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NOTA means **"none of these answers"**

All functions have their "natural" domain (the largest possible one), unless some other domain is specified in the problem.

1. The acceleration of a particle moving on a line is $a = t^{-\frac{1}{2}} + 3t^{\frac{1}{2}}$. What was the difference in velocity from $t = 1$ to $t = 9$?

   A. 56 B. 60 C. 64 D. 54 E. NOTA

2. Find $\int \arctan x \, dx$ using integration by parts.

   A. $\arctan x + \ln\left(1 + x^2\right) + c$

   B. $x \arctan x + c$

   C. $x \arctan x + \ln\left(1 + x^2\right) + c$

   D. $x \arctan x - \frac{1}{2}\ln\left(1 + x^2\right) + c$

   E. NOTA

3. $\int \dfrac{\log_{10}\left(x^3 10^x\right)dx}{x} =$

   A. $\frac{3}{2}\ln 10\left(\log_{10} x\right)^2 + x + c$ B. $\frac{3}{2\ln 10}\left(\ln x\right)^2 + x + c$

   C. $\dfrac{3\left(\log_{10} x\right)^2}{\ln 10} + x + c$ D. $3\ln 10\left(\ln x\right)^2 + x + c$ E. NOTA

4. Let $F(x)$ be an antiderivative of $f(x)$. If $F(x) = \begin{cases} |x| & \text{if } x < 0 \\ -\sin x & \text{if } x \geq 0 \end{cases}$, evaluate $[f(b) - f(a)]$ for $a = \frac{-\pi}{2}$ and $b = \frac{\pi}{2}$.

A. -1 B. 0 C. 1 D. $\frac{\pi + 1}{2}$ E. NOTA

5. $\int (\csc^2 x) 2^{\cot x}\, dx =$

A. $\frac{2^{\cot x}}{\cot x (\ln 2)} + c$ B. $\frac{2\csc^2 x}{\cot x (\ln 2)} + c$ C. $\frac{-2^{\cot x}}{\ln 2} + c$

D. $\frac{2^{\cot x} \csc^2 x}{\cot x (\ln 2)} + c$ E. NOTA

6. Let $\frac{dy}{dx} = 0.1y$ and solve for y. Assume y = 10 when x = 0.

A. $y = 10 + e^{0.1x}$ B. $y = 10e^{0.1x}$ C. $y = x^{0.1} + 10$

D. $y = 0.1e^{10x} + 9.9$ E. NOTA

7. If $f'(x) = F(x)$ and $g'(x) = G(x)$ then $\int f(x)G(x)dx =$

A. $f(x)g(x) - \int F(x)g(x)dx$

B. $F(x)G(x) - \int f(x)G(x)dx$

C. $F(x)G(x) - \int f(x)g(x)dx$

D. $F(x)G(x) - \int F(x)g(x)dx$

E. NOTA

8. If the velocity of a particle moving along the x-axis is $v(t) = 3t^2 - 5$, and if the particle is at $x = 9$ when $t = 1$, then its position function $x(t)$ is

A. $6t + 3$ B. $t^3 - 5t$ C. $3t^2 + 6$ D. $t^3 - 5t + 9$ E. NOTA

9. If $\int f(x)e^{-x}\,dx = -f(x)e^{-x} + \int 2xe^{-x}\,dx$, then $f(x)$ could be:

A. e^x B. $-e^{-x}$ C. x^2 D. $-x^2$ E. NOTA

10. The total area of the region enclosed by the polar graph of $r = \cos 3\theta$ is

A. $\frac{\pi}{12}$ B. $\frac{\pi}{6}$ C. $\frac{\pi}{4}$ D. $\frac{\pi}{3}$ E. NOTA

11. Find the value of c such that the area between the line y = c and the parabola $y = x^2$ is $\frac{1}{48}$.

A. $\frac{1}{512}$ B. $\frac{1}{64}$ C. $\frac{1}{32}$ D. $\frac{1}{16}$ E. NOTA

12. If $f(x) = \int (1 - 2x)^3\,dx$, then the second derivative of $f(x)$ at $x = \frac{1}{2}$ is

A. -48 B. -12 C. 0 D. 96 E. NOTA

13. The average value of $f(x) = \sqrt{9 - x}$ on $[0, 9]$ is

A. 6 B. 2 C. 1.5 D. -6 E. NOTA

14. If four equal subdivisions of $[0, 2]$ are used, then the trapezoid approximation of $\int_0^2 e^{-x^2}\,dx$, correct to 3 decimal places, is

A. 0.485 B. 0.568 C. 0.881 D. 0.969 E. NOTA

15. The region in the first quadrant enclosed by the ellipse $4x^2 + y^2 = 36$ and the coordinate axes is rotated about the y-axis. The volume of the resulting solid is

