

1. What are four significant reasons for studying resource pricing?

Ans: First, the prices of resources (land, labour, capital, and entrepreneurial ability) are paid as rent, wages, interest, and profit, and thus determine nominal incomes. To understand why people earn the incomes they do requires an understanding of how resource prices are determined. Second, prices for resources allocate scarce resources among competing uses in a market economy. Efficient allocation of resources requires shifting of resources to their highest valued use in a dynamic economy. Third, expenditures for resources are a cost to businesses. Businesses are continually seeking to minimize the cost of production. Fourth, there are major policy issues related to resource pricing, such as minimum wage laws, interest rate ceilings, and the taxation of resources.

Page: 268

Learning Objective: 11.1

2. Why aren't the tools of product market analysis directly applicable to the resource market?

Ans: The demand for resources is a derived demand, that is, it is derived from the demand for the products that these resources produce. The demand side of the resource market must be analyzed from that indirect perspective.

(Another distinction between the product and resource markets is on the supply side. Some resources, especially land, are essentially fixed in quantity. Other resources, particularly labour, are not always mobile and again the quantity cannot always be varied. In addition to these complexities, resource markets tend to be more subject to institutional forces including the policies and practices of governments, labour unions, and business organizations.)

Page: 268

Learning Objective: 11.1

3. Why is the demand for resources called a “derived” demand? On what two factors does the strength of the demand for resources depend? How are these two factors related?

Ans: The demand for a resource is “derived” from or depends on the demand for the goods and services that the resource can produce. For example, the demand for workers in the computer industry depends on the demand for computers.

Underlying the demand for resources are two other critical factors. First, the demand for resources depends on the marginal productivity of the resource. Second, the demand for a resource depends on the price of the product that the resource produces. The two factors are related through the concept of marginal revenue product, which is the basis for the resource demand curve. In pure competition, marginal revenue product for an additional unit of a resource is simply the marginal productivity of the resource multiplied by product price.

Page: 268-269

Learning Objective: 11.1

4. Why is the marginal revenue product schedule a demand schedule for the individual firm in a purely competitive resource market and selling output in a purely competitive product market?

Ans: Underlying the demand for a resource is the marginal productivity of the resource and the price of the product the resource produces. The marginal product of an additional unit of a resource will decrease because of the law of diminishing returns. In competitive resource markets, the price of the product for the firm will remain constant. Thus, the marginal revenue product (MRP) will fall as more units of resource are hired because of diminishing marginal productivity, giving a demand schedule that shows the inverse relationship between the price of the resource and the quantity of the resource employed.

The number of resources hired depends on where the marginal factor cost (MFC) equals the marginal revenue product (MRP) along the downward sloping MRP curve. As MFC falls, the firm can afford to hire more workers, so long as MRP equals MFC. The MRP schedule is the firm's demand curve for labour because, by applying the $MRP = MFC$ rule, it shows the amount of resources that the firm will hire at each specified resource price.

Page: 268-270

Learning Objective: 11.1

5. The table below shows the total production a firm will be able to obtain if it employs varying amounts of resource X while the amounts of the other resources the firm employs remain constant. Compute the marginal product of each of the seven units of resource X and enter these figures in the table. Assume the product the firm produces sells in the market for \$3.00 per unit. Compute the total revenue of the firm at each of the eight levels of output and the marginal revenue product of each of the seven units of resource X. Enter these figures in the table below.

Quantity of resource X employed	Total product	Marginal product of X	Total revenue	Marginal revenue product of X
0	0	\$ _____		
1	24	_____	_____	\$ _____
2	44	_____	_____	_____
3	60	_____	_____	_____
4	72	_____	_____	_____
5	80	_____	_____	_____
6	84	_____	_____	_____
7	86	_____	_____	_____

Complete the firm's demand schedule for resource X by indicating in the table below how many units of resource X the firm would employ at the given prices.

Price of X	Quantity of resource X demanded
\$84	_____
72	_____
60	_____
48	_____
36	_____
24	_____
12	_____
6	_____

Ans:

Quantity of resource X employed	Total product	Marginal product of X	Total revenue	Marginal revenue product of X
0	0		\$0	
1	24	24	72	\$72
2	44	20	132	60
3	60	16	180	48
4	72	12	216	36
5	80	8	240	24
6	84	4	252	12
7	86	2	258	6

<u>Price of X</u>	<u>Quantity of resource X demanded</u>
\$84	0
72	1
60	2
48	3
36	4
24	5
12	6
6	7

Page: 268-269

Learning Objective: 11.1

6. What is the difference between the demand curve for a resource under perfect competition and under imperfect competition?

