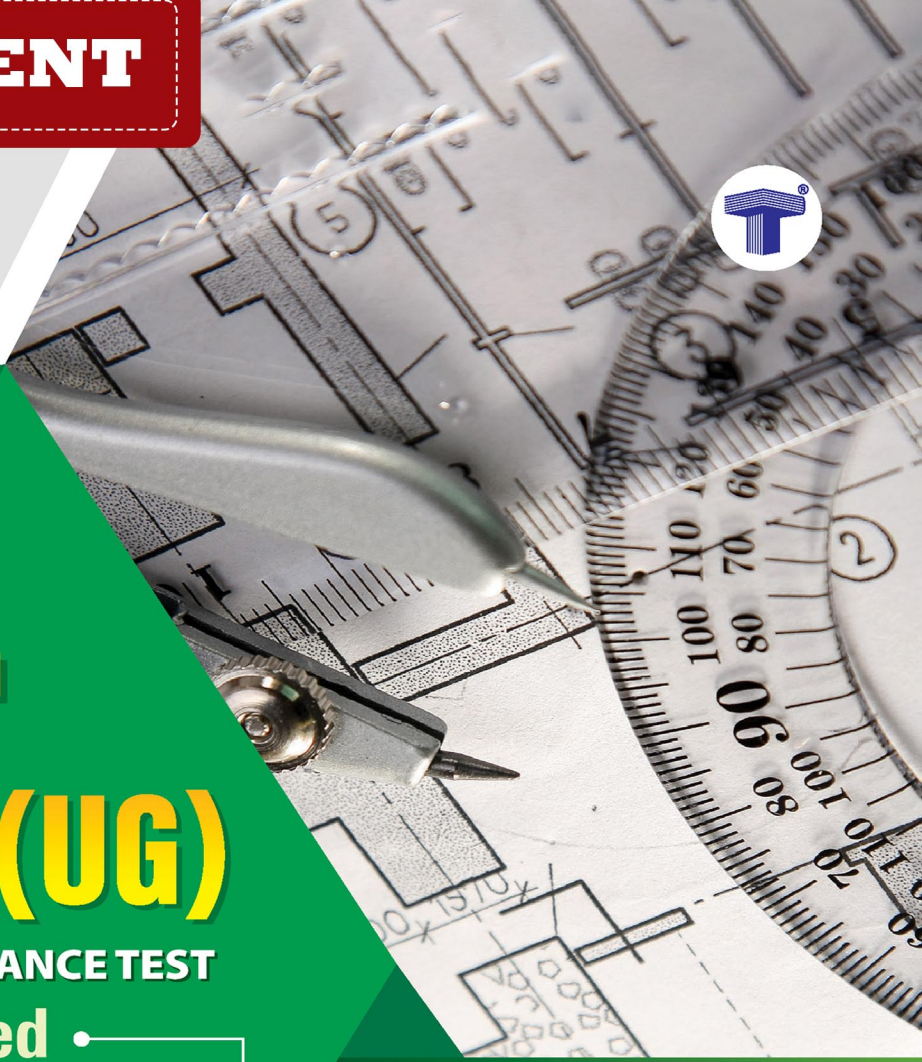
SAMPLE CONTENT

TRIUMPH



CUET (UG)

COMMON UNIVERSITY ENTRANCE TEST

Based on notified syllabus prescribed by NTA

1326 MCQs

LOADED WITH AMAZING FEATURES

- Caution
- Connections
- Topic Test
- Shortcuts
- Subtopic wise MCQs

MATHEMATICS

Mr. Vinod Singh
M.Sc. (Mathematics)

Target Publications®

For Common University Entrance Test CUET (UG) based on syllabus prescribed by Testing Agency (NTA)

TRIUMPH

CUET (UG)

Mathematics

Salient Features

- **'1326'** MCQs for ample practice
- Synopsis to offer a crisp overview of the chapter
- Subtopic wise segregation of MCQs for extensive practice
- Detailed solutions provided for better understanding
- Connections, Cautions designed to impart holistic learning
- Shortcuts are provided wherever deemed necessary
- A list of formulae provided via Q.R. code for quick revision
- Topic Test provided for self-assessment at the end of each chapter
- Solution to Topic Test accessible via Q.R. code
- Includes Passage-based MCQs with Answers (Solution provided through Q.R. code)
- Includes relevant questions of CUCET 2021
- Includes question papers (with solutions accessible via QR code) of:
  - CUET (UG) 2022, 17th August (Slot - 1)
  - CUET (UG) 2023, 22nd May (Slot - 3)
  - CUET (UG) 2024, 16th May

Please scan the adjacent QR code in *Quill - The Padhai App* to access the list of formulae segregated chapter-wise

Sample Content

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PREFACE

Common University Entrance Test, CUET (UG) is a pivotal juncture in a student's academic journey. It is a single-window opportunity for the Students to seek admission in the premier higher education institutions.

Target Publications, with more than a decade of experience and expertise in the domain of competitive examination, offers **"CUET (UG) Mathematics"** for all the CUET (UG) aspirants. This book is compiled according to the notified syllabus prescribed by NTA for CUET (UG).

It is a complete preparation and practice book with the unmatched comprehensive amalgamation of theory, MCQs, and the tools that will be needed to clear the exam successfully.

The content of this book is arranged in a logical sequence to enable strategic learning. It provides the students with scientifically accurate context, several study techniques, and relevant supporting details essential for a better understanding of the concepts of Mathematics.

The chapter begins with a **Synopsis** to offer crisp revision to students in efficient form of pointers, tables, charts etc. followed by a variety of **Multiple Choice Questions (MCQs)** in order to familiarize the students with the pattern of competitive examination.

To aid students, Solutions are provided as pertinent. **'Shortcut'** helps students to save time while dealing with a lengthy solution of a question. **'Caution'** is added to make students watchful against commonly made mistakes. Also, **'Connections'** are furnished to enable students perceive the interlinking of concepts covered in different chapters and preparing them for possible coalition questions.

Topic Test is provided at the end of each chapter for self evaluation. Solution to Topic Test can be viewed by scanning the QR code provided at the end of each chapter.

A section of **Passage-based MCQs** covering a wide range of concepts is included at the end of the book. These passages are segregated chapter-wise and their solutions can be viewed through Q.R. code in a pdf format.

