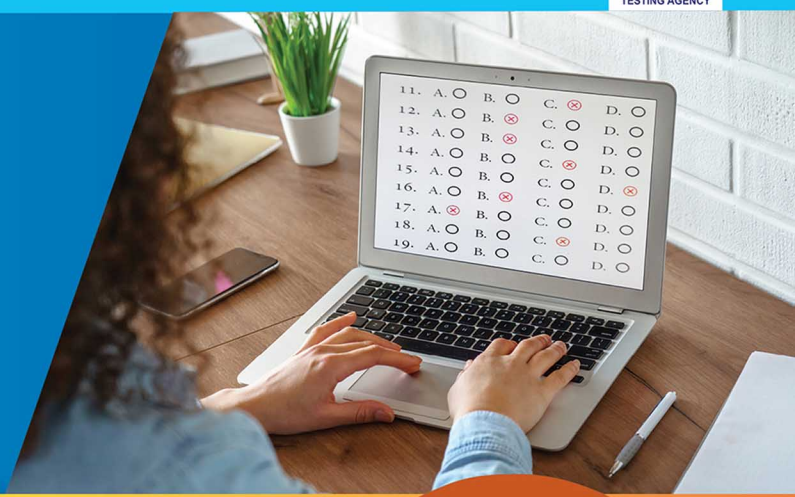
SAMPLE CONTENT

10 PRACTICE PAPER SET

IN ACCORDANCE WITH THE LATEST CUET (UG) PAPER CONDUCTED BY NATIONAL TESTING AGENCY

CUET (UG)

Common University Entrance Test



APPLIED MATHEMATICS

Section - II
(A & B2)
CODE: 319

Features:

- Based on the notified syllabus prescribed by NTA
- Smart keys provided to crack question efficiently
- Includes Quick Revision of Important Concepts
- Covers a variety of questions:
  - Passage / Case - Study Based Questions
  - Assertion and Reason type Questions
  - Statement Based Questions
  - Match the Columns

Target Publications® Pvt. Ltd.

10 PRACTICE PAPER SET

CUET (UG)

(Common University Entrance Test)

APPLIED MATHEMATICS

Section - II (A & B2)

SALIENT FEATURES:

- Created as per the syllabus prescribed by **NTA**
- In accordance with the latest CUET (UG) Paper conducted by **NTA**
- Set of 10 full length Question Papers with Answers and Solutions
- Exhaustive coverage of all types of questions based on the latest CUET (UG) question paper
- **Smart Key** provided to crack questions efficiently
- **Quick Revision of Important Concepts** at the end of the book

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PREFACE

The Common University Entrance Test, CUET (UG) is a crucial milestone for students as they progress towards their undergraduate education. It is the sole opportunity for them to gain admission into premier undergraduate institutions and courses after the completion of Class XII.

Target Publications, with more than a decade of experience and expertise in the domain of competitive examination, offers **'CUET (UG) 10 Practice Paper Set'** – Mathematics for CUET (UG) aspirants, which is a meticulously designed book to assess the threshold of knowledge imbibed by students.

This book charts out a compilation of 10 Practice Papers aimed at students appearing for the CUET (UG) examination. Every question paper in this book has been created in line with syllabus prescribed by NTA for CUET (UG) Mathematics.

Each paper covers various question types (***Passage/Case-Study Based Questions, Match the Columns, Statement Based Questions, Assertion and Reason***) based on CUET (UG) - 2022 question paper and touches upon all the conceptual nodes of Mathematics. The questions throughout this book are specifically curated by our expert authors with an astute attention to detail. The core objective of this book is to gauge the student's preparedness to appear for CUET (UG) examination.

To aid students, ***Solutions*** are provided as deemed necessary. ***Smart Keys*** are provided selectively to encourage cracking a question efficiently by lateral thinking. ***Quick Revision of Important Concepts*** given at the end of the book includes important and relevant terminologies and formulae. This is our attempt to offer students a handy tool to solve problems and ace the last minute revision.

Apart from mastery on the subject content, we hope that this book will also help students to achieve objectives such as time-management and develop their ability to utilize the paper-pattern format (choice of questions to attempt) to their advantage in order to maximize their scores.

We hope that the book helps the learners as we have envisioned.

Publisher

Edition: First

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.
Please write to us on: mail@targetpublications.org

Syllabus for CUET (UG) - Mathematics

SECTION - A

1. ALGEBRA

i. Matrices and types of Matrices
ii. Equality of Matrices, transpose of a Matrix, Symmetric and Skew Symmetric Matrix
iii. Algebra of Matrices
iv. Determinants
v. Inverse of a Matrix
vi. Solving of simultaneous equations using Matrix Method

2. CALCULUS

i. Higher order derivatives
ii. Tangents and Normals
iii. Increasing and Decreasing Functions
iv. Maxima and Minima

3. INTEGRATION AND ITS APPLICATIONS

i. Indefinite integrals of simple functions
ii. Evaluation of indefinite integrals
iii. Definite Integrals
iv. Application of Integration as area under the curve

4. DIFFERENTIAL EQUATIONS

i. Order and degree of differential equations
ii. Formulating and solving of differential equations with variable separable

5. PROBABILITY DISTRIBUTIONS

i. Random variables and its probability distribution
ii. Expected value of a random variable
iii. Variance and Standard Deviation of a random variable
iv. Binomial Distribution

6. LINEAR PROGRAMMING

i. Mathematical formulation of Linear Programming Problem
ii. Graphical method of solution for problems in two variables
iii. Feasible and infeasible regions
iv. Optimal feasible solution

SECTION – B2

UNIT I: NUMBERS, QUANTIFICATION AND NUMERICAL APPLICATIONS

A. Modulo Arithmetic

- Define modulus of an integer
- Apply arithmetic operations using modular arithmetic rules

B. Congruence Modulo

- Define congruence modulo
- Apply the definition in various problems

C. Allegation and Mixture

- Understand the rule of allegation to produce a mixture at a given price
- Determine the mean price of a mixture
- Apply rule of allegation

D. Numerical Problems

- Solve real life problems mathematically

E. Boats and Streams

- Distinguish between upstream and downstream
- Express the problem in the form of an equation

F. Pipes and Cisterns

- Determine the time taken by two or more pipes to fill or

G. Races and Games

- Compare the performance of two players w.r.t. time,
- distance taken/ distance covered/ Work done from the given data

H. Partnership

- Differentiate between active partner and sleeping partner
- Determine the gain or loss to be divided among the partners in the ratio of their investment with due
- consideration of the time volume/ surface area for solid formed using two or more shapes

I. Numerical Inequalities

- Describe the basic concepts of numerical inequalities
- Understand and write numerical inequalities

