

Questions 1-5: multiple choice, 5 points each, circle correct answer.

1. The marginal product of labor is 25. The marginal product of capital is 10. The price per unit of labor is \$10. The price per unit of capital is \$25. From this information we can conclude that:
- B
- a) The firm should use more capital and less labor to produce its current output.  $\frac{MP_L}{W} = \frac{25}{10} = 2.5$   $\frac{MP_K}{r} = \frac{10}{25} = 0.4$
- b) The firm should use more labor and less capital to produce its current output.**
- c) The current input mix minimizes the cost of producing the chosen output.
- d) It is not possible to determine whether the firm has chosen the optimal input mix without knowing how much labor and how much capital the firm is using.
2. Economies of scope means that:
- D
- a)  $f(mL, mK) > mf(L, K)$ .
- b)  $LRAC(Q_1) < LRAC(Q_0)$ , where  $Q_0 < Q_1$ .
- c)  $MRTS_{L,K} = -\Delta K/\Delta L$ , holding  $Q$  constant.
- d)  $TC(X, Y) < TC(X, 0) + TC(0, Y)$ .** *cheaper to produce X and Y together than to produce them separately*
3. Short-run total cost is given by  $SRTC = 1000 + 50Q^2$ . If  $Q = 10$ , then
- D
- a)  $SRAFC = 100$ .
- b)  $SRTVC = 5000$ .
- c)  $SRATC = 600$ .
- d) All of the above are true.**  $TFC = 1000$   
 $TVC = 50Q^2$
4. You find that when you use 8 quarts of insecticide in combination with 16 lbs. of fertilizer, you are able to produce 45 lbs. of zucchini squash in your garden. If you use 22 lbs. of fertilizer, output rises to 50 lbs. of zucchini. If you then cut back on insecticide to 6 quarts, zucchini output falls back to 45 lbs. What is the marginal rate of technical substitution between fertilizer and insecticide between the two points that you have on the isoquant for 45 lbs?
- C
- a) One quart of insecticide for 2 lbs. of fertilizer
- b) Two quarts of insecticide for 5 lbs. of zucchini
- c) One quart of insecticide for 3 lbs. of fertilizer**
- d) Six lbs. of fertilizer for 5 lbs. of zucchini
- $MP_I = \frac{\Delta Q}{\Delta I} = \frac{5}{2}$   
 $MP_F = \frac{\Delta Q}{\Delta F} = \frac{5}{6}$   
 $MRTS = \frac{MP_F}{MP_I} = \frac{6 \text{ lbs } F}{2 \text{ qts } I} = \frac{3}{1}$
5. Given the MRTS that you just calculated in question 4, suppose that you are minimizing cost. If insecticide is \$3 per quart, what must be the price of a lb. of fertilizer?
- A
- a) \$1
- b) \$2
- c) \$3
- d) \$9**
- $1 \text{ qt. } I \text{ for } \$3 \iff 3 \text{ lbs. } F \text{ for } \$X$   
 $X = \$1$

6. (8 pts.) Your parents own and operate a local jewelry store. They buy diamonds at wholesale and sell them at retail. At any point in time they will have some diamonds in inventory that they purchased last month and some that they purchased last year. In their current inventory they have a 1.00 carat diamond of a certain color, clarity, and cut which was purchased a year ago for \$2500. They have an identical diamond that was purchased a month ago for \$3000. To replace either diamond in their inventory they would have to pay the current wholesale price, which is \$2750. If the current retail market price for such a diamond is \$2900, how much economic profit would they make from selling the year-old diamond? The month-old diamond? Explain your answer.

Historical costs are not relevant for making current economic decisions. To calculate the economic profit from selling either diamond you subtract current economic cost from the selling price. Current economic cost is what you will have to pay to replace either diamond in your inventory. If you sell either diamond for \$2900, your economic profit is \$150.

7. (12 pts.) Your professor's younger sister owns and operates a sandwich shop in Fort Walton Beach, FL. The income statement for her business shows annual revenues of \$150,000. Costs include wages for hourly employees (\$35,000), utilities (\$15,000), wholesale cost of food and other supplies (\$40,000), taxes (\$5,000), advertising (\$5,000), and insurance (\$5,000). She quit her job managing a similar business where she earned \$25,000 per year, but she pays herself no salary in this business. She and her husband own the strip mall where her sandwich shop is located, and the space occupied by her shop previously rented for \$12,000 per year. They have \$40,000 invested in the business, which they could recover if they liquidated. They ask you to help them figure out the "rate of return" they are earning on their \$40,000 that they have invested in the sandwich shop. Evaluate the economic profitability of their business.

