(1) Find $\lim_{x \to 3} \frac{x^2-x-6}{x^2-4x+3}$.

(A) $\frac{2}{3}$ (B) $\frac{5}{2}$ (C) ∞ (D) 0
(E) NOTA

(2) Find $\lim_{x \to \infty} \left(1 + \frac{2017}{x}\right)^{2017x}$.

(A) 2017 (B) e^{2017} (C) e^{2017^2} (D) $e^{\frac{1}{2017}}$
(E) NOTA

(3) Find the equation of the line tangent to $y = \frac{\sin(x)}{x}$ at $x = \pi$.

(A) $y = -\frac{1}{\pi}x + 1$ (B) $y = \frac{1}{\pi}x + 1$
(C) $y = -\frac{1}{\pi}x - 1$ (D) $y = \frac{1}{\pi}x - 1$ (E) NOTA

(4) Find the slope of the line <u>normal</u> to $y = x \cdot \ln(x^2 + 1)$ at $x = 1$.

(A) $\frac{1}{\ln(2)+1}$ (B) $-\frac{1}{\ln(2)+1}$ (C) $\ln(2) + 1$ (D) $-\ln(2) - 1$
(E) NOTA

(5) Find $\frac{dy}{dx}$ at the point $(1,2)$ if $y^3 + xy^2 + x^2 = 13$.

(A) $\frac{3}{4}$ (B) $-\frac{3}{4}$ (C) $\frac{3}{8}$ (D) $-\frac{3}{8}$
(E) NOTA

(6) Approximate the area between $y = x^2 + x + 1$ and the x-axis from x = 1 to 3 using a left-handed Riemann Sum with four rectangles of equal width.

(A) $\frac{49}{2}$ (B) $\frac{49}{4}$ (C) $\frac{69}{2}$ (D) $\frac{69}{4}$
(E) NOTA

(7) Evaluate: $\int_1^3 (x^3 - 4x + 3)dx$

(A) 10 (B) $\frac{49}{4}$ (C) 15 (D) 20
(E) NOTA

(8) Find the area in the first quadrant of the finite region bounded by the curves $y = x^3$ and $y = \sqrt[3]{x}$.

(A) 1 (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) $\frac{13}{12}$
(E) NOTA

(9) Evaluate: $\int_0^{\sqrt{\ln(2)}} xe^{x^2}\,dx$

(A) 1 (B) $1-e$ (C) $\frac{1}{2}$ (D) $2-\frac{1}{2}e$
(E) NOTA

(10) Find $f'(1)$ if $f(x)=\int_{\sqrt{\pi}x^4}^{\sqrt{\arctan(x)}}\cos(t^2)\,dt$.

(A) $\frac{\sqrt{2}}{4\sqrt{\pi}}$ (B) $\frac{\sqrt{2}+16\pi}{4\sqrt{\pi}}$ (C) $\frac{-7\sqrt{\pi}}{2}$ (D) $\frac{\sqrt{2}-16\pi}{4\sqrt{\pi}}$
(E) NOTA

(11) A rectangle is drawn such that one side is on the x-axis, one side is on the y-axis, and one vertex is on the curve $y=\frac{2}{1+x^2}$ for $x>0$. Find the maximum area the rectangle could enclose.

(A) 1 (B) 2 (C) $\frac{3}{2}$ (D) $\frac{1}{2}$
(E) NOTA

(12) Find the average value of $f(x)=\sec(x)$ for $x\in\left[-\frac{\pi}{4},\frac{\pi}{4}\right]$.

(A) $\frac{2}{\pi}\ln\left(\sqrt{2}-1\right)$ (B) $\frac{2}{\pi}\ln\left(\sqrt{2}+1\right)$ (C) $\frac{4}{\pi}\ln\left(\sqrt{2}-1\right)$ (D) $\frac{4}{\pi}\ln\left(\sqrt{2}+1\right)$
(E) NOTA

(13) Evaluate: $\int_4^{49}\sqrt{2+\sqrt{x}}\,dx$.

(A) 116 (B) 118 (C) $\frac{1772}{15}$ (D) $\frac{1672}{15}$
(E) NOTA

(14) Approximate $\sqrt[10]{e}$ using differentials and the fact that $e^0=1$.

(A) 1 (B) 1.05 (C) 1.1 (D) 1.2
(E) NOTA

(15) $\int_0^4 \frac{x^2-2x}{x^3-3x^2+4}\,dx=?$

(A) $\frac{1}{3}\ln(5)$ (B) $\frac{1}{3}\ln(20)$ (C) $\ln(20)$ (D) $\ln(4)$
(E) NOTA

(16) The base of a certain solid corresponds to the finite region in the first quadrant bounded by the x-axis and $y = \sin(x)$ for $x \in [0, \pi]$. The solid's cross-sections perpendicular to the x-axis are semi-circles whose diameter lies on the base. Find the volume of this solid.

(A) $\frac{\pi^2}{16}$ (B) $\frac{\pi^2}{32}$ (C) $\frac{\pi}{16}$ (D) $\frac{\pi}{32}$
(E) NOTA

(17) Consider the unbounded region in the first quadrant below the curve $y = e^{-x}$. If this region is revolved around the y-axis, what is the resulting volume?

