Things You May Not Know Your TI-84 Can Do

Hidden Gems Revealed

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1:30 p.m. – 3:00 p.m.
Omni Hotel Level 2
Stockyards 3

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This handout is available for download at users.pfw.edu/lamaster/technology/

The TI-84 Plus has many features that often surprise workshop participants. Some are hidden gems that get overlooked.

Manage the Home Screen (HS)

1. Copy/Paste from History
    The TI-84CE will keep 86 entries in the history
    stack. Press ▲ to select an **Entry** (or an **Ans**),
    then press enter to paste it on the entry line.
    Delete a history pair and the TI-84 Plus
    will also delete both 2nd[entry] and 2nd[ans].
    It will restore what is in the last Entry
    and the last **Ans** to what it was
    before you deleted it.

Entry   Ans

HISTORY
1
                     1.
Ans+2
                     3.

1. Press ▲ to climb the history tree to make a selection from the history of entries.
    2. Press enter to "pluck the fruit" of your selection to paste it to the current entry line.
3. Once it is down on the entry line you can then edit it. No editing up in the history tree is permitted.
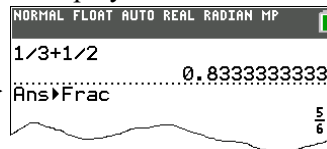
NORMAL FLOAT AUTO REAL RADIAN MP
1
                     1.
Ans+2
                     3.
Ans+3
                     6.

NORMAL FLOAT AUTO REAL RADIAN MP
1
                     1.
Ans+2
                     3.
Ans+3
                     6.
Ans+5
                     11.

OOPS

Right now Entry is **Ans +5** and **Ans** is 11.
Press ▲ to select the entry line **Ans+5**.
Once highlighted, press del or clear.
The history pair is wiped.
After it is deleted, the contents of the last Entry
returns to **Ans +3** and the last **Ans** returns to 6.

NORMAL FLOAT AUTO REAL RADIAN MP
1
                     1.
Ans+2
                     3.
Ans+3
                     6.
Ans+4
                     10.

Cool Tip: If you build a table on the HS, you not need restart from the beginning if a mishap occurs.

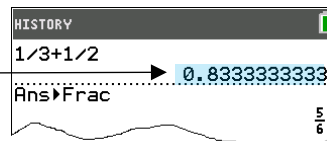2. The contents of **Ans** is more than what is shown on the display.
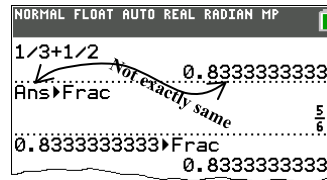
    Compare:
    *   Press math 1 to "Frac" an answer. ——→

NORMAL FLOAT AUTO REAL RADIAN MP
1/3+1/2
            0.8333333333
Ans▶Frac
                     $\frac{5}{6}$

Ans contains more digits
than what is displayed.

    vs

    *   Paste what is *displayed as Ans*
        onto the entry line.

HISTORY
1/3+1/2
            0.8333333333
Ans▶Frac
                     $\frac{5}{6}$

NORMAL FLOAT AUTO REAL RADIAN MP
1/3+1/2
            0.8333333333
Ans▶Frac
                     $\frac{5}{6}$
0.8333333333▶Frac
            0.8333333333

Not exactly same

    Then press math 1 to "Frac" this. ——→

Best practice: For non-exact decimal answers, paste the Entry or 2nd[ans] instead of the *displayed* answer.

3. With the calculator in radian mode, determine sin(45°). Press 2nd apps 1 for ° from the [angle] menu.
    Also useful in programming when you don't want to reset the mode in the program to degrees.
    Common error: If a graph of a trig function is behaving spooky, make sure mode is correct.

4. Press alpha [x,τ,θ,n] for the stacked fraction template.
    Holds for both the 84CE Python and for the non Python 84CE,
    even though it does not show on the keypad on the latter.

link

X,T,θ,n

link

X,T,θ,n

84CE PYTHON   Not a 84CE PYTHON

5. MathPrint™ Cursor "GPS"
   Use ▶ or ◀ in MathPrint™templates to move from term to term. Similar to "tab". Do not use ▲ or ▼.

   On HS in a history stack, ▲ climbs the history tree.

   $$\sum_{\square=\square}^{\square} (\square)$$
   Watch for automatic alpha.

   $$\sum_{J=1}^{10\square} (\square \sum_{J=1}^{10} (2J\square))$$
   Press ▶

   Example:
   To enter $e^{X^3+1}+1$ on the home screen, once you have typed $e^{X\square}$, press ▶ .
   (If you press ▲, you go to history.

   A press of the ▼ key after $e^{X^3\square}$ or $e^{X^3+1\square}$ on the home screen will have no effect.)

   If in Y=, ▲ takes you to the previous Y-var.
         ▼ takes you the previous Y-var.

   Example:
   In Y=, to enter $Y_1 = \ln\left(e^{X^3+1}\right)+1$, once you have typed $\ln\left(e^{X^3\square}\right.$, press ▶ .
   (If you press ▼ , you go to Y2)

   Press ▶ to move ahead!
   If you press ▼ you go
   ■\Y₁ = ln(e^{X^3\square}
   ■\Y₂ =

6. Tethered History Tree Plucking into all parts of a math template with [alpha]▲

   Example:
   On the home screen, enter a math expression, i.e. $x^3 + 2$.
   Press [alpha] [X,T,θ,n] to create a stacked fraction template.
   Press [alpha]▲ to move the cursor out of the template
   (although ▲ will also work, from #1)
   then ▲ to select the expression $x^3 + 2$.
   Press [enter] to paste it into the numerator of the fraction.
   When you are done editing the numerator,
   press ▶ to move to the denominator.