Ans: The demand for a resource depends on the marginal productivity of the resource and the price of the product the resource produces. In purely competitive markets, the price of the product remains constant and only the marginal product of an additional unit of a resource changes. The MRP curve or the firm's resource demand curve declines solely because of diminishing marginal productivity. In imperfect competition, the price of the product will decline as more output is produced and marginal productivity will also decline. Thus the two factors on which resource demand depends will decline. The result is that the resource demand, or MRP curve, will tend to fall faster and be less elastic (resource employment will be less responsive) to a change in resource price for the imperfectly competitive firm compared with the purely competitive producer.

Page: 270-272

Learning Objective: 11.1

7. Evaluate. If the price of a factor decreases by 5%, a perfectly competitive firm will increase its use of the factor by a greater percentage than a monopolistically competitive firm will.

Ans: The statement is correct. Although both firms will want to increase its use of the resource and both firms will encounter diminishing returns with the input, the monopolistically competitive must also lower the product price to sell the additional output. Therefore, the monopolistically competitive firm's marginal revenue product declines more rapidly than that of the purely competitive firm. In other words, the monopolistically competitive firm's demand curve is less elastic than that of the purely competitive firm. The increase in the quantity demanded of the factor for the monopolistically competitive firm will be a smaller percentage than that of the purely competitive firm.

Page: 270-272

Learning Objective: 11.1

8. Contrast the factors that underlie the downward sloping resource demand curve with those which underlie the downward sloping product demand curve.

Ans: The downward sloping resource demand curve is related to the resource's MRP schedule. A firm will hire additional units of a resource as long as each successive unit adds more to the firm's revenue than it does to its costs. The factors behind the MRP curve's downward slope include diminishing returns to a factor of production as successive amounts are added in the short run, and the fact that the demand for the product produced is downward sloping also causing marginal revenue to decline as successive product units are produced. The downward sloping product demand curve is thus one factor in the downward sloping resource demand curve and the factors which cause the product demand curve to slope downward are the income and substitution effects. Since resource demand is a derived demand, these factors indirectly affect the shape of the resource demand curve.

Page: 270-272

Learning Objective: 11.1

9. Use the following total-product schedule for a resource to answer the next three questions. Assume that the quantities of other resources the firm employs remain constant.

<u>Units of resource</u>	<u>Total Product</u>
1	12
2	21
3	27
4	32
5	36

- (a) If the firm's product sells for a constant \$2 per unit, what is the marginal revenue product of the third unit of the resource?
- (b) If the firm's product sells for a constant \$2 per unit and the price of this resource is \$8, how many units of the resource will the firm employ?
- (c) If the firm can sell 12 units of output at a price of \$1.00 per unit and 21 units of output at a price of \$0.80 per unit, what is the marginal revenue product of the second unit of the resource?
- Ans: (a) \$12. The third worker increases TP by 6 units. $6 \times \$2 = \12 .
 (b) 5 units. The marginal product of the fifth resource is 4 units of output ($4 \times \$2 = \8). Thus, $MRP = \$8$ and $MFC = \$8$ when the fifth resource is employed.
 (c) \$4.80. The total revenue from 1 unit of resource is \$12.00 ($12 \times \1.00). The total revenue with 2 units of resource is \$16.80 ($21 \times \0.80). The difference is the MRP of the second resource or \$4.80.

Page: 270-272

Learning Objective: 11.1

10. In the table below are the marginal product data for resource Y. Assume that the quantities of other resources employed by the firm remain constant. Compute the total product (output) of the firm for each of the seven quantities of resource Y employed and enter these figures in the table. Assume that the firm sells its output in an imperfectly competitive market and that the prices at which it can sell its product are those given in the table. Compute and enter in the table total revenue and the marginal revenue product for each of the seven units of resource Y.

<u>Quantity of resource Y employed</u>	<u>Marginal product of Y</u>	<u>Total product</u>	<u>Product price</u>	<u>Total revenue</u>	<u>Marginal revenue product of Y</u>
0	—	0		—	—
1	44	_____	\$2.00	\$_____	_____
2	42	_____	1.90	_____	_____
3	39	_____	1.80	_____	_____
4	32	_____	1.70	_____	_____
5	24	_____	1.60	_____	_____
6	14	_____	1.50	_____	_____
7	2	_____	1.40	_____	_____

How many units of resource Y would the firm employ at each of the following resource prices?

