SAMPLE CONTENT

HOLISTIC

MHT-CET

ROADMAP TO SUCCESS

2024

- Based on latest paper pattern
- Chapter at a glance
- Important Formulae & Shortcuts
- Subtopic wise segregation
- Classwork/Homework segregation
- Previous Years' Questions

MATHEMATICS (STD. XI)

Target Publications® Pvt. Ltd.

Textbook
Chapter No.

03 Trigonometry - II

Subtopics

Canadarm2 Robotic Manipulator

The Canadarm2 Robotic Manipulator on the International Space Station is operated by controlling the angles of its joints. Calculating the final position of the astronaut at the end of the arm requires repeated use of the trigonometric functions of those angles.

Chapter at a glance

1. Trigonometric functions of sum and difference of two angles:

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. $\tan(A + B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B}$

vi. $\tan(A - B) = \dfrac{\tan A - \tan B}{1 + \tan A \tan B}$

vii. $\cot(A + B) = \dfrac{\cot A \cot B - 1}{\cot A + \cot B}$

viii. $\cot(A - B) = \dfrac{\cot A \cot B + 1}{\cot B - \cot A}$

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

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

2. 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
$\sin(A + B + C)$
$= \cos A \cos B \cos C (\tan A + \tan B + \tan C - \tan A \tan B \tan C)$

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

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

3. Trigonometric functions of allied angles:

Two angles are said to be allied when their sum or difference is either zero or a multiple of 90°.

T-functions → / Allied angles ↓	sin θ	cos θ	tan θ
(– θ)	– sin θ	cos θ	– tan θ
(90° – θ) or $\left(\frac{\pi}{2}-\theta\right)$	cos θ	sin θ	cot θ
(90° + θ) or $\left(\frac{\pi}{2}+\theta\right)$	cos θ	– sin θ	– cot θ
(180° – θ) or (π – θ)	sin θ	– cos θ	– tan θ
(180° + θ) or (π + θ)	– sin θ	– cos θ	tan θ
(270° – θ) or $\left(\frac{3\pi}{2}-\theta\right)$	– cos θ	– sin θ	cot θ
(270° + θ) or $\left(\frac{3\pi}{2}+\theta\right)$	– cos θ	sin θ	– cot θ
(360° – θ) or (2π – θ)	– sin θ	cos θ	– tan θ
(360° + θ) or (2π + θ)	sin θ	cos θ	tan θ

4. Trigonometric functions of multiple angles:

i. $\sin 2\theta = 2\sin\theta\cos\theta$

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

ii. $\cos 2\theta = \cos^2\theta - \sin^2\theta$

$= 1 - 2\sin^2\theta$

$= 2\cos^2\theta - 1$

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

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

iv. $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$

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

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

5. Trigonometric functions of half angles:

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

ii. $\cos\theta = \cos^2\left(\frac{\theta}{2}\right) - \sin^2\left(\frac{\theta}{2}\right)$

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

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

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

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

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

vi. $1 + \cos\theta = 2\cos^2\left(\frac{\theta}{2}\right)$

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

6. 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. $\cos C - \cos D = 2\sin\frac{C+D}{2}\sin\frac{D-C}{2}$

$= -2\sin\frac{C+D}{2}\sin\frac{C-D}{2}$

7. 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. $2\sin A\sin B = \cos(A-B) - \cos(A+B)$

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

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

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

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., $-\sqrt{a^2+b^2} \le a\cos\theta + b\sin\theta \le \sqrt{a^2+b^2}$

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

$\cos\alpha + \cos 2\alpha + \cos 3\alpha + \ldots\ldots + \cos n\alpha$

$= \dfrac{\cos\left(\dfrac{n+1}{2}\right)\alpha.\sin\left(\dfrac{n\alpha}{2}\right)}{\sin\left(\dfrac{\alpha}{2}\right)}$

18. If $\dfrac{p}{q} = \dfrac{a}{b}$, then by componendo and dividendo,

$\dfrac{p+q}{p-q} = \dfrac{a+b}{a-b}$

19. $\sin^2 A - \sin^2 B = \sin(A + B)\sin(A - B)$

20. $\sin\theta \sin(60° - \theta)\sin(60° + \theta) = \dfrac{1}{4}\sin 3\theta$

21. $\cos\theta \cos(60° - \theta)\cos(60° + \theta) = \dfrac{1}{4}\cos 3\theta$

22. $\tan\theta \tan(60° - \theta)\tan(60° + \theta) = \tan 3\theta$

23. 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. $\sin A + \sin B + \sin C = 4 \cos\dfrac{A}{2}\cos\dfrac{B}{2}\cos\dfrac{C}{2}$

v. $\cos A + \cos B + \cos C = 1 + 4 \sin\dfrac{A}{2}\sin\dfrac{B}{2}\sin\dfrac{C}{2}$

vi. $\cos A + \cos B - \cos C = -1 + 4 \cos\dfrac{A}{2}\cos\dfrac{B}{2}\sin\dfrac{C}{2}$

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. $\tan\dfrac{A}{2}\tan\dfrac{B}{2} + \tan\dfrac{B}{2}\tan\dfrac{C}{2} + \tan\dfrac{C}{2}\tan\dfrac{A}{2} = 1$

x. $\cot\dfrac{A}{2} + \cot\dfrac{B}{2} + \cot\dfrac{C}{2} = \cot\dfrac{A}{2}\cot\dfrac{B}{2}\cot\dfrac{C}{2}$

Classwork

3.1 Trigonometric functions of sum and difference of angles

1. If $\sin\theta = \dfrac{12}{13}$, $\left(0 < \theta < \dfrac{\pi}{2}\right)$ and $\cos\phi = -\dfrac{3}{5}$, $\left(\pi < \phi < \dfrac{3\pi}{2}\right)$, then $\sin(\theta + \phi)$ will be

(A) $\dfrac{-56}{61}$ (B) $\dfrac{-56}{65}$

(C) $\dfrac{1}{65}$ (D) -56

2. If $\dfrac{\pi}{2} < \alpha < \pi$, $\pi < \beta < \dfrac{3\pi}{2}$; $\sin\alpha = \dfrac{15}{17}$ and $\tan\beta = \dfrac{12}{5}$, then the value of $\sin(\beta - \alpha)$ is

(A) $\dfrac{-171}{221}$ (B) $\dfrac{-21}{221}$

(C) $\dfrac{21}{221}$ (D) $\dfrac{171}{221}$

3. If $\sin\theta = 3\sin(\theta + 2\alpha)$, then the value of $\tan(\theta + \alpha) + 2\tan\alpha$ is

(A) 3 (B) 2

(C) -1 (D) 0

4. The value of $\cos 15° - \sin 15°$ is equal to

(A) $\dfrac{1}{\sqrt{2}}$ (B) $\dfrac{1}{2}$

(C) $-\dfrac{1}{\sqrt{2}}$ (D) 0

5. If $\cos P = \dfrac{1}{7}$ and $\cos Q = \dfrac{13}{14}$, where P and Q both are acute angles, then the value of $P - Q$ is

(A) 30° (B) 60°

(C) 45° (D) 75°

6. The value of $\cos\left(\dfrac{\pi}{4} + x\right) + \cos\left(\dfrac{\pi}{4} - x\right)$ is

(A) $\sqrt{2}\sin^2 x$ (B) $\sqrt{2}\sin x$

(C) $\sqrt{2}\cos^2 x$ (D) $\sqrt{2}\cos x$

7. Given that $\cos\left(\dfrac{\alpha - \beta}{2}\right) = 2\cos\left(\dfrac{\alpha + \beta}{2}\right)$, then $\tan\dfrac{\alpha}{2}\tan\dfrac{\beta}{2}$ is equal to

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

(C) $\dfrac{1}{4}$ (D) $\dfrac{1}{8}$

8. If $\frac{-\pi}{2}<\theta<\frac{\pi}{2}$ and $\theta \neq \pm\frac{\pi}{4}$, then the value of $\cot\left(\frac{\pi}{4}+\theta\right)\cot\left(\frac{\pi}{4}-\theta\right)$ is

(A) 0 (B) –1 (C) 1 (D) –2

9. If $\tan\theta_1 = k\cot\theta_2$, then $\frac{\cos(\theta_1+\theta_2)}{\cos(\theta_1-\theta_2)} =$

(A) $\frac{1+k}{1-k}$ (B) $\frac{1-k}{1+k}$

(C) $\frac{k+1}{k-1}$ (D) $\frac{k-1}{k+1}$

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

[MHT CET 2018]

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

11. The value of $\cos^2 45° - \sin^2 15°$ is

(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{\sqrt{3}}{4}$

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

12. $\cos^2\left(\frac{\pi}{6}+\theta\right) - \sin^2\left(\frac{\pi}{6}-\theta\right) =$

(A) $\frac{1}{2}\cos 2\theta$ (B) 0

(C) $-\frac{1}{2}\cos 2\theta$ (D) $\frac{1}{2}$

13. If α, β are solutions of $6\cos\theta + 8\sin\theta = 9$, then $\sin(\alpha+\beta) =$

(A) $\frac{3}{5}$ (B) $\frac{4}{5}$

(C) $\frac{24}{25}$ (D) $\frac{12}{13}$

14. If $\tan(A+B) = p$, $\tan(A-B) = q$, then the value of $\tan 2A$ in terms of p and q is

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

(C) $\frac{p+q}{1-pq}$ (D) $\frac{1+pq}{1-p}$

15. If $\cos(\alpha+\beta) = \frac{3}{5}$, $\sin(\alpha-\beta) = \frac{5}{13}$ and $0 < \alpha, \beta < \frac{\pi}{4}$, then $\tan(2\alpha)$ is equal to

