Solution to Unsolved Numericals in the Textbook

Economics, Economy and Central Problems of an Economy

1. You have ₹ 1,000 as your pocket money. You can deposit this money in a bank and get ₹ 1,100 after an year. However, you have two other choices:

(i) lend this money to your friend who is ready to pay you ₹ 1,050 after an year, or

(ii) keep the money with you as cash in hand.

What is opportunity cost of keeping the money as cash in hand?

Sol. The opportunity cost of keeping the money as cash in hand is ₹ 100 in terms the loss of interest that the bank would have paid.

Ans. Opportunity cost = ₹ 100.

2. If the slope of PPC remains constant (or does not change) with an increase in the production of Good-X (on horizontal axis) at the cost of Good-Y (on vertical axis), what is the shape of PPC? Draw the PPC.

Sol. PPC in this case will be a downward sloping straight line touches X-axis and Y-axis. It happens when marginal opportunity cost (or marginal rate of transformation) is constant. See **Fig. 1**.

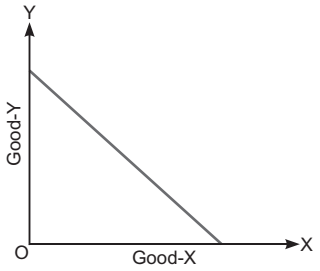

Figure 1

3. An economy produces two goods: wheat and rice. These could be produced in only two combinations.

Combination A: Wheat: 20,000 tonnes; Rice: 5,000 tonnes

Combination B: Wheat: 10,000 tonnes; Rice: 9,000 tonnes

What is the marginal opportunity cost of producing an extra tonne of rice at the cost of wheat. (Compare combination A with combination B.)

Sol. Marginal opportunity cost $= \frac{\text{Loss of wheat production}}{\text{Gain of rice production}} = \frac{10{,}000}{4{,}000} = 2.5.$

Ans. Marginal opportunity cost = 2.5.

4. Calculate the marginal opportunity cost for the various combinations of Good-X and Good-Y in the following table:

Combination	Good-X	Good-Y
A	0	95
B	10	85
C	20	73
D	30	58
E	40	41
F	50	22
G	60	0

Sol.

Combination	Good-X	Good-Y	Marginal Opportunity Cost
A	0	95	—
B	10	85	$\frac{10}{10} = 1$
C	20	73	$\frac{12}{10} = 1.2$
D	30	58	$\frac{15}{10} = 1.5$
E	40	41	$\frac{17}{10} = 1.7$
F	50	22	$\frac{19}{10} = 1.9$
G	60	0	$\frac{22}{10} = 2.2$

5. Draw PPC for the following PPC schedule. Also, calculate the marginal opportunity cost for different combinations:

Combination	Rice ('000 tonnes)	Maize ('000 tonnes)
A	0	120
B	25	100
C	50	75
D	75	45
E	100	0

Sol.

Combination	Rice ('000 tonnes)	Maize ('000 tonnes)	Marginal Opportunity Cost
A	0	120	—
B	25	100	$\frac{20}{25} = 0.8$
C	50	75	$\frac{25}{25} = 1$
D	75	45	$\frac{30}{25} = 1.2$
E	100	0	$\frac{45}{25} = 1.8$

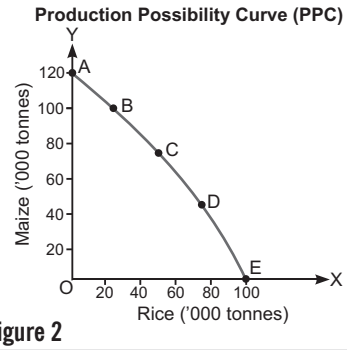

Figure 2

6. Find opportunity cost when investment of ₹ 50,000 in the stock market, by way of withdrawal of demand deposit causes a loss of interest income of ₹ 5,000 per annum. Give logical reasoning.

Sol. Opportunity cost of investment by way of withdrawal of demand deposit from the bank = ₹ 50,000 (the amount of funds withdrawn) + ₹ 5,000 (loss of interest income) = ₹ 55,000. Here, ₹ 50,000 is the explicit cost of investment and ₹ 5,000 is the implicit cost of investment. Opportunity cost is estimated as the total sacrifice involved in the act of investment.

Ans. Opportunity cost = ₹ 55,000

Consumer's Equilibrium—Utility Analysis

1. The total utility schedule of individual 'A' is given below. Derive the marginal utility schedule.

Units Consumed	0	1	2	3	4	5
Total Utility	0	15	27	38	48	55

Sol.

Units Consumed	Total Utility	Marginal Utility
0	0	—
1	15	15
2	27	12
3	38	11
4	48	10
5	55	7

2. Calculate total utility for the various units of commodity-X, given the following information:

Units of Commodity-X	1	2	3	4	5	6	7	8
MU_X (Utils)	20	16	12	9	8	3	0	–5

Sol.

Units of Commodity-X	MU_X (Utils)	TU_X (Utils)
1	20	20
2	16	36
3	12	48
4	9	57
5	8	65
6	3	68
7	0	68
8	–5	63

3. When the consumer is in equilibrium, MU of commodity-X is 45 and price of commodity-X is ₹ 9. Calculate the marginal utility of money. (Assuming marginal utility of money for the consumer is constant in equilibrium.)

Sol. $P_X = ₹\ 9$ and $MU_X = 45$

At equilibrium, $\frac{MU_X}{P_X} = MU_M$

Or, $\frac{45}{9} = MU_M$

Or, $MU_M = 5$

Ans. Marginal utility of money (MU_M) = 5.

4. Following is the total utility schedule of Mr. X:

Units of Commodity-X	1	2	3	4	5	6	7
TU_X (Utils)	20	37	51	61	66	66	64

(i) Derive MU schedule.

