CASIO

fx-8200AU II

NUMBERED MENUS
Fewer key presses and less scrolling

HOME KEY
Press to show all applications

BRIGHTER & BOLDER NAVIGATION & SHIFT COMMANDS
Increased contrast and vibrance to help you find things with ease

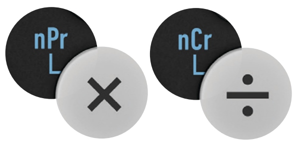
SCIENTIFIC NOTATION
defaults to scientific notatition

PAGE SCROLL KEYS

CATALOG
displays 15 commands on screen at a time, for example:
6 enters %

TOOLS
Application specific settings

nPr & nCr



DEFAULTS TO
S⇔D
FUNCTIONALITY

THE USEABLE MANUAL

MADE FOR AUSTRALIA

fx-8200 AU II vs fx-8200 AU Comparison

Feature		NEW fx-8200 AU II	fx-8200 AU
Availability and support software	Available as of mid-2026	✓	✓
	Web-based emulator software	✓	✓
Functionality	All expected basic calculator functionality	✓	✓
	Natural (textbook) display	✓	✓
	Prime factorisation GCD & LCM	✓	✓
	Vector calculations	✓	✓
	Complex numbers	✓	✓
	Exact value output	✓	✓
	Probability calculations *(Normal, Binomial and user friendly)*	✓	✓
	Vastly improved statistics interface	✓	✓
	Summation and product of a series	✓	✓
	Tabulate	✓	✓
	Logarithms of any numerical base (as well as 10 and *e*)	✓	✓
fx-8200 AU II cosmetic updates	White inlay on navigation keys for better contrast	✓	✗
	Brighter and bolder blue for soft key commands	✓	✗
fx-8200 AU II improved functionality	FORMAT defaults to S⇔D functionality	✓	✗
	Numbered menus	✓	✗
	Improved Catalog View	✓	✗
	nPr & nCr as shift commands	✓	✗
	Recurring decimal output as used in Australian schools	✓	✗

fx-8200 AU II How to Book

'Boost your Curiosity'

First published in 2026
This publication was created using fx-8200 AU II
Questions about this publication should be directed to edusupport@shriro.com.au

Contents

1.1 Getting ready to begin

Turn your calculator ON. Press ⌂ and the screen, right, will be seen.

Two keys below the ON button, you can see a SHIFT key, ⇧. Pressing it allows you to use the blue functions *above* certain keys.

Note that this key does *not* work like a computer's Shift key. A calculator's Shift key is *pressed and released* and then the next button pressed.

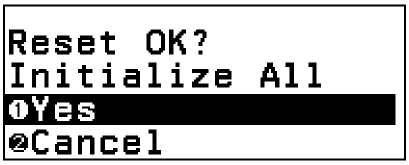
In Section 1 we assume you have just taken the fx-8200 AU II out of the box and have not changed any of the out-of-the-box (factory/default) settings.

If your calculator is *not* out-of-the-box, then we suggest you *initialise* it, which returns all the settings back to the factory settings.

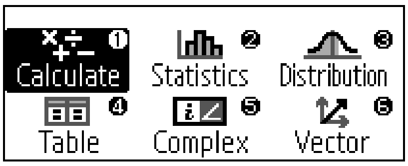
With the Calculate selected, press OK to launch the Calculate application.
Or just press 1, the shortcut key.

To initialise, press:

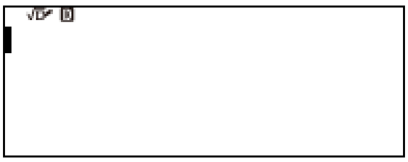
☰ to open the settings
3 to open ③Reset ▶
3 to open ③Initialize All ▶
1 or OK to choose Yes and reset the calculator.



The HOME screen will then be displayed and the Calculate application will be selected.



Press 1 or OK to launch the Calculate application.

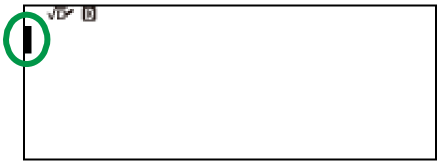


You are now ready to start!

1.2 Some first steps

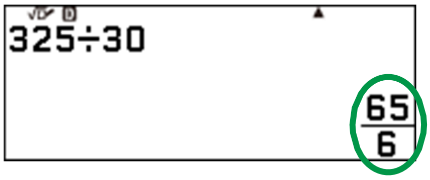
An almost empty screen awaits you.

Notice the flashing cursor to the left of screen. This signifies the calculator is ready for you to enter a calculation.



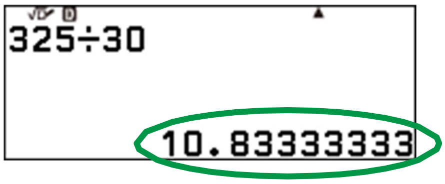
Let's calculate 325 ÷ 30.

Enter:
3 2 5
÷
3 0
EXE



The result in fractional form, $\frac{65}{6}$, is shown on the right side (the output side) of the screen.
Note the fraction is in simplified form.

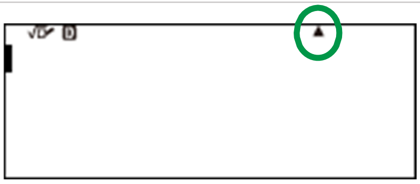
To see the decimal approximation of the result, press FORMAT .



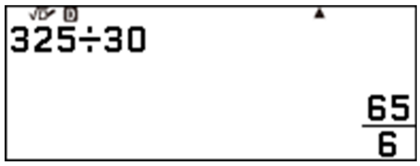
Press AC . This clears the screen.

Notice the small arrow pointing upwards.

This indicates that the calculator has stored the previous calculation.

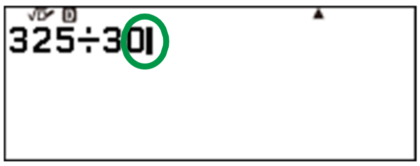


Press ∧ (the cursor key above OK).
The previous calculation is recalled.

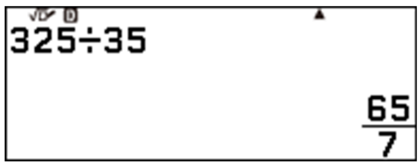


Suppose we wanted to calculate 325 ÷ 35.

Press > > > > > > > to move the cursor to the right of the 0.
(Or just press < .)



Press ⌫ to remove the 0 and then press 5 then EXE .
What do you think 325 ÷ 40 will be?



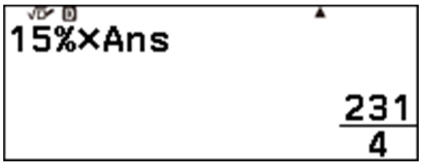
John owns a one-man gardening business. Every time he does a job, he calculates the amount he is owed by multiplying the number of hours worked by $55 and then adds 15% to this figure to pay for his health cover and other similar things.

If he completed a job that took 7 hours, how much would he be owed?

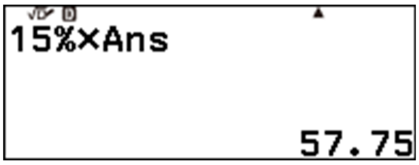
First calculate 55 × 7.

385 will now be stored in the *answer memory*.

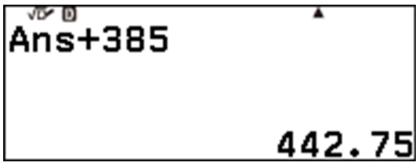
Now let's find the 'extra' that John adds to this.
Enter:
1 5
(catalog) 2 to open ②Probability ▸
1 or OK to enter ①%
× Ans
EXE



To see the decimal form of this result, press FORMAT.

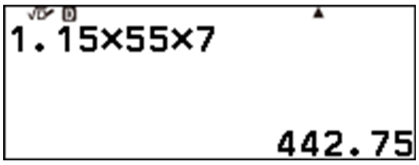


Now we need to add $57.75 to $385.
We can use the answer memory again.
Enter:
+ 3 8 5
EXE



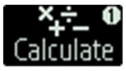
To get the decimal form of the answer directly, press FORMAT.

Alternatively, we could have calculated 115% of 55 × 7.
Enter:
1 . 1 5 × 5 5 × 7
EXE
FORMAT



Ah, the same result!

2.1 Input and output settings

When using the 

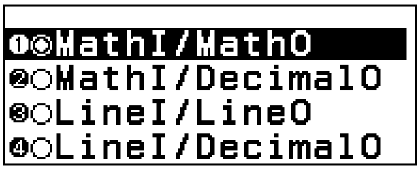
application, you supply an *input* and the calculator returns an *output*. Imagine you supplied the input $4 \times \frac{7}{3}$. Should the calculator return the output,

- $\frac{28}{3}$ or
- 9.333333333.

You can ensure you get the form of output you want by choosing the appropriate Input/Output setting.

This calculator has four Input/Output settings:

1. MathI / MathO,
2. MathI / DecimalO,
3. LineI / LineO,
4. LineI / DecimalO.



MathI/MathO

MathI/MathO allows you to use the nice templates that support *natural display input*, meaning that you can enter a calculation as you would write it on a piece of paper. This setting returns outputs in what is called Standard form.

Standard form is usually the form of a number that is *not* a decimal.
Some examples are:

- fractional form,
- surd form,
- in terms of π.

If you supply the input:

- $4 \times \frac{7}{3}$, the output is $\frac{28}{3}$,
- $\sqrt{2} \times \sqrt{10}$, the output is $2\sqrt{5}$,
- $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$, and the angle unit is set to radians, the output is $\frac{1}{3}\pi$.

MathI / DecimalO

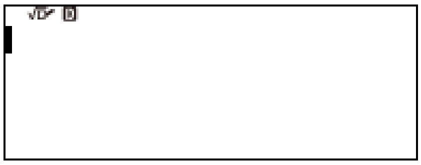
MathI / DecimalO allows you to use the nice templates that support *natural display input* but supplies outputs in Decimal form.

If you supply the input:

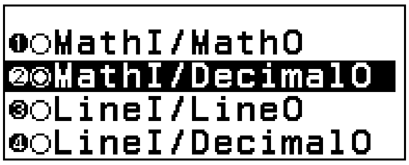
- $4 \times \frac{7}{3}$, the output is 9.333333333 ,
- $\sqrt{2} \times \sqrt{10}$, the output is 4.472135955,
- $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$, and the angle unit is set to radians, the output is 1.047197551.

Suppose you want Decimal outputs.
You can change the Input/Output setting to MathI/DecimalO, and check it works, by doing the following:

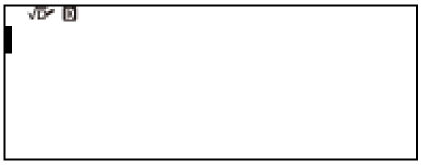
From the ⌂ screen, launch the Calculate application by pressing ①.



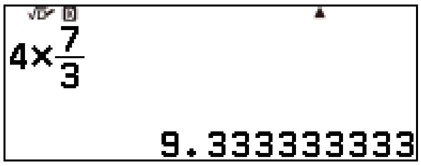
Press ☰
① or OK to open ❶Calc Settings ▶
① or OK to open ❶Input/Output ▶
② to choose ❷◉MathI/DecimalO



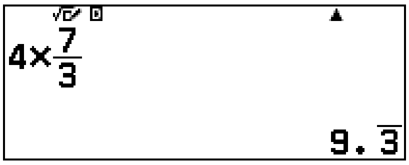
AC to return to the calculation screen.



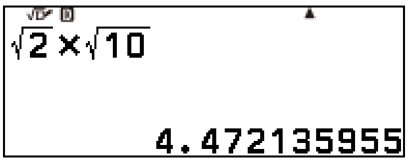
Enter:
④ ⊗
⑦ ▭ ③
EXE



You can see the recurring decimal form of 9.333333333 by pressing:
⇧ then FORMAT (to access (⟲))
③ to choose ❸Recurring Decim…

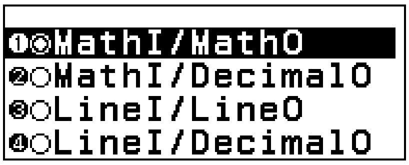


Enter:
√▭ ② ▷
⊗
√▭ ① ⓪
EXE

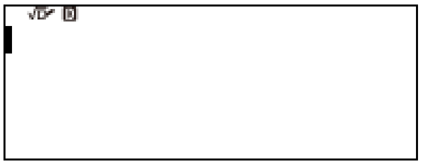


Now change the Input/Output setting back to MathI/MathO, and check it works, by doing the calculations below.

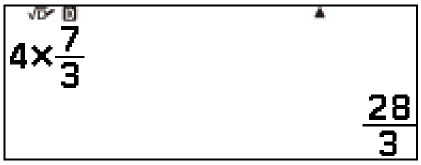
Press ☰
1 or OK to open 1Calc Settings ▶
1 or OK to open 1Input/Output ▶
1 or OK to choose 1◉MathI/MathO



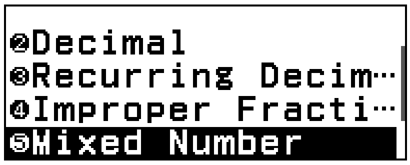
AC to return to the calculation screen.



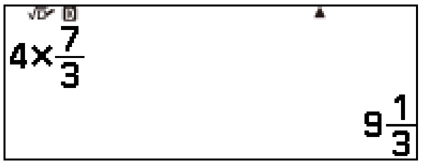
Enter:
4 ×
7 ▭ 3
EXE



You can see the mixed number form of $\frac{28}{3}$ by pressing:
⇧ then FORMAT (to access (⟳))
∨ ∨ ∨ ∨

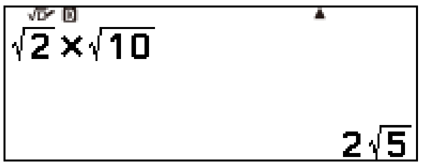


To see and select Mixed Number then
5 or OK to choose 5Mixed Number



Note: Scrolling is not necessary if you know Mixed Number is option 5.

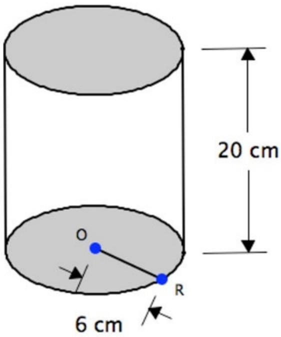
Enter:
√▭ 2 >
×
√▭ 1 0
EXE



2.2 Displaying decimals – Fix and Norm

Set your calculator to MathI/DecimalO, so outputs are displayed in Decimal form. See Section 2.1.

Many of the calculations you do will require a decimal approximation for a quantity. For example, suppose a cylindrical oil tank is to be made for a racing car. The tank has base radius of 6 cm, height of 20 cm and is made of aluminium.



Calculate the area of the circular base of the tank, and its volume, correct to 2 decimal places.

We know that $A_c = \pi r^2$

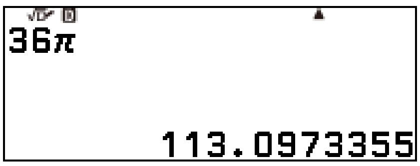
So in this case $A_c = \pi \times 6^2$

$= 36\pi$

$\approx 108 cm^2$ (estimated mentally)

Let's use the calculator to gain a little more accuracy.

From the screen, launch the  application.



3 6

then 7 (to access (π))

EXE

Note that 10 digits are displayed.
We require 2 decimal place accuracy.

So, the area is 113.10 cm^2.

We could set the calculator to display the answer to this level of accuracy automatically.

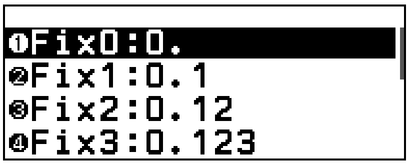
This can be done in the SETTINGS menu.

Press ☰

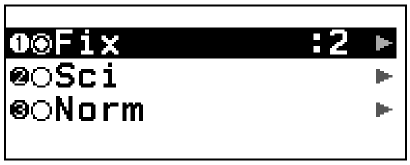
(1) or (OK) to open ①Calc Settings ▶

(3) to open ③Number Format ▶

(1) or (OK) to open ①○Fix ▶

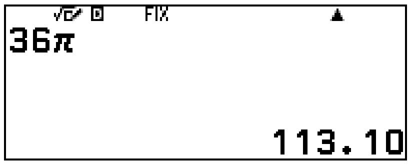


(3) to choose two-decimal place accuracy.