<u>Resource price</u>	<u>Quantity of Resource Y employed</u>
\$90	_____
80	_____
70	_____
60	_____
50	_____
40	_____
30	_____
20	_____
10	_____
1	_____

Ans:

<u>Quantity of resource Y employed</u>	<u>Marginal product of Y</u>	<u>Total product</u>	<u>Product price</u>	<u>Total revenue</u>	<u>Marginal revenue product of Y</u>
0	—	0		\$0.00	—
1	44	44	\$2.00	88.00	\$ 88.00
2	42	86	1.90	163.40	75.40
3	39	125	1.80	225.00	61.60
4	32	157	1.70	266.90	41.90
5	24	181	1.60	289.60	22.70
6	14	195	1.50	292.50	2.90
7	2	197	1.40	275.80	-16.70

<u>Resource price</u>	<u>Quantity of Resource Y employed</u>
\$90	0
80	1
70	2
60	3
50	3
40	4
30	4
20	5
10	5
1	6

Page: 270-272

Learning Objective: 11.1

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11. Complete the following table, where L is the units of labour, TP_L is the total product of labour, MP_L is the marginal product of labour, P is product price, TR is total revenue, and MRP_L is the marginal revenue product of labour.

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$2.00		
1	10	_____	2.00	\$ _____	\$ _____
2	19	_____	2.00	_____	_____
3	27	_____	2.00	_____	_____
4	34	_____	2.00	_____	_____
5	40	_____	2.00	_____	_____
6	45	_____	2.00	_____	_____
7	49	_____	2.00	_____	_____
8	52	_____	2.00	_____	_____
9	54	_____	2.00	_____	_____
10	55	_____	2.00	_____	_____

- (a) In what type of market is the firm selling its product? How do you know?
- (b) Why does the MRP schedule decrease as labour increases?
- (c) Complete the following table:

<u>Wage rate</u>	<u>Quantity of workers employed</u>
\$16	_____
14	_____
12	_____
10	_____
8	_____
6	_____

Ans:

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$2.00	—	
1	10	10	2.00	\$20	\$20
2	19	9	2.00	38	18
3	27	8	2.00	54	16
4	34	7	2.00	68	14
5	40	6	2.00	80	12
6	45	5	2.00	90	10
7	49	4	2.00	98	8
8	52	3	2.00	104	6
9	54	2	2.00	108	4
10	55	1	2.00	110	2

<u>Wage rate</u>	<u>Quantity of workers employed</u>
\$16	3
14	4
12	5
10	6
8	7
6	8

(a) The firm is selling in a perfectly competitive market because product price is constant at \$2.00.

(b) MRP decreases as labour increases solely because of the law of diminishing returns. The marginal product of labour will fall, which causes MRP to fall as more and more workers are hired.

(c) *See table above.*

Page: 270-272

Learning Objective: 11.1

12. Complete the following table, where L is the units of labour, TP_L is the total product of labour, MP_L is the marginal product of labour, P is product price, TR is total revenue, and MRP_L is the marginal revenue product of labour.

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$2.00	\$_____	
1	10	_____	1.90	_____	\$_____
2	19	_____	1.80	_____	_____
3	27	_____	1.70	_____	_____
4	34	_____	1.60	_____	_____
5	40	_____	1.50	_____	_____
6	45	_____	1.40	_____	_____
7	49	_____	1.30	_____	_____
8	52	_____	1.20	_____	_____
9	54	_____	1.10	_____	_____
10	55	_____	1.00	_____	_____

- (a) In what type of market is the firm selling its product? How do you know?
- (b) Why does the MRP schedule decrease as labour increases?
- (c) Complete the following table:

<u>Wage rate</u>	<u>Quantity of workers employed</u>
\$16	_____
14	_____
12	_____
10	_____
8	_____
6	_____

Ans:

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$2.00	\$0	
1	10	10	1.90	19.00	\$ 19.00
2	19	9	1.80	34.20	15.20
3	27	8	1.70	45.90	11.70
4	34	7	1.60	54.40	8.50
5	40	6	1.50	60.00	5.60
6	45	5	1.40	63.00	3.00
7	49	4	1.30	63.70	0.70
8	52	3	1.20	62.40	– 1.30
9	54	2	1.10	59.40	– 3.00
10	55	1	1.00	55.00	– 4.40

<u>Wage rate</u>	<u>Quantity of workers employed</u>
\$16	1
14	2
12	2
10	3
8	4
6	4

(a) An imperfectly competitive market because price declines as more units are produced.

