sinclair

Cambridge Scientific

Advanced scientific calculator

Logs
Trig
$\sqrt{x}$ π $^1/x$
Algebraic logic

Memory
Constant
Scientific and normal notation

Instructions for use

English/Deutsch/Français

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Introduction

The calculator operates from two AAA size batteries. Alkaline cells such as Mallory MN2400 or equivalent are recommended.

Batteries are replaced through the removable cover in the bottom of the calculator. Although reversal will do no damage, batteries must be fitted the right way round or the calculator will not work.

When changing the cells it is most important to replace the complete set at any one time.

Indication of failing batteries will be given by a fading of the display. It is possible for calculations to be affected if batteries are too flat, so it is wise to replace them as soon as significant dimming of the display is noticed.

The calculator is switched on by sliding the ON/OFF switch away from the display. The ON/OFF switch is positioned in the top right hand corner of the keyboard. Always switch the calculator off when not in use, even if only for a short time, to conserve battery life.

The Cambridge Scientific

Capability

Four arithmetic functions: + − × ÷

Algebraic logic on all four arithmetic functions.

Constant on all four arithmetic functions.

Full memory (memory +, memory −, memory clear, memory exchange. Memory recall).

Floating point/scientific notation

Six trigonometric functions:
- sin arcsin
- cos arccos
- tan arctan

Operation in degrees *or* radians (switch selectable).

$\log_e$ and antilog ($= e^x$)

$\sqrt{x}$, $\frac{1}{x}$, π

Automatic clearing when first switched on.

Zero suppression.

Indicators:
- material in memory
- error condition
- upper case function

Design features

Dual keyboard

The Cambridge Scientific uses one set of keys to provide two sets of functions.

The *basic keyboard* is that of a normal arithmetic calculator, operating with algebraic logic.

The designations for this keyboard are printed on the keys.

The same keys operate as an *upper case keyboard*. The designations for this mode of operation are printed on the case over the keys. The uppercase keyboard is brought into operation by pressing the function key [▲].

Floating point/scientific notation

Results can be presented in floating point (arithmetic) format or scientific (mantissa and exponent) notation (see page 6).

Numbers can be *entered* using either notation (see page 6).

With an 8-digit display, the largest number that can be *displayed* in floating-point format is 99,999,999 – yet numbers as large as 9.9999×10^{99} can be handled.

The Cambridge Scientific accordingly presents calculation *results* between 0.001 and 99,999,999 in floating point format, and uses scientific notation to present results outside that range.

[▲] followed by [EE] (ChN) immediately changes from one format to the other.

Indicators

These appear in the left-hand segment of the display.

F indicates that the function key [▲] has been pressed.

E indicates that the calculator has been asked to calculate outside the permissible range (e.g. numbers larger than 9.9999×10^{99}), or to perform an inadmissible operation (e.g. square root of a negative number).

I indicates that the memory is in use.

Number entry

Numbers are accepted in *either* floating point *or* scientific notation.

Floating point

Key in the digits of the number and the decimal point (if any), up to a maximum of eight digits. The machine will ignore any subsequent digits.

Scientific notation

Scientific notation is a method of expressing numbers in two parts—mantissa, and exponent.

The MANTISSA consists of the most significant digits of the number with the decimal point placed after the first digit.

The EXPONENT is the power of 10 by which the mantissa must be multiplied to convert it to the original number.

Examples

Floating point notation	Scientific notation Mantissa	Exponent
123,400,000	1.234	8
1234	1.234	3
0.0001234	1.234	-4

Scientific notation enables the Cambridge Scientific to operate on very large or very small numbers ranging from 1.0000×10^{-99} to 9.9999×10^{99}.

To enter a number in scientific notation, first enter the mantissa with the decimal point after the first digit, then press the [EE] (=enter exponent) key. Then enter the exponent. The exponent may take any value from -99 to 99.

Up to eight digits may be entered as the mantissa, but after [EE] has been pressed only the most significant five digits will be shown. **See also P. 7.**

For the three examples above, the key sequence is as follows.