(AC) and then (EXE) to re-calculate the result.

Note that in this setting the result is rounded correct to 2 decimal places, not truncated.



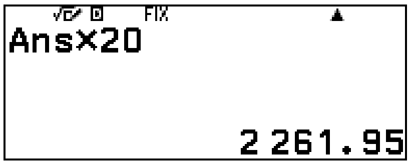
Most importantly though, Fix is a display feature, the calculator has still stored the 10 digit value.

To calculate the volume, we do *not* want to use the rounded figure. We want to use the most accurate value we have – the one with all the decimal places.

We can use the *answer* memory to our advantage:

(×) (2) (0)

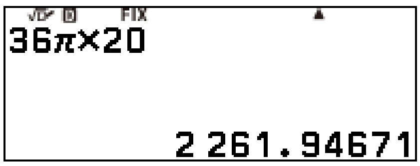
(EXE)



which gives us the volume of the tank,
2261.95 cm^3, rounded to two decimal places.

Note that 113.10 was not used in the calculation, 113.0973355 was, since 113.10 × 20 = 2262.

We can display more digits using the Fix option again.

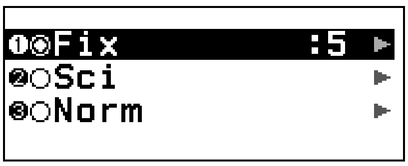


There are a series of different settings you can choose with respect to the display of numbers.

Press ☰

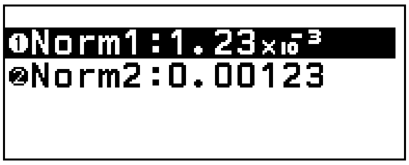
(1) or (OK) to open ①Calc Settings ▶

(3) to open ③Number Format ▶

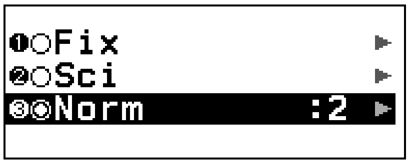


To return to the default setting, Norm2, press:

③ to open ③○Norm ►.

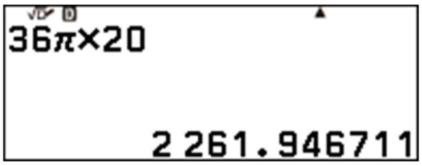


② to choose Norm2.



AC to return to the calculation screen.

EXE to recalculate.



For general calculations there are two Norm settings, Norm1 and Norm2.

One difference between them is that Norm1 displays positive numbers smaller than 0.01 in scientific notation, whereas Norm2 displays positive numbers smaller than 0.000000001 in scientific notation.

For most purposes Norm2 is the most useful display, and is the default setting (restored upon initialisation).

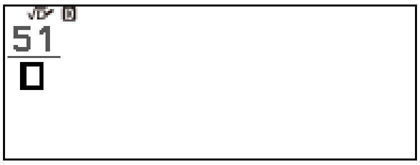
Unless otherwise stated, Norm2 is the setting used in calculations from this point onwards.

2.3 Entering and simplifying fractions

Set your calculator to MathI/MathO, so outputs are displayed in Standard form. See Section 2.1.

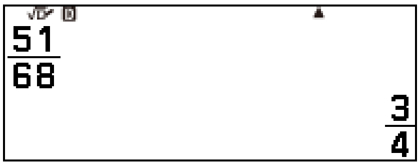
The fraction $\frac{51}{68}$ can be thought of as 51 parts of 68 equal parts of some whole. Is there a simpler way to think about this fraction?

From the screen, launch the Calculate application by pressing 1.



Enter 5 1 then .

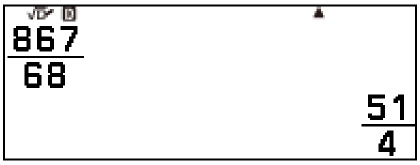
Note that a fraction *template* appears and the cursor is flashing in the denominator waiting for you to enter the 68.



Enter 6 8 and then press EXE.

The calculator simplifies the fraction, dividing numerator and denominator by 17.
Do you know your 17 times table?

Simplify $\frac{867}{68}$.



8 6 7

6 8
EXE

To see the decimal form of this result press FORMAT.

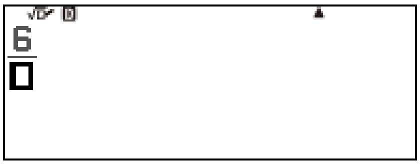
To see the result as a mixed number, press:
then FORMAT (to access)
4 to choose ④Mixed Number

2.4 Fractions and decimals

A fraction is the *exact value* of a quantity. For example, we know that $\frac{6}{33}+\frac{5}{33}$ is exactly equal to $\frac{11}{33}=\frac{1}{3}$ and that the decimal 0.333 (correct to 3 decimal places) is an approximation for $\frac{1}{3}$.

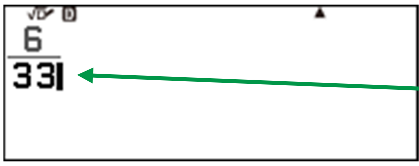
Let's see how the fx-8200 AU II deals with fraction calculations.

Calculate $\frac{6}{33}+\frac{5}{33}$ on the calculator. The fraction key will be used for entry.



Enter 6 then .

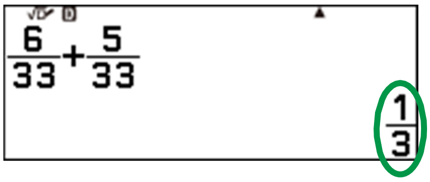
Note that the fraction appears and the cursor is flashing in the denominator waiting for you to enter the 33.



Enter 3 3 .

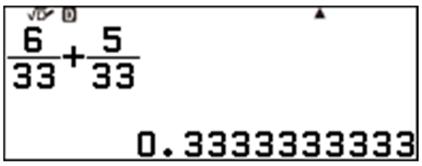
Note that the cursor is still in the denominator and we need it to be *outside and to the right* of the fraction to continue.

Press > to position the cursor as shown.



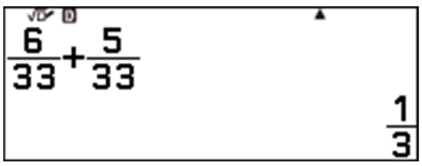
Enter + 5 3 3 EXE .

$\frac{11}{33}$ is displayed in simplified form, $\frac{1}{3}$.



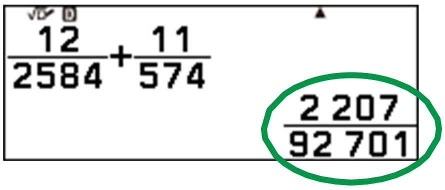
To get the decimal form of the answer, press FORMAT .

Or press then EXE (to access ≈).



Press FORMAT to return to the fraction.

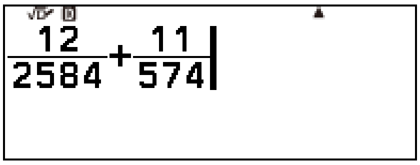
Calculate $\frac{12}{2584}+\frac{11}{574}$.



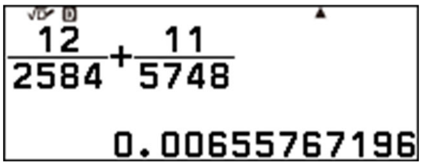
Even in this case, a fractional output is given! This one would be a challenge using mind alone.

Calculate $\frac{12}{2584}+\frac{11}{5748}$.

To do this we can edit the previous calculation, changing 574 to 5748.



Press (<) and note that the cursor is at the right-hand end of the input line.



Press (<) again and then press (8) (EXE).

No fraction this time, rather a decimal approximation. Interesting! Why does this happen? It happens because the calculator has a limit to what it can display as a fraction. The limit is 10 characters made up from the numerator, denominator and the fraction bar.

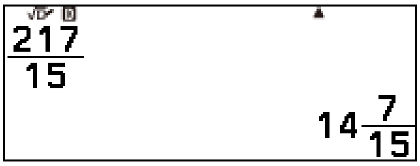
2.5 Fractions and mixed numbers

You have now seen a little of how the calculator works with fractions. Let's explore some more.

Convert $\frac{217}{15}$ to a mixed number.

Enter $\frac{217}{15}$ and press (EXE).

This process simply stores the fraction in the answer memory.



To see the result as a mixed number, press:

(⇧) then (FORMAT) (to access (↻))

(5) to choose ⑤Mixed Number

If you now press (FORMAT), the result will be shown in decimal form.
Press (FORMAT) again, and the result will be shown in Standard form as an improper fraction.

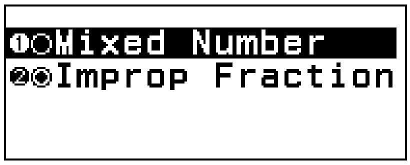
The calculator's factory setting is to display an output as a fraction (proper or improper) as opposed to a mixed number. This setting can be changed so the default display is a mixed number.

This can be done in the SETTINGS menu.

Press (☰)

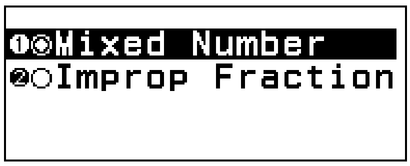
(1) or (OK) to open ①Calc Settings ▸

(4) to open ④Fraction Result ▸



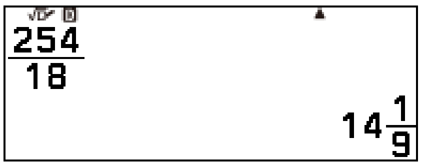
(1) or (OK) to choose Mixed Number.

Press (AC) to return to the calculation screen.



Now enter (2) (5) (4) (▭) (1) (8)

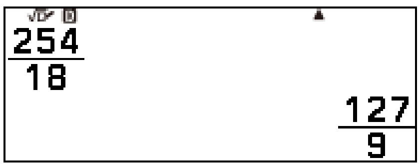
Press (EXE) and the result will be shown as a mixed number.



To see $14\frac{1}{9}$ as an improper fraction, press:

(⇧) (FORMAT) (↻)

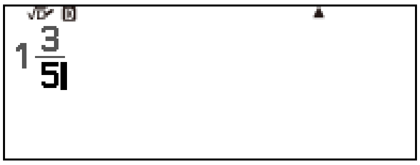
(4) to choose ④Improper Fracti…



2.6 Entering mixed numbers

Calculate $1\frac{3}{5} \times 100$ on the calculator.

Press ⇧ then ⊟ (to access (■⊟)).
This enters a mixed number template.
The cursor is flashing in the non-fraction part.

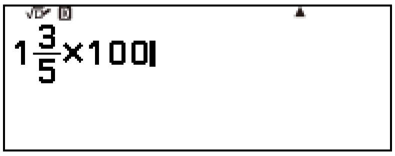


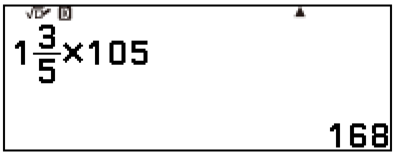
Enter:
① ⟩ ③ ⟨v⟩ ⑤

Now enter:
⟩ ⊗ ① ⓪ ⓪
EXE

Now calculate $1\frac{3}{5} \times 105$ and $1\frac{3}{5} \times 110$.

Press ⟨ to position the cursor to the right of 100 and press ⌫ ⑤ EXE.





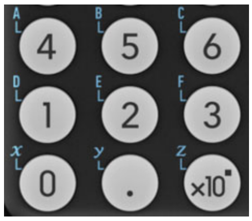
Then, ⟨ ⌫ ⌫ ① ⓪ EXE.

Can you predict what $1\frac{3}{5} \times 115$ will be? What about $1\frac{3}{5} \times 120$?

Can you explain why this works?

If $2\frac{3}{5} \times 100 = 260$, what do you think $2\frac{3}{5} \times 105$ equals? Check it out.

2.7 Letter memories



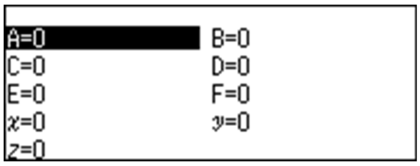
Look at the nine keys on the bottom-left of the keyboard. Above-left of each key you will see a blue letter.

Each letter, A, B, C, D, E, F, *x*, *y* and *z*, can take the place of a previously stored numerical value in a calculation.

From the HOME (⌂) screen, launch the Calculate application, by pressing 1.

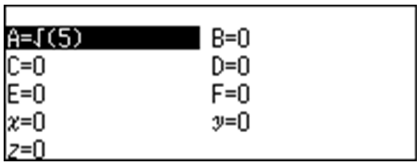
Press (VARIABLE).

You can see the factory state is that the stored value for each letter is 0. Note A = 0 is selected.



Press √■ 5, to prepare to store $\sqrt{5}$ as the value of A.

Press EXE to store the value and return to the memory list.

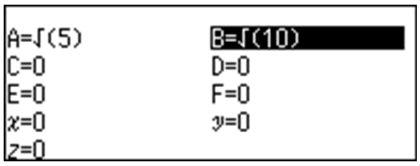


To store $\sqrt{10}$ as the value of B, press:

>

√■ 1 0

EXE



To calculate A×B, press:

AC

⇧ 4

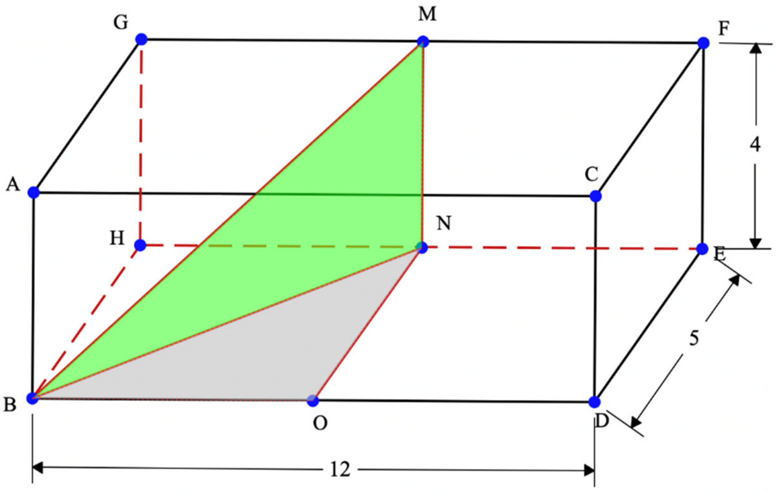
×

⇧ 5

EXE

In the rectangular prism below, M is the midpoint of GF, N is the midpoint of HE and O is the midpoint of BD. Dimensions are measured in metres.

What is the difference between the size of angle NBO and the size of angle MBN?
Provide your answer correct to 4 decimal places.



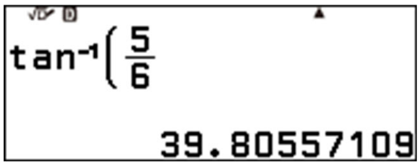
Angle BON and angle BNM are right angles, so both the grey triangle and the green triangle are right-angled triangles. Therefore, we can use trigonometric ratios and Pythagoras' Theorem to answer this question.

We should not use rounded interim values to calculate the difference that is required. Otherwise, a *rounding error* may occur. We can use the memories to help us be accurate.

To find the size of angle NBO press:

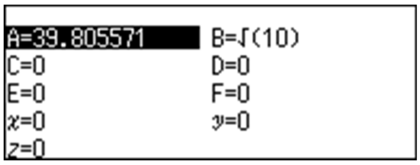
⬆ tan 5 [fraction] 6 EXE

Note: If brackets are not mathematically required, they can be left out.



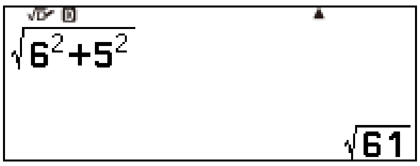
To store this value as A press:

[STO] Ans EXE



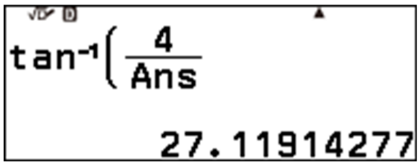
To find the length of BN, press:

AC √ 6 x² + 5 x² EXE



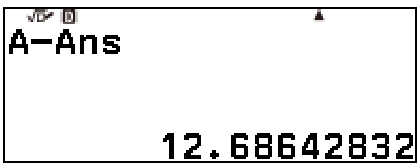
To find the size of angle MBN press:

⬆ tan 4 [fraction] Ans EXE



To calculate the difference between the angles press:

⬆ 4 − Ans EXE



So, the answer required is 12.6864°.

