

For all questions NOTA denotes None of the Above and π and e are constants.

1. What is the graph of $r = \frac{2}{3 - 2 \cos \theta}$?

- a. hyperbola
- b. circle
- c. parabola
- d. ellipse
- e. NOTA

2. What is the equation of the line tangent to $f(x)$ at $x = 2$ when $f(x) = x^4 + 2x + 1$?

- a. $y = 34x + 47$
- b. $y = 34x - 47$
- c. $y = 17x - 47$
- d. $y = -17x - 47$
- e. NOTA

3. What is the volume of the tetrahedron formed by the points $(2,0,0)$, $(0,2,0)$, $(0,0,3)$ and the origin?

- a. 1
- b. $3/2$
- c. 2
- d. $5/2$
- e. NOTA

4. If Jason puts \$3 in the bank at 6% interest, compounded continuously, how long will it take for his account balance to reach \$2000, provided he makes no other deposits or withdrawals. (To the nearest whole year)

- a. 10
- b. 36
- c. 107
- d. 108
- e. NOTA

5. If the triangle with vertices $(1,2)$, $(2,6)$, $(4,7)$ is transformed by the matrix $\begin{bmatrix} 5 & -4 \\ -6 & 5 \end{bmatrix}$, then what is the area of the new triangle?

- a. 4
- b. $7/2$
- c. 7
- d. 14
- e. NOTA

6. Find the area bounded by the graph defined by the parametric equations $x = 5 \cos t$ and $y = 8 \sin t$.

- a. 2π
- b. 10π
- c. 20π
- d. 40π
- e. NOTA

7. Given $f(x) = x \sin \frac{1}{x}$, evaluate $\lim_{x \rightarrow \infty} f(x)$.

- a. 0
- b. 1
- c. $3/2$
- d. ∞
- e. NOTA

8. How many terms are there in the expansion of $(a + 3b - c + 2d)^{10}$ when all like terms are combined?

- a. 11
- b. 36
- c. 286
- d. 858
- e. NOTA

9. If $y = t^2 + 2t$ and $x = t + 3$ find $\frac{dy}{dx}$.

- a. $t+1$ b. $t+2$ c. $2t+1$ d. $2t+2$ e. NOTA

10. If $f(x) = x^2 - 4x - 5$, then evaluate $\frac{f(x+h) - f(x)}{h}$.

- a. 0 b. $2x - 4 + h$ c. $2x - 4$ d. $2x + 4 + h$ e. NOTA

11. Find $f'(x)$ when $f(x) = 4x(3x^2 - 2)^4$.

- a. $16x(3x^2 - 2)^3$
b. $4(3x^2 - 2)^4(27x^2 - 2)$
c. $(3x^2 - 2)^3(27x^2 - 2)$
d. $4(3x^2 - 2)^3(27x^2 - 2)$
e. NOTA

12. Find two positive numbers such that their sum is 4 and the product of their cubes is a maximum.

- a. 1 and 3 b. 0 and 4 c. $7/2$ and $1/2$ d. $9/4$ and $7/4$ e. NOTA

13. Rhonda is blowing up a spherical balloon for a party. The volume of the balloon is changing at $25 \text{ cm}^3/\text{s}$. How fast is the surface area of the balloon changing when the radius is 10 cm. (All answers are in cm^2/s)

- a. 5 b. 10 c. 20 d. 40 e. NOTA

14. Determine the slope of $x^3y + y^2x = x + y$ at $x = 1$ and $y = 1$.

- a. $-3/2$ b. $-1/2$ c. $1/2$ d. $3/2$ e. NOTA

15. Given that $f'(x) = \sin^4x(\cos x)$, find $f(x)$ if $f(0) = 0$.

- a. $4 \sin^3x(\cos x)$ b. $5 \sin^5x(\cos x)$ c. \sin^5x d. $4 \sin^4x(\cos^2x)$ e. NOTA

