CLASS 10TH MID TERM

SCORE BOOSTER

INTRODUCTION TO TRIGONOMETRY ONE SHOT

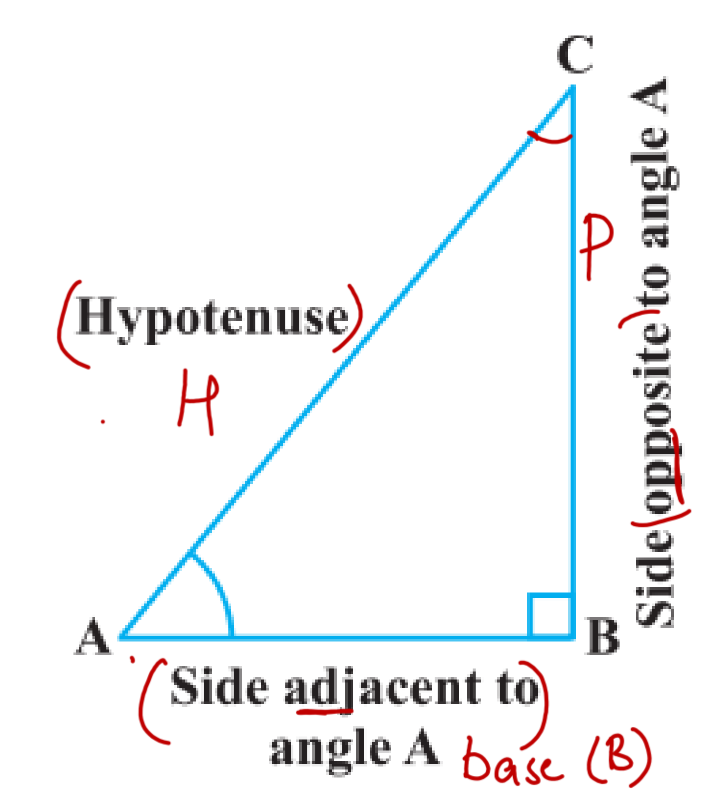
MATHS

Trigonometric Ratio

$$\sin A = \frac{P}{H} = \frac{BC}{AC}$$

$$\cos A = \frac{B}{H} = \frac{AB}{AC}$$

$$\frac{\sin A}{\cos A} \leftarrow \tan A = \frac{P}{B} = \left(\frac{BC}{AB}\right)$$



Reciprocal relation (T. R.)

$$\operatorname{cosec} A = \frac{1}{\sin A} = \frac{H}{P}$$

$$\sec A = \frac{1}{\cos A} = \frac{H}{B}$$

$$\Rightarrow \frac{1/P}{1/B} = \left(\frac{B}{P}\right)$$

$$\cot A = \frac{1}{\tan A} = \frac{B}{P}$$

$$\cot A \leftarrow \checkmark \frac{\operatorname{cosec} A}{\sec A} \rightarrow \boxed{\left(\frac{\cos A}{\sin A}\right)}$$

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13th Sept 2024

Topic	PDF	Link
Real Numbers		
Life processes		

Q. Given 15 cot A = 8, find all the T. R.

① $\sin A = \frac{15k}{17k} = \frac{15}{17}$

② $\cos A = \frac{8k}{17k} = \frac{8}{17}$

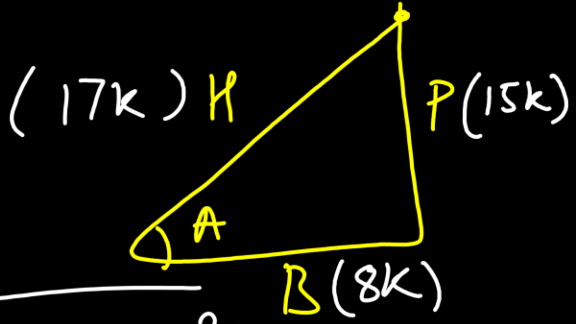
③ $\tan A = \frac{15k}{8k} = \frac{15}{8}$

