Calcpad

Version 5.9 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** PDF or **MS Word** W 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*", "*Α*" - "*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;

  "%" - reminder (obsolete - use the **mod** function instead);

  "*" - multiplication;

  "-" - minus;

  "+" - plus;

  "≡" - equal to;

  "≠" - not equal to;

  "<" - less than;

  ">" - greater than;

  "≤" - less or equal;

  "≥" - greater or equal;

  "=" - assignment;

- Custom functions of type $\boldsymbol{f}(x; y; z; \ldots)$;
- Built-in functions:

  sign(x) – sign of a number;

  abs(x) - absolute value/magnitude;

  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;

  sin(x) - sine;

  cos(x) - cosine;

  tan(x) - tangent;

  csc(x) - cosecant;

  sec(x) - secant;

  cot(x) - cotangent;

  sinh(x) - hyperbolic sine;

  cosh(x) - hyperbolic cosine;

  tanh(x) - hyperbolic tangent;

  csch(x) - hyperbolic cosecant;

  sech(x) - hyperbolic secant;

  coth(x) - hyperbolic cotangent;

  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;

  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;

  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;

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;

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;

random(x) - random number between 0 and x;

min$(x; y; z\ldots)$ - minimum of multiple values;

max$(x; y; z\ldots)$ - maximum of multiple values;

sum$(x; y; z\ldots)$ - sum of multiple values = $x + y + z\ldots$;

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

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

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

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

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

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

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

take$(n; a; b; c\ldots)$ - returns the n-th element from the list;

line$(x; a; b; c\ldots)$ - linear interpolation;

spline$(x; a; b; c\ldots)$ - Hermite spline interpolation.

- 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` $\{ x(t) \mid y(t)\ @\ t = a : b \}$ - parametric;

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

  `$Plot` $\{ x_1(t) \mid y_1(t)\ \&\ x_2(t) \mid y_2(t)\ \&\ \ldots\ @\ x = a : b \}$ - 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
  ```

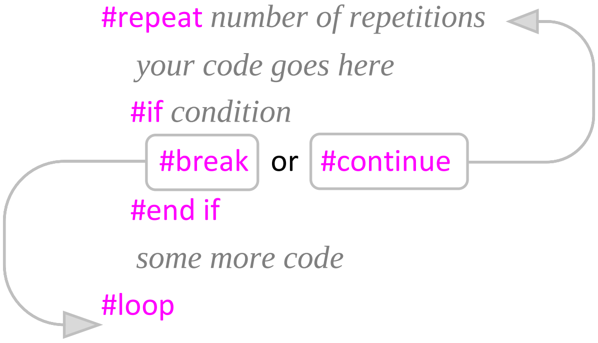
  You can add as many "#else if"s as needed, but only one "#else". You can omit any of them.

- Iteration blocks:

  Simple:

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

  With conditional break/continue:



  ```
  #repeat number of repetitions
      your code goes here
      #if condition
          #break or #continue
      #end if
      some more code
  #loop
  ```

- 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: *°C*, *Δ°C*, *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*, *kΩ*, *MΩ*, *GΩ*, *TΩ*, *mΩ*, *μΩ*, *nΩ*, *pΩ*;

  Conductance: *S*, *kS*, *MS*, *GS*, *TS*, *mS*, *μS*, *nS*, *pS*,
  ℧, *k℧*, *M℧*, *G℧*, *T℧*, *m℧*, *μ℧*, *n℧*, *p℧*;

  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*_$_{\text{UK}}$, *cwt*_$_{\text{US}}$, *ton*, *ton*_$_{\text{UK}}$, *ton*_$_{\text{US}}$, *slug*;
  Length: *th*, *in*, *ft*, *yd*, *ch*, *fur*, *mi*, *ftm*, *cable*, *nmi*, *li*, *rod*, *pole*, *perch*, *lea*;
  Speed: *mph*, *knot*;
  Temperature: *°F*, *Δ°F*, *°R*;
  Area: *rood*, *ac*;
  Volume (fluid): *fl_oz*, *gi*, *pt*, *qt*, *gal*, *bbl*, (dry) *bu*;
  *fl_oz*_$_{\text{UK}}$, *gi*_$_{\text{UK}}$, *pt*_$_{\text{UK}}$, *qt*_$_{\text{UK}}$, *gal*_$_{\text{UK}}$, *bbl*_$_{\text{UK}}$, (dry) *bu*_$_{\text{UK}}$;
  *fl_oz*_$_{\text{US}}$, *gi*_$_{\text{US}}$, *pt*_$_{\text{US}}$, *qt*_$_{\text{US}}$, *gal*_$_{\text{US}}$, *bbl*_$_{\text{US}}$, (dry) *bu*_$_{\text{US}}$;
  Force: *ozf*, *lbf*, *kipf*, *tonf*, *pdl*;
  Pressure: *osi*, *osf psi*, *psf*, *ksi*, *ksf*, *tsi*, *tsf*, *inHg*;
  Energy/work: *BTU*, *therm*, *therm*_$_{\text{UK}}$, *therm*_$_{\text{US}}$, *quad*;
  Power: *hp*, *hpE*, *hpS*.