UNIT II: ALGEBRA

A. Matrices and types of matrices

- Define matrix
- Identify different kinds of matrices

B. Equality of matrices, Transpose of a matrix, Symmetric and Skew symmetric matrix

- Determine equality of two matrices
- Write transpose of given matrix
- Define symmetric and skew symmetric matrix

UNIT III: CALCULUS

A. Higher Order Derivatives

- Determine second and higher order derivatives
- Understand differentiation of parametric functions and implicit functions Identify dependent and independent variables

B. Marginal Cost and Marginal Revenue using derivatives

- Define marginal cost and marginal revenue
- Find marginal cost and marginal revenue

C. Maxima and Minima

- Determine critical points of the function
- Find the point (s) of local maxima and local minima and corresponding local maximum and local minimum values
- Find the absolute maximum and absolute minimum value of a function

UNIT IV: PROBABILITY DISTRIBUTIONS

A. Probability Distribution

- Understand the concept of Random Variables and its Probability Distributions
- Find probability distribution of discrete random variable

B. Mathematical Expectation

- Apply arithmetic mean of frequency distribution to find the expected value of a random variable

C. Variance

- Calculate the Variance and S.D. of a random variable

UNIT V: INDEX NUMBERS AND TIME BASED DATA

A. Index Numbers

- Define Index numbers as a special type of average

B. Construction of Index numbers

- Construct different type of index numbers

C. Test of Adequacy of Index Numbers

- Apply time reversal test

UNIT VI: UNIT V: INDEX NUMBERS AND TIME BASED DATA

A. Population and Sample

- Define Population and Sample
- Differentiate between population and sample
- Define a representative sample from a population

B. Parameter and Statistics and Statistical Interferences

- Define Parameter with reference to Population
- Define Statistics with reference to Sample
- Explain the relation between Parameter and Statistic
- Explain the limitation of Statistic to generalize the estimation for population
- Interpret the concept of Statistical Significance and Statistical Inferences
- State Central Limit Theorem
- Explain the relation between Population-Sampling Distribution-Sample

[Note: The syllabus of Unit VI mentioned above is the part of INFERENTIAL STATISTICS**]**

UNIT VII: INDEX NUMBERS AND TIME-BASED DATA

A. Time Series

- Identify time series as chronological data

B. Components of Time Series

- Distinguish between different components of time series

C. Time Series analysis for univariate data

- Solve practical problems based on statistical data and Interpret

UNIT VIII: FINANCIAL MATHEMATICS

A. Perpetuity, Sinking Funds

- Explain the concept of perpetuity and sinking fund
- Calculate perpetuity
- Differentiate between sinking fund and saving account

B. Valuation of Bonds

- Define the concept of valuation of bond and related terms
- Calculate value of bond using present value approach

C. Calculation of EMI

- Explain the concept of EMI
- Calculate EMI using various methods

D. Linear method of Depreciation

- Define the concept of linear method of Depreciation
- Interpret cost, residual value and useful life of an asset from the given information
- Calculate depreciation

UNIT IX: LINEAR PROGRAMMING

A. Introduction and related terminology

- Familiarize with terms related to Linear Programming Problem

B. Mathematical formulation of Linear Programming Problem

- Formulate Linear Programming Problem

C. Different types of Linear Programming Problems

- Identify and formulate different types of LPP

D. Graphical Method of Solution for problems in two Variables

- Draw the Graph for a system of linear inequalities involving two variables and to find its solution graphically

E. Feasible and Infeasible Regions

- Identify feasible, infeasible and bounded regions

F. Feasible and infeasible solutions, optimal feasible solution

- Understand feasible and infeasible solutions
- Find optimal feasible solution

Broad features of CUET (UG)

Mode of Examination: Computer Based Test (CBT) mode						
Sections	**Subjects/ Tests**	**Questions to be Attempted**	**Marks per Question**	**Total Marks**	**Question Type**	**Duration**
Section IA - Languages	There are 13 different languages. Any of these languages may be chosen.	40 questions out of 50 in each language	5	200	• Language to be tested through Reading Comprehension based on different types of passages– Factual, Literary and Narrative, [Literary Aptitude and Vocabulary] • MCQ Based Questions	45 Minutes for each language
Section IB - Languages	There are 20 Languages. Any other language apart from those offered in Section I A may be chosen.					
Section II - Domain	There are 27 Domains specific Subjects being offered under this Section. A candidate may choose a maximum of Six Domains as desired by the applicable University/ Universities.	40 questions out of 50 in each subject	5	200	• Input text can be used for MCQ Based Questions • MCQs based on syllabus given on NTA website	45 Minutes for each Domain Specific Subjects
Section III General Test	For any such undergraduate programme/ programmes being offered by Universities where a General Test is being used for admission.	60 questions out of 75	5	300	• Input text can be used for MCQ Based Questions • General Knowledge, Current Affairs, General Mental Ability, Numerical Ability, Quantitative Reasoning (Simple application of basic mathematical arithmetic/ algebra geometry/ mensuration /stat taught till Grade 8), Logical and Analytical Reasoning	60 Minutes
Note: • One mark will be deducted for a wrong answer. • Unanswered/Marked for Review will be given no mark (0).						

Candidates are advised to visit the NTA CUET (UG)-2022 official website ***https://cuet.samarth.ac.in/*** *for latest updates regarding the Examination.*

Note: In Section II, there are some Domain Specific Subjects which are multidisciplinary. In those subjects there will be two Sections, wherein Section A will be Compulsory for all. Section B may have more than one Sub Sections out of which a candidate can choose one or more than one Sections depending on the eligibility conditions of the Programme/ University they are applying for.

Mathematics Question Paper **(Section II)** will contain Two Sub-sections - Section A and Section B (B1 and B2, out of which only one Sub Section is to be attended.)

Section II-A will have 15 questions covering both i.e. Mathematics/Applied Mathematics which will be compulsory for all candidates.

Section II-B1 will have 35 questions from Mathematics out of which 25 questions need to be attempted.

Section II-B2 will have 35 questions purely from Applied Mathematics out of which 25 questions will be attempted.

In this book, we will be focusing on Section II-A and Section II-B2.

