

1. A ladder 10 ft long rest against a vertical wall. Let  $\theta$  be the angle between the top of the ladder and the wall. If the bottom of the ladder slides away from the wall at a speed of 1 ft/s, how fast does  $\theta$  change when  $\theta = \pi/3$ ?
2. Find the tangent line of the curve  $x^3y + 2xy^3 = 3$  at the point  $(1, 1)$ .
3. Find the derivative of the function

$$f(x) = 2^{3^{\cos x}}.$$

4. Water is leaking out of an inverted conical tank at a rate of 10,000 cm<sup>3</sup>/min at the same time that water is being pumped into the tank at a constant rate. The tank has height 6 m and the diameter at the top is 4 m. If the water level is rising at a rate of 20 cm/min when the height of the water is 2 m, find the rate at which water is being pumped into the tank.
5. Let  $f(x) = e^x + x$  and  $g(x)$  be its inverse on  $(0, \infty)$ . Find  $g'(e + 1)$ .
6. Find the derivative of the function

$$f(x) = \sqrt{\frac{\ln x + 1}{\ln x - 1}}.$$

7. If  $g(x) = \sec x$ , find  $g'''(\pi/4)$ .
8. Find the derivative of the function

$$f(x) = (\cos^{-1} x)^x.$$

9. If a snowball melts so that its surface area decreases at a rate of 1 cm<sup>2</sup>/min, find the rate at which the diameter decreases when the diameter is 10 cm.
10. Let  $f(x) = x - \sin x$ . For what values of  $x$  does the graph  $f$  have a horizontal tangent?