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### **Homework #3 (due by 9:00pm on Friday, March 2)**

*Please submit your answers to this homework through the Assignment link at Blackboard. **No credit will be given for answers submitted in class or emailed to the professor, regardless of the excuse.** This includes unique excuses like the police confiscated my computer right before I was going to submit it, excuses like “I lost my Internet”, etc. Please note that all submissions are final, again – regardless of the excuse (which includes “I accidentally hit the submit button”). Note that Blackboard allows you to save your answers, but you must hit the “Save and Submit” button to submit your answers. If you are unfamiliar with Blackboard, then it would be a good idea to visit the class page at Blackboard and check out the homework assignments as they are posted.*

Please note that when Blackboard grades homework answers, more specifically – answers to the fill-in-the-blank questions – your answer must match exactly with the answer that Blackboard is looking for. Below, you’ll find some instructions on how to properly format these answers. Reading this section is strongly recommended.

#### **Homework Questions 1-3, 5, 6 and 8**

Formatting matters with the answers in these questions. For this reason, **understand that your answer can be technically correct but graded as wrong because you didn't follow the directions provided below.** Given that formatting is considered part of your answer, a wrongly formatted answer is still a wrong answer.

*Please note the following comments below.*

*(a) **On questions #1, #2, #3, and #5**, please express your answer in terms of dollars, not dollars and cents. I.e., please round your answer to the nearest whole dollar. E.g., if you calculate AC as \$152.10, then express your answer as \$152 and not \$152.10, 152.10 or 152.*

*(b) **On question #6**, please express your answer as a decimal rounded to the nearest tenth and not as a fraction. E.g., if you calculate APL as 10/20 or 15/20, then write your answer as 0.5 or 0.8 respectively, and not 1/2 for 10/20 or 0.75 or 3/4 for 15/20.*

*(c) **On question #8**, please express your answer in terms of dollars **and** cents. I.e., please round your answer to the nearest whole cent. E.g., if you calculate profit as \$152.10, then express your answer as \$152.10 and not \$152, 152 or 152.10.*

*(d) **On question #8**, if you get a loss for your answer, then include the negative sign and leave no space between that negative sign and the dollar sign. E.g., you would write a \$55 loss as -\$55.00 and not as - \$55.00.*

*If you have any questions about the comments above, then please ask them before submitting your homework for grading. Once homework is submitted, it's too late to make any changes.*

### Homework #3 Questions

1. A firm has the following costs ( $q$  = output,  $TC$  = total costs,  $MC$  = marginal costs):

$$\begin{array}{ll} TC = \$40 & \text{if } q = 0 \\ TC = 0.5q^3 - 4q^2 + 5q + 100 & \text{if } q > 0 \\ MC = 1.5q^2 - 8q + 5 & \text{if } q > 0 \end{array}$$

*Based on the equations above, please calculate the various types of cost below and remember to express your answer in terms of dollars, not dollars and cents.*

- If this firm produces 10 units of output, then the firm's average cost is \_\_\_\_\_
- If this firm produces 10 units of output, then the firm's average variable cost is \_\_\_\_\_
- If this firm produces 10 units of output, then the firm's average fixed cost is \_\_\_\_\_
- If this firm produces 10 units of output, then the firm's sunk cost is \_\_\_\_\_
- If this firm produces 10 units of output, then the firm's recoverable fixed cost is \_\_\_\_\_

2. Assume that a profit-maximizing, perfectly competitive firm is producing where economic profit is equal to zero. The firm's output is 10 units and the market price is \$100. The firm has \$50 in recoverable fixed costs and average variable cost of \$80.

Given this information, the amount of sunk cost for the firm is \_\_\_\_\_

3. Assume that a profit-maximizing, perfectly competitive firm (not the firm in the previous question) is producing at what we defined in class as the shut down point. The firm's output is 100 units and the market price is \$50. The firm has \$400 in sunk cost and average variable cost of \$40.

Given this information, the profits of this firm are equal to \_\_\_\_\_

4. Below, you have 3 different long run production functions (where  $Q$  = output,  $K$  = capital,  $L$  = labor). Using the definition for returns to scale, match each production function (on the left) to the type of returns to scale that function exhibits (on the right).

#### Long Run Production Function

a.  $Q = 10(\sqrt{K^3 \cdot L^3})$

b.  $Q = 50(\sqrt{K \cdot L})$

c.  $Q = 4(\sqrt[3]{K \cdot L})$

#### Returns to Scale

A. constant returns to scale

B. increasing returns to scale

C. decreasing returns to scale

5. Assume that a firm has the following costs ( $q$  = output,  $TC$  = total costs,  $MC$  = marginal costs):

$$\begin{array}{ll} TC = \$400 & \text{if } q = 0 \\ TC = 2q^2 + 20q + 600 & \text{if } q > 0 \\ MC = 4q + 20 & \text{if } q > 0 \end{array}$$

*Based on the equations above, please calculate the various types of cost below. Remember to express your answer in terms of dollars, not dollars and cents.*

- If we assume this firm operates under profit maximizing principles and that the market price is \$100, then the firm's average cost (AC) is equal to \_\_\_\_\_
- If we assume this firm operates under profit maximizing principles and that the market price is \$100, then the firm's average variable cost (AVC) is equal to \_\_\_\_\_
- If we assume this firm operates under profit maximizing principles and that the firm is producing 20 units of output, then the profit for this firm is equal to \_\_\_\_\_

6. Firm A is a relatively small distribution firm that transports the goods produced by different manufacturers to various retail locations in the Greater Louisville area. The firm has its own capital, secretarial staff and managers, but hires all other laborers (dock workers and drivers) on a daily basis from a temporary services company.