   NORMAL FLOAT AUTO REAL RADIAN MP
   X³+2   2.

   1. Press ▲ to climb the history tree to make a selection from the history of entries.
   2. Press [enter] to "pluck the fruit" of your selection.
   3. It will paste into the numerator.

   Press [alpha] , then press ▲ to escape out of the template and climb into history.

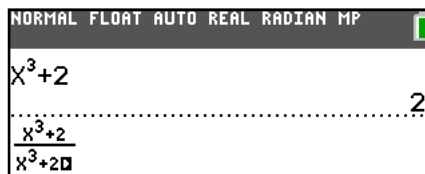   (Using [alpha]▲ will tether you to the denominator when you pluck from the history tree.
   If you just use ▲ the TI-84CE will paste your selection at the end of the expression in the numerator.)

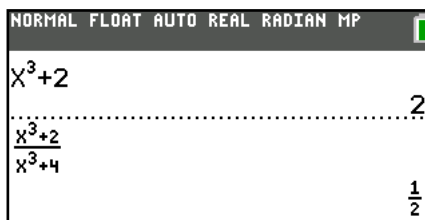   NORMAL FLOAT AUTO REAL RADIAN MP
   X³+2   2.
   $\frac{X^3+2}{\square}$
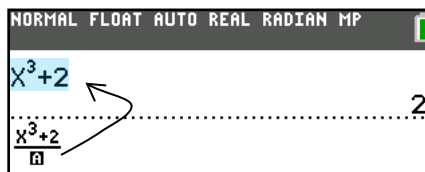
   4. Press [alpha] ▲ to climb the history tree tethered to the denominator.
   5. Press [enter] to "pluck the fruit" of your selection.
   6. It will paste into the denominator.

   NORMAL FLOAT AUTO REAL RADIAN MP
   X³+2   2.
   $\frac{X^3+2}{X^3+2\square}$

   7. Edit the denominator as desired.

   NORMAL FLOAT AUTO REAL RADIAN MP
   X³+2   2.
   $\frac{X^3+2}{X^3+4}$
                        $\frac{1}{2}$

   8. Press [enter].

7. Use [clear][clear] on HS to clear everything.
   Use [clear][clear] in the Y= menu to clear Y-var expression and reset the color and line style to default.

8. Jump Cursor Start to End of an Expression.
   Use [2nd] [◄] and [2nd] [▶] to move the cursor to the start or end of a MathPrint™ expression.

   - Overstrike cursor: $\blacksquare^{x^3+1}+1$
     o Any existing character is overwritten.
   - Insert cursor: $\underline{e}^{x^3+1}+1$
     o A character is inserted *in front* of the cursor location.

   > From #5 above:
   > Cursor at the end of the expression:
   > $e^{x^3+1}+1\blacksquare$
   > [2nd] [◄] moves cursor to start
   > $\underline{e}^{x^3+1}+1$
   > [2nd][ins] press [0][sto→][X,T,θ,n][2nd][:] to insert.
   > $0\rightarrow X:e^{x^3+1}+1$
   > Press [enter] to evaluate.

   Use [2nd] [◄] and [2nd] [▶] to move the cursor to the start or end of a list on an entry line on the HS or in the List Editor.
   On TRACE, [2nd] [◄] or [2nd] [▶] moves left or right every 5 steps.

9. Both X and Y are refreshed every time you press GRAPH so whatever you store there will eventually be lost. If you wish to keep anything that is X or Y, move it elsewhere:

   > X→A
   > 6.203564377

10. Use [2nd] [rcl] to paste the contents of a token anywhere, i.e., [2nd] [rcl] L1 or [2nd] [rcl] Y1 or [2nd] [rcl] Ans, etc,

11. List on your index card other **Home Screen Management** features that have surprised you or others.

In this session those in attendance noted the following was new to them (or to participants when they shared them):
#2 The contents of Ans is not the same as what Ans displays
#3 Use [2nd][apps][1] for ° from the [angle] menu.
#4 Use [alpha][X,T,θ,n] for the stacked fraction ⦂⦂ on a non-Python TI-84 Plus CE
#5 Use [▶] or [◄] in MathPrint™templates to move from term to term similar to "tab".
#6 Use [alpha][▲] to paste into the denominator of a stacked fraction ⦂⦂ template (Tethered History Climb)
#8 Use [2nd] [▶] (like "Home") or [2nd] [◄] (like "End") in math templates or lists.

Another mentioned: Setting up a recursive table on the HS with lists.

See the document "Choose a Prize" (in the PD folder)

> NORMAL FLOAT AUTO REAL RADIAN CL
> {1,100}
>   {1 100}
> {Ans(1)+1,Ans(2)+100}
>   {2 200}
> {Ans(1)+1,Ans(2)+100}
>   {3 300}
> {Ans(1)+1,Ans(2)+100}
>   {4 400}
> ∎

or see
the on-demand Webinar *Get the Most Out of Your TI-84 Plus CE Graphing Calculator*
with Linda Griffith and Ann Schlemper

Manage the Y= Editor or Stat Plot

12. We have three ways to "Copy" and "Paste". Two ways to "Copy" and "Paste" into a Y-var, plus History Tree Plucking.

    ① Paste a home screen expression to Y=.
       After the evaluation of an expression on the HS, the input expression is stored in the last Entry.
       The contents of [2nd] [entry] can be pasted anywhere (in particular, the Y= menu) by pressing [2nd] [entry].

