

For all questions, answer E. "NOTA" means none of the above answers is correct.

1) Given that $a(x) \neq b(x) \neq 0$, find $\frac{d}{dx} \left[\frac{a(x)}{b(x)} \right]$.

- A) $\frac{a(x)b'(x) - a'(x)b(x)}{[b'(x)]^2}$ B) $\frac{b(x)a'(x) - b'(x)a(x)}{[a(x)]^2}$
 C) $\frac{b(x)a'(x) - b'(x)a(x)}{[b(x)]^2}$ D) $\frac{a(x)b'(x) - a'(x)b(x)}{[a'(x)]^2}$ E) NOTA

2) Identify the theorem: If a function $f(x)$ is continuous on $[a, b]$ and there exists a c such that $a < c < b$ then $\int_a^b f(x) dx = f(c)(b - a)$

- A) Extreme Value Theorem B) Mean Value Theorem for Integrals
 C) Theorem of Pappus D) L'Hôpital's Rule E) NOTA

3) Which of the following integral approximation methods gives an exact value for polynomial expressions with degree of 2 or less?

- A) Simpson's Rule B) Midpoint Rule C) Trapezoidal Rule D) Right Hand Riemann Sum E) NOTA

4) Let the function f be defined at c . If $f'(c) = 0$ or if f' is undefined at c then c is a (an) _____.

- A) Inflection Point B) Critical Number C) Relative Maximum D) Root E) NOTA

5) The region bound by the curve $y = 4x^2$, $y = 0$, and $x = 3$ is to be rotated about the y-axis. The volume of the region is given by the following integral expression: $2\pi \int_0^3 4x^3 dx$. This expression is an example of the _____.

- A) Washer Method B) Disc Method C) Shell Method D) Cross Section Method E) NOTA

6) If $g(x)$ is continuous at c and $f(x)$ is continuous at $g(c)$, then the composite function $(f \circ g)(x)$ is continuous at _____.

- A) $g(c)$ B) $f(c)$ C) $(f \circ g)(c)$ D) c E) NOTA

7) Identify the theorem: If f is continuous on $[a, b]$ and differentiable on (a, b) , then there exists a number c in (a, b) such that $f'(c) = \frac{f(b) - f(a)}{b - a}$.

- A) Extreme Value Theorem B) Intermediate Value Theorem C) Parallel Axis Theorem D) Parallel Line Axiom E) NOTA

8) The point where a function changes from concave up to concave down is known as a (an) _____.

- A) Critical Number B) Point of Concavity C) Zero D) Point of Inflection E) NOTA

9) Which technique for approximating real zeros of a function requires an initial approximation and subsequently uses tangent lines to approximate the graph of the function near its x-intercepts.

- A) Linear Approximation Method B) Newton's Method C) Riemann Sum Method D) Euler's Method E) NOTA

10) Using the Theorem of Pappus what would be the volume of a torus formed by revolving a circle of radius r with center at $(0, 3r)$ about the line $y = r$?

- A) $2\pi^2 r^2$ B) $9\pi^2 r^3$ C) $4\pi^2 r^3$ D) $2\pi^2 r^3$ E) NOTA

11) Integration by parts is based on the _____ where both u and v are differentiable functions and u' and v' are continuous. If both sides of the expression are integrated, the familiar integration by parts formula is obtained.

- A) Product rule B) Chain Rule C) Power Rule D) Fundamental Theorem of Calculus E) NOTA

12) Identify the theorem: If $h(x) \leq f(x) \leq g(x)$ for all x in an open interval containing c , except possibly at c itself, and if $\lim_{x \rightarrow c} h(x) = L = \lim_{x \rightarrow c} g(x)$ then $\lim_{x \rightarrow c} f(x)$ exists and it is equal to L .

- A) Bounded Value Theorem B) Rolle's Theorem C) Divergence Theorem D) Intermediate Value Theorem E) NOTA

13) The derivative of f at x is given by _____ provided the limit exists.

- A) $\lim_{\Delta x \rightarrow 0} \frac{f(x) - f(\Delta x)}{x}$ B) $\lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) - f(\Delta x)}{\Delta x}$ C) $\lim_{x \rightarrow 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$ D) $\lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$ E) NOTA

14) _____ is used to approximate the solution of a given differential equation over an indicated interval with a specified value of Δx and a given initial condition.

- A) Newton's Method B) Lagrange Multiplier Method C) Euler's Method D) Taylor Series Method E) NOTA

15) If y is a differentiable function of t such that $y > 0$ and $y' = ky$, for some constant k , then _____. C is the initial value of y , and k is the proportional constant. Exponential growth occurs when $k > 0$, and exponential decay occurs when $k < 0$.

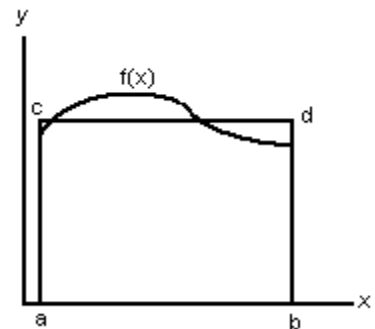
- A) $y = Ce^{kt}$ B) $y = ke^{Ct}$ C) $y = kte^C$ D) $y = Cket$ E) NOTA

16) Identify the rule: If $y = [u(x)]^n$, where u is a differentiable function of x and n is a rational number then $\frac{dy}{dx} = n[u(x)]^{n-1} \frac{du}{dx}$.

