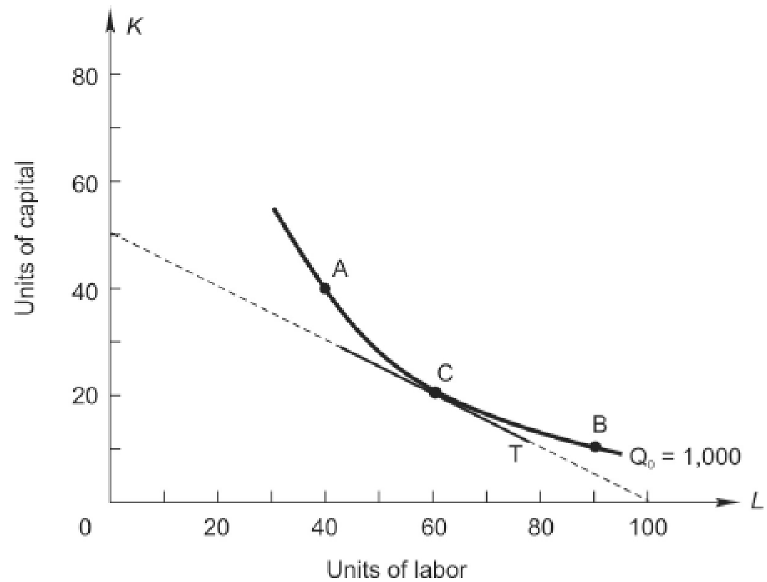
1. In the following figure, isoquant Q_0 is the isoquant for 1,000 units of output.

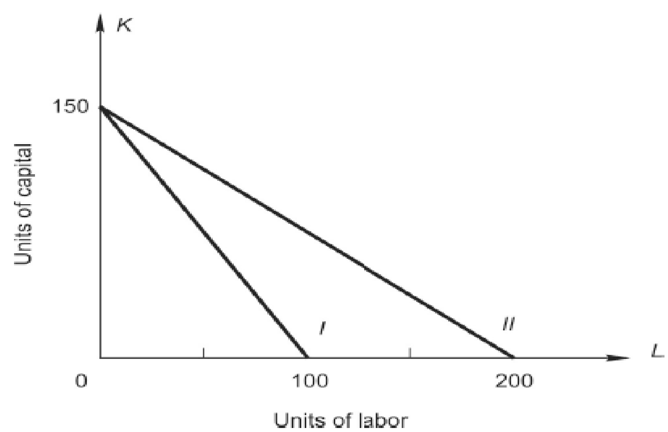


a. Marginal rate of technical substitution between points *A* and *C* is _______.

b. Marginal rate of technical substitution between points *C* and *B* is _______.

c. Marginal rate of technical substitution at point *C* is _______.

2. The following graph shows two isocost curves. The price of capital is $100.



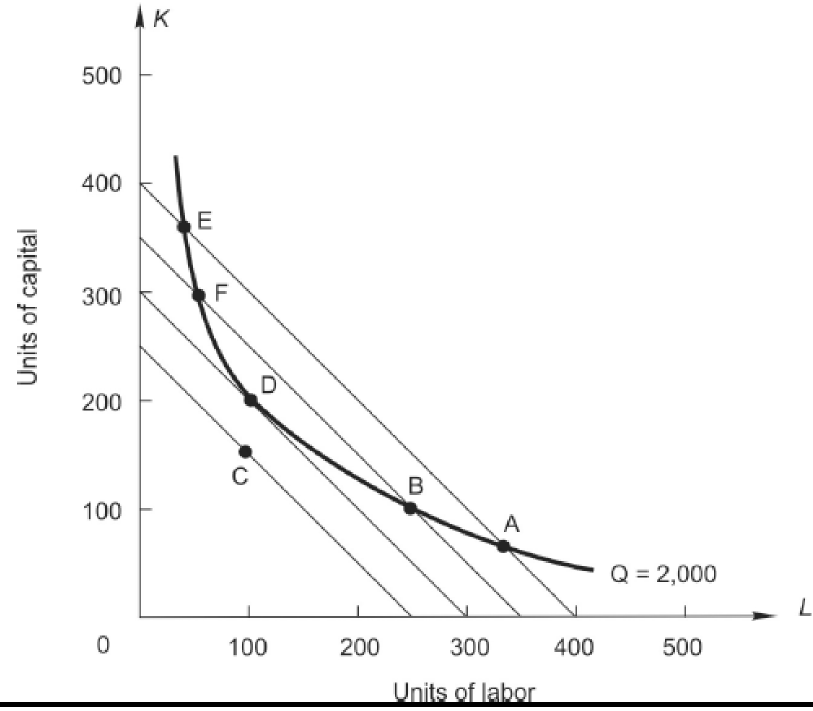
a. The total cost associated with isocost *I* is $__________, and the price of labor is $__________.

