For all questions, answer (E) NOTA means "None of the Above Answers are Correct"
Also, let $\sqrt{-1} = i$ and let $\mathbb{R}$ be the set of Real Numbers.

(1) What is the shape of the graph $r = 16 \sin \theta$?

(A) circle (B) ellipse (C) cardioid (D) limicon (E) NOTA

(2) Evaluate: $\int_1^2 x^2 e^{2x}\, dx$

(A) $\frac{5e^4}{4} - \frac{e^2}{4}$ (B) $\frac{5e^4}{4}$ (C) $\frac{5e^4}{4} + \frac{e^2}{4}$ (D) $\frac{7e^4}{4} - \frac{3e^2}{4}$ (E) NOTA

(3) What is the radius of convergence of the Taylor series expansion centered at $x = 0$ that represents $f(x) = \dfrac{e^x \sin x}{(x+3)(x-5)}$?

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

(4) What is the 5th derivative of $f(x) = \arctan x$ at $x = 0$?

(A) 0 (B) 3 (C) 5 (D) 24 (E) NOTA

(5) What is the volume of $f(x) = \dfrac{1}{x}, x \geq 1$ rotated about the x-axis?

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

(6) Evaluate: $\int_1^5 \sin^2(2^3 y) + \cos^2((\log_3 6561)y)\, dy$

(A) $\frac{1}{6}$ (B) $-\frac{1}{6}$ (C) 4 (D) -4 (E) NOTA

(7) Find the area of two of the 'petals' of $r = \cos 2\theta$

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{8}$ (D) $\frac{\pi}{16}$ (E) NOTA

(8) Find $\frac{d^2y}{dx^2}$ if $x = t^2, y = 2t + 5$

(A) $-\frac{1}{2t^3}$ (B) $-\frac{1}{t^2}$ (C) 0 (D) $2t$ (E) NOTA

(9) Which of the following are true?
I) On a continuous closed curve, the derivative at every point exists and is unique.
II) If the area under a curve does not converge, then the volume of the curve rotated about the x-axis also does not converge.

(A) I (B) II (C) I,II (D) None (E) NOTA

(10) Evaluate: $\int \sin(\sqrt{x})\, dx$

(A) $-\sqrt{x}\cos\sqrt{x} + \sin\sqrt{x} + C$ (B) $\sqrt{x}\cos\sqrt{x} - \sin\sqrt{x} + C$
(C) $-2(\sqrt{x}\cos\sqrt{x} - \sin\sqrt{x}) + C$ (D) $-2(\sqrt{x}\cos\sqrt{x} - \cos\sqrt{x}) + C$ (E) NOTA

(11) What value does $-\frac{1}{3} + \frac{2}{9} - \frac{1}{9} + \frac{4}{81} - \frac{5}{81} + \frac{6}{81}...$ converge to?

(A) $\frac{3}{16}$ (B) $-\frac{3}{16}$ (C) $\frac{5}{16}$
(D) 0 (E) NOTA

(12) $\int_0^1 \frac{1}{x^3 + 2x^2 + x + 2}\, dx = a\ln 3 + b\pi \ln e + c\ln 2$ What is $a + b + c$?

(A) $\frac{5}{8}$ (B) $\frac{1}{2}$ (C) $\frac{3}{8}$ (D) 0 (E) NOTA

(13) Find the slope of the tangent line when $\theta = \frac{\pi}{3}$ of $r = 1 + \sin\theta$

(A) undefined (B) 0 (C) -1 (D) 1 (E) NOTA

(14) What is the square of the amplitude of $f(x) = 4\sin(45x) + 19\cos(45x)$?

(A) 377 (B) 415 (C) 81 (D) 23 (E) NOTA

(15) Find the area of the region bounded by $y = e^x$, $y = x$, $x = 0$ and $x = 1$

(A) $e - \frac{1}{2}$ (B) $e - \frac{3}{2}$ (C) $e - 1$ (D) $e - \frac{5}{2}$ (E) NOTA

(16) Evaluate: $\int_0^{\pi} \sec^2 x \, dx$

(A) 0 (B) 1 (C) $\frac{\sqrt{3}}{3}$ (D) $\sqrt{3}$ (E) NOTA

(17) $f(x) = \frac{x^2 \cos(x) + x^4 + 3}{3 - \sin^2(x)}$ can be represented by a Taylor series centered at $x = 0$.
What is the coefficent of the x^9 term of the series?

(A) $\frac{28}{(451)(9!)}$ (B) $\frac{61}{(345)(9!)}$ (C) $\frac{28}{451}$ (D) $\frac{28}{345}$ (E) NOTA

(18) Set S = {All circles with radii r, $1 \leq r \leq 5$}. What is the average area of a circle in S?

