1. Find \( \lim_{x \to 0} \frac{\sin x - x}{x^2} \).

2. Find \( \lim_{x \to 0} \frac{\ln(x + 1) - x}{x^2} \).

3. Find \( \lim_{x \to \infty} xe^{-x} \).

4. What is \( \lim_{x \to 0^+} x^2 \ln x \)?

5. If \( 0 \leq \theta \leq \frac{\pi}{2} \) and \( \cos \theta = \frac{\sqrt{3}}{2} \), what is \( \sin \theta \)?

6. Solve the equation \( \cos 2\theta = \frac{\sqrt{3}}{2} \) for \( 0 \leq \theta \leq 2\pi \)?

7. If \( 0 \leq \theta \leq \frac{\pi}{2} \) and \( \tan \theta = \sqrt{3} \), what are \( \sin \theta \) and \( \cos \theta \)?

8. What is the equation of the tangent line to the curve \( x^3 + y^3 = 6xy \) at the point \( (3, 3) \)?

9. At what points is the tangent to the curve \( y = x^2 e^{-x} \) horizontal?

10. What is the equation of the tangent line to the curve \( y = x \ln x \) at the point \( \left( \frac{1}{e^2}, -\frac{2}{e^2} \right) \)?

11. Let \( f(t) = \frac{\ln t}{t - 3} \). What is \( f'(2) \)?

12. Let \( h(x) = x^2 \cos x \). What is the value of \( h''(\pi/2) \)?

13. Let \( f(x) = \frac{x^3 - x}{x^2 + x} \). What is \( f'(1) \)?

14. Let \( f(t) = \frac{\sin t}{1 + \cos t} \). What is \( f'(\pi/3) \)?
15. Let \( g(x) = x^2 \ln x \). What is the value of \( g''(1/e) \)?

16. Let \( u(t) = e^{-t} \cos t \). What is the value of \( u''(1) \)?

17. Let \( f(x) = \sin^{-1}(x^2) \). What is \( f'(x) \)?

18. Let \( f(x) = \arctan(2x + 1) \). What is \( f'(1/2) \)?

19. Let \( f(x) = \arcsin(2x + 1) \). Find the equation of the tangent line to \( y = f(x) \) at \((-1/2, 0)\).

20. Let \( g(x) = 3^{\cos x} \). What is the value of \( h'(\pi/2) \)?

21. Let \( g(x) = 3x^2 \). Find \( g'(x) \).

22. Let \( f(t) = \sin(\cos t) \). Find \( f'(\pi/2) \).

23. Let \( h(x) = f(g(x)) \). Suppose \( g(3) = 2, g'(3) = 4, \) and \( f'(2) = 5 \). Find \( h'(3) \).

24. Let \( h(x) = f(g(x)) \). Suppose \( g(1) = 2, g(2) = 3, g(3) = 4, f(1) = 3, f(2) = 4, f(3) = 5, g'(1) = 5, g'(2) = 6, g'(3) = 8, f'(1) = 6, f'(2) = 7, \) \( f'(3) = 8 \). What is \( h'(1) \) and \( h'(2) \)?

25. If \( y = x^2 + \ln x \) and \( \frac{dx}{dt} = 2 \), what is \( \frac{dy}{dt} \) when \( x = 1 \)?

26. If \( u = e^x - x \) and \( \frac{dx}{dt} = 3 \), what is \( \frac{du}{dt} \) when \( x = \ln 3 \)?

27. If \( V = \frac{4}{3} \pi r^3 \) and \( \frac{dr}{dt} = 3 \), what is \( \frac{dV}{dt} \) when \( r = 2 \)?

28. What are the inflection points of the function \( f(x) = (x+1)^2(x+3) \)?
29. What are the inflection points of the function \( f(x) = x^3(x + 1)^2 \)?

30. What is the absolute minimum value of \( f(x) = 2x^3 - 3x^2 - 12x + 5 \) over the interval \([-2, 1]\)?

31. What is the absolute maximum value of \( f(x) = 3x^5 - 5x^3 \) over the interval \([-2, 2]\)?

32. What is the largest interval where \( f(x) = \frac{1}{x^2} \) is increasing?

33. What is the largest interval on which the function \( f(x) = \frac{x}{1 + x} \) is concave up?

34. What is the value of \( \sin^{-1}(1/\sqrt{2}) \)?

35. What are the horizontal asymptotes of the function \( f(x) = \frac{3 + 5x^2}{2x^2 - 1} \)?

36. What are the vertical asymptotes of the function \( f(x) = \frac{x^3 - 8}{x^3 + 8} \)?

37. What are the horizontal asymptotes of the function \( f(x) = \frac{x^3 - 1}{2 - x^3} \)?

38. What are the vertical asymptotes of the function \( f(x) = \frac{x^3 - 1}{x^4 - 16} \)?

39. Find \( \int \sin(-2x) \, dx \)

40. Find the value of \( \int_0^\pi x \sin x \, dx \)

41. What is the value of \( \int_0^{\pi/6} \sin^2 x \cos x \, dx \)?

42. Find \( \int \tan x \sec^2 x \, dx \).
43. Find $\int \sin 2x \cos^3 x \, dx$.

44. Find the volume of the solid obtained by rotating the region bounded by the curves $y = x^3$, $x = 1$ and $y = 0$ about the $x$-axis.

45. Find the volume of the solid obtained by rotating the region bounded by the curves $y = x^4$, $x = 1$, $x = 2$ and $y = 0$ about the $x$-axis.

