SAMPLE CONTENT

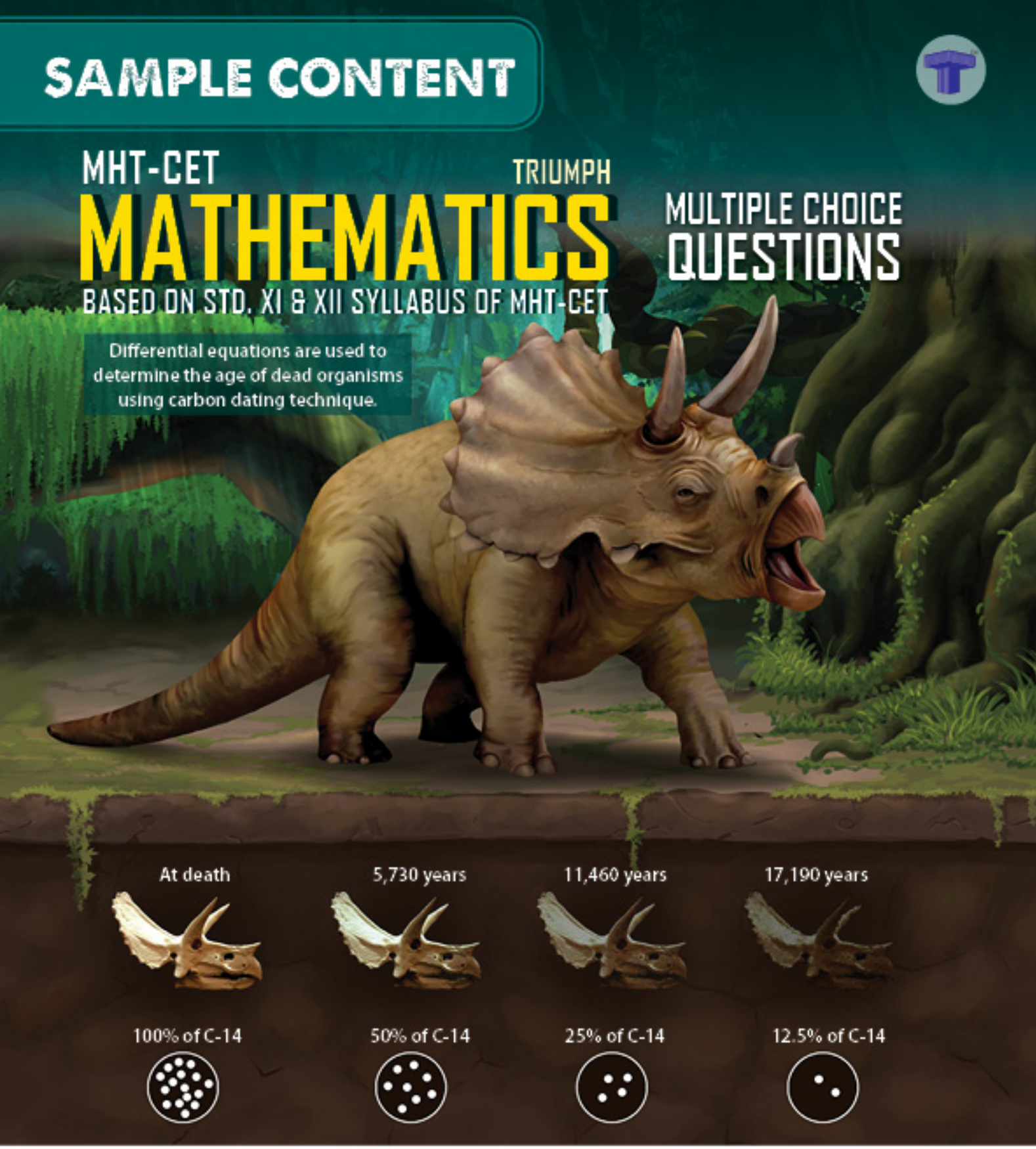
MHT-CET TRIUMPH

MATHEMATICS

MULTIPLE CHOICE QUESTIONS

BASED ON STD. XI & XII SYLLABUS OF MHT-CET

Differential equations are used to determine the age of dead organisms using carbon dating technique.



Target Publications Pvt. Ltd.

Written in accordance with the latest MHT-CET Paper Pattern which includes topics based on Std. XII Sc. and relevant chapters of Std. XI Sc. (Maharashtra State Board)

MHT-CET TRIUMPH MATHEMATICS MULTIPLE CHOICE QUESTIONS

Based on Std. XI & XII Syllabus of MHT-CET

Salient Features

- Includes all chapters of Std. XII and relevant chapters of Std. XI as per latest MHT-CET Syllabus.
- Exhaustive subtopic wise coverage of MCQs.
- Important formulae provided in each chapter.
- Various competitive exam questions updated till the latest year.
- Includes MCQs from JEE (Main) 2016, 2017 and 2018.
- Includes MCQs upto MHT-CET 2018.
- Evaluation test provided at the end of each chapter.
- Two Model Question Papers with answer key at the end of the book.

*Scan the adjacent QR code or visit **www.targetpublications.org/tp12750** to download Hints for relevant questions and Evaluation Test in PDF format.*

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PREFACE

"Triumph Mathematics" is a complete and thorough guide to prepare students for MHT-CET examination. This book is based on the MHT-CET syllabus which includes topics based on Std. XII Sc. and relevant chapters of Std. XI Sc. (Maharashtra State Board)

Formulae that form a key part for solving MCQs have been provided in each chapter. **Shortcuts** for easy and less tedious solving are also included.

MCQs in each chapter are divided into three sections:

Classical Thinking: consisting of straight forward questions including knowledge based questions.

Critical Thinking: consisting of questions that require some understanding of the concept.

Competitive Thinking: consisting of questions from various competitive examinations like MHT-CET, JEE (Main), Assam CEE, KEAM, Karnataka CET, TS EAMCET, AP EAMCET, Gujrat CET etc.

An **Evaluation Test** has been provided at the end of each chapter and two **Model Question Papers** (as per MHT-CET pattern) to assess the level of preparation of the student on a competitive level.

Hints have been provided in downloadable format to relevant MCQs which are broken down to the simplest form possible.

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

Best of luck to all the aspirants!