④ $\operatorname{cosec} A = \frac{17}{15}$

⑤ $\sec A = \frac{17}{8}$

S	C	T
$\frac{P}{H}$	$\frac{B}{H}$	$\frac{P}{B}$

$\cot A = \frac{8}{15} = \frac{B}{P}$



$\sqrt{64k^2 + 225k^2}$

$289k^2 = 17k$

Q. In a right triangle ABC, right-angled at B, if $\tan A = 1$, then verify that $2 \sin A \cos A = 1$.

$\rightarrow \sin A = \frac{P}{H} = \frac{a}{a\sqrt{2}} = \frac{1}{\sqrt{2}}$

$\rightarrow \cos A = \frac{B}{H} = \frac{a}{a\sqrt{2}} = \frac{1}{\sqrt{2}}$

LHS :→ $2 \sin A \cdot \cos A$

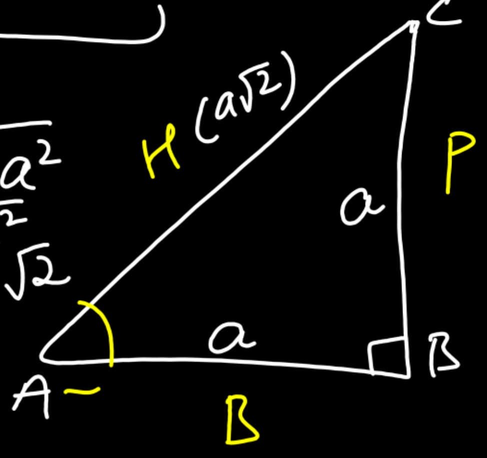
$\Rightarrow 2\left(\frac{1}{\sqrt{2}}\right)\left(\frac{1}{\sqrt{2}}\right) = 2 \times \frac{1}{2}$

$= 1 = $ RHS

$\sqrt{a^2 + a^2}$

$= \sqrt{2a^2}$

$= a\sqrt{2}$



$\tan A = 1$

$\frac{P}{B} = 1$

$P = B$

let $= a = P = B$

Q. If $4\tan\theta = 3$, then $\left(\frac{4\sin\theta - \cos\theta}{4\sin\theta + \cos\theta}\right)$ is equal to $\to 1/2$

$$\Rightarrow \frac{(4\sin\theta - \cos\theta) \div \cos\theta}{(4\sin\theta + \cos\theta) \div \cos\theta}$$

$$\Rightarrow \frac{\frac{4\sin\theta}{\cos\theta} - \frac{\cos\theta}{\cos\theta}}{\frac{4\sin\theta}{\cos\theta} + \frac{\cos\theta}{\cos\theta}} = \frac{4\tan\theta - 1}{4\tan\theta + 1}$$

$$\Rightarrow \frac{4(3/4) - 1}{4(3/4) + 1} = \frac{3-1}{3+1} = \frac{2}{4} = \left(\frac{1}{2}\right)$$

$\tan\theta = 3/4$

$\tan\theta = \frac{\sin\theta}{\cos\theta}$

Q. In triangle ABC, right-angled at B, if $\tan A = \frac{1}{\sqrt{3}}$ find the value of $\sin A \cos C + \cos A \sin C$ $= 1$

$\sin C = \frac{opp.}{H} = \frac{\sqrt{3}k}{2k} = \frac{\sqrt{3}}{2}$

$\sin A \cos C + \cos A \sin C$

$\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) + \left(\frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$

