Sub: Mathematics **TRIGONOMETRY SHEET** Prof. Chetan Sir

Exercise-1 JEE Main & Advanced PYQ

1. If $\cos x+\cos y+\cos\alpha=0$ and $\sin x+\sin y+\sin\alpha=0$, then $\cot(\frac{x+y}{2})=$ **[AIEEE: 2002]**

(A) $\sin\alpha$ (B) $\cos\alpha$ (C) $\cot\alpha$ (D) $2\sin\alpha$

2. $\cos 1^\circ\cos 2^\circ\cos 3^\circ\ldots\cos 179^\circ=$ **[AIEEE: 2002]**

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

3. Let α,β be such that $\pi<\alpha-\beta<3\pi$. If $\sin\alpha+\sin\beta=-\frac{21}{65}$ & $\cos\alpha+\cos\beta=-\frac{27}{65}$ then the value of $\cos\frac{\alpha-\beta}{2}$ is: **[AIEEE: 2004]**

(A) $-\frac{6}{65}$ (B) $\frac{3}{\sqrt{130}}$ (C) $\frac{6}{65}$ (D) $-\frac{3}{\sqrt{130}}$

4. Let $\cos(\alpha+\beta)=\frac{4}{5}$ and let $\sin(\alpha-\beta)=\frac{5}{13}$ where $0\le\alpha,\beta\le\frac{\pi}{4}$. Then $\tan(2\alpha)=$ **[AIEEE: 2010]**

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

5. If $A=\cos^2\theta+\sin^4\theta$ then for all value of θ **[AIEEE: 2011]**

(A) $1\le A\le 2$ (B) $\frac{3}{4}\le A\le 1$ (C) $\frac{13}{16}\le A\le 1$ (D) None of these

6. If $K=\sin(\pi/18)\sin(5\pi/18)\sin(7\pi/18)$, then the numerical value of K is: **[IIT: 1993]**

(A) $1/8$ (B) $1/16$ (C) $1/2$ (D) None of these

7. If $A>0,B>0$ and $A+B=\pi/3$, then the maximum value of $\tan A\tan B$ is: **[IIT: 1993]**

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

8. The expression $3[\sin^4(\frac{3\pi}{2}-\alpha)+\sin^4(3\pi-\alpha)]-2[\sin^6(\frac{\pi}{2}+\alpha)+\sin^6(5\pi-\alpha)]$ is equal to: **[IIT: 1995]**

(A) 0 (B) 1 (C) 3 (D) $\sin 4\alpha+\cos 6\alpha$

9. $3(\sin x-\cos x)^4+6(\sin x+\cos x)^2+4(\sin^6 x+\cos^6 x)=$ **[IIT: 1995]**

(A) 11 (B) 12 (C) 13 (D) 14

10. Which of the following number(s) is rational: **[IIT: 1998]**

(A) $\sin 15^\circ$ (B) $\cos 15^\circ$ (C) $\sin 15^\circ\cos 15^\circ$ (D) $\sin 15^\circ\cos 75^\circ$

11. The function $f(x)=\sin^4 x+\cos^4 x$ increases if: **[IIT: 1998]**

(A) $0<x<\frac{\pi}{8}$ (B) $\frac{\pi}{4}<x<\frac{3\pi}{8}$ (C) $\frac{3\pi}{8}<x<\frac{5\pi}{8}$ (D) $\frac{5\pi}{8}<x<\frac{3\pi}{4}$

12. For a positive integer n, let $f_n(\theta)=\tan(\frac{\theta}{2})(1+\sec\theta)(1+\sec 2\theta)(1+\sec 4\theta)\ldots(1+\sec 2^n\theta)$. Then: **[IIT: 1999]**

(A) $f_2(\frac{\pi}{16})=1$ (B) $f_3(\frac{\pi}{32})=1$
(C) $f_4(\frac{\pi}{64})=1$ (D) $f_5(\frac{\pi}{128})=1$

13. If $\alpha+\beta=\frac{\pi}{2}$ and $\beta+\gamma=\alpha$, then $\tan\alpha$ equals: **[IIT: 2001]**

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

14. The maximum value of $(\cos\alpha_1)(\cos\alpha_2)\ldots(\cos\alpha_n)$, under the restrictions $0\le\alpha_1,\alpha_2,\ldots,\alpha_n\le\frac{\pi}{2}$ and $(\cot\alpha_1)(\cot\alpha_2)\ldots(\cot\alpha_n)=1$ is: **[IIT: 2001]**

(A) $\frac{1}{2^{n/2}}$ (B) $\frac{1}{2^n}$ (C) $\frac{1}{2n}$ (D) 1

15. If $t_1 = (tan\theta)^{\tan\theta}, t_2 = (tan\ \theta)^{\cot\theta}, t_3 = (cot\theta)^{\tan\ \theta}, t_4 = (cot\theta)^{\cot\theta}$ and let $\theta \in (0, \frac{\pi}{4})$, then: **[IIT: 2006]**

(A) $t_4 < t_2 < t_1 < t_3$ (B) $t_4 < t_1 < t_3 < t_2$

(C) $t_4 < t_3 < t_2 < t_1$ (D) $t_2 < t_1 < t_3 < t_4$

16. If $\frac{\sin^4 x}{2} + \frac{\cos^4 x}{3} = \frac{1}{5}$, then: **[IIT: 2009]**

(A) $\tan^2 x = \frac{2}{3}$ (B) $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{1}{125}$

(C) $\tan^2 x = \frac{1}{3}$ (D) $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{2}{125}$

17. The maximum value of the expression $\frac{1}{\sin^2\theta + 3\sin\theta\cos\theta + 5\cos^2\theta}$ is _____. **[IIT: 2010]**

18. The expression $\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A}$ can be written as: **[JEE Mains: 2013]**

(A) $\sec A + \operatorname{cosec} A$ (B) $\sin A \cos A + 1$ (C) $\sec A \operatorname{cosec} A + 1$ (D) $\tan A + \cot A$

19. Let $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$ where $x \in R$ and $k \geq 1$. Then $f_4(x) - f_6(x)$ equals: **[JEE Mains: 2014]**

(A) $\frac{1}{12}$ (B) $\frac{1}{6}$ (C) $\frac{1}{3}$ (D) $\frac{1}{4}$

20. The value of $\sum_{k=1}^{13} \frac{1}{\sin(\frac{\pi}{4} + \frac{(k-1)\pi}{6})\sin(\frac{\pi}{4} + \frac{k\pi}{6})}$ is equal to: **[JEE Adv: 2016]**

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

21. If $5(\tan^2 x - \cos^2 x) = 2\cos 2x + 9$, then the value of $\cos 4x$ is: **[JEE Mains: 2017]**

(A) $-\frac{3}{5}$ (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) $-\frac{7}{9}$

