FINAL REVIEW FOR CALCULUS I

1. Using the graph in the figure, find $\lim_{x \to 0} f(x)$
   (A) 1  (B) 2  (C) No limit  
   (D) 0  (E) None of these

2. Using the graph in the figure to find $\lim_{x \to 2} f(x)$ if the graph in the figure is the graph of $y = f(x)$.
   (A) 1  (B) 2  (C) No limit  
   (D) 0  (E) None of these

3. Find the limit: $\lim_{x \to 3} g(x)$; $g(x) = \begin{cases} 2 - x, & x \leq 3 \\ x^2 - 5, & x > 3 \end{cases}$
   (A) 3  (B) 4  (C) -1  
   (D) No limit  (E) None of these

4. Find the limit: $\lim_{x \to 2} g(x)$; $g(x) = \begin{cases} 3x - 5, & x < 2 \\ x^2 - 3, & x \geq 2 \end{cases}$
   (A) 1  (B) 2  (C) -3  
   (D) No limit  (E) None of these

5. Given $\lim_{x \to 4} \left(\frac{1}{x} + 3\right) = 5$. Find the (the threshold) $\delta$ such that $\left|\left(\frac{1}{x} + 3\right) - 5\right| < 0.005$ whenever $0 < |x - 4| < \delta$.
   (A) 0.1  (B) 0.005  (C) 0.01  
   (D) 0.0025  (E) None of these

6. Find the limit if any: $\lim_{x \to 5} \sec \left(\frac{\pi x}{4}\right)$
   (A) $-\frac{\sqrt{2}}{2}$  (B) $\frac{\sqrt{2}}{2}$  
   (C) $-\sqrt{2}$  (D) $\sqrt{2}$  
   (E) No limit

7. Find the limit if any: $\lim_{x \to -1} \frac{3x^2 - 8x + 4}{x^4 - x^2 + 3}$
   (A) 3  (B) $\frac{4}{3}$  (C) 5  
   (D) $-\frac{1}{3}$  (E) No limit

8. Find the limit if any: $\lim_{x \to 2} \frac{x^2 + x - 6}{x - 2}$
   (A) 3  (B) 5  (C) 0  
   (D) -3  (E) No limit

9. Find the limit if any: $\lim_{x \to 3} \frac{3x^2 - 10x + 3}{x^2 - 2x - 3}$
   (A) -1  (B) 1  (C) 2  
   (D) 3  (E) No limit

10. Find the limit if any: $\lim_{x \to 0} \frac{\sqrt{x + 9} - 3}{x}$
    (A) $\frac{1}{9}$  (B) $\frac{1}{6}$  
    (C) $\frac{1}{3}$  (D) 6  
    (E) No limit

11. Find the limit if any: $\lim_{x \to -3} \frac{x - 3}{\sqrt{x + 1} - 2}$
    (A) $\frac{1}{4}$  (B) $\frac{1}{2}$  
    (C) 0  (D) 4  
    (E) No limit
12. Find the limit if any: \( \lim_{x \to 0} \frac{\sin(3x)}{\tan(4x)} \)
   (A) \( \frac{4}{3} \)  (B) 0  (C) \( \frac{3}{4} \)  (D) 4  (E) No limit

13. Find the limit if any: \( \lim_{x \to 0} \frac{\sin x (1-\cos x)}{x^2} \)
   (A) 2  (B) 0  (C) \(-2\)  (D) 4  (E) No limit

14. Find the limit if any: \( \lim_{x \to 0} \left( \frac{1}{x} - \frac{1}{x^2 + x} \right) \)
   (A) 1  (B) 0  (C) \( \infty \)  (D) \(-\infty\)  (E) No limit

15. Find the limit if any: \( \lim_{x \to \infty} \frac{3x^2 - 2x + 1}{5x^2 + 4x + 1} \)
   (A) \( \frac{3}{5} \)  (B) \( \frac{3}{5} \)  (C) 0  (D) \(-\infty\)  (E) \( \infty \)

16. Find the limit if any: \( \lim_{x \to 0} x^2 \sin \left( \frac{1}{x} \right) \)
   (A) 1  (B) 0  (C) \( \infty \)  (D) \(-\infty\)  (E) No limit

17. Find the limit if any: \( \lim_{x \to \infty} \frac{\sqrt{4x^2 + 1}}{3x - 5} \)
   (A) \( \frac{2}{5} \)  (B) \( \frac{2}{3} \)  (C) \( -\frac{4}{3} \)  (D) \(-\infty\)  (E) \( \infty \)