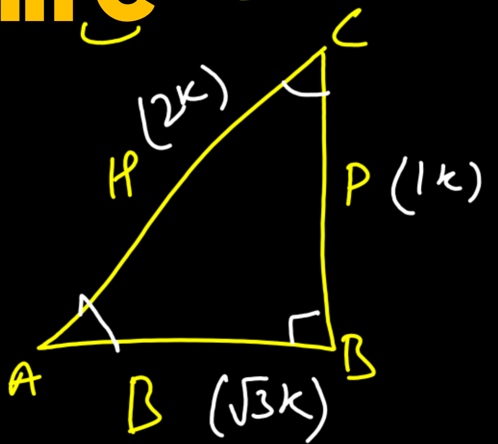
$\frac{1}{4} + \frac{3}{4}$

$= \frac{4}{4} = 1$

$\sin A = \frac{1k}{2k} = \frac{1}{2}$

$\cos A = \frac{\sqrt{3}k}{2k} = \frac{\sqrt{3}}{2}$

$\tan A = \frac{1}{\sqrt{3}} = \frac{P}{B}$



$H = \sqrt{P^2 + B^2}$

$= \sqrt{k^2 + 3k^2}$

$= \sqrt{4k^2}$

$= 2k$

$\cos C = \frac{adj}{H} = \frac{1k}{2k} = \frac{1}{2}$

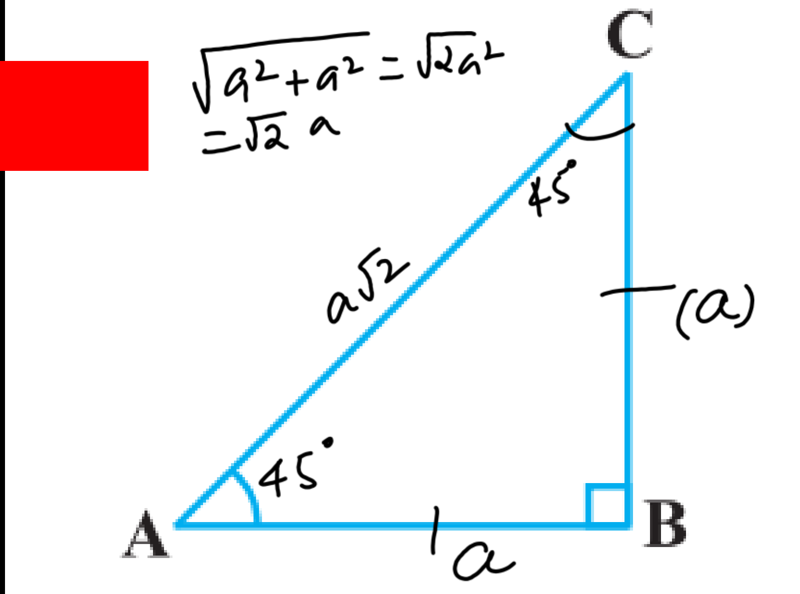
Trigonometric Ratios of Some Specific Angles

Trigonometric Ratios of 45°

$\sin 45^\circ = \frac{a}{a\sqrt{2}} = \frac{1}{\sqrt{2}}$

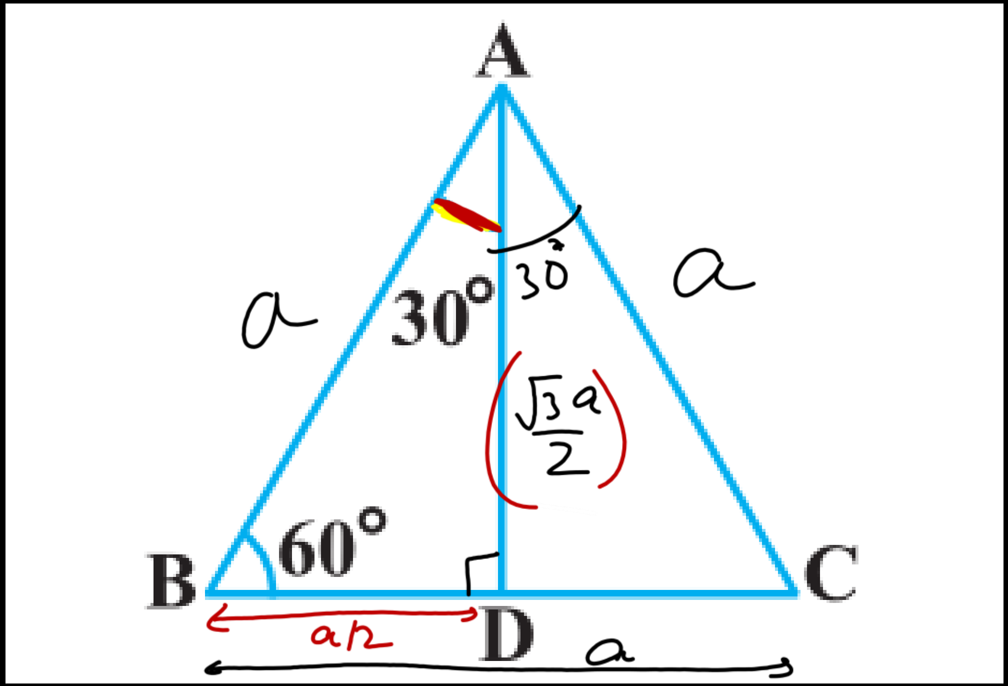
$\cos 45^\circ = \frac{a}{a\sqrt{2}} = \frac{1}{\sqrt{2}}$