22. Let a vertical tower AB have its end A on the level ground. Let C be the mid-point of AB and P be a point on the ground such that $AP = 2AB$. If $\angle BPC = \beta$ then $\tan\beta$ is equal to: **[JEE Mains: 2017]**

(A) $\frac{6}{7}$ (B) $\frac{1}{4}$ (C) $\frac{2}{9}$ (D) $\frac{4}{9}$

23. Let α and β be non-zero real numbers such that $2(\cos\beta - \cos\alpha) + \cos\alpha\cos\beta = 1$. Then which of the following is/are true? **[JEE Adv: 2017]**

(A) $\tan(\frac{\alpha}{2}) + \sqrt{3}\tan(\frac{\beta}{2}) = 0$ (B) $\tan(\frac{\alpha}{2}) - \sqrt{3}\tan(\frac{\beta}{2}) = 0$

(C) $\sqrt{3}\tan(\frac{\alpha}{2}) - \tan(\frac{\beta}{2}) = 0$ (D) $\sqrt{3}\tan(\frac{\alpha}{2}) + \tan(\frac{\beta}{2}) = 0$

24. Let a, b, c be three non-zero real numbers such that the equation $\sqrt{3}a\cos x + 2b\sin x = c$, $x \in [-\frac{\pi}{2}, \frac{\pi}{2}]$ has two distinct real roots α and β with $\alpha + \beta = \frac{\pi}{3}$. Then the value of $\frac{b}{a}$ is _____. **[JEE Adv: 2018]**

25. The value of $\cos^2 10^\circ - \cos 10^\circ \cos 50^\circ + \cos^2 50^\circ$ is: **[JEE Main: 2019]**

(A) $\frac{1}{256}$ (B) $\frac{1}{2}$ (C) $\frac{1}{1024}$ (D) $\frac{3}{4}$

26. Let $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$ for $k = 1, 2, 3, \ldots$. Then for all $x \in R$ the value of $f_4(x) - f_6(x)$ is equal to: **[JEE Main: 2019]**

(A) $\frac{1}{4}$ (B) $\frac{1}{12}$ (C) $\frac{-1}{12}$ (D) $\frac{5}{12}$

27. The maximum value of $3\cos\theta + 5\sin(\theta - \frac{\pi}{6})$ for any real value of θ is: **[JEE Main: 2019]**

(A) $\sqrt{31}$ (B) $\frac{\sqrt{79}}{2}$ (C) $\sqrt{34}$ (D) $\sqrt{19}$

28. 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: **[JEE Main: 2019]**

(A) $\frac{33}{52}$ (B) $\frac{21}{16}$ (C) $\frac{63}{52}$ (D) $\frac{63}{16}$

29. The value of $\cos^2 10^\circ - \cos 10^\circ \cos 50^\circ + \cos^2 50^\circ$ is: **[JEE Main: 2019]**

(A) $3/2$ (B) $\frac{3}{4} + \cos 20^\circ$ (C) $\frac{3}{2}(1 + \cos 20^\circ)$ (D) $3/4$

30. The value of $\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ$ is: **[JEE Main: 2019]**

(A) $\frac{1}{16}$ (B) $\frac{1}{32}$ (C) $\frac{1}{18}$ (D) $\frac{1}{36}$

31. The equation $y = \sin x \sin(x+2) - \sin^2(x+1)$ represents a straight line lying in: **[JEE Main: 2019]**

(A) first, third and fourth quadrants
(B) second and third quadrants only
(C) first, second and fourth quadrants
(D) third and fourth quadrants only

32. The value of $\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\cdot\cdots\cdot\cos\frac{\pi}{2^{10}}\cdot\sin\frac{\pi}{2^{10}}$ is: **[JEE Main: 2019]**

(A) $\frac{1}{1024}$ (B) $\frac{1}{512}$ (C) $\frac{1}{2}$ (D) $\frac{1}{256}$

33. For any $\theta \in (\frac{\pi}{4}, \frac{\pi}{2})$ the expression $3(\sin\theta - \cos\theta)^4 + 6(\sin\theta + \cos\theta)^2 + 4\sin^6\theta$ equal **[JEE Main: 2019]**

(A) $13 - 4\cos^2\theta + 6\cos^4\theta$
(B) $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$
(C) $13 - 4\cos^6\theta$
(D) $13 - 4\cos^4\theta + 2\sin^2\theta\cos^2\theta$

34. The value of $\cos^3(\frac{\pi}{8})\cos(\frac{3\pi}{8}) + \sin^3(\frac{\pi}{8})\sin(\frac{3\pi}{8})$ is: **[JEE Main: 2020]**

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

35. If $\frac{\sqrt{2}\sin\alpha}{\sqrt{1+\cos 2\alpha}} = \frac{1}{7}$ and $\sqrt{\frac{1-\cos 2\beta}{2}} = \frac{1}{\sqrt{10}}$, $\alpha, \beta \in (0, \frac{\pi}{2})$ then $\tan(\alpha + 2\beta)$ is equal to: **[JEE Main: 2020]**

36. If the equation $\cos^4\theta + \sin^4\theta + \lambda = 0$ has real solutions for θ then λ lies in the interval **[JEE Main: 2020]**

(A) $(-\frac{5}{4}, -1)$ (B) $[-1, -\frac{1}{2}]$ (C) $(-\frac{1}{2}, -\frac{1}{4}]$ (D) $[-\frac{3}{2}, -\frac{5}{4}]$

37. If $L = \sin^2(\frac{\pi}{16}) - \sin^2(\frac{\pi}{8})$ and $M = \cos^2(\frac{\pi}{16}) - \sin^2(\frac{\pi}{8})$, then: **[JEE Main: 2020]**

(A) $M = -\frac{1}{2\sqrt{2}} + \frac{1}{2}\cos\frac{\pi}{8}$
(B) $M = \frac{1}{4\sqrt{2}} + \frac{1}{4}\cos\frac{\pi}{8}$
(C) $L = \frac{1}{2\sqrt{2}} - \frac{1}{2}\cos\frac{\pi}{8}$
(D) $L = \frac{1}{4\sqrt{2}} - \frac{1}{4}\cos\frac{\pi}{8}$

38. If $0 < x, y < \pi$ and $\cos x + \cos y - \cos(x+y) = \frac{3}{2}$, then $\sin x + \cos y$ is equal to: **[JEE Main: 2021]**

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

39. If for $x \in (0, \frac{\pi}{2})$, $\log_{10}\sin x + \log_{10}\cos x = -1$ and $\log_{10}(\sin x + \cos x) = \frac{1}{2}(\log_{10} n - 1)$, $n > 0$, then the value of n is equal to: **[JEE Main: 2021]**