Question papers of Latest CUET (UG) examinations upto year 2024 are provided to offer students a glimpse of the complexity of questions asked in entrance examination, solution to which are provided through Q.R. code.

All the features of this book would pave the path for a student to excel in their examination. The features are designed keeping the following elements in mind: Time management, easy memorization, revision, and non-conventional yet simple methods for MCQ solving.

We are confident that this book will cater to the needs of students across varied backgrounds and effectively assist them to achieve their goals.

We hope the book benefits the learner as we have envisioned.

Publisher

Edition: Third

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 at: mail@targetpublications.org

Disclaimer

This reference book is based on syllabus prescribed by National Testing Agency (NTA) for CUET (UG). We the publishers are making this reference book which constitutes as fair use of textual contents which are transformed by adding and elaborating, with a view to simplify the same to enable the students to understand, memorize and reproduce the same in examinations.

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Sample Content

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Note: Symbol along with the question indicates that there exists use of Shortcut for solving that MCQ in the Hint.

'**Caution**' makes students watchful against commonly made mistakes.

'**Connections'** to interlink concepts covered in different chapters.

Does the topic of Calculus scare you? Do you find it too difficult to approach? Here's a book that simplifies it for you in the language that you understand. Scan the adjacent QR Code to know more about our ***"Basics of Calculus Simplified"*** *book*.

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

Scan the adjacent Q.R. Code in *Quill - The Padhai App* to access detailed information on the syllabus and paper pattern issued by NTA.

Sample Content

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03 Matrices

Content and Concepts

3.1 Introduction
3.2 Matrix
3.3 Types of Matrices
3.4 Operations on Matrices
3.5 Transpose of a Matrix
3.6 Symmetric and Skew Symmetric Matrices
3.7 Elementary Operation (Transformation) of a Matrix
3.8 Invertible Matrices

Synopsis

1. Matrix:

A rectangular arrangement of mn numbers (real or complex) in m rows and n columns is called a **matrix**. This arrangement is enclosed by [ ] or ( ). Generally matrices are represented by capital letters A, B, C, etc. and its elements are represented by small letters a, b, c, etc.

Order of a matrix:

If a matrix A has m rows and n columns, then A is of **order** m × n or simple m × n matrix (read as m by n matrix). A matrix A of order m × n is usually written as

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1j} & \dots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2j} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & & \vdots & & \vdots \\ a_{i1} & a_{i2} & a_{i3} & \dots & a_{ij} & \dots & a_{in} \\ \vdots & \vdots & \vdots & & \vdots & & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \dots & a_{mj} & \dots & a_{mn} \end{bmatrix}$$

or $A = [a_{ij}]_{m \times n}$, where $i = 1, 2, \dots m$
$j = 1, 2, \dots n$

Here, a_{ij} denotes the element of the matrix A in i^{th} row and j^{th} column.

A matrix of order m × n contains mn elements. Every row of such a matrix contains n elements and every column contains m elements.

2. Types of matrices:

i. Column matrix:

A matrix having only one column is called a **column matrix** or a **column vector**.

Thus, $A = [a_{ij}]_{m \times n}$ is a column matrix, if n = 1

ii. Row matrix:

A matrix having only one row is called a **row-matrix** or a **row vector**.

Thus, $A = [a_{ij}]_{m \times n}$ is a row matrix, if m = 1.

iii. Square matrix:

A matrix $A = [a_{ij}]_{m \times n}$ is called a **square matrix**, if number of rows is equal to number of columns (m = n).

iv. Diagonal matrix:

A square matrix in which all its non-diagonal elements are zero is called a **diagonal matrix**.

Thus, a square matrix $A = [a_{ij}]_{n \times n}$ is a diagonal matrix, if $a_{ij} = 0 \ \forall \ i \neq j$

v. Scalar matrix:

A square matrix $A = [a_{ij}]_{n \times n}$ is called a **scalar matrix**, if all its non-diagonal elements are zero and diagonal elements are same.

Thus, a square matrix $A = [a_{ij}]_{n \times n}$ is a scalar matrix, if $a_{ij} = \begin{cases} 0, & i \neq j \\ \lambda, & i = j \end{cases}$, where λ is a constant.

Note:

A scalar matrix is always a diagonal matrix

vi. Identity matrix:

A square matrix $A = [a_{ij}]_{n \times n}$ is called an **identity** or **unit matrix**, if all its non-diagonal elements are zero and diagonal elements are one.

Thus, a square matrix $A = [a_{ij}]_{n \times n}$ is a unit matrix, if $a_{ij} = \begin{cases} 0, & i \neq j \\ 1, & i = j \end{cases}$

A unit matrix is denoted by I.

Note:

Every unit matrix is a diagonal as well as a scalar matrix

vii. Zero matrix:

A matrix whose all elements are zero is called a **null matrix** or a **zero matrix**. It is denoted by O.

Thus, $A = [a_{ij}]_{m \times n}$ is a zero matrix, if $a_{ij} = 0 \ \forall$ i and j

3. Equality of matrices:

Two matrices $A = [a_{ij}]$ and $B = [b_{ij}]$ are said to be equal, if

i. they are of the same order

ii. their corresponding elements are equal (i.e., $a_{ij} = b_{ij} \ \forall$ i, j)

4. Operations on matrices:

Addition of matrices:

Let $A = [a_{ij}]_{m \times n}$ and $B = [b_{ij}]_{m \times n}$ be two matrices of the same order. Then their sum (denoted by A + B) is defined to be matrix $[c_{ij}]_{m \times n}$, where $c_{ij} = a_{ij} + b_{ij}$ for $1 \leq i \leq m$, $1 \leq j \leq n$.

