

## **Solution to Mathematical Problems of Market Equilibrium and Efficiency**

### Learning Objectives

- Solution for market equilibrium quantity of demand and supply in terms of quantity (Answer to equilibrium quantity of demand and supply)
- Solution for finding market equilibrium price (Answer to find the equilibrium price in terms of price)
- Solution of effect of change in market demand and supply on equilibrium demand, supply and price (Answer to the questions relating to change in market demand and supply and their effect in equilibrium price, demand and supply)
- Solution of effect of government policies like taxation, subsidies and price control on market equilibrium (Answer to find the equilibrium price, demand and supply when government-imposes tax, provide subsidies and adopt price control policies)

### **Part- A**

#### **Solution for determination of equilibrium market price and equilibrium quantity of demand and supply**

**1. Find the equilibrium price and quantity in the market if demand function is;  $Q_d = 63 - 3P$  and supply function is;  $Q_s = 4P$ . Where,  $Q_d$  is quantity demanded,  $Q_s$  is quantity supplied and  $P$  is price.**

#### **Solution**

Here given,

Market demand function ( $Q_d$ ) =  $63 - 3P$  and

Market supply function ( $Q_s$ ) =  $4P$

Now, to determine the market equilibrium price and quantities we have the market equilibrium condition as;

$$\text{Or, } 63 - 3P = 4P$$

$$\text{Or, } 63 = 7P$$

$$\text{Or, } P = 63/7 = \text{Rs. } 9$$

Now substitution the value of price in demand and supply functions respectively and we will obtain the value of demand and supply quantity in market.

Thus,

Market demand ( $Q_d$ ) =  $63 - 3P = 63 - 3 \times 9 = 63 - 27 = 36$  units and

Market supply ( $Q_s$ ) =  $4P = 4 \times 9 = 36$  units.

Here at equilibrium the value of market demand and supply must be equal. Thus, at such a point, equilibrium price is Rs. 9, equilibrium market demand and supplied are 36 units respectively.

**2. Market research has revealed the following market demand and supply functions of chocolate;  $Q_d=1600-30P$ ,  $Q_s= 1400+70P$ . Calculate the equilibrium price and quantity demand in the market.**

**Solution**

Here given

Market demand for chocolate ( $Q_d$ )= $1600-30P$  and

Market supply of chocolate ( $Q_s$ )= $1400+70P$

Now, for market to be in the state of equilibrium,

Market demand = Market supply ( $Q_d = Q_s$ )

Or,  $1600-30P= 1400+70P$

Or,  $1600-1400= 70P+30P$

OR,  $200= 100P$

$\therefore P = \frac{200}{100} = \text{Rs. } 2$  per chocolate.

For determination of demand and supply quantity, substituting the value of P in above demand and supply function.

$\therefore$  Market demand ( $Q_d$ )= $1600-30P= 1600-30*2= 1540$  units and,

$\therefore$  Market supply ( $Q_s$ )= $1400+70P =1400 +70*2= 1540$  units.

Hence, equilibrium market price per chocolate is Rs. 2 and at such price equilibrium quantity of demand and supply is 1540 units respectively.

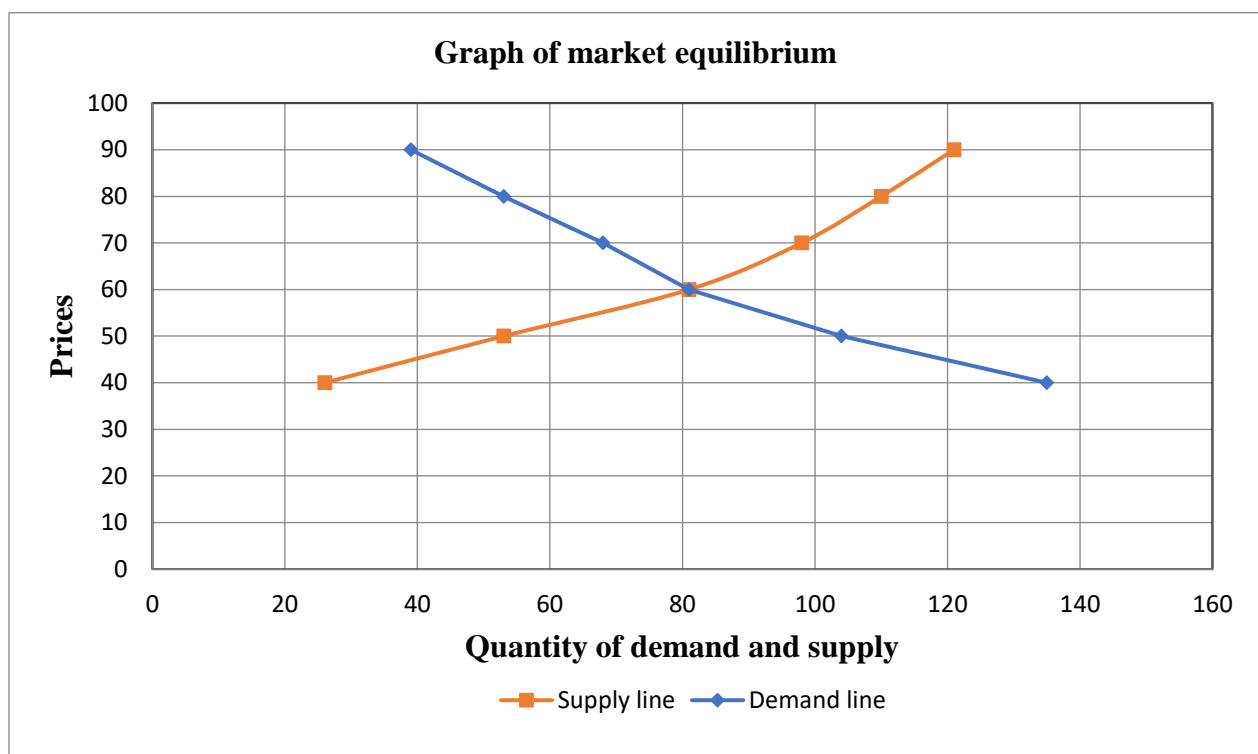
**3. A market for a particular good is shown following demand and supply schedule;**

Price (In Rs.)	Demanded quantity	Supplied quantity
40	135	26
50	104	53
60	81	81
70	68	98
80	53	110

- Graph the above schedule and find equilibrium price, demand and supplied quantity.
- If the actual price in the market is beyond the equilibrium price, what would drive the market towards equilibrium?
- And if actual price is below equilibrium price, what would drive the market towards equilibrium.

