

Part 1

Let us consider an orange grove. When the grove began in the 1950s, the orange trees were planted. Today, you have purchased the grove. The trees must be watered and fertilized. You have drip irrigation on timers to take care of the watering. You hire workers to do the fertilizing. Workers also keep the area clear of competing vegetation, using a small tractor. Herbicides may be applied by the workers. Workers also remove trees that have died and plant new ones from seedlings. The main chore for the workers is the picking of the oranges and the hauling of them to the processor. There are some buildings needed to keep the tractor and other equipment.

This is a reasonable description of an orange grove. Let us examine the costs. Let us assume that we hire six full-time workers (or the equivalent). Each is paid \$12,000 per year (\$1,000 per month), making the labor cost equal \$72,000. The company has buildings. It has machinery, such as the tractor, the trucks, saws, shovels, and so forth. Our measure of cost here is the part of the building and machines used up during the year (called depreciation). Finally, the company buys chemical fertilizers and herbicides. Chemical fertilizers are capital because they are made by people for the purpose of being used in production. Let us assume that the cost of all of this capital for the year is \$16,000. Let us assume that the owner paid \$400,000 for the grove and the capital; this money could have been earning 5% interest. We shall assume here that owner does not work in this business.

The **explicit costs** of owning the orange grove are \$_____.

The **implicit costs** of owning the orange grove are \$_____.

The **variable costs** of owning the orange grove are \$_____.

The **fixed costs** of owning the orange grove are \$_____.

The **total economic cost** of owning the orange grove is \$_____.

If we assume that we sell 180,000 pounds of oranges during the year at a price of \$0.60 per pound, the grove would receive a total revenue of \$108,000. We would say that the **economic profit** is equal to \$_____.

What does this mean?

If the price had been \$0.70 per pound, the revenue received would have been \$126,000. The economic profit would have been \$_____.

What does this mean?

Part 2

Let us assume that you are the owner of an orange grove. The orange grove has its land, buildings, and machinery. These are the fixed factors of production. Let us focus on only one of the variable factors of production: labor. The following table describes the relation between the number of pounds of oranges sold per year and the number of workers hired. Assume that all oranges are the same. This relation is known as a **production function**.

<u>Number of Workers</u>	<u>Number of Pounds Per Year</u>
0	0
1	10,000
2	40,000
3	90,000
4	130,000
5	160,000
6	180,000
7	192,000
8	198,000
9	200,000
10	200,000
11	190,000

In the table below, calculate the average physical product and the marginal physical product

Number of Workers	Average Physical Product	Marginal Physical Product
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

B. Ignore the cost of the capital, the cost of the natural resources, and the opportunity costs of the owner and focus only on the cost of the hired labor. Assume that each worker is paid \$12,000 per year (\$1,000 per month). What is the marginal cost for the first 10,000 pounds of oranges per year? Ignoring the other costs for now, the first 10,000 pounds require the hiring of one worker. That worker is paid \$12,000. Thus, each pound costs \$1.20 worth of labor to produce (\$12,000 divided by 10,000). The total variable cost is calculated as \$12,000 times the number of workers. The marginal cost was the change in the total cost from producing one additional pound of oranges. What is the marginal cost of the next 30,000 pounds of oranges? And so on. Use this to fill in the following table.

Workers	Quantity of Oranges	Total Variable Cost	Marginal Cost
1	10,000	\$12,000	
2	40,000	24,000	
3	90,000	36,000	
4	130,000	48,000	
5	160,000	60,000	
6	180,000	72,000	
7	192,000	84,000	
8	198,000	96,000	
9	200,000	108,000	
10	200,000	120,000	

C. Using the table on the first page, up to how many pounds of oranges are there **increasing marginal returns**? Think of the example of an orange grove. Give some **reasons** why there might be increasing marginal returns.

D. Using the table on the first page, show where there are **diminishing marginal returns**. Think of the example of an orange grove. Give some **reasons** why there might be diminishing marginal returns.

E. Examine your two tables. When the marginal physical product is rising, the marginal cost is _____. And when the marginal physical product is falling, the marginal cost is _____.

Part 3

A. Use the numbers from the last homework assignment to **calculate the average variable cost**. Then, plot the numbers on the **graph** at the end of the Part.

