# Chapter 13 – 2b Integration by Substitution

**Example 1.** The weekly marginal cost of producing x pairs of tennis shoes is given by

Find the cost function assuming fixed costs of $2,000 per week. Find the average cost per pair of shoes if 1,000 pairs of shoes are produced per week.



**Example 2.** An automobile company is ready to introduce a new line of cars through a national sales campaign. After test marketing the line in a carefully selected city, the marketing research department estimates that, for the next two years, total sales (in millions of dollars) will increase at the monthly rate of

where t is the time in months. Find the total sales function assuming that there are no sales at the beginning of the campaign. Find the estimated sales for the first and second years of the campaign.



During the second year, the total sales will be about 99 million dollars.

**Example 3.** Using data from the first 3 years of production and data from geological studies, the management of an oil company estimates that the rate of production for a given oil field is

where t is the time in years since pumping began and R(t) is the instantaneous rate of production in millions of barrels per year. Find the equation for the total production Q(t). How much oil will be produced the first 10 years? The last 10 years?



 million barrels of oil

 million barrels of oil

In the last 10 years, the oil field will produce about 115 million barrels of oil.

**Example 4.** A contaminated lake is found to contain 5,500 harmful bacteria per milliliter of water. The Parks and Recreation Department decides to treat the lake water with bactericide. The rate of change in the number of harmful bacteria per milliliter of water t days after the treatment is given by

What is the bacteria count per milliliter of water one week after the treatment? Two weeks after the treatment?



 bacteria per milliliter

 bacteria per milliliter

**Example 5.** A yeast culture is growing at the rate of grams per hour. If the starting culture had a mass of 2 grams, what will be the mass after 8 hours? After 12 hours?



 grams

 grams