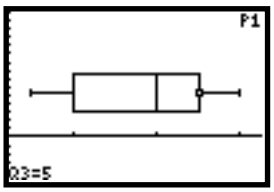
Key Procedures for the TI-82



1. Managing a Work Session

1.1 How to Turn the Calculator On/Off

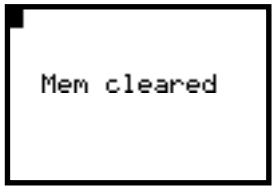
- To turn the TI-82 on, press the **ON** key at the bottom left of the calculator keys.
- To turn the TI-82 off, press the **2nd** key and then the **OFF** key at the bottom left of the calculator keys.

Note
The TI-82 has an automatic 'shutdown' feature which powers the TI-82 down after a few minutes. However the contents of the display are saved for when it is next turned on. This means that any functions entered, graphs plotted and changes to the viewing window dimensions are still in the calculator's memory. This is important to be aware of, since it is wise to establish a routine of 'clearing' any existing functions, and returning to the default viewing window.

After turning on the TI-82, the screen that appears is the home screen. It may or may not be empty, depending on what calculations had been entered prior to when the calculator was last powered down. Since other items are still in memory, such as previously defined functions and the viewing window dimensions, it is wise to begin a work session by clearing such information.

1.2 How to Reset the Calculator

When using a graphics calculator, it is often useful to use a procedure that clears all information, and restores all default settings. Take care with the procedure below - if you have programs, data, or function rules stored then this procedure will delete them completely.

1. After turning the calculator on, press the **2nd** key and then the **MEM** key. **2.** Press the **3:Reset** key to indicate that you wish reset the calculator. Then press the **2:Reset** key to confirm your intention.	 
3. If your batteries are well charged*, then you will see the following screen. Press the CLEAR key to clear the Home screen ready for work. **Note: If your batteries are not well charged, then the screen contrast may not be set sufficiently high to view the 'Mem Cleared' message. If this is the case, press the **2nd** key and then hold down the **UP Cursor** key until the message is displayed clearly.*	

If these steps have been completed, you will now be ready to begin a work session with the TI-82.

2. Entering and Plotting Functions

With the TI-82, the rules for functions are entered via the calculator keys. A maximum of 10 functions may be entered concurrently. The notation used to define each function is the Y_n format, where here n is an integer between 1 to 10 inclusive.

2.1 How to Enter and Plot a Function

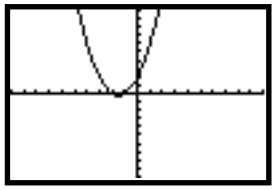
1. Press the **Y=** key. The following screen should appear. Note that the screen has the capacity to show 8 function definitions. There are in fact 10 function definitions permitted, but two (Y_9 and Y_{10}) are off screen.

2. Press the keys required to create a function rule. To represent the independent variable X, press the variable key **X,T,θ**. In this example, type in the function $Y_1 = x^2+3x+2$ by pressing the following sequence of keys;

X,T,θ □ x² □□ + □ 3 □ X,T,θ □ + □ 2

3. If you have made errors when entering the function (eg wrong symbol), use the **cursor** keys and the **DEL** key to delete the incorrect symbol(s), and press the correct keys. This should replace the old symbol(s) with the correct one(s).

4. Press the **ZOOM** key and then select the **6:ZStandard** option to graph th function in the standard viewing window.



2.2 How to Enter and Plot More Than One Function

If you wish to enter and plot a number of functions on the same set of axes, follow the steps below.

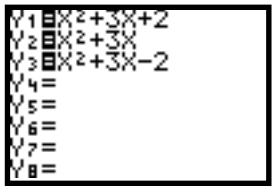
1. Enter the first function as described in the section above entitled "How To Enter And Plot A Function"

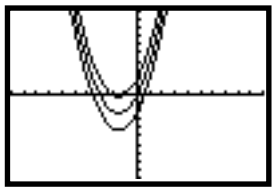
2. To enter further functions, press the **Down Cursor** key to move the cursor to the next empty function rule line

3. Type the appropriate keys to enter the desired function rule (for this example, enter the rules Y2 = x^2 + 3x and Y3 = x^2 + 3x - 2.

4. Repeat steps 2 and 3 until all functions have been entered.

5. Press the **GRAPH** key to display the graphs of all entered functions.





2.3 How to Clear a Function Rule

1. Press the **Y=** key. This will bring all defined function rules into view.

2. Use the cursor keys to move to the function rule you wish to clear.

3. Press the **CLEAR** key.

4. Repeat steps 2 and 3 to clear any other function rules.

2.4 How to Clear An Existing Graph

Each time a new function is defined in the **Y=** screen, the TI-82 assumes that you will want to graph the function, so that if you press the GRAPH key, the calculator will attempt to plot the new function. If you wish to prevent the TI-82 from plotting any function, follow this procedure;

1. Press the **Y=** key to bring up the Function Definition Screen. Note that the **=** symbol for Y_1 is blackened. This means that this function is 'selected' , and will be plotted.

2. Press the **Left Cursor** key until the flashing cursor is on top of the **=** symbol for the function Y_1.

3. Press the **ENTER** key. This 'de-selects' the function, and removes the blackened background. It will now not plot the function Y_1. Confirm that this disables graphing the current function by pressing the **GRAPH** key.

Note: *When you wish the TI-82 to re-plot a defined function, just repeat the above process to 'select' the function Y_1 again. That is, move the cursor above the = symbol and press the **ENTER** key*

3. Using Correct Syntax

The syntax rules in the TI-82 strictly follow the normal rules for the order of mathematical operations (ie - BODMAS). A function rule, when defined, occupies a single line and therefore can be hard to read. For example, an expression such as

$$Y_2 = \frac{x - 3}{x + 2} \quad \text{will appear on screen as } Y_2 = (x - 3)/(x + 2)$$

When entering function rules, pay careful attention to the order of operations. When in doubt, use brackets to make your intention clear.

3.1 How to Enter Exponents (Powers)

- If the exponent is 2 (eg - for x^2), press the **X,T,θ** key followed by the **x^2** key
- If the exponent is -1 (eg for x^{-1}), press the **X,T,θ** key followed by the **x^{-1}** key
- If the exponent is a number other than 2 or -1, (eg x^3) press the **X,T,θ** key followed by the **^** key followed by the exponent (eg 3)
- If the exponent is not a single term (eg 2^{x+3}), ensure that you have bracketed the terms that are exponents (eg 2^(x + 3).

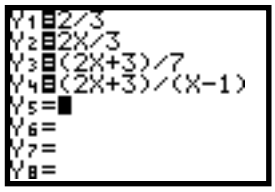
3.2 How to Enter Fractions

1. For simple fractions, press the keys for the numerator

2. Press the ÷ symbol (it will appear as / on the screen).

3. Press the keys for the denominator.

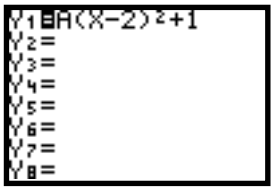
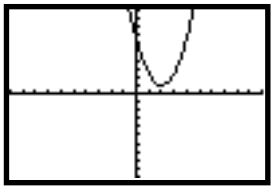
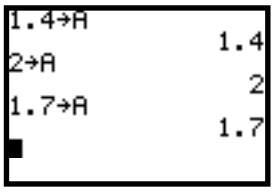
Note: *For more complicated fractions or rational expressions (involving more than one term in either the numerator or denominator (or both)), ensure that you use brackets to preserve the order of operations. Some examples are shown right.*



4. Advanced Graphing Features

4.1 How to Enter and Plot a Function Using Constants

It is possible to change the rule and re-plot a function without using the **Y=** key . To do this it is possible to enter a function rule including parameters (constants). For example, we can enter a function of the form y = Ax, where A is the parameter. By assigning different values for A, we are able to change the function rule and its associated graph without re-entering the function rule.

1. Press the **Y=** key **2.** To enter the constant "A", press the **ALPHA** key, followed by the "**A**" key **3.** Press the required keys to complete entering the rule $\mathbf{Y_1 = A(X-2)^2 + 1}$	
4. Press the **2nd** key and then the **QUIT** key to return to the Home screen. **5.** To enter a specific value for A in the Home screen (eg **A** = 1.4), press the following key sequence **1.4 □ STO □ ALPHA □ A □ ENTER** This sets the current value of the constant **A** to 1.4. **6.** Press the **GRAPH** key to observe the change in the graph.	
7. Try other values of A as required by repeating steps 4, 5 and 6.	

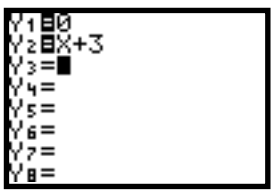
4.2 How to Shade Above/Below a Function Graph

It is possible to shade the region above or below the graph of a function rule on the TI-82, using one of the DRAW features. The following draw function syntax is required.