Economic Profit = Total Revenue - Explicit Costs - Implicit Costs

Explicit Costs:	Implicit Costs
- wages \$35,000	- opportunity cost of her labor time \$25,000
- utilities 15,000	- opportunity cost of building space \$12,000
- wholesale cost of supplies 40,000	- opportunity cost of foregone interest earned on their investment of \$40,000 <span style="float: right; border: 1px solid black; border-radius: 50%; padding: 2px;">?</span>
- taxes 5,000	
- advertising 5,000	
- insurance 5,000	
\$105,000	\$37,000

TR = \$150,000

Econ Profit = \$150,000 - \$105,000 - \$37,000 = \$8,000

She is earning \$8,000 on her \$40,000 investment, for an annual rate of return of  $\frac{8,000}{40,000} = 20\%$ .

Unless she can invest the \$40,000 somewhere else and earn more than a 20% ROR, this is a good deal.

8. (15 pts.) You own and operate an Arby's restaurant. Your production function is given by  $Q=10K^{.5}L^{.5}$ , where  $Q$  represents the number of meals per hour produced in your restaurant and  $K$  and  $L$  refer to inputs of capital and labor per hour.

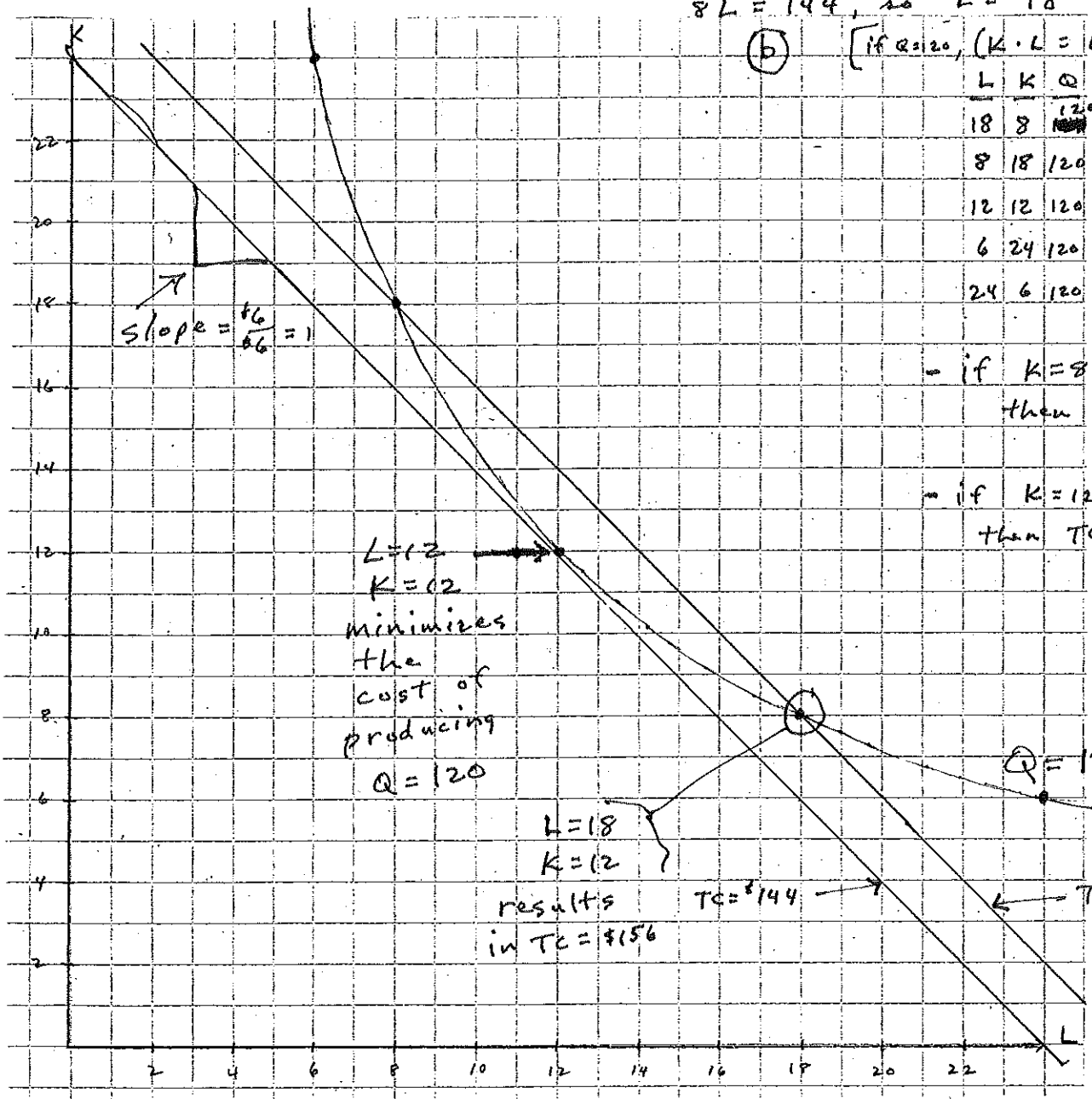
- If capital is fixed at  $K = 8$  in the short run, how much labor must you use if you want to produce 120 meals per hour?
- Suppose the prices per unit of labor and capital are  $w = \$6/\text{hour}$  and  $v = \$6/\text{hour}$ . What level of total cost do you incur by using the input combination in part (a)? Does that combination of labor and capital minimize the cost of producing 120 meals per hour? You should plot the isoquant for  $Q=120$  and draw isocost lines that illustrate your answer.

