SAMPLE CONTENT

Exam Experts

2900+ MCQs

21 YEARS

2004 – 2024

PREVIOUS SOLVED PAPERS

MHT-CET

CHAPTER-WISE & TOPIC-WISE

MATHEMATICS

- Quick Review
- Smart Keys
- Statistical analysis of all the shifts of 2024

Target Publications® Pvt. Ltd.

Exam Experts

MHT-CET

21 YEARS 2004 - 2024

PREVIOUS SOLVED PAPERS

MATHEMATICS

Chapter-wise & Topic-wise

Salient Features

- **Unique Questions:**
  - A vast repository of **2900+** unique and **authentic MCQs** of **21 years** (2004-2024) to enhance your preparation.
  - For the years 2004 – 2020, only questions relevant to the current syllabus have been included.
- **Organized Learning:** Questions are meticulously categorized by chapter and topic.
- **Solutions That Simplify:** Clear, detailed solutions for even the trickiest questions, making complex concepts easy to grasp.
- **The Chapters Include:**
  - **Quick Reviews:** For concept revision
  - **MCQs:** Arranged in a year-wise flow for each topic
  - **Solutions:** Provided wherever required, with solutions from 2004 to 2021 available via QR codes at the end of each chapter
- **Includes Smart Keys for Holistic Learning:**
  - *Thinking Hatke*
  - *Caution*
  - *Shortcuts*
- **2024 Trend Analysis:**
  Gain valuable insights with:
  - Graphs showing difficulty levels across shifts
  - Chapter-wise analysis tables for all shifts
- **QR Codes Provide:** Solutions to MCQs from **2004 to 2021**

Printed at: **Prabodhan Prakashan Pvt. Ltd.,** Navi Mumbai

P.O. No. 14951

TEID: 4285

PREFACE

Target's **'MHT-CET Mathematics : Previous Solved Papers (PSP)'** is a compilation of past 21 years' (2004-2024) questions asked in the MHT-CET examinations conducted by State Common Entrance Test Cell, Maharashtra State. This book is curated as per the **latest MHT-CET syllabus**.

The book features chapter-wise categorization of questions, with each chapter following a topic-wise flow. All questions related to a topic are arranged year-wise, ending with the most recent year. A special topic, **Concept fusion** is drafted at the end of the MCQ section to cover multifarious questions. Answers for all questions from 2004 to 2024 are provided, with solutions from 2004 to 2021 accessible via QR codes and 2022 to 2024 solutions in the book. The solutions will serve as valuable learning tools in understanding the concepts.

Selection of **unique MCQs** is prioritized while making this book to prevent the recurrence of identical questions. This will enable students to save time spent on repetitive questions.

We have infused several **Smart Keys** such as **Cautions, Thinking Hatke and Shortcuts**. These Important Study Techniques are created to help students with key objectives such as time management, easy memorization, revision and non-conventional yet simple methods for MCQ solving. To ensure adequate revision, each chapter begins with a **Quick review**.

A statistical analysis of the number of questions asked per chapter in each shift of MHT-CET 2024 examination is offered in tabular form. This analysis would help students understand the weightage allotted to each chapter. A graphical representation of analysis of all the papers (16 papers of PCM group) is also included at the start of the book to elaborate on the breakdown of the difficulty level of questions asked in the examination. Studying these representations should undoubtedly aid students in planning their study strategy for the examination. *There is a possibility that the weightage to a chapter and the level of difficulty of the question paper in the future examination may vary.*

This book would provide students with confidence regarding their exam preparedness. We are confident that this book will comprehensively cater to the needs of students and effectively assist them to achieve their goal.

Publisher

Edition: Second

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

A book affects eternity; one can never tell where its influence stops.

FEATURES

Quick Review

Quick Review includes tables/charts to summarize the key points of important concepts in the chapter. This is our attempt to help students to reinforce key concepts.

Shortcuts

Shortcuts incorporate important theoretical or formula based short tricks, beneficial in solving MCQs.

Topic-wise Segregation

MCQs are **segregated topic-wise** in each chapter**.** This is our attempt to cater to individualistic pace and preferences of studying a chapter in students and enable easy assimilation of questions based on the specific concept.

Concept Fusion

Concept Fusion topic encompasses questions whose solutions require knowledge of concepts covered in different topics from same chapter or from different chapters.

Thinking Hatke

Thinking Hatke reveals quick witted approach to crack the specific question.

Caution

Caution apprises students about mistakes often made while solving MCQs.

QR Codes

QR Codes include solutions to MCQs from 2004 to 2021

INDEX

MHT-CET PAPER PATTERN

- There will be three papers of Multiple Choice Questions (MCQs) in 'Mathematics', 'Physics and Chemistry' and 'Biology' of 100 marks each.
- Duration of each paper will be 90 minutes.
- Questions will be based on Syllabus of State Council of Educational Research and Training, Maharashtra with approximately 20% weightage given to Std. XI and 80% weightage will be given to Std. XII curriculum.
- Difficulty level of questions will be at par with JEE (Main) for Mathematics, Physics, Chemistry and at par with NEET for Biology.
- There will be no negative marking.
- Questions will be mainly application based.
- Details of the papers are as given below:

Paper	Subject	No. of MCQs based on		Mark(s) Per Question	Total Marks
		Std. XI	Std. XII		
Paper I	Mathematics	10	40	2	100
Paper II	Physics	10	40	1	100
	Chemistry	10	40		
Paper III	Biology	20	80	1	100

- Questions will be set on

i. the entire syllabus of Std. XII of Physics, Chemistry, Mathematics and Biology subjects prescribed by State Council of Educational Research and Training, Maharashtra and

ii. chapters / units from Std. XI curriculum prescribed by State Council of Educational Research and Training, Maharashtra as mentioned below:

Sr. No.	Subject	Chapters / Units of Std. XI
1	Physics	Motion in a plane, Laws of motion, Gravitation, Thermal properties of matter, Sound, Optics, Electrostatics, Semiconductors
2	Chemistry	Some Basic Concepts of Chemistry, Structure of Atom, Chemical Bonding, Redox Reactions, Elements of Group 1 and Group 2, States of Matter: Gaseous and Liquid States, Basic Principles of Organic Chemistry, Adsorption and Colloids, Hydrocarbons
3	Mathematics	Trigonometry - II, Straight Line, Circle, Measures of Dispersion, Probability, Complex Numbers, Permutations and Combinations, Functions, Limits, Continuity
4	Biology	Biomolecules, Respiration and Energy Transfer, Human Nutrition, Excretion and osmoregulation

