Graphics Calculator

The $\boxed{\text{EXE}}$ button, bottom right, executes your commands and is the "equals" button, effectively.

Ordinary arithmetic is done in the **Run** menu but, like all functions, this must be selected before you start. To do this, you use the $\boxed{\text{MENU}}$ button. You can use the arrows to navigate, then use $\boxed{\text{EXE}}$ to execute your choice but pressing 1 to 9 will take you to the appropriate first nine menus.

If you get an error message, you need to press $\boxed{\text{AC/ON}}$ to clear it before anything else will work.

The $\boxed{\text{EXIT}}$ button will go back up levels once inside a menu. The only other way to go up is to "quit" the screen all the way to the top of the current menu, QUIT (= $\boxed{\text{SHIFT}}$─$\boxed{\text{EXIT}}$).

If you are going to re-do a very similar calculation, rather than retype from scratch, it is usually much easier to use the arrows on the big "replay" button to go back up and overtype the new values. The $\boxed{\text{DEL}}$ button allows you to delete material and $\boxed{\text{SHIFT}}$─$\boxed{\text{DEL}}$ will insert extra values.

Numbers may be stored for later use with the $\boxed{\rightarrow}$ button and then $\boxed{\text{ALPHA}}$─letter (in red). For example typing in 6→ALPHA-B, means that 2 × ALPHA-B will return 12.

Changing Settings in SET UP = $\boxed{\text{SHIFT}}$─$\boxed{\text{MENU}}$

Display sets the form of how numbers are shown (e.g. in scientific, normal or rounded). Note that the calculator actually calculates every answer in full, even if it does not display all the digits.

Angle changes between degrees and radians. The default is radians, and this will need to be changed whenever the calculator has its memory cleared (such as before an exam).

Complex Mode changes the form which complex numbers will be displayed.

Arithmetic

Scientific notation is done with the $\boxed{10^x}$ = $\boxed{\text{SHIFT}}$─$\boxed{\text{log}}$ button (with no need for any ×). So that $\boxed{3}$ $\boxed{.}$ $\boxed{2}$ $\boxed{\text{SHIFT}}$ $\boxed{\text{log}}$ $\boxed{5}$ = 3.2×10^5 and an output of 4.77**ᴇ**+6 means 4.77×10^6.

Fractions are done with the $\boxed{a^{\,b}/c}$ button. With that, "3⌐4" means ¾ , whereas "2⌐3⌐4" means 2¾. For changing an answer between fractions and decimals, use the $\boxed{\text{F}\leftrightarrow\text{D}}$ button just to its right.

Powers are done using the $\boxed{\land}$ button, so that 2^5 is entered as 2^5.

Roots are done using the $^x\sqrt{\ }$ function, (= $\boxed{\text{SHIFT}}$─$\boxed{\land}$) so that $\sqrt[4]{8}$ is entered as 4 $^x\sqrt{8}$ (note: both square root and cube root are built in, via shift-x^2 and shift-(respectively).

EQUAtion Menu

This Menu is very powerful, but needs to be properly understood before it can be used to its greatest effect. Three possible types of problems can be solved:

F1   **SIML** allows you to solve simultaneous equations.

You need to indicate how many unknowns are involved, then input the various equations in the exact form given at the top of the screen. The $\boxed{\text{EXE}}$ button enters the values, and to increase accuracy you should enter fractions or even calculations (e.g. $3 \div .365$) to avoid rounding errors.

Correctly rearranging the original equations is the key to successful use of this function.

F2   **POLY** allows you to solve a polynomial equation.

Indicate how many unknowns are involved, called the degree in this case. Input the numerical values of the equation in the exact form given at the top of the screen, with the $\boxed{\text{EXE}}$ button. Again use fractions, calculations, square roots etc to input exact values.

NB: older calculators do not indicate double roots. If at any time you get an answer with an "**i**" in it, then it is imaginary and there are no real solutions. **SET UP** = $\boxed{\textbf{SHIFT}}$ – $\boxed{\textbf{MENU}}$ answers you to specify whether you want imaginary number solutions (and their format) or only real ones.

You can use this to help factorise polynomials, with care to use the negatives of the answers.

F3   **SOLV** allows you to find a solution to an equation.

Type in the equation exactly as it is written after "Eq:" on the screen, using the $\boxed{\text{X,}\theta\text{,T}}$ button for your unknown and $\boxed{\text{SHIFT}}$ – $\boxed{\textbf{.}}$ to get the "=" sign. Then **F6** = **SOLV**.

The closer the "left" and "right" are, the more accurate your answer is. Generally it is very, very accurate.

Note though that solver will only give one answer, even if there are multiple solutions available (polynomials, sine functions etc) and may get stuck with some equations (hyperbolas, tan curves). To assist it to find the answer required, enter an approximate value for the solution in **X=** on the second line. If a previous solution has been found, that will be what appears in the X= line and it may need to be changed.

GRAPH Menu

Type in your equations in terms of *x* using the $\boxed{\text{X,θ,T}}$ button, and enter with $\boxed{\text{EXE}}$.