[1] [·] [2] [3] [4] [EE] [8]

[1] [·] [2] [3] [4] [EE] [3]

[1] [·] [2] [3] [4] [EE] [-] [4]

Although the decimal point normally appears after the first digit of the mantissa, this is not mandatory on number entry.

For example, 123,400,000 can be expressed as 1.234×10^8 *or* 1234×10^5, and may be entered if you wish as [1] [2] [3] [4] [EE] [5]

However the machine will normalise the number to the form 1.234 08 when the next operator is pressed.

Negative number entry

Negative numbers may be entered directly.

Examples

To calculate	Enter	Display shows
-2×3	[-] [2] [×] [3] [=]	-6.
2×-3	[2] [×] [-] [3] [=]	-6.
$2 \div -3$	[2] [÷] [-] [3] [=]	-0.6666666

However, [-] following [+] will simply overwrite the [+] e.g. enter: [3] [+] [-] [2] [=] 1

Display

Results are automatically presented in 8-digit floating point format within the range 0.001 to 99,999,999. Outside that range, the result will be presented in scientific notation with a 5-digit mantissa and 2-digit exponent. Results can be changed from floating point to scientific notation and back again by using the function key [▲]

followed by the [EE] (ChN) (=change notation) key.

Any floating point number can be converted to scientific notation: no digits beyond the fifth significant digit will be displayed, but the extra digits are retained within the machine and can be recovered by changing notation again.

Changing a result displayed in scientific notation to floating point will recover the sixth, seventh and eighth significant digits of the mantissa, but will normally lose the decimal point, unless the result is in the normal floating point range. The location of the decimal point is retained by the machine internally and can be recovered by changing notation again.

Clearing the machine

When the machine is first switched on, all functions are clear and the display shows 0.

To clear the display after a calculation terminated with [=], press [%/CE] once.

To clear the display after a calculation or entry not terminated with [=], press [%/CE] twice.

To clear the memory, press [▲] [%/CE] (MC)

Note: clearing the display does not automatically clear the memory. This allows a new series of calculations to be carried out while a previous result is stored.

The display need not be cleared before a new series of calculations unless the first entry of the new series is [−].

Simple arithmetic

The Cambridge Scientific uses algebraic logic. This means that most calculations can be entered directly as written.

Examples

To calculate	Press	Display shows
17.2+3.5+6.6	[1] [7] [·] [2] [+] [3] [·] [5]	
	[+] [6] [·] [6] [=]	27.3
6.9−2.2+7.3	[6] [·] [9] [−] [2] [·] [2] [+]	
	[7] [·] [3] [=]	12.
4×5×10	[4] [×] [5] [×] [1] [0] [=]	200.
6.2×3÷6+4.4	[6] [·] [2] [×] [3] [÷] [6] [+]	
	[4] [·] [4] [=]	7.5

Calculations containing simple brackets can usually be reconstructed as simple chains.

Examples

To calculate	Press	Display shows
2×7×(11+13)	[1] [1] [+] [1] [3] [×] [2] [×]	
	[7] [=]	336.

More complex expressions with brackets require use of the memory (see page 13).

Error correction

Number correction in floating point format

Simply press [%/CE], enter the correct number and continue.

Example

You intend 10−6=4

You enter [1] [0] [−] [7]

Correction sequence [%/CE] [6] [=] 4

Number correction in scientific notation

To correct a wrong mantissa, proceed as above and re-enter the whole number. A wrong exponent may be simply overwritten.

Example

You intend 1.2 3 EE 4 × 2.3 4 EE 5 = 2.8782 09

You enter [1] [·] [2] [3] [EE] [4] [×] [2] [·] [3] [4] [EE] [6]

Correction sequence [0] [5] = 2.8782 09

To correct an operator

Simply press the correct operator. This will overwrite the wrong operator.

This will not work where the correct operator is [−] and the wrong operator was [×] or [÷]. In these cases the correction sequence is as follows:

You intend 6 − 2

You enter [6] [×] or [6] [÷]

Correction sequence [6] [×] [+] [−] [2] [=] 4

[6] [÷] [+] [−] [2] [=] 4

[+] overwrites [×] or [÷] and [−] overwrites [+]

Constant Arithmetic

The constant allows a number and an operator common to several consecutive calculations to be entered once and re-used without being re-entered.