3.1 Powers

What is a power of 5?

125 is a power of 5. It is actually the 3rd power of 5 because $5 \times 5 \times 5 = 125$ or 5^3 (pronounced '5 to the 3') = 125.

When we write $5^3 = 125$, the number 5 is called the *base* and 3 is called the *exponent* (also known as a logarithm).

$2^6 = 64$. So, we say 64 is the 6th power of 2.

Calculate the following:

a) the 8th power of 3 c) 4^6 e) 7^7

b) the 4th power of 9 d) 16^3 f) 7×49^3

From the screen, launch the Calculate application.

3 $\blacksquare^{\square}$ 8 EXE

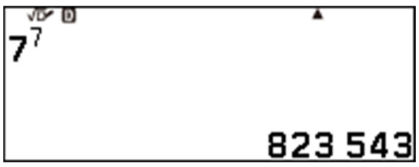
9 $\blacksquare^{\square}$ 4 EXE

What? $3^8 = 9^4$; how can that be?

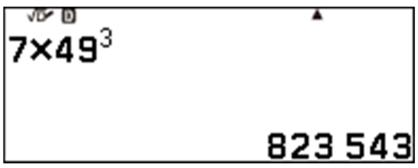
4 $\blacksquare^{\square}$ 6 EXE

1 6 $\blacksquare^{\square}$ 3 EXE

What? $4^6 = 16^3$; how can that be?



7 $\blacksquare^{\square}$ 7 EXE



7 × 4 9 $\blacksquare^{\square}$ 3 EXE

What? $7^7 = 7 \times 49^3$; how can that be?

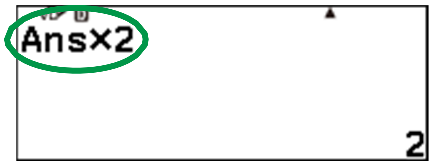
Is $2^{20} = 4 \times 8^6$? If so, try to work out why.

A famous tale tells that the inventor of Chess made his king so happy he was offered a prize of his naming for the work he had done. He asked for 1 grain of wheat for the first square of the board and then double that for the second and double that for the third and …
Let's calculate the amount for each square.

Start by entering 1 and pressing EXE.
This stores 1 in the *answer memory.*

Now press × 2 EXE.

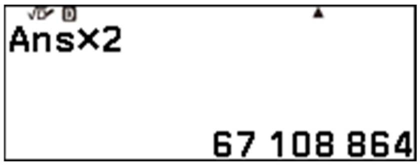
Note the input reads: answer multiplied by 2.



Now press EXE.
You can see we now have a recursive process going.

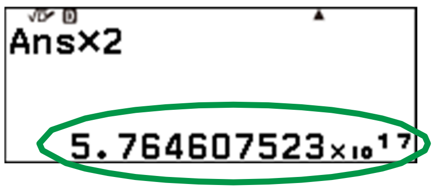
Press EXE, EXE, EXE, …

I have pressed it quite a few times in the screen opposite.

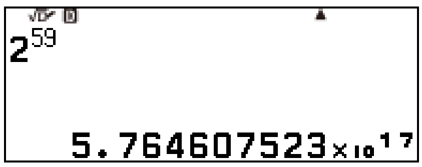


If you forget how many presses you have made, you can press ∧ to go backwards and then use ∨ to go forwards.

The screen opposite shows how many grains I think he got for the 60th square; do you agree?
Note that $5.764607523 \times 10^{17}$ means 5764607523???????? (the ?s are unknown digits).
The decimal point is moved 17 places to the right.
This calculator can display no more than 10 digits.



Another way to calculate this would be to find 2^{59}.
Enter 2 $\blacksquare^{\square}$ 5 9 EXE.



How many wheat grains in total would he have had? See if you can find out how to work that out.
(There are 64 squares on a chess board.)

3.2 Square roots and other roots

I bet you have heard of a square root, e.g. $\sqrt{64} = 8$.

The square root of a number k, is the positive number j, which when multiplied by itself, gives the number k. If j is an integer, then k is called a *perfect square*.

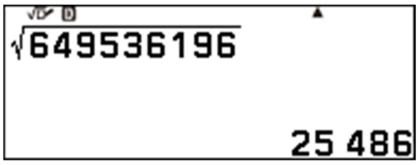
If $k = 25$, then $j = 5$. But if $k = 26$, what will j equal?

As well as square roots there are cubed roots, 4$^{\text{th}}$ roots, 5$^{\text{th}}$ roots, ……., n^{th} roots.

Calculate the value of each of the following:

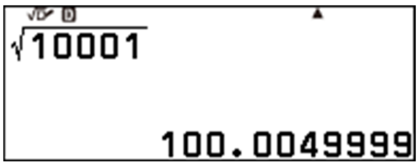
a) $\sqrt{649536196}$	c) $\sqrt{18}$	e) $\sqrt{64 \times 10001}$
b) $\sqrt{10001}$	d) $\sqrt{100 \times 31}$	f) $\sqrt[3]{64}$

From the ⌂ screen, launch the Calculate application.



√■
6 4 9 5 3 6 1 9 6
EXE

So, 649536196 is a perfect square.
I bet you did not know that!

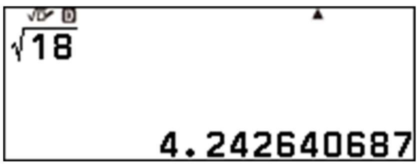


√■
1 0 0 0 1
EXE

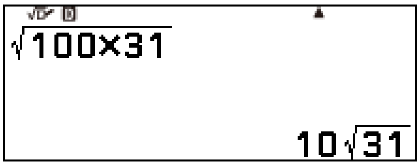
So close to a perfect square, but not close enough.
Numbers like $\sqrt{10001}$ are called *surds*.

√■
1 8
EXE

The surd, $\sqrt{18}$, has been simplified.
If k has a perfect square factor, 9 in this case, the surd can be simplified.



To calculate the decimal approximation of $\sqrt{18}$, press FORMAT.

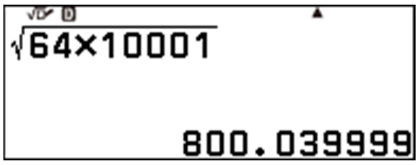


√■

1 0 0 × 3 1

EXE

So $\sqrt{3100} = 10\sqrt{31}$.



√■

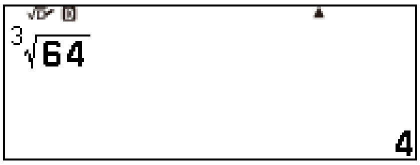
6 4 × 1 0 0 0 1

EXE

The calculator cannot simplify all surds that can be simplified.

$\sqrt{640064} = 8\sqrt{10001}$, but the calculator does not know this, and so returns a decimal approximation.

If k is too large, a decimal approximation will be returned. How large is too large?
See if you can find out.



⇧ √■ – to enter ($\sqrt[\blacksquare]{\square}$)

3

>

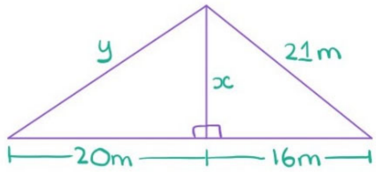
6 4

EXE

64 is not only a perfect square, but a perfect cube as well. Is it a perfect *anything else?*

3.3 Square roots – Pythagoras

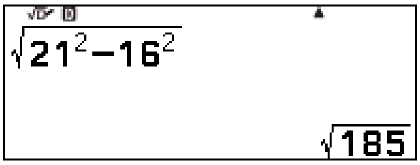
Suppose we need to determine the lengths of the currently unknown sides in the construction shown below. We could begin as follows:



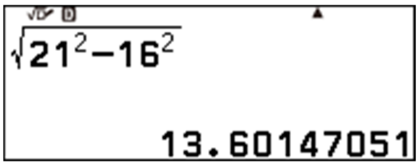
$$c^2 = a^2 + b^2$$
$$\Rightarrow 21^2 = 16^2 + x^2$$
$$\Rightarrow x = \sqrt{21^2 - 16^2}$$
$$y^2 = 20^2 + x^2$$
$$\Rightarrow y = \sqrt{20^2 + x^2}$$

To determine the values of x and y, we can do the following.

From the ⌂ screen, launch the Calculate application.

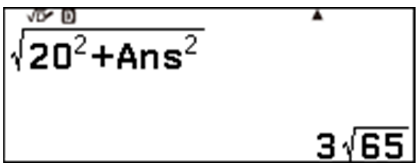


√■
2 1 ■²
−
1 6 ■²
EXE

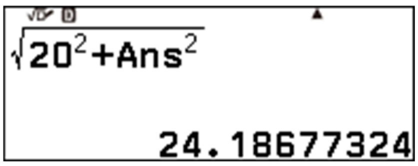


We can also calculate a decimal approximation for x.
Press FORMAT.

The output is stored in the answer memory and so we can use it to calculate the value of y.



√■
2 0 ■²
+
Ans ■²
EXE



To calculate a decimal approximation for y, press FORMAT.

So, we know that $x = \sqrt{185}$ m $\approx$ 13.6 m and that $y = 3\sqrt{65}$ m $\approx$ 24.2 m (correct to 1 decimal place).

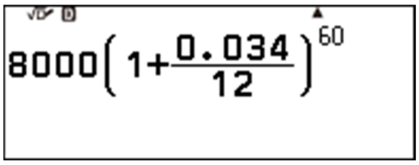
3.4 A financial calculation

Suppose we wish to calculate the value of an investment of $8000, five years after investing it in an account that pays interest of 3.4% p.a. compounded monthly. We can use the formula:

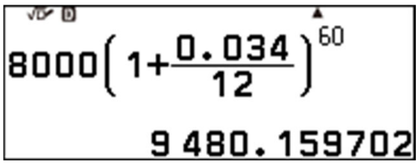
$$A = P\left(1 + \frac{r}{100}\right)^n$$

Calculate $8000\left(1 + \frac{0.034}{12}\right)^{60}$ on your calculator.

From the screen, launch the Calculate application.



8 0 0 0
(1 +
0 . 0 3 4 1 2 >)
6 0



EXE

It is possible to set the calculator to display the result correct to two decimal places.

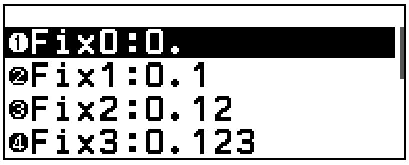
This can be done in the SETTINGS menu.

Press

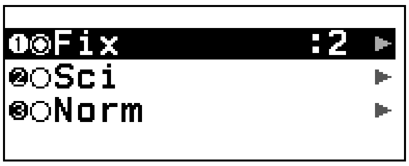
1 or OK to open 1Calc Settings

3 to open 3Number Format

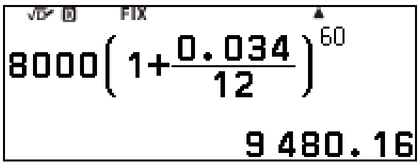
1 or OK to open 1○Fix



3 to choose two-decimal place accuracy.



AC and then EXE to re-calculate the result.



Note: Now set your calculator to Norm 2.
You can learn more about the Norm display setting in Section 2.2.

3.5 Logarithms

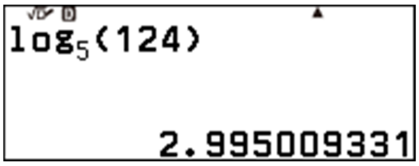
In Section 3.1 we looked at powers.
For example, since $64 = 2^6$, we say that 64 is the 6^{th} power of 2.

Do you recall the name given to the number 6, in the equality $64 = 2^6$?
It is called a *logarithm*. (It is also called an index or an exponent.)

Consider the equation $5^x = 124$. What is the value of x?
x is the value to which 5 is raised to get 124.
You probably know $x \approx 3$. Actually, a little less than 3.

To be precise $x = \log_5(124)$, the decimal approximation of which can be calculated as follows.

From the ⌂ screen, launch the Calculate application.



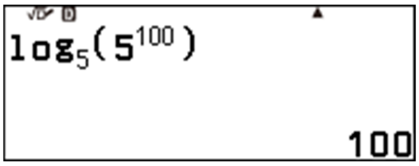
log□ 5 > 1 2 4 EXE

Just under 3, as expected.

Predict the value of each of the following and then calculate them to determine the quality of your predictions.

a) $\log_4(64)$ b) $\log_3(82)$ c) $\log_2(256)$ d) $\log_8(1)$

What is the value of $\log_5(5^{100})$?



log□ 5 > 5 ■□ 1 0 0 EXE

What is going on here?
Can you explain why $\log_5(5^{100}) = 100$?

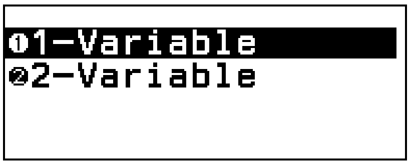
What do you think $\log_a(a^b)$ is equal too?

One last thing before we finish. What do you think $\log_6\left(\frac{1}{36}\right)$ is equal to?

4.1 Things to know

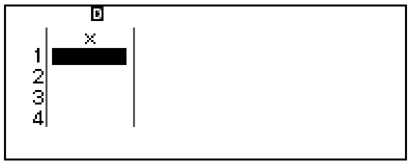
When working with data, you need to use the Statistics application.
It is also suggested that you set it to display the Frequency of each score.

From the screen, launch the Statistics application, by pressing (2).



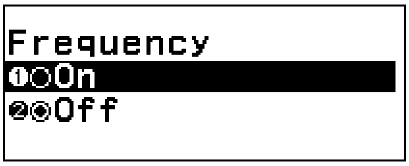
In this application, you can work with univariate (1-Variable) or bivariate data (2-Variable).

For this task, press (1) to choose 1-Variable and open the data list.

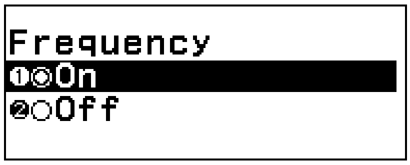


Note: If a Frequency column is showing on your calculator, you do not need to proceed.

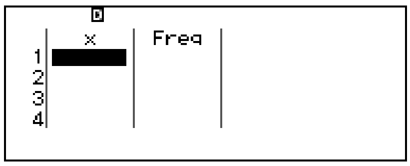
To display the Frequency column, press (⋯) (2) to open 2 Frequency ▶



Press (1) to turn the Frequency setting on.



Now press (AC) to return to the data lists.



How many rows of data can be entered?

This is dependant on the number of columns displayed in the Statstics editor.
One column (single variable, x) = 160 rows.
Two columns (single variable, x + Freq) or (paired variable data x, y) = 80 rows.
Three columns (paired variable data x, y + Freq) = 53 rows.

4.2 Entering, editing and deleting data

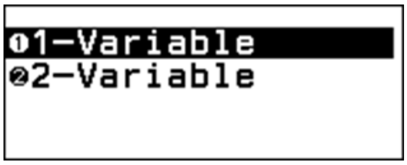
Before doing this section, be sure you have carried out the directions in the previous section.

Below are the weights (in grams) of the last 10 tomatoes I picked.

54, 68, 45, 55, 64, 80, 52, 63, 72, 71.

Enter these data into the Statistics application of your calculator.

From the ⌂ screen, launch the Statistics application.

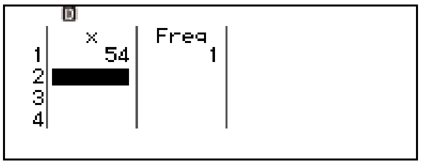


Press ① to choose 1-Variable and open the data list.

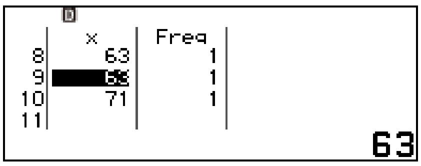
Note 1:
You may be asked if you wish to clear data. This will happen if you have data in the 2-Variable section.
You must choose Yes
if you want to proceed.
Note 2:
If data already exists in the lists, delete it – see the instructions on the bottom of page 29.
Note 3:
See Section 4.1 if you do not have a Freq(uency) column.

You are now ready to enter the data.
⑤ ④
EXE

Pressing EXE 'enters' 54 with a frequency of 1 (meaning it appears just once in our data).