Shade (lower function, upper function, Xleft, XRight)

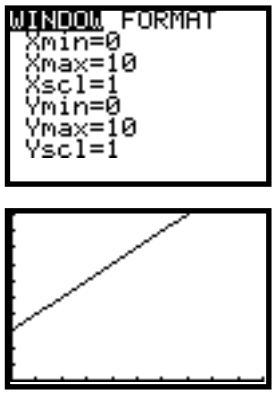
Note that this feature is best suited to shading regions between the graphs of 2 functions, rather than for graphical linear programming. Note that the Xleft and XRight parameters are optional. In the procedure below, we will attempt to display the region of the X-Y plane bounded by the following relationships:

$$y \geq x + 3; \quad \text{and } y \geq 0; \quad x \geq 0.$$

1. Press the **Y=** key, and then press the keys required to enter the function rule **Y1 = 0** (this is to assign a 'dummy' lower function.) **2.** Press the keys required to enter the function rule **Y2 = X + 3.**	

4.2 How to Shade Above or Below a Function Graph (cont.)

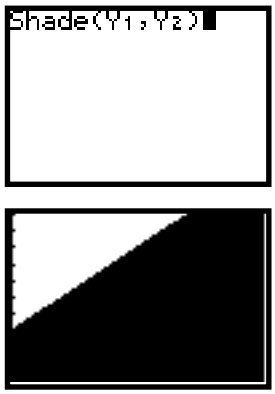
3. Press the **WINDOW** key and set the viewing window dimensions as [0,10] by [0,10]. Then press the **GRAPH** key to view the graphs (unshaded). Note that the graph of Y1 = 0 is not distinguishable from the x-axis.



4. Press the **CLEAR** key to go to the HOME screen. Then press the **2nd** key and then the **DRAW** key. Select the option **7:Shade(** to indicate that you wish to shade the region between two functions. Then enter the appropriate keys to complete the function **Shade (Y1, Y2).** Note from the graph screen below that this has shaded above the graph of Y1 (that is, Y = 0) and below the graph of Y2 (that is, Y2 = X + 3)

Note: To enter the 'Y1' symbol
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option

***Note**: To remove any shading press the **2nd** key and then the **DRAW** key. Then select the **1:ClrDraw** option to clear the graph screen of any 'DRAW' objects.*



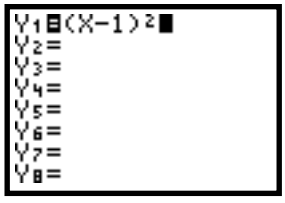
4.3 How to Define Functions in Terms of Other Functions

It is often convenient to define a function which may involve some operation on another previously define function. Examples include:

- *Addition of Ordinates* $Y1 + Y2$
- *Difference Functions* $Y1 - Y2$
- *Pointwise Products* $Y1*Y2$
- *Reciprocal functions* $1/Y1$ or $Y1^{-1}$
- *Squared Functions* $Y1^2$

In the example procedure below, we will define the function with rule $Y1 = (x - 1)^2$ and the Y2 as the reciprocal function of Y1 with rule $Y2 = 1/Y1$. The procedure closely mirrors the procedure that would be required to enter the other example functions shown above.

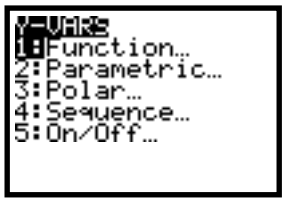
1. Press the **Y=** key and then press the keys required to enter the function rule **$Y1 = (x - 1)^2$** .

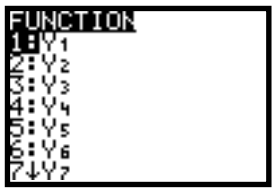


4.3 How to Define Functions in Terms of Other Fns (cont.)

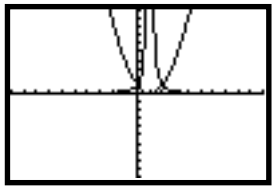
2. Press the keys required to enter and store the function rule **Y2 = 1/Y1**

Note: ***To enter the 'Y1' symbol***
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option





3. Press the **ZOOM** key. and then press **6:ZStandard** to set the viewing window back to the default dimensions, which are [-10,10] by [-10,10], with scale markings at each unit. This will then graph both functions.



4.4 How to Enter and Plot Derivative Functions

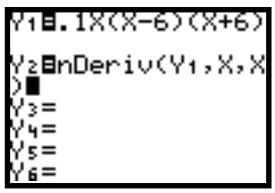
Using the built in numeric derivative calculation feature, the TI-82 is able to plot gradient (or derivative) functions for a defined function rule. The syntax of the rule is as follows. The expression **nDeriv(Y1,X, X)** means 'calculate the numeric derivative for the function in Y1 with respect to the variable X, and for the entire visible (in current viewing window) domain of X' . In the example procedure below, the 'original' function will be defined by the rule Y1 = 0.1X(X – 6)(X +6)

1. Press the **Y=** key, and then press the keys required to enter the function rule **Y1 = 0.1X(x – 6)(x +6)** .

2. Press the keys required to enter the function rule **Y2 =nDeriv(Y1,X,X)**

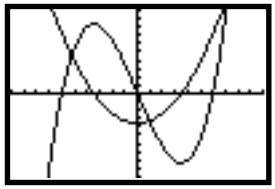
Note: *To enter the NDerivsymbol*
- press the **MATH** key and then the **8:nDeriv(** key

Note: *To enter the 'Y1' symbol*
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option



3. Press the **ZOOM** key. and then press the **6:ZStandard** key to set the viewing window back to the default dimensions, which are [-10,10] by [-10,10], with scale markings at each unit. This will then graph both functions.

Note: *A similar procedure allows the user to enter the 2nd derivative function.*



4.5 How to Plot a Family of Functions

A family of functions is a set of functions that are identical except for the value of a particular parameter. For example, $f(x) = x^2 - 1$, $f(x) = x^2 + 2$, and $f(x) = x^2 + 3.25$ are all member functions of a family, written as $f(x) = x^2 + a$. With a TI-82, we can work with a family of functions by following the procedures below

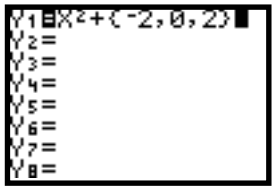
In the following procedure, the example function family will be of the form $Y_1 = x^2 + a$, where a = {-2,0,2}.

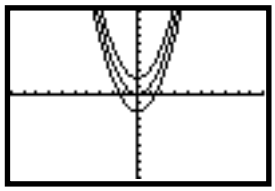
1. Press the **Y =** key to define a function

2. Enter the rule for the function, by entering the following sequence of symbols.

x^2 + {-2,0,2}

***Note**:* The graph of $f(x) = x^2 + a$ will be plotted for a = -2, 0, and 2 (see resultant graphs right). The method of data entry shown in the above example is very useful for quickly observing the impact of a particular constant on the shape of a graph.





4.6 How to Restrict the Domain of a Function

The set of defined x values for which the function is defined is called the 'domain' of the function. Let us say, for example, that a function $f(x) = x^2$ is only defined for $-3 \le x \le 2.5$. It is possible for the TI-82 to incorporate this restriction by following the procedure listed below.

1. Press the **MODE** key

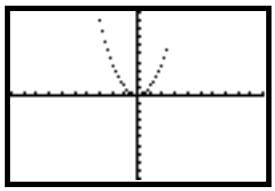
2. Position the cursor on the line that contains the **Connected/Dot** option.

3. Select the **Dot** option and press the **ENTER** key. (This is the only mode in which functions with restricted domains will work properly).

4. Press the **Y=** key and press the appropriate keys to enter the function **Y_1 = (x^2) (x^3-3) (x≤2.5)**

***Note**: keys such as ≥ and ≤ can be entered by pressing the **2nd** key and then the **TEST** key.*

***Note**: This bracketing of statements within the rule and domain (see above) looks a little cumbersome, and working in **Dot** mode is not usually the best view of a function. However, the fact is that domain restrictions and hybrid or piece-wise functions are quite possible in TI-82.*



After pressing the **GRAPH** key, the graph of f(x) should now appear, incorporating the restricted values for x. Note how the function is only plotted between x = -3 and x = 2.5. This procedure of restricting the function is very useful in modelling as it allows the user to focus on the x values (domain) for which a rule makes sense.

4.7 How to Enter and Plot Integral Functions

Using the built in numeric integration calculation feature, the TI-82 is able to plot integral (or antiderivative) functions for a defined function rule. The syntax of the rule is as follows. When entered as a function rule, the expression **fnInt(Y1,X, 0,X)** means 'calculate the definite integral for the function in Y1 with respect to the variable X, between the x values of 0 and the current value of X' . In the example below, the 'derivative' function will be defined by the rule $Y1 = X^2$

4.7 How to Enter and Plot Integral Functions (cont.)

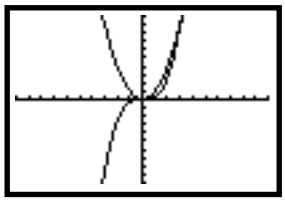
1. Press the **Y=** key, and then press the keys required to enter the function rule **Y1 = X^2**.

2. Press the keys required to enter the function rule **Y2 = fnInt(Y1,X,0,X)**

Note: *To enter the 'fnInt' symbol*
- press the **MATH** key and then the **9:fnInt(** key

Note: *To enter the 'Y1' symbol*
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option

3. Press the **ZOOM** key. and then press the **6:ZStandard** key to set the viewing window back to the default dimensions, which are [-10,10] by [-10,10], with scale markings at each unit. This will then graph both functions.



4.8 How to Enter & Plot a Graph Using Parametric Equations

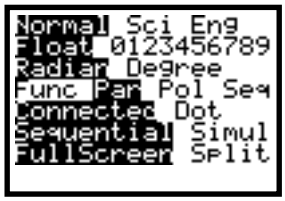
With the TI-82, the rules for graphs may be defined parametrically, that is, by defining a rule for determining the x-coordinate, and a separate rule for determining the value of the y coordinate. A maximum of 6 parametrically defined relationships may be defined in this way may be entered concurrently.