### Solution

Presenting the given demand and supply schedule in graph we get;



By observing the above graph, interaction point of downward sloping demand curve and upward sloping supply curve is market equilibrium point. The price corresponding to such point is Rs. 60 known as equilibrium price and corresponding quantity 81 units is equilibrium quantity of demand and supply.

Now if the actual price is beyond the equilibrium price (more than Rs. 60) then excess supply or surplus in the market would drive the market towards equilibrium.

And if the actual price in the market is less than equilibrium price (Less than Rs. 60) then the excess demand or shortage in the market would drive market towards equilibrium.

Therefore, market equilibrium is the state of equality or balance between any two opposite forces and once if they reached such condition then there is no tendency to deviate from it.

**4. If the market consists of three consumers; J, K and L with their individual demand functions as;  $P= 35-0.50Q_J$  ,  $P= 50-0.250Q_K$  and  $P= 40-2.0Q_L$ . The market supply function is given as  $Q_S= -40+3.5P$ . Determine the market equilibrium price and quantity. Also find individuals demand at equilibrium price.**

### **Solution**

The addition of demand function of J, K and L gives market demand function. Thus, the market demand function is;

$$\text{Market demand } (Q_d) = Q_J + Q_K + Q_L$$

Now,

➤ **Demand function of consumer J is**

$$P = 35 - 0.50Q_J$$

$$\text{Or, } 0.50Q_J = 35 - P$$

$$\text{Or, } Q_J = \frac{35 - P}{0.50} = 70 - 2P$$

➤ **Demand function of consumer K is;**

$$P = 50 - 0.250Q_K$$

$$\text{Or, } 0.250Q_K = 50 - P$$

$$\text{Or, } Q_K = \frac{50 - P}{0.25} = 200 - 4P$$

➤ **Demand function of consumer L is;**

$$P = 40 - 2.0Q_L$$

$$\text{Or, } 2.0Q_L = 40 - P$$

$$\text{Or, } Q_L = \frac{40 - P}{2.0} = 20 - 0.5P$$

Hence, market demand function is;

$$(Q_d) = Q_J + Q_K + Q_L = 70 - 2P + 200 - 4P + 20 - 0.5P = 290 - 6.5P \text{ and}$$

Market supply function is;

$$(Q_s) = -40 + 3.5P$$

For market equilibrium:

Market demand= Market supply

$$\text{Or, } 290 - 6.5P = -40 + 3.5P$$

$$\text{Or, } 330 = 3.5P + 6.5P$$

$$\text{Or, } P = \frac{330}{10} = \text{Rs. } 33$$

Again, substituting the value of P in market demand and market supply functions respectively;

$$Q_d = 290 - 6.5P = 290 - 6.5 \times 33 = 75.5 \text{ and}$$

$$Q_s = -40 + 3.5P = -40 + 3.5 \times 33 = 75.5 \text{ units}$$

Again, for demand of individuals at market equilibrium price;

$$Q_J = 70 - 2P = 70 - 2 \times 33 = 4 \text{ units}$$

$$Q_K = 200 - 4P = 200 - 4 \times 33 = 68 \text{ units and}$$

$$Q_L = 20 - 0.5P = 20 - 0.5 \times 33 = 3.5 \text{ units}$$

Therefore, market demand and supply are 75.5 units at equilibrium price of Rs. 33 and at that price individual quantities of demand are 4 units, 68 units and 3.5 units for individual J, K and L respectively.

**5. Suppose there are 100 identical consumers in the market for the commodity X, each with demand function  $Q_{dx} = 190 - 5P_x$  and 50 identical producers of the commodity X, each with a supply function given by  $Q_{sx} = 20 + 2P_x$ . Find the market demand and market supply function and determine the equilibrium price and equilibrium quantity in the market. What happens if the government grants per unit cash subsidy to all the producers of commodity X?**

**Solution**

Here given

Identical demand function;  $Q_{dx} = 190 - 5P_x$  and number of consumers = 100

Identical supply function;  $Q_{sx} = 20 + 2P_x$  and number of producers = 50

Market demand function ( $Q_{dx}$ ) =  $(190 - 5P_x) \cdot 100 = 19,000 - 500P_x$  and

Market supply function ( $Q_{sx}$ ) =  $(20 + 2P_x) \cdot 50 = 1000 + 100P_x$

As we know, for market to be in equilibrium

Market demand = Market supply ( $Q_{dx} = Q_{sx}$ )

$$\text{Or, } 19,000 - 500P_x = 1000 + 100P_x$$

$$\text{Or, } 19,000 - 1,000 = 100P_x + 500P_x$$

$$\text{Or, } P_x = \frac{18000}{600} = \text{Rs. } 30$$

Thus, for market demand and supply quantity,

$$\text{Or, } Q_{dx} = 19,000 - 500 P_x = 19,000 - 500 * 30 = 4,000 \text{ units and}$$

$$\text{Or, } Q_{sx} = 1000 + 100 P_x = 1,000 + 100 * 30 = 4,000 \text{ units}$$

Therefore, equilibrium quantity of demand and supply is 4,000 units and price are Rs. 30

If the government provides subsidy to the producer of good X, there will increase in supply quantity and as a result of increased supply (with no change in demand) price is reduced. So, supply of good X in the market will increase and price of the good X will fall as a result of subsidy provided by the government to the producer.

**6. From a demand function  $Q_d = 2,000 - 30P$  and a supply function  $Q_s = 20P$ , find out equilibrium price, equilibrium quantity and gap between demand and supply at price of Rs. 50.**

**Solution**

Here given

Demand function is  $Q_d = 2,000 - 30P$ , market supply function is  $Q_s = 20P$

For market equilibrium,

Market demand = Market supply ( $Q_d = Q_s$ )

$$\text{Or, } 2,000 - 30P = 20P$$

$$\text{Or, } 2,000 = 50P$$

$$\text{So, } P = \frac{2,000}{50} = \text{Rs. } 40$$

For equilibrium quantity of demand and supply,

For equilibrium quantity of demand and supply,

$$Q_d = 2,000 - 30P = 2,000 - 3 * 40 = 800 \text{ units and}$$

$$Q_s = 20P = 20 * 40 = 800 \text{ units}$$

Again, finding gap between demand and supply at price Rs. 50

$$Q_d = 2,000 - 30P = 2,000 - 30 * 50 = 500 \text{ units and}$$

$$Q_s = 20P = 20 * 50 = 1000 \text{ units}$$

Therefore, gap between demand and supply =  $Q_s - Q_d = 1000 - 500 = 500$  units and which represent excess supply in the market.

