TI-30X Pro MathPrint™
Scientific Calculator Guidebook

This guidebook applies to software version 1.0. To view the latest version of the documentation, go to *education.ti.com/eguide*.

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Getting Started

This section contains information about basic calculator functions.

Switching the Calculator On and Off

[on] turns on the calculator. [2nd] [off] turns it off. The display is cleared, but the history, settings, and memory are retained.

The APD™ (Automatic Power Down™) feature turns off the calculator automatically if no key is pressed for about 3 minutes. Press [on] after APD™. The display, pending operations, settings, and memory are retained.

Display Contrast

The brightness and contrast of the display depend on room lighting, battery freshness and viewing angle.

To adjust the contrast:

1. Press and release the [2nd] key.
2. Press [▸] (to darken the screen) or [◂] (to lighten the screen).

   Note: This will adjust the contrast one level at a time. Repeat steps 1 and 2 as needed.

Home Screen

On the Home screen, you can enter mathematical expressions and functions, along with other instructions. The answers are displayed on the Home screen.

The TI-30X Pro MathPrint™ screen can display a maximum of four lines with a maximum of 16 characters per line. For entries and expressions longer than the visible screen area, you can scroll left and right (◀ and ▶) to view the entire entry or expression.

In MathPrint™ mode, you can enter up to four levels of consecutive nested functions and expressions, which include fractions, square roots, exponents with ^, $\sqrt[x]{y}$, e^x, and 10^x.

When you calculate an entry on the Home screen, depending upon space, the answer is displayed either directly to the right of the entry or on the right side of the next line.

Special indicators and cursors may be displayed on the screen to provide additional information concerning functions or results.

Indicator	Definition
2ND	2nd function.
FIX	Fixed-decimal setting. (See Mode section.)
SCI, ENG	Scientific or engineering notation. (See Mode section.)

Indicator	Definition
DEG, RAD, GRAD	Angle mode (degrees, radians, or gradians). (See Mode section.)
L1, L2, L3	Displays above the lists in data editor.
H, B, O	Indicates HEX, BIN, or OCT number-base mode. No indicator displayed for default DEC mode.
	The calculator is performing an operation. Use [on] to break the calculation.
▲ ▼	An entry is stored in memory before and/or after the visible screen area. Press ⊕ and ⊖ to scroll.
▸	Indicates that the multi-tap key is active.
	Normal cursor. Shows where the next item you type will appear. Replaces any current character.
	Entry-limit cursor. No additional characters can be entered.
	Insert cursor. A character is inserted in front of the cursor location.
	Placeholder box for empty MathPrint™ template. Use the arrow keys to move into the box.
	MathPrint™ cursor. Continue entering in the current MathPrint™ template, or press ⊕ to exit the template.

2nd Functions

[2nd]

Most keys can perform more than one function. The primary function is indicated on the key and the secondary function is displayed above it. Press [2nd] to enable the secondary function of a given key. Notice that **2ND** appears as an indicator on the screen. To cancel before pressing the next key, press [2nd] again. For example, [2nd] [√] **25** [enter] calculates the square root of 25 and returns the result, 5.

Modes

[mode]

Use [mode] to choose modes. Press ⊖ ⊕ ⊖ ⊕ to choose a mode, and [enter] to select it. Press [clear] or [2nd] [quit] to return to the Home screen and perform your work using the chosen mode settings.

Default settings are highlighted in these sample screens.

DEGREE RADIAN GRADIAN - Sets the angle mode to degrees, radians, or gradians.

NORMAL SCI ENG - Sets the numeric notation mode. Numeric notation modes affect only the display of results, and not the accuracy of the values stored in the unit, which remain maximal.

NORMAL displays results with digits to the left and right of the decimal, as in 123456.78.

SCI expresses numbers with one digit to the left of the decimal and the appropriate power of 10, as in 1.2345678E5, which is the same as the value (1.2345678×10^5) including the brackets for correct order of operation.

ENG displays results as a number from 1 to 999 times 10 to an integer power. The integer power is always a multiple of 3.

Note: [EE] is a shortcut key to enter a number in scientific notation format. The result displays in the numeric notation format selected in the mode menu.

FLOAT 0 1 2 3 4 5 6 7 8 9 - Sets the decimal notation mode.

Float (floating) decimal mode displays up to 10 digits, plus the sign and decimal.

0 1 2 3 4 5 6 7 8 9 (fixed decimal point) specifies the number of digits (0 to 9) to display to the right of the decimal.

REAL a+bi r∠θ - Sets the format of complex number results.

REAL real results

a+bi rectangular results

r∠θ polar results

DEC HEX BIN OCT - Sets the number base used for calculations.

DEC decimal

HEX hexadecimal (To enter hex digits A through F, use [2nd] [A], [2nd] [B], and so on.)

BIN binary

OCT octal

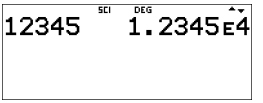
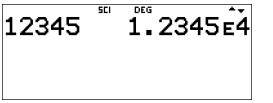
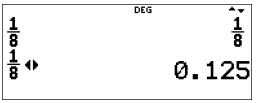
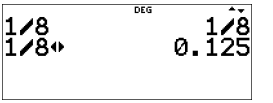
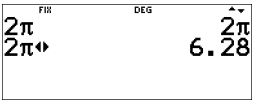
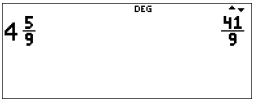
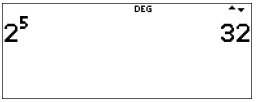
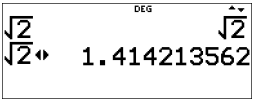
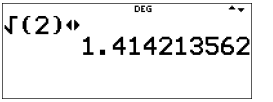
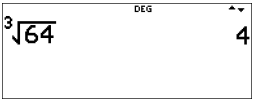
MATHPRINT CLASSIC

MATHPRINT mode displays most inputs and outputs in textbook format.

CLASSIC mode displays inputs and outputs in a single line.

Examples of MathPrint™ and Classic Modes

MathPrint™ Mode	Classic Mode
Sci	Sci

MathPrint™ Mode	Classic Mode
	
Float mode and answer toggle key 	Float mode and answer toggle key. 
Fix 2 and answer toggle key 	Fix 2
Un/d 	Un/d entry
Exponent example 	Exponent example
Square root example 	Square root example 
Cube root example 	Cube root example

Multi-Tap Keys

A multi-tap key is one that cycles through multiple functions when you press it. Press ⊙ to stop multi-tap.

For example, the [sin sin⁻¹] key contains the trigonometry functions **sin** and **sin**$^{-1}$ as well as the hyperbolic functions **sinh** and **sinh**$^{-1}$. Press the key repeatedly to display the function that you want to enter.

Multi-tap keys include [x^{yzt}_{abcd}], [sin sin⁻¹], [cos cos⁻¹], [tan tan⁻¹], [e□ 10□], [ln log], [! nCr nPr], and [π e i]. Applicable sections of this guidebook describe how to use the keys.

Menus

Menus give you access to a large number of calculator functions. Some menu keys, such as [2nd] [recall], display a single menu. Others, such as [math], display multiple menus.

Press ▶ and ▼ to scroll and select a menu item, or press the corresponding number next to the item. To return to the previous screen without selecting the item, press [clear]. To exit a menu and return to the Home screen, press [2nd] [quit].

[2nd] [recall] (key with a single menu):

RECALL VAR
1:x = 0
2:y = 0
3:z = 0
4:t = 0
5:a = 0
6:b = 0
7:c = 0
8:d = 0

[math] (key with multiple menus):

MATHS	NUM	DMS	R◀▶P
1:▶n/d◀▶Un/d	1:abs(	1:°	1:P▶Rx(
2:lcm(	2:round(	2:′	2:P▶Ry(
3:gcd(	3:iPart(	3:″	3:R▶Pr(
4:▶Pfactor	4:fPart(	4:r	4:R▶Pθ(
5:sum(	5:int(	5:g	
6:prod(	6:min(	6:▶DMS	
7:nDeriv(	7:max(		
8:fnInt(	8:mod(		

Examples

Some sections are followed by instructions for keystroke examples that demonstrate the TI-30X Pro MathPrint™ functions.

Notes:

- Examples assume all default settings, as shown in the Modes section unless noted in the example.
- Use [clear] to clear the home screen as needed.

- Some screen elements may differ from those shown in this document.
- Since wizards retain their memory, some keystrokes may be different.

Scrolling Expressions and History

◀ ▶ ▲ ▼

Press ◀ or ▶ to move the cursor within an expression that you are entering or editing. Press 2nd ◀ or 2nd ▶ to move the cursor directly to the beginning or end of the expression.

From an expression or edit, ▲ moves the cursor to the history. Press enter from an input or output in history to paste that expression back to the cursor position on the edit line.

Press 2nd ▲ from the denominator of a fraction in the expressions edit to move the cursor to the history. Press enter from an input or output in history to paste that expression back to the cursor position on the edit line.

Example

7 x^2 − **4** (**3**) (**1**) enter	DEG $7^2-4(3)(1)$ 37
2nd [√] ▲ ▲ enter enter	DEG $7^2-4(3)(1)$ 37 $\sqrt{7^2-4(3)(1)}$ $\sqrt{37}$
◀▶≈	DEG $7^2-4(3)(1)$ 37 $\sqrt{7^2-4(3)(1)}$ $\sqrt{37}$ $\sqrt{37}$ 6.08276253

Answer Toggle

◀▶≈

Press the ◀▶≈ key to toggle the display result (when possible) between fraction and decimal answers, exact square root and decimal, and exact pi and decimal.

Example

Answer toggle	2nd [√] **8** enter	DEG $\sqrt{8}$ $2\sqrt{2}$
	◀▶≈	DEG $\sqrt{8}$ $2\sqrt{2}$ $2\sqrt{2}$ 2.828427125

Note: [◆▶≈] is also available to toggle number formats for values in cells in the Function Table and in the Data Editor. Editors such as in matrix, vector and system solver will display toggled cell values.

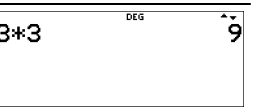
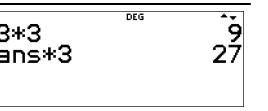
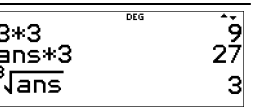
Last Answer

[2nd] [answer]

The last entry performed on the home screen is stored to the variable **ans**. This variable is retained in memory, even after the calculator is turned off. To recall the value of **ans**:

- Press [2nd] [answer] (**ans** displays on the screen), or
- Press any operations key ([+], [−], and so forth) in most edit lines as the first part of an entry. **ans** and the operator are both displayed.

Examples

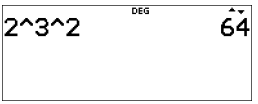
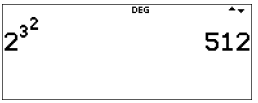
ans	**3** [×] **3** [enter]	
	[×] **3** [enter]	
	3 [2nd] [$\sqrt{\square}$] [2nd] [answer] [enter]	

Note: The variable **ans** is stored and pastes in full precision which is 13 digits.

Order of Operations

The TI-30X Pro MathPrint™ calculator uses Equation Operating System (EOS™) to evaluate expressions. Within a priority level, EOS™ evaluates functions from left to right and in the following order.

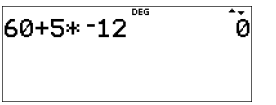
1st	Expressions inside brackets.
2nd	Functions that need a **)** and precede the argument, such as **sin**, **log**, and all **R◆▶P** menu items.
3rd	Functions that are entered after the argument, such as $\mathbf{x}^2$ and angle unit modifiers.
4th	Exponentiation (^) and roots ($\sqrt[x]{}$). **Note:** In Classic mode, exponentiation using the [$x^{\square}$] key is evaluated from left to right. The expression 2^3^2 is evaluated as (2^3)^2, with a result of 64.

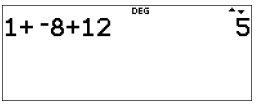
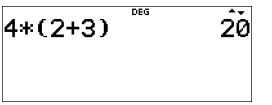
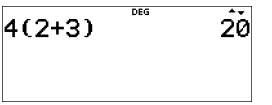
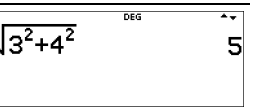
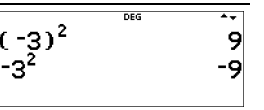
	 In MathPrint™ mode, exponentiation using the $x^{\square}$ key is evaluated from right to left. The expression 2^3^2 is evaluated as 2^(3^2), with a result of 512.  The calculator evaluates expressions entered with x^2 and $\frac{1}{\square}$ from left to right in both Classic and MathPrint™ modes. Pressing **3** x^2 x^2 is calculated as $(3^2)^2 = 81$.
5th	Negation (-).
6th	Fractions.
7th	Permutations (**nPr**) and combinations (**nCr**).
8th	Multiplication, implied multiplication, division, and angle indicator ∠.
9th	Addition and subtraction.
10th	Logic operators **and**, **nand**.
11th	Logic operators **or**, **xor**, **xnor**.
12th	Conversions such as ▶**n/d**◀▶**Un/d**, **F**◀▶**D**, ▶**DMS**.
13th	sto→
14th	enter evaluates the input expression.

Note: End of expression operators and Base n conversions such as ▶**Bin**, angle conversion ▶**DMS**, ▶**Pfactor**, and complex number conversions ▶**Polar** and ▶**Rectangle**, are only valid in the Home Screen. They are ignored in wizards, function table display and data editor features where the expression result, if valid, will display without a conversion. Editors such as in matrix, vector and system solver will also ignore these end of expression operators in the edit line.

Note: Use brackets to clearly indicate the operation order you expect for your expression entry. If necessary, the brackets can be used to override the order of operations followed by the algorithms in the calculator. If the result is not as expected, check how the expression was entered and add brackets as needed.

Examples

+ × ÷ -	**60** + **5** × (−) **12** enter	

(-)	**1** + (−) **8** + **12** enter	
√ and +	2nd [√] **9** + **16** enter	
( )	**4** × (**2** + **3**) enter	
( ) and +	**4** (**2** + **3**) enter	
^ and √	2nd [√] **3** $x^{\square}$ **2** ▶ + **4** $x^{\square}$ **2** enter	
( ) and -	((−) **3**) x^2 enter (−) **3** x^2 enter	

Clearing and Correcting

2nd [quit]	Returns the cursor to the home screen. Quickly dismisses these applications: Expression Evaluation, Set Operation, Function Table, Data Editor, Statistics, Distributions, Vector, Matrix, Numeric Solver, Polynomial Solver, and System Solver.
clear	Clears an error message. Clears characters on entry line.
delete	Deletes the character at the cursor. When the cursor is at the end of an expression, it will backspace and delete.
2nd [insert]	Inserts a character at the cursor.
2nd [clear var] **1**	Clears variables **x**, **y**, **z**, **t**, **a**, **b**, **c**, and **d** to their default value of 0. Any computed Stat Vars will no longer be available in the Stat Vars menu. Recompute statistic features as needed.
2nd [reset] **2**	Resets the calculator.