Index

Time: 45 minutes **Total Marks: 200**

Instructions:

- *All questions from Section A are compulsory.*
- *Attempt any 25 questions from Section B2.*
- *Each question carries 5 marks.*
- *No mark will be given to unanswered/marked for review questions.*
- *Negative marking of 1 mark for a wrong answer.*

SECTION - A

1. If $\begin{bmatrix} 2 & -3 \\ 7 & -4 \\ 9 & 0 \end{bmatrix} + \begin{bmatrix} 3 & x \\ 5 & 4 \\ y & 3 \end{bmatrix} = \begin{bmatrix} 5 & 2 \\ 12 & 0 \\ 11 & 3 \end{bmatrix}$, then $x + y =$ is

(A) 5 (B) 7
(C) 9 (D) 12

2. A random variable X has the following probability distribution:

X	1	2	3	4
P(X)	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{1}{7}$

Then, the variance of this distribution is

(A) $\frac{49}{40}$ (B) $\frac{40}{49}$
(C) $\frac{20}{29}$ (D) $\frac{29}{20}$

3. If $A = \begin{bmatrix} 4 & k & k \\ 0 & k & k \\ 0 & 0 & k \end{bmatrix}$ and det (A) = 256, then |k| equals

(A) 4 (B) 5
(C) 6 (D) 8

4. $\int \frac{x-1}{(x+1)^2}\,dx =$

(A) $\log|x+1| + \frac{2}{x+1} + c$

(B) $\log|x+1| - \frac{2}{x+1} + c$

(C) $\frac{2}{x+1} - \log|x+1| + c$

(D) $2\log|x+1| - \frac{1}{x+1} + c$

5. The abscissae of the points, where the tangent to curve $y = x^3 - 3x^2 - 9x + 5$ is parallel to X- axis, are

(A) $x = 0$ and 1 (B) $x = 1$ and -1
(C) $x = 1$ and -3 (D) $x = -1$ and 3

6. If $x = 2at^2$, $y = at^4$, then $\frac{d^2y}{dx^2}$ at t = 2 is

(A) 4 (B) 2a
(C) $\frac{1}{2a}$ (D) $-\frac{1}{2a}$

7. **Statement I:** The degree and the order of the differential equation $\frac{d^2y}{dx^2} = \sqrt[3]{1+\left(\frac{dy}{dx}\right)^2}$ are 3 and 2 respectively.
Statement II: The order of a differential equation is the order of the highest order derivative occuring in it.

(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

8. If x and y are two positive numbers such that $x + y = 32$, then the minimum value of $x^2 + y^2$ is

(A) 500 (B) 256
(C) 1024 (D) 512

9. If the probability that a student is not a swimmer is $\frac{1}{5}$, then the probability that out of 5 students one is swimmer is

(A) ${}^5C_1 \left(\frac{4}{5}\right)^4 \left(\frac{1}{5}\right)$ (B) ${}^5C_1 \left(\frac{4}{5}\right)\left(\frac{1}{5}\right)^4$
(C) $\frac{4}{5}\left(\frac{1}{5}\right)^4$ (D) $5\left(\frac{4}{5}\right)^5\left(\frac{1}{5}\right)$

10. If $A = \begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$, then $A^n = 2^k A$, where k =

(A) 2^{n-1} (B) n + 1
(C) n – 1 (D) 2(n – 1)

11. If $f(x) = \frac{x}{x^2+1}$ is increasing function, then the value of x lies in

(A) R (B) $(-\infty, -1)$
(C) $(1, \infty)$ (D) $(-1, 1)$

12. Let $f(x) = \begin{vmatrix} 0 & x & 16 \\ x & 5 & 7 \\ 0 & 9 & x \end{vmatrix}$. If $x = 0$ is a root of $f(x) = 0$, then the other roots are

(A) 12, 12 (B) 12, –12
(C) 12, 16 (D) 9, 16

13. The value of $\int_1^{e^2} \frac{dx}{x(1+\log x)^2}$ is

(A) $\frac{2}{3}$ (B) $\frac{1}{3}$

(C) $\frac{3}{2}$ (D) $\frac{1}{2}$

14. The differential equation representing the family of parabolas having vertex at origin and axis along positive direction of X-axis is

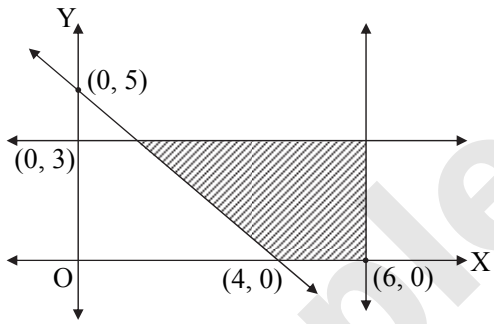
(A) $y^2 - 2xy\,\frac{dy}{dx} = 0$

(B) $y^2 + 2xy\,\frac{dy}{dx} = 0$

(C) $y^2 - 2xy\,\frac{d^2y}{dx^2} = 0$

(D) $y^2 + 2xy\,\frac{d^2y}{dx^2} = 0$

15. The shaded region in the figure is the solution set of the inequations



(A) $5x + 4y \geq 20, x \leq 6, y \geq 3, x \geq 0, y \geq 0$

(B) $5x + 4y \leq 20, x \leq 6, y \leq 3, x \geq 0, y \geq 0$

(C) $5x + 4y \geq 20, x \leq 6, y \leq 3, x \geq 0, y \geq 0$

(D) $5x + 4y \geq 20, x \geq 6, y \leq 3, x \geq 0, y \geq 0$

SECTION - B2

16. Find the Price Index Number using Simple Aggregate Method in the following example.

Use 1995 as base year.

Commodity	P	Q	R	S	T
Price (in ₹) in 1995	15	20	24	23	28
Price (in ₹) in 2000	27	38	32	40	45

(A) 182 (B) 110

(C) 165.45 (D) 60.44

17. Match the columns.

	Matrix		**Matrix Type**
i.	$\begin{bmatrix} \sqrt{5} \\ \frac{4}{3} \\ -1 \end{bmatrix}$	a.	diagonal matrix
ii.	$\begin{bmatrix} 9 & \sqrt{2} & -3 \end{bmatrix}$	b.	row matrix
iii.	$\begin{bmatrix} 0 & -4 & -5 \\ 4 & 0 & 6 \\ 5 & -6 & 0 \end{bmatrix}$	c.	column matrix
iv.	$\begin{bmatrix} 3 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix}$	d.	skew symmetric matrix

	i.	ii.	iii.	iv.
(A)	d	c	a	b
(B)	d	c	b	a
(C)	b	c	d	a
(D)	c	b	d	a

18. If $\sqrt{x} + \sqrt{y} = \sqrt{a}$,then $\frac{dy}{dx} =$

(A) $-\sqrt{\frac{y}{x}}$ (B) $-\sqrt{\frac{x}{y}}$

(C) $\sqrt{\frac{y}{x}}$ (D) $\sqrt{\frac{x}{y}}$

19. Find the Quantity Index Number using Simple Aggregate Method in the following example.

Commodity	I	II	III	IV	V
Base Year Quantities	140	120	100	200	220
Current Year Quantities	100	80	70	150	185

(A) 78 (B) 75

(C) 58.5 (D) 133.33

20. **Assertion (A):** 3 mod 7 = (7 + 3k) mod 7, for any integer k.