Enter the rest of the data.
If you make an error, as I have with data point 9, simply *scroll* to it, type it again and press EXE .



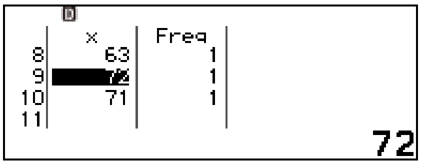
You can delete a row by selecting it and pressing ⌫ .

A row can be inserted in the place of the row selected.

Select row 9 and then press:

① to open **1Edit ▸**

① to choose **1Insert Row**

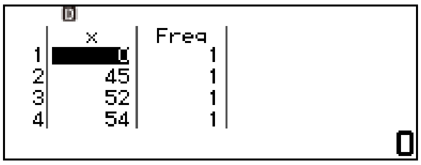


Data can also be sorted in ascending or descending order, by the variable or frequency column.

Press:

③ to open **3Sort ▸**

① to choose **1x Ascending**



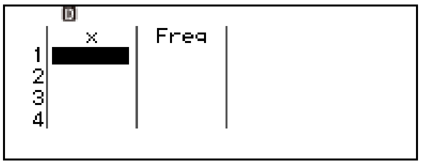
The data will then be displayed in the ascending order.

Note: Once the data has been sorted, it cannot be returned to the order in which it was entered.

To clear/delete all the data previously entered, press:

① to open **1Edit ▸**

② to choose **2Delete All**



4.3 Five number summary

Before doing this section, be sure you have carried out the directions in the two previous sections.

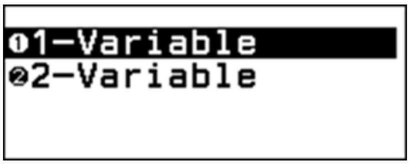
I set my toaster to the 'number 1' setting and then measured how long it took to *pop*. I did this 16 times, letting it cool down in between measurements. The measurements (in seconds) are given below.

94, 96, 96, 96, 98, 98, 99, 99, 96, 97, 127, 96, 99, 96, 99, 96.

Find the five number summary for these data (minimum value, 1st quartile, median, 3rd quartile and maximum value).

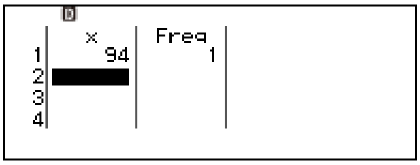
From the ⌂ screen, launch the 

application.



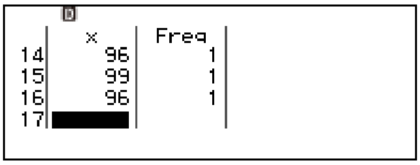
For this example, we have a *single* variable, time, press (1) to choose 1-Variable and open the data list.

You are now ready to enter the data.
(9) (4)
(EXE)
…



Enter all 16 data points.

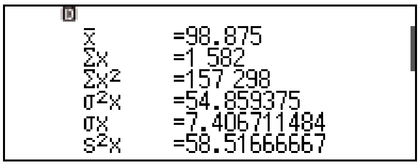
Note: I am choosing to enter every data point as an individual and so the frequency of each will be one, even though some values (like 96) occur seven times.



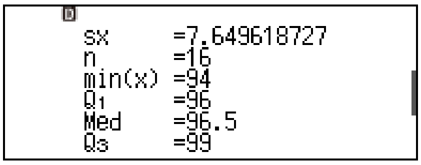
Check all the data is correct by scrolling up and down (⋀, ⋁). Edit if required.

Press (OK) when data entry is complete.

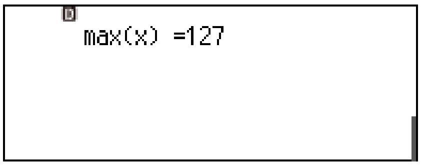
To display the summary statistics, press (1) to choose 1-Var Results.



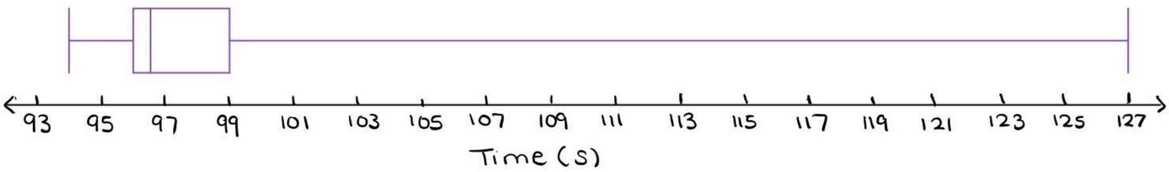
The results for the five number summary (min(x), Q1, Med, Q3, max(x)) will appear over three screens.



Use the (∧), (∨) to move between them.



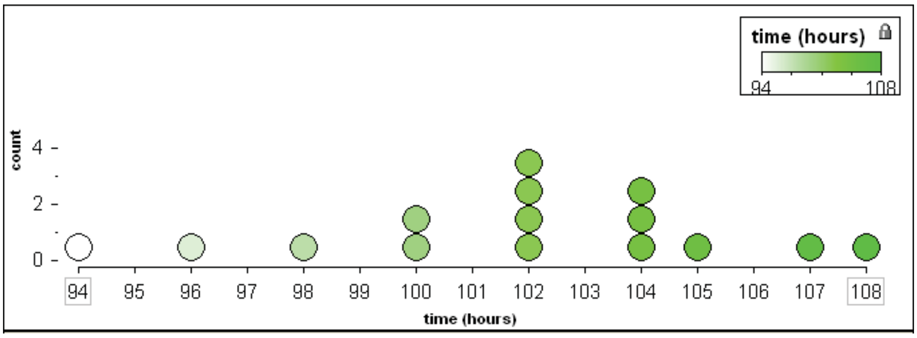
From these statistics a boxplot can be drawn, by hand.



4.4 Mean and standard deviation

Before doing this section, be sure you have carried out the direction in sections 4.1 and 4.2.

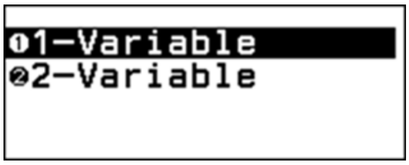
A candle shop makes a certain type of candle called *large-scented*. Each candle is to have a label displaying how long the candle is expected to burn. To determine the expected time, a sample of 15 candles are burned and the number of hours that each burned for (rounded to the nearest hour) is recorded. The data is given below in the form of a dot plot.



Calculate the sample mean ($\bar{x}$) and the sample standard deviation (s).

From the ⌂ screen, launch the 

application.



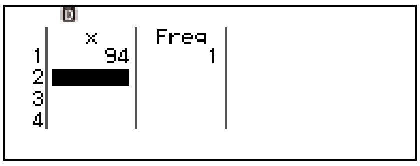
For this example, we have a *single* variable, time, press (1) to choose 1-Variable and open the data list.

You are now ready to enter the data.

(9) (4)

(EXE)

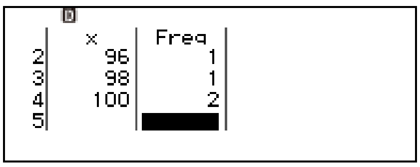
…



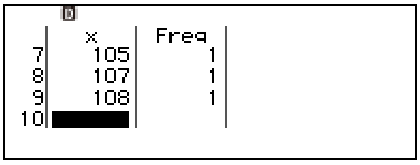
Enter all nine scores from the dotplot *and change the frequency value as required.*

For example, we have two scores of 100 and so after entering 100 press:

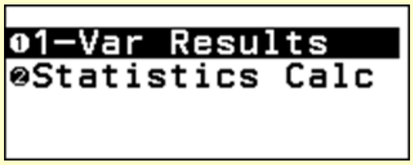
(>) (^) (2) (EXE).



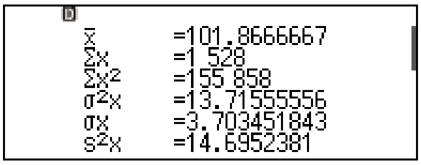
Check all the data is correct by scrolling up and down (⋀, ⋁). Edit if required.



Press OK when data entry is complete.

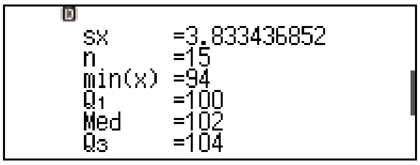


To display the summary statistics, press 1 to choose 1-Var Results.



The results for the mean (x̄) and standard deviation (sx) will appear over two screens.

Use the ⋀ and ⋁ to move between them.



4.5 Linear Regression

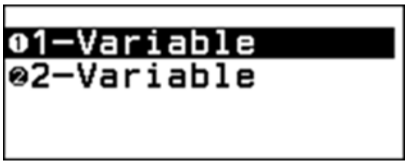
In 1948 General Motors Holden (GMH) made the first Holden, while continuing to also assemble other makes of cars. From this time onwards, GMH decreased the assembly of non-Holden cars, as the production of Holden cars increased.

The table below shows the number of non-Holden cars (N thousands) assembled in each year from 1948 to 1959. In the table, year 1 represents 1948.

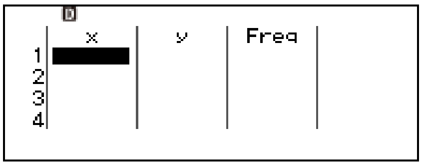
Year	1	2	3	4	5	6	7	8	9	10	11	12
N	25.2	22.2	23.9	20.3	15.4	14.4	19.3	20.6	15.1	10.9	13.8	13.2

a) Find the slope of the least squares regression line.
b) Use the equation to predict how many non-Holden cars would have been made, if the trend seen above continued, in 1974.

From the ⌂ screen, launch the Statistics application.

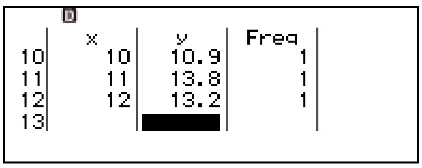


Press ② to open the data lists.



Note 1:
You may be asked if you wish to clear data. This will happen if you have data in the 2-Variable section.
You must choose Yes
if you want to proceed.
Note 2:
If data already exists in the lists, delete it – see Section 4.2.
Note 3:
See Section 4.1 if your calculator does not have a Freq(uency) column displayed.

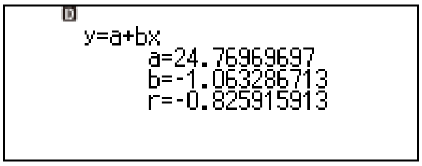
Enter the data.



Once entered and checked, press OK.

To find the slope and y-intercept of the least squares regression line, press:

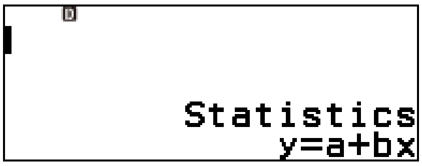
② to open **2 Reg Results ▶**
① to choose **1 y=a+bx**



Therefore, the equation of the least squares line is $N \approx -1.06 \times year + 24.77$

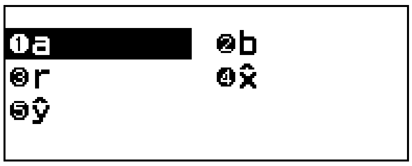
To prepare to do a statistical calculation using the slope and y-intercept, press:

⮌ to return to the data lists,
OK ③ to open **3 Statistics Calc ▶**
① to choose **1 y=a+bx**
to open the statistics calculation screen.



To calculate the predicted number of non-holdens made in 1974, the values of a and b can be found in the CATALOG.

Press:
CATALOG ① to open **1 Statistics ▶**
④ to open **4 Regression ▶**
to access a and b.

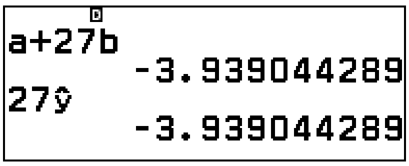


Enter a + 27 x b and press OK.

Note: To enter b, repeat the steps above.

Alternatively, the $\hat{y}$ shortcut can be used.

Oh, a negative number of cars.
I guess the trend did not continue!



Note: $\hat{y}$: Function for determining the y estimated value for an input x-value. For the argument, input the value of x immediately before this function.

4.6 Random numbers

From the ⌂ screen, launch the Calculate application.

Check that your calculator is set to MathI/DecimalO. See Section 2.1.

Press:

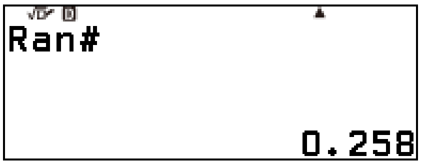
(📖) (2) to open ②Probability ▶

(5) to choose ⑤Random Number

(OK)

This function produces pseudo-random numbers between 0 and 1 (with three decimal places).

Press (OK) a few more times to see more of them.



(1) (0) (0) (0) (×)

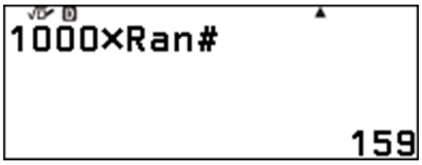
(📖) (2) to open ②Probability ▶

(5) to choose ⑤Random Number

(OK)

A pseudo-random number between 0 and 1000 is produced.

Press (OK) a few more times to see more of them.



To produce pseudo-random numbers between 1 and 6 inclusive.

Press:

(📖) (2) to open ②Probability ▶

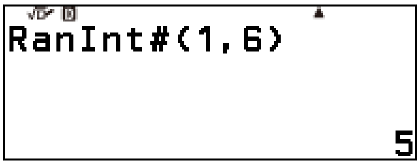
(6) to choose ⑥Random Integer

(1)

(⇧) ( )) – to enter (,)

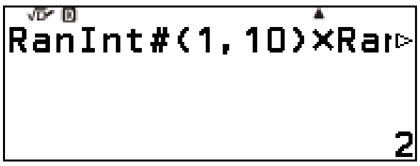
(6) ( ))

(EXE)



On the screen right, we are calculating the *product* of two pseudo-random numbers between 1 and 10 inclusive.

If we pressed (EXE) 1000 times, will square numbers be common or uncommon? Why?



5.1 Degrees, minutes and seconds

Set your calculator to MathI/MathO. See Section 2.1.

One revolution can be broken up into 360 equal turns, each called 1 degree (1°).
What does a 90° angle look like?
What does a 1° angle look like?
What if the angle is less than 1°?

One degree can be broken up into 60 equal turns (small ones), each called 1 minute (1′).

One minute can be broken up into 60 equal turns (very small ones), each called 1 second (1″).

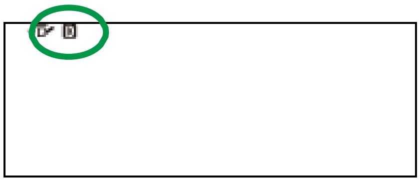
So, 42.5° would be the same as 42° 30′ 0″ and 42.125° ($42\frac{1}{8}$°) would be the same as 42° 7′ 30″ (as 60 ÷ 8 = 7.5) – phew!

Convert each of the following into degrees, minutes and seconds.

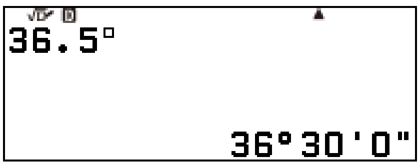
a) 36.5° b) 36.6° c) 36.25°

From the (⌂) screen, launch the Calculate application.

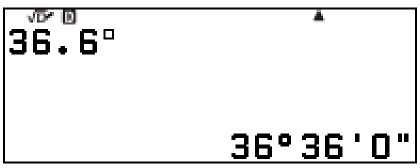
Before starting we need to be sure that the calculator is set to work in degrees. If you can see a small D at top of screen, then it is. If not, do the following:



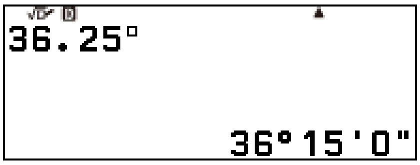
Press (☰)
(1) or (OK) to open 1 Calc Settings ▶
(2) to open 2 Angle Unit ▶
(1) to choose the angle setting to be Degree
(AC)



(3) (6) (.) (5)
(⇧) then (+) (to enter (°′″))
(EXE)



(3) (6) (.) (6)
(⇧) then (+) (°′″)
(EXE)



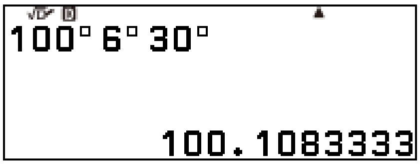
3 6 . 2 5
⇧ then + (°′″)
EXE

Consider the reverse process, converting an angle represented in degrees, minutes and seconds to decimal form (or even fractional form).