On the Cambridge Scientific the constant is automatic. Every calculation completed by [=] enters or maintains a constant.

Entering the constant

The constant is made up of two parts: a number *and* an operator.

[=] enters a constant

Multiplication:

Where [×] is the last operator pressed before [=], the constant formed is made up of the last number or partial result displayed before [×] and [×] itself.
For addition, subtraction and division: the last operator and the last number displayed before [=] become the constant.

Examples

To convert 10 inches, 12 inches, 15 inches to millimetres:

Press	Display shows
[2][5][.][4][×][1][0][=]	254.
[1][2][=]	304.8
[1][5][=]	381.

To convert 28 mm, 360 mm, 722 mm to inches:

Press	Display shows
[2][8][÷][2][5][.][4][=]	1.1023622
[3][6][0][=]	14.173228
[7][2][2][=]	28.425196

Item count

The constant on addition gives an item count feature:

Press	Display shows
[1][+]	1.
[=]	2.
[=]	3.
[=]	4. etc

x^n: integral powers

The constant on multiplication gives integral powers, e.g. for powers of 2:

Press	Display shows	
[2][×]	2.	
[=]	4.	$= 2^2$
[=]	8.	$= 2^3$
[=]	16.	$= 2^4$ etc

This is very useful in evaluating polynomials, see memory section on page 14.

Upper case keyboard

The function key [▲] gives access to the upper case functions marked on the keyboard. It is pressed *after* the quantity to which it refers is shown on the display. The sequence for sin 30°, for example, is [3][0][▲][7] (sin), and *not* [▲][7] (sin) [3][0]. In all, [▲] gives access to

five memory functions
ChN, change notation
sin, cos, tan
arcsin, arccos, arctan
$\sqrt{x}$, square root
$\frac{1}{x}$, reciprocal
ln, natural log
e^x, natural antilog
π, pi

Function [▲] indicator

Use of the function key causes an /= to appear on the left of the display until the function is completed.

Note: all the upper case functions act directly on the display contents. [▲] does *not* complete a previous calculation.

So for example

[4][+][5][▲][1] ($\sqrt{x}$) gives $\sqrt{5}$, *not* $\sqrt{9}$.

Compare the following sequences.

Press		Display	Press		Display
[4][+]		4.	[4][+]		4.
[5]		5.	[5]		5.
[▲]	/=	5.	[=]		9.
$\sqrt{x}$ [1]		2.2360679	[▲]	/=	9.
			$\sqrt{x}$ [1]		3.

A previous calculation must be completed with = or other operator before proceeding to apply an upper case function to the result.

If [▲] is pressed in error, it can be eliminated by pressing [▲] again; this will not affect a previous partial result.

Memory operation

The Cambridge Scientific has a powerful, flexible memory with five separate functions.

Key sequence	Function
▲ [+] (M+)	Memory plus Adds contents of display to memory: leaves display unaltered.
▲ [−] (M−)	Memory minus Subtracts contents of display from memory: leaves display unaltered.
▲ [×] (MEx)	Memory exchange Exchanges contents of display register with memory.
▲ [=] (MR)	Memory recall Overwrites display with contents of memory. Leaves memory unaltered.
▲ [C/CE] (MC)	Memory clear Changes contents of memory to zero: display unaltered.

Memory indicator

A single display segment at the left-hand side of the display is illuminated when anything is stored in the memory.

Sums of products

To calculate

$(2\times3)+(4\times5)+(6\times7)=68$

Press	Display shows	Memory holds
[2] [×] [3] [=]	6.	0
▲ [+] (M+)	I 6.	6
[4] [×] [5] [=]	I 20.	6
▲ [+] (M+)	I 20.	26
[6] [×] [7] [=]	I 42.	26
▲ [+] (M+)	I 42.	68
▲ [=] (MR)	I 68.	68

Complex bracketed expressions

To calculate

$$\frac{2\times3+7}{4\times(2+3)}$$

Press	Display shows	Memory holds
[2] [×] [3]	3.	0
[+] [7] [=]	13.	0
▲ [+] (M+)	I 13.	13
* [C/CE]	I 0.	13
[2] [+] [3]	I 3.	13
[×] [4] [=]	I 20.	13
▲ [×] (MEx)	I 13.	20
[÷] ▲ [=] (MR)	I 20.	20
[=]	I 0.65	20

*Note: this step is not necessary, but is included as a demonstration that clearing the display does not clear the memory.

