THE PRODUCTION PROCESS: THE BEHAVIOR OF PROFIT-MAXIMIZING FIRMS

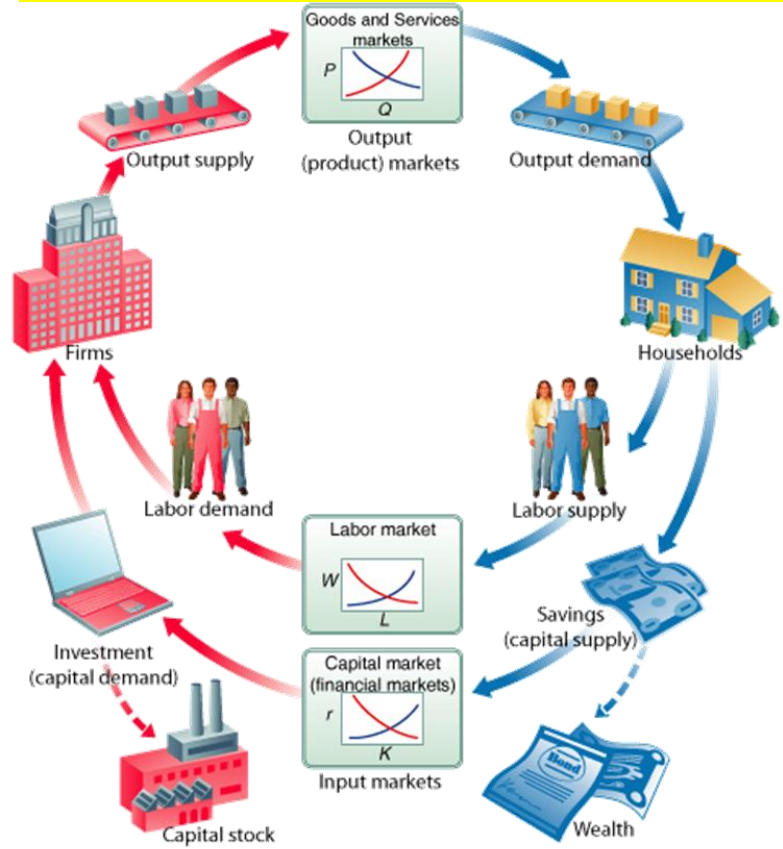


FIGURE 7.1 Firm and Household Decisions

production

The process by which inputs are combined, transformed, and turned into outputs.

Production Is Not Limited to Firms

firm

An organization that comes into being when a person or a group of people decides to produce a good or service to meet a perceived demand. Most firms exist to make a profit.

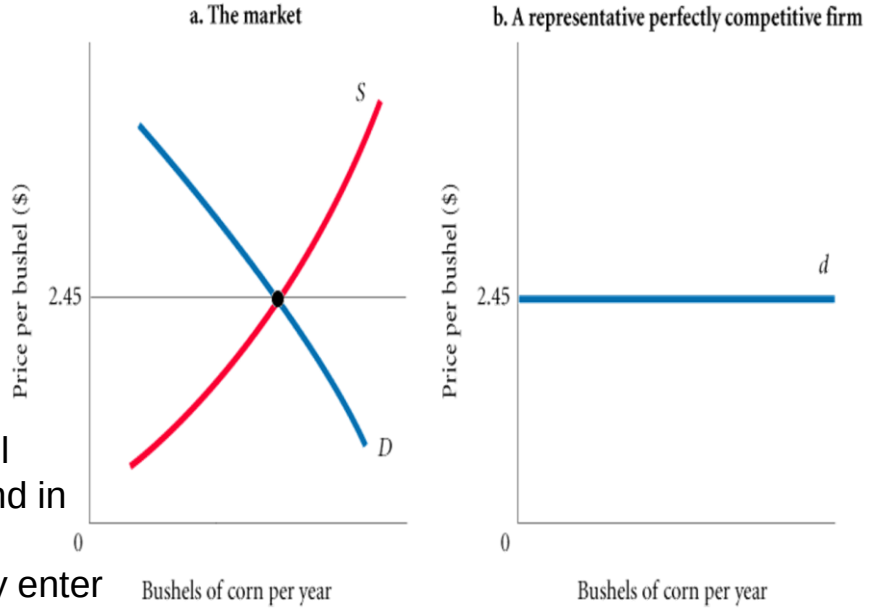


FIGURE 7.2 Demand Facing a Single Firm in a Perfectly Competitive Market

perfect competition

An industry structure in which there are many firms, each small relative to the industry, producing virtually identical products and in which no firm is large enough to have any control over prices.

