

MATHS

BOOKS - KC SINHA MATHS (HINGLISH)

SUMMATION OF TRIGONOMETRIC SERIES - FOR COMPETITION

Solved Examples

1. Find the sum of the series

$$\sin^2 \alpha + \sin^2(\alpha + \beta) + \sin^2(\alpha + 2\beta) \dots + \sin^2(\alpha + (n-1)\beta)$$



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2. If B be the exterior angle of a regular polygon of n - sides and A is any constant then $\cos A + \cos(A + B) + \cos(A + 2B) \dots n$ terms is equal

to



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3. Sum of n terms of the series

$$\sin \alpha - \sin(\alpha + \beta) + \sin(\alpha + 2\beta) - \sin(\alpha + 3\beta) + \dots$$



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4. Sum to terms of the series

$$\sin \theta \sin 2\theta + \sin 2\theta \sin 3\theta + \sin 3\theta \sin 4\theta + \dots \text{ is equal to}$$



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



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6. $\frac{\sin x}{\sin 2x \sin 3x} + \frac{\sin x}{\sin 3x \sin 4x} + \frac{\sin x}{\sin 4x \sin 5x} + \dots n$ terms is equal to



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7. Find the sum of the series $\cos ec\theta \cdot \cos ec2\theta + \cos ec2\theta \cdot \cos ec3\theta + \cos ec3\theta \cdot \cos ec4\theta + \dots$ to n terms



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8. Find the sum of n terms of the series:

$$\frac{1}{\cos \theta + \cos 3\theta} + \frac{1}{\cos \theta + \cos 5\theta} + \frac{1}{\cos \theta + \cos 7\theta} + \dots$$



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9. Find the sum to n terms of the series

$$\frac{\sin x}{\cos x + \cos 2x} + \frac{\sin 2x}{\cos x + \cos 4x} + \frac{\sin 3x}{\cos x + \cos 6x} + \dots$$



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10. Find the sum to n terms of the series

$$\sin^3 \theta + \frac{1}{3} \sin^3 3\theta + \frac{1}{3^2} \sin^3 9\theta + \frac{1}{3^3} \sin^3 27\theta + \dots$$



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11. Prove that: $\cos ec\theta + \cos ec\left(\frac{\theta}{2}\right) + \cos ec\left(\frac{\theta}{2^2}\right) + \cos ec\left(\frac{\theta}{2^3}\right) + \dots$

$$\text{to } n \text{ terms} = \cot\left(\frac{\theta}{2^n}\right) - \cot\theta$$



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12. Find the sum of the series

$$\tan x + 2\tan 2x + 2^2 \tan 2^2 x + \dots = 2^{n-1} \tan 2^{n-1} x$$



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$$13. \frac{1}{2^2} \tan\left(\frac{\pi}{2^2}\right) + \frac{1}{2^3} \tan\left(\frac{\pi}{2^3}\right) + \dots \text{ to } \infty$$



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14. Sum the series

$$\tan^{-1}\left(\frac{x}{1+1 \cdot 2x^1}\right) + \tan^{-1}\left(\frac{x}{1+2 \cdot 3x^2}\right) + \dots + \tan^{-1}\left(\frac{x}{1+n \cdot (n+1)x^n}\right)$$



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15. Find the sum of the series

$$\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{18}\right) + \tan^{-1}\left(\frac{1}{32}\right) + \dots$$

to n terms



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16. Find the sum

$$\tan^{-1}\left(\frac{1}{3+3.1+1^2}\right) + \tan^{-1}\left(\frac{1}{3+3.2+2^2}\right) + \dots + \tan^{-1}\left(\frac{1}{3+3n+n^2}\right)$$



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17. The sum of the infinite series

$$\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) + \sin^{-1}\left(\frac{\sqrt{2}-1}{\sqrt{6}}\right) + \dots + \sin^{-1}\left(\frac{\sqrt{n}-\sqrt{n-1}}{\sqrt{n(n+1)}}\right)$$



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18. Find the sum of the series

$$\cos \alpha + x \cos(\alpha + \beta) + \frac{x^2}{2!} \cos(\alpha + 2\beta) + \dots \rightarrow \infty$$



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19. Find the sum of the series $\sin \theta - \frac{\sin 2\theta}{2!} + \frac{\sin 3\theta}{3!} - \dots \rightarrow \infty$



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Exercise

1. Show that if $n > 2$

$$\cos^2\left(\frac{\pi}{n}\right) + \cos^2\left(\frac{3\pi}{n}\right) + \cos^2\left(\frac{5\pi}{n}\right) + \dots n \text{ terms} = \frac{n}{2}$$



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2. show that : $\sin^2 \alpha + \sin^2\left(\alpha + \frac{2\pi}{n}\right) + \sin^2\left(\alpha + \frac{4\pi}{n}\right) + \dots \quad n$

$$\text{terms} = \frac{n}{2}$$



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3. If $4n\theta = \pi$, then $\sin^2 \theta + \sin^2 3\theta + \sin^2 5\theta + \dots 2n \text{ terms}$ is equal to:(1)

- (1) n , (2) $2n$. (3) $3n$ (4) n^2



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4. Prove that: $\frac{\sin \theta + \sin 3\theta + \sin 5\theta + \dots \rightarrow n \text{ terms}}{\cos \theta + \cos 3\theta + \cos 5\theta + \dots \rightarrow n \text{ terms}} = \tan n\theta$



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5. Sum of n terms of the series $\sin^3 \theta + \sin^3 3\theta + \sin^3 5\theta + \dots$