(A) $\frac{63}{52}$ (B) $\frac{63}{16}$

(C) $\frac{21}{16}$ (D) $\frac{33}{52}$

16. If $\cos(\alpha+\beta) = \frac{4}{5}$, $\sin(\alpha-\beta) = \frac{5}{13}$ and α, β lie between 0 and $\frac{\pi}{4}$, then $\tan 2\alpha =$

(A) $\frac{16}{63}$ (B) $\frac{56}{33}$

(C) $\frac{28}{33}$ (D) None of these

17. A positive acute angle is divided into two parts whose tangents are $\frac{1}{2}$ and $\frac{1}{3}$. Then the angle is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{5}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$

18. $\frac{\cos 9° + \sin 9°}{\cos 9° - \sin 9°} =$

(A) $\tan 54°$ (B) $\tan 36°$

(C) $\tan 18°$ (D) $\tan 9°$

19. If $A - B = \frac{\pi}{4}$, then $(1+\tan A)(1-\tan B) =$

[MHT CET 2019]

(A) 4 (B) 3

(C) 1 (D) 2

20. If $y = (1+\tan A)(1-\tan B)$, where $A - B = \frac{\pi}{4}$, then $(y+1)^{y+1}$ is equal to

(A) 9 (B) 4

(C) 27 (D) 81

21. If $\tan\beta = \frac{n\sin\alpha\cos\alpha}{1-n\sin^2\alpha}$, then $\tan(\alpha-\beta)$ is equal to

(A) $n\tan\alpha$ (B) $(1-n)\tan\alpha$

(C) $(1+n)\tan\alpha$ (D) $\frac{\tan\alpha}{n}$

3.2 Trigonometric functions of allied angles

22. $\sin 765°$ is equal to

(A) 1 (B) 0

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

23. The value of $\sin\frac{31}{3}\pi$ is

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

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

24. The value of
$\cos(270° + \theta)\cos(90° - \theta) - \sin(270° - \theta)\cos\theta$ is
(A) 0 (B) –1
(C) $\frac{1}{2}$ (D) 1

25. At $x = \frac{5\pi}{6}$, the value of $2\sin 3x + 3\cos 3x$ is
(A) 0 (B) 1
(C) –1 (D) None of these

26. $\sin 15° =$
(A) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ (B) $\frac{\sqrt{3}+1}{2\sqrt{2}}$
(C) $\frac{1-\sqrt{3}}{2\sqrt{2}}$ (D) $\frac{1+\sqrt{3}}{\sqrt{2}}$

27. $\tan 75° - \cot 75° =$
(A) $2\sqrt{3}$ (B) $2+\sqrt{3}$
(C) $2-\sqrt{3}$ (D) $-2\sqrt{3}$

28. The value of
$\sin 1^o + \sin 2^o + \ldots + \sin 359^o$ is equal to
(A) 1 (B) 180
(C) 0 (D) –1

29. If $2\sec 2\alpha = \tan\beta + \cot\beta$, then one of the values of $\alpha + \beta$ is
(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$
(C) π (D) 2π

30. $\frac{1-\tan 2°\cot 62°}{\tan 152° - \cot 88°} =$
(A) $\sqrt{3}$ (B) $-\sqrt{3}$
(C) $\sqrt{2}-1$ (D) $1-\sqrt{2}$

31. If $\tan 20° = \lambda$, then $\frac{\tan 160° - \tan 110°}{1+(\tan 160°)(\tan 110°)} =$
(A) $\frac{1+\lambda^2}{2\lambda}$ (B) $\frac{1+\lambda^2}{\lambda}$
(C) $\frac{1-\lambda^2}{\lambda}$ (D) $\frac{1-\lambda^2}{2\lambda}$

32. $\tan 70°$ is equal to
(A) $\tan 20° + \tan 50°$
(B) $2\tan 20° + \tan 50°$
(C) $\tan 20° + 2\tan 50°$
(D) $2\tan 20° + 2\tan 50°$

33. $\sec 50° + \tan 50°$ is equal to
(A) $\tan 20° + \tan 50°$
(B) $2\tan 20° + \tan 50°$
(C) $\tan 20° + 2\tan 50°$
(D) $2\tan 20° + 2\tan 50°$

34. $\sin^2 17.5° + \sin^2 72.5°$ is equal to
(A) $\cos^2 90°$ (B) $\tan^2 45°$
(C) $\cos^2 30°$ (D) $\sin^2 45°$

35. $\sin^2(3°) + \sin^2(6°) + \sin^2(9°) + \ldots + \sin^2(84°) + \sin^2(87°) + \sin^2(90°) =$
(A) $\frac{31}{2}$ (B) $\frac{39}{2}$ (C) $\frac{59}{2}$ (D) 36

3.3 Trigonometric functions of multiple angles

36. The value of $\tan(1^o) + \tan(89^o)$ is _____
(A) $\frac{2}{\sin(1^o)}$ (B) $\frac{1}{\sin(1^o)}$
(C) $\frac{1}{\sin(2^o)}$ (D) $\frac{2}{\sin(2^o)}$

37. $\frac{\sqrt{3}}{\sin(20°)} - \frac{1}{\cos(20°)} =$
(A) 2 (B) $\frac{2\sin 20^o}{\sin 40^o}$
(C) 4 (D) $\frac{4\sin 20^o}{\sin 40^o}$

38. If $\sin x + \cos x = \frac{1}{5}$, then $\tan 2x$ is
(A) $\frac{25}{17}$ (B) $\frac{7}{25}$ (C) $\frac{25}{7}$ (D) $\frac{24}{7}$

39. If α is a root of $25\cos^2\theta + 5\cos\theta - 12 = 0$ and $\frac{\pi}{2} < \alpha < \pi$, then $\sin 2\alpha$ is equal to
(A) $\frac{24}{25}$ (B) $\frac{-24}{25}$ (C) $\frac{13}{18}$ (D) $\frac{-13}{18}$

40. $3(\sin x - \cos x)^4 + 6(\sin x + \cos x)^2 + 4(\sin^6 x + \cos^6 x) =$
(A) 14 (B) 11 (C) 12 (D) 13

41. If n = 1, 2, 3,…., then
$\cos\alpha\cos 2\alpha\cos 2^2\alpha\cos 2^3\alpha\ldots\cos 2^{n-1}\alpha$ is equal to
(A) $\frac{\sin 2n\alpha}{2n\sin\alpha}$ (B) $\frac{\sin 2^n\alpha}{2^n\sin 2^{n-1}\alpha}$
(C) $\frac{\sin 4^{n-1}\alpha}{4^{n-1}\sin\alpha}$ (D) $\frac{\sin 2^n\alpha}{2^n\sin\alpha}$

42. The value of $\frac{1}{8}(3 - 4\cos 2\theta + \cos 4\theta)$ is
(A) $\cos 4\theta$ (B) $\sin 4\theta$
(C) $\sin^4\theta$ (D) $\cos^4\theta$

43. If $8\cos 2\theta + 8\sec 2\theta = 65$, $0 < \theta < \frac{\pi}{2}$, then the value of $4\cos 4\theta$ is equal to
(A) $-\frac{33}{8}$ (B) $-\frac{31}{8}$
(C) $-\frac{31}{32}$ (D) $-\frac{33}{32}$

44. If $5(\tan^2 x - \cos^2 x) = 2\cos 2x + 9$, then the value of $\cos 4x$ is

(A) $-\frac{7}{9}$ (B) $-\frac{3}{5}$

(C) $\frac{1}{3}$ (D) $\frac{2}{9}$

45. If $x + \frac{1}{x} = 2\cos\alpha$, then $x^n + \frac{1}{x^n} =$

(A) $2^n \cos\alpha$ (B) $2^n \cos n\alpha$

(C) $2i \sin n\alpha$ (D) $2\cos n\alpha$

46. If $\sin 2\theta + \sin 2\phi = \frac{1}{2}$ and

$\cos 2\theta + \cos 2\phi = \frac{3}{2}$, then $\cos^2(\theta - \phi) =$

(A) $\frac{3}{8}$ (B) $\frac{5}{8}$ (C) $\frac{3}{4}$ (D) $\frac{5}{4}$

47. $\cos 2\alpha = \frac{3\cos 2\beta - 1}{3 - \cos 2\beta}$, then $\tan\alpha =$

(A) $\sqrt{2}\tan\beta$ (B) $\frac{\tan\beta}{\sqrt{2}}$

(C) $\frac{\tan^2\beta}{\sqrt{2}}$ (D) $\tan\beta$

48. $2\sin A\cos^3 A - 2\sin^3 A\cos A =$

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

(C) $\frac{1}{4}\sin 4A$ (D) $\frac{1}{8}\sin 4A$

49. The value of $\frac{\cot x - \tan x}{\cot 2x}$ is

(A) 1 (B) 2 (C) –1 (D) 4

50. If $\cot\frac{2x}{3} + \tan\frac{x}{3} = \operatorname{cosec}\frac{kx}{3}$, then the value of k is

(A) 1 (B) 2

(C) 3 (D) –1

51. If $2\sin^2\left[\left(\frac{\pi}{2}\right)\cos^2 x\right] = 1 - \cos(\pi\sin 2x)$, $x \neq (2n+1)\frac{\pi}{2}$, $n \in I$, then $\cos 2x$ is equal to