In perfectly competitive industries, new competitors can freely enter and exit the market.

homogeneous products

Undifferentiated products; products that are **identical** to, or indistinguishable from, one another.

THE BEHAVIOR OF PROFIT-MAXIMIZING FIRMS

All firms must make several basic decisions to achieve what we assume to be their primary objective—maximum profits.

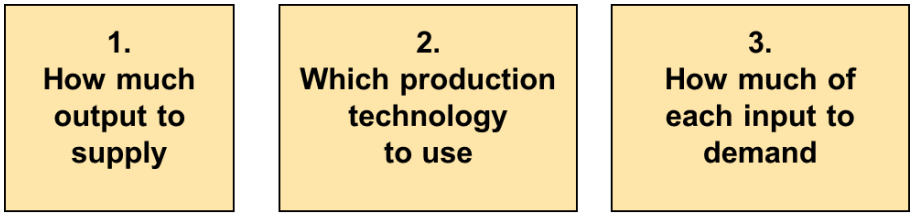


FIGURE 7.3 The Three Decisions That All Firms Must Make

profit (economic profit)

The difference between total revenue and total cost.

profit = total revenue - total cost

total revenue

The amount received from the sale of the product **(*q* x *P*).**

total cost (total economic cost)

The total of
(1) out-of-pocket costs,
(2) normal rate of return on capital, and
(3) opportunity cost of each factor of production.

The term profit will from here on refer to *economic profit*.
So whenever we say profit = total revenue - total cost, what we really mean is

economic profit = total revenue - total economic cost

normal rate of return

A **rate of return on capital** that is just sufficient to keep owners and investors satisfied. For relatively risk-free firms, it should be nearly the same as the interest rate on risk-free government bonds.

TABLE 7.1 Calculating Total Revenue, Total Cost, and Profit

INITIAL INVESTMENT: **MARKET INTEREST RATE AVAILABLE:**	**$20,000** **0.10 OR 10%**
Total revenue (3,000 belts x $10 each)	**$30,000**
Costs	
Belts from Supplier	15,000
Labor cost	14,000
Normal return/Opportunity Cost of Capital ($20,000 x 0.10)	2,000
Total Cost	**$31,000**
Profit = total revenue - total cost	**–1,000**

short run

The period of time for which two conditions hold:
1) The firm is operating under a fixed scale (**fixed factor) of production**, and
2) firms **can neither enter nor exit** an industry.

long run

That period of time for which there are no fixed factors of production:
1) Firms can increase or decrease the **scale of operation**, and
2) new firms can **enter** and existing firms can **exit** the industry.

THE BASES OF DECISIONS: MARKET PRICE OF OUTPUTS, AVAILABLE TECHNOLOGY, AND INPUT PRICES

The bases of decision making:

1. The **market price** of output
2. The **techniques** of production that are available
3. The **prices of inputs**

Output price determines potential revenues. The techniques available tell me how much of each input I need, and input prices tell me how much they will cost. Together, the available production techniques and the prices of inputs determine costs.

