

Calculator Instructions

Casio fx-9860G PLUS

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GROUPING SYMBOLS (BRACKETS)

The Casio has bracket keys that look like $\boxed{[}$ and $\boxed{]}$.

Brackets are regularly used in mathematics to indicate an expression which needs to be evaluated before other operations are carried out.

For example, to evaluate $2 \times (4 + 1)$ we type $2 \boxed{\times} \boxed{[} 4 \boxed{+} 1 \boxed{]} \boxed{=}$.

We also use brackets to make sure the calculator understands the expression we are typing in.

For example, to evaluate $\frac{2}{4+1}$ we type $2 \boxed{\div} \boxed{[} 4 \boxed{+} 1 \boxed{]} \boxed{=}$.

If we typed $2 \boxed{\div} 4 \boxed{+} 1 \boxed{=}$ the calculator would think we meant $\frac{2}{4} + 1$.

In general, it is a good idea to place brackets around any complicated expressions which need to be evaluated separately.

POWER KEYS

The Casio has a power key that looks like $\boxed{\wedge}$. We type the base first, press the power key, then enter the index or exponent.

For example, to evaluate 25^3 we type $25 \boxed{\wedge} 3 \boxed{=}$.

Numbers can be squared on the Casio using the special key $\boxed{x^2}$.

For example, to evaluate 25^2 we type $25 \boxed{x^2} \boxed{=}$.

ROOTS

To enter roots on the Casio we need to use the secondary function key $\boxed{\text{SHIFT}}$.

We enter square roots by pressing $\boxed{\text{SHIFT}} \boxed{x^2}$.

For example, to evaluate $\sqrt{36}$ we press $\boxed{\text{SHIFT}} \boxed{x^2} 36 \boxed{=}$.

You can press the right arrow key $\boxed{\blacktriangleright}$ to move the cursor out of the square root sign. For example, to evaluate $\sqrt{18} + 5$ we type $\boxed{\text{SHIFT}} \boxed{x^2} 18 \boxed{\blacktriangleright} \boxed{+} 5 \boxed{=}$.

Cube roots are entered by pressing $\boxed{\text{SHIFT}} \boxed{[}$.

For example, to evaluate $\sqrt[3]{8}$ we press $\boxed{\text{SHIFT}} \boxed{[} 8 \boxed{=}$.

Higher roots are entered by pressing $\boxed{\text{SHIFT}} \boxed{\wedge}$.

For example, to evaluate $\sqrt[4]{81}$ we press $4 \boxed{\text{SHIFT}} \boxed{\wedge} 81 \boxed{=}$.

INVERSE TRIGONOMETRIC FUNCTIONS

The inverse trigonometric functions \sin^{-1} , \cos^{-1} , and \tan^{-1} are the secondary functions of $\boxed{\sin}$, $\boxed{\cos}$, and $\boxed{\tan}$ respectively. They are accessed by using the secondary function key $\boxed{\text{SHIFT}}$.

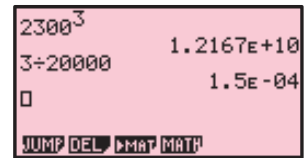
For example, if $\cos x = \frac{3}{5}$, then $x = \cos^{-1}\left(\frac{3}{5}\right)$.

To calculate this, press $\boxed{\text{SHIFT}} \boxed{\cos} \boxed{(} \boxed{3} \boxed{\div} \boxed{5} \boxed{)} \boxed{\text{EXE}}$.

SCIENTIFIC NOTATION

If a number is too large or too small to be displayed neatly on the screen, it will be expressed in scientific notation, which is the form $a \times 10^k$ where $1 \leq a < 10$ and k is an integer.

To evaluate 2300^3 , press $2300 \boxed{\wedge} \boxed{3} \boxed{\text{EXE}}$. The answer displayed is $1.2167\text{E}+10$, which means 1.2167×10^{10} .

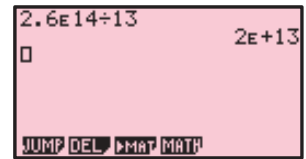


To evaluate $\frac{3}{20000}$, press $3 \boxed{\div} \boxed{20000} \boxed{\text{EXE}}$. The answer displayed is $1.5\text{E}-04$, which means 1.5×10^{-4} .

