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Homework #31E: *Calculator Use on the AP Exam*

Below are excerpts from
http://www.collegeboard.com/student/testing/ap/calculus_ab/calc.html:

Graphing Calculator Capabilities for the Exams

The committee develops exams based on the assumption that all students have access to four basic calculator capabilities used extensively in calculus. A graphing calculator appropriate for use on the exams is expected to have the built-in capability to:

- Plot the graph of a function within an arbitrary viewing window
- Find the zeros of functions (solve equations numerically)
- Numerically calculate the derivative of a function
- Numerically calculate the value of a definite integral

One or more of these capabilities should provide the sufficient computational tools for successful development of a solution to any exam question that requires the use of a calculator. Care is taken to ensure that the exam questions do not favor students who use graphing calculators with more extensive built-in features.

Technology Restrictions on the Exams

You are not permitted to use these items on the AP Calculus Exams: nongraphing scientific calculators, portable and handheld computers, laptops, electronic writing pads, pocket organizers.

Additionally, you cannot use any graphing calculator models with these features or capabilities: QWERTY (typewriter-like) keypad as part of hardware or software (e.g., TI-92 Plus, Voyage 200); pen-input, stylus or touch-screen (e.g., PalmPilot, personal digital assistant, Casio ClassPad); wireless or Bluetooth capabilities; paper tapes; talk or make noise; require an electrical outlet; have cell phone, audio, or video recording capability; can access the Internet; or camera or scanning capability. Also, the use of hardware peripherals with an approved calculator is prohibited.

Proctors are required to check calculators before the exam. Therefore, it is important for each student to have an approved calculator. Students should be thoroughly familiar with the operation of the calculators they plan to use on the exam. Calculators may not be shared, and communication between calculators is prohibited during the exam. Students may bring to the exam one or two (but no more than two) graphing calculators from the current List of Graphing Calculators.

Calculator memories will not be cleared. Students are allowed to bring to the exam calculators containing whatever programs they want.

Students must not use calculator memories to take test materials out of the room. Students that attempt to remove test materials from the room by any method will have their exam grades invalidated.

Showing Work on the Free-Response Sections of the Exams

Students are expected to show enough of their work for Readers to follow their line of reasoning. To obtain full credit for the solution to a free-response problem, students must communicate their methods and conclusions clearly. Answers should show enough work so that the reasoning process can be followed throughout the solution. This is particularly important for assessing partial credit. Students may also be asked to use complete sentences to explain their methods or the reasonableness of their answers, or to interpret their results.

For results obtained using one of the four required calculator capabilities listed above, students are required to write the setup (e.g., the equation being solved, or the derivative or definite integral being evaluated) that leads to the solution, along with the result produced by the calculator. For example, if the student is asked to find the area of a region, the student is expected to show a definite integral (i.e., the setup) and the answer. The student need not compute the antiderivative; the calculator may be used to calculate the value of the definite integral without further explanation. For solutions obtained using a calculator capability other than one of the four required ones, students must also show the mathematical steps that lead to the answer; a calculator result is not sufficient. For example, if the student is asked to find a relative minimum value of a function, the student is expected to use calculus and show the mathematical steps that lead to the answer. It is not sufficient to graph the function or use a built-in minimum folder.

When a student is asked to justify an answer, the justification must include mathematical reasons, not merely calculator results. Functions, graphs, tables, or other objects that are used in a justification should be clearly identified.

Exploration Versus Mathematical Solution

A graphing calculator is a powerful tool for exploration, but students must be cautioned that exploration is not a mathematical solution. Exploration with a graphing calculator can lead a student toward an analytical solution, and after a solution is found, a graphing calculator can often be used to check the reasonableness of the solution.

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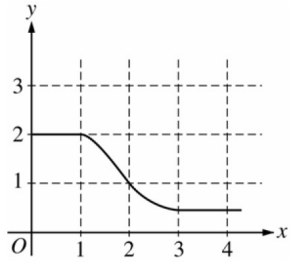
Note: As on previous AP Calculus Exams, a decimal answer must be correct to three decimal places unless otherwise indicated. Students should be cautioned against rounding values in intermediate steps before a final calculation is made. Students should also be aware that there are limitations inherent in graphing calculator technology; for example, answers obtained by tracing along a graph to find roots or points of intersection might not produce the required accuracy.

Calculator-OK

Question 1



The graph of f is shown in the figure above. If $\int_1^3 f(x)dx = 2.3$ and $F'(x) = f(x)$, then $F(3) - F(0) =$

(A) 0.3 (B) 1.3 (C) 3.3 (D) 4.3 (E) 5.3

Question 2

If the derivative of f is given by $f'(x) = e^x - 3x^2$, at which of the following values of x does f have a relative maximum value?

(A) –0.46 (B) 0.20 (C) 0.91 (D) 0.95 (E) 3.73

Question 3

At time $t \geq 0$, the acceleration of a particle moving on the x-axis is $a(t) = t + \sin t$. At $t = 0$, the velocity of the particle is –2. For what value t will the velocity of the particle be zero?

(A) 1.02 (B) 1.48 (C) 1.85 (D) 2.81 (E) 3.14

Question 4

Let f be the function given by $f(x) = 3e^{2x}$ and let g be the function given by $g(x) = 6x^3$. At what value of x do the graphs of f and g have parallel tangent lines?

(A) –0.701
(B) –0.567
(C) –0.391
(D) –0.302
(E) –0.258

Question 5

The first derivative of the function f is given by $f'(x) = \frac{\cos^2 x}{x} - \frac{1}{5}$. How many critical values does f have on the open interval $(0,10)$?

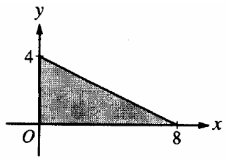
(A) One
(B) Three
(C) Four
(D) Five
(E) Seven

Question 6

Population y grows according to the equation $\frac{dy}{dt} = ky$, where k is a constant and t is measured in years. If the population doubles every 10 years, then the value of k is

(A) 0.069 (B) 0.200 (C) 0.301 (D) 3.322 (E) 5.000

Question 7



The base of a solid is a region in the first quadrant bounded by the x-axis, the y-axis, and the line $x + 2y = 8$, as shown in the figure above. If cross sections of the solid perpendicular to the x-axis are semicircles, what is the volume of the solid?

(A) 12.566 (B) 14.661 (C) 16.755 (D) 67.021 (E) 134.041