

4. (a) The marginal product decreases as a single variable factor increases, holding other factors constant.

(b)

Labor	Total Output	MP
0	0	
1	5	5
2	9	4
3	12	3
4	14	2
5	15	1

The table does exhibit diminishing returns because the marginal product of labor falls as labor increases.

5.

	Q=1		Q=2		Q=3		Q=4		Q=5	
	K	L	K	L	K	L	K	L	K	L
A	2	5	1	10	5	14	6	18	8	20
B	5	2	8	3	11	4	14	5	16	6

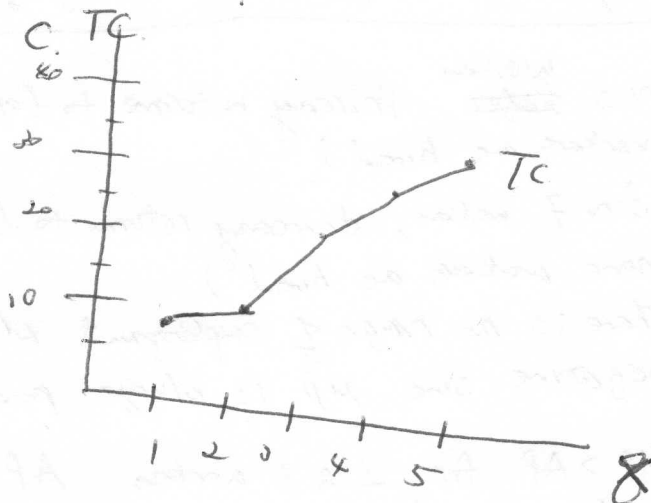
a. $P_L = 1, P_K = 2$

	Q=1	Q=2	Q=3	Q=4	Q=5
TCA	$4+5=9$	$10+2=12$	$14+10=24$	$18+12=30$	$20+16=36$
TCB	$2+10=12$	$3+16=19$	$4+22=26$	$5+28=33$	$6+32=38$

Least cost technology = A for all Q.

b. Labor & Capital employed

Q	L	K
1	5	2
2	10	1
3	14	5
4	18	6
5	20	8



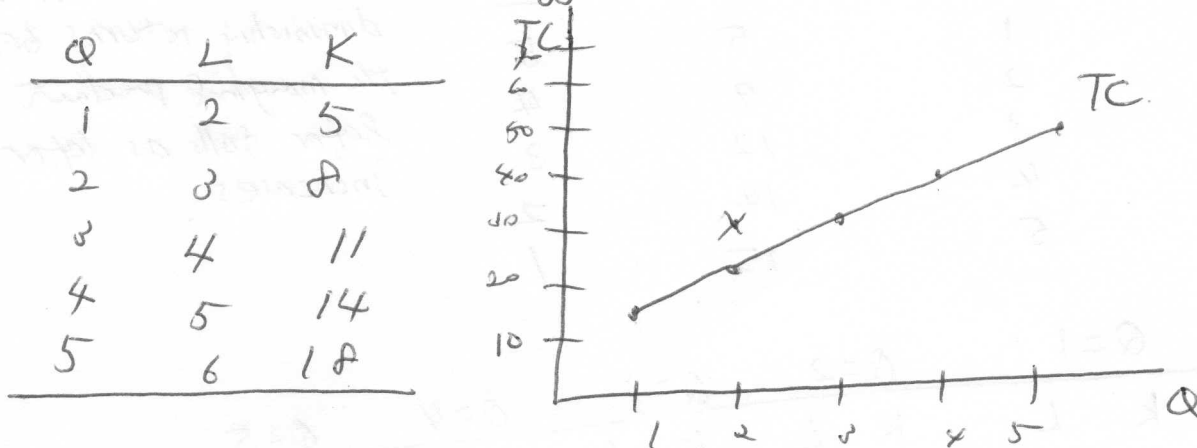
d. $P_L = 3, P_K = 2$

$Q=1$ $Q=2$ $Q=3$ $Q=4$ $Q=5$

TCA $15+4=19$ $30+2=32$ $42+10=52$ $54+12=66$ $60+16=76$

TCB $6+10=16$ $9+16=25$ $12+22=34$ $15+28=43$ $18+32=50$

Least cost technology = B for all Q.



11. The addition of capital (tractors, combines etc.) and the application of technology (nitrous fertilizers) raise the productivity of labor. Capital is a substitute input for labor.

# Workers	# Repairs	MP	AP
0	0		
1	8	8	8/1 = 8
2	20	12	20/2 = 10
3	35	15	35/3 = 11.67
4	45	10	45/4 = 11.25
5	52	7	52/5 = 10.40
6	57	5	57/6 = 9.50
7	60	3	60/7 = 8.57

- b. 1 & 3 ~~workers~~ increasing returns to labor. (MP increases as more workers are hired)
- 3 & 7 workers, decreasing returns to labor. (MP decreases as more workers are hired)
- There is no range of employment where returns to labor are negative since MP is always positive.

c. $MP > AP$ for 2 & 3 workers. AP is increasing as there are two workers are hired

d. $MP < AP$ for 4, 5, 6, & 7 workers. AP is decreasing.

output	Tech 1		Tech 2		Tech 3	
	K	L	K	L	K	L
100	3	7	4	5	5	4
150	3	10	4	7	5	5
200	4	11	5	8	6	6
250	5	13	6	10	7	8

a. $P_K = 100, P_L = 80$

	Tech 1	Tech 2	Tech 3
100	$TC = 300 + 560 = 860$	$TC = 400 + 400 = 800$	$TC = 500 + 320 = 820$
150	$TC = 300 + 800 = 1100$	$TC = 400 + 560 = 960$	$TC = 500 + 400 = 900$
200	$TC = 400 + 880 = 1280$	$TC = 500 + 640 = 1140$	$TC = 600 + 480 = 1080$ *
250	$TC = 500 + 1040 = 1540$	$TC = 600 + 800 = 1400$	$TC = 700 + 640 = 1340$

For $Q = 100$, Tech 2, For $Q = 150, 200$ & 250 , Tech 3.

b. $P_K = 100, P_L = 40$

	Tech 1	Tech 2	Tech 3
100	$TC = 300 + 280 = 580$	$TC = 400 + 200 = 600$	$TC = 500 + 160 = 660$
150	$TC = 300 + 400 = 700$	$TC = 400 + 280 = 680$	$TC = 500 + 200 = 700$
200	$TC = 400 + 440 = 840$	$TC = 500 + 320 = 820$ *	$TC = 600 + 240 = 840$
250	$TC = 500 + 520 = 1020$	$TC = 600 + 400 = 1000$	$TC = 700 + 320 = 1020$

For $Q = 100$, Tech 1, For $Q = 150, 200$ & 250 , Tech 2.

c. The firm shifts its technology from Tech 3 to Tech 2. Employment will increase by 2 workers (6 → 8).