Yours faithfully

Authors

Edition: First

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 the syllabus prescribed by Maharashtra State Board of Secondary and Higher Secondary Education 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	Approximate No. of Multiple Choice Questions (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 (Botany)	10	40	1	100
	Biology (Zoology)	10	40		

- Questions will be set on
  i. the entire syllabus of Physics, Chemistry, Mathematics and Biology subjects of Std. XII, and
  ii. chapters / units from Std. XI curriculum as mentioned below:

Sr. No.	Subject	Chapters / Units of Std. XI
1	Physics	Measurements, Scalars and Vectors, Force, Friction in solids and liquids, Refraction of Light, Ray optics, Magnetic effect of electric current, Magnetism.
2	Chemistry	Some basic concepts of chemistry, States of matter: Gases and liquids, Redox reactions, Surface chemistry, Nature of chemical bond, Hydrogen, s-Block elements (Alkali and alkaline earth metals), Basic principles and techniques in organic chemistry, Alkanes.
3	Mathematics	Trigonometric functions, Trigonometric functions of Compound Angles, Factorization Formulae, Straight Line, Circle and Conics, Sets, Relations and Functions, Probability, Sequences and series.
4	Biology	
	Section I – Botany	Diversity in organisms, Biochemistry of cell, Plant Water Relations and Mineral Nutrition, Plant Growth and Development.
	Section II – Zoology	Organization of Cell, Animal tissues, Human Nutrition, Human Respiration.

CONTENT

Note: Questions of standard XI are indicated by '*' in each Model Question Paper.

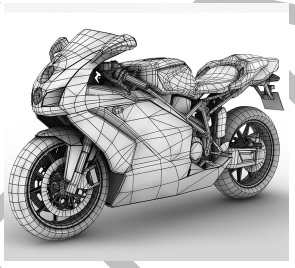
Textbook
Chapter No.

02 Trigonometric Functions

Subtopics

Trigonometry in Graphical Motion

In computer graphics, Trigonometry is used in graphical motion and rotation, 3D rotation matrices are used to rotate objects and these matrices are made up of several trigonometric functions.



Chapter at a glance

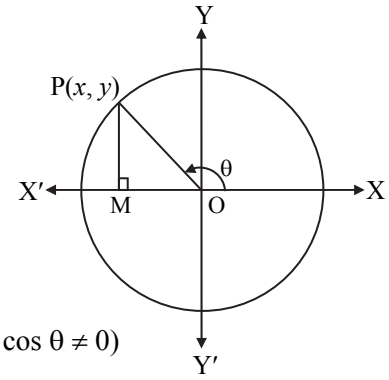
1. Trigonometric Functions with the help of standard unit circle:

Let m∠XOP = θ be the angle in standard position and P(x, y) be the point on the terminal ray such that l(OP) = r > 0. Then,

i. $\sin\theta = \frac{y}{r}$ ii. $\cos\theta = \frac{x}{r}$

iii. $\tan\theta = \frac{y}{x}$, (if $x \neq 0$) iv. $\operatorname{cosec}\theta = \frac{r}{y}$, (if $y \neq 0$)

v. $\sec\theta = \frac{r}{x}$, (if $x \neq 0$) vi. $\cot\theta = \frac{x}{y}$, (if $y \neq 0$)



2. Interrelation between trigonometric functions:

i. $\operatorname{cosec}\theta = \frac{1}{\sin\theta}$, (if $\sin\theta \neq 0$) ii. $\sec\theta = \frac{1}{\cos\theta}$, (if $\cos\theta \neq 0$)

iii. $\tan\theta = \frac{\sin\theta}{\cos\theta}$, (if $\cos\theta \neq 0$) iv. $\cot\theta = \frac{\cos\theta}{\sin\theta}$, (if $\sin\theta \neq 0$)

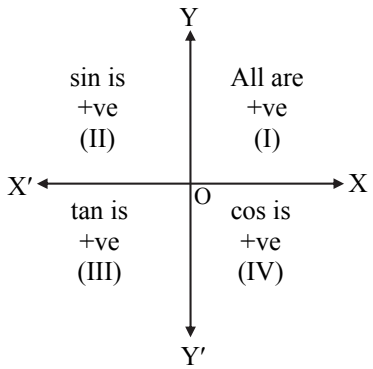
Note: i. Trigonometric functions do not depend upon the position of point P on terminal ray but depends upon the measure of angle (θ).

ii. Co-terminal angles have same trigonometric functions.

iii. P ≡ (x, y) ≡ (cos θ, sin θ)

3. Signs of trigonometric functions in different quadrants:

Quadrant	Signs of the T-functions
I	All T-functions are positive
II	sin θ and cosec θ are positive. All others are negative.
III	tan θ and cot θ are positive. All others are negative.
IV	cos θ and sec θ are positive. All others are negative.



Mnemonics:

The above table can be memorized with the help of

All	sin	tan	cos
(I)	(II)	(III)	(IV)
↓	↓	↓	↓
Add	Sugar	To	Coffee

4. Trigonometric functions of particular angles:

Angles θ / Trigonometric functions	0° (0^c)	30° $\left(\frac{\pi}{6}\right)^c$	45° $\left(\frac{\pi}{4}\right)^c$	60° $\left(\frac{\pi}{3}\right)^c$	90° $\left(\frac{\pi}{2}\right)^c$	180° (π^c)	270° $\left(\frac{3\pi}{2}\right)^c$	360° ($2\pi^c$)
sin θ	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	0	–1	0
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	–1	0	1
tan θ	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞	0	∞	0
cot θ	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	∞	0	∞
sec θ	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞	–1	∞	1
cosec θ	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1	∞	–1	∞

5. Fundamental Identities:

For any angle of measure θ,

i. $\sin^2\theta + \cos^2\theta = 1$
$1 - \sin^2\theta = \cos^2\theta$
$1 - \cos^2\theta = \sin^2\theta$

ii. $1 + \tan^2\theta = \sec^2\theta$
$\sec^2\theta - \tan^2\theta = 1$
$\sec^2\theta - 1 = \tan^2\theta$

iii. $1 + \cot^2\theta = \operatorname{cosec}^2\theta$
$\operatorname{cosec}^2\theta - 1 = \cot^2\theta$
$\operatorname{cosec}^2\theta - \cot^2\theta = 1$

6. Domain and range of trigonometric functions:

i. The domain, range and period of the six trigonometric functions are given below:

T-functions	Domain	Range	Period
sin x	R	[–1, 1]	2π
cos x	R	[–1, 1]	2π
tan x	$\left\{x \in R : x \neq (2n+1)\frac{\pi}{2}, n \in I\right\}$	R	π
cot x	$\{x \in R : x \neq n\pi, n \in I\}$	R	π
sec x	$\left\{x \in R : x \neq (2n+1)\frac{\pi}{2}, n \in I\right\}$	R– (–1, 1)	2π
cosec x	$\{x \in R : x \neq n\pi, n \in I\}$	R– (–1, 1)	2π

ii. Standard inequalities of trigonometric functions:

a. $-1 \le \sin\theta \le 1$ b. $-1 \le \cos\theta \le 1$

c. $\sec\theta \le -1$ or $\sec\theta \ge 1$ d. $\operatorname{cosec}\theta \le -1$ or $\operatorname{cosec}\theta \ge 1$

iii. Periodicity of trigonometric (circular) functions:

A function is periodic if its value repeats after every fixed interval. The fixed interval is called period.

$f(x) = f(x + n)$, for all x and $x + n$ in domain of f, and $n \neq 0$

a. $\sin(\theta + 2n\pi) = \sin\theta$, $\cos(\theta + 2n\pi) = \cos\theta$, where $n \in I$

Hence sin and cos are periodic functions and the period is 2π.

b. $\tan(\theta + n\pi) = \tan\theta$, $\cot(\theta + n\pi) = \cot\theta$, where $n \in I$

Hence tan and cot are periodic functions and the period is π.

7. Trigonometric functions of negative angle:

i. $\sin(-\theta) = -\sin\theta$ ii. $\cos(-\theta) = \cos\theta$

iii. $\tan(-\theta) = -\tan\theta$ iv. $\cot(-\theta) = -\cot\theta$

v. $\sec(-\theta) = \sec\theta$ vi. $\operatorname{cosec}(-\theta) = -\operatorname{cosec}\theta$

Shortcuts

1. If $x = \sec\theta + \tan\theta$, then $\frac{1}{x} = \sec\theta - \tan\theta$

2. If $x = \operatorname{cosec}\theta + \cot\theta$, then $\frac{1}{x} = \operatorname{cosec}\theta - \cot\theta$

3. $\sin\theta_1 + \sin\theta_2 + \ldots\ldots + \sin\theta_n = n$

$\Rightarrow \sin\theta_1 = \sin\theta_2 = \ldots\ldots = \sin\theta_n = 1$

4. $\cos\theta_1 + \cos\theta_2 + \ldots\ldots + \cos\theta_n = n$

$\Rightarrow \cos\theta_1 = \cos\theta_2 = \ldots\ldots = \cos\theta_n = 1$

5. i. $\sin\theta + \operatorname{cosec}\theta = 2 \Rightarrow \sin\theta = 1$

ii. $\sin\theta + \operatorname{cosec}\theta = -2 \Rightarrow \sin\theta = -1$

6. i. $\cos\theta + \sec\theta = 2 \Rightarrow \cos\theta = 1$

ii. $\cos\theta + \sec\theta = -2 \Rightarrow \cos\theta = -1$

7. $\sin^4\theta + \cos^4\theta = 1 - 2\sin^2\theta\cos^2\theta$

8. $\sin^6\theta + \cos^6\theta = 1 - 3\sin^2\theta\cos^2\theta$

9. $\sin^2\theta + \cos^4\theta = \cos^2\theta + \sin^4\theta = 1 - \sin^2\theta\cos^2\theta$

10. $\sin^2\theta + \operatorname{cosec}^2\theta \ge 2$, $\cos^2\theta + \sec^2\theta \ge 2$ and $\sec^2\theta + \operatorname{cosec}^2\theta \ge 4$

11. If $\sec\theta + \tan\theta = m$, $m > 1$, then θ lies in the first quadrant.

If $\sec\theta + \tan\theta = m$, $0 < m < 1$, then θ lies in the fourth quadrant.

If $\sec\theta + \tan\theta = m$, $m < -1$, then θ lies in the second quadrant.

If $\sec\theta + \tan\theta = m$, $-1 < m < 0$, then θ lies in the third quadrant.

Classical Thinking

2.1 Trigonometric Functions

1. If $\sin\theta = \frac{3}{4}$ and $\tan\theta = \frac{9}{2}$, then $\cos\theta$ is

(A) $\frac{1}{6}$ (B) $\frac{8}{27}$ (C) $\frac{27}{8}$ (D) $\frac{15}{4}$

2. If $5\sin\theta = 3$, then $\frac{\sec\theta + \tan\theta}{\sec\theta - \tan\theta}$ is equal to

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

3. $\frac{\sin\theta}{1-\cot\theta} + \frac{\cos\theta}{1-\tan\theta} =$

(A) 0 (B) 1
(C) $\cos\theta - \sin\theta$ (D) $\cos\theta + \sin\theta$

4. If $\sin\theta = -\frac{1}{\sqrt{2}}$ and $\tan\theta = 1$, then θ lies in

(A) first quadrant (B) second quadrant
(C) third quadrant (D) fourth quadrant

5. If $\sin\theta = -\frac{1}{2}$ and $\cos\theta = \frac{\sqrt{3}}{2}$, then θ lies in

(A) I^{st} quadrant (B) II^{nd} quadrant
(C) III^{rd} quadrant (D) IV^{th} quadrant

6. When $x = \frac{\pi}{2}$, then $\tan x$ is

(A) 1 (B) 0
(C) $\frac{1}{\sqrt{3}}$ (D) not defined

7. $\sin^2\frac{\pi}{6} + \cos^2\frac{\pi}{3} - \tan^2\frac{\pi}{4} =$

(A) $\frac{1}{2}$ (B) $-\frac{1}{2}$ (C) $\sqrt{3}$ (D) 1

8. If $x\sin 45°\cos^2 60° = \frac{\tan^2 60°\,\mathrm{cosec}\,30°}{\sec 45°\cot^2 30°}$, then $x =$

(A) 2 (B) 4 (C) 8 (D) 16

9. If $\sin\theta = \sqrt{3}\cos\theta$, then θ is equal to

(A) 45° (B) 30°
(C) 75° (D) 60°

10. If $\sin(\alpha - \beta) = \frac{1}{2}$ and $\cos(\alpha + \beta) = \frac{1}{2}$, where α and β are positive acute angles, then