(a)  $Q = 10K^{1/2}L^{1/2}$ , if  $K = 8$  and  $Q = 120$ , then  
 $120 = 10 \cdot 8^{1/2} \cdot L^{1/2}$   
 $12 = \sqrt{8} \cdot \sqrt{L}$   
 $8L = 144, \text{ so } L = 18$

(b) [if  $Q=120, (K \cdot L = 144)$ ]

L	K	Q
18	8	120
8	18	120
12	12	120
6	24	120
24	6	120

$Q = 120$   
isoquant



- if  $K=8$  and  $L=18$   
then  $TC = \$48 + 108$   
 $= \$156$

- if  $K=12$  and  $L=12$   
then  $TC = 72 + 72$   
 $= \$144$

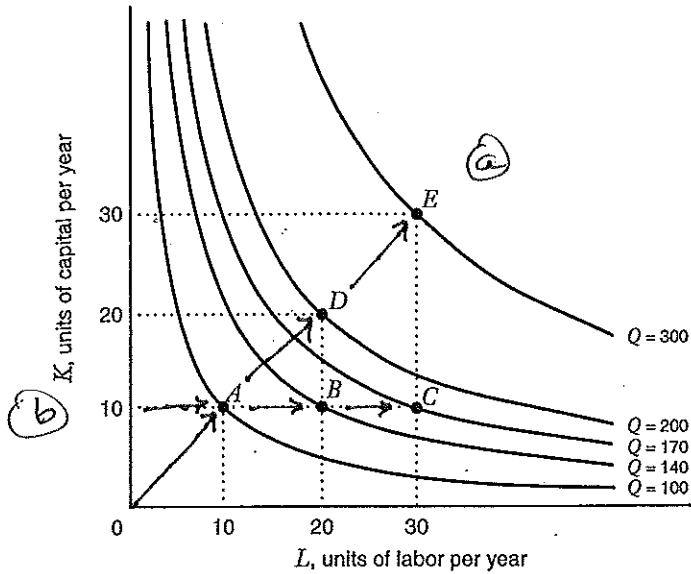
$L=12$   
 $K=12$   
minimizes  
the  
cost of  
producing  
 $Q=120$

$L=18$   
 $K=12$   
results  
in  $TC = \$156$

$TC = \$144$

$TC = \$156$

9. (15 pts.) Use the following diagram to explain the difference between returns to scale and diminishing marginal returns. Be specific and use the numbers in the diagram on capital, labor, and output to explain each of these concepts.



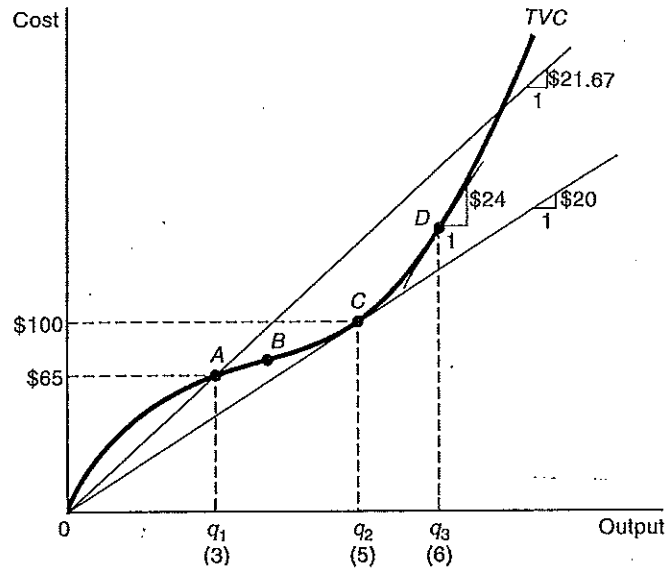
- a) What does "returns to scale" mean? How is it illustrated in the diagram?

