Third Edition

Be Prepared
for the

AP

Calculus Exam

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Appendix: Calculator Skills (TI-Nspire)

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Appendix: Calculator Skills
(TI-Nspire)

The Test Development Committee has defined four calculator operations that are sufficient to answer all AP exam questions:

1. produce a graph of a function within an arbitrary viewing window;
2. find the zeros of a function (i.e., solve an equation numerically);
3. calculate the derivative of a function at a given value;
4. calculate the value of a definite integral.

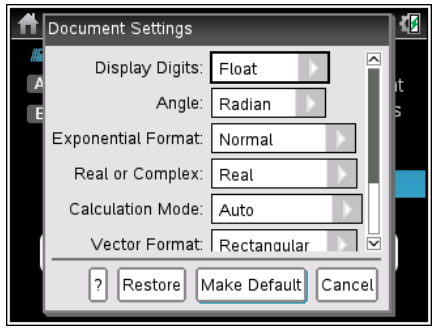
You should practice these skills prior to the AP Exam. A few examples follow, with calculator-assisted solutions for the TI-Nspire. The TI-83 / TI-84, TI-89, and HP Prime models are described in separate documents. There are other acceptable calculator methods to solve these problems. If your calculator model does not match one of the models presented, consult your user's manual to solve the examples.

A.1. Graphing a Function

This is the simplest calculator skill required on the exam. Usually, the hardest part is making sure you enter the function correctly on your calculator, and that you choose a suitable viewing window. Be sure to check that the parentheses that enclose function arguments (as in `sin(X)`) are properly matched.

> **Be sure that your calculator is set to the `Radian` mode when you take the exam.**

To set the mode, press `on/home`, choose `5 Settings` and `2 Document Settings`.) Set `Display Digits` to `Float` and the `Angle` to `Radian`:



Select `Make Default` and press `enter`.

You will see several graphing examples in the following sections.

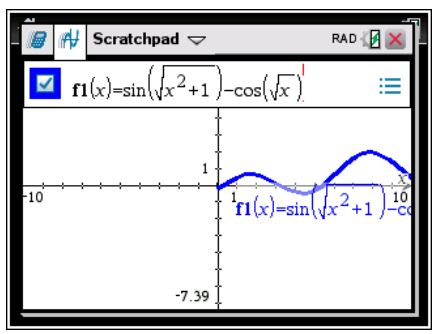
A.2. Solving an Equation

Example 1

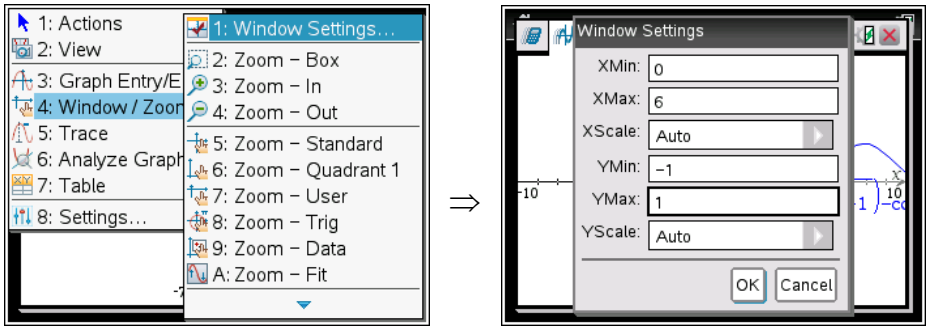
The derivative of a function f is given by $f'(x) = \sin\left(\sqrt{x^2+1}\right) - \cos\left(\sqrt{x}\right)$. Find all the values of x in the open interval (0, 6) where f has a local minimum.

