following formula for the price (P) *of a new car:*

$$P = 20,000 + \frac{20,000}{n} \quad dollars \tag{3.2}$$

where n is the number of breakdowns per year. John drives about 15 thousand miles every year and assumes a linear depreciation to zero value over a period of ten years. The annual cost (C) *of driving is:*

$$C = 2,000 + \frac{2,000}{n} + K + 1,000 \ n \quad dollars \tag{3.3}$$

where K *is the gasoline and regular maintenance cost, which is assumed to be the same for all models. To minimize* C*, he sets the derivative* $dC/dn = 0$*, and obtains,* $n = \sqrt{2} = 1.414$*. From Equation 3.2, the price of the car he should select is determined as \$34,144.*

3.1.2 Production

Production is the process of making articles that society needs. Inputs to production are *labor, land, capital, energy*, and *enterprise* [472]. Enterprise means technical knowhow, organizational skills, etc. The inputs account for the cost of production. Although inputs vary widely, they can all be converted into dollar equivalents. Both fixed and variable costs may be included.

A *short-run* production means that some of the inputs are fixed. An example is the production in a factory over a period during which the size of the manufacturing facility remains fixed. In the short-run, output possibilities are limited. The company can hire more workers, order more raw material, perhaps add a shift, but that is about all. The *long-run* production is over a period during which the company can change all inputs, including the size of the manufacturing plant.

We first consider short-run production. *Production output,* Q, is a function of the inputs x, which presently accounts for only the variable costs of production:

$$Q = Q(x) \tag{3.4}$$

Technological Efficiency. Let us define:

$$\text{Average product} = \frac{Q}{x} \tag{3.5}$$

$$\text{Marginal product} = \frac{dQ}{dx} \tag{3.6}$$

The average product, or the product per unit of input, is called the *technological efficiency*. We maximize this efficiency by setting:

$$\frac{d}{dx}\frac{Q}{x} = 0 \quad \text{or} \quad \frac{1}{x}\frac{dQ}{dx} - \frac{Q}{x^2} = 0$$