(ii) Find out the level of consumption at which Mr. X reaches the saturation point.

(iii) How many units should the consumer purchase to maximise satisfaction when the price of the commodity is ₹ 5? (Assume that utility is expressed in utils and 1 util = ₹ 2). Give reasons for your answer.

Sol. (i)

Units of Commodity-X	TU_X (Utils)	MU_X (Utils)
1	20	20
2	37	17
3	51	14
4	61	10
5	66	5
6	66	0
7	64	–2

(ii) Saturation point is struck when TU stops increasing even when consumption of the commodity is increased. In the present case, the saturation point is reached when 6 units of the commodity are consumed, as corresponding to the 6^{th} unit, MU = 0.

(iii) $P_X = ₹\ 5$ per unit, and $MU_M = 2$

We know, equilibrium is struck when:

$$\frac{MU_X}{P_X} = MU_M$$

It happens when,

$$\frac{MU_X}{5} = 2$$

Or, when $MU_X = 10$

Implying that the consumer purchases four units of the commodity-X to maximise satisfaction.

5. Suppose, price of commodity-Y (P_Y) is ₹ 10 per unit. Also, assume that marginal utility of money (MU_M) is 8 (and constant). Using the following marginal utility schedule of the consumer, find out equilibrium level of consumption and total expenditure on commodity-Y.

Units Consumed	1	2	3	4	5	6
Marginal Utility	170	130	110	80	30	0

Sol. $P_Y = ₹\ 10$ and $MU_M = 8$

At equilibrium, $\frac{MU_Y}{P_Y} = MU_M$

Or, $\frac{MU_Y}{10} = 8$

Or, $MU_Y = 8 \quad 10 = 80$

Implying that the consumer finds his equilibrium when he consumes four units of the commodity-Y.

Total expenditure on commodity-Y at equilibrium level = $4 \times 10 = ₹\ 40$.

Ans. Equilibrium level of consumption = 4 units of commodity-Y.
Total expenditure on commodity-Y = ₹ 40.

6. Summit has ₹ 90 with him. He intends to purchase goods X and Y with his money. The market price of X and Y per unit is ₹10. The marginal utility schedule of goods X and Y is given below. Find out how many units of X and Y should Summit purchase so that he gets maximum satisfaction?

Units of Commodity	MU of X	MU of Y
1	80	40
2	72	32
3	64	24
4	56	20
5	48	16
6	40	12
7	32	8
8	24	4
9	16	0
10	8	0

Sol. Equilibrium condition with respect to consumption of X and Y is that:

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

Or, $\frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$

Here, $P_X = P_Y = ₹10$, so that equilibrium would be struck when:

$$MU_X = MU_Y$$

Or when, $\frac{MU_X}{MU_Y} = \frac{10}{10} = 1$

It occurs when Summit purchases 7 units of X and 2 units of Y. Because at this combination,

MU_X (spending $7 \times 10 = ₹\ 70$) = MU_Y (spending $2 \times 10 = ₹\ 20$) = 32.

Ans. Summit purchases 7 units of commodity-X and 2 units of commodity-Y.

Theory of Demand

1. Suppose the price of a touch-screen mobile is ₹ 15,000. How would you expect its demand curve to be affected with a favourable shift in tastes and preferences of the consumers, price remaining unchanged?

Sol. Demand curve of touch-screen mobile will shift to right due to the favourable shift in tastes and preferences of the consumers, price remaining unchanged.

2. Following table represents the demand schedule of households, A, B and C. Derive market demand.

Price (₹)	Household A	Household B	Household C
8	6	12	22
7	7	13	23
6	8	14	24
5	9	15	25
4	10	16	26

Sol.

Price (₹)	Household A	Household B	Household C	Market Demand
8	6	12	22	40
7	7	13	23	43
6	8	14	24	46
5	9	15	25	49
4	10	16	26	52

3. Following table represents the market demand schedule and demand schedule of Ram, Sohan and Mohan:

Price (₹)	Ram	Sohan	Mohan	Market Demand
3	7	(i)	8	20
4	6	4	(ii)	16
5	4	3	3	(iii)
6	(iv)	2	1	5

(**Assumption:** Market includes three buyers.) Calculate the missing entries.

Sol.

Price (₹)	Ram	Sohan	Mohan	Market Demand
3	7	5	8	20
4	6	4	6	16
5	4	3	3	10
6	2	2	1	5

4. Calculate the demand schedule of Raju, using following table. (Assuming market includes four buyers.)

Price (₹)	Ramesh	Raju	Rahim	Rina	Market Demand
5	19	—	7	6	32
4	20	—	10	9	44
3	21	—	12	11	51
2	22	—	14	15	61
1	23	—	18	19	74

Sol.

Price (₹)	Ramesh	Raju	Rahim	Rina	Market Demand
5	19	0	7	6	32
4	20	5	10	9	44
3	21	7	12	11	51
2	22	10	14	15	61
1	23	14	18	19	74

5. Individual demand schedules of Rakesh and Mohit for ice cream is given below. Derive market demand schedule for ice cream from the following:

Price of Ice Cream (₹ per unit)	Demand of Rakesh (Units)	Demand of Mohit (Units)
10	1	2
9	2	3
8	3	4
7	4	5
6	5	6

Sol.

Price of Ice Cream (₹ per unit)	Demand of Rakesh (Units)	Demand of Mohit (Units)	Market Demand (Units)
10	1	2	1 + 2 = 3
9	2	3	2 + 3 = 5
8	3	4	3 + 4 = 7
7	4	5	4 + 5 = 9
6	5	6	5 + 6 = 11

6. Given below are the individual demand schedules of Maggi and Pasta. Derive market demand schedule and market demand curve (assuming market includes two buyers, Maggi and Pasta) from the following:

Price (₹ per unit)	Maggi (Units)	Pasta (Units)
5	4	6
4	5	7
3	6	8
2	7	9
1	8	10

Sol.

