1. Compute the following:
$$\frac{d}{dx} e^x \ln(x)$$
2. Compute the following:
$$\frac{d}{dx} x^2 \arcsin x$$
3. Compute the following:
$$\frac{d}{dx} \frac{\arctan(x)}{1+x^2}$$
4. Compute the following:
$$\frac{d}{dx} \log_2(2x^2)$$
5. Compute the following:
$$\frac{d}{dx} \log_x 10$$
6. Compute the following:
$$\frac{d}{dx} 3^{2x+4}$$
7. Compute the following:
$$\frac{d}{dx} e^{x^2+3x-5}$$
8. Compute the following:
$$\frac{d}{dx} \left(x \operatorname{arcsec}\left(x^2/2\right)\right)$$
9. Compute the derivatives and explain why you use the differentiation rules that you do.
   a) $\frac{d}{dx}\sqrt{2}^x$
   b) $\frac{d}{dx} x^{\sqrt{2}}$
10. Compute the following:
$$\int_{\pi/8}^{\pi/6} \tan(2x)\, dx$$
11. Compute the following:
$$\int \frac{3\ln x^2}{x}\, dx$$
12. Compute the following:
$$\int \frac{1}{x \log_2 x}\, dx$$
13. Compute: $\int \cot(x)\, dx$
14. Compute the following:
$$\int \frac{\sec^2(3x)}{4+\tan(3x)}\, dx$$
15. Compute the following:
$$\int \frac{e^x}{1+e^x}\, dx$$
16. Compute the following:
$$\int_{-\frac{1}{2}\ln 3}^{0} \left(\frac{e^x}{1+e^{2x}}\right) dx$$
17. Compute the following:
$$\int 3^x\, dx$$
18. Compute the following:
$$\int \sin(x) e^{\cos(x)}\, dx$$
19. Compute the following:
$$\int \frac{1}{\sqrt{9-4x^2}}\, dx$$
20. Compute the following:
$$\int \frac{1}{2+x^2}\, dx$$

21. Compute the following:
$$\int x3^{x^2}\,dx$$

22. Compute the following:
$$\int \frac{1}{\sqrt{4x^2-9}}\,dx$$

23. Compute the following:
$$\int \frac{1}{1-16x^2}\,dx$$

24. Compute the following:
$$\int \frac{1}{x\sqrt{4x^2-1}}\,dx$$

25. Compute the following:
$$\int \frac{\arcsin(x)}{\sqrt{1-x^2}}\,dx$$

26. Compute the following:
$$\int \frac{1}{3x+2}\,dx$$

27. Compute $\displaystyle\int \frac{3}{9-t^2}\,dt$

28. Compute $\displaystyle\int \frac{1}{t\sqrt{25-t^2}}\,dt$

29. Compute $\displaystyle\int \frac{3}{t\sqrt{9+t^2}}\,dt$

30. Compute the following:
$$\frac{d}{dx}\int_{e^{-x}}^{e^x} \ln t\,dt$$

31. Compute two different ways:
$$\frac{d}{dx}x^{2x}$$

32. Compute the following:
$$\frac{d}{dx}\log_x(x+1)$$

33. Compute using logrithmic differentiation.
$$\frac{d}{dx}\sqrt[4]{\frac{(x^2+1)x^3}{(2x-1)^3\sqrt{x-1}}}$$

34. Find an equation of the line tangent to $y = \arctan x$ at the point where $x = 1$.

35. Find an equation of the line tangent to the graph of $y = xe^{x^2}$ at the point where $x = 2$.

36. Find an equation for the line tangent to $y = x\ln x$ at the point where $x = e$.

37. Find the area bounded by the graphs of $y = e^x$ and $y = (e-1)x + 1$.

38. Find the volume of the solid of revolution obtained by rotating the region bounded by the coordinate axes, $y = 3$, and $x = \frac{2}{\sqrt{y+1}}$ about the y-axes.

39. Find the absolute maximum and minimum values of the function $f(x) = e^x - 2x$ for $-1 \le x \le 2$.

40. Show that any curve of the form $y = -\frac{1}{2}x^2 + k$ and any curve of the form $y = \ln(x) + c$ intersect each other at right angles.