16. Find the area bounded by $y = x$, $y = 0$, $x = 1$, and $x = 4$.

- a. 2 b. $15/2$ c. $17/2$ d. 8 e. NOTA

17. Evaluate $\lim_{x \rightarrow 1} \frac{2 \ln x}{3x^2 - x - 2}$
- a. 1/5 b. 2/5 c. 3/5 d. does not exist e. NOTA
18. What is the antiderivative of $3x^2 + 8x + 14$?
- a. $x^3 + 4x^2 + 14x + C$ b. $6x + 8 + C$ c. $3x^3 + 2x^2 + 7x + C$ d. $x^3 + 2x^2 + 14x + C$ e. NOTA
19. Given the conic with equation $4x^2 - 3xy + 4y^2 + 8x - 8y - 14 = 0$, find the angle of rotation needed to eliminate the xy term. (All answers are in degrees.)
- a. 22.5 b. 45 c. 67.5 d. 90 e. NOTA
20. Find all θ such that $|e^{i\theta}| - 1 = 0$, with $0 \leq \theta < 2\pi$.
- a. $\frac{\pi}{4}$ b. $\frac{\pi}{2}$ c. $\frac{\pi}{8}, \frac{\pi}{4}, \frac{\pi}{2}$ d. $\pi, \frac{3\pi}{2}, \frac{5\pi}{4}$ e. NOTA
21. Find the smallest prime that divides $9^{104} + 7^{104} + 5^{104} + 3^{104}$.
- a. 2 b. 3 c. 5 d. 7 e. NOTA
22. Matt and his best friend Sunil take a road trip together. Matt drives the first half of the trip at 45 mph. Sunil complains that Matt drives too slowly, so Sunil drives the rest of the way. What was Sunil's speed if they averaged 60 mph?
- a. 75 mph b. 80 mph c. 85 mph d. 90 mph e. NOTA
23. Unho wants to know the approximation for $33^{1/5}$. Mrs. Gibson tells him to use differentials to find the approximation, but Rebecca tells him to use his calculator to the ten-thousandths place. What is the difference between the two answers?
- a. 0.0001 b. 0.0002 c. 0.0003 d. 0.0004 e. NOTA
24. Evaluate $\lim_{x \rightarrow 0} \frac{(\sin x)^2}{x^2}$.
- a. 0 b. 1/2 c. 1 d. 2 e. NOTA

25. Find the length of the curve $y = \ln(\cos x)$ on the interval $[0, \frac{\pi}{4}]$.

- a. $\ln 2$ b. $\frac{1}{\ln 2}$ c. $\ln(\sqrt{2} + 1)$ d. $\ln(\sqrt{2} + 2)$ e. NOTA

26. Find the first derivative of $y = \log_2 x^2$ at $x = 1$.

- a. 1 b. $\frac{1}{\ln 2}$ c. $\ln 2$ d. $\frac{2}{\ln 2}$ e. NOTA

27. Find the second derivative of $y = 2e^2 - 4\pi e + 7$.

- a. $2e - 4\pi$ b. $4e$ c. $4e - 4\pi$ d. $2e^2 - 4\pi e + 7$ e. NOTA

28. Find all values of x where $f(x) = f'(x)$, given $f(x) = x^2 + 2x - 2$.

- a. -2 b. -1 c. 0 d. 1 e. NOTA

29. Sand is falling in a conical pile at a rate of 100 cubic feet per minute. If the radius of the conical pile is always equal to its height, what is the rate of change in the height when the height is 10 feet. Find the value to three decimal places.

- a. 0.159 b. 0.318 c. 0.636 d. 0.954 e. NOTA

30. Find an equation of a circle with center at (2,4) and tangent to the line $y = -4$.

- a. $x^2 + y^2 - 2x - 4y - 22 = 0$
b. $x^2 + y^2 + 4x - 8y - 44 = 0$
c. $x^2 + y^2 - 4x - 8y - 44 = 0$
d. $x^2 + y^2 - 2x + 4y - 22 = 0$
e. NOTA