(A) $\alpha = 45°, \beta = 15°$ (B) $\alpha = 15°, \beta = 45°$
(C) $\alpha = 60°, \beta = 15°$ (D) $\alpha = 15°, \beta = 60°$

2.2 Fundamental Identities

11. If $\tan\theta = \frac{20}{21}$, then $\cos\theta$ is equal to

(A) $\pm\frac{20}{41}$ (B) $\pm\frac{1}{21}$
(C) $\pm\frac{21}{29}$ (D) $\pm\frac{20}{21}$

12. If $\tan\theta = -\frac{1}{\sqrt{10}}$ and θ lies in the fourth quadrant, then $\sec\theta =$

(A) $\frac{1}{\sqrt{11}}$ (B) $\frac{-1}{\sqrt{11}}$
(C) $\sqrt{\frac{11}{10}}$ (D) $-\sqrt{\frac{10}{11}}$

13. If $\tan\theta = \frac{1}{\sqrt{5}}$ and θ lies in the I^{st} quadrant, then $\cos\theta$ is

(A) $\frac{1}{\sqrt{6}}$ (B) $-\frac{1}{\sqrt{6}}$
(C) $\frac{\sqrt{5}}{\sqrt{6}}$ (D) $-\frac{\sqrt{5}}{\sqrt{6}}$

14. If $\sin\theta = \frac{21}{29}$ and θ lies in the second quadrant, then the value of $\sec\theta + \tan\theta$ is

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

15. For any real number $x \neq (2n+1)\frac{\pi}{2}$, $\sec^4 x - \sec^2 x$ is equal to

(A) $\tan^4 x - \tan^2 x$ (B) $\tan^4 x + \tan^2 x$
(C) $\tan^2 x - \tan^4 x$ (D) $2\tan^2 x$

16. Which of the following is true?

(A) $\tan^2\theta - \sin^2\theta = \tan^2\theta\sin^2\theta$
(B) $\sec^2\theta\,\mathrm{cosec}^2\theta = \sec^2\theta - \mathrm{cosec}^2\theta$
(C) $\mathrm{cosec}^2\theta + \cot^2\theta = \mathrm{cosec}^2\theta\cot^2\theta$
(D) none of these

17. If $x = \sec\theta + \tan\theta$, then $x + \frac{1}{x} =$

(A) 1 (B) $2\sec\theta$
(C) 2 (D) $2\tan\theta$

18. $\cot x + \tan x =$

(A) $\cot 2x$ (B) $2\cot^2 x$
(C) $\sec x\,\mathrm{cosec}\,x$ (D) $\cot^2 2x$

19. The value of $\frac{\sin^2 20° + \cos^4 20°}{\sin^4 20° + \cos^2 20°}$ is

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

20. If $x = a\cos\theta + b\sin\theta$ and $y = a\sin\theta - b\cos\theta$, then $a^2 + b^2$ is equal to

(A) $x^2 - y^2$ (B) $x^2 + y^2$
(C) $(x+y)^2$ (D) $(x-y)^2$

21. If $x = a\cos^3\theta$, $y = b\sin^3\theta$, then

(A) $\left(\frac{a}{x}\right)^{\frac{2}{3}} + \left(\frac{b}{y}\right)^{\frac{2}{3}} = 1$ (B) $\left(\frac{b}{x}\right)^{\frac{2}{3}} + \left(\frac{a}{y}\right)^{\frac{2}{3}} = 1$

(C) $\left(\frac{x}{a}\right)^{\frac{2}{3}} + \left(\frac{y}{b}\right)^{\frac{2}{3}} = 1$ (D) $\left(\frac{x}{b}\right)^{\frac{2}{3}} + \left(\frac{y}{a}\right)^{\frac{2}{3}} = 1$

22. If $\cos x + \cos^2 x = 1$, then the value of $\sin^2 x + \sin^4 x$ is

(A) 1 (B) – 1 (C) 0 (D) 2

23. If $\sin x + \sin^2 x = 1$, then $\cos^8 x + 2\cos^6 x + \cos^4 x =$

(A) 0 (B) – 1 (C) 2 (D) 1

24. Which one of the following is incorrect?

(A) $\sin\theta = -\frac{1}{5}$ (B) $\cos\theta = 1$

(C) $\sec\theta = \frac{1}{2}$ (D) $\tan\theta = 20$

25. Which of the following is possible?

(A) $\cos\theta = \frac{7}{5}$ (B) $\sin\theta = \frac{8}{5}$

(C) $\sec\theta = \frac{4}{5}$ (D) $\tan\theta = 45$

26. The smallest value of $5\cos\theta + 12$ is

(A) 5 (B) 12 (C) 7 (D) 17

Critical Thinking

2.1 Trigonometric Functions

1. If $\tan\theta = \frac{p}{q}$, then the value of $\frac{p\sin\theta - q\cos\theta}{p\sin\theta + q\cos\theta}$ is

(A) $\frac{p^2 - q^2}{p^2 + q^2}$ (B) $\frac{p^2 + q^2}{p^2 - q^2}$

(C) 0 (D) $\frac{p-q}{p+q}$

2. The value of $\cos^2\theta + \sec^2\theta$ is always

(A) less than 1
(B) equal to 1
(C) greater than 1, but less than 2
(D) greater than or equal to 2

3. If $\sin x + \text{cosec}\, x = 2$, then $\sin^n x + \text{cosec}^n x$ is equal to

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

4. Which of the following relations is correct ?

(A) $\sin 1 < \sin 1°$ (B) $\sin 1 > \sin 1°$

(C) $\sin 1 = \sin 1°$ (D) $\frac{\pi}{180}\sin 1 = \sin 1°$

5. Which of the following is correct ?

(A) $\tan 1 > \tan 2$ (B) $\tan 1 = \tan 2$
(C) $\tan 1 < \tan 2$ (D) $\tan 1 = 1$

6. If $\cos A = \frac{\sqrt{3}}{2}$, then $\tan 3A =$

(A) 0 (B) $\frac{1}{2}$
(C) 1 (D) not defined

7. If $\tan(A - B) = 1$, $\sec(A + B) = \frac{2}{\sqrt{3}}$, then the smallest positive value of B is

(A) $\frac{25\pi}{24}$ (B) $\frac{19\pi}{24}$
(C) $\frac{13\pi}{24}$ (D) $\frac{11\pi}{24}$