(A) 20 (B) 12 (C) 9 (D) 16

40. If $15\sin^4\alpha + 10\cos^4\alpha = 6$ for some $\alpha \in R$ then the value of $27\sec^6\alpha + 8\,\mathrm{cosec}^6\alpha$ is equal to: **[JEE Main: 2021]**

(A) 350 (B) 500 (C) 400 (D) 250

41. The value of $\cot\frac{\pi}{24}$ is: **[JEE Main: 2021]**

(A) $\sqrt{2} - \sqrt{3} - 2 + \sqrt{6}$
(B) $3\sqrt{2} - \sqrt{3} - \sqrt{6}$
(C) $\sqrt{2} + \sqrt{3} + 2 - \sqrt{6}$
(D) $\sqrt{2} + \sqrt{3} + 2 + \sqrt{6}$

42. If $\sin\theta + \cos\theta = \frac{1}{2}$, then $16(\sin(2\theta) + \cos(4\theta) + \sin(6\theta))$ is equal to: **[JEE Main: 2021]**

(A) 27 (B) 23 (C) -27 (D) -23

43. $\mathrm{cosec}\,18^\circ$ is a root of the equation: **[JEE Main: 2021]**

(A) $x^2 - 2x - 4 = 0$ (B) $4x^2 + 2x - 1 = 0$ (C) $x^2 + 2x - 4 = 0$ (D) $x^2 - 2x + 4 = 0$

44. The number of integral values of k for which the equation $3\sin x + 4\cos x = k + 1$ has a solution, $k \in R$ is _____. **[JEE Main: 2021]**

45. The value of $2\sin(\frac{\pi}{8})\sin(\frac{2\pi}{8})\sin(\frac{3\pi}{8})\sin(\frac{5\pi}{8})\sin(\frac{6\pi}{8})\sin(\frac{7\pi}{8})$ is: **[JEE Main: 2021]**

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

46. Let $S = \{\theta \in (0, \frac{\pi}{2}) : \sum_{m=1}^{9} \sec(\theta + (m-1)\frac{\pi}{6})\sec(\theta + \frac{m\pi}{6}) = -\frac{8}{\sqrt{3}}\}$. Then: **[JEE Main: 2022]**

(A) $S = \{\frac{\pi}{12}\}$ (B) $S = \{\frac{2\pi}{3}\}$ (C) $\sum_{\theta\in S}\theta = \frac{\pi}{2}$ (D) $\sum_{\theta\in S}\theta = \frac{3\pi}{4}$

47. The value of $2\sin\frac{\pi}{22}\sin\frac{3\pi}{22}\sin\frac{5\pi}{22}\sin\frac{7\pi}{22}\sin\frac{9\pi}{22}$ is equal to: **[JEE Main: 2022]**

(A) $\frac{1}{16}$ (B) $\frac{5}{16}$ (C) $\frac{7}{16}$ (D) $\frac{3}{16}$

48. If $\cot\alpha = 1$ and $\sec\beta = -\frac{5}{3}$, where $\pi < \alpha < \frac{3\pi}{2}$ and $\frac{\pi}{2} < \beta < \pi$, then the value of $\tan(\alpha+\beta)$ and the quadrant in which $\alpha+\beta$ lies, respectively are: **[JEE Main: 2022]**

(A) $-\frac{1}{7}$ and IV^{th} quadrant (B) 7 and I^{st} quadrant

(C) -7 and IV^{th} quadrant (D) $\frac{1}{7}$ and I^{st} quadrant

49. The value of $\cos(\frac{2\pi}{7})+\cos(\frac{4\pi}{7})+\cos(\frac{6\pi}{7})$ is equal to: **[JEE Main: 2022]**

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

50. $\alpha = \sin 36^\circ$ is a root of which of the following equation: **[JEE Main: 2022]**

(A) $16x^4 - 20x^2 + 5 = 0$ (B) $16x^4 + 20x^2 + 5 = 0$

(C) $10x^4 - 10x^2 - 5 = 0$ (D) $16x^4 - 10x^2 + 5 = 0$

51. $16\sin(20^\circ)\sin(40^\circ)\sin(80^\circ)$ is equal to: **[JEE Main: 2022]**

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

52. If $\sin^2(10^\circ)\sin(20^\circ)\sin(40^\circ)\sin(50^\circ)\sin(70^\circ) = \alpha - \frac{1}{16}\sin(10^\circ)$, then $16+\alpha^{-1}$ is equal to _____. **[JEE Main: 2022]**

53. The value of $2\sin 12^\circ - \sin 72^\circ$ is: **[JEE Main: 2022]**

(A) $\frac{\sqrt{5}(1-\sqrt{3})}{4}$ (B) $\frac{1-\sqrt{5}}{8}$ (C) $\frac{\sqrt{3}(1-\sqrt{5})}{2}$ (D) $\frac{\sqrt{3}(1-\sqrt{5})}{4}$

54. $96\cos\frac{\pi}{33}\cos\frac{2\pi}{33}\cos\frac{4\pi}{33}\cos\frac{8\pi}{33}\cos\frac{16\pi}{33}$ is equal to: **[JEE Main: 2023]**

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

55. The value of $36(4\cos^2 9^\circ - 1)(4\cos^2 27^\circ - 1)(4\cos^2 81^\circ - 1)(4\cos^2 243^\circ - 1)$ is: **[JEE Main: 2023]**

(A) 54 (B) 18 (C) 27 (D) 36

56. The value of $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ$ is _____. **[JEE Main: 2023]**

57. If $\tan 15^\circ + \frac{1}{\tan 75^\circ} + \frac{1}{\tan 105^\circ} + \tan 195^\circ = 2a$, then the value of $(a+\frac{1}{a})$ is: **[JEE Main: 2023]**

(A) 4 (B) $4-2\sqrt{3}$ (C) 2 (D) $5-\frac{3}{2}\sqrt{3}$

58. Let $|\cos\theta\cos(60-\theta)\cos(60+\theta)| \le \frac{1}{8}$, $\theta \in [0, 2\pi]$. Then, the sum of all $\theta \in [0, 2\pi]$, where $\cos 3\theta$ attains its maximum value, is: **[JEE Main: 2024]**

(A) 15π (B) 18π (C) 6π (D) 9π

59. If $\sin x = -\frac{3}{5}$ where $\pi < x < \frac{3\pi}{2}$ then $80(tan^2 x - cos\, x)$ is equal to: **[JEE Main: 2024]**

(A) 108 (B) 109 (C) 18 (D) 19

60. If the value of $\frac{3\cos 36^\circ + 5\sin 18^\circ}{5\cos 36^\circ - 3\sin 18^\circ}$ is $\frac{a\sqrt{5}-b}{c}$, where a, b, c are natural numbers and $\gcd(a,c) = 1$, then $a+b+c$ is equal to: **[JEE Main: 2024]**