Reason (R): X mod Y = (X + kY) mod Y; where X, Y and k are integers.

For the given statements, choose the correct option.

(A) Both A and R are true and R is correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

21. The value of objective function is maximize under linear constraints.
(A) at the centre of feasible region
(B) at (0, 0)
(C) at any vertex of feasible region.
(D) The vertex which is at maximum distance from (0, 0).

22. A price index which is based on the prices of the items in the composite, weighted by their relative index is called:
(A) price relatives
(B) Consumer price index
(C) Weighted aggregative price index
(D) Simple aggregative index

23. The price per unit of a commodity produced by a company is given by $p = x^8 (5x^2 - 4x - 8)^9$ and 'x' is the quantity demanded. Then find the marginal revenue.
(A) $9(5x^3 - 4x^2 - 8x)^8 (15x^2 - 8x - 8)$
(B) $9(5x^3 - 4x^2 - 8x)^9 (15x^2 - 8x - 8)$
(C) $9(5x^3 - 4x^2 - 8x)^8 (5x^2 - 8x - 8)$
(D) $9(5x^3 - 4x^2 - 8x)^9 (5x^2 - 8x - 8)$

24. Three partners shared the profit in a business in the ratio 5 : 6 : 7. They had partnered for 12 months, 10 months and 8 months respectively. What was the ratio of their investments?
(A) 5 : 6 : 7 (B) 7 : 6 : 5
(C) 50 : 72 : 105 (D) 105 : 72 : 50

25. _____ component is a time series captures the periodic variability in the data, capturing the regular pattern of variability; within one-year periods.
(A) Secular trend (B) Seasonal
(C) Cyclical (D) Irregular

26. One of the most important application of statistics is making estimations about an entire population based on the information from a small sample. This process is known as_____.
(A) Random Experiment
(B) Sample Testing
(C) Trial
(D) Statistical Inference

27. The maximum value of $z = 5x + 3y$. subject to the constraints $3x + 5y \leq 15$; $5x + 2y \leq 10$, $x, y \geq 0$ is.
(A) 235 (B) $\frac{235}{9}$
(C) $\frac{235}{19}$ (D) $\frac{235}{3}$

28. Find: –31 mod 7
(A) 3 (B) 4
(C) 1 (D) 5

29. If $\sum p_0q_0 = 140$, $\sum p_0q_1 = 200$, $\sum p_1q_0 = 350$, $\sum p_1q_1 = 460$, then find Laspeyre's Price Index Number.
(A) 240 (B) 250
(C) 230 (D) 238.24

30. Determine the local maximum value of $f(x) = 2x^3 - 21x^2 + 36x - 20$
(A) 1 (B) 6
(C) –30 (D) –3

31. The intermediate solutions of constraints must be checked by substituting them back into
(A) Objective function
(B) Constraint equations
(C) Not required
(D) None of these

32. There are two milk brands, A and B. Cost of the milk A is ₹ 60 per litre and the cost of milk B is ₹ 85 per litre. In what ratio must two types of milk to be mixed so that the mixture will worth ₹ 78 per litre?
(A) 2 : 9 (B) 5 : 18
(C) 7 : 11 (D) 7 : 18

33. In a test of Mathematics, there are two types of questions to be answered–short answered and long answered. The relevant data is given below

Type of questions	Time taken to solve	Marks	Number of questions
Short answered questions	5 minute	3	10
Long answered questions	10 minute	5	14

The total marks is 100. Students can solve all the questions. To secure maximum marks, a student solves x short answered and y long answered questions in three hours, then the linear constraints except $x \geq 0, y \geq 0$, are
(A) $5x + 10y \leq 180, x \leq 10, y \leq 14$
(B) $x + 10y \geq 180, x \leq 10, y \leq 14$
(C) $5x + 10y \geq 180, x \geq 10, y \geq 14$
(D) $5x + 10y \leq 180, x \geq 10, y \geq 14$

34. There are 68 boxes with 16 books in each box. When we rearrange all the books in new boxes such that each box contains 12 books, how many books will be left out without box?
(A) 32 (B) 8
(C) 4 (D) 12

35. **Assertion (A):** If $\sum p_0 = 240$, $\sum p_1 = 313$, where p_0 : Price of a commodity in the base year, p_1 : Price of a commodity in the current year, then the Price Index Number using Simple Aggregate Method is 130.42.

Reason (R): Quantity index number for the current year with respect to base year is given by the formula, $\frac{\sum q_1}{\sum q_0} \times 100$

For the given statements, choose the correct option.

(A) Both A and R are true and R is correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

36. Arman rows 60 km upstream and 36 km downstream in 6 hours each time. What is the speed of the boat in still water?

(A) 2 km/hr (B) 8 km/hr

(C) 10 km/hr (D) 6 km/hr

37. If a sampling process systematically favours certain outcomes over others, it is said to be _____.

(A) Unbiased Sampling

(B) Unrepresentative Sample

(C) Representative Sample

(D) Biased Sampling

38. For $A = \begin{bmatrix} 1 & -2 \\ 3 & -5 \\ -6 & 0 \end{bmatrix}$, $B = \begin{bmatrix} -1 & -2 \\ 4 & 2 \\ 1 & 5 \end{bmatrix}$, $C = \begin{bmatrix} 2 & 4 \\ -1 & -4 \\ -3 & 6 \end{bmatrix}$, find the matrix X such that $3A - 4B + 5X = C$.

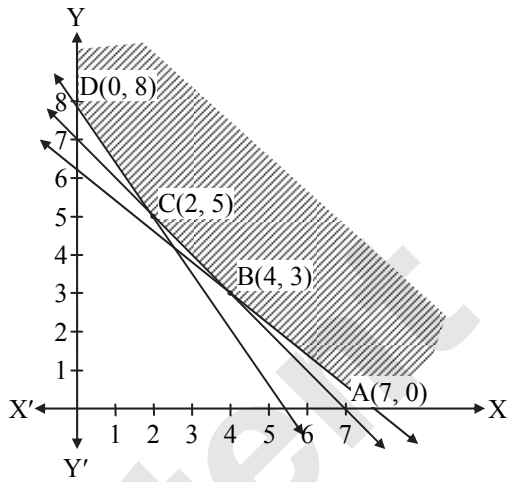
(A) $\begin{bmatrix} -5 & 2 \\ 6 & 19 \\ 19 & 26 \end{bmatrix}$

(B) $\begin{bmatrix} -4 & -8 \\ 16 & 8 \\ 4 & 20 \end{bmatrix}$

(C) $\begin{bmatrix} 3 & -6 \\ 9 & -15 \\ -18 & 0 \end{bmatrix}$

(D) $\frac{1}{5}\begin{bmatrix} -5 & 2 \\ 6 & 19 \\ 19 & 26 \end{bmatrix}$

39. Feasible region for an LPP is shown shaded in the following figure. Minimum of $Z = 4x + 3y$ occurs at the point.



(A) (0, 8) (B) (2, 5)

(C) (4, 3) (D) (9, 0)

40. Apply addition modulo to positive integers 16 and 7 for modulo 25.

(A) 3 (B) 23

(C) 2 (D) None of these

Read the following passage and answer the questions from 41 to 45.

