Using The TI-Nspire Calculator in AP Calculus

(Version 3.2)

You must be able to perform the following procedures on your calculator:
1. Plot the graph of a function within an arbitrary viewing window,
2. Find the zeros of functions (solve equations numerically),
3. Numerically calculate the derivative of a function, and
4. Numerically calculate the value of a definite integral.

On the free response questions,
- You may use the calculator to perform any of the four listed procedures. When you do, you need only to write the “setup” (the equation, derivative, or definite integral that will produce the solution), then write the calculator result.
- For a solution for which you use the calculator for something other than the four procedures listed above, you must write down the mathematical steps that yield the answer.
- When asked to “justify”, you must provide mathematical reasoning to support your answer. Calculator results alone will not be sufficient.
All answers on the AP exam must be accurate to 3 decimal places unless otherwise specified in the problem. Your calculator should be set to display enough decimal places to have that degree of accuracy.

On Home screen, select 5. Settings.

Select 2:Document Settings

Change the Display Digits to Float.
Change the Angle to Radian.
Make Default.

On a Graphs page, from menu, select 9:Settings.
Change the Display Digits to Auto and Graphing Angle to Radian. Make Default.
Plot the graph of a function within an arbitrary viewing window.

(Using TI-Nspire Version 3.2)

1. Let \( f \) and \( g \) be functions given by \( f(x) = \frac{1}{4} + \sin(\pi x) \) and \( g(x) = 4^{-x} \).

Let \( R \) be the shaded region in the first quadrant enclosed by the \( y \)-axis and the graphs of \( f \) and \( g \), and let \( S \) be the shaded region in the first quadrant enclosed by the graphs of \( f \) and \( g \), and shown in the figure above.

On Home screen, select **1. New Document**.

Enter the first function in \( f_1 \).

Press **enter**, then **tab**.
Enter the second function in $f_2$.

Press enter.

To adjust the window to match the given graph, go to menu, select 4: Window/Zoom, then 2:Zoom-Box.

Put a box around the part of the graph you want to include in your window. Move cursor to the first corner of the box, enter, then move to the opposite corner, enter, then esc.
2. Let \( R \) be the region in the first and second quadrants bounded above by the graph of \( y = \frac{20}{1 + x^2} \) and below by the horizontal line \( y = 2 \).

Enter the first function in \( f_1 \).

Press \( \text{enter} \), then \( \text{tab} \).

Enter the second function in \( f_2 \).

Press \( \text{enter} \).

The graph displayed in the standard window is misleading. When this question appeared on the 2007 AP exam, several students were unable to answer correctly the questions that went along with the graph. Many students thought the graph had a vertical asymptote at \( x = 0 \).

Think analytically about the function and adjust the window to show the \( y \)-intercept.

\[
f(x) = \frac{20}{1 + x^2} \quad \rightarrow \quad f(0) = \frac{20}{1+0^2} \quad \rightarrow \quad (0, 20)
\]
From \( \text{menu} \), select \textbf{4:Window/Zoom}, then \textbf{1: Window Settings}.

Change the \textbf{YMax} to be greater than \( y = 20 \). Tab to \textbf{OK}, then \textbf{enter}. 
Find the zeros of functions (solve equations numerically)

(Using the TI-Nspire Version 3.2)

Example 1: Solve \( x^3 - x - 1 = 0 \).
Enter the function \( f(x) = x^3 - x - 1 \).

Method 1

From \( \text{menu} \), select 6: Analyze Graph
then 1: Zero.

Move pointer to left side of the zero, enter, then the right side, enter. enter
To save the $x$-coordinate of the zero to use later, store it as a variable.

Highlight the $x$-coordinate.

Press $\text{ctrl} \varnothing$.

Type the variable name. $\text{enter}$

The bold $x$-coordinate indicates the value has been stored as a variable.

Method 2

From $\text{menu}$, select 5: Trace then 1: Graph Trace.

Move cursor along curve until you reach the zero. Press $\text{enter}$, $\text{esc}$. 
Example 2: Solve \( x^3 - 5x^2 - 8x + 12 = x^2 - 5x + 1 \).

On a graph page, enter \( f_1(x) = x^3 - 5x^2 - 8x + 12 \) and \( f_2(x) = x^2 - 5x + 1 \).

**Method 1**

Set the window to show the intersection of the two functions.

From \(\text{menu}\), select 6: **Analyze Graph**, then 4: **Intersection**.

Move the pointer to the left side, of the intersection point.

Move the pointer to the right side of the intersection point.

Repeat the steps to find the coordinates of each of the other intersection points.

Each coordinate can be stored as a variable using the method shown on page 8.
Method 2

This method finds all points of intersection in the same step.

From \( \text{menu} \), select \( 8: \text{Geometry} \),
1: \( \text{Points & Lines} \).

then 3: \( \text{Intersection Point(s)} \).

Use pointer to highlight the graph of each function. Press \( \text{enter} \) to select each graph.

Press \( \text{enter} \), then \( \text{esc} \).
Labels may overlap.

Grab and move the coordinates of the intersection points.
Numerically calculate the derivative of a function

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Example: Find \( \frac{dy}{dx} \) at \( x = 3 \) if \( y = x^3 - 5x^2 + 8x - 4 \).

1: Add Calculator

From menu, select 4: Calculus.

1: Numerical Derivative at a Point

Fill in the variable and value.

Fill in the template with the function.
Numerically calculate the value of a definite integral

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Example: Find the area of the region between \( y = \frac{20}{1 + x^2} \) and the horizontal line \( y = 2 \).

(Evaluate \( \int_{-3}^{3} \left( \frac{20}{1 + x^2} - 2 \right) dx \))

Press ~, Select 4:Insert, then 3:Calculator.

From menu, select 4: Calculus, then 2: Numerical Integral.
Fill in the definite integral template to evaluate the integral.

\[
\int_{-3}^{3} \frac{20}{1+x^2} \, dx
\]

\[
\int_{-3}^{3} (f_1(x) - f_2(x)) \, dx
\]

OR  It is often easier to use the name of the function instead of the function itself.
Graphing a Slope Field and Solution Curve for a Differential Equation

(This is not one of the four calculator procedures that do not require showing mathematical steps.)

Example: Graph the slope field for \( \frac{dy}{dx} = \frac{x}{y} \) and the solution curve for \( x = -1, y = 2 \).

Open a graph page.

From \( \text{Menu} \), select 3: Graph Entry/Edi7, then 6: Diff Eq.
Type \( \frac{x}{y_1} \) in the box for \( y_1' \).

Press \( \text{enter} \) to view the slopefield graph.

To see a solution curve drawn through the given point \((-1, 2)\), \( \text{tab} \) \( \uparrow \) type \((-1, 2)\) in the box next to \((x_0, y_0)\).

Press \( \text{enter} \) to view the solution curve through \((-1, 2)\).