Sample Content

10. (C)

Here, $g(f(x)) = |\sin x|$

$\Rightarrow g(f(x)) = \sqrt{\sin^2 x}$

$\Rightarrow g(\sin^2 x) = \sqrt{\sin^2 x}$

$\Rightarrow g(x) = \sqrt{x}$

11. (B)

Given, $g(x) = x^2 + x - 2$

and $\frac{1}{2}(gof)(x) = 2x^2 - 5x + 2$

$\Rightarrow g(f(x)) = 4x^2 - 10x + 4$

$\Rightarrow (f(x))^2 + f(x) - 2 = 4x^2 - 10x + 4$

$\Rightarrow (f(x))^2 + f(x) - (4x^2 - 10x + 6) = 0$

$$\Rightarrow f(x) = \frac{-1 \pm \sqrt{1 + 16x^2 - 40x + 24}}{2}$$

$$= \frac{-1 \pm (4x - 5)}{2}$$

$$= 2x - 3, -2x + 2$$

12. (C)

We have, $f(x) = \frac{5x}{4x+5}, x \in R - \left\{\frac{5}{4}\right\}$

Let $f(x) = y$

$\Rightarrow x = f^{-1}(y)$

$$y = \frac{5x}{4x+5}$$

$\Rightarrow 4xy + 5y = 5x$

$\Rightarrow 5y = 5x - 4xy = x(5 - 4y)$

$$\Rightarrow x = \frac{5y}{5-4y}$$

$$g(y) = f^{-1}(y) = \frac{5y}{5-4y}, \; y \in R - \left\{\frac{5}{4}\right\}$$

13. (A)

$(gof)(e) + (fog)(\pi) = g(f(e)) + f(g(\pi))$

$= g(1) + f(0)$

$= -1 + 0$

$= -1$

14. (B)

For $1 \in N$ in co-domain we cannot find any $x \in N$ in domain such that $f(x) = 1$

$\therefore$ function is into $\Rightarrow f^{-1}(x)$ does not exist.

15. (A)

$(fofof)(x) = (fof)(f(x))$

$$= (fof)\left(\frac{x}{\sqrt{1+x^2}}\right)$$

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

$$= f\left[\frac{\frac{x}{\sqrt{1+x^2}}}{\sqrt{1+\frac{x^2}{1+x^2}}}\right]$$

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

$$= \frac{\frac{x}{\sqrt{1+2x^2}}}{\sqrt{1+\frac{x^2}{1+2x^2}}}$$

$$= \frac{x}{\sqrt{1+3x^2}}$$

1.5 Binary Operations

1. (B)

Consider 'Subtraction' operation $-: N \times N \to N$ given by $(a, b) \to a - b$.

Consider (2, 4) under '–'

Here, $2 - 4 = -2 \notin N$

$\therefore$ Subtraction is not a binary operation on N.

> **CAUTION**
>
> In such examples, be careful about the domain. As subtraction is binary operation on R but it is not a binary operation on N.

2. (D)

3. (A)

Consider, $b * a = ba + 1$

$= ab + 1 = a * b$

$\therefore$ * is commutative.

Consider $(a * b) * c = (ab + 1) * c$

$= abc + c + 1$

Also, $a * (b * c) = a * (bc + 1)$

$= abc + a + 1$

Here, $(a * b) * c \neq a * (b * c)$

$\therefore$ * is not associative.

4. (C)

Consider, $b * a = \frac{ba}{2} = \frac{ab}{2} = a * b$

Consider, $a * (b * c) = a + \left(\frac{bc}{2}\right) = \frac{abc}{4}$

Also, $(a * b) * c = \left(\frac{ab}{2}\right) * c = \frac{abc}{4}$

Here, $a * (b * c) = (a * b) * c$

$\therefore$ * is associative.

Sample Content

3.4 Operations on Matrices

1. (A)
If A and B are square matrices of same order, then
A + B = B + A …[By commutative law]

2. (C)
For subtraction of two matrix, they should be of the same order.
∴ p = r, q = s.

3. (D)

$$\cos\theta\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}+\sin\theta\begin{bmatrix}\sin\theta & -\cos\theta\\ \cos\theta & \sin\theta\end{bmatrix}$$

$$=\begin{bmatrix}\cos^2\theta & \cos\theta\sin\theta\\ -\cos\theta\sin\theta & \cos^2\theta\end{bmatrix}+\begin{bmatrix}\sin^2\theta & -\cos\theta\sin\theta\\ \sin\theta\cos\theta & \sin^2\theta\end{bmatrix}$$

$$=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$$

4. (B)
4A + 5B – C = 0

$$\Rightarrow C = 4A + 5B$$

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

$$=\begin{bmatrix}20 & 0\\ 4 & 0\end{bmatrix}+\begin{bmatrix}0 & 5\\ -5 & 0\end{bmatrix}=\begin{bmatrix}20 & 5\\ -1 & 0\end{bmatrix}$$

5. (B)

$$2A+3B=\begin{bmatrix}2 & -1 & 4\\ 3 & 2 & 5\end{bmatrix} \quad ...(i)$$

$$\text{and } A+2B=\begin{bmatrix}5 & 0 & 3\\ 1 & 6 & 2\end{bmatrix}$$

$$\therefore \quad 2A+4B=\begin{bmatrix}10 & 0 & 6\\ 2 & 12 & 4\end{bmatrix} \quad ...(ii)$$

Subtracting (ii) from (i), we get

$$B=\begin{bmatrix}8 & 1 & 2\\ -1 & 10 & -1\end{bmatrix}$$

6. (B)

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

$$\Rightarrow\begin{bmatrix}x-2 & 1\\ 4 & y+4\end{bmatrix}=\begin{bmatrix}1 & 1\\ 4 & 2\end{bmatrix}$$

∴ by the equality of matrices,
$x - 2 = 1, y + 4 = 2$
$\Rightarrow x = 3, y = -2$

7. (C)

$$kA=\begin{bmatrix}0 & 3a\\ 2b & 24\end{bmatrix}$$

$$\Rightarrow k\begin{bmatrix}0 & 2\\ 3 & -4\end{bmatrix}=\begin{bmatrix}0 & 3a\\ 2b & 24\end{bmatrix}$$

$$\Rightarrow\begin{bmatrix}0 & 2k\\ 3k & -4k\end{bmatrix}=\begin{bmatrix}0 & 3a\\ 2b & 24\end{bmatrix}$$

∴ by the equality of matrices,
$2k = 3a, 3k = 2b, -4k = 24$
$\Rightarrow k = \frac{3a}{2}, k = \frac{2b}{3}, k = -6$
$\Rightarrow -6 = \frac{3a}{2}, -6 = \frac{2b}{3}$
$\Rightarrow a = -4, b = -9$