After you press [enter] on the HS, press [y=]   Press [2nd] [entry] to paste the last entry.

    ② Use [2nd] [rcl] (See #10)
       On Y4 press [alpha] [X,T,θ,n] to create a stacked fraction template.
       Once in the numerator, press [2nd][rcl] and then use the shortcut menu to paste Y1.
       Press [enter] to paste it into the numerator of the fraction.
       When you are done editing the numerator,
       press [▶] to move to the denominator.
       Once in the numerator, press [2nd][rcl] and then use the shortcut menu to paste Y2.
       Below is a trail, from left to right, to use [2nd][rcl] to paste expression into a math template in the Y= Editor.

You could also just use the Y-var tokens themselves:

    ③ History Tree Plucking
       This only works with the Home Screen (See #1 and #6)

13. Reminder: the following have similar functionality in the Y= menu.
    [▶],[◀] in MathPrint™templates will move from term (See #5)
    [▲],[▼] will move to the previous or next Y-var. (See #5)
    [alpha][▲],[alpha][▼] will move the cursor from a MathPrint™ expression to the previous or next Y-var
    [clear][clear] will clear Y-var expression and reset the color and line style to default (See #7)

14. Turn Me On or Turn Me Off!

- Press 2nd ON to turn the TI84 off. (OK, this may seem obvious but I have had a participant tell me it was not!)
- Turn on or off Y-Var or Plots or Background is similar in process:
  - Interactively:
   For Y-Var or Plots, press y= , sit your cursor on the = sign or Plot # and press enter to deselect.

    Use 2nd format tourn background on or off. (See #32).

    Yet another way (secret back door) to turn Background on or off
    interactively is at #32 with 2nd draw BACKGROUND.
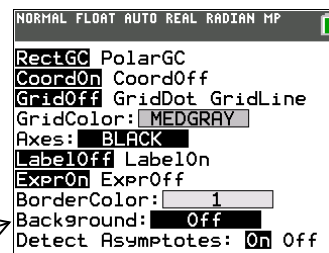
  - Command-driven:
    - Press 2nd stat plot
      PlotsOn (every plot is turned on)
      PlotsOn # , [#] (specified plot(s) turned on)
      PlotsOff (every plot is turned off)
      PlotsOff #, [#] (specified plot(s) turned off)
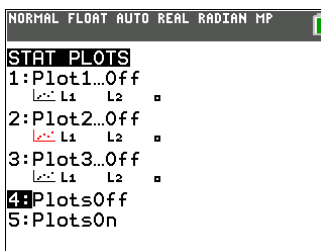
    - Function # on or off
      Catalog: Press 2nd quit to get to HS, then press 2nd [catalog] [F] (alpha is on in catalog)
      FnOn (every Y-var is turned on)
      FnOn #, [#] (specified Y-var(s) turned on)
      FnOff (every Y-var is turned off)
      FnOff #, [#] (specified Y-vars(s) turned off)

      FnOn, FnOff also found in vars [Y-VARS]
      FnOff and FnOn only work for Y-vars in
      function mode.
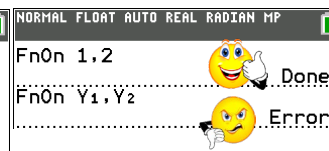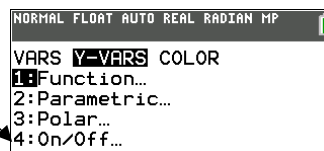
    - Turning the Background on or off can be **command driven** from HS.
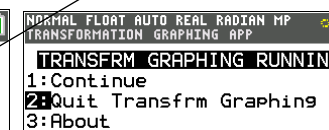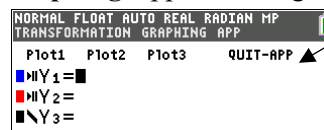   Press 2nd draw **BACKGROUND**.

      BackgroundOn # (specified Background is turned on)
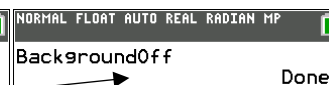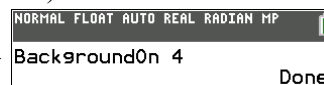
      BackgroundOff (current background is turned off)
  - On the TI-84CE or TI-84C, if you see **QUIT-APP** along the Plot1 Plot2 Plot3 line in Y=,
    either **Inequality Graphing** App or **Transformation Graphing** App is running. Select **QUIT-APP** to turn off
    either of these Apps. Press enter and follow the
    prompts.

15. List on your index card other **Y= Management** features that have surprised you or others.
    In this session those in attendance noted the following was new to them (or to participants when they shared them):
    #12 How to "copy" and "paste"
    #13 Use clear clear to clear Y-var expression and reset the color and line style to default.
    #14 Parallel behavior between FnOn # , PlotsOn #, Background #, StorePic #, RecallPic #, StoreGDB #, RecallGDB #,
        and turning items off with FnOff, PlotsOff, and BackgroundOff.
   Other gems mentioned: Piecewise functions and the CONDITIONS menu
                    Features of Transformation Graphing: See https://users.pfw.edu/lamaster/technology/ for
                    the Webinar *Deep Dive into TI-84 Plus Technology Series No. 3: Using Images and Apps as
                    Tools for Inquiry* with John LaMaster and Karen Campe.