1. Press the **MODE** key and move to the **Func Par Pol Seq** line. Then select the Par option (indicating 'parametric')

2. Press the **Y=** key. The following screen should appear. To represent the independent variable T, press the variable key **X,T,θ**. In this example, type in the following sequence of keys:

$$X1_T = 4T^2$$
$$Y1_T = 2T$$

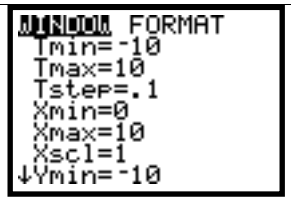
3. If you have made errors when entering the function (eg wrong symbol), use the **cursor** keys and the **DEL** key to delete the incorrect symbol(s), and press the correct keys. This should replace the old symbol(s) with the correct one(s).

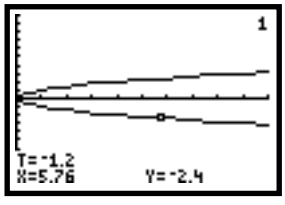


4. Press the **WINDOW** key and then enter the values as shown below.

Tmin=-10, Tmax=10, Tstep=0.1, Xmin=0, Xmax=10, Xscl=1, Ymin=-10, Ymax=10

5. Prtess the **GRAPH** key and then the **TRACE** key.

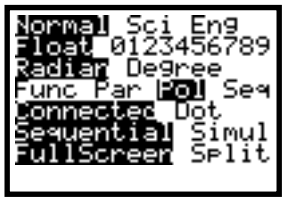




4.9 How to Enter and Plot a Polar Graph

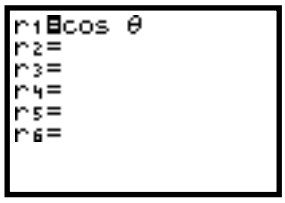
With the TI-82, polar graphs may be defined. A maximum of 6 relationships of this type may be defined concurrently.

1. Press the **MODE** key and move to the **Func Par Pol Seq** line. Then select the **Pol** option (indicating 'polar')



2. Press the **Y=** key. The following screen should appear. To represent the independent variable **θ**, press the variable key **X,T,θ**. In this example, type in the following sequence of keys:

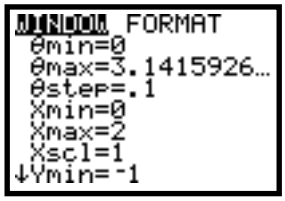
$$r_1 = \cos\theta$$



3. If you have made errors when entering the function (eg wrong symbol), use the **cursor** keys and the **DEL** key to delete the incorrect symbol(s), and press the correct keys. This should replace the old symbol(s) with the correct one(s).

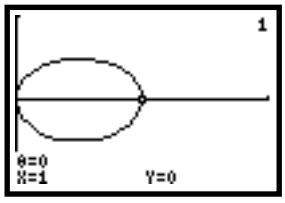
4. Press the **WINDOW** key and then enter the values as shown below.

θmin=0, θmax=□, θstep=0.1, Xmin=0, Xmax=2, Xscl=1, Ymin=-1, Ymax=1



5. Press the **GRAPH** key and then the **TRACE** key.

Note: Using **ZOOM** and then **5:ZSquare** will make the scales equal and improve the 'circular look'.



5. Moving Around the Viewing Window

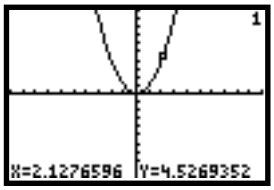
The **GRAPH** screen can be thought of as a true 'window' through which we can observe the graphs of defined functions. If the relevant portion(s) of the function's graph are not quite in view, there are a number of options for changing the viewing window so that we can more clearly examine the behaviour of the function.

5.1 How to Display Graph Co-ordinates

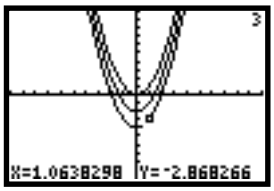
1. Press the **GRAPH** key (this procedure assumes that you have already entered the function rule Y1 = X^2)

2. Press the **TRACE** Key. This locates the cursor on the graph of the function Y_1, allowing the user to trace the function along the path of Y_1. The symbol **1** is displayed in the top right hand corner of the screen to indicate that Y_1 is the function whose co-ordinates are being displayed (see diagram right).

3. Use the **Left & Right Cursor** keys to 'trace' the path of the function. The co-ordinates of the cursor are updated each time a cursor key is pressed.



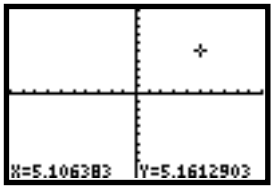
4. If you have more than one function rule defined (say Y2 = X^2 - 2 and Y3 = X^2 - 4), press the **Up** or **Down Cursor** key to move the TRACE cursor to the other function graphs. The number displayed in the top right hand corner of the screen (eg 2 for Y_2, 3 for Y_3, and so on) indicates which function graph's co-ordinates are currently being displayed.



5.2 How to Change to the Default Viewing Window

1. Press the **ZOOM** key.

2. Press the **6:ZStandard** key (this will return to the default viewing window which is the region bounded by the points (-10 £ x £ 10 and -10 £ y £ 10)



5.3 How to Change the Viewing Window Dimensions

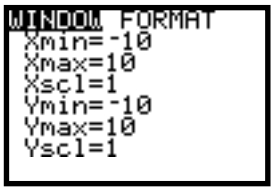
It is possible to alter the dimensions of the viewing window directly, as well as the spacing between the markings on each of the axes. The parameters that can be directly altered are:

Xmin/Xmax - the minimum/maximum X value that will be visible in the viewing window;
Ymin/Ymax - the minimum/maximum Y value that will be visible in the viewing window;
Xscl/Yscl - the number of units between markings on the X-axis/Y-axis.

1. Press the **WINDOW** key. This will bring up the screen shown right.

2. Use the **Up** and **Down Cursor** keys to move to the **WINDOW** option you wish to alter. Then enter the new figure.

3. Press the **GRAPH** key to show the resultant change in the viewing window.

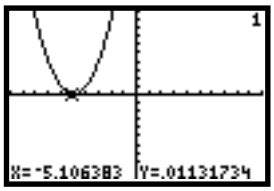


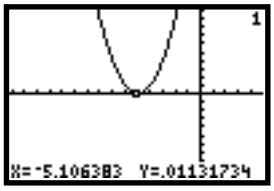
5.4 How to Change the Centre of the Viewing Window

1. Press the required keys to enter and plot the function Y1 = x2 + 10x + 25 in the standard viewing window

2. Press the **TRACE** key to display graph co-ordinates. Then Press **Left** or **Right Cursor** key (as required) to move the cursor to the desired point (in this example, to around x = -5, near the minimum value of the function). Press the **ENTER** key to re-centre the viewing window around the selected point.

Note: *If there is more than one function defined, or if the function of interest is not Y_1, press the **Down Cursor** key (as required) to select the relevant graph. The upper right corner of the graph screen indicates which of the function graphs the cursor is located on (ie - 1 is displayed for Y_1, 2 for Y_2, etc).*



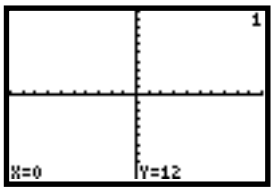


5.5 How to Locate a Graph Not In the Viewing Window

Sometimes the graph may not be displayed in the current viewing window. The **TRACE** key allows the user to locate the cursor on such a graph and to change the viewing window so that part of the graph will come into view.

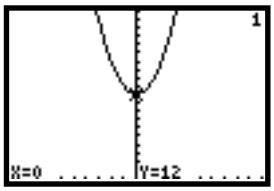
1. Press the **GRAPH** key to display the graph screen (for this example, we will use the function rule Y1 = x^2 + 12).

2. Press the **TRACE** key to display graph co-ordinates. This locates the cursor on the graph of Y1 (not on screen).



3. If Y_1 is the graph that is not in view, press the **ENTER** key. This will reposition the viewing window so that a portion of the graph of Y_1 is now displayed (see example right for the graph of y = x^2 + 12).

4. If there is more than one function defined, and the function of interest is not Y_1, press the **Up** or **Down Cursor** key (as required) to select the relevant graph. The upper right corner of the graph screen indicates which of the function graphs the cursor is located on (ie 1 is displayed for Y_1, 2 for Y_2, and so on). Then press the **ENTER** key to re-centre the viewing window around the selected point.



6. Using Scaling/Zooming Options

Scaling is the process of changing the scales on either or both axes. Function graphers often refer to the processes of **zooming in** and **zooming out**:

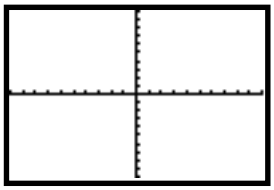
- **Zooming In** - looking more closely at the graph through a smaller viewing window
- **Zooming Out** - looking more widely at the graph through a larger viewing window

*The options available after pressing the **ZOOM** key*

6.1 How to Change to the Default Zoom Level

1. Press the **ZOOM** key.

2. Press the **6:ZStandard** key this will return to the default viewing window which is the region bounded by the points [-10,10] by [-10,10].



6.2 How to Zoom In

The **Zoom In** option permits zooming in around a user definable co-ordinate. The TI-82 defaults to zooming in on both axes by a factor of 4.

