

## Lesson 5 Applications of Substitution

### I. Tools

### II. Examples

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(1) If  $F$  is differentiable, then

$$\int_a^b F'(x) dx = F(b) - F(a) \quad \text{Net change thm}$$

(2) Ave Value of a function

① The average value of an integrable function  $f$  on  $[a, b]$  is

$$f_{\text{ave}} \stackrel{\text{Def'n}}{=} \int_a^b \frac{f(x)}{b-a} dx = \frac{\int_a^b f(x) dx}{b-a}$$

#### II. Examples

**[Ex]** A population of bacteria is changing at a rate of  $5 + 25e^{-2t}$  bacteria/hour.

Find the average rate at which the bacteria population is growing during the first ten hours.

$$\text{rate}_{\text{ave}} = \frac{\int_0^{10} (5 + 25e^{-2t}) dt}{10 - 0} \quad u = -2t$$