Economics for Engineers

Department of Humanities

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Theory of Production

- The act of production involves the transformation of inputs into output

- It is not merely confined to physical transformation in the matter but it is addition or creation of value

- The relation between inputs and output of a firm has been called the production function

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Short run Production Function
- At least one factor input is fixed
- Production is increased by varying the other factors
- Law of diminishing return

Long run Production Function
- All factor inputs are variable
- All factors varied proportionately
- Law of return to scale

Production Function

Shows **maximum output** possible for any combination of inputs (technical efficiency):

$$q = F(K, L, E, M, \dots).$$

Marginal products:

$$MP_K = \frac{\partial q}{\partial K}, \qquad MP_L = \frac{\partial q}{\partial L}, \qquad etc.$$

Average Products:

$$AP_K = \frac{q}{K}, \qquad AP_L = \frac{q}{L}, \qquad etc.$$

Production function with one variable factor

- Short run two factor production function:

$$Q = f(L, \bar{K})$$

Specific form of production function known as Cobb-Douglas production function which is most widely used in economics can be written as

$$Q = AL^{\alpha}K^{\beta}$$

Concepts of Physical Product

- **Total Product (TP):** TP of a variable factor is the amount of total output produced by the given quantity of variable factor

- **Average Product (AP):** AP of a variable factor is the total output divided by the amount of variable factor along with a given quantity of the fixed factor.

- **Marginal Product (MP):** MP of a variable factor is the addition made to total output by employing one additional unit of a factor
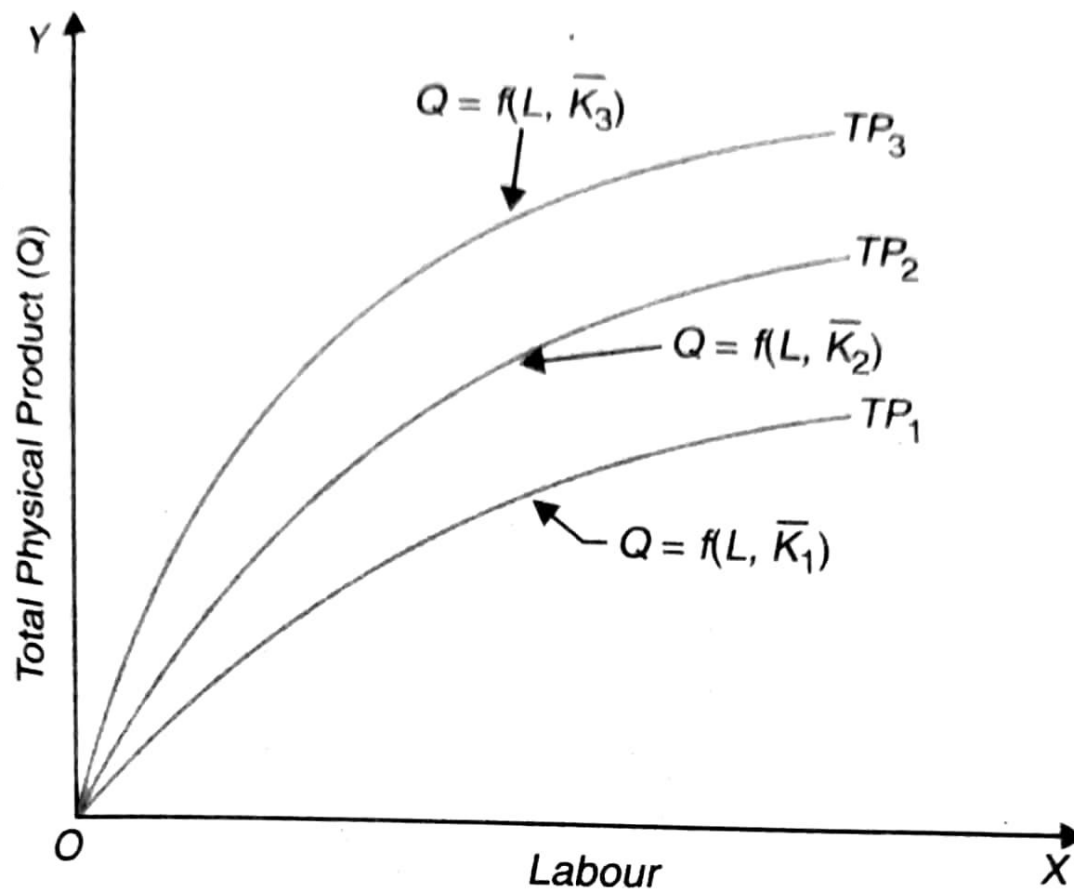
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Labour (i.e. No. of workers)	Total Product (TP)	Marginal Product (MP)	Average Product (AP)
L	Q	$\left(\dfrac{\Delta Q}{\Delta L}\right)$	$\left(\dfrac{Q}{L}\right)$
1	80	80	80
2	170	90	85
3	270	100	90
4	368	98	92
5	430	62	86
6	480	50	80
7	504	24	72
8	504	0	0
9	495	−9	55
10	480	−15	48