Price (₹ per unit)	Maggi (Units)	Pasta (Units)	Market Demand (Units)
5	4	6	10
4	5	7	12
3	6	8	14
2	7	9	16
1	8	10	18

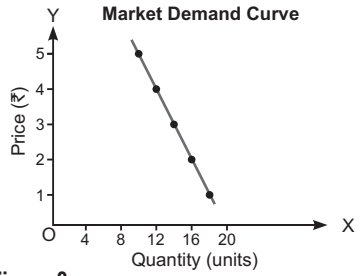

Figure 3

Price Elasticity of Demand

1. Find out elasticity of demand given the following information:

Price per unit (₹)	Quantity Demanded (kg)
10	20
9	25

Sol. $E_d = (-)\frac{P}{Q} \quad \frac{Q}{P}$

$P = ₹\ 10; P_1 = ₹\ 9; \quad P = P_1 - P = ₹\ 9 - ₹\ 10 = (-)₹\ 1$

$Q = 20 \text{ kg}; Q_1 = 25 \text{ kg}; \quad Q = Q_1 - Q = (25 - 20) \text{ kg} = 5 \text{ kg}$

$$E_d = (-)\frac{10}{20} \quad \frac{5}{-1} = 2.5$$

Ans. Elasticity of demand (E_d) = 2.5.

2. A consumer purchased 10 units of a commodity when its price was ₹ 5 per unit. He purchased 12 units of the commodity when its price falls to ₹ 4 per unit. What is the price elasticity of demand for the commodity at that price?

Sol. $E_d = (-)\frac{P}{Q} \quad \frac{Q}{P}$

$P = ₹\ 5; P_1 = ₹\ 4; \quad P = P_1 - P = ₹\ 4 \quad ₹\ 5 = (-)₹\ 1$

$Q = 10 \text{ units}; Q_1 = 12 \text{ units}; \quad Q = Q_1 - Q = (12 - 10) \text{ units} = 2 \text{ units}$

$$E_d = (-)\frac{5}{10} \quad \frac{2}{-1} = 1 \text{ (unity)}$$

Ans. Elasticity of demand (E_d) is unity (= 1), or unitary elastic demand.

3. As a result of 10 per cent fall in price of a good, its demand rises from 100 units to 120 units. Find out the price elasticity of demand.

Sol. Percentage change in price = (–)10%

$$\text{Percentage change in quantity demanded} = \frac{Q}{Q} \quad 100 \quad \frac{120 \quad 100}{100} \quad 100$$

$$\frac{20}{100} \quad 100 = 20\%$$

$$\text{Price elasticity of demand } (E_d) = (-)\frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= (-)\frac{20\%}{10\%} \quad 2$$

Ans. Price elasticity of demand = 2 (greater than unity).

4. A certain quantity of the commodity is purchased when its price is ₹ 10 per unit. Quantity demanded increases by 50 per cent in response to a fall in price by ₹ 2 per unit. Find elasticity of demand.

Sol. Percentage change in quantity demanded = 50%

$$\text{Percentage change in price} = \frac{P}{P} \quad 100 = \frac{2}{10} \quad 100 = (-)\ 20\%$$

$$\text{Elasticity of demand } (E_d) = (-)\frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= (-)\frac{50\%}{-20\%} = 2.5$$

Ans. The elasticity of demand = 2.5.

5. A consumer buys 80 units of a good at a price of ₹ 4 per unit. When the price falls, he buys 100 units. If price elasticity of demand is (–) 1, find out the new price.

Sol. Elasticity of demand has been specified as – 1. Accordingly, we need not use '–' sign as a prefix to the formula of measuring elasticity of demand. Thus,

$$E_d = \frac{P}{Q} \quad \frac{Q}{P}$$

$P = ₹\ 4;\ P_1 = ₹\ X;\quad P = ₹\ (X \quad 4$

$Q = 80$ units; $Q_1 = 100$ units; $\quad \Delta Q = Q_1 - Q = (100 - 80)$ units $= 20$ units

$E_d = (\ )\ 1$

Substituting given values:

$$(-)\ 1 = \frac{4}{80} \quad \frac{20}{X \quad 4} \quad \frac{1}{X \quad 4}$$

$$X - 4 = -1$$

$$X = -1 + 4$$

$$= 3$$

Ans. New price = ₹ 3 per unit.

6. When the price is ₹ 5 per unit a consumer buys 40 units of a commodity and his price elasticity of demand is (–) 1.5. How much will he buy if the price is reduced to ₹ 4 per unit?

Sol.

$$E_d = \frac{\Delta Q_1 \quad Q}{P_1 \quad P} \quad \frac{P}{Q} = (-)\ 1.5$$

Substituting given values:

$$\frac{\Delta Q_1 \quad 40}{4 \quad 5} \quad \frac{5}{40} = -1.5$$

$$\frac{\Delta Q_1 \quad 40}{1} \quad \frac{1}{8} = -1.5$$

$$\frac{\Delta Q_1 \quad 40}{8} = -1.5$$

$$\Delta Q_1 - 40 = 12$$

$$Q_1 = 12 + 40 = 52$$

Ans. The consumer will buy 52 units of the commodity when price reduces to ₹ 4 per unit.

7. Price elasticity of demand of a good is (–) 1. At a price the consumer buys 60 units of the good. How many units will the consumer buy if the price falls by 10 per cent?