(b) Because the marginal product of labour decreases *and* because the price of the product decreases.

(c) *See table above.*

Page: 270-272

Learning Objective: 11.1

13. Complete the following table, where L is the units of labour, TP_L is the total product of labour, MP_L is the marginal product of labour, P is product price, TR is total revenue, and MRP_L is the marginal revenue product of labour.

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$5.00	\$_____	
1	30	_____	5.00	_____	\$_____
2	57	_____	5.00	_____	_____
3	81	_____	5.00	_____	_____
4	102	_____	5.00	_____	_____
5	120	_____	5.00	_____	_____
6	135	_____	5.00	_____	_____
7	147	_____	5.00	_____	_____
8	156	_____	5.00	_____	_____
9	162	_____	5.00	_____	_____
10	165	_____	5.00	_____	_____

- (a) In what type of market is the firm selling its product? How do you know?
- (b) Why does the MRP schedule decrease as labour increases?
- (c) Complete the following table:

<u>Wage rate 8-hr shift</u>	<u>Quantity of workers employed</u>
\$135	_____
120	_____
105	_____
90	_____
75	_____
60	_____

Ans:

L	TP_L	MP_L	P	TR	MRP_L
0	0		\$5.00	\$0	
1	30	30	5.00	150	\$150
2	57	27	5.00	285	135
3	81	24	5.00	405	120
4	102	21	5.00	510	105
5	120	18	5.00	600	90
6	135	15	5.00	675	75
7	147	12	5.00	735	60
8	156	9	5.00	780	45
9	162	6	5.00	810	30
10	165	3	5.00	825	15

<u>Wage rate 8-hr shift</u>	<u>Quantity of workers employed</u>
\$135	2
120	3
105	4
90	5
75	6
60	7

(a) The firm is selling in a perfectly competitive market because product price is constant at \$5.00.

(b) MRP decreases as labour increases because of the law of diminishing returns. The marginal product of labour will fall, which causes MRP to fall as more and more workers are hired.

(c) *See table above.*

Page: 270-272

Learning Objective: 11.1

14. What is the difference between a change in resource demand and a change in the quantity of a resource demanded? What factors contribute to a change in resource demand or a change in the quantity of a resource demanded?

Ans: A change in resource demand is a shift of the entire demand curve or schedule of the resource to the right or left. A change in the quantity of a resource demanded is a movement along a given resource demand schedule or curve. A change in resource demand is caused by: (a) a change in the demand for the product for which the resource is an input; (b) a change in the productivity of the resource; and (c) a change in the prices of other resources that are substitutes or complements of the resource. The sole cause of a movement along an existing resource demand curve is a change in the price of the resource

Page: 269-270, 273-276

Learning Objective: 11.1, 11.2

15. How will a change in productivity change the demand for a resource? What three factors affect productivity?

Ans: Other things equal, an increase in the productivity of a resource will increase the demand for the resource. Also, a decrease in the productivity of a resource will decrease the demand for the resource. Thus, changes in productivity change resource demand in the same direction.

Three factors can affect the productivity of a resource. First, the quantities of other resources will affect productivity. The greater the amount of other resources such as capital or land, the greater will be the productivity of labour. Second, technological progress will improve the quality of resources and this change will increase productivity. If there is a technological improvement in capital goods, it can increase output. Third, improvements in the quality of the resource, such as labour, can increase productivity. Education and training, for example, may increase worker quality and thus enable these workers to be more productive.

Page: 274

Learning Objective: 11.2

16. Compare the factors that will cause shifts in the downward-sloping resource demand and product demand curves.

Ans: Any of the factors that cause shifts in the product demand curve such as changes in income, tastes, prices of related products, and expectations will generally change the price of the product and will also cause a shift in the demand curve for the resources used to produce that product. Resource demand is derived from the product demand. In addition, changes in productivity, prices of substitute resources, and prices of complementary resources would cause the resource demand curve to shift.