## Part-B

**Solution to the problems relating to change in market demand and supply and their effect in equilibrium price, demand and supply**

**1. If the demand and supply functions are given as below;  $Q_d=100-5P$  and  $Q_s=10+5P$ . Determine the equilibrium price and quantity. If there is increase in consumer's income and so that new market demand becomes  $Q'_d=200-5P$  then determine new equilibrium price and quantities.**

### Solution

Here given

Initial demand function;  $Q_d=100-5P$

New demand function;  $Q'_d=200-5P$

Market supply function;  $Q_s=10+5P$

Now for market equilibrium:  $Q_d = Q_s$

Or,  $100-5P=10+5P$  or  $P= \text{Rs. } 9$

Thus,  $Q_d= 100-5*9= 55$  and  $Q_s=10+5P= 10+5*9= 55$

For new equilibrium  $P$ ,  $Q_d$  and  $Q_s$

$Q'_d=Q_s$  or,  $200-5P=10+5P$  or,  $P =\text{Rs. } 19$

So,  $Q'_d= 200-5P= 200-5*19= 105$  units and  $Q_s= 10+5*19= 105$  units.

Therefore, when there is increase in demand with fixed supply, the equilibrium price increases from Rs. 9 to Rs. 19 and equilibrium quantity of demand and supply is also increased.

**2. If you are given the following demand schedule;**

Price	Quantity Demanded	Quantity Supplied
1	20	10
2	17	13
3	14	14
4	12	15
5	8	16

**Find the equilibrium price and quantities. If the quantity demanded at each price is increased by 3 units then what would be the new equilibrium price and quantity?**

### Solution

By observing the given demand and supply schedule, Rs. 3 is the equilibrium price because at Rs. 3 market demand is exactly equal to market supply and which is 14 units.

Again, when market demand is increased by 3 units at every price level the new demand schedule will look like;

Price	Initial Quantity demanded	Quantity supplied	New Quantity demanded
1	20	10	20+3=23
2	17	13	17+3= 20
3	14	14	14+3= 17
4	12	15	12+3= 15
5	8	16	8+3= 11

In the above table it is seen that the market demand is increased as a result of increase in consumer's income and which results shift in demand curve with constant market supply.

Thus, equilibrium takes place at price Rs.4 with quantity 15 units. It is the point where market demand is equal to market supply and it is also observed that there will increase in equilibrium price and equilibrium quantity when there is increase in market demand with no change in supply curve.

**3. Suppose there are 1000 identical individuals in the market for a particular commodity each with a demand function  $Q_d=12-2P$  and 1000 identical suppliers each with a function given by  $Q_s=2P$ . Find the market demand function and market supply function. Calculate the value of economic variables at the point of equilibrium. Again, suppose there is an improvement in the technology of producing unit so that a new market supply curve is given by  $Q'_s=4000+2000P$ . State the new equilibrium price and the new equilibrium quantity of the goods.**

### Solution

Here given

Demand function is given as  $Q_d=12-2P$

Number of identical consumers= 1000

Supply function is  $Q_s=2P$

Number of identical suppliers= 1000

$\therefore$ Market demand=  $1000(12-2P) = 12000- 2000P$  and Market Supply=  $1000(2P) = 2000P$

For market equilibrium:  $Q_d=Q_s$

Or  $12000- 2000P=2000P$  or  $P= Rs. 3$

Market demand  $Q_d=12000-2000*3= 12000-6000= 6000$  units and

Market supply  $Q_s=2000*3= 6000$  units



Again

New market supply  $Q'_s=4000+2000P$

For new equilibrium price and quantity,

Market demand= New market supply ( $Q_d = Q'_s$ )

Or,  $12000- 2000P=4000+2000P$

Or,  $12000-4000= 2000P+2000P$

Or  $P= 8000/4000= \text{Rs. } 2$

New market supply=  $Q'_s=4000+2000P= 4000+2000*2= 8000$  units

And market demand=  $12000-2000*2= 8000$  units

**4. Let, demand function  $Q_d= 100-5P$ , supply function  $Q_s= 30+ 5P$ . Using graph, compute equilibrium price and quantity. What will be the effect on equilibrium price and quantity when demand function increases to:  $Q'_d= 120-5P$ ? What will be the effect on equilibrium price and quantity when supply function increases to:  $Q'_s= 40+5P$ ? What will be the simultaneous effect on equilibrium price and quantity when both demand and supply functions increase?**

### Solution

Here given

Initial demand function:  $Q_d= 100-5P$  and

Initial supply function:  $Q_s= 30+ 5P$

Derivation of demand and supply schedule and finding equilibrium price and quantity;

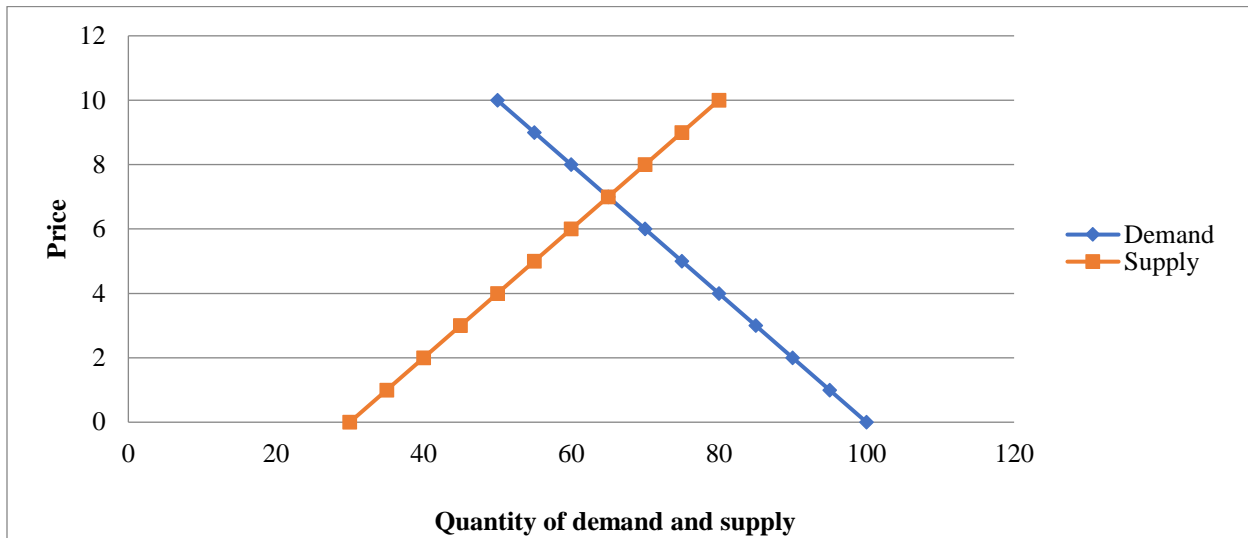
*(Note: if the range of price is not given in the question then we can use price from zero or one to equilibrium price or sometimes until quantity demand will become zero)*