(A) 40 (B) 52 (C) 50 (D) 54

61. If $\tan A = \frac{1}{\sqrt{x(x^2+x+1)}}, \tan B = \frac{\sqrt{x}}{\sqrt{x^2+x+1}}$ and $\tan C = (x^{-3}+x^{-2}+x^{-1})^{\frac{1}{2}}$, $0 < A, B, C < \frac{\pi}{2}$ then $A+B$ is equal to: **[JEE Main: 2024]**

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

62. For $\alpha,\beta \in (0,\frac{\pi}{2})$ let $3\sin(\alpha+\beta) = 2\sin(\alpha-\beta)$ and a real number k be such that $\tan\alpha = k\tan\beta$. Then the value of k is equal to: **[JEE Main: 2024]**

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

63. If for $\theta \in [-\frac{\pi}{3},0]$, the points $(x,y) = (3\tan(\theta+\frac{\pi}{3}), 2\tan(\theta+\frac{\pi}{6}))$ lie on $xy+\alpha x+\beta y+\gamma = 0$, then $\alpha^2+\beta^2+\gamma^2$ is equal to: **[JEE Main: 2025]**

(A) 75 (B) 96 (C) 80 (D) 72

64. If $10\sin^4\theta + 15\cos^4\theta = 6$, then the value of $\frac{27\,\mathrm{cosec}^6\theta + 8\sec^6\theta}{16\sec^6\theta}$ is: **[JEE Main: 2025]**

(A) 1 (B) $\frac{2}{5}$ (C) $\frac{1}{5}$ (D) $\frac{3}{4}$

65. If $\sin x + \sin^2 x = 1, x \in (0,\frac{\pi}{2})$, then $(\cos^{12}x + \tan^{12}x) + 3(\cos^{10}x + \tan^{10}x + \cos^8 x + \tan^8 x) + (\cos^6 x + \tan^6 x)$ is equal to: **[JEE Main: 2025]**

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

66. If $\sum_{r=1}^{13} \frac{1}{\sin(\frac{\pi}{4}+(r-1)\frac{\pi}{6})\sin(\frac{\pi}{4}+\frac{r\pi}{6})} = a\sqrt{3}+b$, where $a,b \in \mathbb{Z}$, then a^2+b^2 is equal to: **[JEE Main: 2025]**

(A) 10 (B) 4 (C) 8 (D) 2

67. Let the range of the function $f(x) = 6 + 16\cos x \cdot \cos(\frac{\pi}{3}-x)\cdot\cos(\frac{\pi}{3}+x)\cdot\sin 3x\cdot\cos 6x, x \in \mathbb{R}$ be $[\alpha,\beta]$. Then the distance of the point (α,β) from the line $3x+4y+12=0$ is: **[JEE Main: 2025]**

(A) 11 (B) 10 (C) 8 (D) 9

68. The value of $(\sin 70^\circ)(\cot 10^\circ \cot 70^\circ - 1)$ is: **[JEE Main: 2025]**

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

69. Let α and β be real numbers such that $-\frac{\pi}{4} < \beta < 0 < \alpha < \frac{\pi}{4}$. If $\sin(\alpha+\beta) = \frac{1}{3}$ and $\cos(\alpha-\beta) = \frac{2}{3}$, then the greatest integer less than or equal to $(\frac{\sin\alpha}{\cos\beta} + \frac{\cos\beta}{\sin\alpha} + \frac{\cos\alpha}{\sin\beta} + \frac{\sin\beta}{\cos\alpha})^2$ is _____. **[JEE Advanced: 2022]**

70. Let $\frac{\pi}{2} < x < \pi$ be such that $\cot x = \frac{-5}{\sqrt{11}}$. Then $(\sin\frac{11\pi}{2})(\sin 6x - \cos 6x) + (\cos\frac{11\pi}{2})(\sin 6x + \cos 6x)$ is equal to: **[JEE Advanced: 2024]**

(A) $\frac{\sqrt{11}-1}{2\sqrt{3}}$ (B) $\frac{\sqrt{11}+1}{2\sqrt{3}}$ (C) $\frac{\sqrt{11}+1}{3\sqrt{2}}$ (D) $\frac{\sqrt{11}-1}{3\sqrt{2}}$

71. Let $\alpha = \frac{1}{\sin 60^\circ \sin 61^\circ} + \frac{1}{\sin 62^\circ \sin 63^\circ} + \cdots + \frac{1}{\sin 118^\circ \sin 119^\circ}$. Then the value of $(\frac{\mathrm{cosec}\,1^\circ}{\alpha})^2$ is _____. **[JEE Advanced: 2025]**

Answer Key

1 (C)	**2** (A)	**3** (D)	**4** (B)	**5** (B)	**6** (A)	**7** (B)	**8** (B)	**9** (C)	**10** (C)
11 (B)	**12** (B)	**13** (C)	**14** (A)	**15** (D)	**16** (A, B)	**17** (2)	**18** (C)	**19** (A)	**20** (C)
21 (D)	**22** (C)	**23** (A, B)	**24** (0.5)	**25** (D)	**26** (B)	**27** (D)	**28** (D)	**29** (D)	**30** (A)
31 (D)	**32** (B)	**33** (C)	**34** (B)	**35** (1)	**36** (B)	**37** (A)	**38** (B)	**39** (B)	**40** (D)
41 (D)	**42** (D)	**43** (A)	**44** (11)	**45** (A)	**46** (C)	**47** (A)	**48** (A)	**49** (B)	**50** (A)
51 (B)	**52** (80)	**53** (D)	**54** (A)	**55** (D)	**56** (4)	**57** (A)	**58** (C)	**59** (B)	**60** (B)
61 (A)	**62** (A)	**63** (A)	**64** (A)	**65** (C)	**66** (C)	**67** (A)	**68** (C)	**69** (1)	**70** (B)
71 (3)									

Exercise-2 MHT CET PYQ

1. The value of $\cos 20^\circ + 2\sin^2 55^\circ - \sqrt{2}\sin 65^\circ$ is: **[MHT CET: 2024]**

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

2. 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: **[MHT CET: 2024]**

(A) $\frac{1}{2^{(n/2)}}$ (B) $\frac{1}{2^n}$ (C) 2^n (D) $2^{\frac{n}{2}}$

3. If $A + B = 225^\circ$, then $\frac{\cot A}{1+\cot A} \cdot \frac{\cot B}{1+\cot B}$, if it exists, is equal to: **[MHT CET: 2024]**

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

4. The value of $\cos(18^\circ - A)\cos(18^\circ + A) - \cos(72^\circ - A)\cos(72^\circ + A)$ is equal to: **[MHT CET: 2024]**

(A) $\cos 54^\circ$ (B) $\cos 36^\circ$ (C) $\sin 54^\circ$ (D) $\sin 36^\circ$

5. The value of $(1+\cos\frac{\pi}{8})(1+\cos\frac{3\pi}{8})(1+\cos\frac{5\pi}{8})(1+\cos\frac{7\pi}{8})$ is: **[MHT CET: 2024]**