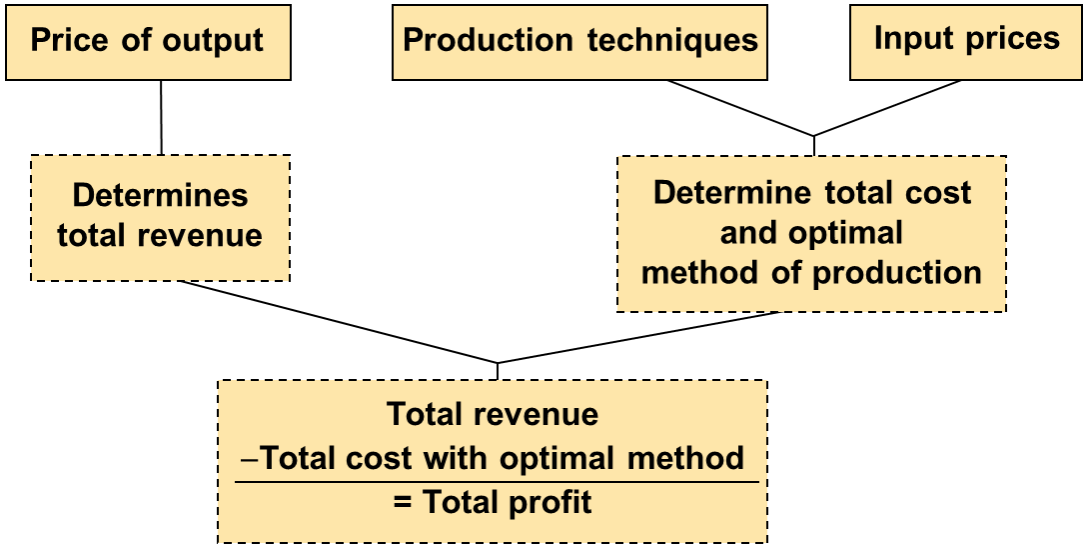


FIGURE 7.4 Determining the Optimal Method of Production

optimal method of production

The production method that minimizes cost.

THE PRODUCTION PROCESS

production technology

The quantitative relationship between inputs and outputs.

labor-intensive technology (economic welfare)

Technology that relies heavily on human labor instead of capital.

capital-intensive technology (cost effective)-(economic efficiency)

Technology that relies heavily on capital instead of human labor.

production function or total product function

A numerical or mathematical expression of a relationship between inputs and outputs.
It shows units of total product as a function of units of inputs.

marginal product

The additional output that can be produced by adding one more unit of a specific input, ceteris paribus.

law of diminishing returns

When additional units of a variable input are added to fixed inputs after a certain point, the marginal product of the variable input declines.

Diminishing returns always apply in the short run, and in the short run every firm will face diminishing returns.
This means that every firm finds it progressively more difficult to increase its output as it approaches capacity production.

average product

The average amount produced by each unit of a variable factor of production

$$\text{average product of labor} = \frac{\text{total product}}{\text{total units of labor}}$$

PRODUCTION FUNCTIONS WITH TWO VARIABLE FACTORS OF PRODUCTION

In general, additional capital increases the productivity of labor.
Because capital—buildings, machines, and so on—is of no use without people to operate it, we say that capital and labor are *complementary inputs*.

TABLE 7.2 Production Function

(1) LABOR UNITS EMPLOYEES	(2) TOTAL PRODUCT (SANDWICHES PER HOUR)	(3) MARGINAL PRODUCT OF LABOR	(4) AVERAGE PRODUCT OF LABOR (TOTAL PRODUCT LABOR UNITS)
0	0	–	–
1	10	10	10.0
2	25	15	12.5
3	35	10	11.7
4	40	5	10.0
5	42	2	8.4
6	42	0	7.0

