MATHS

BOOKS - KC SINHA ENGLISH

SUMMATION OF TRIGONOMETRIC SERIES - FOR COMPETITION

Solved Examples

1. Find the sum of the series $\sin^2\alpha + \sin^2(\alpha+\beta) + \sin^2(\alpha+2\beta)\ldots + \sin^2(\alpha+(n-1)\beta)$

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

to

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3. Sum of n terms of the series

$\sin\alpha - \sin(\alpha+\beta) + \sin(\alpha+2\beta) - \sin(\alpha+3\beta) + \ldots.$

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4. Sum to terms of the series

$\sin\theta\sin 2\theta + \sin 2\theta\sin 3\theta + \sin 3\theta\sin 4\theta + \ldots.$ is equal to

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5. Find the value of $\cos\frac{\pi}{11} + \cos\frac{3\pi}{11} + \cos\frac{5\pi}{11} + \cos\frac{7\pi}{11} + \cos\frac{9\pi}{11}.$

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

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

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8. Find the sum of n terms the series: $\frac{1}{\cos\theta + \cos 3\theta} + \frac{1}{\cos\theta + \cos 5\theta} + \frac{1}{\cos\theta + \cos 7\theta} + \ldots$

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9. Find the sum to n terms of the series $\frac{\sin x}{\cos x + \cos 2x} + \frac{\sin 2x}{\cos x + \cos 4x} + \frac{\sin 3x}{\cos x + \cos 6x} + \ldots$

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10. Find the sum to n terms of the series $\sin^3\theta + \frac{1}{3}\sin^3 3\theta + \frac{1}{3^2}\sin^3 9\theta + \frac{1}{3^3}\sin^3 27\theta + \ldots$

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11. Prove that: $\cos ec\theta + \cos ec\left(\frac{\theta}{2}\right) + \cos ec\left(\frac{\theta}{2^2}\right) + \cos ec\left(\frac{\theta}{2^3}\right) + \ldots$ to n terms = $\cot\left(\frac{\theta}{2^n}\right) - \cot\theta$

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12. Find the sum of the series $\tan x + 2\tan 2x + 2^2\tan 2^2x + \ldots + 2^{n-1}\tan 2^{n-1}x$

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13. $\frac{1}{2^2}\tan\left(\frac{\pi}{2^2}\right)+\frac{1}{2^3}\tan\left(\frac{\pi}{2^3}\right)+\ldots.$ to ∞

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14. Sum the series

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

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15. Find the sum of the series

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

to n terms

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16. Find the sum

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

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17. The sum of the infinte series

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

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18. Find the sum of the series

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

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

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Exercise

1. Show that if $n > 2$

$$\cos^2\left(\frac{\pi}{n}\right) + \cos^2\left(\frac{3\pi}{n}\right) + \cos^2\left(\frac{5\pi}{n}\right) + \ldots nterms = \frac{n}{2}$$

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

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

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4. Prove that: $\frac{\sin\theta + \sin 3\theta + \sin 5\theta + \ldots \to nterms}{\cos\theta + \cos 3\theta + \cos 5\theta + \ldots \to nterms} = \tan n\theta$

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5. Sum ot n terms the series $\sin^3\theta + \sin^3 3\theta + \sin^3 5\theta + \ldots$

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6. Sum to n terms the series

$\cos\theta - \sin 2\theta - \cos 3\theta + \sin 4\theta + \cos 5\theta - \ldots\ldots$

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7. Sum of n terms of the series

$\sin\alpha - \sin(\alpha+\beta) + \sin(\alpha+2\beta) - \sin(\alpha+3\beta) + \ldots.$

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8. Find the sum to n terms o the series $\cos^2\alpha + \cos^2(\alpha+\beta) + \cos^2(\alpha+2\beta) + ..$

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9. Find the sum of the series $\cos\theta.\cos 2\theta + \cos 3\theta.\cos 4\theta + \cos 5\theta.\cos 6\theta + \ldots \to n\text{terms}$

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10. Prove that: $\frac{\sin\theta + \sin 3\theta + \sin 5\theta + \ldots \to nterms}{\cos\theta + \cos 3\theta + \cos 5\theta + \ldots \to nterms} = \tan n\theta$

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11. Find the sum of n terms of the series $\sqrt{1-\sin 2\theta} + \left(\sqrt{1-\sin 4\theta} + \sqrt{1-\sin 6\theta} + \ldots\right.$

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

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

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13. Prove that $\cos^2 x + \cos^2 3x + \cos^2 5x + \ldots. +$ to n terms= 1/2 $\left[n + \frac{\sin 4nx}{2\sin 2x}\right]$

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14. Prove that:

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

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15. Find the sum of the series:

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

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16. Prove that:

$$\sec\theta\sec 2\theta + \sec 2\theta\sec 3\theta + \sec 3\theta.\sec 4\theta + \ldots \to nterms = \frac{1}{\sin\theta}[\tan(n$$

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17. Prove that,

$$\frac{1}{\cos\theta - \cos 3\theta} + \frac{1}{\cos\theta - \cos 5\theta} + \frac{1}{\cos\theta - \cos 7\theta} + \ldots + \to nterms =$$

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18. Prove that:

$$\sec x.\sec(x+y) + \sec(x+y).\sec(x+2y) + \sec(x+2y)\sec(x+3y) + ..$$

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19. Prove that:

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

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20. Prove that

$$\tan x.\sec 2x+\tan 2x\sec 4x+\tan 4x.\sec 8x+..\rightarrow nterms=\tan^{2^n x}-\text{t}$$

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21. Find the sum series:

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

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22. Sum the following series to infinity :

$$\frac{\tan^{-1}1}{1+1+1^2}+\frac{\tan^{-1}1}{1+2+2^2}+\frac{\tan^{-1}1}{1+3+3^2}+\ldots$$

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23. Sum the series :

$$\tan^{-1}\left(\frac{4}{1+3\cdot 4}\right)+\tan^{-1}\left(\frac{6}{1+8\cdot 9}\right)+\tan^{-1}\left(\frac{8}{1+15\cdot 16}\right)+\ldots\ldots$$

is :

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

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25. Prove that:

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

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26. If the sum of first 16 terms of the series $s = \cot^{-1}\left(2^2 + \frac{1}{2}\right) + \cot^{-1}\left(2^3 + \frac{1}{2^2}\right) + \cot^{-1}\left(2^4 + \frac{1}{2^3}\right) +$ up to terms is $\cot^{-1}\left(\frac{1+2^n}{2(2^{16}-1)}\right)$, then find the value of n.

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27. Sum the infinite series :

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

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28. Sum the infinite series :

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

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

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

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