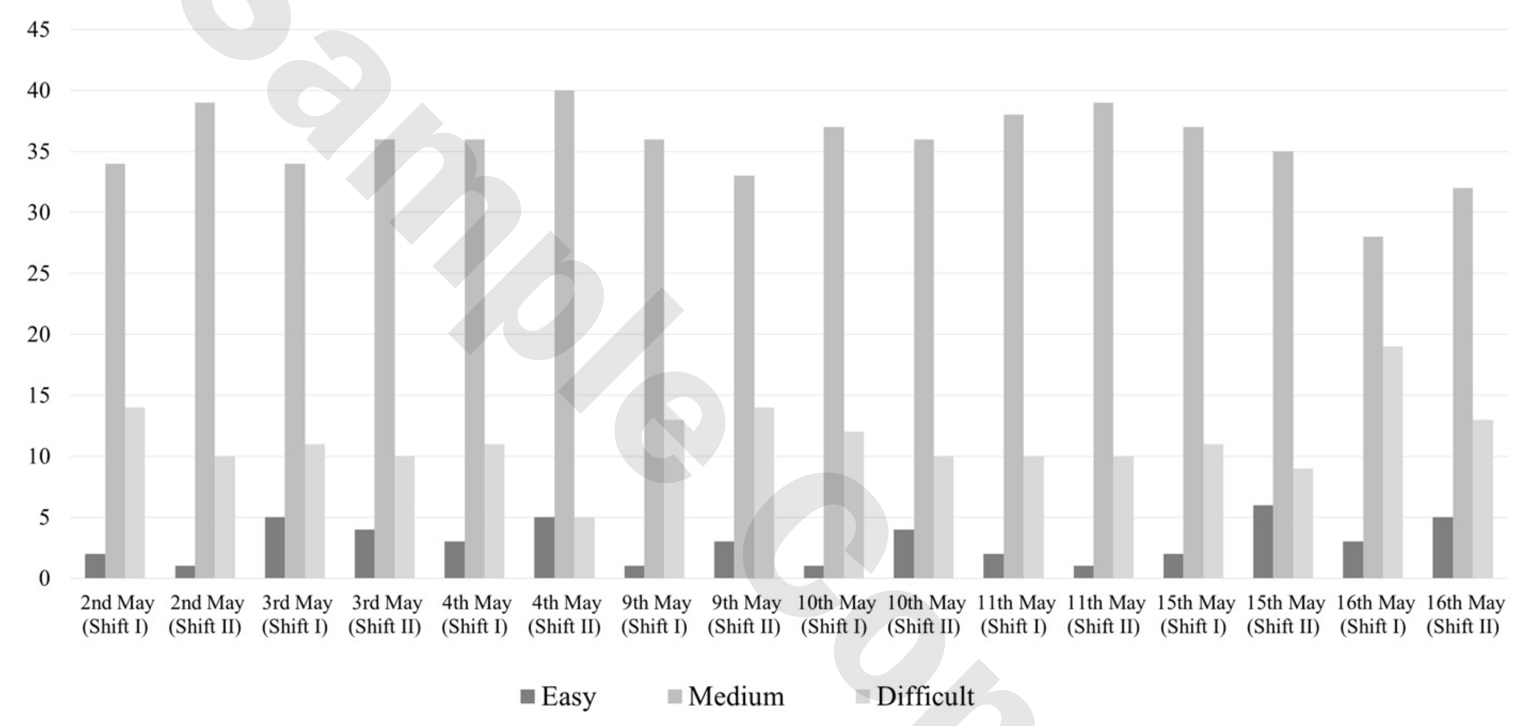
MATHEMATICS

Chapter-wise Analysis of MHT-CET 2024 Exam Papers

Ch. no.	Std.	Chapter name	2nd May (Shift I)	2nd May (Shift II)	3rd May (Shift I)	3rd May (Shift II)	4th May (Shift I)	4th May (Shift II)	9th May (Shift I)	9th May (Shift II)	10th May (Shift I)	10th May (Shift II)	11th May (Shift I)	11th May (Shift II)	15th May (Shift I)	15th May (Shift II)	16th May (Shift I)	16th May (Shift II)	Total
3	11th	Trigonometry - II	0	1	1	1	1	1	1	2	1	0	1	0	2	1	1	1	**15**
5	11th	Straight Line	1	1	2	1	1	1	1	1	1	2	1	1	1	0	1	1	**17**
6	11th	Circle	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
8	11th	Measures of Dispersion	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
9	11th	Probability	1	1	0	0	1	1	2	1	1	1	1	1	1	1	1	1	**15**
1	11th	Complex Numbers	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	**15**
3	11th	Permutations and Combinations	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	**14**
6	11th	Functions	1	0	1	1	1	1	0	2	1	1	1	1	1	1	1	1	**15**
7	11th	Limits	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
8	11th	Continuity	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
1	12th	Mathematical Logic	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	**33**
2	12th	Matrices	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
3	12th	Trigonometric Functions	6	5	5	5	5	5	6	4	5	5	5	6	4	6	5	5	**82**
4	12th	Pair of Straight Lines	1	1		1	1	1	1	1	1		2	1	1	1	1	1	**15**
5	12th	Vectors	7	6	6	6	5	4	6	6	6	7	5	6	7	5	6	6	**94**
6	12th	Line and Plane	4	4	4	4	5	5	4	4	4	4	4	4	3	4	4	4	**65**
7	12th	Linear Programming	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
1	12th	Differentiation	3	4	3	3	3	3	3	3	3	4	3	3	3	4	3	3	**51**
2	12th	Applications of Derivatives	4	5	5	5	5	4	5	5	5	3	5	5	5	5	5	5	**76**
3	12th	Indefinite Integration	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	**64**
4	12th	Definite Integration	1	1	1	1	1	2	1	1	1	3	1	1	1	3	1	1	**21**
5	12th	Application of Definite Integration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
6	12th	Differential Equations	4	3	3	3	3	4	3	3	3	3	3	3	3	2	3	3	**49**
7	12th	Probability Distributions	1	2	3	3	2	2	2	2	2	1	2	2	2	1	2	2	**31**
8	12th	Binomial Distribution	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**
		Total	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**800**

MATHEMATICS

Difficulty level-wise Analysis of MHT-CET 2024 Exam Papers



E – Easy: Questions whose answers can be directly and easily answered by the information given in Std. XI and XII Textbooks.
M – Medium: These questions require students to identify and apply the appropriate concepts which they studied from Std. XI and XII Textbooks.
D – Difficult: The most Challenging Questions that require application of various concepts and encourage students to think beyond the information given in the textbooks.

Analysis

- **Analysis of questions by difficulty level:** While the distribution of easy, medium, and difficult questions varies among the sixteen papers, a notable trend is the prevalence of medium-level questions, with a smaller number of both difficult and easy questions.
  This suggests that the entrance exam places a strong emphasis on the comprehension and practical application of concepts. Students are encouraged to approach their preparation by meticulously studying the chapters, with a particular focus on effectively applying formulas and concepts in order to excel in the entrance exam.

Chapter

3 Trigonometry - II

Quick Review

➢

	Trigonometric functions of sum and difference of two angles	Formulae
i.	**sin (A + B)**	sin A cos B + cos A sin B
ii.	**sin (A – B)**	sin A cos B – cos A sin B
iii.	**cos (A + B)**	cos A cos B – sin A sin B
iv.	**cos (A – B)**	cos A cos B + sin A sin B
v.	**tan (A + B)**	$\frac{\tan A + \tan B}{1 - \tan A \tan B}$
vi.	**tan (A – B)**	$\frac{\tan A - \tan B}{1 + \tan A \tan B}$
vii.	**cot (A + B)**	$\frac{\cot A \cot B - 1}{\cot A + \cot B}$
viii.	**cot (A – B)**	$\frac{\cot A \cot B + 1}{\cot B - \cot A}$
ix.	**sin(A + B) sin(A – B)**	$= \sin^2 A - \sin^2 B$ $= \cos^2 B - \cos^2 A$
x.	**cos(A + B) cos(A – B)**	$= \cos^2 A - \sin^2 B$ $= \cos^2 B - \sin^2 A$

➢ **Trigonometric functions of sum and difference of three angles:**

i. sin (A + B + C) = sin A cos B cos C + cos A sin B cos C + cos A cos B sin C – sin A sin B sin C

or

sin (A + B + C) = cos A cos B cos C (tan A+ tan B + tanC – tan A tanB tanC)

ii. cos (A + B + C) = cos A cos B cos C – sin A sin B cos C – sin A cos B sin C – cos A sin B sin C

or

cos (A + B + C) = cos A cos B cos C (1 – tan A tan B – tan B tan C – tan C tan A)

iii. $\tan (A + B + C) = \frac{\tan A + \tan B + \tan C - \tan A \tan B \tan C}{1 - \tan A \tan B - \tan B \tan C - \tan C \tan A}$

iv. $\cot (A + B + C) = \frac{\cot A \cot B \cot C - \cot A - \cot B - \cot C}{\cot A \cot B + \cot B \cot C + \cot C \cot A - 1}$

Trigonometric functions of allied angles:

I Quadrant

$\frac{\pi}{2} - \theta$: sin ⇒ cos, cos ⇒ sin, tan ⇒ cot, cot ⇒ tan, sec ⇒ cosec, cosec ⇒ sec

θ or $2\pi + \theta$: sin ⇒ sin, cos ⇒ cos, tan ⇒ tan, cot ⇒ cot, sec ⇒ sec, cosec ⇒ cosec

II Quadrant

$\frac{\pi}{2} + \theta$: sin ⇒ cos, cos ⇒ –sin, tan ⇒ –cot, cot ⇒ –tan, sec ⇒ –cosec, cosec ⇒ sec

$\pi - \theta$: sin ⇒ sin, cos ⇒ –cos, tan ⇒ –tan, cot ⇒ –cot, sec ⇒ – sec, cosec ⇒ cosec

III Quadrant

$\pi + \theta$: sin ⇒ –sin, cos ⇒ –cos, tan ⇒ tan, cot ⇒ cot, sec ⇒ – sec, cosec ⇒ –cosec

$\frac{3\pi}{2} - \theta$: sin ⇒ –cos, cos ⇒ –sin, tan ⇒ cot, cot ⇒ tan, sec ⇒ – cosec, cosec ⇒ –sec

IV Quadrant

$\frac{3\pi}{2} + \theta$: sin ⇒ –cos, cos ⇒ sin, tan ⇒ –cot, cot ⇒ –tan, sec ⇒ cosec, cosec ⇒ –sec

$2\pi - \theta$ or $-\theta$: sin ⇒ –sin, cos ⇒ cos, tan ⇒ –tan, cot ⇒ –cot, sec ⇒ sec, cosec ⇒ –cosec

(Axes: $\frac{\pi}{2}$, π, $\frac{3\pi}{2}$, $0/2\pi$)

Trigonometric functions of multiple angles:

Trigonometric functions of multiple angles

sin θ

→ $\sin 2\theta = 2 \sin\theta \cos\theta = \frac{2\tan\theta}{1+\tan^2\theta}$

→ $\sin 3\theta = 3 \sin\theta - 4 \sin^3\theta$

cos θ

→ $\cos 2\theta = \cos^2\theta - \sin^2\theta$
$= 1 - 2\sin^2\theta$
$= 2\cos^2\theta - 1$
$= \frac{1-\tan^2\theta}{1+\tan^2\theta}$

→ $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

Note:
$1 + \cos 2\theta = 2\cos^2\theta$
$1 - \cos 2\theta = 2\sin^2\theta$

tan θ

→ $\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$

→ $\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1-3\tan^2\theta}$

Trigonometric functions of half angles:

Trigonometric functions of half angles

sin θ

→ $\sin\theta = 2\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)$

→ $\sin\theta = \frac{2\tan\left(\frac{\theta}{2}\right)}{1+\tan^2\left(\frac{\theta}{2}\right)}$

cos θ

→ $\cos\theta = \cos^2\left(\frac{\theta}{2}\right) - \sin^2\left(\frac{\theta}{2}\right)$
$= 1 - 2\sin^2\left(\frac{\theta}{2}\right)$
$= 2\cos^2\left(\frac{\theta}{2}\right) - 1$
$= \frac{1-\tan^2\left(\frac{\theta}{2}\right)}{1+\tan^2\left(\frac{\theta}{2}\right)}$

Note: $1 + \cos\theta = 2\cos^2\left(\frac{\theta}{2}\right)$
$1 - \cos\theta = 2\sin^2\left(\frac{\theta}{2}\right)$

tan θ

→ $\tan\theta = \frac{2\tan\left(\frac{\theta}{2}\right)}{1-\tan^2\left(\frac{\theta}{2}\right)}$

➢ **Formulae to convert sum or difference into product:**

i.	**sin C + sin D**	$2\sin\frac{C+D}{2}\cos\frac{C-D}{2}$
ii.	**sin C – sin D**	$2\cos\frac{C+D}{2}\sin\frac{C-D}{2}$
iii.	**cos C + cos D**	$2\cos\frac{C+D}{2}\cos\frac{C-D}{2}$
iv.	**cos C – cos D**	$= 2\sin\frac{C+D}{2}\sin\frac{D-C}{2}$ $= -2\sin\frac{C+D}{2}\sin\frac{C-D}{2}$

➢ **Formulae to convert product into sum or difference:**

i.	**2 sin A cos B**	sin(A + B) + sin(A – B)
ii.	**2 cos A sin B**	sin(A + B) – sin(A – B)
iii.	**2 cos A cos B**	cos(A + B) + cos(A – B)
iv.	**2 sin A sin B**	cos(A – B) – cos(A + B)

➢ **Trigonometric functions of angles of a triangle:**

i. If A, B, C are the angles of a triangle ABC, then $A + B + C = \pi$

a. $\sin(B + C) = \sin(\pi - A) = \sin A$
$\sin(C + A) = \sin B$
$\sin(A + B) = \sin C$

b. $\cos(B + C) = \cos(\pi - A) = -\cos A$
$\cos(C + A) = -\cos B$
$\cos(A + B) = -\cos C$

c. $\tan(B + C) = \tan(\pi - A) = -\tan A$
$\tan(C + A) = -\tan B$
$\tan(A + B) = -\tan C$

ii. If $A + B + C = \pi$, then $\frac{A+B}{2} = \frac{\pi}{2} - \frac{C}{2}$,
$\frac{C+A}{2} = \frac{\pi}{2} - \frac{B}{2}$ and $\frac{B+C}{2} = \frac{\pi}{2} - \frac{A}{2}$

a. $\sin\left(\frac{A+B}{2}\right) = \sin\left(\frac{\pi}{2} - \frac{C}{2}\right) = \cos\frac{C}{2}$
$\sin\left(\frac{B+C}{2}\right) = \cos\frac{A}{2}$
$\sin\left(\frac{C+A}{2}\right) = \cos\frac{B}{2}$

b. $\cos\left(\frac{A+B}{2}\right) = \sin\frac{C}{2}$
$\cos\left(\frac{B+C}{2}\right) = \sin\frac{A}{2}$
$\cos\left(\frac{C+A}{2}\right) = \sin\frac{B}{2}$

➢ **Some Important results:**

i. $\sin 15° = \frac{\sqrt{3}-1}{2\sqrt{2}}$

ii. $\cos 15° = \frac{\sqrt{3}+1}{2\sqrt{2}}$

iii. $\sin 18° = \frac{\sqrt{5}-1}{4}$

iv. $\cos 36° = \frac{\sqrt{5}+1}{4}$

Shortcuts

1. $\sin n\pi = 0$, $\cos n\pi = (-1)^n$

2.
i. $\sin(n\pi + \theta) = (-1)^n \sin\theta$
ii. $\cos(n\pi + \theta) = (-1)^n \cos\theta$
iii. $\sin(n\pi - \theta) = (-1)^{n-1} \sin\theta$
iv. $\cos(n\pi - \theta) = (-1)^n \cos\theta$

3. $\sin\left(\frac{n\pi}{2} + \theta\right) = (-1)^{\frac{n-1}{2}} \cos\theta$, if n is odd
$= (-1)^{\frac{n}{2}} \sin\theta$, if n is even

4. $\cos\left(\frac{n\pi}{2} + \theta\right) = (-1)^{\frac{n+1}{2}} \sin\theta$, if n is odd
$= (-1)^{\frac{n}{2}} \cos\theta$, if n is even

5. $\left|\sin\frac{A}{2} + \cos\frac{A}{2}\right| = \sqrt{1+\sin A}$

or $\sin\frac{A}{2} + \cos\frac{A}{2} = \pm\sqrt{1+\sin A}$

i.e., $\begin{cases} +\text{ve,, if } 2n\pi - \frac{\pi}{4} \le \frac{A}{2} \le 2n\pi + \frac{3\pi}{4} \\ -\text{ve, otherwise} \end{cases}$

6. $\left|\sin\frac{A}{2} - \cos\frac{A}{2}\right| = \sqrt{1-\sin A}$

or $\sin\frac{A}{2} - \cos\frac{A}{2} = \pm\sqrt{1-\sin A}$

i.e., $\begin{cases} +\text{ve, if } 2n\pi + \frac{\pi}{4} \le \frac{A}{2} \le 2n\pi + \frac{5\pi}{4} \\ -\text{ve, otherwise} \end{cases}$

