

## Class Notes: Definite Integrals

Review: Common Antiderivatives (indefinite integrals)

$$\int n \, dx =$$

$$\int x^n \, dx =$$

$$\int (f(x) + g(x)) \, dx =$$

$$\int e^x \, dx =$$

$$\int \frac{1}{x} \, dx =$$

$$\int n^x \, dx =$$

$$\int \sin x \, dx =$$

$$\int \cos x \, dx =$$

Antiderivatives allow us to compute \_\_\_\_\_, which are *very* useful in many different real-life applications.

Informal Definition: The area of a region between the \_\_\_\_\_ of a function & the \_\_\_\_\_ over a given interval of the domain (x-coordinates).

### Why this is helpful...

Melissa drives her car at a constant speed of 35 mph. Graphically determine how far she will travel in 6 hours.

Method 1: Distance Function

Method 2: Speed Function

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### A more complicated example...

Company A currently earns profits at a rate of \$40,000 per year. Financial experts estimate that Company A will be able to grow profits at a constant rate of \$5000 per year, per year for the next 10 years.

(\*In other words...)

QUESTION: How much total profit will Company A earn over the next 10 years?

Point to Ponder: Will Company A earn \$45,000 of profits in year 1? Explain...

Function for the *rate* at which Company A earns profits:

Graph:

Definite Integral over the interval from 0 to 10:

To use antiderivatives to find the definite integral, we can use the...

### FUNDAMENTAL THEOREM OF CALCULUS

If  $F(x)$  is the antiderivative of  $f(x)$ ... then the definite integral of  $f(x)$  over the interval from  $a$  to  $b$  on the  $x$ -axis is: 
$$\int_a^b f(x) dx = F(b) - F(a)$$

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Using the Fundamental Theorem of Calculus to solve the problem...

Recall - Function for the rate at which Company A earns profits:

Antiderivative (indefinite integral):

Calculation of Definite Integral:

### More Examples

An industrial machine that is  $t$  years old earns revenue at the rate of  $R'(t) = 8000 - 18t^2$  dollars per year. The cost of operating the machine is  $C'(t) = 2000 + 12t^2$  dollars per year. Compute the profit earned by the machine during the first 10 years of its existence. (Recall: Profit = Revenue - Cost)

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After an advertising campaign, Sales revenue attributable to the campaign changes at a rate of  $S'(t) = -25t^2 + 300t$  dollars per day, where  $t$  is the number of days after the advertising campaign. Find the total sales for the first week (7 days) after the campaign. Then, find the total sales for the second week after the campaign.