18. Find the limit if any: \( \lim_{x \to \infty} \sqrt{x^2 + 8x - 100} - x \)
   (A) 100  (B) 8  (C) 4  (D) 1  (E) No limit

19. Find the limit if any: \( \lim_{x \to 0} \frac{x^2}{e^x - x - 1} \)
   (A) 2  (B) 1  (C) 0  (D) \( \infty \)  (E) No limit

20. Find the limit: \( \lim_{h \to 0} \frac{\sqrt{2x + 2h + 1} - \sqrt{2x + 1}}{h} \)
   (A) \( -\sqrt{2} \)  (B) \( \sqrt{2} \)  (C) \( \frac{1}{2\sqrt{2x+1}} \)  (D) \( \frac{1}{\sqrt{2x+1}} \)  (E) No limit

21. Determine the value of \( c \) so that \( f(x) \) is continuous over the entire set of real numbers when
   \[ f(x) = \begin{cases} 
   2x - 5, & x < 4 \\
   cx - 2, & x \geq 4 
   \end{cases} \]
   (A) \( -\frac{5}{4} \)  (B) \( \frac{5}{4} \)  (C) \( \frac{1}{5} \)  (D) \( -\frac{1}{5} \)  (E) None of these

22. Which of the following statement must be true?
   I. If \( f \) is differentiable at \( x = a \), then \( f \) is continuous at \( x = a \).
   II. If \( f \) is continuous at \( x = a \), then \( f \) is differentiable at \( x = a \).
   III. If \( f \) is differentiable at \( x = a \), then \( f' \) is differentiable at \( x = a \).
   (A) I only  (B) II only  (C) III only  (D) I and II only  (E) II and III only
23. Find the derivative of \( y, \frac{dy}{dx} : y = 5e^x - 4 \cos x + \ln(x - 1) \)
(A) \( 5e^x - 4 \sin x + \frac{1}{x-1} \)  
(B) \( 5e^x + 4 \sin x + \frac{1}{x-1} \)  
(C) \( 5e^x - 4 \sin x + \frac{x}{x-1} \)  
(D) \( 5e^x + 4 \sin x + \frac{x}{x-1} \)  
(E) None above

24. Find the derivative of \( y, \frac{dy}{dx} : y = \sqrt{x} - 2 \ln x \)
(A) \( \frac{1}{2} x \sqrt{x} - \frac{2}{x} \)  
(B) \( \frac{1}{2} \sqrt{x} - \frac{2}{x} \)  
(C) \( \frac{1}{2 \sqrt{x}} - \frac{2}{x} \)  
(D) \( \frac{2}{\sqrt{x}} - \frac{2}{x} \)  
(E) None of these

25. Find the derivative of \( y, \frac{dy}{dx} : y = \frac{2x^3 - 3x}{x^2} \)
(A) \( \frac{4x^3 - 3}{2x} \)  
(B) \( 2 - \frac{3}{x} \)  
(C) \( 2 + \frac{3}{x^2} \)  
(D) \( \frac{3}{x} \)  
(E) None of these

26. Find the derivative of \( y, \frac{dy}{dx} : y = \frac{x}{x^2 + 4} \)
(A) \( \frac{4x^2 - x^2}{(x^2 + 4)^2} \)  
(B) \( \frac{x^2 + 4}{(x^2 + 4)^2} \)  
(C) \( \frac{1}{2x} \)  
(D) \( -\frac{1}{2x^2 + 4} \)  
(E) None of these

27. Find the derivative of \( y, \frac{dy}{dx} : y = \ln \sqrt{x^2 - 3} \)
(A) \( \frac{x}{x^2 - 3} \)  
(B) \( \frac{2x}{x^2 - 3} \)  
(C) \( \frac{4x}{x^2 - 3} \)  
(D) \( \frac{x}{2(x^2 - 3)} \)  
(E) None of these

28. Find the derivative of \( y, \frac{dy}{dx} : y = (2x^3 + 5)^7 \)
(A) \( 7x^2 (2x^3 + 5)^6 \)  
(B) \( 14x^2 (2x^3 + 5)^6 \)  
(C) \( 42x^2 (2x^3 + 5)^6 \)  
(D) \( 7x^2 (2x^3 + 5)^8 \)  
(E) None above