7. $\tan x.\tan 2x.\tan 3x = \tan 3x - \tan 2x - \tan x$
8. $\tan 2\alpha.\tan 3\alpha.\tan 5\alpha = \tan 5\alpha - \tan 3\alpha - \tan 2\alpha$
9. $\frac{1-\cos\theta}{\sin\theta} = \tan\frac{\theta}{2}$, where $\theta \neq (2n+1)\pi$
10. $\frac{1+\cos\theta}{\sin\theta} = \cot\frac{\theta}{2}$, where $\theta \neq 2n\pi$
11. $\frac{1-\cos\theta}{1+\cos\theta} = \tan^2\frac{\theta}{2}$, where $\theta \neq (2n+1)\pi$
12. $\frac{1+\cos\theta}{1-\cos\theta} = \cot^2\frac{\theta}{2}$, where $\theta \neq 2n\pi$
13. $\cos\alpha.\cos 2\alpha.\cos 2^2\alpha.\cos 2^3\alpha \ldots.. \cos 2^{n-1}\alpha$
$= \frac{\sin 2^n\alpha}{2^n \sin\alpha}$, if $\alpha \neq n\pi$
$= 1$, if $\alpha = 2n\pi$
$= -1$, if $\alpha = (2n+1)\pi$
14. i. $\tan(45° + \theta) = \frac{1+\tan\theta}{1-\tan\theta} = \frac{\cos\theta+\sin\theta}{\cos\theta-\sin\theta}$
ii. $\tan(45° - \theta) = \frac{1-\tan\theta}{1+\tan\theta} = \frac{\cos\theta-\sin\theta}{\cos\theta+\sin\theta}$
15. Maximum and minimum values of
$a\cos\theta + b\sin\theta$ are $\sqrt{a^2+b^2}$ and $-\sqrt{a^2+b^2}$
i.e., $-\sqrt{a^2+b^2} \leq a\cos\theta + b\sin\theta \leq \sqrt{a^2+b^2}$
16. $\sin\alpha + \sin(\alpha+\beta) + \sin(\alpha+2\beta) + \ldots\ldots + \sin[\alpha + (n-1)\beta]$
$$= \frac{\sin\left[\alpha + \left(\frac{n-1}{2}\right)\beta\right]}{\sin\frac{\beta}{2}}.\sin\frac{n\beta}{2}$$
If $\beta = \alpha$, then
$\sin\alpha + \sin 2\alpha + \sin 3\alpha + \ldots.. + \sin n\alpha$
$$= \frac{\sin\left(\frac{n+1}{2}\right)\alpha.\sin\frac{n\alpha}{2}}{\sin\left(\frac{\alpha}{2}\right)}$$
17. $\cos\alpha + \cos(\alpha+\beta) + \cos(\alpha+2\beta) + \ldots\ldots + \cos[\alpha + (n-1)\beta]$
$$= \frac{\cos\left[\alpha + (n-1)\frac{\beta}{2}\right].\sin\left(\frac{n\beta}{2}\right)}{\sin\frac{\beta}{2}}$$
If $\beta = \alpha$, then
$\cos\alpha + \cos 2\alpha + \cos 3\alpha + \ldots\ldots + \cos n\alpha$
$$= \frac{\cos\left(\frac{n+1}{2}\right)\alpha.\sin\left(\frac{n\alpha}{2}\right)}{\sin\left(\frac{\alpha}{2}\right)}$$
18. $\sin\theta\sin(60° - \theta)\sin(60° + \theta) = \frac{1}{4}\sin 3\theta$
19. $\cos\theta\cos(60° - \theta)\cos(60° + \theta) = \frac{1}{4}\cos 3\theta$
20. $\tan\theta\tan(60° - \theta)\tan(60° + \theta) = \tan 3\theta$
21. If $A + B + C = 180°$, then
i. $\sin 2A + \sin 2B + \sin 2C = 4\sin A\sin B\sin C$
ii. $\cos 2A + \cos 2B + \cos 2C = -1 - 4\cos A\cos B\cos C$
iii. $\cos 2A + \cos 2B - \cos 2C = 1 - 4\sin A\sin B\cos C$
iv. $\sin A + \sin B + \sin C = 4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$
v. $\cos A + \cos B + \cos C = 1 + 4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$
vi. $\cos A + \cos B - \cos C = -1 + 4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$
vii. $\tan A + \tan B + \tan C = \tan A\tan B\tan C$
viii. $\cot A\cot B + \cot B\cot C + \cot C\cot A = 1$
ix. $\tan\frac{A}{2}\tan\frac{B}{2} + \tan\frac{B}{2}\tan\frac{C}{2} + \tan\frac{C}{2}\tan\frac{A}{2} = 1$
x. $\cot\frac{A}{2} + \cot\frac{B}{2} + \cot\frac{C}{2} = \cot\frac{A}{2}\cot\frac{B}{2}\cot\frac{C}{2}$

Multiple Choice Questions

3.1 Trigonometric functions of sum and difference of angles

1. If $\theta \in R$, then $\sin^6\theta + \cos^6\theta + 3\sin^2\theta\cos^2\theta =$ **[2019]**
(A) 3 (B) 1
(C) 8 (D) 2

2. If $1 + \tan x = \sqrt{2}$, then $1 - \cot x =$ **[2019]**
(A) $\frac{1}{\sqrt{2}}$ (B) $-\sqrt{2}$
(C) $-\frac{1}{\sqrt{2}}$ (D) $\sqrt{2}$

3. The value of $(\sqrt{3}\sin 75° - \cos 75°)$ is **[2019]**
(A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$
(C) $2\cos 15°$ (D) $2\sin 15°$

4. If $\sec x + \tan x = 3$, where $x \in \left(0, \frac{\pi}{2}\right)$, then $\sin x =$ **[2020]**
(A) $\frac{4}{5}$ (B) $\frac{3}{5}$
(C) -1 (D) $\frac{1}{5}$

5. If $2\cos^2\theta + 3\cos\theta = 2$, then permissible value of $\cos\theta$ is **[2020]**

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

(C) $\frac{1}{2}$ (D) 0

6. If $\sin x + \text{cosec } x = 3$, then value of $\sin^4 x + \text{cosec}^4 x$ is **[2020]**

(A) 49 (B) 47

(C) 7 (D) 74

7. If $\frac{1-\tan\theta}{1+\tan\theta} = \frac{1}{\sqrt{3}}$, where $\theta \in \left(0, \frac{\pi}{2}\right)$, then $\theta =$ **[2020]**

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{12}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

8. If $\tan\theta + \sin\theta = a$ and $\tan\theta - \sin\theta = b$, then the values of $\cot\theta$ and $\text{cosec }\theta$ are respectively **[2020]**

(A) $\frac{2}{a+b}, \frac{2}{a-b}$ (B) $\frac{2}{a-b}, \frac{2}{a+b}$

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

9. $\sin\left(\frac{\pi}{3}+x\right) - \cos\left(\frac{\pi}{6}+x\right) =$ **[2020]**

(A) $-\sin x$ (B) $-\cos x$

(C) $\sin x$ (D) $\cos x$

10. If $x = 3\sin\theta$, $y = 3\cos\theta\cos\phi$, $z = 3\cos\theta\sin\phi$, then $x^2 + y^2 + z^2 =$ **[2020]**

(A) 9 (B) 3

(C) 18 (D) 27

11. If $\sin x + \sin^2 x = 1$, then $\cos^8 x + 2\cos^6 x + \cos^4 x$ is **[2020]**

(A) 3 (B) 2

(C) 4 (D) 1

12. $\tan 1° \times \tan 2° \times \tan 3° \times \ldots\ldots. \times \tan 89° =$ **[2020]**

(A) 1 (B) $\sqrt{3}$

(C) 2 (D) $\sqrt{2}$

13. If A and B are two angles such that A, B, $\in(0, \pi)$ and they are not supplementary angles such that $\sin A - \sin B = 0$, then **[2020]**

(A) $A - B = \frac{\pi}{2}$ (B) $A - B = \frac{\pi}{3}$

(C) $A \neq B$ (D) $A = B$

14. For $\theta \in \left(0, \frac{\pi}{2}\right)$,

$\tan 3\theta \cdot \tan 2\theta \cdot \tan\theta + \tan 2\theta + \tan\theta = 1$, then $\theta =$ **[2020]**

(A) $\frac{\pi^c}{3}$ (B) $\frac{\pi^c}{6}$

(C) $\frac{\pi^c}{12}$ (D) $\frac{\pi^c}{4}$

15. If $\tan A = \frac{5}{6}$, $\tan B = \frac{1}{11}$, then $A + B =$ **[2020]**

(A) $\frac{\pi}{3}$ (B) $\frac{-\pi}{3}$

(C) $\frac{-\pi}{4}$ (D) $\frac{\pi}{4}$

16. If $\text{cosec }\theta + \cot\theta = 5$, then $\sin\theta =$ **[2020]**

(A) $\frac{5}{26}$ (B) $\frac{5}{13}$

(C) $\frac{1}{13}$ (D) $\frac{1}{5}$

17. If $2\sin\left(\theta+\frac{\pi}{3}\right) = \cos\left(\theta-\frac{\pi}{6}\right)$, then $\tan\theta =$ **[2021]**

(A) $\frac{-1}{\sqrt{3}}$ (B) $-\sqrt{3}$

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

18. $\tan 3A \cdot \tan 2A \cdot \tan A =$ **[2021]**

(A) $\tan 3A + \tan 2A - \tan A$

(B) $\tan 3A - \tan 2A - \tan A$

(C) $\tan 3A + \tan 2A + \tan A$

(D) $\tan 3A - \tan 2A + \tan A$

19. If $\theta + \phi = \alpha$ and $\tan\theta = k\tan\phi$ (where $k > 1$), then the value of $\sin(\theta - \phi)$ is **[2021]**

(A) $k\tan\phi$ (B) $\sin\alpha$

(C) $\left(\frac{k-1}{k+1}\right)\sin\alpha$ (D) $k\cos\phi$

20. Let $\cos(\alpha + \beta) = \frac{4}{5}$ and $\sin(\alpha - \beta) = \frac{5}{13}$, where $0 \le \alpha, \beta \le \frac{\pi}{4}$, then $\tan 2\alpha =$ **[2022]**

(A) $\frac{25}{16}$ (B) $\frac{19}{13}$

(C) $\frac{20}{7}$ (D) $\frac{56}{33}$

21. If $\cot\alpha = \frac{1}{2}$ and $\sec\beta = -\frac{5}{3}$ where $\alpha \in \left(\pi, \frac{3\pi}{2}\right)$ and $\beta \in \left(\frac{\pi}{2}, \pi\right)$, then $\tan(\alpha + \beta)$ has the value **[2022]**

(A) $\frac{2}{11}$ (B) $\frac{3}{11}$

(C) $\frac{22}{9}$ (D) $\frac{9}{11}$

Page no. **6** to **8** are purposely left blank.