Equations will default to "*y* =" graphs, but you can also enter others, such as "*x* = 3" and parametric types with **F3** = TYPE. Remember to delete such graphs and turn the type back afterwards!

Once your equation or equations are entered, **F6** = **DRAW** draws the graph or graphs. **F1** = SEL will turn on and off which graphs will display (useful when finding intersections of only two of them).

If the resulting graph is not visible, or only partly visible, then the window size needs changing:

- **F3** = **V-Window** then:

    - You can manually enter the minimum and maximum *x* and *y* values, or

    - **F1** = **INIT** will give the initial default setting, which is quite zoomed in.

    - **F2** = **TRIG** sets a standard size for trigonometric graphs.

    - **F3** = **STD** will give the most useful size, with both *x* and *y* values going from −10 to 10.

- **F2** (Zoom) then **F5** = **AUTO** will give an automatic zoom, but is rather unreliable, and **F3** = **IN** and **F4** = **OUT** will zoom in and out centred on the cross hairs moved by the arrows. This is usually slow and clunky, but good for looking at particular points

 (Looking at the axes will often give a hint how far zoomed in or out you are. A very thick axis indicates points close together, while few markings indicate you a zoomed in a long way.)

Once the graph is properly visible, then you can use **F5** = **G-Solv** to locate points of interest (Note: G-Solv does not work on points that cannot be seen, so it is **vital** to get the visibility right first):

- **F1** = **ROOT** gives where the *x*-axis intercept(s). The arrows allow you to move from one root to the next.

- **F2** = **MAX** and **F3** = **MIN** find local minimums and maximums. Arrow between them.

- **F4** = **Y-ICPT** gives where the *y*-axis intercept.

- **F5** = **ISCT** gives where two graphs intersect (cross).

- **F6** then **F1** = **Y-CAL** allows you to calculate which *x* values give a specific *y* value. and **F1** = **Y-CAL** allows a similar calculation of *y* from *x* (or you can use Trace).

With a drawn graph, **F1** = **Trace** moves a point along the graph, giving its values as it does so. With later calculators you can also type in an *x* value and be given the matching *y* value, which is useful in sketching.

F6 (G↔T) alternates between graph and table. **F4** (Sketch) is of specialised use only.

TABLE Menu

The Table menu allows you to enter functions of the same types as the Graph menu. I recommend drawing most graphs from Table initially, only using Graph to check the shape, as more values are displayed and it is easier to work from.

Any equation entered Table will appear in Graph and **vice versa**, so there is no loss of time entering twice. Table will accept different types, and it can be a very good way to follow what is happening with parametric equations.

Once the equation is entered, at the bottom **F5** is **RANG** (for range). Set it for your lowest *x* value of interest, your highest *x* value of interest and a "pitch" of how far apart you want individual points, then $\boxed{\text{EXE}}$.

Now, back in the main Table Function menu, **F6** is **TABL** (for table) and it will give you all the points in a matching *x* then *y* format. If you have multiple formulas, then they will be in side-by-side columns.

You can see what the graph of the table looks like by pressing **F5** = **G-CON** (for graph with connected points).

You can type over the top of the *x* value, and the *y* value(s) will change automatically. This allows you to quickly sketch points on a graph, or find approximate solutions, without needing to change the range each time.

STATistics Menu – Calculating statistics from data

In the Stats Menu you get a set of lists on screen. Use these to enter actual data for calculations.

Type all your data into a single list (usually List 1) item by item, with $\boxed{\text{EXE}}$ to enter each. The $\boxed{\text{REPLAY}}$ arrows allow you to move up and down the list. Sideways will move you to the next list.

If you want to remove an item, pressing the $\boxed{\text{DEL}}$ key will remove it. (Also **F6** gets you to **DEL**. Beside that is **DEL-A** for deleting all data in a list.) If you want to change items, such as correcting an error, just enter over the top of them, you do not need to delete them first.

Once the data is entered **F2 = CALC** then **F1 = 1VAR** will calculate the statistics on the basis that the data is a list of single items. (**2VAR** allows you to calculate regression etc with bivariate data).

You need to recognise the abbreviations used in the data output, in particular, $\overline{x}$ is mean, $x\sigma n$ is standard deviation, and **Q1** and **Q3** are the quartiles.

Multiple Data Sets

If you have two or more sets of data in one exercise, then it is sensible to put them in different lists so that either can be used at any time without having to retype them.

If so, press **F6 = SET** and in **1VAR XList** to select which list you want to calculate from each for the **F2 = CALC** calculations.

If you do change which data set is being used, remember that for later data! Data and settings are stored when the calculator is off and it will continue to use an data set until it is removed. I recommend when starting a new exercise that **all old data is removed** to prevent this problem.

(You can also use **2VAR**, but there is no need and it is likely to end with a mistake of some sort.)

Weighting Entries in List 1

It is possible to use F6 = **SET** to make some other list the frequency or probability for list 1 (second line offered. Now the stats returned for **1VAR** will be only **n** (= 1 if using probabilities), Σx, Σx^2, $\overline{x}$, and $x\sigma n$ for each value *at the listed frequency*.) <u>Use with caution</u> as it is easy to forget it is set this way.