Manage Graphing and Plotting Functionality

16. To speed up graphing (especially for students during exams), press [mode] > Simultaneous graphing

17. Press [2nd][zoom][format]
    - Set GridLine.
    - Set colors, and even a Background Image (5 Image Vars are pre-loaded)
    - You can turn Detect Asymptotes Off for faster graphing.
      (It will not take time to check for singularities at each pixel.)
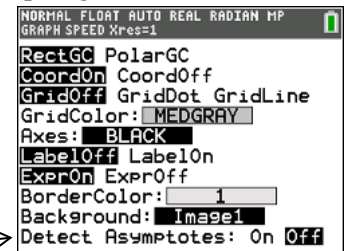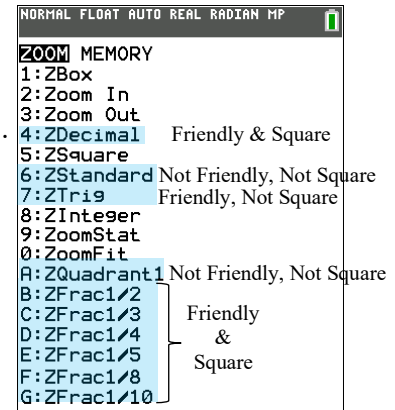
18. Pre-set Viewing Windows
    Shown highlighted on the right are the **fixed pre-set** windows.
    All but two are friendly (screen coordinates are sweet): **ZStandard** and **ZQuadrant1**.
    (View both with Gridline to see why.)
    All but three are square (true geometric perspective): **ZStandard**, **ZTrig** and **ZQuadrant1**.

19. Charlatan Coordinates Exposed.
    - **Screen Coordinates** (charlatans!) are displayed with the free-floating cursor.
      Press [graph] followed by ▶ and ◀. The values displayed for X and Y depend on the
      window settings and are not the same color as the graph's.
    - **Trace Coordinates** are displayed after you press [trace]. The value displayed for the
      charlatan X depends on the window setting. The Y value is the calculated output at the
      charlatan X. The values are same color as the graph's color.
    - Neither **Screen Coordinates** nor **Trace Coordinates** should be trusted for intersections, max, min, etc.
    - **Smart Trace** – While tracing, enter a value to jump to that point, ignoring any restrictions from the window!
      o Similarly for Intersection, Minimum, and Maximum

20. Plot Trace and Table Trace in Graph-Table (G-T) Mode
   a. Press [trace] or [graph] to get to the Left Pane
       o When you press [trace] followed by the ▶ and ◀ key, you will trace
         the plot as the corresponding ordered pair is highlighted in the *table*.
       o The left pane has same functionality as Full screen graphing. If more
         than one plot or function is on, use the ▼ and ▲ keys to move
         between plots or graphs.
       o When active, notice the right pane is gray and
         the lower border on the left pane is shaded.
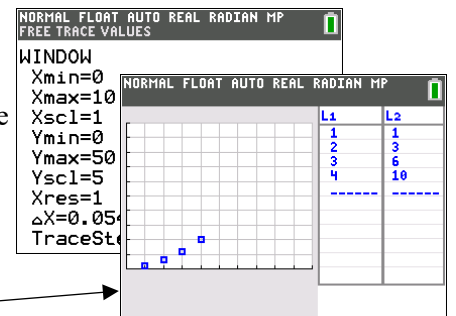
    [graph] and [trace] give graph focus

    b. Press [2nd] [table] to get to the Right Pane.
       o When you press [2nd] [table] followed by the ▼ and ▲ keys,
         the corresponding point is highlighted on the *plot*.
       o Use the ▶ and ◀ keys to move left or right in the table.
       o When active, notice the right pane has a dark black border and the
         full value of the list element is on the lower entry line.
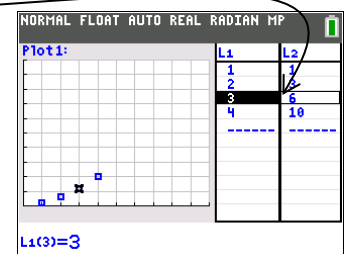
    [2nd] [table] gives table tracing

21. Plot Interactively in G-T Mode with Safety Harness
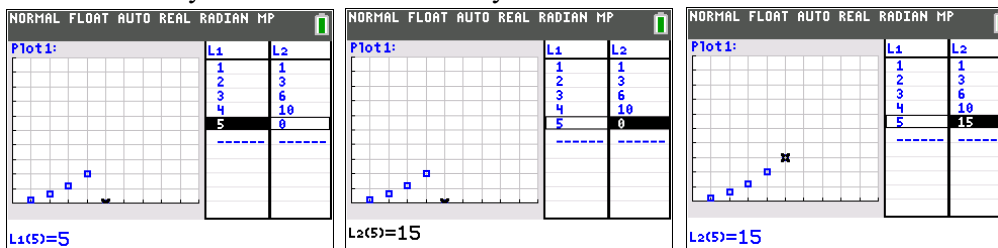
    When on the right pane, if you highlight a row and press the DEL key, both pairs will be deleted so that no
    mismatch occurs. This kindness is not preserved if you perform this action in the List editor. In the List Editor,
    if you delete an element in L1, its match in L2 is not deleted.

