bc Precision calculator

START HERE

`bc -l`
Calculator with math library

`ibase=16`
Read hex input

`echo '2^10' | bc`
Calculate from a pipe

`last`
Previous result

`scale=4`
Digits after the point

`define f(x) { return x*x }`
Own function

`obase=2`
Print in binary

`quit`
Leave bc

Input read in ibase → *compute* → **Arbitrary precision** scale decides digits → *print* → **Output** shown in obase

CONCEPTS

Division truncates to scale digits and scale starts at 0, so 10/3 prints 3. Set scale=N first, or use -l (scale 20).

Set obase before ibase when both change: after ibase=16, the number 10 means sixteen. Use A for ten while ibase is 16.

This sheet covers Gavin Howard's bc (BSD, macOS, many Linux distros). GNU bc lacks some extensions marked here.

RUNNING BC

`bc`
Start interactive calculator

`bc -l`
Math library and scale 20

`echo '<expr>' | bc -l`
Evaluate an expression from a pipe

`bc -e '<expr>'`
Evaluate an expression argument

`bc <file>`
Run a script file, then read stdin

`bc -f <file>`
Run a file, exit afterwards

`bc -q`
Skip banner (GNU compatibility)

`bc -s`
Accept strict POSIX bc only

`bc -w`
Warn about non-POSIX extensions

`bc -S <n> -I <base> -O <base>`
Preset scale, ibase, obase

`bc -P`
Disable the interactive prompt

`bc -z`
Print leading zero (0.5, not .5)

`bc -L`
Do not wrap long output lines

`bc --version`
Show version

`BC_LINE_LENGTH=0 bc`
Same as -L via environment
Default wrap is 70 digits with a backslash, which breaks piping long results; 0 turns it off.

`BC_ENV_ARGS="-l"`
Default options for every run

PRECISION AND BASES

`scale=<n>`
Digits kept after the decimal point

`scale`
Show current scale

`scale(<x>)`
Digits after the point of a value

`obase=<n>`
Output base (2 to max)

`ibase=<n>`
Input base (2 to 36)

`obase=16; <n>`
Convert decimal to hex

`ibase=16; <HEX>`
Read hex as input (uppercase digits)

`obase=0`
Scientific notation output

`obase=1`
Engineering notation output

`<n>e<exp>`
Scientific input, e.g. 1.5e3

`<x>@<n>`
Compute x at scale n

`$<x>`
Truncate to scale 0 digits

`x<<n  x>>n`
Shift decimal point by n digits

`maxibase() maxobase() maxscale()`
Query the limits

`last  or  .`
Last printed result

OPERATORS

`+  -  *  /  %`
Basic arithmetic and remainder
Modulus honours scale; with scale=0 it is the integer remainder.

`^`
Power with integer exponent

`sqrt(<x>)`
Square root

`++x  x--  x+=1`
Increment and compound assignment

`==  !=  <  <=  >  >=`
Comparisons giving 1 or 0

`&&  ||  !`
Boolean and, or, not

`abs(<x>)`
Absolute value

`length(<x>)`
Number of significant digits

`divmod(<a>, <b>, r[])`
Quotient; remainder lands in r[0]

OPERATORS (cont.)

`modexp(<b>, <e>, <m>)`
Modular exponentiation (integers)

`rand()  irand(<n>)`
Random number; random 0..n-1

`read()`
Read an expression from stdin

MATH LIBRARY (-L)

`s(<x>)`
Sine in radians

`c(<x>)`
Cosine in radians

`a(<x>)`
Arctangent in radians

`l(<x>)`
Natural logarithm

`e(<x>)`
e to the power x

`j(<x>, <n>)`
Bessel function of order n

`4*a(1)`
Pi to current scale

`pi(<p>)`
Pi at precision p

`t(<x>)`
Tangent

`l(<x>)/l(10)`
Log base 10 (or l10(x))

`log(<x>, <b>)`
Logarithm in any base

`p(<x>, <y>)`
Power with non-integer exponent

`r(<x>, <p>)`
Round to p places

`ceil(<x>, <p>)`
Round away from zero

`root(<x>, <n>)  cbrt(<x>)`
Nth root; cube root

`f(<n>)`
Factorial

`comb(<n>, <k>)  perm(<n>, <k>)`
Combinations; permutations

`gcd(<a>, <b>)  lcm(<a>, <b>)`
Greatest common divisor; least common multiple

`max(<a>, <b>)  min(<a>, <b>)`
Larger or smaller of two

`band(<a>, <b>)  bor(<a>, <b>)  bxor(<a>, <b>)`
Bitwise operations on integers

`bshl(<x>, <n>)  bshr(<x>, <n>)`
Bit shifts

MATH LIBRARY (-L) (cont.)

`hex(<x>)  binary(<x>)`
Print integer as hex or binary

`r2d(<x>)  d2r(<x>)`
Radians to degrees and back

PROGRAMMING

`define <f>(<a>, <b>) { ... }`
Define a function

`define void <f>() { ... }`
Function that returns no value

`auto <i>, <j>`
Local variables (first line in function)
Without auto, variables are global and shared with the caller.

`return (<x>)`
Return a value

`if (<c>) { } else { }`
Conditional

`while (<c>) { ... }`
Loop while true

`for (i=0; i<10; i++) { ... }`
Counting loop

`break  continue`
Leave or skip a loop iteration

`a[<i>] = <x>`
Array element (zero-based)

`define <f>(*<a>[])`
Pass array by reference

`print "<text>", <x>, "\n"`
Print without implicit newline

`"<text>"`
String literal prints as is

`/* ... */  # ...`
Comments

`quit`
Exit bc

RECIPES

Precise division in a script

```
echo 'scale=6; 22/7' | bc
echo '22/7' | bc -l | cut -c1-8
echo 'scale=2; 100*1.0825' | bc
```

Convert between bases

```
echo 'obase=16; 255' | bc
# FF
echo 'ibase=16; FF' | bc
# 255
echo 'obase=2; ibase=16; A5' |
bc     # 10100101
```

Sum a column of numbers

```
paste -sd+ numbers.txt | bc
awk '{s+=$1} END {print s}'
numbers.txt
```

Define a function and use it

```
bc -l <<'EOF'
define cube(x) { return x^3 }
scale=3; cube(1.5) + e(1)
EOF
```