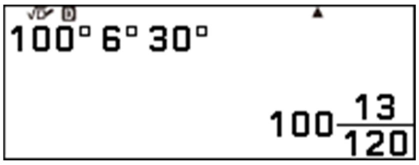
What would 100° 6′ 30″ be in decimal form?

Convert each of the following decimal form.

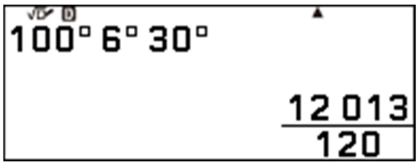
a) 100° 6′ 30″ b) 34° 20′ 20″ c) 51° 28′ 38″



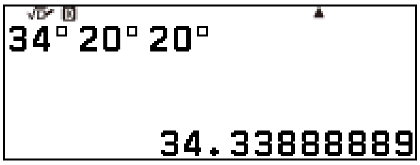
1 0 0
⇧ then + (°′″)
6
⇧ then + (°′″)
3 0
⇧ then + (°′″)
⇧ then EXE (≈)



To see the mixed number press:
⇧ FORMAT (⟳)
5 to choose 5:Mixed Number

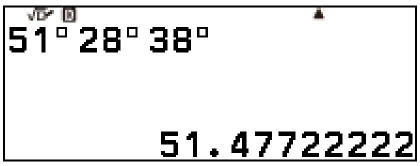


To see the fractional form press:
⇧ FORMAT (⟳)
4 to choose 4:Improper Fracti…



3 4 ⇧ + (°′″)
2 0 ⇧ + (°′″)
2 0 ⇧ + (°′″)
⇧ then EXE (≈) (or EXE FORMAT FORMAT)

Did you predict that? It is $34 + \frac{20}{60} + \frac{20}{3600}$. Check it.

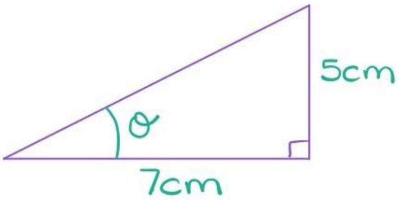


The angle given in part c) is the longitude measure of Greenwich. Why is Greenwich important?

5.2 Trigonometric calculations

Set your calculator to MathI/MathO. See Section 2.1.

Suppose you are required to find the size of the angles (expressed in degrees minutes and seconds) in a right-angled triangle with perpendicular legs of length 5 cm and 7 cm. We could begin as follows:

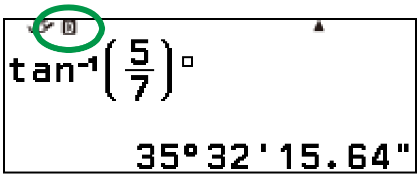


$$\tan(\theta) = \frac{5}{7}$$

$$\theta = \tan^{-1}\left(\frac{5}{7}\right)$$

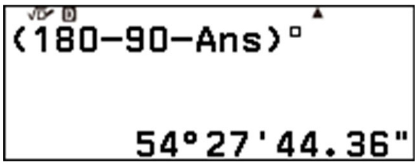
$$\theta = \ldots$$

To calculate the value of θ:



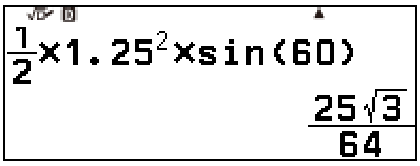
First ensure the calculator is set in Degrees.
If it is not, then press:
[MENU/SETUP] (1) to open ①Calc Settings ▶
(2) to open ②Angle Unit ▶
(1) to choose Degree
(AC)

Then:
(SHIFT) (tan) (to enter (tan⁻¹))
(5) (fraction) (7) (▷) ( ))
(SHIFT) then (+) (to enter (°′″))
(EXE)

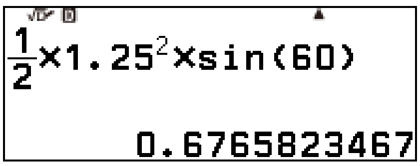


To calculate the other unknown angle:
(( ) (1) (8) (0) (−) (9) (0) (−) (Ans) ( ))
(SHIFT) then (+) (to enter (°′″))
(EXE)

What is the area of an equilateral triangle with side length 1.25 cm?

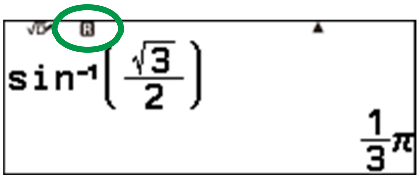


(1) (fraction) (2) (▷)
(×) (1) (.) (2) (5) (x²)
(×) (sin) (6) (0) ( ))
(EXE)



To see the decimal approximation for $\frac{25\sqrt{3}}{64}$ cm^2, press (FORMAT).

Solve the equation $\sin(3x) = \frac{\sqrt{3}}{2}$ for $0^c < x < \pi^c$



First ensure the calculator is set in Radians.
If it is not, then press:

≡ 1 to open ①Calc Settings ▶
2 to open ②Angle Unit ▶
2 to choose Radian
AC

Then:

⇧ sin (to enter (sin⁻¹))
▭ √▭ 3 ∨ 2 >)
EXE

So,

$$3x = \frac{\pi}{3} \pm 2k\pi \text{ or } 3x = \frac{2\pi}{3} \pm 2k\pi$$

Therefore,

$$x = \frac{\pi}{9} \pm \frac{2k\pi}{3} \text{ or } x = \frac{2\pi}{9} \pm \frac{2k\pi}{3}$$

To find specific solutions, we can add or subtract multiples of $\frac{2\pi}{3}$.

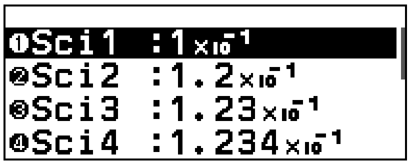
⇧ 7 (to enter (π)) ▭ 9 >
\+ 2 ⇧ 7 (to enter (π)) ▭ 3
EXE

Convince yourself that $\sin(3x) = \frac{\sqrt{3}}{2}$ for $0^c < x < \pi^c$, has exactly four solutions.

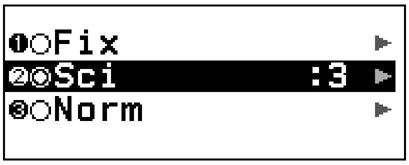
5.3 Scientific notation and ENG notation

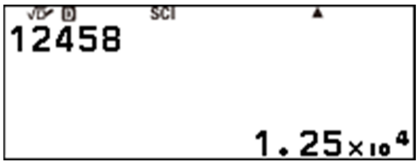
Numbers can be expressed in scientific notation, correct to 3 significant figures, by setting the calculator to display values in that way.

Press (MENU)
(1) to open 1:Calc Settings ▶
(3) to open 3:Number Format ▶
(2) to open 2:○Sci ▶



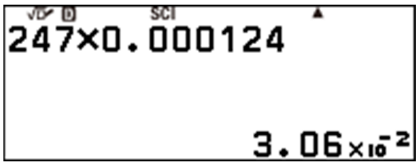
(3) to choose three significant figures.



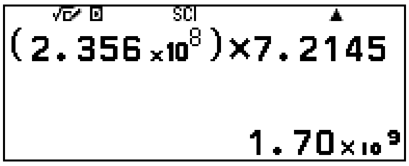


(AC) to return to the calculation screen.

(1) (2) (4) (5) (8)
(EXE)

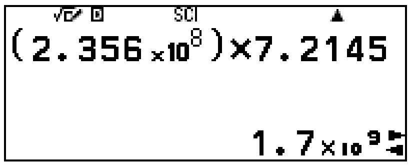


Enter this example.
(2) (4) (7) (×) (0) (.) (0) (0) (0) (1) (2) (4)
(EXE)

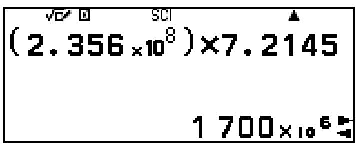


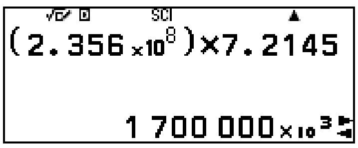
Then this example.
(2) (.) (3) (5) (6) (×10ˣ) (8) (>)
(×)
(7) (.) (2) (1) (4) (5)
(EXE)

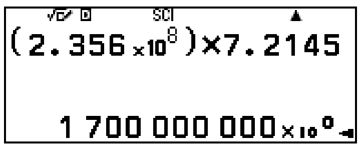
With the previous calculation active, press
(SHIFT) (FORMAT) (↻)
(4) to choose 4:ENG Notation



Press (>) three times.







What does it do?
Press (<) to go backwards.
Press (AC) to cancel ENG notation mode.

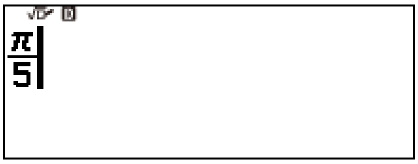
Now set your calculator back to Norm 2.

5.4 Radians to degrees

To convert an angle in radians to degrees, set the calculator to compute in degrees.

(≡) (1) to open **1Calc Settings ▶**
(2) to open **2Angle Unit ▶**
(1) or (OK) to choose the angle setting to be Degree.

Convert $\frac{\pi^c}{5}$ to degrees.



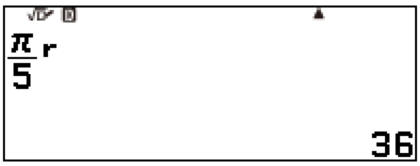
(AC) to return to the calculation screen.

(⇧) (7) (π)

(▭)

(5) (>)

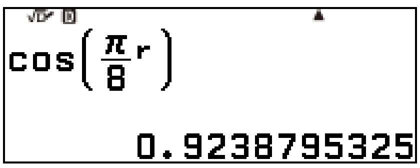
(📖) (4) to open **4Angle/Coord/Se⋯▶**
(2) to choose **2Radians**
and insert the radian symbol (^{r}).



(OK) to see the angle in degrees.

The **4Angle/Coord/Se⋯▶** menu options can be useful when used in an input, as they over-ride the angle unit setting of the calculator.

For example, suppose we want to calculate cos $\left(\frac{\pi^c}{8}\right)$. We can do this without having to change the calculator's angle setting to radians by inserting the 'r' immediately after the $\frac{\pi}{8}$, as shown below.



Note: Both ^{c} and ^{r} can be used to denote radians, as can rad.

6.1 Lowest common multiple (LCM)

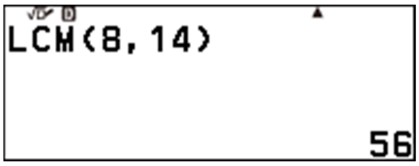
Both the hot water tap and cold water tap in my sink are leaking; drip, drip, drip, drip, drip, drip, drip, drip,… and so on.
Every now and again I hear what sounds like a single big DRIP.
I figured out that the hot water tap drips every 8 seconds and the cold water every 14 seconds. How often do I hear the single big drip (I.e., when are they in sync)?

We could make two lists:
hot: 8, 16, 24, 32, 40, 48, **56**, …
cold: 14, 28, 42, **56**, 70, …

So, if the taps started dripping in unison I would hear the single big drip after 56 seconds and every 56 seconds after that, with 9 drips in between DRIPs.

56 is called the lowest common multiple (LCM) of 8 and 14.
The calculator is able to calculate the LCM of two integers.

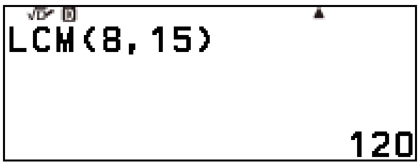
Find the LCM of 8 and 14.



3 to open ③Numeric Calc ▶
2 to choose ②LCM
8
) (,)
1 4)
EXE

The calculator agrees with my table!

Find the LCM of 8 and 15.



< <
5
EXE

Note that $8 \times 15 = 120$. However $8 \times 14 \neq 56$. Try to explain this observation.

What must be true for the LCM of two integers, a and b, to be equal to the product ab?

6.2 Greatest common divisor (GCD)

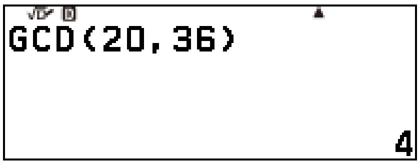
Consider the numbers 20 and 36.
20 can be found in the 1-times table, 2-times table, 4-times table, 5-times table, 10-times table and of course the 20-times table. Another way of saying this is that 20 is divisible by 1, 20 is divisible by 2, …
Divisible means divides with no remainder.

36 is divisible by 1, 2, 3, …

What is the largest number that will divide into, 20 and 36, with no remainder? This number is called the *greatest common divisor*, or GCD, of 20 and 36.

We can make two lists and compare:
20 is divisible by 1, 2, **4**, 5, 10 and 20.
36 is divisible by 1, 2, 3, **4**, 6, 9, 12, 18 and 36.
So 4 is the GCD of 20 and 36. Does the calculator agree?

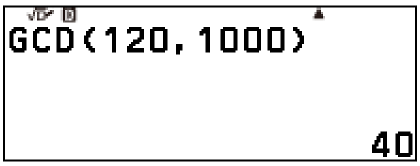
Find the GCD of 20 and 36.



(📖) (3) to open 3:Numeric Calc ▶
(1) to choose 1:GCD
(2) (0)
(SHIFT) ()) (,)
(3) (6) ())
(EXE)

We have agreement!

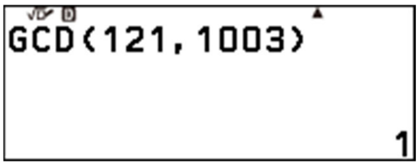
Suppose we have a single rectangular block of land 120 m wide and 1000 m long and we want to divide it into identical square blocks. If the squares have integer dimensions, what is the size of the largest squares that can be used?



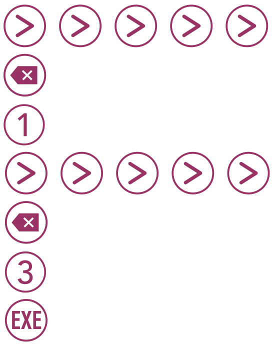
(📖) (3) to open 3:Numeric Calc ▶
(1) to choose 1:GCD
(1) (2) (0)
(SHIFT) ()) (,)
(1) (0) (0) (0) ())
(EXE)

So a square 40 m by 40 m is the largest that can be used.

What is the GCD of 121 and 1003?



Edit the previous calculation as follows:

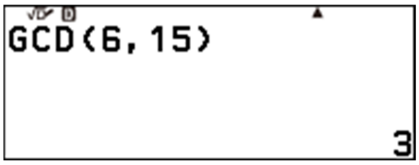


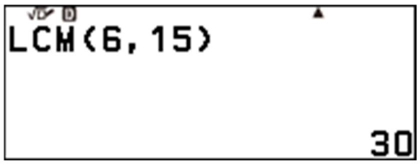
1!
So, there is no integer apart from 1 that will divide, with no remainder, 121 and 1003.

Such pairs of numbers are called co-prime, or relatively prime.

Does that mean 1003 is prime? 121 is clearly not as $11 \times 11 = 121$.

Find the product of the GCD and LCM of 6 and 15.





So $\mathrm{GCD}(6, 15) \times \mathrm{LCM}(6, 15) = 90$.

Note also that $6 \times 15 = 90$.

Coincidence? Try some more cases.

If you cannot find a counter example, try to reason why:

$$\mathrm{GCD}(a, b) \times \mathrm{LCM}(a, b) = ab, \text{ where } a, b \in Z^{+}.$$

6.3 Prime factorisation

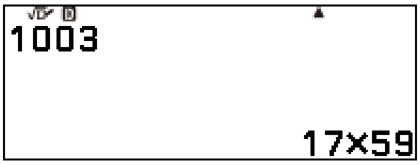
Is 1003 prime?

To find out we could start checking to see if the integers between 1 and $\sqrt{1003}$ divide 1003 with no remainder.