b. The equation for isocost *I* is ________________________. With isocost *I* the firm must give up ______ units of capital to purchase one more unit of labor in the market.

c. The total cost associated with isocost *II* is $__________, and the price of labor is $__________.

d. The equation for isocost *II* is ________________________. With isocost *II* the firm must give up ______ units of capital to purchase one more unit of labor in the market.

3. The following figure shows a firm's isoquant for producing 2,000 units of output and four isocost curves. Labor and capital each cost $50 per unit.



a. At point *A*, the *MRTS* is ____________ (less than, greater than, equal to) the input price ratio, *w*/*r*. The total cost of producing 2,000 units of output with input combination *A* is $____________.

b. By moving from *A* to *B*, the firm ________________ (increases, decreases) labor usage and ________________ (increases, decreases) capital usage. At point *B* the *MRTS* is _______________ (greater than, less than, equal to) the input price ratio, *w*/*r*. The movement from *A* to *B* ________________ (increased, decreased) total cost by $___________.

c. At Point *D* the firm ________________ (minimizes, maximizes) the cost of producing 2,000 units of output. The *MRTS* is _______________ (greater than, less than, equal to) the input price ratio, *w*/*r*.

d. The optimal input combination is _________ units of labor and _________ units of capital. At this combination, the total cost of producing 2,000 units is $ _________________.

e. At point *E*, the *MP* per dollar spent on ___________ is less than the *MP* per dollar spent on ___________. The total cost of producing 2,000 units of output with input combination *E* is $____________.

f. The movement from *E* to *F* reduces the *MP* per dollar spent on ___________ and increases the *MP* per dollar spent on ___________. This movement ________________ (increased, decreased) total cost by $_____________.

g. At input combination *D*, the *MP* per dollar spent on labor is ____________ (greater than, less than, equal to) the *MP* per dollar spent on capital.

h. Input combination *C* costs $___________. The firm would not use this combination to produce 2,000 units of output because _________________.