### Demand and supply schedule

Price	Demand ( $Q_d= 100-5P$ )	Supply ( $Q_s= 30+ 5P$ )	State of market
0	$100-5*0=100$	$30+5*0=30$	Excess demand
1	$100-5*1=95$	$30+5*1=35$	
2	$100-5*2=90$	$30+5*2=40$	
3	$100-5*3=85$	$30+5*3=45$	
4	$100-5*4=80$	$30+5*4=50$	
5	$100-5*5=75$	$30+5*5=55$	
6	$100-5*6=70$	$30+5*6=60$	Equilibrium
7	$100-5*7=65$	$30+5*7=65$	
8	$100-5*8=60$	$30+5*8=70$	Excess supply

9	$100-5*9=55$	$30+5*9=75$	
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Showing the above schedule in graph we get,



From the graph and table, we can see that equilibrium price is Rs. 7 and equilibrium quantity is 65 units. Now,

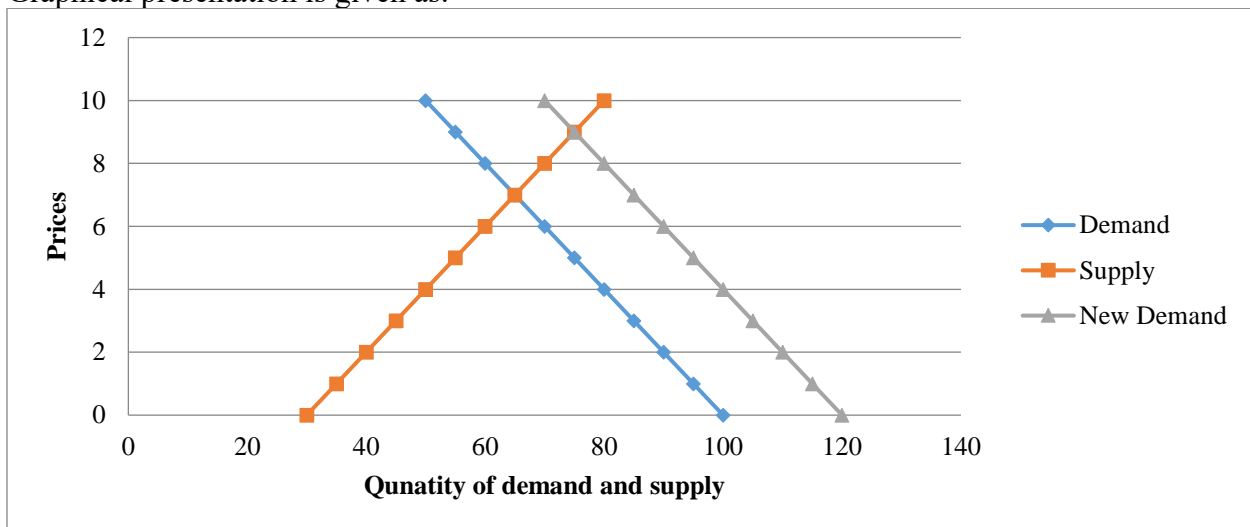
When there is Case of new demand function  $Q'_d = 120 - 5P$  then the demand schedule and graph can be shown as;

#### New demand and supply schedule when demand increases

Price	Initial demand	Initial supply	New demand ( $Q'_d = 120 - 5P$ )
0	100	30	120
1	95	35	115
2	90	40	110
3	85	45	105
4	80	50	100
5	75	55	95
6	70	60	90
7	65	65	85
8	60	70	80
9	55	75	75

10	50	80	70
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Graphical presentation is given as:



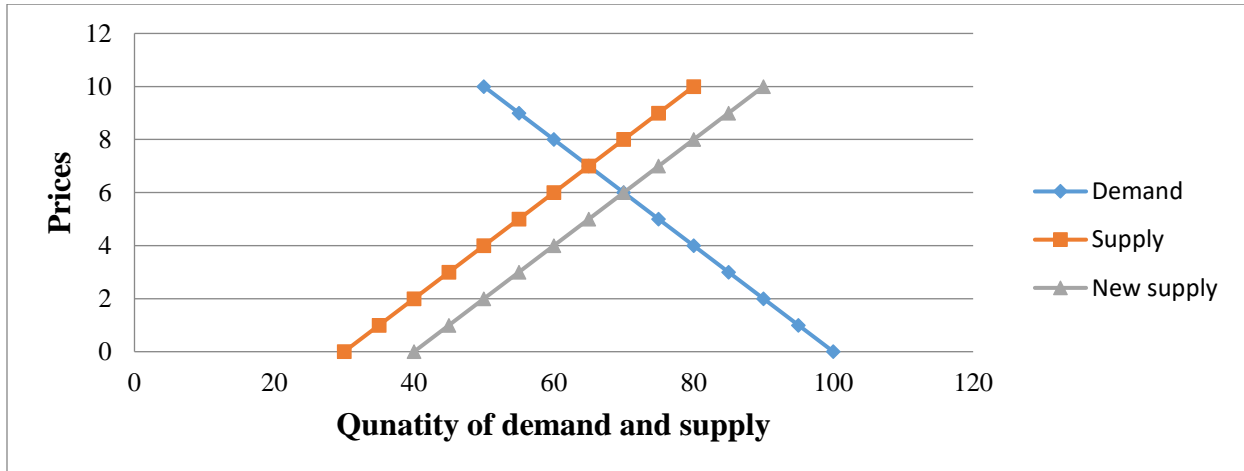
From the graph and table, we can see that new equilibrium price when demand is increased and supply remains constant is Rs. 9 and equilibrium quantity is 85 units. Thus, effect of increased demand is increase in equilibrium price as well as quantity when there is no change in supply function.

- When there is Case of new supply function  $Q'_s = 40 + 5P$  then the demand schedule and graph can be shown as;

#### New demand and supply schedule when supply increases

Price	Initial demand	Initial supply	New supply ( $Q'_s = 40 + 5P$ )
0	100	30	40
1	95	35	45
2	90	40	50
3	85	45	55
4	80	50	60
5	75	55	65
<b>6</b>	<b>70</b>	60	<b>70</b>
7	65	65	75
8	60	70	80
9	55	75	85
10	50	80	90

Graphical presentation of the schedule is;



From the graph and table, we can see that new equilibrium price when supply is increased and demand remains constant is Rs. 6 and equilibrium quantity is 70 units. Thus, effect of increased supply is decrease in equilibrium price and increase in quantity when there is no change in demand function.

