

1

XH-C1

MICRO-ECONOMICS

PREVIOUS YEARS EXAM QUESTIONS

Multiple Choice Questions (MCQ)

1. A firm finds that for the product that it produces, its (own) price elasticity of demand is 4. Currently, the firm is selling 2000 units per month at ₹ 5 per unit. If it wishes to increase its sales by 10%, it must

(A) lower its price by 4%
(B) lower its price by 2%
(C) lower its price by 2.5%
(D) increase its price by 2%

2. For the production function $Q = F(K, L) = \sqrt{KL}$ with $P_K = 4$ and $P_L = 2$, find the values of K and L that will minimize the cost of producing 2 units of output.

(A) $K = 2\sqrt{3}\,;\ L = 3\sqrt{2}$ (B) $K = 2\sqrt{2}\,;\ L = \sqrt{2}$
(C) $K = \sqrt{2}\,;\ L = 2\sqrt{2}$ (D) $K = 2;\ L = 2$

(1 MARK 2021)

3. XYZ Co. Ltd. is a costless monopoly from suburban Mumbai producing and selling exotic mushrooms. The demand for mushrooms is given by $Q = 700 - 100P$. Do you agree that XYZ will have a maximum possible total revenue of ₹ 1500?

(A) Yes, the maximum possible total revenue is ₹ 1500
(B) No, the maximum possible total revenue is less than ₹ 1500
(C) No, the maximum possible total revenue is more than ₹ 1500
(D) No, the maximum possible total revenue cannot be estimated

(1 MARK 2021)

4. Consider a duopoly market in which the market demand function is as follows: $P = 40 - Q$. For the two firms producing with identical marginal costs of 10, the Bertrand-Nash equilibrium price will be:

(A) 40 (B) 10
(C) 20 (D) 30

(1 MARK 2021)

5. Walras' Law implies that if there are N markets in the economy, then one only needs to find equilibrium prices in

(A) $N - 2$ markets (B) $N - 1$ markets
(C) $N + 1$ markets (D) all the N markets

(1 MARK 2021)

6. Assuming that external economies exist, when demand increases in a perfectly competitive market, in the long-run, the price of the product

(A) rises above the initial price (before the demand increase) and quantity increases
(B) remains the same as the initial price (before the demand increase) and quantity increases
(C) falls below the initial price (before the demand increase) and quantity increases
(D) equals the initial price (before the demand increase) and quantity decreases

(1 MARK 2021)

7. Consider an individual who maximizes her expected utility having Bernoulli utility function $u(w) = \alpha - \beta e^{-rw}$; $w > 0$ is wealth. The individual displays _____ relative risk aversion.

(A) constant (B) increasing
(C) decreasing (D) uncertain

(2 MARK 2021)

8. Consider the following demand-supply model, where
Demand function: $P = Q^2 - 12Q + 35$
Supply function: $4P - 3Q = 0$
The stable market equilibrium price-quantity combination will be

(A) $(P^*, Q^*) = (3, 4)$ (B) $(P^*, Q^*) = \left(\frac{105}{16}, \frac{70}{8}\right)$
(C) $(P^*, Q^*) = (6,8)$ (D) $(P^*, Q^*) = (14,3)$

(2 MARK 2021)

9. Trisha's consumption preference on biryani (x) and pudding (y) is given by the utility function $U(x,y) = x + 4y$. The price per unit of biryani is ₹ 2 and the price per unit of pudding is ₹ 3. Trisha's total income is ₹ 120. However, she faces an extra quantity constraint as she is not allowed to consume biryani more than 60 units and pudding more than 30 units. The optimum quantity of biryani and pudding consumed by Trisha is

(A) $(x^*, y^*) = (30,20)$ (B) $(x^*, y^*) = (15,30)$
(C) $(x^*, y^*) = (30,15)$ (D) $(x^*, y^*) = (60,0)$

(2 MARK 2021)

10. Consider a Cournot type n-firm natural spring oligopoly where the market demand for natural spring water is given by $P(Q) = a - Q, a > 0$. The n firms are symmetric. Each firm incurs a bottling cost of $C_i = cq_i, c > 0$ and $a > c$. The equilibrium market price will be

(A) $\frac{(n+1)}{a} + \frac{n(n+1)}{c}$ (B) $\frac{a}{(n+1)} + \frac{nc}{(n+1)}$
(C) $\frac{na}{(n+1)} + \frac{nc}{(n+1)}$ (D) $\frac{(a-c)}{(n+1)} + \frac{c}{n(n+1)}$

(2 MARK 2022)

11. Suppose a firm has the following production function:

$$f(x_1, x_2, x_3, x_4) = min\{x_1, x_2\} + min\{x_3, x_4\}$$

The per unit cost of input x_i is given by w_i, where i = 1, 2, 3, 4. Suppose that $w_1 = 1, w_2 = 5, w_3 = 3$, and $w_4 = 6$. If the firm is minimizing cost, which of the following input choices by the firm can be observed?

(A) $x_1 > 0, x_2 = 0, x_3 > 0, x_4 = 0$
(B) $x_1 > 0, x_2 > 0, x_3 = 0, x_4 = 0$
(C) $x_1 > 0, x_2 > 0, x_3 = 0, x_4 > 0$
(D) $x_1 = 0, x_2 = 0, x_3 > 0, x_4 > 0$

(1 MARK 2022)

12. Suppose that a firm has a technology represented by the following production function:

$$Y(K, L) = K^x L^y$$

where K denotes capital, L denotes labour, Y denotes the maximum output that is possible to produce using capital K and labour L. x and y are two positive real numbers. It is also known that the production function satisfies constant returns to scale. Then which of the following is true?

(A) $x + y = 0.5$ (B) $x + y = 1$
(C) $x + y = 1.5$ (D) $x + y = 2$

(2 MARK 2022)

13. There are two regions in a country. The demand for chocolates in region 1 is given by

$$Q_1(P) = 100 - P$$

and the demand for chocolates in region 2 is given by

$$Q_2(P) = 200 - P$$

where $Q_1(P)$ and $Q_2(P)$ denote the demand for chocolates in region 1 and 2 respectively at a price P. There is only one seller who is licensed to sell chocolates in the country. Suppose the seller sets a price of $P = 125$. The total demand for chocolates in the country at this price is

(A) 50 (B) 75
(C) 100 (D) 125

(2 MARK 2022)

14. Tom and Jerry both arrive at a petrol pump. Without worrying about price, Tom says, "I want 10 liters of petrol." Also, without worrying about price, Jerry says, "I want petrol worth 1000 rupees." The own price elasticities of demand for Tom (denoted by ε_T) and Jerry (denoted by ε_J) are:

(A) $\varepsilon_T = 0, \varepsilon_J = -\infty$ (B) $\varepsilon_T = 0, \varepsilon_J = -1$
(C) $\varepsilon_T = -\infty, \varepsilon_J = 0$ (D) $\varepsilon_T = -1, \varepsilon_J = 0$

(2 MARK 2022)

15. A monopolist faces the following inverse demand function:

$$P = 40 - Q,$$

where P denotes price and Q denotes quantity. The monopolist has zero fixed cost and a marginal cost of 5 per unit of output produced. The monopolist aims to maximize profit. Suppose the government imposes a tax of 5 per unit of output on the monopolist. As a result, the price charged by the profit-maximizing monopolist to the consumer increases by:

(A) 0 (B) 2.5
(C) 5 (D) 10

(2 MARK 2023)

16. Suppose the own price elasticity of demand and income elasticity of demand are given by e_p and e_I respectively. The subscript p represents own price of a good and the subscript I represents the income of the consumer. Identify the correct statement(s) from the following.

(A) If $1 < e_p < \infty$, the demand is price inelastic.
(B) Luxury goods are more price inelastic and the necessities are price elastic.
(C) Luxury goods have $e_I > 1$.
(D) If $0 < e_p < 1$, the demand is price elastic.

(1 MARK 2023)

17. An individual is endowed with income of Rs. 142 and has the utility function $U(x_1, x_2) = x_2(x_1 + 1)$, where $x_1 \geq 0, x_2 \geq 0$. The unit price of x_1 is Rs. 2 and the unit price of x_2 is Rs. 3. The utility maximizing bundle is

(A) $x_1 = 35, x_2 = 20$ (B) $x_1 = 30, x_2 = 24$
(C) $x_1 = 35, x_2 = 24$ (D) $x_1 = 30, x_2 = 20$

(2 MARK 2023)

18. A firm in a market with perfect competition has the following total cost (TC) function:

$$TC(Q) = a + b(Q)$$

where Q is the quantity produced by the firm, a is the fixed cost and $b(Q)$ is the variable cost. What will happen if the fixed cost increases?

(A) In the short-run, the firm's Average Variable Cost (AVC) curve will shift upwards.

(B) In the short-run, the firm's Average Total Cost (ATC) curve will shift upwards.

(C) The firm will earn higher profits.

(D) In the short-run, the firm's Marginal Cost (MC) curve will shift upwards.

(1 MARK 2024)

19. In the sticky-price model of aggregate supply, if none of the firms in the market have flexible prices, then the short-run aggregate supply curve will be

(A) horizontal

(B) vertical

(C) steeper than it would be if some firms had flexible prices

(D) upward sloping to the right

(2 MARK 2024)

20. Two friends Aditi and Raju are deciding independently whether to watch a movie or go to a music concert that evening. Both friends would prefer to spend the evening together than apart. Aditi would prefer that they watch a movie together, while Raju would prefer that they go to the concert together. The payoff matrix arising from their actions is presented below. p and $(1 - p)$ are the probabilities that Aditi will decide in favour of the movie and concert, respectively. Similarly, q and $(1 - q)$ are the probabilities that Raju will decide in favour of the movie and concert, respectively. Which one of the following options correctly contains all the Nash Equilibria?

		Raju	
		Movie	Concert
Aditi	Movie	2,1	0,0
	Concert	0,0	1,2

(A) $(p = 0, q = 0); (p = 1, q = 1); \left(p = \frac{2}{3}, q = \frac{1}{3}\right)$

(B) $(p = 0, q = 1); (p = 1, q = 0); \left(p = \frac{2}{3}, q = \frac{1}{3}\right)$

(C) $(p = 0, q = 0); (p = 1, q = 1); \left(p = \frac{1}{3}, q = \frac{2}{3}\right)$

(D) $(p = 0, q = 1); (p = 1, q = 0); (p = \frac{1}{3}, q = \frac{2}{3})$

(2 MARK 2024)

21. Consider a two good economy where a denotes consumption of apricots and b denotes consumption of bananas. Anu's utility function is $U^{Anu}(a, b) = a + 2b$, and Binu's utility function is $U^{Binu}(a, b) = min\{a, 2b\}$. Anu initially has no apricots and 12 bananas. Binu initially has 12 apricots and no bananas. In the competitive equilibrium, which one of the following will be Anu's optimal consumption bundle?