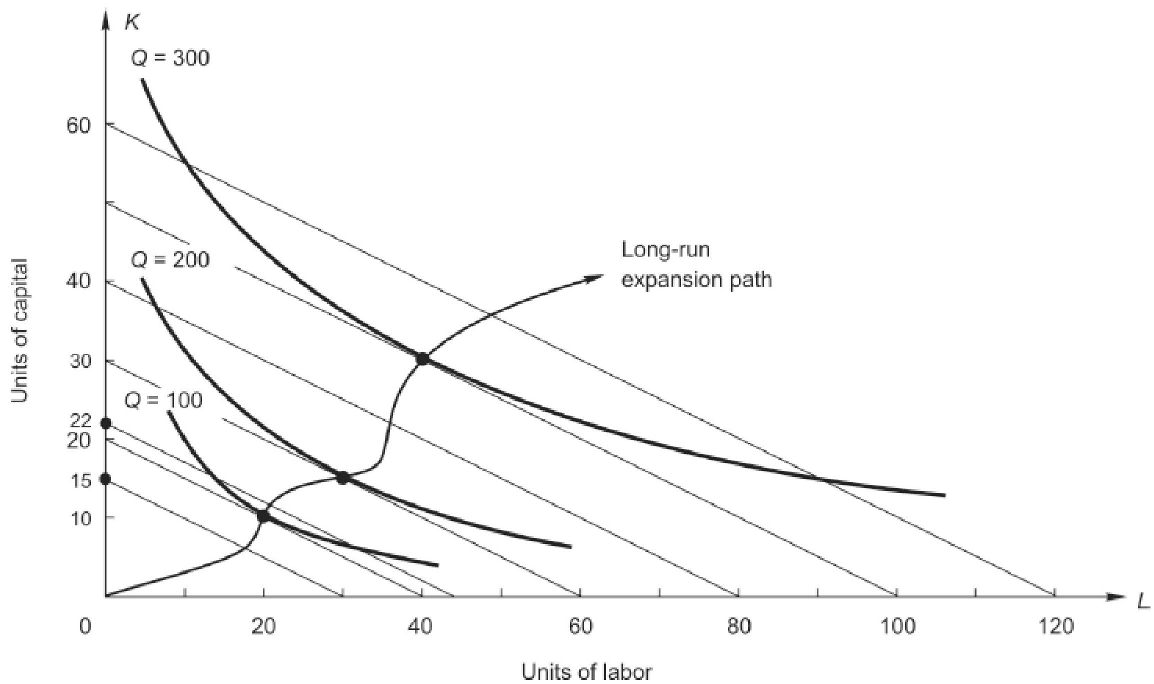
4. Your firm produces clay pots entirely by hand even though a pottery machine exists that can make clay pots faster than a human. Workers cost $100 per day and each additional worker can produce 20 more pots per day (i.e., marginal product is constant and equal to 20). Installation of the first pottery machine would increase output by 300 pots per day. Currently your firm produces 1,200 pots per day.

   a. Your financial analysis department estimates that the price of a pottery machine is $2,000 per day. Can you reduce the cost of producing 1,200 pots per day by adding a pottery machine to your production process and reducing the amount of labor? Explain why or why not.

   b. If a labor union negotiates higher wages so that labor costs rise to $150 per day, does this change your answer to part *a*? Explain.

   c. Suppose your firm wants to expand output to 2,500 pots per day and input prices are $100 and $2,000 per day for labor and capital, respectively. Is it efficient to hire more labor or more capital? Explain using the ratio of marginal products and input prices.

5. The figure below shows a portion of the expansion path for a firm. The price of labor is $75.



a. The price of capital is $________. Along the expansion path, the marginal rate of technical substitution is equal to ______.

b. To produce 100 units in the long run, a manager would use ________ units of labor and ________ units of capital. The long-run total cost of producing 100 units is $________.

c. To produce 200 units in the long run, a manager would use ________ units of labor and ________ units of capital. The long-run total cost of producing 200 units is $________.

d. To produce 300 units in the long run, a manager would use ________ units of labor and ________ units of capital. The long-run total cost of producing 300 units is $________.

e. The firm currently operates with 15 units of capital equipment. In the figure above, construct the firm's short-run expansion path and label it "Short-run expansion path."

f. To produce 100 units in the short run, a manager would use ________ units of labor and ________ units of capital. The short-run total cost of producing 100 units is $________, which is ________________ (more than, less than, the same as) the long-run total cost of producing 100 units.

g. To produce 200 units in the short run, a manager would use ________ units of labor and ________ units of capital. The short-run total cost of producing 200 units is $________, which is ________________ (more than, less than, the same as) the long-run total cost of producing 200 units.

h. To produce 300 units in the short run, a manager would use ________ units of labor and ________ units of capital. The short-run total cost of producing 300 units is $________, which is ________________ (more than, less than, the same as) the long-run total cost of producing 300 units.

i. If the firm is producing 100 units in the short run, it can restructure its production in the long-run and reduce its costs of producing 100 units by $________.

j. If the firm is producing 300 units in the short run, it can restructure its production in the long-run and reduce its costs of producing 300 units by $________.

k. Only when the firm wishes to produce ________ units in the short run will the manager be unable to restructure production in the long run and reduce costs. Explain.

