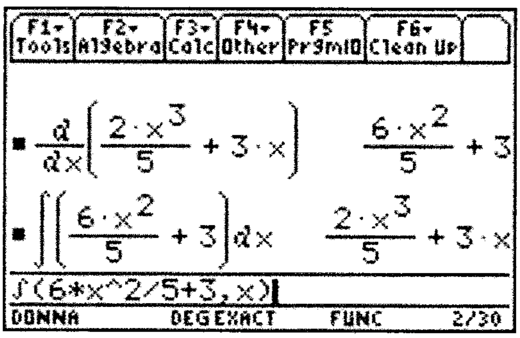
Calculus 1 Supplement

Using the TI-89 Graphing Calculator

By Donna Sue Brewer



Math 2413

Chapter

Limits

Section 1

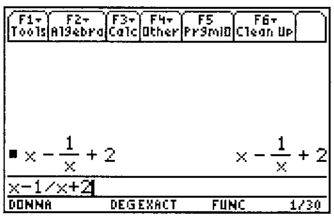
Chapter 1 Section 1
Parenthesis

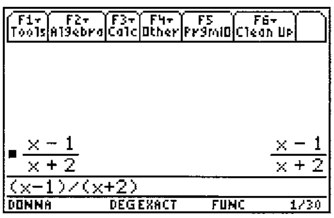
This material supplements your TI-89 operator's manual.

The Advanced Math Lab has several TI-89 operators' manuals that can be borrowed. Read the first chapter in the TI-89 operator's manual, "Getting Started" to become familiar with some of the basic functions of the TI-89 calculator.

In Calculus 1, you will have mandatory lab assignments. Some of these labs require downloading a program into your TI-89 calculator. The Appendix of this supplement has the procedures for downloading into your calculator.

Your first drill is on the use of parenthesis. Placement of the parenthesis is critical. Type x-1/x+2. Just looking at this equation, it is not understood what is wanted. There are two different ways of interpreting this equation.





Notice the syntax involved. By adding parenthesis, I was able to keep the numerator and denominator separate. Just remember, it is better to have too many parenthesis then not enough. Here are a few examples for you to try.
(The rest of this supplement will not have problems for you to work. You are expected to go to your Calculus Textbook and work the problems given for homework)

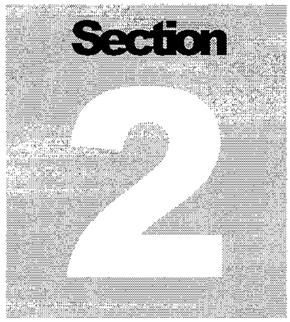
1) $x^{(2\cdot x+1)}$ 2) $x+\sqrt{4-x^2}$ 3) $\frac{5}{x^2+1}-1$

4) $\frac{1}{2} \cdot x - 4$

5) $3 \cdot (x+4)^{\sqrt{6}}$

6) $\frac{1}{x^{(2+x)} - 4} + 3$

7) $8 \cdot (\cos(30+x))^{x} + 2$



Chapter 1-Section 2
Finding Limits

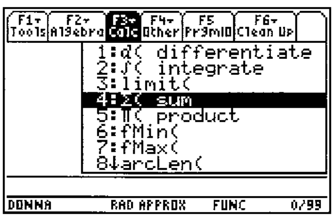
Limit is found under the F3 key.

$$\lim_{x \to 1} \frac{x^3 - 1}{x - 1}$$

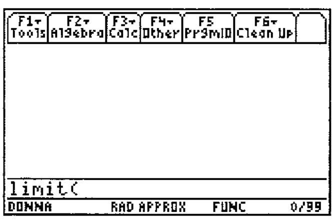
The syntax involved in finding this limit is

limit(function, variable, point)

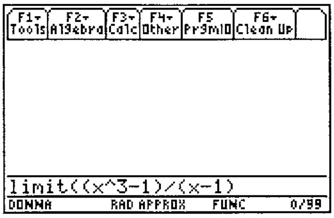
Touch F3,



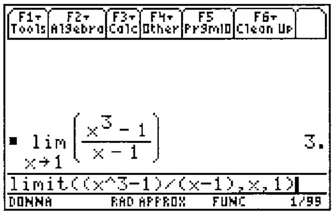
Arrow down to limit (#3), and touch enter. The limit command automatically gives an open parenthesis.



Type in the function. Be sure to use parenthesis to separate the numerator from the denominator.



Put a comma then the variable you want to take the limit with respect to, a comma, then the number you want to approach. Touch enter.



The TI-89 puts the equation on the home screen, followed by the answer. Check to be sure the equation is written correctly.

Using the homework problems in your textbook, take the limit of the functions.

Section 3

Chapter 1-Section 3
One-Sided Limits

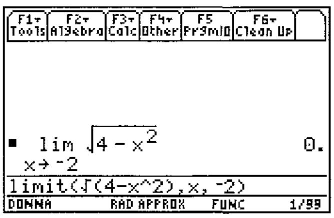
To approach a limit from the right (+) or left (-), the syntax is much the same as finding a limit from both sides.

Recall, the syntax for approaching a limit from both sides, is

(limit, function, variable, point)

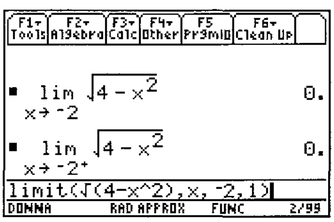
For example

$$\lim_{x \to -2} \sqrt{(4 - x^2)}$$



To approach a limit from the right, the syntax is

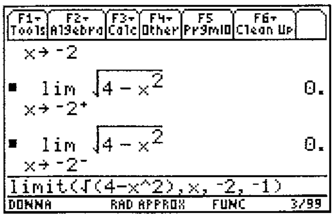
limit(function,variable,point,+1)



I am using a +1, but any positive number will work. When a positive number follows the -2, it means the limit is approaching from the right.