22. Function Trace and Table Trace in G-T and a "Window Medic" with ΔX.

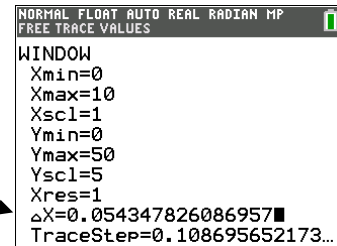Enter y1 = x(x+2)/2. Press TRACE. Cursor will first sit on a plot if turned on.

o As in #20a,

use the ▶ and ◀ keys to move across the graph and up or down the table.

o Use ▼ and ▲ to move to the graph.

Use the ▶ and ◀ keys to trace the graph.

o Notice the right pane. What fresh hell is this?
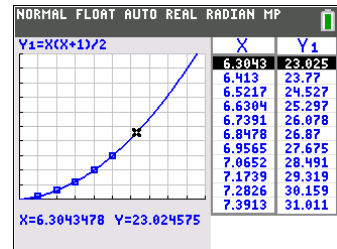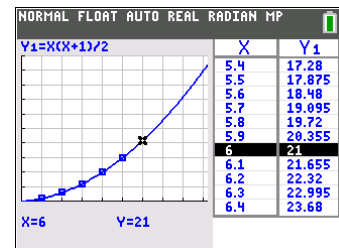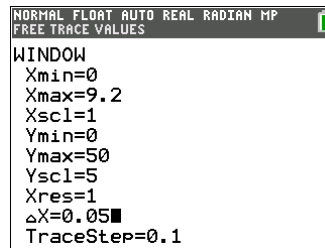
Press WINDOW.

Diagnosis: We have a case of a nasty ΔX.

Change ΔX to a friendly value, say 0.05.

In G-T, the increment in table is ΔX determined from the viewing window,

Now press TRACE.

o Use ▼ and ▲ to move to the graph.

Use ▶ and ◀ to trace the graph.

o Notice the right pane.

In G-T, first make sure you are tracing on the function.

Use ▶ and ◀ to move to the graph if necessary.

Then press [2nd] [table] for table tracing

o Use ▶ and ◀ to move left or right in the table.

o Use ▼ and ▲ to scroll the table.

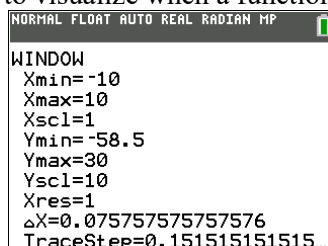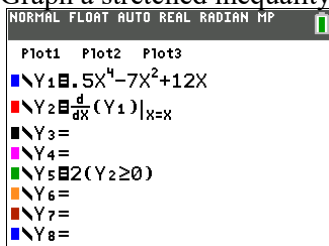o The increment in table is determined from ΔTbl defined in [2nd] [tblset].

o Here ΔTbl = 1.
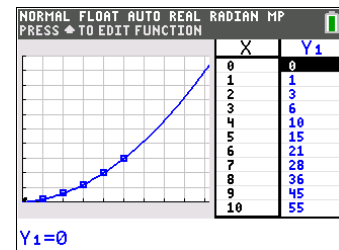
23. Holes

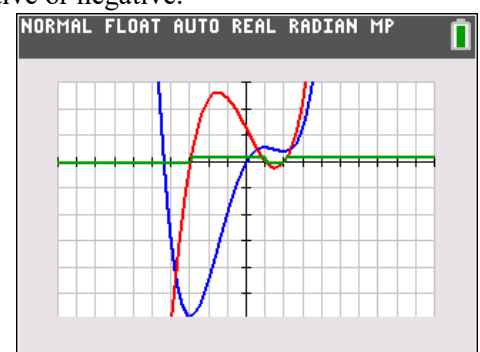Use a decimal window or any friendly window that captures the singularity:

This graph has a hole at (−1, −0.5).
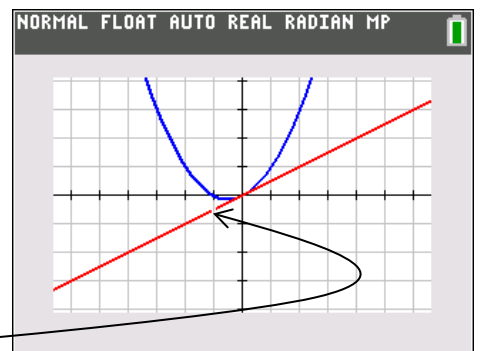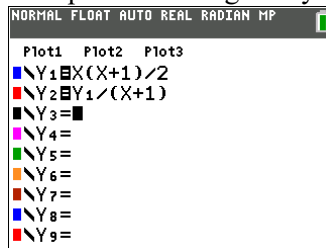
24. Graph a stretched inequality to visualize when a function's derivative is positive or negative.

