

ECON 2020:G
Intermediate Microeconomics I: Production
Problem Set # 1

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In this problem set, as in all following ones and the exams, the term marginal refers to an infinitesimally small increment. In other words, use derivatives to determine marginal products etc.

1 Short-run production (6 points)

Popsi Inc. produces soft drinks in quantity q in a manufacturing plant in Canada with labor input L and machines K according to the production function

$$q = f(K, L) = 7L + (3/2)K^{1/2}L^2 - L^3/3.$$

In the short run, no additional machinery can be used, but workers can work overtime, so that the labor input is variable.

- (a) What is the short-run marginal and average product of labor for a given capital stock K ? (2)
- (b) For the following, assume that $K = 4$. For which value of L do the functions MP_L and AP_L intersect? What is the maximum of the AP_L function? What is the connection? (2)
- (c) Where is the production function no longer defined? Why? (1)
- (d) Does the law of diminishing marginal returns hold? Why? [One sentence is sufficient.] (1)

2 Long-run production (6 points)

Another firm in the same industry, Cake, considers setting up a plant in Canada and is thus evaluating its long-run production possibilities there. Besides using machinery K , it can hire labor L . The production function is

$$q = f(K, L) = K^{0.5}L^{0.5}.$$

- (a) What is the equation of the isoquant, i.e. K as a function of labor (and output)? (2)

- (b) What is the marginal rate of technical substitution? (2)
- (c) The manufacturer estimates that it will sell 12 units of its product. How many additional units of capital do you need to substitute for one marginal unit of labor when $L = 6$? How many do you need when you want to substitute for one marginal unit of labor when $L = 12$? In which case do you need more additional capital?¹ (2)

3 Production (6 points)

The firm Avanti produces custom-made sports cars that appeal to a certain clientele because of their high price and thus exclusivity. Avanti has the following production function:

$$q = f(k, l) = k^{2/3}l^{1/3},$$

where k and l are the capital and labor input respectively.

- (a) What additional output does one additional marginal unit of capital produce when the capital-labor ratio is $(k/l) = 8$? (2)
- (b) If you employ one less (marginal) worker, how many additional units of capital do you need to produce the same output? Again, assume that the capital-labor ratio is $(k/l) = 8$. [Do not assume this any further.] (2)
- (c) How many units of labor does the firm need to produce q units of output in the short run when the capital stock is fixed at a level of $k = 5$? (2)

4 Multiple-choice question (2 points)

Returns to scale refers to the change in output when

- (a) all inputs increase proportionately;
- (b) labor increases holding all other inputs fixed;
- (c) capital equipment is doubled;
- (d) you double all inputs.

¹Hint: You're being asked about the slope of the isoquant with given values for output q , labor L , and capital K . To solve this, first figure out how much capital is being used when the output is 12 units and labor is 6 or 12. Use your answers from parts (a) and (b).