Sol.

$$\text{Elasticity of demand } (E_d) = (-)\ \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$(-)\ 1 = \frac{\text{Percentage change in quantity demanded}}{(-)\ 10\%}$$

Percentage change in quantity demanded = 10

$$\frac{\Delta Q}{Q} \quad 100 = 10$$

$$\frac{\Delta Q}{60} \quad 100 = 10$$

$$\Delta Q = 6$$

$$\text{New quantity} = Q + \quad \Delta Q$$

$$= 60 + 6 = 66$$

Ans. New quantity = 66 units.

8. At a given market price of a good a consumer buys 120 units. When price falls by 50 per cent he buys 150 units. Calculate price elasticity of demand.

Sol. Percentage change in price = (–) 50%

$$\text{Percentage change in demand} = \frac{\Delta Q}{Q} \quad 100 = \frac{150 \quad 120}{120} \quad 100 = 25\%$$

$$\text{Price elasticity of demand } (E_d) = (-)\ \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$E_d = (-)\ \frac{25\%}{-50\%} = 0.5$$

Ans. Price elasticity of demand = 0.5.

9. Price elasticity of demand is found to be (–) 2. Price falls from ₹ 10 per unit to ₹ 8 per unit. Find the percentage change in quantity demanded.

Sol. $P = ₹\ 10;\ P_1 = ₹\ 8;\quad \Delta P = ₹\ 8 - ₹\ 10 = (-)₹\ 2$

$E_d = (-)\ 2$

$$\text{Percentage change in price} = \frac{\Delta P}{P} \quad 100$$

$$= \frac{-2}{10} \quad 100 = (-)20\%$$

$$\text{Price elasticity of demand } (E_d) = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$(-)\ 2 \quad \frac{\text{Percentage change in quantity demanded}}{-20\%}$$

Percentage change in quantity demanded = $(-)2 \times (-)20 = 40$

Ans. Percentage change in quantity demanded = 40%.

10. A commodity shows $E_d = (-)\ 2$. Quantity demanded reduces from 300 units to 150 units in response to increase in price. Find the increased price when initially it was ₹ 20 per unit.

Sol. Initial price (P) = ₹ 20

$Q = 300$ units; $Q_1 = 150$ units; $\Delta Q = Q_1 - Q = (150 - 300)$ units $= (-)\ 150$ units

$E_d = (-)2$

$$\text{Elasticity of demand } (E_d) = \frac{P}{Q} \quad \frac{\Delta Q}{\Delta P}$$

$$(-)\ 2 = \frac{20}{300} \quad \frac{-150}{\Delta P}$$

$$-\ 2 = \frac{-10}{\Delta P}$$

$$\Delta P = \frac{10}{2}$$

$$\Delta P = 5$$

$$P_1 = P + \Delta P$$

$$= 20 + 5 = 25$$

Ans. Increased price = ₹ 25.

11. For a commodity, $\frac{\Delta P}{P}$ –0.2, and elasticity of demand is – 0.5. Find quantity demanded after a fall in price when initially it was 60 units.

Sol. Initially, quantity demanded = 60 units

$\frac{\Delta P}{P}$ –0.2, $E_d = (-)\ 0.5$

$$E_d = \frac{P}{Q} \quad \frac{\Delta Q}{\Delta P}$$

Or,

$$E_d = \frac{P}{\Delta P} \quad \frac{Q}{\Delta Q}$$

Substituting given values:

$$(-)\ 0.5 = \frac{1}{-0.2} \quad \frac{Q}{60}$$

$$(-)\ 0.5 = \frac{Q}{-12}$$

$$Q = 6$$

$$Q_1 = Q + \Delta Q$$

$$= 60 + 6 = 66$$

Ans. New quantity = 66 units.

12. A consumer buys 80 units of a good at a price of ₹ 5 per unit. Suppose price elasticity of demand is (–) 2. At what price will he buy 64 units?

Sol. Supposing the new price = ₹ X.

We know,

Price elasticity of demand $(E_d) = (-)\frac{P}{Q} \quad \frac{Q}{P}$

$P = ₹ 5$; $P_1 = ₹ X$; $P = ₹ (X - 5)$

$Q = 80$ units; $Q_1 = 64$ units; $Q = (64 - 80)$ units $= -16$ units

$E_d = (-) 2$

Substituting given values:

$$(-) 2 = \frac{5}{80} \quad \frac{-16}{X \quad 5}$$

$$-2 = \frac{1}{X \quad 5} \qquad 1 = 2(X - 5)$$

$$1 = 2X - 10 \qquad 2X = 11$$

$$X = \frac{11}{2} = 5.5$$

Ans. New price = ₹ 5.5.

13. When price of the commodity reduces from ₹ 5 per unit to ₹ 4 per unit, expenditure on the commodity reduces from ₹ 60 to ₹ 48. Find price elasticity of demand.

Sol. (Using Percentage Method):

Total expenditure = ₹ 60, $P_X = ₹ 5$

$$Q_X = \frac{\text{Total expenditure}}{P_X}$$

$$= \frac{60}{5} = 12 \text{ units}$$

Total expenditure = ₹ 48, $P_X = ₹ 4$

$$Q_X = \frac{\text{Total expenditure}}{P_X}$$

$$= \frac{48}{4} = 12 \text{ units}$$

Thus, there is no change in quantity demanded even when price has reduced from ₹ 5 to ₹ 4 per unit. Hence, E_d = zero.

Ans. $E_d = 0$ (zero).

14. When price of a good rises from ₹ 5 per unit to ₹ 6 per unit, its demand falls from 20 units to 10 units. Compare expenditures on the good to determine whether demand is elastic or inelastic.

Sol.