To approach from the left, the syntax is

limit(function,variable,point,-1)



I am using a -1, but any negative number will work. When a negative number follows the -2, it means the limit is approaching from the left.

Using the homework problems in your textbook, find the limit by approaching from the left or from the right.

Chapter

The Derivative

Section 1

Chapter 2 Section 1
Derivative

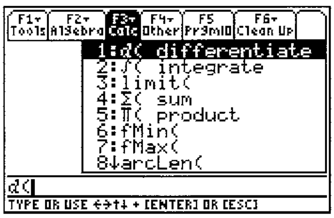
Let's begin with the function

y=2x+4

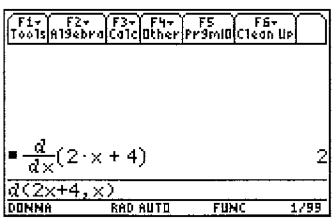
To take the derivative of this function, we start with the syntax involved.

***d*(function, variable)**

The (***d***) symbol, representing derivative, can be found by touching F3, 1(differentiate).



The calculator automatically gives an open parenthesis with the ***d*** symbol. Type in your function, a comma, variable with respect to (x) and close the parenthesis. Touch Enter.



Using the homework in your Calculus textbook, find the derivatives.

Section 2

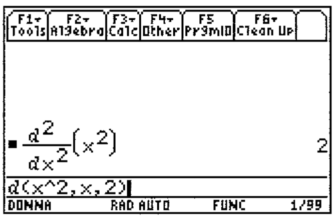
Chapter 2 Section 2
Higher-Order Derivatives

To take a higher order derivative, use the syntax:

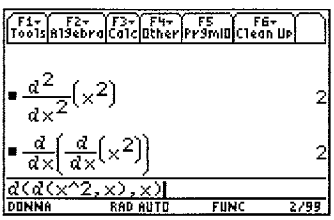
d(function, variable, order)

Example:

Take the second derivative of $f(x)= x^2$



You can also "nest" your derivative by taking the derivative of the derivative.



Using the homework problems in your textbook, find higher order derivatives.

Chapter 3

Curve Sketching

Section 1

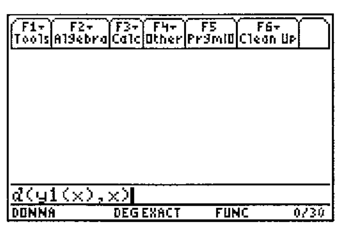
Chapter 3 Section 1
Extrema on an Interval

The steps involved in finding the extrema of a function are as follows:

1) Put the original equation into Y=

2) Find the derivative of the original function, and set the derivative equal to zero.
To do this, type this on the home screen.

$$d(y1(x),x)$$



Then take the answer, set it up equal to zero, and solve for (x).
Note You can use the solve feature of the calculator to solve for x. Touch F2, 1(solve). Type in the equation and touch = 0. Touch a comma, and variable to be solved. See the example below.

3) Find the 2nd derivative and set this equal to zero.

$$d(y1(x),x,2)$$

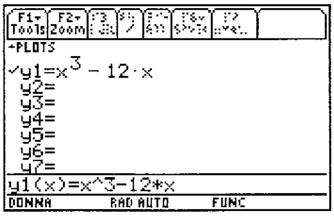
Solve for x as in #2.

Here is an example of the above :

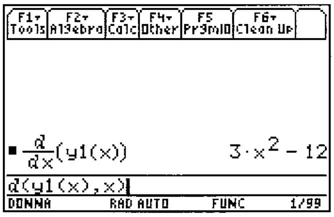
$y = x^3 - 12 \cdot x$ on the interval [0,4].

Answer:

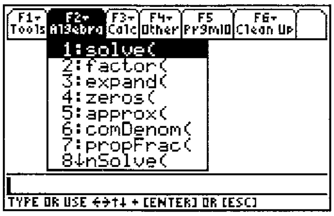
1) Put the equation into the y=



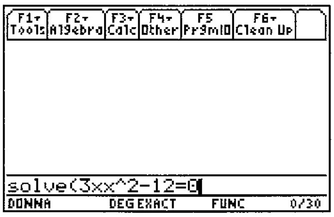
2) Find derivative of the function and set it up equal to zero.



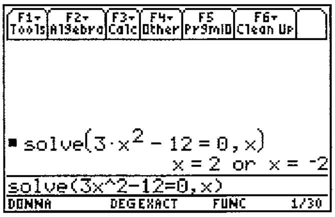
Solve Feature Touch F2, 1(solve)



Type in the equation and put = 0 after the equation.

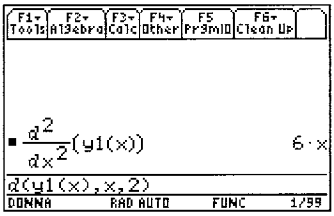


Type a comma, and the variable to be solve for. Touch Enter.



Solving for x, the answer is ±2. Because -2 is not in the interval from 0 to 4, we can throw it out.

3) Find the 2nd derivative, and set it up equal to zero.

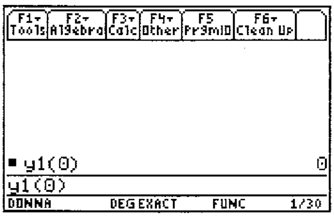


Solving for x, the answer is 0. There are no undefined areas in either of the derivatives.

Now take all the values you found (critical numbers) and the interval endpoints and put them into the original function.

To do this, using 0, type in the following on the home screen:

y1(0)



You should get the answer of 0. So the ordered pair will be (0,0).
Try 2, and you should get the ordered pair (2,-16).
Try 4, and you should get the ordered pair (4,16).

Because -16 is the smallest value, (2,-16) is the minimum.
Because 16 is the largest value, (4,16) is the maximum.

Determine the absolute extrema of functions in a closed interval using the homework problems in your Calculus textbook.