(A) e (B) π (C) $2e$ (D) 2π
(E) NOTA

(18) A wheel corresponds to a circle of radius 1 centered at the origin. The wheel is rotating at a rate of 4 radians per minute counterclockwise, and has a light at one point on its edge. What is the rate of change, in units per minute, of the distance from the light to an observer at the point $(3,3)$ when the light is at the point $(1,0)$? Assume only the two dimensions described in this problem.

(A) $\frac{-5\sqrt{13}}{13}$ (B) $\frac{-12\sqrt{13}}{13}$ (C) $\frac{5\sqrt{13}}{13}$ (D) $\frac{12\sqrt{13}}{13}$
(E) NOTA

(19) Consider the function $f(x) = x + \frac{d}{dx}\left(x + \frac{d}{dx}\left(x + \frac{d}{dx}(x + \cdots)\right)\right)$. If $f(1) = 5$, what is $f''(1)$?

(A) 3 (B) 2 (C) 1 (D) 0
(E) NOTA

(20) Evaluate: $\int_{-1}^{0} \frac{x^2+4x+5}{x^2+2x+2} dx$.

(A) 1 (B) $1 + \frac{\pi}{4}$
(C) $1 + \frac{\pi}{4} + \ln(2)$ (D) $1 + \frac{\pi}{4} + \ln(2) + e^2$ (E) NOTA

(21) If $\int_0^{-5} f(x)dx = 7$, $\int_{-4}^{5} f(x)dx = 3$, and $f(x)$ is odd, what is $\int_0^4 f(x)dx$?

(A) 3 (B) 4 (C) 7 (D) 10
(E) NOTA

(22) Find $\frac{d}{du}(f^{-1}(u))$ at $u = 8$ if $f(x) = x^3 + 2x^2 + 3x + 2$.

(A) 10 (B) -10 (C) $\frac{1}{10}$ (D) $-\frac{1}{10}$
(E) NOTA

(23) Which of the following statements is/are true concerning the series $\sum_{n=1}^{\infty} \frac{n}{n^2+1}$?

I. This series converges based on the n^{th} term test.
II. This series diverges based on the limit comparison test when compared to $\sum_{n=1}^{\infty} \frac{1}{n}$.
III. This series diverges based on the integral test.
IV. This series diverges based on the ratio test.
V. This series diverges based on the root test.

(A) I only (B) II, III, IV, & V only (C) II, III, & V only

(D) II & III only (E) NOTA

(24) $\int_{\pi/6}^{\pi/4} \frac{\cos(x)-\sin(x)}{\cos(x)+\sin(x)} dx = ?$

(A) $\ln\left(\frac{2\sqrt{2}}{\sqrt{3}+1}\right)$ (B) $\ln\left(\frac{1}{\sqrt{3}+\sqrt{2}}\right)$ (C) π (D) 2π
(E) NOTA

(25) Let $f(x)$ be a continuous, differentiable function such that $\lim_{x\to\infty} f(x) = 0$ and, for any real $\alpha > 0$, $\int_1^{\infty} f'(\alpha x)dx = \frac{\alpha}{\alpha^4+1}$. Find $\int_1^{\infty} \frac{f'(x)}{x} dx$.

(A) $\frac{\pi}{8}$ (B) $-\frac{\pi}{8}$ (C) $\frac{\pi}{4}$ (D) $-\frac{\pi}{4}$
(E) NOTA

(26) The finite region in the first quadrant bounded by the x-axis and $y = \frac{4}{m^3}x(m-x)$ is revolved around the line $y = \frac{1}{m}x + 1$. If $V(m)$ is the resulting volume, find $\lim_{m\to\infty} V(m)$.

(A) $\frac{4\pi}{3}$ (B) $\frac{3\pi}{2}$ (C) π (D) 2π
(E) NOTA

(27) Jackson and Max are playing a game with two coins. Max's coin is fair. Jackson's coin, however, is a magic coin that remembers how many times Jackson has flipped the coin during the game. The first time Jackson flips the coin, the probability of Heads is $\frac{1}{2}$. The second time it is $\frac{2}{3}$, and in general the probability of Heads on the n^{th} flip is $\frac{n}{n+1}$. With Jackson going first, they alternate flipping their coins until one of them flips Heads; that player wins. Find the probability that Jackson wins.

(A) $2-\sqrt{e}$ (B) $\frac{e}{e+1}$ (C) $4-2\sqrt{e}$ (D) $\frac{1}{\sqrt{e}}$
(E) NOTA

(28) Find, in terms of positive integer m, $\lim_{n\to\infty} \sum_{k=0}^{n-1} \frac{k}{n}\left(\sqrt[m]{\frac{k+1}{n}} - \sqrt[m]{\frac{k}{n}}\right)$.

(A) $\frac{1}{m+1}$ (B) $\frac{2}{m}$ (C) m (D) $\sqrt[m]{m}$
(E) NOTA

(29) Let $f(x)$ be a continuous, even function such that $\int_0^a f(x)dx = K$. Let $g(x)$ be a continuous, positive function such that $g(x)g(-x) = 1$ and $\int_0^a g(x)dx = L$. Find $\int_{-a}^{a} \frac{f(x)}{1+g(x)} dx$.

(A) $\frac{K}{1+L}$ (B) $\frac{K}{L}$ (C) K (D) $2K$
(E) NOTA

(30) Find $f'(1)$ if $f(x) = 2x^2 + 3x - 4$.

(A) 2 (B) 0 (C) 1 (D) 7
(E) NOTA