Let X denote the number of hours for which Raj study. A random variable 'X' has the following probability distribution.

X	1	2	3	4	5	6	7	8	9
P(X)	2k	5k	6k	8k	k	7k	3k	4k	9k

Based on the given information, answer the following questions:

41. Choose the correct option to depict the probability distribution, P(X) for the random variable, X.

(A) $\sum_{i=1}^{n} P(X) = 1$ (B) $\sum_{i=1}^{n} P(X) = \pm 1$

(C) $\sum_{i=1}^{n} P(X) = 0$ (D) $\sum_{i=1}^{n} xP(X) = 1$

42. Find the value of k for the given probability distribution.

(A) $k = \frac{1}{47}$ (B) $k = \frac{1}{45}$

(C) $k = \frac{1}{49}$ (D) $k = \frac{1}{53}$

43. Find the probability that Raj studies for 7 hours.

(A) $\frac{1}{19}$ (B) $\frac{1}{25}$

(C) $\frac{1}{10}$ (D) $\frac{1}{15}$

44. Find the mean of the given probability distribution.

(A) 6.2 (B) 3.7

(C) 2.9 (D) 5.4

45. Find the variance of the given probability distribution.

(A) 8.86 (B) 6.72

(C) 8.52 (D) 6.68

Read the following passage and answer the questions from 46 to 50.

Perpetuity is an annuity where payments continue forever. There are two types of perpetuity.

Type 1 – Where payment is done at the end of each period.

Type 2 – Where payment is done at the beginning of each period.

Observe the following table showing the payments made by Shalaka, Shakil, Shyam, Shubham and Sherin in perpetuity.

	Size of each payment (R)	Rate per period (i)	Perpetuity Type	Present value of perpetuity (P)
Shalaka	₹ 60	4% - Semi-annually	Type 1	α
Shakil	₹ 600	6% - Quarterly	Type 1	β
Shyam	₹ 450	y – Semi-annually	Type 1	₹ 20,000
Shubham	₹ 2500	5% Annually	Type 2	γ
Sherin	x	6% - Semi-annually	Type 1	₹ 40,000

Based on the given information, answer the following questions.

46. Find the value of α.

(A) ₹ 1500 (B) ₹ 3000

(C) ₹ 6000 (D) ₹ 2000

47. Find the value of β.

(A) ₹ 30,000 (B) ₹ 10,000

(C) ₹ 20,000 (D) ₹ 40,000

48. Find the value of y.

(A) 45% (B) 4.5%

(C) 0.45% (D) 0.045%

49. Find the value of γ.

(A) ₹ 50,000 (B) ₹ 1,00,000

(C) ₹ 52,500 (D) ₹ 1,02,500

50. Find the value of x

(A) ₹ 1,200 (B) ₹ 120

(C) ₹ 2,400 (D) ₹ 240

Page no. **6** to **42** are purposely left blank.

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Practice Paper – 01

1. (B)

$$\begin{bmatrix} 2 & -3 \\ 7 & -4 \\ 9 & 0 \end{bmatrix} + \begin{bmatrix} 3 & x \\ 5 & 4 \\ y & 3 \end{bmatrix} = \begin{bmatrix} 5 & 2 \\ 12 & 0 \\ 11 & 3 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 5 & -3+x \\ 12 & 0 \\ 9+y & 3 \end{bmatrix} = \begin{bmatrix} 5 & 2 \\ 12 & 0 \\ 11 & 3 \end{bmatrix}$$

$\Rightarrow -3 + x = 2 \Rightarrow x = 5$

and $9 + y = 11 \Rightarrow y = 2$

$\therefore \quad x + y = 7$

2. (B)

$$E(X) = \sum x_i . P(x_i)$$

$$= 1\left(\frac{1}{7}\right) + 2\left(\frac{2}{7}\right) + 3\left(\frac{3}{7}\right) + 4\left(\frac{1}{7}\right)$$

$$= \frac{18}{7}$$

$$E(X^2) = (1^2)\left(\frac{1}{7}\right) + (2^2)\left(\frac{2}{7}\right) + (3^2)\left(\frac{3}{7}\right) + (4^2)\left(\frac{1}{7}\right)$$

$$= \frac{1}{7} + \frac{8}{7} + \frac{27}{7} + \frac{16}{7} = \frac{52}{7}$$

$\therefore \quad Var(X) = E(X^2) - [E(X)]^2$

$$= \frac{52}{7} - \left(\frac{18}{7}\right)^2$$

$$= \frac{40}{49}$$

3. (D)

$$|A| = \begin{vmatrix} 4 & k & k \\ 0 & k & k \\ 0 & 0 & k \end{vmatrix}$$

$\therefore \quad |A| = 4\,(k^2)$

$\Rightarrow 256 = 4\,k^2$

$\Rightarrow k = \pm 8$

$\Rightarrow |k| = 8$

4. (A)

$$\int \frac{x-1}{(x+1)^2} dx = \int \frac{x+1-2}{(x+1)^2} dx$$

$$= \int \frac{1}{x+1} dx - \int \frac{2}{(x+1)^2} dx$$

$$= \log|x+1| + \frac{2}{(x+1)} + c$$

5. (D)

$y = x^3 - 3x^2 - 9x + 5 \Rightarrow \frac{dy}{dx} = 3x^2 - 6x - 9$

Since the tangent is parallel to X-axis, $\frac{dy}{dx} = 0$

$\Rightarrow 3x^2 - 6x - 9 = 0 \Rightarrow x = -1, 3$

6. (C)

$x = 2at^2$ and $y = at^4$

$\therefore \quad \frac{dx}{dt} = 4at$ and $\frac{dy}{dt} = 4at^3$

$\therefore \quad \frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = t^2$

$\therefore \quad \frac{d^2y}{dx^2} = 2t.\ \frac{dt}{dx} = 2t.\ \frac{1}{4at} = \frac{1}{2a}$

$\therefore \quad \left(\frac{d^2y}{dx^2}\right)_{(t=2)} = \frac{1}{2a}$

7. (A)

$$\frac{d^2y}{dx^2} = \sqrt[3]{1 + \left(\frac{dy}{dx}\right)^2}$$

$$\Rightarrow \left(\frac{d^2y}{dx^2}\right)^3 = 1 + \left(\frac{dy}{dx}\right)^2$$

Here, the highest order derivative is $\frac{d^2y}{dx^2}$ with power 3.

