

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

$$1) \int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} \sin(2x) dx$$

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

2) What is the area of the region bounded by $f(x) = 10 - 2^x$ and $g(x) = 10$ on the interval $[0, 3]$?

- A) $7 \ln 2$ B) $\frac{8}{\ln 2}$ C) $8 \ln 2$ D) $\frac{7}{\ln 2}$ E) NOTA

$$3) \int_{-1}^{\frac{5}{2}} |2x^2 - 3x| dx$$

- A) $\frac{131}{24}$ B) $\frac{77}{24}$ C) $\frac{54}{27}$ D) $\frac{2687}{648}$ E) NOTA

4) What is the average value of $\phi(x) = \frac{x^2 - 6x - 3}{x^2 - 6x + 9}$ on the interval $[0, 2]$?

- A) -6 B) -3 C) -2 D) -4 E) NOTA

$$5) \int \theta \sqrt{1 + \theta^2} d\theta$$

- A) $\frac{\arctan \theta}{2} + C$ B) $\frac{(\theta^2 + 1)^{\frac{2}{3}}}{3} + C$ C) $\frac{(2\theta + 1)}{2} + C$ D) $\frac{\sqrt{(\theta^2 + 1)^3}}{3} + C$ E) NOTA

$$6) \int \frac{-e^{-x}}{1 - e^{-x}} dx$$

- A) $e^x - \ln(1 + e^x) + C$ B) $x - \ln(e^x - 1) + C$
 C) $\ln(e^x + 1) - x + C$ D) $\ln(e^x - 1) + e^x + C$ E) NOTA

7) What is the value of c guaranteed by the mean value theorem for integrals for the function $f(x) = \frac{6}{x^2}$ on the interval $[1, 2]$?

- A) $\sqrt{2}$ B) $2\sqrt{2}$ C) $\frac{3}{2}$ D) $\frac{\sqrt{2}}{2}$ E) NOTA

8) Which of the following represents the solid of revolution formed by revolving the region bounded by $f(x) = 6 + x - x^2$, $g(x) = 6$, and $x = 3$ about the x -axis?

- A) $\pi \int_1^3 (x^2 - x) dx$ B) $2\pi \int_0^6 (y^3 - y^2) dy$
 C) $\pi \int_1^3 (x^4 - 2x^3 + x^2) dx$ D) $\pi \int_1^3 (-x^4 + 2x^3 + 11x^2 - 12x) dx$ E) NOTA

9) $\int \frac{dx}{x^2 - 2x + 3}$

- A) $\frac{1}{4} \ln \frac{x-3}{x+1} + C$ B) $\frac{\sqrt{2}}{2} \arctan \frac{\sqrt{2}(x-1)}{2} + C$
 C) $\frac{\sqrt{2}}{2} \arcsin \frac{\sqrt{2}(x-1)}{2} + C$ D) $\frac{(x^2 - 2x + 3)^2}{6} + C$ E) NOTA

10) What is the area of the region between the curves $y = 4 \sin\left(\frac{x}{2}\right)$ and $y = 2 \sin x$ on the interval $[0, 2\pi]$?

- A) 12 B) $12\sqrt{2}$ C) 12π D) $6\sqrt{3}$ E) NOTA

11) $\int \frac{\csc z}{\cot^2 z} dz$

- A) $\csc z + C$ B) $\sec z + C$ C) $\sec^2 z + C$ D) $\cot z + C$ E) NOTA

12) Find the volume of the torus formed by revolving the circle $x^2 + y^2 - 4x + 6y = 3$ about the line $x = 9$.

- A) $288\pi^2$ B) $784\pi^2$ C) $224\pi^2$ D) $112\pi^2$ E) NOTA

13) $\int 4^{2x} dx$

- A) $\frac{4^x}{4 \ln 2} + C$ B) $\frac{16^x}{16 \ln 2} + C$ C) $\frac{4^x}{16 \ln 2} + C$ D) $\frac{16^x}{4 \ln 2} + C$ E) NOTA

14) $\int \frac{4 \arctan 2x}{4x^2 + 1} dx$

- A) $\arctan^2 2x + C$ B) $\frac{\arctan^2 4x}{2} + C$ C) $\frac{\arctan^2 2x}{2} + C$ D) $2 \arctan^2 2x + C$ E) NOTA

15) Solve for a : $\int_1^4 (4ax^2 + 2x + 3a) dx = \int_{-2}^1 (2ax^2 - 3ax + 2) dx$

- A) $\frac{3}{19}$ B) $\frac{5}{41}$ C) $-\frac{6}{55}$ D) $-\frac{7}{65}$ E) NOTA

16) Find the volume of the solid formed by the revolution about the y -axis of the region bounded by the curve $f(x) = (x-3)^{-2}$, the line $x = \frac{7}{2}$, and the line $y = 1$.