Answers:

1. a. $1\ (= -\frac{20-40}{60-40})$, which is the slope over the interval from *A* to *C*.

   b. $0.33\ (= -\frac{10-20}{90-60})$, which is the slope over the interval from *C* to *B*.

   c. $0.5\ (= -\frac{-50}{100})$, which is the slope of the tangent line at point *C*.

2. a. 15,000; 150. The *K*-intercept is 150, so the isocost curve represents a cost of \$15,000 (= 150×\$100). The *L*-intercept is 100, to w = \$150 (= 15,000/100).

   b. $K = 150 - 1.5L$ (or $K = 150 - (150/100)L$ or $15{,}000 = 150L + 100K$); 1.5

   c. 15,000; \$75. The price of labor decreases and causes an outward rotation of the isocost curve.

   d. $K = 150 - 0.75L$ (or $K = 150 - (150/200)L$ or $15{,}000 = 75L + 100K$); 0.75

3. a. less than; \$20,000 (= \$50 × 400)

   b. decreases; increases; less than; decreased; \$2,500 [= (400–350) × \$50]. [Note: For the last part of this answer, you must decide visually that the isocost curve passing through point B intersects the *L* or *K*-intercepts at 350. Do not panic, your instructor knows this.]

   c. minimizes; equal

   d. 100; 200; \$15,000 (= 300 × \$50)

   e. capital; labor; \$20,000

   f. labor; capital; decreased; \$2,500 (see answer to part *b* above)

   g. equal to

   h. \$12,500 (= 250 × \$50); this combination lies below the 2,000 unit isoquant and so 2,000 units cannot be produced with combination C.

4. a. By purchasing one pottery machine, which would increase output by 300 units, 15 laborers could be fired and output would remain exactly equal to 1,200 units per day. This reduces the cost of labor by 15 × \$100 = \$1,500. The cost of capital increases by \$2,000. Clearly, substituting the machine for an equally productive amount of labor (i.e., the 15 workers) increases the total cost of producing 1,200 clay pots per day.

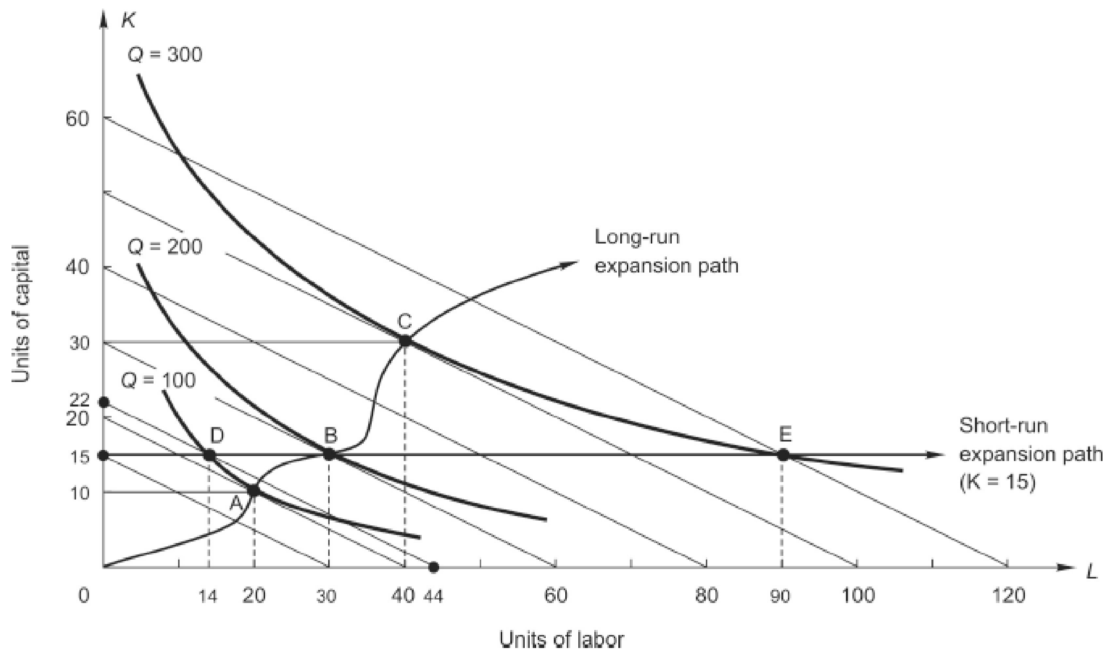
   b. Yes, at \$150 per worker, the reduction in wage expense is now 15 × 150 = \$2,250, which is more than the cost of the machine (\$2,000 per day). Thus, the higher wages make buying a machine efficient.