$\therefore \quad$ Order = 2 and degree = 3

8. (D)

$x + y = 32 \Rightarrow y = 32 - x$

$\Rightarrow x^2 + y^2 = x^2 + (32 - x)^2$

Let $f(x) = x^2 + (32 - x)^2$

$\Rightarrow f'(x) = 2x + 2(32 - x)(-1)$

$= 4x - 64$

For maximum or minimum of $f(x)$,

$f'(x) = 0$

$\Rightarrow 4x - 64 = 0 \Rightarrow x = 16$

$\therefore \quad f(x)$ is minimum at $x = 16$.

Now, $f''(x) = 4 > 0$

$\therefore \quad$ Minimum value $= x^2 + y^2 = (16)^2 + (16)^2 = 512$

9. (B)

Here, $q = \frac{1}{5}$

$\therefore \quad p = 1 - \frac{1}{5} = \frac{4}{5}$

Also, n = 5

$\therefore \quad$ Required probability $= P(X = 1)$

$$= {}^5C_1\left(\frac{4}{5}\right)\left(\frac{1}{5}\right)^4$$

10. (D)

$$A = \begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$$

$\therefore \quad A^2 = \begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix} = \begin{bmatrix} 8 & -8 \\ -8 & 8 \end{bmatrix} = 4A$

$\therefore \quad A^2 = 2^2 A \quad \ldots(i)$

$A^3 = A^2 . A = 4A . A = 4A^2 = 4 (4A) = 16 A$

$\therefore \quad A^3 = 2^4 A \quad \ldots(ii)$

$A^4 = A^3 . A = 16A . A = 16A^2 = 16 (4A) = 64 A$

$\therefore \quad A^4 = 2^6 A \quad \ldots(iii)$

$A^n = 2^k . A \quad \ldots(iv)$[Given]

From (i), (ii), (iii) and (iv), we can conclude that $k = 2 (n - 1)$

11. (D)

$$f(x) = \frac{x}{x^2+1}$$

$$\therefore \quad f'(x) = \frac{(x^2+1)(1) - x(2x)}{(x^2+1)^2} = \frac{1-x^2}{(x^2+1)^2}$$

For $f(x)$ to be increasing,

$f'(x) > 0$

$$\Rightarrow \frac{1-x^2}{(x^2+1)^2} > 0$$

$\Rightarrow 1 - x^2 > 0 \quad \ldots[(x^2+1)^2 \neq 0]$

$\Rightarrow x^2 < 1$

$\Rightarrow x \in (-1, 1)$

12. (B)

$$\begin{vmatrix} 0 & x & 16 \\ x & 5 & 7 \\ 0 & 9 & x \end{vmatrix} = 0$$

$\Rightarrow -x (x^2) + 16 (9x) = 0$

$\Rightarrow -x (x^2 - 144) = 0$

$\Rightarrow x = 0$ or $x^2 = 144$

$\Rightarrow x = \pm 12$

$\therefore$ The other two roots are 12, –12.

13. (A)

$$\text{Let } I = \int_1^{e^2} \frac{dx}{x(1+\log x)^2}$$

Put $(1 + \log x) = t \Rightarrow \frac{1}{x} dx = dt$

When $x = 1$, $t = 1$ and when $x = e^2$, $t = 3$

$$\therefore \quad I = \int_1^3 \frac{dt}{t^2} = \left[\frac{-1}{t}\right]_1^3$$

$$= -\left(\frac{1}{3} - 1\right) = \frac{2}{3}$$

14. (A)

The differential equation representing the family of parabolas having vertex at origin and axis along positive direction of X-axis is

$y^2 = 4ax \quad \ldots(i)$

Differentiating w.r.t. x, we get

$$2y\frac{dy}{dx} = 4a$$

$$\Rightarrow 2y\frac{dy}{dx} = \frac{y^2}{x} \quad \ldots[\text{From (i)}]$$

$$\Rightarrow 2yx\frac{dy}{dx} = y^2$$

$$\Rightarrow y^2 - 2xy\frac{dy}{dx} = 0$$

15. (C)

Shaded region lies on non-origin side of $5x + 4y = 20$, and on origin side of the lines $x = 6$ and $y = 3$.

$\therefore \quad 5x + 4y \geq 20, x \leq 6, y \leq 3, x \geq 0, y \geq 0$

16. (C)

Commodity	Price in 1995 (Base year) p_0	Price in 2000 (Current year) p_1
P	15	27
Q	20	38
R	24	32
S	23	40
T	28	45
Total	110	182

From the table, $\Sigma p_0 = 110$, $\Sigma p_1 = 182$

$$\text{Price Index Number } (P_{01}) = \frac{\sum p_1}{\sum p_0} \times 100$$

$$= \frac{182}{110} \times 100$$

$$= 165.45$$

17. (D)

18. (A)

$\sqrt{x} + \sqrt{y} = \sqrt{a}$

Differentiating both sides w.r.t. x, we get

$$\frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{y}} \cdot \frac{dy}{dx} = 0$$

$$\therefore \quad \frac{1}{2\sqrt{y}} \cdot \frac{dy}{dx} = \frac{-1}{2\sqrt{x}}$$

$$\therefore \quad \frac{dy}{dx} = -\sqrt{\frac{y}{x}}$$

19. (B)

Commodity	Base Year Quantities q_0	Current Year Quantities q_1
I	140	100
II	120	80
III	100	70
IV	200	150
V	220	185
Total	780	585

From the table, $\sum q_0 = 780$, $\sum q_1 = 585$

Quantity Index Number $(Q_{01}) = \frac{\sum q_1}{\sum q_0} \times 100$

$= \frac{585}{780} \times 100$

$= 75$

20. (D) **21. (D)**

22. (C)

23. (A)

The revenue function R (or R(x)) is given by,

$R = px$

$= x^8 (5x^2 - 4x - 8)^9 \times x$

$= x^9 (5x^2 - 4x - 8)^9$

$\therefore$ $R = (5x^3 - 4x^2 - 8x)^9$

Differentiating both sides w.r.t.x, we get

$\frac{dR}{dx} = \frac{d}{dx}\left[(5x^3 - 4x^2 - 8x)^9\right]$

$= 9(5x^3 - 4x^2 - 8x)^8 \cdot \frac{d}{dx}(5x^3 - 4x^2 - 8x)$

$= 9(5x^3 - 4x^2 - 8x)^8 \cdot \left[5(3x^2) - 4(2x) - 8\right]$

$\therefore$ $\frac{dR}{dx} = 9(5x^3 - 4x^2 - 8x)^8 \cdot (15x^2 - 8x - 8)$

24. (C)

Let the ratio of investments of the three partners be p : q : r.

They partnered for 12 months, 10 months and 8 months respectively.

$\therefore$ The profit shared by the partners will be in proportion of the product of capitals invested and their respective time periods.

$\therefore$ $12 \times p : 10 \times q : 8 \times r = 5 : 6 : 7$

Now, $\frac{12p}{10q} = \frac{5}{6}$

$\therefore$ $\frac{p}{q} = \frac{50}{72}$ …(i)

and $\frac{10q}{8r} = \frac{6}{7}$

$\therefore$ $\frac{q}{r} = \frac{48}{70} = \frac{24}{35} \times \frac{3}{3}$

$\therefore$ $\frac{q}{r} = \frac{72}{105}$ …(ii)

From (i) & (ii), we have

p : q : r = 50 : 72 : 105

$\therefore$ The ratio of their investments was 50 : 72 : 105.

25. (B) **26. (D)**

27. (C)

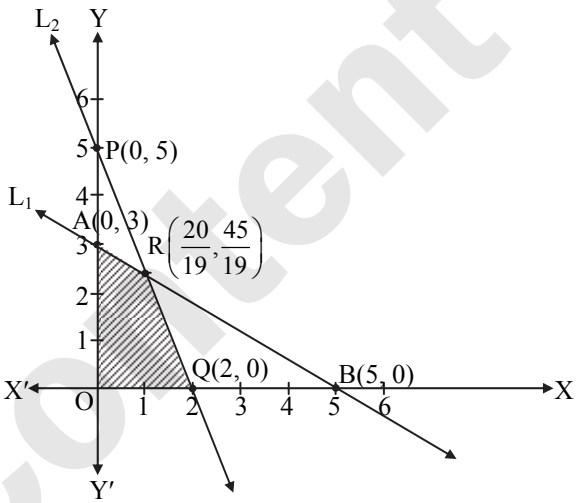
$Z = 5x + 3y$

The inequalities are $3x + 5y \le 15$, $5x + 2y \le 10$

Consider lines L_1 and L_2 where

$L_1 : 3x + 5y = 15$, $5x + 2y = 10$

OQRAO is the required feasible region.



At O (0, 0), Z = 0

At Q (2, 0), Z = 5(2) + 0 = 10

At R $\left(\frac{20}{19}, \frac{45}{19}\right)$, $z = 5\left(\frac{20}{19}\right) + 3\left(\frac{45}{19}\right) = \frac{235}{19}$.

At A (0, 3), Z = 0 + 3(3) = 9

The maximum value of Z is $\frac{235}{19}$ and it occurs at point R $\left(\frac{20}{19}, \frac{45}{19}\right)$.

28. (B)

$-31 = 7 \times (-5) + 4$

$-31 \bmod 7 = 4$

29. (B)

Laspeyre's Price Index Number:

$P_{01}(L) = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

$= \frac{350}{140} \times 100$

$= 250$

30. (D)

$f(x) = 2x^3 - 21x^2 + 36x - 20$

$\therefore$ $f'(x) = 6x^2 - 42x + 36$ and $f''(x) = 12x - 42$

Consider, $f'(x) = 0$

$\therefore$ $6x^2 - 42x + 36 = 0$

$\therefore$ $(x - 1)(x - 6) = 0$

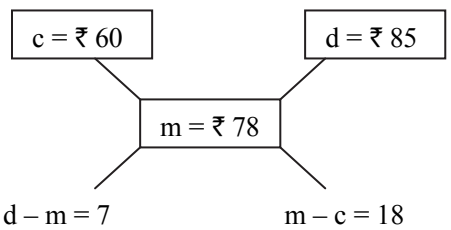
$\therefore$ $x = 1$ or $x = 6$

For $x = 6$,
$f''(6) = 12(6) - 42 = 72 - 42 = 30 > 0$
$\therefore$ $f(x)$ attains minimum value at $x = 6$.

For $x = 1$,
$f''(1) = 12(1) - 42 = 12 - 42 = -30 < 0$
$\therefore$ $f(x)$ attains maximum value at $x = 1$.
$\therefore$ Maximum value = f(1)
$= 2 - 21 + 36 - 20$
$= -3$

31. (B)

32. (D)
Let c = ₹ 60, m = ₹ 78, d = ₹ 85



$\therefore$ Required Ratio = (d – m) : (m – c)
= 7 : 18

33. (A)

34. (B)
Required number of books
$= (68 \times 16) \bmod 12$
$= (68 \bmod 12 \times 16 \bmod 12) \bmod 12$
$= (8 \times 4) \bmod 12$
$= 32 \bmod 12$
$= 8$

35. (B)
From the table, $\sum p_0 = 240$, $\sum p_1 = 313$
Price Index Number is given by formula
$= \frac{\sum p_1}{\sum p_0} \times 100$
$= \frac{313}{240} \times 100$
$= 130.42$

36. (B)
Let the speed of the boat in still water be x km/hr and the speed of the current be y km/hr
$\therefore$ $(x + y) \times 6 = 60$ and $(x - y) \times 6 = 36$
…[Distance = Speed × Time]
$x + y = 10$ and $x - y = 6$
On solving we get, $x = 8$ and $y = 2$
$\therefore$ Speed of the boat in still water is 8 km/hr.

37. (D)

38. (D)
$3A - 4B + 5X = C$
$\therefore$ $5X = C + 4B - 3A$

$$= \begin{bmatrix} 2 & 4 \\ -1 & -4 \\ -3 & 6 \end{bmatrix} + 4\begin{bmatrix} -1 & -2 \\ 4 & 2 \\ 1 & 5 \end{bmatrix} - 3\begin{bmatrix} 1 & -2 \\ 3 & -5 \\ -6 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 4 \\ -1 & -4 \\ -3 & 6 \end{bmatrix} + \begin{bmatrix} -4 & -8 \\ 16 & 8 \\ 4 & 20 \end{bmatrix} - \begin{bmatrix} 3 & -6 \\ 9 & -15 \\ -18 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 2-4-3 & 4-8+6 \\ -1+16-9 & -4+8+15 \\ -3+4+18 & 6+20-0 \end{bmatrix}$$

$$\therefore \quad 5X = \begin{bmatrix} -5 & 2 \\ 6 & 19 \\ 19 & 26 \end{bmatrix}$$

$$\therefore \quad X = \frac{1}{5}\begin{bmatrix} -5 & 2 \\ 6 & 19 \\ 19 & 26 \end{bmatrix}$$

39. (B)
At D(0, 8), Z = 24
At C(2, 5), Z = 23
At B(4, 3), Z = 25
At A(7, 0), Z = 28
The Minimum value of Z is 23 and it occurs at C(2, 5).