8. If $\sin(A + B + C) = 1$, $\tan(A - B) = \frac{1}{\sqrt{3}}$ and $\sec(A + C) = 2$, then

(A) $A = 120°, B = 60°, C = 0°$
(B) $A = 60°, B = 30°, C = 0°$
(C) $A = 90°, B = 60°, C = 30°$
(D) $A = 120°, B = 0°, C = 60°$

2.2 Fundamental Identities

9. If $\cos A = \frac{3}{5}$, $\cos B = \frac{4}{5}$ and $\frac{-\pi}{2} < A < 0$, $\frac{-\pi}{2} < B < 0$, then the value of $2\sin A + 4\sin B =$

(A) 4 (B) 2 (C) –4 (D) 0

10. If $\tan\theta + \sec\theta = \sqrt{3}$ and $0 < \theta < \pi$, then θ is equal to

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{2\pi}{3}$ (D) $\frac{5\pi}{6}$

11. If $\frac{\pi}{2} < \theta < \frac{3\pi}{2}$, then $\sqrt{\frac{1-\sin\theta}{1+\sin\theta}}$ is equal to

(A) $\sec\theta - \tan\theta$ (B) $\sec\theta + \tan\theta$
(C) $\tan\theta - \sec\theta$ (D) $\sec^2\theta + \tan^2\theta$

12. If θ lies in the second quadrant, then the value of $\sqrt{\left(\frac{1-\sin\theta}{1+\sin\theta}\right)}+\sqrt{\left(\frac{1+\sin\theta}{1-\sin\theta}\right)}$ is equal to

(A) 2 sec θ (B) –2 sec θ
(C) 2 cosec θ (D) 2 cos θ

13. If $\pi<\alpha<\frac{3\pi}{2}$, then $\sqrt{\frac{1-\cos\alpha}{1+\cos\alpha}}+\sqrt{\frac{1+\cos\alpha}{1-\cos\alpha}}=$

(A) $\frac{2}{\sin\alpha}$ (B) $-\frac{2}{\sin\alpha}$
(C) $\frac{1}{\sin\alpha}$ (D) $-\frac{1}{\sin\alpha}$

14. If A lies in the second quadrant and 3 tan A + 4 = 0, then the value of 2 cot A – 5 cos A + sin A is equal to

(A) $\frac{-53}{10}$ (B) $\frac{-7}{10}$
(C) $\frac{7}{10}$ (D) $\frac{23}{10}$

15. If sec θ – tan θ = $\frac{1}{2}$, then θ lies in the

(A) first quadrant (B) second quadrant
(C) third quadrant (D) fourth quadrant

16. If cos θ + sin θ = $\sqrt{2}$ cos θ, then cos θ – sin θ =

(A) $\sqrt{2}$ sin θ (B) 2 sin θ
(C) $-\sqrt{2}$ sin θ (D) $\sqrt{2}$ cos θ

17. If sin x + cos x = a, then |sin x – cos x| equals

(A) $\sqrt{2-a^2}$ (B) $\sqrt{2+a^2}$
(C) $\sqrt{a^2-2}$ (D) $\sqrt{a^2-4}$

18. If 3 sin θ + 4 cos θ = 5, then the value of 3 cos θ – 4 sin θ is equal to

(A) 0 (B) –5
(C) 5 (D) 4

19. If $u_n = \sin^n\theta + \cos^n\theta$, then $2u_6 - 3u_4$ is equal to

(A) –1 (B) $12\sin^2\theta\cos^2\theta$
(C) 1 (D) $12\tan^2\theta\cos^2\theta$

20. If sin x + $\sin^2 x$ = 1, then the value of $\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + \cos^6 x - 2$ is equal to

(A) 0 (B) 1
(C) – 1 (D) 2

21. If 10 $\sin^4\alpha$ + 15 $\cos^4\alpha$ = 6, then 27 $\text{cosec}^6\alpha$ + 8 $\sec^6\alpha$ =

(A) 125 (B) 250
(C) 50 (D) 75

22. If $\sin\alpha=\frac{2pq}{p^2+q^2}$, then sec α – tan α =

(A) $\frac{p-q}{p+q}$ (B) $\frac{pq}{p^2+q^2}$
(C) $\frac{p+q}{p-q}$ (D) $\frac{pq}{p+q}$

23. If sec θ – tan θ = $\frac{a+1}{a-1}$, then cos θ =

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

24. If sec θ = $x+\frac{1}{4x}$, $x \in R$, $x \neq 0$, then the value of sec θ + tan θ is

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

25. The value of

$$\sin^6\left(\frac{\pi}{49}\right)+\cos^6\left(\frac{\pi}{49}\right)-1+3\sin^2\left(\frac{\pi}{49}\right)\cos^2\left(\frac{\pi}{49}\right)$$

is

(A) $\tan^6\frac{\pi}{49}$ (B) $\cot^6\frac{\pi}{49}$
(C) 1 (D) 0

26. If $\frac{2\sin\alpha}{1+\cos\alpha+\sin\alpha}=x$, then $\frac{1-\cos\alpha+\sin\alpha}{1+\sin\alpha}$ is equal to

(A) $\frac{1}{x}$ (B) x
(C) $1-x$ (D) $1+x$

27. The value of the expression

$$1-\frac{\sin^2 y}{1+\cos y}+\frac{1+\cos y}{\sin y}-\frac{\sin y}{1-\cos y}$$ is

(A) 0 (B) 1
(C) sin y (D) cos y

28. The value of the expression $\frac{2\sin\theta\tan\theta(1-\tan\theta)+2\sin\theta\sec^2\theta}{(1+\tan\theta)^2}$ is

(A) $\frac{\sin\theta}{1+\tan\theta}$ (B) $\frac{2\sin\theta}{1+\tan\theta}$

(C) $\frac{2\sin\theta}{(1+\tan\theta)^2}$ (D) $\frac{\sin\theta}{(1+\tan\theta)^2}$

29. If A is an obtuse angle, then $\frac{\sin^3 A-\cos^3 A}{\sin A-\cos A}+\frac{\sin A}{\sqrt{1+\tan^2 A}}-2\tan A\cot A$ is equal to