Price (₹)	Quantity Demanded (Units)	Total Expenditure (₹)
5	20	100
6	10	60

Here, total expenditure decreases with rise in price, hence elasticity of demand is more than unity. It is a situation of elastic demand.

Ans. Demand is elastic.

15. When price of a good falls from ₹ 10 per unit to ₹ 9 per unit, its demand rises from 9 units to 10 units. Compare expenditures on the good to find price elasticity of demand.

Sol.

Price (₹)	Quantity Demanded (Units)	Total Expenditure (₹)
10	9	90
9	10	90

Since, total expenditure remains constant, elasticity of demand is equal to unity.

Ans. Price elasticity of demand = 1.

Production Function and Returns to a Factor

1. Calculate the average and marginal product from the following:

Units of Labour	1	2	3	4	5
Total Product	18	38	50	60	72

Sol.

Units of Labour	Total Product	Average Product	Marginal Product
1	18	18	18
2	38	19	20
3	50	16.67	12
4	60	15	10
5	72	14.4	12

2. Complete the following table:

Units of Labour	Total Product	Average Product	Marginal Product
1	40	—	—
2	—	—	60
3	—	—	50
4	180	—	—
5	—	36	—
6	—	—	–18

Sol.

Units of Labour	Total Product	Average Product	Marginal Product
1	40	40	40
2	100	50	60
3	150	50	50
4	180	45	30
5	180	36	0
6	162	27	–18

3. Calculate the total and marginal product from the following:

Units of Labour	1	2	3	4	5
Average Product	4	5	5	4	3

Sol.

Units of Labour	Average Product	Total Product	Marginal Product
1	4	4	4
2	5	10	6
3	5	15	5
4	4	16	1
5	3	15	–1

4. Complete the following table:

Input (Units)	Total Product	Average Product	Marginal Product
1	20	—	—
2	—	—	18
3	—	—	16
4	—	—	14
5	—	—	12
6	—	—	10

Sol.

Input (Units)	Total Product	Average Product	Marginal Product
1	20	20	20
2	38	19	18
3	54	18	16
4	68	17	14
5	80	16	12
6	90	15	10

5. Following is known about a firm:

Units of Labour (Input)	1	2	3	4	5	6
Total Output	50	110	150	180	180	150

State and explain the law underlying the change in output as input is changed. Also identify the various stages (or phases) in total product.

Sol.

Units of Labour	TP	AP	MP	Phases/Stages
1	50	50	50	**Phase/Stage-I** Increasing returns up to 2nd unit of labour employment. Here, MP increases.
2	110	55	60	
3	150	50	40	**Phase/Stage–II** Diminishing returns between 2nd to 5th unit of labour employment. Here, MP diminishes.
4	180	45	30	
5	180	36	0	**Phase/Stage–III** Negative returns beyond 5th unit of labour employment. Here, TP diminishes and MP is negative.
6	150	25	–30	

6. Identify the different output levels which makes the different phases/stages of the operation of the law of variable proportions from the following data:

Variable Input	0	1	2	3	4	5
Total Product	0	8	20	28	28	26

Sol.

Variable Input	Total Product	Marginal Product	Phases/Stages
0	0	0	**Phase/Stage-I** Increasing returns to a factor; MP increases.
1	8	8	
2	20	12	**Phase/Stage-II** Diminishing returns to a factor; MP diminishes.
3	28	8	
4	28	0	**Phase/Stage-II** Negative returns to a factor; MP turns negative. TP diminishes.
5	26	–2	

Concepts of Cost

1. From the following data on the cost of production of a firm calculate TFC, AFC, TVC, AVC and MC:

Output (kg)	0	1	2	3	4	5	6
TC (₹)	60	80	100	111	116	130	150

Sol.

Output (kg)	TC (₹)	TFC (₹)	AFC (₹)	TVC (₹)	AVC (₹)	MC (₹)
0	60	60		—	—	—
1	80	60	60	20	20	20
2	100	60	30	40	20	20
3	111	60	20	51	17	11
4	116	60	15	56	14	5
5	130	60	12	70	14	14
6	150	60	10	90	15	20

2. From the following data regarding cost of a firm, calculate:
(i) average fixed cost, and (ii) average variable cost.

Output (Units)	0	1	2	3	4	5	6
Total Cost (₹)	60	78	90	102	112	120	126

Sol.

Output (Units)	Total Cost (₹)	Total Fixed Cost (₹)	Average Fixed Cost (₹)	Total Variable Cost (₹)	Average Variable Cost (₹)
0	60	60		—	—
1	78	60	60	18	18
2	90	60	30	30	15
3	102	60	20	42	14
4	112	60	15	52	13
5	120	60	12	60	12
6	126	60	10	66	11

3. Calculate TVC and AVC with the help of the following data:

Output (Units)	1	2	3
MC (₹)	20	16	12

Sol.

Output (Units)	MC (₹)	TVC (₹)	AVC (₹)
1	20	20	20
2	16	36	18
3	12	48	16

4. Calculate 'total variable cost' and 'total cost' from the following cost schedule of a firm whose fixed costs are ₹ 10.

Output (Units)	1	2	3	4
Marginal Cost (₹)	6	5	4	6

Sol.

Output (Units)	Marginal Cost (₹)	Total Fixed Cost (₹)	Total Variable Cost (₹)	Total Cost (₹)
1	6	10	6	16
2	5	10	11	21
3	4	10	15	25
4	6	10	21	31

5. From the following data on the cost of production of a firm calculate (i) average fixed cost, and (ii) average variable cost of producing four units and the marginal cost of the fourth unit:

Output (kg)	0	1	2	3	4
Total Cost (₹)	80	102	122	140	156

Sol.