29. Find the derivative of \( y, \frac{dy}{dx} : y = \sin(5x^3) - 6e^x \)
(A) \( -\cos(5x^3) - 6e^x \)  
(B) \( 6 \cos(15x^2) e^x \)  
(C) \( 15x^2 \cos(5x^3) - 6e^x \)  
(D) \( -15x^2 \cos(5x^3) - 6e^x \)  
(E) None above

30. Find the derivative of \( y, \frac{dy}{dx} : y = \cos^5(2x) \)
(A) \( 10 \sin(2x) \cos^4(2x) \)  
(B) \( -10 \sin(2x) \cos^4(2x) \)  
(C) \( 5 \sin(2x) \cos^4(2x) \)  
(D) \( -5 \sin(2x) \cos^4(2x) \)  
(E) \( 10 \cos^4(2x) \)

31. Find the derivative of \( y, \frac{dy}{dx} : y = \csc^2 x + \cot^2 x \)
(A) \( 0 \)  
(B) \( -\cot x - \csc^2 x \)  
(C) \( -\csc^2 x (\csc^2 x + \cot^2 x) \)  
(D) \( -4 \csc^2 x \cot x \)  
(E) None of these

32. Find the derivative of \( f, \frac{df}{dx} : f(x) = \frac{x^2 - 4x}{\sqrt{x}} \)
(A) \( \frac{3x-4}{2\sqrt{x}} \)  
(B) \( \frac{2x-4}{\sqrt{x}} \)  
(C) \( \frac{2x-4}{1/(2\sqrt{x})} \)  
(D) \( x^{3/2} - 4x^{1/2} \)  
(E) None of these

33. Find the second derivative of \( y, \frac{d^2y}{dx^2} : y = \frac{x-2}{x+4} \)
(A) \( \frac{12}{(x+4)^3} \)  
(B) \( 0 \)  
(C) \( -\frac{12}{(x+4)^3} \)  
(D) \( \frac{6}{(x+4)^3} \)  
(E) None of these
34. Find the derivative of \( f, \frac{df}{dx} : 5x^2 - 2xy + 7y^2 = 0 \)
\[ \text{(A)} \frac{5x+7y}{x} \quad \text{(B)} \frac{y-5x}{7y} \quad \text{(C)} 10x - 2y + 14y \]
\[ \text{(D)} \frac{y-5x}{7y-x} \quad \text{(E)} \text{None of these} \]

35. Find an equation of the tangent line to the graph of \( f(x) = 2x^3 - 4x \) when \( x = 1. \)
\[ \text{(A)} y = 1 \quad \text{(B)} y = 2x \quad \text{(C)} y = 2x - 4 \quad \text{(D)} y = 2x + 1 \quad \text{(E)} \text{None of these} \]

36. Find an equation of the tangent line to the graph of \( f(x) = \frac{1}{x-1} \) at the point (2,1)
\[ \text{(A)} x + y + 3 = 0 \quad \text{(B)} x - y = 1 \quad \text{(C)} y - 1 = \frac{(x-2)}{(x-1)^2} \]
\[ \text{(D)} x + y = 3 \quad \text{(E)} \text{None of these} \]

37. Find an equation of the tangent line to the graph of \( f(x) = x^3 - 3x - 2 \) when \( x = -1. \)
\[ \text{(A)} y = x \quad \text{(B)} y = 0 \quad \text{(C)} y = x + 1 \quad \text{(D)} x = 0 \quad \text{(E)} \text{None of these} \]

38. Find an equation of the tangent line to the graph of \( f(x) = x^2 + 4y^2 = 16 \) at the point (4,0).
\[ \text{(A)} y = 0 \quad \text{(B)} y = 4x - 4 \quad \text{(C)} x = 4 \quad \text{(D)} x = 0 \quad \text{(E)} \text{None of these} \]

39. Find the point(s) on the graph of the function \( y = x^3 - 9x \), where slope of the tangent line is 3.
\[ \text{(A)} (2,-10) \quad \text{(B)} (-2,10) \quad \text{(C)} (2,0), (-2,0) \]
\[ \text{(D)} (2,-10), (-2,10) \quad \text{(E)} \text{None of these} \]