8. (B)

$$A-B=\frac{1}{\pi}\begin{bmatrix}\sin^{-1}(\pi x) & \tan^{-1}\left(\frac{x}{\pi}\right)\\ \sin^{-1}\left(\frac{x}{\pi}\right) & \cot^{-1}(\pi x)\end{bmatrix}-\frac{1}{\pi}\begin{bmatrix}-\cos^{-1}(\pi x) & \tan^{-1}\left(\frac{x}{\pi}\right)\\ \sin^{-1}\left(\frac{x}{\pi}\right) & -\tan^{-1}(\pi x)\end{bmatrix}$$

$$=\begin{bmatrix}\frac{1}{\pi}.\frac{\pi}{2} & 0\\ 0 & \frac{1}{\pi}.\frac{\pi}{2}\end{bmatrix} \quad \cdots \begin{bmatrix}\because \sin^{-1}x+\cos^{-1}x=\frac{\pi}{2},\\ \tan^{-1}x+\cot^{-1}x=\frac{\pi}{2}\end{bmatrix}$$

$$=\begin{bmatrix}\frac{1}{2} & 0\\ 0 & \frac{1}{2}\end{bmatrix}=\frac{1}{2}\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}=\frac{1}{2}I$$

Connections – Q.8.

In Chapter 2: Inverse Trigonometric Functions, we have studied 'Properties of inverse trigonometric functions'.

9. (B)
A + B is defined when A and B are of same order m × n (say).
A . B is defined
⇒ Number of columns in A
= Number of rows in B
⇒ n = m
⇒ A and B are square matrices of same order.

10. (A)

$$AB=\begin{bmatrix}1 & 2 & 3\end{bmatrix}_{1\times1}\begin{bmatrix}2\\ 3\\ 4\end{bmatrix}_{1\times1}$$

$$=[20]_{1\times1}$$

∴ AB is defined.

11. (A)

$$A^2=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ a & b & -1\end{bmatrix}\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ a & b & -1\end{bmatrix}=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$$

= a unit matrix

Sample Content

4. **(C)**

At $x = 1$, $f(x)$ is not defined.

For $x \in R - \{1\}$,

$$g(x) = f[f\{f(x)\}] = f\left[f\left(\frac{1}{1-x}\right)\right] = f\left(\frac{1}{1-\frac{1}{1-x}}\right)$$

$$= f\left(\frac{x-1}{x}\right) = \frac{1}{1-\frac{x-1}{x}} = x$$

$\therefore$ $g'(x) = 1$ for all $x \in R - \{1\}$

5. **(C)**

$y = (\sin x)^{(\sin x)^{(\sin x)\ldots\infty}} \Leftrightarrow y = (\sin x)^y$

$$\Rightarrow \frac{dy}{dx} = \frac{y^2 \cos x}{\sin x[1 - y\log(\sin x)]} = \frac{y^2 \cot x}{1 - y\log(\sin x)}$$

Shortcut

If $y = [f(x)]^y$, then $\frac{dy}{dx} = \frac{y^2 f'(x)}{f(x)[1 - y \log f(x)]}$.

Aliter:

Taking log on both sides, we get

$\log y = y \log (\sin x)$

$$\Rightarrow \left(\frac{1}{y} - \log\sin x\right) y' = y\left(\frac{1}{\sin x}\right)\cos x$$

$$\Rightarrow y' = \frac{y^2 \cot x}{1 - y \log \sin x}$$

6. **(C)**

$y = f(x^2 + 2)$

$\therefore$ $\frac{dy}{dx} = f'(x^2 + 2).(2x)$

$\therefore$ $\left(\frac{dy}{dx}\right)_{x=1} = f'(1^2 + 2).(2 \times 1)$

$= f'(3).2 = 5.2 = 10$

7. **(D)**

$g(x) = [f(2f(x) + 2)]^2$

$\therefore$ $g'(x) = 2[f(2f(x) + 2)] . [f(2f(x) + 2)]'$

$= 2[(2f(x) + 2] f'[2f(x) + 2] . 2f'(x)$

$\therefore$ $g'(0) = 2[f(-2 + 2)] f'[-2 + 2] . 2(1)$

$= 2[f(0)][f'(0)] 2$

$= 2(-1)(1)2$

$= -4$

8. **(B)**

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

$\therefore$ $f'(x) = \frac{1}{2\sqrt{1 + \cos^2(x^2)}} .(2 \cos x^2).(-\sin x^2).(2x)$

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

$\therefore$ $f'\left(\frac{\sqrt{\pi}}{2}\right) = \frac{-\frac{\sqrt{\pi}}{2} \cdot \sin\frac{2\pi}{4}}{\sqrt{1 + \cos^2\frac{\pi}{4}}} = -\frac{\frac{\sqrt{\pi}}{2} \cdot 1}{\sqrt{\frac{3}{2}}} = -\sqrt{\frac{\pi}{6}}$

9. **(C)**

$$f(x) = \frac{\sin^2 x}{1 + \cot x} + \frac{\cos^2 x}{1 + \tan x}$$

$$= \frac{\sin^2 x(\sin x)}{\sin x + \cos x} + \frac{\cos^2 x(\cos x)}{\cos x + \sin x}$$

$$= \frac{\sin^3 x + \cos^3 x}{\sin x + \cos x}$$

$= \sin^2 x - \sin x \cos x + \cos^2 x$

$\ldots[\because a^3 + b^3 = (a + b)(a^2 - ab + b^2)]$

$= (\sin^2 x + \cos^2 x) - \frac{1}{2}(2 \sin x \cos x)$

$= 1 - \frac{1}{2}.\sin 2x$

$\therefore$ $f'(x) = -\cos 2x \Rightarrow f'\left(\frac{\pi}{4}\right) = -\cos\left(\frac{\pi}{2}\right) = 0$

10. **(A)**

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

$\Rightarrow y^2 - x^2 y = 1 \Rightarrow (2y - x^2) y' = 2xy$

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

Shortcut

If $y = f(x) + \frac{1}{y}$, then $\frac{dy}{dx} = \frac{y f'(x)}{2y - f(x)}$.