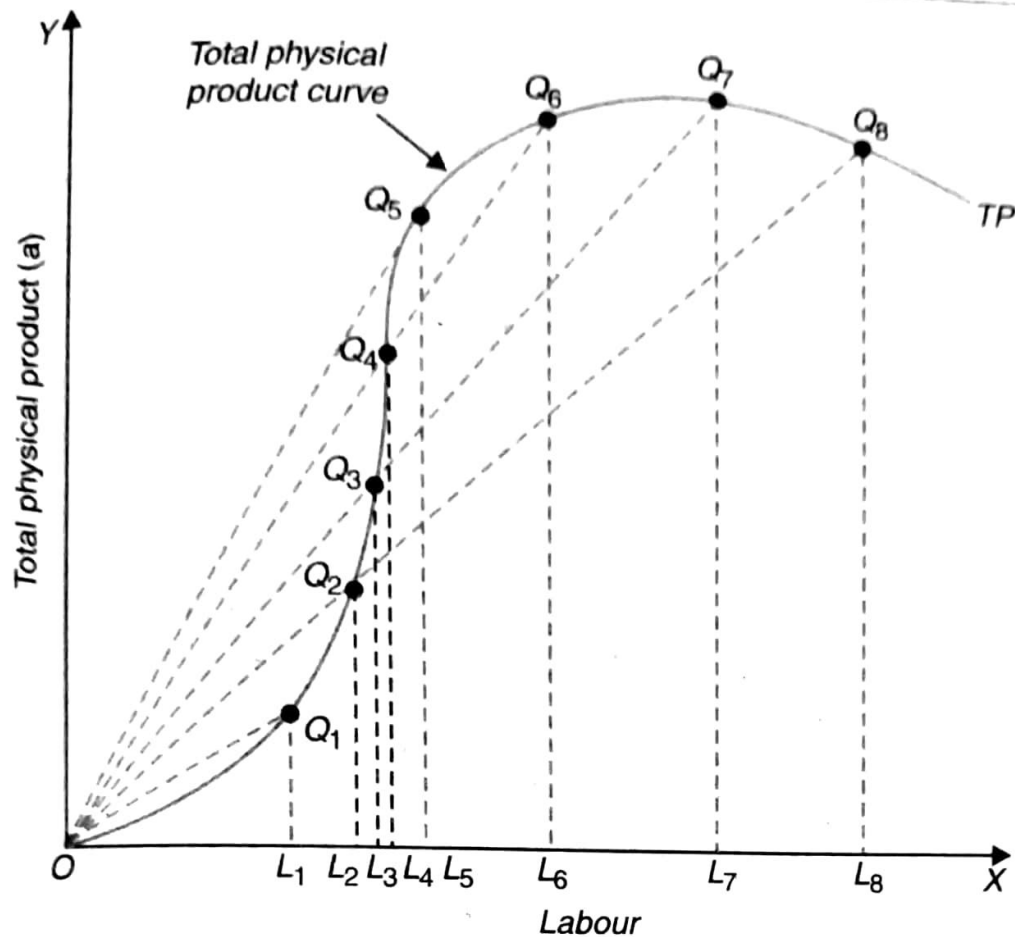# Total Product Curve and its Shift
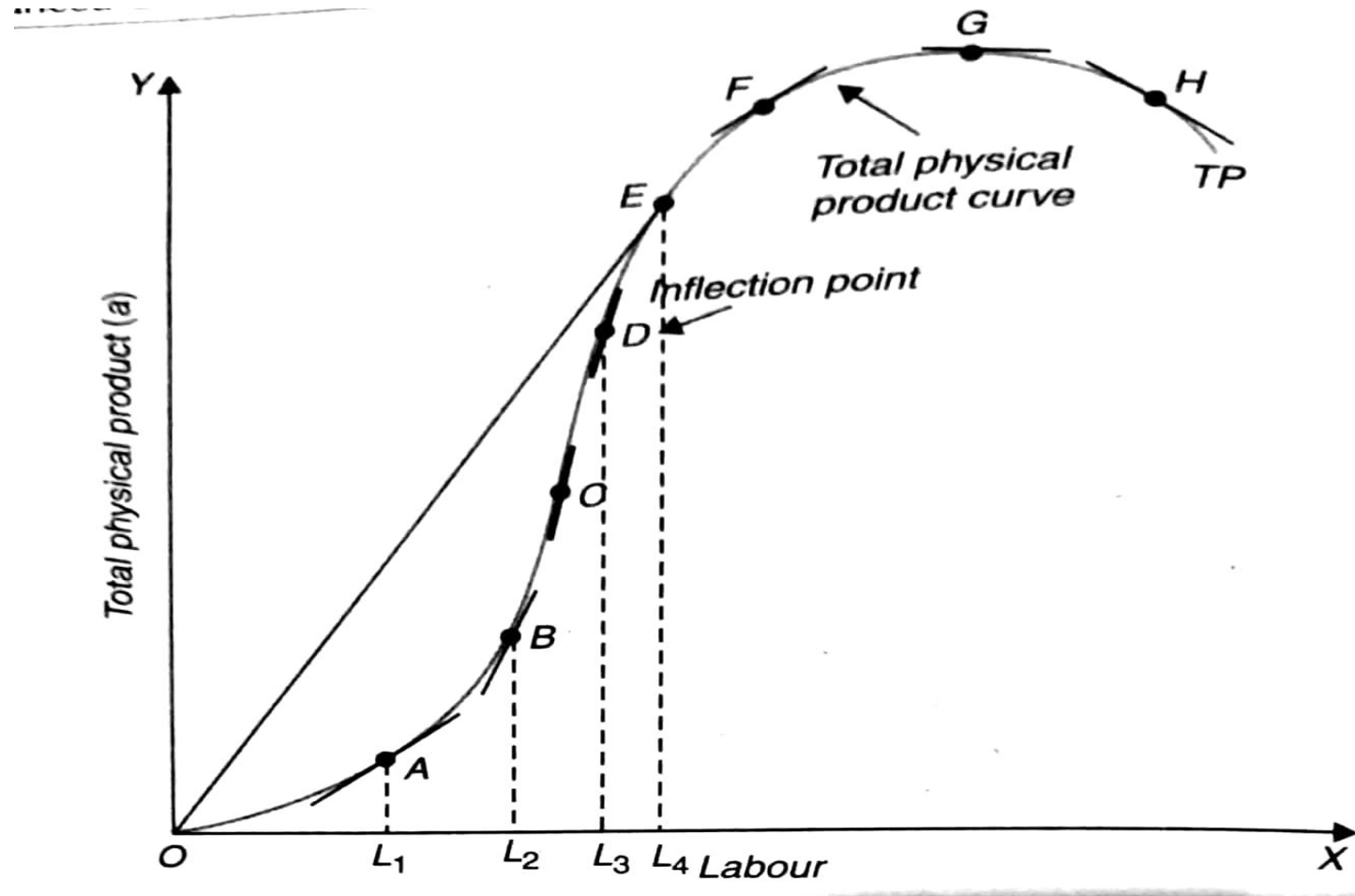
Total product curve of Labour
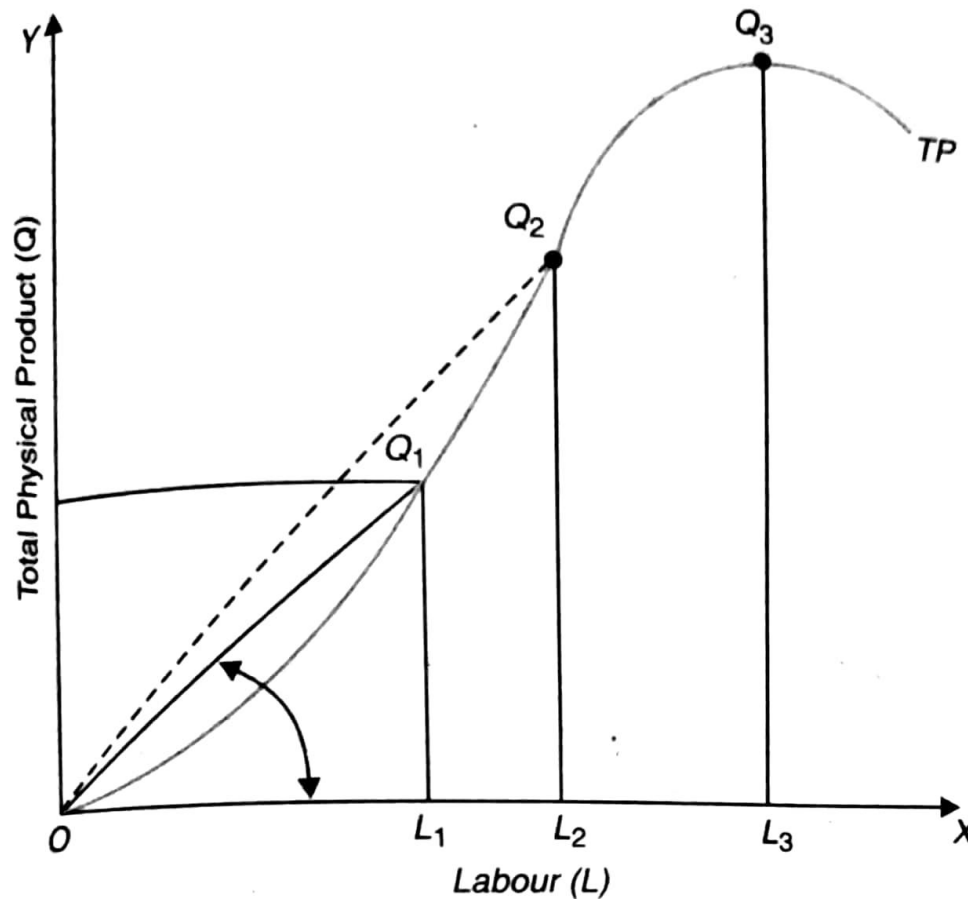
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Average Product and its derivation from Total Product

Marginal product and its derivation

Output Elasticity of Input

$$E_L = \frac{\%\Delta Q}{\%\Delta L}$$

$$E_L = \frac{\Delta Q}{\Delta L} \cdot \frac{L}{Q}$$

Here, the first ratio is marginal product of labour and reciprocal of the second term is the average product of labour. As a result, output elasticity of input is $E_L = \frac{MP_L}{AP_L}$