(A) $\frac{1}{5}$ (B) $\frac{3}{5}$ (C) $\frac{4}{5}$ (D) 1

52. If $a\tan\theta = b$, then $a\cos 2\theta + b\sin 2\theta =$

(A) a (B) b

(C) – a (D) – b

53. If $2\tan A = 3\tan B$, then $\frac{\sin 2B}{5 - \cos 2B}$ is equal to

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

(C) $\tan(A + B)$ (D) $\tan(A + 2B)$

54. If $\tan x = \frac{3}{4}$, $\pi < x < \frac{3\pi}{2}$, then the value of $\cos\frac{x}{2}$ is

(A) $-\frac{1}{\sqrt{10}}$ (B) $\frac{3}{\sqrt{10}}$

(C) $\frac{1}{\sqrt{10}}$ (D) $-\frac{3}{\sqrt{10}}$

55. If $\cos\theta = \frac{\cos\alpha - \cos\beta}{1 - \cos\alpha\cos\beta}$, then one of the values of $\tan\left(\frac{\theta}{2}\right)$ is

(A) $\cot\frac{\beta}{2}\tan\frac{\alpha}{2}$ (B) $\tan\alpha\tan\frac{\beta}{2}$

(C) $\tan\frac{\beta}{2}\cot\frac{\alpha}{2}$ (D) $\tan^2\frac{\alpha}{2}\tan^2\frac{\beta}{2}$

56. If $\theta \in \left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$, then the value of $\sqrt{4\cos^4\theta + \sin^2 2\theta} + 4\cot\theta\cos^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)$ is

(A) $-2\cot\theta$ (B) $2\cot\theta$

(C) $2\cos\theta$ (D) $2\sin\theta$

57. $\cos 2(\theta + \phi) - 4\cos(\theta + \phi)\sin\theta\sin\phi + 2\sin^2\phi =$

(A) $\cos 2\theta$ (B) $\cos 3\theta$

(C) $\sin 2\theta$ (D) $\sin 3\theta$

58. If $\operatorname{cosec}\theta = \frac{p+q}{p-q}$, then $\cot\left(\frac{\pi}{4} + \frac{\theta}{2}\right) =$

(A) $\sqrt{\frac{p}{q}}$ (B) $\sqrt{\frac{q}{p}}$ (C) $\sqrt{pq}$ (D) pq

59. $\sin^4\frac{\pi}{8} + \sin^4\frac{2\pi}{8} + \sin^4\frac{3\pi}{8} + \sin^4\frac{4\pi}{8} + \sin^4\frac{5\pi}{8} + \sin^4\frac{6\pi}{8} + \sin^4\frac{7\pi}{8} =$

(A) $\frac{3}{2}$ (B) $\frac{5}{2}$ (C) 3 (D) $\frac{7}{2}$

60. The value of the expression

$$\frac{1+\sin 2\alpha}{\cos(2\alpha - 2\pi)\tan\left(\alpha - \frac{3\pi}{4}\right)} - \frac{1}{4}\sin 2\alpha\left(\cot\frac{\alpha}{2} + \cot\left(\frac{3\pi}{2} + \frac{\alpha}{2}\right)\right) \text{ is}$$

(A) 0 (B) 1

(C) $\sin^2\frac{\alpha}{2}$ (D) $\sin^2\alpha$

61. The value of $\tan\frac{\pi}{5} + 2\tan\frac{2\pi}{5} + 4\cot\frac{4\pi}{5}$ is

(A) $\cot\frac{\pi}{5}$ (B) $\cot\frac{2\pi}{5}$

(C) $\cot\frac{4\pi}{5}$ (D) $\cot\frac{3\pi}{5}$

62. If $90° < A < 180°$ and $\sin A = \frac{4}{5}$, then $\tan \frac{A}{2}$ is equal to
(A) $\frac{1}{2}$ (B) $\frac{3}{5}$ (C) $\frac{3}{2}$ (D) 2

63. If θ is an acute angle and $\sin \frac{\theta}{2} = \sqrt{\frac{x-1}{2x}}$, then tan θ is equal to
(A) $x^2 - 1$ (B) $\sqrt{x^2 - 1}$
(C) $\sqrt{x^2 + 1}$ (D) $x^2 + 1$

64. $(m + 2) \sin \theta + (2m - 1) \cos \theta = (2m + 1)$, if tan θ is equal to
(A) $\frac{4}{3}$ or $\frac{2m}{m^2 - 1}$ (B) $\frac{3}{4}$ or $\frac{2m}{m^2 + 1}$
(C) $\frac{4}{3}$ or $\frac{2m+1}{m^2}$ (D) $\frac{3}{4}$ or $\frac{m^2}{2m+1}$

65. $\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right) + \tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right)$ is equal to
(A) sec θ (B) 2 sec θ
(C) $\sec \frac{\theta}{2}$ (D) sin θ

66. If $\tan\left(\frac{x}{2}\right) = \text{cosec } x - \sin x$, then the value of $\tan^2\left(\frac{x}{2}\right)$ is
(A) $2 - \sqrt{5}$ (B) $\sqrt{5} - 2$
(C) $\sqrt{5} + 2$ (D) $9 - 4\sqrt{5}$

67. The value of $\tan\left(7\frac{1}{2}\right)^\circ$ is equal to
(A) $\sqrt{6} + \sqrt{3} + \sqrt{2} - 2$
(B) $\sqrt{6} - \sqrt{3} + \sqrt{2} - 2$
(C) $\sqrt{6} - \sqrt{3} + \sqrt{2} + 2$
(D) $\sqrt{6} - \sqrt{3} - \sqrt{2} - 2$

68. If $\cos \theta = \frac{1}{2}\left(a + \frac{1}{a}\right)$, then the value of cos 3θ is
(A) $\frac{1}{8}\left(a^3 + \frac{1}{a^3}\right)$ (B) $\frac{3}{2}\left(a + \frac{1}{a}\right)$
(C) $\frac{1}{2}\left(a^3 + \frac{1}{a^3}\right)$ (D) $\frac{1}{3}\left(a^3 + \frac{1}{a^3}\right)$

69. $\cos^3 110° + \cos^3 10° + \cos^3 130° =$
(A) $\frac{3}{4}$ (B) $\frac{3}{8}$ (C) $\frac{3\sqrt{3}}{8}$ (D) $\frac{3\sqrt{3}}{4}$

70. If $\sin 6\theta = 32 \cos^5 \theta \sin \theta - 32 \cos^3 \theta \sin \theta + 3x$, then $x =$
(A) cos θ (B) cos 2θ
(C) sin θ (D) sin 2θ

3.4 Factorization formulae

71. The value of $\sin 47° + \sin 61° - \sin 11° - \sin 25° =$
(A) sin 36° (B) cos 36°
(C) sin 7° (D) cos 7°

72. The expression
$\cos\frac{10\pi}{13} + \cos\frac{8\pi}{13} + \cos\frac{3\pi}{13} + \cos\frac{5\pi}{13}$ is equal to
(A) −1 (B) 0
(C) 1 (D) None of these

73. The expression
$2 \cos\frac{\pi}{13} \cos\frac{9\pi}{13} + \cos\frac{3\pi}{13} + \cos\frac{5\pi}{13}$ is equal to
(A) − 1 (B) 0
(C) 1 (D) $\frac{1}{2}$

74. $1 + \cos 10° + \cos 20° + \cos 30° =$
(A) $4 \cos 5° \cos 10° \cos 15°$
(B) $4 \cos 10° \cos 20° \cos 30°$
(C) $4 \sin 5° \sin 10° \sin 15°$
(D) $4 \sin 10° \sin 20° \sin 30°$

75. $1 + \cos 56° + \cos 58° - \cos 66° =$
(A) $2 \cos 28° \cos 29° \cos 33°$
(B) $4 \cos 28° \cos 29° \cos 33°$
(C) $4 \cos 28° \cos 29° \sin 33°$
(D) $2 \cos 28° \cos 29° \sin 33°$

76. $\frac{\sin 85° - \sin 35°}{\cos 65°} =$
(A) 2 (B) − 1 (C) 1 (D) 0

77. The value of $\frac{\sin 55° - \cos 55°}{\sin 10°}$ is
(A) $\frac{1}{\sqrt{2}}$ (B) 2
(C) 1 (D) $\sqrt{2}$

78. $\frac{\sin A - \sin B}{\cos A + \cos B}$ is equal to
(A) $\sin\left(\frac{A+B}{2}\right)$ (B) 2 tan (A + B)
(C) $\cot\left(\frac{A-B}{2}\right)$ (D) $\tan\left(\frac{A-B}{2}\right)$

79. If $\sin 4A - \cos 2A = \cos 4A - \sin 2A$ $\left(0 < A < \frac{\pi}{4}\right)$, then the value of tan 4A=
(A) 1 (B) $\frac{1}{\sqrt{3}}$
(C) $\sqrt{3}$ (D) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$

