Production Problem How to use production inputs (Land, Labor, Capital)

to maximize output Q. for a given cost level

(or) to minimize cost C to produce a given level of output Q

- understanding production is crucial to understand the behavior of the firms in perfect competition and monopoly (and other markets)

Production Function $Q = f(L,K)$

Q = output
L = Labor
K = Capital.

- relationship between the highest output Q achievable from using L and K as efficiently as possible at the given technology.

Ex $Q = f(L,K) = 10 L^{0.5} K^{0.5}$

$L=400, K=900 \Rightarrow Q = 6{,}000$ units.

$L=100, K=900 \Rightarrow Q = 3{,}000$ units.

Short-Run Production: Time frame that there is at least one input that cannot be changed

- Usually in S.R. - capital is the fixed factor.
- there is some fixed cost - that does not change with Q

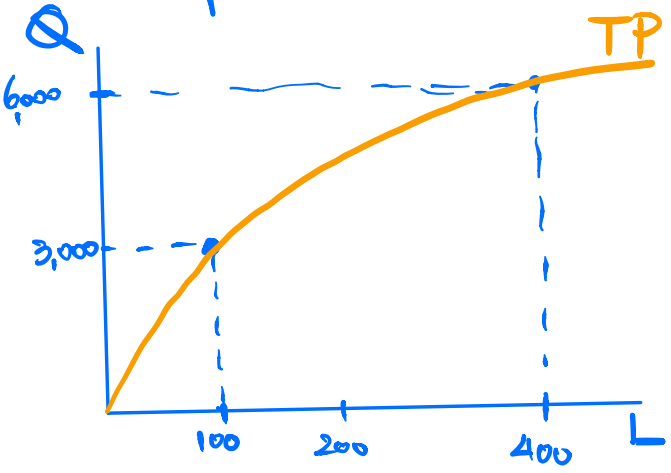
Long-Run Production Time frame that is long enough to vary every input - no fixed factor → no fixed cost.

S.R. production Assume K is fixed at $K_0 = 900$

$$Q = 10 L^{0.5} K_0^{0.5} \quad (K_0 = 900)$$

$$= 300 L^{0.5}$$

we can change Q by changing L.



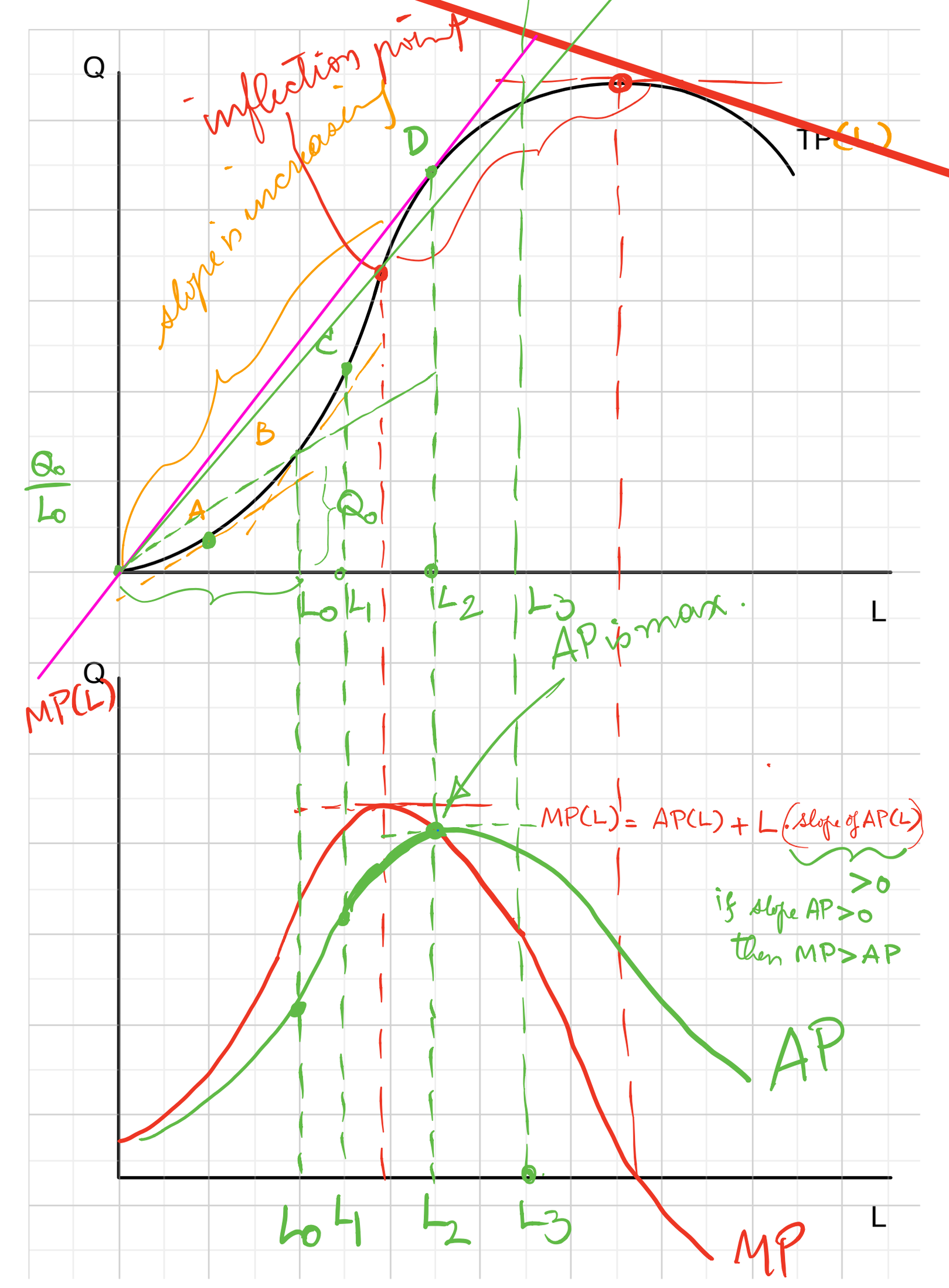
Total Product line $= TP_{K_0}(L) = Q(L, K_0)$