You can enter values in scientific notation using the $\boxed{\text{EXP}}$ key. For

example, to evaluate $\frac{2.6 \times 10^{14}}{13}$, press $2.6 \boxed{\text{EXP}} \boxed{14} \boxed{\div} \boxed{13} \boxed{\text{EXE}}$.

The answer is 2×10^{13} .



SECONDARY FUNCTION AND ALPHA KEYS

The **shift function** of each key is displayed in yellow above the key. It is accessed by pressing the $\boxed{\text{SHIFT}}$ key followed by the key corresponding to the desired shift function.

For example, to calculate $\sqrt{36}$, press $\boxed{\text{SHIFT}} \boxed{x^2} (\sqrt{\quad}) \boxed{36} \boxed{\text{EXE}}$.

The **alpha function** of each key is displayed in red above the key. It is accessed by pressing the $\boxed{\text{ALPHA}}$ key followed by the key corresponding to the desired letter. The main purpose of the alpha keys is to store values which can be recalled later.

B

MEMORY

Utilising the memory features of your calculator allows you to recall calculations you have performed previously. This not only saves time, but also enables you to maintain accuracy in your calculations.

SPECIFIC STORAGE TO MEMORY

Values can be stored into the variable letters A, B, ..., Z. Storing a value in memory is useful if you need that value multiple times.

Suppose we wish to store the number 15.4829 for use in a number of calculations. To store this number in variable A, type in the number then press \rightarrow $\boxed{\text{ALPHA}}$ $\boxed{\text{X},\theta,\text{T}}$ (A) $\boxed{\text{EXE}}$.

15.4829→A	15.4829
A+10	25.4829
A ³	3711.563767
JUMP DEL ▶MAT MATP	

We can now add 10 to this value by pressing $\boxed{\text{ALPHA}}$ $\boxed{\text{X},\theta,\text{T}}$ $\boxed{+}$ 10 $\boxed{\text{EXE}}$, or cube this value by pressing $\boxed{\text{ALPHA}}$ $\boxed{\text{X},\theta,\text{T}}$ $\boxed{\wedge}$ 3 $\boxed{\text{EXE}}$.

ANS VARIABLE

The variable **Ans** holds the most recent evaluated expression, and can be used in calculations by pressing $\boxed{\text{SHIFT}}$ $\boxed{(-)}$. For example, suppose you evaluate 3×4 , and then wish to subtract this from 17. This can be done by pressing 17 $\boxed{-}$ $\boxed{\text{SHIFT}}$ $\boxed{(-)}$ $\boxed{\text{EXE}}$.

3×4	12
17-Ans	5
□	
JUMP DEL ▶MAT MATP	

If you start an expression with an operator such as $\boxed{+}$, $\boxed{-}$, etc, the previous answer **Ans** is automatically inserted ahead of the operator. For example, the previous answer can be halved simply by pressing $\boxed{\div}$ 2 $\boxed{\text{EXE}}$.

3×4	12
17-Ans	5
Ans÷2	2.5
□	
JUMP DEL ▶MAT MATP	

If you wish to view the answer in fractional form, press $\boxed{\text{F} \leftrightarrow \text{D}}$.

RECALLING PREVIOUS EXPRESSIONS

Pressing the up cursor key $\boxed{\blacktriangle}$ allows you to access the most recently evaluated expressions, and is useful if you wish to repeat a calculation with a minor change, or if you have made an error in typing.

Suppose you have evaluated $100 + \sqrt{132}$. If you now want to evaluate $100 + \sqrt{142}$, instead of retyping the command, it can be accessed by pressing the $\boxed{\blacktriangle}$ key. Move the cursor between the 3 and the 2, then press $\boxed{\text{DEL}}$ 4 to remove the 3 and change it to a 4. Press $\boxed{\text{EXE}}$ to re-evaluate the expression.

C

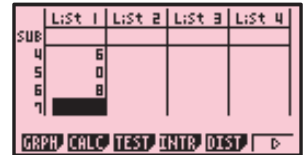
LISTS

Lists enable us to store sets of data, which we can then analyse and compare.

CREATING A LIST

Selecting **STAT** from the Main Menu takes you to the **list editor** screen.

To enter the data $\{2, 5, 1, 6, 0, 8\}$ into **List 1**, start by moving the cursor to the first entry of **List 1**. Press 2 **[EXE]** 5 **[EXE]** ... and so on until all the data is entered.