	Returns the calculator to default settings; clears memory variables, pending operations, all entries in history and statistical data; clears any stored operation and **ans**.

Memory and Stored Variables

x^{yzt}_{abcd} sto→ 2nd [recall] 2nd [clear var]

The TI-30X Pro MathPrint™ calculator has 8 memory variables—**x**, **y**, **z**, **t**, **a**, **b**, **c**, and **d**. You can store the following to a memory variable:

- real or complex numbers
- expression results
- calculations from various applications such as Distributions
- data editor cell values (stored from the edit line)

Features of the calculator that use variables will use the values that you store.

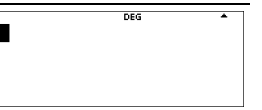
sto→ lets you store values to variables. Press sto→ to store a variable, and press x^{yzt}_{abcd} to select the variable to store. Press enter to store the value in the selected variable. If this variable already has a value, that value is replaced by the new one.

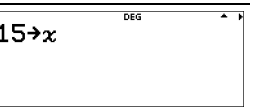
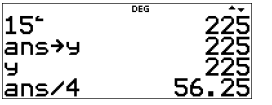
x^{yzt}_{abcd} is a multi-tap key that cycles through the variable names **x**, **y**, **z**, **t**, **a**, **b**, **c**, and **d**. You can also use x^{yzt}_{abcd} to recall the stored values for these variables. The name of the variable is entered in the current entry, but the value assigned to the variable is used to evaluate the expression. To enter two or more variables in succession, press ⊙ after each.

2nd [recall] recalls the values of variables. Press 2nd [recall] to display a menu of variables and their stored values. Select the variable you want to recall and press enter. The value assigned to the variable is inserted into the current entry and used to evaluate the expression.

2nd [clear var] clears variable values. Press 2nd [clear var] and select **1:Yes** to clear all variable values. Any computed Stat Vars will no longer be available in the Stat Vars menu. Recompute statistic features as needed.

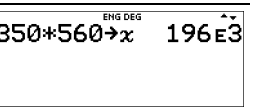
Examples

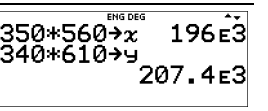
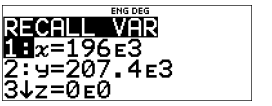
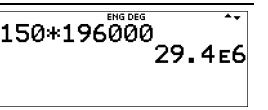
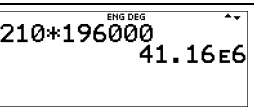
Start with clear screen	2nd [quit] clear	
Clear Var	2nd [clear var] **1** (Selects **Yes**)	

Store	**15** sto→ x^{yzt}_{abcd}	
	enter	
Recall	2nd [recall]	
	enter x^2 enter	
	sto→ x^{yzt}_{abcd} x^{yzt}_{abcd}	
	enter	
	x^{yzt}_{abcd} x^{yzt}_{abcd}	
	enter ÷ **4** enter	

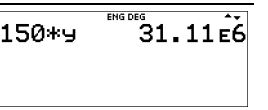
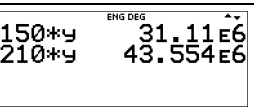
Problem

In a gravel quarry, two new excavations have been opened. The first one measures 350 metres by 560 metres, the second one measures 340 metres by 610 metres. What volume of gravel does the company need to extract from each excavation to reach a depth of 150 metres? To reach 210 metres? Display the results in engineering notation.

mode ⊖ ⊕ ⊕ enter clear **350** × **560** sto→ x^{yzt}_{abcd} enter	

340 × **610** sto→ x^{yzt}_{abcd} x^{yzt}_{abcd} enter	
clear **150** × 2nd [recall]	
enter enter	
clear **210** × 2nd [recall] enter enter	

For the first excavation, the company needs to extract 29.4 million cubic metres to reach a depth of 150 metres, and extract 41.16 million cubic metres to reach a depth of 210 metres.

clear **150** × x^{yzt}_{abcd} x^{yzt}_{abcd} enter	
210 × x^{yzt}_{abcd} x^{yzt}_{abcd} enter	

For the second excavation, the company needs to extract 31.11 million cubic metres to reach a depth of 150 metres, and extract 43.554 million cubic metres to reach a depth of 210 metres.

Math Functions

This section contains information about using the calculator maths functions such as trigonometry, statistics and probability.

Fractions

[▫/▫] [2nd] [□▫/▫] [math] **1** [2nd] [f◂▸d]

Fractions with [▫/▫] can include real and complex numbers, operation keys ([+], [×], etc.), and most function keys ([x^2], [2nd] [%], etc.).

In Classic mode or classic entries in MathPrint™ mode, the fraction bar [▫/▫] displays in-line as a thick bar, for example 8/9. Use brackets to clearly indicate the arithmetic you expect. While the Order of Operations rules will apply, you are in control of the way an expression evaluates by placing the correct brackets in your inputs.

Fraction Results

- Fraction results are automatically simplified and output is in improper fraction format.
- When mixed number output is desired, use the ▸n/d◂▸Un/d mixed number conversion at the end of the input expression. This feature is located in [math] **1: ▸n/d◂▸Un/d**.
- Fraction results are obtained when the calculated value can display within the limits of the fraction format supported by the calculator and no decimal value was entered in the input expression.
- If decimal numbers are used or calculated in a fraction numerator or denominator, the result will display as a decimal. Entering a decimal forces the result to display in decimal format.
- Use [2nd] [f◂▸d] (above [◂▸≈]) on results to attempt fraction to decimal conversions within the fraction display limits offered by this numeric calculator.

Mixed Numbers and Conversions

- [2nd] [□▫/▫] enters a mixed number. Press the arrow keys to cycle through the unit, numerator, and denominator.
- [math] **1** converts between simple fractions and mixed-number form (▸n/d◂▸Un/d).
- [2nd] [f◂▸d] converts results between fractions and decimals.

MathPrint™ Entry

- To enter numbers or expressions in the numerator and denominator in MathPrint™ mode, press [▫/▫].
- Press ⌄ or ⌃ to move the cursor between the numerator and denominator.
- Pressing [▫/▫] before or after numbers or functions may pre-populate the numerator with parts of your expression. Watch the screen as you press keys to ensure you enter the expression exactly as needed.

On the Home Screen

- To paste a previous entry from history in the numerator or mixed number unit, place the cursor in the numerator or unit, press ▲ to scroll to the desired entry, and then press enter to paste the entry to the numerator or unit.
- To paste a previous entry from history in the denominator, place the cursor in the denominator, press 2nd ▲ to jump into history. Press ▲ to scroll to the desired entry, and then press enter to paste the entry to the denominator.

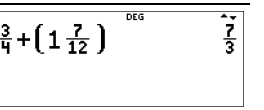
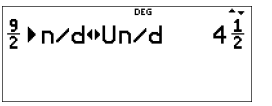
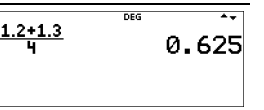
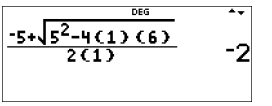
Evaluation of Your Expression

- When enter is pressed to evaluate your input expression, brackets may be displayed to clearly indicate how it was interpreted and calculated by the calculator. If it is not what you expected, copy the input expression and edit as needed.

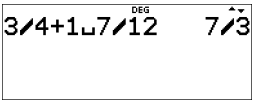
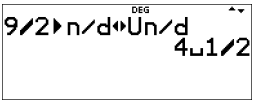
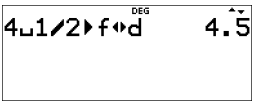
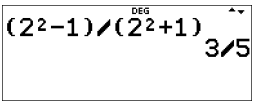
Classic Mode or Classic Entry

- If the cursor is in a classic entry location, enter the numerator expression enclosed by brackets, then press ▫/▫ to display the thick fraction bar, and then enter the denominator expression also enclosed with brackets for the result to be calculated as you expect for your problem.

Examples in MathPrint™ Mode

n/d, Un/d	▫/▫ **3** ▼ **4** ▶ + **1** 2nd [▫/▫] **7** ▼ **12** enter **Note:** Brackets are added automatically.	
▶n/d◀▶Un/d	**9** ▫/▫ **2** ▶ math **1** enter	
f◀▶d	**4** 2nd [▫/▫] **1** ▼ **2** ▶ 2nd [f◀▶d] enter	
Example	▫/▫ **1.2** + **1.3** ▼ **4** enter **Note:** Result is decimal since decimal numbers were used in the fraction.	
Example	▫/▫ (−) **5** + 2nd [√] **5** [x²] − **4** (**1**) (**6**) ▼ **2** (**1**) enter	

Examples in Classic Mode

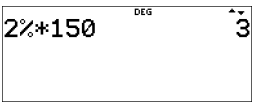
n/d, Un/d	**3** ▯/▯ **4** + **1** 2nd [▯ ▯] **7** ▯/▯ **12** enter	
▸n/d◂▸Un/d	**9** ▯/▯ **2** math **1** enter	
f◂▸d	**4** 2nd [▯ ▯] **1** ▯/▯ **2** 2nd [f◂▸d] enter	
Brackets	(**2** x^2 − **1**) ▯/▯ (**2** x^2 + **1**) enter	

Percentages

2nd [%]

To perform a calculation involving a percentage, press 2nd [%] after entering the value of the percentage.

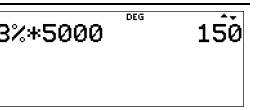
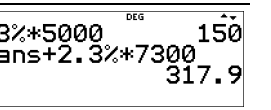
Example

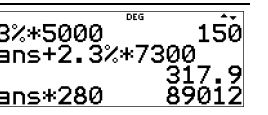
2 2nd [%] × **150** enter	

Problem

A mining company extracts 5000 tonnes of ore with a concentration of metal of 3% and 7300 tonnes with a concentration of 2.3%. On the basis of these two extraction figures, what is the total quantity of metal obtained?

If one tonne of metal is worth 280 units of currency, what is the total value of the metal extracted?

3 2nd [%] × **5000** enter	
+ **2.3** 2nd [%] × **7300** enter	

× **280** enter	

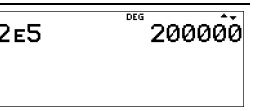
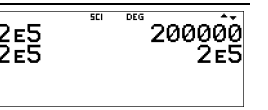
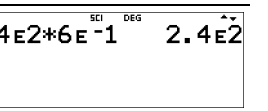
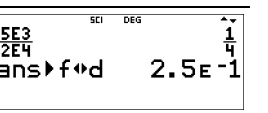
The two extractions represent a total of 317.9 tonnes of metal for a total value of 89012 units of currency.

Scientific Notation [EE]

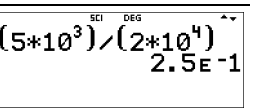
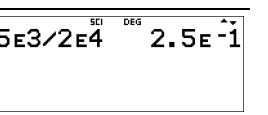
EE

EE is a shortcut key to enter a number in scientific notation format. A number such as (1.2×10^{-4}) is entered in the calculator as the number 1.2E-4.

Example

2 EE **5** enter **Note:** Enters (2×10^5) using the calculator E notation.	
mode ⊖ ⊕ enter **Note:** The **SCI** mode setting displays results in scientific notation.	
clear enter	
clear **4** EE **2** × **6** EE (−) **1** enter	
▫/▫ **5** EE **3** ⊖ **2** EE **4** enter 2nd [answer] 2nd [f◂▸d]	

Example

Textbook Problem clear (**5** × **10** $x^{\square}$ **3** ⊕) ÷ (**2** × **10** $x^{\square}$ **4** ⊕) enter	
Using EE clear **5** EE **3** ÷ **2** EE **4** enter	

Powers, Roots and Inverses

[x^2]	Calculates the square of a value.
[$x^{\square}$]	Raises a value to the power indicated. Use ▶ to move the cursor out of the power in MathPrint™ mode.
[2nd] [$\sqrt{}$]	Calculates the square root of a non-negative value. In complex number modes, a+bi and r∠θ, calculates the square root of a negative real value.
[2nd] [$\sqrt[\square]{}$]	Calculates the xth root of any non-negative value and any odd integer root of a negative value.
[$\frac{1}{\square}$]	Inverts the entered value as 1/x.

Examples

5 [x^2] [+] **4** [$x^{\square}$] **2** [+] **1** ▶ [enter]	5^2+4^{2+1} → 89
10 [$x^{\square}$] [(−)] **2** [enter]	10^{-2} → $\frac{1}{100}$
[2nd] [$\sqrt{}$] **49** [enter]	$\sqrt{49}$ → 7
[2nd] [$\sqrt{}$] **3** [x^2] [+] **2** [$x^{\square}$] **4** [enter]	$\sqrt{3^2+2^4}$ → 5
6 [2nd] [$\sqrt[\square]{}$] **64** [enter]	$\sqrt[6]{64}$ → 2
3 [enter] [2nd] [$\frac{1}{\square}$] [enter]	3, $\frac{1}{ans}$ → 3, $\frac{1}{3}$

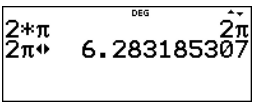
Pi (symbol Pi)

[π] (multi-tap key)

π ≈ 3.14159265359 for calculations.

π ≈ 3.141592654 for display in Float mode.

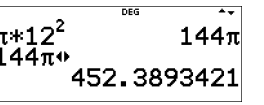
Example

π	**2** × π^e_i enter	
	◂▸≈	

Problem

What is the area of a circle if the radius is 12 cm?

Reminder: $A = \pi \times r^2$

π^e_i × **12** x^2 enter ◂▸≈	

The area of the circle is 144 π square cm. The area of the circle is approximately 452.4 square cm when rounded to one decimal place.

Math

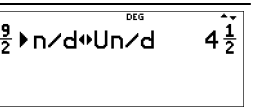
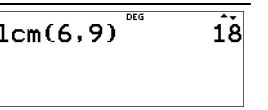
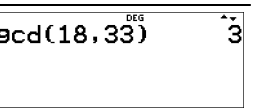
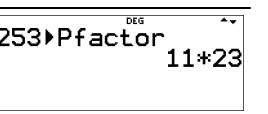
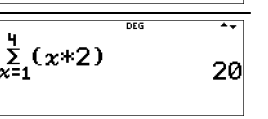
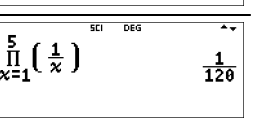
math **MATH**

math displays the **MATH** menu:

1:▸n/d◂▸Un/d	Converts between simple fractions and mixed-number form.
2:lcm(	Least common multiple Syntax: **lcm(***valueA*,*valueB***)**
3:gcd(	Greatest common divisor Syntax: **gcd(***valueA*,*valueB***)**
4:▸Pfactor	Prime factors
5:sum(	Summation Syntax: **sum(***expression*,*variable*,*lower*,*upper***)** (Classic mode syntax)
6:prod(	Product Syntax: **prod(***expression*,*variable*,*lower*,*upper***)** (Classic mode syntax)
7:nDeriv(	Numerical derivative at a point with optional tolerance argument, ε, when command is used in Classic mode, classic entry, and in MathPrint™

	mode. Syntax: **nDeriv(***expression*,*variable*,*point* [,*tolerance*]**)** (Classic mode syntax)
8:fnInt(	Numerical integral over an interval with optional tolerance argument, ε, when command is used in Classic mode, classic entry, and in MathPrint™ mode. Syntax: **fnInt(***expression*,*variable*,*lower*,*upper* [,*tolerance*]**)** (Classic mode syntax)

Examples

▸n/d◂▸Un/d	**9** □/□ **2** ▸ **math** **1** **enter**	
lcm(	**math** **2** **6** **2nd** [,] **9**) **enter**	
gcd(	**math** **3** **18** **2nd** [,] **33**) **enter**	
▸Pfactor	**253** **math** **4** **enter**	
sum(	**math** **5** **1** ▸ **4** ▸ x^{yst}_{abcd} × **2** **enter**	
prod(	**math** **6** **1** ▸ **5** ▸ **1** □/□ x^{yst}_{abcd} ▸ ▸ **enter**	

Note: See Numerical Derivative, nDeriv(, and Numerical Integral, fnInt(in Maths Functions for examples and more information.

