1. Which one of the following is true?

(A) If f is not continuous at c, then $\lim_{x \to c} f(x)$ does not exist

(B) If f is not continuous at c, then $\lim_{x \to c^+} f(x) \neq \lim_{x \to c^-} f(x)$

(C) If $\lim_{x \to c} f(x) = L$, then $f(c) = L$

(D) If f is continuous at c, then $\lim_{x \to c^+} f(x) = \lim_{x \to c^-} f(x)$

(E) If $f(c) = L$, then $\lim_{x \to c} f(x) = L$

2. $\lim_{x \to 1} (x^2 - 1) \csc (x - 1) =$

(A) $-\infty$ (B) ∞ (C) 0 (D) 1 (E) 2

3. $\lim\limits_{x \to 1} \dfrac{x - 1}{\sqrt{x + 3} - 2} =$

(A) 0 (B) ∞ (C) 4 (D) 2 (E) $\frac{1}{2}$

4. The function $f(x) = \begin{cases} \cos x, & x \le 0 \\ \dfrac{\sin x}{x}, & 0 < x \le \dfrac{\pi}{2} \\ \dfrac{2x - \pi + 1}{4x - 2\pi + 1}, & x > \dfrac{\pi}{2} \end{cases}$

(A) is continuous only when $0 < x < \frac{\pi}{2}$

(B) is continuous for all values of x

(C) is discontinuous only at $x = \frac{\pi}{2}$

(D) is discontinuous only at $x = 0$

(E) is discontinuous at both $x = 0$ and $x = \frac{\pi}{2}$

5. $\lim\limits_{h \to 0} \dfrac{(\sqrt{2} + h)^5 - (\sqrt{2})^5}{h} =$

(A) $20\sqrt{2}$ (B) 20 (C) $10\sqrt{2}$ (D) 10 (E) $5\sqrt{2}$

6.

From the graphs, which one of the following appears to be true?

(A) h is the derivative of f

(B) g is the derivative of f

(C) h is the derivative of g

(D) g is the derivative of h

(E) f is the derivative of g

7. Suppose f(x) is a function for which $f(1) = 2$ and $f'(1) = 3$. If

$$g(x) = \frac{x + 1}{f(x)},$$

then $g'(1) =$

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

8. If $f(x) = \frac{3x + 8}{x + 2}$, then $f''(0) =$

(A) $\frac{1}{4}$ (B) $-\frac{1}{2}$ (C) $\frac{1}{2}$ (D) $-\frac{1}{4}$ (E) 0

9. The equation of the tangent line to the curve $y = \cot x$ at the point $\left(\frac{\pi}{4}, 1\right)$ is

(A) $y = -x + \frac{\pi}{4} + 1$ (B) $y = -\frac{1}{2}x + \frac{\pi}{8} + 1$

(C) $y = -\frac{1}{2}x + \frac{\pi}{4} + 1$ (D) $y = -2x + \frac{\pi}{4} + 1$

(E) $y = -2x + \frac{\pi}{2} + 1$

10. If $f(x) = x^2\cos x$, then $f'\left(\frac{\pi}{2}\right) =$

(A) $\frac{\pi^2}{4}$ (B) $-\pi$ (C) 0 (D) $-\frac{\pi^2}{4}$ (E) π

11. The position of a body moving along a coordinate line is given by the equation

$$s = t^4 - 4t^3 + 8t^2 - 2t + 1.$$

At a certain time, the acceleration of the body happens to be 4, and then the positic of the body is given by $s =$

(A) -2 (B) 4 (C) 1 (D) 3 (E) 0

12. If $f(x) = \left(x^2 - x - \frac{2}{x}\right)^{10}$, then $f'(2) =$

(A) 35 (B) $10\left(\frac{7}{2}\right)^9$ (C) 10 (D) $\left(\frac{7}{2}\right)^{10}$ (E) 70

13. If $f(x) = \tan^2\left(2x + \frac{\pi}{4}\right)$, then $f'(0) =$

(A) 2 (B) $\sqrt{2}$ (C) $2\sqrt{2}$ (D) 8 (E) 4

14. The tangent line to the curve

$$x^2 y^2 - 3x + 6y + 8 = 0$$

at the point $(2, -1)$ has equation

(A) $y = -\frac{1}{2} x$ (B) $y = -2x + 3$ (C) $y = x - 3$

(D) $y = \frac{1}{2} x - 2$ (E) $y = 2x - 5$

15. Suppose $f(x) = x^3 - 3x^2 + 10$. Let M be the largest value of f(x), and m the smallest value of f(x), where the values of x lie in the interval $[-2, 3]$. Then

(A) $M = 6$ and $m = -10$

(B) $M = 6$ and $m = -6$

(C) $M = 6$ and $m = 0$

(D) $M = 10$ and $m = -10$

(E) $M = 10$ and $m = 6$

16. A certain function f(x) has <u>derivative</u> given by

$$f'(x) = x(x-1)^2(x-2)^3.$$

The function f(x) is increasing on the intervals

(A) (1, 2) and (2, ∞)
(B) (− ∞, 0) and (2, ∞)
(C) (0, 1) and (2, ∞)
(D) (0, 1) and (1, 2)
(E) (− ∞, 0) and (1,2)

17. Suppose f(x) is a differentiable function for which f(−1) = −1 and f(1) = 2. Then the mean value theorem or Rolle's theorem implies

(A) There is a value of c between −1 and 1 for which $f'(c) = \frac{3}{2}$.
(B) There is exactly one value of x between −1 and 1 where f(x) = 0.
(C) There is at least one value of x between −1 and 1 where f(x) has either a local maximum or a local minimum.
(D) There is a value of c between −1 and 1 for which $f'(c) = 0$.
(E) f(x) is never decreasing anywhere within the interval (−1, 1).