To see complete chapter buy **Target Notes** or **Target E-Notes**

10. The value of $\cos 20° + 2\sin^2 55° - \sqrt{2}\sin 65°$ is **[2024]**
(A) 0 (B) 1
(C) –1 (D) $\frac{1}{2}$

11. The smallest positive value of x in degrees satisfying the equation
$\tan\left(x+100^\circ\right) = \tan\left(x+50^\circ\right)\tan(x)\tan\left(x-50^\circ\right)$ is **[2024]**
(A) 30° (B) 15°
(C) 45° (D) 60°

12. The value of
$\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$ is **[2024]**
(A) $\frac{1}{8}$ (B) $\frac{-1}{8}$
(C) $\frac{1}{16}$ (D) $\frac{-1}{16}$

13. Let a, b, c be three non-zero real numbers such that the equation $\sqrt{3}a\cos x + 2b\sin x = c$, $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ has two distinct real roots α and β with $\alpha + \beta = \frac{\pi}{3}$. Then the value of $\frac{b}{a}$ is **[2024]**
(A) $0\cdot1$ (B) $0\cdot5$
(C) $-0\cdot5$ (D) 1

3.5 Trigonometric functions of angles of a triangle

1. If A, B, C are the angles of ΔABC then $\cot A \cdot \cot B + \cot B \cdot \cot C + \cot C \cdot \cot A =$ **[2018]**
(A) 0 (B) 1
(C) 2 (D) –1

2. In ΔABC, if $\tan A + \tan B + \tan C = 6$ and $\tan A \cdot \tan B = 2$ then $\tan C =$ **[2019]**
(A) 4 (B) 1
(C) 3 (D) 2

3. In ΔABC, with usual notations; if $\cos A = \sin B - \cos C$, then $\cos A \cdot \cos C =$ **[2019]**
(A) $\frac{1}{4}$ (B) 0
(C) $\frac{1}{2}$ (D) $\frac{\sqrt{3}}{4}$

4. If A, B, C are angles of a ΔABC, then $\tan 2A + \tan 2B + \tan 2C =$ **[2020]**
(A) $\tan 2A \tan 2B \tan 2C$
(B) $\tan A \tan B \tan C$
(C) $\tan 3A \tan 2B \tan 2C$
(D) $\tan 2A \tan 3B \tan 2C$

5. If $A + B + C = 180°$, then the value of
$\tan\left(\frac{A}{2}\right)\tan\left(\frac{B}{2}\right) + \tan\left(\frac{B}{2}\right)\tan\left(\frac{C}{2}\right) + \tan\left(\frac{C}{2}\right)\tan\left(\frac{A}{2}\right)$ is **[2020]**
(A) 2 (B) 1
(C) –2 (D) –1

6. In a triangle ABC if $\frac{\sin A - \sin C}{\cos C - \cos A} = \cot B$, then A, B, C are in **[2020]**
(A) Harmonic progression
(B) Geometric progression
(C) Arithmetico-Geometric progression
(D) Arithmetic progression

7. If $\alpha + \beta + \gamma = \pi$, then the expression $\sin^2\alpha + \sin^2\beta - \sin^2\gamma$ has the value **[2024]**
(A) $2\sin\alpha \sin\beta \sin\gamma$
(B) $2\cos\alpha \sin\beta \sin\gamma$
(C) $2\sin\alpha \cos\beta \sin\gamma$
(D) $2\sin\alpha \sin\beta \cos\gamma$

8. If A, B, C are the angles of a triangle with $\tan\frac{A}{2} = \frac{1}{3}, \tan\frac{B}{2} = \frac{2}{3}$ then the value of $\tan\frac{C}{2}$ is **[2024]**
(A) $\frac{-7}{9}$ (B) $\frac{7}{9}$
(C) $\frac{9}{7}$ (D) $\frac{-9}{7}$

Concept Fusion

1. The maximum value of $(\cos\alpha_1) \cdot (\cos\alpha_2) \ldots (\cos\alpha_n)$ under the constraints $0 \le \alpha_1, \alpha_2, \ldots, \alpha_n \le \frac{\pi}{2}$ and $(\cot\alpha_1) \cdot (\cot\alpha_2) \ldots (\cot\alpha_n) = 1$ is **[2024]**
(A) $\frac{1}{2^{\left(\frac{n}{2}\right)}}$ (B) $\frac{1}{2^n}$
(C) 2^n (D) $2^{\frac{n}{2}}$

Answers and Solutions to MCQs

3.1 Trigonometric functions of sum and difference of angles

1.	(B)	2.	(B)	3.	(B)
4.	(A)	5.	(C)	6.	(B)
7.	(B)	8.	(A)	9.	(C)
10.	(A)	11.	(D)	12.	(A)
13.	(D)	14.	(C)	15.	(D)
16.	(B)	17.	(B)	18.	(B)
19.	(C)				

[**Note:** *Detailed solutions for Q.1 to Q.19 (wherever applicable) can be accessed via QR code at the end of the chapter.*]

20. (D)

Given, $\cos(\alpha+\beta) = \frac{4}{5}$

$\Rightarrow \sin(\alpha+\beta) = \frac{3}{5}$

$\Rightarrow \tan(\alpha+\beta) = \frac{3}{4}$ …(i)

Also, $\sin(\alpha-\beta) = \frac{5}{13}$

$\Rightarrow \cos(\alpha-\beta) = \frac{12}{13}$

$\Rightarrow \tan(\alpha-\beta) = \frac{5}{12}$ …(ii)

Now, $\tan 2\alpha = \tan[(\alpha+\beta)+(\alpha-\beta)]$

$= \frac{\tan(\alpha+\beta)+\tan(\alpha-\beta)}{1-\tan(\alpha+\beta)\cdot\tan(\alpha-\beta)}$

$= \frac{\left(\frac{3}{4}\right)+\left(\frac{5}{12}\right)}{1-\left(\frac{3}{4}\right)\left(\frac{5}{12}\right)}$ …[From (i) and (ii)]

$\Rightarrow \tan 2\alpha = \frac{36+20}{48-15} = \frac{56}{33}$

21. (A)

$\cot\alpha = \frac{1}{2}$

$\Rightarrow \tan\alpha = 2$ and

$\sec\beta = -\frac{5}{3}$

$\Rightarrow \cos\beta = \frac{-3}{5}$

$\Rightarrow \sin\beta = \frac{4}{5}$ …$\left[\because \beta \in \left(\frac{\pi}{2}, \pi\right)\right]$

$\Rightarrow \tan\beta = \frac{-4}{3}$

Consider,

$\tan(\alpha+\beta) = \frac{\tan\alpha+\tan\beta}{1-\tan\alpha\cdot\tan\beta}$

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

$= \frac{6-4}{3+8} = \frac{2}{11}$

22. (C)

$\cos^2 A - \sin^2 B = \cos(A+B)\cdot\cos(A-B)$

$\therefore$ $\cos^2 48° - \sin^2 12° = \cos(60°)\cdot\cos(36°)$

$= \frac{1}{2}\cdot\left(1-2\sin^2\frac{36}{2}\right)$

$= \frac{1}{2}(1-2\sin^2 18°)$

$= \frac{1}{2}\left[1-2\left(\frac{\sqrt{5}-1}{4}\right)^2\right]$

$= \frac{\sqrt{5}+1}{8}$

23. (C)

$\sqrt{3}\operatorname{cosec}20° - \sec 20°$

$= \frac{\sqrt{3}}{\sin 20°} - \frac{1}{\cos 20°}$

$= \frac{\sqrt{3}\cos 20° - \sin 20°}{\sin 20°\cos 20°}$

$= \frac{4\left(\frac{\sqrt{3}}{2}\cos 20° - \frac{1}{2}\sin 20°\right)}{2\sin 20°\cos 20°}$

$= \frac{4(\sin 60°\cos 20° - \cos 60°\sin 20°)}{\sin 40°}$

$= 4\frac{\sin 40°}{\sin 40°} = 4$

24. (C)

Given, $\tan A - \tan B = x$

$\cot B - \cot A = y$

$\Rightarrow \frac{1}{\tan B} - \frac{1}{\tan A} = y$

$\Rightarrow \frac{\tan A - \tan B}{\tan A\cdot\tan B} = y$

$\Rightarrow \tan A\cdot\tan B = \frac{x}{y}$ …(i)

Now, $\cot(A-B) = \frac{1}{\tan(A-B)}$

$= \frac{1+\tan A\cdot\tan B}{\tan A - \tan B}$

$= \dfrac{1+\frac{x}{y}}{x}$ …[from (i)]

