

AP Calculus AB: Gateway Exam #2 (15 min)
Passing Score = 75% Correct

1. **Definition of Continuity at a Point:** A function f is continuous at c if $\lim_{x \rightarrow c^-} f(x) = \lim_{x \rightarrow c^+} f(x) = f(c)$.

2. **The Intermediate Value Theorem:**

If f is continuous on the interval $[a, b]$, and k is any number between $f(a)$ and $f(b)$, then there is at least one number c in $[a, b]$ such that $f(c) = k$.

3. **Definition of Horizontal Asymptote:**

The line $y = L$ is a horizontal asymptote of the graph of f if $\lim_{x \rightarrow -\infty} f(x) = L$ or $\lim_{x \rightarrow \infty} f(x) = L$.

4. **Definitions of the Derivative of a Function:**

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} \quad (\text{original}) \quad \text{and} \quad f'(c) = \lim_{x \rightarrow c} \frac{f(x) - f(c)}{x - c} \quad (\text{alternative})$$

5. **Continuity and Differentiability:** If f is differentiable at $x = c$, then f is continuous at $x = c$.

6. **Average Rate of Change:** The average rate of change of a function f on an interval $[a, b]$ is $\frac{f(b) - f(a)}{b - a}$.

For Problems 7-9, $s(t)$ represents the position of a particle at time t , $v(t)$ represents the instantaneous velocity of the particle at time t , and $a(t)$ represents the instantaneous acceleration of the particle at time t .

7. **Particle Motion (Average Rates of Change):**

Average velocity on $[a, b]$: $\frac{s(b) - s(a)}{b - a}$ and average acceleration on $[a, b]$: $\frac{v(b) - v(a)}{b - a} = \frac{s'(b) - s'(a)}{b - a}$

8. **Particle Motion (Instantaneous Rates of Change):**

Velocity $v(t) = \underline{s'(t)}$, speed $|v(t)| = |s'(t)|$, and acceleration $a(t) = \underline{v'(t) = s''(t)}$

9. **Particle Motion (Speeding Up and Slowing Down):**

The particle is speeding up at time $t = c$ if $v(c)$ and $a(c)$ have the same sign .

The particle is slowing down at time $t = c$ if $v(c)$ and $a(c)$ have opposite signs .

10. **The Extreme Value Theorem:** If f is continuous on an interval $[a, b]$,

then f has both a minimum and a maximum on the interval.

11. **Definition of a Critical Number:** Let f be defined at c .

If $f'(c) = 0$ or if f is not differentiable at c , then c is a critical number of f .

12. **The Mean Value Theorem:**

If f is continuous on the interval $[a, b]$ and differentiable on the interval (a, b) ,

then there exists a number c in (a, b) such that $f'(c) = \frac{f(b) - f(a)}{b - a}$.

13. **Test for Increasing and Decreasing Functions:** Let f be continuous on the interval $[a, b]$.

If $f'(x) > 0$ for all x in (a, b) , then f is increasing on $[a, b]$.

If $f'(x) < 0$ for all x in (a, b) , then f is decreasing on $[a, b]$.

14. **The First Derivative Test:**

If $f'(x)$ changes from negative to positive at c , then f has a relative minimum at $x = c$.

If $f'(x)$ changes from positive to negative at c , then f has a relative maximum at $x = c$.

15. **Definition of Concavity:**

The graph of f is concave upward on (a, b) if $f'(x)$ is increasing on (a, b) .

The graph of f is concave downward on (a, b) if $f'(x)$ is decreasing on (a, b) .

16. **Test for Concavity with the Second Derivative:**

The graph of f is concave upward on (a, b) if $f''(x) > 0$ for all x in (a, b) .

The graph of f is concave downward on (a, b) if $f''(x) < 0$ for all x in (a, b) .

17. **Definition of Point of Inflection:**

There is a point of inflection of the graph of f at $x = c$ if the concavity of f changes

from upward to downward (or downward to upward) at the point.

18. **Test for Point of Inflection with the First Derivative:**

There is a point of inflection of the graph of f at $x = c$ if $f'(x)$ changes

from increasing to decreasing (or decreasing to increasing) at the point.