(A) 6 apricots and 9 bananas

(B) 9 apricots and 9 bananas

(C) 4 apricots and 10 bananas

(D) 0 apricots and 12 bananas

(2 MARK 2024)

22. An incumbent firm (I) faces the possibility of entry by a challenger firm (C). If C enters, I may either accommodate or fight. If C does not enter, its payoff is 1, while I's payoff is 2. If C enters, and I accommodates, their payoffs are 2 and 1, respectively. However, if C's entry is met with a fight by I, their payoffs are 0 and 1, respectively. Which one of the following is a subgame perfect Nash equilibrium (SPNE) under perfect information?

(A) enter; accommodate (B) enter; fight

(C) not enter; accommodate (D) not enter; fight

(1 MARK 2025)

23. In the context of a perfectly competitive market, identify the statement that is NOT CORRECT.

(A) Producing less than the competitive output lowers welfare

(B) Producing more than the competitive output lowers welfare.

(C) The welfare is dependent on both price and the competitive output.

(D) If a consumer values the last unit more than its marginal cost of production, producing an additional unit shall lower welfare.

(1 MARK 2025)

24. The demand function is given as $\log Q = \log A + 0.5 \log P$, where Q is quantity, P is the unit price of the good and A is a positive real number. The own price elasticity of demand is

(A) Perfectly elastic (B) Perfectly inelastic

(C) Elastic (D) Inelastic

(2 MARK 2025)

25. Consider a three-firms oligopoly market with a linear demand function given by

$P = 25 - Q$

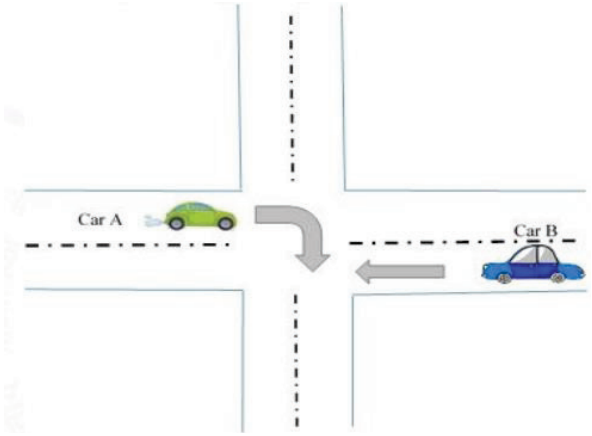
where P is the unit price and Q is the total quantity supplied.

The total quantity $Q = (q_1 + q_2 + q_3)$ where qi is the output from the ith firm with i=1,2,3.
The total cost (TC) curve of firm i is given by TCi=(αi+5qi) , where αi's are positive real numbers.
Assuming a Cournot solution exists, the value of Q is
(A) 9 (B) 15
(C) 12 (D) 21

Multiple Select Questions (MSQ)

(2 MARK 2021)

1. Consider an intersection of roads without any traffic light. Two cars A and B approach an intersection and they want to proceed as indicated by respective arrows in the following diagram. If both proceed without stopping and there is an accident, then A would have a payoff of -100 and B would have a payoff of -500 (since B is responsible for the accident). If one stops, and the other proceeds then the payoff is: -5 and 10, respectively. If both of them stop, then it takes a little longer to reach their respective destinations, they have a payoff of -5 each. Find the Pure Strategy Nash Equilibrium (PSNE) of the players (Car drivers).



(A) (Car A, Car B) = (Stop, Stop)
(B) (Car A, Car B) = (Stop, Proceed)
(C) (Car A, Car B) = (Proceed, Stop)
(D) (Car A, Car B) = (Proceed, Proceed)

(2 MARK 2023)

2. Which of the following models explain(s) the upward-sloping aggregate supply curve in the short-run?
(A) Sticky-wage model
(B) Worker-misperception model
(C) Imperfect-information model
(D) Solow model

(2 MARK 2024)

3. A decrease in the income tax rate has a _____ effect on the labour supply if the _____ effect dominates.
(A) negative; income
(B) positive; substitution
(C) positive; income
(D) negative; substitution

(1 MARK 2024)

4. Which of the following statements is/are TRUE?
(A) A firm experiences economies of scale when an increase in its output of a good or service brings a reduction in the average total cost of production
(B) A firm experiences economies of scope when an increase in its range of goods produced brings down the average total cost of production
(C) A firm experiences economies of scale when an increase in the range of products produced brings down the short-run average total cost of production
(D) A firm experiences economies of scope when an increase in its output of a good or service brings a reduction in the marginal cost of production.

5. A Cobb-Douglas type short-run production function is given by

$$q = 2\sqrt{LK}$$

where q,L and K are the output, labour and capital, respectively.
K is fixed at $\bar{K}$. The unit price of L is w and the unit price of K is r. It is given that w is 12.
Considering the above information, which of the following statements is/are CORRECT? (2 MARK 2025)
(A) The short-run marginal cost is $\frac{6q}{\bar{K}}$
(B) The short-run average variable cost is $\frac{3q}{\bar{K}}$
(C) To produce 10 units of the output, required L is $\frac{25}{\bar{K}}$
(D) For $\bar{K}$=3 and r=4, the total cost is 12+3q^2

Numerical Answer Type Questions (NAT)

(2 MARK 2021)

1. Two farmers, Rohit and Harish, graze their animals on a common land. They can choose to use this common resource 'lightly' or 'heavily' and the resulting strategic interaction may be described as a simultaneous-move game. The payoff matrix is given below:

	Harish		
Rohit		Graze Lightly	Graze Heavily
	Graze Lightly	40,40	20,55
	Graze Heavily	55,20	30,30

The minimum value of the discount rate (where the discount rate is less than one) under infinite repetition of the game where the threat strategy ("Graze lightly if

the opponent also grazes lightly, whereas, if the opponent renege then always graze heavily in all the future periods"), is a Sub-game Perfect Nash Equilibrium (SPNE) and, both the farmers graze their animals lightly is _____ (round off to one decimal place).

(2 MARK 2021)

2. Suppose Vijay has purchased a high-speed car worth ₹ 1000000. During the purchase, an Insurance company has shared the latest available road safety survey, wherein it is mentioned that, due to heavy congestion on roads, there is 40% chance of an accident within the first year of car purchase resulting in loss of the car value by 60%. Vijay's utility function for wealth (W) is given by $U(W) = In(W)$. If Vijay plans to buy an accident insurance having a premium of 30%, then he will purchase an insurance of ₹ _____ (round off to the nearest integer).

(2 MARK 2021)

3. Consider a competitive market where the demand and supply functions are given by $q^D = 12 - 2P$ and $q^S = 4P$, respectively. The tax rate per unit of output that maximizes the tax yield (revenue) is _____ (in integer).

(2 MARK 2021)

4. Suppose the demand for a new pharmaceutical drug, on which the manufacturer has a patent monopoly, is given by: $Q = (100 - P)A^{0.5}$; where Q is output, P is the price and A is advertising expenditure. Production cost of the patented drug is given by: $C(Q) = 60Q$. At the firm's optimal choices, the ratio of advertising expenditure to sales revenue for the pharmaceutical product will be 1:_____ (in integer).

(2 MARK 2022)

5. The long-run cost function of all identical firms in a perfectly competitive industry is given by:

$$C = 25q - 3q^2 + 1.5q^3$$

The market demand function is: P = 2500 -0.25Q
The number of firms in the industry at equilibrium is

(2 MARK 2022)

6. Consider a lottery with two possible outcomes:

- Rupees 100 with probability 0.6
- Rupees 50 with probability 0.4

The maximum amount that a risk-neutral person would be willing to pay to play the above lottery equals Rupees _____ (in integer).

(2 MARK 2022)

7. Mr. Sharma's consumption preference for tea (denoted by x) and sugar (denoted by y) is given by the utility function

$$U(x, y) = min\{x, 2y\}$$

The price per unit of tea is 10 and the price per unit of sugar is 10. Mr. Sharma's total income is 900.
The optimum quantity of tea purchased by Mr. Sharma equals (in integer).

(2 MARK 2022)

8. Suppose α is a real number between 0 and 1. Rohit is choosing x and y to maximize the following utility function: $U(x, y) = x^2 + 2xy + y^2 + 4\alpha^2 + 8\alpha + 10$ subject to the following constraints: $2x + y = 10, x, y \geq 0$
Then the optimal value of y chosen by Rohit is (in integer).

9. In a competitive market for dry-cleaning, the inverse market demand function is given by

$$P = 100 - Q$$

where P denotes price and Q denotes quantity. The (private) marginal cost (MC) of production for all the dry-cleaning firms together is given by

$$MC = 20 + 2Q$$

The market pollution generated by the dry-cleaning processes of all firms creates external damages given by the marginal external cost (MEC):

$$MEC = 2Q$$

The socially efficient output of dry-cleaning is _____ (in integer).

(2 MARK 2023)

10. The demand and supply functions for a commodity are given by:

$$D(p) = 10 - 2p \text{ and } S(p) = -2 + p$$

where $D(p)$ and $S(p)$ are the quantity demanded and supplied, respectively, and p (in USD) is the unit price of the good.
If the government sets a price ceiling of USD 3 per unit, then the increase in consumer surplus (in USD) is _____ (round off to two decimal places).

(2 MARK 2023)

11. A duopoly faces the inverse market demand function $p = 120 - Q$, where p is the unit price (in Rs.) of the good being sold by firms A and B, and Q is the total output. Firm A has a constant marginal cost of Rs. 20, which is exactly half of firm B's constant marginal cost. There is no fixed cost for both the firms. If there exists a Cournot-Nash equilibrium, Q is _____ (in integer).

(2 MARK 2023)

12. Consider the following short-run cost function:

$$C(q) = 10q^3 + 80q^2 + 300q + 50$$

At the minimum average variable cost (AVC), the value of marginal cost (MC) is _____ (in integer).

(2 MARK 2023)

13. A labour-augmenting production function is

$$Y = K^{0.33}(A\,L)^{0.67}$$

where Y = output, K = capital, L = labour, and A = technology.

Assume that the growth rate of L is 1.2 percent per annum, the growth rate of K is 3 percent per annum, and the growth rate of A is 1.5 percent per annum. Using the growth-accounting approach, the growth rate of Y in percent per annum is _____ (round off to two decimal places).