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

6. If angle θ in $[0, 2\pi]$ satisfies both the equations $\cot\theta = \sqrt{3}$ and $\sqrt{3}\sec\theta + 2 = 0$ then θ is: **[MHT CET: 2024]**

(A) $\frac{\pi}{6}$ (B) $\frac{7\pi}{6}$ (C) $\frac{5\pi}{6}$ (D) $\frac{11\pi}{6}$

7. $\cos^3(\frac{\pi}{8})\cos(\frac{3\pi}{8}) + \sin^3(\frac{\pi}{8})\sin(\frac{3\pi}{8}) =$ **[MHT CET: 2024]**

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

8. The value of the expression $\sqrt{3}\operatorname{cosec} 20^\circ - \sec 20^\circ$ is equal to: **[MHT CET: 2024]**

(A) 2 (B) $\frac{2\sin 20^\circ}{\sin 40^\circ}$ (C) 4 (D) $4\frac{\sin 20^\circ}{\sin 40^\circ}$

9. If $\tan x = \frac{3}{4}$ and $\pi < x < \frac{3\pi}{2}$ then $\cos\frac{x}{2} =$ **[MHT CET: 2024]**

(A) $\frac{-2}{5}$ (B) $\frac{2}{5}$ (C) $\frac{1}{\sqrt{10}}$ (D) $\frac{-1}{\sqrt{10}}$

10. $\cos^2 48^\circ - \sin^2 12^\circ =$ if $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$ **[MHT CET: 2023]**

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

11. If $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$, then $\cos^2 48^\circ - \sin^2 12^\circ$ 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) $\frac{-1-\sqrt{5}}{8}$

12. If $p = \tan 20^\circ$, then value of $\frac{\tan 160^\circ - \tan 110^\circ}{1+\tan 160^\circ \tan 110^\circ}$ in terms of p is: **[MHT CET: 2022]**

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

13. $\frac{\sin^2(-160^\circ)}{\sin^2 70^\circ} + \frac{\sin(180^\circ-\theta)}{\sin\theta} =$ **[MHT CET: 2022]**

(A) $\sec^2(20^\circ)$ (B) $\cot^2(20^\circ)$ (C) $\tan^2(20^\circ)$ (D) $\operatorname{cosec}^2(20^\circ)$

14. The value of $(\cos\alpha + \cos\beta)^2 + (\sin\alpha + \sin\beta)^2$ is: **[MHT CET: 2022]**

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

15. If $\tan\theta = \frac{a}{b}$ then $b\cos 2\theta + a\sin 2\theta =$ **[MHT CET: 2022]**

(A) b (B) a (C) 0 (D) 1

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

(A) $\frac{3}{11}$ (B) $\frac{22}{9}$ (C) $\frac{9}{11}$ (D) $\frac{2}{11}$

17. $\tan A + 2\tan 2A + 4\tan 4A + 8\cot 8A =$ **[MHT CET: 2021]**

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

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

(A) $k\tan\phi$ (B) $\sin\alpha$ (C) $(\frac{k-1}{k+1})\sin\alpha$ (D) $k\cos\phi$

20. $\frac{\sin A+\sin 7A+\sin 13A}{\cos A+\cos 7A+\cos 13A} =$ **[MHT CET: 2020]**

(A) $\cot 7A$ (B) $\tan 6A$ (C) $\tan 7A$ (D) $\cot 6A$

21. The value of $\sin^2(\frac{\pi}{8}) =$ **[MHT CET: 2020]**

(A) $\frac{\sqrt{2}+1}{2\sqrt{2}}$ (B) $\frac{\sqrt{5}+1}{2\sqrt{2}}$ (C) $\frac{\sqrt{5}-1}{2\sqrt{2}}$ (D) $\frac{\sqrt{2}-1}{2\sqrt{2}}$

22. If $\sin x+\operatorname{cosec} x=3$, then value of $\sin^4 x+\operatorname{cosec}^4 x$ is: **[MHT CET: 2020]**

(A) 7 (B) 47 (C) 14 (D) 49

23. If $\sin\theta=\sin 15^\circ+\sin 45^\circ$, where $0^\circ<\theta<180^\circ$ then $\theta =$ **[MHT CET: 2020]**

(A) 75° (B) 150° (C) 45° (D) 60°

24. If A, B, C, D are the angles of a cyclic quadrilateral taken in order, then $\cos A+\cos B+\cos C+\cos D =$ **[MHT CET: 2020]**

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

25. If $\tan\theta+\cot\theta=4$ then $\tan^4\theta+\cot^4\theta =$ **[MHT CET: 2020]**

(A) 194 (B) 110 (C) 80 (D) 191

26. If A and B are supplementary angles, then $\sin^2\frac{A}{2}+\sin^2\frac{B}{2} =$ **[MHT CET: 2020]**

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

27. $\frac{1-\sin\theta+\cos\theta}{1-\sin\theta-\cos\theta} =$ **[MHT CET: 2020]**

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

28. $\operatorname{cosec} 2\theta-\cot 2\theta =$ **[MHT CET: 2020]**

(A) $\tan\theta$ (B) $\sin 2\theta$ (C) $\cos\theta$ (D) $\tan 2\theta$

29. 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: **[MHT CET: 2020]**

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

30. $\cos(36^\circ-A)\cos(36^\circ+A)+\cos(54^\circ+A)\cos(54^\circ-A) =$ **[MHT CET: 2020]**

(A) $\cos 2A$ (B) $\sin 2A$ (C) $\cos A$ (D) $\sin A$

31. If $\sin\theta=\frac{-12}{13}, \cos\phi=\frac{-4}{5}$ and θ,ϕ lie in the third quadrant, then $\tan(\theta-\phi) =$ **[MHT CET: 2020]**

(A) $\frac{-33}{56}$ (B) $\frac{-56}{33}$ (C) $\frac{56}{33}$ (D) $\frac{33}{56}$

32. If $a=\sin 175^\circ+\cos 175^\circ$ then: **[MHT CET: 2020]**

(A) $a>0$ (B) $a=0$ (C) $a<0$ (D) $a=1$

33. $\sqrt{2+\sqrt{2+2\cos 4\theta}} =$ **[MHT CET: 2020]**

(A) $2\cos\theta$ (B) $\frac{\cos\theta}{2}$ (C) $\frac{\cos\theta}{\sqrt{2}}$ (D) $\sqrt{2}\cdot\cos\theta$

34. If $A+B+C=180^\circ$, then the value of $\tan(\frac{A}{2})\tan(\frac{B}{2})+\tan(\frac{B}{2})\tan(\frac{C}{2})+\tan(\frac{C}{2})\tan(\frac{A}{2})$ is: **[MHT CET: 2020]**