- A) Exponent Rule B) Logarithm Rule C) General Power Rule D) Product Rule E) NOTA

17) In the illustration to the right, the area of rectangle $abdc$ is equal to the area under the curve $f(x)$ on the closed interval from $x = a$ to $x = b$. Find the length of side ac .

- A) $\frac{a+b}{2} \int_a^b f(x) dx$ B) $\frac{1}{b-a} \int_a^b f(x) dx$ C) $ab \int_a^b f(x) dx$
 D) $\frac{1}{b-d} \int_a^b f(x) dx$ E) NOTA



18) Given a composite function $(b \circ a)(x)$, find its derivative using the Chain Rule.

- A) $b'(a(x))b'(x)$ B) $b'(a(x))a'(x)$ C) $a'(b(x))b'(x)$ D) $a'(b(x))a'(x)$ E) NOTA

19) The region bound by the curve $y = 2x^2 + 2$, $y = 2$, and $x = 2$ is to be rotated about the y-axis. The volume of the region is given by the following integral expression: $\pi \int_2^{10} \left(5 - \frac{y}{2}\right) dy$. This expression is an example of the _____.

- A) Shell Method B) Washer Method C) Cross Section Method D) Theorem of Pappus E) NOTA

20) Identify the theorem: Let f be continuous on the interval $[a, b]$ and differentiable on the interval (a, b) . If $f(a) = f(b)$ then there is at least one number c in (a, b) such that $f'(c) = 0$

- A) Extreme Value Theorem B) Rolle's Theorem
 C) Fundamental Theorem of Calculus D) Intermediate Value Theorem E) NOTA

21) Which theorem states that if f is continuous on a closed interval $[a, b]$, then f has both a minimum and a maximum on the interval?

- A) Endpoint Theorem B) Relative Extrema Theorem
 C) Extreme Value Theorem D) Minimum-Maximum Theorem E) NOTA

22) Identify the theorem: Let c be a critical number of a function f that is continuous on an open interval I containing c . If f is differentiable on the interval, except possibly at c , then $f(c)$ can be classified

- i) If $f'(x)$ changes from negative to positive at c , then $f(c)$ is a relative minimum of f .
 ii) If $f'(x)$ changes from positive to negative at c , then $f(c)$ is a relative maximum of f .

- A) First Derivative Test B) Second Derivative Test C) Continuity Test D) Test for Concavity E) NOTA

23) The second fundamental theorem of calculus states that if f is continuous on an open interval I containing a then, for every x in the interval, _____.

- A) $\int_a^x f(t) dt = f'(x)$ B) $\int_a^x f(t) dt = f(x)$ C) $\frac{d}{dx} \left[\int_a^x f(t) dt \right] = f'(x)$ D) $\frac{d}{dx} \left[\int_a^x f(t) dt \right] = f(x)$ E) NOTA

24) The region bounded by the curve $y = 4 - x^2$, $y = 0$, and $x = 0$, is to be rotated about the line $x = 0$. The volume of the region is given by the following integral expression: $\pi \int_0^4 (4 - y) dy$. This expression is an example of the _____.

- A) Washer Method B) Disc Method C) Cross Section Method D) Shell Method E) NOTA

25) Let f be a function that is differentiable on an interval I . If f has an inverse function g , then g is differentiable at any x for which $f'(g(x)) \neq 0$. Find $g'(x)$

- A) $\frac{f(x)}{f'(g(x))}$ B) $\frac{1}{f'(g(x))}$ C) $\frac{g(x)}{f'(g(x))}$ D) $\frac{f'(x)}{f'(g(x))}$ E) NOTA

26) The use of L'Hôpital's Rule does not apply to which of the following indeterminate forms?

- A) $\frac{\infty}{\infty}$ B) $\frac{0}{0}$ C) 1^∞ D) $\frac{\infty}{-\infty}$ E) NOTA

27) The equation $\int [g(x)]^n g'(x) dx = \frac{[g(x)]^{n+1}}{n+1} + C$ where n does not equal 1 is referred to as the _____.

- A) Substitution Rule for Integrals B) Fundamental Theorem of Calculus
C) Second Fundamental Theorem of Calculus D) Log Rule for Integrals E) NOTA

28) If f and g are differentiable on an open interval (a, b) and continuous on $[a, b]$ such that $g'(x) \neq 0$ for any x in (a, b) , then there exists a point c in (a, b) such that $\frac{f'(c)}{g'(c)} = \frac{f(b) - f(a)}{g(b) - g(a)}$. This is known as the _____.

- A) Mean Value Theorem B) Extended Mean Value Theorem
C) Intermediate Value Theorem D) Absolute Mean Value Theorem E) NOTA

29) The _____ states that if a function f is continuous on the closed interval $[a, b]$ and F is an antiderivative of f on the interval $[a, b]$, then $\int_a^b f(x) dx = F(b) - F(a)$.

- A) Substitution Rule for Integrals B) Definition of a Riemann Sum
C) Second Fundamental Theorem of Calculus D) Fundamental Theorem of Calculus E) NOTA

30) Let f be differentiable on an open interval I . The graph of f is _____ on I if f' is _____ on the interval.

- A) Concave upward; Increasing B) Concave downward; Increasing
C) Increasing; Increasing D) Decreasing; Decreasing E) NOTA