Solution

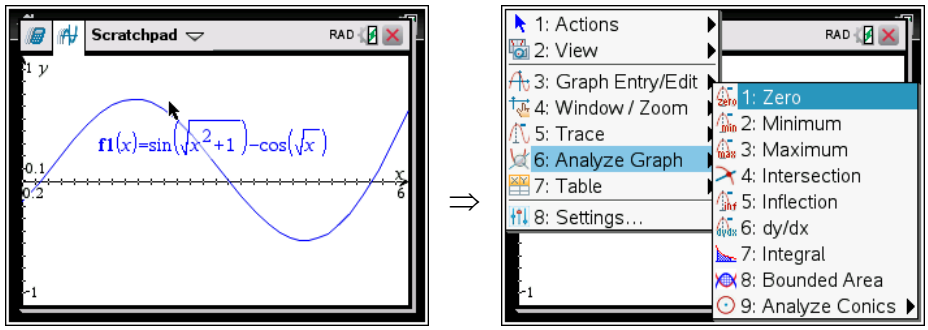
On the home screen, select `B Graph`. Enter $f'(x)$ as `f1(x)`:



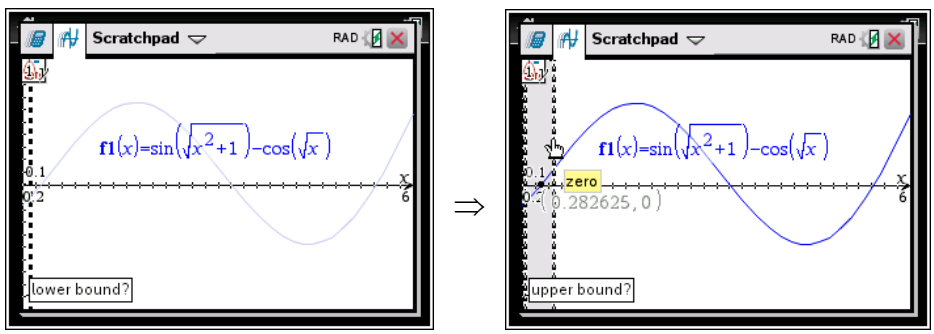
To set the viewing window, press `menu`, select `4: Window/Zoom`, then `1: Window Settings…`:



Enter the desired settings. To find the zeros, press `menu`, select `6: Analyze Graph`, then `1: Zero`:

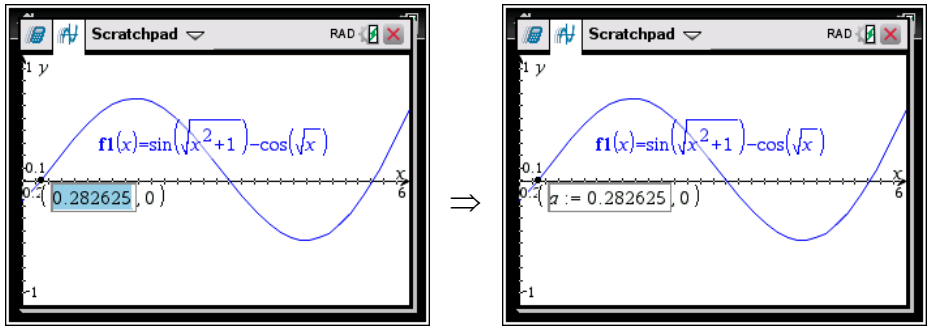


Use the touchpad or arrows to move the lower bound the left of the zero. Press `enter`, then move the upper bound to the right of the zero:



Finally, press `enter` to see the zero. You could also omit setting of the upper bound. As you move the cursor near the zero, you will see the zero called out on the screen. You can press `enter` at that time.

If you want to store this value into a variable for later use, select the *x*-coordinate of the point (this can be a bit tricky, and takes some practice to get right), press `ctrl-var` for the `sto→` command, and enter the variable name. The value will appear in bold to indicate it has been stored:

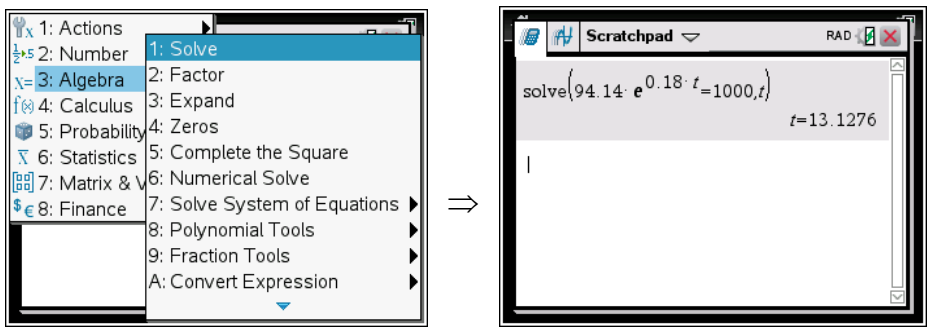


Example 2

The number of bees in a colony is given by $B(t) = 523e^{0.18t}$, where t is the number of days since the colony was established. The derivative of $B(t)$ is given by $B'(t) = 94.14e^{0.18t}$. On what day is the number of bees in the colony increasing at the rate of 1000 bees per day?

Solution

Press `home` and select `A Calculate`. Then press `menu`, select `3: Algebra`, then `1: Solve`. Fill in the arguments to the `solve` command:

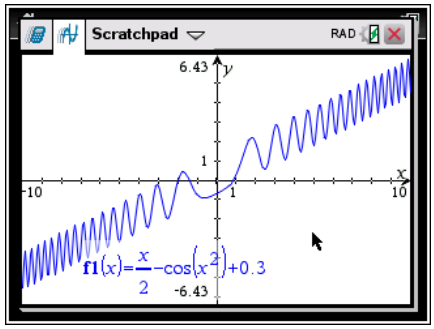


Example 3

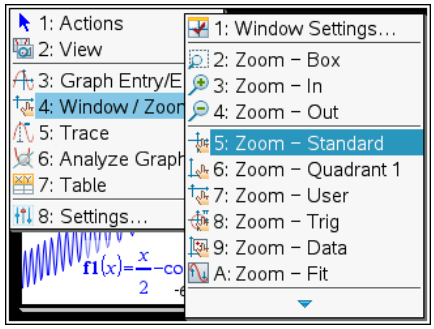
The derivative of a function g is given by $g'(x) = \frac{x}{2} - \cos\left(x^2\right) + 0.3$. What is the x-coordinate of a local maximum point on the graph of g?

Solution

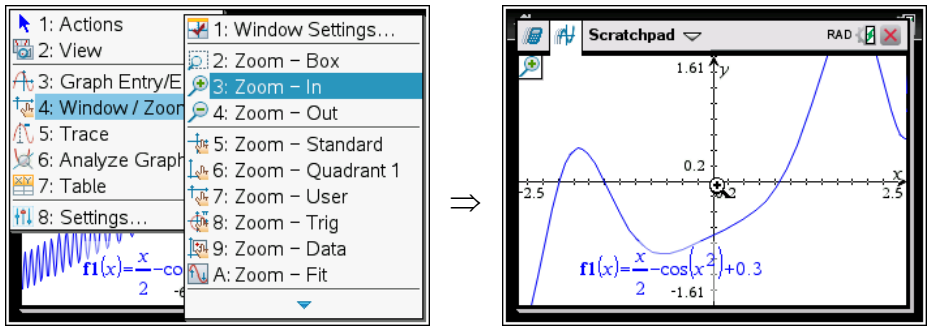
Follow the same basic procedure as you did with Example 1. On the home screen, select `B Graph`. Enter $g'(x)$ as `f1(x)`:



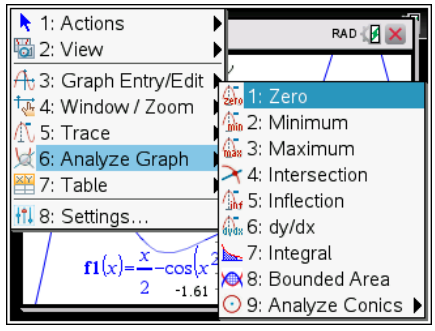
If necessary, set the viewing window. Press `menu`, select `4: Window/Zoom`, then `5: Zoom - Standard`:



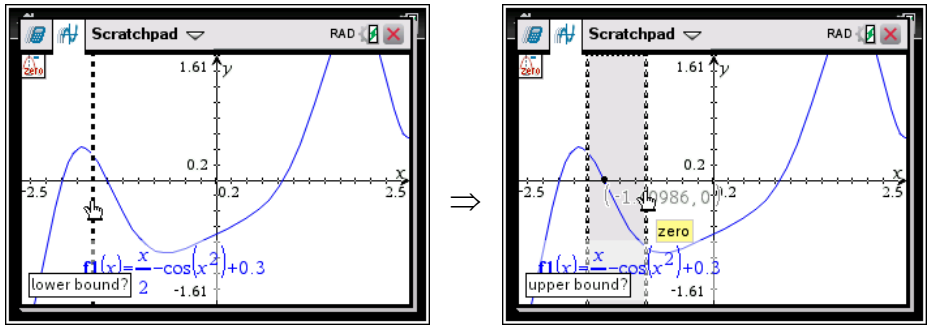
To zoom to the graph at the origin, press `menu`, select `4: Window/Zoom`, then `3: Zoom – In`. A little magnifying glass appears with a `+` in it. Press enter a couple of times to zoom in:



Press `menu`, select `6: Analyze Graph`, then `1: Zero`:



Use the touchpad or arrows to move the lower bound the left of the zero. Press `enter`, then move the upper bound to the right of the zero:



Finally, press `enter` to see the zero. Example 1 showed a procedure to store this zero into a variable for later calculations.

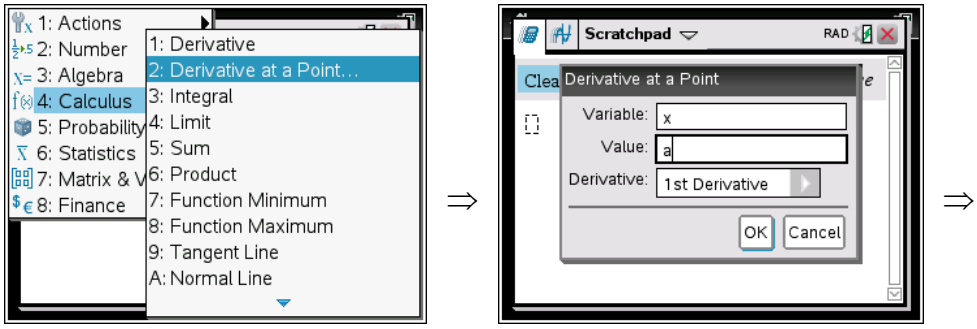
A.3. Evaluating a Derivative at a Point

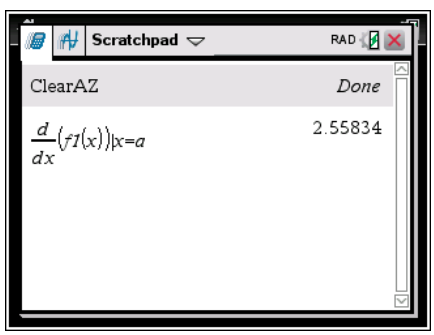
Example 4

Find the slope of the line tangent to the graph of $y = 2x + \sin(1+x^2) + \cos(1-x^2)$ at the point where the graph crosses the x-axis.

Solution

As with the TI-89, it is a good idea to clear all of the one letter variables before starting this activity. Press `menu`, select `1: Actions`, then `4: Clear a..z`. Then use the procedure from the previous section to find the zero of the function and store that zero into the variable *a*. Navigate to the `Calculate` screen, press `menu`, select `4: Calculus`, then `2: Derivative at a Point...`. Leave the variable as *x*, and enter *a* for the `Value`, and press `enter`. Enter `f1(x)` as the function of which you need to take the derivative:





