1. Chapter 3 Section 1: Formulas - Powers and Polynomials

Recall the formulas from section 2.3 For the following k, m, b and n represents constant real numbers.

(1) **Constant Function:** $\frac{d}{dx}(k) =$

(2) **Linear Function:** $\frac{d}{dx}(mx + b) =$

(3) **Power Function:** $\frac{d}{dx}(x^n) =$

We want to extend these formulas to include polynomials, but first explore the effect that scaling a function has on slope using the desmos site:
https://www.desmos.com/calculator/gtbervbhpx. Use the slide for b to change the scaling. Use the slider for a to change the point the slope is calculated. From the experiment, you may be able to guess the next formula.

(4) **Scale a function:** $\frac{d}{dx}(cf(x)) =$

Example 1.1. *Prove formula 4 using the definition of a derivative.*

2. Sum and Difference Formulas

(5) $\dfrac{d}{dx}(f(x)+g(x)) =$

(6) $\dfrac{d}{dx}(f(x)-g(x)) =$

Example 2.1. $\dfrac{d}{dx}(x^{\pi}+\pi^2) = ?$

Example 2.2 (3.1 Text 27 and 28)**.** *Differentiate the function* $f(\theta) = 3\theta^2 - \dfrac{1}{3\theta^2}$.

Example 2.3 (3.1 Text Problem 40)**.** *Differentiate the function* $f(t) = \dfrac{\sqrt{t}(1+t)}{t^2}$.

3. Applications

Example 3.1 (3.1 Text 51 and 64)**.** *Let* $f(3) = 5$ *and* $f'(3) = 6$.

(1) Find the line tangent to the graph of f *at* $x = 3$.

(2) Use the tangent line at $x = 3$ *to approximate* $f(3.01)$.

(3) Use the tangent line at $x = 3$ *to approximate* $f(2.98)$.

Example 3.2 (3.1 WP Homework Question 10 , Text 80). *A ball is dropped from the top of the Empire State building to the ground below. The height, y, of the ball above the ground (in feet) is given as a function of time, t (in seconds), by*

$$y = 1250 - 16t^2.$$

(1) *Find the velocity of the ball at time t. What is the sign of the velocity? Why is this to be expected?*

(2) *Show that the acceleration of the ball is constant. What are the value and sign of this constant?*

(3) *When does the ball hit the ground, and how fast is it going at that time? Give your answer in feet per second and in miles per hour (1ft/sec $= 15/22$ mph).*