DELETING LIST DATA

To delete a list of data from the list editor screen, move the cursor to anywhere on the list you wish to delete, then press **[F6]** (**>**) **[F4]** (**DEL-A**) **[F1]** (**Yes**).

REFERENCING LISTS

Lists can be referenced using the List function, which is accessed by pressing **[SHIFT]** **1**.

For example, if you want to add 2 to each element of **List 1** and display the results in **List 2**, move the cursor to the heading of **List 2** and press **[SHIFT]** **1** (**List**) **1** **[+]** 2 **[EXE]**.

Casio models without the List function can do this by pressing **[OPTN]** **[F1]** (**LIST**) **[F1]** (**List**) **1** **[+]** 2 **[EXE]**.

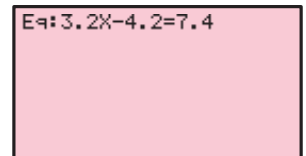
D

SOLVING EQUATIONS

SOLVING LINEAR EQUATIONS

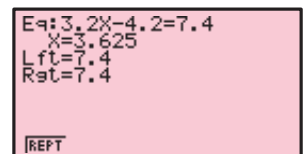
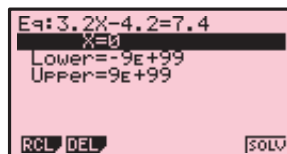
To solve the linear equation $3.2x - 4.2 = 7.4$, select **EQUA** from the Main Menu, then press **[F3]** (**SOLV**).

Enter the equation by pressing 3.2 **[X,θ,T]** **[=]** 4.2 **[SHIFT]** **[=]** (**=**) 7.4 **[EXE]**.



Highlight **X=** with the cursor and press **[F6]** (**SOLV**) to solve the equation.

So, the solution is $x = 3.625$.



SOLVING SIMULTANEOUS EQUATIONS

To solve $\begin{cases} 2x - 3y = 4 \\ 3x + 2y = 19 \end{cases}$ using technology, select **EQUA** from the

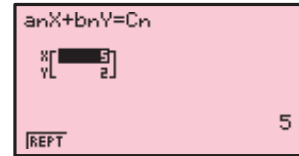
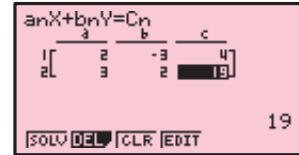
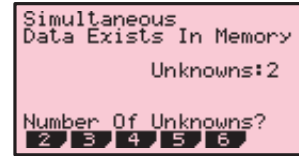
Main Menu, then press **F1** (**SIML**).

There are two unknowns, so press **F1** (**2**).

Enter the coefficients of the equations as shown, pressing **EXE** after each entry.

Press **F1** (**SOLV**) to solve the system.

So, $x = 5$ and $y = 2$.

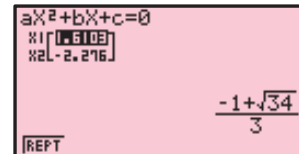
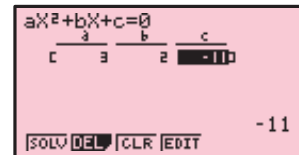
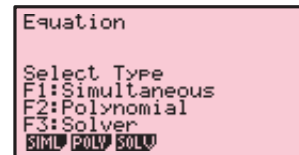


SOLVING QUADRATIC EQUATIONS

To solve the quadratic equation $3x^2 + 2x - 11 = 0$, select **EQUA** from the Main Menu. Press **F2** (**POLY**) then **F1** (**2**).

Enter the coefficients 3, 2 and -11 and then press **F1** (**SOLV**) to solve the equation.

So, the solutions are $x \approx -2.28$ or 1.61 .



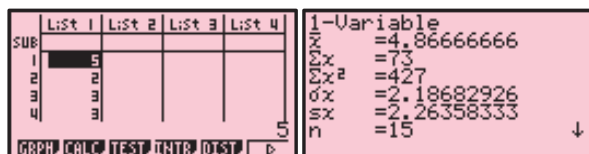
E

STATISTICS

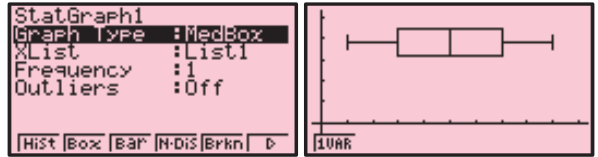
Your graphics calculator is a useful tool for analysing data and creating statistical graphs.