$\tan 45^\circ = \frac{a}{a} = 1$



Trigonometric Ratios of 30° & 60°

$$AD = \sqrt{H^2 - B^2}$$
$$= \sqrt{a^2 - \frac{a^2}{4}} = \sqrt{\frac{3a^2}{4}}$$
$$= \frac{a}{2}\sqrt{3}$$



$$\sin 30^\circ = \frac{a/2}{a} = 1/2$$

$$\cos 30^\circ = \frac{\frac{\sqrt{3}}{2}a}{a} = \frac{\sqrt{3}}{2}$$

$$\tan 30^\circ = \frac{a/2}{\frac{\sqrt{3}a}{2}} = 1/\sqrt{3}$$

$$\sin 60^\circ = \frac{\frac{\sqrt{3}}{2}a}{a} = \frac{\sqrt{3}}{2}$$

$$\cos 60^\circ = \frac{a/2}{a} = 1/2$$

$$\tan 60^\circ = \frac{\frac{\sqrt{3}}{2}a}{a/2} = \sqrt{3}$$

Trigonometric Ratios of 0° and 90°

$\angle A = 1^\circ$

$\angle A \to 0$

$AC = AB$

$BC = 0$

$\angle A = 0^\circ$

$\sin A = \frac{BC}{AC} = \frac{0}{AC} = 0$

$\cos A = \frac{AB}{AC} = 1$

$\tan A = \frac{BC}{AB} = \frac{0}{AB} = 0$

$\angle A = 89^\circ$

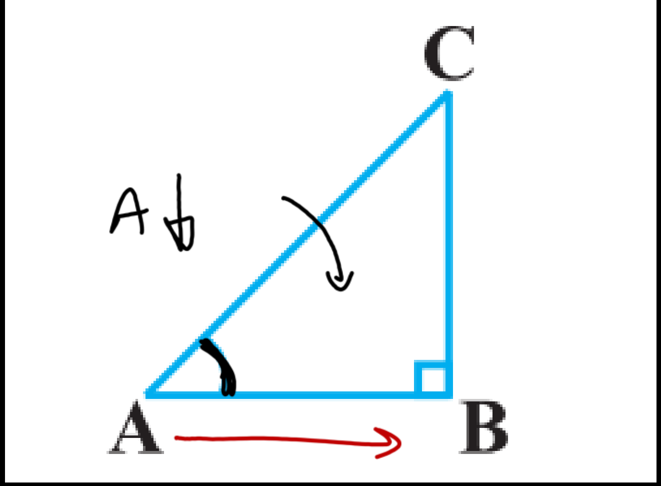
$\angle A = 90^\circ$ $AB = 0$

$AC = BC$

$\sin A = \frac{BC}{AC} = 1$

$\cos A = \frac{AB}{AC} = \frac{0}{AC} = 0$

$\tan A = \frac{1}{0} = \infty$



Trigonometric Ratios (Table)

