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

1. A particle moves along a line such that its velocity is given by $v(t) = 9t^2 - 8t + 5$. Find the particle's displacement between times $t = 1$ and $t = 2$.

    A) 14          B) 16          C) 17          D) 19          E) NOTA

2. Let $k$ be a real number. If $\int_{-1}^{k} \left(3x^2 - 2x\right) dx = 6$, then $k = $

    A) -1          B) 0          C) 1          D) 2          E) NOTA

3. If $\int_{1}^{3} f(x)\, dx = 5$ and $\int_{1}^{7} f(x)\, dx = -4$, then compute $\int_{7}^{3} \left(x + f(x)\right) dx$.

    A) -21          B) -11          C) -1          D) 9          E) NOTA

4. $\int_{0}^{4} \left(|x - 2| + 3\right) dx = $

    A) 7          B) 12          C) 14          D) 16          E) NOTA

5. Which one of the following is an antiderivative of $\dfrac{6x^4 + 3x^2 + 1}{x^2}$?

    A) $\dfrac{18x^4 + 15x^2 + 15}{5x^2}$

    B) $\dfrac{2x^4 + 3x^2 - 1}{x}$

    C) $\dfrac{12x^4 - 2}{x^3}$

    D) $\dfrac{18x^4 + 5x^2 + 5}{x}$

    E) NOTA

6. $\int xe^{-x}\, dx = $

    A) $e^{-x}(1 - x) + C$      B) $\dfrac{e^{1-x}}{1 - x} + C$      C) $-e^{-x}(x + 1) + C$      D) $-\dfrac{1}{2}x^2 e^{-x} + C$      E) NOTA

7. $\int_0^1 x\sinh(x^2)\,dx =$

A) $-\dfrac{1}{2}\cosh(x^2) + C$

B) $\dfrac{1}{2}\cosh(x^2) + C$

C) $x\cosh(x^2) - \sinh(x^2) + C$

D) $x\cosh(x^2) + \sinh(x^2) + C$

E) NOTA

8. $\int_0^1 \int_1^{e^x} (x+y)\,dy\,dx =$

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

9. The length of the curve $C$ from $x = 2$ to $x = 3$ is given by
$$\int_2^3 \sqrt{1 + \left(12x^2 - 4\right)^2}\,dx.$$

   Which of the following is the equation of $C$, given that $C$ goes through the point $(2,22)$?

A) $y = 4x^3 - 4x + 2$

B) $y = 4x^3 - 4x - 2$

C) $y = 12x^2 - 4$

D) $y = 12x^2 - 94$

E) NOTA

10. Let $\lfloor x \rfloor$ be the greatest integer less than or equal to $x$ and let $\lceil x \rceil$ be the least integer greater than or equal to $x$. Compute $\int_0^{10} \left(\lceil x \rceil - \lfloor x \rfloor\right) dx.$

A) 0                B) 9                C) 10                D) 11                E) NOTA

11. Let $a$ and $b$ be integers. If $\int_2^6 (ax + b)\, dx = 8$, then

    A) $a$ must be even.
    B) $a$ must be odd.
    C) $b$ must be even.
    D) $b$ must be odd.
    E) NOTA

12. A continuous function $f$ has values shown in the table below, where $a$, $b$, and $c$ are real numbers.

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $f(x)$ | $a$ | $b$ | $c$ | $c$ | $a$ |

Let $T_2$ be the trapezoidal sum approximation of $\int_0^4 f(x)\, dx$ with 2 equal subintervals. Let $T_4$ be the trapezoidal sum approximation of $\int_0^4 f(x)\, dx$ with 4 equal subintervals. Compute $T_2 - T_4$.

    A) $a - b$        B) $a + b$        C) $a + b + c$        D) $b + 2c$        E) NOTA

13. Let $F(x) = \int_1^x \dfrac{1}{t}\, dt$. Find the average value of $F$ over the interval $\left[\dfrac{1}{3}, 3\right]$.

    A) $-1 + \ln 3$        B) $\dfrac{3}{4}\ln 3$        C) $\ln 3$        D) $\dfrac{8}{3}\ln 3$        E) NOTA

14. $\displaystyle\int_1^9 \dfrac{1}{4 + 5\sqrt{x}}\, dx =$

    A) $\dfrac{16}{25}(1 - \ln 3)$

    B) $\dfrac{4}{25}\left(5 + 2\ln\dfrac{9}{19}\right)$

    C) $\ln\dfrac{19}{9}$

    D) $2 + \dfrac{4}{5}\ln\dfrac{9}{19}$

    E) NOTA

15. Find the area of the region bounded by the curve $y = \dfrac{8}{x}$ and the line $y = 16 - 2x$ for

$e \le x \le e^2$.