1. Press the **ZOOM** key.

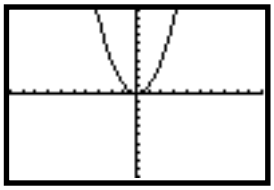
2. Press **2** to select the **2:Zoom In** option. This takes you back to the graph screen. A cursor will be flashing (possibly at the origin). If you wish to zoom in around that point, press the **ENTER** key without changing the cursor location. To zoom in again (around the same point), press **ENTER** again.

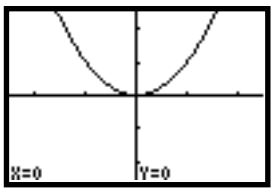
(If you wish to zoom in around another point in the current viewing window, follow steps 3 and 4 below.)

3. Move the **Cursor** keys to change the point around which the **Zoom In** will occur.

4. When you have located the cursor in the region of interest, press the **ENTER** key.

5. To zoom in further, repeat steps 3 and 4





6.3 How to Box Zoom

The **ZBox** option permits zooming inside a user definable rectangular 'box' of the current viewing window..

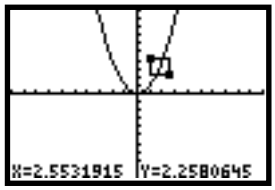
1. Press the **ZOOM** key

2. Press **1** to select the **1:ZBox** option

This takes you back to the graph screen. A cursor will be flashing (possibly at the origin). You then use the cursor arrows to define the zoom in 'box'. Follow the procedure below.

3. Use the **Cursor** keys to locate the 'upper left corner' of the zoom box and then press the **ENTER** key.

4. Use the **Cursor** keys to locate the 'bottom right corner' of the zoom box (a box will be created on screen) and then press the **ENTER** key. (This then zooms into the boxed region).



6.4 How to Zoom Out

Zooming out permits the user to observe more of the graph, including perhaps more of the general shape or global features of the graph. The TI-82 defaults to zooming out on both axes by a factor of 4.

The **Zoom Out** option permits zooming out around a user definable co-ordinate.

1. Press the **ZOOM** key.

2. Press **3** to select the **3:Zoom Out** option. This takes you back to the graph screen. A cursor will be flashing (possibly at the origin). If you wish to zoom out around that point, press the **ENTER** key without changing the cursor location. To zoom out again (around the same point), press **ENTER** again.

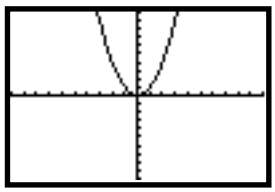
Note: *Zooming out often creates the illusion of the 'double thickness' axis. This is because the markings on the axes are not being adjusted to account for the different zoom level. To alter these, press the* ***WINDOW*** *key and adjust the values for Xscl and/or Yscl.*

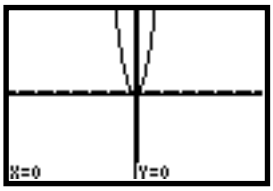
(If you wish to zoom out around another point in the current viewing window, follow steps 3 and 4 below.)

3. Move the **Cursor** keys to change the point around which the **Zoom Out** will occur.

4. When you have located the cursor in the region of interest, press the **ENTER** key.

5. To zoom out further (around the same point), press **ENTER** again.





6.5 How to Change the Zoom Factors

The default zoom factors is 4 for each axis. This means that zooming in (or out) creates a change in the magnification of 400% (or 25%) in the direction of each axis. The procedure for changing any or all of these zoom factors is given below.

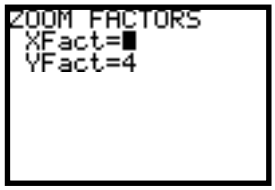
1. Press the **ZOOM** key

2. Press the **Right Cursor** key to move to the **MEMORY** option

3. Press **4** to select the **4:SetFactors** option

4. Change the values of **XFact** or **YFact** as required.

5. Press the **GRAPH** key to return to the graph screen.

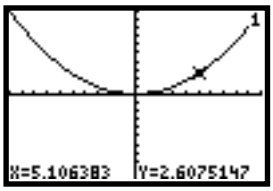


6.6 How to Use the ZInteger Option

The **ZInteger** option permits the user to trace functions by redefining the viewing window so that each press of the **TRACE** cursor increments X (or Y) by 1 unit. This may be useful if you are considering integer only solutions to problems. This may also be useful if you are wishing to trace a function, incrementing by integer values of the independent variable, rather than incrementing by amounts dependent on the current zoom level.

(The procedure below assumes that you have entered a function into Y1. In this example, we will use the function with rule $Y1 = 0.1X^2$ in the standard viewing window)

1. Press the required keys to enter and plot the function $Y1 = 0.1\ X^2$ in the standard viewing window. Then press the TRACE key, noticing how the coordinates displayed are 'unrounded'



2. Press the **ZOOM** key and then press **8** to select the **8:ZInteger** option.

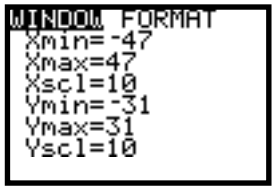
3. Move the **Cursor** keys to select the centre of the new viewing window (if desired).

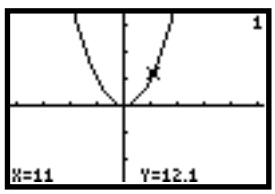
4. Press the **ENTER** key to re-plot the functions in the new viewing window (which will be [-47,47] by [-31,31] as shown right) .

5. Press the **TRACE** key to position the cursor on the relevant graph.

6. Press the **Right Cursor** key to calculate the function value for successive integer values of the independent variable.

Note: *If this viewing window is not suitable, performing zoom in or out operations leaves the 'integer incrementing effect' intact. However, using the zoom box or changing the viewing dimensions directly will cancel the effect.*

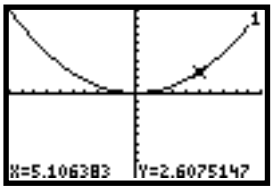




6.7 How to Use the ZDecimal Option

The **ZDecimal** option permits the user to trace functions by redefining the viewing window so that initially each press of the **TRACE** cursor increments X (or Y) by 0.1 of a unit. This may be useful if you are wishing to trace a function incrementing by values of 0.1, rather than incrementing by amounts dependent on the current zoom level. (The procedure below assumes that you have entered a function into Y1. In this example, we will begin with the function with rule Y1 = $0.1X^2$ in the standard viewing window)

1. Press the required keys to enter and plot the function Y1 = $0.1\ X^2$ in the standard viewing window. Then press the **TRACE** key, noticing how the coordinates displayed are 'unrounded'



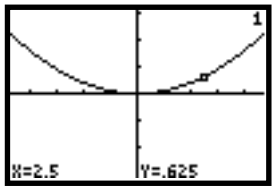
2. Press the **ZOOM** key and then press **4** to select the **4:ZDecimal** option.

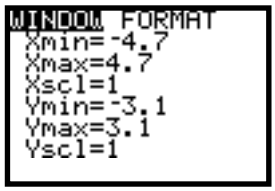
3. Press the **ENTER** key to re-plot the functions in the new viewing window (which will be [-4.7,4.7] by [-3.1,3.1] as shown right).

4. Press the **TRACE** key to position the cursor on the relevant graph.

5. Press the **Right Cursor** key to calculate the function value for successive increments of 0.1 of the independent variable.

Note: *If this viewing window is not suitable, performing zoom in or out operations leaves the 'rounded incrementing effect' intact, although the number of decimal places used will depend on the extent of zooming. However, using the zoom box or changing the viewing dimensions directly will cancel the effect.*



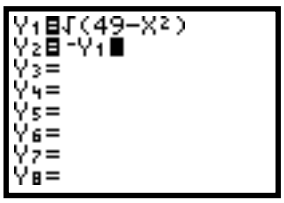


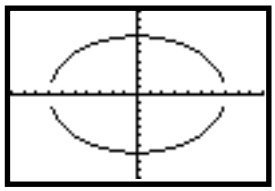
6.8 How to Use the ZSquare Option

The **ZSquare** option attempts to display the true graph proportions by replotting the graphs of all entered functions with equal scales for the x and y axes. It does this by altering the current viewing window so that pressing the **Left** or **Right** cursor key moves the cursor the same distance as pressing the **Up** or **Down** cursor key. To illustrate the benefit of ZSquare, enter the functions Y1 = $\sqrt{49 - x^2}$ and Y2 = – $\sqrt{49 - x^2}$

1. Press the **Y=** key and enter function rules Y1 = $\sqrt{49 - x^2}$ and Y2 = – Y1

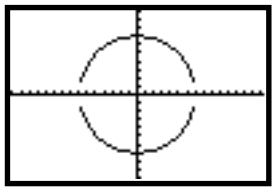
2. Press the **ZOOM** key and then press **6** to select the **6:ZStandard** to graph the functions in the standard viewing window.





3. Press **5** to select the **5:ZSquare** option. This will re-plot the functions in the new viewing window. (This will also create axis markings that have equivalent scale on each axis)

Note*: The circle appears not to meet near the X-axis - this is due to the steepness near those points and the number of available pixels horizontally in that region.*



6.9 How to Use the ZPrev Option

Sometimes a user may perform a zoom operation (eg ZBox) which creates a viewing window that is unhelpful. In this case, the user may wish to return to the previous zoom level (that is, the previous viewing window dimensions). With the TI-82, there is an option 'ZPrev' which restores the user's most recently used zoom setting.