How does ~~an~~ output change with an equal proportionate change in all inputs? As labor and capital each increase from 10 to 20 to 30, output increases from 100 to 200 to 300, or by the same proportion as the change in all inputs. So this production process exhibits constant returns to scale.  $O \rightarrow A \rightarrow D \rightarrow E$  in the diagram.

- b) What does "diminishing marginal returns" mean? How is it illustrated in the diagram?

Diminishing marginal returns refers to what happens to output as more and more of one input is combined with a fixed amount of the other input. When K is fixed at  $\bar{K} = 10$ , and L increases from  $L = 10$  to  $L = 20$  to  $L = 30$ , then Q increases from  $Q = 100$  to  $Q = 140$  to  $Q = 170$ , output increases by smaller and smaller amounts.  $A \rightarrow B \rightarrow C$  in the diagram.

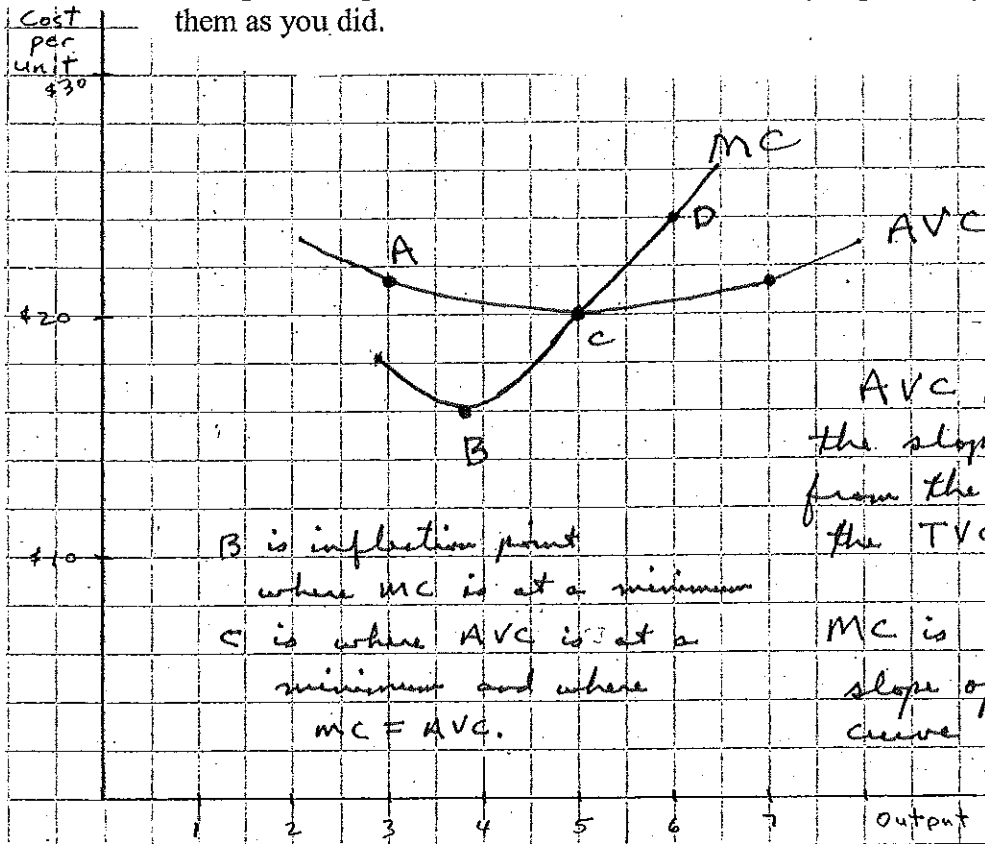
10. (25 pts.) The following diagram contains the short-run total variable cost curve for a firm.



$$AVC = \frac{TVC}{Q}$$

$$MC = \frac{\Delta TVC}{\Delta Q}$$

- a) From the information contained in the diagram, you should be able to sketch the firm's average variable cost curve and its marginal cost curve. Carefully label points A, B, C, and D on your AVC and MC curves that correspond to the equivalent points on the TVC curve and briefly explain why you drew them as you did.



- b) If total fixed cost equals 50, what is average total cost when output equals 5?  
 at  $Q = 5$ ,  $AVC = \$20$ ,  $AFC = \$10$ ,  
 so  $ATC = \$30$  per unit.