11. **(B)**

$h(x) = f(g(x))$

$\Rightarrow h(x) = f(\sin^{-1} x) = e^{\sin^{-1} x}$ ...(i)

$\therefore$ $h'(x) = e^{\sin^{-1} x} . \frac{d}{dx}(\sin^{-1} x) = e^{\sin^{-1} x} \cdot \frac{1}{\sqrt{1 - x^2}}$

$\therefore$ $\frac{h'(x)}{h(x)} = \frac{1}{\sqrt{1 - x^2}}$ ...[From (i)]

12. **(C)**

$y = e^{m \sin^{-1} x}$ ...(i)

$\therefore$ $\frac{dy}{dx} = e^{m \sin^{-1} x} . \frac{m}{\sqrt{1 - x^2}}$

$\Rightarrow \sqrt{1 - x^2}\ \frac{dy}{dx} = my$ ...[From (i)]

$\Rightarrow (1 - x^2)\left(\frac{dy}{dx}\right)^2 = m^2 y^2$

$\therefore$ $A = m^2$

Sample Content

13. Let W denote the words in English dictionary. Define the relation R by R = {(*x*, *y*) ∈ W × W: the words *x* and *y* have at least one letter in common}, then R is
(A) reflexive, not symmetric and transitive
(B) not reflexive, symmetric and transitive
(C) reflexive, symmetric and not transitive
(D) reflexive, symmetric and transitive

14. Let P be any non-empty set containing p elements. Then, what is the number of relations on P? **[CUCET 2021]**
(A) 2p (B) 2^{p^2} (C) p^2 (D) p^p

15. The number of reflexive relations of a set with four elements is equal to
(A) 2^{16} (B) 2^{12}
(C) 2^8 (D) 2^4

1.3 Types of Functions

1. The function f : N → N, where N is the set of natural numbers, defined by f(*x*) = 2*x* + 3, is
(A) surjective (B) bijective
(C) injective (D) none of these

2. Let A and B be two finite sets having m and n elements respectively. If m ≤ n, then total number of injective functions from A to B is
(A) m^n (B) n^m
(C) $\frac{n!}{(n-m)!}$ (D) n!

3. If *x*, *y* ∈ R and *x*, *y* ≠ 0; f(*x*, *y*) → $\frac{x}{y}$, then the function is a/an
(A) surjective (B) bijective
(C) one-one (D) none of these

4. The number of surjections from A = {1, 2,…., n}, n ≥ 2, onto B = {a, b} is
(A) $^nP_2$ (B) $2^n - 2$
(C) $2^n - 1$ (D) 2^n

5. The number of onto functions from {1, 2, 3} onto {p, q} is
(A) 7 (B) 5 (C) 6 (D) 4

6. If A = {a, b, c}, then f = {(a, b), (b, c), (c, a)} is
(A) not a function from A to A
(B) a bijection from A to A
(C) one-one but not onto
(D) none of these

7. A function f from the set of natural numbers to integers defined by
$$f(n) = \begin{cases} \frac{n-1}{2}, & \text{when } n \text{ is odd} \\ -\frac{n}{2}, & \text{when } n \text{ is even} \end{cases}$$, is
(A) one-one but not onto
(B) onto but not one-one
(C) one-one and onto both
(D) neither one-one nor onto

8. If $f(x) = \begin{cases} x, & \text{if } x \text{ is rational} \\ 0, & \text{if } x \text{ is irrational} \end{cases}$
and $g(x) = \begin{cases} 0, & \text{if } x \text{ is rational} \\ x, & \text{if } x \text{ is irrational} \end{cases}$,
then f – g is
(A) one-one and onto
(B) only one-one
(C) only onto
(D) neither one-one nor onto

9. If f : [0, ∞) → [0, 2] be defined by f(*x*) = $\frac{2x}{1+x}$, then f is
(A) one-one but not onto
(B) onto but not one-one
(C) both one-one and onto
(D) neither one-one nor onto

10. The function f : R → R, f(*x*) = x^2 is
(A) injective but not surjective
(B) surjective but not injective
(C) injective as well as surjective
(D) neither injective nor surjective

11. Let f : R → R be defined by f(*x*) = x^4, then
(A) f is one-one and onto
(B) f may be one-one and onto
(C) f is one-one but not onto
(D) f is neither one-one nor onto

12. Let f: R → R be a function defined by f(*x*) = $\frac{x^2-8}{x^2+2}$, then f is
(A) one-one but not onto
(B) one-one and onto
(C) onto but not one-one
(D) neither one-one nor onto

13. If R denotes the set of all real numbers, then the function f : R → R defined by f(*x*) = [*x*] is
(A) one-one only
(B) onto only
(C) both one-one and onto
(D) neither one-one nor onto

14. Function f : R → R, f(*x*) = $x^2 + x$, is
(A) one-one only
(B) onto only
(C) both one-one and onto
(D) neither one-one nor onto

Sample Content

Multiple Choice Questions

6.2 Rate of Change of Quantities

1. Radius of a circle is increasing uniformly at the rate of 3cm/sec. The rate of increase in area when radius is 10cm, will be
(A) $\pi cm^2/s$ (B) $2\pi cm^2/s$
(C) $10\pi cm^2/s$ (D) $60\pi\ cm^2/sec$

2. Sides of a square are increasing at the rate 0.5 cm/ sec. When the side is 10 cm long, its area is increasing at the rate of
(A) $100\ cm^2/sec$ (B) $0.10\ cm^2/sec$
(C) $10\ cm^2/sec$ (D) $1\ cm^2/sec$

3. The length of the side of a square sheet of metal is increasing at the rate of 4 cm / sec. The rate at which the area of the sheet is increasing when the length of its side is 2 cm, is
(A) $16\ cm^2/sec$ (B) $8\ cm^2/sec$
(C) $32\ cm^2/sec$ (D) $4\ cm^2/sec$

4. Gas is being pumped into a spherical balloon at the rate of 30 ft^3/min. Then, the rate at which the radius increases when it reaches the value 15 ft is
(A) $\frac{1}{30\pi}$ ft/min (B) $\frac{1}{15\pi}$ ft/min
(C) $\frac{1}{20}$ ft/min (D) $\frac{1}{25}$ ft/min

5. The edge of a cube is increasing at the rate of 5cm/sec. How fast is the volume of the cube increasing when the edge is 12cm long?
(A) $432\ cm^3/sec$ (B) $2160\ cm^3/sec$
(C) $180\ cm^3/sec$ (D) $1920\ cm^3/sec$

