

1. Differentiate the function  $f(x) = (\sin x)(\cos x)$ .
2. Differentiate the function  $f(x) = \frac{\sin x}{x}$ .
3. Differentiate the function  $f(x) = \cos(1 + x^2)$ .
4. Differentiate the function  $f(x) = \sqrt{1 + \sqrt{x}}$ .
5. Calculate the second derivative of the function  $f(x) = \frac{3x + 1}{2x - 1}$ .
6. Calculate the second derivative of the function  $f(x) = \sin(x^2)$ .
7. Find the second derivative of  $f(x) = \frac{1}{1+x^2}$ .
8. Use implicit differentiation to find  $\frac{dy}{dx}$  when  $x^2 + 2xy - y^2 + x = 2$ .
9. Find an equation for the tangent line to the curve  $y = \cos^2 x$  at the point  $(\frac{\pi}{4}, \frac{1}{2})$ .
10. Find an equation for the tangent line to the curve  $x^2 + y^4 = 5$  at the point  $(2, 1)$ .
11. If  $y = x^2 - 2x + 2$  and  $\frac{dx}{dt} = 2$ , find  $\frac{dy}{dt}$  when  $x = 3$ .
12. Two people leave a point at the same time. The first person jogs North at 4 m/s and the second person jogs West at 3 m/s. How fast is the distance between the people increasing 2 seconds after they leave?
13. Use a linear approximation of  $f(x) = x^{\frac{3}{2}}$  at 4 to estimate the value of  $(4.2)^{\frac{3}{2}}$ . (You may make use of the fact that  $f(4) = 8$ ).
14. Determine if the function
$$f(x) = \begin{cases} x^2 & \text{if } x < 1 \\ x & \text{if } x \geq 1 \end{cases}$$
is differentiable at  $x = 1$ .
15. Use the definition of the derivative to find  $f'(1)$  for  $f(x) = x^2 - 5x$ .