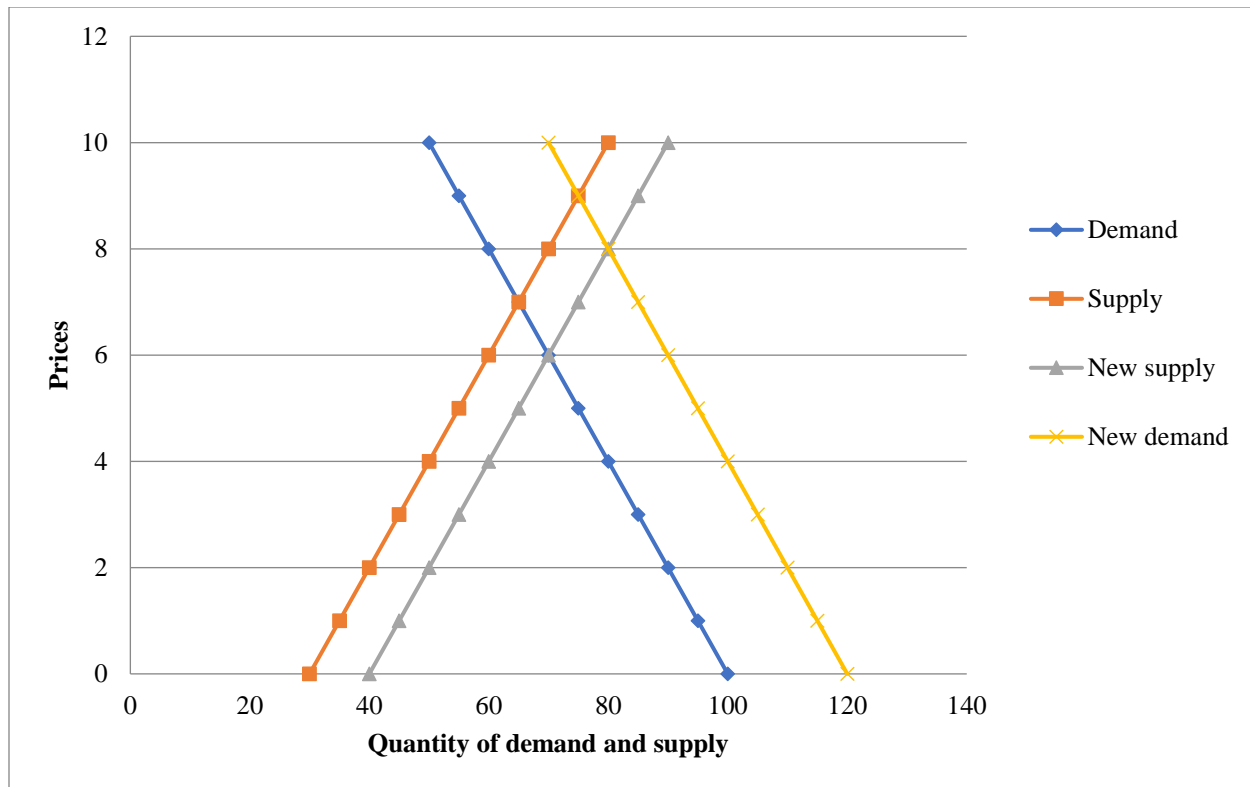
Again,

When there is Case of both demand and supply functions increases then the demand schedule and graph can be shown as;

### New demand and supply schedule when both demand and supply increase

Price	Initial demand	Initial supply	New demand	New supply
0	100	30	120	40
1	95	35	115	45
2	90	40	110	50
3	85	45	105	55
4	80	50	100	60
5	75	55	95	65
6	70	60	90	70
7	65	65	85	75
<b>8</b>	60	70	<b>80</b>	<b>80</b>
9	55	75	75	85
10	50	80	70	90

Graphical presentation of the schedule is;



From the graph and table, we can see that new equilibrium price when demand and supply both are increased is Rs. 8 and equilibrium quantity is 80 units. It shows increase in both equilibrium price and quantities.

The effect of increase in demand and supply both is based on the size of increment in their quantities.

- If increase in supply is greater than increase in demand then resulting price will decrease and quantity will increase.
- If increase in demand is greater than increase in supply that resulting price will increase and quantity will also increase.
- If both demand and supply are increased by same degree than price remains same and quantity will be increased.
- Above case is therefore increase in demand is greater than increase in supply so price as well as quantity both have increased from their previous values.

### Part- C

**Solution for determination of equilibrium market price, equilibrium quantity of demand and supply when government play its role through price fixing or price control, taxation and subsidies**

1. The demand function for a product is  $Q_d = 75 - 1.5P$ , and supply function is  $Q_s = 30 + 3P$ , where quantity demanded is  $Q_d$ , quantity supplied is  $Q_s$  and per unit price is  $P$ . Find the equilibrium price and quantity. Suppose the government imposes the specific sales tax at the rate of Rs. 6 per unit then find the equilibrium price and quantity.

### Solution

Here given

Market demand function  $Q_d = 75 - 1.5P$  and

Market supply function  $Q_s = 30 + 3P$

For market equilibrium,

Market demand = Market supply ( $Q_d = Q_s$ )

Or,  $75 - 1.5P = 30 + 3P$

Or,  $75 - 30 = 3P + 1.5P$

Or,  $P = 45/4.5 = \text{Rs. } 10$

$\therefore$  Market demand ( $Q_d$ ) =  $75 - 1.5 \times 10 = 60$  units, and Market supply ( $Q_s$ ) =  $30 + 3 \times 10 = 60$  units

Again

#### ➤ Determining the effect of per unit tax imposition of the government

If the government imposes the specific sales tax at the rate of Rs. 6 per unit then new supply function can be ascertained as

$$Q'_s = 30 + 3(P - 6) = 30 + 3P - 18$$

Here per unit sales tax imposed by the government is to be reduced from the price because the seller has to pay Rs. 6 to the government as tax from the price that he receives from the consumer. Thus, for measuring new equilibrium price that seller will charge to buyers can be measured as

$$Q'_s = Q_d$$

Or,  $30 + 3P - 18 = 75 - 1.5P$

Or,  $30 - 75 - 18 = -1.5P - 3P$

Or,  $-63 = -4.5P$

Therefore, new equilibrium price after tax ( $P$ ) = Rs. 14

$Q'_s = 30 + 3P - 18 = 30 + 3 \times 14 - 18 = 54$  units and

$Q_d = 75 - 1.5P = 75 - 1.5 \times 14 = 54$  units

Therefore, new equilibrium price is higher than original price or price before taxation and new equilibrium quantity is less than old quantity. Thus, per unit sales tax increases price to the buyers and decrease the quantity supply in the market.

