## Study Problems

1. For each of the firm's decisions, determine whether the manager is making a decision in the short run or the long run.

   _____ a. Eckerd's decides to stay open 24 hours a day rather than 16 hours a day.

   _____ b. Harley Davidson builds another production facility.

   _____ c. American Airlines restructures its flight schedules to increase the percentage of seats filled on each of its flights.

   _____ d. Dell Computer adds more workers in its shipping department to speed delivery of new PC orders.

2. Fill in the blanks in the following table:

| *Usage of Variable Input* | *Total Product* | *Marginal Product* | *Average Product* |
|---|---|---|---|
| 1..... | _____ | _____ | 4 |
| 2..... | _____ | 8 | _____ |
| 3..... | 18 | _____ | _____ |
| 4..... | _____ | _____ | 5 |
| 5..... | _____ | –5 | _____ |

The wage rate is $12 per unit of labor. After completing the table, answer the following questions:

a. After _____ units of labor usage, the firm experiences diminishing returns.

b. At _____ units of labor, *SMC* = *AVC*.

c. The level of output at which *SMC* = *AVC* is _____ units of output.

d. Minimum average variable cost = $_____.

e. At the level of labor usage and associated output for which *SMC* = *AVC*, marginal cost = $_____.

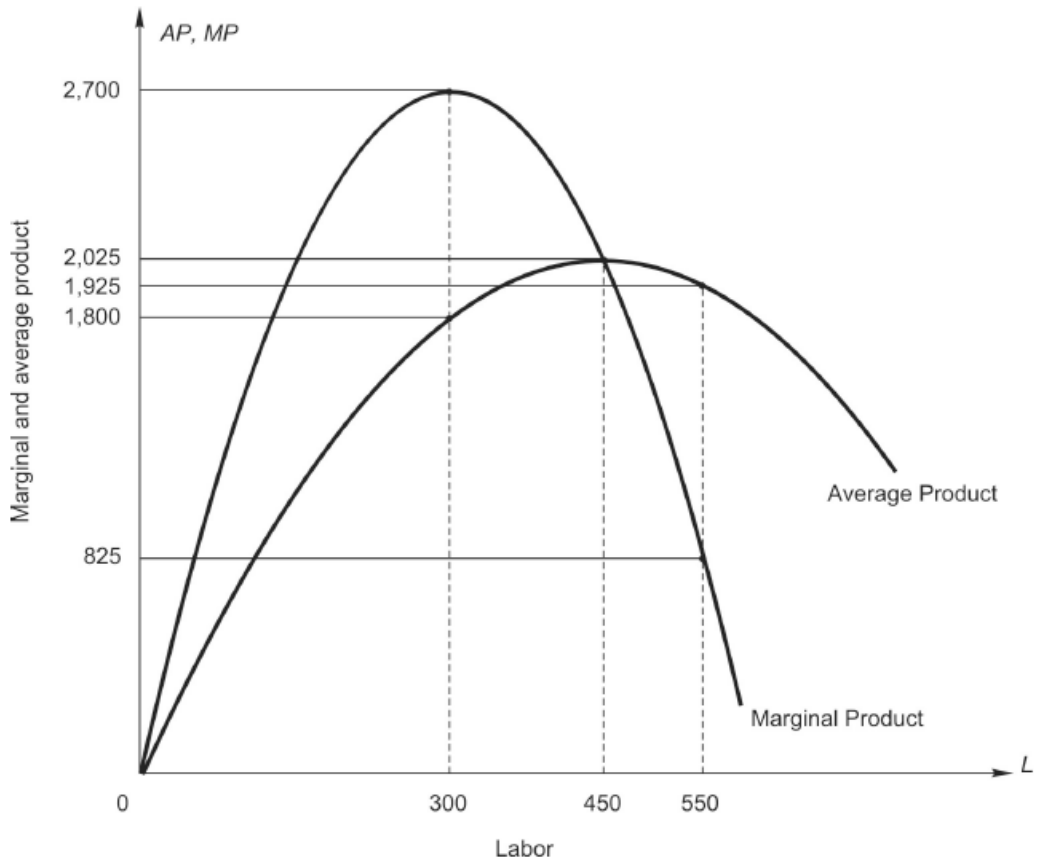
3. Consider a firm using a single variable input and a single fixed input, capital. When the amount of capital is increased:

   a. the total product curve will _____.

   b. the average product curve will _____.

   c. the marginal product curve will _____.

4. Assume labor—the only variable input of a firm—has average and marginal product curves shown in the following figure. The price of labor is $1,000 per unit (i.e., $w$ = $1,000).




a. At minimum average variable cost, the firm employs _____ units of labor.

b. Minimum average variable cost is reached at _____ units of output.

c. At its minimum value, average variable cost is $_____.

d. Marginal cost reaches its minimum value at _____ units of labor usage, which corresponds to _____ units of output.

e. At its minimum value, marginal cost is $_____.

f. The average variable cost when 550 units of labor are employed is $_____.

g. The marginal cost when 550 units of labor are employed is $_____.

