

## AP Calculus BC Unit 3 Study Guide

1. Be able to sketch derivatives when given a graph.
2. Know the big theorems – Extreme Value Theorem, Fermat's Theorem, Mean Value Theorem, Rolle's Theorem, understand when to use them and their differences.

### The Extreme Value Theorem

If  $f(x)$  is continuous on the closed interval  $[a, b]$ , then  $f(x)$  attains its maximum & minimum values somewhere in  $[a, b]$

### Fermat's Theorem

If  $f(x)$  has a local max (or minimum) at  $x=c$  &  $f'(c)$  exists, then  $f'(c) = 0$ .

### Rolle's Theorem

So suppose that

1.  $f(x)$  is continuous on  $[a, b]$
2.  $f(x)$  is differentiable on  $(a, b)$
3.  $f(a) = f(b)$

Then, there must exist at least a number  $c$  in  $[a, b]$  such that  $f'(c) = 0$ .

### Mean Value Theorem

So suppose that

1.  $f(x)$  is continuous on  $[a, b]$
2.  $f(x)$  is differentiable on  $(a, b)$

Then, there exists a number  $c$  in  $(a, b)$  such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

3. Be able to apply the Extreme Value Theorem by using the "Closed Interval Method"; also how to apply when given a graph.
  4. Be able to apply the Rolle's Theorem and/or the Mean Value Theorem appropriately.
  5. Be able to apply the First Derivatives Test to find the critical values, intervals of increase and decrease, and local minimum and local maximum (graphically and algebraically).
  6. Be able to apply the Second Derivatives Test to find the intervals of concavity and points of inflection (graphically and algebraically).
  7. Know how to write proper and appropriate justifications of answers by using correct mathematical terminology and symbol usage.
  8. Be able to apply L'Hospital's Rule appropriately, with its proper notation.
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Know how to do the following in the calculator:

- Graph functions (or multiple functions)
- Graph derivatives of functions
- Find maximum and minimum values
- Determine x-intercepts (roots, zeros, solutions)

Remember to approximate decimal answers to **3 decimal places** on any AP Calculus exam.

EXAM FORMAT – 90 minutes

Part A – no calculator (no more than 55 minutes)

Section I: Multiple Choice

Section II: Free Response

Part B – Calculator (at least 35 minutes)

Section I: Multiple Choice

Section II: Free Response