**2. Assume that a linear demand function is given as;  $Q_d=120-5P$  and linear supply function is;  $Q_s= -30+10P$ . On the basis of these functions give the answer of following questions,**

- **Calculate the demanded and supplied quantities from the price range of Rs. 3 to Rs. 15. And plot into the graph.**
- **Calculate the equilibrium price and output graphically and mathematically.**
- **If the government imposes a specific tax per unit of Rs. 3 per unit then derive new supply function and plot the new supply curve on the original diagram.**
- **Calculate new equilibrium price and quantity from the graphical presentation.**

**Solution**

Here given

Demand function ( $Q_d$ )= $120-5P$  and

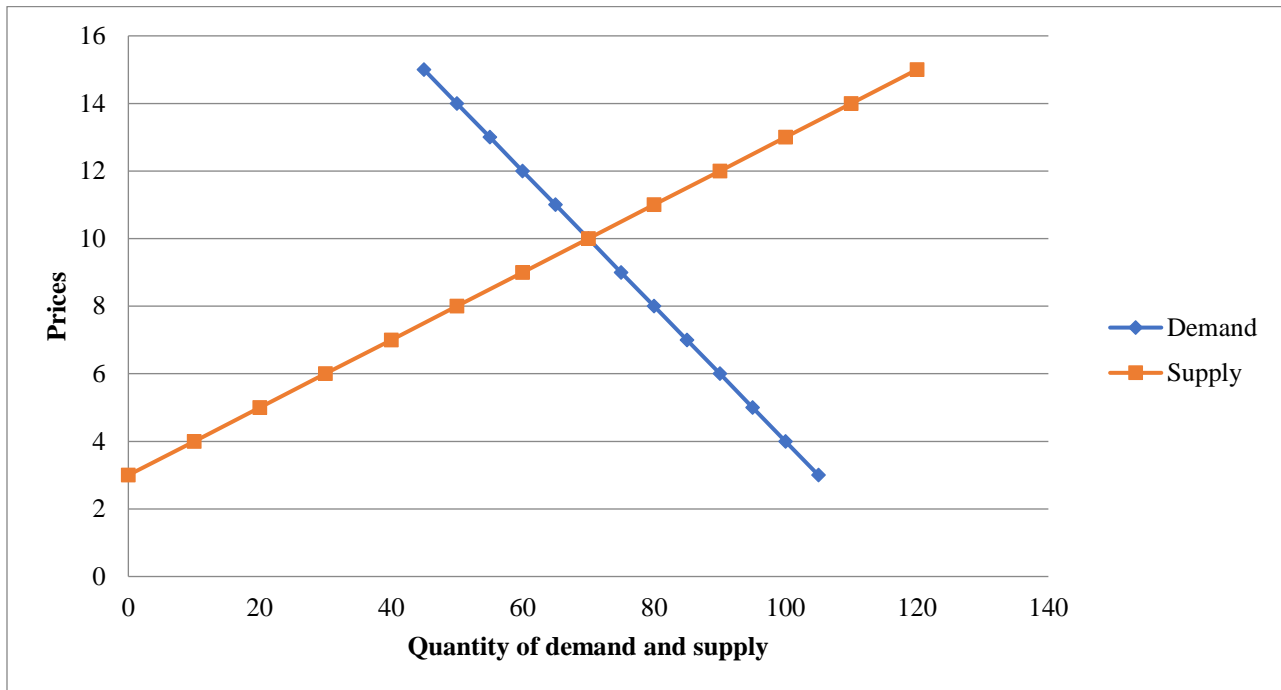
Supply function ( $Q_s$ )=  $-30+10P$

Derivation of demand and supply schedule from price range Rs. 3 to 15

Price (Rs.)	Demand ( $Q_d=120-5P$ )	Supply ( $Q_s= -30+10P$ )
3	105	0
4	100	10
5	95	20
6	90	30
7	85	40
8	80	50
9	75	60
10	70	70
11	65	80
12	60	90
13	55	100
14	50	110

15	45	120
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Now, calculation of equilibrium price and quantity with help of graph and mathematical calculation;



From the graph, equilibrium price is Rs. 10 and equilibrium quantity of demand and supply is 70 units.

**Mathematically:**

At equilibrium: Market demand= Market supply

Or  $120-5P=-30+10P$

Or,  $120+30=10P+5P$

Or,  $P= Rs. 10$

Therefore,

Market demand ( $Q_d$ )= $120-5*10= 70$  units

Market supply ( $Q_s$ )= $-30+10*10= 70$  units

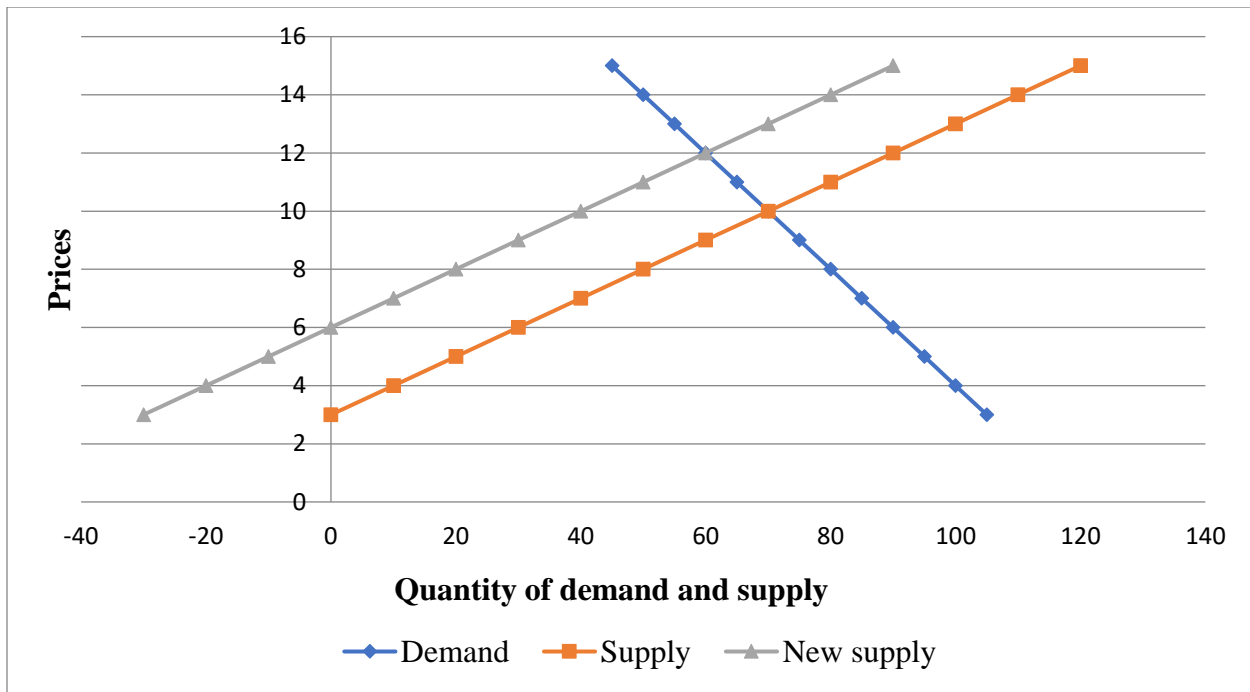
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- If Per unit tax= Rs 3 per unit and due to such tax producer will receive Rs. 3 less amount in each product he sold. Thus, the new supply curve is;