6. The diagonal of a square is changing at the rate of 0.5 cm/sec. Then the rate of change of area, when the area is 400 cm^2, is equal to
(A) $20\sqrt{2}\ cm^2/sec$ (B) $10\sqrt{2}\ cm^2/sec$
(C) $\frac{1}{10\sqrt{2}}\ cm^2/sec$ (D) $\frac{10}{\sqrt{2}}\ cm^2/sec$

7. A man of height 1.8 metre is moving away from a lamp post at the rate of 1.2 m/sec. If the height of the lamp post be 4.5 metre, then the rate at which the shadow of the man is lengthening is
(A) 0.4m/sec (B) 0.8m/sec
(C) 1.2m/sec (D) 1.8m/sec

8. A ladder 5 m in length is resting against vertical wall. The bottom of the ladder is pulled along the ground away from the wall at the rate of 1.5m/sec. The length of the highest point of the ladder when the foot of the ladder 4 m away from the wall decreases at the rate of
(A) 2 m/sec (B) 3 m/sec
(C) 2.5 m/sec (D) 1.5 m/sec

9. The sides of an equilateral triangle are increasing at the rate of 2 cm/sec. The rate at which the area increases, when the side is 10 cm is
(A) $\sqrt{3}$ sq. unit/sec (B) 10 sq. unit/sec
(C) $10\sqrt{3}$ sq. unit/sec (D) $\frac{10}{\sqrt{3}}$ sq. unit/sec

10. The rate of change of volume of a sphere with respect to its surface area when the radius is 4 cm is
(A) $4\ cm^3/cm^2$ (B) $2\ cm^3/cm^2$
(C) $6\ cm^3/cm^2$ (D) $8\ cm^3/cm^2$

11. The point on the curve $6y = x^3 + 2$ at which y–co-ordinate is changing 8 times as fast as x-co-ordinate is _____
(A) (4, 11) (B) (4, – 11)
(C) (–4, 11) (D) (– 4, – 11)

12. The total revenue in rupees received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$. The marginal revenue, when $x = 5$, is
(A) 36 (B) 66 (C) 78 (D) 108

6.3 Increasing and Decreasing Functions

1. The function $f(x) = x^2$ is increasing in the interval
(A) (–1, 1) (B) $(-\infty,\infty)$
(C) $(0, \infty)$ (D) $(-\infty, 0)$

2. The function $f(x) = 2x^3 + 9x^2 + 12x + 20$ is increasing in the interval
(A) $(-\infty,-1)$
(B) $(2, \infty)$
(C) $(-\infty, -2) \cup (-1, \infty)$
(D) $(-2, \infty)$

3. If $f(x) = x^3 - 6x^2 + 9x + 3$ is a decreasing function, then x lies in
(A) $(-\infty, -1) \cap (3, \infty)$
(B) (1, 3)
(C) $(3, \infty)$
(D) (1, 4)

4. On the interval $\left(0, \frac{\pi}{2}\right)$, the function log (sin x) is
(A) Increasing
(B) Decreasing
(C) Neither increasing nor decreasing
(D) None of these

5. The values of x for which the function $\frac{\log x}{x}$ decreases is
(A) $x > 1$ (B) $x < 1$
(C) $x > e$ (D) $x > 3$

Sample Content

44. The value of the expression $\tan\left(\frac{1}{2}\cos^{-1}\frac{2}{\sqrt{5}}\right)$ is

(A) $2-\sqrt{5}$ (B) $\sqrt{5}-2$

(C) $\frac{\sqrt{5}-2}{2}$ (D) $5-\sqrt{2}$

45. If $\sin^{-1}\left(\frac{2a}{1+a^2}\right)+\sin^{-1}\left(\frac{2b}{1+b^2}\right)=2\tan^{-1}x$, then $x=$

(A) $\frac{a-b}{1+ab}$ (B) $\frac{b}{1+ab}$

(C) $\frac{b}{1-ab}$ (D) $\frac{a+b}{1-ab}$

Answers to MCQs

2.2 :	1.	(B)	2.	(B)	3.	(D)	4.	(D)	5.	(D)	6.	(B)	7.	(B)	8.	(B)	9.	(B)	
2.3 :	1.	(B)	2.	(C)	3.	(A)	4.	(C)	5.	(A)	6.	(D)	7.	(A)	8.	(D)	9.	(A)	10. (C)
	11.	(B)	12.	(D)	13.	(B)	14.	(B)	15.	(A)	16.	(B)	17.	(B)	18.	(C)	19.	(D)	20. (A)
	21.	(D)	22.	(D)	23.	(C)	24.	(D)	25.	(B)	26.	(A)	27.	(C)	28.	(A)	29.	(B)	30. (A)
	31.	(A)	32.	(B)	33.	(B)	34.	(B)	35.	(A)	36.	(A)	37.	(D)	38.	(A)	39.	(D)	40. (D)
	41.	(A)	42.	(C)	43.	(C)	44.	(B)	45.	(D)									

Solutions to MCQs

2.2 Basic Concepts

1. (B) 2. (B) 3. (D)

4. (D)

5. (D)

Let $\sin^{-1}\left(-\frac{1}{2}\right)=y$

$\Rightarrow \sin y=-\frac{1}{2}$

The principal value branch of $\sin^{-1}$ is $\left[\frac{-\pi}{2},\frac{\pi}{2}\right]$

and $\sin\left(-\frac{\pi}{6}\right)=-\frac{1}{2}$

$\therefore$ The principal value of $\sin^{-1}\left(-\frac{1}{2}\right)$ is $-\frac{\pi}{6}$.

6. (B)

$\sin^{-1}\left(\frac{1}{2}\right)+\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)+\cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$

$=\frac{\pi}{6}+\frac{\pi}{6}+\frac{2\pi}{3}$

$=\pi$

7. (B)

$$\frac{\tan^{-1}\left(\sqrt{3}\right)-\sec^{-1}(-2)}{\operatorname{cosec}^{-1}\left(-\sqrt{2}\right)+\cos^{-1}\left(-\frac{1}{2}\right)}$$

$$=\frac{\frac{\pi}{3}-\frac{2\pi}{3}}{\frac{-\pi}{4}+\frac{2\pi}{3}}$$

$$=\frac{-4}{5}$$

8. (B)

$\sin^{-1}\left(\frac{2x+1}{3}\right)$ is defined for

$-1\le\frac{2x+1}{3}\le 1$

$\Rightarrow -3\le 2x+1\le 3$

$\Rightarrow -4\le 2x\le 2$

$\Rightarrow -2\le x\le 1$

9. (B)

For y to be defined, $\left|\frac{x^2}{1+x^2}\right|<1$ which is true for all $x\in R$. So, the domain = $(-\infty,\infty)$.