Section 2

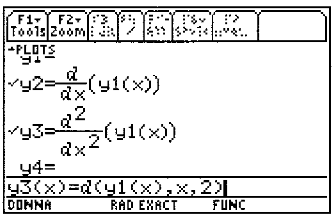
Chapter 3 Section 2
The First Derivative Test and Increasing and Decreasing Functions

In this section, you will learn to use the APPS feature of your calculator. First, go to y= editor, and type in the following into y2 and y3:

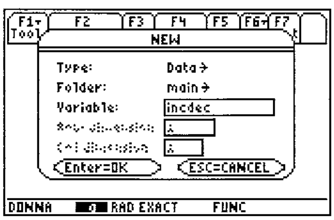
y2=*d*(y1(x),x)

y3=*d*(y1(x),x,2)

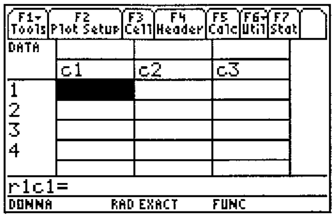
Your screen should look like this:



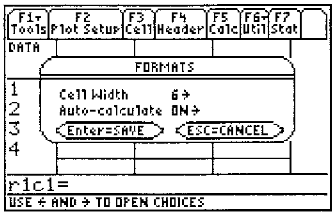
In y1, we will put the function we are working with. For right now, leave it empty. Touch APPS, #6 (Data/Matrix Editor, then NEW. Arrow down to variable and type in INCDEC which will stand for increasing and decreasing.



Touch enter twice.



Each rectangle is called a cell. Touch F1, and arrow down to FORMAT. Touch ENTER. Be sure Auto-calculate is ON.



Before we begin to build the application, we need a function to work with.

Find the open interval on which f(x) is increasing or decreasing.

$$f(x) = x^3 - \left(\frac{3}{2}\right)\cdot x^2$$

1) Find the derivative of f(x) and find all critical points within the interval.

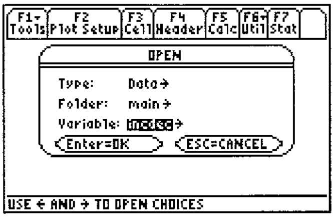
$$y' = 3\cdot x^2 - 3\cdot x$$

$$critical\cdot points = 0, 1$$

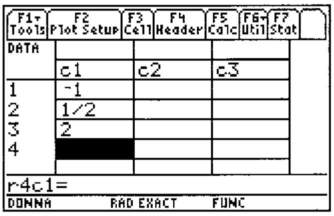
2) Use the critical numbers to determine the test intervals.

$$(-\infty < x < 0) \qquad (0 < x < 1) \qquad (1 < x < \infty)$$

3) Because of the test intervals, I chose to test the points -1, 1/2, and 2. Put these values into c1. Touch APPS, #6 (Data/Matrix Editor), #2 (Open). Be sure your screen looks like the one below. If it does, touch Enter twice.

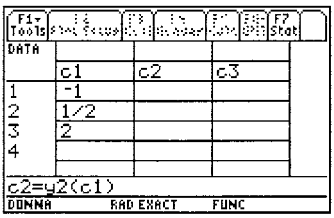


4) Put the test points into c1.



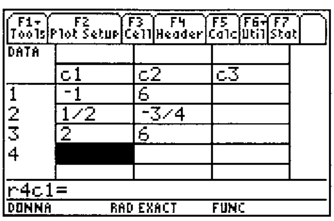
5) Arrow up to c2, and touch enter. This is where you put in a formula for the program to use. Type into c2:

$$y2(c1)$$



NOTE If you make a mistake in a cell, clear will not empty the cell. You must highlight the cell and touch ← (back arrow key).

6) Now touch enter.



Where c2 is positive, the function is increasing.
Where c2 is negative, the function is decreasing.

At the interval $(-\infty, 0)$ the function is increasing.

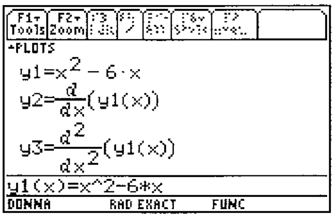
At the interval $(0, 1)$ the function is decreasing.

At the interval $(1, \infty)$ the function is increasing.

Now work an example on your own. The program is saved, so all you need to do is to load the new equation into y1, find your critical numbers to determine the test interval, and load the test points into c2.

Find where f(x) is increasing or decreasing.

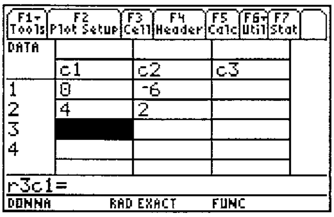
$$f(x) = x^2 - 6\cdot x$$



Take the derivative to find the critical numbers. Critical number is 3 . Test intervals would be:

$$(-\infty, 3) \text{ and } (3, \infty)$$

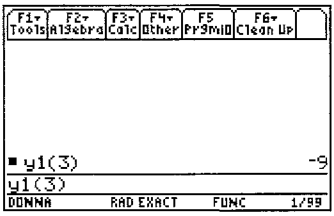
The test points that I choose within the test intervals are (0 and 4). To access the program, touch Apps, 6 (Data/Matrix Editor), Open, and under variable, highlight incdec.



On the interval $(-\infty, 3)$ the function is decreasing.

On the interval $(3, \infty)$ the function is increasing.

The First Derivative Test says that if f'(c) changes from a negative to a positive, then f(c) is a relative minimum of f. If f'(c) changes from a positive to a negative, then f(c) is a relative maximum. We can apply the First Derivative Test to the above example. Looking at column c2, the numbers are changing from a negative to a positive which means there is a relative minimum at the critical number 3. On the home screen, find the value of f(x) at 3.



There is a relative minimum at the point (3, -9).