5. Use the figure below to answer these questions:

At 200 units of output, find the following costs:

a. *AFC* = _____

b. *AVC* = _____

c. *ATC* = _____

d. *TFC* = _____

e. *TVC* = _____

f. *TC* = _____

g. *SMC* = _____

At 600 units of output, find the following costs:

h. *AFC* = _____

i. *AVC* = _____

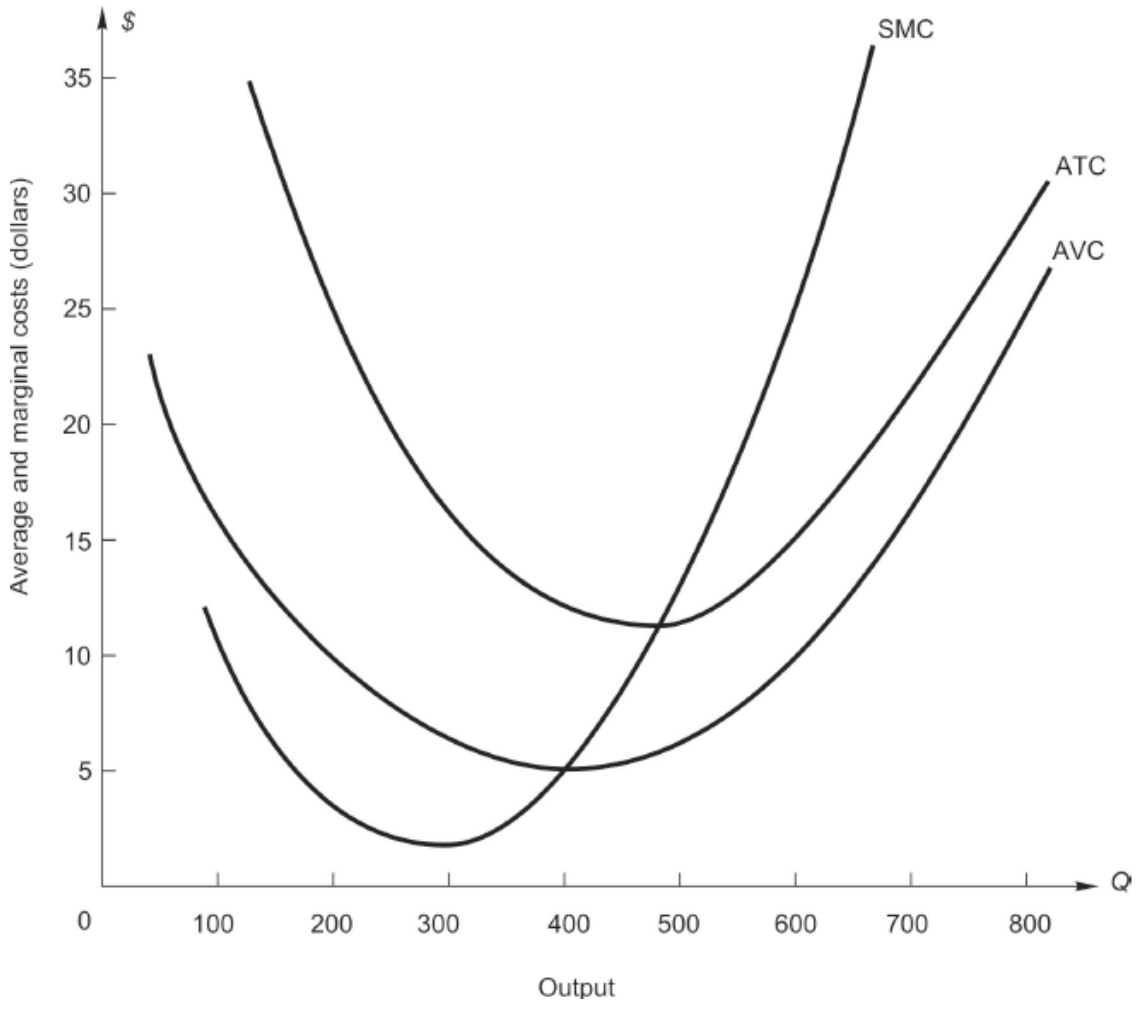
j. *ATC* = _____

k. *TFC* = _____

l. *TVC* = _____

m. *TC* = _____

n. *SMC* = _____



6. Total fixed cost is $150 per week and the price per week of labor is $500 per worker. Fill in the blanks in the table below:

| | *Product* | | | *Total Cost* | | | *Average Cost* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Labor* | *Total* | *Average* | *Marginal* | *Fixed* | *Variable* | *Total* | *Fixed* | *Variable* | *Total* | *Marginal Cost* |
| 0 | 0 | xx | xx | ____ | _____ | _____ | xx | xx | xx | xx |
| 1 | 2 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 2 | 5 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 3 | 10 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 4 | 16 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 5 | 25 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 6 | 30 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 7 | 34 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 8 | 37 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 9 | 39 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |
| 10 | 40 | _____ | _____ | ____ | _____ | _____ | ____ | _____ | _____ | ____ |

## Answers

1. a. short run; This decision involves increasing the usage of a fixed input, the store.
   b. long run; A new plant allows increased usage of capital inputs that are fixed in the short run.
   c. short run; American Airlines is still using the same number of planes (presumably a fixed input in the short run), but using the planes more intensively.
   d. short run; Dell did not increase the capital resources employed by the shipping department; it is just using more of the variable input labor.

