1. Compute the following:

$$
\frac{d}{d x} e^{x} \ln (x)
$$

2. Compute the following:

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

3. Compute the following:
$\frac{d}{d x} \frac{\arctan (x)}{1+x^{2}}$
4. Compute the following:
$\frac{d}{d x} \log _{2}\left(2 x^{2}\right)$
5. Compute the following:
$\frac{d}{d x} \log _{x} 10$
6. Compute the following:
$\frac{d}{d x} 3^{2 x+4}$
7. Compute the following:

$$
\frac{d}{d x} e^{x^{2}+3 x-5}
$$

8. Compute the following:

$$
\frac{d}{d x}\left(x \operatorname{arcsec}\left(x^{2} / 2\right)\right)
$$

9. Compute the derivatives and explain why you use the differentiation rules that you do.
a) $\frac{d}{d x} \sqrt{2}^{x}$
b) $\frac{d}{d x} x^{\sqrt{2}}$
10. Compute: $\lim _{x \rightarrow 0} \frac{x \sin (x)}{1-\cos (x)}$
11. Compute: $\lim _{x \rightarrow 0} \frac{\sin (x)-x+\frac{1}{6} x^{3}}{x^{5}}$
12. Compute: $\lim _{x \rightarrow 0^{+}} x^{-1 / \ln x}$
13. Compute: $\lim _{x \rightarrow 0}\left(\frac{4 x+1}{x}-\frac{1}{\sin x}\right)$
14. Compute: $\lim _{x \rightarrow \infty} \frac{1}{x \ln x} \int_{1}^{x} \ln t d t$
15. Compute the following:

$$
\int_{\pi / 8}^{\pi / 6} \tan (2 x) d x
$$

16. Compute the following:
$\int \frac{3 \ln x^{2}}{x} d x$
17. Compute the following:
$\int \frac{1}{x \log _{2} x} d x$
18. Compute: $\int \cot (x) d x$
19. Compute the following:
$\int \frac{\sec ^{2}(3 x)}{4+\tan (3 x)} d x$
20. Compute the following:
$\int \frac{e^{x}}{1+e^{x}} d x$
21. Compute the following:
$\int_{-\frac{1}{2} \ln 3}^{0}\left(\frac{e^{x}}{1+e^{2 x}}\right) d x$
22. Compute the following:
$\int 3^{x} d x$
23. Compute the following:

$$
\int \sin (x) e^{\cos (x)} d x
$$

24. Compute the following:
$\int \frac{1}{\sqrt{9-4 x^{2}}} d x$
25. Compute the following:
$\int \frac{1}{2+x^{2}} d x$
26. Compute the following:
$\int x 3^{x^{2}} d x$
27. Compute the following:
$\int \frac{\arcsin (x)}{\sqrt{1-x^{2}}} d x$
28. Compute the following:

$$
\int \frac{1}{3 x+2} d x
$$

29. Compute the following:
$\frac{d}{d x} \int_{e^{-x}}^{e^{x}} \ln t d t$
30. Compute in two different ways: $\frac{d}{d x} x^{2 x}$
31. Compute the following:
$\frac{d}{d x} \log _{x}(x+1)$
32. Compute using logrithmic differentiation.
$\frac{d}{d x} \sqrt[4]{\frac{\left(x^{2}+1\right) x^{3}}{(2 x-1)^{3} \sqrt{x-1}}}$
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 $f(x)=e^{x}-$ $2 x$ for $-1 \leq x \leq 2$.
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) $x \ln (x)=o\left(x^{2}\right)$
b) $x^{2}=o(x \ln (x))$
37. True of false? (Show why.)
a) $x^{3}=o\left(x \sqrt{x^{5}}\right)$
b) $x \sqrt{x^{5}}=o\left(x^{3}\right)$
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) $x^{2}=O\left(x^{2}(2+\sin (x))\right.$
b) $x^{2}(2+\sin (x))=O\left(\left(x^{2}\right)\right.$
40. Solve the differential equation:

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

41. Solve the differential equation:

$$
x y^{\prime}+2 y=\frac{2}{x}, x>0 .
$$

42. Solve the differential equation:
$x^{2} y^{\prime}=e^{y}, x>0$
43. Solve the differential equation:
$x y^{\prime}=x^{2}-y, x>0$
44. Solve the differential equation:
$y^{\prime}+\frac{y}{\left(1+x^{2}\right) \arctan (x)}=\frac{x}{\arctan (x)}, x>$ 0 .
45. Solve the inital value problem:
$y^{\prime}+y \cot x=1, y\left(\frac{\pi}{2}\right)=1$
46. solve the initial value problem:

$$
y^{\prime}=3 e^{x+y}, y(0)=-1
$$

47. If 10 g of a radioactive substance decays to 8 g in 3 years, find its half life. If the half life of another substance is 1 year, find how long it takes 10 g of the substance to decay to 8 g .
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 $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]$and the hydroxyl ion concentration $\left[\mathrm{OH}^{-}\right]$(both in moles per liter) is $10^{-14}$.
a) What value of $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]$minimizes the sum $S=\left[\mathrm{OH}^{-}\right]+\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]$?
b) What is the pH of solution you found in part a)?
c) What ratio of $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]$to $\left[\mathrm{OH}^{-}\right]$ minimizes $S$ ?