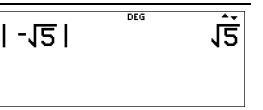
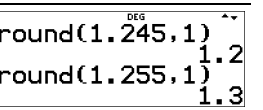
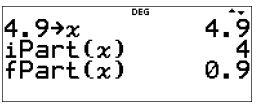
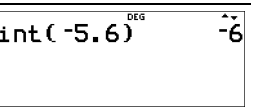
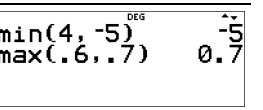
Number Functions

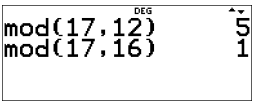
math **NUM**

math ▸ displays the **NUM** menu:

1:abs(	Absolute value Syntax: **abs(***value***)**
2:round(	Rounded value Syntax: **round(***value*,*#decimals***)**
3:iPart(	Integer part of a number Syntax: **iPart(***value***)**
4:fPart(	Fractional part of a number Syntax: **fPart(***value***)**
5:int(	Greatest integer that is ≤ the number Syntax: **int(***value***)**
6:min(	Minimum of two numbers Syntax: **min(***valueA*,*valueB***)**
7:max(	Maximum of two numbers Syntax: **max(***valueA*,*valueB***)**
8:mod(	Modulo (remainder of first number ÷ second number) Syntax: **mod(***dividend*,*divisor***)**

Examples

abs(	math ▶ **1** (−) 2nd [√] **5** enter	
round(	math ▶ **2** **1.245** 2nd [,] **1**) enter ▲ ▲ enter ◀ ◀ ◀ ◀ ◀ **5** enter	
iPart(fPart(	**4.9** sto→ $x^{y\,z\,t}_{abcd}$ enter math ▶ **3** $x^{y\,z\,t}_{abcd}$) enter math ▶ **4** $x^{y\,z\,t}_{abcd}$) enter	
int(	math ▶ **5** (−) **5.6**) enter	
min(max(	math ▶ **6** **4** 2nd [,] (−) **5**) enter math ▶ **7** **.6** 2nd [,] **.7**) enter	

mod(	[math] ▶ **8** **17** [2nd] [,] **12** [)] [enter] ▲ ▲ [enter] ◀ ◀ **6** [enter]	

Angles

[math] **DMS**

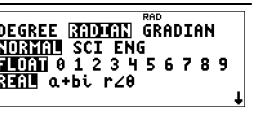
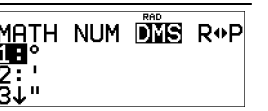
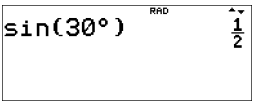
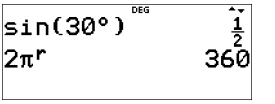
[math] ▶ ▶ displays the **DMS** menu:

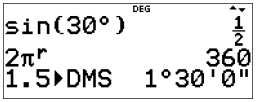
1:°	Specifies the angle unit modifier as degrees (°).
2:′	Specifies the angle unit modifier as minutes (′).
3:″	Specifies the angle unit modifier as seconds (″).
4:r	Specifies a radian angle.
5:g	Specifies a gradian angle.
6:▸DMS	Converts angle from decimal degrees to degrees, minutes, and seconds.

Choose an angle mode from the mode screen. You can choose from DEGREE (default), RADIAN, or GRADIAN. Entries are interpreted and results displayed according to the angle mode setting without needing to enter an angle unit modifier.

Note: You can also convert between rectangular coordinate form (R) and polar coordinate form (P). (See Rectangular to Polar for more information.)

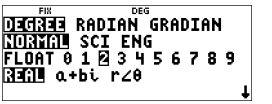
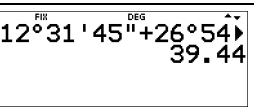
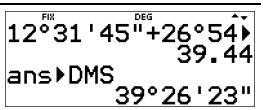
Examples

RADIAN	[mode] ▶ [enter]	
	[clear] [sin/sin⁻¹] **30** [math] ▶ ▶	
	1 [)] [enter]	
DEGREE	[mode] [enter]	
	[clear] **2** [π e^i] [math] ▶ ▶ **4** [enter]	

▸DMS	**1.5** [math] ▷ ▷ **6** [enter]	

Problem

Two adjacent angles measure 12° 31′ 45″ and 26° 54′ 38″ respectively. Add the two angles and display the result in DMS format. Round the results to two decimal places.

[clear] [mode] ▽ ▽ ▷ ▷ ▷ [enter]	
[clear] **12** [math] ▷ ▷	
1 **31** [math] ▷ ▷ **2** **45** [math] ▷ ▷ **3** [+] **26** [math] ▷ ▷ **1** **54** [math] ▷ ▷ **2** **38** [math] ▷ ▷ **3** [enter]	
[math] ▷ ▷ **6** [enter]	

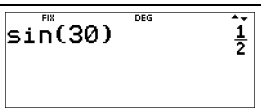
The result is 39 degrees, 26 minutes and 23 seconds.

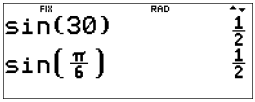
Problem

It is known that 30° = π / 6 radians. In the default mode, degrees, find the sine of 30°. Then set the calculator to radian mode and calculate the sine of π / 6 radians.

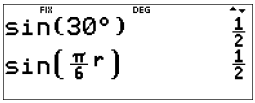
Notes

- Press [clear] to clear the screen between problems.
- The indicator row displays DEG or RAD mode setting for the current calculation only.

[clear] [sin sin⁻¹] **30** [)] [enter]	

[mode] [▶] [enter] [clear] [sin/sin⁻¹] [π e/i] [□/□] 6 [▶] [)] [enter]	

Retain radian mode on the calculator and calculate the sine of 30°. Change the calculator to degree mode and find the sine of π / 6 radians.

[clear] [sin/sin⁻¹] 30 [math] [▶] [▶] [enter] [)] [enter] [mode] [enter] [clear] [sin/sin⁻¹] [π e/i] [□/□] 6 [▶] [math] [▶] [▶] 4 [)] [enter]	

Rectangular to Polar

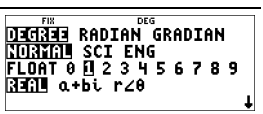
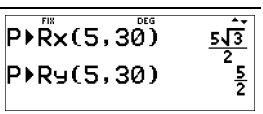
[math] **R◀▶P**

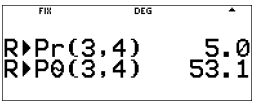
[math] [◀] displays the **R◀▶P** menu, which has functions for converting coordinates between rectangular (x,y) and polar (r,θ) format. Set Angle mode, as necessary, before starting calculations.

1:P▶Rx(	Converts polar to rectangular and displays x. Syntax: **P▶Rx(***r*,θ**)**
2:P▶Ry(	Converts polar to rectangular and displays y. Syntax: **P▶Ry(***r*,θ**)**
3:R▶Pr(	Converts rectangular to polar and displays r. Syntax: **R▶Pr(***x*,*y***)**
4:R▶Pθ(	Converts rectangular to polar and displays θ. Syntax: **R▶Pθ(***x*,*y***)**

Example

Convert polar coordinates (r,θ) = (5,30) into rectangular coordinates. Then convert rectangular coordinates (*x*,*y*) = (3,4) into polar coordinates. Round decimal results to one decimal place.

R◀▶P	[clear] [mode] [▼] [▼] [▶] [▶] [enter]	
	[clear] [math] [◀] 1 5 [2nd] [,] 30 [)] [enter] [math] [◀] 2 5 [2nd] [,] 30 [)] [enter]	

	math ◀ 3 3 2nd [,] 4) enter math ◀ 4 3 2nd [,] 4) enter	

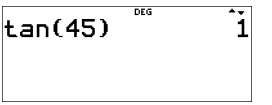
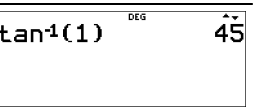
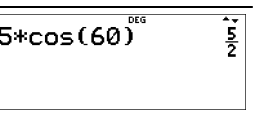
Converting (r,θ) = (5,30) gives $(x,y) = \left(\frac{5\sqrt{3}}{2}, \frac{5}{2}\right)$ and (x,y) = (3,4) gives (r,θ) = (5.0,53.1).

Trigonometry

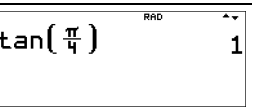
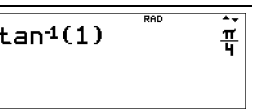
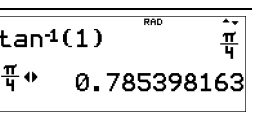
sin sin⁻¹ cos cos⁻¹ tan tan⁻¹ (multi-tap keys)

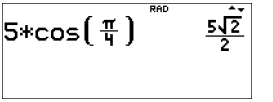
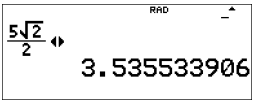
Pressing one of these multi-tap keys repeatedly lets you access the corresponding trigonometric or inverse trigonometric function. Set the Angle mode - Degree or Radian - before your calculation.

Example in Degree Mode

tan	clear mode enter clear tan tan⁻¹ 45) enter	
$\tan^{-1}$	clear tan tan⁻¹ tan tan⁻¹ 1) enter	
cos	clear 5 × cos cos⁻¹ 60) enter	

Example in Radian Mode

tan	clear mode ▶ enter clear tan tan⁻¹ π e^i □/□ 4 ▶) enter	
$\tan^{-1}$	clear tan tan⁻¹ tan tan⁻¹ 1) enter	
	◀▶≈	

cos	[clear] 5 [×] [cos cos⁻¹] [π e i] [□/□] 4 [▶] [)] [enter]	
	[clear] [◀▶≈]	

Problem

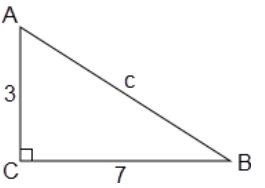
Find angle A of the right triangle below. Then calculate angle B and the length of the hypotenuse c. Lengths are in metres. Round results to one decimal place.

Reminder:

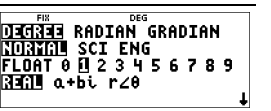
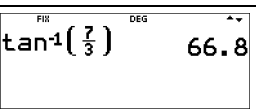
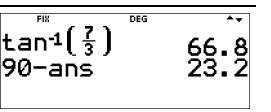
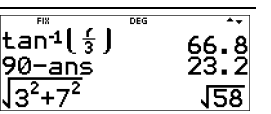
tan A = $\frac{7}{3}$ therefore $m\angle$A = $\tan^{-1}\left(\frac{7}{3}\right)$

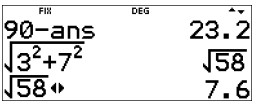
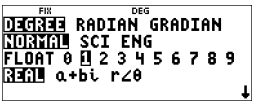
$m\angle$A + $m\angle$B + 90° = 180°
therefore $m\angle$B = 90° - $m\angle$A

c = $\sqrt{3^2+7^2}$



Note: Set mode to **DEGREE** and fix 1 decimal place for the calculations.

[mode] [enter] [▼] [▼] [▶] [▶] [enter]	
[clear] [tan tan⁻¹] [tan tan⁻¹] 7 [□/□] 3 [▶] [)] [enter]	
90 [−] [2nd] [answer] [enter]	
[2nd] [√‾] 3 [x^2] [+] 7 [x^2] [enter]	

[◆▶≈]	
[mode] [enter] [▼] [▼] [▶] [▶] [enter]	

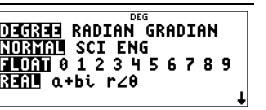
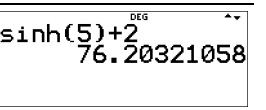
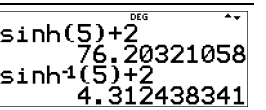
To one decimal place, the measure of angle A is 66.8°, the measure of angle B is 23.2°, and the length of the hypotenuse is 7.6 metres.

Hyperbolics

[sin sin⁻¹] [cos cos⁻¹] [tan tan⁻¹] (multi-tap keys)

Pressing one of these multi-tap keys repeatedly lets you access the corresponding hyperbolic or inverse hyperbolic function. Angle modes do not affect hyperbolic calculations.

Example

Set floating decimal	[mode] [▼] [▼] [enter]	
	[clear] [sin sin⁻¹] [sin sin⁻¹] [sin sin⁻¹] **5** [)] [+] **2** [enter]	
	[▲] [▲] [enter] [2nd] [◀] [sin sin⁻¹] [sin sin⁻¹] [sin sin⁻¹] [sin sin⁻¹] [enter]	

Logarithm and Exponential Functions

[ln log] [e^□ 10^□] (multi-tap keys)

[ln log] pastes the natural logarithm, ln, of a number to the base e. The argument of the function is **ln(***value***)**.

e ≈ 2.718281828459 for calculations.

e ≈ 2.718281828 for display in Float mode.

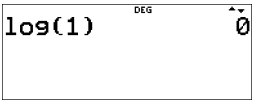
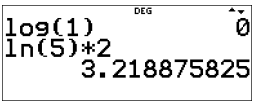
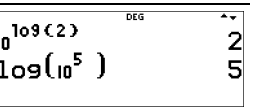
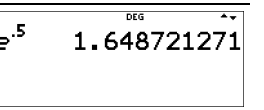
[ln log] [ln log] pastes the common logarithm, $\log_{10}$, of a number. The argument of the function is **log(***value***)**.

[ln log] [ln log] [ln log] pastes the logBASE function as a MathPrint™ template. When needed, the arguments in classic entry are **logBASE(***value*,*base***)**.

[e^□ 10^□] pastes *e* to the power function.

[e□10□] [e□10□] pastes 10 to the power function.