Now, $y=\sin^{-1}\left(\frac{x^2}{1+x^2}\right)$

$\Rightarrow \frac{x^2}{1+x^2}=\sin y$

$\Rightarrow x^2=\sin y+x^2\sin y$

$\Rightarrow x^2=\frac{\sin y}{1-\sin y}$

$\Rightarrow x=\sqrt{\frac{\sin y}{1-\sin y}}$

For x to be real, $\sin y\ge 0$ and $1-\sin y>0$

$\Rightarrow 0\le\sin y<1$

$\Rightarrow y\in\left[0,\frac{\pi}{2}\right)$

$\therefore$ Range = $\left[0,\frac{\pi}{2}\right)$

Sample Content

Topic Test

1. The area bounded by the curve $y = |\sin x|$, X axis and the lines $x = -\pi$ and $x = \pi$ is
(A) 2 sq. units (B) 1 sq. unit
(C) 4 sq. units (D) None of these

2. The area enclosed by the parabola $y^2 = 4ax$ and the straight line $y = 2ax$ is
(A) $\frac{a^2}{3}$ sq. units (B) $\frac{1}{3a^2}$ sq. units
(C) $\frac{1}{3a}$ sq. units (D) $\frac{2}{3a}$ sq. units

3. The area bounded by the curve $y = 2x - x^2$ and the line $y = -x$ is given by
(A) $\frac{2}{3}$ (B) $\frac{9}{2}$ (C) $\frac{1}{2}$ (D) 9

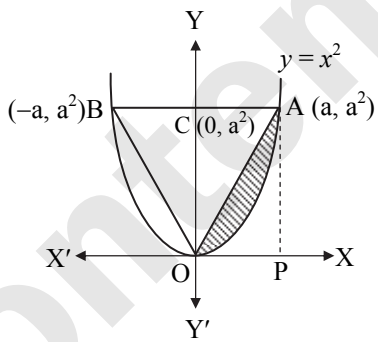
4. The area of the region bounded by the parabola $y = x^2 + 2$ and the lines $y = x$, $x = 0$ and $x = 3$ is
(A) $\frac{21}{2}$ sq. unit (B) $\frac{17}{2}$ sq. unit
(C) $\frac{27}{2}$ sq. unit (D) $\frac{9}{2}$ sq. unit

5. The area bounded by the curve $x = 2 - y - y^2$ and the Y-axis is
(A) $\frac{5}{2}$ sq. units (B) $\frac{7}{2}$ sq. units
(C) $\frac{9}{2}$ sq. units (D) $\frac{11}{2}$ sq. units

6. The area of the region bounded by the curve $y^2 = 4a^2(x - 1)$ and the lines $x = 1$, $y = 4a$ is
(A) $\frac{21a}{2}$ sq. units (B) $\frac{16}{3}$ sq. units
(C) $\frac{17a}{3}$ sq. units (D) $\frac{16a}{3}$ sq. units

7. The area bounded by the two curves $y^2 = x + 1$ and $y^2 = -x + 1$ is
(A) $\frac{8}{3}$ sq. units (B) $\frac{4}{3}$ sq. units
(C) 2 sq. units (D) $\frac{16}{3}$ sq. units

8. The area of the region bounded by the curves $x^2 + 4y^2 = 4$ and $4y^2 = 3x$ is
(A) $\left(\frac{2\pi}{3} + \frac{1}{2\sqrt{3}}\right)$ sq. unit
(B) $\left(\frac{3\pi}{2} + \frac{2}{2\sqrt{3}}\right)$ sq. unit
(C) $\left(\frac{2\pi}{5} + \frac{1}{2\sqrt{5}}\right)$ sq. unit
(D) None of these

9. 

The area of the shaded portion in the figure is
(A) $\frac{a^3}{2}$ sq. unit (B) $\frac{a^3}{3}$ sq. unit
(C) $\frac{a^3}{6}$ sq. unit (D) None of these

10. The area enclosed by the parabola $(y - 2)^2 = x - 1$, the tangent to the parabola at (2, 3) and the X-axis is
(A) 4 sq. units (B) 6 sq. units
(C) 9 sq. units (D) 12 sq. units

Answers to Topic Test

1. (C) 2. (C) 3. (B) 4. (A)
5. (C) 6. (D) 7. (A) 8. (A)
9. (C) 10. (C)

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Sample Content

CUET (UG) - 2024 Question Paper

16th May 2024

Note:

- *All questions from section A are compulsory.*
- *Attempt any 25 questions from section B1.*

SECTION - A

1. If A and B are symmetric matrices of the same order, then AB – BA is a:
   (A) symmetric matrix
   (B) zero matrix
   (C) skew symmetric matrix
   (D) identity matrix

2. If A is square matrix of order 4 and |A| = 4, then |2A| will be :
   (A) 8 (B) 64
   (C) 16 (D) 4

3. If $[A]_{3\times 2}\,[B]_{x\times y} = [C]_{3\times 1}$, then :
   (A) $x = 1, y = 3$ (B) $x = 2, y = 1$
   (C) $x = 3, y = 3$ (D) $x = 3, y = 1$

4. If a function $f(x) = x^2 + bx + 1$ is increasing in the interval [1, 2], then the least value of b is :
   (A) 5 (B) 0
   (C) –2 (D) –4

5. Two dice are thrown simultaneously. If X denotes the number of fours, then the expectation of X will be :
   (A) $\frac{5}{9}$ (B) $\frac{1}{3}$
   (C) $\frac{4}{7}$ (D) $\frac{3}{8}$

6. For the function $f(x) = 2x^3 - 9x^2 + 12x - 5$, $x \in [0, 3]$, match List-I with List-II :

List – I		List – II	
i.	Absolute maximum value	a.	3
ii.	Absolute minimum value	b.	0
iii.	Point of maxima	c.	–5
iv.	Point of minima	d.	4

