MA205 Lesson 9

Indefinite Integrals and Net Change

Friday, August 31, 2007

Outline

1. ADMIN
2. From Lesson 8
   - FTC I and FTC II
3. More FTC I and II
   - Problems using FTC I
   - Problems using FTC I and FTC II
4. Indefinite Integrals and Net Change
   - Indefinite Integral vs. Definite Integral
   - Net Change
   - Displacement vs. Total Distance
5. Look at for Next Time

ADMIN NOTES

- **Show me the Course Guide**
- **Mathematica Password - 52017-42369-40796-53088-00703-863**

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FTC I and FTC II

- FTC I: If f is continuous on $[a, b]$, then the function g defined by
$$g(x) = \int_a^x f(t)dt \quad a \leq x \leq b$$
is continuous on $[a, b]$ and differentiable on (a, b), and $g'(x) = f(x)$.
- FTC II: If f is continuous on $[a, b]$, then
$$\int_a^b f(x)dx = F(b) - F(a)$$
Where F is any antiderivative of f, that is, a function such that $F' = f$.

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Problems using FTC I

- Find a function f and a number a such that:
  $$6 + \int_a^x \frac{f(t)}{t^2}\,dt = 2\sqrt{x} \quad \text{for all } x \geq 0.$$

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Problems using FTC I and FTC II

- Use FTC to calculate $g'(5)$ given that: $g(x) = \int_0^x (t^2 + 2t + 5)dt$. Then show that your answer is correct by performing the integration and subsequent differentiation and evaluation.

Problems using FTC I and FTC II

- Use FTC to calculate $g'(5)$ given that: $g(x) = \int_0^x (t^2 + 2t + 5)dt$. Then show that your answer is correct by performing the integration and subsequent differentiation and evaluation.
- Given a particle has acceleration $a(t) = e^{-t} + t^2$ in feet per second squared, and at $t = 3$ the particle is traveling at 21 feet per second, find a velocity function for the particle at any time t.

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Indefinite Integral vs. Definite Integral

- **Definite Integral** $\int_a^b f(x)dx$ Results in a **Number**.
- **Indefinite Integral** $\int f(x)dx$ Results in a **Function Plus C**. I.E. $F(x) + C$.

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Net Change

- **Definition:** The integral of a rate of change is the net change:

$$\int_a^b F'(x)dx = F(b) - F(a)$$

- This principle can be applied to all rates of change
  - Volume of water flowing out of a reservoir or bucket
  - Concentration of a chemical reaction
  - Mass of a rod measured from one side to the other when looking for density
  - Rate of growth of a population
  - Cost of producing units of an item
  - projectile motion like the velocity of a car

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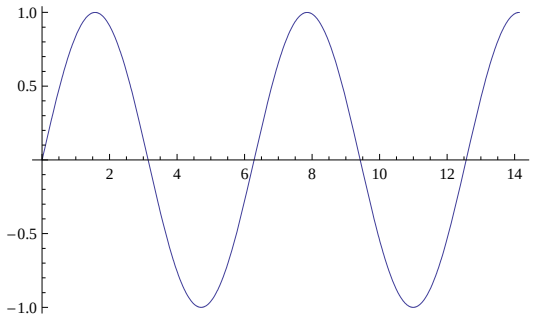
Displacement vs. Total Distance

- **Displacement:**

$$\int_{t_1}^{t_4} v(t)dt = s(t_4) - s(t_1)$$

- **Total Distance:**

$$\int_{t_1}^{t_4} |v(t)|dt = \int_{t_1}^{t_2} |v(t)|dt + \int_{t_2}^{t_3} |v(t)|dt + \int_{t_3}^{t_4} |v(t)|dt$$



Problem Solving Lab 2

- Look over this weeks material

Questions