46. Find the volume of the solid obtained by rotating the region bounded by the curves $y = \sqrt{x}$, $x = 1$ and $y = 0$ about the $x$-axis.

47. Find $\int \cot x \, dx$.

48. Find $\int_{\pi/6}^{\pi/4} \frac{\sec^2 x}{\tan x} \, dx$.

49. Find $\int_{1}^{3} |x - 2| \, dx$.

50. Find $\int_{-3}^{1} |x + 1| \, dx$.

51. Find $\int \frac{\cos 2x}{\sin x} \, dx$.

52. Find $\int_{0}^{\pi/4} \frac{\sin x}{\cos^2 x} \, dx$.

53. Find the area between the curves defined by $y = \sqrt{x}$ and $y = x$.

54. Find an expression for the area between the curves defined by $y = x^2 + 4$ and $y = 3x + 2$.

55. Find $\int \frac{1}{(x + 1)(x + 5)} \, dx$. 
56. Find \( \int \frac{1}{(x - 1)(x + 2)} \, dx \).

57. Find \( \int \frac{1}{x^2(x + 3)} \, dx \).

58. Find \( \int e^{2x} \ln x \, dx \).

59. Let \( f(x) = \int_3^{\sin x} e^{t^2} \, dt \). What is \( f'(x) \)?

60. Let \( f(x) = \int_1^x \arcsin t \, dt \). What is \( f'(x) \)?

61. Find \( \int \frac{\arctan x}{1 + x^2} \, dx \).

62. Find \( \int_2^3 \frac{1}{x - 1} \, dx \).

63. Find \( \int_2^3 \frac{1}{3x - 4} \, dx \).

64. Find \( \int_{-2}^{2} \frac{1}{\sqrt{2x + 5}} \, dx \).

65. Find \( \int_0^{2} \frac{x^2}{\sqrt{1 + x^3}} \, dx \).

66. Find \( \int \frac{1}{\sqrt{4 + x^2}} \, dx \).

67. Find \( \int \frac{1}{\sqrt{4 - x^2}} \, dx \).

68. Find \( \int_0^{2} e^{3x} \, dx \).

69. If \( f''(x) = 6x^2 - 4x + \frac{4}{x^2}, f(1) = 4 \) and \( f'(1) = 2 \), what is \( f(x) \)?

70. If \( f''(x) = 12x + \sin x, f(0) = 3 \) and \( f'(0) = -2 \), what is \( f(x) \)?
Answers: 1. 0; 2. \(-\frac{1}{2}\); 3. 0; 4. 0; 5. \(\frac{1}{2}\); 6. \(\theta = \frac{\pi}{12}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{23\pi}{12}\); 7. \(\sin \theta = \sqrt{3}/2, \cos \theta = 1/2\); 8. \(y = -x + 6\); 9. \(x = 0, 2\); 10. \(y = -x - (1/e^2)\); 11. \((-\frac{1}{2}) - \ln 2\); 12. \(-2\pi\); 13. 1; 14. \(2/3\); 15. 1; 16. \((2\sin 1)/e\); 17. \(2x/\sqrt{1 - x^4}\); 18. \(2/5\); 19. \(2x + 1\); 20. \(-\ln 3\); 21. \(3^{x^2}(2 \ln 3)x\); 22. \(-1\); 23. \(20\); 24. \(h'(1) = 35, h'(2) = 48\); 25. 6; 26. 6; 27. \(48\pi\); 28. \((-5/3, 16/27)\); 29. \(x = 0, x = (-3/5) + \sqrt{6}/10, x = (-3/5) - \sqrt{6}/10\); 30. \(-8\); 31. \(56\); 32. \((-\infty, 0)\); 33. \((-\infty, -1)\); 34. \(\pi/4\); 35. \(y = 5/2\) only; 36. \(x = -2\) only; 37. \(y = -1\) only; 38. \(x = 2\) and \(x = -2\); 39. \(\cos(2x)/2 + C\); 40. \(\pi\); 41. \(1/24\); 42. \((1/2) \sec^2 x + C\) or \((1/2) \tan^2 x + C\); 43. \((-2/5) \cos^5 x + C\); 44. \(\pi/7\); 45. \(511\pi/9\); 46. \(\pi/2\); 47. \(\ln |\sin x| + C\); 48. \((\ln 3)/2\); 49. 1; 50. 4; 51. \(\ln |\csc x - \cot x| + 2 \cos x + C|\); 52. \(\sqrt{2} - 1\); 53. \(1/6\); 54. \(f_1^2(-x^2 + 3x - 2) \, dx\); 55. \(1/4 \ln |(x + 1)/(x + 5)| + C\); 56. \((1/3) \ln |(x - 1)/(x + 2)| + C\); 57. \((1/9) \ln |(x + 3)/x| - (1/3x) + C\); 58. \(e^2\); 59. \(e^{\sin^2 x} \cos x\); 60. \(-\arcsin x\); 61. \((\arctan x)^2/2 + C\); 62. \(\ln 2\); 63. \((1/3) \ln(5/2)\); 64. 2; 65. \(4/3\); 66. \(\ln((\sqrt{4 + x^2}/2) + (x/2)) + C\); 67. \(\arcsin(x/2) + C\); 68. \((e^6 - 1)/3\); 69. \(f(x) = (1/2)x^4 - (2/3)x^3 - 4 \ln x + 6x - (11/6)\) for \(x > 0\); 70. \(f(x) = 2x^3 - \sin x - x + 3\);