2017

AP CollegeBoard

AP Microeconomics

Sample Student Responses and Scoring Commentary

Inside:

- ☑ Free Response Question 2
- ☑ Scoring Guideline
- ☑ Student Samples
- ☑ Scoring Commentary

AP Central is the official online home for the AP Program: apcentral.collegeboard.org

AP® MICROECONOMICS
2017 SCORING GUIDELINES

Question 2

5 points (1 + 4)

(a) 1 point:

- One point is earned for stating that the firm would be operating with increasing returns to scale and for explaining that doubling inputs will more than double output (output increases from 10 units to 50 units as a result of doubling labor and capital) **or** for explaining that average total cost decreases from $27.50 to $11 when labor and capital double.

(b) 4 points:

- One point is earned for correctly calculating the marginal product (MP) for the third unit of labor as 25 units and showing the work: $\frac{75-50}{3-2} = 25$.

- One point is earned for answering yes and for explaining that the MP of the third unit of labor (25 units) is less than the MP of the second unit of labor (30 units).

- One point is earned for correctly calculating the firm's average total cost (ATC) and showing the work: $\frac{75*2}{75} + \frac{200*3}{75} = 2 + 8 = \$10$ **or** $\frac{(75*2)+(200*3)}{75} = \frac{750}{75} = \$10$.

- One point is earned for identifying the lowest output price as $8 at which the third unit of labor would be hired.

ANSWER PAGE FOR QUESTION 2

a) The firm will be operating with increasing returns to scale. When the firm uses one unit of capital and one unit of labor, it produces 10 units of output. However, when the firm doubles its inputs so that it uses two units of capital and two units of labor, it produces 50 units of output, which is more than double 10.

b) (i) $MP = \frac{\Delta TP}{\Delta L} = \frac{75-50}{3-2} = 25$ units of output

(ii) Yes, the firm did experience diminishing marginal returns with the addition of the third unit of labor. Using two units of capital, the marginal products of the first, second, and third units of labor are 20, 30, and 25 units, respectively. From the second to the third unit of labor, marginal product decreased.

(iii) $TC = (\$75 \times 2) + (\$200 \times 3) = \$150 + \$600 = \$750$

$ATC = \frac{TC}{Q} = \frac{\$750}{75} = \$10$

(iv) $MRC_L = \$200 \quad \frac{\$200}{25} = \$8$

ANSWER PAGE FOR QUESTION 2

2a) The firm will be operating with an increasing returns to scale. This is because at 0 labor the output is 0 units, but when the labor is increased to 1, the outputs are increased to 10 units.

bi) $\frac{75-50}{3-2} =$ 25 marginal product

bii) The firm experienced diminishing marginal returns. This is because the addition of the second worker had the marginal product of an additional 30 units of output. The addition of the third unit of labor only boosted the additional output by 25 units. That is 5 less than when the second worker was added on.

biii) $(2 \cdot \$75) + (3 \times 200) = \$750 = ATC$

$150 + 600 = 750$

biv) The lowest output price at which the 3rd unit of labor would be hired is $8 per output.

GO ON TO THE NEXT PAGE.

2C

ANSWER PAGE FOR QUESTION 2

2A. IF THE FIRM USES ONE UNIT OF CAPITAL AND ONE UNIT OF LABOR, IT WILL BE OPERATING WITH INCREASING RETURNS TO SCALE BECAUSE FROM 0 LABOR WITH CAPITAL 1 PRODUCING 0 OUTPUT, IT GOES TO 1 LABOR WITH CAPITAL 1 PRODUCING 10 OUTPUT. THE RETURNS ON THE TABLE INCREASE.

2Bi. MARGINAL PRODUCT FOR THIRD UNIT $= \frac{75 - 50}{3 - 2} = 25$

2Bii. THE FIRM DID NOT EXPERIENCE DIMINISHING MARGINAL RETURNS WITH THE ADDITION OF THE THIRD UNIT OF LABOR BECAUSE INSTEAD OF PAYING ~~$0.140~~ $17.00 PER PRODUCT MADE THEY PAY ~~$10.00~~ $10.00 PER PRODUCT MADE

2Biii. AVERAGE TOTAL COST FOR CURRENT LEVEL $= \frac{(75)(2) + (200)(3)}{75}$

$= 10$

2BIV. IF THE FIRM'S OUTPUT IS SOLD IN A COMPETITIVE MARKET, THE LOWEST OUTPUT PRICE AT WHICH THE THIRD UNIT OF LABOR WOULD BE HIRED WOULD BE THE PRICE OF THE PRODUCT IN THE MARKET, SO AT LEAST THEY'D BREAK EVEN.

GO ON TO THE NEXT PAGE.

AP® MICROECONOMICS
2017 SCORING COMMENTARY

Question 2

Overview

The question assessed students' ability to apply the concept of returns to scale for a given input–output table based on the variation of the inputs (labor and capital) in the long run and short run under the assumption of perfectly competitive input markets. Students also needed to demonstrate knowledge of how to calculate marginal product, how to determine where diminishing marginal returns set in, how to calculate average total costs, and how to determine the number of workers a firm should hire to maximize profit, using the marginal product of labor, the wage rate, and the product price.

The question provided a production data table that shows the output produced using varying levels of labor and capital. In part (a) students were expected to use the data in the table to recognize that the firm operates with increasing returns to scale. Using 1 unit of labor and 1 unit of capital results in producing 10 units of output. When the inputs are doubled, 2 units of labor and 2 units of capital results in producing 50 units of output. Therefore, when both inputs are doubled, output more than doubles so the firm operates with increasing returns to scale.

In part (b)(i), using data in a table, students were expected to calculate the marginal product of labor by applying the formula $\frac{\Delta TP}{\Delta L}$. In part (b)(ii) students were asked to recognize that the firm experiences diminishing marginal returns and explain that this is because the marginal product of the additional worker hired is less than the marginal product of the previously hired worker. Part (b)(iii) required students to calculate the average total cost using the formula $\frac{TC}{Q} = ATC \text{ or } AVC + AFC = ATC$. Finally, in part (b)(iv), students were asked to identify the lowest price at which the additional unit of labor would be hired. This required the student to understand that (1) the marginal revenue product of labor must be equal to the marginal resource (factor) cost; (2) that the marginal resource (factor) cost is equal to the wage; (3) that the marginal revenue product of labor is equal to the marginal revenue times the marginal product; and (4) that the marginal revenue is equal to the product price when markets are perfectly competitive. This results in finding the lowest product price that the firm will charge in order to hire the third worker: $\mathrm{P} = \frac{\mathrm{W}}{\mathrm{MP}}$.

Sample: 2A
Score: 5

The student answers all parts of the question correctly and earned all 5 points.

Sample: 2B
Score: 3

The student earned 1 point in part (b)(i) for correctly calculating the marginal product (MP) for the third unit of labor as 25 units and showing the work: $\frac{75-50}{3-2}$. The student earned 1 point in part (b)(ii) for explaining that the firm experiences diminishing marginal returns with the addition of the third unit of labor and for explaining that the MP of the third unit of labor (25 units) is less than the MP of the second unit of labor (30 units). The student earned 1 point in part (b)(iv) for correctly determining the lowest output price, at which the third unit of labor would be hired, as $8.

Question 2 (continued)

Sample: 2C
Score: 2

The student earned 1 point in part (b)(i) for correctly calculating the marginal product for the third unit of labor as 25 units and showing the work $\frac{75-50}{3-2}$. The student earned 1 point in part (b)(iii) for correctly calculating the firm's average total cost (ATC) as $10 and for showing the work: $\frac{(750*2)+(200*3)}{75}$.