Clearly we can ignore all the even numbers, and since the digit sum is 4 then 3 will not work, nor 5, how about 7, …

The calculator is able to very efficiently perform a process similar to that started above and return the number written as a product of its prime factors.

Prime factorise 1003.

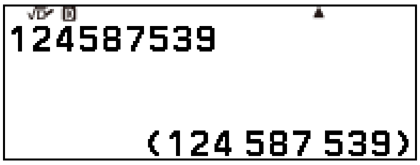


1 0 0 3
EXE
SHIFT FORMAT (↻)
3 to choose ⊗Prime Factor

So 1003 is not prime, it is divisible by 17 and 59 (as well as 1 and 1003).

Try and find the biggest prime you can in 60 seconds.

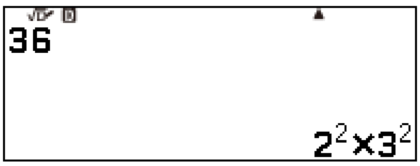
See if you can find one bigger than me:



36 has 9 divisors (or factors): 1, 2, 3, 4, 6, 9, 12, 18 and 36.

How can you determine this fact from its prime factorisation?

Below you can see the prime factorisation of 36 – I will leave it to you to think about. Try some other examples.

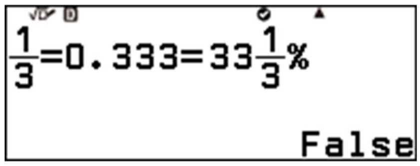


6.4 Verifying equality

Verify mode allows you to check whether or not different numerical forms, or algebraic expressions, are equal.

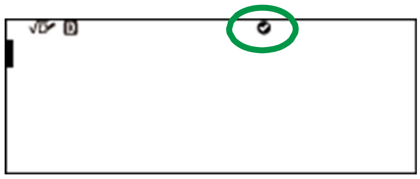
It is a useful mode for testing out your knowledge of various mathematical ideas/processes.

One ‘fraction’ example is shown right.



To enable Verify mode, press:
(⋯) (2) to choose ②Verify ON
and return to the calculation screen.

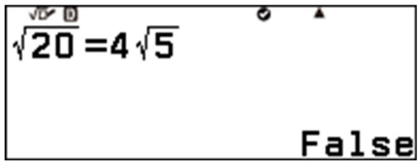
You will notice the ✔ at the top of the screen.
This indicates that Verify is on.
When Verify is on, you cannot calculate in a typical manner, you are locked out of that.



The number $4\sqrt{5}$ can be written in many different forms.
What is $4\sqrt{5}$ when written in the form $\sqrt{k}$ where k is a whole number?

I think it is $\sqrt{20}$; is that true? Let’s verify.

(√■) (2) (0) (>)
(⇧) (() (=)
(4) (√■) (5)
(EXE)

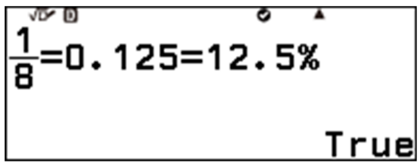


False!
See if you can figure out the correct answer and get the calculator to return True.
Try some more examples.

Can you write down the correct decimal form and percentage form of $\frac{1}{8}$?

I think $\frac{1}{8} = 0.125 = 12.5\%$; is that true? Let’s verify.

(1) (■/□) (8) (>)
(⇧) (() (=)
(0) (.) (1) (2) (5)
(⇧) (() (=)
(1) (2) (.) (5)
(📖) (3) to open ③Probability ▶
(1) or (OK) to enter ①%
(EXE)

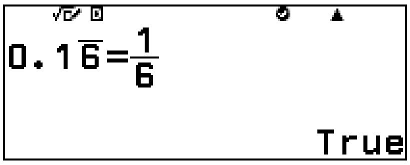


Success!

Is $0.1\overline{6} = \frac{1}{6}$?

To enter a number in recurring decimal form, like $0.1\overline{6}$, and verify whether it is $\frac{1}{6}$, press:

(0) (.) (1)
(4) to choose **4Numeric Calc ▸**
(4) to choose **4Recurring Decim…**
(6) (>)
(⇧) (( ) (=)
(1) (▭) (6)
(EXE)

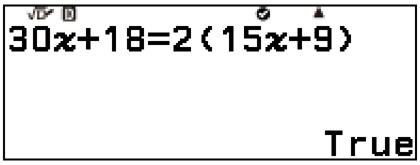


Try some more fraction/decimal form/percentage form examples.

Can you write down a factorised form of $30x + 18$?
Check your answer using Verify mode.

I think that $30x + 18 = 2(15x + 9)$; is that true? Let's verify.

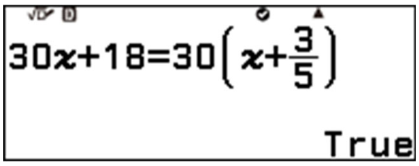
(3) (0) (x) (+) (1) (8)
(⇧) (( ) (=)
(2) (( ) (1) (5) (x) (+) (9) ( ))
(EXE)



Success!
However, now that I think about it a little more, I do not think $2(15x + 9)$ is *fully* factorised.

Try to find a different expression that is also a factored form of $30x + 18$, try for the *fully* factorised form.

There are many factorised forms of $30x + 18$, but only one that is *fully* factorised.
The one shown to the right is **not** considered *fully* factorised. 😊



When the calculator verifies the truth of an algebraic expression, it is only verifying it for one numerical value of x. The value of x in its memory.
To see that value, and change it, press the VARIABLE key, (⇄x).

It is wise to think carefully about the value(s) of x you choose to verify an algebraic equality, before concluding that the algebraic expressions are equal in general.

Note: Don't forget to turn Verify mode off, press (○○○) (2) to choose **2Verify OFF** and return to the calculation screen.

6.5 Summation

Set your calculator to MathI/MathO. See Section 2.1.

The concept of summation is the adding up of a sequence of numbers, where the sequence obeys a rule.

Consider the following:

- $\frac{1}{4}$
- $\frac{1}{4}+\left(\frac{1}{4}\times\frac{1}{4}\right)$
- $\frac{1}{4}+\left(\frac{1}{4}\times\frac{1}{4}\right)+\left(\frac{1}{4}\times\frac{1}{4}\times\frac{1}{4}\right)$

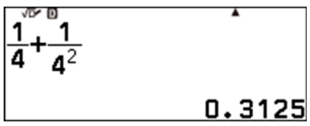
Each of these are consecutive steps in the sum of a sequence of numbers. At each step we add on one more number, and we could keep doing this forever. Given the rule is that the next number is *one-quarter of the previous*, then the never-ending summation, S_n, can be written as follows:

$$S_n=\frac{1}{4}+\left(\frac{1}{4}\times\frac{1}{4}\right)+\left(\frac{1}{4}\times\frac{1}{4}\times\frac{1}{4}\right)+\left(\frac{1}{4}\times\frac{1}{4}\times\frac{1}{4}\times\frac{1}{4}\right)+\cdots+\frac{1}{4^n}$$

where n is a positive whole number.

The value of S_2 can be calculated as follows:

The decimal form can also be calculated.
Press 



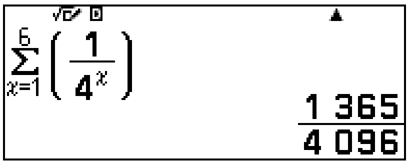
Complete the following table for $1 \le n \le 6$.

n	1	2	3	4	5	6
(S_n) (fractional form)	$\frac{1}{4}$	$\frac{5}{16}$				
S_n (decimal form)	0.25	0.3125				

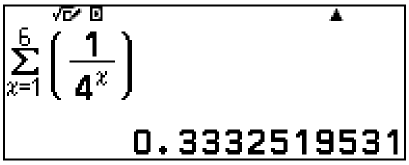
What do you notice?

There is a more efficient way to calculate the value of a given number of steps of a summation using this calculator.

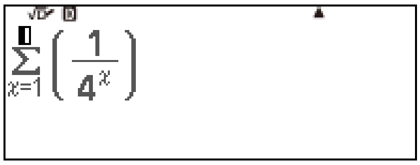
S_6 can be calculated as follows.



[CATALOG] [1] to open **Func Analysis ▶**
[1] to choose **Summation(Σ)**
[1] [fraction] [4] [power] [x]
[▽] [1] [△] [6]
[EXE]



Press [FORMAT] to see the decimal approximation.



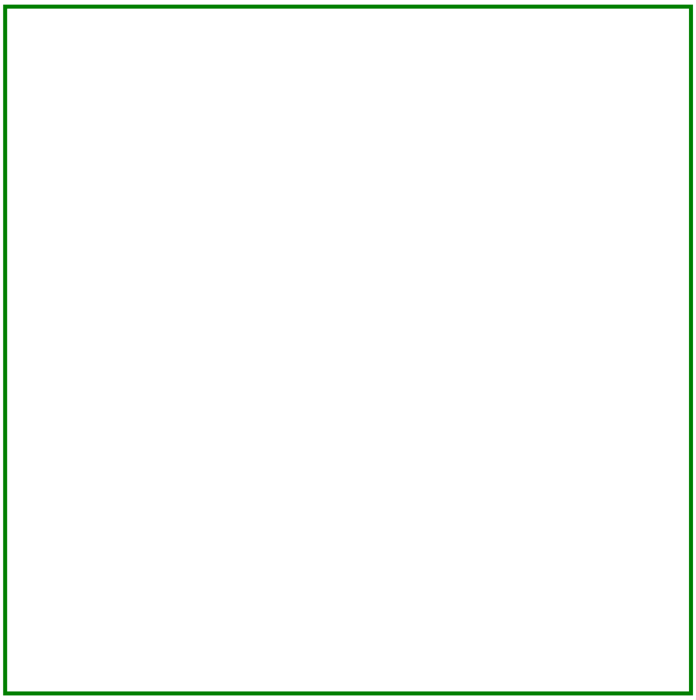
To calculate further steps in this summation press:
[>] [>] [>] to move the cursor to the right of the 6 and [⌫] to delete the 6.

You can now enter any value of n you wish.

Calculate S_{10}, S_{12}, …

Can you suggest what will happen to the value of the sum, S_n, as the value of n becomes larger and larger (I.e., as $n \to \infty$.)?

Can you "fraction-up" the square shown below in a way that would convince another person that as $n \to \infty$, $S_n \to \frac{1}{3}$?



Calculate some steps in the sum:

$$S_{5,n} = \frac{1}{5} + \frac{1}{5 \times 5} + \frac{1}{5 \times 5 \times 5} + \cdots + \frac{1}{5^n}$$

What happens to the value of $S_{5,n}$ as $n \to \infty$?

Calculate some steps in the sum:

$$S_{6,n} = \frac{1}{6} + \frac{1}{6 \times 6} + \frac{1}{6 \times 6 \times 6} + \cdots + \frac{1}{6^n}$$

What happens to the value of $S_{6,n}$ as $n \to \infty$?

Calculate some steps in the sum:

$$S_{7,n} = \frac{1}{7} + \frac{1}{7 \times 7} + \frac{1}{7 \times 7 \times 7} + \cdots + \frac{1}{7^n}$$

What happens to the value of $S_{7,n}$ as $n \to \infty$?

Consider the sum:

$$S_{a,n} = \frac{1}{a} + \frac{1}{a \times a} + \frac{1}{a \times a \times a} + \cdots + \frac{1}{a^n}$$

Can you suggest what happens to the value of $S_{a,n}$ as $n \to \infty$?

Can you prove that your suggestion is correct?

To finish of this section, consider the sum:

$$S_n = 1 + \frac{2}{3} + \frac{4}{9} + \frac{8}{27} + \cdots + \frac{2^{n-1}}{3^{n-1}}$$

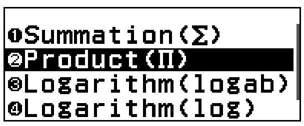
What happens to the value of S_n as $n \to \infty$?

Note:
Instead of summing a sequence of numbers, one can find their product.

For example,

$$P_n = \frac{7}{9} \times \frac{26}{28} \times \frac{63}{65} \times \frac{124}{126} \times \ldots$$

The ‘product’ function (Π) can be used to investigation this critter. Investigate away.



7.1 Making a table of values for a function

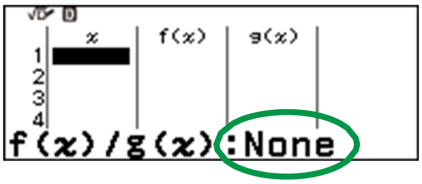
Consider the function:

$$f(x) = \frac{2x - 1}{x}$$

Make a table of values of $f(x)$ for $-10 \leq x \leq 10$ and see what you notice.

From the ⌂ screen, launch the Table application.

None tells us that there are no functions defined in the calculator.



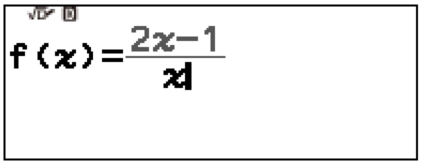
To define $f(x)$ in the calculator press:

⊙⊙⊙

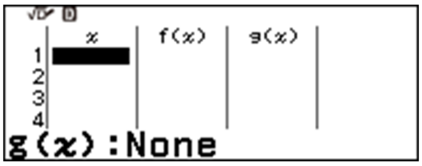
2 to open ②Define f(x)/g(…▸

1 to choose ①Define f(x)

▤ 2 x − 1 ∨ x to enter the function.



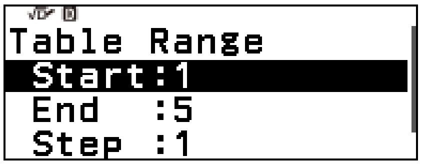
EXE to return to the table.



⊙⊙⊙ (TOOLS),

1 to choose ①Table Range

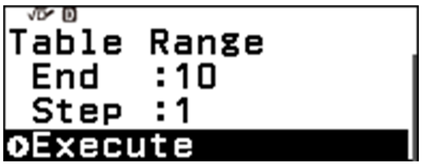
and see the Table Range settings.



− 1 0 EXE

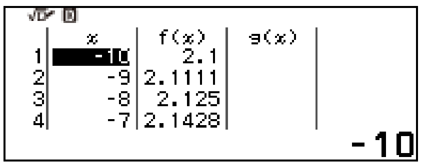
1 0 EXE

1 EXE

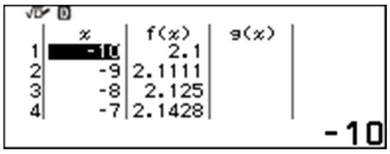


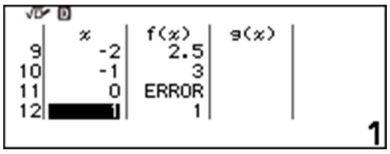
You are now prepared to calculate values for $f(x)$ for all integer values (Step = 1) in the interval, $-10 \leq x \leq 10$.

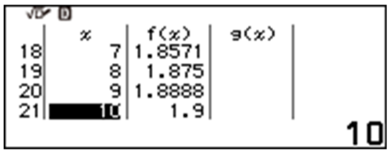
EXE to see the table.



You can scroll up and down the table using ⓥ and ⓐ.







Notice that when $x = 0$, $\mathrm{f}(x) =$ ERROR.
Can you explain why ERROR is returned?

Also notice that at either ends of the table, $\mathrm{f}(x)$ gets close to 2.
Is there an x value for which $\mathrm{f}(x) = 2$?

Change the table range to $-20 \le x \le 10$ and look at the values of $\mathrm{f}(x)$.
Now change the table range to $10 \le x \le 20$ and look at the values of $\mathrm{f}(x)$.

Did you find an x value for which $\mathrm{f}(x) = 2$?
Mmm. 🤔

7.2 Solving an equation using table of values

Consider the functions:

$$f(x) = x^2 + 2x + 7 \text{ and } g(x) = 6x + 3.$$

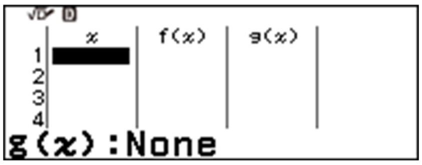
Are there any values of x that return the same value of $f(x)$ and $g(x)$?

I.e., are there any values of x for which $f(x) = g(x)$?

One way to find an answer to this question is to make a table of values for each function and compare.

The Table ④ application enables us to do just that.

From the ⌂ screen, launch the Table ④ application.



If the table on your calculator contains numbers press:

(○○○)

④ to open ④Edit ▶

② to choose ②Delete All

and clear the table of numbers.