(A) 1 (B) -2 (C) -1 (D) 2

35. If A, B, C are angles of a $\triangle ABC$, then $\tan 2A+\tan 2B+\tan 2C =$ **[MHT CET: 2020]**

(A) $\tan 2A\tan 3B\tan 2C$ (B) $\tan 2A\tan 2B\tan 2C$ (C) $\tan A\tan B\tan C$ (D) $\tan 3A\tan 2B\tan 2C$

36. $\sin 690^\circ\times\sec 240^\circ =$ **[MHT CET: 2020]**

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

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

(A) 18 (B) 27 (C) 9 (D) 3

38. $\sin(\frac{\pi}{3}+x)-\cos(\frac{\pi}{6}+x) =$ **[MHT CET: 2020]**

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

39. If $\tan\theta+\sin\theta=a$ and $\tan\theta-\sin\theta=b$ then the values of $\cot\theta$ and $\operatorname{cosec}\theta$ are respectively: **[MHT CET: 2020]**

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

40. $\frac{\cos 12^\circ - \sin 12^\circ}{\cos 12^\circ + \sin 12^\circ} + \frac{\sin 147^\circ}{\cos 147^\circ} =$ **[MHT CET: 2020]**

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

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

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

42. If $\tan\theta = 2$ and θ lies in the third quadrant, then the value of $\sec\theta$ is: **[MHT CET: 2020]**

(A) $-\sqrt{5}$ (B) $\sqrt{3}$ (C) $-\sqrt{2}$ (D) $\sqrt{5}$

43. $\cos x \cdot \cos 7x - \cos 5x \cdot \cos 13x =$ **[MHT CET: 2020]**

(A) $2\cos^2 6x \cdot \cos 12x$ (B) $2\sin^2 6x \cdot \cos 6x$ (C) $2\sin 6x \cdot \sin 12x$ (D) $2\sin 6x \cdot \cos 12x$

44. If $\cos x + \cos y = -\cos\alpha$, $\sin x + \sin y = -\sin\alpha$, then $\cot(\frac{x+y}{2}) =$ **[MHT CET: 2020]**

(A) $\sin\alpha$ (B) $\cot\alpha$ (C) $\tan\alpha$ (D) $\cos\alpha$

45. If $\tan\theta = \frac{1}{3}$ then $\cos 2\theta =$ **[MHT CET: 2020]**

(A) $\frac{1}{4}$ (B) $\frac{1}{10}$ (C) $\frac{1}{5}$ (D) $\frac{4}{5}$

46. If $\sec\theta = \frac{13}{12}$ lies in 4^{th} quadrant, then $\tan\theta \times \operatorname{cosec}\theta \times \sin\theta \times \cos\theta =$ **[MHT CET: 2020]**

(A) $-\frac{5}{13}$ (B) $\frac{144}{169}$ (C) $\frac{25}{169}$ (D) $\frac{5}{13}$

47. $\sec 2\theta - \tan 2\theta =$ **[MHT CET: 2020]**

(A) $\tan(\frac{\pi}{4} - \theta)$ (B) $\tan 2\theta$ (C) $\cot 2\theta$ (D) $\cot(\frac{\pi}{4} - \theta)$

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

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

49. The maximum value of the function $y = e^{5+\sqrt{3}\sin x + \cos x}$ is: **[MHT CET: 2020]**

(A) e^7 (B) e^2 (C) e^5 (D) e^8

50. If $\theta = \frac{17\pi}{3}$ then $(\tan\theta - \cot\theta)$ is: **[MHT CET: 2019]**

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

51. In $\triangle ABC$, if $\tan A + \tan B + \tan C = 6$ and $\tan A \cdot \tan B = 2$ then $\tan C =$ **[MHT CET: 2019]**

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

52. $\frac{1 - 2(\cos 60^\circ - \cos 80^\circ)}{2\sin 10^\circ} =$ **[MHT CET: 2019]**

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

53. If A, B, C are the angles of $\triangle ABC$ then $\cot A\cot B + \cot B\cot C + \cot A\cot C =$ **[MHT CET: 2018]**

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

54. If $2\sin(\theta + \frac{\pi}{3}) = \cos(\theta - \frac{\pi}{6})$, then $\tan\theta =$ **[MHT CET: 2018]**

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

Answer Key

1 (B)	**2** (A)	**3** (D)	**4** (C)	**5** (A)	**6** (B)	**7** (A)	**8** (C)	**9** (D)	**10** (C)
11 (C)	**12** (C)	**13** (A)	**14** (C)	**15** (A)	**16** (D)	**17** (B)	**18** (B)	**19** (C)	**20** (C)
21 (D)	**22** (B)	**23** (A)	**24** (D)	**25** (A)	**26** (A)	**27** (B)	**28** (A)	**29** (C)	**30** (A)
31 (D)	**32** (C)	**33** (A)	**34** (A)	**35** (B)	**36** (A)	**37** (C)	**38** (D)	**39** (B)	**40** (B)
41 (A)	**42** (A)	**43** (C)	**44** (B)	**45** (D)	**46** (A)	**47** (A)	**48** (D)	**49** (A)	**50** (D)
51 (A)	**52** (B)	**53** (B)	**54** (D)						

DPP-1 Transformation Formulas

1. If $\sin A+\cos 2A = 1/2$ and $\cos A+\sin 2A = 1/3$, then the value of $\sin 3A$ is:

(A) $-\frac{59}{72}$ (B) $\frac{59}{72}$ (C) $-\frac{59}{36}$ (D) $\frac{13}{72}$

[Comprehension for below two questions:]
Let $\sin\alpha+\sin\beta = \frac{\sqrt{6}}{3}$ and $\cos\alpha+\cos\beta = \frac{\sqrt{3}}{3}$.

2. The value of $\tan(\frac{\alpha+\beta}{2})$ is equal to:

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

3. The value of $100\cos^2(\frac{\alpha-\beta}{2})$ is equal to:

(A) 5 (B) 25 (C) 50 (D) 75

4. The value of $\frac{\sin 50^\circ+\sin 10^\circ}{\sin 70^\circ}$ is equal to:

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

5. If $\sin\alpha-\sin\beta = 1/3$ and $\cos\beta-\cos\alpha = 1/2$, find the value of $\cot\frac{\alpha+\beta}{2}$.

(A) $\frac{2}{3}$ (B) 1 (C) 0 (D) none of these

6. The roots of the equation $4x^2-2\sqrt{5}x+1=0$ are:

(A) $\sin 36^\circ, \sin 18^\circ$ (B) $\sin 18^\circ, \cos 36^\circ$ (C) $\sin 36^\circ, \cos 18^\circ$ (D) $\cos 18^\circ, \cos 36^\circ$

7. If $\frac{\sin\theta\sin 2\theta+\sin 3\theta\sin 6\theta+\sin 4\theta\sin 13\theta}{\sin\theta\cos 2\theta+\sin 3\theta\cos 6\theta+sin4\theta\cos 13\theta} = \tan(k\theta)$, then find k.

8. Find the exact value of the expression $\frac{\sin^2 34^\circ-\sin^2 11^\circ}{\sin 34^\circ\cos 34^\circ-\sin 11^\circ\cos 11^\circ}$.

DPP-2 Multiple and Submultiple Angle

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

(a) a (b) b (c) $-a$ (d) $-b$

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

(a) $\frac{\tan 2A}{\tan 8A}$ (b) $\frac{\tan 8A}{\tan 2A}$ (c) $\frac{\cot 8A}{\cot 2A}$ (d) None of these

3. 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) $\frac{7}{2\sqrt{5}}$

4. 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) $\frac{5}{4}$

5. $1-2\sin^2(\frac{\pi}{4}+\theta) =$

(a) $\cos 2\theta$ (b) $-\cos 2\theta$ (c) $\sin 2\theta$ (d) $-\sin 2\theta$

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

(a) $\sec A-\tan A$ (b) $\operatorname{cosec} A+\cot A$ (c) $\tan(\frac{\pi}{4}-\frac{A}{2})$ (d) $\tan(\frac{\pi}{4}+\frac{A}{2})$

7. If $\tan\frac{A}{2} = \frac{3}{2}$, then $\frac{1+\cos A}{1-\cos A} =$

(a) -5 (b) 5 (c) $9/4$ (d) $4/9$

8. $\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}$ (when x lies in II^{nd} quadrant) =

(a) $\sin\frac{x}{2}$ (b) $\tan\frac{x}{2}$ (c) $\sec\frac{x}{2}$ (d) $\operatorname{cosec}\frac{x}{2}$

9. $\frac{\sin 2A}{1+\cos 2A}\cdot\frac{\cos A}{1+\cos A} =$

(a) $\tan\frac{A}{2}$ (b) $\cot\frac{A}{2}$ (c) $\sec\frac{A}{2}$ (d) $\operatorname{cosec}\frac{A}{2}$

10. If $\sin\alpha = -\frac{3}{5}$, where $\pi < \alpha < \frac{3\pi}{2}$, then $\cos\frac{1}{2}\alpha =$

(a) $-\frac{1}{\sqrt{10}}$ (b) $\frac{1}{\sqrt{10}}$ (c) $\frac{3}{\sqrt{10}}$ (d) $-\frac{3}{\sqrt{10}}$

11. Let $0 < x < \frac{\pi}{4}$. Then $\sec 2x - \tan 2x =$

(a) $\tan(x - \frac{\pi}{4})$ (b) $\tan(\frac{\pi}{4} - x)$ (c) $\tan(x + \frac{\pi}{4})$ (d) $\tan^2(x + \frac{\pi}{4})$

DPP-3 Conditional Identities

1. In any triangle ABC, which is not right angled, $\sum \cot A \cot B$ is equal to:

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

2. If $A + B + C = \frac{3\pi}{2}$, then $\cos 2A + \cos 2B + \cos 2C$ is equal to:

(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) $1 - 4 \sin A \sin B \sin C$

3. If $\alpha + \beta + \gamma = 0$, then $\sin 2\alpha + \sin 2\beta + \sin 2\gamma$ is equal to:

(A) $4\cos\alpha\cos\beta\cos\gamma$ (B) $-1 - 4\cos\alpha\cos\beta\cos\gamma$
(C) $-4\sin\alpha\sin\beta\sin\gamma$ (D) $4\sin\alpha\sin\beta\sin\gamma$

4. In $\triangle ABC$, if $\cot A \cot C = \frac{1}{2}$ and $\cot B \cot C = \frac{1}{18}$ then find the value of $\tan C$.

DPP-4 Sum of Trigonometric Series

1. The value of $\cos 0 + \cos\frac{\pi}{9} + \cos\frac{2\pi}{9} + \cos\frac{3\pi}{9} + \cos\frac{4\pi}{9} + \cos\frac{5\pi}{9} + \cos\frac{6\pi}{9} + \cos\frac{7\pi}{9} + \cos\frac{8\pi}{9}$ is:

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

2. If ϕ is the exterior angle of a regular polygon of n sides and θ is any constant, then $\sin\theta + \sin(\theta+\phi) + \sin(\theta+2\phi) + \ldots$ up to n terms =

(A) $\sin n\theta$ (B) $\sin n\phi$ (C) $2n\pi$ (D) 0

3. $\cos\frac{\pi}{11}\cos\frac{2\pi}{11}\cos\frac{3\pi}{11}\cos\frac{4\pi}{11}\cos\frac{5\pi}{11} =$

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

4. The value of $\cos\frac{\pi}{10}\cos\frac{2\pi}{10}\cos\frac{6\pi}{10}\cos\frac{8\pi}{10}\cos\frac{16\pi}{10}$ is:

(A) $-\frac{\cos(\pi/10)}{16}$ (B) $\frac{\cos(\pi/10)}{16}$ (C) $\frac{1}{16}$ (D) $-\frac{1}{16}$

5. The value of $\cos\frac{\pi}{19} + \cos\frac{3\pi}{19} + \cos\frac{5\pi}{19} + \cdots + \cos\frac{17\pi}{19}$ is equal to:

(A) $1/2$ (B) 0 (C) 1 (D) 2

6. $\cos\frac{\pi}{11} + \cos\frac{3\pi}{11} + \cos\frac{5\pi}{11} + \cos\frac{7\pi}{11} + \cos\frac{9\pi}{11}$ is equal to:

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

7. The value of $(\cos^4 1^\circ + \cos^4 2^\circ + \cos^4 3^\circ + \cdots + \cos^4 179^\circ) - (\sin^4 1^\circ + \sin^4 2^\circ + \sin^4 3^\circ + \cdots + \sin^4 179^\circ)$ equals:

(A) $2\cos 1^\circ$ (B) -1 (C) $2\sin 1^\circ$ (D) 0

8. The value of $\sum_{r=0}^{10} \cos^3\frac{r\pi}{3}$ is equal to $\frac{-a}{b}$, then the value of b is (where g.c.d of (a,b) is 1).