Page: 273-276

Learning Objective: 11.2

17. Assume that labour and capital are substitutes in production. If there is an increase in the price of capital, how can this lead to either an increase or decrease in the demand for labour?

Ans: The answer depends on the relative magnitudes of the substitution and output effects. With the substitution effect, an increase in the price of capital will cause more labour to be used in place of capital. With the output effect, an increase in the price of capital will cause production cost to increase, output to decrease, and for less labour and capital to be used. If the substitution effect is greater than the output effect, the demand for labour will increase. If the substitution effect is less than the output effect, the demand for labour will decrease.

Page: 274-276

Learning Objective: 11.2

18. Does it matter whether capital and labour are substitutes or complements when figuring out what will happen to the demand for labour if the price of capital increases? Explain.

Ans: The impact of increases in the price of capital on the demand for labour depends on whether the two inputs are substitutes for each other or complementary. If labour and capital are substitutes in production, the demand for labour can either increase or decrease depending on the magnitudes of the substitution and output effects. With the substitution effect, an increase in the price of capital will cause more labour to be used in place of capital. With the output effect, an increase in the price of capital will cause production cost to increase, output to decrease, and for less labour and capital to be used. If the substitution effect is greater than the output effect, the demand for labour will increase. If the substitution effect is less than the output effect, the demand for labour will decrease.

If labour and capital are complements in production, there will be no substitution of labour for capital. The output effect, however, will be negative because production costs increase with the increase in the price of capital. This result leads to less use of both labour and capital. The combined effect is that the demand for labour decreases.

Page: 274-276

Learning Objective: 11.2

19. Compare and explain the significance of the substitution and output effects as they apply to resource pricing. What relationship, if any, do they bear to the income and substitution effects discussed in connection with product demand?

Ans: In both cases the effects apply to the relationship of the product or resource to its substitutes. In the case of resource pricing, if the price of a substitute resource declines, this will cause a decrease in the demand for the original resource as producers hire more of the substitute. However, there may be an offsetting output effect, as lower costs mean that the producer will find it profitable to produce and sell a larger output that may require more employment of all resources including the one that was originally displaced.

In the case of the income and substitution effects discussed with regard to product demand, they tend to reinforce one another in the case of a normal good. If the price of a substitute product declines, it will cause a decrease in the demand for the original product because buyers will buy more of the now lower-priced substitute in place of the original product. However, buyers will also find that they have more income left to spend since their costs have declined and this may cause them to buy more of everything.

Page: 274-276

Learning Objective: 11.2

20. Indicate how the following events will shift the firm's demand curve for labour: increase it (**I**); decrease it (**D**); keep it the same (**S**).

- ___ Technological advances increase labour's productivity.
- ___ The wage rate increases.
- ___ The demand for the product that labour produces decreases.
- ___ The wage rate decreases.
- ___ Absenteeism reduces labour's productivity.
- ___ The price of labour-saving machinery is reduced and the substitution effect is greater than the output effect.

Ans:

- I Technological advances increase labour's productivity.
- S The wage rate increases.
- D The demand for the product that labour produces decreases.
- S The wage rate decreases.
- D Absenteeism reduces labour's productivity.
- D The price of labour-saving machinery is reduced and the substitution effect is greater than the output effect.

Page: 273-276

Learning Objective: 11.2

21. What will be the elasticity of resource demand in the following cases: (a) unit wages rise by 10 percent and the number of employed workers falls by 5 percent; (b) unit wages rise by 4 percent and the number of employed workers falls by 6 percent; and (c) unit wages rise by 3 percent and the number of employed workers falls by 3 percent.

- Ans: (a) inelastic. ($5/10 = .5$)
(b) elastic ($6/4 = 1.5$)
(c) unit elastic ($3/3 = 1$)

Page: 276

Learning Objective: 11.3

22. Compare the factors that explain the elasticity of resource and product demand.

Ans: Elasticity of resource demand is directly affected by the elasticity of product demand, and thus by the same factors that affect product demand elasticity. In addition, resource demand elasticity will be affected by the ease of resource substitutability, and the proportion of total production costs accounted for by the resource (the larger the proportion, the more elastic the demand).

Page: 277

Learning Objective: 11.3

23. What effect, if any, will each of the following have upon the elasticity or the location of the demand curve for resource J that is being used in the production of commodity X? If there is uncertainty as to the precise effect, explain the sources of that uncertainty.