(A) 1 (B) – 1

(C) 2 (D) –2

30. If $\frac{x}{a}\cos\theta+\frac{y}{b}\sin\theta+1=0$ and $\frac{x}{a}\sin\theta-\frac{y}{b}\cos\theta-1=0$, then $\frac{x^2}{a^2}+\frac{y^2}{b^2}$ is equal to

(A) 2 (B) 0 (C) –2 (D) 1

31. If $x\sin^3\alpha+y\cos^3\alpha=\sin\alpha\cos\alpha$ and $x\sin\alpha-y\cos\alpha=0$, then $x^2+y^2=$

(A) – 1 (B) ±1

(C) 1 (D) 0

32. If $a\cos^3\alpha+3a\cos\alpha\sin^2\alpha=m$ and $a\sin^3\alpha+3a\cos^2\alpha\sin\alpha=n$, then $(m+n)^{2/3}+(m-n)^{2/3}$ is equal to

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

(C) $2a^{\frac{2}{3}}$ (D) $2a^3$

33. If $\tan^2\alpha\tan^2\beta+\tan^2\beta\tan^2\gamma+\tan^2\gamma\tan^2\alpha+2\tan^2\alpha\tan^2\beta\tan^2\gamma=1$, then the value of $\sin^2\alpha+\sin^2\beta+\sin^2\gamma$ is

(A) 0 (B) – 1 (C) 1 (D) 2

34. If $p=\frac{2\sin\theta}{1+\cos\theta+\sin\theta}$ and $q=\frac{\cos\theta}{1+\sin\theta}$, then

(A) pq = 1 (B) $\frac{q}{p}=1$

(C) q – p = 1 (D) p + q = 1

35. If $x=\sec\phi-\tan\phi$, $y=\operatorname{cosec}\phi+\cot\phi$, then

(A) $x=\frac{y+1}{y-1}$ (B) $x=\frac{y-1}{y+1}$

(C) $y=\frac{1-x}{1+x}$ (D) $y=\frac{1+x}{(1-x)^2}$

36. If $\sin\theta_1+\sin\theta_2+\sin\theta_3=3$, then $\cos\theta_1+\cos\theta_2+\cos\theta_3=$

(A) 3 (B) 2 (C) 1 (D) 0

37. The equation $(a+b)^2=4ab\sin^2\theta$ is possible only when

(A) 2a = b (B) a = b

(C) a = 2b (D) a = –b

38. The maximum value of $12\sin\theta-9\sin^2\theta$ is

(A) 3 (B) 4 (C) 5 (D) 2

39. If $y=\sin^2\theta+\cos^4\theta$, then for all real values of θ

(A) $y\in[1,2]$ (B) $y\in[13/16,1]$

(C) $y\in[3/4,13/16]$ (D) $y\in[3/4,1]$

Competitive Thinking

2.1 Trigonometric Functions

1. If $5\tan\theta=4$, then $\frac{5\sin\theta-3\cos\theta}{5\sin\theta+2\cos\theta}=$ **[Karnataka CET 1998]**

(A) 0 (B) 1 (C) $\frac{1}{6}$ (D) 6

2. If $\sin\theta+\operatorname{cosec}\theta=2$, then $\sin^2\theta+\operatorname{cosec}^2\theta=$ **[MP PET 1992; MNR 1990; UPSEAT 2002]**

(A) 1 (B) 3 (C) 2 (D) 4

3. If $\sin\theta+\operatorname{cosec}\theta=2$, the value of $\sin^{10}\theta+\operatorname{cosec}^{10}\theta$ is **[MP PET 2004]**

(A) 10 (B) 2^{10} (C) 2^9 (D) 2

4. If $\tan A+\cot A=4$, then $\tan^4 A+\cot^4 A$ is equal to **[Kerala (Engg.) 2002]**

(A) 110 (B) 191

(C) 80 (D) 194

5. $\sin 200°+\cos 200°$ is **[K.U.K.C.E.E.T. 1995]**

(A) negative (B) positive

(C) zero (D) zero or positive

6. $\cos 1°.\cos 2°.\cos 3°\ldots..\cos 179°=$ **[Karnataka CET 1999; DCE 2005; MHT CET 2018]**

(A) 0 (B) 1 (C) $-\frac{1}{2}$ (D) –1

7. If $x\in\left[0,\frac{\pi}{2}\right]$, $y\in\left[0,\frac{\pi}{2}\right]$ and $\sin x+\cos y=2$, then the value of $x+y$ is equal to **[KEAM 2017]**

(A) 2π (B) π (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{2}$

2.2 Fundamental Identities

8. If $\sin\theta - \cos\theta = 1$, then the value of $\sin^3\theta - \cos^3\theta$ is equal to **[KEAM 2018]**
(A) 1 (B) –1
(C) 0 (D) 2

9. If $\tan\theta = \frac{-4}{3}$, then $\sin\theta =$
[IIT 1979; Pb. CET 1995; Orissa JEE 2002]
(A) – 4/5 but not 4/5
(B) – 4/5 or 4/5
(C) 4/5 but not – 4/5
(D) Neither $\frac{4}{5}$ nor $\frac{-4}{5}$

10. If $\sin\theta = \frac{24}{25}$ and θ lies in the second quadrant, then $\sec\theta + \tan\theta =$ **[MP PET 1997]**
(A) – 3 (B) – 5 (C) – 7 (D) – 9

11. If $\sin\theta = \frac{2t}{1+t^2}$ and θ lies in the second quadrant, then $\cos\theta$ is equal to **[WB JEE 2011]**
(A) $\frac{1-t^2}{1+t^2}$ (B) $\frac{t^2-1}{1+t^2}$
(C) $\frac{-\left|1-t^2\right|}{1+t^2}$ (D) $\frac{1+t^2}{\left|1-t^2\right|}$

12. If $\frac{3\pi}{4} < \alpha < \pi$, then $\sqrt{\operatorname{cosec}^2\alpha + 2\cot\alpha}$ is equal to **[Pb. CET 2000; AMU 2001; MP PET 2004]**
(A) $1+\cot\alpha$ (B) $1-\cot\alpha$
(C) $-1-\cot\alpha$ (D) $-1+\cot\alpha$

13. If $\operatorname{cosec}\theta - \cot\theta = 2017$, then quadrant in which θ lies is **[TS EAMCET 2017]**
(A) I (B) IV (C) III (D) II