80. If $\sin x + \sin y = \frac{1}{2}$ and $\cos x + \cos y = 1$, then $\tan(x+y) =$

(A) $\frac{-8}{3}$ (B) $\frac{8}{3}$ (C) $\frac{4}{3}$ (D) $-\frac{3}{4}$

81. If $\cos x = 3\cos y$, then $2\tan\left(\frac{y-x}{2}\right) =$

(A) $\cot\left(\frac{y-x}{2}\right)$ (B) $\cot\left(\frac{x+y}{4}\right)$

(C) $\cot\left(\frac{y-x}{4}\right)$ (D) $\cot\left(\frac{x+y}{2}\right)$

82. The sum $S = \sin\theta + \sin 2\theta + \ldots + \sin n\theta$, equals

(A) $\frac{\sin\frac{n\theta}{2}.\sin\frac{\theta(n+1)}{2}}{\sin\frac{\theta}{2}}$

(B) $\frac{\sin\frac{n\theta}{2}.\cos\frac{\theta(n+1)}{2}}{\sin\frac{\theta}{2}}$

(C) $\frac{\cos\frac{n\theta}{2}.\sin\frac{\theta(n+1)}{2}}{\sin\frac{\theta}{2}}$

(D) $\frac{\cos\frac{n\theta}{2}.\cos\frac{\theta(n+1)}{2}}{\sin\frac{\theta}{2}}$

83. $\cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{6\pi}{7}$

(A) is equal to zero
(B) lies between 0 and 3
(C) is a negative number
(D) lies between 3 and 6

84. $\cos^2 76° + \cos^2 16° - \cos 76° \cos 16° =$

(A) $-\frac{1}{4}$ (B) $\frac{1}{2}$ (C) 0 (D) $\frac{3}{4}$

85. $\sin 12° \sin 48° \sin 54° =$

(A) $\frac{1}{16}$ (B) $\frac{1}{32}$ (C) $\frac{1}{8}$ (D) $\frac{1}{4}$

86. $\operatorname{cosec} 48° + \operatorname{cosec} 96° + \operatorname{cosec} 192° + \operatorname{cosec} 384° =$

(A) -2 (B) -1 (C) 0 (D) $\frac{\sqrt{3}}{2}$

87. $\cos\frac{\pi}{7} - \cos\frac{2\pi}{7} + \cos\frac{3\pi}{7} - \cos\frac{4\pi}{7} + \cos\frac{5\pi}{7} - \cos\frac{6\pi}{7} =$

(A) 0 (B) $\frac{3}{2}$ (C) $\frac{3}{4}$ (D) 1

3.5 Trigonometric functions of angles of a triangle

88. In triangle ABC, the value of $\sin 2A + \sin 2B + \sin 2C$ is equal to
(A) $4\sin A \sin B \sin C$
(B) $4\cos A \cos B \cos C$
(C) $2\cos A \cos B \cos C$
(D) $2\sin A \sin B \sin C$

89. If $A + B + C = \pi$ and $\cos A = \cos B \cos C$, then $\tan B \tan C$ is equal to

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

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

90. If A, B, C are the angles of ΔABC then $\cot A \cdot \cot B + \cot B \cdot \cot C + \cot C \cdot \cot A =$ **[MHT CET 2018]**

(A) 0 (B) 1
(C) 2 (D) –1

91. If A, B and C are the angles of a plain triangle and $\tan\frac{A}{2} = \frac{1}{3}$, $\tan\frac{B}{2} = \frac{2}{3}$, then $\tan\frac{C}{2}$ is equal to

(A) $\frac{7}{9}$ (B) $\frac{2}{9}$

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

92. If $A + B + C = \pi$, then $\sin(A + B) =$
(A) $\sin A$ (B) $\sin B$
(C) $\sin A + \sin C$ (D) $\sin C$

93. In a ΔABC, $\operatorname{cosec} A(\sin B \cos C + \cos B \sin C)$ is equal to
(A) 1 (B) 0
(C) 2 (D) –1

Miscellaneous

94. $\begin{vmatrix} \sin^2\theta & \cos^2\theta \\ -\cos^2\theta & \sin^2\theta \end{vmatrix} =$

(A) $\cos 2\theta$ (B) $\frac{1}{2}(1+\cos^2 2\theta)$

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

95. Let $f : (-1, 1) \to R$ be such that $f(\cos 4\theta) = \frac{2}{2-\sec^2\theta}$ for $\theta \in \left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$.

Then the values of $f\left(\frac{1}{3}\right)$ are

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

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

96. The sum of the series $\sum_{n=1}^{\infty}\sin\left(\frac{n!\pi}{720}\right)$ is

(A) $\sin\left(\frac{\pi}{180}\right)+\sin\left(\frac{\pi}{360}\right)+\sin\left(\frac{\pi}{540}\right)$

(B) $\sin\left(\frac{\pi}{6}\right)+\sin\left(\frac{\pi}{30}\right)+\sin\left(\frac{\pi}{120}\right)+\sin\left(\frac{\pi}{360}\right)$

(C) $\sin\left(\frac{\pi}{6}\right)+\sin\left(\frac{\pi}{30}\right)+\sin\left(\frac{\pi}{120}\right)+\sin\left(\frac{\pi}{360}\right)+\sin\left(\frac{\pi}{720}\right)$

(D) $\sin\left(\frac{\pi}{180}\right)+\sin\left(\frac{\pi}{360}\right)$

Homework

3.1 Trigonometric functions of sum and difference of angles

1. If $\sin A=\frac{4}{5}$ and $\cos B=-\frac{12}{13}$, where A and B lie in first and third quadrant respectively, then $\cos(A+B)=$

(A) $\frac{56}{65}$ (B) $-\frac{56}{65}$ (C) $\frac{16}{65}$ (D) $-\frac{16}{65}$

2. If $\cos\theta=\frac{8}{17}$ and θ lies in the 1st quadrant, then the value of $\cos(30°+\theta)+\cos(45°-\theta)+\cos(120°-\theta)$ is

(A) $\frac{23}{17}\left(\frac{\sqrt{3}-1}{2}+\frac{1}{\sqrt{2}}\right)$ (B) $\frac{23}{17}\left(\frac{\sqrt{3}+1}{2}+\frac{1}{\sqrt{2}}\right)$

(C) $\frac{23}{17}\left(\frac{\sqrt{3}-1}{2}-\frac{1}{\sqrt{2}}\right)$ (D) $\frac{23}{17}\left(\frac{\sqrt{3}+1}{2}-\frac{1}{\sqrt{2}}\right)$

3. If $\cos(A-B)=\frac{3}{5}$ and $\tan A\tan B=2$, then

(A) $\cos A\cos B=\frac{1}{5}$ (B) $\sin A\sin B=-\frac{2}{5}$

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

4. The maximum value of $\sin\left(x+\frac{\pi}{6}\right)+\cos\left(x+\frac{\pi}{6}\right)$ in the interval $\left(0,\frac{\pi}{2}\right)$ is attained at

(A) $x=\frac{\pi}{3}$ (B) $x=\frac{\pi}{12}$

(C) $x=\frac{\pi}{6}$ (D) $x=\frac{\pi}{2}$

5. If $\sin A=\frac{1}{\sqrt{10}}$ and $\sin B=\frac{1}{\sqrt{5}}$, where A and B are positive acute angles, then $A+B=$

(A) π (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

6. If $\sin\alpha=\frac{1}{\sqrt{5}}$ and $\sin\beta=\frac{3}{5}$, then $\beta-\alpha$ lies in the interval

(A) $\left(0,\frac{\pi}{4}\right)$ (B) $\left(\frac{\pi}{2},\frac{3\pi}{4}\right)$

(C) $[0,\pi]$ (D) $\left(\pi,\frac{5\pi}{4}\right)$

7. If $\cos(\theta-\alpha)=a$, $\sin(\theta-\beta)=b$, then $\cos^2(\alpha-\beta)+2ab\sin(\alpha-\beta)$ is equal to

(A) $4a^2b^2$ (B) a^2-b^2

(C) a^2+b^2 (D) $-a^2b^2$

8. If $\tan\theta=\frac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}$, then $\sin\alpha+\cos\alpha$ and $\sin\alpha-\cos\alpha$ is equal to

(A) $\sqrt{2}\cos\theta,\ \sqrt{2}\sin\theta$

(B) $-\sqrt{2}\sin\theta,-\sqrt{2}\cos\theta$

(C) $\sqrt{2}\sin\theta,\sqrt{2}\sin\theta$

(D) $\sqrt{2}\cos\theta,\ \sqrt{2}\cos\theta$

9. If $\tan\theta=\frac{1}{2}$ and $\tan\phi=\frac{1}{3}$, then $\tan(2\theta+\phi)$ is equal to

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

10. If $A+B=\frac{\pi}{4}$, then $(1+\tan A)(1+\tan B)=$

(A) 1 (B) 2 (C) ∞ (D) -2

11. If $A+B=45°$, then $(\cot A-1)(\cot B-1)=$

(A) 0 (B) 2 (C) 1 (D) 4

12. If x, y, z are any three real numbers, then $\tan(x-y)+\tan(y-z)+\tan(z-x)$ is equal to

(A) 1

(B) 0

(C) $\tan(x-y)\tan(y-z)\tan(z-x)$

(D) $\tan(y-x)\tan(z-y)\tan(x-z)$

13. $\tan 3A-\tan 2A-\tan A=$

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

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

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

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

14. $\tan 20°+\tan 40°+\sqrt{3}\tan 20°\tan 40°=$

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

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

15. $\tan\frac{2\pi}{5}-\tan\frac{\pi}{15}-\sqrt{3}\tan\frac{2\pi}{5}\tan\frac{\pi}{15}$ is equal to