We will first produce descriptive statistics and graphs for the data set 5 2 3 3 6 4 5 3 7 5 7 1 8 9 5.

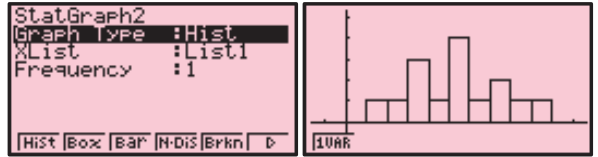
Enter the data into **List 1**. To obtain the descriptive statistics, press **F6** (**▷**) until the **GRPH** icon is in the bottom left corner of the screen, then press **F2** (**CALC**) **F1** (**1 VAR**).



To obtain a boxplot of the data, press **EXIT** **EXIT** **F1** (**GRPH**) **F6** (**SET**), and set up **StatGraph1** as shown. Press **EXIT** **F1** (**GPH1**) to draw the boxplot.

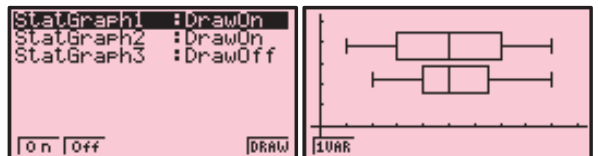
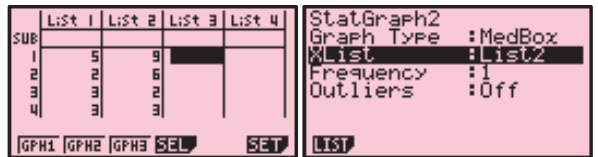


To obtain a vertical bar chart of the data, press **EXIT** **F6** (**SET**) **F2** (**GPH2**), and set up **StatGraph2** as shown. Press **EXIT** **F2** (**GPH2**) to draw the bar chart (set Start to 0, and Width to 1).



We will now enter a second set of data, and compare it to the first.

Enter the data set 9 6 2 3 5 5 7 5 6 7 6 3 4 4 5 8 4 into **List 2**, then press **F6** (**SET**) **F2** (**GPH2**) and set up **StatGraph2** to draw a boxplot of this data set as shown. Press **EXIT** **F4** (**SEL**), and turn on both **StatGraph1** and **StatGraph2**. Press **F6** (**DRAW**) to draw the side-by-side boxplots.



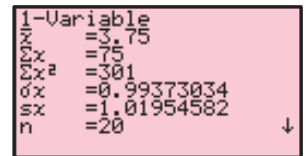
STATISTICS FROM GROUPED DATA

To obtain descriptive statistics for the data in the table alongside, enter the data values into **List 1**, and the frequency values into **List 2**.

Data	Frequency
2	3
3	4
4	8
5	5



Press **F2** (**CALC**) **F6** (**SET**), and change the **1 Var Freq** variable to **List 2**. Press **EXIT** **F1** (**1 Var**) to view the statistics.



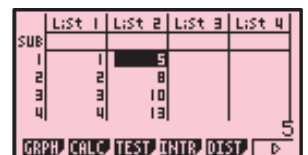
F TWO VARIABLE STATISTICS

Given a set of bivariate data, we can use our calculator to draw a scatter diagram of the data, find Pearson's correlation coefficient r , and find the line of best fit for the data.

Consider the bivariate data:

x	1	2	3	4	5	6	7
y	5	8	10	13	16	18	20

We first enter the x values into **List 1** and the y values into **List 2**.



To produce a scatter diagram for the data, press **F1** (**GRPH**) **F6** (**SET**), and set up **StatGraph1** as shown. Press **EXIT** **F1** (**GPH 1**) to draw the scatter diagram.

```
StatGraph1
Graph Type : Scatter
XList      : List1
YList      : List2
Frequency  : 1
Mark Type  : □
[Scat] [XY] [HPF] [Pie] [D]
```

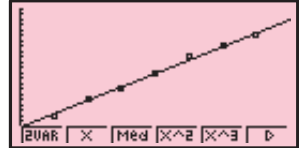


To find r and the line of best fit, from the scatter diagram press **F1** (**CALC**) **F2** (**X**) **F1** (**aX+b**).

```
LinearReg
a = 2.53571428
b = 2.71428571
r = 0.99772648
r² = 0.99545813
MSe = 0.16428571
y = ax + b
[COPY] [DRAW]
```

We can see that $r \approx 0.998$, and the line of best fit is given as $y \approx 2.54x + 2.71$.