Using the homework problems in your Calculus textbook, find the critical numbers of f(x), find where the function is increasing and decreasing, and find any relative minimum or maximum.

Section 3

Chapter 3 Section 3
Concavity and the Second Derivative Test

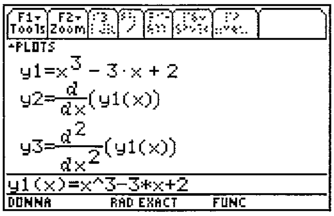
We will now build another program that will simplify the last couple of sections, and make curve sketching a little easier.

First, we will begin with the function:

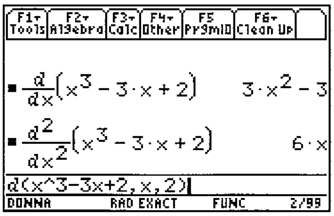
$$f(x) = x^3 - 3 \cdot x + 2$$

Put this equation into y= editor.

Be sure you have y2 defined as the first derivative, and y3 as the second derivative.



Find the first and second derivative of the function.



Set the first derivative equal to zero, and solve for x.

x = -1 and 1

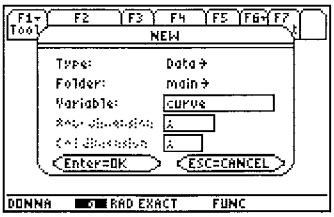
Set the second derivative equal to zero and solve.

$$x=0$$

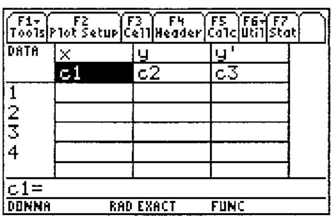
Take the values -1, 0 and 1 and determine the test intervals.

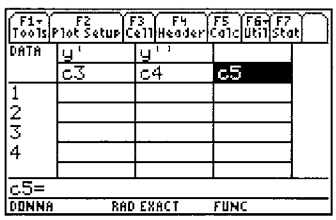
$$(-\infty, -1), (-1, 0), (0, 1), (1, \infty)$$

Choose a number within the interval to test. Also use the critical values themselves. My list of test points will be -2, -1, -1/2, 0, 1/2, 1, and 2. Now we begin to build our new program. Touch APPS, #6 (Data/ Matrix Editor), NEW. Type CURVE into the variable line. That will be the name of this program.

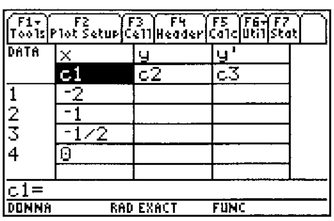


Touch ENTER twice to create the name of the program. Arrow up to the empty cell above c1. Type (x) in that cell. Arrow right one cell and type (y). Arrow one cell and type in (y'). Arrow one more cell over and type (y'').





Under the heading of c1, type in the test points from y' and y''.



NOTE If the test points are not typed in at this time, and you try to go on programming, you will get an error message.

Arrow down to see the rest of the test points on your calculator.

Highlight c2 and type in the function:

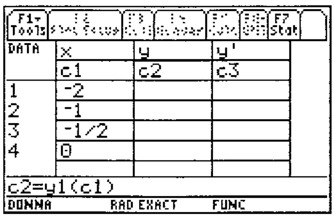
y1(c1)

Highlight c3 and type in the function:

y2(c1)

Highlight c4 and type in the function:

y3(c1)



You will now have the following table:

X	Y	Y'	Y"
c1	c2	c3	c4
-2	0	9	-12
-1	4	0	-6
-1/2	27/8	-9/4	-3
0	2	-3	0
1/2	5/8	-9/4	3
1	0	0	6
2	4	9	12

From this table, we can extract a wealth of information.

When Y>0, the function is increasing.
When Y<0, the function is decreasing.

When Y<0, the function is concave down.

When Y>0, the function is concave up.
When Y=0, and has a positive and a negative number on either side in the same column, then there is an inflection point.
When Y"=0 and the numbers on either side are both the same sign, the Second Derivative test is inconclusive, and you must use the First Derivative test to find the local max and min.

When Y=0 and Y<0, then the function has a local maximum at this point.
When Y=0 and Y>0, then the function has a local minimum at this point.

Looking at Y' column, the function is increasing at (-2, 0) and (2, 4).
The function is decreasing at (-1/2, 27/8), and (1/2, 5/8)

Looking at Y" column, the function is concave up at ((-1, 4) and concave down at (1, 0).
There is an inflection point at (0, 2).

Looking at the Y' column that has a zero, and the Y" column, there is a local maximum at (-1, 4) and a local minimum at (1, 0).

To see if the information derived is correct, graph the original function. Is it correct?

Use the homework problems in your Calculus textbook to practice.

Section 4

Chapter 3 Section 4
Limits at Infinity

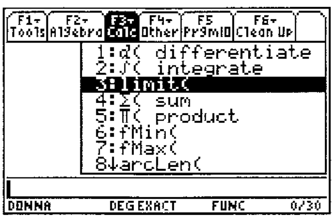
You may need to review on how to find vertical, horizontal, and slant asymptotes. First, let's review how to take a limit to find end behavior. The syntax involved is:

limit(function, variable, approaching)

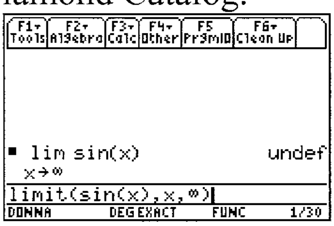
For example:

$$f(x) = \lim_{x \longrightarrow \infty} (\sin(x))$$

Limit can be found by typing F3, 3 (limit)



Type in the function, a comma, the variable with respect to, a comma, what you are approaching and close the parenthesis. The infinity symbol can be found by touching Green Diamond Catalog.



The answer would be undefined because the sine function oscillates between 1 and -1.