$(Q'_s) = -30+10(P-3) = -30+10P-30 = -60+10P$



Graphical presentation of new supply curve in the original graph is shown as;



By observing the graph, we can see that equilibrium price is Rs. 12 and equilibrium quantity is 60 units. So, after charging sales tax per unit by the government, the price per unit is increased and equilibrium quantity is decreased.

**3. Consider the given market demand and supply functions for a particular product;  $(Q_d)=12000-200P$  and  $(Q_s)= 6000+300P$ . Calculate equilibrium price and quantity. If the government impose sales tax of Rs. 2 per unit then what is new supply function and what is your saying regarding its effect.**

### Solution

Here given

Marked demand function  $(Q_d)=12000-200P$  and

Market supply function  $(Q_s)= 6000+300P$

For equilibrium:

Market demand = Market supply

Or,  $12000-200P=6000+300P$

Or,  $12,000-6,000= 300P+200P$

Or,  $6,000= 500P$

Or,  $P= Rs. 12$  per unit and

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- Market demand ( $Q_d$ ) =  $12000 - 200 \times 12 = 9600$  units and
- Market supply ( $Q_s$ ) =  $6000 + 300 \times 12 = 9600$  units.

Again

### **Derivation of new supply curve when government imposes sales tax of Rs. 2 per unit**

When the sales tax is imposed by the government it directly affects the quantity of supply in the market and prices that consumer has to pay for the product. So new supply curve can be defined in the form of quantity for explaining the unit price of the product;

$$(Q_s) = 6000 + 300P$$

$$\text{Or, } 300P = Q_s - 6000$$

$$\text{Or, } P = \frac{Q_s - 6000}{300}$$

$$\text{Or, } P = \frac{Q_s}{3000} - 20$$

When Rs. 2 per unit sales tax is imposed then price per unit will increase by Rs. 2 and the new supply function can be expressed as;

$$\text{Or, } P = \frac{Q_s}{3000} - 20 + 2$$

$$\text{Or, } P = \frac{Q_s}{3000} - 18$$

Or,  $Q_s = 5400 + 300P$  which is the new supply function after imposition of taxation.

**Alternatively,**

New supply function =  $6000 + 300(P - 2)$

$$\text{Or, } 6000 + 300P - 600 = 5400 + 300P$$

Which is the new supply function after imposition of taxation.

**4. The demand function for a product is  $(Q_d) = 75 - 1.5P$ , and supply function is  $(Q_s) = 30 + 3P$ . where  $Q_d$  is quantity demanded,  $Q_s$  is quantity supplied and  $P$  is price. Find the equilibrium price and quantity. If government provides subsidy to the producer at the rate of Rs.6 per unit then find the new equilibrium price and quantity.**

**Solution**

Here given

Demand function  $(Q_d) = 75 - 1.5P$  and

Supply function  $(Q_s) = 30 + 3P$

For equilibrium:

Market demand = Market supply ( $Q_d = Q_s$ )

$$\text{Or, } 75 - 1.5P = 30 + 3P$$

$$\text{Or, } 75 - 30 = 3P + 1.5P$$

$$\text{Or, } 45 = 4.5P$$

$$\text{Or, } P = \text{Rs. } 10$$

### **Effect of provision of subsidy by the government**

When the government gives the subsidy at the rate of Rs. 6 per unit then new supply function is defined as;

$$(Q_s) = 30 + 3(P+6) = 30 + 3P + 18 = 48 + 3P$$

Here if government provides subsidy at the rate of Rs. 6 per unit then the seller gets Rs. 6 per unit price charged to the costumers from the government in the form of subsidy. Thus, new supply function requires addition of subsidy per unit in the original supply function and new supply function becomes  $Q'_s = 48 + 3P$ .

### **Alternatively,**

When the subsidy is provided by the government it directly affects the quantity of supply in the market and prices that consumer has to pay for the product. So new supply curve can be defined in the form of quantity for explaining the unit price of the product;

$$(Q_s) = 30 + 3P$$

$$\text{Or, } 3P = Q_s - 30$$

$$\text{Or, } P = \frac{Q_s - 30}{3}$$

$$\text{Or, } P = \frac{Q_s}{3} - 10$$

When Rs. 6 per unit subsidy is provided then price per unit will decrease by Rs. 2 and the new supply function can be expressed as;

$$\text{Or, } P = \frac{Q_s}{3} - 10 - 6$$

$$\text{Or, } P = \frac{Q_s}{3} - 16$$

Or,  $Q_s = 48 + 3P$  Which is the new supply function after providing subsidy.

➤ For new equilibrium price and quantity:

Market demand function = New supply function

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$$\text{Or, } 75 - 1.5P = 48 + 3P$$

$$\text{Or, } 75 - 48 = 3P + 1.5P$$

$$\text{Or, } 27 = 4.5P$$

$$\text{Or, } P = \text{Rs. } 6$$

Market demand ( $Q_d$ ) =  $75 - 1.5 \times 6 = 75 - 9 = 66$  units, and Market supply =  $Q_s = 48 + 3 \times 6 = 48 + 18 = 66$  units.

Hence, the new price after subsidy is decreased as comparison to original price and quantity supply is more than original quantity. So, the subsidy provided of the government reduces the price and increases the quantity supplied in the market.

