

Problem Set 8

On what and how to submit

- Due before Lecture 10.
- Name the file “ps08_[lastname].pdf”. For example, my file would be “ps08_brooks.pdf”.
- Turn in via this [google survey](#).
- Make sure your name is at the top of the submission.
- You do not need to type your submission. Any **legible** submission in pdf format is ok. For example, you can write the problem set with hand-drawn graphs, take a picture, make a pdf, and submit the pdf.

1. GLS Chapter 6, Question 4

Answer:

(a) Short run production function

In the short run, capital is fixed, or $K = 9$. Therefore, the short-run production function is

$$Q = 100\sqrt{KL} = 100\sqrt{9L} = 300\sqrt{L}$$

(b) Number of cars Bob can repair each year for $L \in \{1, 2, 3, 4, 5\}$

| K | L | Q , or number of cars repaired per year | MP_L | AP_L |
|-----|-----|---|--------|-----------------------|
| 9 | 1 | $300\sqrt{L} = 300\sqrt{1} = 300$ | . | $\frac{300}{1} = 300$ |
| 9 | 2 | $300\sqrt{L} = 300\sqrt{2} \approx 424$ | 124 | $\frac{424}{2} = 212$ |
| 9 | 3 | $300\sqrt{L} = 300\sqrt{3} \approx 520$ | 96 | $\frac{520}{3} = 173$ |
| 9 | 4 | $300\sqrt{L} = 300\sqrt{4} = 600$ | 80 | $\frac{600}{4} = 150$ |
| 9 | 5 | $300\sqrt{L} = 300\sqrt{5} \approx 671$ | 71 | $\frac{671}{5} = 134$ |

(c) Marginal product of labor

See table above. We calculate marginal product of labor as additional output (Q) from one additional worker, so, for example $Q_{L=3} - Q_{L=2} = 520 - 424 = 124$. Yes – the marginal product of labor is declining as L increases and K is fixed.

(d) Average product of labor

See table above. Average product of labor is $\frac{Q}{L}$. For levels we examine, $AP_L > MP_L$. Because MP_L is decreasing in L , it brings the average down as L increases.

2. GLS Chapter 6, Question 7

Answer:

- (a) As L increases, since $MP_L = \frac{2K^{1/3}}{3L^{1/3}}$, MP_L declines. We can see this because L is in the denominator. Thus, as L increases MP_L decreases. Intuitively, when capital is fixed, adding additional units of labor becomes not particularly useful at some point.
- (b) As K increases, since $MP_L = \frac{2K^{1/3}}{3L^{1/3}}$, MP_L increases.
- (c) The marginal product of labor increases as K increases because workers have more stuff with which to successfully do their jobs. For example, imagine five workers in a coffee shop who get an additional coffee machine. This additional machine may allow them to be produce more output.
- (d) As K increases, the marginal product of capital declines. As L increases, the marginal product of capital increases. Both of these use the same logic and in (b) and (c).

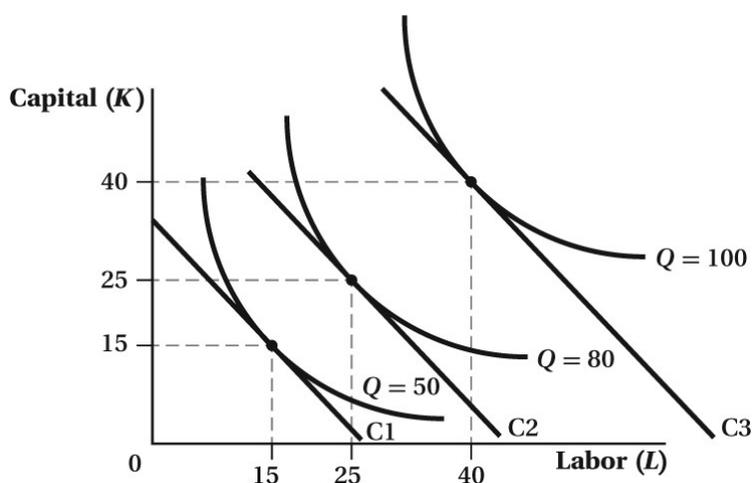
3. GLS Chapter 6, Question 23

Answer:

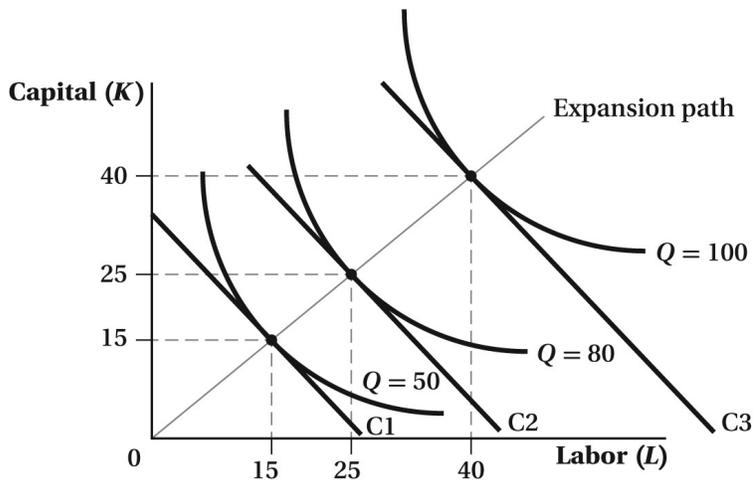
From the question, we know that the isocost curve is

$$\begin{aligned} C &= RK + WL \\ &= 10K + 10L \end{aligned}$$

- (a) See figure below



- (b) See figure below



- (c) To find the total cost of production, use the cost curve we wrote above and the amounts of K and L for each level of production.

| Q | K | L | Total Cost |
|-----|-----|-----|---------------------------|
| 50 | 15 | 15 | $15 * 10 + 15 * 10 = 300$ |
| 80 | 25 | 25 | $25 * 10 + 25 * 10 = 500$ |
| 100 | 40 | 40 | $40 * 10 + 40 * 10 = 800$ |

- (d) Total cost figure: graph Q on the x axis, and total cost on the y axis.