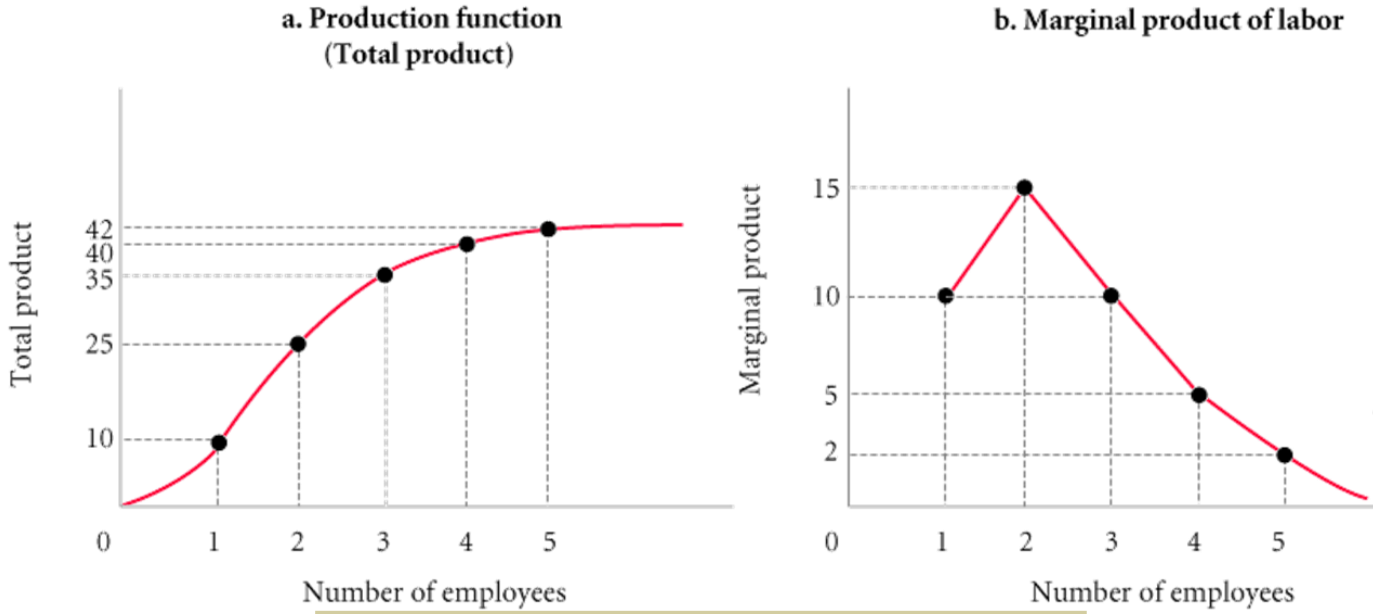
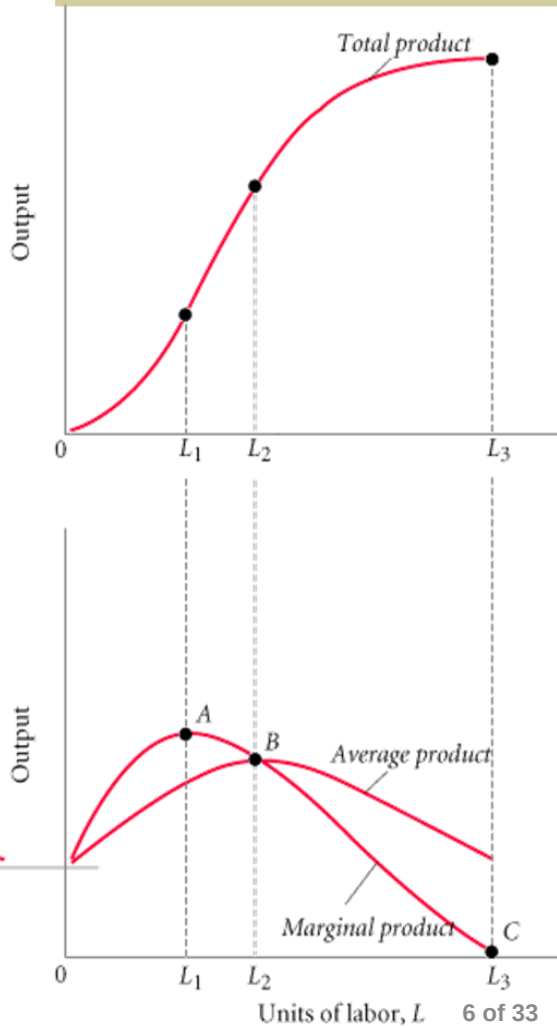


FIGURE 7.5 Production Function for Sandwiches

FIGURE 7.6 Total Average and Marginal Product



CHOICE OF TECHNOLOGY

REVIEW TERMS AND CONCEPTS

- average product
- capital-intensive technology
- firm
- homogeneous products
- labor-intensive technology
- law of diminishing returns
- long run
- marginal product
- normal rate of return
- optimal method of production
- perfect competition
- production
- production function or total product function
- production technology
- profit (economic profit)
- short run
- total cost (total economic cost)
- total revenue

1. $\text{Profit} = \text{total revenue} - \text{total cost}$

2. $\text{Average product of labor} = \frac{\text{total product}}{\text{total units of labor}}$

TABLE 7.3 Inputs Required to Produce 100 Diapers Using Alternative Technologies

TECHNOLOGY	UNITS OF CAPITAL (*K*)	UNITS OF LABOR (*L*)
A	2	10
B	3	6
C	4	4
D	6	3
E	10	2

TABLE 7.4 Cost-Minimizing Choice Among Alternative Technologies (100 Diapers)

(1) TECHNOLOGY	(2) UNITS OF CAPITAL (*K*)	(3) UNITS OF LABOR (*L*)	(4) Cost = ($L \times P_L$) + ($K \times P_K$) P_L = \$1, P_K = \$1	(5) Cost = ($L \times P_L$) + ($K \times P_K$) P_L = \$5, P_K = \$1
A	2	10	\$12	\$52
B	3	6	9	33
C	4	4	8	24
D	6	3	9	21
E	10	2	12	20

Two things determine the cost of production: (1) technologies that are available and (2) input prices. Profit-maximizing firms will choose the technology that minimizes the cost of production given current market input prices.