Quantity of Oranges	Average Variable Cost
10,000	
40,000	
90,000	
130,000	
160,000	
180,000	
192,000	
198,000	
200,000	

B. **Explain why** the average variable cost **decreases** in the case of the orange grove.

Then, **explain why** the average variable cost **increases** in the case of the orange grove.

C. Up to now, we have consider only the variable cost. But we must also consider the fixed cost. The fixed costs are generally the costs of the capital and the implicit costs. In this orange grove, the total fixed cost was \$36,000 per year. **Calculate the average fixed cost** in the following table and plot the numbers on the **graph** at the end of the Part

Quantity of Oranges	Total Fixed Cost	Average Fixed Cost
10,000	\$36,000	
40,000	36,000	
90,000	36,000	
130,000	36,000	
160,000	36,000	
180,000	36,000	
192,000	36,000	
198,000	36,000	
200,000	36,000	

D. Now we are ready to examine the **average total cost** --- the cost of producing each pound of oranges. Calculate the average total cost from the following table and then plot the points on the graph at the end of the Part.

Quantity of Oranges Per Year	Total Cost	Average Total Cost
10,000	\$48,000	
40,000	60,000	
90,000	72,000	
130,000	84,000	
160,000	96,000	
180,000	108,000	
192,000	120,000	
198,000	132,000	
200,000	144,000	

E. Notice that average cost has a U - shape. First, **explain why it declines** up to 180,000 pounds per year.

Then, **explain why it rises** after 180,000 pounds per year.

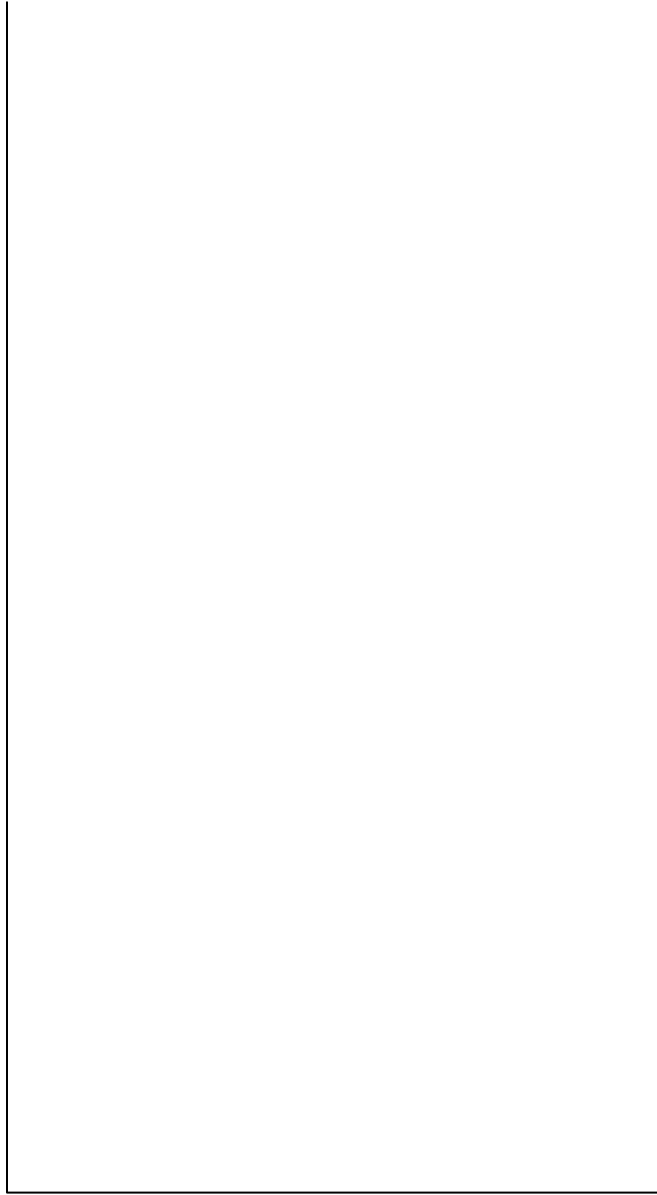
F. Compare the calculations of the average variable cost and the average total cost with those of the marginal cost in Part 2. When the average variable cost is falling, the marginal cost is _____ the average variable cost. When the average variable cost is rising, the marginal cost is _____ the average variable cost. (Answer “below” or “above”)

When the average total cost is falling, the marginal cost is _____ the average total cost. When the average total cost is rising, the marginal cost is _____ the average total cost. (Answer “below” or “above”)

G: In the number set above, when we hired the fourth worker and increased production from 90,000 pounds to 130,000 pounds, the marginal cost rose but the average variable cost fell. How do you explain this?