1. To return to the 'previous' zoom setting, press the ZOOM key and then the Right cursor key. The following screen will appear. **2.** Press **1** to select the **1: ZPrevious** option	

7. Using Calculus Features

7.1 How to 'Jump-To' Significant Points

The TI-82 has a number of built in functions that allow the user to 'jump' to significant points that may be present in the current viewing window. These are:

value Jumps to the value of a function for a user-specified x value (if in current viewing window)

root Jumps to the roots of a given function in the current viewing window

minimum Jumps to any local minimum values for the specified function in the current viewing window

maximum Jumps to any local minimum values for the specified function in the current viewing window

intersect Jumps to any intersection points between two function graphs in the current viewing window

Please Note

- Where more than one function rule has been graphed, the user will be first asked to place the cursor key on the appropriate graph. In such cases, it is best to use the TRACE cursor to first select the appropriate graph.
- Some of the jump-to features (eg root) of the TI-82 prompt the user to specify upper and lower bounds and a guess for the relevant point.
- If a significant point cannot be located in the current viewing window, the message 'ERR: DOMAIN' is displayed.

The procedure below assumes that you have entered the function rule and have graphed it in the standard viewing window. In this procedure, we will calculate the value of the local maximum, but the procedures will be similar for all the jump-to features.

1. Enter and plot the function with rule Y1 = 0.1X(X - 6)(X + 6)

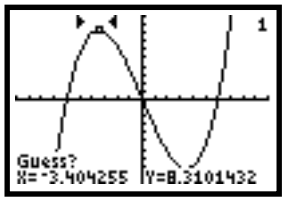
2. Press the **2nd** key and then the **CALC** key to bring up the Jump-to options.

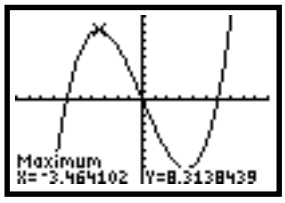
3. Press the **4:maximum** key to begin 'jump-to' procedure for local maxima. Remember that if you have more than one function rule defined, use the TRACE cursor first to select the appropriate graph.

4. You will be prompted to locate the lower bound. Press the **Right** and **Left Cursor** keys to locate a point just to left of the desired naximum.

5. You will be prompted to locate the upper bound. Press the **Right** and **Left Cursor** keys to locate a point just to right of the desired naximum.

6. You will be prompted to locate a guess at the maximum value. Press the **Right** and **Left Cursor** keys to locate a point as close as possible to the local maximum.





7.2 How to Calculate the Numeric Derivative (Home)

It is possible to calculate the numerical derivative or slope of the tangent line at a given point on the function graph. The first method is via the Home Screen which involves a number of key strokes but allows user to enter precise x-value for which numeric derivative of the function is to be calculated. The expression **nDeriv(Y1, X,1.03)** means calculate the numeric derivative of Y1 with respect to X at x = 1.03

Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to calculate the numeric derivative of Y1 at x = 1.03. It is also possible to enter the function rule directly, that is entering X^2 instead of Y1.

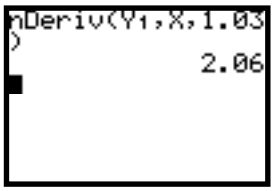
7.2 How to Calculate the Numeric Derivative (Home) (cont.)

1. Press the **2nd** key and then the **QUIT** key to move to the Home screen. Then press the **CLEAR** key to clear the Home screen.

2. Press the **MATH** key and then the **8:nDeriv(** key.

3. Complete the expression **nDeriv(Y1, X,1.03)** and press the **ENTER** key.

Note: *To enter the 'Y1' symbol*
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option



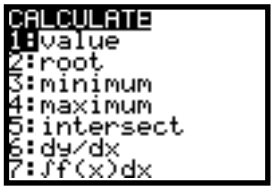
7.3 How to Calculate the Numeric Derivative (Graph)

It is possible to calculate the numerical derivative or slope of the tangent line at a given point on the function graph. This second method is via the Graph Screen which involves fewer keystrokes and more interactivity than the Home screen method, but the choice of x-values is restricted by the current x-increment *(see example below)*.

Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to calculate the numeric derivative of Y1 at x = 1.03

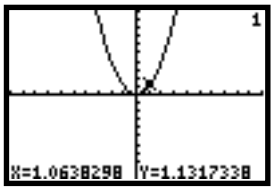
1. Press the **GRAPH** key to graph the function $Y1 = X^2$.

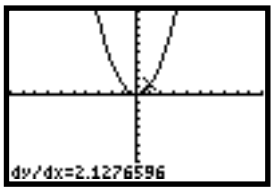
2. Press the **2nd** key and then the **CALC** key to bring up the Jump-to options.



3. Press the **6:dy/dx** key to select the numeric derivative option. This returns the user to the graph screen (with TRACE cursor on) and prompts the user to move the cursor to the point at which the numeric derivative is to be calculated (see below right). Press the **Right Cursor** key until the cursor is as close as possible to x = 1.03 (here about 1.06), and then press the **ENTER** key. This then calculates the value of the derivative at that point.

Note *: Because of screen resolution limitations, it is not possible in this window to place the TRACE cursor exactly on the point x = 1. 03. This is a limitation of this method, but can be overcome somewhat by defining an appropriate viewing window beforehand*





7.4 How to Calculate the Numeric Integral (Home Screen)

It is possible to calculate the numeric integral of a function between two given x-values. The first method is via the Home Screen which involves a number of key strokes but allows user to enter precise x-value for which numeric integral of the function is to be calculated. The expression***fnInt(Y1, X,-1, 1.55)*** means calculate the numeric integral of Y1 w.r.t. X b/w x = -1 and x = 1.55.

Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to calculate the numeric integral of Y1 between x = -1 and x = 1.55. It is also possible to enter the function rule directly, that is entering X^2 instead of Y1.

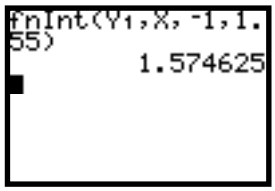
7.4 How to Calculate the Numeric Integral (Home) (cont.)

1. Press the **2nd** key and then the **QUIT** key to move to the Home screen. Then press the **CLEAR** key to clear the Home screen.

2. Press the **MATH** key and then the **9:fnInt(** key.

3. Complete the expression **fnInt(Y1, X,–1,1.55)** and press the **ENTER** key.

Note: *To enter the 'Y1' symbol*
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option



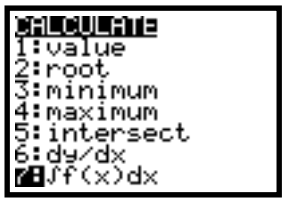
7.5 How to Calculate the Numeric Integral (Graph)

It is possible to calculate the numerical integral for a given function between two x values. This second method via the Home & Graph Screen allows the user to view the shaded region enclosed by the numeric integral command.

Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to calculate the numeric integral of Y1 between x = -1 and x = 1.55.

1. Press the **GRAPH** key to graph the function $Y1 = X^2$. in the window [-2,2] by [-1,5]

2. Press the **2nd** key and then the **CALC** key to bring up the Jump-to options.

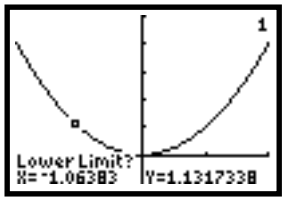


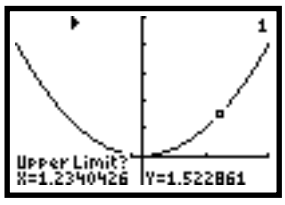
3. Press the **7:∫ f(x) dx** key to select the numeric integral option. This returns the user to the graph screen (with TRACE cursor on)

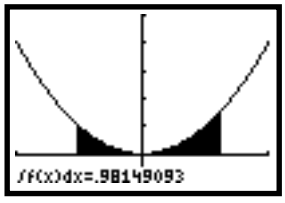
4. Press the cursor keys to move as close as possible to the 'Lower Limit' (in this example x = –1) and then press the **ENTER** key. This then calculates the value of the integral at that point.

5. Press the cursor keys to move as close as possible to the 'Upper Limit' (in this example x = 1.55) and then press the **ENTER** key. This then calculates the value of the integral between the approximate limits, and shades the relevant region (see below right).

Note : Because of screen resolution limitations, it is not possible in this window to place the TRACE cursor exactly on the point x = –1 or x = 1.55. This is a limitation of this method, but can be overcome somewhat by defining a more appropriate viewing window before hand.







7.6 How to Draw Tangent Lines (Home)

The TI-82 is able to draw tangent lines on a function graph at user specified x values. The first method is via the Home Screen which involves a number of key strokes but allows the user to enter a precise x-value for which the tangent line is to be drawn. The expression**Tangent(Y1, 1.3)** means draw the tangent of Y1 at x = 1.3.

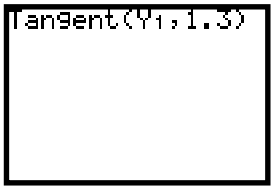
Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to draw the tangent of Y1 at x = 1.3. It is also possible to enter the function rule directly, that is entering X^2 instead of Y1

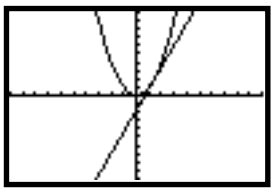
1. Press the **2nd** key and then the **QUIT** key to move to the Home screen. Then press the **CLEAR** key to clear the Home screen.

