Instructor: Derek Olmstead Duration: 105 minutes
Note: Non-programmable calculators permitted Total marks: 20 points

---

Part A: Short-answer questions [3 points each]

Note: Use <u>diagrams</u> and/or <u>equations</u> to <u>explain</u> your answer.

I. Explain the difference between diminishing total returns to labour and diminishing marginal returns to labour.

Diminishing returns to labour means that an increase in the number of labour units will decrease the amount of output. Diminishing marginal returns means that additional units of labour increase output at a decreasing rate.

II. Suppose the production function for T-shirts can be represented as $q = L^{0.25} K^{0.75}$. When $K = 1$ and $q = 2$, what is the slope of the isoquant? If there is insufficient information to answer the question, describe what information is missing.

In the short run, $MPL = 0.25 * (q/L)$. The change in MP with respect to L equals $d(MPL)/dL = -0.25 * q/L^2$. Thus, for all levels of labour hired, MPL falls as L increases.

III. Consider the following short-run production function: $q = 5L^2 – (1/3)L^3$. At what level of L do diminishing marginal returns begin? At what level of L do diminishing total returns begin?

$MP = 10L - L^2$. Marginal product peaks when L = 5 and equals zero when L = 10. Thus, diminishing marginal returns begin when L = 5, and diminishing returns begin when L = 10.

Part B: True-false questions [3 points each]

Note: Use <u>diagrams</u> and/or <u>equations</u> to <u>explain</u> your answer. <u>ALL</u> answer points for explanation.

IV. A firm operating with diminishing total returns cannot be profit maximizing.

True. This firm could produce more output with fewer inputs. This cannot be profit maximizing. A graph of the production function would be helpful. In the vicinity of diminishing total returns, the production function is downward-sloped indicating that additional inputs decrease output and, equivalently, fewer inputs increase output.

V. If increasing returns to scale are present, the long-run average cost increases as more output is produced.

False. Increasing returns to scale imply that with a doubling of inputs, output more than doubles. Since average cost is the ratio of total cost divided by output, this increase in inputs will cause the numerator to be just double the old value while the new denominator is more than double the old value. As a result, long-run average cost falls as more output is produced.

Part C: Multiple-choice questions [0.5 points each]

Note: Copy each answer to the exam booklet. The order of answers varies across exams.

VI. Average productivity will fall as long as
- i. marginal productivity is falling.
- **ii. it exceeds marginal productivity.**
- iii. it is less than marginal productivity.
- iv. the number of workers is increasing.

VII. Joey cuts lawns during the summer. Let q equal the number of acres mowed per day, and let L equal the number of hours worked per day. Joey never works more than eight hours per day, and during that time his short-run production function is q = 0.2 * L. Which of the following statements is FALSE?
- i. Joey's marginal productivity equals his average productivity.
- **ii. Joey's marginal productivity diminishes by 0.2 for each additional hour worked.**
- iii. Joey's average productivity is constant.
- iv. Joey's marginal productivity is constant.

VIII. Jennifer is the only employee of her sole proprietorship. She is entertaining the idea of hiring an additional employee. She knows that on her own she can produce 100 units per day. Jennifer figures that Applicant A will help her produce 175 units per day whereas Applicant B will help her produce 155 units per day. Which of the following statements is most accurate?
- i. Applicant B has a marginal product of 75 units.
- ii. Applicant B has an average product of 77.5 units.
- **iii. Applicant A has a marginal product of 75 units.**
- iv. Applicant A has an average product of 87.5 units.

IX. L-shaped isoquants imply that production requires that the inputs
- i. are perfect substitutes.
- ii. are imperfect substitutes.
- iii. cannot be used together.
- **iv. must be used together in a certain proportion.**

X. With capital on the vertical axis and labour on the horizontal axis, vertical isoquants imply that
- **i. capital is not productive.**
- ii. capital and labour are perfect substitutes.
- iii. capital and labour must be used together in a certain proportion.
- iv. labour is not productive.

XI. Suppose that each worker must use only one shovel to dig a trench, and shovels are useless by themselves. In the long run, the firm's cost function is
- i. TC = (w/r) * q.
- ii. TC = (w + r)/q.
- iii. TC = (w + r).
- **iv. TC = (w + r) * q.**

XII. The slope of the isoquant tells the firm how much
- i. output increases when labour increases by one unit.
- ii. output increases when capital and labour are doubled.
- **iii. capital must decrease to keep output constant when labour increases by one unit.**
- iv. a unit of capital costs relative to the cost of labour.

XIII. If the cost of labour increases the isocost line will
- i. stay the same.
- ii. shift outward in parallel fashion.
- **iii. rotate inward around the point where only capital is employed in production.**
- iv. shift inward in parallel fashion.

XIV. If a firm's total cost is $TC(q) = 10q^2 + 3q + 5$ then its average variable cost is
- **i. $\mathbf{10q + 3}$**
- ii. $20q + 3$
- iii. $20q + 3 + (5/q)$
- iv. $5/q$

XV. Given the total cost from question IX., the marginal cost of the 17 unit of output is
- i. 340
- **ii. 343**
- iii. 173
- iv. 2944