- (a) A decline in the demand for product X.
- (b) An increase in the price of Y, a substitute product for X.
- (c) A decline in the price of substitute resource K.
- (d) A decline in the number of available resources that are substitutable for J in the production of X.
- (e) An increase in the price of complementary resource L.
- (f) An increase in the elasticity of demand for product X due to an increase in the number of sellers in the market.

Ans: (a) The demand curve for J would shift leftward, as less X is sold at existing prices.

(b) The demand curve for J would shift rightward, as more X is sold at existing prices due to a rise in the relative price of substitute product Y.

(c) The impact on the demand curve for J is unclear. The demand curve for J would shift leftward as producers substitute resource K, which is relatively less expensive. This is known as the substitution effect. However, the lower price for K also leads to higher output and therefore, to a rightward shift in the demand for all inputs including J. This is the output effect. Overall, the effect on the demand curve for J depends on the relative sizes of the substitution and output effects. If the substitution effect is larger, the demand for J will shift to the left. If the output effect is larger, the demand for J will shift to the right.

(d) The demand curve for J would become less elastic (more inelastic) as the number of available substitutes declines.

(e) The demand curve for J would shift leftward because J and L are used in a complementary manner and the combination is now more expensive. This causes the demand for J to be less.

(f) If the elasticity of demand for X increases, the elasticity of demand for J should also increase unless the other sellers also use resource J. In that case, the answer is indeterminate because the demand for J has shifted.

Page: 273-277

Learning Objective: 11.2-11.3

24. A firm combines two resources, X and Y, to produce an output level Q in a purely competitive market. The price of a unit of X is \$15 and the price of a unit of Y is \$8. The marginal product of X is 30 units and the marginal product of Y is currently 24 units at output level Q. What would you recommend that the firm do given this resource combination?

Ans: The firm can reduce the cost of production by changing the mix of resources X and Y. The least-costly method of production is determined by finding the equality of the ratio of the marginal product to price for the resources. In this case, the firm should use more Y and less X because currently the marginal productivity per dollar of resource spent on X yields less than the marginal productivity per dollar spent on Y ($30/\$15 < 24/\8 , or $2 < 3$).

Page: 278

Learning Objective: 11.4

25. A firm combines two resources, X and Y, to produce an output level Q in a purely competitive market. The price of a unit of X is \$10 and the price of a unit of Y is \$6. The marginal product of X is 30 units and the marginal product of Y is currently 12 units at output level Q. What will happen to the marginal product of X and Y as the firm adjusts its use of inputs to minimize cost?

Ans: The firm can reduce the cost of production by changing the mix of resources X and Y. The least-costly method of production is determined by finding the equality of the ratio of the marginal product to price for the resources. In this case, the firm should use more X and less Y because currently the marginal productivity per dollar of resource spent on Y yields less than the marginal productivity per dollar spent on X ($30/\$10 > 12/\6 , or $3 > 2$). As the firm increases its use of X and decreases its use of Y, the marginal product of X will decline and the marginal product of Y will increase.

Page: 278

Learning Objective: 11.4

26. Explain briefly and concisely the meaning and significance of the following equation:

$$\text{MRP}_{\text{Labour}} / P_{\text{Labour}} = \text{MRP}_{\text{Capital}} / P_{\text{Capital}} = 1$$

Ans: This equation shows the profit-maximizing combination of resources, labour and capital in this case, that a firm should employ. It states that the firm should employ both labour and capital up to the point that their marginal revenue products are just equal to their prices, that is, their ratio is equal to 1. If these fractions were greater than one, it would mean that the firm could profitably employ more units of the resources because it would add more to its revenue than to its cost. If these fractions were less than one, it would mean the firm should employ less of the resources because their marginal revenue products are below their marginal cost.

Page: 279

Learning Objective: 11.4

27. A perfectly competitive firm in the factor and product markets sells its output for \$1 and pays factors $P_L = \$9$ and $P_c = \$12$. What is the profit-maximizing combination of labour (L) and capital (C) for the firm?

Q_L	MP_L	Q_c	MP_c
1	28	1	18
2	24	2	15
3	20	3	12
4	16	4	9
5	9	5	6
6	4	6	3
7	2	7	2

Ans: The firm would employ 5 units of labour and 3 units of capital to maximize profit.

$$\frac{\text{MRP}_L}{P_L} = \frac{\text{MRP}_c}{P_c} = 1 \quad \frac{\$9}{\$9} = \frac{\$12}{\$12} = 1$$

Page: 279-281

Learning Objective: 11.4

28. In the table below are the marginal-product and marginal-revenue-product schedules for resource A and resource B. Both resources are variable and are employed in purely competitive markets. The price of A is \$1 and the price of B is \$2.