(A) 9π (B) $\frac{31\pi}{3}$ (C) 13π (D) 31π (E) NOTA

(19) Find the tangent line at $(0, \frac{1}{2})$ of the cardioid $x^2 + y^2 = (2x^2 + 2y^2 - x)^2$

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{1}{4}$ (D) 1 (E) NOTA

(20) Evaluate: $\lim_{x \to \infty} \log(\frac{e^{\frac{1}{x}} + 2x^2}{x^2 + 4x})$

(A) 2 (B) 1 (C) $\log 2$ (D) DNE (E) NOTA

(21) Find the volume of the polygon with vertices (1,1),(2,2)(-1,5) rotated about the line $x = 7$

(A) 18π (B) 19π (C) 36π (D) 38π (E) NOTA

(22) The area of the region that lies inside $r = 3\sin\theta$ and outside $r = 1 + \sin\theta$ is equal to which of the following integrals?

(A) $.5\displaystyle\int_{\pi/6}^{5\pi/6} (2\sin\theta - 1)\,d\theta$ (B) $\displaystyle\int_{\pi/6}^{5\pi/6} (2\sin\theta - 1)\,d\theta$

(C) $\displaystyle\int_{\pi/6}^{\pi/2} (8\sin^2\theta - 1 - 2\sin\theta)\,d\theta$ (D) $\displaystyle\int_{\pi/6}^{5\pi/6} (8\sin^2\theta - 1 - 2\sin\theta)\,d\theta$ (E) NOTA

(23) The length of one arch of the cycloid ($0 \le \theta \le 2\pi$) is equal to which of the following integrals?

$$x = 2(\theta - \sin\theta)$$
$$y = 2(1 - \cos\theta)$$

(A) $\displaystyle\int_0^{2\pi} \sqrt{2(1-\cos\theta)}\,d\theta$ (B) $\displaystyle 2\int_0^{2\pi} \sqrt{2(1-\cos\theta)}\,d\theta$

(C) $\displaystyle 2\int_0^{\pi} \sqrt{2(1-\cos\theta)}\,d\theta$ (D) $\displaystyle\int_0^{2\pi} \sqrt{2(1-\sin\theta)}\,d\theta$ (E) NOTA

(24) Given that $\displaystyle\int \frac{\sqrt{9-x^2}}{x^2}\,dx = A\frac{\sqrt{B+Cx^D}}{x^E} - \arcsin\frac{x}{3} + \mathbf{C}$.

What is $A + B + C + D + E$?

(A) 9 (B) 10 (C) 11 (D) 12 (E) NOTA

(25) Evaluate: $\displaystyle\lim_{n\to\infty} \sqrt{\frac{1}{n^3}} + \sqrt{\frac{2}{n^3}} + \sqrt{\frac{3}{n^3}} + \sqrt{\frac{4}{n^3}} + \ldots$

(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{3}{5}$ (D) $\frac{3}{2}$ (E) NOTA

(26) Solve the following Differential Equation by multiplying by e^{x^3} :

$$y' + 3x^2y = 6x^2$$

(A) $y = \dfrac{e^{x^3}}{2} + \mathbf{C}$ (B) $y = 2 + \dfrac{\mathbf{C}}{e^{x^3}}$ (C) $y = \dfrac{e^{x^3}}{3}$

(D) $y = \dfrac{e^{x^3}}{3} + \dfrac{\mathbf{C}}{(x^3)}$ (E) NOTA

(27) Evaluate: $\displaystyle\int_0^{\frac{\pi}{6}} \cos 3x \sin x \, dx$

(A) $-\dfrac{3}{8}$ (B) $-\dfrac{1}{16}$ (C) $\dfrac{3}{8}$ (D) $\dfrac{1}{16}$ (E) NOTA

(28) For $|x| < 4$, the series representation of $\dfrac{4}{4+x}$ is?

(A) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{x^n}{4^{n+1}}$ (B) $\displaystyle\sum_{n=0}^{\infty}(-1)^n\frac{4^n}{x^{n+1}}$ (C) $\displaystyle\sum_{n=0}^{\infty}(-\frac{x}{4})^n$ (D) Does Not Converge
(E) NOTA

(29) Which of the following are true?

I) A function can cross its horizontal asymptote
II) If $\lim\limits_{x\to\infty} f(x) = k$, then $f(x)$ has an horizontal asymptote at $y = k$

(A) I (B) II (C) I,II (D) None (E) NOTA

(30) Evaluate: $\dfrac{\pi}{180}\displaystyle\int_0^{30^\circ} \cos x \, dx$

(A) $\dfrac{\pi}{360}$ (B) $-\dfrac{\pi}{360}$ (C) $\dfrac{\pi\sqrt{3}}{360}$ (D) $-\dfrac{\pi\sqrt{3}}{360}$ (E) NOTA