A.4. Evaluating an Integral Numerically

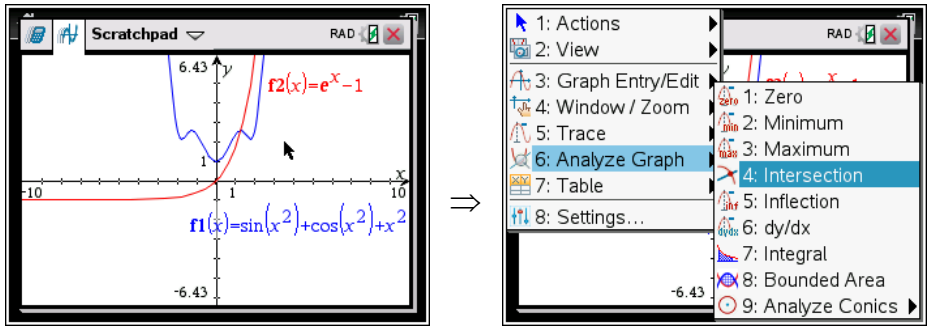
> **On the open-calculator free-response part of the AP exam (Section II, Part A), always use your calculator when you need to evaluate a definite integral. You don't get "extra credit" for evaluating an integral by first finding an antiderivative.**

Example 5

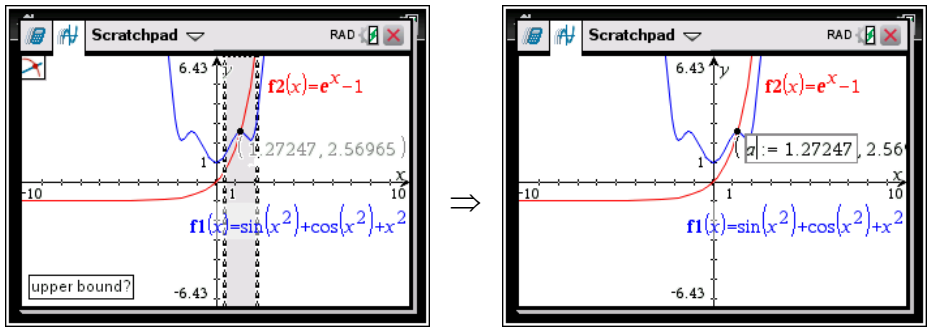
Find the area of the region in the first quadrant bounded by the graphs of $f(x) = \sin(x^2) + \cos(x^2) + x^2$, $g(x) = e^x - 1$, and the y-axis.

Solution

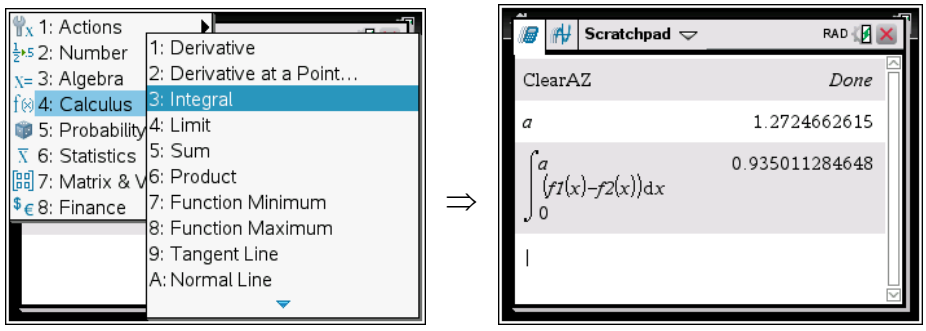
Clear the one letter variables as described in the previous section. Define f and g as `f1(x)` and `f2(x)`. Look at the graphs. Press `menu`, select `6: Analyze Graph`, then `4: Intersection`:



Use the touchpad or arrows to move the lower bound to the left of the intersection, and press `enter`. Move the upper bound to the right of the intersection, and press `enter`. Select the x-coordinate, press `ctrl-var`, and store the value into the variable a. The value will appear bold:



Go to the `Calculate` screen, press `menu`, select `4: Calculus`, and `3: Integral`. Enter the arguments for the integral:



You could also use the `Templates` key (just to the right of the "9" key) to enter the integral command: