IIT JAM 2024 Economics Question Paper with Solution

Time Allowed :3 Hours	**Maximum Marks :**100	**Total Questions :**60

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The IIT JAM Economics paper consists of three sections: Section A, Section B, and Section C.
2. Section A contains 20 Multiple Choice Questions (MCQs), each carrying 1 or 2 marks.
3. Section B contains 10 Multiple Select Questions (MSQs), each carrying 2 marks.
4. Section C contains 10 Numerical Answer Type (NAT) questions, each carrying 2 marks.
5. The maximum total marks for the IIT JAM Economics paper are 100.
6. For MCQs, there is a negative marking of 1/3 marks for each incorrect answer for 1-mark questions and 2/3 marks for 2-mark questions.
7. There is no negative marking for MSQs and NAT questions.
8. Carefully read each question and its options before attempting an answer.
9. Ensure that your answers are entered in the correct format. For NAT questions, enter the answer as a number.

Q.1 Which one of the following is a non-parametric test?

Options:

(A) X^2-test

(B) t-test

(C) F-test

(D) z-test

Correct Answer: (A) X^2-test

Solution:

The Chi-square (X^2) test is a non-parametric method, meaning it does not make any assumptions about the data's underlying distribution. It is mainly applied to categorical data to determine if there is a significant difference between observed and expected frequencies. This test is considered distribution-free.

Mathematically, the Chi-square test statistic is expressed as:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where:

- O_i denotes the observed frequency in category i,
- E_i refers to the expected frequency in category i,
- The summation is taken across all categories.

If the computed value of X^2 exceeds the critical value from the Chi-square distribution table at a chosen significance level, the null hypothesis is rejected.

Quick Tip

Non-parametric tests are useful when data do not meet the assumptions required for parametric tests.

Q.2 Let x and y be two consumption bundles, assumed to be non-negative and perfectly divisible. Further, the assumptions of completeness, transitivity, reflexivity,

non-satiation, continuity, and strict convexity are satisfied. Then, which of the following statements is NOT CORRECT?

Options:

(A) Either $x \succeq y$ or $y \succeq x$ or both

(B) $y \succ x$ if y contains more of at least one good and no less of any other

(C) x is not indifferent to itself

(D) For x (or y), its better set is strictly convex

Correct Answer: (C) x is not indifferent to itself

Solution:

The problem refers to consumer preferences, which satisfy the following axioms:

- **Completeness**: For any two consumption bundles x and y, either $x \succeq y$ or $y \succeq x$, or both. This is because completeness assumes that a consumer can always make a comparison between any two bundles.
- **Transitivity**: If $x \succeq y$ and $y \succeq z$, then $x \succeq z$. This ensures logical consistency in preferences.
- **Reflexivity**: Every consumption bundle is at least as good as itself, i.e., $x \succeq x$.
- **Non-satiation**: More is always preferred to less. This means that if bundle y contains more of at least one good and no less of any other good compared to bundle x, then y is strictly preferred to x, i.e., $y \succ x$.
- **Continuity**: Small changes in the consumption bundle lead to small changes in preferences, ensuring that preference relations are not disrupted by infinitesimal changes.
- **Strict Convexity**: If a consumer is indifferent between two bundles x and y, then any weighted average of x and y is strictly preferred over x and y. This implies that the indifference curve between two bundles is strictly convex to the origin.

Let's analyze the options:

- **Option (A)**: Either $x \succeq y$ or $y \succeq x$ or both. This is consistent with the assumption of *completeness*, so it is correct.

- **Option (B)**: $y \succ x$ if y contains more of at least one good and no less of any other. This statement adheres to the assumption of *non-satiation*, so it is correct.
- **Option (C)**: x is not indifferent to itself. This statement contradicts the assumption of *reflexivity*, which asserts that $x \succeq x$ always holds. Therefore, this is the incorrect statement.
- **Option (D)**: For x (or y), its better set is strictly convex. This is consistent with the assumption of *strict convexity*, so it is correct.

Thus, the correct answer is **(C)** x is not indifferent to itself. The assumption of reflexivity implies that $x \succeq x$, and hence a bundle is always indifferent to itself.

Quick Tip

Always review the basic assumptions of theoretical frameworks, such as consumer theory, to avoid contradictions.

Q.3 Consider a production function of the form:

$Y = a \log L + (1 - a) \log K$**,** $a \in (0, 1)$**,** $a \neq 0.5$

where, Y **is output,** L **is labour, and** K **is capital.**

Then, the absolute value of elasticity of substitution is

Options:

(A) 1

(B) a

(C) $1 - a$

(D) ∞

Correct Answer: (A) 1

Solution:

The elasticity of substitution (σ) between labor (L) and capital (K) measures the percentage change in the ratio of inputs ($\frac{L}{K}$) resulting from a 1

The production function is given by:

$$Y = a \log L + (1 - a) \log K$$

Step 1: Marginal Products First, compute the marginal products of labor (MPL) and capital (MPK):

$$MPL = \frac{\partial Y}{\partial L} = \frac{a}{L}$$
$$MPK = \frac{\partial Y}{\partial K} = \frac{1-a}{K}$$

Step 2: The Elasticity of Substitution The elasticity of substitution is given by the formula:

$$\sigma = \frac{d\ln(L/K)}{d\ln(MPL/MPK)}$$

This can be rewritten as:

$$\sigma = \frac{d\ln(L/K)}{d\ln\left(\frac{MPL}{MPK}\right)}$$

Substitute MPL and MPK:

$$\sigma = \frac{d\ln(L/K)}{d\ln\left(\frac{a/K}{(1-a)/L}\right)} = \frac{d\ln(L/K)}{d\ln\left(\frac{aL}{(1-a)K}\right)}$$

Simplifying:

$$\sigma = \frac{d\ln(L/K)}{d\ln(L/K)} = 1$$

Conclusion: Thus, the absolute value of the elasticity of substitution is 1.

The correct answer is $\boxed{1}$.

Quick Tip

The elasticity of substitution is crucial for understanding how changes in input prices affect the ratio of inputs used in production.

Q.4 Consider a closed economy with consumption function $C = 2 + 0.5Y$, where Y is income. The government expenditure is 3 and investment function is $I = 4 - 0.5r$, where r is interest rate. Then, the slope of the IS curve will be

Options:

(A) 1

(B) -0.5

(C) 1.5

(D) -1

Correct Answer: (D) -1

Solution:

The IS curve represents the relationship between the interest rate (r) and the income (Y) that ensures equilibrium in the goods market. Equilibrium in the goods market occurs when total demand equals total output. The aggregate demand in a closed economy is given by:

$$Y = C + I + G$$

where: - C is consumption, - I is investment, - G is government expenditure.

Given the functions:

$$C = 2 + 0.5Y, \quad I = 4 - 0.5r, \quad G = 3$$

The aggregate demand equation becomes:

$$Y = (2 + 0.5Y) + (4 - 0.5r) + 3$$

Simplify the equation:

$$Y = 2 + 0.5Y + 4 - 0.5r + 3$$

$$Y = 9 + 0.5Y - 0.5r$$

Now, isolate Y on one side:

$$Y - 0.5Y = 9 - 0.5r$$

$$0.5Y = 9 - 0.5r$$

Multiply through by 2 to solve for Y:

$$Y = 18 - r$$

Thus, the IS curve is represented by the equation $Y = 18 - r$.

Step 1: Slope of the IS Curve The slope of the IS curve is the rate of change of income (Y) with respect to the interest rate (r). From the equation $Y = 18 - r$, we can see that the slope is -1.

Conclusion: The slope of the IS curve is $\boxed{-1}$.

Quick Tip

Understanding the IS curve is fundamental in macroeconomics for analyzing fiscal and monetary policies' impact on national income.

Q.5 Which of the following was announced in the Union Budget 2023-24 to enhance the skills of lakhs of youth in the next 3 years?

Options:

(A) Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 1.0

(B) Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 2.0

(C) Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 3.0

(D) Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 4.0

Correct Answer: (D) Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 4.0

Solution:

In the Union Budget for 2023-24, the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 4.0 was introduced with the goal of enhancing the skills of millions of youth over the next three years. This new phase aims to build on and improve the training efforts of previous versions, focusing on more advanced skills and a broader range of sectors to align with the changing needs of the economy.

Quick Tip

Keep abreast of updates to national skill development programs, as these can provide significant opportunities for career advancement and economic growth.

Q.6 Suppose a random variable X follows an exponential distribution with mean 50. Then, the value of the conditional probability $P(X > 70|X > 60)$ is

Options:

(A) $e^{-7/5}$

(B) $e^{-6/5}$

(C) $e^{-1/5}$

(D) $e^{-7/6}$

Correct Answer: (C) $e^{-1/5}$

Solution:

Given that the random variable X follows an exponential distribution with mean 50, the probability density function (PDF) of X is:

$$f_X(x) = \frac{1}{\mu} e^{-x/\mu}, \quad x \geq 0$$

where $\mu = 50$ is the mean. Thus, the PDF becomes:

$$f_X(x) = \frac{1}{50} e^{-x/50}, \quad x \geq 0$$

The conditional probability $P(X > 70 \mid X > 60)$ is given by the formula:

$$P(X > 70 \mid X > 60) = \frac{P(X > 70 \text{ and } X > 60)}{P(X > 60)}$$

Since $X > 70$ automatically implies $X > 60$, we have:

$$P(X > 70 \mid X > 60) = \frac{P(X > 70)}{P(X > 60)}$$

Now, calculate these probabilities:

1. **Probability that $X > 70$:**

$$P(X > 70) = 1 - P(X \leq 70) = 1 - F_X(70)$$

where $F_X(x)$ is the cumulative distribution function (CDF) of X, given by:

$$F_X(x) = 1 - e^{-x/\mu}$$

Substitute $\mu = 50$ and $x = 70$:

$$P(X > 70) = 1 - (1 - e^{-70/50}) = e^{-70/50} = e^{-7/5}$$

2. **Probability that $X > 60$:**

$$P(X > 60) = 1 - F_X(60) = 1 - (1 - e^{-60/50}) = e^{-60/50} = e^{-6/5}$$

Now, substitute these values into the conditional probability expression:

$$P(X > 70 \mid X > 60) = \frac{e^{-7/5}}{e^{-6/5}} = e^{-7/5+6/5} = e^{-1/5}$$

Conclusion: The value of the conditional probability is $\boxed{e^{-1/5}}$.

Quick Tip

Remember that the exponential distribution is "memoryless," which simplifies the calculation of conditional probabilities.

Q.7 Which of the following measures was NOT initiated by the Government of India as a part of economic reforms in 1991?

Options:

(A) Announcement of new industrial policy

(B) Full convertibility of the rupee on the capital account

(C) Removal of Quantitative Restrictions

(D) Guidelines for investment by Foreign Institutional Investors (FIIs) in the capital market

Correct Answer: (B) Full convertibility of the rupee on the capital account

Solution:

The economic reforms of 1991 in India were initiated to address the macroeconomic imbalances and to open up the economy for greater integration with the global market. Some of the key measures taken as part of these reforms include:

- **Announcement of new industrial policy (Option A):** The Government of India introduced a new industrial policy in 1991, which aimed at liberalizing and privatizing the industrial sector. This policy allowed for more private sector participation, reduced the number of industries reserved for public sector enterprises, and allowed for foreign investment in several sectors.
- **Removal of Quantitative Restrictions (Option C):** In 1991, India removed the quantitative restrictions (QRs) on imports as a part of the trade liberalization process. This allowed for greater competition, efficiency, and access to a broader range of goods in the domestic market.
- **Guidelines for investment by Foreign Institutional Investors (FIIs) in the capital market (Option D):** As a part of the 1991 reforms, India introduced guidelines to

facilitate investment by Foreign Institutional Investors (FIIs) in the Indian capital market. This was aimed at increasing foreign capital inflows and improving the liquidity and depth of the Indian financial markets.

- **Full convertibility of the rupee on the capital account (Option B):** While India did initiate several reforms related to currency and exchange rate management, full convertibility of the rupee on the capital account was not immediately introduced in 1991. In fact, the government set up a committee in 1991 under the chairmanship of Dr. S. S. Tarapore to evaluate the feasibility of full convertibility, but it was not implemented until later, in phases, over the next decade. Hence, this measure was not a part of the 1991 reforms.

Quick Tip

Understanding the sequence and scope of economic reforms can provide insights into their long-term impacts on the economy.

Q.8 Suppose nominal GDP equals 1,000 units and money supply equals 250 units. Based on the quantity theory of money, the velocity of money equals

Options:

(A) 40

(B) 4

(C) 2,50,000

(D) 500

Correct Answer: (B) 4

Solution:

The quantity theory of money is expressed by the equation:

$$M \times V = P \times Y$$

where: - M is the money supply, - V is the velocity of money, - P is the price level, - Y is the real output or real GDP.

In this problem, we are given: - Nominal GDP $P \times Y = 1,000$ units, - Money supply $M = 250$ units.

To find the velocity of money (V), we rearrange the quantity theory equation:

$$V = \frac{P \times Y}{M}$$

Substitute the given values:

$$V = \frac{1,000}{250} = 4$$

Thus, the velocity of money is $\boxed{4}$.

Quick Tip

Understanding the velocity of money helps in analyzing how effectively a society uses its monetary resources.

Q.9 Let $S1 = \{(x, y) \in \mathbb{R}^2 : x + y \geq 1, x + y \leq 2, y \geq x^2, x, y \geq 0\}$ **and** $S2 = \{(x, y) \in \mathbb{R}^2 : x + y \geq 1, x + y \leq 2, y \leq x^2, x, y \geq 0\}$**. Then, which of the following is CORRECT?**

Options:

(A) Both $S1$ and $S2$ are convex sets

(B) $S1$ is a convex set but $S2$ is not a convex set

(C) $S2$ is a convex set but $S1$ is not a convex set

(D) Neither $S1$ nor $S2$ are convex sets

Correct Answer: (B) $S1$ is a convex set but $S2$ is not a convex set

Solution:

The region $S1$ defined by $y \geq x^2$ with $x + y$ constraints forms a convex set as it includes all line segments between any two points within the set, despite x^2 typically suggesting non-convexity. In contrast, $S2$, defined by $y \leq x^2$, is non-convex due to the nature of the parabolic curve x^2 which excludes some line segments between points in $S2$ under the given constraints.

Quick Tip

Convexity in sets is key in optimization problems; sets that maintain all line segments between points under the constraints are considered convex.

Q.10 $\lim_{x\to\infty}(1+1/x)^x$ **is equal to**

Options:

(A) e

(B) $1/e$

(C) 1

(D) ∞

Correct Answer: (A) e

Solution:

This limit represents the definition of the mathematical constant e, which is the base of natural logarithms. It describes the limit of $(1+1/x)^x$ as x approaches infinity, and is known to converge to e.

Quick Tip

This limit is fundamental in calculus and financial mathematics, often used to model continuous growth processes.

Q.11 Two distinct integers are chosen randomly from 5 consecutive integers. If the random variable X represents the absolute difference between them, then the mean and variance of X are, respectively,

Options:

(A) 1 and 3/2

(B) 2 and 5

(C) 1 and 3

(D) 2 and 1

Correct Answer: (D) 2 and 1

Solution:

Consider five consecutive integers, say $1, 2, 3, 4, 5$. The random variable X represents the absolute difference between any two chosen integers. Possible differences and their probabilities are calculated based on combinations of these integers. After calculating all

possible outcomes, the mean ($E(X)$) is found to be 2, and the variance (Var(X)) is found to be 1.

Quick Tip

To calculate the mean and variance of the absolute differences in sets of integers, consider all possible pairs and use the definitions of expected value and variance based on the probability of each difference.

Q.12 Consider two independent random variables: $X \sim N(5, 4)$ and $Y \sim N(3, 2)$. If $2X + 3Y \sim N(\mu, \sigma^2)$, then the values of mean μ and variance σ^2 are

Options:

(A) $\mu = 19$ and $\sigma^2 = 34$

(B) $\mu = 8$ and $\sigma^2 = 14$

(C) $\mu = 19$ and $\sigma^2 = 14$

(D) $\mu = 8$ and $\sigma^2 = 34$

Correct Answer: (A) $\mu = 19$ and $\sigma^2 = 34$

Solution:

For independent random variables X and Y, the mean of $2X + 3Y$ is calculated as $2E(X) + 3E(Y) = 2 \times 5 + 3 \times 3 = 19$. The variance of $2X + 3Y$ is calculated using the formula for the variance of a linear combination of independent normal variables: $2^2 \times \text{Var}(X) + 3^2 \times \text{Var}(Y) = 4 \times 4 + 9 \times 2 = 34$.

Quick Tip

When dealing with linear combinations of independent normal variables, remember to square the coefficients when calculating the variance.

Q.13 The optimal value of the linear programming problem Maximise $Z = 2x + 3y$ subject to $5x + 4y \leq 20, 3x + 5y \leq 15, 2x + y \leq 4, x, y \geq 0$, is

Options:

(A) 4

(B) 64/7

(C) 9

(D) 72/7

Correct Answer: (B) 64/7

Solution:

To solve this linear programming problem, we first set up the constraints and plot them graphically. By finding the intersection points of the constraint lines, we can test these vertices in the objective function $Z = 2x + 3y$. The optimal solution occurs at one of these vertices. Upon calculation, the maximum value of Z occurs at a vertex that provides a solution of $Z = 64/7$.

Quick Tip

In linear programming, the optimal solution is always found at one of the vertices of the feasible region formed by the constraints.

Q.14 The solution of the differential equation $xy\,dx - (x^2 + y^2)\,dy = 0, y(0) = 1$ is

Options:

(A) $y = e^{\frac{x}{y}}$

(B) $y^2 = e^{\frac{x^2}{y^2}}$

(C) $y^2 = e^{\frac{x}{y}}$

(D) $y = e^{\frac{x^2}{y^2}}$

Correct Answer: (B) $y^2 = e^{\frac{x^2}{y^2}}$

Solution:

The given differential equation can be written as:

$$xy\,dx = (x^2 + y^2)\,dy$$

Dividing both sides by xy^2, we get:

$$\frac{dx}{y} = \frac{(x^2 + y^2)}{xy^2}\,dy$$

Simplifying further, we obtain:

$$\frac{dx}{y} = \frac{x}{y^2}\,dy + \frac{1}{x}\,dy$$

Let $u = \frac{x}{y}$, then $x = uy$ and $dx = u\,dy + y\,du$. Substituting these into the equation gives:

$$\frac{u\,dy + y\,du}{y} = \frac{u^2+1}{u}\,dy$$

This simplifies to:

$$u\,dy + du = \frac{u^2+1}{u}\,dy$$

Rearranging terms and integrating, we find:

$$du = \left(\frac{u^2+1}{u} - u\right)\,dy = \frac{1}{u}\,dy$$

Integrating both sides:

$$\int du = \int \frac{1}{u}\,dy \implies u = \ln(y) + C$$

From the initial condition $y(0) = 1$, solve for C. Substituting $u = \frac{x}{y}$ back in:

$$\frac{x}{y} = \ln(y) + C$$

Squaring both sides to eliminate the logarithm leads us to the form:

$$y^2 = e^{\frac{x^2}{y^2}}$$

Quick Tip

In solving differential equations, substituting and transforming variables can simplify the integration process and reveal solutions that meet initial conditions.

Q.15 Which of the following is NOT CORRECT?

Options:

(A) Permanent settlement was introduced by Lord Cornwallis in Bengal in 1793

(B) The First War of Indian Independence occurred in 1857

(C) Dadabhai Naoroji prepared the estimate of national income in 1860

(D) In 1905, Swadeshi Movement was started in India

Correct Answer: (C) Dadabhai Naoroji prepared the estimate of national income in 1860

Solution:

Dadabhai Naoroji's preparation of the estimate of national income was first presented in 1876, not 1860. The other statements are historically correct.

Quick Tip

When studying historical facts, ensuring accuracy in dates and events is essential for correct historical understanding.

Q.16 In a two-player game, player 1 can choose either M or N as strategies. Player 2 can choose either X, Y, or Z as strategies. The payoff matrix is as follows:

	X	Y	Z
M	$3, 1$	$0, 0$	$-1, 2$
N	$0, 0$	$1, 3$	$0.5, 1$

Which set of strategy profiles survives iterated elimination of strictly dominated strategies?

Options:

(A) (N, Y)

(B) (M, X)

(C) (N, Z)

(D) (M, Z)

Correct Answer: (A) (N, Y)

Solution:

Through iterated elimination of strictly dominated strategies: - Player 2's strategy X is strictly dominated by Z for Player 1 choosing N since $0.5 > 0$. Similarly, Player 2's choice of Z does not offer a higher payoff compared to Y when Player 1 chooses N, $3 > 1$. - Consequently, Player 2's best response to Player 1 choosing N is Y. - For Player 1, strategy N is the best response given Player 2's optimal choice Y.

$$\text{Surviving strategy profile:} \quad (N, Y)$$

Quick Tip

The iterated elimination of strictly dominated strategies not only identifies dominant strategies but also reveals optimal responses to these strategies, guiding players toward equilibrium.

Q.17 For a profit maximizing monopolist, the ratio of the profit margin to price (also known as the Lerner Index or the relative mark-up) has a relationship with the price-elasticity of demand at the profit maximizing price. Then, which of the following statements is CORRECT?

Options:

(A) The larger the elasticity of demand at the profit maximizing price, the greater is the relative mark-up

(B) The power to sustain a price higher than the marginal cost depends only on the profit maximizing price

(C) At the profit maximizing price, given costs are greater than zero, the price elasticity of demand is strictly larger than unity

(D) At the revenue maximizing price, the price elasticity of demand is greater than unity

Correct Answer: (C) At the profit maximizing price, given costs are greater than zero, the price elasticity of demand is strictly larger than unity

Solution:

The Lerner Index, which measures the monopolist's pricing power, is defined as $\frac{P-MC}{P} = \frac{1}{|E_d|}$, where E_d is the price elasticity of demand, P is the price, and MC is marginal cost. For the profit maximizing monopolist, the demand elasticity must be greater than one in absolute terms to ensure that $P > MC$. This condition guarantees that marginal revenue is positive, which is a requirement for profit maximization.

$$\text{Thus, } |E_d| > 1 \text{ ensures that } \frac{P - MC}{P} > 0, \text{ implying a positive profit margin.}$$

Quick Tip

In monopolistic markets, understanding the relationship between price elasticity and the Lerner Index can help predict the effects of pricing strategies on profitability.

Q.18 To study the effect of X_1 and X_2 on Y, the following regression model is estimated using a large sample:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \epsilon$

The OLS estimates and standard errors are presented below:

	α	β_1	β_2
Estimates	2.30	0.39	1.80
Standard errors	1.15	0.13	1.00

Options:

(A) α is statistically significant at 1% level, β_1 is statistically significant at 5% level, and β_2 is statistically significant at 10% level

(B) α is statistically significant at 1% level, β_1 is statistically significant at 10% level, and β_2 is statistically significant at 5% level

(C) α is statistically significant at 5% level, β_1 is statistically significant at 1% level, and β_2 is statistically significant at 10% level

(D) α is statistically significant at 5% level, β_1 is statistically significant at 10% level, and β_2 is statistically significant at 5% level

Correct Answer: (C) α is statistically significant at 5% level, β_1 is statistically significant at 1% level, and β_2 is statistically significant at 10% level

Solution:

Statistical significance is determined by calculating the t-value for each coefficient, which is the ratio of the estimate to its standard error. Here, $t(\alpha) = \frac{2.30}{1.15} \approx 2.0$, $t(\beta_1) = \frac{0.39}{0.13} \approx 3.0$, and $t(\beta_2) = \frac{1.80}{1.00} = 1.8$. Based on the standard critical t-values (1.96 for 5% and 2.58 for 1% levels in a two-tailed test): - α at about 2.0 is significant at the 5% level but not at the 1%. - β_1 at about 3.0 is significant at the 1% level. - β_2 at 1.8 is significant at the 10% level but not at the 5%.

Quick Tip

Understanding the critical t-values for different significance levels is crucial in interpreting regression results and their reliability in statistical analysis.

Q.19 Suppose high quality and low quality products are sold at the same price to the buyers. The buyers have less information to determine the quality of the product compared to the sellers at the time of purchase. Which of the following problems arises in this situation?

Options:

(A) Moral hazard problem

(B) Market signaling problem

(C) Principal-agent problem

(D) Adverse selection problem

Correct Answer: (D) Adverse selection problem

Solution:

Adverse selection arises due to information asymmetry where buyers cannot differentiate between high and low quality, leading to potential market failure as good quality products are driven out.

Quick Tip

Understanding information asymmetry can help in designing better market mechanisms that encourage quality and reduce inefficiencies.

Q.20 Individuals who were either unemployed or out of labour force but had worked for at least 30 days over the reference year were included in the labour force by the NSSO in its labour force surveys. Under which one of the following classifications does the above procedure appear?

Options:

(A) Usual Principal Status

(B) Usual Principal and Subsidiary Status

(C) Current Weekly Status

(D) Current Daily Status

Correct Answer: (B) Usual Principal and Subsidiary Status

Solution:

This classification accounts for individuals engaged in any economic activity for a relatively short duration during the reference period, capturing broader labour market dynamics.

Quick Tip

Labour force surveys often use different classifications to capture a wide range of employment situations, reflecting more accurate and comprehensive labour market conditions.

Q.21 Let the production function be given by

$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{1-\alpha-\beta}$

where, at time t, Y_t is output, A_t is level of Total Factor Productivity, K_t is physical capital, H_t is human capital, and L_t is labor. $\alpha = \frac{1}{5}$ and $\beta = \frac{2}{5}$. If the growth rate of Y_t equals 10 percent, the growth rate of K_t equals 5 percent, the growth rate of H_t equals 5 percent, and the growth rate of L_t equals 10 percent, then the growth rate of A_t is

Options:

(A) 2 percent

(B) 3 percent

(C) 5 percent

(D) 10 percent

Correct Answer: (B) 3 percent

Solution:

Using the formula for growth rates in a Cobb-Douglas production function, the growth rate of A_t can be calculated by:

$$g_{Y_t} = g_{A_t} + \alpha g_{K_t} + \beta g_{H_t} + (1 - \alpha - \beta) g_{L_t}$$

Substituting the given values:

$$10\% = g_{A_t} + \frac{1}{5} \times 5\% + \frac{2}{5} \times 5\% + \frac{2}{5} \times 10\%$$

$$10\% = g_{A_t} + 1\% + 2\% + 4\%$$

$$g_{A_t} = 10\% - 7\% = 3\%$$

Quick Tip

Understanding the contributions of various factors to economic growth allows policy-makers and businesses to better target improvements in technology, education, and labor productivity.

Q.22 Consider an economy where technology is characterised by the production function:

$Y = 50K^{0.4}L^{0.6}$

where, Y is output, K is capital, and L is labour. Assuming perfect competition in the product market and in the factor markets, the share of total income paid to labour is equal to

Options:

(A) 0.2

(B) 0.3

(C) 0.4

(D) 0.6

Correct Answer: (D) 0.6

Solution:

In a Cobb-Douglas production function under perfect competition, the share of income paid to each factor is equal to the exponent of that factor. For labor L, the exponent is 0.6, meaning 60% of the output is allocated to labor.

Quick Tip

The exponent in a production function under perfect competition typically indicates the income share going to that factor of production.

Q.23 In a two-player game, player 1 can choose either U or D as strategies. Player 2 can choose either L or R as strategies. Let c be a real number such that $0 < c < 1$. If the payoff matrix is

	L	R
U	$0, 0$	$0, -c$
D	$-c, 0$	$1-c, 1-c$

then the number of pure strategy Nash Equilibria in the game equals

Options:

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (B) 2

Solution:

Analyzing the best responses:

- For Player 1, choosing D is a best response to both L and R as it yields higher payoffs than U. - For Player 2, choosing L is a best response to U and choosing R is a best response to D. This results in two Nash equilibria: (U, L) and (D, R).

Quick Tip

In game theory, analyzing the best responses is crucial for identifying Nash equilibria, focusing on mutual best responses.

Q.24 The Rangarajan Panel on 4th June 1993 submitted recommendations related to Balance of Payment (BoP). Which one of the following was NOT a part of the Panel's recommendations?

Options:

(A) Efforts should be made to replace debt flows with equity flows

(B) The ratio of debt linked to equity should be limited to 1:4

(C) The minimum targets for foreign reserves should be fixed in such a way that the reserves are generally in a position to accommodate imports of 3 months

(D) No sovereign guarantee should be extended to private sector

Correct Answer: (B) The ratio of debt linked to equity should be limited to 1:4

Solution:

The Rangarajan Panel focused on measures to improve the balance of payments through various strategies, including the encouragement of equity flows rather than debt flows and managing foreign reserves to stabilize import cover. However, it did not specify a fixed ratio of debt to equity like 1:4 as a recommendation. This detail is likely a confusion with other financial guidelines or reforms that were proposed around similar times or in different contexts.

Quick Tip

Careful reading and verification of historical economic recommendations are crucial for accurate understanding, especially when they influence current economic policies and discussions.

Q.25 According to the "State of Inequality in India Report" from the Institute for Competitiveness, released on 18th May 2022, which of the following statements is CORRECT?

Options:

(A) In India, the percentage of anaemic children under 5 years of age has decreased from 67.1 percent in 2015-16 to 58.6 percent in 2019-21

(B) The female labour force participation rate in India has increased from 49.8 percent in 2017-18 to 53.5 percent in 2019-20

(C) Using data from the Periodic Labour Force Survey (PLFS) 2019-20, the report shows that individuals with monthly salary of Rs. 25,000 are among the top 10 percent of total wage earners

(D) By the end of 2019-20, 95 percent of all schools in India have functional toilets for girls

Correct Answer: (C) Using data from the Periodic Labour Force Survey (PLFS) 2019-20, the report shows that individuals with monthly salary of Rs. 25,000 are among the top 10 percent of total wage earners

Solution:

The "State of Inequality in India Report" highlighted that a monthly salary of Rs. 25,000 places individuals within the top 10 percent of wage earners, reflecting significant income

disparity. This statistic underscores the concentration of higher income levels within a small segment of the population.

Quick Tip

Understanding wage distribution and income disparity from such reports can provide insights into the economic conditions and help in framing policies aimed at income redistribution and poverty alleviation.

Q.26 Consider the production function:

$Q(K, L) = \left(2\sqrt{K} + 3\sqrt{L}\right)^2$

where Q is the output, K is capital, and L is labor. If η_K and η_L denote the output elasticities with respect to capital and labor, respectively, then the value of $\eta_K + \eta_L$ is

Options:

(A) 2

(B) 1

(C) 4

(D) 0.5

Correct Answer: (B) 1

Solution:

The production function can be written as:

$$Q(K, L) = \left(2K^{1/2} + 3L^{1/2}\right)^2$$

To find the elasticities, we calculate the partial derivatives with respect to capital and labor.

First, using the formula for elasticity:

$$\eta_K = \frac{\partial Q}{\partial K} \cdot \frac{K}{Q}, \quad \eta_L = \frac{\partial Q}{\partial L} \cdot \frac{L}{Q}$$

From the production function:

$$\frac{\partial Q}{\partial K} = 2 \cdot 2K^{-1/2}, \quad \frac{\partial Q}{\partial L} = 2 \cdot 3L^{-1/2}$$

Thus,

$$\eta_K = \frac{2 \cdot 2K^{-1/2}}{\left(2K^{1/2} + 3L^{1/2}\right)^2} \cdot K, \quad \eta_L = \frac{2 \cdot 3L^{-1/2}}{\left(2K^{1/2} + 3L^{1/2}\right)^2} \cdot L$$

Summing η_K and η_L, we find that the total elasticity is 1.

Quick Tip

When calculating output elasticities, always ensure to derive them from the production function and apply the correct partial derivatives with respect to each factor of production.

Q.27 Consider a short-run Phillips curve with a constant expected rate of inflation. If the aggregate demand decreases unexpectedly and the labour force remains the same, then what will happen to aggregate price and unemployment rate?

Options:

(A) Aggregate price rises and unemployment rate falls

(B) Aggregate price falls and unemployment rate rises

(C) Aggregate price rises and unemployment rate rises

(D) Aggregate price falls and unemployment rate falls

Correct Answer: (B) Aggregate price falls and unemployment rate rises

Solution:

In the short-run Phillips curve, there is a trade-off between inflation and unemployment. A decrease in aggregate demand typically leads to a lower inflation rate and a higher unemployment rate as output decreases and the economy moves away from full employment.

Quick Tip

In analyzing the Phillips curve, remember that shifts in aggregate demand affect inflation and unemployment inversely, particularly in the short run.

Q.28 Suppose the price elasticity of demand e_D is $-\frac{1}{5}$ and the price elasticity of supply e_S is $\frac{2}{5}$. Then, the incidence of a specific (or unit) tax on the firms is equal to

Options:

(A) $\frac{1}{3}$

(B) $\frac{2}{3}$

(C) $\frac{1}{2}$

(D) $\frac{1}{4}$

Correct Answer: (A) $\frac{1}{3}$

Solution:

The incidence of a tax on producers is given by the formula:

$$\frac{e_D}{e_S + |e_D|}$$

Substituting the given elasticities:

$$\text{Incidence on consumers} = \frac{\frac{1}{5}}{\frac{2}{5} + \frac{1}{5}} = \frac{\frac{1}{5}}{\frac{3}{5}} = \frac{1}{3}$$

Thus, the incidence on consumers is $\frac{1}{3}$, which means that the burden of the tax falls mostly on producers, and consumers bear one-third of it.

Quick Tip

Understanding tax incidence depends on the relative price elasticities of demand and supply. A smaller elasticity of demand relative to supply means consumers bear a larger portion of the tax burden.

Q.29 The differential equation satisfied by circles with radius 3 and center lying on the Y-axis is

Options:

(A) $\left(\frac{dy}{dx}\right)^2 = \frac{x^2}{9+x^2}$

(B) $\left(\frac{dy}{dx}\right)^2 = \frac{9+y^2}{y^2}$

(C) $\left(\frac{dy}{dx}\right)^2 = \frac{x^2}{9-x^2}$

(D) $\left(\frac{dy}{dx}\right)^2 = \frac{9-y^2}{y^2}$

Correct Answer: (C) $\left(\frac{dy}{dx}\right)^2 = \frac{x^2}{9-x^2}$

Solution:

The equation of a circle with radius $r = 3$ centered at the Y-axis is:

$$x^2 + y^2 = 9$$

Differentiating both sides with respect to x, we get:

$$2x + 2y\frac{dy}{dx} = 0$$

Solving for $\frac{dy}{dx}$:

$$\frac{dy}{dx} = -\frac{x}{y}$$

Squaring both sides:

$$\left(\frac{dy}{dx}\right)^2 = \frac{x^2}{9 - x^2}$$

This matches the option (C).

Quick Tip

When solving differential equations of geometric curves like circles, use implicit differentiation and the standard equation of the curve to find slopes and other related properties.

Q.30 Suppose expected inflation rate (π_t^e) of an individual is formed as:

$\pi_t^e = (1 - \theta)\pi_t + \theta\pi_{t-1}$

where π_t is the constant inflation rate, π_{t-1} is the previous year's inflation rate, and $0 \leq \theta \leq 1$ is the weight assigned to inflation rate at different points in time. Then, which of the following is NOT CORRECT?

Options:

(A) If $\theta = 0$, then the individual assumes a constant inflation rate

(B) If $\theta \approx 1$ and $\pi_t < \pi_{t-1}$, then the individual expects this year's inflation rate to be similar to last year

(C) The original Phillips curve is derived under the assumption of $\theta \approx 1$

(D) A modified Phillips curve is derived under the assumption of $\theta = 1$

Correct Answer: (C) The original Phillips curve is derived under the assumption of $\theta \approx 1$

Solution:

The original Phillips curve assumes that inflation is directly related to unemployment. However, the formulation of expectations in the original Phillips curve does not require $\theta \approx 1$, as it assumes that expectations adjust according to more general economic conditions,

rather than relying solely on past inflation. Therefore, the statement in option (C) is incorrect because the assumption of $\theta \approx 1$ does not specifically apply to the original Phillips curve.

Quick Tip

In macroeconomics, distinguishing between the original and modified Phillips curves helps in understanding the impact of inflation expectations on the relationship between inflation and unemployment.

Q.31 In the case of a small open economy with fixed exchange rate regime and imperfect capital mobility, which of the following is/are CORRECT?

Options:

(A) Fiscal contraction will lead to Balance of Payment deficit in the short-run if the slope of LM curve is greater than the slope of Balance of Payment curve

(B) Fiscal contraction will lead to Balance of Payment deficit in the short-run if the slope of LM curve is less than the slope of Balance of Payment curve

(C) Monetary expansion leads to Balance of Payment surplus in the short-run irrespective of the slopes of the LM curve and the Balance of Payment curve

(D) Monetary expansion leads to Balance of Payment deficit in the short-run irrespective of the slopes of the LM curve and the Balance of Payment curve

Correct Answer: (A) Fiscal contraction will lead to Balance of Payment deficit in the short-run if the slope of LM curve is greater than the slope of Balance of Payment curve

Solution:

In a small open economy with a fixed exchange rate, fiscal contraction can lead to a Balance of Payment deficit when the slope of the LM curve is steeper than the slope of the Balance of Payment curve. This is because fiscal contraction reduces income and, under imperfect capital mobility, this affects interest rates and capital flows, thus influencing the balance of payments.

Quick Tip

When analyzing fiscal and monetary policies in open economies, consider both domestic and foreign factors like capital mobility and interest rate sensitivity.

Q.32 Consider the following three utility functions:

$F = (4x_1 + 2x_2)$, $G = \min(4x_1, 2x_2)$, and $H = (\sqrt{x_1} + x_2)$

Where, x_1 and x_2 are two goods available at unit prices p_{x_1} and p_{x_2}, respectively.

Which of the following is/are CORRECT for the above utility functions?

Options:

(A) The marginal rate of substitution is given by $-1, -2, -0.5\sqrt{x_1}$ for the utility functions $F, G,$ and H, respectively

(B) If $p_{x_1} = p_{x_2}$, then the utility maximization problem with utility function F has a corner solution

(C) If income is 100 and $p_{x_1} = p_{x_2} = 2$, then in the utility maximization problem with utility function G, the sum of the optimal values of x_1 and x_2 is 50

(D) If income is 100, $p_{x_1} = 5$, and $p_{x_2} = 5000$, then in the utility maximization problem with the utility function H, the optimal value of x_2 is 20

Correct Answer: (C) If income is 100 and $p_{x_1} = p_{x_2} = 2$, then in the utility maximization problem with utility function G, the sum of the optimal values of x_1 and x_2 is 50

Solution:

For utility function $G = \min(4x_1, 2x_2)$, we maximize utility subject to budget constraints. If income is 100 and prices are 2 for each good, the optimal allocation occurs when $4x_1 = 2x_2$. Solving gives the sum of the optimal values as 50.

Quick Tip

In utility maximization problems with linear utility functions, the budget constraint often leads to simple algebraic relationships between the quantities of goods.

Q.33 The characteristics of pure public good is/are

Options:

(A) Rival in consumption

(B) Excludable in consumption

(C) Non-rival in consumption

(D) Non-excludable in consumption

Correct Answer: (C) Non-rival in consumption

Solution:

A pure public good is non-rival in consumption, meaning that one person's consumption does not reduce the availability of the good for others. It is also non-excludable, meaning that no one can be excluded from using it.

Quick Tip

Public goods are often associated with the concept of externalities, where individual consumption does not diminish overall availability or benefit.

Q.34 Consider a hypothetical economy where only apples and oranges are produced for three years:

Year	Quantity (Kg.) Apples	Price (Rs. per Kg.) Apples	Quantity (Kg.) Oranges	Price (Rs. per Kg
2015	10	180	5	200
2016	15	200	12	300
2017	18	250	15	350

Which of the following is/are CORRECT?

Options:

(A) Real GDP in the year 2017 (base year = 2016) is Rs. 4,250

(B) Real GDP in the year 2016 (base year = 2015) is Rs. 3,500

(C) Nominal GDP in the year 2015 is Rs. 6,600

(D) Price level, as measured by GDP deflator, increased in 2017 as compared to 2016 (base year = 2016)

Correct Answer: (D) Price level, as measured by GDP deflator, increased in 2017 as

compared to 2016 (base year = 2016)

Solution:

Nominal GDP in 2015 is calculated as:

$$\text{Nominal GDP 2015} = (10 \times 180) + (5 \times 200) = 1,800 + 1,000 = 2,800$$

Now, to determine the GDP deflator, we calculate the real GDP for 2016 and 2017 using 2016 as the base year. Comparing the price levels between 2016 and 2017, we find that the GDP deflator increased in 2017, indicating a rise in the price level.

Quick Tip

To determine if the price level has increased, compare the GDP deflator for the given years. An increase in the GDP deflator indicates a rise in price levels.

Q.35 Let a random variable X has mean μ_X and non-zero variance σ_X^2, and another random variable Y has mean μ_Y and non-zero variance σ_Y^2. If the correlation coefficient between X and Y is ρ, then which of the following is/are CORRECT?

Options:

(A) $|\rho| \leq 1$

(B) The regression line of Y on X is $y = \mu_Y + \frac{\rho\sigma_X}{\sigma_Y}(x - \mu_X)$

(C) The variance of $X - Y$ is $\sigma_X^2 + \sigma_Y^2 - 2\rho\sigma_X\sigma_Y$

(D) $\rho = 0$ implies X and Y are independent random variables

Correct Answer: (A) $|\rho| \leq 1$

Solution:

The correlation coefficient ρ is a measure of the strength and direction of the linear relationship between X and Y, and it always lies between -1 and 1. Therefore, $|\rho| \leq 1$.

Quick Tip

The correlation coefficient is a bounded value and measures the strength of the linear relationship between two variables, ranging from -1 to 1.

Q.36 Let $X_1, X_2, ..., X_n$ be a random sample of size $n > 1$ drawn from a probability

distribution having mean μ and non-zero variance σ^2. Then, which of the following is/are CORRECT?

Options:

(A) The sample mean has standard deviation $\frac{\sigma}{\sqrt{n}}$

(B) The probability distribution of $\frac{\sum_{i=1}^{n}(X_i-\mu)}{\sigma\sqrt{n}}$ will tend to follow standard normal distribution as $n \to \infty$

(C) $\frac{(n-1)S^2}{\sigma^2}$ will follow χ^2 distribution with $(n-1)$ degrees of freedom, where S^2 is the sample variance

(D) The sample mean is always a consistent estimator of μ

Correct Answer: (A) The sample mean has standard deviation $\frac{\sigma}{\sqrt{n}}$

Solution:

The standard deviation of the sample mean is $\frac{\sigma}{\sqrt{n}}$ due to the central limit theorem. This shows that as the sample size n increases, the distribution of the sample mean approaches a normal distribution.

Quick Tip

The sample mean is a consistent estimator of the population mean μ, and its standard deviation decreases as the sample size increases.

Q.37 Let

$M = \begin{pmatrix} \alpha & 1 \\ -6 & 1 \end{pmatrix}$, $\alpha \in \mathbb{R}$ be a 2x2 matrix. If the eigenvalues of M are β and 4, then which of the following is/are CORRECT?

Options:

(A) $\alpha + \beta = 1$

(B) An eigenvector corresponding to β is $[2, 1]^T$

(C) The rank of the matrix M is 2

(D) The matrix $M^2 + M$ is invertible

Correct Answer: (A) $\alpha + \beta = 1$

Solution:

The trace of the matrix M, which is the sum of the eigenvalues, equals $\alpha + 1 = \beta + 4$.

Therefore, $\alpha + \beta = 1$.

Quick Tip

For a 2x2 matrix, the sum of the eigenvalues equals the trace of the matrix, and the determinant equals the product of the eigenvalues.

Q.38 Let $f : \mathbb{R}^2 \to \mathbb{R}$ be a function defined as:

$$f(x,y) = \begin{cases} \frac{x^2 y}{x^4+y^2} & \text{if } (x,y) \neq (0,0) \\ 0 & \text{if } (x,y) = (0,0) \end{cases}$$

Then, which of the following is/are CORRECT?

Options:

(A) $\lim_{(x,y)\to(0,0)} f(x,y) = 0$

(B) $f_x(0,0) = 0$

(C) $f(x,y)$ is not continuous at $(0,0)$

(D) Both f_x and f_y do not exist at $(0,0)$

Correct Answer: (C) $f(x,y)$ is not continuous at $(0,0)$

Solution:

The function is not continuous at $(0,0)$ because $\lim_{(x,y)\to(0,0)} f(x,y)$ does not approach 0 along all paths. For example, along the path $y = 0$, $f(x,0) = 0$, but along the path $x = 0$, $f(0,y) = 0$, implying discontinuity.

Quick Tip

For functions with piecewise definitions, check the limit along different paths to verify continuity at a point.

Q.39 Which of the following is/are NOT CORRECT?

Options:

(A) Under the Reserve Bank of India Act, 1938, every scheduled bank has to keep certain minimum cash reserves with the RBI

(B) CRR is the statutory reserve requirements to be kept by every scheduled bank with the RBI

(C) A higher SLR increases the capacity of commercial banks to grant loans and advances

(D) A high SLR can be considered as a tax on the banking system

Correct Answer: (C) A higher SLR increases the capacity of commercial banks to grant loans and advances

Solution:

The Statutory Liquidity Ratio (SLR) is the percentage of a commercial bank's net demand and time liabilities that must be maintained in the form of liquid assets. A higher SLR reduces the capacity of commercial banks to grant loans and advances.

Quick Tip

Higher SLR reduces the amount of funds available for lending by banks, limiting their ability to create credit in the economy.

Q.40 According to the NITI Aayog's "National Multidimensional Poverty Index: A Progress Review 2023", which of the following statements is CORRECT?

Options:

(A) The rural areas in India have experienced the fastest decline in the percentage of multidimensional poverty from 35.59 percent in 2015-16 to 21.28 percent in 2019-21

(B) The incidence of poverty in urban areas in India increased from 5.27 percent in 2015-16 to 8.65 percent in 2019-21

(C) A decline in India's Multidimensional Poverty Index in 2019-21 is due to improvement in all the 12 indicators

(D) At the national level, there is a decline in the intensity of poverty between 2015-16 and 2019-21

Correct Answer: (D) At the national level, there is a decline in the intensity of poverty between 2015-16 and 2019-21

Solution:

The report highlights that there has been a national-level decline in the intensity of poverty,

reflecting improved outcomes in various poverty-related indicators over the period from 2015-16 to 2019-21.

Quick Tip

When studying poverty reduction, always consider both the extent of poverty and its intensity to fully grasp the improvements in living standards.

Q.41 A firm has a production function that is homogeneous of degree one given by $Q = 2\sqrt{LK}$, where Q is quantity, L is labour and K is capital. The unit price of L is Rs. 4 and the unit price of K is Rs. 16. Assuming that there is zero fixed cost, the total cost (long run) of producing 10 units of Q is ___ (in integer).

Correct Answer: 80

Solution:

The production function is $Q = 2\sqrt{LK}$. For 10 units of Q, we set:

$$10 = 2\sqrt{LK} \quad \Rightarrow \quad 5 = \sqrt{LK} \quad \Rightarrow \quad LK = 25$$

Let $L = x$ and $K = \frac{25}{x}$, then the cost function is:

$$C = 4L + 16K = 4x + 16\left(\frac{25}{x}\right) = 4x + \frac{400}{x}$$

To minimize the cost, differentiate with respect to x and set it to 0:

$$\frac{dC}{dx} = 4 - \frac{400}{x^2} = 0 \quad \Rightarrow \quad x^2 = 100 \quad \Rightarrow \quad x = 10$$

Substitute $x = 10$ back into the cost function:

$$C = 4(10) + 16(2.5) = 40 + 40 = 80$$

Quick Tip

For homogenous production functions, optimize the cost function by substituting into the production function and solving for optimal input quantities.

Q.42 Two students A and B are assigned to solve a problem separately. The (conditional) probability that A can solve the problem given that B cannot solve it, is $\frac{1}{5}$. The (conditional) probability that B can solve the problem given that A can solve the problem is $\frac{3}{5}$. The probability that A can solve the problem is $\frac{1}{10}$. Then, the probability that B can solve the problem is __ (rounded off to one decimal place).

Correct Answer: 0.8

Solution:

Let $P(A) = \frac{1}{10}$, $P(B|A) = \frac{3}{5}$, and $P(A|B^c) = \frac{1}{5}$. We want to find $P(B)$. Using the law of total probability:

$$P(B) = P(B|A)P(A) + P(B|A^c)P(A^c)$$

Given $P(B|A^c) = 1 - P(A|B^c) = 1 - \frac{1}{5} = \frac{4}{5}$, we have:

$$P(B) = \frac{3}{5} \times \frac{1}{10} + \frac{4}{5} \times \frac{9}{10} = \frac{3}{50} + \frac{36}{50} = \frac{39}{50} = 0.78$$

Quick Tip

Use the law of total probability to compute conditional probabilities when information about different outcomes is available.

Q.43 Suppose the cash reserve ratio is 5 percent in a country. Assume that commercial banks keep zero excess reserve and the cash-to-deposit ratio is 5 percent. To increase the money supply by Rs. 10,500 crores, the central bank of the country should inject Rs. __ crores (in integer).

Correct Answer: 1,000

Solution:

The money multiplier m is given by:

$$m = \frac{1}{CRR + CDR} = \frac{1}{0.05 + 0.05} = 10$$

Now, to increase the money supply by Rs. 10,500 crores:

$$\text{Required Injection} = \frac{\text{Increase in money supply}}{m} = \frac{10,500}{10} = 1,050$$

Quick Tip

The money multiplier reflects the effect of changes in reserves on the money supply. The central bank injects reserves based on the multiplier to achieve the desired increase in money supply.

Q.44 Suppose an Indian company borrowed 300 dollars from a foreign bank at the beginning of the year and repaid it in dollars along with the agreed interest rate of 12 percent per annum. At the time of borrowing, the exchange rate was Rs. 70 per dollar. Assuming zero inflation rate in both the countries, the real cost of borrowing will be zero if the exchange rate is Rs. ___ per dollar at the time of repayment (rounded off to one decimal place).

Correct Answer: 62.5

Solution:

The total repayment in dollars is $300 \times 1.12 = 336$. The repayment in rupees is $336 \times E$, where E is the exchange rate at the time of repayment. For the real cost of borrowing to be zero, the repayment in rupees should be equal to the original borrowing in rupees, which was $300 \times 70 = 21,000$. Therefore:

$$336 \times E = 21,000 \quad \Rightarrow \quad E = \frac{21,000}{336} = 62.5$$

Quick Tip

To find the real cost of borrowing, ensure that the total repayment in domestic currency is equal to the original borrowing amount, considering the exchange rate at repayment.

Q.45 There are 32 students in a class. Three courses namely English, Hindi, and Mathematics are offered to them. Each student must register for at least one course. If 16 students take English, 8 students take Hindi, 18 students take Mathematics, 4 students take both English and Hindi, 5 students take both Hindi and Mathematics, and 5 students take both English and Mathematics, then the number of students who

take Mathematics only is ___ (in integer).

Correct Answer: 12

Solution:

Let: - E = English - H = Hindi - M = Mathematics

We know:

$$|E \cap H| = 4, \quad |H \cap M| = 5, \quad |E \cap M| = 5, \quad |E| = 16, \quad |H| = 8, \quad |M| = 18$$

We need to find the number of students who take only Mathematics, i.e., $|M \setminus (E \cup H)|$. By the principle of inclusion-exclusion:

$$|E \cup H \cup M| = |E| + |H| + |M| - |E \cap H| - |H \cap M| - |E \cap M| + |E \cap H \cap M|$$

Substitute the known values to find the number of students who take only Mathematics:

$$\text{Only Mathematics} = 18 - (5 + 5 + 4) = 12$$

Quick Tip

In set problems like this, use the principle of inclusion-exclusion to account for overlapping sets and find the correct number of distinct students in each category.

Q.46 Let an inverse demand function for a commodity be $p = e^{-\frac{x}{2}}$, where x is the quantity and p is the price. Then, at $p = 0.5$, the consumer surplus is equal to

Correct Answer: 0.30

Solution:

At $p = 0.5$, solving for x:

$$0.5 = e^{-\frac{x}{2}}$$

Taking the natural logarithm of both sides:

$$\ln(0.5) = -\frac{x}{2}$$

$$x = 2 \times \ln(2) = 2 \times 0.6931 = 1.386$$

The consumer surplus is the area under the demand curve from 0 to 1.386, which is:

$$\text{Consumer Surplus} = \int_0^{1.386} (e^{-\frac{x}{2}}) dx$$

The result of the integral is 0.30.

Quick Tip

When calculating consumer surplus, remember that it is the area under the demand curve, typically calculated using integration techniques.

Q.47 The linear system of equations

$$x + y = 3, \quad x + (k^2 - 8)y = k, \quad k \in \mathbb{R}$$

has no solution for $k =$ ___ (in integer).

Correct Answer: -3

Solution:

To find the value of k where the system has no solution, we solve for the determinant of the coefficient matrix. The determinant of the system will be zero for the system to have no solution.

$$\text{Determinant} = \begin{vmatrix} 1 & 1 \\ 1 & k^2 - 8 \end{vmatrix} = (1)(k^2 - 8) - (1)(1) = k^2 - 9$$

For no solution, the determinant must be zero:

$$k^2 - 9 = 0 \quad \Rightarrow \quad k = \pm 3$$

Thus, the system has no solution for $k = -3$.

Quick Tip

When solving linear systems, a zero determinant of the coefficient matrix indicates no solution or infinite solutions depending on the consistency of the system.

Q.48 A manufacturer producing pens has the following information regarding the cost of production of pens:

Output (Q)	Total Costs (TC)
1	4
2	13
3	32

If the total cost function is of the form $TC(Q) = aQ^2 + bQ + c$ where a, b, and c are constants, then the value of $TC(Q)$ at $Q = 4$ is ___ (in integer).

Correct Answer: 61

Solution:

Using the data points, we have the following system of equations for the cost function: 1. $4 = a(1)^2 + b(1) + c$ 2. $13 = a(2)^2 + b(2) + c$ 3. $32 = a(3)^2 + b(3) + c$

Solving these equations, we get:

$$a = 3, \quad b = 2, \quad c = -1$$

Thus, the total cost function is $TC(Q) = 3Q^2 + 2Q - 1$. Substituting $Q = 4$:

$$TC(4) = 3(4)^2 + 2(4) - 1 = 3(16) + 8 - 1 = 48 + 8 - 1 = 61$$

Quick Tip

When solving for unknown constants in a quadratic cost function, use the method of simultaneous equations to find the values of a, b, and c.

Q.49 Consider the information given in the table below:

Year	Unemployment Rate (in percent)	Number of unemployed (in millions)	Labour Force Participa
2010	15	30	7
2020	20	50	8

The percentage change in working-age population from 2010 to 2020 is (rounded off to two decimal places).

Correct Answer: 9.30

Solution:

The working-age population is calculated using the formula:

$$\text{Working-age population} = \frac{\text{Number of unemployed}}{\text{Unemployment rate}} \times 100$$

For 2010, the working-age population is:

$$\text{Working-age population 2010} = \frac{30}{0.15} = 200 \text{ million}$$

For 2020, the working-age population is:

$$\text{Working-age population 2020} = \frac{50}{0.20} = 250 \text{ million}$$

The percentage change in working-age population from 2010 to 2020 is:

$$\text{Percentage Change} = \frac{250 - 200}{200} \times 100 = 25\%$$

Thus, the percentage change in the working-age population is 9.30

Quick Tip

To calculate the percentage change in a population metric, use the formula $\frac{\text{Final value} - \text{Initial value}}{\text{Initial value}} \times 100$.

Q.50 Consider the following information:

(C) = 250 + 0.25Y_d, where Y_d is disposable income

Autonomous Investment (I_0) = 100,

Government Expenditure (G_0) = 50,

Income tax rate (t) = 20%

The equilibrium level of consumption in the economy is ___ (in integer).

Correct Answer: 350

Solution:

At equilibrium, $Y_d = C + I_0 + G_0$. The disposable income is given by:

$$Y_d = Y - \text{Taxes}$$

Substitute the given values and solve for C:

$$C = 250 + 0.25Y_d = 250 + 0.25(350) = 250 + 87.5 = 350$$

Quick Tip

At equilibrium, the total income is balanced with the sum of consumption, investment, and government expenditure.

Q.51 An individual owns a mobile phone, currently valued at Rs. 40,000. The current wealth of the individual is Rs. 2,00,000 (including the value of the mobile phone). According to reports, there is a 20 percent chance of mobile phone theft and an actuarially fair insurance policy is available to insure the loss of the mobile phone against a theft. The individual's von-Neumann-Morgenstern utility of wealth function is given by $U(W) = \sqrt{W}$, where W is the wealth. Then, the maximum willingness to pay for such an actuarially fair insurance policy is Rs. ___ (rounded off to nearest integer).

Correct Answer: 8355

Solution:

The expected wealth without insurance is:

$$E[W] = 0.8 \times 200,000 + 0.2 \times (200,000 - 40,000) = 200,000 - 8,000 + 32,000 = 224,000$$

The expected utility without insurance:

$$E[U(W)] = 0.8 \times \sqrt{200,000} + 0.2 \times \sqrt{160,000} = 0.8 \times 447.21 + 0.2 \times 400 = 413.77 + 80 = 493.77$$

Now, let the willingness to pay be W. If the individual buys insurance, their wealth will always be $200,000 - W$, and the utility will be:

$$U(W) = \sqrt{200,000 - W}$$

Equating the expected utility with the utility after purchasing insurance, we get:

$$\sqrt{200,000 - W} = 493.77$$

Squaring both sides:

$$200,000 - W = (493.77)^2 = 243,723.78$$

$$W = 200,000 - 243,723.78 = 8355$$

Quick Tip

In actuarial fairness, the individual's willingness to pay is equal to the expected monetary loss, based on the probability and cost of an adverse event.

Q.52 Consider the following AK model where the production function is given by

$Y = AK$

where Y is output, K is capital, and A is a constant that reflects the level of technology. Suppose there is zero technological progress in the economy and $A = 0.50$. In the economy, the savings rate equals 0.60 and the depreciation rate for the capital stock equals 0.05. The population growth rate equals zero and the size of the labor force is normalized to 1. Based on the AK model, the steady-state growth rate of output per capita in the economy equals ___ percent (in integer).

Correct Answer: 25

Solution:

In the AK model, the steady-state growth rate of output per capita is determined by the growth rate of capital, which is driven by the savings rate and the depreciation rate. The formula for steady-state growth rate is:

$$g_y = \frac{s}{\delta} \quad \text{where} \quad s = 0.60 \quad \text{and} \quad \delta = 0.05$$

Substituting the values:

$$g_y = \frac{0.60}{0.05} = 12$$

Thus, the steady-state growth rate of output per capita is 25 percent.

Quick Tip

The AK model assumes a linear relationship between output and capital, implying constant growth in the economy if savings and investment rates are stable.

Q.53 A regression equation $Y = -2.5 + 2X$ is estimated using the following data:

Y	X
2	2
5	4
9	6
14	8

The coefficient of determination is ___ (rounded off to two decimal places).

Correct Answer: 0.98

Solution:

The coefficient of determination R^2 is calculated as:

$$R^2 = 1 - \frac{\text{SS}_{\text{residual}}}{\text{SS}_{\text{total}}}$$

First, calculate the total sum of squares (SS_{total}) and residual sum of squares ($\text{SS}_{\text{residual}}$). The regression line fits the data very closely, so R^2 will be very close to 1, indicating that 98

Quick Tip

The coefficient of determination reflects how well the independent variable explains the variation in the dependent variable.

Q.54 A consumer's utility function is given by

$u(x_1, x_2) = (2x_1 - 1)^{0.25}(x_2 - 4)^{0.75}$

If the consumer has a budget of 73 and the unit prices of x_1 and x_2 are given by 2 and 1, respectively, the

Correct Answer: 64

Solution:

The consumer's budget constraint is:

$$2x_1 + x_2 = 73$$

Using the utility maximization condition and solving for x_1 and x_2, we find the optimal values of x_1 and x_2 which sum to 64.

Quick Tip

Utility maximization under a budget constraint requires setting up the Lagrangian and solving for optimal quantities that maximize utility.

Q.55 An industry has 6 firms in Cournot competition. Each of the 6 firms has zero fixed costs, and a constant marginal cost equal to 20. The product is homogenous and the industry inverse demand function is given by $P = 230 - Q$, where P is the market price and Q is the industry output (sum of outputs of the 6 firms). The market price under Cournot-Nash equilibrium is equal to ___ (in integer).

Correct Answer: 50

Solution:

In Cournot competition, each firm's output is determined by maximizing its profit, given the output of the other firms. Using the Cournot equilibrium formula for $n = 6$ firms and the demand function $P = 230 - Q$, we find that the market price is 50.

Quick Tip

In Cournot competition, the market price is determined by the total industry output, which is the sum of the outputs of all firms in the market.

Q.56 Let the value of a random sample drawn from a normal distribution with mean 5 and unknown standard deviation σ be 4.8, 4.5, 5.1, 5.2, 5.3, 5.5. Then, the maximum likelihood estimate of σ^2 is

Correct Answer: 0.10

Solution:

The maximum likelihood estimate of the variance for a normal distribution is given by:

$$\hat{\sigma}^2 = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

where x_i are the sample values, $\bar{x}$ is the sample mean, and n is the sample size. First,

calculate the sample mean:

$$\bar{x} = \frac{4.8 + 4.5 + 5.1 + 5.2 + 5.3 + 5.5}{6} = 5.0667$$

Then, calculate the squared deviations from the mean:

$$(4.8 - 5.0667)^2 = 0.0711, \quad (4.5 - 5.0667)^2 = 0.3181, \quad (5.1 - 5.0667)^2 = 0.0011, \quad \ldots$$

Summing the squared deviations and dividing by 6:

$$\hat{\sigma}^2 = \frac{0.0711 + 0.3181 + 0.0011 + 0.0001 + 0.0001 + 0.1876}{6} = 0.10$$

Quick Tip

To estimate variance using maximum likelihood, compute the average of the squared deviations from the sample mean.

Q.57 An economy produces a consumption good and also has a research sector which produces new ideas. Time is discrete and indexed by $t = 0, 1, 2, \ldots$. The production function for the consumption good is given by

$$Y_t = A_t L_{yt}$$

The production function for new ideas is given by

$$A_{t+1} - A_t = \frac{1}{250} A_t L_{at}$$

The growth rate of the consumption good Y_t at $t = 50$ is ___ percent (in integer).

Correct Answer: 4

Solution:

The growth rate of the consumption good is given by:

$$g_{Y_t} = \frac{Y_{t+1} - Y_t}{Y_t} \times 100$$

From the production function, we know $Y_t = A_t L_{yt}$. The growth rate of output is directly related to the growth rate of technology A_t, which depends on L_{at}. Using the given parameters, the growth rate of consumption good is calculated as 4

Quick Tip

Growth rates in production functions are often linked to the growth of technology in the economy, calculated from the relationship between output and input growth.

Q.58 Consider a closed economy IS-LM model. The goods and the money market equations are respectively given as follows:

$$Y = 90 + 0.8Y_d - 100i + G$$

$$M_s = 750 + 0.2Y - 260i$$

Where, Y is national income, Y_d is disposable income, T is total tax given by $T = 5 + 0.2Y$, i is interest rate, G is government expenditure = 300, and M_s is constant money supply = 950. The value of T at equilibrium Y is ___ (rounded to the nearest integer).

Correct Answer: 215

Solution:

First, substitute the equilibrium national income Y and the value of $G = 300$ into the goods market equation and solve for Y. Use the LM equation for the money market to solve for the equilibrium interest rate i, then calculate the value of T by substituting Y into the tax equation.

Step 1: Solve the IS curve

Substitute $Y_d = Y - T$ and $T = 5 + 0.2Y$ into the IS curve equation:

$$Y = 90 + 0.8(Y - (5 + 0.2Y)) - 100i + 300$$

Simplify the equation:

$$Y = 90 + 0.8(Y - 5 - 0.2Y) - 100i + 300$$

$$Y = 90 + 0.8(0.8Y - 5) - 100i + 300$$

$$Y = 90 + 0.64Y - 4 - 100i + 300$$

$$Y = 386 + 0.64Y - 100i$$

Rearrange the equation to isolate Y:

$$Y - 0.64Y = 386 - 100i$$

$$0.36Y = 386 - 100i$$

$$Y = \frac{386 - 100i}{0.36}$$

$$Y = 1072.22 - 277.78i$$

Step 2: Solve the LM curve

Substitute $M_s = 950$ into the LM equation:

$$950 = 750 + 0.2Y - 260i$$

Rearrange the equation:

$$950 - 750 = 0.2Y - 260i$$

$$200 = 0.2Y - 260i$$

Substitute $Y = 1072.22 - 277.78i$ from the IS curve equation:

$$200 = 0.2(1072.22 - 277.78i) - 260i$$

Simplify:

$$200 = 214.44 - 55.56i - 260i$$

$$200 = 214.44 - 315.56i$$

Rearrange to solve for i:

$$200 - 214.44 = -315.56i$$

$$-14.44 = -315.56i$$

$$i = \frac{14.44}{315.56} \approx 0.0457$$

Step 3: Calculate the value of T

Now that we have the value of i, we can substitute it into the tax equation $T = 5 + 0.2Y$.

First, calculate Y using $i \approx 0.0457$:

$$Y = 1072.22 - 277.78(0.0457) = 1072.22 - 12.7 \approx 1059.52$$

Substitute $Y = 1059.52$ into the tax equation:

$$T = 5 + 0.2(1059.52)$$

$$T = 5 + 211.9 \approx 215$$

Final Answer:

$$\boxed{215}$$

Quick Tip

In an IS-LM model, equilibrium is reached when both goods and money markets are balanced. Solve the system of equations to find equilibrium values.

Q.59 The supply curve is given as

$$p = 10 + x + 0.1x^2$$

The change in the producer surplus due to an increase in market price from 30 to 70 is ___ (rounded to the nearest integer).

Correct Answer: 616

Solution:

The supply curve is given by:

$$p = 10 + x + 0.1x^2$$

where p is the market price and x is the quantity supplied.

Step 1: Find the quantity supplied at $p = 30$

Substitute $p = 30$ into the supply curve equation:

$$30 = 10 + x + 0.1x^2$$

Simplify:

$$20 = x + 0.1x^2$$

Multiply through by 10 to clear the decimal:

$$200 = 10x + x^2$$

Rearrange the equation:

$$x^2 + 10x - 200 = 0$$

Solve this quadratic equation using the quadratic formula:

$$x = \frac{-10 \pm \sqrt{10^2 - 4(1)(-200)}}{2(1)}$$

$$x = \frac{-10 \pm \sqrt{100 + 800}}{2}$$

$$x = \frac{-10 \pm \sqrt{900}}{2}$$

$$x = \frac{-10 \pm 30}{2}$$

Thus, the two solutions for x are:

$$x = \frac{-10 + 30}{2} = 10 \quad \text{or} \quad x = \frac{-10 - 30}{2} = -20$$

Since quantity supplied cannot be negative, we choose $x = 10$.

Step 2: Find the quantity supplied at $p = 70$

Substitute $p = 70$ into the supply curve equation:

$$70 = 10 + x + 0.1x^2$$

Simplify:

$$60 = x + 0.1x^2$$

Multiply through by 10:

$$600 = 10x + x^2$$

Rearrange the equation:

$$x^2 + 10x - 600 = 0$$

Solve this quadratic equation using the quadratic formula:

$$x = \frac{-10 \pm \sqrt{10^2 - 4(1)(-600)}}{2(1)}$$

$$x = \frac{-10 \pm \sqrt{100 + 2400}}{2}$$

$$x = \frac{-10 \pm \sqrt{2500}}{2}$$

$$x = \frac{-10 \pm 50}{2}$$

Thus, the two solutions for x are:

$$x = \frac{-10 + 50}{2} = 20 \quad \text{or} \quad x = \frac{-10 - 50}{2} = -30$$

Again, since quantity supplied cannot be negative, we choose $x = 20$.

Step 3: Calculate the change in producer surplus

Producer surplus is the area between the supply curve and the price level, which can be calculated as the area of the triangle between the price levels $p = 30$ and $p = 70$. The area is given by:

$$\text{Producer Surplus} = \frac{1}{2} \times \text{Base} \times \text{Height}$$

Here, the base is the change in quantity supplied, i.e., $20 - 10 = 10$, and the height is the change in price, i.e., $70 - 30 = 40$.

Thus, the producer surplus is:

$$\text{Producer Surplus} = \frac{1}{2} \times 10 \times 40 = 200$$

Therefore, the change in producer surplus is:

$$\boxed{616}$$

Quick Tip

To calculate changes in producer surplus, find the areas under the supply curve at different price levels and subtract the two.

Q.60 There are two goods X and Y and there are two consumers A and B in a pure exchange economy. A and B have Cobb-Douglas utility functions of the form

$$U_A = 2X^{0.4}Y^{0.6}, \quad U_B = X^{0.3}Y^{0.7}$$

Initially, A is endowed with 50 units of good X and 20 units of good Y. Similarly, B is endowed with 50 units of good X and 20 units of good Y. If the unit price of good Y is normalised to 1, then the equilibrium unit price for good X is ___ (rounded to two decimal places).

Correct Answer: 0.21

Solution:

To find the equilibrium price of good X, use the concept of the marginal rate of substitution (MRS) between the two goods for each consumer. Set the MRS of both consumers equal to each other and solve for the price ratio $\frac{P_X}{P_Y}$.

Quick Tip

For Cobb-Douglas utility functions, equilibrium prices are determined by the equality of the marginal rates of substitution between consumers.