Output (kg)	Total Cost (₹)	Total Fixed Cost (₹)	Average Fixed Cost (₹)	Total Variable Cost (₹)	Average Variable Cost (₹)	Marginal Cost (₹)
0	80	80		0	—	—
1	102	80	80	22	22	22
2	122	80	40	42	21	20
3	140	80	26.6	60	20	18
4	156	80	20	76	19	16

6. From the following table, calculate average variable cost of each given level of output:

Output (Units)	1	2	3	4
Marginal Cost (₹)	40	30	35	39

Sol.

Output (Units)	Marginal Cost (₹)	Total Variable Cost (₹)	Average Variable Cost $= \frac{TVC}{Q}$ (₹)
1	40	40	$\frac{40}{1}$ 40
2	30	70	$\frac{70}{2}$ 35
3	35	105	$\frac{105}{3}$ 35
4	39	144	$\frac{144}{4}$ 36

7. Complete the following table:

Output (Units)	Total Cost (₹)	Average Fixed Cost (₹)	Average Cost (₹)	Variable Cost (₹)
1	20	6		
2	26	3		
3	39	2		

Sol.

Output (Units)	Total Cost (₹)	Average Fixed Cost (₹)	Average Cost (₹)	Total Fixed Cost (₹)	Variable Cost (₹)
1	20	6	20	6	14
2	26	3	13	6	20
3	39	2	13	6	33

8. Complete the following table:

Output (Units)	Total Variable Cost (₹)	Average Variable Cost (₹)	Marginal Cost (₹)
1	20	—	—
—	—	16	12
3	54	—	—
—	—	20	26

Sol.

Output (Units)	Total Variable Cost (₹)	Average Variable Cost (₹)	Marginal Cost (₹)
1	20	20	20
2	32	16	12
3	54	18	22
4	80	20	26

Concept of Revenue

1. Find out total revenue, average revenue and marginal revenue:

Price (₹)	1	2	3	4	5	6	7
Demand (Units)	10	9	8	7	6	5	4

Sol.

Price (₹)	Demand (Units)	Total Revenue (₹)	Average Revenue (₹)	Marginal Revenue (₹)
1	10	10	1	10
2	9	18	2	8
3	8	24	3	6
4	7	28	4	4
5	6	30	5	2
6	5	30	6	0
7	4	28	7	–2

2. From the table given below, calculate total revenue and marginal revenue:

Units Sold	Average Revenue (₹)	Total Revenue (₹)	Marginal Revenue (₹)
3	8		
4	7		
5	6		

Sol.

Units Sold	Average Revenue = Price (₹)	Total Revenue (₹)	Marginal Revenue (₹)
3	8	24	—
4	7	28	4
5	6	30	2

[**Hint:** Average Revenue = Price.]

3. Find average revenue and marginal revenue from the following data:

Units Sold	Total Revenue (₹)	Average Revenue (₹)	Marginal Revenue (₹)
1	10		
2	24		
3	33		
4	40		
5	40		
6	36		
7	28		

Sol.

Units Sold	Total Revenue (₹)	Average Revenue (₹)	Marginal Revenue (₹)
1	10	10	10
2	24	12	14
3	33	11	9
4	40	10	7
5	40	8	0
6	36	6	–4
7	28	4	–8

4. Find marginal revenue on the basis of the following data:

Units Sold	Total Revenue (₹)	Marginal Revenue (₹)
1	10	
2	18	
3	24	
4	28	
5	30	

Sol.

Units Sold	Total Revenue (₹)	Marginal Revenue (₹)
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2

5. Complete the following table:

Output (Units)	Price (₹)	Total Revenue (₹)	Marginal Revenue (₹)
1	7	—	—
2	6	—	—
3	4	—	—
4	2	—	—

Sol.

Output (Units)	Price (₹)	Total Revenue (₹)	Marginal Revenue (₹)
1	7	7	7
2	6	12	5
3	4	12	0
4	2	8	–4

6. Complete the following table:

Output (Units)	Total Revenue (₹)	Marginal Revenue (₹)	Average Revenue (₹)
1	14		
2	24		
3	24		
4	16		

Sol.

Output (Units)	Total Revenue (₹)	Marginal Revenue (₹)	Average Revenue (₹)
1	14	14	14
2	24	10	12
3	24	0	8
4	16	–8	4

7. Complete the following table:

Output (Units)	Marginal Revenue (₹)	Total Revenue (₹)	Average Revenue (₹)
1	10	—	—
2	8	—	—
3	0	—	—
4	–2	—	—

Sol.

Output (Units)	Marginal Revenue (₹)	Total Revenue (₹)	Average Revenue (₹)
1	10	10	10
2	8	18	9
3	0	18	6
4	–2	16	4

8. Complete the following table:

Units Sold	Total Revenue (₹)	Average Revenue (₹)	Marginal Revenue (₹)
1	20	—	—
2	—	18	—
3	—	—	12
4	56	—	—
5	—	—	4
6	—	—	0

Sol.

Units Sold	Total Revenue (₹)	Average Revenue (₹)	Marginal Revenue (₹)
1	20	20	20
2	36	18	16
3	48	16	12
4	56	14	8
5	60	12	4
6	60	10	0

Producer's Equilibrium

1. Find out profit of the producer, when total revenue is ₹ 400, total variable cost is ₹ 270, average fixed cost is ₹ 25 per unit and 4 units of output are produced.

Sol. Total Revenue = ₹ 400

Total Variable Cost = ₹ 270

Average Fixed Cost = ₹ 25

Total Fixed Cost = AFC Output

= ₹ 25 4 ₹ 100

Total Cost = Total Fixed Cost + Total Variable Cost

= ₹ 100 + ₹ 270 = ₹ 370

Profit = Total Revenue – Total Cost

= ₹ 400 – ₹ 370 = ₹ 30

Ans. Profit = ₹ 30.