Using the homework problems in your Calculus textbook, find limits of infinity.

Section 5

Chapter 3 Section 5
A Summary of Curve Sketching

This is the section we combine the whole chapter.

Let's begin with a function:

$$f(x) = \frac{2\cdot(x^2 - 9)}{x^2 - 4}$$

1) Find the x and y intercepts. Find all asymptotes (horizontal, vertical, and slant).

$$x\cdot intercepts = \text{-3 and 3}$$

$$y\cdot intercept = \frac{9}{2}$$

$$Horizontal\cdot Asymtope\cdot is\cdot y = 2$$

$$Vertical\cdot Asymtote\cdot is\cdot x = \text{-2 and 2}$$

2) Find the first Derivative and find where x=0 and where x is undefined.

$$f'(x) = \frac{20\cdot x}{(x^2 - 4)^2}$$

$$x = \text{0, 2, and -2}$$

3) Find the second Derivative and find where x=0 and where x is undefined.

$$f''(x) = \frac{-20\cdot(3\cdot x^2 + 4)}{(x^2 - 4)^3}$$

$$x = \text{-2 and 2}$$

4) Use the numbers found for x to decide on test intervals.

$$(-\infty, -2)\cdot(-2, 0)\cdot(0, 2)\cdot(2, \infty)$$

5) Use the above intervals to decide on test points. I choose -5, -1, 1, and 5. Load these numbers as well as the numbers you found when you set x=0 and undefined areas, into the c1 column of the APPS program CURVE. Be sure you have the original function loaded into y1 and ***d***(y1) in y2 and ***d***(y2) in y3. If you are unsure of how to do this, refer back to Chapter 3 Section 1 of this supplement. For the Y' and Y", we are only interested in the sign of the number, not the number itself.

X	Y	Y'	Y"
c1	c2	c3	c4
-5	32/21	-	-
-2	undef	undef	undef
-1	16/3	-	+
0	9/2	0	+
1	16/3	+	+
2	undef	undef	undef
5	32/21	+	-

C1 #	Characteristic of Graph
-5	Decreasing, concave down
-2	Vertical Asymptote
-1	Decreasing, Concave up
0	Relative minimum
1	Increasing, concave up
2	Vertical Asymptote
5	Increasing, concave down

Using the homework problems in your Calculus textbook, find and label x and y intercepts, asymptotes, relative maximums, relative minimums, and inflection points.

Section 6

Chapter 3 Section 6
Optimization

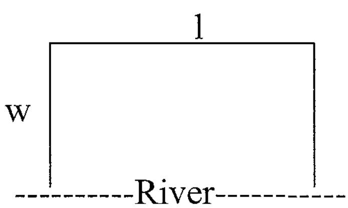
There are 7 steps in working optimization problems.

1) Draw a picture
2) Derive the equations
3) Solve the first equation with respect to y
4) Substitute this equation into the second equation
5) Put this equation into y1 (Be sure to have y2 and y3 defined as in section 4)
6) Take the first derivative and find the critical point(s)
7) Call up the "Curve" program under APPS and input critical point
8) Interpret the results

Lets begin with an Area problem.

A farmer plans to fence a rectangular pasture adjacent to a river. The pasture must contain 180,000 square meters in order to provide enough grass for the herd. What dimensions would require the least amount of fencing if no fencing is needed along the river?

1) Draw a picture



2) Derive the equations

Area = l*w $\qquad$ l=x $\qquad$ w=y

Perimeter = l + 2w (there is only one length because the river is adjacent one side.)

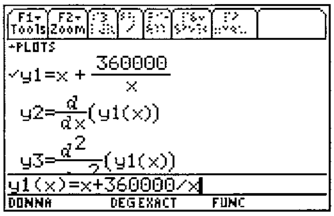
2) Solve the first equation with respect to y

$$180000=xy$$
$$y=180000/x$$

3) Substitute this equation in for the second equation

$$\text{Perimeter} = 2x + 2y$$
$$P = x + 2(18000/x)$$
$$P = x + (360000/x)$$

5) Put this equation into y1



6) Take the first derivative and find the critical points.

$$\frac{d}{dx}\left(x+\left(\frac{360000}{x}\right)\right)$$

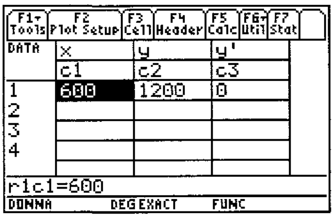
$$1-\frac{360000}{x^2}$$

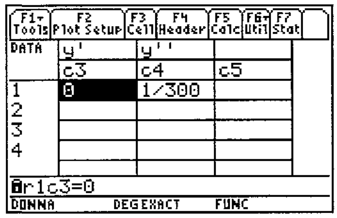
critical point is 600.

7) Call up the "Curve" program.

To call up a program, touch APPS, 6(Data/Matrix Editor), 2(Open), and under Variable, be sure curve is showing.

Under c1, put 600. You will get the following screen:





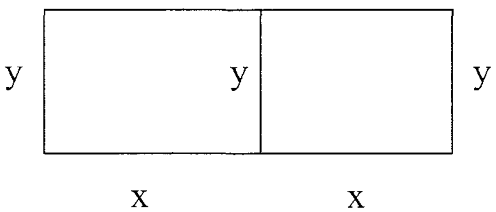
8) Interpret the results.

Because y'=0 and y">0, this is a local minimum which will give the least amount of fencing. If you put 600 into the original equation xy = 180000 and solve for y, you will have the y value of 300. Therefore, the minimum amount of fencing would be 600 meters by 300 meters.

Let's try one more.

A rancher has 200 feet of fencing with which to enclose two adjacent rectangular corrals. What dimensions should be used so that the enclosed area will be a maximum?

1) Draw a picture.