40. Let \( f(x) = e^{-x^2} \). Find the linear approximation of \( f(x) \) near \( a = 1. \)
\[ \text{(A)} e(x-1) + 1 \quad \text{(B)} 2x e^{x^2-1}(x-1) + e \]
\[ \text{(C)} e(x-1) + e \quad \text{(D)} 2x e^{x^2-1}(x-1) \]
\[ \text{(E)} 2e(x-1) + e \]

41. Find the critical points of the graph of \( f(x) = \sqrt[3]{x^2} + 2 + 1 \)
\[ \text{(A)} (2,0) \quad \text{(B)} (-2,0) \quad \text{(C)} (2,1) \]
\[ \text{(D)} \text{No critical points} \quad \text{(E)} \text{None of these} \]

42. Find the local maximum of the graph of \( f(x) = \frac{1}{4} x^4 - \frac{2}{3} x^3 \)
\[ \text{(A)} 0 \quad \text{(B)} \frac{5}{12} \quad \text{(C)} \frac{4}{3} \]
\[ \text{(D)} \text{No local maximum} \quad \text{(E)} \text{None of these} \]

43. If \( f(x) = x^3 - 3x^2 + 6 \), then \( f(x) \) is decreasing on the interval(s):
\[ \text{(A)} (-\infty, 2) \quad \text{(B)} (1, \infty) \quad \text{(C)} (0,1) \]
\[ \text{(D)} (0,2) \quad \text{(E)} (-\infty, 0) \cup (2, \infty) \]

44. Find all inflection points of the graph of \( f(x) = \frac{1}{12} x^4 - \frac{1}{2} x^2 - 3. \)
\[ \text{(A)} (1, 0), (-1,0) \quad \text{(B)} (1,0) \quad \text{(C)} \left(1, -\frac{41}{12}\right), \left(-1, -\frac{41}{12}\right) \]
\[ \text{(D)} \text{No inflection points} \quad \text{(E)} \text{None of these} \]
45. What is the absolute minimum value of the function \( f(x) = x^4 - 2x^2 \) on the interval \([-2, 2]\)?
(A) -1  (B) 1  (C) 0  (D) 8  (E) None of these

46. Determine from the graph whether the function \( f \) possesses extrema on the interval \([a, b]\)
(A) There is a maximum at \( x = a \) and a minimum at \( x = b \)
(B) There is a maximum at \( x = a \) and no minimum
(C) There is no maximum, and there is a minimum at \( x = b \)
(D) There are no extrema.
(E) None of these

47. Given the graph of a function \( f \) in the below figure, determine which of the following statements is FALSE.

(A) \( \lim_{x \to 0} f(x) \) exists
(B) It is discontinuous at \( x = 2 \).
(C) It is continuous at \( x = 4 \)
(D) \( \lim_{x \to -7} f(x) \) exists
(E) It is not differentiable at \( x = 0 \)

48. Find the indefinite integral: \( \int \frac{4}{x^3} \, dx \)
(A) \( \frac{4x}{x^4} + C \)
(B) \( \frac{4}{x^2} + C \)
(C) \( -\frac{4}{x^2} + C \)
(D) \( \frac{2}{x^2} + C \)
(E) None of these

49. Find the indefinite integral: \( \int \sec(x) \tan(x) \, dx \)
(A) \( 4 \sec(x) \tan(x) + C \)
(B) \( 4 \sec^3(x) \tan(x) \)
(C) \( 4 \sec(x) + C \)
(D) \( 4 \tan(x) + C \)
(E) None of these

50. Find the indefinite integral: \( \int \frac{x^4 + 2x}{x^2} \, dx \)
(A) \( x^3 + 2 + C \)
(B) \( \frac{1}{3}x^5 + \frac{x^2}{3} + C \)
(C) \( \frac{1}{3}x^3 + 2 \ln |x| + C \)
(D) \( \frac{1}{3}x^3 + 2 + C \)
(E) None of these
51. Find the indefinite integral: \( \int x^2(x^3 + 3)^9 \, dx \)
   (A) \((x^3 + 3)^9 + C\)
   (B) \(\frac{1}{24}(x^3 + 3)^9 + C\)
   (C) \(\frac{1}{27}(x^3 + 3)^9 + C\)
   (D) \(\frac{1}{9}(x^3 + 3)^9 + C\)
   (E) None of these

52. Find the indefinite integral: \( \int 2x + 3 \, dx \)
   (A) \(2x + |x + 1| + C\)
   (B) \(2 + |x + 1| + C\)
   (C) \(2 + |x + 1| + C\)
   (D) \(2 + |x + 1| + C\)
   (E) None of these