2. Press the **2nd** key and then the **DRAW** key. Then press the **5:Tangent(** key.

3. Complete the expression **Tangent(Y1, 1.3)** and press the **ENTER** key to draw the tangent at this point.

Note: *To enter the 'Y1' symbol*
- Press the **2nd** key and then the **Y-VARs** key
- Then press the **1:Function …** key
- Then press the **1:Y1** key to select the Y1 variable option





7.7 How to Draw Tangent Lines (Graph)

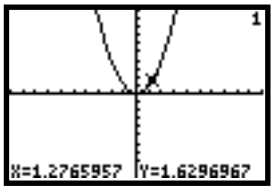
The TI-82 is able to draw tangent lines on a function graph at user specified x values. This second method is via the Graph Screen which involves fewer keystrokes and more interactivity than the Home screen method, but the choice of x-values is restricted by the x-increment *(see example below)*.

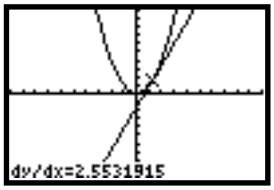
Note The procedure below assumes that you have entered a function rule $y = x^2$ in Y1, and wish to draw the tangent of Y1 as close as possible to x = 1.3

1. Enter the required keys to enter and graph the function $Y1 = x^2$ in the standard viewing window.

2. Press the **2nd** key and then the **DRAW** key. Then select the **5:Tangent (** option. The graph screen will then come back into view, and the TRACE cursor will be flashing. Press the right (or left cursor keys) to move as close possible to the point on the graph that is closest to x = 1.3. Then press the **ENTER** key to draw a tangent line to the curve at that point.

Note *: Because of screen resolution limitations, it is not possible in this window to place the TRACE cursor exactly on the point x = 1.3 . This is a limitation of this method, but can be overcome somewhat by defining a more appropriate viewing window before hand.*





8. Working With Univariate Data

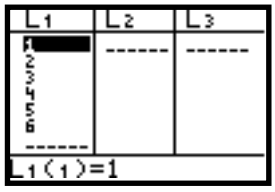
In the following procedures, we will use the following data values for the variable x.

x	12	15	28	31	16

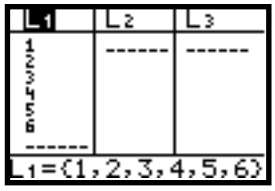
8.1 How to Clear Existing Data

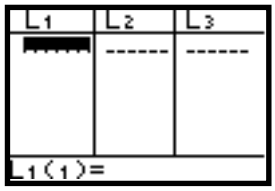
When entering a new data set on the TI-82, you may wish to clear existing data from one of the columns (or list variables).

1. Press the **STAT** key and then press the **1:Edit …** key . This brings up the data 'editing' screen, and positions the cursor on the first item of the statistical 'list' variable L1.



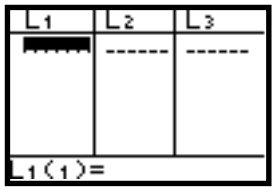
2. Press the **Right** or **Left Cursor** keys to move to the column that contains the data you wish to delete. Then press the **Up Cursor** key so that the cursor is over the column name (either L1, L2, L3, L4, L5 or L6). Then press the **CLEAR** key and then the **ENTER** key. Now all the data in that column will have been deleted.





8.2 How to Enter & Store Univariate Data

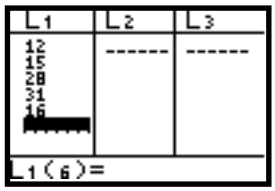
1. Press the **STAT** key and the press the **1:Edit …** key . This brings up the data 'editing' screen, and positions the cursor on the first item of the statistical 'list' variable L1.



8.2 How to Enter & Store Univariate Data (cont.)

2. Enter the number '12' and then press the **ENTER** key. This places the number 12 in L1(1) and moves the cursor to the next line of L1 . Enter the other four numbers above in the same manner. Use the cursor keys to correct any mistakes.

3. When finished, press the **2nd** key and then the **QUIT** key to return to the Home screen.



8.3 How to Perform Calculations on Univariate Data

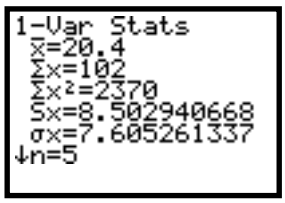
1. Enter the data using the above procedure entitled 'How to Enter and Store Univariate Data'

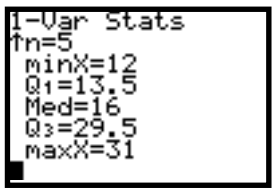
2. Press the **STAT** key and then press the **Right Cursor** key to move to the CALC menu (see below)

3. To calculate statistics for the values entered in L1 , press the **1:1–Var Stats**, and then **2nd** key and the **L1** key and then the **ENTER** key. This produces the following screens.

Explanation of symbols

Mean of Sample	$\bar{x}$
Sum of x data	Σx
Sum of Squares of x data	Σx^2
Sample Standard Deviation	S_x
Population Standard Deviation	σ_x
Number of x data values	**n**
Minimum value	**minX**
Ist Quartile value	**Q1**
Median value	**Med**
3rd Quartile value	**Q3**
Maximum value	**maxX**





4. When finished, press the **2nd** key and then the **QUIT** key to return to the Home screen.

8.4 How to Create a Histogram

Data analysis can be numerical or graphical. For example, it is possible to create a histogram of the following data, obtained by rolling a die 32 times:

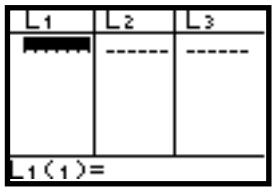
Score	1	2	3	4	5	6
Frequency	3	6	4	8	5	6

In the procedure below, note that the X variable will be the score on the die, and the Y variable will be the frequency. The TI-82 is able to create a histogram for this data.

Note: When setting up any plots on the TI-82, it is important to check that any existing Plots have been turned off. To do this, press the 2nd key and the STAT PLOT key, and then press the 4:PlotsOff option key.

8.4 How to Create a Histogram (cont.)

1. Press the **STAT** key and the press the **1:Edit …** key . This brings up the data 'editing' screen, and positions the cursor on the first item of the statistical 'list' variable L1.



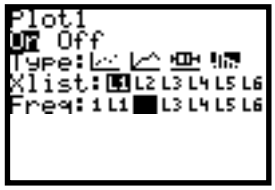
2. Enter the data above by placing the scores in L1 and the frequencies in L2. Use the cursor keys to correct any mistakes.

3. When finished, press the **2nd** key and then the **STAT PLOT** key to set up the Histogram options. Press the **1:Plot1** key to indicate that you wish to set up options for Plot 1.

4. Place the flashing cursor over the 'On' option and press the **ENTER** key to indicate that Plot 1 will be 'active' . Then set the following additional options:

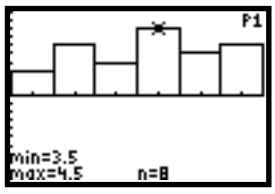
- In the *Type* line, place the flashing cursor on the last (Histogra) icon option and press the **ENTER** key.
- In the *Xlist* line, place the flashing cursor on the L1 option and press the **ENTER** key.
- In the *Freq* line, place the flashing cursor on the L2 icon option and press the **ENTER** key.

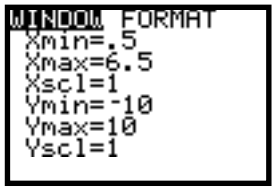
Note: *If L2 is blank (eg for ungrouped data), then '1' should be chosen as the Freq option*



5. Press the **ZOOM** key and then the **9:ZoomStat** key to create the histogram in an appropriate viewing window. Press the **TRACE** key to identify significant points on the histogram. Press the **WINDOW** key to examine the dimensions of the current viewing window (if desired, or if no histogram appears).

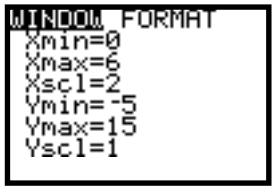
Note*: The Xscl value is the critical option for determining the number of columns in the histogram.*

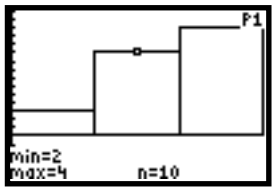




8.4 How to Create a Histogram (cont.)

6. It is possible to alter the class width (to vary the number and width of the columns), by pressing the **WINDOW** key. Change the Xmin to 0 and the Xmax to 6. Change the Xscl to 2 (this is the option which controls the number and width of the columns). Change the Ymin to -5 and the Ymax to 15 (to adjust for higher frequencies). Then press the **GRAPH** key to view the changes to the histogram.





8.5 How to Create a Box Plot

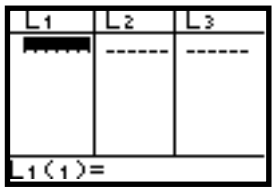
Data analysis can be numerical or graphical. For example, it is possible to create a box plot of the following data, obtained by rolling a die 32 times:

Score	1	2	3	4	5	6
Frequency	3	6	4	8	5	6

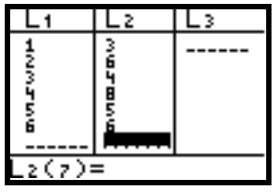
In the procedure below, note that the X variable will be the score on the die, and the Y variable will be the frequency. The TI-82 is able to create a box plot for this data.

Note: When setting up any plots on the TI-82, it is important to check that any existing Plots have been turned off. To do this, press the 2nd key and the STAT PLOT key, and then press the 4:PlotsOff option key.

1. Press the **STAT** key and the press the **1:Edit …** key . This brings up the data 'editing' screen, and positions the cursor on the first item of the statistical 'list' variable L1.