H: Explain why there is no relation between the marginal cost and the average fixed cost.

Price of Oranges



0

Quantity of Oranges

Part 4

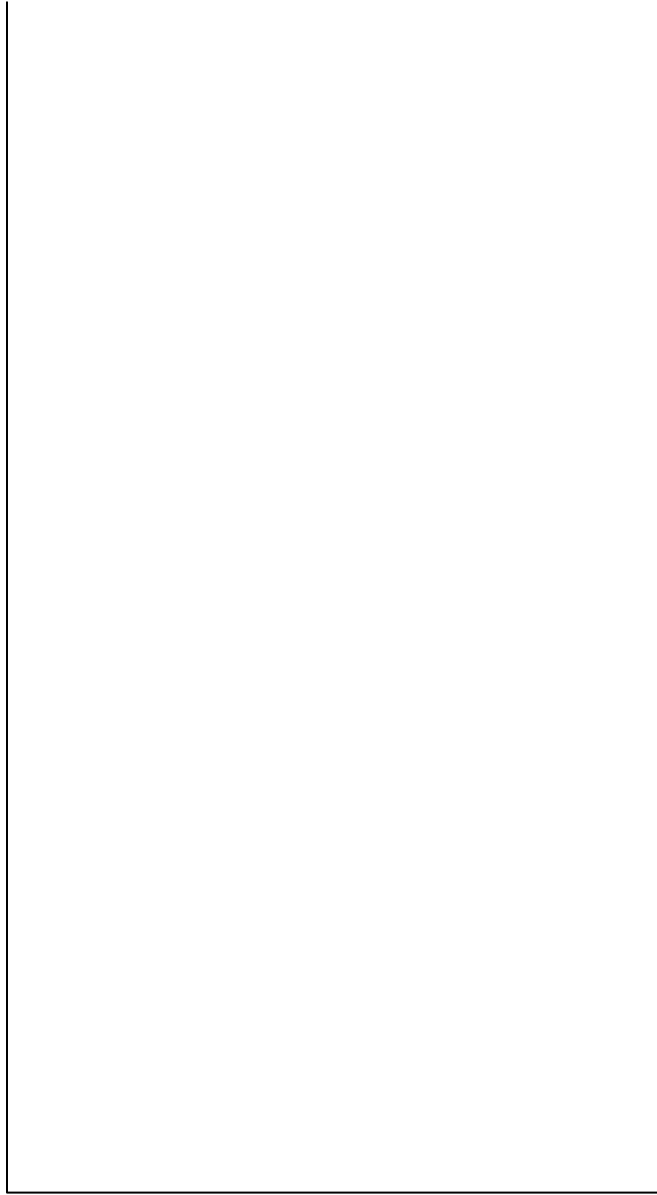
Go back to Part 3. Now, let us consider two choices in the amount of capital. One is the choice we have used then. The other is a larger grove with more machinery; the total amount of land, capital, and implicit cost is now \$54,000, instead of \$36,000. The larger amount of capital means that we do not need as many workers. The machinery can do some of the work that people were previously doing. And the additional machinery makes the remaining workers more productive. To simplify, let us assume that the reduced need for labor lowers the average variable cost by \$0.15 per pound for each pound of oranges produced. Calculate the new average fixed cost, the new average variable cost, and the new average total cost for the larger grove: (For the Average Variable Cost, subtract \$0.15 from the Average Variable Cost you calculated in Part 3.)

Quantity	Average Fixed Cost	Average Variable Cost	Average Total Cost
10,000			
40,000			
90,000			
130,000			
160,000			
180,000			
192,000			
198,000			
200,000			

Show the graph of the original average total cost curve and the new average total cost curve on the graph paper on the back of this page. Up to _____ pounds per year, it is cheaper to produce with the smaller orange grove. Above this quantity, it is cheaper to produce with the larger orange grove. Show the relevant portions of the two average total cost curves in the graph on next page. The portion you have shown is called the _____.