$= \dfrac{y+x}{xy}$

$= \dfrac{1}{x}+\dfrac{1}{y}$

25. **(C)**

Given, $\alpha = \beta + \gamma$

$\therefore$ $\gamma = \alpha - \beta$

$\tan\gamma = \tan(\alpha - \beta)$

$= \dfrac{\tan\alpha - \tan\beta}{1+\tan\alpha\cdot\tan\beta}$

$= \dfrac{\tan\alpha - \tan\beta}{1+\tan\alpha\cdot\tan\left(\frac{\pi}{2}-\alpha\right)}$ …$\left[\begin{array}{l}\alpha+\beta = \frac{\pi}{2}\\ \therefore \beta = \frac{\pi}{2}-\alpha\end{array}\right]$

$= \dfrac{\tan\alpha - \tan\beta}{1+\tan\alpha\cot\alpha}$

$= \dfrac{\tan\alpha - \tan\beta}{2}$

$\Rightarrow 2\tan\gamma = \tan\alpha - \tan\beta$

$\Rightarrow \tan\alpha = 2\tan\gamma + \tan\beta$

3.2 Trigonometric functions of allied angles

1.	**(A)**	**2.**	**(B)**	**3.**	**(B)**
4.	**(B)**	**5.**	**(C)**	**6.**	**(D)**
7.	**(B)**	**8.**	**(A)**	**9.**	**(B)**
10.	**(C)**	**11.**	**(C)**	**12.**	**(B)**

[Note: *Detailed solutions for Q.1 to Q.12 (wherever applicable) can be accessed via QR code at the end of the chapter.***]**

13. **(C)**

$\dfrac{\tan160^\circ - \tan110^\circ}{1+\tan160^\circ\cdot\tan110^\circ} = \tan(160^\circ - 110^\circ)$

$= \tan 50^\circ$

$= \tan(90^\circ - 40^\circ)$

$= \cot 40^\circ$

$= \dfrac{1}{\tan 40^\circ}$

$= \dfrac{1}{\tan 2(20^\circ)}$

$= \dfrac{1}{\left(\frac{2\tan20^\circ}{1-\tan^2 20^\circ}\right)}$

$= \dfrac{1-\tan^2 20^\circ}{2\tan 20^\circ}$

$= \dfrac{1-p^2}{2p}$ …[$\because$ p = tan 20°(given)]

14. **(C)**

$\dfrac{\sin^2(-160^\circ)}{\sin^2 70^\circ}+\dfrac{\sin(180^\circ-\theta)}{\sin\theta}$

$= \dfrac{[-\sin160^\circ]^2}{\sin^2 70^\circ}+\dfrac{\sin\theta}{\sin\theta}$

$= \dfrac{\sin^2 160^\circ}{\sin^2 70^\circ}+1$

$= \dfrac{[\sin(180^\circ-20^\circ)]^2}{[\sin(90^\circ-20^\circ)]^2}+1$

$= \dfrac{\sin^2 20^\circ}{\cos^2 20^\circ}+1$

$= \tan^2 20^\circ + 1$

$= \sec^2 20^\circ$

15. **(B)**

$\cot(A + B) = 0$

$\Rightarrow A + B = 90^\circ$ …(i)

$\sin(A + 2B)$

$= \sin(A + B)\cos B + \cos(A + B)\sin B$

$= \sin 90^\circ \cos B + \cos 90^\circ \sin B$

$= \cos B$

$= \cos(90^\circ - A)$ …[From (i)]

$= \sin A$

16. **(D)**

$\tan\theta = \dfrac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}$

$\dfrac{\sin\theta}{\cos\theta} = \dfrac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}$

$\therefore$ $\sin\alpha\sin\theta + \cos\alpha\sin\theta = \sin\alpha\cos\theta - \cos\alpha\cos\theta$

$\therefore$ $\cos\alpha\cos\theta + \sin\alpha\sin\theta = \sin\alpha\cos\theta - \cos\alpha\sin\theta$

$\therefore$ $\cos(\alpha - \theta) = \sin(\alpha - \theta)$

$\therefore$ $\alpha - \theta = \dfrac{\pi}{4}$ …$\left[\because 0 \le \alpha \le \frac{\pi}{2}\right]$

$\therefore$ $\theta = \alpha - \dfrac{\pi}{4}$

$\therefore$ $2\theta = 2\alpha - \dfrac{\pi}{2}$

$\therefore$ $\cos 2\theta = \cos\left(2\alpha - \dfrac{\pi}{2}\right)$

$= \cos\left[-\left(\dfrac{\pi}{2}-2\alpha\right)\right]$

$= \cos\left(\dfrac{\pi}{2}-2\alpha\right)$ …[$\because \cos(-\theta) = \cos\theta$]

$\therefore$ $\cos 2\theta = \sin 2\alpha$

17. **(B)**

$\cos(18^\circ - A)\cos(18^\circ + A) - \cos(72^\circ - A)\cos(72^\circ + A)$

$= \cos(18^\circ - A)\cos[90^\circ - (72^\circ - A)] - \cos(72^\circ - A)\cos[90^\circ - (18^\circ - A)]$

$= \sin(72^\circ - A)\cos(18^\circ - A) - \cos(72^\circ - A)\sin(18^\circ - A)$

$= \sin[(72^\circ - A) - (18^\circ - A)]$

$= \sin 54^\circ$

18. (D)

$$\frac{\cot A}{1+\cot A}\cdot\frac{\cot B}{1+\cot B}$$

$$=\frac{1}{(1+\tan A)(1+\tan B)}$$

$$=\frac{1}{\tan A+\tan B+1+\tan A\tan B}$$

$$=\frac{1}{1-\tan A\tan B+1+\tan A\tan B}$$

$$\ldots\left[\begin{array}{l}\because \tan(A+B)=\tan 225^\circ\\ \Rightarrow \tan A+\tan B=1-\tan A\tan B\end{array}\right]$$

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

3.3 Trigonometric functions of multiple angles

1.	**(D)**	**2.**	**(D)**	**3.**	**(B)**
4.	**(C)**	**5.**	**(D)**	**6.**	**(C)**
7.	**(C)**	**8.**	**(B)**	**9.**	**(D)**
10.	**(B)**	**11.**	**(B)**	**12.**	**(B)**

[**Note:** *Detailed solutions for Q.1 to Q.12 (wherever applicable) can be accessed via QR code at the end of the chapter.*]

13. (D)

$\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

$\therefore\ 4\cos^3\theta = \cos 3\theta + 3\cos\theta$

$\therefore\ 4\cos^3 20^\circ = \cos 3(20^\circ) + 3\cos 20^\circ$

$= \cos 60^\circ + 3\cos 20^\circ$

$= \frac{1}{2} + 3\cos 20^\circ$

14. (B)

Given: $\tan A = \frac{1}{2}$, $\tan B = \frac{1}{3}$

$$\tan 2B = \frac{2\tan B}{1-\tan^2 B}$$

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

$$=\frac{2}{3}\times\frac{9}{8}=\frac{3}{4}$$

$$\tan(A+2B)=\frac{\tan A+\tan 2B}{1-(\tan A)(\tan 2B)}$$

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

$$=\frac{(4+6)}{8-3}$$

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

$$=2$$

15. (A)

Given $\tan\theta = \frac{a}{b}$ …(i)

$b\cos 2\theta + a\sin 2\theta$

$$= b\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right)+a\left(\frac{2\tan\theta}{1+\tan^2\theta}\right)$$

$$= b\left[\frac{1-\left(\frac{a^2}{b^2}\right)}{1+\left(\frac{a^2}{b^2}\right)}\right]+a\left[\frac{2\left(\frac{a}{b}\right)}{1+\left(\frac{a^2}{b^2}\right)}\right] \quad \ldots\text{[From (i)]}$$

$$= b\left(\frac{b^2-a^2}{b^2+a^2}\right)+a\left(\frac{2a}{b}\times\frac{b^2}{b^2+a^2}\right)$$

$$= b\left(\frac{b^2-a^2}{b^2+a^2}\right)+a\left(\frac{2ab}{a^2+b^2}\right)$$

$$=\frac{b^3-a^2b+2a^2b}{a^2+b^2}$$

$$=\frac{a^2b+b^3}{a^2+b^2}$$

$$=\frac{b\left(a^2+b^2\right)}{a^2+b^2}=b$$

16. (C)

$(\cos\alpha+\cos\beta)^2+(\sin\alpha+\sin\beta)^2$

$=(\cos^2\alpha+\sin^2\alpha)+(\cos^2\beta+\sin^2\beta)$
$\quad + 2(\cos\alpha\cos\beta+\sin\alpha\sin\beta)$