   Choose the correct answer from the options given below:
   (A) i – d, ii – b, iii – a, iv – c
   (B) i – b, ii – c, iii – a, iv – d
   (C) i – d, ii – c, iii – b, iv – a
   (D) i – d, ii – c, iii – a, iv – b

7. An objective function Z = ax + by is maximum at points (8, 2) and (4, 6). If a ≥ 0 and b ≥ 0 and ab = 25, then the maximum value of the function is equal to :
   (A) 60 (B) 50
   (C) 40 (D) 80

8. The area of the region bounded by the lines $x + 2y = 12$, $x = 2$, $x = 6$ and x-axis is:
   (A) 34 sq. units (B) 20 sq. units
   (C) 24 sq. units (D) 16 sq. units

9. A die is rolled thrice. What is the probability of getting a number greater than 4 in the first and the second throw of dice and a number less than 4 in the third throw?
   (A) $\frac{1}{3}$ (B) $\frac{1}{6}$
   (C) $\frac{1}{9}$ (D) $\frac{1}{18}$

10. The corner points of the feasible region determined by
    $x + y \le 8, 2x + y \ge 8, x \ge 0, y \ge 0$
    are A(0, 8), B(4, 0) and C(8, 0). If the objective function Z = ax + by has its maximum value on the line segment AB, then the relation between a and b is :
    (A) 8a + 4 = b (B) a = 2b
    (C) b = 2a (D) 8b + 4 = a

11. If $t = e^{2x}$ and $y = \log_e t^2$, then $\frac{d^2y}{dx^2}$ is :
    (A) 0 (B) 4t
    (C) $\frac{4e^{2t}}{t}$ (D) $\frac{e^{2t}(4t-1)}{t^2}$

12. $\int \frac{\pi}{x^{n+1} - x}dx =$
    (A) $\frac{\pi}{n}\log_e\left|\frac{x^n-1}{x^n}\right| + C$ (B) $\log_e\left|\frac{x^n+1}{x^n-1}\right| + C$
    (C) $\frac{\pi}{n}\log_e\left|\frac{x^n+1}{x^n}\right| + C$ (D) $\pi\log_e\left|\frac{x^n}{x^n-1}\right| + C$

13. The value of $\int_0^1 \frac{a - bx^2}{(a + bx^2)^2}dx$ is :
    (A) $\frac{a-b}{a+b}$ (B) $\frac{1}{a-b}$
    (C) $\frac{a+b}{2}$ (D) $\frac{1}{a+b}$

Sample Content

45. The distance between the lines $\vec{r} = \hat{i} - 2\hat{j} + 3\hat{k} + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$ and $\vec{r} = 3\hat{i} - 2\hat{j} + 1\hat{k} + \mu\left(4\hat{i} + 6\hat{j} + 12\hat{k}\right)$ is :

(A) $\frac{\sqrt{28}}{7}$ (B) $\frac{\sqrt{199}}{7}$

(C) $\frac{\sqrt{328}}{7}$ (D) $\frac{\sqrt{421}}{7}$

46. If $f(x) = 2\left(\tan^{-1}\left(e^{x}\right) - \frac{\pi}{4}\right)$, then $f(x)$ is :

(A) even and is strictly increasing in $(0, \infty)$
(B) even and is strictly decreasing in $(0, \infty)$
(C) odd and is strictly increasing in $(-\infty, \infty)$
(D) odd and is strictly decreasing in $(-\infty, \infty)$

47. For the differential equation
$(x \log_e x)dy = (\log_e x - y)dx$
i. Degree of ther given differential equation is 1
ii. It is a homogeneous differential equation.
iii. Solution is $2y \log_e x + A = (\log_e x)^2$, where A is an arbitrary constant
iv. Solution is $2y \log_e x + A = \log_e(\log e\, x)$, where A is an arbitrary constant
Choose the correct answer from the options given below:
(A) i and iii only (B) i, ii and iii only
(C) i, ii and iv only (D) i and iv only

48. There are two bags. Bag – 1 contains 4 white and 6 black balls and Bag – 2 contains 5 white and 5 black balls. A die is rolled, if it shows a number divisible by 3, a ball is drawn from Bag – 1, else a ball is drawn from Bag – 2. If the ball drawn is not black in colour, the probability that it was not drawn from Bag – 2 is :

(A) $\frac{4}{9}$ (B) $\frac{3}{8}$

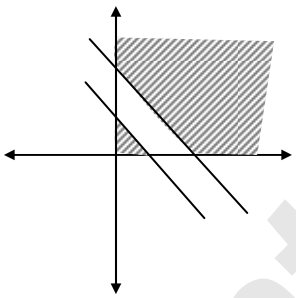
(C) $\frac{2}{7}$ (D) $\frac{4}{19}$

49. Which of the following cannot be the direction ratios of the straight line $\frac{x-3}{2} = \frac{2-y}{3} = \frac{z+4}{-1}$?

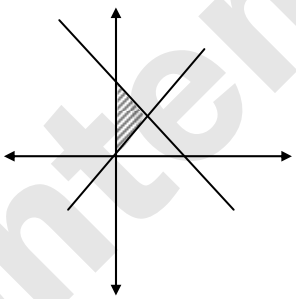
(A) 2, –3, –1 (B) –2, 3, 1
(C) 2, 3, –1 (D) 6. –9, –3

50. Which one of the following represents the correct feasible region determined by the following constraints of an LPP ?
$x + y \geq 10, 2x + 2y \leq 25, x \geq 0, y \geq 0$

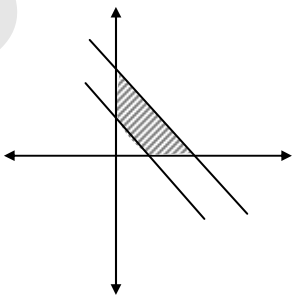
(A)



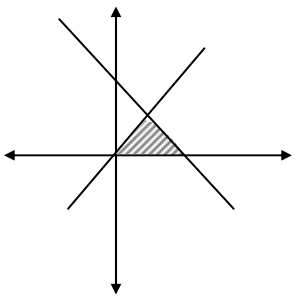
(B)



(C)



(D)



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