Examples

log	[ln log] [ln log] **1** [)] [enter]	
ln	[ln log] **5** [)] [×] **2** [enter]	
$10^{\square}$	[clear] [e□10□] [e□10□] [ln log] [ln log] **2** [)] [enter] [ln log] [ln log] [e□10□] [e□10□] **5** [▶] [)] [enter]	
$e^{\square}$	[clear] [e□10□] **.5** [enter]	

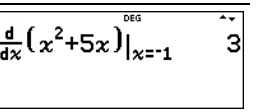
Numerical Derivative

The TI-30X Pro MathPrint™ calculates the (approximate) numerical derivative of an expression at a point given a tolerance for the numerical method. (See the **About the Numerical Derivative at a Point** section for more information.)

MathPrint™ Mode

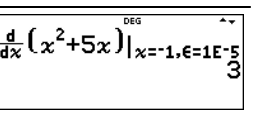
[2nd] [$d/dx\square$] pastes the numerical derivative template from the keypad to calculate the numerical derivative with the default tolerance ε is 1E-5.

Example

[2nd] [$d/dx\square$]	[2nd] [$d/dx\square$] [$x^{y\,z\,t}_{a\,b\,c\,d}$] [x^2] [+] **5** [$x^{y\,z\,t}_{a\,b\,c\,d}$] [▶] [▶] [(−)] **1** [enter]	

To change the default tolerance, ε, and observe how the tolerance plays a role in the numerical solution, paste the numerical derivative from the menu location, [math] **MATH 7:nDeriv(**, where the numerical derivative template will paste with the option to modify the tolerance as needed for an investigation of the numerical derivative result.

Example

[math] **MATH** **7:nDeriv(**	[math] **7** [$x^{y\,z\,t}_{a\,b\,c\,d}$] [x^2] [+] **5** [$x^{y\,z\,t}_{a\,b\,c\,d}$] [▶] [▶] [(−)] **1** [▶] **1** [EE] [(−)] **5** [enter]	

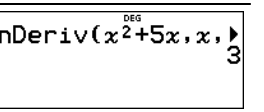
with optional tolerance		

Classic Mode or Entry

In Classic mode or in classic edit lines, the **nDeriv(** command will paste from the keypad or **MATH** menu.

Syntax: **nDeriv(***expression*,*variable*,*point*[,*tolerance*]**)** where *tolerance* is optional and the default ε is 1E-5.

Example

2nd [d/dx□] or math **MATH** **7:nDeriv(**	2nd [d/dx□] x^{yzt}_{abcd} x^2 + 5 x^{yzt}_{abcd} 2nd [,] x^{yzt}_{abcd} 2nd [,] (−) 1) enter	

About the Numerical Derivative at a Point

The numerical derivative at a point command, **nDeriv(** or d/dx, uses the symmetric difference quotient method. This method approximates the numerical derivative at a given point as the slope of the secant line about the point.

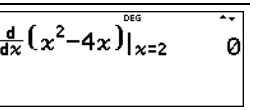
$$f'(x) = \frac{f(x+\varepsilon) - f(x-\varepsilon)}{2\varepsilon}$$

As ε becomes smaller, the approximation usually becomes more accurate to approximate the slope of the tangent line at the given point x.

- Because of the method used to calculate the numerical derivative at a point, the calculator can return a false derivative value at a non-differentiable point.
- Always have some knowledge of the function behaviour near the point by using a table of values near the point (or a graph of the function).

Problem

Find the slope of the tangent line to the function $f(x) = x^2 - 4x$ at $x = 2$. What do you notice?

2nd [d/dx□] x^{yzt}_{abcd} x^2 − 4 x^{yzt}_{abcd} ▶ ▶ **2** enter	

Numerical Integral

The TI-30X Pro MathPrint™ calculates the (approximate) numerical integral of an expression with respect to a variable x, given a lower limit, an upper limit and a tolerance for the numerical method.

MathPrint™ Mode

2nd [$\int_{\square}^{\square} d\square$] pastes the numerical integral template from the keypad to calculate the numerical integral on a given interval with the default tolerance ε is 1E-5.

Example in RADIAN Angle Mode

2nd [$\int_{\square}^{\square} d\square$]	mode ▶ enter 2nd [$\int_{\square}^{\square} d\square$] 0 ▶ [$\pi$] ▶ ▶ [$x^{\square}$] [sin sin⁻¹] [$x^{\square}$]) ▶ enter	RAD $\int_0^{\pi}(x\sin(x))dx$ π

To change the default tolerance, ε, and observe how the tolerance plays a role in the numerical solution, paste the numerical integral from the menu location, math **MATH 8:fnInt(**, where the numerical integral template will paste with the option to modify the tolerance as needed for an investigation of the numerical integral result.

Example in DEGREE Angle Mode

math **MATH** **8:fnInt(** with optional tolerance	mode enter math **8** 0 ▶ **3** ▶ [$x^{\square}$] [$x^{\square}$] **5** enter	DEG $\int_0^3(x^5)dx,\epsilon=1E\text{-}5$ 121.5

Classic Mode or Entry

In Classic mode or in classic edit lines, the **fnInt(** command will paste from the keypad or **MATH** menu.

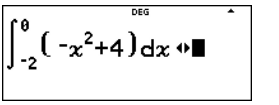
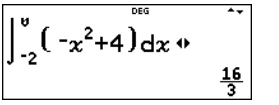
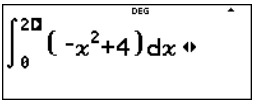
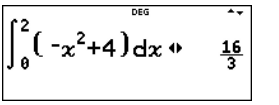
Syntax: **fnInt(***expression*,*variable*,*upper*,*lower*[,*tolerance*]**)** where *tolerance* is optional and the default ε is 1E-5.

Example

2nd [$\int_{\square}^{\square} d\square$] or math **MATH** **8:fnInt(**	2nd [$\int_{\square}^{\square} d\square$] [$x^{\square}$] [$x^{\square}$] **5** 2nd [·] [$x^{\square}$] 2nd **.0** 2nd **.3**) enter	DEG fnInt(x^5,x,0,3) 121.5

Problem

Find the area under the curve $f(x) = -x^2+4$ on the x intervals from -2 to 0 and then from 0 to 2. What do you notice about the results? What could you say about the graph of this function?

2nd [$\int_{\square}^{\square}\square dx$] (−) 2 ▷ 0 ▷ (−) [$x^{y\,z\,t}_{abcd}$] [$x^2$] + 4 ▷ [◂▸≈]	
enter	
▽ △ enter 2nd ◁ ▷ 0 delete ▷ 2	
enter	

Notice that both areas are equal. Since this is a parabola with the vertex at (0,4) and zeros at (-2,0) and (2,0) you see that the symmetric areas are equal.

Statistics, Regressions and Distributions

data 2nd [stat-reg/distr]

data lets you enter and edit the data lists. (See Data Editor section.)

2nd [stat-reg/distr] displays the **STAT-REG** menu, which has the following options.

Notes:

- Regressions store the regression information, along with the 2-Var statistics for the data, in StatVars (menu item 1).
- A regression can be stored to either f(x) or g(x). The regression coefficients display in full precision.

Important note about results: Many of the regression equations share the same variables **a**, **b**, **c**, and **d**. If you perform any regression calculation, the regression calculation and the 2-Var statistics for that data are stored in the **StatVars** menu until the next statistics or regression calculation. The results must be interpreted based on which type of statistics or regression calculation was last performed. To help you interpret correctly, the title bar reminds you of which calculation was last performed.

1:StatVars	Displays a secondary menu of the last computed statistical result variables. Use ▽ and △ to locate the desired variable, and press enter to select it. If you select this option before calculating 1-Var stats, 2-Var stats, or any of the regressions, a reminder appears.
2:1-VAR STATS	Analyses statistical data from 1 data set with 1 measured variable, x. Frequency data may be

	included.
3:2-VAR STATS	Analyses paired data from 2 data sets with 2 measured variables—x, the independent variable, and y, the dependent variable. Frequency data may be included. **Note:** 2-Var Stats also computes a linear regression and populates the linear regression results. It displays values for **a** (slope) and **b** (y-intercept); it also displays values for $\mathbf{r}^2$ and **r**.
4:LinReg ax+b	Fits the model equation y=ax+b to the data using a least-squares fit for at least two data points. It displays values for **a** (slope) and **b** (y-intercept); it also displays values for $\mathbf{r}^2$ and **r**.
5:PropReg ax	Fits the model equation y=ax to the data using using least squares fit for at least one data point. It displays the value for **a**. Supports data forming a vertical line with the exception of all 0 data.
6:RecipReg a/x+b	Fits the model equation y=a/x+b to the data using least squares fit on linearised data for at least two data points. It displays values for **a** and **b**; it also displays values for $\mathbf{r}^2$ and **r**.
7:QuadraticReg	Fits the second-degree polynomial $y=ax^2+bx+c$ to the data. It displays values for **a**, **b**, and **c**; it also displays a value for $\mathbf{R}^2$. For three data points, the equation is a polynomial fit; for four or more, it is a polynomial regression. At least three data points are required.
8:CubicReg	Fits the third-degree polynomial $y=ax^3+bx^2+cx+d$ to the data. It displays values for **a**, **b**, **c**, and **d**; it also displays a value for $\mathbf{R}^2$. For four points, the equation is a polynomial fit; for five or more, it is a polynomial regression. At least four points are required.
9:LnReg a+bln$x$	Fits the model equation y=a+b ln(x) to the data using a least squares fit and transformed values ln (x) and y. It displays values for **a** and **b**; it also displays values for $\mathbf{r}^2$ and **r**.
:PwrReg ax^b	Fits the model equation $y=ax^b$ to the data using a least-squares fit and transformed values ln(x) and ln(y). It displays values for **a** and **b**; it also displays values for $\mathbf{r}^2$ and **r**.
:ExpReg ab^x	Fits the model equation $y=ab^x$ to the data using a least-squares fit and transformed values x and ln (y). It displays values for **a** and **b**; it also displays values for $\mathbf{r}^2$ and **r**.

:expReg ae^(b*x*)	Fits the model equation y=a e^(bx) to the data using least squares fit on linearised data for at least two data points. It displays values for **a** and **b**; it also displays values for r^2 and **r**.

2nd [stat-reg/distr] ▶ displays the **DISTR** menu, which has the following distribution functions:

1:Normalpdf	Computes the probability density function (**pdf**) for the normal distribution at a specified *x* value. The defaults are mean *mu*=0 and standard deviation *sigma*=1. The probability density function (pdf) is: $f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-(x-\mu)^2}{2\sigma^2}}, \sigma > 0$
2:Normalcdf	Computes the normal distribution probability between *LOWERbnd* and *UPPERbnd* for the specified mean *mu* and standard deviation *sigma*. The defaults are *mu*=0; *sigma*=1; with *LOWERbnd* = -1E99 and *UPPERbnd* = 1E99. **Note:** -1E99 to 1E99 represents -infinity to infinity.
3:invNormal	Computes the inverse cumulative normal distribution function for a given area under the normal distribution curve specified by mean *mu* and standard deviation *sigma*. It calculates the *x* value associated with an area to the left of the *x* value. $0 \le area \le 1$ must be true. The defaults are *area*=1, *mu*=0 and *sigma*=1.
4:Binomialpdf	Computes a probability at *x* for the discrete binomial distribution with the specified *numtrials* and probability of success (*p*) on each trial. *x* is a non-negative integer and can be entered with options of SINGLE entry, LIST of entries or ALL (list of probabilities from 0 to *numtrials* is returned). $0 \le p \le 1$ must be true. The probability density function (**pdf**) is: $f(x) = \binom{n}{x} p^x (1-p)^{n-x}, x = 0,1,...,n$
5:Binomialcdf	Computes a cumulative probability at *x* for the discrete binomial distribution with the specified *numtrials* and probability of success (*p*) on each trial. *x* can be non-negative integer and can be entered with options of SINGLE, LIST or ALL (a list of cumulative probabilities is returned.) $0 \le p \le 1$ must be true.
6:Poissonpdf	Computes a probability at *x* for the discrete Poisson distribution with the specified mean *mu*

	(μ), which must be a real number > 0. x can be an non-negative integer (SINGLE) or a list of integers (LIST). The default is *mu*=1. The probability density function (**pdf**) is: $f(x) = e^{-\mu}\mu^x/x!, x = 0,1,2,...$
7:Poissoncdf	Computes a cumulative probability at x for the discrete Poisson distribution with the specified mean *mu*, which must be a real number > 0. x can be an non-negative integer (SINGLE) or a list of integers (LIST). The default is *mu*=1.

Stats Results

Variables	**1-Var or 2-Var**	**Definition**
n	1-Var	Number of x or (x,y) data points.
$\bar{x}$	Both	Mean of all x values.
$\bar{y}$	2-Var	Mean of all y values.
Sx	Both	Sample standard deviation of x.
Sy	2-Var	Sample standard deviation of y.
σ**x**	Both	Population standard deviation of x.
σ**y**	2-Var	Population standard deviation of y.
Σ**x** or Σ**x**^{2}	Both	Sum of all x or x^2 values.
Σ**y** or Σ**y**^{2}	2-Var	Sum of all y or y^2 values.
Σ**xy**	2-Var	Sum of $(x \times y)$ for all xy pairs.
a	2-Var	Linear regression slope.
b	2-Var	Linear regression y-intercept.
r^2 or **r**	2-Var	Correlation coefficient.
x′	2-Var	Uses a and b to calculate predicted x value when you input a y value.
y′	2-Var	Uses a and b to calculate predicted y value when you input an x value.
minX or **maxX**	Both	Minimum or maximum of x values.
Q1	1-Var	Median of the elements between minX and Med (1st quartile).
Med	1-Var	Median of all data points.

Variables	1-Var or 2-Var	Definition
Q3	1-Var	Median of the elements between Med and maxX (3rd quartile).
minY or **maxY**	2-Var	Minimum or maximum of y values.

To define statistical data points:

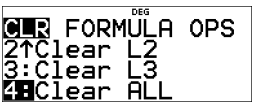
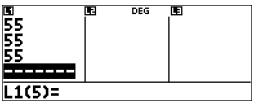
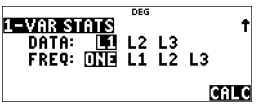
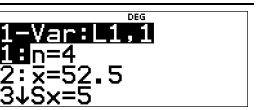
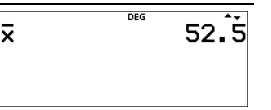
1. Enter data in L1, L2, or L3. (See Data Editor section.)

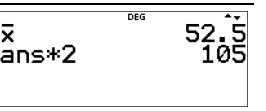
   Note: Non-integer frequency elements are valid. This is useful when entering frequencies expressed as percentages or parts that add up to 1. However, the sample standard deviation, Sx, is undefined for non-integer frequencies, and Sx=Error is displayed for that value. All other statistics are displayed.

2. Press 2nd [stat-reg/distr]. Select **1-Var** or **2-Var** and press enter.
3. Select L1, L2, or L3, and the frequency.
4. Press enter to display the menu of variables.
5. To clear data, press data data, select a list to clear, and press enter.

1-Var Example

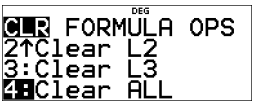
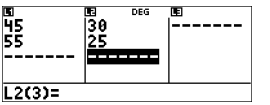
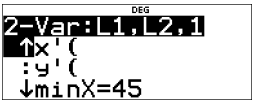
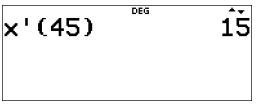
Find the mean of {45,55,55,55}.

Clear all data	data data ▼ ▼ ▼	
Data	enter **45** ▼ **55** ▼ **55** ▼ **55** enter	
Stat	2nd [quit] 2nd [stat-reg/distr]	
	2 (Selects **1-VAR STATS**) ▼ ▼	
	enter	
Stat Var	**2** enter	

	× **2** enter	

2-Var Example

Data: (45,30); (55,25). Find: x′(45).

Clear all data	data data ⏷ ⏷ ⏷	
Data	enter **45** ⏷ **55** ⏷ ⏵ **30** ⏷ **25** ⏷	
Stat	2nd [stat-reg/distr]	
	3 (Selects **2-VAR STATS**) ⏷ ⏷ ⏷	
StatVars	enter 2nd [quit] 2nd [stat-reg/distr] **1** ⏶ ⏶ ⏶ ⏶ ⏶ ⏶	
	enter **45**) enter	

Problem

For his last four tests, Anthony obtained the following scores. Tests 2 and 4 were given a weight of 0.5, and tests 1 and 3 were given a weight of 1.

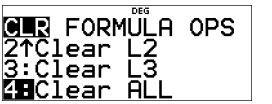
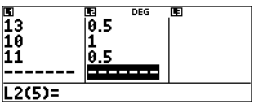
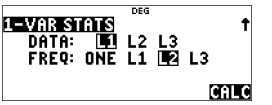
Test No.	1	2	3	4
Score	12	13	10	11
Weight	1	0.5	1	0.5

1. Find Anthony's average grade (weighted average).
2. What does the value of n given by the calculator represent? What does the value of Σx given by the calculator represent?

   Reminder: The weighted average is

$$\frac{\Sigma x}{n} = \frac{(12)(1)+(13)(0.5)+(10)(1)+(11)(0.5)}{1+0.5+1+0.5}$$

3. The teacher gave Anthony 4 more points on test 4 due to a grading error. Find Anthony's new average grade.

data data ⊙ ⊙ ⊙	
enter data ⊙ ⊙ ⊙ ⊙ ⊙	
enter **12** ⊙ **13** ⊙ **10** ⊙ **11** ⊙ ⊙ **1** ⊙ **.5** ⊙ **1** ⊙ **.5** enter	
2nd [stat-reg/distr]	
2 ⊙ ⊙ ⊙ enter	
enter	

Anthony has an average ($\bar{x}$) of 11.33 (to the nearest hundredth).

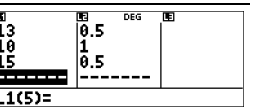
On the calculator, n represents the total sum of the weights.

$n = 1 + 0.5 + 1 + 0.5$.

Σx represents the weighted sum of his scores.

$(12)(1) + (13)(0.5) + (10)(1) + (11)(0.5) = 34$.

Change Anthony's last score from 11 to 15.

data ⊙ ⊙ ⊙ **15** enter	
2nd [stat-reg/distr] **2** ⊙ ⊙ ⊙ enter enter	

If the teacher adds 4 points to Test 4, Anthony's average grade is 12.

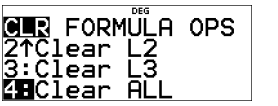
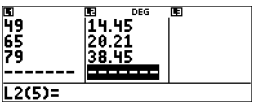
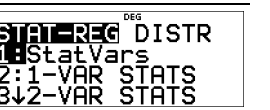
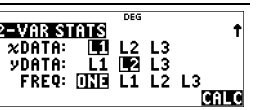
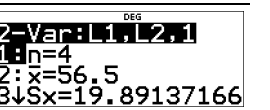
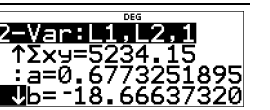
Problem

The table below gives the results of a braking test.

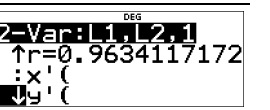
Test No.	1	2	3	4
Speed (kph)	33	49	65	79
Braking distance (m)	5.30	14.45	20.21	38.45

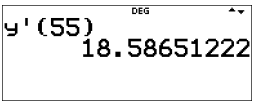
Use the relationship between speed and braking distance to estimate the braking distance required for a vehicle travelling at 55 kph.

A hand-drawn scatter plot of these data points suggest a linear relationship. The calculator uses the least squares method to find the line of best fit, $y'=ax'+b$, for data entered in lists.

data data ▼ ▼ ▼	
enter **33** ▼ **49** ▼ **65** ▼ **79** ▼ ▶ **5.3** ▼ **14.45** ▼ **20.21** ▼ **38.45** enter	
2nd [quit] 2nd [stat-reg/distr]	
3 (Selects **2-VAR STATS**) ▼ ▼ ▼	
enter	
Press ▼ as necessary to view a and b.	

This line of best fit, $y'=0.67732519x'-18.66637321$ models the linear trend of the data.

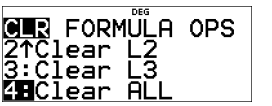
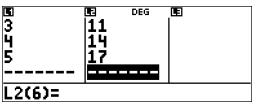
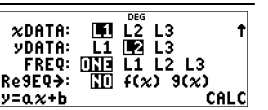
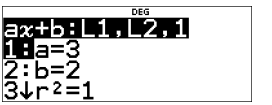
Press ▼ until y' is highlighted.	

enter **55**) enter	

The linear model gives an estimated braking distance of 18.59 metres for a vehicle travelling at 55 kph.

Regression Example 1

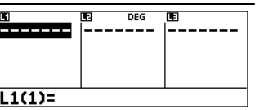
Calculate an ax+b linear regression for the following data: {1,2,3,4,5}; {5,8,11,14,17}.

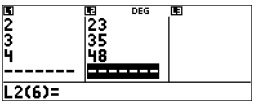
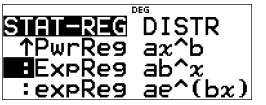
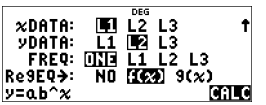
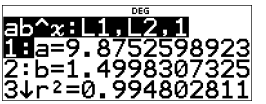
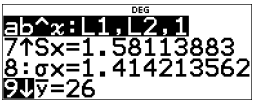
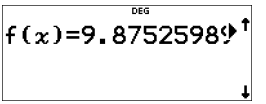
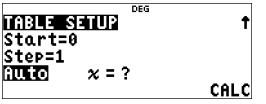
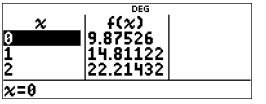
Clear all data	data data ⊙ ⊙ ⊙	
Data	enter **1** ⊙ **2** ⊙ **3** ⊙ **4** ⊙ **5** ⊙ ⊙ **5** ⊙ **8** ⊙ **11** ⊙ **14** ⊙ **17** enter	
Regression	2nd [quit] 2nd [stat-reg/distr] ⊙ ⊙ ⊙	
	enter	
	⊙ ⊙ ⊙ ⊙ enter Press ⊙ to examine all the result variables.	

Regression Example 2

Calculate the exponential regression for the following data:

- L1 = {0,1,2,3,4}; L2 = {10,14,23,35,48}
- Find the average value of the data in L2.
- Compare the exponential regression values to L2.

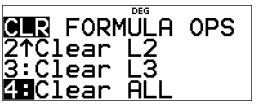
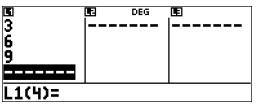
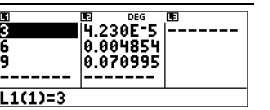
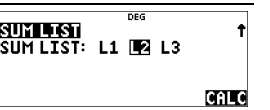
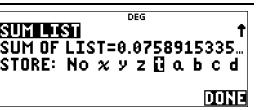
Clear all data	data data **4**	

Data	**0** ⊙ **1** ⊙ **2** ⊙ **3** ⊙ **4** ⊙ ⊙ **10** ⊙ **14** ⊙ **23** ⊙ **35** ⊙ **48** enter	
Regression	2nd [stat-reg/distr] ⊙ ⊙	
Save the regression equation to f(x) in the table menu.	enter ⊙ ⊙ ⊙ ⊙ enter	
Regression Equation	enter	
Find the average value ($\bar{y}$) of the data in L2 using StatVars.	2nd [stat-reg/distr] **1** (Selects **StatVars**) ⊙ ⊙ ⊙ ⊙ ⊙ ⊙ ⊙ ⊙	 Notice that the title bar reminds you of your last statistical or regression calculation.
Examine the table of values of the regression equation.	table **1**	
	enter ⊙ **0** enter **1** enter	
	enter enter	

Warning: If you now calculate 2-Var Stats on your data, the variables **a** and **b** (along with **r** and $\mathbf{r}^2$) will be calculated as a linear regression. Do not recalculate 2-Var Stats after any other regression calculation if you want to preserve your regression coefficients (a, b, c, d) and r values for your particular problem in the **StatVars** menu.

Distribution Example

Compute the binomial pdf distribution at x values {3,6,9} with 20 trials and a success probability of 0.6. Enter the x values in list L1, store the results in L2, and then find the sum of the probabilities and store in the variable *t*.

Clear all data	data data ▼ ▼ ▼	
Data	enter **3** ▼ **6** ▼ **9** enter	
DISTR	2nd [stat-reg/distr] ▶ ▼ ▼ ▼	
	enter ▶	
	enter **20** ▼ **0.6**	
	enter ▼ ▼	
	enter	
	data ◀ **4** ▶ enter	
	enter ▶ ▶ ▶ ▶ enter enter	

Probability

[! nCr nPr] 2nd [random]

[! nCr nPr] is a multi-tap key that cycles through the following options:

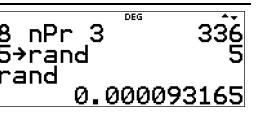
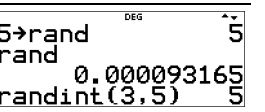
!	A **factorial**, n!, is the product of the positive integers from 1 to n. The value of n must be a positive whole number ≤ 69. When n = 0, n! = 1
nCr	Calculates the number of possible **combinations** given n and r, non-negative integers. The order of objects is not important, as in a hand of cards.
nPr	Calculates the number of possible **permutations** of n items taken r at a time, given n and r, non-negative integers. The order of objects is important, as in a race.

2nd [random] displays a menu with the following options:

rand	Generates a random real number between 0 and 1. To control a sequence of random numbers, store an integer (seed value) ≥ 0 to **rand**. The seed value changes randomly every time a random number is generated.
randint(	Generates a random integer between two integers, A and B, where $A \le$ randint $\le B$. The arguments of the function are: **randint(***integerA*,*integerB***)**

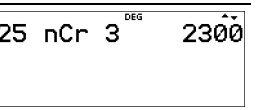
Examples

!	**4** [! nCr nPr] enter	DEG 4! 24
nCr	**52** [! nCr nPr] [! nCr nPr] **5** enter	DEG 4! 24 52 nCr 5 2598960
nPr	**8** [! nCr nPr] [! nCr nPr] [! nCr nPr] **3** enter	DEG 4! 24 52 nCr 5 2598960 8 nPr 3 336
Store value to rand	**5** sto→ 2nd [random]	DEG RANDOM 1:rand 2:randint(
	1 (Selects **rand**) enter	DEG 52 nCr 5 2598960 8 nPr 3 336 5→rand 5

rand	2nd [random] **1** enter	
randint(	2nd [random] **2** **3** 2nd [,] **5**) enter	

Problem

An ice cream store advertises that it makes 25 flavours of home made ice cream. You like to order three different flavours in a dish. How many combinations of ice cream can you test over a very hot summer?

clear **25** ! nCr nPr ! nCr nPr **3** enter	

You can choose from 2300 dishes with different combinations of flavours!

Math Tools

This section contains information about using the calculator tools such as data lists, functions and conversions.

Stored Operations

2nd [op] 2nd [set op]

2nd [set op] lets you store an operation.

2nd [op] pastes an operation to the home screen.

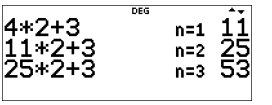
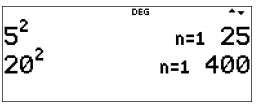
To set an operation and then recall it:

1. Press 2nd [set op].
2. Enter any combination of numbers, operations and/or values.
3. Press enter to store the operation.
4. Press 2nd [op] to recall the stored operation and apply it to the last answer or the current entry.

   If you apply 2nd [op] directly to a 2nd [op] result, the **n=1** iteration counter is incremented.

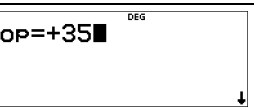
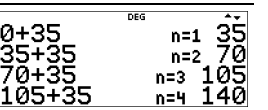
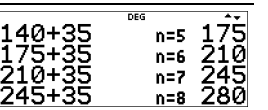
Examples

Clear op	2nd [set op] If a stored op is present, press clear to clear it.	DEG op= Enter operation. Set op:[enter] ↓
Set op	× **2** + **3**	DEG op=*2+3 ↓
	enter	DEG Operation set! [2nd][op] pastes to Home Screen.
Recall op	**4** 2nd [op]	DEG 4*2+3 n=1 11
	2nd [op]	DEG 4*2+3 n=1 11 11*2+3 n=2 25

	2nd [op]	
Redefine op	clear 2nd [set op] clear x^2 enter	
Recall op	**5** 2nd [op] **20** 2nd [op]	

Problem

A local store allows you to earn loyalty points that you can redeem for various gifts. The store adds 35 points to your mobile app for every visit. You would like to get a music download which costs 275 points. How many visits will it take? Currently, you have 0 points.

2nd [set op] clear + **35** enter	
0 2nd [op] 2nd [op] 2nd [op] 2nd [op]	
2nd [op] 2nd [op] 2nd [op] 2nd [op]	

After 8 visits to the store you will have 280 points which is enough for your download!

Data Editor and List Formulas

data

Pressing data displays the Data Editor where you can enter data in up to 3 lists (L1, L2, L3). Each list can contain up to 50 items.

Note: This feature is available in DEC mode only.

When editing a list, press data to access the following menus:

CLR	FORMULA	OPS
1:Clear L1	1:Add/Edit Frmla	1:Sort Sm-Lg...

2:Clear L2	2:Clear L1 Frmla	2:Sort Lg-Sm...
3:Clear L3	3:Clear L2 Frmla	3:Sequence...
4:Clear ALL	4:Clear L3 Frmla	4:Sum List...
	5:Clear ALL	

Entering and Editing Data

- Use ◀ ▶ ▲ ▼ to highlight a cell in the data editor and then enter a value.
- Mode settings such as number format, Float/Fix decimal and angle modes affect the display of a cell value.
- Fractions, radicals and π values will display.
- Press:
  - sto→ in a cell edit to store the value of the cell to a variable.
  - ◆▸≈ to toggle the number format when a cell is highlighted.
  - delete to delete a cell.
  - enter clear to clear the edit line of a cell.
  - 2nd [quit] to return to the Home Screen.
  - 2nd ▲ to go to the top of a list.
  - 2nd ▼ to go to the bottom of a list.
- Use the **CLR** menu to clear the data from a list.

List Formulas (FORMULA menu)

- In the data editor, press data ▶ to display the **FORMULA** menu. Select the appropriate menu item to add or edit a list formula in the highlighted column, or clear formulas from a particular list.
- When a data cell is highlighted, pressing sto→ is a shortcut to open the formula edit state.
- In the formula edit state, pressing data displays a menu to paste L1, L2 or L3 in the formula.
- Formulas cannot contain a circular reference such as L1=L1.
- When a list contains a formula, the edit line will display the reversed cell name. Cells will update if referenced lists are updated.
- To clear a formula list, clear the formula first, and then clear the list.
- If sto→ is used in a list formula, the last element of the computed list is stored to the variable. Lists cannot be stored.
- List formulas accept all calculator functions and real numbers.

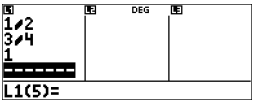
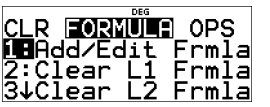
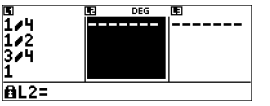
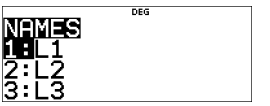
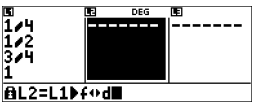
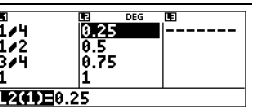
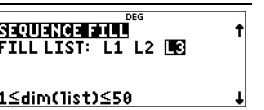
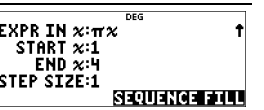
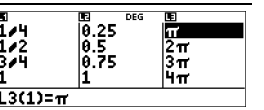
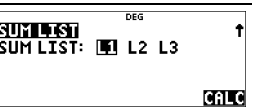
Options (OPS menu)

In the data editor, press data ◀ to display the **OPS** menu. Select the appropriate menu item to:

- Sort values from smallest to largest or largest to smallest.
- Create a Sequence of values to fill a list.

- Sum the elements in a list and store to a variable for further investigation.

Example

L1	data data 4 data 1 ▫/▫ 4 ▼ 2 ▫/▫ 4 ▼ 3 ▫/▫ 4 ▼ 4 ▫/▫ 4 enter	
Formula	▶ data ▶	
	enter	
	data	
	enter 2nd [f◀▶d]	
	enter	
Fill a list with a sequence	▶ data ◀ 3 ▶ ▶ enter	
	π e i x^{yzt}_{abcd} enter 1 enter 4 enter 1 enter	
	enter	
Store the Sum of L1 to the variable *z*	data ◀ 4 enter	

	enter ▶ ▶ ▶ enter enter	

Problem

On a November day, a weather report on the Internet listed the following temperatures.

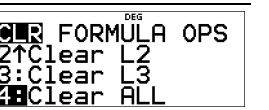
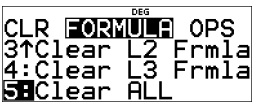
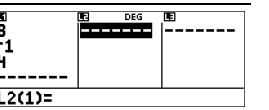
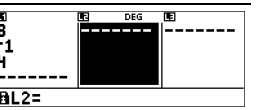
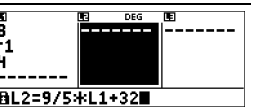
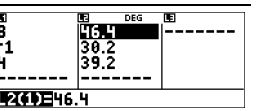
Paris, France 8°C

Moscow, Russia -1°C

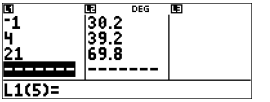
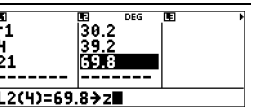
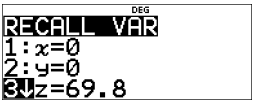
Montreal, Canada 4°C

Convert these temperatures from degrees Celsius to degrees Fahrenheit. (See also the section on Conversions.)

Reminder: $F = \frac{9}{5} C + 32$

data data **4** data ▶ **5**	 
8 ▼ (−) **1** ▼ **4** ▼ ▶	
data ▶ **1**	
9 ÷ **5** × data **1** + **32**	
enter	

If Sydney, Australia is 21°C, find the temperature in degrees Fahrenheit and store the temperature in the variable *z*.

◀ ▼ ▼ ▼ **21** enter	
▲ ▶ enter 2nd ▶ sto→ x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd}	
enter 2nd [recall] ▼ ▼	

Function Table

table displays a menu with the following options:

1:Add/Edit Func	Lets you define the function **f(*x*)** or **g(*x*)** or both and generates a table of values. ◀▶≈ on a value in the table will toggle the number format.
2:f(	Pastes **f(** to an input area such as the Home screen to evaluate the function at a point (for example, **f(2)**).
3:g(	Pastes **g(** to an input area such as the Home screen to evaluate the function at a point (for example, **g(3)**).

The function table allows you to display a defined function in a tabular form. To set up a function table:

1. Press table and select **Add/Edit Func**.
2. Enter one or two functions and press enter.
3. Select the table start, table step, auto, or ask-*x* options and press enter.

The table is displayed using the specified values. Table results will display as Real numbers in DEC mode only. Complex functions evaluate on the home screen only.

Start	Specifies the starting value for the independent variable, *x*.
Step	Specifies the incremental value for the independent variable, *x*. The step can be positive or negative.
Auto	The calculator automatically generates a series of values based on table start and table step.
Ask-*x*	Lets you build a table manually by entering specific values for the independent variable, *x*. The table has a maximum of three rows, but you can

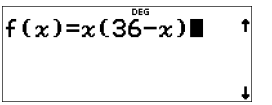
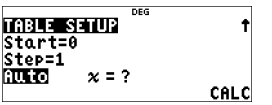
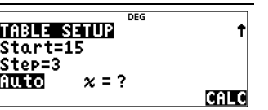
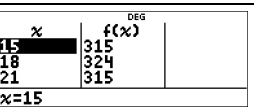
	overwrite the x values as needed to see more results.

Note: In the Function Table view, press clear to display and edit the Table Setup wizard as needed.

Problem

Find the vertex of the parabola, $y = x(36 - x)$ using a table of values.

Reminder: The vertex of the parabola is the point on the parabola that is also on the line of symmetry.

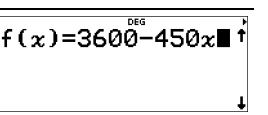
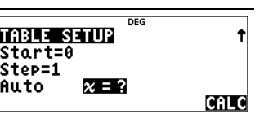
table **1** clear $x_{abcd}^{y\,z\,t}$ **(** **36** **−** $x_{abcd}^{y\,z\,t}$ **)**	
enter clear enter	
15 ⏷ **3** ⏷ ⏷	
enter	

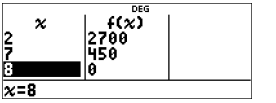
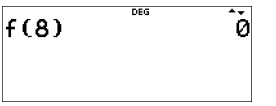
After searching close to x = 18, the point (18,324) appears to be the vertex of the parabola since it appears to be the turning point of the set of points of this function. To search closer to x = 18, change the Step value to smaller and smaller values to see points closer to (18,324).

Problem

A charity collected £3,600 to help support a local food kitchen. £450 will be given to the food kitchen every month until the funds run out. How many months will the charity support the kitchen?

Reminder: If x = months and y = money left, then $y = 3600 - 450x$.

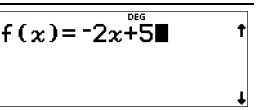
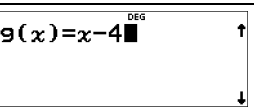
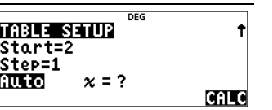
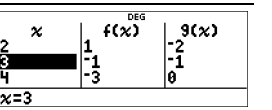
table **1** clear **3600** **−** **450** $x_{abcd}^{y\,z\,t}$	
enter clear enter **0** ⏷ **1** ⏷ ⏵ enter enter	

Input each guess and press enter.	
Calculate the value of **f(8)** on the Home screen. 2nd [quit] table	
2 Selects **f(** **8**) enter	

The support of £450 per month will last for 8 months since $y(8) = 3600 - 450(8) = 0$ as shown in the table of values.

Problem

Find the intersection of the lines f(x)=⁻2x+5 and g(x)=x-4.

table **1** clear (−) **2** x^{yzt}_{abcd} + **5**	
enter clear x^{yzt}_{abcd} − **4**	
enter **2** enter **1** Select **Auto** enter enter	
enter ⊙	

The two lines intersect at (x,y) = (3,⁻1).

Matrices

In addition to those in the Matrix **MATH** menu, the following matrix operations are allowed. Dimensions must be correct:

- *matrix* + *matrix*
- *matrix* – *matrix*
- *matrix* × *matrix*
- Scalar multiplication (for example, 2 × *matrix*)
- *matrix* × *vector* (*vector* will be interpreted as a column vector)

2nd [matrix] **NAMES**

2nd [matrix] displays the matrix **NAMES** menu, which shows the dimensions of the matrices and lets you use them in calculations. The row and column dimension of a matrix can be 1≤row≤3 and 1≤column≤3.

1:[A]	Definable matrix [A].
2:[B]	Definable matrix [B].
3:[C]	Definable matrix [C].
4:[Ans]	Last matrix result (**[Ans]=***row*×*column*), or last vector result (**[Ans] dim=***n*). Not editable. **Note:** Cell values can be toggled. To view the full precision or exact format, highlight the cell.
5:[I2]	2×2 identity matrix (not editable).
6:[I3]	3×3 identity matrix (not editable).

2nd [matrix] **MATH**

2nd [matrix] ▶ displays the matrix **MATH** menu, which lets you perform the following operations:

1:Determinant	Determinant of a square matrix. Syntax: **det(***squarematrix***)**
2:^{T} Transpose	Transpose of a matrix. Syntax: *matrix*^{T}
3:Inverse	Inverse of a square matrix. Syntax: *squarematrix*$^{-1}$
4:ref reduced	Row echelon form. Syntax: **ref(***matrix***)**
5:rref reduced	Reduced row echelon form. Syntax: **rref(***matrix***)**

2nd [matrix] **EDIT**

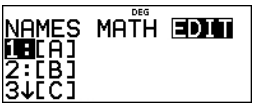
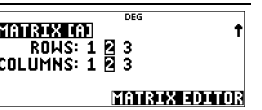
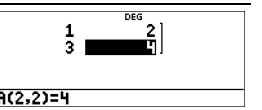
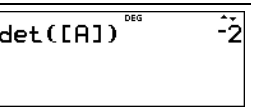
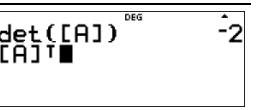
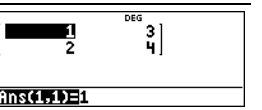
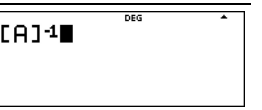
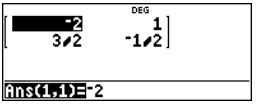
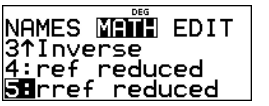
2nd [matrix] ◀ displays the matrix **EDIT** menu, which lets you define or edit matrix [A], [B], or [C].

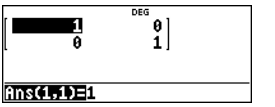
Note: Press [◆▶≈] to toggle the number format in a cell as needed.

Example

Define matrix [A] = $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

Calculate the determinant, transpose, inverse, and rref of [A].

Define [A]	2nd [matrix] ◀	
	enter	
Set dimensions	▶ enter ▶ enter enter	
Enter values	**1** ▼ **2** ▼ **3** ▼ **4** ▼	
det([A])	2nd [quit] 2nd [matrix] ▶	
	enter 2nd [matrix] enter ( ) enter	
Transpose	2nd [matrix] enter 2nd [matrix] ▶ ▼ enter	
	enter	
Inverse	2nd [quit] clear 2nd [matrix] enter 2nd [matrix] ▶ ▼ ▼ enter	
	enter	
rref	clear clear 2nd [matrix] ▶ ▲	

	enter 2nd [matrix] enter)	
	enter	

Vectors

In addition to those in the Vector **MATH** menu, the following vector operations are allowed. Dimensions must be correct:

- *vector* + *vector*
- *vector* – *vector*
- Scalar multiplication (for example, 2 × *vector*)
- *matrix* × *vector* (*vector* will be interpreted as a column vector)

2nd [vector] **NAMES**

2nd [vector] displays the vector **NAMES** menu, which shows the dimensions of the vectors and lets you use them in calculations.

The dimension of a vector can be 1≤dim≤3.

1:[u]	Definable vector [u]
2:[v]	Definable vector [v]
3:[w]	Definable vector [w]
4:[Ans]	Last matrix result (**[Ans]=***row*×*column***)**, or last vector result (**[Ans] dim=***n*). Not editable. **Note:** Cell values can be toggled. To view the full precision or exact format, highlight the cell.

2nd [vector] **MATH**

2nd [vector] ▶ displays the vector **MATH** menu, which lets you perform the following vector calculations:

1:DotProduct	Dot product of two vectors with the same dimension. Syntax: **DotP(***vector1*,*vector2***)**
2:CrossProduct	Cross product of two vectors with the same dimension. Syntax: **CrossP(***vector1*,*vector2***)**
3:norm	Norm (magnitude) of a vector.

magnitude	Syntax: **norm(***vector***)**

2nd [vector] **EDIT**

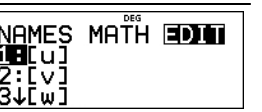
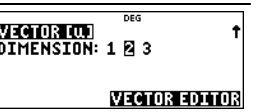
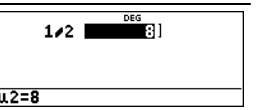
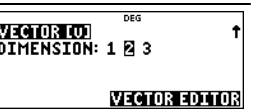
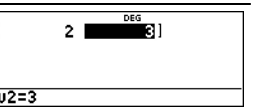
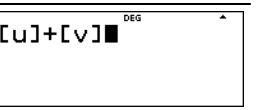
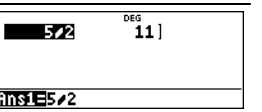
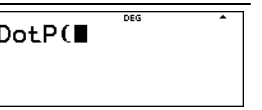
2nd [vector] ◀ displays the vector **EDIT** menu, which lets you define or edit vector [u], [v], or [w].

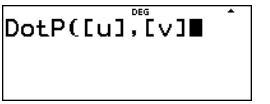
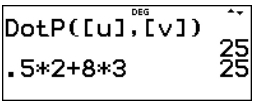
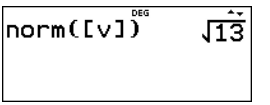
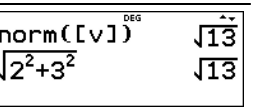
Note: Press ◆▶≈ to toggle the number format in a cell as needed.

Example

Define vector [u] = [0.5 8]. Define vector [v] = [2 3].

Calculate [u] + [v], **DotP(**[u],[v]**)**, and **norm(**[v]**)**.

Define [u]	2nd [vector] ◀	
	enter ▶ enter	
	enter **1** ⬚ **2** enter **8** enter	
Define [v]	2nd [vector] ◀ ▼ enter ▶ enter	
	enter **2** enter **3** enter	
Add vectors	2nd [quit] 2nd [vector] enter + 2nd [vector] ▼ enter	
	enter	
DotP	clear clear 2nd [vector] ▶ enter	

	2nd [vector] enter 2nd [,] 2nd [vector] ▼ enter	
	) enter .5 × 2 + 8 × 3 enter **Note:** DotP is calculated here in two ways.	
norm	clear 2nd [vector] ▶ ▼ ▼ enter 2nd [vector] ▼ enter) enter	
	2nd [√] 2 x^2 + 3 x^2 ▶ enter **Note:** norm is calculated here in two ways.	

Solvers

Numeric Equation Solver

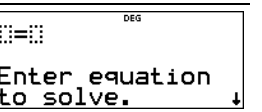
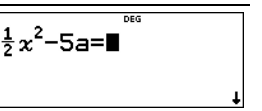
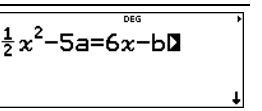
2nd [num-solv]

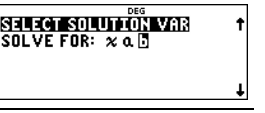
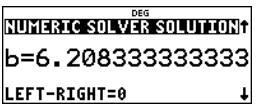
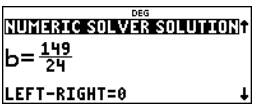
2nd [num-solv] prompts you for the equation and the values of the variables. You then select the variable you want to solve.

Example

For the following equation shown, solve for the variable b.

Reminder: If you have already defined variables, the solver will assume those values.

Num-solv	2nd [num-solv]	
Left side	1 ▫/▫ 2 ▶ x^{yzt}_{abcd} x^2 − 5 x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} ▶ ▶	
Right side	6 x^{yzt}_{abcd} − x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd}	

Initial Variable Value	enter 1 ▯/▯ 2 ▶	
	enter 2 ▯/▯ 3 ▶	
	enter 1 ▯/▯ 4 ▶	
Select Solution Variable	enter ▶ ▶	
Solution Bounds	enter ▼ ▼ Enter the interval where you expect the solution as [*LOWER*,*UPPER*] if needed.	
	enter ◀▶≈ **Note: LEFT-RIGHT** is the difference between the left- and right-hand sides of the equation evaluated at the solution. This difference gives how close the solution is to the exact answer.	 

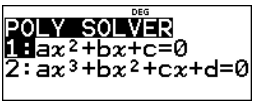
Polynomial Solver

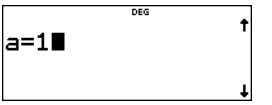
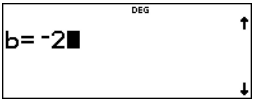
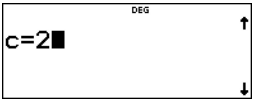
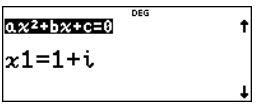
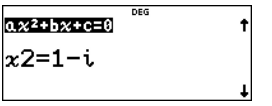
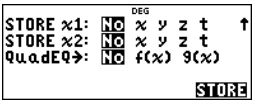
2nd [poly-solv]

2nd [poly-solv]prompts you to select either the quadratic or the cubic equation solver. You then enter the real coefficients of the variables and solve. Solutions will be real or complex.

Example of Quadratic Equation

Reminder: If you have already defined variables, the solver will assume those values.

Poly-solv	2nd [poly-solv]	

Enter coefficients	enter **1**	
	⊙ (−) **2**	
	⊙ **2** enter	
Solutions	enter	
	⊙	
	⊙ **Note:** If you choose to store the polynomial to f(x) or g(x), you can use table to study the table of values.	
	⊙ ⊙ ⊙ enter Vertex form (quadratic solver only)	

On the solution screens of the polynomial solver, you can press ◆▶≈ to toggle the number format of the solutions x1, x2 for quadratic, or x1, x2, and x3 for cubic.

System of Linear Equations Solver

2nd [sys-solv]

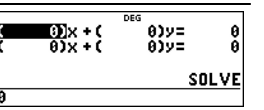
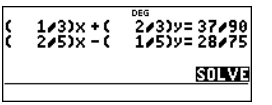
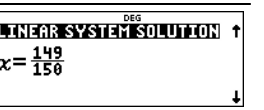
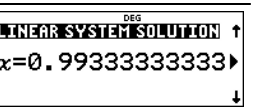
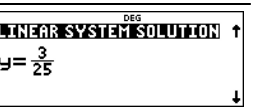
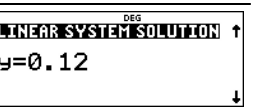
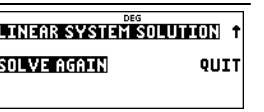
2nd [sys-solv] solves systems of linear equations. You choose from 2×2 or 3×3 systems.

Notes:

- x, y, and z results are automatically stored in the x, y, and z variables.
- Use ◆▶≈ to toggle the results (x, y and z) as needed.
- The system solver solves for a unique solution or infinite solutions in closed form, or it indicates no solution.

Example 2×2 System

Solve: $\frac{1}{3}x + \frac{2}{3}y = \frac{37}{90}$
$\frac{2}{5}x - \frac{1}{5}y = \frac{28}{75}$

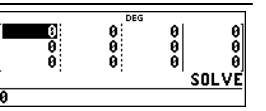
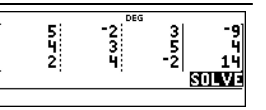
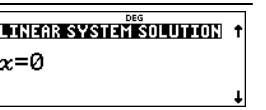
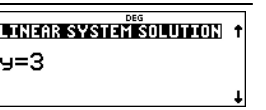
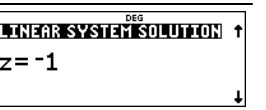
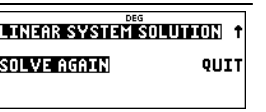
Sys-solv	2nd [sys-solv]	
2×2 system	enter	
Enter equations	**1** ▯/▯ **3** enter enter **2** ▯/▯ **3** enter **37** ▯/▯ **90** enter **2** ▯/▯ **5** enter (−) **1** ▯/▯ **5** enter **28** ▯/▯ **75** enter	
Solution	enter	
Change number format (if needed)	◆▶≈	
	enter	
Change number format (if needed)	◆▶≈	
	enter	

Example 3×3 System

Solve: 5x – 2y + 3z = −9

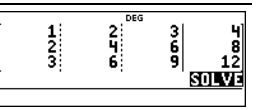
$4x + 3y + 5z = 4$

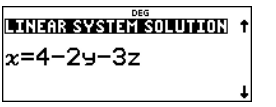
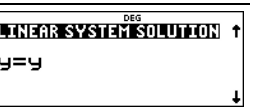
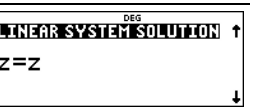
$2x + 4y - 2z = 14$

Sys-solv	2nd [sys-solv] ⊙	
3×3 system	enter	
Enter coefficients	**5** enter (−) **2** enter **3** enter (−) **9** enter **4** enter **3** enter **5** enter **4** enter **2** enter **4** enter (−) **2** enter **14** enter **Note:** For 3x3, notice that the first equation must be entered as: $5x + -2 + 3z = -9$	
Solution	enter	
	enter	
	enter	
	enter	

Note: Press [◆▶≈] to change the number format if needed.

Example 3×3 System with Infinite Solution

Enter the system	2nd [sys-solv] **2** **1** enter **2** enter **3** enter **4** enter	

	2 enter **4** enter **6** enter **8** enter **3** enter **6** enter **9** enter **12** enter	
Solution	enter	
	enter	
	enter	
	enter	
	enter	

Number Bases

2nd [base n]

Base Conversion

2nd [base n] displays the **CONVR** menu, which converts a real number to the equivalent in a specified base.

1:▶ Hex	Converts to hexadecimal (base 16).
2:▶ Bin	Converts to binary (base 2).
3:▶ Dec	Converts to decimal (base 10).
4:▶ Oct	Converts to octal (base 8).

Base Type

2nd [base n] ⊙ displays the **TYPE** menu, which lets you designate the base of a number regardless of the calculator's current number-base mode.

1:h	Designates a hexadecimal integer.
2:b	Designates a binary integer.

3:d	Designates a decimal number.
4:o	Designates an octal integer.

Examples in DEC Mode

Note: Mode can be set to DEC, BIN, OCT, or HEX. See the Mode section.

d ▶ Hex	clear **127** 2nd [base n] **1** enter	127▶Hex 7Fh
h ▶ Bin	clear 2nd [F] 2nd [F] 2nd [base n] ⊙ **1** 2nd [base n] **2** enter	FFh▶Bin 11111111b
b ▶ Oct	clear **10000000** 2nd [base n] ⊙ **2** 2nd [base n] **4** enter	10000000b▶Oct 200o
o ▶ Dec	⊙ enter enter	10000000b▶Oct 200o 200o 128

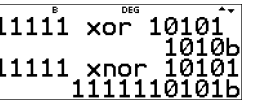
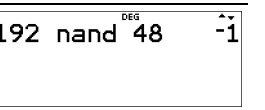
Boolean Logic

2nd [base n] ⊙ displays the **LOGIC** menu, which lets you perform boolean logic.

1:and	Bitwise AND of two integers
2:or	Bitwise OR of two integers
3:xor	Bitwise XOR of two integers
4:xnor	Bitwise XNOR of two integers
5:not(	Logical NOT of a number
6:2's(	2's complement of a number
7:nand	Bitwise NAND of two integers

Examples

BIN mode: **and**, **or**	clear mode ⊙ ⊙ ⊙ ⊙ ⊙ ⊙ enter **1111** 2nd [base n] ⊙ **1** **1010** enter **1111** 2nd [base n] ⊙ **2**	1111 and 1010 1010b 1111 or 1010 1111b

	1010 enter	
BIN mode: **xor, xnor**	clear **11111** 2nd [base n] ◀ **3** **10101** enter **11111** 2nd [base n] ◀ **4** **10101** enter	
HEX mode: **not, 2's**	clear mode ▼ ▼ ▼ ▼ ▶ enter 2nd [base n] ◀ **6** 2nd [F] 2nd [F]) enter 2nd [base n] ◀ **5** 2nd [answer]) enter	
DEC mode: **nand**	clear mode ▼ ▼ ▼ ▼ enter **192** 2nd [base n] ◀ **7** **48** enter	

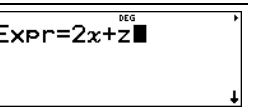
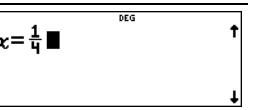
Expression Evaluation

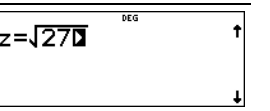
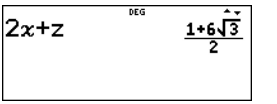
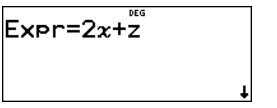
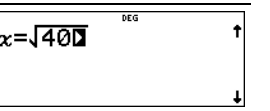
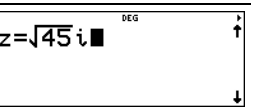
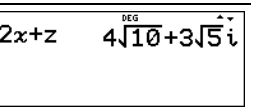
2nd [expr-eval]

Press 2nd [expr-eval] to input and calculate an expression using numbers, functions and variables/parameters. Pressing 2nd [expr-eval] from a populated home screen expression pastes the content to **Expr=**. If the cursor focus is in history, the selected expression will paste to **Expr=** when 2nd [expr-eval] is pressed.

If variables, x, y, z, t, a, b, c or d are used in the expression, you will be prompted for values or use the stored values displayed for each prompt. The number stored in the variables will update in the calculator.

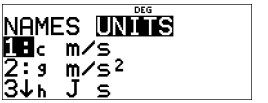
Example

2nd [expr-eval] clear	
2 x^{yzt}_{abcd} + x^{yzt}_{abcd} x^{yzt}_{abcd} x^{yzt}_{abcd}	
enter clear **1** ▯/▯ **4**	

enter clear 2nd [√‾] **27**	
enter	
2nd [expr-eval]	
enter clear 2nd [√‾] **40**	
enter clear 2nd [√‾] **45** ▶ [π^e_i] [π^e_i] [π^e_i]	
enter	

Constants

Constants lets you access scientific constants to paste in various areas of the TI-30X Pro MathPrint™ calculator. Press 2nd [constants] to access, and ◀ or ▶ to select either the **NAMES** or **UNITS** menus of the same 20 physical constants. Use ▲ and ▼ to scroll through the list of constants in the two menus. The **NAMES** menu displays an abbreviated name next to the character of the constant. The **UNITS** menu has the same constants as **NAMES** but the units of the constant show in the menu.



Note: Displayed constant values are rounded. The values used for calculations are given in the following table.

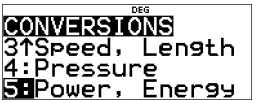
Constant		Value used for calculations
c	speed of light	299792458 metres per second
g	gravitational acceleration	9.80665 metres per second^2
h	Planck's constant	6.626070040×10^{-34} Joule seconds
NA	Avogadro's number	6.022140857×10^{23} molecules per

Constant		Value used for calculations
		mole
R	ideal gas constant	8.3144598 Joules per mole per Kelvin
$\mathbf{m}_e$	electron mass	9.10938356×10^{-31} kilograms
$\mathbf{m}_p$	proton mass	$1.672621898\times10^{-27}$ kilograms
$\mathbf{m}_n$	neutron mass	$1.674927471\times10^{-27}$ kilograms
$\mathbf{m}_\mu$	muon mass	$1.883531594\times10^{-28}$ kilograms
G	universal gravitation	6.67408×10^{-11} meters^3 per kilogram per seconds^2
F	Faraday constant	96485.33289 Coulombs per mole
$\mathbf{a}_0$	Bohr radius	$5.2917721067\times10^{-11}$ metres
$\mathbf{r}_e$	classical electron radius	$2.8179403227\times10^{-15}$ metres
k	Boltzmann constant	1.38064852×10^{-23} Joules per Kelvin
e	electron charge	$1.6021766208\times10^{-19}$ Coulombs
u	atomic mass unit	1.66053904×10^{-27} kilograms
atm	standard atmosphere	101325 Pascals
$\varepsilon\mathbf{0}$	permittivity of vacuum	$8.85418781762\times10^{-12}$ Farads per metre
$\mu\mathbf{0}$	permeability of vacuum	$1.256637061436\times10^{-6}$ Newtons per ampere^2
Cc	Coulomb's constant	$8.987551787368\times10^{9}$ metres per Farad

Conversions

The **CONVERSIONS** menu allows a total of 20 conversions (or 40 if converting both ways). The conversion must be at the end of an expression. The value of the full expression will be converted. A conversion can be stored to a variable.