2. Enter the data above by placing the scores in L1 and the Frequencies in L2. Use the cursor keys to correct any mistakes.



8.5 How to Create a Box Plot (cont.)

3. When finished, press the **2nd** key and then the **STAT PLOT** key to set up the Box Plot options. Press the **1:Plot1** key to indicate that you wish to set up options for Plot 1.

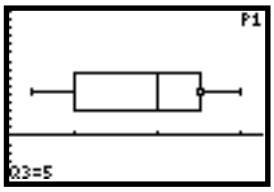
4. Place the flashing cursor over the 'On' option and press the **ENTER** key to indicate that Plot 1 will be 'active' . Then set the following additional options:

- In the *Type* line, place the flashing cursor on the third (Box Plot) icon option and press the **ENTER** key.
- In the *Xlist* line, place the flashing cursor on the L1 option and press the **ENTER** key.
- In the *Freq* line, place the flashing cursor on the L2 icon option and press the **ENTER** key.

Note: *If L2 is blank (eg for ungrouped data), then '1' should be chosen as the Freq option*

5. Press the **ZOOM** key and then the **9:ZoomStat** key to create the box plot in an appropriate viewing window. Press the **TRACE** key and then the cursor keys to identify significant points on the box plot.

Note: *The TI-82 can display up to 3 box plots simultaneously. To set up additional box plots, set up options for Plot 2 and Plot 3*



9. Working With Bivariate Data

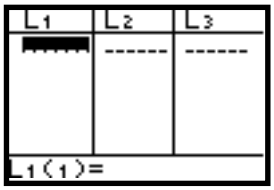
In the following procedures, we will use the following data values.

x	1	2	3	4	5	6
y	2.2	3.5	4.7	6.6	7.2	9.1

9.1 How to Enter & Store Bivariate Data

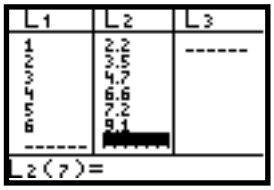
To enter and store bivariate data, the user needs to enter the REGRESSION mode, and use a similar procedure to that used when working with univariate data:

1. Press the **STAT** key and the press the **1:Edit …** key . This brings up the data 'editing' screen, and positions the cursor on the first item of the statistical 'list' variable L1.



2. Enter the data above by placing the x values in L1 and the y values in L2. Use the cursor keys to correct any mistakes.

3. When finished, press the **2nd** key and then the **QUIT** key to return to the Home screen.



9.2 How to Perform Calculations on Bivariate Data

1. Enter the data using the above procedure entitled 'How to Enter and Store Bivariate Data'

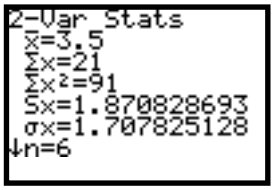
2. Press the **STAT** key and then press the **Right cursor** key to move to the CALC menu (see below)

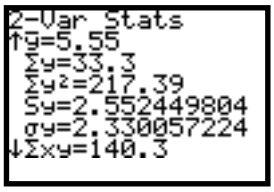
9.2 How to Perform Calculations on Bivariate Data (cont.)

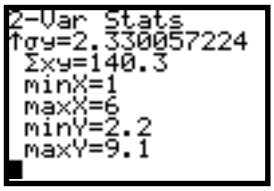
3. To calculate statistics for the values entered in L1 and L2 , press the **2:2–Var Stats** key and then the **ENTER** key. This produces the following screens.

Explanation of symbols

Mean of x data	$\bar{x}$
Sum of x data	S**x**
Sum of Squares of x data	Sx^2
Sample Standard Deviation S_x	
Population Standard Deviation	σ_x
Number of x data values	**n**
Mean of y data	$\bar{y}$
Sum of y data	S**y**
Sum of Squares of y data	Sy^2
Sample Standard Deviation S_y	
Population Standard Deviation	σ_y
Sum of Product of x & y data	S**xy**
Minimum x value	**minX**
Maximum x value	**maxX**
Minimum y value	**minY**
Maximum y value	**maxY**







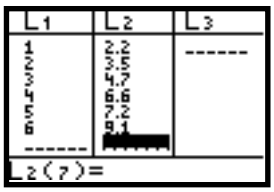
4. When finished, press the **CLEAR** key to clear the Home screen.

9.3 How to Create a Scatter Plot

Note: When setting up any plots on the TI-82, it is important to check that any existing Plots have been turned off. To do this, press the 2nd key and the STAT PLOT key, and then press the 4:PlotsOff option key.

1. First enter and store the data above, using the procedure entitled 'How To Enter & Store Bivariate Data'.

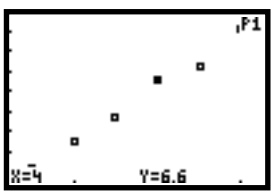
2. When finished, press the **2nd** key and then the **STAT PLOT** key to set up the Scatter Plot options. Press the **1:Plot1** key to indicate that you wish to set up options for Plot 1.



3. Place the flashing cursor over the 'On' option and press the **ENTER** key to indicate that Plot 1 will be 'active' . Then set the following additional options:

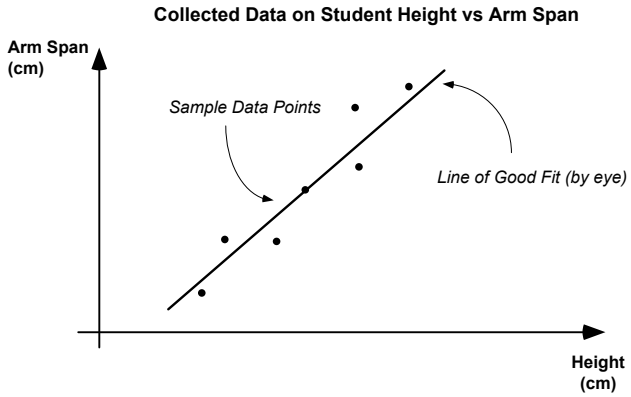
In the *Type* line, place the flashing cursor on the first (Scatter Plot) icon option and press the **ENTER** key.
In the *Xlist* line, place the flashing cursor on the L1 option and press the **ENTER** key.
In the *Ylist* line, place the flashing cursor on the L2 icon option and press the **ENTER** key.
In the *Mark* line, place the flashing cursor on the ' square' marker option and press the **ENTER** key.

4. Press the **ZOOM** key and then the **9:ZoomStat** key to create the scatter plot in an appropriate viewing window. Press the **TRACE** key and then the cursor keys to identify significant points on the scatter plot.



9.4 How to Fit a Function to Data (By Eye)

When attempting to fit functions to data that has been collected, it is convenient to enter and plot data points (in a scatter plot), and then attempt to find function graphs which seem to line up with the points . The sample chart below illustrates a possible scenario where plotting points might be used.



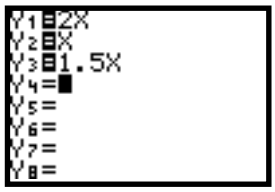
It is possible to try different functions that might fit the data points. One useful way of defining such functions is to denote the parameters of a function as letters. For this example (using the collected data above), we will try to fit a function of the form y = Ax, where A is the parameter that we will alter to try to achieve a good fit.

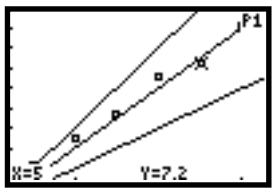
Note: When setting up any plots on the TI-82, it is important to check that any existing Plots have been turned off. To do this, press the 2nd key and the STAT PLOT key, and then press the 4:PlotsOff option key.

1. First enter and store the data above, using the procedure entitled 'How To Enter & Store Bivariate Data'.

2. Then create a scatter plot of the data given, using the procedure entitled 'How to Create a Scatterplot'

3. To fit a function rule to this data, press the Y= key and enter a function rule that you believe will fit the data well. In this example we try to fit linear functions of the type y = Ax to the data. Note that after experimentation, the linear rule Y = 1.5 X appears to fit the data reasonably well (by eye).





9.5 How to Fit a Function to Data (By Regression)

With the TI-82, the following regression models are available:

- Linear $y = ax + b$ *and* $y = a + bx$
- Quadratic $y = ax^2 + bx + c$
- Cubic $y = ax^3 + bx^2 + cx + d$
- Quartic $y = ax^4 + bx^3 + cx^2 + dx + e$
- Logarithmic $y = a + b\log_e x$
- Exponential $y = ae^{bx}$
- Power $y = ax^b$

In the procedure below, a linear regression model will be applied, but the procedure is similar for applying other models.

In the following procedures, we will use the following data values.

x	1	2	3	4	5	6
y	2.2	3.5	4.7	6.6	7.2	9.1

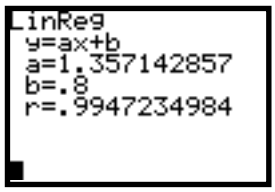
9.5 How to Fit a Function to Data (By Regression) (cont.)

1. First enter and store the data above, using the procedure entitled 'How To Enter, Store and Plot Bivariate Data'.

2. Press the **STAT** key and then press the **Right cursor** key to move to the **CALC** menu (see below)

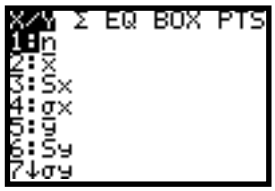
3. To calculate the linear regression equation for the values entered in L1 and L2 , press the **5:LinReg(ax+b) key** and then the **ENTER** key. This produces the following screen, where a represents the gradient of the regression line, b represents the y-intercept of the regression line, and r represents the correlation coefficient.

