

# Introduction to Differentiation

## Problem Set 16

1. Use the definition of the derivative to differentiate the following functions.

(a)  $f(x) = x^2 + 3x + 2$

(c)  $f(x) = \frac{1}{x}$

(b)  $g(x) = x^3$

(d)  $f(x) = 4x^2 + 1$

2. Find the derivative of the following functions.

(a)  $f(x) = x^6$

(f)  $f(x) = x^{-10}$

(j)  $f(x) = \sqrt[5]{x}$

(b)  $g(x) = x^{100}$

(g)  $g(x) = \frac{1}{x^4}$

(k)  $f(x) = \frac{1}{\sqrt{x}}$

(c)  $f(x) = x$

(h)  $y = \frac{1}{x^2}$

(l)  $y = \frac{1}{\sqrt[3]{x}}$

(d)  $y = x^{-4}$

(i)  $f(x) = \sqrt[3]{x}$

(e)  $y = x^{-6}$

3. Differentiate the following functions.

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

(g)  $k(x) = 20 - x - 3x^{-5}$

(b)  $g(x) = 5x^{-6}$

(h)  $f(n) = 2n^3 - 4n + \frac{1}{n}$

(c)  $f(t) = \frac{5}{t^4}$

(i)  $g(x) = 3x^4 + 5\pi - \frac{1}{x^2}$

(d)  $f(t) = \sqrt{5t}$

(j)  $f(t) = t^6 - \frac{1}{\sqrt{t}}$

(e)  $g(x) = \frac{1}{5\sqrt{x^3}}$

(k)  $f(x) = \sqrt{x} + \frac{7}{\sqrt{x}}$

(f)  $p(x) = 5x^4 + 9x^3 - 6x^2 - 2x + 5$

4. Find the derivative of the following functions.

(a)  $y = (x + 2)(x + 3)$

(c)  $f(x) = (x - \sqrt{x})^2$

(b)  $y = \frac{x^3 + 5}{x}$

(d)  $f(x) = \frac{1 + \sqrt{x}}{x^2}$

5. Given  $f(x) = x^4 + x^2 + 1$ , find  $f'(2)$ .

6. Given  $f(x) = 3\sqrt{x} - \frac{4}{x^2}$ , find  $f'(1)$ .

7. Given  $f(x) = x^3 + 4x^2$ , find  $f'(3)$ .

8. Find the equation of the tangent to the curve  $f(x) = 3x^2 - 2x + 1$  at the point  $(1, 2)$ .
9. Find the equation of the tangent to the curve  $y = \frac{1}{\sqrt{x}}$  at  $x = 4$ .
10. Find the equation of the normal to the curve  $y = \frac{1}{\sqrt{x}}$  at  $x = 4$ .
11. Find the equations of the tangent and normal to the curve  $y = \sqrt{x}$  at  $(9, 3)$ .

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Ans: 2a)  $6x^5$ , b)  $100x^{99}$ , c)  $1$ , d)  $-4x^{-5}$ , e)  $-6x^{-7}$ , f)  $-10x^{-11}$ , g)  $-4x^{-5}$ , h)  $-2x^{-3}$ , i)  $\frac{1}{3}x^{-\frac{2}{3}}$ , j)  $\frac{1}{5}x^{-\frac{4}{5}}$ ,  
k)  $-\frac{1}{2}x^{-\frac{3}{2}}$ , l)  $-\frac{1}{3}x^{-\frac{4}{3}}$ , 3a)  $24x^2$ , b)  $-30x^{-7}$ , c)  $-20t^{-5}$ , d)  $\frac{\sqrt{5}}{2}t^{-\frac{1}{2}}$ , e)  $-\frac{3}{10}t^{-\frac{5}{2}}$ , f)  $20x^3 + 27x^2 - 12x - 2$ ,  
g)  $1 + 15x^{-6}$ , h)  $6n^2 - 4 - n^{-2}$ , i)  $12x^3 + 2x^{-3}$ , j)  $6t^5 + \frac{1}{2}t^{-\frac{3}{2}}$ , k)  $\frac{1}{2}x^{-\frac{1}{2}} - \frac{7}{2}x^{-\frac{3}{2}}$