Compare with Y5☐2/(Y2≥0)
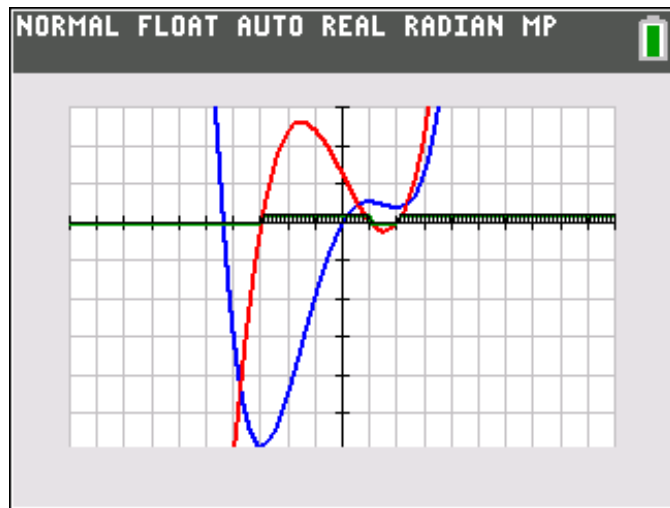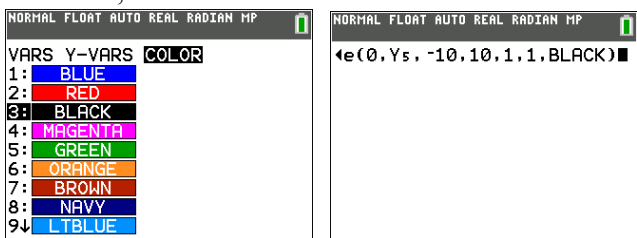
25. Use Catalog Help for command syntax.

Example from #24: Press [2nd][draw], sit your cursor on the menu item **7: Shade(** but do not press [enter].

Instead, press [+]. (If you then press [▲] and you will scroll through the catalog since that's where the TI-84 put you now.)

Memory Tip: "On the 84 Plus, for help press [+]".
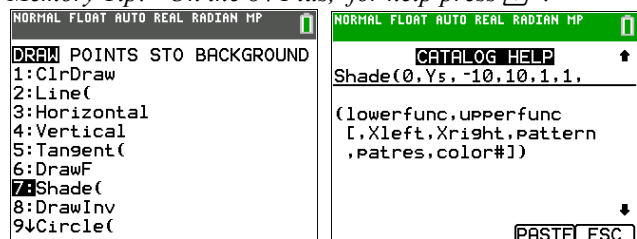
For color, use VARS > COLOR menu.

You can also get to any command directly by pressing [2nd][catalog]. You will be in ALPHA lock automatically.

26. Use values of X and Y from the graph screen or [2nd][calc] menu for later calculations.

Calculate the maximum of the derivative of y1 and store this into a "safe" variable, say A.

Use Smart Trace (See #19) to place cursor on an inflection point.
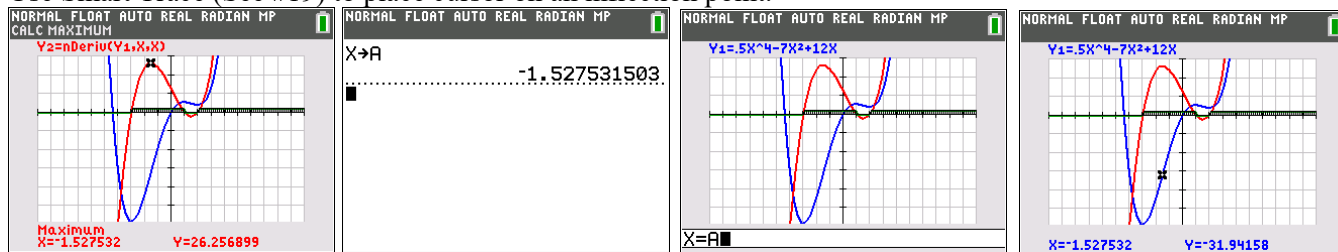
27. Entering the Draw Menu from the Graph Screen or "There and Back Again"

If you start **from the Graph Screen** and immediately press [2nd][draw],

after you select a command the TI-84 returns you back to the Graph Screen where you play the command **interactively** (except for DrawF, Shade, and DrawInv).

Example: Press [graph]. Then press [2nd] [draw], select **4:Vertical**, then press [enter] to get a moving vertical line. Use [▶] and [◀] to move left or right to indicate endpoints of the inequality. How else could a moving vertical line be used in the curriculum?

From the home screen run `Vertical A,BROWN,1` (or your own favorite color) to draw a line at $x = A$ to show the connection between the maximum of Y2 and the inflection point of Y1.
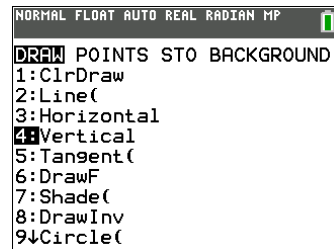
28. Xres = Xresolution = XRescue! To graph every other 8 pixels, press [window] and make Xres = 8, especially when graphing definite integrals or partial sums of series.

Replay `Vertical A,BROWN,1` to show Y3 = $\int_A^A Y_2(T)dT = 0$ and $\int_A^x Y_1'(T)dT$ is a vertical shift up C ≈ 30 units of Y1.
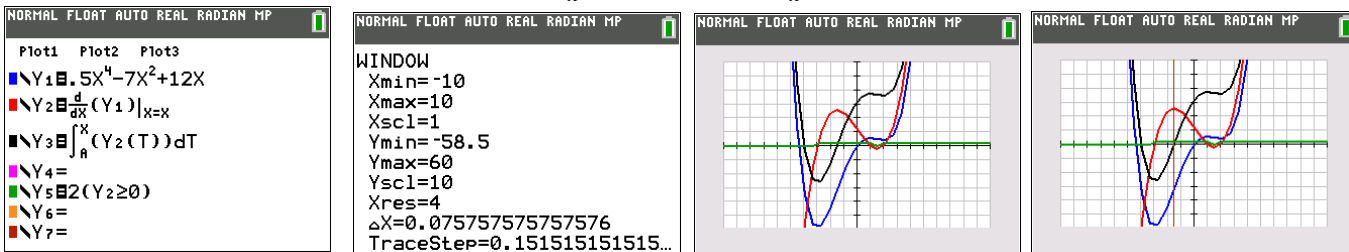
The TI-Smartview Emulator runs at a much faster speed than the calculator. (Here we used Xres = 4 just for beauty's sake with the emulator but would use Xres = 8 on the handheld.)

