4. The graph of $y = 2x^3 + 24x - 18$ is

  (A) increasing for all x

  (B) decreasing for all x

  (C) only increasing for all x such that $|x| > 2$

  (D) only increasing for all x such that $|x| < 2$

  (E) only decreasing for all x such that $x < -2$

5. If $f = \begin{cases} x^2 + 2, & x \le 1 \\ 2x + 1, & x > 1 \end{cases}$, then $f'(1)$ is

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

6. What is the maximum value of the <u>derivative</u> of $f(x) = 3x^2 - x^3$?

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

7. Let f be a differentiable function for all x. Which of the following must be true?

  I. $\dfrac{d}{dx} \displaystyle\int_0^3 f(x)\, dx = f(x)$

  II. $\displaystyle\int_3^x f'(x)\, dx = f(x)$

  III. $\dfrac{d}{dx} \displaystyle\int_3^x f(x)\, dx = f(x)$

  (A) II only

  (B) III only

  (C) I and II only

  (D) II and III only

  (E) I, II, and III

8. If $\sin(xy) = x^2$, then $\dfrac{dy}{dx} =$

  (A) $2x \sec(xy)$

  (B) $\dfrac{\sec(xy)}{x^2}$

  (C) $2x \sec(xy) - y$

  (D) $\dfrac{2x \sec(xy)}{y}$

  (E) $\dfrac{2x \sec(xy) - y}{x}$

9. A particle moves along the x-axis so that its position at any time $t \geq 0$ is given by $x(t) = 3t^3 - 18t^2 + 24t$. At which time t is its average velocity zero?

(A) Never

(B) 0 only

(C) 2 only

(D) 2 and 4 only

(E) 0, 2, and 4

10. How many points of inflection does the graph of $y = 2x^6 + 9x^5 + 10x^4 - x + 2$ have?

(A) None

(B) One

(C) Two

(D) Three

(E) Four

11. If $\int_0^4 (x^2 - 6x + 9)\, dx$ is approximated by 4 inscribed rectangles of equal width on the x-axis, then the approximation is

(A) 14

(B) 10

(C) 6

(D) 5

(E) 4

12. What is the 20th derivative of $y = \sin(2x)$?

(A) $-2^{20} \sin(2x)$

(B) $2^{20} \sin(2x)$

(C) $-12^{19} \cos(2x)$

(D) $2^{20} \cos(2x)$

(E) $2^{21} \cos(2x)$

13. What is the equation of the line tangent to the graph of $f(x) = 7x - x^2$ at the point where $f'(x) = 3$?

(A) $y = 5x - 10$

(B) $y = 3x + 4$

(C) $y = 3x + 8$

(D) $y = 3x - 10$

(E) $y = 3x - 16$

14. Suppose that $f(x)$ is a twice-differentiable function on the closed interval $[a, b]$. If there is a number c, $a < c < b$, for which $f'(c) = 0$, which of the following must be true?

I. $f(a) = f(b)$

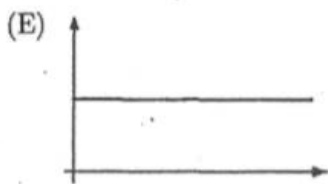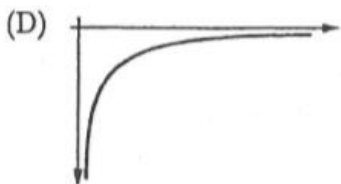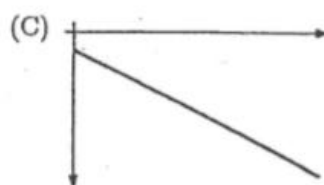II. f has a relative extremum at $x = c$.

III. f has a point of inflection at $x = c$.
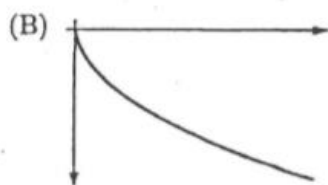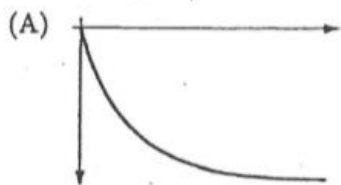
(A) None   (B) I only   (C) II only   (D) I and II   (E) II and III

15. A sky diver has a negative velocity while falling from an airplane. Before the sky diver opens the parachute, her velocity decreases quickly and then levels off due to air resistance. Which graph approximates the acceleration of the sky diver?

16. If $f(x) = x\sqrt[3]{x}$, then $f'(x) =$

(A) $4x^3$ (B) $\frac{3}{7}x^{\frac{7}{3}}$ (C) $\frac{4}{3}x^{\frac{1}{3}}$ (D) $\frac{1}{3}x^{\frac{1}{3}}$ (E) $\frac{1}{3}x^{-\frac{2}{3}}$

17. If $k > 0$ and $\displaystyle\int_k^6 \frac{dx}{x+2} = \ln k$, then $k =$

(A) 1   (B) 2   (C) 3   (D) 4   (E) 5