53. Find the indefinite integral: \( \int \sqrt{2x + 5} \, dx \)
   (A) \(\sqrt{2x + 5} + C\)
   (B) \(2\sqrt{2x + 5} + C\)
   (C) \(\sqrt{2x + 5} + C\)
   (D) \(\frac{1}{2}\sqrt{2x + 5} + C\)
   (E) None of these

54. Find the indefinite integral: \( \int x\sqrt{x - 1} \, dx \)
   (A) \((x - 1)^{5/2} + C\)
   (B) \(\frac{2}{3}(x - 1)^{5/2} + C\)
   (C) \(\frac{2}{5}(x - 1)^{5/2} + \frac{2}{3}(x - 1)^{3/2} + C\)
   (D) \(\frac{2}{5}(x - 1)^{5/2} - \frac{2}{3}(x - 1)^{3/2} + C\)
   (E) None of these

55. Find the definite integral: \( \int_0^{\frac{\pi}{10}} \cos(5x) \, dx \)
   (A) \(\frac{1}{5}\)
   (B) \(-\frac{1}{5}\)
   (C) \(1\)
   (D) \(-1\)
   (E) None of these

56. Find the definite integral: \( \int_0^1 \frac{1}{\sqrt{x}} \, dx \)
   (A) \(-1\)
   (B) \(1\)
   (C) \(2\)
   (D) \(4\)
   (E) None of these

57. Which of the following definite integrals represents the area of the shaded region in the figure below?
   (A) \(\int_{-2}^{3} f(x) \, dx\)
   (B) \(\int_{-2}^{3} f(x) \, dx - \int_{0}^{3} f(x) \, dx\)
   (C) \(\int_{-2}^{3} f(x) \, dx - \int_{-2}^{0} f(x) \, dx\)
   (D) \(\int_{-2}^{3} f(x) \, dx\)
   (E) None of these

58. Suppose the position equation for a moving object is given by \(s(t) = 3t^2 - 2t + 9\), where \(s\) is measured in meters and \(t\) is measured in seconds. Find the velocity of the object when \(t = 2\).
   (A) 13 m/s
   (B) 14 m/s
   (C) 10 m/s
   (D) 6 m/s
   (E) None of these

59. Find the definite integral: \( \int_{-2}^{2} |x + 1| \, dx \)
   (A) 5
   (B) 2
   (C) \(\frac{9}{2}\)
   (D) 0
   (E) None of these
60. Find \( y = f(x) \) if \( f''(x) = x^2, \ f'(0) = 6, \) and \( f(0) = -2. \)
   (A) \( x^2 + 6 \)  
   (B) \( \frac{1}{12}x^4 + 6x - 2 \)  
   (C) \( x^2 + 7x + 2 \)  
   (D) \( x^4 + 6x - 2 \)  
   (E) None of these

61. Find the average (mean) value of \( f(x) = 4x^2 + 3 \) on the interval \([0,2] \).
   (A) \( \frac{25}{3} \)  
   (B) \( \frac{16}{3} \)  
   (C) \( \frac{32}{3} \)  
   (D) \( \frac{50}{3} \)  
   (E) None of these

62. Determine which of the following definite integrals equal \( \lim_{n \to \infty} \sum_{i=1}^{n} \left( \frac{1}{n} \sqrt{i} \right) \)
   (A) \( \int_0^1 \frac{1}{\sqrt{x}} \, dx \)  
   (B) \( \int_0^1 \sqrt{x} \, dx \)  
   (C) \( \int_0^1 4\sqrt{4x} \, dx \)  
   (D) \( \int_0^1 2\sqrt{x} \, dx \)  
   (E) None of these

63. If a volume \( V \) of a cube is decreasing at the rate of 24 \( \text{cm}^3/\text{min} \), find the rate at which the length of a side of the cube is decreasing when \( V = 8 \text{ cm}^3/\text{min} \).
   (A) 1 \( \text{cm/min} \)  
   (B) 2 \( \text{cm/min} \)  
   (C) 3 \( \text{cm/min} \)  
   (D) 4 \( \text{cm/min} \)  
   (E) None of these