To define f(x) in the calculator press:

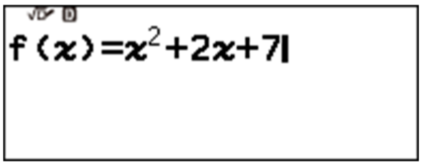
(○○○)

② to open ②Define f(x)/g(…▶

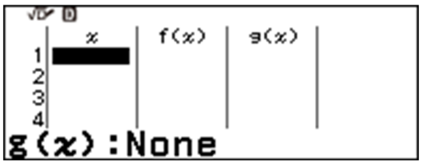
① to choose ①Define f(x)

(AC) (if you completed Section 7.1)

(x) ($\blacksquare^2$) (+) (2) (x) (+) (7) to enter the function.



(EXE) to return to the table.



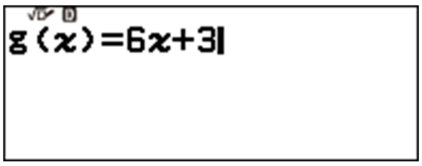
To define g(x) press:

(○○○)

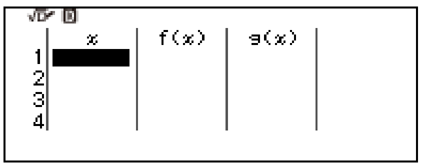
② to open ②Define f(x)/g(…▶

② to choose ②Define g(x)

(6) (x) (+) (3) to enter the function.

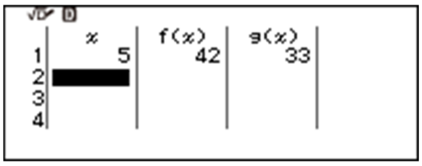


(EXE) to return to the table.



5 EXE will calculate f(5) and g(5).

Clearly $x = 5$ is not a value that makes $f(x) = g(x)$ true. ☹

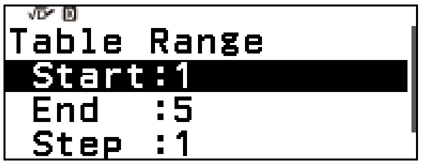


Instead of entering one value of x at a time, we can calculate the values of $f(x)$ and $g(x)$ for a set of x values.

OPTN

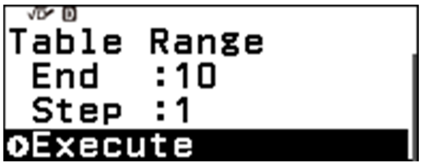
1 to choose **Table Range**

and see the `Table Range` settings.

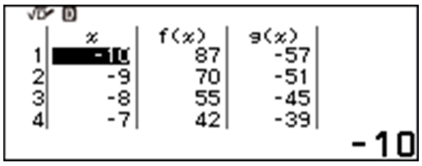


(−) 1 0 EXE 1 0 EXE 1 EXE

You are now prepared to calculate values for $f(x)$ and $g(x)$ for all integer values (Step = 1) in the interval, $-10 \leq x \leq 10$.

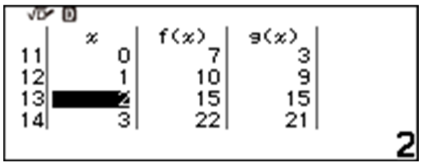


EXE to see the table.



You can scroll up and down the table using ⋁ and ⋀.

Note:
You can scroll across the table using < and >.



So, $x = 2$ makes $f(x) = g(x) = 15$. ☺

Do you think there might be any other values of x for which $f(x) = g(x)$?

You could change the `Table Range` and explore further, but we could never look at all values of x.

Using an algebraic approach to solve the equation $x^2 + 2x + 7 = 6x + 3$ will give us all possible values of x for which $f(x) = g(x)$.

We will start:

$$x^2 + 2x + 7 = 6x + 3$$
$$\Rightarrow x^2 - 4x + 4 = 0$$
$$\Rightarrow \ldots$$

Can you finish it off ?

7.3 Checking if two algebraic expressions are equal

The expressions $x^2 + 8$ and $\sqrt{x}+8$ are equal in value if $x = 0$.
But if $x = 4$, then the expressions are not equal, since $24 \neq 10$.
So, $x^2 + 8 \neq \sqrt{x}+8$ for all values of x.

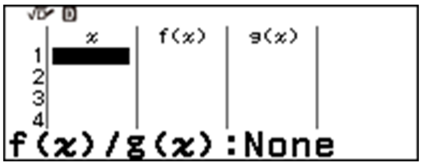
Ashley believes that when $2x^2 + 11x + 15$ is factorised, it is equal to $(2x + 5)(x + 3)$.

Use a table of values to check whether or not Ashley's belief is true for more than one value of x.

One way to check this is to make a table of values for each function and compare.

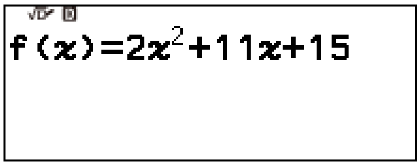
The Table application enables us to do just that.

From the ⌂ screen, launch the Table application.



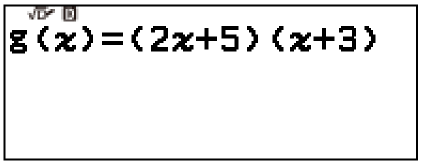
To define f(x) press:
f(x)
3 to choose ③Define f(x)
Enter $2x^2 + 11x + 15$.

EXE to return to the table.

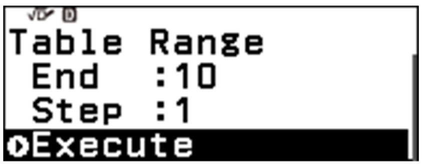


To define g(x) press:
f(x)
4 to choose ④Define g(x)
Enter $(2x + 5)(x + 3)$.

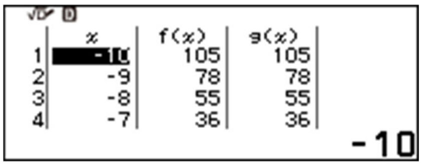
EXE to return to the table.



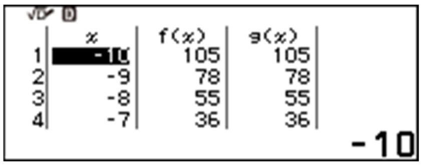
⋯ (TOOLS),
1 to choose ①Table Range
and see the Table Range settings.
(−) 1 0 EXE 1 0 EXE 1 EXE
You are now prepared to calculate values for f(x) and g(x) for all integer values (Step = 1) in the interval, $-10 \leq x \leq 10$.

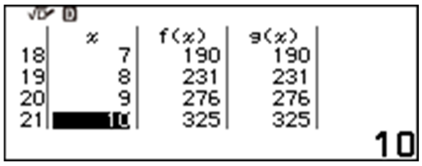


EXE to see the table.



You can scroll up and down the table using ∨ and ∧.



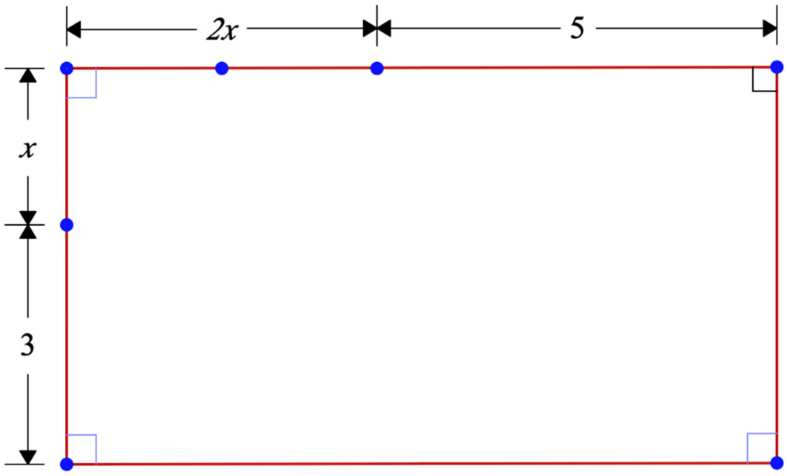


So, at least for the values of x in this table, $2x^2 + 11x + 15 = (2x + 5)(x + 3)$.

But is $2x^2 + 11x + 15 = (2x + 5)(x + 3)$ for all values of x?

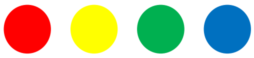
Use the rectangle below to convince yourself that

$$2x^2 + 11x + 15 = (2x + 5)(x + 3) \text{ for all } x \in \mathbb{R}.$$



8.1 Factorials

Ashley has four coloured balls and places them in a row as follows: red, yellow, green and blue.



Ashley wonders how many different ways these four balls can be ordered.

Ashley's teacher suggests a tree diagram might help. Ashley created the tree diagram you can see on the next page.

As you can see, the first stage of branches shows what is possible for the first position in the row. There are 4 options for the first position.
For each of these 4 options there are 3 options for the second position.
So, there are 4×3, or 12, possible ways to fill the first two positions.

There are 2 branches leaving each one of the 12 second position branches.
So, there are 12×2, or $4 \times 3 \times 2$, possible ways to fill the first three positions.

The last position can only be filled by the single remaining ball. Thus, there are $4 \times 3 \times 2 \times 1$ different orderings (often called arrangements) of the four balls.

There is a special way to represent products like $4 \times 3 \times 2 \times 1$, products of consecutive numbers all the way down to 1.

$$4 \times 3 \times 2 \times 1 = 4!$$

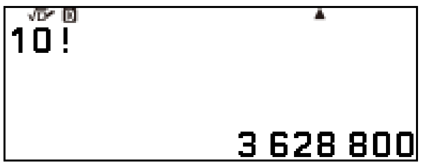
4! is pronounced *four factorial*.

$$10! = 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$$

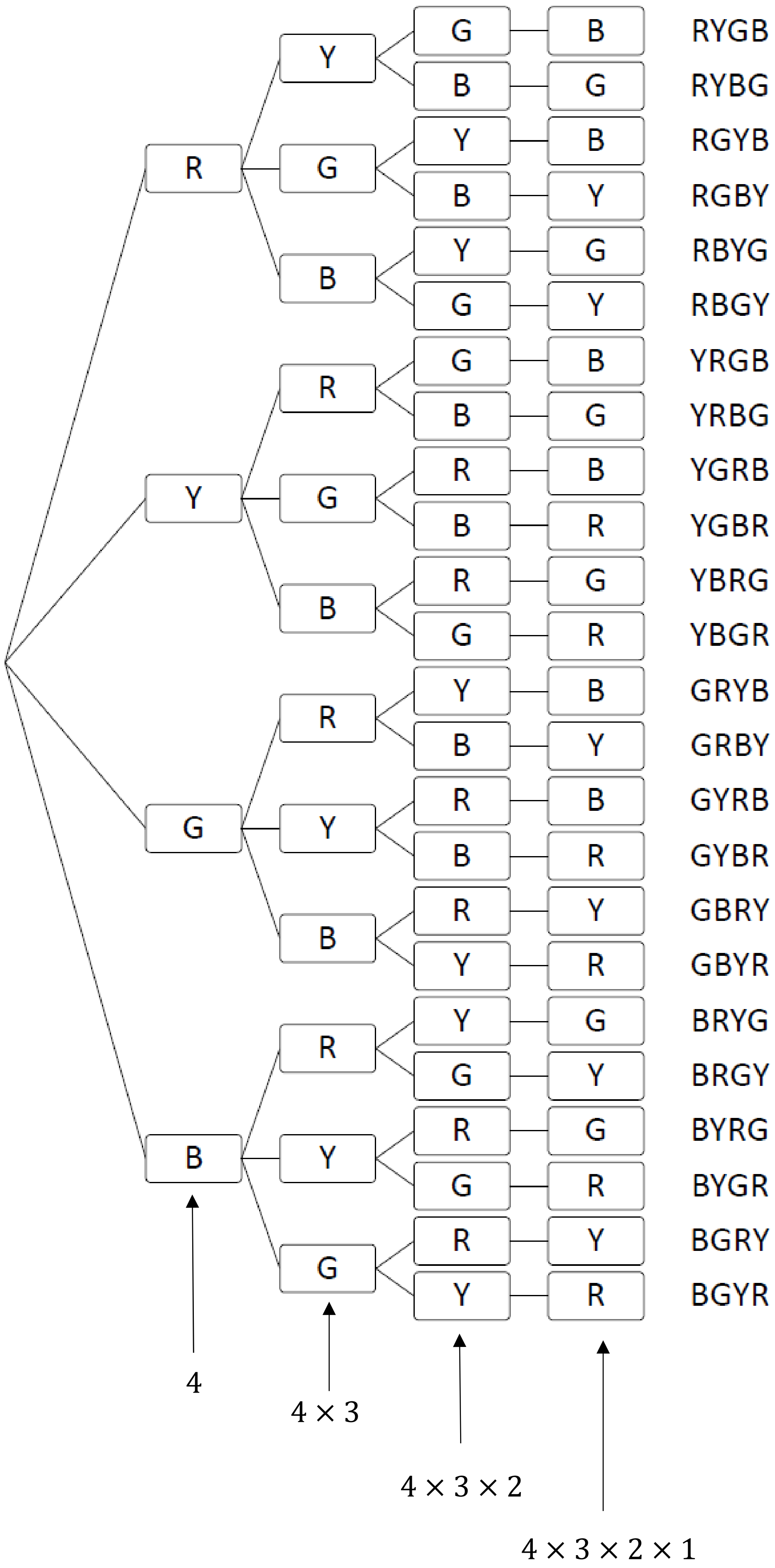
$$n! = n \times (n-1) \times (n-2) \times \ldots \times 3 \times 2 \times 1$$

To calculate 10!, in the Calculate application, you can do the following.
Enter:

1 0
(catalog) 2 to open Probability
2 to choose Factorial(!)
EXE



So, $10! = 3\ 628\ 000$.


RYGB
RYBG
RGYB
RGBY
RBYG
RBGY
YRGB
YRBG
YGRB
YGBR
YBRG
YBGR
GRYB
GRBY
GYRB
GYBR
GBRY
GBYR
BRYG
BRGY
BYRG
BYGR
BGRY
BGYR
4
4 × 3
4 × 3 × 2
4 × 3 × 2 × 1

8.2 Permutations

Ashley was not done with the four balls, wondering how many different arrangements are possible if any 3 balls are chosen from the original set of four.

Ashley's teacher suggests that the tree diagram, as seen on the previous page, holds the answer.

Ashley realised that the branches in the first three stages of the tree diagram show all the possible arrangements.

So, there are $4 \times 3 \times 2$ arrangements.

What about if any two balls were chosen from the original 4?
We can use the branches in the first two stages; so, 4×3 arrangements.

What if Ashley had n balls and chose to arrange any r of them, where $r \leq n$?
How many arrangements would be possible?
Well, all the stages in a tree diagram would provide $n!$ branches, but we would need to divide $n!$ that by $(n - r)!$

The formal name for arrangements of this type is *permutations*.
The notation for the number of permutations of r objects chosen from n objects is P_r^n, and

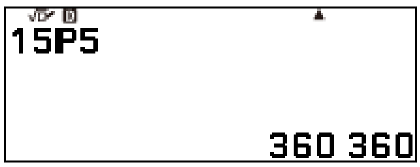
$$P_r^n = \frac{n!}{(n-r)!}, \text{where } r \leq n.$$

If Ashley had 15 differently coloured balls and took any 5 balls from the 15, how many permutations would there be?

$$P_5^{15} = \frac{15!}{(15-5)!}$$

To calculate P_5^{15}, in the Calculate application, you can do the following.
Enter:

1 5
⇧ × (nPr)
5
EXE



So, $P_5^{15} = 360\ 360$.

8.3 Combinations

Ashley was still not done, wondering what happened if only the colour combination deemed one collection to be different to another, rather than the colour *and* the order of the colours. How many of these type of collections would there be?

For example, instead of ordering the red, yellow and green balls as follows: R-Y-G, R-G-Y, Y-R-G, Y-G-R, G-R-Y and G-Y-R, we just paid attention to the combination of red, yellow and green and **not** the order.

Ashley thought for a while and realised there would be $\frac{1}{r!} \times P_r^n$ collections, because we only need to count $\frac{1}{r!}$ of the permutations.

Collections like this, when the order is not considered to matter, are formally called *combinations*.

