Name Answer Key

Date _____ Pd _____

AP Calculus AB: Quarter 4 Gateway Exam (10 min)
Passing Score = 75% Correct

1. **Definition of Antiderivative**:

   A function F is an antiderivative of f on an interval I if $F'(x) = f(x)$ for all x in I.

2. **Left Riemann Sums**:

   A left Riemann sum approximation of $\int_a^b f(x)\,dx$ is less than the actual value when f is increasing,

   and greater than the actual value when f is decreasing.

3. **Right Riemann Sums**:

   A right Riemann sum approximation of $\int_a^b f(x)\,dx$ is greater than the actual value when f is increasing,

   and less than the actual value when f is decreasing.

4. **Trapezoidal Approximations**:

   A trapezoidal approximation of $\int_a^b f(x)\,dx$ is greater than the actual value when the graph of f is

   concave upward, and less than the actual value when the graph of f is concave downward.

5. **The First Fundamental Theorem of Calculus**: If a function f is continuous on the interval $[a, b]$

   and F is an antiderivative of f on the interval $[a, b]$, then $\int_a^b f(x)\,dx = F(b) - F(a)$.

6. **Definition of the Average Value of a Function on an Interval**:

   If f is integrable on the interval $[a, b]$, then the average value of f on the interval is $\frac{1}{b-a}\int_a^b f(x)\,dx$.

7. **The Second Fundamental Theorem of Calculus**:

   If f is continuous on an interval I containing a, then, for every x in the interval, $\frac{d}{dx}\left[\int_a^x f(t)\,dt\right] = f(x)$.

8. **The Net Change Theorem**: If $F'(x)$ is a rate of change of a quantity $F(x)$,

   then the total (or net) change of $F(x)$ on the interval $[a, b]$ is given by $\int_a^b F'(x)\,dx = F(b) - F(a)$.

For Problems 9-10, $s(t)$ 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.

9. **Particle Motion (Integration)**:

   Average velocity on $[c, d]$: $\frac{1}{d-c}\int_c^d v(t)\,dt$ and average acceleration on $[c, d]$: $\frac{1}{d-c}\int_c^d a(t)\,dt$

10. **Particle Motion (Displacement vs. Total Distance)**:

    Displacement on $[c, d]$: $\int_c^d v(t)\,dt$ and total distance traveled on $[c, d]$: $\int_c^d |v(t)|\,dt$

11. **Area of a Region Between Two Curves**:

    If f and g are continuous on $[a, b]$ and $g(x) \le f(x)$ for all x in $[a, b]$, then the area of the region bounded by the graphs of f and g and the vertical lines $x = a$ and $x = b$ is: $A = \int_a^b \left(f(x) - g(x)\right) dx$

12. **The Washer Method**: To find the volume of a solid of revolution with the washer method, use one of the following:

    Horizontal axis of revolution on $[a, b]$: $V = \pi\int_a^b \left(\left(R(x)\right)^2 - \left(r(x)\right)^2\right) dx$

    Vertical axis of revolution on $[c, d]$: $V = \pi\int_c^d \left(\left(R(y)\right)^2 - \left(r(y)\right)^2\right) dy$

13. **Volumes of Solids with Known Cross Sections**:

    On $[a, b]$, for cross sections of area $A(x)$ taken perpendicular to the x-axis: $V = \int_a^b A(x)\,dx$

    On $[c, d]$, for cross sections of area $A(y)$ taken perpendicular to the y-axis: $V = \int_c^d A(y)\,dy$

14. **L'Hôpital's Rule**:

    Let f and g be functions that are differentiable on an interval (a, b) containing c, except possibly at c itself.

    Assume that $g'(x) \neq 0$ for all x in (a, b), except possibly at c itself.

    If $\lim_{x\to c} f(x) = 0$ and $\lim_{x\to c} g(x) = 0$ (OR) $\lim_{x\to c} f(x) = -\infty \text{ or } \infty$ and $\lim_{x\to c} g(x) = -\infty \text{ or } \infty$,

    then $\lim_{x\to c} \frac{f(x)}{g(x)} = \lim_{x\to c} \frac{f'(x)}{g'(x)}$ provided the limit on the right exists (or is infinite).

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   and _____ the actual value when f is _____.

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4. **Trapezoidal Approximations**:

   A trapezoidal approximation of $\int_a^b f(x)\,dx$ is _____ the actual value when the graph of f is

   _____, and _____ the actual value when the graph of f is _____.

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   and F is an _____ of f on the interval _____, then _____.

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   If f is integrable on the interval _____, then the average value of f on the interval is _____.

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   If f is _____ on an interval I containing a, then, for every x in the interval, _____.

8. **The Net Change Theorem**: If _____ is a rate of change of a quantity _____,

   then the total (or net) change of _____ on the interval _____ is given by _____.

For Problems 9-10, $s(t)$ 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.

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    Displacement on $[c, d]$: _____ and total distance traveled on $[c, d]$: _____

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    Vertical axis of revolution on $[c, d]$: $V =$ _____

13. **Volumes of Solids with Known Cross Sections**:

    On $[a, b]$, for cross sections of area _____ taken perpendicular to the x-axis: $V =$ _____

    On $[c, d]$, for cross sections of area _____ taken perpendicular to the y-axis: $V =$ _____

14. **L'Hôpital's Rule**:

    Let f and g be functions that are differentiable on an interval (a, b) containing c, except possibly at c itself.

    Assume that _____ for all x in (a, b), except possibly at c itself.

    If _____ and _____ (OR) _____ and _____,

    then _____ provided the limit on the right exists (or is infinite).