Math 1300: Calculus I **Fall 2020**

Lecture: Section 4.8: Antiderivatives

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Today's Goal: Learn about antiderivatives!

Logistics: We will start and finish this section on Wednesday. Don't forget Check-In 14 on Friday! Review sections 4.6 and 4.8 (this section!).

Warm-Up 1.1 *Find two positive numbers whose sum is 300 and whose product is a maximum.*

(A) $150, 150$

(B) $100, 200$

(C) $50, 250$

(D) $300, 300$

(E) None of the above

1.1 Antiderivatives

1.1.1 Terminology

Find the derivative of $f(x) = x^3 - 2x + 1$:

$$f'(x) =$$

Let's just name this new function $g(x)$:

$$g(x) =$$

Since the derivative of $f(x)$ is equal to $g(x)$, we say that $f(x)$ is an **antiderivative** of $g(x)$.

Question: Are there other anti-derivatives of $g(x)$?

Theorem 1.2 *If $F(x)$ is an antiderivative of $f(x)$, then so is $F(x) + C$, for any real number C.*

Example 1.3 *Find all functions* $f(x)$ *that satisfy* $f'(x) = \frac{2}{1+x^2} - e^{-x}$.

Example 1.4 *Find* $f(x)$ *if* $f'(x) = 3x^2 - 4x + 5$ *and* $f(-1) = 2$.

Example 1.5 *Find* $g(t)$ *if* $g''(t) = 2e^t + 3\sin(t)$, $g(0) = 0$, *and* $g(\pi) = 0$.

Recall now and always that the acceleration due to gravity is $-9.8m/s^2$, or equivalently $-32ft/s^2$.

Example 1.6 *A ball is thrown upward with a speed of* 48 *ft/s from the edge of a cliff 432 ft above the ground. Find its height above the ground t seconds later. When does it reach its maximum height? When does it hit the ground?*

Example 1.7 *A stone was dropped off a cliff and hit the ground with a speed of* 120 *ft/s. What is the height of the cliff?*