Notice also that the larger orange grove, if utilized sufficiently, will allow us to produce at a lower possible cost than the smaller one. That is, with the larger orange grove, if we produce and sell 180,000 pounds per year, we can produce each pound at a cost \$0.55. There is no way we can produce a pound of oranges at a cost this low with the smaller orange grove. This phenomenon is called _____.

Price of Oranges



0

Quantity of Oranges

Part 5

1. Go back to the Homework for Chapter 14 concerning the orange grove. Assume that the company sells its product in perfect competition at a market price of \$0.60 per pound. Using the principles described in the reading, the profit-maximizing quantity is _____ and the economic profit is \$ _____

SHOW ALL CALCULATIONS

Quantity	Total Revenue	Marginal Revenue	Marginal Cost
10,000			\$1.20
40,000			.40
90,000			.24
130,000			.30
160,000			.40
180,000			.60
192,000			1.00
198,000			2.00
200,000			6.00

2. On a graph on the next page, re-draw the average total cost and the marginal cost as they were drawn for Part 3. Then, **draw the marginal revenue**. Show on the **graph** the profit-maximizing **quantity** as well as the **economic profits or losses**

3. Now assume that demand for oranges falls. Now the company sells its product in perfect competition at a market price of \$0.40 per pound. Using the principles described in the reading, the profit-maximizing quantity is _____ and the economic profit is \$ _____. **Draw the new marginal revenue**. Show on the **graph** the new profit-maximizing **quantity** as well as the new **economic profits or losses**.

Quantity	Total Revenue	Marginal Revenue	Marginal Cost
10,000			
40,000			
90,000			
130,000			
160,000			
180,000			
192,000			
198,000			
200,000			

4. Use the principles of Chapter 16 to answer the following question: since the company is making an **economic loss**, should it continue to produce in the short-run or should it shut down? Explain why.

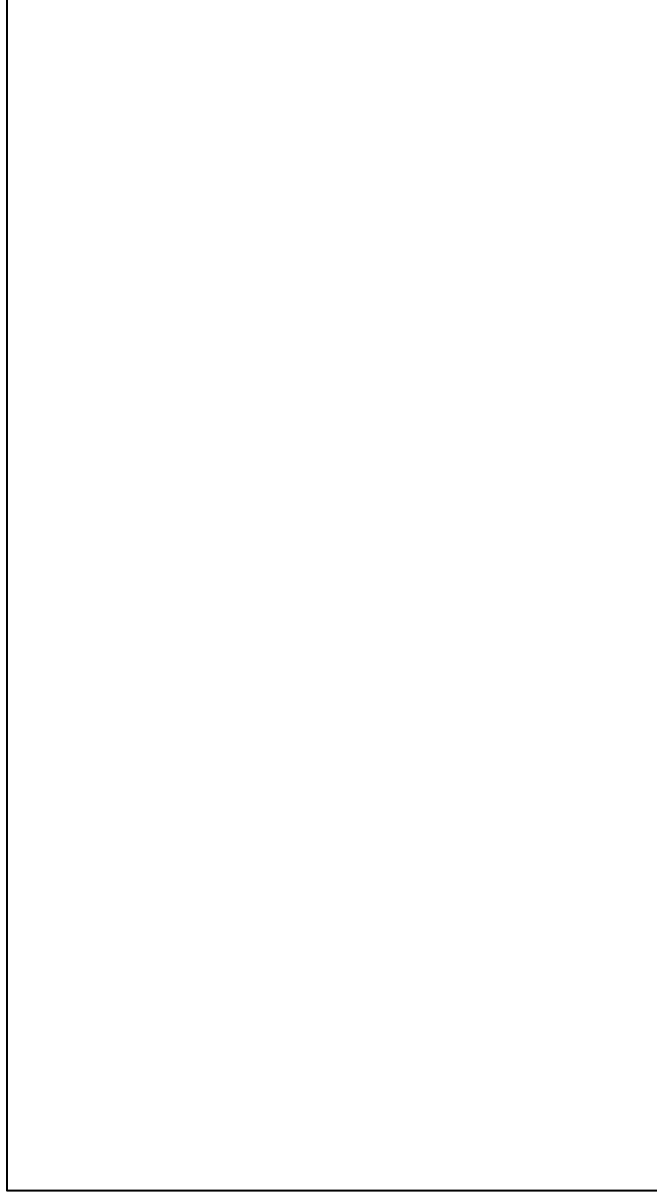
5. Assume now that the demand for oranges falls again. The company now sells its product in perfect competition at a market price of \$0.30 per pound. Using the principles described in the reading, the profit-maximizing quantity is _____ and the economic profit is \$_____

