5. $\lim_{x\to 1}\dfrac{\dfrac{3}{x}-3}{x-1}$ is

(A) -3 (B) -1 (C) 1 (D) 3 (E) nonexistent

6. For polynomial function p, $p''(2) = -6$, $p''(4) = 0$, and $p''(5) = 3$. Then p must:

(A) have an inflection point at $x = 4$ (B) have a minimum at $x = 4$
(C) have a root at $x = 4$ (D) be increasing on [2,5] (E) none of these

7. $\int_0^6 |x-4|\,dx =$

(A) 6 (B) 8 (C) 10 (D) 11 (E) 12

8. $\lim_{x\to\infty}\dfrac{3+x-2x^2}{4x^2+9}$ is

(A) $-\dfrac{1}{2}$ (B) $\dfrac{1}{2}$ (C) 1 (D) 3 (E) nonexistent

9. The maximum value of the function $f(x) = x^4 - 4x^3 + 6$ on [1, 4] is

(A) 1 (B) 0 (C) 3 (D) 6 (E) none of these

10. Let $\begin{cases} f(x) = \dfrac{\sqrt{x+4}-3}{x-5} \text{ if } x \neq 5, \text{ and let } f \text{ be continuous at } x = 5. \text{ Then } c = \\ f(5) = c \end{cases}$

(A) $-\dfrac{1}{6}$ (B) 0 (C) $\dfrac{1}{6}$ (D) 1 (E) 6

11. $\int_0^{\pi/2} \cos^2 x \sin x\,dx =$

(A) -1 (B) $-\dfrac{1}{3}$ (C) 0 (D) $\dfrac{1}{3}$ (E) 1

12. If $\sin x = \ln y$ and $0 < x < \pi$, then, in terms of x, $\dfrac{dy}{dx}$ equals

(A) $e^{\sin x}\cos x$ (B) $e^{-\sin x}\cos x$ (C) $\dfrac{e^{\sin x}}{\cos x}$

(D) $e^{\cos x}$ (E) $e^{\sin x}$

13. If $f(x) = x\cos x$, then $f'\left(\dfrac{\pi}{2}\right)$ equals

(A) $\dfrac{\pi}{2}$ (B) 0 (C) -1 (D) $-\dfrac{\pi}{2}$ (E) 1

14. The equation of the tangent to the curve $y = e^x \ln x$, where $x = 1$, is

(A) $y = ex$ **(B)** $y = e^x + 1$ **(C)** $y = e(x - 1)$
(D) $y = ex + 1$ **(E)** $y = x - 1$

15. If the displacement from the origin of a particle moving along the x-axis is given by $s = 3 + (t - 2)^4$, then the number of times the particle reverses direction is

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** none of these

16. $\int_{-1}^{0} e^{-x}dx$ equals

(A) $1 - e$ **(B)** $\frac{1-e}{e}$ **(C)** $e - 1$ **(D)** $1 - \frac{1}{e}$ **(E)** $e + 1$

17. If $f(x) = \begin{cases} x^2 & \text{for } x \le 2 \\ 4x - x^2 & \text{for } x > 2 \end{cases}$, then $\int_{-1}^{4} f(x)\,dx$ equals

(A) 7 **(B)** $\frac{23}{3}$ **(C)** $\frac{25}{3}$ **(D)** 9 **(E)** $\frac{65}{3}$

18. If the position of a particle on a line at time t is given by $s = t^3 + 3t$, then the speed of the particle is decreasing when

(A) $-1 < t < 1$ **(B)** $-1 < t < 0$ **(C)** $t < 0$
(D) $t > 0$ **(E)** $|t| > 1$

19. A rectangle with one side on the x-axis is inscribed in the triangle formed by the lines $y = x$, $y = 0$, and $2x + y = 12$. The area of the largest such rectangle is

CHALLENGE

(A) 6 **(B)** 3 **(C)** $\frac{5}{2}$ **(D)** 5 **(E)** 7

20. The x-value of the first-quadrant point that is on the curve of $x^2 - y^2 = 1$ and closest to the point (3, 0) is

(A) 1 **(B)** $\frac{3}{2}$ **(C)** 2 **(D)** 3 **(E)** none of these

21. If $y = \ln(4x + 1)$, then $\frac{d^2y}{dx^2}$ is

(A) $\frac{1}{4}$ **(B)** $\frac{-1}{(4x+1)^2}$ **(C)** $\frac{-4}{(4x+1)^2}$

(D) $\frac{-16}{(4x+1)^2}$ **(E)** $\frac{-1}{16(4x+1)^2}$

22. The region bounded by the parabolas $y = x^2$ and $y = 6x - x^2$ is rotated about the x-axis so that a vertical line segment cut off by the curves generates a ring. The value of x for which the ring of largest area is obtained is

(A) 4 **(B)** 3 **(C)** $\frac{5}{2}$ **(D)** 2 **(E)** $\frac{3}{2}$