29. **Don't Judge a Graph By Its Resolution**
    Graphs produced with Xres = 8 will have low resolution but it does not affect
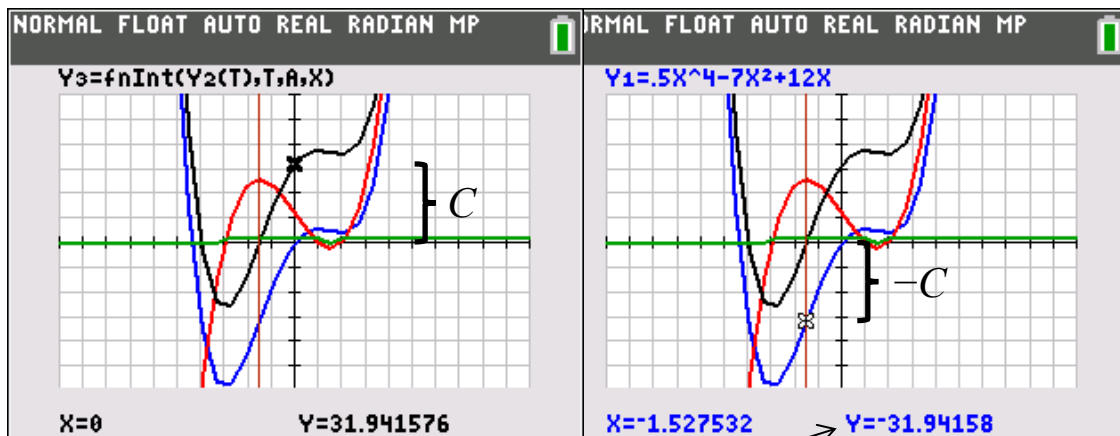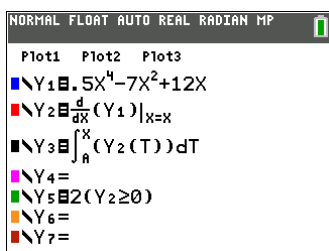   the 2nd CALC answers (Zero, Intersect, etc.)
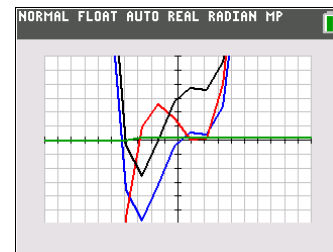
Here we have Xres = 8

Example: Use Smart-Trace to verify the antiderivative $\int_{A}^{x} Y_1'(T)dT$ is a vertical shift $C = -Y_1(A)$ units of $Y_1(x)$.

$$\int_{A}^{x} Y_1'(T)dT = Y_1(x) - Y_1(A)$$
$$= Y_1(x) + C$$

Plot1 Plot2 Plot3
Y1 = .5X^4 − 7X^2 + 12X
Y2 = $\frac{d}{dx}(Y_1)|_{x=x}$
Y3 = $\int_{A}^{x}(Y_2(T))dT$
Y4 =
Y5 = 2(Y2≥0)
Y6 =
Y7 =

Y3=fnInt(Y2(T),T,A,X)

X=0   Y=31.941576

Y1=.5X^4-7X²+12X

X=-1.527532   Y=-31.94158

$C = Y_3(0)$
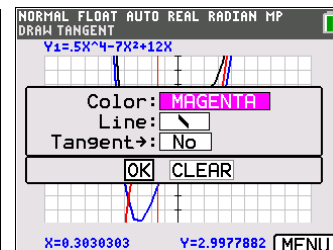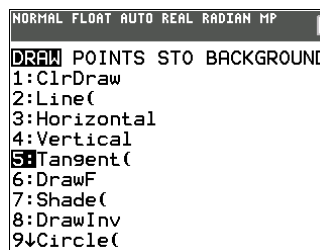$= -Y_1(A)$

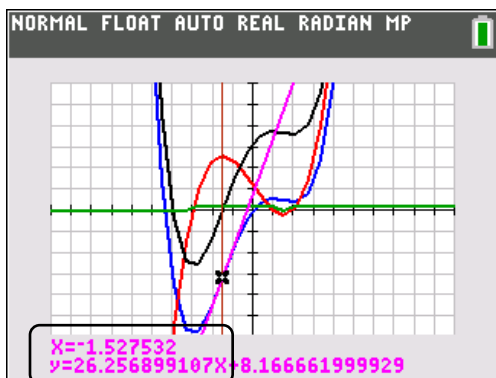$$Y_3(0) = \int_{A}^{0} Y_1'(T)dT$$
$$= Y_1(0) - Y_1(A) = -Y_1(A)$$

When $X = A$,
$Y_1 = -C$

30. **Draw Tangent Line has spinner options.**
    Start from the Graph Screen, immediately press [2nd][draw],
    select **5:Tangent**,
    then press the menu soft key [graph] to
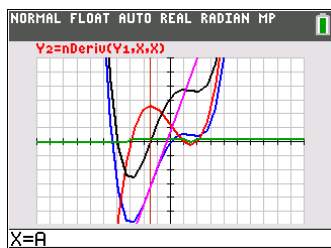   see the spinner. You can store this into a Y-Var, such as Y4.

