

1. $3^{2x+1} = e$. Solve for x . Keep your answer exact.

2. Find the relative maximum and relative minimum values of $f(x) = x^3 + 3x^2 - 9x$ if they exist.

3. $f(x) = xe^{-3x} - \frac{2}{3}e^{-3x}$ and $f'(x) = e^{-3x}(-3x + 3)$. Find the absolute maximum and minimum values of $f(x)$ on the interval $[0, 2]$.

4. Differentiate $f(x) = e^{-5x} \sec \sqrt{x}$.

5. $g(x) = \frac{x + e}{1 - 5e^{3x}}$. Evaluate $g'(0)$.

6. $xy + y^2 = \sin y$. Find $\frac{dy}{dx}$.

7. Use linearization to approximate $\sqrt[3]{25}$. Keep your answer exact.

8. $R(x) = \frac{-x^2 - 2x^3 + 10}{x^2 - 5}$. Find the vertical, horizontal and oblique asymptotes of $R(x)$ if they exist.

9. An environmental study of a certain city indicates that there will be

$$Q(p) = \frac{p^2 + 3p + 1200}{1000}$$

units of harmful pollutant in the air, where p is the population. The population is currently 30,000 and is increasing at a rate of 2,000 per year. At what rate is the level of air pollution increasing?

10. The amount of bacteria in a culture increases at a rate of 10% per day. There are 100 bacteria initially. After how many days will the bacteria triple? Round your answer to the nearest hundredth.

11. Of all rectangles that have a perimeter of 32 ft, what is the largest area possible?

12. An oil barrel is constructed in the usual cylindrical shape, consisting of two circular ends, and a rectangular metal sheet wrapped into a cylinder to form the “sides.” The thicker metal used for the circular ends costs \$2 per square foot, whereas the metal used for the “sides” only costs \$1 per square foot. If the barrel must contain a volume of 8 cubic feet, what is the total cost (in dollars) in terms of the radius, r , of the circular ends?