

1. Find the equation of the tangent line to the curve at the given point.

(a)  $y = 4x - 3x^2$  at  $(2, -4)$

(b)  $y = x^3 - 3x + 1$  at  $(2, 3)$

(c)  $y = \sqrt{x}$  at  $(1, 1)$

(d)  $y = \frac{2x + 1}{x + 2}$  at  $(1, 1)$

2. Find the derivative of the function using the definition of derivative.

(a)  $f(x) = 3x - 8$

(b)  $g(t) = \frac{1}{\sqrt{t}}$

3. Differentiate the following functions using the differentiation rules.

(a)  $f(x) = e^x - x^5$

(b)  $f(x) = \frac{x^2 + x - 2}{x^3 + 6}$

(c)  $f(x) = (x^3 + 1)e^x$

(d)  $f(x) = (5x^6 + 2x^3)^4$

(e)  $f(x) = (3x - 1)^4(2x + 1)^{-3}$

4. Differentiate the following functions.

(a)  $f(x) = x^2 \sin(7x)$

(b)  $f(\theta) = \sec(\theta) \tan(4\theta)$

(c)  $f(t) = \frac{t \sin(t^2 + 2t)}{1 + t}$

(d)  $f(x) = \frac{\sin(4x^3)}{1 + \tan(x^2)}$

5. Find the limit.

(a)  $\lim_{x \rightarrow 0} \frac{\sin(5x)}{3x}$

(b)  $\lim_{x \rightarrow 0} \frac{\sin(x)}{\sin(\pi x)}$

(c)  $\lim_{x \rightarrow 0} \frac{\sin(x^2)}{x}$

6. If  $F(x) = f(3x)$ , where  $f'(0) = 2$ , find  $F'(0)$ .

7. Find the 50th derivative of  $y = \cos(x)$ .
8. Use implicit differentiation to find an equation of the tangent line to the curve at the given point.
- (a)  $y \sin(2x) = x \cos(2y)$  at  $(\frac{\pi}{2}, \frac{\pi}{4})$
  - (b)  $x^2 + 2xy + 4y^2 = 12$  at  $(2, 1)$
9. Find  $y'$ .
- (a)  $y = \sqrt{x} \ln x$
  - (b)  $y = \ln(1 + \ln x)$
10. A bacteria culture initially contains 100 cells and grows at a rate proportional to its size. After an hour the population has increased to 420.
- (a) Find an expression for the number of bacteria after  $t$  hours.
  - (b) Find the rate of growth after 3 hours.