SHOW ALL CALCULATIONS

Quantity	Total Revenue	Marginal Revenue	Marginal Cost
10,000			
40,000			
90,000			
130,000			
160,000			
180,000			
192,000			
198,000			
200,000			

6. Use the principles of Chapter 16 to answer the following question: since the company is making an economic loss, should it continue to produce in the short-run or should it shut down? Explain why.

Price of Oranges



0

Quantity of Oranges

7. Fill in the following table. You are given a demand curve for oranges. Assume there are **1,000 orange groves and that they are identical**.

Price	Supply of One Grove	Industry Supply	Quantity Demanded
\$0.30			200,000,000
\$0.40			190,000,000
\$0.60			180,000,000
\$1.00			170,000,000
\$2.00			120,000,000
\$6.00			80,000,000

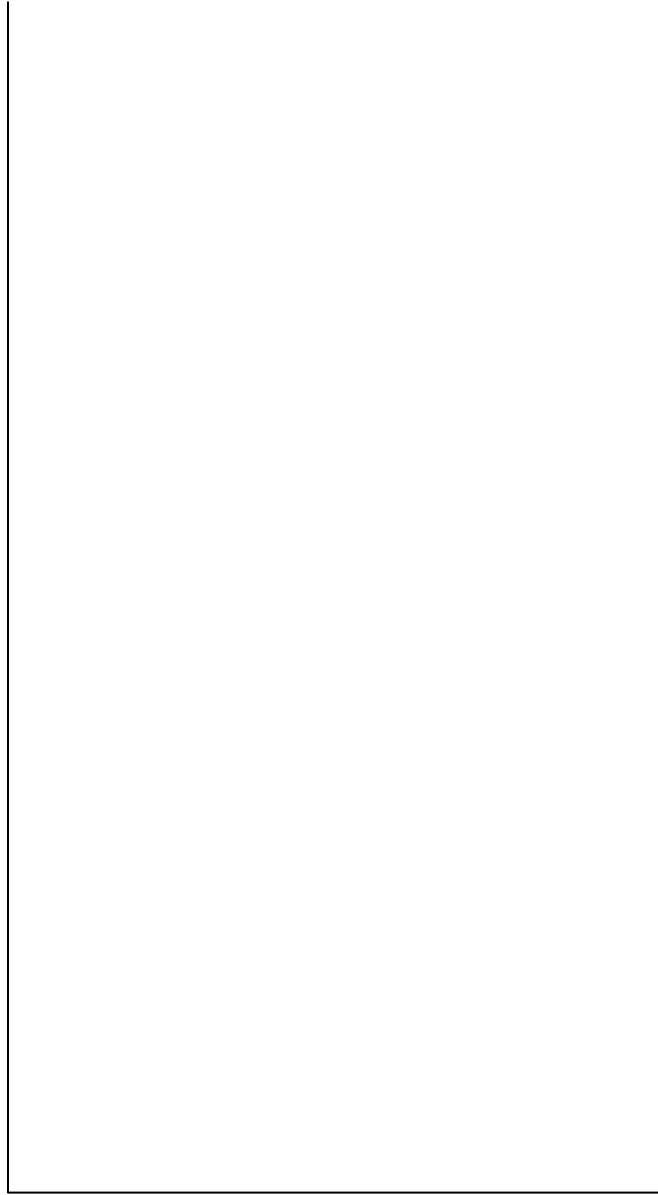
The **equilibrium quantity** of oranges is _____ and the **equilibrium price** of oranges is \$ _____.

Part 6

1. In Part 5, you filled-in the following table. Assume again that there are 1000 orange groves and that they are identical. You decided that the equilibrium price of oranges was \$0.60, that 180,000,000 pounds of oranges would be produced, and that the economic profits equaled 0. Show this situation on the **graph** (this repeats the graph from Part 5.)
2. Now assume that the **demand for oranges rises**, because it comes out that oranges are especially good for fighting disease. The new demand is shown on the table. What is the new equilibrium **price**? What is the new equilibrium **quantity** of oranges? What **economic profits** will each producer make in the short-run? (To answer this, you have to look up the costs from the previous Parts.) Show the result of the rise in demand for oranges on the **graph**.
3. Now, explain what will occur in the **long-run**. Why will this occur? Show the change of the long-run on the **graph**.