$= 1 + 1 + 2\cos(\alpha-\beta)$

$= 2[1+\cos(\alpha-\beta)]$

$$=2\left[2\cos^2\left(\frac{\alpha-\beta}{2}\right)\right]$$

$$=4\cos^2\left(\frac{\alpha-\beta}{2}\right)$$

17. (A)

$$\left(1+\sqrt{1+x}\right)\tan x = 1+\sqrt{1-x}$$

$$\Rightarrow \tan x = \frac{1+\sqrt{1-x}}{1+\sqrt{1+x}}$$

Put $x = \sin\theta$

$$\therefore\ \tan x = \frac{1+\sqrt{1-\sin\theta}}{1+\sqrt{1+\sin\theta}}$$

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

$$=\frac{1+\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}{1+\cos\frac{\theta}{2}+\sin\frac{\theta}{2}}$$

$$=\frac{2\cos^2\frac{\theta}{4}-2\sin\frac{\theta}{4}\cos\frac{\theta}{4}}{2\cos^2\frac{\theta}{4}+2\sin\frac{\theta}{4}\cos\frac{\theta}{4}}$$

$$= \frac{2\cos^2\frac{\theta}{4}\left(1-\tan\frac{\theta}{4}\right)}{2\cos^2\frac{\theta}{4}\left(1+\tan\frac{\theta}{4}\right)}$$

$\therefore$ $\tan x = \tan\left(\frac{\pi}{4}-\frac{\theta}{4}\right)$ ... $\left[\because \tan\frac{\pi}{4}=1\right]$

$\Rightarrow x = \frac{\pi-\theta}{4}$

$\Rightarrow \sin 4x = \sin(\pi-\theta) = \sin\theta = x$

18. **(A)**

We have, a cos 2θ + b sin 2θ = c

$\Rightarrow a\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right)+b\left(\frac{2\tan\theta}{1+\tan^2\theta}\right)=c$

$\Rightarrow a - a\tan^2\theta + 2b\tan\theta = c + c\tan^2\theta$

$\Rightarrow -(a+c)\tan^2\theta + 2b\tan\theta + (a-c) = 0$

$\therefore$ $\tan\alpha + \tan\beta = -\frac{2b}{-(c+a)} = \frac{2b}{c+a}$

19. **(A)**

$\cos 2B = \frac{\cos(A+C)}{\cos(A-C)}$

$\frac{1-\tan^2 B}{1+\tan^2 B} = \frac{\cos A\cos C - \sin A\sin C}{\cos A\cos C + \sin A\sin C}$

$\frac{1-\tan^2 B}{1+\tan^2 B} = \frac{\cos A\cos C(1-\tan A\tan C)}{\cos A\cos C(1+\tan A\tan C)}$

$\frac{1-\tan^2 B}{1+\tan^2 B} = \frac{(1-\tan A\tan C)}{(1+\tan A\tan C)}$

$(1-\tan^2 B)(1+\tan A\tan C)$

$= (1-\tan A\tan C)(1+\tan^2 B)$

$1+\tan A\tan C - \tan^2 B - \tan^2 B\tan A\tan C$

$= 1+\tan^2 B - \tan A\tan C - \tan A\tan C\tan^2 B$

$2\tan A\tan C = 2\tan^2 B$

$\tan^2 B = \tan A \cdot \tan C$

$\therefore$ tanA, tanB, tanC are in G.P.

20. **(D)**

$\tan x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$

$\therefore$ $1+\tan^2 x = \sec^2 x$

$\therefore$ $\sec^2 x = \frac{25}{16}$

$\therefore$ $\sec x = \frac{-5}{4}$ ...$\left[\because \pi < x < \frac{3\pi}{2}\right]$

$\therefore$ $\cos x = \frac{-4}{5}$

$\therefore$ $\cos\frac{x}{2} = -\sqrt{\frac{1+\cos x}{2}}$ ...$\left[\pi < x < \frac{3\pi}{2} \Rightarrow \frac{\pi}{2} < \frac{x}{2} < \frac{3\pi}{4}\right]$

$= -\sqrt{\frac{1}{10}}$

$= \frac{-1}{\sqrt{10}}$

21. **(B)**

sin (θ – α), sin θ and sin (θ + α) are in H.P.

$\Rightarrow \frac{1}{\sin(\theta-\alpha)}, \frac{1}{\sin\theta}, \frac{1}{\sin(\theta+\alpha)}$ will be in A.P.

$\therefore$ $\frac{2}{\sin\theta} = \frac{1}{\sin(\theta-\alpha)} + \frac{1}{\sin(\theta+\alpha)}$

$\Rightarrow \frac{2}{\sin\theta} = \frac{\sin(\theta+\alpha)+\sin(\theta-\alpha)}{\sin(\theta-\alpha)\sin(\theta+\alpha)}$

$\Rightarrow \frac{2}{\sin\theta} = \frac{2\sin\theta\cos\alpha}{\sin^2\theta-\sin^2\alpha}$

$\Rightarrow \sin^2\theta - \sin^2\alpha = \sin^2\theta\cos\alpha$

$\Rightarrow \sin^2\theta(1-\cos\alpha) = \sin^2\alpha$

$\Rightarrow \sin^2\theta\left(2\sin^2\frac{\alpha}{2}\right) = 4\sin^2\frac{\alpha}{2}\cos^2\frac{\alpha}{2}$

$\Rightarrow 1-\cos^2\theta = 2\cos^2\frac{\alpha}{2}$

$\Rightarrow \cos^2\theta = 1-2\cos^2\frac{\alpha}{2}$

$\Rightarrow 2\cos^2\theta - 1 = 1-4\cos^2\frac{\alpha}{2}$

$\Rightarrow \cos 2\theta = 1-4\cos^2\frac{\alpha}{2}$

3.4 Factorization formulae

1.	**(A)**	**2.**	**(C)**	**3.**	**(C)**
4.	**(D)**	**5.**	**(C)**	**6.**	**(A)**
7.	**(C)**				

[**Note:** *Detailed solutions for Q.1 to Q.7 (wherever applicable) can be accessed via QR code at the end of the chapter.*]

8. **(C)**

$\cos^2 10° - \cos 10° \cos 50° + \cos^2 50°$

$= \frac{1}{2}(2\cos^2 10° - 2\cos 10°\cos 50° + 2\cos^2 50°)$

$= \frac{1}{2}[1+\cos 20° - (\cos 60° + \cos 40°)$

$+ 1 + \cos 100°]$

$= \frac{1}{2}[2 + (\cos 20° + \cos 100°) - \cos 60° - \cos 40°]$

$= \frac{1}{2}[2 + (2\cos 60°\cos 40°) - \cos 60° - \cos 40°]$

$= \frac{1}{2}\left(2+\cos 40° - \frac{1}{2} - \cos 40°\right)$

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

$= \frac{3}{4}$

9. (C)

$\cos x + \cos y - \cos(x + y) = \frac{3}{2}$

$\therefore\ 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) - \left(2\cos^2\left(\frac{x+y}{2}\right) - 1\right) = \frac{3}{2}$

…$\left[\because \cos\alpha + \cos\beta = 2\cos\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right) \text{ and } \cos\theta = 2\cos^2\left(\frac{\theta}{2}\right) - 1\right]$

$\therefore\ 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) - 2\cos^2\left(\frac{x+y}{2}\right) = \frac{3}{2} - 1$

$\therefore\ 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) - 2\cos^2\left(\frac{x+y}{2}\right) = \frac{1}{2}$

$\therefore\ 4\cos^2\left(\frac{x+y}{2}\right) - 4\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) + 1 = 0$

Substituting $\cos\left(\frac{x+y}{2}\right) = t$, we get

$4t^2 - 4t\cos\left(\frac{x-y}{2}\right) + 1 = 0$

As t is real, we get $b^2 - 4ac \geq 0$

$\Rightarrow \left[-4\cos\left(\frac{x-y}{2}\right)\right]^2 - 4 \times 4 \times 1 \geq 0$

$\Rightarrow 16\cos^2\left(\frac{x-y}{2}\right) - 16 \geq 0$

$\Rightarrow \cos^2\left(\frac{x-y}{2}\right) \geq 1$

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

…[$\because\ -1 \leq \cos\theta \leq 1$, for all values of θ]

$\Rightarrow \frac{x-y}{2} = 0$

$\Rightarrow x = y$

10. (B)

$\cos 20° + 2\sin^2 55° - \sqrt{2}\sin 65°$

$= \cos 20° + 1 - \cos 2(55°) - \sqrt{2}\sin 65°$

…$[2\sin^2\theta = 1 - \cos 2\theta]$

$= \cos 20° - \cos 110° - \sqrt{2}\sin 65° + 1$

$= 2\sin 65° \sin 45° - \sqrt{2}\sin 65° + 1$

$= 2\sin 65°\left(\frac{1}{\sqrt{2}}\right) - \sqrt{2}\sin 65° + 1$

$= \sqrt{2}\sin 65° - \sqrt{2}\sin 65° + 1 = 1$

11. (A)