Polynomials

Evaluation of polynomials uses both memory and constant facility.

A polynomial takes the form

$$\sum_{r=0}^{r=n} a_r x^r$$

Each term $a_r x^r$ can be evaluated by the sequences x [×] [=] [=] . . . [=] x a_r [=]

where [=] is pressed $(r-1)$ times. The sequence [▲] [+] (M+) then adds this to the memory, and we proceed to the next term.

So to evaluate say $3x^2+7x+4$ for $x=2$, the sequence is

Press	Display shows	Memory holds
[2] [×]	2.	0
[=] [×]	4.	0
[3]	3.	0
[=]	12.	0
[▲] [+] (M+)	I 12.	12
[2] [×]	I 2.	12
[7] [=]	I 14.	12
[▲] [+] (M+)	I 14.	26
[4] [+]	I 4.	26
[▲] [=] (MR)	I 26.	26
[=]	I 30.	26

Answer: 30

Trigonometric functions

The Cambridge Scientific operates in *either* degrees *or* radians. Either mode can be selected using the slide switch located in the battery compartment.

[▲] gives access to the six trigonometric functions indicated on the keyboard:

Key sequence	*Function*
[▲] [7] (sin)	sin
[▲] [8] (cos)	cos
[▲] [9] (tan)	tan
[▲] [4] (arcsin)	arcsin
[▲] [5] (arccos)	arccos
[▲] [6] (arctan)	arctan

Argument range

The allowable range on the trig functions is as follows:

	Degrees	Radians
Sin, Cos	$0<x<90°$	$0<x<\frac{\pi}{2}$
Tan	$0<x<89.99°$	$0<x<1.5706218$

Any attempt to use trig functions outside the allowable ranges will result in the E (Error) indicator appearing on the display. The machine must then be cleared before restarting.

Execution time

Average 4 seconds.

Accuracy

About ± one unit in fourth significant digit.

Square root

Square root is available directly

using [▲] [1] ($\sqrt{x}$)

Argument range

$x \geq 0$

Accuracy

± one unit in 8th significant digit.

Other roots may be obtained using the log function.

Log_e and e^x (antilog)

Both these functions are available directly using [▲] followed by [2] (ln) or [3] (e^x)

Accuracy

± one unit in the fourth significant figure

Argument range

log_n : $0<x<9.9999$ E 99

$antilog_n$: $x \leq 230.25853$

x^y (roots and non-integral powers)

(Square roots and integral powers have been dealt with in earlier sections.)

We use the relationship
$\log x^y = y \log x$,
or $x^y = \text{antilog}\ \{y \log x\}$

Example 1

Find the cube (3rd) root of 343

$\sqrt[3]{343} = (343)^{\frac{1}{3}} = \text{antilog}\ (\frac{1}{3} \log 343)$

Press	Display shows	Comments
[3][4][3]	343	
[▲][2] (ln)	5.8378	$\log_e 343$
[÷][3][=]	1.9459333	$\frac{1}{3} \log_e 343$
[▲][3] (e^x)	7.0001	

Example 2

£4000 is invested for 6 years and 3 months at 11% interest. What is the value of capital plus interest at the end of that time?

Capital + interest = $4000(1+0.11)^{6.25}$

Press	Display shows
[1][.][1][1]	1.11
[▲][2] (ln)	0.10436
[×][6][.][2][5]	6.25
[=]	0.65225
[▲][3] (e^x)	1.9198
[×][4][0][0][0][=]	7679.2
Answer	£7679.20

Base 10 logs (Common logs)

In the examples above the formulae work equally well with natural (base e) or common (base 10) logs. For some purposes the value of common logs is required. These are not available directly, but can be quickly obtained using the formula

$$\log_{10} x = \frac{\log_e x}{\log_e 10}$$

Example

Find $\log_{10} 2$.