- A) $\frac{\pi(4\ln 2 + 5)}{4}$ B) $\frac{\pi(8\ln 2 + 9)}{4}$ C) $\frac{\pi(6\ln 2 + 3)}{4}$ D) $\frac{\pi(9\ln 2 + 6)}{4}$ E) NOTA

17) Find the volume of the right circular cone formed by revolving the area bounded by the x and y - axes and the line $y = 4 - 3x$ about the x - axis.

- A) $\frac{64\pi}{27}$ B) $\frac{128\pi}{9}$ C) $\frac{128\pi}{27}$ D) $\frac{256\pi}{9}$ E) NOTA

18) $\int 3x(3-x^2)^3 dx$

- A) $\frac{-3(3-x^2)^4}{2} + C$ B) $\frac{(3-x^2)^4}{4} + C$ C) $\frac{(3-x^2)^4}{3} + C$ D) $\frac{-3(3-x^2)^4}{8} + C$ E) NOTA

19) Find the centroid of the region bounded by $2x - y = 9$ and $y = x^2 - 8x + 7$.

- A) $\left(5, \frac{18}{5}\right)$ B) $\left(5, -\frac{13}{5}\right)$ C) $\left(6, -\frac{9}{5}\right)$ D) $\left(5, -\frac{11}{5}\right)$ E) NOTA

20) Find the area under the derivative of the curve $f(x) = \frac{x^3}{2} + 6x^2 - 12x + 4$ on the interval $[-4, 8]$.

- A) 1392 B) 216 C) 624 D) 664 E) NOTA

21) Initially in a bacteria culture there are 1.2 million organisms. The temperature is increased, and the organisms begin to reproduce. 5 minutes later there are 1.35 million. How many organisms to three significant figures can be expected when 45 minutes have past?

- A) 3.46×10^6 B) 3.39×10^6 C) 1.22×10^7 D) 3.33×10^6 E) NOTA

22) For the function $f(x) = \ln(x-2)$ on the interval $[3, 10]$ find the value of α to three decimal places for which the line $x = \alpha$ divides the area under the curve into two equal parts.

- A) 4.818 B) 6.735 C) 7.466 D) 8.146 E) NOTA

23) $\int \log x dx$

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

24) Find the general solution for the differential equation $(3x^2 + 9)\frac{dy}{dx} = xy$.

- A) $y = C(3x^2 + 9)^{\frac{1}{6}}$ B) $y = C(x^2 + 3)^{\frac{1}{2}}$ C) $y = C(x^2 + 3)^{\frac{1}{3}}$ D) $y = C(x^2 + 3)^{\frac{1}{6}}$ E) NOTA

25) $\int_0^1 (e^{2x} + 1)^2 dx$

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

26) Semi-circular cross sections parallel to the y-axis are taken along the graph of $y = 3x^2 - 6x$ on the interval $[2, 4]$. Find the volume of the surface formed.

- A) $\frac{186\pi}{5}$ B) $\frac{744\pi}{5}$ C) $\frac{1488\pi}{5}$ D) $\frac{372\pi}{5}$ E) NOTA

27) Given the region bounded by the curve $f(x) = \sqrt[3]{x}$, $y = 0$, and $x = 8$, place the respective volumes of revolution in order from smallest to largest for revolutions about the x-axis, the y-axis, and the line $x = 8$.

- A) y-axis, $x = 8$, x-axis B) x-axis, y-axis, $x = 8$
 C) x-axis, $x = 8$, y-axis D) y-axis, $x = 8$, x-axis E) NOTA

28) $\int \frac{x}{\sqrt{x}} dx$

- A) $\frac{3}{2}x^{\frac{2}{3}} + C$ B) $\frac{2}{3}x^{\frac{2}{3}} + C$ C) $\frac{3}{2}x^{\frac{3}{2}} + C$ D) $\frac{2}{3}x^{\frac{3}{2}} + C$ E) NOTA

29) A sphere of radius 7 has a hole drilled through it at its center with a drill bit of diameter 4 inches. Find the volume of the resulting ring.

- A) $192\pi\sqrt{5}$ B) $180\pi\sqrt{5}$ C) $168\pi\sqrt{5}$ D) $156\pi\sqrt{5}$ E) NOTA

30) Evaluate $\frac{d}{dx} \left[\int_0^x t\sqrt{2t^2 + 3} dt \right]$

- A) $\frac{(2x^2 + 3)^{\frac{3}{2}}}{6}$ B) $x\sqrt{2x^2 + 3}$ C) $\sqrt{2x^2 + 3} + \frac{2x^2}{\sqrt{2x^2 + 3}}$ D) $\frac{2(2x^2 + 3)^{\frac{3}{2}}}{3}$ E) NOTA