, MW, GW, TW, mW, μW, nW, pW, hpM, ks,
VA, kVA, MVA, GVA, TVA, mVA, μVA, nVA, pVA,
VAR, $kVAR$, $MVAR$, $GVAR$, $TVAR$, $mVAR$, μVAR, $nVAR$, $pVAR$;
Electric charge: C, kC, MC, GC, TC, mC, μC, nC, pC, Ah, mAh;
Potential: V, kV, MV, GV, TV, mV, μV, nV, pV;
Capacitance: F, kF, MF, GF, TF, mF, μF, nF, pF;
Resistance: Ω, $k\Omega$, $M\Omega$, $G\Omega$, $T\Omega$, $m\Omega$, $\mu\Omega$, $n\Omega$, $p\Omega$;
Conductance: S, kS, MS, GS, TS, mS, μS, nS, pS,
$\mho$, $k\mho$, $M\mho$, $G\mho$, $T\mho$, $m\mho$, $\mu\mho$, $n\mho$, $p\mho$;
Magnetic flux: Wb , kWb, MWb, GWb, TWb, mWb, μWb, nWb, pWb;
Magnetic flux density: T, kT, MT, GT, TT, mT, μT, nT, pT;
Inductance: H, kH, MH, GH, TH, mH, μH, nH, pH;
Luminous flux: lm;
Illuminance: lx;
Radioactivity: Bq, kBq, MBq, GBq, TBq, mBq, μBq, nBq, pBq, Ci, Rd;
Absorbed dose: Gy, kGy, MGy, GGy, TGy, mGy, μGy, nGy, pGy;
Equivalent dose: Sv, kSv, MSv, GSv, TSv, mSv, μSv, nSv, pSv;
Catalytic activity: kat;

- Non-metric units (Imperial/US):
  Mass: gr, dr, oz, lb, kip , st, qr, cwt, cwt_{UK}, cwt_{US}, ton, ton_{UK}, ton_{US}, $slug$;
  Length: th, in, ft, yd, ch, fur, mi, ftm, $cable$, nmi, li, rod, $pole$, $perch$, lea;
  Speed: mph, $knot$;
  Temperature: $°F$, $\Delta°F$, $°R$;
  Area: $rood$, ac;
  Volume (fluid): fl_oz, gi, pt, qt, gal, bbl, (dry) bu;
  fl_oz_{UK}, gi_{UK}, pt_{UK}, qt_{UK}, gal_{UK}, bbl_{UK}, (dry) bu_{UK};
  fl_oz_{US}, gi_{US}, pt_{US}, qt_{US}, gal_{US}, bbl_{US}, (dry) bu_{US};
  Force: ozf, lbf, $kipf$, $tonf$, pdl;
  Pressure: osi, $osf\ psi$, psf, ksi, ksf, tsi, tsf, $inHg$;
  Energy/work: BTU, $therm$, $therm\_{UK}$, $therm\_{US}$, $quad$;
  Power: hp, hpE, hpS.