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

16. If tan A = 2 tan B + cot B, then 2 tan (A – B) is equal to

(A) tan B (B) 2 tan B
(C) cot B (D) 2 cot B

17. $\frac{1}{\tan 3A-\tan A}-\frac{1}{\cot 3A-\cot A}=$

(A) tan A (B) tan 2A
(C) cot A (D) cot 2A

18. If $\alpha,\beta,\gamma\in\left(0,\frac{\pi}{2}\right)$, then $\frac{\sin(\alpha+\beta+\gamma)}{\sin\alpha+\sin\beta+\sin\gamma}$ is

(A) < 1 (B) >1
(C) 1 (D) None of these

3.2 Trigonometric functions of allied angles

19. cot (45° + θ) cot (45° – θ) =

(A) – 1 (B) 0 (C) 1 (D) ∞

20. $\tan\left(\frac{\pi}{4}+\theta\right)\tan\left(\frac{3\pi}{4}+\theta\right)$ is equal to

(A) –2 (B) –1 (C) 1 (D) 0

21. sin 75° =

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

22. The value of cos 105° + sin 105° is

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

23. The value of
sin 600° cos 330° + cos 120° sin 150° is

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

24. $\frac{\sin(-660^\circ)\tan(1050^\circ)\sec(-420^\circ)}{\cos(225^\circ)\operatorname{cosec}(315^\circ)\cos(510^\circ)}=$

(A) $\frac{\sqrt{3}}{4}$ (B) $\frac{\sqrt{3}}{2}$ (C) $\frac{2}{\sqrt{3}}$ (D) $\frac{4}{\sqrt{3}}$

25. $3\left[\sin^4\left(\frac{3\pi}{2}-\alpha\right)+\sin^4(3\pi+\alpha)\right]$
$-2\left[\sin^6\left(\frac{\pi}{2}+\alpha\right)+\sin^6(5\pi-\alpha)\right]=$

(A) 0 (B) 1
(C) 3 (D) sin 4α + sin 6α

26. $\frac{\cos12^\circ-\sin12^\circ}{\cos12^\circ+\sin12^\circ}+\frac{\sin147^\circ}{\cos147^\circ}=$

(A) 1 (B) – 1
(C) 0 (D) $\sqrt{3}$

27. tan 100° + tan 125° + tan 100° tan 125° =

(A) 0 (B) $\frac{1}{2}$
(C) – 1 (D) 1

28. If A + B = 225°, then $\frac{\cot A}{1+\cot A}\cdot\frac{\cot B}{1+\cot B}=$

(A) 1 (B) – 1
(C) 0 (D) $\frac{1}{2}$

29. If $\alpha+\beta=\frac{\pi}{2}$ and $\beta+\gamma=\alpha$, then tan α equals

(A) 2 (tan β + tan γ) (B) tan β + tan γ
(C) tan β + 2 tan γ (D) 2 tan β + tan γ

30. The value of
tan 81° – tan 63° – tan 27° + tan 9° is equal to

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

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

(A) sin (α + β) sin (α – β)
(B) cos (α + β) cos (α – β)
(C) sin (α – β) cos (α + β)
(D) sin (α + β) cos (α – β)

32. $\cos^2\frac{\pi}{12}+\cos^2\frac{\pi}{4}+\cos^2\frac{5\pi}{12}=$

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

3.3 Trigonometric functions of multiple angles

33. If A lies in the third quadrant and 3tan A– 4 = 0, then 5sin 2A+3 sinA + 4cosA =

(A) 0 (B) $\frac{-24}{5}$
(C) $\frac{24}{5}$ (D) $\frac{48}{5}$

34. Which of the following numbers is/are rational?

(A) sin 15° (B) cos 15°
(C) sin15° cos 15° (D) sin 15° cos 75°

35. If $\sin2\theta=\frac{3}{4}$, then $\sin^3\theta+\cos^3\theta=$

(A) $\frac{\sqrt{5}}{8}$ (B) $\frac{\sqrt{7}}{8}$
(C) $\frac{\sqrt{11}}{8}$ (D) $\frac{5\sqrt{7}}{16}$

36. If $\tan\theta - \cot\theta = a$ and $\sin\theta + \cos\theta = b$, then $(b^2 - 1)^2 (a^2 + 4)$ is equal to
(A) 2 (B) -4
(C) ± 4 (D) 4

37. $8 \sin\frac{x}{8} \cos\frac{x}{2} \cos\frac{x}{4} \cos\frac{x}{8}$ is equal to
(A) $8 \sin x$ (B) $\sin x$
(C) $\cos x$ (D) $8 \cos x$

38. If $x = \cos 10° \cos 20° \cos 40°$, then the value of x is
(A) $\frac{1}{4}\tan 10°$ (B) $\frac{1}{8}\cot 10°$
(C) $\frac{1}{8}\operatorname{cosec} 10°$ (D) $\frac{1}{8}\sec 10°$

39. The value of $\frac{1}{\sin 10^\circ} - \frac{\sqrt{3}}{\cos 10^\circ}$ is equal to
(A) 1 (B) 2
(C) 4 (D) 3

40. If $|\tan A| < 1$ and $|A|$ is acute, then $\frac{\sqrt{1+\sin 2A} + \sqrt{1-\sin 2A}}{\sqrt{1+\sin 2A} - \sqrt{1-\sin 2A}}$ is equal to
(A) tan A (B) $-$ tan A
(C) cot A (D) $-$ cot A

41. Maximum and minimum values of $\sin^4\theta + \cos^4\theta$ are
(A) 0, 2 (B) $1, \frac{1}{2}$
(C) $-1, 1$ (D) $1, -\frac{1}{2}$

42. If $\theta = \frac{\pi}{2^n + 1}$, then $\cos\theta \cos 2\theta \cos 2^2\theta \ldots \cos 2^{n-1}\theta$ is equal to
(A) $\frac{1}{2^n}$ (B) $\cos\theta$
(C) 2 (D) 2^n

43. $\cos\frac{\pi}{7} \cos\frac{2\pi}{7} \cos\frac{4\pi}{7} =$
(A) 0 (B) $\frac{1}{2}$
(C) $\frac{1}{4}$ (D) $-\frac{1}{8}$

44. $\cos\frac{\pi}{5} \cos\frac{2\pi}{5} \cos\frac{4\pi}{5} \cos\frac{8\pi}{5} =$
(A) $\frac{1}{16}$ (B) 0
(C) $\frac{-1}{8}$ (D) $\frac{-1}{16}$

45. $\cos\frac{2\pi}{15} \cos\frac{4\pi}{15} \cos\frac{8\pi}{15} \cos\frac{16\pi}{15} =$
(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{1}{8}$ (D) $\frac{1}{16}$

46. If $k = \sin\frac{\pi}{18} \sin\frac{5\pi}{18} \sin\frac{7\pi}{18}$, then the numerical value of k is
(A) $\frac{1}{4}$ (B) $\frac{1}{8}$
(C) $\frac{1}{16}$ (D) $\frac{1}{32}$

47. The value of $\sin\frac{\pi}{14}\sin\frac{3\pi}{14}\sin\frac{5\pi}{14}\sin\frac{7\pi}{14}\sin\frac{9\pi}{14}\sin\frac{11\pi}{14}\sin\frac{13\pi}{14}$ is equal to
(A) $\frac{1}{8}$ (B) $\frac{1}{16}$
(C) $\frac{1}{32}$ (D) $\frac{1}{64}$

48. $\cos 15° =$
(A) $\sqrt{\frac{1+\cos 30°}{2}}$ (B) $\sqrt{\frac{1-\cos 30°}{2}}$
(C) $\pm\sqrt{\frac{1+\cos 30°}{2}}$ (D) $\pm\sqrt{\frac{1-\cos 30°}{2}}$

49. $2\cos^2\theta - 2\sin^2\theta = 1$, then $\theta =$
(A) 15° (B) 30°
(C) 45° (D) 60°

50. Let $B = 2\sin^2 x - \cos 2x$, then
(A) $-1 \le B \le 3$ (B) $0 \le B \le 2$
(C) $-1 \le B \le 1$ (D) $-2 \le B \le 2$

51. If $\cos\theta = \frac{1}{2}\left(x + \frac{1}{x}\right)$, then $\frac{1}{2}\left(x^2 + \frac{1}{x^2}\right) =$
(A) $\sin 2\theta$ (B) $\cos 2\theta$
(C) $\tan 2\theta$ (D) $\sec 2\theta$

52. If $\sec 2\theta = p + \tan 2\theta$, then the value of $\sin^2\theta$ in terms of p is
(A) $\frac{(p-1)^2}{2(p^2+1)}$ (B) $\frac{1}{2}\left(\frac{p-1}{p+1}\right)^2$
(C) $\frac{p^2-1}{2(p^2+1)}$ (D) $\frac{p^2-1}{2(p+1)^2}$

