Keys to Success
Things to remember for the AP Test…

About the Test:

1. MC – Calculator – Usually only 5 out of 17 questions actually require calculators.

2. Free-Response Tips
   a. You get 2 booklets – write all work in the answer booklet (it is white on the inside)…the colored paper with the question WILL NOT be seen by the graders!
   b. Explain everything *clearly!*
   c. If you are using a justification/reason/explanation from Part A or B, use an arrow.
   d. ***UNITS*** are important!
   e. Cross out work that you do not want to be read. Do not erase!
   f. A justification is a mathematical explanation AND/OR a written explanation.
   g. Do NOT use rounded answers in later parts of a problem. Store these answers in your calculator.
   h. If you don't know something MAKE IT UP!
   i. Even if you use your calculator, you must show your work. Do NOT use calculator jargon in your work!
   j. Be sure you have answered all parts of the question.

   ** MC – check answers backwards (plug in the answer choices)
   ** FR – they are NOT in order from easy to hard; however MC tends to be!

3. Make sure your calculator is in RADIAN mode.

4. **Always round to 3 decimal places, unless otherwise specified.**

Top Student Errors

1. $f''(x)=0$ implies $(x, f(x))$ is a point of inflection.
2. $f'(x)=0$ implies $f(x)$ has relative extrema at $(x, f(x))$.
3. Average rate of change of $f(x)$ on [a, b] is $\frac{1}{b-a}\int_a^b f(x)dx$.
4. Volume by washers is $\pi\int_a^b (R-r)^2\, dx$
5. Separable differential equations can be solved without separating the variables.
6. Omitting the constant of integration.
7. Not showing setup work on the calculator portion.
8. Universal logarithmic antidifferntiation: $\int \frac{1}{f(x)}dx = \ln|f(x)|+C$
9. Forgetting to use chain rule.
10. Using calculator jargon in your work.
11. Not answering all parts of a question.
12. Forgetting the units.
13. Not rounding to three decimal places.

TIPS:

1. The maximum number of horizontal asymptotes is always 2. ***Remember it is an END BEHAVIOR of the function and the answers are ALWAYS "y = "the number that the limit is approaching:***
   If $\lim_{x\to\infty} f(x)=b$, AND $\lim_{x\to-\infty} f(x)=c$, the HAs are $y=b$ and $y=c$

2. Vertical Asymptotes: After simplifying/ reducing the rational function to the lowest terms:
   Find the candidates by setting the denominator equal to zero and then find the limits:
   $\lim_{x\to a^-} f(x)$, AND $\lim_{x\to a^+} f(x)$, The limits must equal $\pm\infty$. If so the VA is $x=a$

3. Label the number line for $f'(x)$ or $g''(x)$. REMEMBER THAT NUMBER LINES **ARE NOT** JUSTIFICATIONS. YOU MUST WRITE A SENTENCE.

4. Recognize:

$$\lim_{\Delta x \to 0} \frac{g(x+\Delta x)-g(x)}{\Delta x}$$

This is the definition of the derivative!

5. Study the SECOND DERIVATIVE TEST
   a. If $f''(c)>0$, $f(c)$ is a relative MINIMUM value
   b. If $f''(c)<0$, $f(c)$ is a relative MAXIMUM value
   c. If $f''(c)=0$, the test FAILS. You must resort to the first derivative test and use a number line.
6. Volume By Rotation
   a. Rotation about a horizontal axis $y=c$, $f(x)$ is the farther function and $g(x)$ is the closer function:

$$\pi\int_{x_1}^{x_2}\left[\left(f(x)-c\right)^2-\left(g(x)-c\right)^2\right]dx$$

   b. Rotation about a vertical axis $x=d$, $f(x)$ is the right function and $g(x)$ is the left function:

$$\pi\int_{y_1}^{y_2}\left[\left(f(y)-d\right)^2-\left(g(y)-d\right)^2\right]dy$$

7. Volume by Cross Section – DRAW A PICTURE. You may want to memorize the formulas, especially the triangle formulas.
8. Particle Motion - Position/ Velocity/ Acceleration
   - PVAJ:
     - Position: $x(t)$
     - Velocity: $x'(t)=v(t)$
     - Acceleration: $x''(t)=v'(t)=a(t)$
   - SPEED
     - INCREASING – velocity and acceleration have the same signs
     - DECREASING – velocity and acceleration have opposite signs
   - Initially: t=0
   - At Rest: v(t)=0
   - Particle Moving Right: v(t)>0
   - Particle Moving Left: v(t)<0
   - Average velocity on [a, b]: $\dfrac{x(b)-x(a)}{b-a}$ or $\dfrac{1}{b-a}\displaystyle\int_a^b v(t)\,dt$
   - Instantaneous velocity at t=a: $v(a)=x'(a)$

9. Area Accumulation Functions: $w(x)=\displaystyle\int_c^{g(x)} f(t)\,dt$
   a. To find the derivative: $w'(x)=f\left(g(x)\right)g'(x)$ (2ND FTC)

10. Given a graph of *f* and $g(x)=\displaystyle\int_0^x f(t)\,dt$:
    a. The graph *f* is the graph of g'
    b. $\displaystyle\int_0^x f(t)\,dt$ is the AREA under the curve.
    c. To evaluate *g*(x), evaluate the integral by using geometric shapes.
11. Piecewise Functions – find the derivative of each piece INDIVIDUALLY

$f(x)=|x|$

ex: $f(x)=\begin{cases} x, & x\ge 0 \\ -x, & x<0 \end{cases}$

ALWAYS split the absolute value!!

12. For the range of any function, use the absolute extrema.
13. Net Distance: $\displaystyle\int_a^b v(t)\,dt$

14. Total Distance: $\int_a^b |v(t)|dt$, OR find when the velocity equals 0. Find the position at endpoints and at points were the velocity equals 0, and sum the difference in distances.

15. Derivative Approximations

x	f(x)
a	e
b	f
d	g

To approximate $f'(c) \approx \dfrac{f(d) - f(b)}{d - b}$

16. Tangent Line Approximations
1. Write the tangent line at the given point: $(a, f(a))$
$$y - f(a) = f'(a)(x - a)$$
2. Then plug in the point $x = x_1$
$$y = f'(a)(x_1 - a) + f(a)$$

17. Absolute extrema – Compare the y-values of the relative extrema AND the endpoints. If there is only 1 critical number then the critical number is both a relative and absolute extrema.

18. CCU – The tangent line approximation is LESS; CCD – The tangent line approximation is GREATER

19. If $\int_a^b f(x)dx = F(a) - F(b)$:

   a. $\int_a^b f(x)dx$ is the area under the curve of f(x)

   b. $\int_b^a f(x)dx$ is the negative if the area is below the x-axis