Press **F6** (**DRAW**) to view the line of best fit.



CALCULATING χ^2

To calculate χ^2 for the data alongside, select **STAT** from the Main Menu, then press **F3** (**TEST**) **F3** (**CHI**) **F2** (**2WAY**).

	A ₁	A ₂
B ₁	21	28
B ₂	13	24

```
χ² Test
Observed: Mat A
Expected: Mat B
Save Res: None
Execute
[Mat] [▶MAT]
```

Press **F2** (**▶MAT**), make sure **Mat A** is highlighted, then press **F3** (**DIM**) **2** **EXE** **2** **EXE** **EXE** **EXE**. This indicates that the contingency table has 2 rows and 2 columns.

```
MAT A
Dimension m×n
m : 2
n : 2
Mat E : None
Mat F : None
[DEL] [DEL] [DIM]
```

Enter the elements of the contingency table, pressing **EXE** after each entry.

```
A
1 [ 13 28 ]
2 [ 13 24 ]
24
[R-OP] [ROW] [COL] [EDIT]
```

Press **EXIT** twice to return to the χ^2 Test screen, highlight **Execute**, then press **EXE**.

```
χ² Test
χ² = 0.52586523
P = 0.4683504
df = 1
[▶MAT]
```

So, $\chi^2 \approx 0.526$. The p -value and the degrees of freedom are also given. The expected values are stored in matrix **B**.

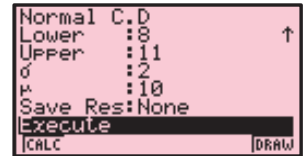
G

NORMAL PROBABILITIES

Suppose X is normally distributed with mean 10 and standard deviation 2.

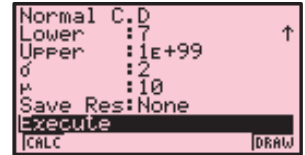
To find $P(8 \leq X \leq 11)$, select **STAT** from the Main Menu and press **F5** (**DIST**) **F1** (**NORM**) **F2** (**Ncd**).

Set up the screen as shown. Go to **Execute** and press **EXE** to display the result, which is 0.533.



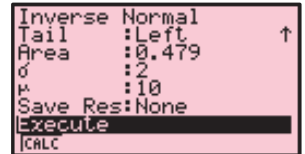
To find $P(X \geq 7)$, select **STAT** from the Main Menu and press **F5** (**DIST**) **F1** (**NORM**) **F2** (**Ncd**).

Set up the screen as shown. Go to **Execute** and press **EXE** to display the result, which is 0.933.



To find a such that $P(X \leq a) = 0.479$, select **STAT** from the Main Menu and press **F5** (**DIST**) **F1** (**NORM**) **F3** (**InvN**).

Set up the screen as shown. Go to **Execute** and press **EXE** to display the result, which is $a \approx 9.89$.

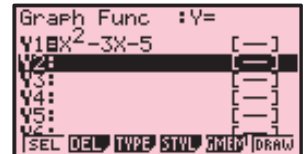


H

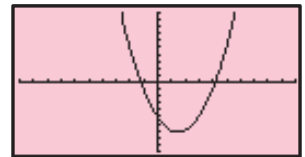
WORKING WITH FUNCTIONS

GRAPHING FUNCTIONS

Selecting **GRAPH** from the Main Menu takes you to the Graph Function screen, where you can store functions to graph. Delete any unwanted functions by scrolling down to the function and pressing **DEL** **F1** (**Yes**).



To graph the function $y = x^2 - 3x - 5$, move the cursor to **Y1** and press **X,θ,T** **x²** **-** **3** **X,θ,T** **-** **5** **EXE**. This stores the function into **Y1**. Press **F6** (**DRAW**) to draw a graph of the function.



To view a table of values for the function, press **MENU** and select **TABLE**. Press **F6** (**TABL**) to view the table. You can adjust the table settings by pressing **EXIT** and then **F5** (**SET**) from the Table Function screen.

X	Y1
-2	13
-1	5
0	-5

FORM DEL ROW EDIT F-COM G-PLT -3

ADJUSTING THE VIEWING WINDOW

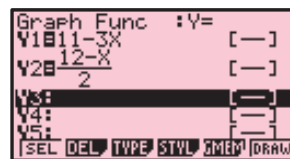
When graphing functions it is important that you are able to view all the important features of the graph. As a general rule it is best to start with a large viewing window to make sure all the features of the graph are visible. You can then make the window smaller if necessary.