2) Perimeter = 2(2x) + 3y = 200
Area = 2xy

3) $y = (200 - 4x)/3$

4) Area = $\dfrac{400 \cdot x - 8 \cdot x^2}{3}$

5) Put this equation into y1

6)

$$\frac{d}{dx}\frac{400\cdot x - 8\cdot x^2}{3}$$

$$\frac{400}{3} - \frac{16\cdot x}{3}$$

critical point is 25

7) When y'=0 and y"<0, then the function has a local maximum at this point.
When 25 is put into the original equation, the corresponding y value is 100/3.
To maximize the enclosed area, the dimensions should be 25 by 100/3 feet.

Use the homework problems in your Calculus textbook to practice using optimization.

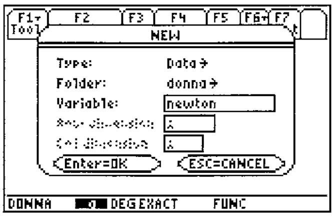
Section 7

Chapter 3 Section 7
Newton's Method

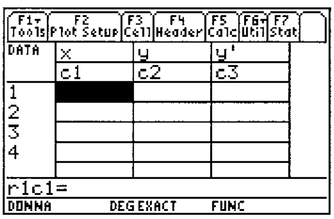
Let's begin by building a new program.

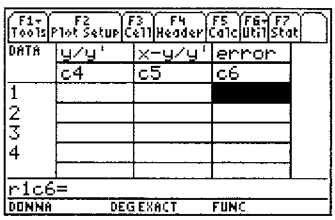
Touch APPS, 6(Data/Matrix Editor), 3(New)

We will call this program "Newton".



Arrow to the area above c1...type x
c2 y
c3 y'
c4 y/y'
c5 x-y/y'
c6 error





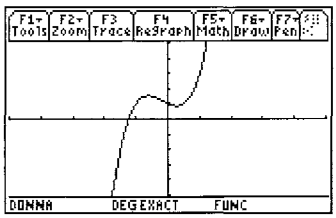
We can't load the equations into the cells until we load data into c1 and put an equation into y1. Let's begin a problem.

Use Newton's Method to approximate the zeros for:

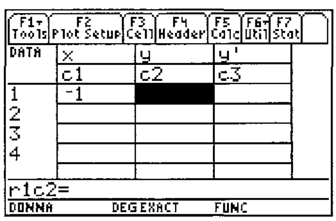
$$2 \cdot x^3 + x^2 - x + 1$$

Continue until two successive approximates differ by less then .0001.

First, load this equation into y1 and graph. This will allow us to narrow down where our approximate zero is.
NOTE Be sure you have y2 = the derivative of y1 and y3 = the second derivative of y1. If you don't remember how to do this, reread Ch. 3 Section 2.



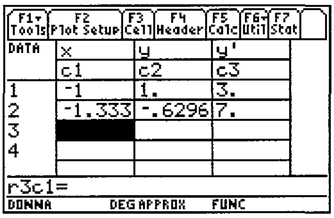
According to the graph, it appears there is a zero near -1. Go to your Newton Program and put -1 into the cell under c1.

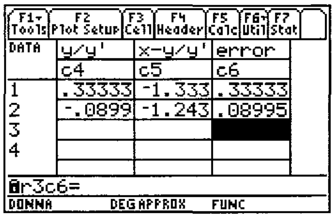


Arrow up until c2 is highlighted. Touch enter. This puts the curser on the command line.

into c2.....type	y1(c1)
into c3	y2(c1)
into c4	c2/c3
into c5	c1-c4
into c6	abs(c1-c5)

Look under c6 (error). Is .333333333<.0001? Of course not. Take the number in c5 and put it in the next line of c1. Because you want the complete number, and not just part of it, let's cut and paste it. Highlight the number you want to cut. Touch Green Diamond then the black up arrow key. Arrow over to the place you want to paste. Touch Green Diamond and the ESC key. This will paste. Touch enter. The calculator calculates all the values across our cells.





Is our error <.0001? If not, keep going. The correct answer is -1.23375.

Use the homework problems in your Calculus textbook to practice Newton's Method.

Chapter

The Integral

Chapter 4 Section 1
Antiderivatives

There is one main thing you need to remember about the calculator and integration:

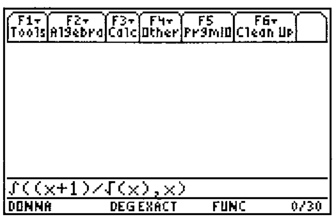
****the calculator does not add the "+ C"****

Let's begin with the syntax involved in finding the antiderivative, or otherwise known as the integral.

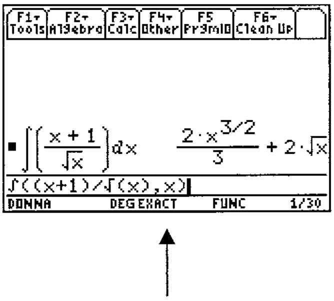
$$\int \frac{x+1}{\sqrt{x}}\,dx$$

• (expression, variable with respect to)

The integral symbol can be found by touching 2nd and the #7. Using the syntax discussed, the calculator screen will look like this:



Notice the extra parenthesis. If you are still a little rusty on parenthesis, reread Chapter 1. Now touch enter to execute the equation. Notice I am in exact mode (bottom of my calculator screen)



exact mode

Remember when writing your answer to put + C.

Use the homework problems in your Calculus textbook to practice integration.

Section 2

Chapter 4 Section 2
Area

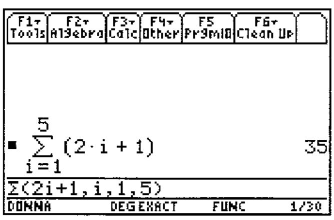
Let's begin with an example:

$$\sum_{i=1}^{5} (2 \cdot i + 1)$$

The syntax involved is as follows:

sigma(equation, index of summation, lower bound, upper bound)

The summation symbol can be found by touching F3, 4 (sum). Type in the equation, the index of summation (i), the lower bound and the upper bound. Put commas as I did in the screen below. Touch Enter.