53. If $\tan x = \frac{b}{a}$, then $\sqrt{\frac{a+b}{a-b}} + \sqrt{\frac{a-b}{a+b}} =$
(A) $\frac{2\sin x}{\sqrt{\sin 2x}}$ (B) $\frac{2\cos x}{\sqrt{\cos 2x}}$
(C) $\frac{2\cos x}{\sqrt{\sin 2x}}$ (D) $\frac{2\sin x}{\sqrt{\cos 2x}}$

54. $\tan(60° + A)\tan(60° - A)$ is equal to

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

(C) $\frac{\cos 2A + 21}{\cos 2A - 1}$ (D) $\frac{\cos 2A - 1}{\cos 2A + 21}$

55. If $\sin A + \sin 2A = x$ and $\cos A + \cos 2A = y$, then $(x^2 + y^2)(x^2 + y^2 - 3) =$

(A) $2y$ (B) y

(C) $3y$ (D) $4y$

56. If $\tan^2\theta = 2\tan^2\phi + 1$, then $\cos 2\theta + \sin^2\phi$ equals

(A) -1 (B) 0

(C) 1 (D) 2

57. If $\sin(\theta + \alpha) = a$ and $\sin(\theta + \beta) = b$, then $\cos 2(\alpha - \beta) - 4ab\cos(\alpha - \beta)$ is equal to

(A) $1 - a^2 - b^2$ (B) $1 - 2a^2 - 2b^2$

(C) $2 + a^2 + b^2$ (D) $2 - a^2 - b^2$

58. If θ and ϕ are angles in the 1st quadrant such that $\tan\theta = \frac{1}{7}$ and $\sin\phi = \frac{1}{\sqrt{10}}$, then

(A) $\theta + 2\phi = 90°$ (B) $\theta + 2\phi = 60°$

(C) $\theta + 2\phi = 30°$ (D) $\theta + 2\phi = 45°$

59. $\frac{\sec 8A - 1}{\sec 4A - 1} =$

(A) $\frac{\tan 2A}{\tan 8A}$ (B) $\frac{\tan 8A}{\tan 2A}$

(C) $\frac{\cot 8A}{\cot 2A}$ (D) $\frac{\tan 6A}{\tan 2A}$

60. If $0 < x < \frac{\pi}{4}$, then $\sec 2x - \tan 2x =$

(A) $\tan\left(x - \frac{\pi}{4}\right)$ (B) $\tan\left(\frac{\pi}{4} - x\right)$

(C) $\tan\left(x + \frac{\pi}{4}\right)$ (D) $\tan^2\left(x + \frac{\pi}{4}\right)$

61. $\tan\left(\frac{\pi}{4} + \theta\right) - \tan\left(\frac{\pi}{4} - \theta\right) =$

(A) $2\tan 2\theta$ (B) $2\cot 2\theta$

(C) $\tan 2\theta$ (D) $\cot 2\theta$

62. If $\tan\alpha = \frac{1}{7}$ and $\tan\beta = \frac{1}{3}$, then $\cos 2\alpha =$

(A) $\sin 2\beta$ (B) $\sin 4\beta$

(C) $\sin 3\beta$ (D) $\sin\beta$

63. If $\sin x + \cos x = \frac{1}{5}$ and $0 \le x \le \pi$, then $\tan x$ is equal to

(A) $-\frac{4}{3}$ (B) $-\frac{1}{2}$

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

64. If $0 < x < \pi$ and $\cos x + \sin x = \frac{1}{2}$, then $\tan x$ is equal to

(A) $\frac{1 - \sqrt{7}}{4}$ (B) $\frac{4 - \sqrt{7}}{3}$

(C) $-\frac{4 + \sqrt{7}}{3}$ (D) $\frac{\sqrt{7} + 1}{4}$

65. If $\tan x = \frac{2b}{a - c}(a \ne c)$,
$y = a\cos^2 x + 2b\sin x\cos x + c\sin^2 x$ and
$z = a\sin^2 x - 2b\sin x\cos x + c\cos^2 x$, then

(A) $y = z$

(B) $y + z = a + c$

(C) $y - z = a + c$

(D) $y - z = (a - c)^2 + 4b^2$

66. If $a\cos 2\theta + b\sin 2\theta = c$ has α and β as its solution, then the value of $\tan\alpha + \tan\beta$ is

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

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

67. If $A = 133°$, then $2\cos\frac{A}{2}$ is equal to

(A) $-\sqrt{1 + \sin A} - \sqrt{1 - \sin A}$

(B) $-\sqrt{1 + \sin A} + \sqrt{1 - \sin A}$

(C) $\sqrt{1 + \sin A} - \sqrt{1 - \sin A}$

(D) $\sqrt{1 + \sin A} + \sqrt{1 - \sin A}$

68. If $0 < \theta < \frac{\pi}{2}$ and $\frac{y + 1}{1 - y} = \sqrt{\frac{1 + \sin\theta}{1 - \sin\theta}}$, then y is equal to

(A) $\cot\frac{\theta}{2}$ (B) $\tan\frac{\theta}{2}$

(C) $\cot\frac{\theta}{2} + \tan\frac{\theta}{2}$ (D) $\cot\frac{\theta}{2} - \tan\frac{\theta}{2}$

69. If $\sin\theta = \frac{-4}{5}$ and θ lies in the third quadrant, then $\cos\frac{\theta}{2} =$

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

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

70. If $\sec\theta = 1\frac{1}{4}$, then $\tan\frac{\theta}{2} =$

(A) $\frac{1}{3}$ (B) $\frac{3}{4}$

(C) $\frac{1}{4}$ (D) $\frac{5}{4}$

71. If $\cos\theta = \frac{3}{5}$ and $\cos\phi = \frac{4}{5}$, where θ and ϕ are positive acute angles, then $\cos\frac{\theta-\phi}{2} =$

(A) $\frac{7}{\sqrt{2}}$ (B) $\frac{7}{5\sqrt{2}}$

(C) $\frac{7}{\sqrt{5}}$ (D) $\frac{7}{2\sqrt{5}}$

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

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

(C) $4\cos^2\left(\frac{\alpha+\beta}{2}\right)$ (D) $4\sin^2\left(\frac{\alpha+\beta}{2}\right)$

73. $\frac{1+\sin A-\cos A}{1+\sin A+\cos A} =$

(A) $\sin\frac{A}{2}$ (B) $\cos\frac{A}{2}$

(C) $\tan\frac{A}{2}$ (D) $\cot\frac{A}{2}$

74. $\frac{\tan A+\sec A-1}{\tan A-\sec A+1} =$

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

(C) $\frac{1+\sin A}{\cos A}$ (D) $\frac{1+\cos A}{\sin A}$

75. If $\tan A = \frac{1-\cos B}{\sin B}$, then tan 2A is equal to

(A) tan B (B) $\tan^2 B$

(C) $\tan^2 B + 2\tan B$ (D) $\tan B + 2\tan B$

76. $\sqrt{2}+\sqrt{3}+\sqrt{4}+\sqrt{6}$ is equal to

(A) $\cot\left(7\frac{1}{2}\right)^\circ$ (B) $\sin\left(7\frac{1}{2}\right)^\circ$

(C) $\sin 15^\circ$ (D) $\cos 15^\circ$

77. If $\alpha = 22^\circ 30'$, then $(1+\cos\alpha)(1+\cos 3\alpha)(1+\cos 5\alpha)(1+\cos 7\alpha)$ equals

(A) $\frac{1}{8}$ (B) $\frac{1}{4}$

(C) $\frac{1+\sqrt{2}}{2\sqrt{2}}$ (D) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

78. $\frac{\sqrt{2}-\sin\alpha-\cos\alpha}{\sin\alpha-\cos\alpha} =$

(A) $\sec\left(\frac{\alpha}{2}-\frac{\pi}{8}\right)$ (B) $\cos\left(\frac{\pi}{8}-\frac{\alpha}{2}\right)$

(C) $\tan\left(\frac{\alpha}{2}-\frac{\pi}{8}\right)$ (D) $\cot\left(\frac{\alpha}{2}-\frac{\pi}{2}\right)$

79. If $\sin\theta + \sin\phi = a$ and $\cos\theta + \cos\phi = b$, then $\tan\frac{\theta-\phi}{2}$ is equal to

(A) $\sqrt{\frac{a^2+b^2}{4-a^2-b^2}}$ (B) $\sqrt{\frac{4-a^2-b^2}{a^2+b^2}}$

(C) $\sqrt{\frac{a^2+b^2}{4+a^2+b^2}}$ (D) $\sqrt{\frac{4+a^2+b^2}{a^2+b^2}}$

80. If tan A and tan B are the roots of the equation $x^2 - ax + b = 0$, then the value of $\sin^2(A+B)$ is

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

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

81. For a positive integer n, let $f_n(\theta) = \left(\tan\frac{\theta}{2}\right)(1+\sec\theta)(1+\sec 2\theta)(1+\sec 4\theta)\ldots(1+\sec 2^n\theta)$. Then, which one of the following is incorrect?

