WHAT TO EXPECT ON THE FREE RESPONSE QUESTIONS FOR MAY 3RD, 2006

1. **Area and Volume Problem**
   - Calculate Area
   - Calculate Volume
   - Rotated around x-axis
   - Rotated around y-axis
   - Rotated around line x = k
   - Rotated around line y = k
   - Calculate Volume of Cross Section

Special note:
This is typically the easiest (and most predictable) of the Free Response questions.
Your goal is to get a NINE on this one!

2. **Analyzing a Graph of a Derivative**
   - Graph could be given as **f ' (derivative)**
   - Graph could be given as **velocity** [derivative of x(t)]
   - Graph could be given as **2nd Fundamental Theorem of Calculus**: {MOST LIKELY}
     - For example, graph of f(x) is given and g(x) = $\int_c^x f(t)\,dt$
     - Thus, g ' (x) would then equal f (x) so graph is REALLY g ' (x)

Special note: Look at Particle Problem and Detective's Hat Problem (Piecewise Graph)

3. **Particle Problem**
   - If they don't give a graph of velocity, then expect a particle problem where velocity is given.
   - If it's a calculator problem (likely), then graph velocity {be careful of endpoints}
   - Use calc 1 (value) to calculate **velocity**
   - Use calc 8 (derivative) to calculate **acceleration**
   - Use calc 9 (integral) to calculate **change in position**.
     - Remember initial position!
   - **Total Distance** traveled = $\int_a^b |\text{velocity}|\,dt$
   - Particle **changes position** when v(t) changes signs.
   - **Speed** = |velocity|

Special note:
Concept of Absolute Max and Absolute Min could be tested on this problem. Remember the endpoints!

4. **Implicit Differentiation and/or Variable Separable**
   - Expect one problem where you will have to do **implicit differentiation** or **variable separable**
   - Remember that a **horizontal** tangent line will have a slope of zero when the numerator of the derivative is 0.
   - Remember that a **vertical** tangent line will have a slope of undefined when the denominator of the derivative is 0.

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5. Equation(s) given as rates of change

- Typically an equation will be given that is a rate of change. Keep in mind that it is a **derivative**!
- If it's a graphing calculator problem, graph the equation and keep in mind that it is a **derivative**!
- Use calc 1 (value) to calculate **rate of change**.
- Use calc 8 (derivative) to calculate if **rate of change is increasing (+) or decreasing (—)**
- Use calc 9 (integral) to calculate **total amount** over time.
    - Remember initial amount!
- You should notice that this problem is similar to number 3 above.

Special note:
These problems include: Amusement Park, Sand, Mosquitoes, Traffic Flow, etc. in last two years.

6. 2nd Derivative test

- Remember that a derivative sign chart is NOT acceptable for justifications.
- You must state, for example, "Relative Max at x = 5 because f ' (x) changes from positive to negative at x = 5."
- Be prepared to use the **2nd Derivative test**.
- For example, "Relative Max at x = 5 because f ' (5) = 0 and f '' > 0."

7. Analyze a Table of Values

- It's a good idea to quickly graph the table of values.
- By giving a table of values, they can ask:
- **Reimann Sum**
- **Mean Value Theorem (Rolle's)**
- **Average (Y) Value Theorem**
- **Rate of Change** (slope = derivative)

Special Note: Examples include 2003 #3 (Fuel Consumption) and 2003B #3 (Blood Vessel)

8. Slope Fields

- **Variable Separable** would be included in this one.
- Relatively new topic (last two years). It's been on the exam both years!
- Look at the four questions from 2004 and 2005 to make sure you know how to do it.

9. Related Rates

- Surprisingly not given the last two years.
- I believe that we are due (overdue!) for a related rates problem.
- Make a table of values to keep things organized.