To access the **CONVERSIONS** menu, press 2nd [convert]. Press one of the numbers (1-5) to select, or press ▲ and ▼ to scroll through and select one of the **CONVERSIONS** sub-menus. The sub-menus include the categories English-Metric, Temperature, Speed and Length, Pressure, Power and Energy.



English-Metric Conversion

in ▶ cm	inches to centimetres
cm ▶ in	centimetres to inches
ft ▶ m	feet to metres
m ▶ ft	metres to feet
yd ▶ m	yards to metres
m ▶ yd	metres to yards
mile ▶ km	miles to kilometres
km ▶ mile	kilometres to miles
acre ▶ m^2	acres to square metres
m^2 ▶ acre	square metres to acres
gal US ▶ L	US gallons to litres
L ▶ gal US	litres to US gallons
gal UK ▶ L	UK gallons to litres
L ▶ gal UK	litres to UK gallons
oz ▶ gm	ounces to grams
gm ▶ oz	grams to ounces
lb ▶ kg	pounds to kilograms
kg ▶ lb	kilograms to pounds

Temperature Conversion

°F ▶ °C	Fahrenheit to Celsius
°C ▶ °F	Celsius to Fahrenheit
°C ▶ K	Celsius to Kelvin
K ▶ °C	Kelvin to Celsius

Speed and Length Conversion

km/hr ▶ m/s	kilometres/hour to metres/second
m/s ▶ km/hr	metres/second to kilometres/hour
LitYr ▶ m	light years to metre
m ▶ LitYr	metres to light years

pc ▶ m	parsecs to metres
m ▶ pc	metres to parsecs
Ang ▶ m	Angstrom to metres
m ▶ Ang	metres to Angstrom

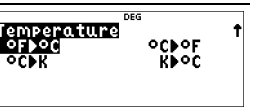
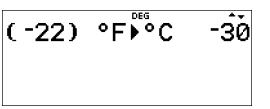
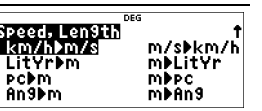
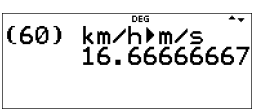
Power and Energy Conversion

J ▶ kWh	Joules to kilowatt hours
kWh ▶ J	kilowatt hours to Joules
J ▶ cal	Joules to calories
cal ▶ J	calories to Joules
hp ▶ kW	horsepower to kilowatt
kW ▶ hp	kilowatt to horsepower

Pressure Conversion

atm ▶ Pa	atmospheres to Pascals
Pa ▶ atm	Pascals to atmospheres
mmHg ▶ Pa	millimetres of mercury to Pascals
Pa ▶ mmHg	Pascals to millimetres of mercury

Examples

Temperature	[(] [(−)] **22** [)] [2nd] [convert] **2** [enter] [enter] (Enclose negative numbers or expressions in brackets).	 
Speed, Length	[clear] [(] **60** [)] [2nd] [convert] ⊙ ⊙ [enter] [enter] [enter]	 

Power, Energy	clear (200) 2nd [convert] ▼ ▼ ▼ ▼ enter ▶ enter enter	

Complex Numbers

2nd [complex]

The calculator performs the following complex number calculations:

- Addition, subtraction, multiplication and division
- Argument and absolute value calculations
- Reciprocal, square and cube calculations
- Complex Conjugate number calculations

Setting the Complex Format

Set the calculator to DEC mode when computing with complex numbers.

mode ▼ ▼ ▼ Selects the **REAL** menu. Use ◀ and ▶ to scroll with in the **REAL** menu to highlight the desired complex results format **a+bi**, or **r**$\angle\theta$, and press enter.

REAL, **a+bi**, or **r**$\angle\theta$ set the format of complex number results.

a+bi rectangular complex results

r$\angle\theta$ polar complex results

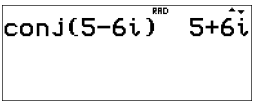
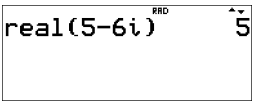
Notes:

- Complex results are not displayed unless complex numbers are entered.
- To access i on the keypad, use the multi-tap key π i.
- Variables x, y, z, t, a, b, c, and d are real or complex.
- Complex numbers can be stored.
- Complex numbers are not allowed in data, matrix, vector, and where complex arguments are not valid. A function can be defined with a complex number expression and will calculate on the home screen and not in table.
- For conj(, real(, and imag(, the argument can be in either rectangular or polar form. The output for conj(is determined by the mode setting.
- The output for real(and imag(are real numbers.
- Set mode to DEGREE or RADIAN depending on the angle measure needed.

Complex Menu	Description
1:∠	∠ (polar angle character) Lets you paste the polar representation of a complex number (such as 5∠π).
2:polar angle	Returns the polar angle of a complex number. Syntax: **angle(***value***)**
3:magnitude	Returns the magnitude (modulus) of a complex number. Syntax: **abs(***value***)** (or |□| in MathPrint™ mode)
4:▸r∠θ	Displays a complex result in polar form. Valid only at the end of an expression.
5:▸a+bi	Displays a complex result in rectangular form. Valid only at the end of an expression.
6:conjugate	Returns the conjugate of a complex number. Syntax: **conj(***value***)**
7:real	Returns the real part of a complex number. Syntax: **real(***value***)**
8:imaginary	Returns the imaginary (non-real) part of a complex number. Syntax: **imag(***value***)**

Examples (set mode to RADIAN)

Polar angle character: ∠	clear 5 2nd [complex] enter π^{e}_{i} $\frac{\square}{\square}$ 2 enter	RAD $5\angle\frac{\pi}{2}$ 5i
Polar angle: angle(	clear 2nd [complex] ⊙ enter 3 + 4 π^{e}_{i} π^{e}_{i} π^{e}_{i}) enter	RAD angle(3+4i) 0.927295218
Magnitude: abs(	clear 2nd [complex] 3 (3 + 4 π^{e}_{i} π^{e}_{i} π^{e}_{i}) enter	RAD |(3+4i)| 5
▸r∠θ	clear 3 + 4 π^{e}_{i} π^{e}_{i} π^{e}_{i} 2nd [complex] 4 enter	RAD 3+4i▸r∠θ 5∠0.927295218
▸a+bi	clear 5 2nd [complex] enter 3 π^{e}_{i} $\frac{\square}{\square}$ 2 ⊙ 2nd [complex] 5 enter	RAD $5\angle\frac{3\pi}{2}$▸a+bi -5i

Conjugate: conj(	clear 2nd [complex] 6 5 − 6 π^e_i π^e_i π^e_i) enter	
Real: real(	clear 2nd [complex] 7 5 − 6 π^e_i π^e_i π^e_i) enter	

Reference Information

This section contains information about errors, maintaining and replacing the batteries, and troubleshooting problems.

Errors and Messages

When the calculator detects an error, the screen will display the error type or a message.

- To correct an error: Press [clear] to clear the error screen. The cursor will display at or near the error. Correct the expression.
- To close the error screen without correcting the expression: Press [2nd] [quit] to return to the home screen.

The following list includes some of the errors and messages that you may encounter.

Error/Message	Description
Argument	This error is returned when: • a function does not have the correct number of arguments • the lower limit is greater than upper limit in summation or product function
Bad Guess	This error is returned when the variable entry for the "solve for" variable in Numeric Solver is outside the lower and upper bounds entered.
Bounds: Enter LOWER ≤ UPPER	This error is returned when input for lower bound > upper bound for: • Normalcdf distribution • Numeric Solver solution bounds
Break	This error is returned when the [on] key is pressed to stop the evaluation of an expression.
Calculate 1-Var,2-Var Stat or a regression.	This message is returned when no statistics or regression calculation has been stored.
Change mode to DEC.	This error is returned when the mode is set to BIN, HEX or OCT and the following apps are accessed: [expr-eval][table] [convert] [stat-reg/distr] [data] [num-solv][poly-solv][sys-solv][matrix] [vector] These apps are available in DEC mode only.
Dimension mismatch	This error is returned if the dimensions of a matrix or vector in a calculation are not correct for the operation.

Error/Message	Description
Division by 0	This error is returned if the expression evaluation contains division by 0.
Domain	This error is returned when an argument is not in the function domain. For example: • For $x\sqrt{y}$: $x = 0$ – or – $y < 0$ and x is not an odd integer. • For y^x: y and $x = 0$. • For $\sqrt{x}$: $x < 0$. • For **log**, **ln** or **logBASE**: $x \leq 0$. • For **tan**: $x = 90°, -90°, 270°, -270°, 450°$, etc., and equivalent for radian mode. • For **sin**$^{-1}$ or **cos**$^{-1}$: $\lvert x \rvert > 1$. • For **nCr** or **nPr**: n or r are not integers ≥ 0. • For $x!$: x is not an integer between 0 and 69.
Enter 0≤area≤1	This error is returned when you enter an invalid area value in invNormal for a distribution.
Enter sigma>0	This error is returned when the input for sigma in a distribution is invalid.
Expression is too long	This error is returned when an entry exceeds the digit limits. For example, pasting an expression entry with a constant that exceeds the limit. A chequerboard cursor may display when limits are reached in each MathPrint™ feature.
Formula	This error is returned in data when: • the formula does not contain a list name (L1, L2, or L3) • the formula for a list contains its own list name For example, a formula for L1 contains L1.
Frequency: Enter FREQ≥0	This error is returned when at least one element in a list selected for $FREQ$ is a negative real number in **1-VAR** or **2-VAR STATS**.
Highest degree coefficient cannot be zero.	This error is returned when the coefficient, a, in the polynomial solver calculation is pre-populated with zero, or if the input to a is zero. Change to a non-zero value.

Error/Message	Description
Input must be non-negative Integer.	This error is returned when an input is not the expected number type. For example, in distribution arguments $TRIALS$ and x in Binomialpdf.
Input must be Real	This error is returned when an input requires a real number.
Invalid data type	This error is returned when the argument of a command or function is the incorrect data type. For example, the error will be displayed for sin (i) or min(i,7) where the arguments must be Real numbers.
Invalid Dimension	This error is returned when a matrix or vector operation cannot be performed due to incorrect dimensions.
Invalid equation	This error is returned when an invalid equation is entered such as 1000=10000 or a blank equation in the numeric solver.
Invalid Function	This error is returned when no function is defined and a function evaluation is attempted. Define functions in table.
List Dimension 1≤dim(list)≤50	This error is returned when, in data: • the **SUM LIST** function is executed on an empty list • a sequence is created with a length of 0 or >50.
Max iterations reached. Try new guess.	This error is returned when the numeric equation solver has exceeded the maximum number of permitted iterations for finding a solution. Change the initial guess for the solution variable or check the equation.
Mean: Enter mu>0	This error is returned when an invalid value is input for the mean ($mean = mu$) in poissonpdf or poissoncdf.
Memory limit reached	This error is returned when a calculation contains a circular reference such as two functions referencing each other, or a very long calculation.
No sign change found. Try new guess.	This error is returned when the numeric solver algorithm cannot find a solution. Change the initial guess for the solution variable or check the equation. Repeated roots equations, such as x^2=0, do

Error/Message	Description
	not have a sign change around the root which is essential for the numeric solver algorithm to iterate to a solution.
[2nd] [set op]: Operation is not defined.	This error is returned when an operation has not been defined in 2nd [set op] and 2nd [op] is pressed.
Operation set! [2nd] [op] pastes to Home Screen.	This message is returned when an operation is stored (set) from 2nd [set op] editor. Press any key to continue.
Overflow	This error is returned when a calculation or value is beyond the range of the calculator.
Probability: Enter 0≤p≤1	This error is returned when input for the probability in distributions is invalid.
Singular matrix	This error is returned when the inverse of a singular matrix is attempted. A singular matrix has determinant = 0.
Singularity	This error is returned when the numeric solver algorithm cannot return a solution due to a point at which the function is not defined.
Statistics	This error is returned when a statistical or regression function is invalid. For example, when a calculation of 1-var or 2-var stats is attempted with no defined data points.
Step size must not be 0.	This error is returned when, in data, the *STEP SIZE* input is set to 0 in the **SEQUENCE FILL** function.
Syntax	This error is returned when an expression contains misplaced functions, arguments, parentheses, or commas.
Tolerance not met	This error is returned when the tolerance argument, such as in numeric differentiation or numeric integration, is such that the algorithm cannot return an accurate result.
TRIALS: Enter 0≤n≤49	This error is returned in Binomialpdf and Binomialcdf, when the number of trials is out of range, 0≤*n*≤49 in the case of ALL.
Undefined	This error is returned when a matrix or a vector is not defined. Define the matrix or vector in the [matrix] or [vector] **EDIT** menu.

Battery Information

Battery Precautions

- Do not leave batteries within reach of children.
- Do not mix new and used batteries.
- Do not mix brands (or types within brands) of batteries.
- Do not use rechargeable batteries.
- Do not place non-rechargeable batteries in a battery charger.
- Install batteries according to polarity (+ and -) diagrams.
- Properly dispose of used batteries immediately.
- Do not incinerate or dismantle batteries.
- Seek Medical Advice immediately if a cell or battery has been swallowed. (In the USA, contact the National Capital Poison Center at 1-800-222-1222.)

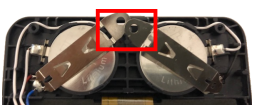
Battery Disposal

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

How to Remove or Replace the Batteries

The TI-30X Pro MathPrint™ calculator uses two 3-volt CR2032 batteries.

- Remove the protective cover and turn the calculator face downwards.
- Remove the screws from the back of the case with a small screwdriver.
- From the bottom, carefully separate the front from the back. Be careful not to damage any of the internal parts.
- Remove the screw on the battery clip with a small screwdriver and remove the batteries.



- To replace the batteries, check the polarity (+ and -) and slide in the new batteries. Press firmly to snap the new batteries into place and replace the screw in the battery clip.

  Important: When replacing the batteries, avoid any contact with the other components of the calculator.

Dispose of the used batteries immediately and in accordance with local regulations.

Per CA Regulation 22 CCR 67384.4, the following applies to the button cell batteries in this unit:

Perchlorate Material - Special handling may apply.

See: www.dtsc.ca.gov/hazardouswaste/perchlorate

Troubleshooting

Review instructions to make sure that certain calculations were performed properly.

Check the batteries to ensure that they are fresh and properly installed.

Change the batteries when:

- [on] does not turn the unit on, or
- the screen goes blank, or
- you get unexpected results.

General Information

Online Help

education.ti.com/eguide

Select your country for more product information.

Contact TI Support

education.ti.com/ti-cares

Select your country for technical and other support resources.

Service and Warranty Information

For information about the length and terms of the warranty or about product service, refer to the warranty statement enclosed with this product or contact your local Texas Instruments retailer/distributor.