ISOQUANTS AND ISOCOSTS

ISOQUANTS

TABLE 7A.1 Alternative Combinations of Capital (K) and Labor (L) Required to Produce 50, 100, and 150 Units of Output

	$Q_X = 50$		$Q_X = 100$		$Q_X = 150$	
	K	L	K	L	K	L
A	1	8	2	10	3	10
B	2	5	3	6	4	7
C	3	3	4	4	5	5
D	5	2	6	3	7	4
E	8	1	10	2	10	3

Isoquant

A graph that shows all the combinations of capital and labor that can be used to produce a given amount of output.

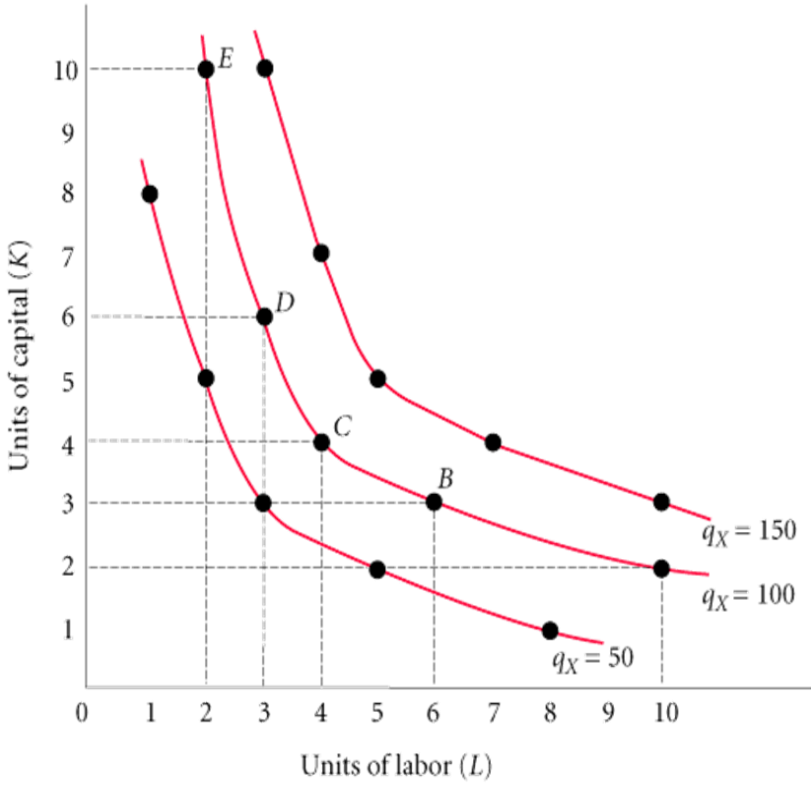


FIGURE 7A.1 Isoquants Showing All Combinations of Capital and Labor That Can Be Used to Produce 50, 100, and 150 Units of Output

marginal rate of technical substitution

The rate at which a firm can substitute capital for labor and hold output constant.

Slope of isoquant:

$$\frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K}$$

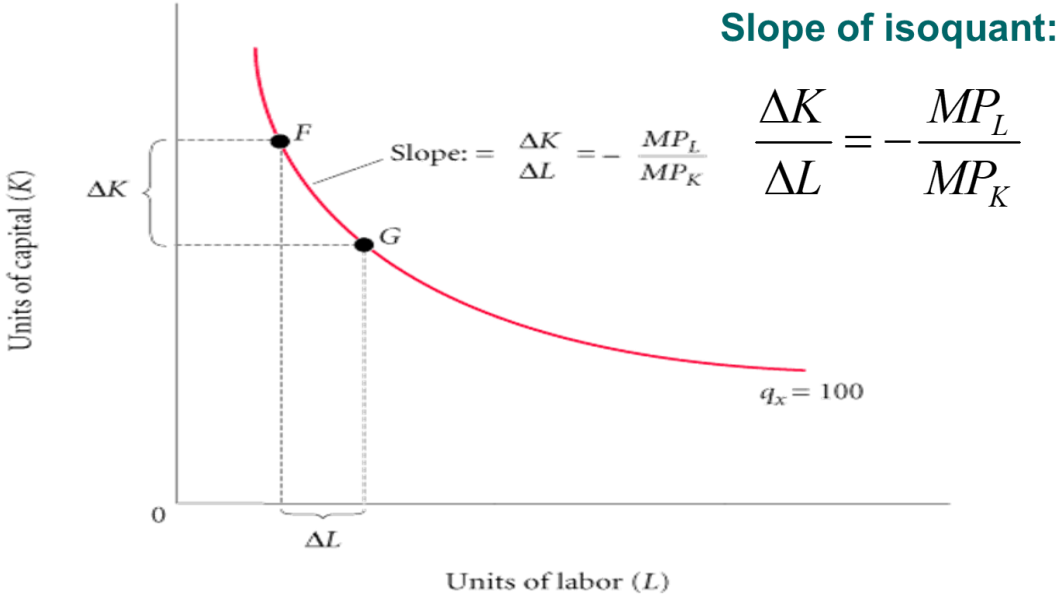


FIGURE 7A.2 The Slope of an Isoquant Is Equal to the Ratio of MP_L to MP_K

FACTOR PRICES AND INPUT COMBINATIONS: ISOCOSTS

isocost line

A graph that shows all the combinations of capital and labor available for a given total cost.

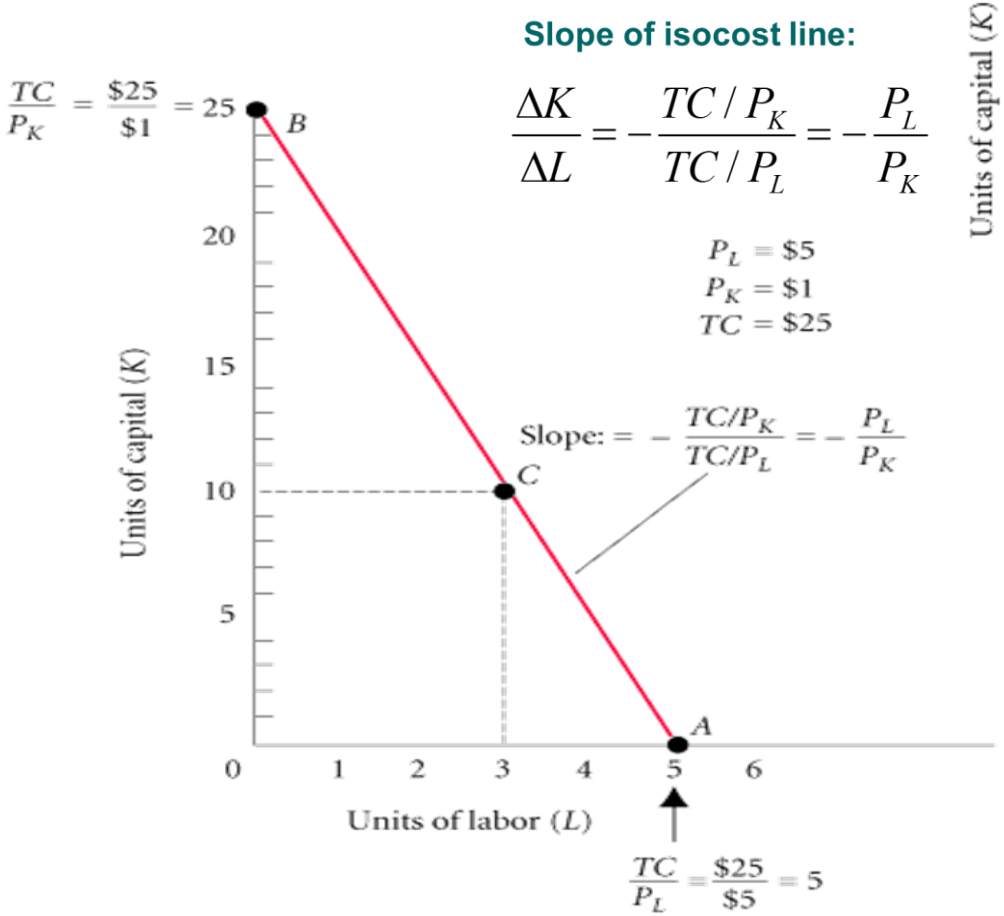


FIGURE 7A.4 Isocost Line Showing All Combinations of Capital and Labor Available for $25

