2.1 – The Power Rule

Basic Derivative Laws

Let *f* and *g* be differentiable functions of *x* and let $c \in \mathbb{R}$.

- Sum Rule: $\frac{d}{dx}\left[f(x) + g(x) \right] = f'(x) + g'(x)$
- Constant Multiple Rule: $\frac{d}{dx}\left[cf(x) \right] = c\, f'(x)$
- Derivative of a Constant: $\frac{d}{dx}\left[c \right] = 0$
- Derivative of a Linear Term: $\frac{d}{dx}\left[mx \right] = m$

Based on observations from your prior work with derivatives from Unit 1, give rules for the following:

- Power Rule: $\frac{d}{dx}\left[x^n \right] =$
- Derivative of e^x: $\frac{d}{dx}\left[e^x \right] =$

1. Find the derivative for each function.

a. $f\left(x\right)=9x^{4}-3e^{x}$

b. $v\left(\alpha\right)=2\alpha^{5/3}-\sqrt{\alpha}$

c. $P=\dfrac{2-t^{3}}{t^{5}}$

d. $u\left(y\right)=3\sqrt{y}\left(\sqrt[4]{y^{3}}-2\right)$

2. Calculate $\left.\frac{dy}{dx}\right|_{x=-2}$ given $y = 4x - 3 + \frac{2}{x^3}$.

3. Find an equation for the line tangent to $g(x) = 3 - 2\sqrt{x}$ at $x = 25$.

4. The **normal line** is defined as the line that passes through the point of tangency perpendicular to the tangent line. Find the values of *a* and *b* such that $f(x) = x^3 + ax + b$ has a normal line with equation $2x - 3y = 4$ at $x = -1$.

5. Find the point(s) on the curve $g(x) = 5e^x - 3x$ where the tangent line is horizontal.