$\tan(x + 100°) = \tan(x + 50°)\tan(x)\tan(x - 50°)$

$\Rightarrow \frac{\tan(x+100°)}{\tan(x-50°)} = \tan(x + 50°)\tan(x)$

$\Rightarrow \frac{2\sin(x+100°)\cos(x-50°)}{2\cos(x+100°)\sin(x-50°)} = \frac{2\sin(x+50°)\sin x}{2\cos(x+50°)\cos x}$

$\Rightarrow \frac{\sin(2x+50)+\sin 150°}{\sin(2x+50)-\sin 150°} = \frac{\cos(50°)-\cos(2x+50°)}{\cos(2x+50°)+\cos 50°}$

By componendo-dividendo, we get

$\frac{2\sin(2x+50°)}{2\sin(150°)} = \frac{2\cos 50°}{-2\cos(2x+50°)}$

$\Rightarrow 2\sin(2x + 50°)\cos(2x + 50°) = -2\sin(150°)\cos(50°)$

$\Rightarrow \sin(4x + 100°) = -\cos 50°$

$\Rightarrow \sin(4x + 100°) = \sin(270° - 50°)$

$\Rightarrow 4x + 100° = 220°$

$\Rightarrow 4x = 120°$

$\Rightarrow x = 30°$

12. (A)

$\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)$

$=\left(1+\cos\frac{\pi}{8}\right)\left(1-\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1-\cos\frac{3\pi}{8}\right)$

…[$\because \cos(\pi - \theta) = -\cos\theta$]

$= \left(1-\cos^2\frac{\pi}{8}\right)\left(1-\cos^2\frac{3\pi}{8}\right)$

$= \sin^2\frac{\pi}{8}\sin^2\frac{3\pi}{8}$

$= \frac{1}{4}\left(2\sin\frac{\pi}{8}.\sin\frac{3\pi}{8}\right)^2$

$= \frac{1}{4}\left(\cos\frac{\pi}{4} - \cos\frac{\pi}{2}\right)^2$

$= \frac{1}{8}$

13. (B)

α and β are roots of $\sqrt{3}\ a\cos x + 2b\sin x = c$

$\therefore\ \sqrt{3}\ a\cos\alpha + 2\ b\sin\alpha = c$ …(i)

$\sqrt{3}\ a\cos\beta + 2\ b\sin\beta = c$ …(ii)

Subtracting (ii) from (i), we get

$\sqrt{3}\ a(\cos\alpha - \cos\beta) + 2b(\sin\alpha - \sin\beta) = 0$

$\Rightarrow \sqrt{3}a\left[-2\sin\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right] + 2b\left[2\cos\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right] = 0$

$\Rightarrow -\sqrt{3}a\left[2\sin\left(\frac{\pi}{6}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right] + 2b\left[2\cos\left(\frac{\pi}{6}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right] = 0$

$\Rightarrow -\sqrt{3}a\sin\left(\frac{\alpha-\beta}{2}\right) + 2b\left[\sqrt{3}\sin\left(\frac{\alpha-\beta}{2}\right)\right] = 0$

$\Rightarrow -\sqrt{3}a + 2\sqrt{3}b = 0 \Rightarrow \frac{b}{a} = \frac{1}{2} = 0.5$

3.5 Trigonometric functions of angles of a triangle

1.	**(B)**	**2.**	**(C)**	**3.**	**(B)**
4.	**(A)**	**5.**	**(B)**	**6.**	**(D)**

[**Note:** *Detailed solutions for Q.1 to Q.6 (wherever applicable) can be accessed via QR code at the end of the chapter.*]

7. (D)

$\sin^2\alpha + \sin^2\beta - \sin^2\gamma$
$= \sin^2\alpha + \sin(\beta+\gamma)\sin(\beta-\gamma)$
$= \sin^2\alpha + \sin(\pi-\alpha)\sin(\beta-\gamma)$
$= \sin\alpha\,[\sin\alpha + \sin(\beta-\gamma)]$
$= \sin\alpha\,[\sin(\beta+\gamma) + \sin(\beta-\gamma)]$
$= 2\sin\alpha\sin\beta\cos\gamma$

8. (B)

$A + B + C = \pi$

$\therefore \tan\left(\frac{A+B}{2}\right) = \tan\left(\frac{\pi}{2} - \frac{C}{2}\right)$

$\Rightarrow \dfrac{\tan\frac{A}{2} + \tan\frac{B}{2}}{1 - \tan\frac{A}{2}\tan\frac{B}{2}} = \cot\frac{C}{2}$

$\Rightarrow \dfrac{\frac{1}{3} + \frac{2}{3}}{1 - \left(\frac{1}{3}\right)\left(\frac{2}{3}\right)} = \cot\frac{C}{2}$

$\Rightarrow \frac{9}{7} = \cot\frac{C}{2}$

$\Rightarrow \tan\frac{C}{2} = \frac{7}{9}$

Concept Fusion

1. (A)

Here, $(\cot\alpha_1)(\cot\alpha_2)\ldots(\cot\alpha_n) = 1$

$\therefore$ $\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n$
$= \sin\alpha_1.\sin\alpha_2\ldots\sin\alpha_n$ …(i)

Now, $(\cos\alpha_1 . \cos\alpha_2 \ldots \cos\alpha_n)^2$
$= (\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n)(\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n)$
$= (\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n)(\sin\alpha_1.\sin\alpha_2\ldots\sin\alpha_n)$ …[From (i)]
$= \frac{1}{2^n}\sin2\alpha_1.\sin2\alpha_2\ldots\sin2\alpha_n$ …[$\because \sin2A = 2\sin A\cos A$]

But each of $\sin2\alpha_i \le 1$

$\therefore$ $(\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n)^2 \le \frac{1}{2^n}$

But each of $\cos\alpha_i$ is positive

$\therefore$ $\cos\alpha_1.\cos\alpha_2\ldots\cos\alpha_n \le \sqrt{\frac{1}{2^n}} = \frac{1}{2^{\frac{n}{2}}}$

Scan the adjacent QR code in *Quill - The Padhai App* to view the solutions for questions from 2004 to 2021.

AVAILABLE BOOKS FOR COMPETITIVE EXAMINATIONS

For NEET-UG & JEE (Main) Exam

ABSOLUTE SERIES
- Physics Vol - I & II
- Chemistry Vol - I & II
- Mathematics Vol - I & II
- Biology Vol - I & II

CHALLENGER SERIES
- Physics Vol - I & II
- Chemistry Vol - I & II
- Mathematics Vol - I & II
- Biology Vol - I & II

PSP SERIES (37 YEARS) (PREVIOUS SOLVED PAPERS)
- Physics
- Chemistry
- Biology

PSP SERIES (12 YEARS) (PREVIOUS SOLVED PAPERS)
- Physics
- Chemistry
- Biology

NEET-UG TEST SERIES
- Physics
- Chemistry
- Biology

ADDITIONAL BOOKS
- NEET-UG 10 Mock Tests With Answer Key & Hints
- Previous 12 Years NEET Solved Papers With Solutions
- JEE MAIN Numerical Value Type Questions (NVT)

For MHT-CET Exam

STD. XI & XII TRIUMPH SERIES
- Physics
- Chemistry
- Mathematics
- Biology

SOLUTIONS TO MCQs
- Physics Solutions to MCQs
- Chemistry Solutions to MCQs
- Mathematics Solutions to MCQs
- Biology Solutions to MCQs

MHT-CET TEST SERIES
- Physics With Answer Key & Solutions
- Chemistry With Answer Key & Solutions
- Mathematics With Answer Key & Solutions
- Biology With Answer Key & Solutions

PSP SERIES (26 YEARS) (PREVIOUS SOLVED PAPERS)
- Physics
- Chemistry
- Mathematics
- Biology

PSP SERIES (10 YEARS) (PREVIOUS SOLVED PAPERS)
- Physics
- Chemistry
- Mathematics
- Biology

ADDITIONAL BOOKS
- MHT-CET PCB Solved Papers 2024
- MHT-CET PCM Solved Papers 2024
- MHT-CET 10 Model Question Papers (Physics, Chemistry, Biology)
- MHT-CET 10 Model Question Papers (Physics, Chemistry, Mathematics)
- MHT-CET 22 Model Question Papers (Physics, Chemistry, Biology)
- MHT-CET 22 Model Question Papers (Physics, Chemistry, Mathematics)
- MHT-CET 22 Model Question Papers (Physics, Chemistry, Mathematics, Biology)

Visit Our Website

Explore our range of MHT-CET Books

Published by:
Target Publications® Pvt. Ltd.
Transforming lives through learning

B2, 9th Floor, Ashar, Road No. 16/Z, Wagle Industrial Estate, Thane (W)-400604 | 88799 39712 / 14 | 88799 39713 / 15
www.targetpublications.org mail@targetpublications.org