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:  $\lim_{x \to 0} \frac{x \sin(x)}{1 \cos(x)}$
- 11. Compute:  $\lim_{x \to 0} \frac{\sin(x) x + \frac{1}{6}x^3}{x^5}$

12. Compute: 
$$\lim_{x \to 0^+} x^{-1/\ln x}$$

13. Compute: 
$$\lim_{x \to 0} \left( \frac{4x+1}{x} - \frac{1}{\sin x} \right)$$

- 14. Compute:  $\lim_{x \to \infty} \frac{1}{x \ln x} \int_1^x \ln t \, dt$
- 15. Compute the following:  $\int_{\pi/8}^{\pi/6} \tan(2x) \, dx$
- 16. Compute the following:  $\int \frac{3\ln x^2}{x} dx$
- 17. Compute the following:

$$\int \frac{1}{x \log_2 x} \, dx$$

18. Compute: 
$$\int \cot(x) dx$$

19. Compute the following:

$$\int \frac{\sec^2(3x)}{4 + \tan(3x)} \, dx$$

20. Compute the following:

$$\int \frac{e^x}{1+e^x} \, dx$$

21. Compute the following:

$$\int_{-\frac{1}{2}\ln 3}^{0} \left(\frac{e^x}{1+e^{2x}}\right) dx$$

22. Compute the following:

$$\int 3^x dx$$

- 23. Compute the following:  $\int \sin(x) e^{\cos(x)} dx$
- 24. Compute the following:

$$\int \frac{1}{\sqrt{9-4x^2}} \, dx$$

25. Compute the following:

$$\int \frac{1}{2+x^2} dx$$

26. Compute the following:

$$\int x 3^{x^2} dx$$

27. Compute the following:

$$\int \frac{\arcsin(x)}{\sqrt{1-x^2}} \, dx$$

28. Compute the following:

$$\int \frac{1}{3x+2} \, dx$$

29. Compute the following:

$$\frac{d}{dx} \int_{e^{-x}}^{e^x} \ln t \, dt$$

30. Compute in two different ways:

$$\frac{d}{dx}x^{2x}$$

31. Compute the following:

$$\frac{d}{dx}\log_x(x+1)$$

32. Compute using logrithmic differentiation.

$$\frac{d}{dx} \sqrt[4]{\frac{(x^2+1)x^3}{(2x-1)^3\sqrt{x-1}}}$$

- 33. 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.
- 34. Find the absolute maximum and minimum values of the function  $f(x) = e^x - 2x$  for  $-1 \le x \le 2$ .
- 35. 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.
- 36. True of false? (Show why.)

a) 
$$x \ln(x) = o(x^2)$$
  
b)  $x^2 = o(x \ln(x))$ 

37. True of false? (Show why.)

a) 
$$x^{3} = o(x\sqrt{x^{5}})$$
  
b)  $x\sqrt{x^{5}} = o(x^{3})$ 

- 38. True of false? (Show why.)
  - a)  $\ln(n!) = O(n \ln(n))$
  - b)  $n \ln(n) = O(\ln(n!))$
- 39. True of false? (Show why.)

a) 
$$x^2 = O(x^2(2 + \sin(x)))$$

b)  $x^2(2 + \sin(x)) = O((x^2))$ 

40. Solve the differential equation:

$$y'x = \frac{2y}{x}, \ x > 0$$

41. Solve the differential equation:

$$xy' + 2y = \frac{2}{x}, x > 0$$

- 42. Solve the differential equation:  $x^2y'=e^y,\,x>0$
- 43. Solve the differential equation:  $xy' = x^2 - y, x > 0$
- 44. Solve the differential equation:

$$y' + \frac{y}{(1+x^2)\arctan(x)} = \frac{x}{\arctan(x)}, x > 0.$$

- 45. Solve the initial value problem:  $y' + y \cot x = 1, \ y\left(\frac{\pi}{2}\right) = 1$
- 46. solve the initial value problem:  $y' = 3e^{x+y}, y(0) = -1$
- 47. 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.
- 48. 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.)

- 49. 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?
- 50. 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?