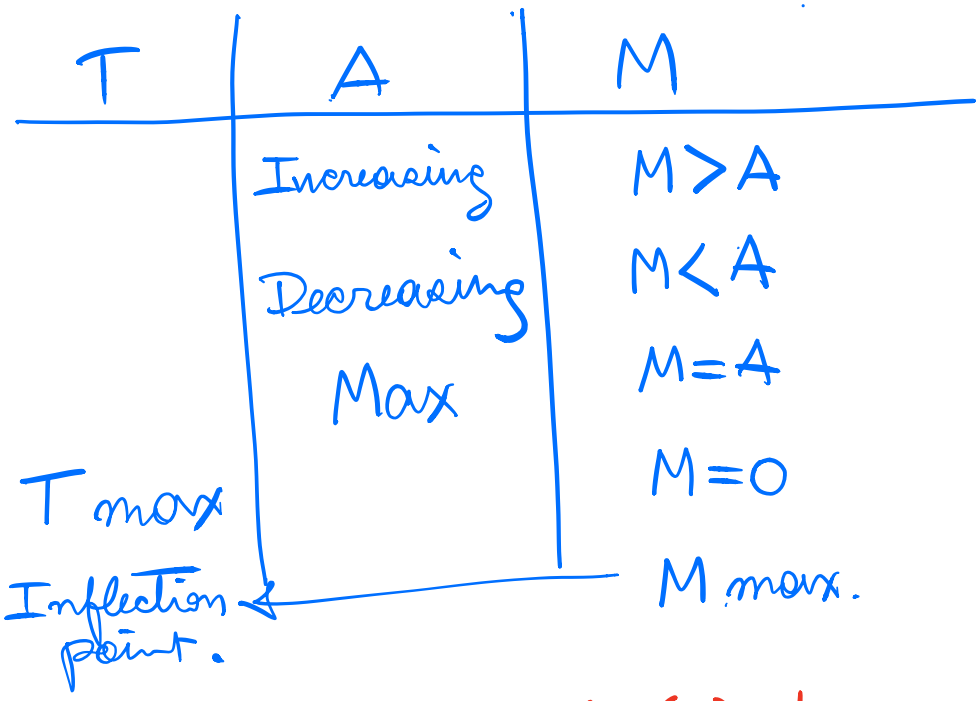
- output from using Labor = L and capital is fixed at K_0.

$$MP_{K_0}(L) = \frac{d\,TP_{K_0}(L)}{dL}$$

= rate of additional output Q you get from 1 more unit of L

$$AP_{K_0}(L) = \frac{TP_{K_0}(L)}{L}$$ = slope of straight from origin to the point on $TP_{K_0}(L)$ curve.