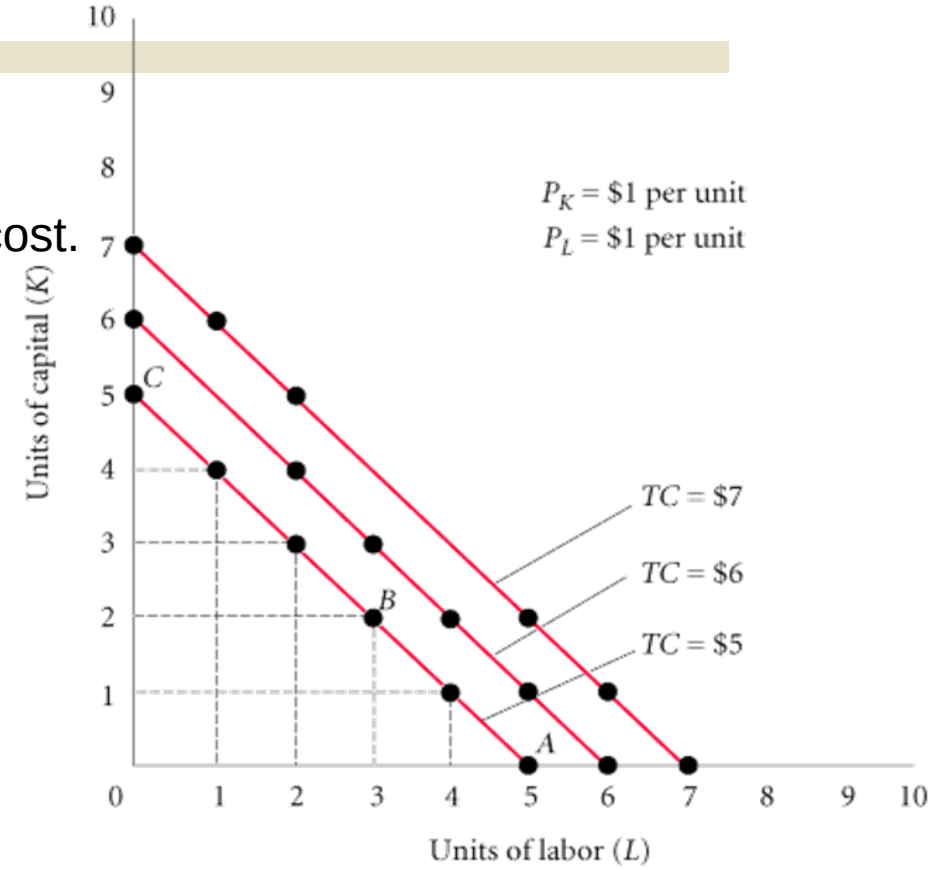
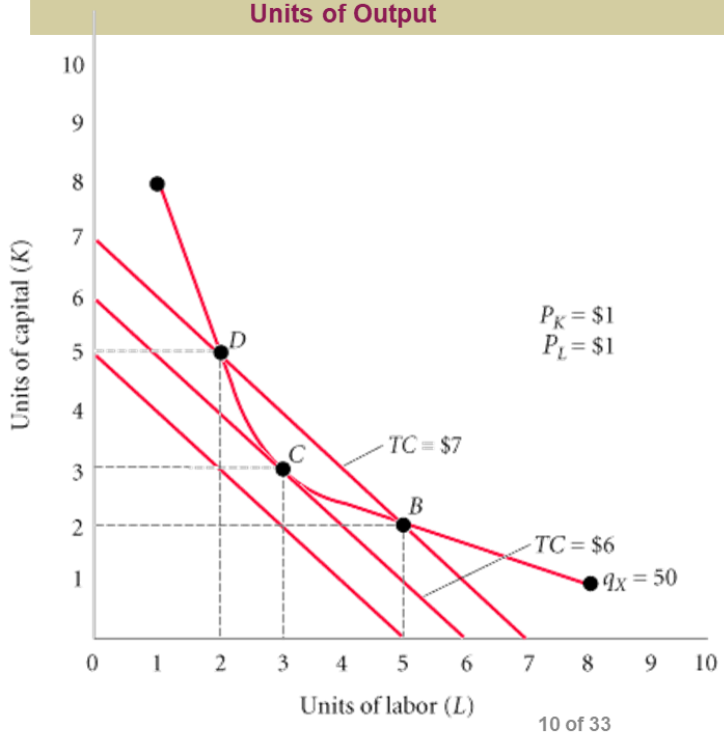