19. **The Second Derivative Test:** Let f be a function such that $f'(c) = 0$.

If $f''(c) > 0$, then f has a relative minimum at $x = c$.

If $f''(c) < 0$, then f has a relative maximum at $x = c$.

20. **The First Derivative Test for Absolute Extrema:**

If $f'(x) < 0$ for all $x < c$ and $f'(x) > 0$ for all $x > c$, then f has an absolute minimum at $x = c$.

If $f'(x) > 0$ for all $x < c$ and $f'(x) < 0$ for all $x > c$, then f has an absolute maximum at $x = c$.

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1. **Definition of Continuity at a Point:** A function f is continuous at c if _____.

2. **The Intermediate Value Theorem:**

If f is _____ on the interval _____, and k is any number between _____ and _____, then there is at least one number c in _____ such that _____.

3. **Definition of Horizontal Asymptote:**

The line _____ is a horizontal asymptote of the graph of f if _____ or _____.

4. **Definitions of the Derivative of a Function:**

$f'(x) =$ _____ (original) and $f'(c) =$ _____ (alternative)

5. **Continuity and Differentiability:** If f is _____ at $x = c$, then f is _____ at $x = c$.

6. **Average Rate of Change:** The average rate of change of a function f on an interval $[a, b]$ is _____.

For Problems 7-9, $s(t)$ represents the position of a particle at time t , $v(t)$ represents the instantaneous velocity of the particle at time t , and $a(t)$ represents the instantaneous acceleration of the particle at time t .

7. **Particle Motion (Average Rates of Change):**

Average velocity on $[a, b]$: _____ and average acceleration on $[a, b]$: _____

8. **Particle Motion (Instantaneous Rates of Change):**

Velocity $v(t) =$ _____, speed _____, and acceleration $a(t) =$ _____

9. **Particle Motion (Speeding Up and Slowing Down):**

The particle is speeding up at time $t = c$ if _____ and _____ have _____.

The particle is slowing down at time $t = c$ if _____ and _____ have _____.

10. **The Extreme Value Theorem:** If f is _____ on an interval _____, then f has both a _____ and a _____ on the interval.

11. **Definition of a Critical Number:** Let f be defined at c .

If _____ or if f is _____ at c , then c is a critical number of f .

12. **The Mean Value Theorem:**

If f is _____ on the interval _____ and _____ on the interval _____,

then there exists a number c in _____ such that _____.

13. **Test for Increasing and Decreasing Functions:** Let f be _____ on the interval _____.

If _____ for all x in (a, b) , then f is increasing on _____.

If _____ for all x in (a, b) , then f is decreasing on _____.

14. **The First Derivative Test:**

If _____ changes from _____ to _____ at c , then f has a relative minimum at $x = c$.

If _____ changes from _____ to _____ at c , then f has a relative maximum at $x = c$.

15. **Definition of Concavity:**

The graph of f is concave upward on (a, b) if _____ is _____ on (a, b) .

The graph of f is concave downward on (a, b) if _____ is _____ on (a, b) .

16. **Test for Concavity with the Second Derivative:**

The graph of f is concave upward on (a, b) if _____ for all x in (a, b) .

The graph of f is concave downward on (a, b) if _____ for all x in (a, b) .

17. **Definition of Point of Inflection:**

There is a point of inflection of the graph of f at $x = c$ if the _____ of f changes from _____ to _____ (or _____ to _____) at the point.

18. **Test for Point of Inflection with the First Derivative:**

There is a point of inflection of the graph of f at $x = c$ if _____ changes from _____ to _____ (or _____ to _____) at the point.

19. **The Second Derivative Test:** Let f be a function such that _____.

If _____, then f has a relative minimum at $x = c$.

If _____, then f has a relative maximum at $x = c$.

20. **The First Derivative Test for Absolute Extrema:**

If _____ for all $x < c$ and _____ for all $x > c$, then f has an absolute minimum at $x = c$.

If _____ for all $x < c$ and _____ for all $x > c$, then f has an absolute maximum at $x = c$.