The notation for the number of combinations of r objects chosen from n objects is C_r^n, and

$$C_r^n = \frac{1}{r!} \times P_r^n = \frac{n!}{(n-r)!\,r!}, \text{where } r \le n.$$

If Ashley had 15 differently coloured balls and had to write down every combination of 5 balls taken from the 15, how many combinations would there be?

$$C_5^{15} = \frac{15!}{(15-5)!\,5!}$$

To calculate C_5^{15}, in the Calculate application, you can do the following.

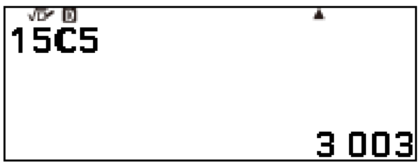
Enter:

1 5

⬆ ÷ (nCr)

5

EXE



So, $C_5^{15} = 3\,003$.

8.4 Distribution – Normal

In 1861 Dr C.R.A. Wunderlich studied the body temperatures of many thousands of healthy people. The body temperatures were measured under standard conditions. Dr Wunderlich concluded that, for the population of healthy people, body temperature (T) was normally distributed with a mean of 37°C and a standard deviation of 0.5°C.

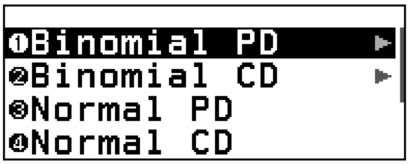
Using Dr Wunderlich's conclusions, find the percentage of the population of healthy people who had a body temperature:

a) between 37°C and 38.2°C.

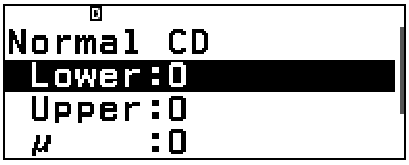
b) above 39°C.

To answer part a) we need to calculate $P(37 < T < 38.2)$.
We can calculate this as follows.

From the HOME (⌂) screen, launch the Distribution application by pressing ③.

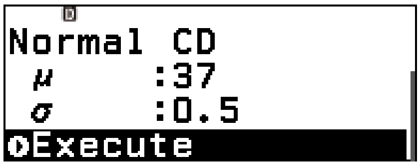


④ to choose Normal CD, to see the screen where we will enter the parameters.

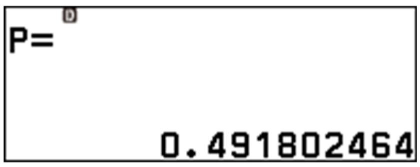


③ ⑦ EXE
③ ⑧ . ② EXE
③ ⑦ EXE
⓪ . ⑤ EXE

The parameters are now entered and you are ready to calculate $P(37 < T < 38.2)$.



EXE



So, about 49% of the population had a body temperature between 37°C and 38.2°C when healthy.

To answer part b) we need to calculate P($T > 39$).
We can calculate this as follows.

AC
3 9 EXE
1 0 0 0 EXE

```
Normal CD
 Lower:39
 Upper:1000
 μ     :37
```

Note: When entering an upper limit in a situation like this, we enter a value that is many, many standard deviations higher than the mean. 1000 in this case.

∨ ∨ to select Execute.

```
Normal CD
 μ     :37
 σ     :0.5
Execute
```

OK

```
P=

          0.00003167126
```

So, about 0.003% of the population had a body temperature above 39°C when healthy.

Consider the *hottest* 10% of the population. What was the lowest body temperature in this group.

To answer this question we need to calculate t, such that P($T \geq t$) = 0.1.

The Inverse Normal function can help us with this calculation.
However, it calculates x, such that P($X < x$) = p.

Thus, we need to calculate t such that P($T < t$) = 0.9.
We can do this as follows:

↶ ↶
∨ ∨ ∨ ∨
Inverse Normal will then be selected, and it is the option we need.

```
2Binomial CD
3Normal PD
4Normal CD
5Inverse Normal
```

5
0 . 9
EXE

```
Inverse Normal
 Area :0.9
 μ     :37
 σ     :0.5
```

∨ ∨
OK

So, the lowest body temperature in the *hottest* 10% of the population was approximately 37.6°C.

```
xInv=

            37.64077582
```

8.5 Distribution – Binomial

A common drug is known to cause a mild side effect in some people.
Data shows that one-in-eight of those who take the drug experience the side effect.
For a given group of people who take the drug, let Y be the number who experience the side effect.

Given that Y can be modelled using the binomial distribution, find the probability that if:

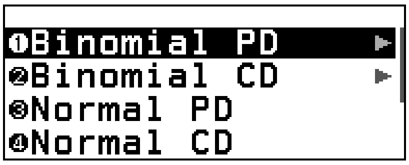
a) sixty-four people take the drug, eight will experience the side effect.

b) 350 people take the drug, fifty or more will experience the side effect.

To answer part a) we note that $n = 64$, $p = \frac{1}{8}$ and we need to calculate $P(Y = 8)$.
We can calculate this as follows.

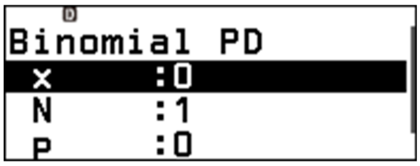
From the HOME (⌂) screen, launch the Distribution application by pressing ③.

Binomial PD, which is the option we require.



①

② to choose ②Variable

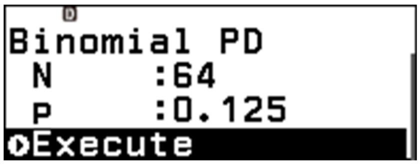


⑧ EXE

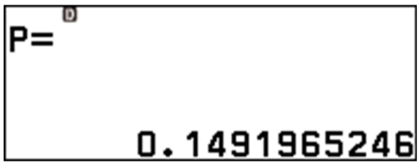
⑥ ④ EXE

① ⊟ ⑧ EXE

The parameters are now entered and you are ready to calculate $P(Y = 8)$.



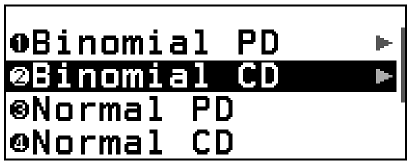
EXE



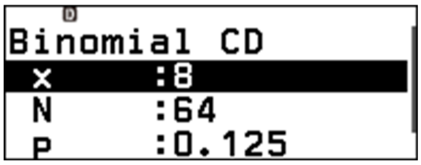
So, there is about a 15% chance that eight of the sixty-four people will experience the side effect.

To answer part b) we note that $n = 350$ and we need to calculate $P(Y \geq 50)$.

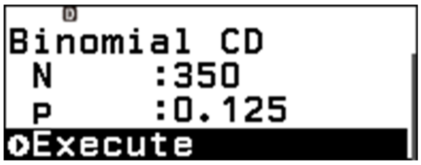
We can calculate this with the help of the Binomial CD function. However, it calculates $P(Y \leq y)$. So, we need to calculate $1 - P(Y \leq 49)$, which we can do in the following way.



to see the probability options.

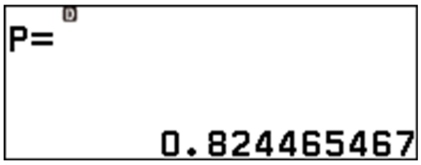


2 to open 2Binomial CD
2 to choose 2Variable



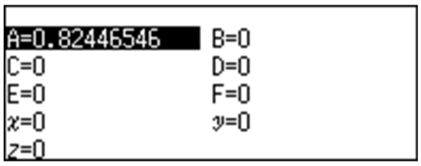
4 9 EXE
3 5 0 EXE

The parameters are now entered and you are ready to calculate $P(Y \leq 49)$.



OK

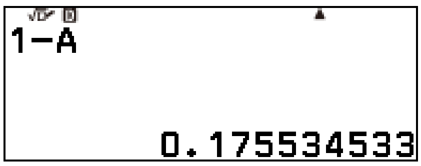
So, $P(Y \leq 49)$ is approximately 82%.



To store this value as A press:

Ans

EXE



We can now calculate $1 - P(Y \leq 49)$ in the Calculate application as follows:

1

1 − 4

EXE

So, there is about a 17.6% chance that 50 or more people, of the 350, will experience the side effect.

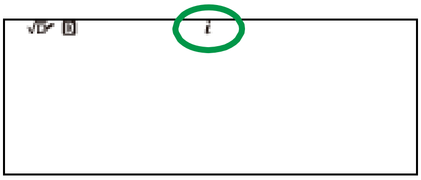
9.1 Complex number calculations

The Complex application enables various calculations with complex numbers to be done.

Set your calculator to MathI/MathO. See Section 2.1.

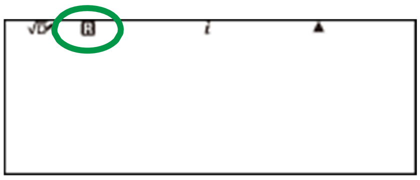
From the (HOME) screen, launch the Complex application.

Note that $\boldsymbol{i}$ is seen at the top centre of the screen to indicate that outputs will be in cartesian form ($a + b\boldsymbol{i}$). This is the factory setting.



Results can be displayed in either cartesian ($a + b\boldsymbol{i}$) or polar form ($r\angle\theta$).

Ensure the calculator is set to Radians.
If it is not, then:



(MENU) (1) to open ①Calc Settings ▶
(2) to open ②Angle Unit ▶
(2) to choose Radian
(AC) to return to the calculation screen

Note that R is seen on the top left of the screen to indicate the calculator is set to calculate in radians.

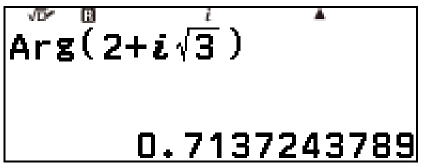
Let $z = 2 + i\sqrt{3}$.

a) Calculate $\arg(z)$

b) Express z in polar form.

Press:

(CATALOG) (1) to open ①Complex ▶
(3) to choose ③Argument
(2) (+)
(SHIFT) (9) (i)
(√■) (3)
(▷)
())
(EXE)

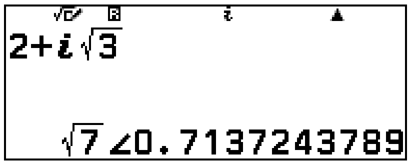


So, $\arg(z) \approx 0.714^c$.

To convert to polar form, we could now find the modulus, or use the automatic conversion feature as follows:

2 +
SHIFT 9 (i)
√■ 3
▷
EXE

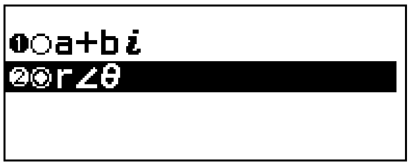
SHIFT FORMAT (⟳)
4 to choose ④Polar Coord



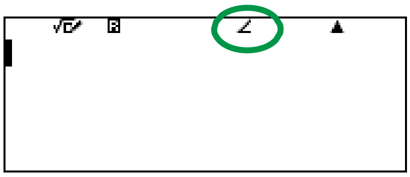
So, $2 + i\sqrt{3} \approx \sqrt{7}\ \text{cis}(0.714^c)$.

If you want the output of complex number calculations to be displayed in polar form without you having to convert them, you can change the Complex Result setting as follows:

☰ 1 to open ①Calc Settings ▶
5 to open ⑤Complex Result ▶
2 to choose ②○r∠θ

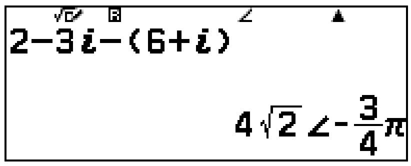


AC to return to the calculation screen.



Note: ∠ is seen at the top centre of the screen to indicate that outputs will be in polar form

Now enter:
2 − 3 SHIFT 9 (i)
− (6 + SHIFT 9 (i))
EXE



9.2 Vector calculations

When in the Vector application, various two and three-dimensional vector calculations can be done.

Given points P(1,2,3), Q(3,3,1) and R(8,4,11)

a) Calculate $\overrightarrow{PQ} \cdot \overrightarrow{QR}$

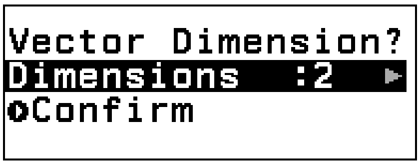
b) Calculate $\overrightarrow{PQ} \cdot \overrightarrow{PR}$

c) Calculate a vector perpendicular to both $\overrightarrow{PQ}$ and $\overrightarrow{PR}$.

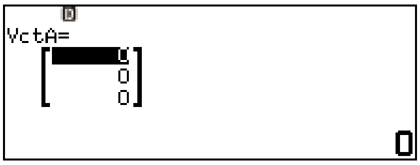
Firstly, $\overrightarrow{PQ} = (2,1,-2)$, $\overrightarrow{QR} = (5,1,10)$ and $\overrightarrow{PR} = (7,2,8)$.

From the ⌂ screen, launch the Vector application.

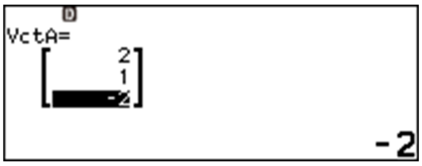
To set the dimension for each vector, press:
(⋯) (1) to choose ❶VctA:None



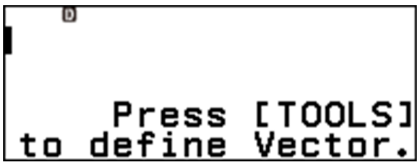
Press:
(OK) (2) to choose ❷3 Dimensions
(OK) to select Confirm



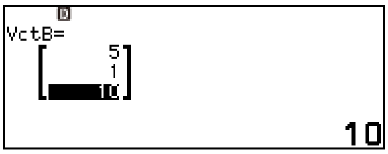
Enter each component, pressing (EXE) after each.



(OK) to return to the vector calculation screen.

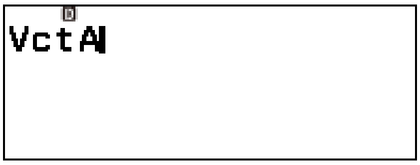


Repeat the process described above to enter $\overrightarrow{QR}$ and $\overrightarrow{PR}$ as VctB and VctC respectively.



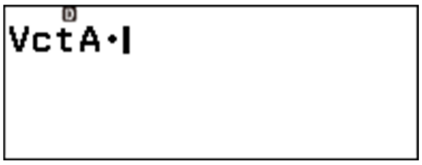
To calculate $\overrightarrow{PQ} \cdot \overrightarrow{QR}$ (the scalar (or dot) product), press:

① to open **1Vector ▸**
② to choose **2VctA**



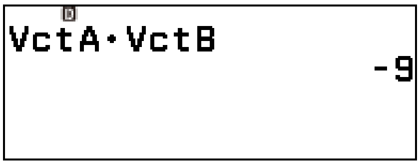
Then:

① to open **1Vector ▸**
① to open **1Vector Calc ▸**
① to choose **1Dot Product**

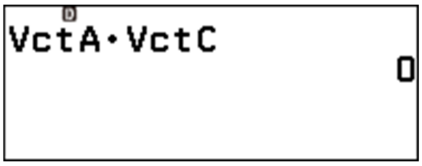


Then:

① to open **1Vector ▸**
③ to choose **3VctB**
OK



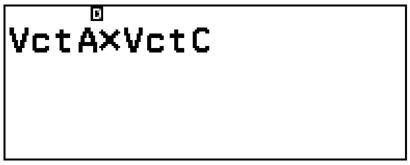
Now calculate $\overrightarrow{PQ} \cdot \overrightarrow{PR}$ (VctA · VctC).



Note that pressing ⊲ will insert the cursor into the working line, so it can be edited.

So $\overrightarrow{PQ} \cdot \overrightarrow{PR} = 0$, meaning that $\overrightarrow{PQ}$ and $\overrightarrow{PR}$ are perpendicular.

To calculate a vector that is perpendicular to both $\overrightarrow{PQ}$ and $\overrightarrow{PR}$, we can calculate the vector product (or cross product) of $\overrightarrow{PQ}$ and $\overrightarrow{PR}$, denoted as $\overrightarrow{PQ} \times \overrightarrow{PR}$ (VctA × VctC).



Use the ⊗ key to enter the ×.

So, $\overrightarrow{PQ} \times \overrightarrow{PR} = (12, -30, -3)$.

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For all enquiries and emulator support please contact:
edusupport@shriro.com.au
+61 2 9415 5521

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- Video tutorials -
- Classroom resources -