(2 MARK 2023)

14. A monopolist is facing the demand function $Q = \frac{100}{(P-1)}$, where Q is the quantity demanded and P is the price per unit of the good $(P > 1)$. The average variable cost for the monopolist is $\frac{4}{\sqrt{Q}}$ and the fixed cost is 10. The profit maximizing price is _____ (in integer).

(1 MARK 2023)

15. Suppose Amar borrows Rs. 1000 from Ujala. After one year, Ujala wants Rs. 1100 back from Amar. The yield to maturity in percent (%) on this borrowing is _____ $(round\ off\ to\ one\ decimal\ place)$.

(1 MARK 2024)

16. Consider a cobb-Douglas utility function given as $U(H) = (24 - H)^{1-\alpha}(wH)^{\alpha}$, where H is the number of hours spent working per day, and w is the wage rate per hour. If $= \frac{1}{2}$, then the corresponding labour supply (in hours) is_____ (in integer).

(2 MARK 2024)

17. An industry comprising only two firms produces a homogenous product where the market demand function is given by $P = 200 - 2(q_1 + q_2)$ where q_1 and q_2 are the output levels of firm 1 and firm 2, respectively. The individual firm's cost functions are $TC_1 = 4q_1$ and $TC_2 = 4q_2$, where TC_1 and TC_2 are total costs of firm 1 and 2, respectively. If firm 2 is a Stackelberg Leader, and firm 1 is a Follower, then the profit of the Stackelberg Leader will be _____ (rounded off to two decimal places).

(2 MARK 2024)

18. In an economy, the effort level of a worker in firm i is denoted by e_i and depends on the wage W_i received by the worker from the firm, and the minimum wage W_o is set by the government. The effort function is given by $e_i(W_i, W_o) = \sqrt{W_i - W_o}$

If the firm employs N_i unit of workers, then the efficiency unit of labour employed by the firm is $e_i N_i$. The production is based on only the efficiency unit of labour, and the production function is given by $F(e_i N_i) = \log_e(e_i N_i)$

If the minimum wage set by the government is 10, and the profit maximizing firms sell the good in a competitive market at price P by choosing W_i and N_i, then the profit maximizing wage set by the firm will be _____ (rounded off to one decimal place).

(2 MARK 2024)

19. In a perfectly competitive market, suppose the market demand curve is given by $P = 10 + W - Q$, where P is the market price, W is the average wealth of the consumers in the market, and Q is the industry output. The total cost function for a representative firm is given by $C(q) = q^3 - 2q^2 + 5q$, where q is the output of a firm. If $W = 80$, then the total number of firms in this industry in the long-run will be _____ (in integer).

(2 MARK 2024)

20. Consider an industry with six firms. An analyst collated the data for this industry as given below. The Herfindahl-Hirschman Index (HHI) for this industry will be _____ (in integer).

Firm	Market Share
F1	30%
F2	20%
F3	15%
F4	15%
F5	10%
F6	10%

(2 MARK 2024)

21. Consider a duopoly market where Firm 1 and Firm 2 produce differentiated products such that the demand function of each firm is given by:

$$q_1(p_1, p_2) = 18 - p_1 + p_2$$
$$q_2(p_1, p_2) = 18 + p_1 - p_2$$

Here, q_1 and q_2 are the outputs produced by Firm 1 and Firm 2, respectively, and p_i and p_2 are the corresponding per unit prices. Cost of production for the i^{th} firm is given by $C_i(q_i) = 2q_i \; \forall \; i = 1, 2$

The firms compete in prices. The price set by Firm 2 such that the market is in Nash equilibrium will be _____ (in integer).

(1 MARK 2025)

22. Consider a lottery with three possible outcomes:

Outcomes	Probability	Reward/Win (in INR)
I	0.2	25
II	0.3	50
III	0.5	100

The maximum amount that a risk-neutral person would be willing to pay to play the above lottery is INR _____ (*in integer*)

(1 MARK 2025)

23. The inverse demand function for a monopolist is given by

P=100−kQ

where P is the unit price of the good, Q is the quantity and k is a constant.

The cost function facing the monopolist is given as (Q)=50+2Q(1+Q).

If the profit maximizing output is 7, the maximum profit is _____ (*in integer*)

(2 MARK 2025)

24. There are two firms in an industry producing a homogeneous product. The market demand function is given by $P = 1 - (q_1 + q_2)$ where q_1 and $q_2)$ are the output levels of Firm 1 and Firm 2, respectively.

Firm 1's cost function is common knowledge and equals zero. Firm 2's cost function is private information. Firm 1 believes that Firm 2's cost function is 0.5$q_2)$ with probability 0.5 and that Firm 2's cost function is 0.25$q_2)$ with probability 0.5. The firms choose their quantities simultaneously.

Let $q1*$ denote the quantity produced by Firm 1 in the Bayesian Nash equilibrium of this game. Then, the value of 24q_1^* is _____ (*round off to one decimal place*)

(2 MARK 2025)

25. Consider a two-person exchange economy where two goods, x and y are available in limited quantities of 50 and 100, respectively. The preferences of the two persons, Anil and Binod are given by the utility functions

$$\text{Anil: } U_{\text{Anil}}(x_{\text{Anil}}, y_{\text{Anil}}) = x_{\text{Anil}}^{0.4} y_{\text{Anil}}^{0.6}$$

and

$$\text{Binod: } U_{\text{Binod}}(x_{\text{Binod}}, y_{\text{Binod}}) = x_{\text{Binod}}^{0.6} y_{\text{Binod}}^{0.4}$$

If they decide to share good y equally among themselves, the amount of good x Anil receives is _____ (*in integer)*

(2 MARK 2025)

26. Two players A and B are playing a game. Player A has two available actions $a1$ and $a2$. Player B has two available actions $b1$ and $b2$. The payoff matrix arising from their actions is presented below.

	$b1$	$b2$
$a1$	−1,3	4,−1
$a2$	3,−4	−2,2

Let p be the probability that player A plays action a_1 in the mixed strategy Nash equilibrium of the game. Then the value of p is _____ (*round off to one decimal place*)

Answer Key									
Multiple Choice Questions (MCQ)									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	C	B	B	B	C	B	A	B	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	B	B	B	C	C	B	A	A
21	**22**	**23**	**24**	**25**					
A	A	D	D	B					
Multiple Select Questions (MSQ)									
1	**2**		**3**		**4**		**5**		
B,C	A,B,C		A,B		A,B		A,B,C		
Numerical Answer Type Questions (NAT)									
1	**2**		**3**		**4**		**5**		
0.6	857143		3		8		9906		
6	**7**		**8**		**9**		**10**		
80	60		10		16		3		
11	**12**		**13**		**14**		**15**		
60	140		2.799		26		10		
16	**17**		**18**		**19**		**20**		
12	2401		20		86		1950		
21	**22**		**23**		**24**		**25**		
20	70		293		11		40		
26									
0.6									

EXPLANATIONS

Multiple Choice Questions (MCQ)

1. Explanation (C):

We know that price elasticity of demand is:

$$E_d = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

Here, the price elasticity of demand is given as 4, and the firm wants to increase its sales (quantity demanded) by 10%. We need to calculate the required change in price. We rearrange the formula to find the percentage change in price:

$$\%\text{ change in price} = \frac{\%\text{ change in quantity demanded}}{E_d}$$

Substitute the values:

$$\%\text{ change in price} = \frac{10}{4} = 2.5\%$$

Since the firm wants to increase sales, the price should be lowered by 2.5%.

2. Explanation (C): We are given the production function $Q = F(K, L) = \sqrt{KL}$ and the prices of capital ($P_K = 4$) and labour ($P_L = 2$).

The objective is to minimize the cost of producing 2 units of output, i.e., $Q = 2$.

Express the constraint for output.

The production function is $\sqrt{KL} = 2$. Squaring both sides, we get:

$$KL = 4$$

The total cost of production is given by:

$$C = P_K K + P_L L = 4K + 2L$$

To minimize cost subject to the constraint $KL = 4$, we set up the Lagrangian function:

$$\mathcal{L} = 4K + 2L + \lambda(4 - KL)$$

where λ is the Lagrange multiplier.

Take the partial derivatives with respect to K, L, and λ and set them equal to zero:

- $\frac{\partial \mathcal{L}}{\partial K} = 4 - \lambda L = 0$
- $\frac{\partial \mathcal{L}}{\partial L} = 2 - \lambda K = 0$
- $\frac{\partial \mathcal{L}}{\partial \lambda} = 4 - KL = 0$

From the first two equations, solve for λ:

$$\lambda = \frac{4}{L} \text{ and } \lambda = \frac{2}{K}$$

Equating these two expressions for λ, we get:

$$\frac{4}{L} = \frac{2}{K}$$

Simplifying:

$$K = \frac{L}{2}$$

Substitute into the constraint.

Substitute $K = \frac{L}{2}$ into the constraint $KL = 4$:

$$\left(\frac{L}{2}\right) L = 4$$

$$\frac{L^2}{2} = 4$$

$$L^2 = 8$$

$$L = \sqrt{8} = 2\sqrt{2}$$

Solve for K.

From $K = \frac{L}{2}$, we get:

$$K = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

Thus, the values of K and L that minimize the cost of producing 2 units of output are $K = \sqrt{2}$ and $L = 2\sqrt{2}$.

The **Explanation**: **(C) K = $\sqrt{2}$; L = 2$\sqrt{2}$**.

3. Explanation (B): To find the maximum possible total revenue (TR), we need to calculate the total revenue function, which is given by:

$$TR = P \times Q$$

Given the demand function $Q = 700 - 100P$, we can express the price P in terms of Q:

$$P = \frac{700 - Q}{100}$$

Thus, the total revenue (TR) becomes:

$$TR = P \times Q = \left(\frac{700 - Q}{100}\right) \times Q$$

$$TR = \frac{700Q - Q^2}{100}$$

To maximize total revenue, we need to take the derivative of the TR function with respect to Q and set it equal to zero:

$$\frac{d(TR)}{dQ} = \frac{700 - 2Q}{100} = 0$$

Solving for Q:

$$700 - 2Q = 0 \Rightarrow Q = 350$$

Substitute $Q = 350$ back into the demand function to find the price P:

$$P = \frac{700 - 350}{100} = \frac{350}{100} = 3.5$$

Now, calculate the total revenue at this quantity and price:

$$TR = P \times Q = 3.5 \times 350 = 1225$$

Thus, the maximum possible total revenue is ₹ 1225, which is less than ₹ 1500. Therefore, the **Explanation** (B).

4. Explanation (B): In a Bertrand-Nash equilibrium, firms compete by setting prices simultaneously and consumers purchase from the firm offering the lowest price. Since both firms have identical marginal costs (MC = 10), and assuming they produce homogeneous goods, each firm will try to undercut the other's price to capture the entire market. In this scenario, the firms will keep lowering their prices until the price reaches the marginal cost (10), because if either firm sets a price higher than the other, the competitor will take the entire market by setting the lower price.