Price	Supply of One Grove	Industry Supply	Quantity Demanded	New Quantity Demanded
\$0.30	130,000	130,000,000	200,000,000	260,000,000
\$0.40	160,000	160,000,000	190,000,000	235,000,000
\$0.60	180,000	180,000,000	180,000,000	220,000,000
\$1.00	192,000	192,000,000	170,000,000	198,000,000
\$2.00	198,000	198,000,000	120,000,000	180,000,000
\$6.00	200,000	200,000,000	80,000,000	160,000,000

Price of Oranges



0

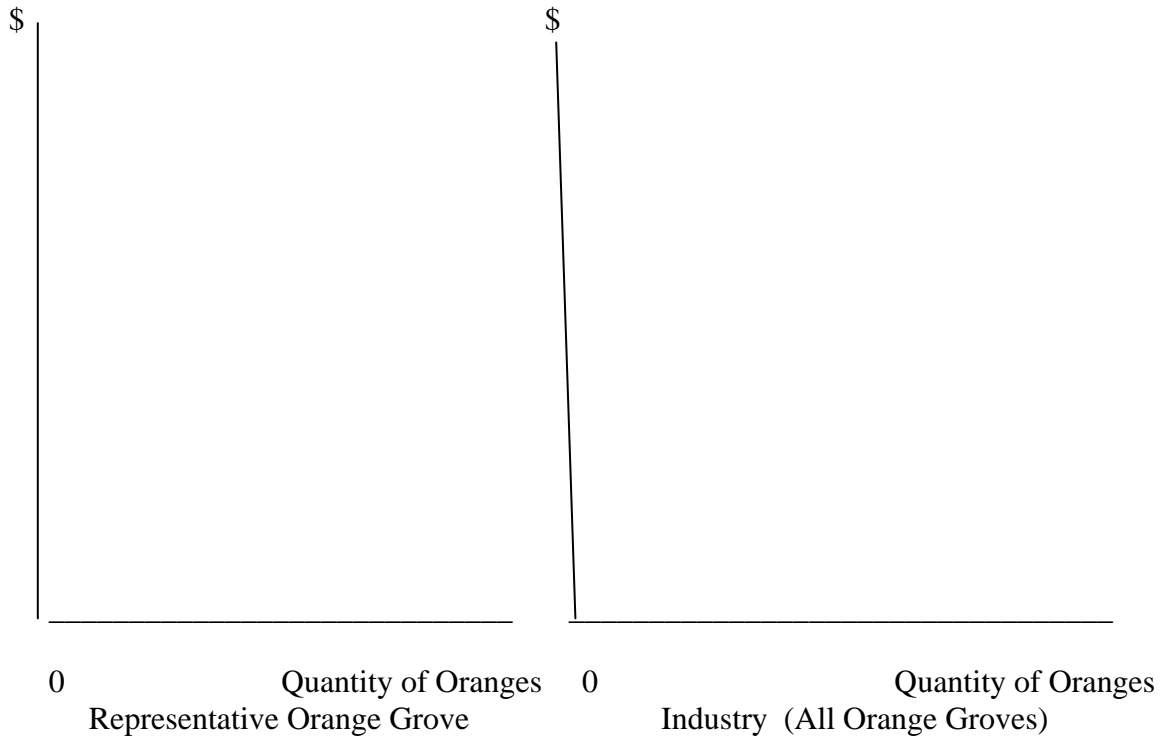
Quantity of Oranges

Part 7

Return to Part 3. The fixed costs were the costs of the capital, the land, and the opportunity costs of the owners -- \$36,000. Let us assume that **these drop by \$6,000 from \$36,000 to \$30,000** (for example, caused by a reduction in the property taxes paid). Everything else (the variable costs and the price of oranges) stays the same. The calculations now become as follows:

Quantity	Total Variable Cost	Total Fixed Cost	Total Cost	Average Total Cost	Marginal Cost	Marginal Revenue
10,000	\$12,000	\$30,000	\$42,000			\$0.60
40,000	24,000	30,000	54,000			.60
90,000	36,000	30,000	66,000			.60
130,000	48,000	30,000	78,000			.60
160,000	60,000	30,000	90,000			.60
180,000	72,000	30,000	102,000			.60
192,000	84,000	30,000	114,000			.60
198,000	96,000	30,000	126,000			.60
200,000	108,000	30,000	138,000			.60

Compare these calculations to the earlier ones. On the **graph** below, show the situation for one orange grove and for all groves, **beginning in long-run equilibrium**. Then, show the results of the change in the fixed cost.