Q
TP(L)
- inflection point
- slope is increasing
D
C
B
A
$\frac{Q_0}{L_0}$
Q_0
L_0 L_1 L_2 L_3
L
AP is max.
Q
MP(L)
MP(L) = AP(L) + L (slope of AP(L))
>0
if slope AP >0
then MP > AP
AP
MP
L_0 L_1 L_2 L_3
L

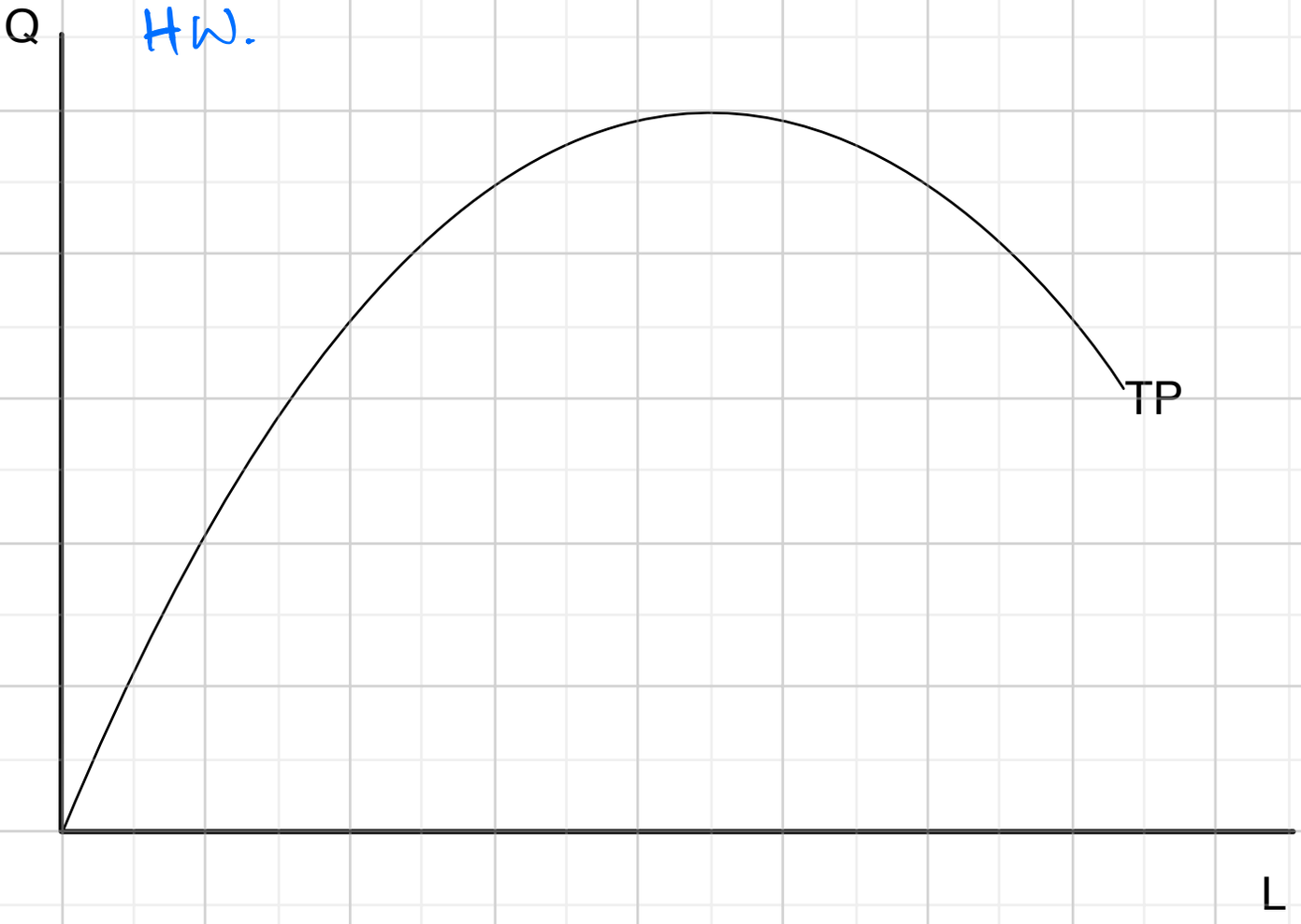


$$TP(L) = AP(L) \cdot L$$

$$MP(L) = \frac{d}{dL} TP(L) = AP(L)\frac{dL}{dL} + L\frac{d\,AP(L)}{dL}$$

$$MP(L) = AP(L) + L\,(\text{slope of } AP(L))$$

HW.



Graph of Production function.