64. A spherical air balloon is inflated at a rate of 6 \( \text{cm}^3/\text{min} \). At what rate is the radius of the air balloon increasing when its radius is 10 cm?
   (A) 6 \( \text{cm/min} \)  
   (B) 10 \( \text{cm/min} \)  
   (C) \( \frac{3}{200\pi} \) \( \text{cm/min} \)  
   (D) \( \frac{1}{200\pi} \) \( \text{cm/min} \)  
   (E) None of these

65. Two boats move on the same (at) lake. At noon boat B is 10 miles east of boat A. For the rest of the day, both boats sail at 10 mph, however boat A sails north and boat B sails east. Find out how fast the distance between the boats is changing at 3 pm.
   (A) 30 \( \text{mi/hr} \)  
   (B) 40 \( \text{mi/hr} \)  
   (C) \( 30\sqrt{2} \) \( \text{mi/hr} \)  
   (D) 50 \( \text{mi/hr} \)  
   (E) None of these

66. The management of a large department store wishes to add a fenced-in rectangular storage yard of 80,000 square feet, using the building as one side of the yard. Find the minimum amount of fencing that must be used to enclose the remaining 3 sides.
   (A) 400 \( \text{ft} \)  
   (B) 800 \( \text{ft} \)  
   (C) 1000 \( \text{ft} \)  
   (D) 8000 \( \text{ft} \)  
   (E) None of these

67. An open box is to be made from a 6-foot by 8-foot rectangular piece of material by cutting equal squares from each corner and turning up the sides. Find the volume of the largest box that can be made in this manner. Round to the nearest hundredth of a cubic foot.
   (A) 16.04 \( \text{ft}^3 \)  
   (B) 24.26 \( \text{ft}^3 \)  
   (C) 31.36 \( \text{ft}^3 \)  
   (D) 16.65 \( \text{ft}^3 \)  
   (E) None of these

68. Use the trapezoidal Rule, with \( n = 4 \), to approximate: \( \int_0^1 (x + 1)^2 \, dx \).
   (A) 1.84375  
   (B) 1.171875  
   (C) 0.921875  
   (D) 2.96875  
   (E) None of these

69. 2700 \( \text{cm}^2 \) of material is available to make a box with a square base and an open top. What is the largest possible volume \( V \) of the box?
   (A) 30 \( \text{cm}^3 \)  
   (B) 6,750 \( \text{cm}^3 \)  
   (C) 13,500 \( \text{cm}^3 \)  
   (D) 27,000 \( \text{cm}^3 \)  
   (E) None of these
70. Determine whether the Mean Value Theorem applies to \( f(x) = -\frac{1}{x} \) on the interval \([-3, -\frac{1}{2}]\). If the Mean Value Theorem applies, find all values of \( c \) in this interval such that \( f'(c) = \frac{f\left(-\frac{1}{2}\right) - f(-3)}{-\frac{1}{2} - (-3)} \). If the Mean Value theorem does not apply, state why.

(A) The mean Value Theorem applies: \( c = \pm \sqrt{\frac{3}{2}} \)

(B) The mean Value Theorem applies: \( c = -\sqrt{\frac{3}{2}} \)

(C) The mean Value Theorem does not apply because \( f \) is not continuous at \( x = 0 \):

(D) The mean Value Theorem does not apply because \( f \left(-\frac{1}{2}\right) \neq f(-3) \)

71. Find the derivative of \( G : G(x) = \int_{0}^{x^2} t \sin(t) \, dt \)

(A) \( x \sin(x) + C \)  
(B) \( x^2 \sin(x^2) \)  
(C) \( x \sin(x) \)

(D) \( 2x^3 \sin(x^2) \)  
(E) None of above

72. The graph in the figure is the graph of the derivative of the function \( f(x) \): so it is the graph of \( y = f'(x) \). Which of the following statements is true about the function \( y = f(x) \)?

(A) \( f(x) \) is increasing on \((-\infty, A) \cup (C, F)\) and it is concave down on \((-\infty, B) \cup (E, \infty)\)

(B) \( f(x) \) is increasing on \((-\infty, A) \cup (C, F)\) and it is concave down on \((B, F)\)

(C) \( f(x) \) is increasing on \((B, E)\) and it is concave down on \((D, \infty)\)

(D) \( f(x) \) is increasing on \((B, E)\) and it is concave down on \((-\infty, B) \cup (E, \infty)\)

(E) \( f(x) \) is increasing on \((B, F)\) and it is concave down on \((-\infty, D)\)
## SOLUTIONS

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