The company maximizes profits by producing _____pounds of oranges. With 1,000 companies, the market supply is _____ pounds of oranges. Economic profits are now equal to _____.

In the **long-run**, the situation will change. New companies will be attracted by the economic profits being earned and will enter the industry. Show the results in the long-run on the graph on page 1.

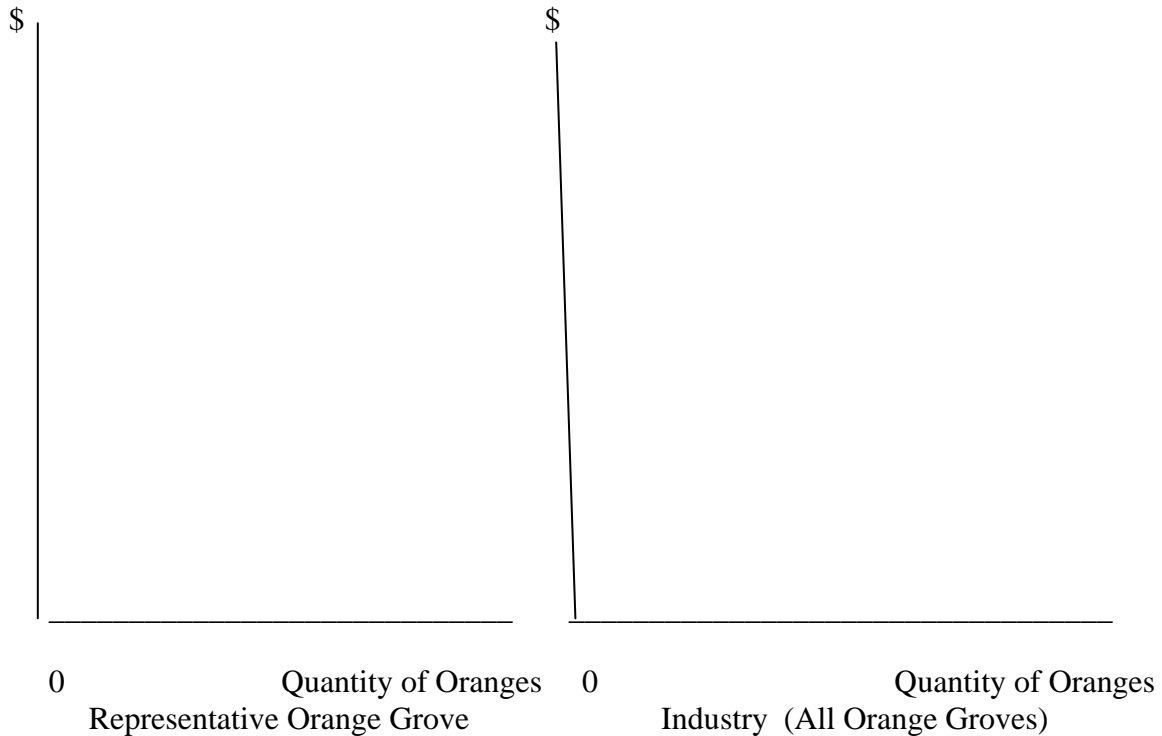
The long-run results of a decrease in a fixed cost are as follows: the quantity produced in the market is _____and the market price is _____ (answer “higher” or “lower”).

