Discussion 10-Solutions

Important Topics

- Input Markets
- General equilibrium and Pareto efficiency

Input Markets

Exercise 1 Willy Wonka's Chocolate factory produces chocolate bars by using Oompa Loompas (labor) and boats that float down the chocolate river (capital). Assume that Willy Wonka is a price taker in the markets for chocolate bars, Oompa Loompas and boats.

a.) Suppose the price of a chocolate bar is \$5 and at the current level of labor and capital $MP_L = 10$, $MP_K = 100$, the price of labor is \$40 and the rental price of a boat is \$600. Assuming the chocolate factory exhibits diminishing marginal returns to both labor and capital, what should Willy Wonka do to improve his profits?

Solution: Since $MP_L * P = (10)5 = 50 > 40$*, Willy Wonka should hire more Oompa Loompas. On the other hand, since* $MP_K * P = 100 * 5 = 500 < 600$*, he should rent fewer boats.*

b.) Charlie eventually takes over the chocolate factory and ensures that it always maximizes profits. Years later the price of a chocolate bar is \$6 and the wage of an Oompa Loompa is \$72. Calculate the MP_L under Charlie's management.

Solution: Since

$$P_L = MRP_L \longrightarrow 72 = 6 * MP_L \longrightarrow MP_L = 12$$

Exercise 2 Consider a representative firm producing a certain good using labor as an input. The firm is a price taker both in labor market and in output market.

a.) Complete the following table for the firm. What is the market equilibrium price for the good?

Number of Workers	Output (q)	MPL	MRPL
0	0	-	-
1	**19**	**19**	380
2	**36**	**17**	340
3	**51**	**15**	300
4	64	**13**	**260**
5	75	**11**	220
6	**84**	9	**180**
7	**91**	7	**140**
8	96	5	**100**

Since $MRP_L = PX * MP_L$, for any quantity of labor, we can find that the price of good X is \$20.

b.) Suppose the current market wage is \$200. How many laborers will the firm hire?

Solution: We want to hire the highest number of laborers such that $MRP_L \geq P_L$. For this problem, this is when the fire hires 5 workers.

c.) Assume labor is the only input and wage is still \$200. This firm's output level is 64, what is the average cost for this firm?

Solution: When output $q = 64$, we can find this firm hires 4 workers through the table above. Since wage for each worker is \$200 per worker, its total cost is $4 * 200 = 800$. Then $AC = TC/q = 800/64 = 12.5/unit$.

d.) Suppose the market wage falls by \$65. How many workers will the firm hire now?

Solution: Similar to the previous question, P_L now equals \$135. The highest number of workers such that $MRP_L \geq P_L$ is 7 workers.

Exercise 3 Consider the retail gasoline market, which is perfectly competitive. Market demand and supply for gasoline are represented by the following:

$$\text{Supply: } P = 0.2Q$$
$$\text{Demand: } P = 400 - 0.2Q$$

P is the price of gasoline and Q is gallons of gasoline. There are 100 identical firms in the market. Each gas station hires workers in a perfectly competitive labor market. The supply and demand for labor are represented by:

$$\text{Supply: } W = 0.03L$$
$$\text{Demand: } W = 50 - 0.02L$$

W is the price of labor (wage) and L is the quantity of workers.

a.) How many workers will be hired by each firm in equilibrium?

Solution: Equating supply and demand in the labor market we can solve for the equilibrium quantity of labor in the market

$$\begin{aligned} 0.03L &= 50 - 0.02L \quad \textit{(Add 0.02L to each side)} \\ 0.05L &= 50 \quad \textit{(Divide by 0.05)} \\ L^* &= 50/0.05 \\ &= 1000 \end{aligned}$$

Since the total number of workers is 1000, we divide this by the number of firms (100) to get that each firm hires 10 workers.

b.) What is the market equilibrium wage?

Solution: Using the information from part (a), we see the $L^* = 1000$. *Plugging this into either the supply or demand of the labor market gets that*

$$W^* = 0.03 * 1000 = 50 - 0.02 * 1000 = \$30$$

c.) What is the market equilibrium price of gasoline?

Solution: Using information from this question, we know market demand and supply of this gasoline market. Then we can solve for its equilibrium price and quantity:

$$0.2Q = 400 - 0.2Q \Longrightarrow 400 = 0.4Q \Longrightarrow Q = 1000$$

Plug $Q = 1000$ *into its supply:*

$$Px = 0.2Q = 0.2 * 1000 = \$200$$

d.) Calculate the marginal product of labor for each firm.

Solution: In equilibrium, we know that $P_L = MRP_L = MP_L * PX$. *We have* $P_L = W = \$30$. *From part (c), we can find* $P_X = \$200$. *Therefore we can get*

$$MP_L = MRP_L/P_X = \$30/\$200 = 0.15$$

Exercise 4 Suppose Dr. Wells own a running machine company called "STAR". He hires technicians (called "Cisco", capital) and normal workers (called "Barry", labor) to produce treadmills. The marginal product of "Cisco" is MPK = 30 + 3L and marginal product of "Barry" is MPL = 20 - L.

a.) In equilibrium, wage of "Cisco" is three times as much as wage of "Barry". How many "Barry" workers will be hired?

Solution: In equilibrium, $MP_K/P_K = MP_L/P_L$. Thus, $(30+3L)/P_K = (20-L)/P_L$. In this question, we also know $P_K = 3 * P_L$. Then we have

$$\begin{aligned}(30+3L)/(3P_L) &= (20-L)/P_L \\ (30+3L)/3 &= 20-L \\ 10+L &= 20-L\end{aligned}$$

Therefore, $L = 5$. Dr. Wells hires 5 "Barry" workers.

b.) When the number of "Barry" workers increases, what happens to MP_K? Increase or decrease? What is the relationship between these two inputs?

Solution: Since $MP_K = 30 + 3L$, MP_K increases when L increases. It means these two inputs are complementary. (More "Barry" increases the productivity of "Cisco"!)

c.) If the wage of "Cisco" increase, does Dr. Wells hire more "Barry" workers? Or fewer "Barry" workers? Why? [Hint: Consider both "Output effect" and "factor substitution effect"!]

*Solution: **Output effect**: When wage of "Cisco" increases ($P_K \uparrow$), cost of producing treadmills increases. This firm will produce fewer and thus hire fewer "Barry" workers.*
***Factor Substitution Effect**: When wage of "Cisco" increases ($P_K \uparrow$), this firm hires fewer "Cisco". Then this firm will hire fewer its complementary input "Barry" workers too.*
***These Two Effects together**: This firm hires fewer "Barry" workers.*

Pareto Efficiency Questions

Exercise 5 Hurley and Leonard pool their money to buy a lottery ticket and manage to win one million dollars. Which of the following is a Pareto efficient division of the winnings, assuming Hurley and Leonard both want as much money as possible?

a.) Hurley and Leonard split the money fifty-fifty.

Solution: This is Pareto efficient: in order to give Hurley more money we must take some from Leonard, and vice versa.

b.) Hurley gets all the money and Leonard gets nothing.

Solution: This is also Pareto efficient since to make Leonard better off we must take money from Hurley (and we cannot make Hurley better off at all).

c.) Leonard gets \$400,000, Hurley gets \$300,000 and the other \$300,000 is burned.

Solution: This is not Pareto efficient: instead of burning the other $300,000 we could give it to Leonard or Hurley.