

PROBLEM SET 6: DIFFERENTIATION FORMULAS

Note: Most of the problems were taken from the textbook [1].

Problem 1. Differentiate the next functions.

a) $y = \sqrt[3]{2}(2 + x);$

b) $y = \frac{\sqrt{x+x}}{x^2};$

c) $D(x) = \frac{1+16x^2}{(4x)^3}.$

Problem 2. Find the second derivative of the function $f(x) = \sqrt{x} + \sqrt[3]{x}.$

Problem 3. Find the points on the curve $y = 2x^3 + 3x^2 - 12x + 1$ where the tangent line is horizontal.

Problem 4. Find a second-degree polynomial P such that $P(2) = 5$, $P'(2) = 3$, and $P''(2) = 2$.

Problem 5. Find a cubic function $y = ax^3 + bx^2 + cx + d$ whose graph has horizontal tangent lines at the points $(-2, 6)$ and $(2, 0)$.

Problem 6. Differentiate the next functions.

a) $f(x) = \frac{\sqrt{x}}{2+x};$

b) $f(x) = \frac{4+x}{xe^x};$

c) $f(x) = \frac{\sin x}{1+\cos x};$

d) $f(x) = xe^x \cot x.$

Problem 7. Prove that $(\sec x)' = \sec x \tan x.$

Problem 8. For which values of x does the graph of $f(x) = e^x \cos x$ have horizontal tangent line?

Problem 9. Find the following limits:

$$\lim_{x \rightarrow 0} \frac{\sin 3x \sin 5x \sin 7x}{x^3} \quad \text{and} \quad \lim_{x \rightarrow 1} \frac{\sin(x-1)}{x^2 + x - 2}.$$

Problem 10. Find $\frac{d^{35}}{dx^{35}}(x \sin x).$

REFERENCES

- [1] J. Stewart: *Single Variable Calculus* 8th Edition, Cengage Learning, Boston 2015.