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6. Sum to n terms of the series
 $\cos \theta - \sin 2\theta - \cos 3\theta + \sin 4\theta + \cos 5\theta - \dots$



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7. Sum of n terms of the series
 $\sin \alpha - \sin(\alpha + \beta) + \sin(\alpha + 2\beta) - \sin(\alpha + 3\beta) + \dots$



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8. Find the sum to n terms of the series

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



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9. Find the sum of the series

$$\cos \theta \cdot \cos 2\theta + \cos 3\theta \cdot \cos 4\theta + \cos 5\theta \cdot \cos 6\theta + \dots \rightarrow n \text{ terms}$$



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10. Prove that: $\frac{\sin \theta + \sin 3\theta + \sin 5\theta + \dots \rightarrow n \text{ terms}}{\cos \theta + \cos 3\theta + \cos 5\theta + \dots \rightarrow n \text{ terms}} = \tan n\theta$



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11. Find the sum of n terms of the series

$$\sqrt{1 - \sin 2\theta} + (\sqrt{1 - \sin 4\theta} + \sqrt{1 - \sin 6\theta} + \dots)$$



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12. If ϕ be the exterior angle of a regular polygon of n sides and θ is any constant, then prove that

$$\cos \theta + \cos(\theta + \phi) + \cos(\theta + 2\phi) + \dots + nterm = 0$$



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13. Prove that $\cos^2 x + \cos^2 3x + \cos^2 5x + \dots +$ to n terms = $1/2$

$$\left[n + \frac{\sin 4nx}{2 \sin 2x} \right]$$



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14. Prove that:

$$\cos^3 \theta + \cos^3 \left(\theta - \frac{2\pi}{n} \right) + \cos^3 \left(\theta - \frac{4\pi}{n} \right) + \dots + nterms = 0$$



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15. Find the sum of the series:

$$\sin^3\left(\frac{x}{3}\right) + 3\sin^3\left(\frac{x}{3^2}\right) + 3^2\sin^3\left(\frac{x}{3^3}\right) + \dots \rightarrow n$$



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16.

Prove

that:

$$\sec \theta \sec 2\theta + \sec 2\theta \sec 3\theta + \sec 3\theta \sec 4\theta + \dots \rightarrow n \text{ terms} = \frac{1}{\sin \theta} [\tan(n - 1)\theta - \tan \theta]$$



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17.

Prove

that,

$$\frac{1}{\cos \theta - \cos 3\theta} + \frac{1}{\cos \theta - \cos 5\theta} + \frac{1}{\cos \theta - \cos 7\theta} + \dots + \rightarrow n \text{ terms} =$$



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18.

Prove

that:

$$\sec x \cdot \sec(x + y) + \sec(x + y) \cdot \sec(x + 2y) + \sec(x + 2y) \sec(x + 3y) + \dots$$



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19.

Prove

that:

$$\frac{\sin 2\theta}{\cos \theta \cos 3\theta} + \frac{\sin 4\theta}{\cos 3\theta \cdot \cos 5\theta} + \frac{\sin 6\theta}{\cos 5\theta \cdot \cos 7\theta} + \dots \rightarrow \text{terms} = \frac{1}{2 \sin \theta} [\text{se}]$$



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20.

Prove

that

$$\tan x \cdot \sec 2x + \tan 2x \sec 4x + \tan 4x \cdot \sec 8x + \dots \rightarrow n \text{ terms} = \tan^{2^n x} - t$$



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21.

Find

the

sum

series:

$$\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) + \dots \rightarrow \infty$$



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22. Sum to n terms the series

$$\tan^{-1}\left(\frac{1}{1+1+1^2}\right) + \tan^{-1}\left(\frac{1}{1+2+2^2}\right) + \tan^{-1}\left(\frac{1}{1+3+3^2}\right) + \dots$$



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23. Sum the series :

$$\tan^{-1}\left(\frac{4}{1+3.4}\right) + \tan^{-1}\left(\frac{6}{1+8.9}\right) + \tan^{-1}\left(\frac{8}{1+15.16}\right) + \dots \infty$$

is :



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24. Find the sum $\cot^{-1} 2 + \cot^{-1} 8 + \cot^{-1} 18 + \dots \infty$



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25. Prove that:

$$\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{2}{9}\right) + \tan^{-1}\left(\frac{4}{33}\right) + \dots \rightarrow \infty = \frac{\pi}{4}$$



26. The sum to infinite terms of the series

$$\cot^{-1}\left(2^2 + \frac{1}{2}\right) + \cot^{-1}\left(2^3 + \frac{1}{2^2}\right) + \cot^{-1}\left(2^4 + \frac{1}{2^3}\right) + \dots \text{ is}$$



27. The sum of the series

$$\sin \alpha + x \sin(\alpha + \beta) + \frac{x^2}{2!} \sin(\alpha + 2\beta) + \dots \infty \text{ is}$$



28. Sum the infinite series :

$$\sin \alpha + x \sin(\alpha + \beta) + \frac{x^2}{2!} \sin(\alpha + 2\beta) + \frac{x^3}{3!} \sin(\alpha + 3\beta) + \dots$$



29. Find the sum of the series $\cos \theta - \frac{\cos 2\theta}{2!} + \frac{\cos 3\theta}{3!} - \dots \rightarrow \infty$



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30. Find the sum: $\cos \theta + \frac{a \cos 2\theta}{1!} + \frac{a^2 \cos 3\theta}{2!} + \frac{a^3 \cos 4\theta}{3!} + \dots \rightarrow \infty$



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