2. The table should look like this:

| *Usage of Variable Input* | *Total Product* | *Marginal Product* | *Average Product* |
|---|---|---|---|
| 1..... | 4 | 4 | 4 |
| 2..... | 12 | 8 | 6 |
| 3..... | 18 | 6 | 6 |
| 4..... | 20 | 2 | 5 |
| 5..... | 15 | –5 | 3 |

   a. 2; *MP* begins to fall after 2 units of labor are employed.
   b. 3; *SMC* will equal *AVC* when $MP = AP$.
   c. 18; *TP* is 18 at $L = 3$
   d. \$2; $AVC = w/AP = 12/6$
   e. \$2; $SMC = w/MP = 12/6$

3. a. increase (shift upward)
   b. increase (shift upward)
   c. increase (shift upward)

4. a. 450; *AVC* is minimized when *AP* is maximized.
   b. 911,250; Since $AP = Q/L$, $2{,}025 = Q/450 \Rightarrow Q = 911{,}250$.
   c. \$0.49; $AVC = w/AP \Rightarrow \$1{,}000/2{,}025$.
   d. 300; 540,000; *SMC* is minimized at the level of labor usage where *MP* is maximized. Since $AP = Q/L$ and $AP = 1{,}800$ at $L = 300$, then $1{,}800 = Q/300 \Rightarrow Q = 540{,}000$.
   e. \$0.37; $SMC = w/MP = \$1{,}000/2{,}700$
   f. \$0.52; $AVC = w/AP = \$1{,}000/1{,}925$
   g. \$1.21; $SMC = w/MP = \$1{,}000/825$

5. a. \$15; the vertical distance between *ATC* and *AVC* at $Q = 200$.
   b. \$10; read this off the *AVC* curve at $Q = 200$
   c. \$25; read this off the *ATC* curve at $Q = 200$
   d. \$3,000; $TFC = AFC \times Q = 15 \times 200$
   e. \$2,000; $TVC = AVC \times Q = 10 \times 200$
   f. \$5,000; $TC = ATC \times Q = 25 \times 200$ or $TC = TVC + TFC = 3{,}000 + 2{,}000$
   g. about \$4; read this off the *SMC* curve at $Q = 200$
   h. \$5; the vertical distance between *ATC* and *AVC* at $Q = 600$

i. $10; read this off the *AVC* curve at $Q = 600$

j. $15; read this off the *ATC* curve at $Q = 600$

k. $3,000; $TFC = AFC \times Q = 5 \times 600$

l. $6,000; $TVC = AVC \times Q = 10 \times 600$

m. $9,000; $TC = ATC \times Q = 15 \times 600$ or $TC = TVC + TFC = 3{,}000 + 6{,}000$

n. $25; read this off the *SMC* curve at $Q = 600$

6. Your table should look like this:

| | *Product* | | | *Total Cost* | | | *Average Cost* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Labor* | *Total* | *Average* | *Marginal* | *Fixed* | *Variable* | *Total* | *Fixed* | *Variable* | *Total* | *Marginal Cost* |
| 0 | 0 | 0 | xx | 150 | 0 | 150 | xx | xx | xx | xx |
| 1 | 2 | 2 | 2 | 150 | 500 | 650 | 75 | 250 | 325 | 250 |
| 2 | 5 | 2.5 | 3 | 150 | 1,000 | 1,150 | 30 | 200 | 230 | 166.67 |
| 3 | 10 | 3.3 | 5 | 150 | 1,500 | 1,650 | 15 | 150 | 165 | 100 |
| 4 | 16 | 4 | 6 | 150 | 2,000 | 2,150 | 9.37 | 125 | 134.37 | 83.33 |
| 5 | 25 | 5 | 9 | 150 | 2,500 | 2,650 | 6 | 100 | 106 | 55.55 |
| 6 | 30 | 5 | 5 | 150 | 3,000 | 3,150 | 5 | 100 | 105 | 100 |
| 7 | 34 | 4.85 | 4 | 150 | 3,500 | 3,650 | 4.41 | 102.94 | 107.35 | 125 |
| 8 | 37 | 4.62 | 3 | 150 | 4,000 | 4,150 | 4.05 | 108.11 | 112.16 | 166.67 |
| 9 | 39 | 4.33 | 2 | 150 | 4,500 | 4,650 | 3.85 | 115.38 | 119.23 | 250 |
| 10 | 40 | 4 | 1 | 150 | 5,000 | 5,150 | 3.75 | 125 | 128.75 | 500 |