Quantity of resource A <u>employed</u>	Marginal product of A	Marginal revenue product of A	Quantity of resource B <u>employed</u>	Marginal product of B	Marginal revenue product of B
1	20	\$5.00	1	20	\$5.00
2	16	4.00	2	18	4.50
3	12	3.00	3	16	4.00
4	10	2.50	4	12	3.00
5	8	2.00	5	8	2.00
6	4	1.00	6	6	1.50
7	2	.50	7	4	1.00

(a) What is the least-cost combination of resources A and B that would enable the firm to product 120 units of output?

(b) What is the profit-maximizing combination of A and B?

(c) What is total output and profit when the firm is employing the profit-maximizing combinations of A and B?

Ans: (a) Use the formula $MP_A/P_A = MP_B/P_B$. In this case, 120 units can be produced by employing 5 units of A and 3 units of B. To check: $(8/\$1) = (16/\$2)$. The sum of the marginal products of 5A and 3B equal 120.

(b) Use the formula $MRP_A/P_A = MRP_B/P_B = 1$. In this data, profit is maximized by employing 6 units of A and 5 units of B. To check: $(\$1.00/\$1.00) = (\$2.00/\$2.00) = 1$.

(c) Total output is 144 units. The total cost of resources is $\$16[(\$1 \times 6) + (\$2 \times 5)]$. The total revenue is $\$36(144 \times \$0.25)$. Total profit is \$20.

Page: 279-281

Learning Objective: 11.4

29. In the table below are the marginal-product and marginal-revenue-product schedules for resource A and resource B. Both resources are variable and are employed in purely competitive markets. The price of A is \$2 and the price of B is \$4.

Quantity of resource A employed	Marginal Product of A	Marginal revenue product of A	Quantity of resource B employee	Marginal Product of B	Marginal revenue product of B
1	40	\$10.00	1	40	\$10.00
2	32	8.00	2	36	9.00
3	24	6.00	3	32	8.00
4	20	5.00	4	24	6.00
5	16	4.00	5	16	4.00
6	8	2.00	6	12	3.00
7	4	1.00	7	8	2.00

- (a) What is the least-cost combination of resources A and B that would enable the firm to produce 240 units of output?
- (b) What is the profit-maximizing combination of A and B?
- (c) What is the total output and profit when the firm is employing the profit-maximizing combination of A and B?

Ans: (a) Use the formula $MP_A/P_A = MP_B/P_B$. In this case, 240 units can be produced by employing 5 units of A and 3 units of B. To check: $(16/\$2) = (32/\$4)$. The sum of the marginal products of 5A and 3B equal 240.

(b) Use the formula $MRP_A/P_A = MRP_B/P_B = 1$. In these data, profit is maximized by employing 6 units of A and 5 units of B. To check: $(\$2.00/\$2.00) = (\$4.00/\$4.00) = 1$.

(c) Total output is 288 units. The total cost of resources is \$32 $[(\$2 \times 6) + (\$4 \times 5)]$. The total revenue is \$72 $(288 \times \$0.25)$. Total profit is \$40.

Page: 279-281

Learning Objective: 11.4

30. Evaluate. A firm is producing its output at the lowest cost. Therefore, the firm must be maximizing profit.

Ans: A firm achieves cost minimization by using resources such that the marginal productivity per dollar spent on each resource is equal. This condition does not ensure that the profit maximizing condition, $MRP = MFC$ for all variable inputs, is met. Although the firm is producing its output at the lowest cost, this output level may not be the profit maximizing level. Therefore, this statement is incorrect.

Page: 279-281

Learning Objective: 11.4

31. Evaluate. A firm is maximizing profit by producing its current output. Therefore, the firm must be producing this output at the lowest cost.

Ans: This statement is true. If the firm is not producing its output at the lowest cost, it cannot be maximizing profit because it could alter its use of resources, lower its cost and make more profit.

Page: 280-281

Learning Objective: 11.4

32. A firm combines two factors, A and B, to produce an output level Q in a perfectly competitive market. The price of a unit of A is \$15 and the price of a unit of B is \$12. The marginal revenue product of A is \$10 and the marginal revenue product of B is currently \$8. What would you recommend that the firm do given this factor combination?