41. Find $\displaystyle\lim_{x\to 0}\frac{e^x-1}{\sin x}$

42. Find $\displaystyle\lim_{x\to 0}\frac{\cos x - 1 + x^2/2}{x^4}$

43. Find $\lim_{n\to\infty}\left(1-\frac{1}{n}\right)^{2n}$

44. Find $\lim_{n\to\infty} n^{\frac{1}{n}}$

45. Find $\lim_{n\to\infty}\frac{n^2}{1.00001^n}$

46. Find $\lim_{t\to 0^+} t\ln t$

47. Using the definition of ln, prove that for any positve real numbers a and b, $\ln(ab)=\ln(a)+\ln(b)$.

48. Using the definition of ln, prove that $\ln x$ is an increasing function.

49. Using the definition of the exponential function Exp, derive the formula for the derivative of $\mathrm{Exp}(x)$.

50. Derive the formula for $\frac{d}{dx}\arctan x$.

51. Derive the formula for $\frac{d}{dx}\arccos x$.

52. Use the definition of $\log_a x$ and properties of ln, prove that for any positive a,b,c, $\log_a(bc)=\log_a(b)+\log_a(c)$.

53. Use the definition of the expontential function $\mathrm{Exp}(x)$, prove that $\mathrm{Exp}(x+y)=\mathrm{Exp}(x)\mathrm{Exp}(y)$.

54. Let $a>0$. Give the definition of a^x in terms of the exponential function. Use this definition (and properties of the exponential function) to show that $a^{x+y}=a^xa^y$ for any real numbers x and y.

55. Give the domain and range for each of the inverse trigonometric functions.

56. Prove that $\arcsin x+\arccos x=\frac{\pi}{2}$.

57. How many zeros does the function $f(x)=2^x-1-x^2$ have on the real line? (Prove your answer.)

58. Find the formula for the n^{th} term of the sequence that starts

$$1,1,3,3,5,5,7,7,\cdots$$

59. Find the formula for the n^{th} term of the sequence that starts

$$0,7,0,7,0,7,\cdots$$

60. Find the formula for the n^{th} term of the sequence that starts

$$1,\frac{1}{5},\frac{1}{25},\frac{1}{125},\cdots$$

61. Does the sequence below converge? If so find its limit.

$$a_n=\sqrt{\frac{2n+3}{3n-1}}$$

62. Does the sequence below converge? If so find its limit.

$$a_n=\frac{3n^2+2n-1}{1+5n+7n^2}$$

63. Does the sequence below converge? If so find its limit.

$$a_n=(-1)^n+1$$

64. Does the sequence below converge? If so find its limit.

$$b_n = \frac{n!}{n^n}$$

65. Does the sequence below converge? If so find its limit.

$$c_n = \sqrt[n]{n+1}$$

66. Determine if the sequence below is bounded above, bounded below, nondecreasing, or nonincreasing.

$$a_n = \frac{n+1}{2n+3}$$

67. Determine if the sequence below is bounded above, bounded below, nondecreasing, or nonincreasing.

$$a_n = \sin n + \frac{1}{n}$$

68. If 10g of a radioactive substance decays to 8g in 3 years, find its half life. If the half life of another substance is 1 year, find how long it takes 10g of the substance to decay to 8g.

69. Suppose that after 10 years of earning interest at the rate of 7% per year, you have \$100,000 in an account. How much money was invested in this account 10 years ago to earn this amount? (No money was aded in the mean time.)

70. A rectangle with sides parallel to the axis is to have one corner at the origin and the other on the curve $y = e^{-x^2}$. What is the largest rectangular area that can be formed in this way?

71. In a solution, the product of the hydronium ion concentration $[H_3O^+]$ and the hydroxyl ion concentration $[OH^-]$ (both in moles per liter) is 10^{-14}.

    a) What value of $[H_3O^+]$ minimizes the sum $S = [OH^-] + [H_3O^+]$?

    b) What is the pH of solution you found in part a)?

    c) What ratio of $[H_3O^+]$ to $[OH^-]$ minimizes S?

72. Compute

$$\sum_{n=0}^{\infty} \frac{\pi^n}{4^n}$$

73. Compute

$$\sum_{n=0}^{\infty} (-1)^n \frac{1}{5^n}$$

74. Compute

$$\sum_{n=1}^{\infty} \frac{4}{(4n-3)(4n+1)}$$

75. Determine if the series converges or diverges. Justify carefully.

$$\sum_{n=1}^{\infty} 1.000001^n$$

76. Compute and state for which values of x the series converges

$$\sum_{n=0}^{\infty} e^{nx}$$

77. Compute

$$\sum_{n=1}^{\infty} \frac{1}{4n^2-1}$$

78. Compute write the number $2.373737\ldots$ as a ratio of two integers.

79. Assume that $|x| < 1$ and compute the sum

$$\sum_{n=0}^{\infty} x^n.$$

Use your answer to compute the sum

$$\sum_{n=1}^{\infty} nx^{n-1}.$$