

**MATH 201**  
**The Fundamental Theorem of Calculus**

The Fundamental Theorem of Calculus, discovered by Isaac Newton and Gottfried Leibniz in the 17th century has been called one of the greatest discoveries in the history of science.

$$\int_a^b f(x) dx = \int_a^b \frac{dF}{dx} dx = F(x) \Big|_a^b = F(b) - F(a)$$

**Problem 1** *The area of an oil spill is increasing at a rate of  $25t$  ft<sup>2</sup>/s,  $t$  seconds after the spill. Find the increase in the area of the spill between times  $t = 2$  and  $t = 4$ .*

**Problem 2** *A traffic engineer monitors the rate at which cars enter the main highway during the afternoon rush hour. From her data she estimates that between 4:30p and 5:30p, the rate  $R(t)$  at which cars enter the highway is given by the formula*

$$R(t) = 100(1 - .0001t^2)$$

*cars per minute, where  $t$  is the time (in minutes) since 4:30p. Estimate the number of cars that enter the highway during the rush hour.*

**Problem 3** *Let  $f(x) = \int_1^x (2t + 3) dt$ . Use the FTC given above to find another expression for  $f(x)$ . Then compute  $f'(x)$ .*

**Problem 4** *Let  $f(x) = \int_1^{3x^2} (2t + 3) dt$ . Use the FTC given above to find another expression for  $f(x)$ . Then compute  $f'(x)$ .*

**Problem 5** *Compute  $\frac{d}{dx} \int_0^{2x} \sin(t^2) dt$ .*