Ans: The firm must decrease its use of both inputs to achieve the profit-maximizing level of output. Although the ratio of MRP to price for factor A is just equal to that for factor B, each factor's MRP is less than its price. The ratios of MRP to price for each resource must be equal to one in order for the firm to be maximizing profit.

Page: 280-281

Learning Objective: 11.4

33. A firm combines two factors, A and B, to produce an output level Q in a purely competitive market. The price of a unit of A is \$5 and the price of a unit of B is \$12. The marginal revenue product of A is \$5 and the marginal revenue product of B is currently \$12. What would you recommend that the firm do given this factor combination?

Ans: The firm should do nothing because it has achieved the profit-maximizing level of output. The MRP for factor A is just equal to the price of a unit of A. Similarly, the MRP for factor B is just equal to the price of a unit of B. The ratios of MRP to price for each resource used are equal to one. The firm is maximizing profit and at the same time is achieving the least-costly production of output Q using resources A and B.

Page: 280-281

Learning Objective: 11.4

34. The theory of resource pricing is sometimes referred to by economists as the theory of income distribution. Why?

Ans: Resource prices are what producers must pay for the use of those resources. The owners of those resources are the recipients of these payments, or in the simple circular flow model, households supply resources to business firms in exchange for income payments. In other words, the payments that households receive from the sale of their resources constitute income in its various forms: wages and salaries, rent, interest, and profits. Therefore, any theory of how resources are priced is essentially a theory of how incomes are determined.

Page: 281

Learning Objective: 11.4

35. What are two criticisms of the marginal productivity theory of income distribution?

Ans: The marginal productivity theory of income distribution suggests that people should be paid according to their contribution to output. There are two basic problems with this idea. First, productive resources are not equally distributed. Human abilities and skills differ substantially. Also, there is an unequal distribution of property resources because of inheritances and other factors. As a result, some people with a limited human or property resource base will not receive a sufficient income from that resource base with which to live. Second, the theory is based on the assumption of competitive resource and product markets. Imperfect competition, however, exists in both product and resource markets. These imperfect markets give rise to monopolies that can distort the distribution of income.

Page: 281

Learning Objective: 11.4

36. “Under competition, workers are paid what they are worth.” Explain and evaluate this statement. Does it follow that the resulting distribution of wage incomes is desirable?

Ans: If one believes that workers are “worth” their marginal revenue product, then this would be a true statement in competitive markets. Firms would behave in a profit-maximizing manner and would hire workers as long as the wage did not exceed the marginal revenue product of the last worker hired. Beyond this point, the firm would add more to its costs than to its revenues and would not pay a worker more than the worker was worth in terms of the worker's contribution to the firm's revenues. The firm would not pay less than this amount because competing firms would benefit by hiring the worker away.

It does not follow that the resulting distribution of wages is desirable. First, it is unlikely that there are many markets that fit the model, so the marginal productivity theory is only an approximation of reality. Second, the ability of some workers to contribute to production may be severely limited because of some handicap and the worker may not be able to earn enough income to live on if income were limited to the worker's worth. Others may earn far more than is necessary for survival and have achieved an affluent lifestyle, and redistribution of some of this income may be desirable. Finally, much of the value of the marginal revenue product depends on the initial distribution of income, which in turn determines the demand for various products. If this initial distribution of income is undesirable, the value of the marginal revenue product of many workers may not be “desirable” from the society's view.

Page: 281

Learning Objective: 11.4

37. Why are banks using more automatic banking machines (ABMs) and employing fewer human tellers? What economic principle is illustrated about resource markets by this example?

Ans: The economic principle is that firms achieve the least-cost combination of inputs when the last dollar spent on each makes the same contribution to total output. This least-cost rule implies that firms will change inputs in response to technological change or changes in input prices. If the marginal product of an ABM divided by its price is greater than the marginal product of a human teller divided by its price, then more ABMs will be employed in the banking sector, especially because ABMs serve as substitutes for some aspect of human teller work.

Between 1990 and 2000, some 8,000 positions for human tellers were eliminated and many more will lose positions in years to come. The reason for the change is that ABMs are highly productive because a single machine can handle hundreds of transactions daily, and millions of transaction in several years. Human tellers cannot compete with this level of output.

Page: 282

Learning Objective: Last Word