

Calculus Honors - M7H

Derivatives - Homework 1

1. Find the derivatives of the following functions. Show your work.

(i) $f(x) = 6x^5 - 3x^{3/2} + 7 - \frac{4}{x}$

(ii) $g(x) = \sqrt{x}(x^2 - 5)$

(iii) $y = (2x^3 - 1) \sin x$

(iv) $y = x^2 e^{3x}$

(v) $y = (x^2 + 1) \ln x$

(vi) $y = \frac{x^2 + 1}{\sqrt{x}}$

(vii) $y = \frac{\ln x}{x^3}$

(viii) $y = \cos(4x^3 - 2x)$

(ix) $y = e^{\sqrt{5x-1}}$

(x) $y = \ln\left(\frac{x^2 + 1}{x - 1}\right)$

(xi) $y = \frac{x \sin x}{1 + x^2}$

(xii) $y = (3x^2 - 2x + 1)^5$

(xiii) $y = (\ln x)^3 \cdot e^{2x}$

(xiv) $y = \frac{e^x \cos x}{x^2}$

(xv) $y = \ln(\sqrt{x^2 + 1})$

(xvi) $y = \sin(\ln(x^2 + 1))$

2. Let $f(x) = x^2 e^{3x}$. Find the equation of the tangent line to the graph of f at $(0, f(0))$.

3. Let $g(x) = \cos(\sin(2x^4 - 1))$. Find the equation of the tangent line to the graph of g at $(\frac{1}{2}, g(\frac{1}{2}))$.

4. Let

$$f(x) = \begin{cases} ax - 3, & x < 1, \\ 4x^2 + 5, & x \geq 1. \end{cases}$$

(i) Find the value of a so that f is continuous at $x = 1$.

(ii) Using the value of a that you found, determine whether f is differentiable at $x = 1$. Justify your answer.