Therefore, the Bertrand-Nash equilibrium price will be equal to the marginal cost, which is **10**.

5. Explanation (B): Walras' Law states that the sum of the value of excess demand (or supply) across all markets in an economy must be zero. This means that if you know the excess demand or supply in N−1N-1N−1 markets, the excess demand in the last market can be determined automatically by the condition that the total excess demand in the economy is zero. Therefore, you only need to find the equilibrium prices in N−1N-1N−1 markets, as the price in the final market can be adjusted accordingly to ensure equilibrium across all markets.

Thus, the **Explanation** (B) N-1 markets.

6. **Explanation (C):** In the case of **external economies**, when demand increases in a perfectly competitive market, the following occurs:

1. **Short-run effects**: Initially, the increase in demand leads to higher prices and higher output. Firms are incentivized to produce more at the higher price.
2. **Long-run effects**: In the long run, external economies lead to a reduction in production costs as the industry expands. These economies could stem from factors such as technological advancements, improved infrastructure, or better economies of scale. As a result, the supply curve shifts to the right, leading to a decrease in the price of the product. The price ultimately falls below its initial level (before the demand increase) due to these reduced costs, but the quantity produced and sold continues to rise as the demand remains higher.

Therefore, the **Explanation (C)**: "falls below the initial price (before the demand increase) and quantity increases."

7. **Explanation (B):** The individual's utility function is given as $u(w) = \alpha - \beta e^{-rw}$, where w represents wealth, α and β are constants, and r is the coefficient of risk aversion.

To determine the relative risk aversion, we need to calculate the **relative risk aversion coefficient** (denoted as $R(w)$), which is defined as:

$$R(w) = -\frac{w \cdot u''(w)}{u'(w)}$$

Let's first compute the first and second derivatives of the utility function:

- The first derivative $u'(w)$ is:

$$u'(w) = \beta r e^{-rw}$$

- The second derivative $u''(w)$ is:

$$u''(w) = -\beta r^2 e^{-rw}$$

Now, we substitute these into the formula for relative risk aversion:

$$R(w) = -\frac{w \cdot (-\beta r^2 e^{-rw})}{\beta r e^{-rw}} = \frac{rw}{1}$$

So, the relative risk aversion $R(w) = rw$, which **increases with wealth**. This indicates that the individual displays **increasing relative risk aversion**.

Therefore, the **Explanation (B) increasing**.

8. **Explanation (A):** To find the stable market equilibrium price-quantity combination, we need to set the **demand function** equal to the **supply function**. This is because at equilibrium, the quantity demanded equals the quantity supplied.

The supply function is given as:

$$4P - 3Q = 0$$

Solving for P, we get:

$$P = \frac{3Q}{4}$$

The demand function is:

$$P = Q^2 - 12Q + 35$$

At equilibrium, the price P from the demand function must equal the price P from the supply function:

$$Q^2 - 12Q + 35 = \frac{3Q}{4}$$

or $4(Q^2 - 12Q + 35) = 3Q$

or $4Q^2 - 48Q + 140 = 3Q$

or $4Q^2 - 51Q + 140 = 0$

Now, solve this quadratic equation using the quadratic formula:

$$Q = \frac{-(-51) \pm \sqrt{(-51)^2 - 4(4)(140)}}{2(4)}$$

$$Q = \frac{51 \pm \sqrt{2601 - 2240}}{8}$$

$$Q = \frac{51 \pm \sqrt{361}}{8}$$

$$Q = \frac{51 \pm 19}{8}$$

Thus, we have two possible values for Q:

$$Q = \frac{51 + 19}{8} = \frac{70}{8} = 8.75 \text{ or } Q = \frac{51 - 19}{8} = \frac{32}{8} = 4$$

Now, substitute each value of Q back into the supply function $P = \frac{3Q}{4}$.

1. For $Q = 8.75$:

$$P = \frac{3(8.75)}{4} = \frac{26.25}{4} = 6.5625$$

2. For $Q = 4$:

$$P = \frac{3(4)}{4} = 3$$

The stable equilibrium price-quantity combination is the one where the values of P and Q are reasonable in both the demand and supply functions. Checking both possibilities, we find that the combination $(P^*, Q^*) = (3,4)$ satisfies both functions, as:

- For $P = 3$, substituting into the demand function:

$$3 = Q^2 - 12Q + 35$$
$$Q^2 - 12Q + 32 = 0$$
$$(Q - 4)(Q - 8) = 0$$

Thus, $Q = 4$ is a valid solution.

Thus, the stable market equilibrium price-quantity combination is **(A) (P*, Q*) = (3, 4)**.

9. Explanation (B): To determine the optimal consumption of biryani (x) and pudding (y) for Trisha, we need to solve the utility maximization problem given her budget constraint and the quantity constraints.

Trisha's utility function is given by: $U(x, y) = x + 4y$

The price of biryani is ₹ 2 per unit and the price of pudding is ₹ 3 per unit. Trisha's total income is ₹ 120. So, the budget constraint is: $2x + 3y = 120$

Additionally, Trisha faces the following quantity constraints:

- $x \leq 60$ (She can't consume more than 60 units of biryani)
- $y \leq 30$ (She can't consume more than 30 units of pudding)

Trisha's utility function is linear, and the marginal utility of biryani is 1 (from the term x) and the marginal utility of pudding is 4 (from the term $4y$). To maximize utility, Trisha should allocate her budget in such a way that she gets the most utility from the product with the higher marginal utility per rupee.

Now, the marginal utility per rupee for each product:

- **Marginal utility per rupee of biryani**: $\frac{MU_x}{P_x} = \frac{1}{2}$
- **Marginal utility per rupee of pudding**: $\frac{MU_y}{P_y} = \frac{4}{3}$

Since the marginal utility per rupee of pudding ($\frac{4}{3}$) is higher than that of biryani ($\frac{1}{2}$), Trisha should spend as much of her income as possible on pudding, subject to the budget and quantity constraints.

To maximize her utility, Trisha should first buy as much pudding as possible, subject to the constraints. Since the price of pudding is ₹ 3, she can buy at most:

$$\frac{120}{3} = 40 \text{ units of pudding}$$

However, she is limited by the quantity constraint, which states that she can consume no more than 30 units of pudding. So, Trisha will buy 30 units of pudding.

After purchasing 30 units of pudding, Trisha has:

$$120 - (30 \times 3) = 120 - 90 = 30$$

She has ₹ 30 left to spend on biryani. The price of biryani is ₹ 2 per unit, so she can buy:

$$\frac{30}{2} = 15 \text{ units of biryani}$$

Trisha can consume 15 units of biryani and 30 units of pudding within her budget and quantity constraints. This allocation maximizes her utility because she spends as much as possible on the good with the higher marginal utility per rupee (pudding).

Thus, the optimum quantity of biryani and pudding consumed by Trisha is **(B) (x*, *y*) = (15, 30)***.

10. Explanation (B): In a Cournot oligopoly with n symmetric firms, the firms choose quantities simultaneously to maximize their profits, given the market demand function $P(Q) = a - Q$, where Q is the total quantity produced by all firms. Each firm incurs a cost of $C_i = cq_i$, where q_i is the quantity produced by firm i.

Total Market Quantity: The total quantity produced by all n firms is $Q = \sum_{i=1}^{n} q_i$. Since the firms are symmetric, each firm produces the same quantity, $q_i = q$, so $Q = nq$.

Market Price: The market price is given by the demand function: $P(Q) = a - Q = a - nq$

Revenue and Cost: Each firm's revenue is $R_i = P \cdot q_i = (a - nq)q$. The cost for each firm is $C_i = cq_i = cq$.

Profit Maximization: Each firm maximizes its profit $\pi_i = R_i - C_i = (a - nq)q - cq$. Differentiating profit with respect to q and setting it equal to zero to find the equilibrium quantity:

$$\frac{d\pi_i}{dq} = a - nq - cq - nq = a - (n+1)q - c = 0$$

Solving for q, we get: $q = \frac{a-c}{n+1}$

Total Market Quantity in Equilibrium: The total quantity is: $Q = nq = n\left(\frac{a-c}{n+1}\right) = \frac{n(a-c)}{n+1}$

Equilibrium Market Price: Substituting Q back into the demand function:

$$P = a - Q = a - \frac{n(a-c)}{n+1} = a - \left(\frac{na - nc}{n+1}\right)$$

Simplifying:

$$P = a - \frac{na}{n+1} + \frac{nc}{n+1} = \frac{a(n+1) - na + nc}{n+1}$$
$$= \frac{a + nc}{n+1}$$

Therefore, the equilibrium market price is:

(B) $\frac{a}{n+1} + \frac{nc}{n+1}$

11. Explanation (B): The firm's production function is:

$$f(x_1, x_2, x_3, x_4) = \min\{x_1, x_2\} + \min\{x_3, x_4\}$$

The term $\min\{x_1, x_2\}$ implies that the output from this part depends on the **smaller value** between x_1 and x_2. Similarly, $\min\{x_3, x_4\}$ depends on the smaller value between x_3 and x_4.

The firm seeks to minimize cost while satisfying production needs.

Input Costs:

The per-unit costs of inputs are:

$w_1 = 1$, $w_2 = 5$, $w_3 = 3$, and $w_4 = 6$.

Cost-Minimizing Strategy:

1. **For** $\min\{x_1, x_2\}$**:**

The cost of x_1 is lower ($w_1 = 1$) compared to x_2 ($w_2 = 5$).

However, the **"min" operator** requires that both $x_1 > 0$ and $x_2 > 0$ to maximize the contribution from $\min\{x_1, x_2\}$. If $x_2 = 0$, the value of $\min\{x_1, x_2\}$ will be 0, regardless of how much x_1 is used.

Thus, the firm must use **positive amounts of both x_1 and x_2** to meet production requirements, despite x_2 being more expensive.

2. **For $\min\{x_3, x_4\}$:**

Since $w_3 = 3 < w_4 = 6$, the firm will choose to use only $x_3 > 0$ and set $x_4 = 0$ to minimize costs. However, if $x_3 = 0$, this term will contribute nothing to output.

Analysis of the Options:

Option (A): Incorrect because it sets $x_2 = 0$, which would result in $\min\{x_1, x_2\} = 0$, failing to meet production needs.

Option (B): Correct because the firm uses both $x_1 > 0$ and $x_2 > 0$ to ensure $\min\{x_1, x_2\}$ contributes fully. At the same time, $x_3 = 0$ and $x_4 = 0$ are valid as the second term does not contribute.