Note: *If another model is more appropriate to the data, change the regression model (using **STAT-CALC**) by repeating steps 2 and 3.*

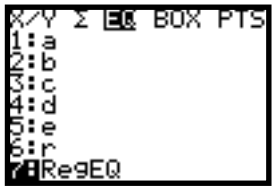


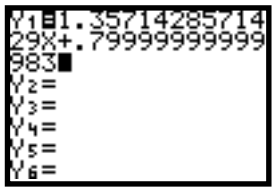
4. It is also possible to overlay the scatter plot of the data with the regression line by first pressing the Y= key (to prepare to enter the regression rule in Y1)

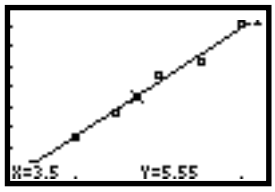
5. Press the **VARS** key, and then the **5:Statistics …** key.



6. Press the **Right cursor** key to move to the **EQ (Equation)** menu and then press the **7:RegEQ** key. This pastes the regression equation into Y1. Then press the GRAPH key to overlay the scatter plot with the regression line.





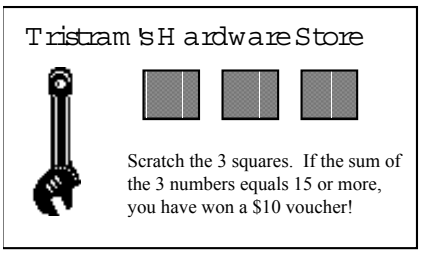


10. Programming the TI-82

The following activity is designed to illustrate the value of writing a small programto perform customised calculations. It is not designed as a collection of all procedures necessary to master programming the TI-82 (the manual is useful for this.)

10.1 How to Write and Run a Program

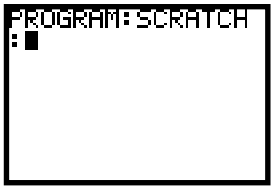
As a marketing gimmick, Tristram's Hardware Store is sending the 'scratch' card below to all its valued (and potential) customers. The card assures them that if the sum of the three numbers equals or exceeds 15, they will receive a $10 voucher for goods from the store. Each of the three squares are randomly assigned the values 1 to 9 inclusive.



1. Press the **PRGM** key to enter programming mode and then use the **Right Cursor** key to select the **NEW** menu. Then select the **1:Create New** option to indicate that you wish to write a new program.

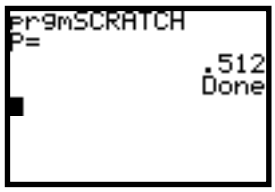
2. Enter the program title '**SCRATCH**' (because this is a 'scratchie' ticket simulation). Then press the **ENTER** key to begin entering program instructions.

3. Enter the following program instructions for the 'SCRATCH' program. The program is on the left, the instruction interpretation is in the middle column, and specific key strokes for program keywords are given in the column on the right.



Program Instructions	**Explanation of command**	**Key sequence to access particular commands**
`:0∅W`	*(initialise 'win')*	**∅** - STO
`:0∅N`	*(initialise 'ticket no.')*	***Lbl*** - PRGM•CTL•9
`:Lbl 1`	*(insert a label for goto statements)*	
`:1+int(9*rand)∅A`	*(integer b/w 1 and 9 in square A of scratchie)*	***int*** - MATH•NUM•4
`:1+int(9*rand)∅B`	*(integer b/w 1 and 9 in square B of scratchie)*	***rand*** - MATH•PRB•1
`:1+int(9*rand)∅C`	*(integer b/w 1 and 9 in square C of scratchie)*	
`:If A+B+C<15`	*(if sum<15 then bypass next line, and goto Lbl 2)*	**If** - PRGM•CTL•1
`:Goto 2`		< - 2nd•TEST•5
`:W+1∅W`	*(increment 'win' if sum □ 15)*	
`:Lbl 2`	*(insert a label for goto statements)*	
`:N+1∅N`	*(increment 'ticket no.)*	
`:If N<500`	*(if ticket no. <500, go to Lbl 1 and repeat)*	
`:Goto 1`		
`:W/N∅P`	*(calculate p, the prop. of wins (if 500 trials complete))*	
`:Disp "P= "`	*(print value of P)*	***Disp*** - PRGM•I/O•3
`:Disp P`		= - 2nd•TEST•1

10.1 How to Write and Run a Program (cont.)

4.	When the program is finished, press the **2nd** key and then the **QUIT** key. To run the program, press the **PRGM** key to call up the program mode operations. Select the **EXEC** option and note that the 'scratch' program is displayed.	
5.	Select the **1:SCRATCH** option and press the **ENTER** key. This will then run the program (for 500 trials) and print the value of p (proportion of winning tickets) as calculated for those trials.	

11. Creating a List or Table of Values

Creating a table of values from the function rule allows the user to observe another representation of the function. It could be a more convenient way of listing the function values of a number of functions at once. The example below is to create a table of values for the function $f(x) = x^2$ for $23 \leq x \leq 25$, with increments of 0.1.

11.1 How to Create a Table of Values

1. Press the **Y=** key and define the function $Y_1 = x^2$.

2. Press the **2nd** key and then press the **TblSet** Key (associated with the **WINDOW** key).

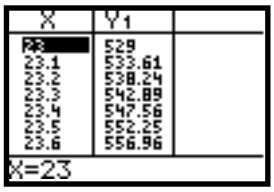
3. Enter 23 as the new **TblMin** (minimum x value for Table) figure.

4. Enter 0.1 as the new **ΔTbl** (x increment for Table) figure.

5. Select **Auto** as the data entry option for the **Indpnt** variable, and press the **ENTER** key. This tells the TI-82 that you want the x values in the table generated automatically from **TblMin** and **ΔTbl.**

6. Select **Auto** as the data entry option for the **Depend** variable, and press the **ENTER** key. This tells the TI-82 that you want the y values in the table generated automatically from the function rule and the x values obtained from the table.

7. Press the **2nd Key** and then press the **TABLE** key. The result is shown right.



12. Defining Sequence Relationships

Sequences and series can be defined and studied numerically and graphically very easily in Sequence Mode on the TI-82. Sequence relationships can be defined in the following manner:

- U_n and V_n are the two sequence functions
- Each function can defined with respect to the terms U_{n-1}, V_{n-1}, and n

These varieties cover arithmetic and geometric sequences, and most difference equations that might be investigated within the secondary school mathematics curriculum.

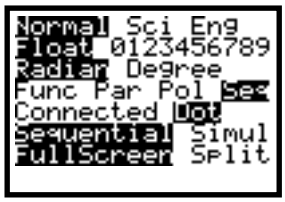
12.1 How to Define and Explore a Sequence Rule

In the procedure below, we will use a Fibonacci's sequence rule. That is where Un and Vn are defined in the following manner.

$$U_n = V_{n-1} \text{ and } Vn = U_{n-1} + V_{n-1}$$

The procedures shown below will be similar to those for use with other sequence rules or difference equations.

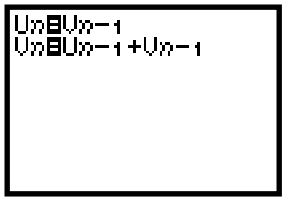
1. Press the **MODE** key and use the cursor keys to move to the 'Seq' (Sequence) option. Press the **ENTER** key. Also, move the cursor to the 'Dot' option and press the **ENTER** key (since the sequence will only take integer values).



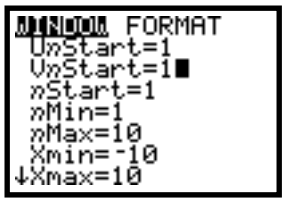
2. Press the **Y=** key and then note that the terms of the rules have changed from function to sequence mode. Enter the following rules.

$U_n = V_{n-1}$ *(V_{n-1} is accessed by pressing **2nd** key & then the **8** key)*

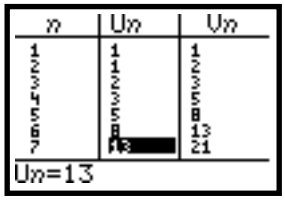
$V_{n-1} = U_{n-1} + V_{n-1}$ *(U_{n-1} is accessed by pressing **2nd** key & then the **7** key)*



3. Press the WINDOW key to set the starting values for the sequence variable as Un and Vn. Enter UnStart = 1, VnStart = 1 and nStart = 1

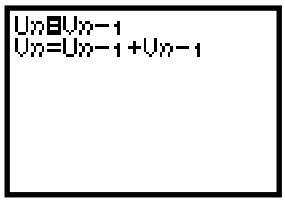


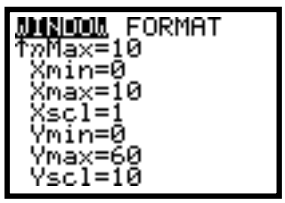
4. Press the **2nd** key and then the **TblSet** key to set up the table of sequence values. Enter the TblMin = 1 and □Tbl = 1. To view a table of the sequence values press the **2nd** key and then the **TABLE** key. By scrolling down through the table, observe how each successive term of the sequence U_n is the sum of the previous two terms.



12.1 How to Define and Explore a Sequence Rule (cont.)

5. This pattern can be explored graphically. First press the **Y=** key and place the cursor over the '=' symbol on the V_n line and press the **ENTER** key (to disable the plotting of V_n) . Then press the **WINDOW** key to set the appropriate viewing window dimensions.





6. Press the **GRAPH** key to create a scatter plot of the sequence values U_n against n.