9. $\sin\theta + \sin 3\theta + \sin 5\theta + \ldots \sin(2n-1)\theta$ is equal to

(A) $\operatorname{cosec}\theta - \frac{\cos^2 n\theta}{\sin\theta}$ (B) $\frac{\sin^2 n\theta}{\sin\theta}$ (C) $\sin n\theta$ (D) $\cos^2 n\theta$

10. If $\theta = \frac{\pi}{2^{n+1}}$, then the value of $\cos\theta\cos 2\theta\cos 2^2\theta \ldots \cos 2^{n-1}\theta$ is

(A) 1 (B) $1/2^n$ (C) 2^n (D) none of these

11. The value of $\cos(\frac{\pi}{4}) \cdot \cos(\frac{\pi}{8}) \cdot \cos(\frac{\pi}{16}) \ldots \cos(\frac{\pi}{2^n})$ equals

(A) $\frac{1}{2^n}\operatorname{cosec}(\frac{\pi}{2^n})$ (B) $\frac{1}{2^{n-1}}\operatorname{cosec}(\frac{\pi}{2^{n-1}})$ (C) $\frac{1}{2^n}\operatorname{cosec}(\frac{\pi}{2^{n-1}})$ (D) $\frac{1}{2^{n-1}}\operatorname{cosec}(\frac{\pi}{2^n})$

12. $\cos\frac{\pi}{11} + \cos\frac{3\pi}{11} + \cos\frac{5\pi}{11} + \cos\frac{7\pi}{11} + \cos\frac{9\pi}{11}$ is equal to

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

13. Find the value of $\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}$.

14. Find the value of $\sin\frac{\pi}{n}+\sin\frac{3\pi}{n}+\sin\frac{5\pi}{n}+\cdots+\sin\frac{(2n-1)}{n}\pi$.

15. If $S=\sum_{n=1}^{89}\frac{1}{1+(\tan n^\circ)^2}$ then $2S$ equals.

16. $\sum_{k=1}^{88}(-1)^{k+1}\frac{1}{\sin^2(k+1)^\circ-\sin^2 1^\circ}$ is equal to:

(A) $\tan 2^\circ$ (B) $\cot 2^\circ$ (C) $\frac{\sin 2^\circ}{\cot 2^\circ}$ (D) $\frac{\cot 2^\circ}{\sin 2^\circ}$

17. Find the sum of the series $\operatorname{cosec}\theta+\operatorname{cosec}2\theta+\operatorname{cosec}4\theta+\ldots$ to n terms.

(A) $\cot\frac{\theta}{2}$ (B) $\cot 2^{n-1}\theta$ (C) $\cot\frac{\theta}{2}-\cot 2^n\theta$ (D) $\cot 2^n\theta-\cot\frac{\theta}{2}$

18. The average of $2\sin 2^\circ, 4\sin 4^\circ, 6\sin 6^\circ, \ldots, 180\sin 180^\circ$ is:

(A) $\tan 1^\circ$ (B) $\cot 1^\circ$ (C) $\cos 1^\circ$ (D) $\sin 1^\circ$

19. Let $P=\sum_{k=0}^{100}k\cos^2(\sin k^\circ)$ and $Q=\sum_{k=0}^{100}k\sin^2(\sin k^\circ)$, then the value of $P+Q$ is equal to:

(A) 5050 (B) 5052 (C) 5150 (D) None

20. The value of $\sum_{k=1}^{5}\frac{1}{\sin(k+1)\cdot\sin(k+2)}$ is:

(A) positive (B) negative (C) $\frac{\cot 2-\cot 7}{\sin 1}$ (D) $\frac{\tan 2-\tan 7}{\sin 1}$

DPP-5 Range of Trigonometric Functions

1. If $0\le x\le\frac{\pi}{3}$ then Range of $f(x)=\sec(\frac{\pi}{6}-x)+\sec(\frac{\pi}{6}+x)$ is:

(A) $(\frac{4}{\sqrt{3}},\infty)$ (B) $[\frac{4}{\sqrt{3}},\infty)$ (C) $[0,\frac{4}{\sqrt{3}}]$ (D) $(0,\frac{4}{\sqrt{3}})$

2. The greatest and least value of $y=3\cos(\theta+\frac{\pi}{3})+5\cos\theta+3$ are respectively:

(A) 11, -5 (B) 3, -3 (C) 3, 0 (D) 10, -4

3. The greatest and least value of $y=10\cos^2 x-6\sin x\cos x+2\sin^2 x$ are respectively:

(A) 11, 1 (B) 10, 2 (C) 12, -4 (D) 11, -1

4. Find the sum of maximum and minimum values of $\cos^2\theta-6\sin\theta\cos\theta+3\sin^2\theta+2$.

5. $y=\cos 2x+3\sin x$. Find the range of y.

(A) $[-1,3]$ (B) $[-1,2]$ (C) $[-2,2]$ (D) $[-4,\frac{17}{8}]$

6. If $\sin x_1+\sin x_2+\sin x_3+\cdots+\sin x_{2021}=2021$. Then value of $\cos x_1+\cos x_2+\cdots+\cos x_{2021}=$

(A) 1 (B) 0 (C) π (D) $\frac{\pi}{2}$

7. If the maximum value of expression $\frac{1}{5\sec^2\theta-\tan^2\theta+4\operatorname{cosec}^2\theta}$ is equal to $\frac{p}{q}$ (where p and q are coprime), then the value of $(p+q)$ is

(A) 14 (B) 15 (C) 16 (D) 18

8. If m is the minimum value of $f(x)=3\sin x+5$ and n is the maximum value of $g(x)=3-2\sin x$, then $(m+n+2)$ is equal to

(A) 11 (B) 9 (C) 8 (D) 10

9. The maximum value of $1+\sin(\frac{\pi}{4}+\theta)+2\cos(\frac{\pi}{4}-\theta)$ for real values of θ is

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

10. The ratio of the greatest value of $2-\cos x+\sin^2 x$ is to its least value, is

(A) 7/4 (B) 11/4 (C) 13/4 (D) none of these

11. Match the Column:

Column-I	**Column-II**
(a) Minimum value of $5\sin^2\theta+4\cos^2\theta$ is	(P) 2
(b) The maximum value of $\cos^2(\frac{\pi}{3}-x)-\cos^2(\frac{\pi}{3}+x)$ is	(Q) 4
(c) Minimum value of $\tan^2\theta+\cot^2\theta$ is	(R) $\frac{\sqrt{3}}{2}$
(d) Minimum value of $9\tan^2\theta+4\cot^2\theta$ is	(S) 12

Answer Key (DPP-1)

1 (A) **2** (A) **3** (B) **4** (B) **5** (A) **6** (B) **7** (9) **8** (1)

Answer Key (DPP-2)

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

Answer Key (DPP-3)

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

Answer Key (DPP-4)

1 (D) **2** (D) **3** (D) **4** (B) **5** (A) **6** (B) **7** (B) **8** (8)
9 (B) **10** (B) **11** (D) **12** (B) **13** (-1/2) **14** (0) **15** (89) **16** (D)
17 (C) **18** (B) **19** (A) **20** (C)

Answer Key (DPP-5)

1 (B) **2** (D) **3** (A) **4** (8) **5** (D) **6** (B) **7** (C) **8** (C)
9 (C) **10** (C)
11 (a)→(Q), (b)→(R), (c)→(P), (d)→(S)