**5. Suppose the demand and supply functions are given as below; ( $Q_d$ ) =  $1000 - 2P$ , and supply function is ( $Q_s$ ) =  $-100 + 8P$ . Where  $Q_d$  is quantity demanded,  $Q_s$  is quantity supplied and  $P$  is price. Find the equilibrium price and quantity. If government imposes price ceiling of Rs. 80, what are quantity demanded and supplied. What does it imply?**

### **Solution**

Here given

Market demand function; ( $Q_d$ ) =  $1000 - 2P$  and

Market supply function ( $Q_s$ ) =  $-100 + 8P$

For market equilibrium:

Market demand = Market supply ( $Q_d = Q_s$ )

$$\text{Or, } 1000 - 2P = -100 + 8P$$

$$\text{Or, } 1000 + 100 = 10P$$

$$\text{Or, } P = \text{Rs. } 110$$

Market demand ( $Q_d$ ) =  $1000 - 2 \times 110 = 780$  units and

Market supply ( $Q_s$ ) =  $-100 + 8 \times 110 = 780$  units

Now

- If the ceiling price = Rs. 80 which is below the equilibrium price

Market demand ( $Q_d$ ) =  $1000 - 2 \times 80 = 840$  units and

Market supply ( $Q_s$ ) =  $-100 + 8 \times 80 = 540$  units

Here, with the price ceiling decision of the government, demand is increased and supply is decreased. It means there is creation of shortage in the market by 300 units.

6. Suppose the demand and supply functions are given as below;  $(Q_d)=1000-2P$ , and supply function is  $(Q_s)= -100+8P$ . where  $Q_d$  is quantity demanded,  $Q_s$  is quantity supplied and  $P$  is price. Find the equilibrium price and quantity. If government imposes price floor of Rs.120, what are quantity demanded and supplied. What does it imply?

Now

- If the ceiling price =Rs. 80 which is below the equilibrium price

Market demand  $(Q_d)=1000-2*80= 840$  units and

Market supply  $(Q_s)= -100+8*80= 540$  units

Here, with the price ceiling decision of the government, demand is increased and supply is decreased. It means there is creation of shortage in the market by 300 units.

7. Suppose the demand and supply functions are given as below;  $(Q_d)=1000-2P$ , and supply function is  $(Q_s)= -100+8P$ . where  $Q_d$  is quantity demanded,  $Q_s$  is quantity supplied and  $P$  is price. Find the equilibrium price and quantity. If government imposes price floor of Rs.120, what are quantity demanded and supplied. What does it imply?

### Solution

Given demand function;  $(Q_d)=1000-2P$  and

Market supply function  $(Q_s)= -100+8P$

For market equilibrium:

Market demand= Market supply  $(Q_d = Q_s)$

Or,  $1000-2P=-100+8P$

Or,  $1000+100=10P$

Or,  $P= Rs. 110$

Market demand  $(Q_d)=1000-2*110= 780$  units and

Market supply  $(Q_s)= -100+8*110= 780$  units

Now

- If the floor price =Rs. 120 which is above the equilibrium price

Market demand  $(Q_d)=1000-2*120= 760$  units and

Market supply  $(Q_s)= -100+8*120= 8600$  units

Here, with the floor price decision of the government, supply is increased and demand is decreased. It means there is creation of excess supply called buffer stock in the market by 100 units.

8. The demand and supply functions for the market of sugarcane in the Province No. 2 are as  $P = 100 - \frac{Q}{100}$  and  $P = \frac{Q}{100}$ . Compute equilibrium price of sugarcane and quantity demanded and supplied in the market. Suppose the state parliament sets a price floor of Rs. 60 per units as a result of farmers protest in Maitighar Kathmandu.

Government also ensures that any surplus units will be purchased by government to maintain such floor price in the market. Determine the market demand quantity and governments perchance quantity. Again, suppose that for the government to store buffer stock of sugarcane costs Rs. 10 per unit then calculate the total cost for the government.

### Solution

Here given

$$\text{Market demand function: } P = 100 - \frac{Q}{100}$$

$$\text{Or, } 100P = 10000 - Q$$

$$\text{Or, } Q_d = 10,000 - 100P$$

$$\text{Market supply function: } P = \frac{Q}{100}$$

$$\text{Or, } 100P = Q$$

$$\text{Or, } Q_s = 100P$$

For market equilibrium:

$$\text{Market demand} = \text{Market supply } (Q_d = Q_s)$$

$$\text{Or, } 10,000 - 100P = 100P$$

$$\text{Or, } 200P = 10,000$$

$$\text{Or, } P = 50 \text{ per unit.}$$

$$\text{Market demand } Q_d = 10,000 - 100 \times 50 = 5,000 \text{ units and}$$

$$\text{Market supply } Q_s = 100 \times 50 = 5,000 \text{ units}$$

➤ Now when there is floor price = Rs. 60 then,

$$\text{Market demand at Rs. 60} = 10,000 - 100 \times 60 = 4,000 \text{ units}$$

$$\text{Market supply at Rs. 60} = 100 \times 60 = 6,000 \text{ units}$$

Here demanded quantity with price floor is 4000 and which is 2000 units lower than the supplied quantity in the market. Thus, there is buffer stock of 2000 units at support price fixed by the state parliament of Province No. 2. Hence to keep such support price lasting in the market, government has to purchase such buffer stock.

So, quantity of supplied that government has to purchase =  $6,000 - 4,000 = 2,000$  units. (Supplied - demanded = Government purchase).

Again

Total cost to the government = Purchase price + Storage cost

$$= (\text{Rs. } 60 * 2,000) + (\text{Rs. } 10 * 2,000)$$

$$= \text{Rs. } 120,000 + \text{Rs. } 20,000$$

$$= \text{Rs. } 140,000$$

So, total cost for the government to keep support price in the market is Rs. 140,000.

**9. Instead of support price/floor price, if the government introduced a price guarantee policy with a target price of Rs. 60. Government said that farmers are paid the difference between what they are paid by consumers and target price. Determine the production of farmers. Also compute the price paid by the consumers to farmers and amount paid by the government.**

### **Solution**

Here guaranteed price = Rs. 60 and at such price,

Market supply or production  $Q_s = 100 * 60 = 6,000$  units and to sell all 6000 unit of market supply the price to be charged for the consumers can be calculated as;

$$P = 100 - \frac{6,000}{100} = 100 - 60 = \text{Rs. } 40$$

Here the price consumers are willing to pay is Rs. 40 per unit and guaranteed price is Rs. 60. So the deviation between these two prices is Rs. 20 per unit.

So, government will have to pay Rs. 20 per unit to the farmers to keep trade in guaranteed price with them. Hence total expenditure if the government is;

Total cost for government = Storage cost + cost to bear excess price

$$= 0 + (\text{Rs. } 20 * 6,000) = \text{Rs. } 120,000$$

Here government does not need to store the goods so no storage cost is there to government and only the cost for government is to ensure guaranteed price and for such they have to pay the amount of price per unit of the sugarcane above the price paid by the consumers (Rs. 60 - Rs. 40 = Rs. 20 per unit)