Part 8

Now, let us consider a **decrease in a variable cost of production**. The variable costs are the costs of the natural resources and the labor. Let us assume that the wages of the workers are reduced from \$12,000 to \$7,200 per year (\$600 per month). Our calculations are now as follows:

Quantity	Total Variable Cost	Total Fixed Cost	Total Cost	Average Total Cost	Marginal Cost	Marginal Revenue
10,000	\$ 7,200	\$36,000	\$43,200			\$0.60
40,000	14,400	36,000	50,400			.60
90,000	21,600	36,000	57,600			.60
130,000	28,800	36,000	64,800			.60
160,000	36,000	36,000	72,000			.60
180,000	43,200	36,000	79,200			.60
192,000	50,400	36,000	86,400			.60
198,000	57,600	36,000	93,600			.60
200,000	74,800	36,000	100,800			.60

Compare these calculations to the original calculations. Show the changes in the **graphs** below. Begin your graph in **long-run equilibrium**.



The company will maximize profits at that quantity for which the marginal revenue equals the marginal cost. This is now _____ pounds of oranges. One company increasing quantity will have no effect on the market. But if all companies increase quantity, the result is to create a surplus in the market. Show the change in supply on the graph for all orange groves. The result is that the price _____ (rise or fall?). The individual company must now respond to the new price. **Show the new price equals marginal revenue line.** Then, show the **new quantity produced** by a representative orange grove as point c. Show the **total industry equilibrium** as point C. Show the individual orange grove's **economic profit** on the **graph**.

The analysis thus far has been confined to the short-run. In the **long-run**, there will be a response to the economic profits that are now being earned. New companies will enter the industry. Show the change on the **graphs** above. In the space below, explain what you did and **what happened to the price, the quantity produced, and the economic profits.**

When the new long-run equilibrium is reached, who gains from the reduction in the workers' wages?

Part 9

Return to the case of the orange grove from the homework to previous chapters. Assume that all groves sell their oranges through one cooperative. **This cooperative acts as a pure monopoly.** Assume that, at a price of \$1.50 per pound, the monopoly cooperative will sell 10,000 pounds of oranges. Every time the price is lowered by 5 cents per pound, another 10,000 pounds will be sold. This is shown below. Fill in the table. The average total cost and the marginal cost are repeated from the previous homework assignments.

Quantity Price Total Revenue Marginal Revenue Average Total Cost Marginal Cost

10,000	\$1.50			\$4.80	\$1.20
20,000	1.45				
30,000	1.40				
40,000	1.35			1.50	0.40
50,000	1.30				
60,000	1.25				
70,000	1.20				
80,000	1.15				
90,000	1.10			0.80	0.24
100,000	1.05				
110,000	1.00				
120,000	0.95				
130,000	0.90			0.65	0.30
140,000	0.85				
150,000	0.80				
160,000	0.75			0.60	0.40
170,000	0.70				
180,000	0.65			0.60	0.60
190,000	0.60				
200,000	0.55			0.72	6.00

The **quantity** that the monopolist will choose in order to maximize profits is _____.
Explain the reason that this quantity will be produced.

The **price** that this monopolist will charge is \$_____.

The **economic profits** that this monopolist will earn will equal \$_____.
Show calculations.

Chapter 25: Homework

In Chapter 14, you were given homework concerning an orange grove. The following table described the relation between the number of pounds of oranges sold per year and the number of workers hired. This was the **production function**. You were asked to calculate the marginal physical product (MPP). Refer back to that homework.

<u>Number of Workers</u>	<u>Number of Pounds Per Year</u>
0	0
1	10,000
2	40,000
3	90,000
4	130,000
5	160,000
6	180,000
7	192,000
8	198,000
9	200,000
10	200,000
11	190,000

You were also given that the price of oranges was \$0.60 per pound and that the wage paid to each worker was \$12,000 per year. Assume that oranges are sold in a perfectly competitive product market and that the workers are hired in a perfectly competitive labor market.

In the table below, calculate the **marginal revenue product** & the **marginal resource cost**.

<u>Workers</u>	<u>MPP</u>	<u>Price</u>	<u>Marginal Revenue Product</u>	<u>Wage</u>	<u>Marginal Resource Cost</u>
1		\$0.60		\$12,000	
2		\$0.60		\$12,000	
3		\$0.60		\$12,000	
4		\$0.60		\$12,000	
5		\$0.60		\$12,000	
6		\$0.60		\$12,000	
7		\$0.60		\$12,000	
8		\$0.60		\$12,000	
9		\$0.60		\$12,000	
10		\$0.60		\$12,000	
11		\$0.60		\$12,000	

This company will hire _____ workers because _____.
(Compare this to the number hired in the homework in Chapter 14.)

