Problem Set #7

Sonoma State University Dr. Cuellar
Economics 305-Intermediate Microeconomic Theory

Consider a firm that faces the following total product curves depending on how much capital it employs.

K=1 Unit			K=2 Units			K=3 Units		
Quantity of Labor	Total Product	MP_L	Quantity of Labor	Total Product	MP_L	Quantity of Labor	Total Product	MP_L
1	100		1	123		1	139	
2	152		2	187		2	193	
3	193		3	237		3	263	
4	215		4	263		4	319	
5	233		5	286		5	366	
6	249		6	306		6	407	
7	263		7	323		7	410	

(1) Compute the marginal product of labor (MP_L) in the table above.

(2) Suppose the firm currently employs 1 unit of capital and 3 units of labor.
   (i) Compute the MP_L and the MP_K.
   (ii) Compute the $MRTS_{LK}$.

(3) Suppose that the firm currently employs 2 units of capital. The price of capital is $4 per unit and the price of labor is $10 per unit.
   (i) What is the short run total cost of producing 263 units?
   (ii) What is the long run total cost of producing 263 units?

(4) Suppose again that the firm currently employs two units of capital but that the price of capital increases to $20 per unit and the price of labor falls to $5 per unit.
   (i) What is the short run total cost of producing 263 units?
   (ii) What is the long run total cost of producing 263 units?

(5) Beginning with one unit of capital and 2 units of labor, does this production function exhibit increasing, constant or decreasing returns to scale?

(6) Prove that when resources are allocated such that $\frac{MP_L}{w} = \frac{MP_k}{r}$, costs are minimized (or alternatively output is maximized).
Note, your answer should include a discussion of total product, marginal product and the law of diminishing marginal returns.

(7) Suppose that a firm producing Kathy Lee Gifford CD's employs only two inputs, labor and toxic emissions. It turns out the production of Kathy Lee CD's somehow results in toxic fumes emitted into the atmosphere. The firm faces a positive wage rate for labor but faces no charge for emitting toxic fumes.

(i) Given a fixed total cost of production, show graphically using iso-cost and iso-quant curves, the cost minimizing output. Explain fully the equilibrium condition that holds at the cost minimizing output and the implications of this condition on factor usage.

(ii) Suppose that in an effort to reduce air pollution, the government imposes a fixed annual fee of $1,000 on the firm. Show graphically using iso-cost and iso-quant curves how this will affect the equilibrium level of output and the amount of toxic fumes emitted by the firm. Explain your answer.

(iii) Suppose that instead of fixed annual fee, a per unit fee for toxic emissions is charged. Show graphically using iso-cost and iso-quant curves how this will affect the equilibrium level of output and the amount of toxic fumes emitted by the firm. Explain your answer.

(iv) Suppose the above firm hires an economist to estimate its production function. Through econometric analysis, the production function is estimated to be $Q = 6LP$, where Q = annual number of Kathy Lee Gifford CD's produced, L = labor hours , and P = tons of pollution emitted into the air. The marginal products of labor and pollution are $MP_L = 6P$ and $MP_P = 6L$ respectively. Assume the wage rate faced by the firm is $7.50 per hour and the per unit emissions fee is $30 per ton. If the firm's budget is $300,000, how much labor and pollution should the firm employ? How much output will the firm produce?