(A) $f_2\left(\frac{\pi}{16}\right) = 1$ (B) $f_3\left(\frac{\pi}{32}\right) = 1$

(C) $f_4\left(\frac{\pi}{64}\right) = 1$ (D) $f_5\left(\frac{\pi}{128}\right) = -1$

82. If $3\sin 2\theta = 2\sin 3\theta$, $0 < \theta < \pi$, then the value of $\sin\theta$ is

(A) 0 (B) $\frac{\sqrt{15}}{4}$

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

83. If $\sin 2A = \sin 3A$ and $0 \le A \le 90^\circ$, then A is equal to

(A) 45° (B) 60°

(C) 0° or 36° (D) 72°

84. If $\tan\theta + \tan\left(\theta+\frac{\pi}{3}\right) + \tan\left(\theta+\frac{2\pi}{3}\right) = 3$, then

(A) $\tan 2\theta = 1$ (B) $\tan 3\theta = 1$

(C) $\tan^3\theta = 1$ (D) $\tan^2\theta = 1$

3.4 Factorization formulae

85. The value of $\cos 12^\circ + \cos 84^\circ + \cos 156^\circ + \cos 132^\circ$ is

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

(C) $-\frac{1}{2}$ (D) $\frac{1}{8}$

86. $\cos A + \cos(240^\circ + A) + \cos(240^\circ - A) =$

(A) $\cos A$ (B) 0

(C) $\sqrt{3}\sin A$ (D) $\sqrt{3}\cos A$

87. The value of $\cot 70° + 4 \cos 70°$ is

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

88. $\cos 10x + \cos 8x + 3 \cos 4x + 3 \cos 2x =$

(A) $8 \cos x \cos 3x$ (B) $8 \cos^3 x + \cos 3x$

(C) $8 \cos^3 x \cos^3 3x$ (D) $8 \cos x \cos^3 3x$

89. $1 + \cos 2x + \cos 4x + \cos 6x =$

(A) $2 \cos x \cos 2x \cos 3x$

(B) $4 \sin x \cos 2x \cos 3x$

(C) $4 \cos x \cos 2x \cos 3x$

(D) $2 \sin x \cos 2x \cos 3x$

90. $2 \cos x - \cos 3x - \cos 5x =$

(A) $16 \cos^3 x \sin^2 x$ (B) $16 \sin^3 x \cos^2 x$

(C) $4 \cos^3 x \sin^2 x$ (D) $4 \sin^3 x \cos^2 x$

91. The expression $\frac{\cos 6x + 6\cos 4x + 15\cos 2x + 10}{\cos 5x + 5\cos 3x + 10\cos x}$ is equal to

(A) $\cos 2x$ (B) $2 \cos x$

(C) $\cos^2 x$ (D) $1 + \cos x$

92. $\tan 9° - \tan 27° - \tan 63° + \tan 81° =$

(A) $\frac{1}{2}$ (B) 2 (C) 4 (D) 8

93. If $\sin \theta + \sin 2\theta + \sin 3\theta = \sin \alpha$ and $\cos \theta + \cos 2\theta + \cos 3\theta = \cos \alpha$, then θ is equal to

(A) $\frac{\alpha}{2}$ (B) α (C) 2α (D) $\frac{\alpha}{6}$

94. If $\cos x + \cos y + \cos \alpha = 0$ and $\sin x + \sin y + \sin \alpha = 0$, then $\cot\left(\frac{x+y}{2}\right) =$

(A) $\sin \alpha$ (B) $\cos \alpha$

(C) $\cot \alpha$ (D) $\sin\left(\frac{x+y}{2}\right)$

95. $(\cos A + \cos B)^2 + (\sin A - \sin B)^2$ is equal to

(A) $4 \cos^2\left(\frac{A-B}{2}\right)$ (B) $4 \cos^2\left(\frac{A+B}{2}\right)$

(C) $4 \sin^2\left(\frac{A-B}{2}\right)$ (D) $4 \sin^2\left(\frac{A+B}{2}\right)$

96. $\cos^2 \alpha + \cos^2 (\alpha + 120°) + \cos^2 (\alpha - 120°)$ is equal to

(A) $\frac{3}{2}$ (B) 1 (C) $\frac{1}{2}$ (D) 0

97. $\frac{\sin(B+A) + \cos(B-A)}{\sin(B-A) + \cos(B+A)} =$

(A) $\frac{\cos B + \sin B}{\cos B - \sin B}$ (B) $\frac{\cos A + \sin A}{\cos A - \sin A}$

(C) $\frac{\cos A - \sin A}{\cos A + \sin A}$ (D) $\frac{\cos B - \sin B}{\cos B + \sin B}$

98. If $\frac{\cos(A+B)}{\cos(A-B)} = \frac{\sin(C+D)}{\sin(C-D)}$, then $\tan A \tan B \tan C + \tan D =$

(A) 0 (B) –1

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

99. If $\cos A = m \cos B$, then

(A) $\cot\left(\frac{A+B}{2}\right) = \frac{m+1}{m-1} \tan\left(\frac{B-A}{2}\right)$

(B) $\tan\left(\frac{A+B}{2}\right) = \frac{m+1}{m-1} \cot\left(\frac{B-A}{2}\right)$

(C) $\cot\left(\frac{A+B}{2}\right) = \frac{m+1}{m-1} \tan\left(\frac{A-B}{2}\right)$

(D) None of these

100. $\frac{\sin^2 A - \sin^2 B}{\sin A \cos A - \sin B \cos B} =$

(A) $\tan (A - B)$ (B) $\tan (A + B)$

(C) $\cot (A - B)$ (C) $\cot (A + B)$

101. The value of $\cos\frac{\pi}{11} + \cos\frac{3\pi}{11} + \cos\frac{5\pi}{11} + \cos\frac{7\pi}{11} + \cos\frac{9\pi}{11}$ is

(A) 0 (B) 1

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

102. If $\cos A = \frac{3}{4}$, then the value of $2 \sin\frac{A}{2} \sin\frac{5A}{2} =$

(A) $\frac{\sqrt{11}}{16}$ (B) $-\frac{\sqrt{11}}{16}$

(C) $\frac{11}{16}$ (D) $-\frac{11}{16}$

103. The value of $\sin\frac{\pi}{16} \sin\frac{3\pi}{16} \sin\frac{5\pi}{16} \sin\frac{7\pi}{16}$ is

(A) $\frac{1}{16}$ (B) $\frac{\sqrt{2}}{16}$

(C) $\frac{1}{8}$ (D) $\frac{\sqrt{2}}{8}$

104. $\sin 12° \sin 24° \sin 48° \sin 84° =$

(A) $\cos 20° \cos 40° \cos 60° \cos 80°$

(B) $\sin 20° \sin 40° \sin 60° \sin 80°$

(C) $\frac{3}{15}$

(D) $\frac{5}{16}$

105. $\sin 20° \sin 40° \sin 60° \sin 80° =$

(A) $\frac{-3}{16}$ (B) $\frac{5}{16}$

(C) $\frac{3}{16}$ (D) $\frac{-5}{16}$

106. $\tan 20° \tan 40° \tan 60° \tan 80° =$
(A) 1 (B) 2
(C) 3 (D) $\frac{\sqrt{3}}{2}$

107. The value of $\frac{\tan 70° - \tan 20°}{\tan 50°} =$
(A) 1 (B) 2 (C) 3 (D) 0

108. $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right) =$
(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{1}{8}$ (D) $\frac{1}{16}$

109. The value of $\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}+\cos\frac{7\pi}{7} =$
(A) 1 (B) –1
(C) $\frac{1}{2}$ (D) $\frac{-3}{2}$

110. The expression
$\cos^2(A - B) + \cos^2 B - 2\cos(A - B)\cos A \cos B$ is
(A) dependent on B
(B) dependent on A – B
(C) dependent on A
(D) independent of A and B

111. $2\sin^2\beta + 4\cos(\alpha+\beta)\sin\alpha\sin\beta + \cos 2(\alpha+\beta) =$
(A) $\sin 2\alpha$ (B) $\cos 2\beta$
(C) $\cos 2\alpha$ (D) $\sin 2\beta$

112. If A = tan 6° tan 42° and B = cot 66° cot 78°, then
(A) 3 A = 2 B (B) A = B
(C) A = 2 B (D) $A = \frac{1}{3}$

3.5 Trigonometric functions of angles of a triangle

113. In Δ ABC, $\angle A = \frac{\pi}{2}$, then $\cos^2 B + \cos^2 C =$
(A) –2 (B) –1 (C) 0 (D) 1

114. If A + B + C = 180°, then the value of (cot B + cot C) (cot C + cot A) (cot A + cot B) will be
(A) sec A sec B sec C
(B) cosec A cosec B cosec C
(C) tan A tan B tan C
(D) 1

115. If A, B, C are the angles of a triangle, then sin 2A + sin 2B – sin 2C is equal to
(A) 4 sinA cos B cos C
(B) 4 cos A
(C) 4 sin A cos A
(D) 4 cos A cos B sin C

116. If A + B + C = π, then $\cos 2A + \cos 2B + \cos 2C =$
(A) 1 + 4 cos A cos B sin C
(B) – 1 + 4 sin A sin B cos C
(C) –1 – 4 cos A cos B cos C
(D) 1 + 4 sin A sin B sin C

117. If $x + y + z = 180°$, then $\cos 2x + \cos 2y - \cos 2z$ is equal to
(A) 4 sin x sin y sin z
(B) 1 – 4 sin x sin y cos z
(C) 4 sin x sin y sin z – 1
(D) cos x cos y cos z