Option (C): Incorrect because $x_3 = 0$ and $x_4 > 0$ would result in unnecessary additional costs, as $w_4 > w_3$.

Option (D): Incorrect because it sets both $x_1 = 0$ and $x_2 = 0$, which would result in no output from the first term.

Final Answer:

(B) $x_1 > 0, x_2 > 0, x_3 = 0, x_4 = 0$

12. **Explanation (B):**

The production function is: $Y(K, L) = K^x L^y$

A production function satisfies constant returns to scale if, for any scalar $t > 0$,

$$Y(tK, tL) = t \cdot Y(K, L).$$

Substitute tK and tL into the production function:

$Y(tK, tL) = (tK)^x (tL)^y = t^x K^x \cdot t^y L^y = t^{x+y} K^x L^y$.

The original production function is: $Y(K, L) = K^x L^y$.

For constant returns to scale: $t^{x+y} K^x L^y = t \cdot K^x L^y$.

This implies: $t^{x+y} = t$.

Taking the natural logarithm of both sides: $(x + y)\ln t = \ln t$.

Since this must hold for all $t > 0$, we have:

$$x + y = 1.$$

13. **Explanation (B):** The total demand for chocolates in the country is the sum of the demand in **region 1** and **region 2**. Let us calculate step by step:

The demand in region 1 is given by: $Q_1(P) = 100 - P$

At $P = 125$:

$$Q_1(125) = 100 - 125 = -25$$

Since demand cannot be negative, $Q_1(P) = 0$ for $P > 100$.

The demand in region 2 is given by:

$Q_2(P) = 200 - P$

At $P = 125$:

$Q_2(125) = 200 - 125 = 75$

The total demand is the sum of demands in both regions:

$Q_{\text{total}}(P) = Q_1(P) + Q_2(P)$

$\boldsymbol{Q_{\text{total}}(125) = 0 + 75 = 75}$

14. **Explanation (B):** To determine the correct answer, let us analyze the price elasticities of demand for Tom and Jerry based on their respective statements:

The own price elasticity of demand (ϵ) is defined as:

$$\epsilon = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

For Tom:

Tom demands a fixed quantity of petrol (10 liters), irrespective of its price. This means that:

The quantity demanded does not change with price ($\Delta Q = 0$).

Elasticity of demand for Tom, $\epsilon_T = 0$, because the numerator (% change in quantity demanded) is zero.

For Jerry:

Jerry demands petrol worth a fixed amount (1000 rupees). This means:

If the price of petrol increases, Jerry will buy less quantity, and if the price decreases, he will buy more quantity, such that his total expenditure remains constant ($P \cdot Q = 1000$).

For such a case, the price elasticity of demand is $\epsilon_J = -1$, as total expenditure remaining constant implies unitary elasticity.

Correct Answer

The correct option is:

(B) $\epsilon_T = 0, \epsilon_J = -1$.

15. **Explanation (B):** To solve this, we analyze the monopolist's pricing behaviour before and after the tax is imposed, using the inverse demand function and marginal cost information.

The monopolist maximizes profit where **marginal revenue (MR) = marginal cost (MC)**. The demand function is: $P = 40 - Q$

The total revenue (TR) is: $TR = P \cdot Q = (40 - Q)Q = 40Q - Q^2$

Now, $MR = \frac{d(TR)}{dQ} = 40 - 2Q$

The monopolist has zero fixed costs and a constant marginal cost (MC) of 5 per unit.

Set $MR = MC$ to find the profit-maximizing quantity (Q^*):

$40 - 2Q = 5 \Rightarrow 2Q = 35 \Rightarrow Q^* = 17.5$

The profit-maximizing price (P^*) is:

$P^* = 40 - Q^* = 40 - 17.5 = 22.5$

After a per-unit tax of 5 is imposed, the effective marginal cost becomes:

$MC_{\text{new}} = 5 + 5 = 10$

Set $MR = MC_{\text{new}}$ to find the new profit-maximizing quantity (Q_t^*):

$40 - 2Q = 10 \Rightarrow 2Q = 30 \Rightarrow Q_t^* = 15$

The new profit-maximizing price (P_t^*) is:

$P_t^* = 40 - Q_t^* = 40 - 15 = 25$

The price charged to consumers increases from $P^* = 22.5$ to $P_t^* = 25$, so the increase is:

$\Delta P = P_t^* - P^* = 25 - 22.5 = 2.5$

16. Explanation (C): Analyzing the Options:

(A) If $1 < e_p < \infty$, the demand is price inelastic.

Incorrect. If $1 < e_p < \infty$, demand is **price elastic**, not inelastic. This means that a percentage change in price leads to a larger percentage change in quantity demanded.

(B) Luxury goods are more price inelastic, and necessities are price elastic.

Incorrect. Luxury goods tend to be **price elastic**, as consumers are more sensitive to price changes for non-essential goods. Necessities tend to be **price inelastic**, as consumers continue to buy them regardless of price changes.

(C) Luxury goods have $e_I > 1$.

Correct. Luxury goods are defined as goods with an income elasticity of demand greater than 1, meaning that demand increases more than proportionally with income.

(D) If $0 < e_p < 1$, the demand is price elastic.

Incorrect. If $0 < e_p < 1$, the demand is **price inelastic**, meaning that quantity demanded is less responsive to price changes.

17. Explanation (C): We aim to find the utility-maximizing bundle of x_1 and x_2 for the given income, utility function, and prices.

Given:

1. **Utility function**: $U(x_1, x_2) = x_2(x_1 + 1)$.
2. **Budget constraint**: $2x_1 + 3x_2 = 142$, where Rs. 2 and Rs. 3 are the unit prices of x_1 and x_2, respectively.
3. **Non-negativity constraint**: $x_1 \geq 0, x_2 \geq 0$.

The problem is to maximize $U(x_1, x_2)$ subject to the budget constraint:

$$\mathcal{L} = x_2(x_1 + 1) + \lambda(142 - 2x_1 - 3x_2).$$

We will solve the first-order conditions (FOC)

$\frac{\partial \mathcal{L}}{\partial x_1} = x_2 - 2\lambda = 0 \Rightarrow \lambda = \frac{x_2}{2}$.

$\frac{\partial \mathcal{L}}{\partial x_2} = x_1 + 1 - 3\lambda = 0 \Rightarrow \lambda = \frac{x_1+1}{3}$.

Equating the two expressions for λ:

$\frac{x_2}{2} = \frac{x_1+1}{3} \Rightarrow 3x_2 = 2(x_1 + 1) \Rightarrow 3x_2 = 2x_1 + 2.$

or $x_2 = \frac{2x_1+2}{3}$.

Substitute $x_2 = \frac{2x_1+2}{3}$ into $2x_1 + 3x_2 = 142$:

$2x_1 + 3\left(\frac{2x_1+2}{3}\right) = 142.$

or $2x_1 + 2x_1 + 2 = 142$

$\Rightarrow 4x_1 + 2 = 142$

$\Rightarrow 4x_1 = 140 \Rightarrow \boldsymbol{x_1 = 35}.$

Substitute $x_1 = 35$ into $x_2 = \frac{2x_1+2}{3}$:

$\boldsymbol{x_2 = \frac{2(35)+2}{3} = \frac{70+2}{3} = \frac{72}{3} = 24}.$

The utility-maximizing bundle is: $\boldsymbol{x_1 = 35, x_2 = 24}$.

18. Explanation (B): The total cost (TC) function is given as:

$TC(Q) = a + b(Q)$,

where a is the fixed cost and $b(Q)$ is the variable cost. In this setup:

Fixed costs (a) do not vary with output Q.

Variable costs ($b(Q)$) depend on output Q.

If the fixed cost (a) increases, the following implications arise:

1. **Average Total Cost (ATC)**:

   $ATC = \frac{TC}{Q} = \frac{a+b(Q)}{Q}$.

   Since the fixed cost (a) increases, the average total cost (ATC) increases for all levels of Q, causing the ***ATC* curve to shift upwards.**

2. **Average Variable Cost (AVC)**:

   $AVC = \frac{b(Q)}{Q}$.

   The variable cost component ($b(Q)$) remains unchanged because it is independent of the fixed cost. Therefore, the **AVC curve does not shift**.

3. **Marginal Cost (MC)**:

   $MC = \frac{dTC}{dQ} = \frac{d[b(Q)]}{dQ}$.

   Marginal cost depends only on the variable cost component $b(Q)$ and is not affected by changes in fixed cost. Thus, the **MC curve does not shift**.

4. **Profit**:

   If fixed costs increase, the firm's total costs rise, which reduces profits (assuming revenue remains constant). Hence, the **firm will not earn higher profits.**

19. Explanation (A): In the sticky-price model of aggregate supply, when all firms have sticky prices (i.e., prices are fixed in the short run and cannot adjust to changes in economic conditions), the short-run aggregate supply (SRAS) curve becomes **horizontal**. This is because, in such a scenario, output rather than prices adjusts to changes in aggregate demand. Since firms cannot change their prices, they respond to demand fluctuations by altering production levels, leading to a flat SRAS curve.

The other options are incorrect because:

(B) A vertical SRAS curve represents the long-run aggregate supply, where prices are flexible, and output is determined by factors of production.

(C) The steepness depends on the degree of price flexibility; with no flexible prices, the curve cannot be steep.

(D) An upward-sloping SRAS curve occurs when some firms have flexible prices, but here the question specifies that none of the firms have flexible prices.

Thus, with no flexible prices, the SRAS curve is horizontal.

20. Explanation (A): The Nash Equilibria occur when neither player (Aditi or Raju) can improve their payoff by unilaterally changing their strategy. In this case, the payoff matrix indicates the outcomes for each combination of choices between Aditi and Raju.

The payoff matrix is:

Aditi \ Raju	Movie (R)	Concert (R)
Movie (A)	2, 1	0, 0
Concert (A)	0, 0	1, 2

Nash Equilibrium Conditions

Aditi will prefer to watch the movie (A) if the payoff from watching the movie is greater than the payoff from attending the concert.

Raju will prefer to go to the concert (R) if the payoff from attending the concert is greater than the payoff from watching the movie.

Checking the Nash Equilibria

1. **(p = 0, q = 0)**: Aditi chooses the concert, and Raju chooses the movie. The payoffs are (0, 0), which are not optimal for either Aditi or Raju, so this is not a Nash equilibrium.
2. **(p = 1, q = 1)**: Aditi and Raju both choose the movie, leading to a payoff of (2, 1). Aditi prefers the movie and will stick with it, and Raju prefers the concert and will switch. So, this is **not** a Nash equilibrium.
3. **(p = 2/3, q = 1/3)**: Aditi has a 2/3 chance of choosing the movie, and Raju has a 1/3 chance of choosing the concert. Aditi prefers the movie and will keep it, while Raju prefers the concert, so this could be a Nash equilibrium where each person is making the best decision given the other's behaviour.