Given the above, we can state the following about firm A:

- Labor is variable.* I.e., the output of firm A depends entirely on how many dock workers and drivers are hired on any given day.
- Capital is fixed.* I.e., no matter how much output may change from day to day, firm A uses the same fixed quantity of capital (e.g. warehouse, office space, forklifts and trucks).
- Assume that firm A's daily output can be calculated by using this production function:  
$$Q = 50\sqrt{5L}$$

*If the production function doesn't appear correctly on your computer, it should say that  $Q$  is equal to 50 multiplied by the square root of ( $5 \times L$ ), or alternatively as  $Q = 50(5L)^{0.5}$  (where  $L$  is a variable for the quantity of labor).*

- If this firm hires 5 units of labor, then the average product of labor for this firm would be equal to \_\_\_\_\_
- If this firm increases the quantity of labor hired from 5 units to 6 units, then the marginal product of labor for this firm would be equal to \_\_\_\_\_

7. Let's assume that you run a company where labor is the only variable factor (both capital and land are fixed factors). You sell widgets that are very inexpensive and you hire low skilled labor (because making cheap widgets doesn't require much skill), so the wage is fairly low (assume no minimum wage). Assume further that you have a production function equation which tells you how much output you get for different amounts of labor.

The information described above is given below. Use this information to answer the question.

- Price of widgets:  $P = \$5$
- Wage (of each unit of labor that produces widgets):  $w = \$25$
- The production function equation:  $Q = 10\sqrt{5L}$

*If the production function doesn't appear correctly on your computer, it should say that  $Q$  is equal to 10 multiplied by the square root of  $(5 \times L)$ , or alternatively as  $Q = 10(5L)^{0.5}$  (where  $L$  is a variable for the quantity of labor).*

At this point, you must decide upon how many units of labor to hire. Making your decision should involve the use of marginal analysis, where you consider the marginal benefit and marginal cost of hiring specific amounts of labor. Based upon your analysis, choose the (overall) amount of labor from the list below that should be hired in this example.

- 1 unit of labor
- 2 units of labor
- 3 units of labor
- 4 units of labor
- 5 units of labor
- 6 units of labor
- 7 units of labor
- 8 units of labor
- 9 units of labor
- none of the above

8. The questions in parts a-d below relate to Output-Cost table on the following page. Assume that the information in this table is taken from a single perfectly competitive firm that follows the basic profit maximizing principles discussed in class and the textbook.

Remember to express your answers in terms of dollars and cents. *To avoid “round off error” in the calculation of profit – please calculate profit using the following equation:  $\pi = (PQ - TC)$*

a. Assume that this perfectly competitive firm is operating as a profit maximizer when producing 15 units of output. If so, then this firm’s current profits are equal to \_\_\_\_\_

Today, the market price is \$4.90 (i.e.  $P = 4.9$ )

b. The highest possible profits in this situation would be equal to \_\_\_\_\_

Suppose industry demand increases, causing the market price to become \$6.30 (i.e.  $P = 6.3$ )

c. The highest possible profits in this situation would be equal to \_\_\_\_\_

Industry demand increases again, causing the market price to become \$9.80 (i.e.  $P = 9.8$ )

d. The highest possible profits in this situation would be equal to \_\_\_\_\_

***Multiple Choice Question #9 refers to the Output-Cost table (below).***

9. Assume that the market price is currently equal to \$8.20 (i.e.  $P = 8.2$ ), and that demand within the market is expected to remain unchanged (i.e. firms expect that the conditions which led to  $P = 8.2$  are a permanent or long run change).

Given the level of profit that this firm would earn in the short run, and the demand which led to that profit level is expected to remain unchanged, predict how this market should change or adapt over the long run?

a. There will be no changes in this market over the long run (i.e. firms are currently in a long run equilibrium).

b. Firms in this market will shut down in the long run

c. Existing firms in this market will either contract or exit the market in the long run

d. Existing firms in this market will expand or new firms will enter this market in the long run.

### Firm A's Output and Costs:

<b>Firm's output</b>	<b>Total Costs</b>	<b>Marginal Costs</b>	<b>Average Variable Costs</b>
0	60.0	-	-
1	84.8	4.6	4.8
2	89.3	4.3	4.6
3	93.5	4.1	4.5
4	97.4	3.9	4.4
5	101.3	3.8	4.3
6	105.0	3.7	4.2
7	108.6	3.6	4.1
8	112.3	3.7	4.04
9	116.1	3.8	4.01
10	120.0	4.0	4.0
11	124.1	4.2	4.01
12	128.5	4.5	4.04
13	133.2	4.9	4.1
14	138.2	5.3	4.2
15	143.8	5.8	4.3
16	149.8	6.3	4.4
17	156.3	6.9	4.5
18	163.5	7.5	4.6
19	171.4	8.2	4.8
20	180.0	9.0	5.0
21	189.4	9.8	5.2
22	199.7	10.7	5.4
23	210.9	11.7	5.7
24	223.0	12.7	6.0
25	236.3	13.8	6.3

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*Note: The values in each (cost) column were rounded off to the nearest single decimal point – except when it was important to distinguish between various rows. Round-off error may arise in the calculation of profit, causing answers to vary slightly between the two approaches discussed in class (i.e. between the  $(P - AC)Q$  approach and the  $(PQ - TC)$  approach).*