2. Calculate the profit from the following:

Output (Units)	Marginal Revenue (₹)	Total Cost (₹)
1	7	8
2	5	10
3	4	12
4	2	15
5	1	16

Sol.

Output (Units)	Marginal Revenue (₹)	Total Cost (₹)	Total Revenue (₹)	Profit (= TR – TC) (₹)
1	7	8	7	–1
2	5	10	12	2
3	4	12	16	4
4	2	15	18	3
5	1	16	19	3

3. Complete the following table:

Output (Units)	Total Revenue (₹)	Total Cost (₹)	Profit (₹)
1	6	8	—
2	—	9	–1
3	10	—	0
4	12	11	—
5	14	8	—

Sol.

Output (Units)	Total Revenue (₹)	Total Cost (₹)	Profit (₹)
1	6	8	–2
2	8	9	–1
3	10	10	0
4	12	11	1
5	14	8	6

4. Find the profit maximising level of output.

Quantity Sold (Units)	Total Revenue (₹)	Marginal Cost (₹)
1	14	15
2	30	12
3	44	9
4	48	5
5	52	6

Sol.

Quantity Sold (Units)	Total Revenue (₹)	Marginal Cost (₹)	Total Variable Cost (₹)	Profit (= TR – TVC) (₹)
1	14	15	15	–1
2	30	12	27	3
3	44	9	36	8
4	48	5	41	7
5	52	6	47	5

Profit is maximised when the output level = 3 units.

[**Note:** Profit is maximised at that level of output where the difference between TR and TC is maximised, or where the difference between TR and TVC is maximised, because fixed cost, by defination, remains constant.]

5. Find producer's equilibrium from the following table given below:

Quantity Sold (Units)	Total Revenue (₹)	Marginal Cost (₹)
1	9	15
2	18	8
3	27	9
4	36	10
5	45	11

Sol.

Quantity Sold (Units)	Total Revenue (₹)	Marginal Cost (₹)	Marginal Revenue (₹)
1	9	15	9
2	18	8	9
3	27	9	9
4	36	10	9
5	45	11	9

The producer will strike his equilibrium when 3 units of output are produced. Because, it is here that: (i) MR = MC, and (ii) MC is rising.

6. Given below is a cost and revenue schedule of a producer. At what level of output is the producer in equilibrium? Give reasons for your answer.

Quantity Sold (Units)	Price (₹ per unit)	Total Cost (₹)
1	15	14
2	16	24
3	17	30
4	18	51
5	19	75

Sol.

Quantity Sold (Units)	Price (₹ per unit)	TC (₹)	TR (₹)	MR (₹)	MC (₹)	Profit (= TR – TC) (₹)
1	15	14	15	15	14	1
2	16	24	32	17	10	8
3	17	30	51	19	6	21
4	18	51	72	21	21	21
5	19	75	95	23	24	20

Producer is in equilibrium when the level of output = 4 units.

Reason: At output levels 3rd and 4th unit, the difference between total revenue and total cost (*i.e.*, profit) is maximum which is equal to 21 in both the cases. But, producer is in equilibrium at 4th unit only where MR = MC (= 21).

Theory of Supply

1. Price of a commodity increases from ₹ 10 to ₹ 12. As a result, its supply rises from 35 units to 42 units. Find out elasticity of supply.

Sol. $P = ₹ 10; P_1 = ₹ 12;\quad P = P_1 - P = ₹ 12 \quad ₹ 10 = ₹ 2$

$Q = 35$ units; $Q_1 = 42$ units; $\quad Q = Q_1 - Q = (42 - 35)$ units $= 7$ units

$$\text{Elasticity of supply } (E_s) = \frac{P}{Q} \quad \frac{Q}{P}$$

$$E_s = \frac{10}{35} \quad \frac{7}{2} = 1 \text{ (unity)}$$

Ans. Elasticity of supply = 1.

2. As a result of 15 per cent rise in the price of a commodity, its supply increases from 25 to 30 units. Calculate elasticity of supply.

Sol. Percentage rise in price = 15%

$Q = 25$ units; $Q_1 = 30$ units; $\quad Q = Q_1 - Q = (30 - 25)$ units $= 5$ units

$$\text{Percentage rise in quantity supplied} = \frac{Q}{Q} \quad 100 \quad \frac{5}{25} \quad 100 = 20\%$$

$$\text{Elasticity of supply } (E_s) = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$\frac{20\%}{15\%} = 1.33$$

Ans. Elasticity of supply = 1.33.

3. The price of a commodity is ₹ 12 per unit and its quantity supplied is 500 units. When its price rises to ₹ 15 per unit, its quantity supplied rises to 650 units. Calculate its price elasticity of supply. Is supply elastic?

Sol. $P = ₹ 12; P_1 = ₹ 15;\quad P = P_1 - P = ₹ 15 \quad ₹ 12 = ₹ 3$

$Q = 500$ units; $Q_1 = 650$ units; $\quad Q = Q_1 - Q = (650 - 500)$ units $= 150$ units

$$\text{Price elasticity of supply } (E_s) = \frac{P}{Q} \quad \frac{Q}{P}$$

$$\frac{12}{500} \quad \frac{150}{3} = 1.2$$

Ans. Price elasticity of supply = 1.2; Yes, supply is elastic.

4. Price elasticity of supply for a product is 'unity'. A firm supplies 25 units of this product at a price of ₹ 5 per unit. If the price of product rises to ₹ 6 per unit, how much quantity of the product will be supplied by the firm?

Sol. Let the seller supply X units.