118. If $A + B + C = \frac{3\pi}{2}$, then
$\cos 2A + \cos 2B + \cos 2C =$
(A) 1 – 4 cos A cos B cos C
(B) 4 sin A sin B sin C
(C) 1 + 2 cos A cos B cos C
(D) 1 – 4 sin A sin B sin C

119. If A + B + C = π, then
$\frac{\cos A}{\sin B \sin C} + \frac{\cos B}{\sin C \sin A} + \frac{\cos C}{\sin A \sin B} =$
(A) 0 (B) 1 (C) 2 (D) 3

120. If A, B, C are the angles of a triangle, then $\sin^2 A + \sin^2 B + \sin^2 C - 2\cos A \cos B \cos C =$
(A) 1 (B) 2 (C) 3 (D) 4

121. In a Δ ABC, the value of
$\cos^2 A + \cos^2\left(A+\frac{\pi}{3}\right) + \cos^2\left(A-\frac{\pi}{3}\right)$ is
(A) 0 (B) $\frac{1}{2}$ (C) $\frac{3}{2}$ (D) 1

122. If A + B + C = π, then
$\cos^2\frac{A}{2} + \cos^2\frac{B}{2} - \cos^2\frac{C}{2}$ is
(A) $2\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$
(B) $4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$
(C) $1 - 2\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$
(D) $1 - 4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$

123. In a triangle ABC, the value of sin A + sin B + sin C is
(A) $4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$
(B) $4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$
(C) $4\cos\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$
(D) $4\cos\frac{A}{2}\sin\frac{B}{2}\cos\frac{C}{2}$

124. If A + B + C = 180°, then $\frac{\sin 2A+\sin 2B+\sin 2C}{\cos A+\cos B+\cos C-1}$ =

(A) $8\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

(B) $8\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

(C) $8\sin\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

(D) $8\cos\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

125. If A + B + C = 180°, then the value of $\cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}$ will be

(A) $2\cot\frac{A}{2}\cot\frac{B}{2}\cot\frac{C}{2}$

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

(C) $\cot\frac{A}{2}\cot\frac{B}{2}\cot\frac{C}{2}$

(D) $8\cot\frac{A}{2}\cot\frac{B}{2}\cot\frac{C}{2}$

126. If $\alpha+\beta+\gamma=2\pi$, then

(A) $\tan\frac{\alpha}{2}+\tan\frac{\beta}{2}+\tan\frac{\gamma}{2}$
$=\tan\frac{\alpha}{2}\tan\frac{\beta}{2}\tan\frac{\gamma}{2}$

(B) $\tan\frac{\alpha}{2}+\tan\frac{\beta}{2}+\tan\frac{\gamma}{2}$
$=-\tan\frac{\alpha}{2}\tan\frac{\beta}{2}\tan\frac{\gamma}{2}$

(C) $\tan\frac{\alpha}{2}\tan\frac{\beta}{2}+\tan\frac{\beta}{2}\tan\frac{\gamma}{2}$
$+\tan\frac{\gamma}{2}\tan\frac{\alpha}{2}=1$

(D) $\tan\alpha\tan\beta+\tan\beta\tan\gamma+\tan\gamma\tan\alpha=1$

127. If A, B, C are the angles of a triangle, then $\sum\frac{\cot A+\cot B}{\tan A+\tan B}$ =

(A) 1 (B) 2
(C) –1 (D) – 2

Previous Years' Questions

1. $\cos\left(\frac{3\pi}{4}+x\right)-\sin\left(\frac{\pi}{4}-x\right)$ = **[MHT CET 2020]**

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

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

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$
(C) $\frac{\pi}{12}$ (D) $\frac{\pi}{3}$

3. The value of sin18° is **[MHT CET 2021]**

(A) $\frac{4}{\sqrt{5}+1}$ (B) $\frac{4}{\sqrt{5}-1}$
(C) $\frac{\sqrt{5}+1}{4}$ (D) $\frac{\sqrt{5}-1}{4}$

4. 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 2α = **[MHT CET 2022]**

(A) $\frac{20}{7}$ (B) $\frac{56}{33}$
(C) $\frac{19}{12}$ (D) $\frac{25}{16}$

5. If $\sin18°=\frac{\sqrt{5}-1}{4}$, then $\cos^2 48° - \sin^2 12°$ has the value **[MHT CET 2023]**

(A) $\frac{-\sqrt{5}+1}{8}$ (B) $\frac{\sqrt{5}-1}{8}$
(C) $\frac{\sqrt{5}+1}{8}$ (D) $\frac{-1-\sqrt{5}}{8}$

6. If $\cos x+\cos y-\cos(x+y)=\frac{3}{2}$, then **[MHT CET 2023]**

(A) $x+y=0$ (B) $x=2y$
(C) $x=y$ (D) $2x=y$

7. The value of the expression $\sqrt{3}\operatorname{cosec}20°-\sec20°$ is equal to **[MHT CET 2024]**

(A) 2 (B) $\frac{2\sin20°}{\sin40°}$
(C) 4 (D) $4\frac{\sin20°}{\sin40°}$

8. 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 **[MHT CET 2024]**

(A) $\frac{1}{8}$ (B) $\frac{-1}{8}$ (C) $\frac{1}{16}$ (D) $\frac{-1}{16}$

Answer Key

Classwork

1.	(B	2.	(D)	3.	(D)	4.	(A)	5.	(B)	6.	(D)	7.	(B)	8.	(C)	9.	(B)	10.	(D)
11.	(B)	12.	(A)	13.	(C)	14.	(C)	15.	(B)	16.	(B)	17.	(A)	18.	(A)	19.	(D)	20.	(C)
21.	(B)	22.	(D)	23.	(A)	24.	(D)	25.	(D)	26.	(A)	27.	(A)	28.	(C)	29.	(A)	30.	(B)
31.	(D)	32.	(C)	33.	(C)	34.	(B)	35.	(A)	36.	(D)	37.	(C)	38.	(D)	39.	(B)	40.	(D)
41.	(D)	42.	(C)	43.	(B)	44.	(A)	45.	(D)	46.	(B)	47.	(A)	48.	(B)	49.	(B)	50.	(B)
51.	(B)	52.	(A)	53.	(B)	54.	(A)	55.	(A)	56.	(B)	57.	(A)	58.	(B)	59.	(C)	60.	(D)
61.	(A)	62.	(D)	63.	(B)	64.	(A)	65.	(B)	66.	(B)	67.	(B)	68.	(C)	69.	(C)	70.	(D)
71.	(D)	72.	(B)	73.	(B)	74.	(A)	75.	(C)	76.	(C)	77.	(D)	78.	(D)	79.	(C)	80.	(C)
81.	(D)	82.	(A)	83.	(C)	84.	(D)	85.	(C)	86.	(C)	87.	(D)	88.	(A)	89.	(B)	90.	(B)
91.	(A)	92.	(D)	93.	(A)	94.	(B)	95.	(A)	96.	(C)								

Homework

1.	(D)	2.	(A)	3.	(A)	4.	(B)	5.	(D)	6.	(A)	7.	(C)	8.	(A)	9.	(C)	10.	(B)
11.	(B)	12.	(C)	13.	(A)	14.	(B)	15.	(D)	16.	(C)	17.	(D)	18.	(A)	19.	(C)	20.	(B)
21.	(B)	22.	(D)	23.	(A)	24.	(C)	25.	(B)	26.	(C)	27.	(D)	28.	(D)	29.	(C)	30.	(D)
31.	(D)	32.	(D)	33.	(A)	34.	(C)	35.	(D)	36.	(D)	37.	(B)	38.	(B)	39.	(C)	40.	(C)
41.	(B)	42.	(A)	43.	(D)	44.	(D)	45.	(D)	46.	(B)	47.	(D)	48.	(A)	49.	(B)	50.	(A)
51.	(B)	52.	(A)	53.	(B)	54.	(A)	55.	(A)	56.	(B)	57.	(B)	58.	(D)	59.	(B)	60.	(B)
61.	(A)	62.	(B)	63.	(A)	64.	(C)	65.	(B)	66.	(B)	67.	(C)	68.	(B)	69.	(B)	70.	(A)
71.	(B)	72.	(A)	73.	(C)	74.	(C)	75.	(A)	76.	(A)	77.	(A)	78.	(C)	79.	(B)	80.	(A)
81.	(D)	82.	(B)	83.	(C)	84.	(B)	85.	(C)	86.	(B)	87.	(B)	88.	(D)	89.	(C)	90.	(A)
91.	(B)	92.	(C)	93.	(A)	94.	(C)	95.	(B)	96.	(A)	97.	(B)	98.	(A)	99.	(A)	100.	(B)
101.	(C)	102.	(C)	103.	(B)	104.	(A)	105.	(C)	106.	(C)	107.	(B)	108.	(C)	109.	(D)	110.	(C)
111.	(C)	112.	(B)	113.	(D)	114.	(B)	115.	(D)	116.	(C)	117.	(B)	118.	(D)	119.	(C)	120.	(B)
121.	(C)	122.	(A)	123.	(B)	124.	(B)	125.	(C)	126.	(A)	127.	(A)						

Previous Years' Question

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

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