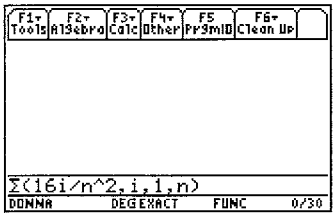


The next equation is how to take a limit of a summation.

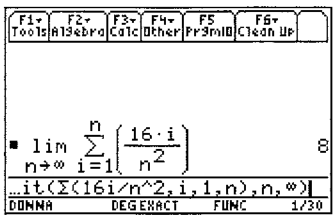
$$\lim_{n \to \infty} \sum_{i=1}^{n} \left(\frac{16 \cdot i}{n^2} \right)$$

Note If you have forgotten the syntax for a limit, reread Chapter 1 section 2**

The above equation is called a nested equation. A nested equation is an equation within an equation. These can become very complicated quickly and are hard to visualize. It is easier if you work one part at a time. I would start with the summation.



Do not touch enter yet. Arrow over to the left of the summation symbol. Touch F3, and arrow down to limit. (Did your summation sign move to the right when you touched limit? If you erased the summation sign instead of moving it over, touch 2nd and the back arrow key next to Clear). Now arrow to the right of the last parenthesis. Type a comma, an "n", a comma, ∞ and close the parenthesis then touch enter.



Use the homework in your Calculus textbook to practice taking limits of summation.

Section 3

Chapter 4 Section 3
Definite Integrals

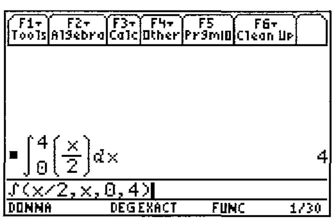
When we evaluated an indefinite integral in Chapter 4 Section 1, we didn't put in any bounds. The only difference in definite integral syntax is we add a left and right bound.

sigma(equation, variable, lower bound, upper bound)

Let's work with an example.

$$\int_0^4 \frac{x}{2}\,dx$$

The calculator screen will look like this:



The syntax involved is very strait forward. Go to the homework in your Calculus textbook and practice definite integrals.

Section 4

Chapter 4 Section 4
Riemann Sums

The calculator will not do Riemann Sums as we have done derivatives and integration. We will have to assign a function to a variable name, and then call up this function when we need it. Once you assign the function to the variable name, you do not have to assign it every time you want to use it. The function will be in memory until you delete it from memory. Clearing the home screen does not delete the memory.

First, let's show what each of the variables in the function will represent.

b = left bound
r = right bound
n = # of subintervals

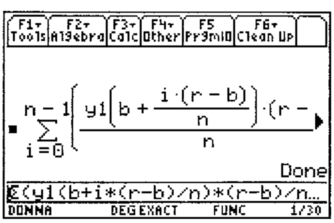
The first function will be to find the approximation from the left.

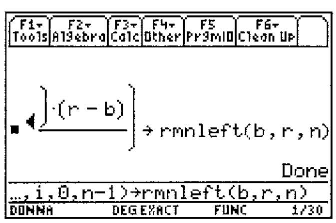
On the home screen, type:

sigma(y1(b + i *(r-b)/n)*(r-b)/n, i, 0, n-1) → rmnleft(b, r, n)

** → is found above the "ON" button (sto). It is for storing numbers, ect. in for variables.**

The whole equation will not fit on the calculator screen, so I will make 2 screens.



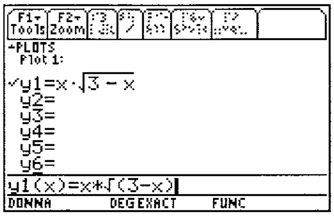


If your calculator says "Done" when you touch enter, then it accepted the assignment.

Let's work with the following equation and use 8 subintervals

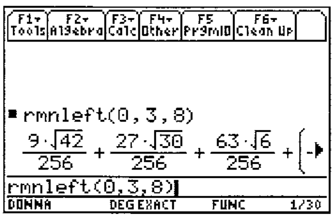
$$\int_0^3 \left(x\cdot\sqrt{3 - x}\right)\, dx$$

First, you have to type the equation into y1.

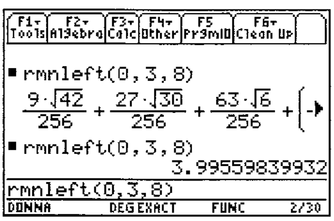


The syntax for Riemann Sums from the left is:

rmnleft(left bound, right bound, # subintervals)

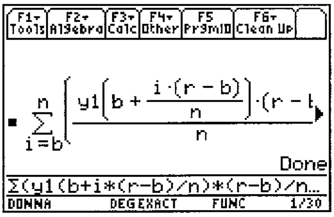


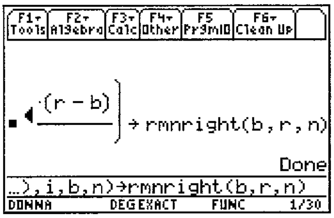
This long fraction doesn't really help me understand what I am looking at. Touch Green Diamond and then Enter. This will give you a decimal approximation.