$P = ₹ 5; P_1 = ₹ 6;\quad P = P_1 - P = ₹ 6 \quad ₹ 5 = ₹ 1$

$Q = 25$ units; $Q_1 = X$ units; $\quad Q = Q_1 - Q = (X - 25)$ units

$E_s = 1$

Price elasticity of supply $(E_s) = \frac{P}{Q} \quad \frac{Q}{P}$

$1 \quad \frac{5}{25} \quad \frac{X \quad 25}{1} \qquad\qquad 1 \quad \frac{X \quad 25}{5}$

$X - 25 = 5$

$X = 25 + 5$

$= 30$

Ans. The seller will supply 30 units.

5. When the price of a commodity falls from ₹10 per unit to ₹ 9 per unit, its quantity supplied falls by 20 per cent. Calculate its price elasticity of supply. Is its supply elastic?

Sol. Percentage fall in quantity supplied = (–) 20%

$P = ₹\ 10; P_1 = ₹\ 9; \quad P = P_1 - P = ₹\ 9 \quad ₹\ 10 = (-)₹\ 1$

Percentage fall in price $= \frac{P}{P} \quad 100 \quad \frac{-1}{10} \quad 100$

$= (-)10\%$

Price elasticity of supply $(E_s) = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$

$\frac{-20\%}{-10\%} = 2$

Ans. Price elasticity of supply = 2; Yes, supply is elastic.

6. The quantity supplied of a commodity at a price of ₹ 8 per unit is 400 units. Its price elasticity of supply is 2. Calculate the price at which its quantity supplied will be 600 units.

Sol. Let the new price be ₹ P_1

$P = ₹\ 8; P_1 = ₹\ P_1; \quad P = ₹\ (P_1 - 8)$

$Q = 400$ units; $Q_1 = 600$ units; $\quad Q = Q_1 - Q = (600 \quad 400)$ units $= 200$ units

$E_s = 2$

Price elasticity of supply $(E_s) = \frac{P}{Q} \quad \frac{Q}{P}$

$2 = \frac{8}{400} \quad \frac{200}{P_1 \quad 8}$

$2 = \frac{4}{P_1 \quad 8}$

$2(P_1 \quad 8) = 4$

$2P_1 \quad 16 = 4$

$2P_1 = 4 + 16 = 20$

$P_1 = 10$

Ans. New price = ₹ 10.

7. When the price of a commodity rises from ₹ 10 to ₹ 11 per unit, its quantity supplied rises by 100 units. Its price elasticity of supply is 2. Calculate its quantity supplied at the increased price.

Sol. $E_s = \frac{P}{Q} \quad \frac{Q}{P}$

$P = ₹\ 10; P_1 = ₹\ 11; \quad P = P_1 - P = ₹\ 11 \quad ₹\ 10 = ₹\ 1$

$Q = M$ units; $Q_1 = (M + 100)$ units; $\quad Q = 100$ units

$E_s = 2$

Substituting given values:

$2 = \frac{10}{M} \quad \frac{100}{1}$

$2M = 1{,}000$

$$M = \frac{1{,}000}{2} = 500$$

$$Q_1 = 500 + 100 = 600$$

Ans. Quantity supplied at increased price is 600 units.

8. The price elasticity of supply of a commodity is 2. When its price falls from ₹ 10 to ₹ 8 per unit, its quantity supplied falls by 500 units. Calculate the quantity supplied at the reduced price.

Sol.
$$E_s = \frac{P}{Q} \quad \frac{Q}{P}$$

$P = ₹\ 10$; $P_1 = ₹\ 8$; $P = P_1 - P = ₹\ 8 \quad ₹\ 10 = (-)₹\ 2$

$Q = X$ units; $Q_1 = (X - 500)$ units; $Q = (-)\ 500$ units

$E_s = 2$

Substituting given values:

$$2 = \frac{10}{X} \quad \frac{-500}{-2}$$

$$2 = \frac{2{,}500}{X} \qquad 2X = 2{,}500$$

$$X = \frac{2{,}500}{2} = 1{,}250$$

$$Q_1 = 1{,}250 - 500 = 750$$

Ans. Quantity supplied at reduced price is 750 units.

9. For a commodity, if $E_s = 1.4$ and $\frac{P}{P} = 0.6$, find the percentage change in quantity supplied.

Sol. $E_s = 1.4$ and $\frac{P}{P} = 0.6$

$$\text{Percentage change in price} = \frac{P}{P} \quad 100 = 0.6 \quad 100 = 60$$

$$\text{Elasticity of supply } (E_s) = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$1.4 \quad \frac{\text{Percentage change in quantity supplied}}{60\%}$$

Percentage change in quantity supplied $= 1.4 \times 60 = 84$

Ans. Percentage change in quantity supplied = 84%.

10. The market price of a good changes from ₹ 5 to ₹ 20. As a result, the quantity supplied by the firm increases by 15 units. The price elasticity of supply is 0.5. Find the initial and final output levels of the firm.

Sol.
$$E_s = \frac{P}{Q} \quad \frac{Q}{P}$$

$P = ₹\ 5$; $P_1 = ₹\ 20$; $P = P_1 - P = ₹\ 20 \quad ₹\ 5 = ₹\ 15$

$Q = X$ units; $Q_1 = (X + 15)$ units; $Q = 15$ units

$E_s = 0.5$

Substituting given values:

$$0.5 = \frac{5}{X} \quad \frac{15}{15}$$

$$0.5 = \frac{5}{X} \qquad 0.5X = 5$$

$$X = \frac{5}{0.5} = 10$$

$$X_1 = 10 + 15 = 25$$

Ans. Initial output = 10 units.

Final output = 25 units.