Conclusion: The correct Nash Equilibrium options are **(p = 2/3, q = 1/3)**, making **Option A** the correct answer.

21. Explanation (A): In this problem, we are looking for the competitive equilibrium, where both Anu and Binu maximize their utility given their initial endowments and the consumption bundle they choose. Let's analyze the utility functions and the constraints.

Anu's utility function is given by: $U^{Anu}(a, b) = a + 2b$

Anu's utility increases as she consumes more apricots (a) and bananas (b).

The marginal utility of apricots is 1, and the marginal utility of bananas is 2.

Anu values bananas more than apricots, so she would prefer to consume more bananas if possible.

Binu's utility function is: $U^{Binu}(a, b) = \min(a, 2b)$

This utility function implies that Binu is limited by the smaller of the two values: the number of apricots (a) and twice the number of bananas (2b).

Binu's utility will be maximized when the number of apricots equals twice the number of bananas (i.e., $a = 2b$).

Initial Endowments

Anu initially has 0 apricots and 12 bananas.

Binu initially has 12 apricots and 0 bananas.

In the competitive equilibrium, they will trade apricots and bananas until both of their utility functions are maximized.

To determine the optimal consumption bundle for Anu, consider the following:

Anu's goal: She wants to consume as many bananas as possible because she values bananas more. However, her utility is constrained by the fact that she has no apricots at first. Since Anu starts with 12 bananas, she will likely trade these bananas for apricots from Binu.

Binu's goal: Binu will trade apricots for bananas, aiming to satisfy $a = 2b$, which maximizes her utility.

Competitive Equilibrium

In the equilibrium, the market clears, meaning that the total amount of apricots and bananas is fully allocated. The competitive equilibrium will involve Anu and Binu trading until they are both maximizing their utility, which happens when:

Binu consumes apricots and bananas such that $a = 2b$. If Binu ends up with 6 bananas, he would have 12 apricots, satisfying $a = 2b$.

Anu, given her preference for bananas, will then consume all the remaining bananas. In this case, Anu will end up with 6 apricots and 9 bananas, which maximizes her utility given that she values bananas more.

Conclusion:

The **Explanation (A) 6 apricots and 9 bananas**.

22. Explanation (A): To determine the subgame perfect Nash equilibrium (SPNE), we analyze the game using **backward induction**. The payoffs are as follows:

1. **If C does not enter**, C gets 1 and I gets 2.
2. **If C enters and I accommodates**, C gets 2 and I gets 1.
3. **If C enters and I fights**, C gets 0 and I gets 1.

Step 1: Analyze I's strategy if C enters

If C enters:

If I accommodates, I gets **1**.

If I fights, I gets **1**.

Since I is indifferent between accommodating and fighting, we assume I accommodates.

Step 2: Analyze C's decision to enter

If C **does not enter**, C gets **1**.

If C **enters** and I accommodates, C gets **2**.

If C **enters** and I fights, C gets **0**.

Since entering and being accommodated gives the **highest payoff (2)** for C, C will choose to **enter**.

Step 3: Verify SPNE

The strategies consistent with rational decisions in each subgame are:

C enters.

I accommodates (if C enters).

Thus, the SPNE is:

(A) enter; accommodate.

23. Explanation (D): The statement that is **NOT CORRECT** in the context of a perfectly competitive market is:

(D) If a consumer values the last unit more than its marginal cost of production, producing an additional unit shall lower welfare.

This statement is incorrect because in a perfectly competitive market, if a consumer values the last unit more than its marginal cost of production, it means that the production of that unit adds to welfare. In fact, producing more would increase overall welfare as long as the value consumers place on the good (the price they are willing to pay) is greater than the cost of producing it (marginal cost).

24. Explanation (D): The given demand function is:

$$\log Q = \log A + 0.5 \log P$$

To find the own price elasticity of demand (ε), we need to compute the percentage change in quantity demanded with respect to a percentage change in price. The general formula for the own price elasticity of demand is:

$$\varepsilon = \frac{dQ}{dP} \times \frac{P}{Q}$$

Step 1: Express Q as a function of P

Rearrange the given equation:

$$\log Q = \log A + 0.5 \log P$$

Exponentiate both sides to get rid of the logarithms:

$$Q = A \cdot P^{0.5}$$

Step 2: Differentiate Q with respect to P

Now, differentiate $Q = A \cdot P^{0.5}$ with respect to P:

$$\frac{dQ}{dP} = A \cdot 0.5 \cdot P^{-0.5} = \frac{A}{2\sqrt{P}}$$

Step 3: Compute the price elasticity of demand

Now, substitute $\frac{dQ}{dP}$ into the elasticity formula:

$$\varepsilon = \frac{dQ}{dP} \times \frac{P}{Q}$$

Substitute the expressions for $\frac{dQ}{dP}$ and Q:

$$\varepsilon = \frac{A}{2\sqrt{P}} \times \frac{P}{A \cdot P^{0.5}}$$

Simplify the equation:

$$\varepsilon = \frac{1}{2}$$

Conclusion: The own price elasticity of demand is $\varepsilon = 0.5$, which is **inelastic** because the elasticity is less than 1.

25. Explanation (B): To solve this problem using the **Cournot competition** model, we need to determine the **equilibrium quantity** Q, where each firm maximizes its profit given the output of the other firms. Let's break the problem down step-by-step.

Step 1: Write the Demand and Profit Functions

The **inverse demand function** is given by:

$$P = 25 - Q$$

where $Q = q_1 + q_2 + q_3$ is the total quantity supplied by all firms in the market.

The **total cost (TC)** for firm i is given by:

$$TC_i = \alpha_i + 5q_i$$

The **profit** for firm i, π_i, is:

$$\pi_i = P \cdot q_i - TC_i$$

Substitute the inverse demand function and the cost function into the profit equation:

$$\pi_i = (25 - Q) \cdot q_i - (\alpha_i + 5q_i)$$

Simplifying:

$$\pi_i = (25 - (q_1 + q_2 + q_3))q_i - (\alpha_i + 5q_i)$$
$$\pi_i = 25q_i - (q_1 + q_2 + q_3)q_i - \alpha_i - 5q_i$$
$$\pi_i = (25 - 5)q_i - (q_1 + q_2 + q_3)q_i - \alpha_i$$
$$\pi_i = 20q_i - Qq_i - \alpha_i$$

Step 2: Maximize Profit for Each Firm

To find the profit-maximizing quantity for each firm, we differentiate the profit function with respect to q_i and set it equal to zero. The derivative of π_i with respect to q_i is:

$$\frac{d\pi_i}{dq_i} = 20 - Q - q_i$$

Set this equal to zero to maximize profit:

$$20 - Q - q_i = 0$$
$$q_i = 20 - Q$$

Step 3: Symmetry and Solve for Q

Since the firms are symmetric, $q_1 = q_2 = q_3 = q$. Thus, the total quantity is:

$$Q = 3q$$

Substitute $Q = 3q$ into the equation $q_i = 20 - Q$:

$$q = 20 - 3q$$

Solving for q:

$$4q = 20$$
$$q = 5$$

Step 4: Find the Total Quantity Q

Now, substitute $q = 5$ into the equation for total quantity:

$$Q = 3q = 3 \times 5 = 15$$

Multiple Select Questions (MSQ)

1. Explanation (B and C):

Given payoffs and scenario:

(A proceeds, B proceeds): Both cars proceed without stopping, leading to an accident. The payoffs are:
Car A: -100 (because it caused an accident).
Car B: -500 (because it caused the accident).

(A stops, B proceeds): Car A stops and Car B proceeds. The payoffs are:
Car A: -5 (waiting, but no accident).
Car B: 10 (proceeding without any problem).

(A proceeds, B stops): Car A proceeds and Car B stops. The payoffs are:
Car A: 10 (proceeding without any problem).
Car B: -5 (waiting, but no accident).

(A stops, B stops): Both cars stop. The payoffs are:
Car A: -5 (waiting, but no accident).
Car B: -5 (waiting, but no accident).

Analyzing the Payoff Matrix:

Car A / Car B	**Stop**	**Proceed**
Stop	(-5, -5)	(-5, 10)
Proceed	(10, -5)	(-100, -500)

Best Responses:

1. **If Car A stops:**
   If Car B stops, Car A gets -5 (no accident, but waiting).
   If Car B proceeds, Car A gets -5 (no accident, but waiting).
   So, **Car A's best response** is **Stop**, regardless of what Car B does.
2. **If Car A proceeds:**
   If Car B stops, Car A gets 10 (proceeds without delay).
   If Car B proceeds, Car A gets -100 (accident).
   So, **Car A's best response** is **Proceed** if Car B stops and **Stop** if Car B proceeds.
3. **If Car B stops:**
   If Car A stops, Car B gets -5 (no accident, but waiting).
   If Car A proceeds, Car B gets -5 (no accident, but waiting).
   So, **Car B's best response** is **Stop**, regardless of what Car A does.
4. **If Car B proceeds:**
   If Car A stops, Car B gets 10 (proceeds without delay).
   If Car A proceeds, Car B gets -500 (accident).
   So, **Car B's best response** is **Proceed** if Car A stops and **Stop** if Car A proceeds.

Conclusion:

The Pure Strategy Nash Equilibria (PSNE) occur when:
Car A stops and Car B proceeds, resulting in a payoff of (-5, 10).
Car A proceeds and Car B stops, resulting in a payoff of (10, -5).
These are the **Nash Equilibria** because each player's strategy is the best response to the other player's strategy.
Thus, the correct answers are **(B) (Car A, Car B) = (Stop, Proceed)** and **(C) (Car A, Car B) = (Proceed, Stop)**.

2. Explanation (A, B and C):

1. **Sticky-Wage Model**:
   This model explains an upward-sloping short-run aggregate supply (SRAS) curve by arguing that nominal wages are "sticky" (i.e., slow to adjust) due to contracts, expectations, or other frictions. If prices rise unexpectedly, real wages fall, making labour cheaper and encouraging firms to increase production, leading to a positive relationship between output and the price level.
2. **Worker-Misperception Model**:
   In this model, workers may misinterpret nominal wage

changes as real wage changes due to imperfect information about the price level. If the price level rises unexpectedly, workers may perceive their real wages as higher and offer more labour, increasing production. **This explains the upward-sloping SRAS curve.**

3. **Imperfect-Information Model**:
   This model posits that producers do not have perfect information about the overall price level and may mistake general price level changes for changes in the relative prices of their goods. This misperception leads them to adjust output, resulting in **an upward-sloping SRAS curve.**
4. **Solow Model**:
   The Solow model is a long-run growth model that focuses on capital accumulation, technological progress, and population growth. It **does not explain short-run fluctuations or the upward-sloping SRAS curve.**

3. Explanation (A and B):

(A) Negative; income effect: A decrease in the income tax rate increases the after-tax income of individuals, which can lead to a negative impact on labour supply if the **income effect** dominates. This happens because individuals may feel wealthier and decide to work less to enjoy more leisure time.