A. 9π B. 12π C. 18π D. 36π E. NOTA

16. Suppose $f(x) = \ln 3x$ and $f^{-1}(x)$ is its inverse. Then $\int f^{-1}(x)dx =$

A. $3e^x + c$ B. $\frac{1}{3}e^x + c$ C. $\frac{1}{x} + c$ D. $\frac{1}{3x} + c$ E. NOTA

17. A region in the first quadrant is enclosed by the coordinate axes and the lines y = k and $x = 3k$, $k > 0$. If the volume of the solid that is generated by rotating the region about the y-axis is 72π, then k =

A. 2 B. 3 C. $2\sqrt{3}$ D. 4 E. NOTA

18. Which of the following are antiderivatives of $\sin x \cos x$?

I. $\frac{1}{2}\sin^2 x$

II. $\frac{-1}{2}\cos^2 x$

III. $\frac{-1}{4}\cos 2x$

A. I only B. III only C. I & II only D. II & III only E. NOTA

19. Let R be the region in the fourth quadrant enclosed by the x-axis and the curve $y = x^2 - 2kx$, where k > 0. If the area of R is 36, then what is k?

A. 2 B. 3 C. 4 D. 6 E. NOTA

20. At any time $t \geq 0$, in days, the rate of growth of a bacteria population is given by $y' = ky$, where y is the number of bacteria present and k is a constant. The initial population is 1500 and the population is quadrupled during the first 2 days. By what factor will the population have increased during the first 3 days?

A. 4 B. 5 C. 6 D. 8 E. NOTA

21. For $0 \leq x < \frac{\pi}{2}$, an antiderivative of $2\tan x$ is

A. $\ln(\sec 2x)$ B. $2\sec^2 x$ C. $\ln(\sec^2 x)$

D. $2\ln(\cos x)$ E. NOTA

22. Which of the following is equal to $\int \frac{dx}{16 + x^2}$?

A. $Arc\tan 4x + c$ B. $Arc\tan \frac{x}{4} + c$ C. $\frac{1}{4} Arc\tan \frac{x}{4} + c$

D. $\frac{1}{4} Arc\tan 4x + c$ E. NOTA

23. If $\int x\sec^2 x\,dx = f(x) + \ln|\cos x| + c$, then $f(x) =$

A. $\tan x$ B. $\frac{1}{2}x^2$ C. $x\tan x$ D. $x^2\tan x$ E. NOTA

24. If $f'(x) = e^x + \sin x$, then $f(x)$ may be

A. $e^x + \cos x$ B. $e^x - \cos x - 1$ C. $xe^{-x} + \cos x$

D. $e^{2x} - \cos x$ E. NOTA

25. At each point (x, y) on a curve, the slope of the curve is $4x^3y$. If the curve contains the point $(0, 5)$, then the equation is

A. $y = x^4 + 5$ B. $y = 5e^{x^4}$ C. $y = e^{x^4} + 5$

D. $y^2 = x^3 + 5$ E. NOTA

26. The area outside $r = 1$ and inside $r = 1 + \sin\theta$ is

A. $2 + \pi$ B. $2 + \frac{\pi}{2}$ C. $2 + \frac{\pi}{4}$ D. $2 - \frac{\pi}{4}$ E. NOTA

27. If the motion of a particle on the x-axis has acceleration $\frac{d^2x}{dt^2} = t^2 - 2t$, and is stationary at 1 when $t = 1$, then $12x(t) =$

A. $t^4 + 4t^3$ B. $t^4 - 4t^3 + 8t + 7$ C. $4t^4 + 8t^3$

D. $t^4 - 4t^3 + 15t^2$ E. NOTA

28. The first three terms of the MacLaurin Series of the function $f(x) = \int_0^x \frac{\sin t}{t} dt$ are:

A. $1 - \frac{1}{6}x^2 + \frac{1}{120}x^4$

B. $x - \frac{1}{18}x^3 + \frac{1}{600}x^5$

C. $x^2 - \frac{1}{6}x^4 + \frac{1}{120}x^6$

D. $\frac{1}{3}x^3 - \frac{1}{30}x^5 + \frac{1}{720}x^7$

E. NOTA

29. $\int \sqrt{4 - x^2}\, dx =$

A. $2\cos^{-1}\frac{x}{2} + c$

B. $\frac{x}{2}\sqrt{4 - x^2} + c$

C. $2\ln\left|x + \sqrt{4 - x^2}\right| + c$

D. $2\sin^{-1}\frac{x}{2} + \frac{x}{2}\sqrt{4 - x^2} + c$

E. NOTA

30. $\int \cos(3x + 1)dx =$

A. $3\sin(3x + 1) + c$

B. $\sin(3x + 1) + c$

C. $\frac{1}{3}\sin(3x + 1) + c$

D. $\frac{-1}{3}\sin(3x + 1) + c$

E. NOTA