14. If $\operatorname{cosec}\theta - \cot\theta = \frac{1}{2}$; $0 < \theta < \frac{\pi}{2}$, then $\cos\theta$ is equal to **[K.U.K.C.E.E.T. 2000]**
(A) $\frac{-3}{5}$ (B) $-\frac{5}{3}$ (C) $\frac{5}{3}$ (D) $\frac{3}{5}$

15. If $\operatorname{cosec} A + \cot A = \frac{11}{2}$, then $\tan A =$
[Roorkee 1995]
(A) $\frac{21}{22}$ (B) $\frac{15}{16}$ (C) $\frac{44}{117}$ (D) $\frac{117}{43}$

16. If $\sec\theta + \tan\theta = p$, then $\tan\theta$ is equal to **[MP PET 1994]**
(A) $\frac{2p}{p^2-1}$ (B) $\frac{p^2-1}{2p}$
(C) $\frac{p^2+1}{2p}$ (D) $\frac{2p}{p^2+1}$

17. If $\tan\theta + \sec\theta = e^x$, then $\cos\theta$ equals **[AMU 2002]**
(A) $\frac{(e^x+e^{-x})}{2}$ (B) $\frac{2}{(e^x+e^{-x})}$
(C) $\frac{(e^x-e^{-x})}{2}$ (D) $\frac{(e^x-e^{-x})}{(e^x+e^{-x})}$

18. If $\sin\theta + \cos\theta = 1$, then $\sin\theta\cos\theta =$ **[Karnataka CET 1998]**
(A) 0 (B) 1
(C) 2 (D) $\frac{1}{2}$

19. If $3\sin A + 5\cos A = 5$, then the value of $(3\cos A - 5\sin A)^2$ is **[MP PET 2010]**
(A) 4 (B) 5 (C) 2 (D) 9

20. If $\sec\theta = m$ and $\tan\theta = n$, then $\frac{1}{m}\left[(m+n)+\frac{1}{m+n}\right] =$
[Karnataka CET 2006]
(A) 2 (B) 2m
(C) 2n (D) mn

21. If $\sin\theta + \cos\theta = m$ and $\sec\theta + \operatorname{cosec}\theta = n$, then $n(m+1)(m-1) =$ **[MP PET 1986]**
(A) m (B) n
(C) 2m (D) 2n

22. If $2y\cos\theta = x\sin\theta$ and $2x\sec\theta - y\operatorname{cosec}\theta = 3$, then $x^2 + 4y^2 =$ **[WB JEE 1988]**
(A) 4 (B) – 4
(C) – 2 (D) 2

23. If $\tan\theta + \sin\theta = m$ and $\tan\theta - \sin\theta = n$, then **[IIT 1970]**
(A) $m^2 - n^2 = 4mn$ (B) $m^2 + n^2 = 4mn$
(C) $m^2 - n^2 = m^2 + n^2$ (D) $m^2 - n^2 = 4\sqrt{mn}$

24. If $(\sec\alpha + \tan\alpha)(\sec\beta + \tan\beta)(\sec\gamma + \tan\gamma) = \tan\alpha\tan\beta\tan\gamma$, then $(\sec\alpha - \tan\alpha)(\sec\beta - \tan\beta)(\sec\gamma - \tan\gamma) =$
[Kurukshetra CEE 1998]
(A) $\cot\alpha\cot\beta\cot\gamma$
(B) $\tan\alpha\tan\beta\tan\gamma$
(C) $\cot\alpha + \cot\beta + \cot\gamma$
(D) $\tan\alpha + \tan\beta + \tan\gamma$

25. If $P_n = \cos^n \theta + \sin^n \theta$, then $2P_6 - 3P_4 + 1 =$ **[DCE 1996, Karnataka CET 2000, MP CET 2000]**

(A) 2 (B) 3
(C) 0 (D) 1

26. $(\sec A + \tan A - 1)(\sec A - \tan A + 1) - 2\tan A =$ **[Roorkee 1972]**

(A) sec A (B) 2 sec A
(C) 0 (D) 1

27. $\cos^4 \theta - \sin^4 \theta$ is equal to **[UPSEAT 2005; MP PET 2006]**

(A) $1 - 2\sin^2\left(\frac{\theta}{2}\right)$ (B) $2\cos^2 \theta - 1$
(C) $1 + 2\sin^2\left(\frac{\theta}{2}\right)$ (D) $1 + 2\cos^2 \theta$

28. $\sin^6 \theta + \cos^6 \theta + 3\sin^2 \theta \cos^2 \theta =$ **[MP PET 1995, 2002; DCE 2005]**

(A) 0 (B) –1
(C) 1 (D) None of these

29. The value of $6(\sin^6 \theta + \cos^6 \theta) - 9(\sin^4 \theta + \cos^4 \theta) + 4$ is **[MP PET 2001]**

(A) –3 (B) 0
(C) 1 (D) 3

30. If $\sin x + \sin^2 x = 1$, then the value of $(\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + \cos^6 x - 1)$ is equal to **[BCECE 2015]**

(A) 2 (B) 1
(C) – 1 (D) 0

31. The value of k, for which $(\cos x + \sin x)^2 + k \sin x \cos x - 1 = 0$ is an identity, is **[Kerala (Engg.) 2001]**

(A) – 1 (B) – 2
(C) 0 (D) 1

32. The equation $\sec^2 \theta = \frac{4xy}{(x+y)^2}$ is only possible when **[MP PET 1986; IIT 1996]**

(A) $x = y$ (B) $x < y$
(C) $x > y$ (D) None of these

33. Let $\theta \in \left(0, \frac{\pi}{4}\right)$ and $t_1 = (\tan\theta)^{\tan\theta}$, $t_2 = (\tan\theta)^{\cot\theta}$, $t_3 = (\cot\theta)^{\tan\theta}$ and $t_4 = (\cot\theta)^{\cot\theta}$. Then, **[IIT JEE 2006]**

(A) $t_1 > t_2 > t_3 > t_4$
(B) $t_4 > t_3 > t_1 > t_2$
(C) $t_3 > t_1 > t_2 > t_4$
(D) $t_2 > t_3 > t_1 > t_4$