    A) $17e^2 - e^4 - 16e - 8$

    B) $16e^2 - 16e - 8$

    C) $16e^2 - e^4 - 16e - 8$

    D) $16e^2 - e^4 - 16e + 8$

    E) NOTA

16. Find the average value of $g(x) = 4^{\sinh x} \cosh x$ over the interval $[0, 3]$.

    A) $\dfrac{4^{\sinh 3}}{3\ln 4}$      B) $\dfrac{4^{\sinh 3} - 1}{3\ln 4}$      C) $\dfrac{4^{\sinh 3}}{\ln 4}$      D) $\dfrac{1}{3\ln 4}$      E) NOTA

17. $\displaystyle\int_2^3 \dfrac{1}{x^2 - 4x + 5}\, dx =$

    A) $\dfrac{1}{2}\ln\dfrac{2}{5}$      B) $\dfrac{1}{6}\ln\dfrac{1}{2}$      C) $\dfrac{1}{6}\ln 2$      D) $\dfrac{\rho}{4}$      E) NOTA

18. $\displaystyle\int_0^1 e^{e^x + x}\, dx =$

    A) $e^{e-1}$      B) $e^e - e$      C) $e^e + 1$      D) $e^{e+1}$      E) NOTA

19. What are all values of $p$ for which $\displaystyle\int_1^{\infty} \dfrac{1}{x^{2p-3}}\, dx$ diverges?

    A) $p \le 0$      B) $p \le 1$      C) $p \le \dfrac{3}{2}$      D) $p \le 2$      E) NOTA

20. $\displaystyle\int_0^1 \dfrac{x^5 + 5x^4 + 10x^3 + 10x^2 + 4x}{(x+1)^5}\, dx =$

    A) $\dfrac{1}{8}$      B) $\dfrac{17}{24}$      C) $\dfrac{49}{64}$      D) $1 + 4\ln 2$      E) NOTA

21. Let $R$ be the region bounded by $y = e^{-x^2}$ and the $x$-axis over $\left[0, \sqrt{\ln 10}\right]$. Find the volume of the solid generated when $R$ is revolved about the $y$-axis.

A) $\dfrac{9p}{20}$         B) $\dfrac{11p}{20}$         C) $\dfrac{9p}{10}$         D) $\dfrac{11p}{10}$         E) NOTA

22. The integral $\displaystyle\int_{2/\sqrt{3}}^{2} \sec^{-1}x \, dx$ is

A) equal to $\dfrac{2\pi}{3} - \dfrac{\pi}{3\sqrt{3}} + \ln\left|2\sqrt{3} - 3\right|$.

B) equal to $\dfrac{\pi}{3} - \dfrac{2\pi}{3\sqrt{3}} + \ln\left|2\sqrt{3} - 3\right|$.

C) equal to $\dfrac{\pi}{3} - \dfrac{2\pi}{3\sqrt{3}} + \ln\left|2\sqrt{3} + 3\right|$.

D) undefined.

E) NOTA

23. $\displaystyle\int_{\sqrt{p}}^{\sqrt{2p}} x^3 \cos\left(x^2\right) dx =$

A) 0         B) 1         C) $\dfrac{p}{2}$         D) 2         E) NOTA

24. Find the area inside the loop of the polar curve defined by

$$r = \begin{cases} 5\left(\sec\theta + \tan\theta\right) & \dfrac{\pi}{2} < \theta < \dfrac{3\pi}{2}, \quad \dfrac{3\pi}{2} < \theta < \dfrac{5\pi}{2} \\ 0 & \theta = \dfrac{3\pi}{2} \end{cases}$$

A) $\dfrac{5}{2}(4 - p)$       B) $\dfrac{5}{2}(p - 2)$       C) $\dfrac{25}{2}(4 - p)$       D) $\dfrac{25}{2}(p - 2)$       E) NOTA

25. Let $n$ be an integer greater than 1. Evaluate $\displaystyle\int x^{n-1} \ln x \, dx$.

A) $nx^{n-1} + C$       B) $nx^n - \ln x + C$   C) $\dfrac{1}{2}x^n \ln^2 x + C$   D) $x^{n-2} - x\ln x + C$     E) NOTA

26. The region between the curves $x = \sqrt{y}$ and $x = y^2$ in the first quadrant is the base of a solid. The cross sections perpendicular to the $y$-axis are rectangles whose height is $420p\ln5$ times the length of the plane of the base. What is the volume of the solid?

   A) $54p\ln5$        B) $63p\ln5$        C) $72p\ln5$        D) $140p\ln5$        E) NOTA

27. Let $a$ be a positive real number. Given that
$$\int_{-a}^{2a}\left(x^3 - (a+1)x^2 - 3ax + 4a\right)dx = 0,$$
compute the sum of the possible values of $a$.

   A) 6                B) 8                C) 10                D) 12                E) NOTA

28. $\displaystyle\int_0^p \int_x^p \frac{\sin y}{y}\, dy\, dx =$

   A) 1                B) 2                C) $p$                D) $p^2$                E) NOTA

29. Evaluate $\displaystyle\int_{\pi/6}^{\pi/4}\left(\sec x\tan^2 x + \sec^3 x - \tan x - \sec^2 x\cot x\right)dx.$

   A) $\sqrt{2} - \sqrt{3} - 1 + \ln\left|5\sqrt{2} - \sqrt{3} - 2\right|$

   B) $\sqrt{2} + 1 - \sqrt{3} - \ln\left|\sqrt{6} + \sqrt{3}\right|$

   C) $\sqrt{2} - 2\sqrt{3} - \dfrac{1}{2}\ln 24$

   D) $\sqrt{2} - \dfrac{2}{3} + \ln\dfrac{\sqrt{2}}{3}$

   E) NOTA

30. $\displaystyle\int_0^{\yen} e^{-x^2}\, dx =$

   A) 1                B) $\sqrt{p}$                C) $\dfrac{5}{2}\ln 2$                D) $\yen$                E) NOTA