(B) Positive; substitution effect: A decrease in the income tax rate also makes work more financially rewarding relative to leisure. This creates a **substitution effect**, where individuals are incentivized to work more because the opportunity cost of leisure has increased, leading to a positive effect on labour supply.

The overall impact on labour supply depends on which effect—income or substitution—dominates

4. Explanation (A and B):

(A) Economies of Scale:

A firm experiences **economies of scale** when increasing the production of a single good or service leads to a reduction in the **average total cost (ATC)** of production. This occurs because fixed costs are spread over a larger output, and operational efficiencies improve as production scales up.

(B) Economies of Scope:

A firm experiences **economies of scope** when producing a wider variety of goods results in a lower **average total cost (ATC)** compared to producing each good independently. This typically happens due to shared resources, technology, or distribution channels across multiple products.

The other options are incorrect:

(C): Economies of scale refer to an increase in the output of a single product, not the range of products, and are related to long-run, not short-run, average costs.

(D): Economies of scope are about reducing **average total costs** when diversifying production, not marginal costs of individual goods.

Thus, the correct and true statements are **(A) and (B)**.

5. Explanation (A, B, C): We are given a Cobb-Douglas short-run production function:

$$q = 2\sqrt{LK}$$

where q is the output, L is labour, and K is capital. The capital K is fixed at $\bar{K}$, and the prices of labour and capital are given by $w = 12$ and r, respectively.

We need to analyze the following options.

1. **Short-Run Marginal Cost (MC):**
   The total cost (TC) function in the short run is:
   $$TC = wL + rK$$
   Substituting $L = \frac{q^2}{4\bar{K}}$ and $K = \bar{K}$, and given $w = 12$, we get:
   $$TC = 12 \times \frac{q^2}{4\bar{K}} + r\bar{K}$$
   Now, the marginal cost (MC) is the derivative of total cost with respect to q:
   $$MC = \frac{d(TC)}{dq} = \frac{d}{dq}\left(12 \times \frac{q^2}{4\bar{K}} + r\bar{K}\right)$$
   Simplifying the derivative:
   $$MC = 12 \times \frac{2q}{4\bar{K}} = \frac{6q}{\bar{K}}$$
   So, the **short-run marginal cost** is:
   $$MC = \frac{6q}{\bar{K}}$$
   Thus, **Option (A)**: "The short-run marginal cost is $6q/\bar{K}$ is **correct**.
2. **Short-Run Average Variable Cost (AVC):**
   The average variable cost is the variable cost divided by output. The variable cost (VC) is the cost of labour, which is:
   $$VC = wL = 12 \times \frac{q^2}{4\bar{K}} = \frac{3q^2}{\bar{K}}$$
   Now, the **average variable cost** is:
   $$AVC = \frac{VC}{q} = \frac{\frac{3q^2}{\bar{K}}}{q} = \frac{3q}{\bar{K}}$$
   Thus, the **short-run average variable cost** is:
   $$AVC = \frac{3q}{\bar{K}}$$
   This matches **Option (B)**: "The short-run average variable cost is $3q\bar{K}$", which is **correct**.
3. **Required Labour to Produce 10 Units of Output:**

To produce $q = 10$ units of output, use the production function:

$$q = 2\sqrt{L\bar{K}}$$

Substitute $q = 10$:

$$10 = 2\sqrt{L\bar{K}}$$

Solve for L:

$$5 = \sqrt{L\bar{K}}$$

Square both sides:

$$25 = L\bar{K}$$

Thus, the labour required to produce 10 units of output is:

$$L = \frac{25}{\bar{K}}$$

This matches **Option (C)**: "To produce 10 units of output, required $L = 25/\bar{K}$", which is **correct**.

4. Total Cost for $\bar{K} = 3$ and $r = 4$:

The total cost is:

$$TC = 12 \times \frac{q^2}{4\bar{K}} + r\bar{K}$$

Substitute $\bar{K} = 3$ and $r = 4$:

$$TC = 12 \times \frac{q^2}{4 \times 3} + 4 \times 3$$

Simplify:

$$TC = \frac{3q^2}{\bar{K}} + 12$$

Thus, the total cost is:

$$TC = 12 + \frac{3q^2}{\bar{K}}$$

This does not match the form provided in **Option (D)**: "The total cost is $12 + 3q^2$", because the cost depends on $\bar{K}$. Therefore, **Option (D)** is **incorrect**.

Thus, the correct answers are **(A), (B), and (C)**.

Numerical Answer Type Questions (NAT)

1. Explanation (0.6): To determine the minimum discount rate under which the given strategy is a Sub-game Perfect Nash Equilibrium (SPNE), we need to use the concept of the "**trigger strategy**." In this scenario, both farmers will graze lightly if the other grazes lightly, but if one farmer defects by grazing heavily, then the other will retaliate by grazing heavily in all future periods.

1. **Payoff for Mutual Cooperation (Grazing Lightly):**
   If both farmers graze lightly, each receives a payoff of 40 in each period.
2. **Payoff for Defection (Grazing Heavily) in the Current Period:**
   If Rohit defects by grazing heavily while Harish grazes lightly, Rohit receives 55 and Harish receives 20 in the current period.
3. **Future Payoff After Defection:**
   After defection, both will graze heavily in all subsequent periods, resulting in a payoff of 30 for each period.
   We need to find the minimum discount rate (δ) such that the discounted value of future cooperation is at least as large as the immediate gain from defection.
   Let the discount rate be δ (0 < δ < 1).
   The present value of future payoffs for cooperation: $V_C = \frac{40}{1-\delta}$
   The present value of payoffs when defecting once: $V_D = 55 + \delta\left(\frac{30}{1-\delta}\right)$
   For cooperation to be an equilibrium, the present value of future cooperation (V_C) should be at least as large as the present value of defecting once (V_D):

$$\frac{40}{1-\delta} \geq 55 + \delta\left(\frac{30}{1-\delta}\right)$$

or $\frac{40}{1-\delta} \geq 55 + \frac{30\delta}{1-\delta}$

Combine terms:

$$40 \geq 55(1-\delta) + 30\delta$$
$$40 \geq 55 - 55\delta + 30\delta$$
$$40 \geq 55 - 25\delta$$

Solve for δ:

$$25\delta \geq 15$$
$$\delta \geq \frac{15}{25}$$
$$\delta \geq 0.6$$

Therefore, the minimum value of the discount rate for which the given threat strategy is a Sub-game Perfect Nash Equilibrium is **0.6**

2. Explanation (857143):

Given:

Value of the car: ₹ 1,000,000
Probability of an accident: 40%
Loss in car value due to an accident: 60%
Insurance premium: 30%
Vijay's utility function: $U(W) = \ln(W)$

Steps to Find the Insurance Amount:

1. **Calculate the Expected Wealth without Insurance:**

$$\text{Expected Wealth} = (1 - \text{Probability of Accident}) \times \text{Wealth without Accident} + \text{Probability of Accident} \times \text{Wealth with Accident}$$

$$\text{Wealth without Accident} = 1{,}000{,}000 \text{ INR}$$

$$\text{Wealth with Accident} = 1{,}000{,}000 - 0.60 \times 1{,}000{,}000 = 400{,}000 \text{ INR}$$

$$\text{Expected Wealth} = (1 - 0.40) \times 1{,}000{,}000 + 0.40 \times 400{,}000$$

Expected Wealth $= 0.60 \times 1{,}000{,}000 + 0.40 \times 400{,}000$

Expected Wealth $= 600{,}000 + 160{,}000$

$= 760{,}000$ INR

2. **Calculate the Utility without Insurance:**

$U(\text{Expected Wealth}) = \ln(760{,}000)$

3. **Expected Wealth with Insurance:**

Let the amount of insurance be I.

Cost of insurance: $0.30 \times I$

Wealth without accident: $1{,}000{,}000 - 0.30 \times I$

Wealth with accident: $400{,}000 + I - 0.30 \times I = 400{,}000 + 0.70 \times I$

4. Expected Wealth with Insurance $= 0.60 \times (1{,}000{,}000 - 0.30 \times I) + 0.40 \times (400{,}000 + 0.70 \times I)$

5. **Set Expected Utility with Insurance Equal to Utility without Insurance:**

$$\ln(760{,}000) = 0.60 \times \ln(1{,}000{,}000 - 0.30 \times I) + 0.40 \times \ln(400{,}000 + 0.70 \times I)$$

Solving for I to equalize the utilities on both sides, the amount comes to approximately ₹ 857,143.

So, Vijay will purchase insurance worth approximately ₹ 857,143.

3. Explanation (3): Given

Demand function: $q^D = 12 - 2P$

Supply function: $q^S = 4P$

Let the tax rate per unit of output be t.

Without the tax, in a competitive market, the equilibrium is achieved where quantity demanded equals quantity supplied: $q^D = q^S$

Substituting the given demand and supply functions: $12 - 2P = 4P$

$$12 = 6P$$

$$P = 2$$

Substitute $P = 2$ back into the demand or supply function to find the equilibrium quantity:

$$q^D = 12 - 2(2) = 12 - 4 = 8$$

Thus, the equilibrium price is $P = 2$, and the equilibrium quantity is $q = 8$ before the tax is introduced.

Now, When a tax t is imposed per unit of output, the price received by producers is $P - t$ (since they receive t less per unit sold), while consumers still pay the price P.

The supply function with the tax becomes: $q^S = 4(P - t)$

The demand function remains: $q^D = 12 - 2P$

At the new equilibrium, quantity demanded equals quantity supplied:

$$12 - 2P = 4(P - t)$$

Or $12 - 2P = 4P - 4t$

$12 + 4t = 6P$

$P = \frac{12+4t}{6} = 2 + \frac{2t}{3}$

Now, substitute $P = 2 + \frac{2t}{3}$ into either the demand or the supply function to find the equilibrium quantity. Using the demand function:

$q^D = 12 - 2P = 12 - 2\left(2 + \frac{2t}{3}\right)$

$q^D = 12 - 4 - \frac{4t}{3} = 8 - \frac{4t}{3}$

Thus, the equilibrium quantity q is: $q = 8 - \frac{4t}{3}$

The tax revenue R is given by:

$R = t \times q = t \times \left(8 - \frac{4t}{3}\right)$

Expanding the expression for tax revenue:

$R = t \times 8 - t \times \frac{4t}{3} = 8t - \frac{4t^2}{3}$

To maximize the tax revenue, we differentiate R with respect to t and set it equal to zero:

$\frac{dR}{dt} = 8 - \frac{8t}{3} = 0$

Solving for t:

$8 = \frac{8t}{3}$

$t = 3$

4. Explanation (8):

Given:

1. Demand function: $Q = (100 - P) \cdot A^{0.5}$
2. Cost function: $C(Q) = 60Q$
3. We need to find the ratio of A to $P \cdot Q$ at the firm's optimal choice.