40. (B)
Required addition modulo $= (16 + 7) \bmod 25$
$= 23 \bmod 25$
$= 23$

41. (A)

42. (B)
$\sum_{i=1}^{n} P(X) = 1$
$\therefore$ $2k + 5k + 6k + 8k + k + 7k + 3k + 4k + 9k = 1$
$45k = 1$
$\therefore$ $k = \frac{1}{45}$

43. (D)
Required probability = $P(X = 7) = 3k = 3 \times \frac{1}{45}$
$\therefore$ $P(X = 7) = \frac{1}{15}$

44. (D)
$E(X) = x_1p_1 + x_2p_2 + x_3p_3 + \ldots x_np_n$
$= 1(2k) + 2(5k) + 3(6k) + 4(8k) + 5(k)$
$+ 6(7k) + 7(3k) + 8(4k) + 9(9k)$
$= 243(k)$
$= \frac{243}{45}$
$= 5.4$

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Quick Revision of Important Concepts

1. Numbers, Quantification and Numerical Applications

MODULO OPERATOR:

- Modulo operator is a mathematical operator which gives the value of remainder when an integer X is divided by another integer Y. It is written as "modulo" or "mod" and is represented as equation: X mod Y = R

  i.e., for two integers X and Y; such that X > Y and Y ≠ 0, mod (modulo) gives the remainder R, after X is divided by Y.

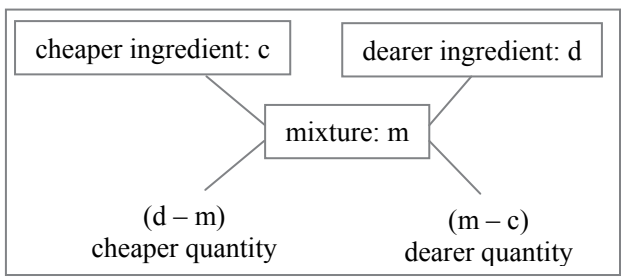
- Note that X, Y can either be positive, negative or even 0 (if we exclude Y) whereas R can only be non-negative.

PROPERTIES OF MODULO OPERATOR:

- X mod Y = (X + kY) mod Y; where k is any integer
- (A + B) mod C = (A mod C + B mod C) mod C
- (A – B) mod C = (A mod C – B mod C) mod C
- (A × B) mod C = (A mod C × B mod C) mod C
- If $a \equiv b \pmod m$ where a, b and m are positive integers, then $a^k \equiv b^k \pmod m$ for any positive integer k.

ALLIGATION AND MIXTURE

- Dearer ingredient is the ingredient whose cost is more (greater).
  Cheaper ingredient is the ingredient whose cost is less.
  Let Mean Price of mixture be 'm'
  Cost Price of cheaper ingredient be 'c'
  Cost Price of dearer ingredient be 'd'
  Ratio of cheaper and dearer = (d – m): (m – c)
- Above formula can also be understood through the following diagram :



Ratio of cheaper and dearer = (d – m): (m – c)

BOATS AND STREAMS:

- Speed of a boat in still water is *x* km/hr,
  Speed of stream be *y* km/hr. Then
  Speed of the boat along the stream (downstream) = (*x* + *y*) km/hr
  Speed of the boat in the opposite direction to the stream (upstream) = (*x* – *y*) km/hr.

PIPES AND CISTERNS

- Let a pipe fills a tank in *x* hours, then it can fill $\left(\frac{1}{x}\right)^{th}$ portion of the tank in one hour.
- If a pipe can empty a tank in *y* hours, then it can empty out $\left(\frac{1}{y}\right)^{th}$ portion of the tank in one hour.
- The portion of tank they can fill together in one hour = $\left(\frac{1}{x}-\frac{1}{y}\right)^{th}$

RACES AND GAMES

Dead Heat: When all the participants of the race finish the race at the same instant of time, such a situation is known as dead heat situation.

PARTNERSHIP

A's (investment × duration) : B's (investment × duration) = A's profit : B's Profit

NUMERICAL INEQUALITIES

- If a, b are positive numbers and A and G are their arithmetic mean and geometric mean respectively, then A ≥ G.
- PROPERTIES:
  For three real numbers a, b and c:
  If a > b, and b > c, then a > c
  If a > b, and c > 0, then a + c > b + c
  If a > b, and c > 0, then a – c > b – c
  If a > b, and c > 0, then a × c > b × c
  If a > b, and c > 0, then a ÷ c > b ÷ c
  If a > b, and c < 0, then a × c < b × c
  If a > b, and c < 0, then a ÷ c < b ÷ c

2. Algebra

DEFINITION OF A MATRIX:

A matrix is an ordered rectangular array of numbers or functions enclosed in brackets,

$\begin{bmatrix} \quad \end{bmatrix}$ or $\begin{pmatrix} \quad \end{pmatrix}$

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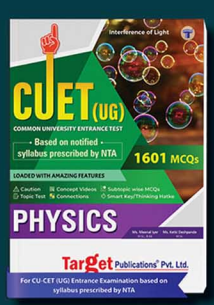

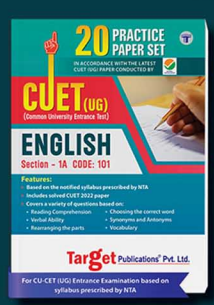

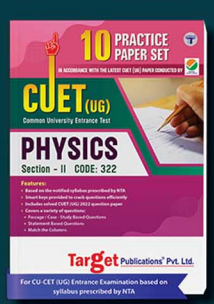

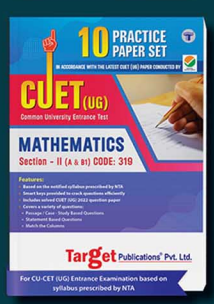

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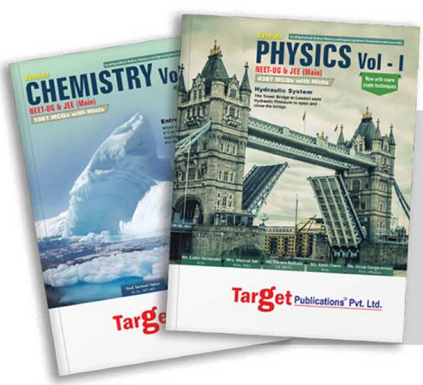

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