Now, let's approximate from the right. We have to define another variable. On your home screen, type:

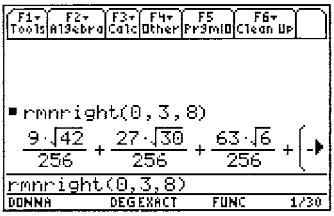
sigma(y1(b +i*(r-b)/n)*(r-b)/n,i,b,n) → rmnright(b,r,n)

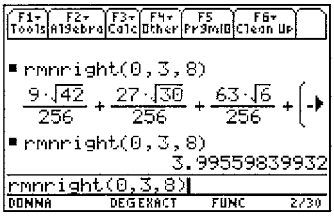




The syntax for Riemann Sum from the right:

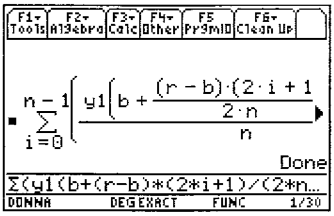
rmnright(left bound, right bound, # subintervals)





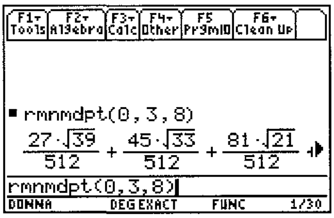
Now let's use the midpoints in our Riemann Sum. On the home screen type:

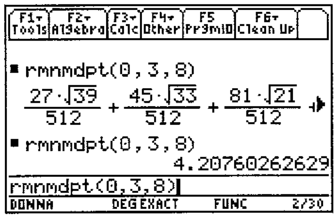
sigma(y1(b+(r-b)*(2*i+1)/(2*n))*(r-b)/n,i,0,n-1) → rmnmdpt(b,r,n)



The syntax for finding the Riemann Sum using the midpoints is:

rmnmdpt(left bound, right bound, # subintervals)





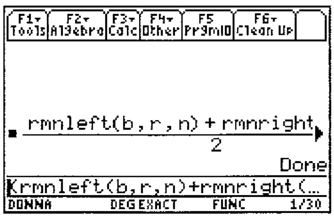
Using the homework problems in your Calculus textbook, practice Riemann Sums.

Section 5

Chapter 4 Section 5
Trapezoidal Rule

Be sure you have the 3 Riemann Sum programs in your calculator from the previous section. The Trapezoidal Rule program works off of the Riemann Sum programs. The Trapezoidal Rule is nothing more then the average of the function values at the endpoints of the subintervals. On the home screen, type:

(rmnleft(b,r,n)+rmnright(b,r,n))/2 → trapzoid(b,r,n)

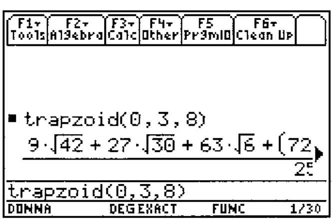


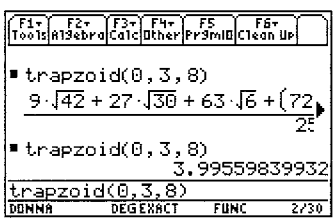
Let's use the same problem from the previous section.

$$\int_0^3 \left(x\cdot\sqrt{3-x}\right)\,dx$$ Divided into 8 subintervals

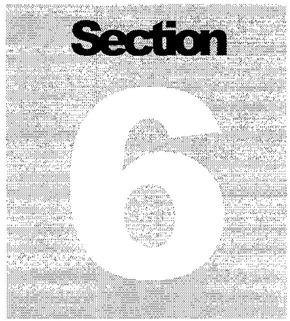
Be sure the equation is in y1. On the home screen type:

trapzoid(0,3,8)





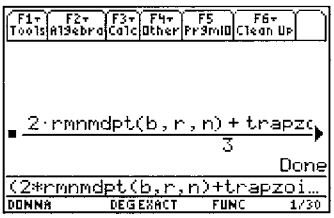
The screen on the right is the decimal approximation. Use the homework in your Calculus textbook to practice the Trapezoidal Rule.

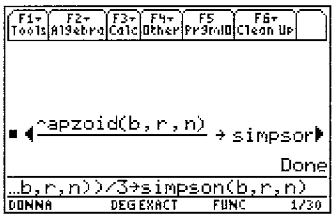


Chapter 4 Section 5
Simpson Rule

This program uses the Riemann Sum and Trapezoidal Rule programs derived in the sections earlier to work. If you do not have them already in your calculator, you need to put them in. The Simpson Rule program will not work with out them. On the home screen, type:

(2*rmnmdpt(b,r,n)+trapzoid(b,r,n))/3 → simpson(b,r,n)





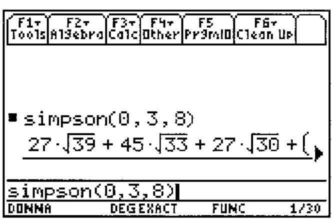
Let's use the equation we have used on the previous 2 sections:

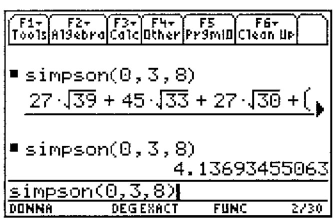
$$\int_0^3 \left(x\cdot\sqrt{3-x}\right)\,dx$$

Divided into 8 subintervals.

The syntax is:

simpson(0,3,8)





The screen on the right is the decimal approximation. Use the homework in your Calculus textbook to practice the Simpson's Rule.

Appendix
Downloading From One TI-89 To Another

Connect the two calculators together with a graph link (the small cord that came with the calculator).

Sending Unit

1) Press 2nd, Var-link
2) Highlight the program to send by pressing F4.
3) Press F3 (Link)

Receiving Unit

1) Press 2nd Var-Link
2) Press F3
3) Press 2 (Receive)
4) (On Sending Unit) Press 1 (Send to TI-89/92 Plus)

Done.

Appendix B

Appendix
To Set the Windows

Touch Green Diamond, Window

x-min to set up the smallest x value at the left end of the x axis

x-max to set up the largest x value at the right end of the x axis

x-scl defines the spacing between tic marks along the x axis. To turn off the marks, set the x-scl to 0

y-min to set up the smallest y value at the bottom of the y axis

y-max to set up the largest y value at the top of the y axis

y-scl defines the spacing between tic marks along the y axis. To turn off the marks, set the y-scl to 0

x-res establishes how often the function is evaluated. It is best to leave it at 1.