The viewing window can be adjusted by pressing **SHIFT** **F3** (**V-Window**). You can manually set the minimum and maximum values of the x and y axes, or press **F3** (**STD**) to obtain the standard viewing window $-10 \leq x \leq 10$, $-10 \leq y \leq 10$.

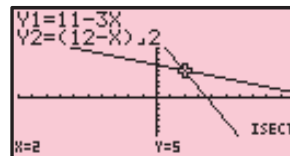


FINDING POINTS OF INTERSECTION

To find the intersection point of $y = 11 - 3x$ and $y = \frac{12-x}{2}$, select **GRAPH** from the Main Menu, then store $11 - 3x$ into **Y1** and $\frac{12-x}{2}$ into **Y2**. Press **F6** (**DRAW**) to draw a graph of the functions.



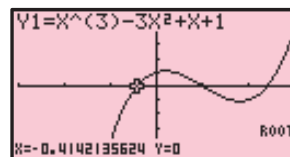
To find their point of intersection, press **F5** (**G-Solv**) **F5** (**ISCT**). The graphs intersect at (2, 5).



If there is more than one point of intersection, the remaining points of intersection can be found by pressing **▶**.

FINDING x -INTERCEPTS

To find the x -intercepts of $f(x) = x^3 - 3x^2 + x + 1$, select **GRAPH** from the Main Menu and store $x^3 - 3x^2 + x + 1$ into **Y1**. Press **F6** (**DRAW**) to draw the graph.



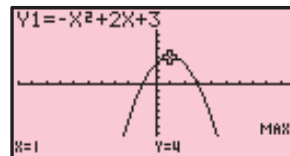
To find the x -intercepts, press **F5** (**G-Solv**) **F1** (**ROOT**). The first x -intercept $x \approx -0.414$ is given.

Press **▶** to find the remaining x -intercepts $x = 1$ and $x \approx 2.41$.

TURNING POINTS

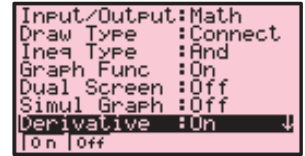
To find the turning point or vertex of $y = -x^2 + 2x + 3$, select **GRAPH** from the Main Menu and store $-x^2 + 2x + 3$ into **Y1**. Press **F6** (**DRAW**) to draw the graph.

From the graph, it is clear that the vertex is a maximum, so to find the vertex press **F5** (**G-Solv**) **F2** (**MAX**). The vertex is (1, 4).

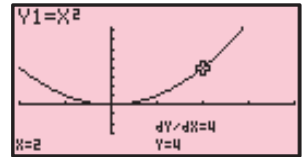


THE TANGENT TO A FUNCTION

To find the gradient of the tangent to $y = x^2$ when $x = 2$, we first press **SHIFT** **MENU** (SET UP), and change the **Derivative** setting to **On**.

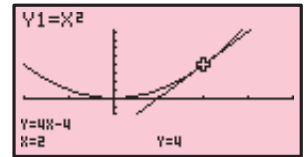


Draw the graph of $y = x^2$, then press **SHIFT** **F4** (Sketch) **F2** (Tang).



Press **2** **EXE**. We can see that the tangent has a gradient of 4 at this point.

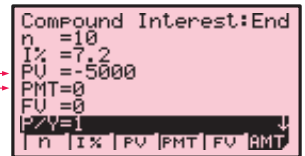
Press **EXE** again to draw the tangent. The equation of the tangent is $y = 4x - 4$.



I

FINANCIAL MATHEMATICS

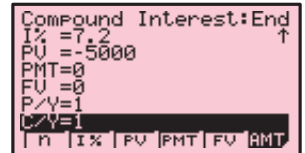
Suppose we invest \$5000 at 7.2% p.a. compounded annually. To find the value of the investment after 10 years, select **TVM** from the Main Menu and press **F2** (CMPD) to display the compound interest screen.



Set up the screen as shown:

Note: All the money being invested is considered as outgoings and is entered as a negative value.

There are no payments into the account during the term of the investment, so **PMT** is set to 0.



Press **F5** (FV) to find the future value.

So, the investment amounts to \$10021.16.