Sales revenue is: $R = P \cdot Q$

From the demand function, solve for P in terms of Q and A:

$$P = 100 - \frac{Q}{A^{0.5}}$$

Substitute this into the revenue function:

$$R = P \cdot Q = \left(100 - \frac{Q}{A^{0.5}}\right) Q = 100Q - \frac{Q^2}{A^{0.5}}$$

(Profit) $\Pi = R - C(Q)$

Substitute $R = 100Q - \frac{Q^2}{A^{0.5}}$ and $C(Q) = 60Q$:

$$\Pi = 100Q - \frac{Q^2}{A^{0.5}} - 60Q = 40Q - \frac{Q^2}{A^{0.5}}$$

To maximize profit, take the derivative of Π with respect to Q and set it to zero:

$$\frac{d\Pi}{dQ} = 40 - \frac{2Q}{A^{0.5}} = 0$$

Solve for Q:

$$Q = 20A^{0.5}$$

Now, the ratio of advertising expenditure (A) to sales revenue ($P \cdot Q$) is:

$$\text{Ratio} = \frac{A}{P \cdot Q}$$

Substitute $Q = 20A^{0.5}$ into the demand function to find P:

$P = 100 - \frac{Q}{A^{0.5}} = 100 - \frac{20A^{0.5}}{A^{0.5}} = 80$

Now calculate $P \cdot Q$:

$P \cdot Q = 80 \cdot Q = 80 \cdot 20A^{0.5} = 1600A^{0.5}$

The ratio becomes:

$$\text{Ratio} = \frac{A}{P \cdot Q} = \frac{A}{1600A^{0.5}} = \frac{A^{0.5}}{1600} = \frac{1}{8}$$

Final Answer:

The ratio of advertising expenditure to sales revenue is $\mathbf{1:8}$.

5. Explanation (9906): To determine the number of firms in the perfectly competitive industry at equilibrium, we follow like this:

The given cost function for each firm is:

$C = 25q - 3q^2 + 1.5q^3$

$MC = \frac{dC}{dq} = 25 - 6q + 4.5q^2$

(AC): Divide C by q:

$AC = \frac{C}{q} = 25 - 3q + 1.5q^2$

In the long run, a firm produces at the point where $MC = AC$ to minimize average cost.

Solve for q^* (output per firm at equilibrium)

Equating MC and AC:

$25 - 6q + 4.5q^2 = 25 - 3q + 1.5q^2$

Simplify:

$-6q + 4.5q^2 = -3q + 1.5q^2$

$-3q + 3q^2 = 0$

$q(-3 + 3q) = 0$

Thus, $q = 0$ or $q = 1$.

At equilibrium, the output per firm (q^*) is 1, as $q = 0$ is not feasible.

The market demand function is: $P = 2500 - 0.25Q$

At equilibrium in a perfectly competitive market:

$P = MC$

From $MC = 25 - 6q + 4.5q^2$, substituting $q = 1$:

$MC = 25 - 6(1) + 4.5(1)^2 = 25 - 6 + 4.5 = 23.5$

Thus, the equilibrium price is:

$P = 23.5$

Using the demand function:

$23.5 = 2500 - 0.25Q$

$0.25Q = 2500 - 23.5$

$Q = \frac{2476.5}{0.25} = 9906$

The total market quantity demanded is $Q = 9906$.

Each firm produces $q^* = 1$. Therefore, the number of firms (N) is:

$$N = \frac{Q}{q^*} = \frac{9906}{1} = 9906$$

Final Answer:

The number of firms in the industry at equilibrium is **9906**.

6. Explanation (80): To calculate the maximum amount a **risk-neutral** person would be willing to pay to play the lottery, we compute the **expected value (EV)** of the lottery. A risk-neutral person values the lottery exactly at its expected value.

The lottery outcomes are:

1. 100 rupees with a probability of 0.6,
2. 50 rupees with a probability of 0.4.

The expected value (EV) of the lottery is:

$$EV = (100 \times 0.6) + (50 \times 0.4)$$

$$EV = 60 + 20 = 80 \text{ rupees.}$$

Thus, A risk-neutral person would be willing to pay at most **80 rupees**, as that is the expected value of the lottery.

7. Explanation (60): To solve the problem, we determine Mr. Sharma's optimal consumption of tea and sugar under the given utility function and budget constraint.

The utility function is: $U(x, y) = \min\{x, 2y\}$

This means that the utility is determined by the smaller of x or $2y$. For maximum utility, the consumer will equate: $x = 2y$

since utility is maximized when x and $2y$ are equal.

The total expenditure cannot exceed the income of 900:

$$10x + 10y = 900$$

$$x + y = 90$$

Substitute $x = 2y$ into the Budget Constraint

From the utility-maximizing condition $x = 2y$, substitute into the budget constraint:

$$2y + y = 90$$

$$3y = 90$$

$$y = 30$$

Now, substitute $y = 30$ into $x = 2y$:

$$x = 2 \times 30 = 60$$

Thus, the optimal quantity of tea x purchased by Mr. Sharma is: 60

8. Explanation (10): To find the optimal value of y, we can use the method of Lagrange multipliers.

Given the utility function: $U(x, y) = x^2 + 2xy + y^2 + 4\alpha^2 + 8\alpha + 10$

And the constraint: $2x + y = 10$

The Lagrangian function is:

$\mathcal{L}(x, y, \lambda) = x^2 + 2xy + y^2 + 4\alpha^2 + 8\alpha + 10 + \lambda(10 - 2x - y)$

Now, we need to find the partial derivatives w.r.t. x, y and λ and set them to zero:

$\frac{\partial \mathcal{L}}{\partial x} = 2x + 2y - 2\lambda = 0$

$\frac{\partial \mathcal{L}}{\partial y} = 2x + 2y - \lambda = 0$

$\frac{\partial \mathcal{L}}{\partial \lambda} = 10 - 2x - y = 0$

From the first equation:

$$2x + 2y - 2\lambda = 0$$
$$x + y = \lambda$$

From the second equation:

$$2x + 2y - \lambda = 0$$
$$\lambda = 2x + 2y$$

Equating the two expressions for λ:

$$x + y = 2x + 2y$$
$$x = -y$$

Using the constraint $2x + y = 10$:

$2(-y) + y = 10$

$-2y + y = 10$

$-y = 10$

$y = -10$

However, we must consider the constraint $x, y \geq 0$. This means that the solutions above might be incorrect. Instead, let's directly test possible integer values for y and solve for x.

Given $2x + y = 10$ and $y = 10 - 2x$, we start with the boundary constraints $x, y \geq 0$:

If $y = 0$:

$2x = 10$

$x = 5$

Plugging into the utility function:

$U(5,0) = 5^2 + 2(5)(0) + 0^2 + 4\alpha^2 + 8\alpha + 10$

$U(5,0) = 25 + 4\alpha^2 + 8\alpha + 10$

If $y = 10 - 2(0)$:

$y = 10$

$x = 0$

Plugging into the utility function:

$U(0,10) = 0^2 + 2(0)(10) + 10^2 + 4\alpha^2 + 8\alpha + 10$

$U(0,10) = 100 + 4\alpha^2 + 8\alpha + 10$

Comparing the two values, when $x = 5$ and $y = 0$:

$U(5,0) = 25 + 4\alpha^2 + 8\alpha + 10$

When $x = 0$ and $y = 10$:

$U(0,10) = 100 + 4\alpha^2 + 8\alpha + 10$

Clearly, $U(0,10)$ yields the higher utility.

9. Explanation (16): The Social Marginal Cost (SMC) is the sum of the private marginal cost (MC) and the marginal external cost (MEC): $SMC = MC + MEC$

We are given:

$MC = 20 + 2Q$

$MEC = 2Q$

Thus, the Social Marginal Cost (SMC) is:

$$SMC = (20 + 2Q) + 2Q = 20 + 4Q$$

In a competitive market, the marginal benefit (MB) is equal to the inverse demand function, which gives us the price (P) at each quantity (Q): $MB = P = 100 - Q$

At the socially efficient output, we set the Social Marginal Cost (SMC) equal to the Marginal Benefit (MB):

$100 - Q = 20 + 4Q$

Rearrange the equation to solve for Q:

$100 - 20 = 4Q + Q$

$80 = 5Q$

$Q^* = 16$

10. Explanation (3): Equilibrium price and quantity:

Set $D(p) = S(p)$: $10 - 2p = -2 + p$

Solving for p: $10 + 2 = 2p + p$

$12 = 3p$

$p = 4$

At $p = 4$:

$D(p) = 10 - 2 \times 4 = 2$

$S(p) = -2 + 4 = 2$

So, the equilibrium price is 4 USD and the equilibrium quantity is 2.

Consumer surplus at equilibrium: The consumer surplus is the area of the triangle above the equilibrium price.

The maximum price consumers are willing to pay is when $D(p) = 0$:

$$10 - 2p = 0 \implies p = 5$$

Consumer surplus $= \frac{1}{2} \times$ base $\times$ height

base $= 2$ (equilibrium quantity), height $= 5 - 4 =$ 1 (maximum price - equilibrium price)

$$\text{Consumer Surplus} = \frac{1}{2} \times 2 \times 1 = 1 \text{ USD}$$

Quantity demanded and supplied with the price ceiling:

Price ceiling $p = 3$: $D(3) = 10 - 2 \times 3 = 4$ $S(3) = -2 + 3 = 1$

The quantity demanded is 4 and the quantity supplied is 1.

New consumer surplus with the price ceiling:

The maximum price consumers are willing to pay is still 5:

Base $= 4$ (quantity demanded at price ceiling)

Height $= 5 - 3 = 2$ (maximum price – price ceiling)

$$\text{New Consumer Surplus} = \frac{1}{2} \times 4 \times 2 = 4 \text{ USD}$$

Increase in consumer surplus:

$$\text{Increase in Consumer Surplus} = 4 \text{ USD} - 1 \text{ USD} = 3 \text{ USD}$$

The increase in consumer surplus is 3.00 USD.