DRAW POINTS STO BACKGROUND
1:ClrDraw
2:Line(
3:Horizontal
4:Vertical
5:Tangent(
6:DrawF
7:Shade(
8:DrawInv
9↓Circle(

DRAW TANGENT
Y1=.5X^4-7X²+12X
Color: MAGENTA
Line:
Tangent→: No
OK CLEAR
X=0.3030303   Y=2.9977882 MENU

Type [alpha] A
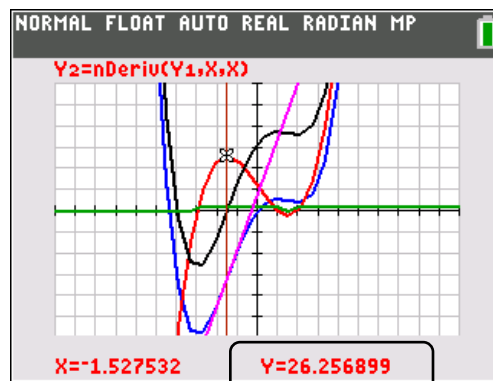
The slope of the tangent line
to Y1 at $x = A$ is the value of
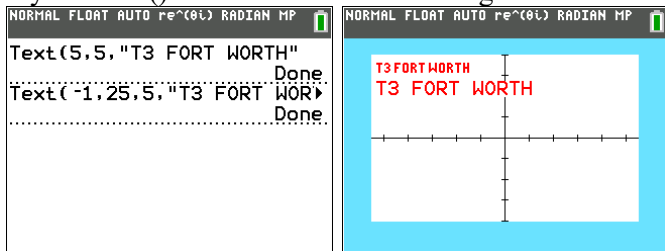Y2(A).

At $x = A$, Y2 = Y1' has
a relative maximum.

X=-1.527532
y=26.256899107X+8.166661999929

Y2=nDeriv(Y1,X,X)

X=A

Use smart trace [alpha] A

Y2=nDeriv(Y1,X,X)

X=-1.527532   Y=26.256899

At $x = A$, Y2 = Y1' has
a relative maximum.

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31. Try the Text() command with the first argument = −1. Thank you Pat Milheron!

32. Wall and Wallpaper
A Background Image is like the wall. All other items placed on the wall (graphs, Pic Vars, "Drawn" figures) are like the wallpaper. A Pic Var can not be used as a background. Background images can be selected three ways.
   1. Press [2nd][format] to access the Graph Format menu.
      Place your cursor on the Background Spinner.
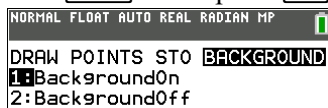   Press [▶] on the spinner to select Image1.
      Then press [▲] or [▼].
      Image1 should be highlighted.
   2. Typing the command BackgroundOn 4 (See #13)
   3. Interactivly (See # 27). Press [graph]. Then press [2nd][draw], go to BACKGROUND menu.
      Select BackgroundOn.

Press [◀] or [▶] to move through the spinner. Press [enter] to select.

**Manage Storage**
33. See https://users.pfw.edu/lamaster/technology/ for this Webinar:
   - *How-To" With Your TI-84 Plus CE Graphing Calculator, Part 3* with John LaMaster and Stuart Moskowitz

Manage the Lists
34. Manage the List Editor with SetUpEditor
   - Press [stat] SetUpEditor to return the list editor to L1, L2, L3, L4, L5, L6.
   - SetUpEditor L1,L3,L2 would place only these three lists in the list editor
     (and in this order). You can also use named lists selected from [2nd][list].
     Named lists selected from [2nd][list]. Example: SetUpEditor ∟QPX,∟QPY.
     Notice the TI-84 prefixes a named list with a "baby" ∟.
     (The named lists ∟QPX and ∟QPY are created behind the scenes by the TI-84CE after you run QuickPlot&Fit-EQ.)
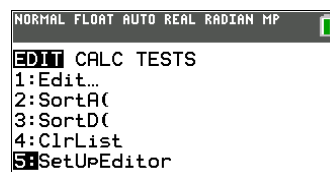
Manage the Table
35. See https://users.pfw.edu/lamaster/technology/ for these Webinars
   - *How-To" With Your TI-84 Plus CE Graphing Calculator, Part 4* with John LaMaster and Stuart Moskowitz
   - *What's On Your (84) Table?* with John LaMaster and Stuart Moskowitz

Other sessions at this conference on this topic on Saturday, Feb. 11, 2023:
   - John LaMaster's Breakout Session *Making Real-World Connections With Your TI-84 Plus CE Graphing Calculator*, 10:30 a.m. – 11:50 a.m EST, Fort Worth Ballroom 6, 2nd Floor
   - Tom Reardon's Breakout Session *I Got To Do This With My Kids! 25 Clever Activities on the TI-84 Plus CE Graphing Calculator With Conceptual Understanding*, 3:00 pm - 4:20 pm EST, Fort Worth Ballroom 8, 2nd Floor and his Website bit.ly/IGTDTWMK.
See also the following on demand:
   - 2020 Virtual T³IC Session: *Little-Known Tips and Tricks for the TI-84 Family of Graphing Calculators and TI-SmartView™ CE Emulator Software* by Corey Boby and Tracy Watson