Answer Key

Classical Thinking

1.	(A)	2.	(B)	3.	(D)	4.	(C)	5.	(D)	6.	(D)	7.	(B)	8.	(C)	9.	(D)	10.	(A)
11.	(C)	12.	(C)	13.	(C)	14.	(D)	15.	(B)	16.	(A)	17.	(B)	18.	(C)	19.	(C)	20.	(B)
21.	(C)	22.	(A)	23.	(D)	24.	(C)	25.	(D)	26.	(C)								

Critical Thinking

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

Competitive Thinking

1.	(C)	2.	(C)	3.	(D)	4.	(D)	5.	(A)	6.	(A)	7.	(D)	8.	(A)	9.	(B)	10.	(C)
11.	(C)	12.	(C)	13.	(D)	14.	(D)	15.	(C)	16.	(B)	17.	(B)	18.	(A)	19.	(D)	20.	(A)
21.	(C)	22.	(A)	23.	(D)	24.	(A)	25.	(C)	26.	(C)	27.	(B)	28.	(C)	29.	(C)	30.	(D)
31.	(B)	32.	(A)	33.	(B)														

Evaluation Test

1. If $\sin A = a \cos B$ and $\cos A = b \sin B$, then $(a^2 - 1)\tan^2 A + (1 - b^2)\tan^2 B$ is equal to

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

(C) $\frac{a^2 + b^2}{b^2}$ (D) $\frac{a^2 + b^2}{a^2}$

2. If $\tan\theta = \frac{x\sin\phi}{1 - x\cos\phi}$ and $\tan\phi = \frac{y\sin\theta}{1 - y\cos\theta}$, then $\frac{x}{y} =$

(A) $\frac{\sin\phi}{\sin\theta}$ (B) $\frac{\sin\theta}{\sin\phi}$

(C) $\frac{\sin\phi}{1 - \cos\theta}$ (D) $\frac{\sin\theta}{1 - \cos\phi}$

3. If $a\sin^2 x + b\cos^2 x = c$, $b\sin^2 y + a\cos^2 y = d$ and $a\tan x = b\tan y$, then $\frac{a^2}{b^2}$ is equal to

(A) $\frac{(b - c)(d - b)}{(a - d)(c - a)}$ (B) $\frac{(a - d)(c - a)}{(b - c)(d - b)}$

(C) $\frac{(d - a)(c - a)}{(b - c)(d - b)}$ (D) $\frac{(b - c)(b - d)}{(c - a)(a - d)}$

4. If $\text{cosec}\,\theta - \sin\theta = a$ and $\sec\theta - \cos\theta = b$, then $a^{2/3} b^{2/3}(a^{2/3} + b^{2/3}) =$

(A) 1 (B) 2

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

5. If $\sin x + \sin^2 x + \sin^3 x = 1$, then $\cos^6 x - 4\cos^4 x + 8\cos^2 x =$

(A) 2 (B) 1

(C) 3 (D) 4

6. If $\cot\theta + \tan\theta = m$ and $\sec\theta - \cos\theta = n$, then which of the following is correct?

(A) $m(mn^2)^{1/3} - n(nm^2)^{1/3} = 1$

(B) $m(m^2n)^{1/3} - n(mn^2)^{1/3} = 1$

(C) $n(mn^2)^{1/3} - m(nm^2)^{1/3} = 1$

(D) $n(m^2n)^{1/3} - m(mn^2)^{1/3} = 1$

7. If $\frac{\sin^4\theta}{a} + \frac{\cos^4\theta}{b} = \frac{1}{a + b}$, then which one of the following is incorrect?

(A) $\frac{\sin^4\theta}{a^2} = \frac{\cos^4\theta}{b^2}$

(B) $\frac{\sin^4\theta}{b^2} = \frac{\cos^4\theta}{a^2}$

(C) $\sin^4\theta = \frac{a^2}{(a + b)^2}$

(D) $\frac{\sin^8\theta}{a^3} + \frac{\cos^8\theta}{b^3} = \frac{1}{(a + b)^3}$

8. If $x\sin\theta = y\cos\theta = \frac{2z\tan\theta}{1 - \tan^2\theta}$, then $4z^2(x^2 + y^2) =$

(A) $(x^2 + y^2)^3$ (B) $(x^2 - y^2)^3$

(C) $(x^2 - y^2)^2$ (D) $(x^2 + y^2)^2$

9. If $3\cot A = 6\sec B = -2\sqrt{10}$, where $\frac{\pi}{2} < A < \pi$, $\pi < B < \frac{3\pi}{2}$, then $\text{cosec}\,A - \tan B$ is equal to

(A) 1 (B) –1

(C) 2 (D) –2

10. For $0 < \phi < \frac{\pi}{2}$, if $x = \sum_{n=0}^{\infty}\cos^{2n}\phi$, $y = \sum_{n=0}^{\infty}\sin^{2n}\phi$, $z = \sum_{n=0}^{\infty}\cos^{2n}\phi\sin^{2n}\phi$, then

(A) $xyz = xz + y$ (B) $xyz = xy + z$

(C) $xyz = x + yz$ (D) none of these

Answers to Evaluation Test

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

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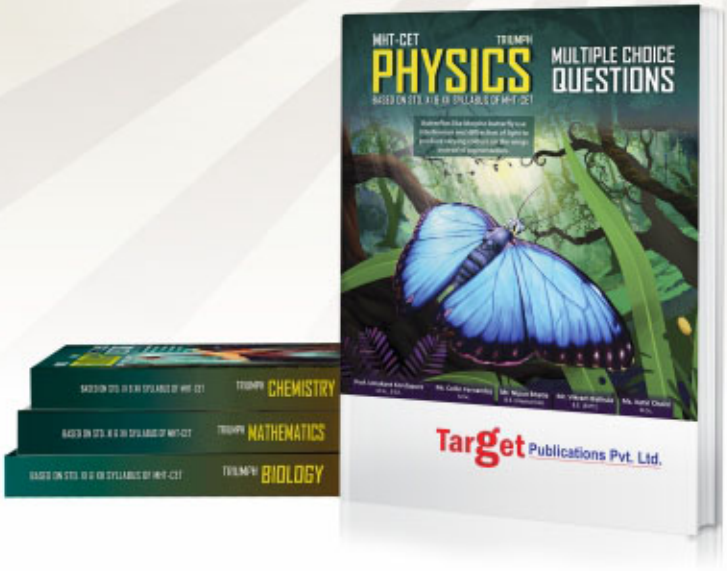

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