

1. Find equations for the two lines tangent to the curve

$$y = \frac{x-1}{x+1}$$

that have slope 2.

2. Let  $f(x) = e^{-x^2}$ . Show that there is a  $c$  in  $[0, 1]$  for which  $f'(c) = -1/2$ . [*Hint:* Apply the Intermediate Value Theorem to  $f'(x)$ .]

3. A rectangle with fixed perimeter 36 is rotated around one of its sides, thus sweeping out a figure in the shape of a right circular cylinder. What is the maximum possible volume of that cylinder?

4. Let  $f(x)$  be a function. Suppose that the slope of the tangent line to the graph of  $f(x)$  at the point  $(2, -1)$  is  $-3$ . What is the slope of the tangent line to the graph of  $(f(x))^2$  at the point  $(2, 1)$ ?

5. Use the limit definition of the derivative to compute  $g'(2)$  if  $g(x) = \sqrt{x^2 + 3}$ .

6. A particle moves along the curve  $y = \sqrt{1 + x^3}$ . As it reaches the point  $(2, 3)$ , the  $y$ -coordinate is increasing at a rate of 4 cm/s. How fast is the  $x$ -coordinate of the point changing at that instant?

7. Find the two points on the hyperbola  $x^2 - y^2 = 1$  at which the slope of the tangent line is 2.

8. Evaluate the following limits.

(a)  $\lim_{x \rightarrow 1} \frac{\sqrt{x+1} - \sqrt{2x}}{\sqrt{x+2} - \sqrt{3x}}$

(b)  $\lim_{x \rightarrow \pi^+} \frac{x}{\sin x}$

9. The function

$$q(z) = \frac{\tan z}{\sin 2z}$$

is not defined, and therefore not continuous, at  $z = 0$ . Is the discontinuity removable?

10. Differentiate the following functions.

(a)  $f(x) = \sqrt{x + \sqrt{2x + \cos 3x}}$

(b)  $g(y) = \cos^3 \left( \sqrt[3]{1 + \ln x} \right)$