   c. $MP_L/w = 20/100 = 0.2$ additional pots per additional dollar spent on labor

   $MP_K/r = 300/2{,}000 = 0.15$ additional pots per extra dollar spent on capital

   Since each additional dollar spent on labor increases output by more than an additional dollar spent on capital, it is less costly to expand output by hiring more labor than by buying pottery machines.

5. a. The price of capital is \$150. You can discover this by noting in the figure that the slope of the isocost curves is ½. Since the slope of isocost curves equals w/r and you are told that r = \$150, you can see that $75/r$ = ½ and thus r = 150. At every tangency point along the (long-run) expansion path, the slope of the isoquant equals the slope of the isocost line. Since the isocost lines are always parallel, their slopes are constant along the expansion path and equal to *MRTS*, which must be ½ in this case.



b. 20; 10; \$3,000. At point *A* in the figure above, you can see that the tangency occurs at 20 units of labor and 10 units of capital, which costs \$3,000 (= \$150 × 20 or \$75 × 20 + 150 × 10).

c. 30; 15; \$4,500. At point *B* in the figure above, you can see that the tangency occurs at 30 units of labor and 15 units of capital, which costs \$4,500 (= \$150 × 30 or \$75 × 30 + 150 × 15).

d. 40; 30; \$7,500. At point *C* in the figure above, you can see that the tangency occurs at 40 units of labor and 30 units of capital, which costs \$7,500 (= \$150 × 50 or \$75 × 40 + 150 × 30).

e. The short-run expansion path is a horizontal line at 15 units of capital, which is designated in the figure above as "Short-run expansion path."

f. 14; 15; \$3,300; more than. At point *D* in the figure above, you can see that the 100-unit isoquant is reached with 15 units of capital by employing 14 units of labor at a cost of \$3,300 (= \$150 × 22 or \$75 × 14 + 150 × 15), which is more than the long-run cost of \$3,000.

g. 30; 15; \$4,500; the same as. At point *B* in the figure above, you can see that the 200-unit isoquant is reached with 15 units of capital by employing 30 units of labor, which costs \$4,500 (= \$150 × 30 or \$75 × 30 + 150 × 15), which is the same as the long-run cost of \$4,500.

h. 90; 15; $9,000; more than. At point *E* in the figure, you can see that the 300-unit isoquant is reached with 15 units of capital by employing 90 units of labor at a cost of $9,000 (= $150 × 60 or $75 × 90 + $150 × 15), which is more than the long-run cost of $7,500.

i. $300; This is the difference between the short-run and long-run total costs of producing 100 units (= $3,300 – $3,000).

j. $1,500; This is the difference between the short-run and long-run total costs of producing 300 units (= $9,000 – $7,500).

k. 200; When 200 units are produced in the short-run, the fixed amount of capital (15 units) happens also to be the long-run optimal level of capital, so the costs are equal in the long-run and short-run for 200 units of output.