Press	Display shows	Memory holds
[2]	2	0
[▲][2] (ln)	0.69314	0
[▲][+] (M+)	I 0.69314	0.69314
[1][0]	I 10	0.69314
[▲][2] (ln)	I 2.3025	0.69314
[▲][×] (MEx)	I 0.69314	2.3025
[÷][▲][−] (MR)	I 2.3025	2.3025
[=]	I 0.301038 ($=\log_{10} 2$)	

π

The value of π may be called into the display register directly and used at any point in a calculation.

Example

Evaluate

$4\pi r^2$, where $r = 2.75$

Press	Display shows
[2][.][7][5][×]	2.75
[=]	7.5625 (using constant)
[×][▲][0] (π)	3.1415926
[×][4][=]	95.033176

$\frac{1}{x}$: Reciprocal

The reciprocal of any non-zero number may be obtained directly using the sequence [▲] [1/x].

Example

Evaluate

$$\frac{1}{0.75 \sin 43.28°}$$

Select degree mode.

Press	Display shows	
[4] [3] [·] [2] [8]	43.28	
[▲] [7] (sin)	0.68556	
[×] [·] [7] [5]	0.75	
[=]	0.51417	Note use of =
[▲] [·] (1/x)	1.944882	

Note that the reciprocal may also be obtained using the constant sequence

[÷] [=] [=]

Calculator care

If your calculator remains unused for a long period, especially in a hot or humid climate, it is possible for a thin film of oxide to form underneath the keyboard plate and cause incorrect number entry. You can clear this film simply by pressing each key firmly once.

Service and Guarantee

Your calculator is fully and unconditionally guaranteed for one year from the date of purchase against defects in materials or workmanship. During this period it will be repaired or replaced (at Manufacturer's Option) without charge to the owner, if it is returned, carefully packed, postage pre-paid, preferably by registered or recorded delivery, to Sinclair Radionics Ltd. Enclose a letter clearly stating your name and address, the date and place of purchase, and the nature of the fault. The guarantee is invalid, if the calculator has been damaged by accident, unreasonable use, neglect, or improper service.

BEFORE RETURNING YOUR CALCULATOR CAREFULLY RE-CHECK THE INSTRUCTIONS AND ALSO CHECK THAT THE BATTERIES DO NOT NEED REPLACING; PLEASE RETAIN THE BATTERIES AND DO NOT RETURN THEM WITH THE CALCULATOR.

U.K. owners should return their calculator direct to:

Sinclair Radionics Limited,
Calculator Service Dept.,
London Road, St. Ives,
HUNTINGDON, Cambs. PE17 4HJ

U.S.A. owners to:

Sinclair Radionics Inc.,
Galleria,
115 East 57th Street,
NEW YORK
NY 10022

Outside the U.K. and U.S.A. consult your local Sinclair dealer or distributor.

Please use the space below to record the relevant details for your reference.

Date of purchase ____________________

Place of purchase ____________________

Owner's name and address ____________________

____

____

ADDENDUM to Calculator Instruction Book

Service and Guarantee

Before returning your calculator (preferably by registered or recorded delivery) please re-check the instructions and also check that the batteries do not need replacing. Retain the batteries, do not return them with the calculator. The guarantee is void if the calculator has been damaged by accident, unreasonable use, neglect, or improper service.

U.K. owners should return their calculator direct to:
Sinclair Radionics Ltd., Calculator Service Department,
London Road, St. Ives, HUNTINGDON, Cambs. PE17 4HJ.

U.S.A. owners
Sinclair Radionics Inc., Galleria, 115 East 57th Street,
NEW YORK, NY 10022.

In France
Cogel S.A.R.L., 23 Rue des Taillandiers, PARIS XI 750011.

In Germany
Generalvertretung der Sinclair Radionics Ltd. in der B.R.D.
Jürgen Schumpich, 8021 Taufkirchen b. München,
Platanenstrasse 33

Outside these countries please consult your local Sinclair dealer or distributor.

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