FIGURE 7A.3 Isocost Lines Showing the Combinations of Capital and Labor Available for $5, $6, and $7

FINDING THE LEAST-COST TECHNOLOGY WITH ISOQUANTS AND ISOCOSTS

FIGURE 7A.5 Finding the Least-Cost Combination of Capital and Labor to Produce 50 Units of Output



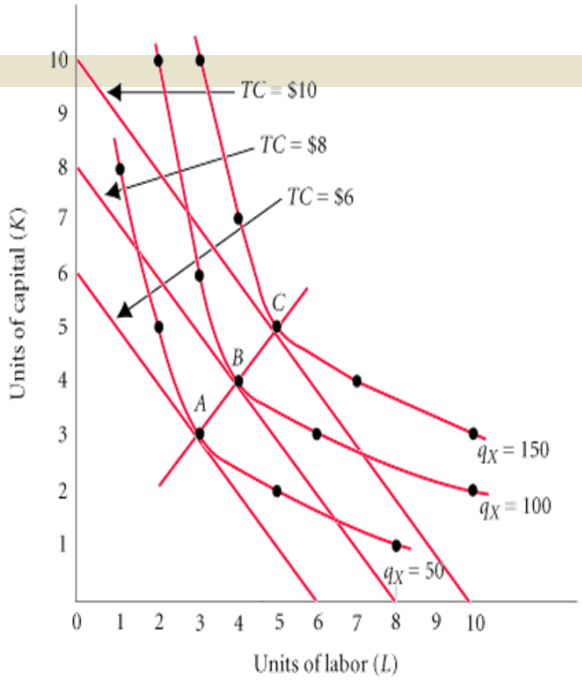


FIGURE 7A.6 Minimizing Cost of Production for $q_X = 50$, $q_X = 100$, and $q_X = 150$

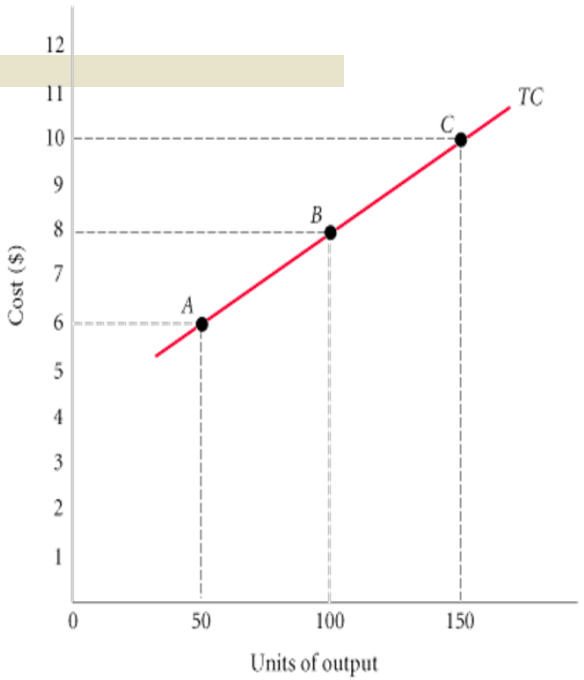


FIGURE 7A.7 A Cost Curve Shows the *Minimum* Cost of Producing Each Level of Output

The firm will choose the combination of inputs that is least costly. The least costly way to produce any given level of output is indicated by the point of tangency between an isocost line and the isoquant corresponding to that level of output.

THE COST-MINIMIZING EQUILIBRIUM CONDITION

At the point where a line is just tangent to a curve, the two have the same slope.
At each point of tangency, the following must be true:

$$\text{slope of isoquant} = -\frac{MP_L}{MP_K} = \text{slope of isocost} = -\frac{P_L}{P_K}$$

Thus, $$\frac{MP_L}{MP_K} = \frac{P_L}{P_K}$$

Dividing both sides by P_L and multiplying both sides by MP_K, we get $$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$