	0°	30°	45°	60°	90°
Sin	$\sqrt{\frac{0}{4}} = 0$	$\sqrt{\frac{1}{4}} = \left(\frac{1}{2}\right)$	$\sqrt{\frac{2}{4}} = \frac{1}{\sqrt{2}}$	$\sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2}$	$\sqrt{\frac{4}{4}} = 1$
Cos	1	$\sqrt{3}/2$	$\frac{1}{\sqrt{2}}$	$1/2$	0
Tan	0	$1/\sqrt{3}$	1	$\sqrt{3}$	$\infty = \frac{1}{0}$
Cosec	∞	2	$\sqrt{2}$	$2/\sqrt{3}$	1
Sec	1	$2/\sqrt{3}$	$\sqrt{2}$	2	∞
Cot	∞	$\sqrt{3}$	1	$1/\sqrt{3}$	$\frac{0}{1} = 0$

$\frac{\sin\theta}{\cos\theta} =$ Tan

Q. Evaluate: (all angles are in degrees)

$$\frac{5\cos^2 60 + 4\sec^2 30 - \tan^2 45}{\sin^2 30 + \cos^2 30}$$

$$\Rightarrow \frac{5\left(\frac{1}{2}\right)^2 + 4\left(\frac{2}{\sqrt{3}}\right)^2 - 1^2}{\left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2}$$

$$\Rightarrow \frac{\frac{5}{4} + \frac{16}{3} - \frac{1}{1}}{\frac{1}{4} + \frac{3}{4}} = \frac{\frac{5\times3}{12} + \frac{16\times4}{12} - \frac{12}{12}}{4/4}$$

$$= \frac{15}{12} + \frac{64}{12} - \frac{12}{12} = \left(\frac{67}{12}\right)$$

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Q. If $\cos 9\alpha = \sin\alpha$ and $9\alpha < 90^\circ$, then the value of $\tan 5\alpha$ is

$\to = 1$

$\Rightarrow \tan 5\alpha$

$= \tan 5(9^\circ)$

$= \tan 45^\circ = 1$

$\cos 9\alpha = \sin\alpha$

$\alpha + 9\alpha = 90^\circ$

$10\alpha = 90^\circ$

$\alpha = 9^\circ$

Q. If $\tan(A + B) = \sqrt{3}$ and $\tan(A - B) = \frac{1}{\sqrt{3}}$; $0 \le A + B \le 90$; A > B, find A & B. → $(45°, 30°)$

$\tan(A+B) = \sqrt{3}$

$\tan(A+B) = \tan 60°$

$A + B = 60°$ — ①

$\tan(A-B) = \frac{1}{\sqrt{3}} = \tan 30°$

$A - B = 30°$ — ②

⇒ Add ① & ②

$2A = 90°$

$A = 45°$

$A - B = 30°$

$45° - 30° = B$

$B = 15°$

Trigonometric Identities

- $\cos^2 A + \sin^2 A = 1$
- $1 + \tan^2 A = \sec^2 A$
- $\cot^2 A + 1 = \mathrm{cosec}^2 A$

$$\left(\frac{B}{H}\right)^2 + \left(\frac{P}{H}\right)^2 = \frac{B^2}{H^2} + \frac{P^2}{H^2}$$

$$= \frac{B^2 + P^2}{H^2} = \frac{H^2}{H^2} = 1$$

Q. Prove that $\sqrt{\dfrac{1+\sin A}{1-\sin A}} = \sec A + \tan A$

$(a-b)(a+b)$

(1.) $\cos^2 A + \sin^2 A = 1$

$\cos^2 A = 1 - \sin^2 A$

$$\sqrt{\frac{1+\sin A}{1-\sin A} \times \frac{1+\sin A}{1+\sin A}}$$

$$\Rightarrow \sqrt{\frac{(1+\sin A)^2}{1^2 - \sin^2 A}}$$

$$\Rightarrow \sqrt{\frac{(1+\sin A)^2}{\cos^2 A}}$$

$$= \frac{1+\sin A}{\cos A}$$

$$\frac{1+\sin A}{\cos A} = \frac{1}{\cos A} + \frac{\sin A}{\cos A}$$

$$= \sec A + \tan A$$

$= \text{RHS}$

Q. Prove that $\left(\frac{\cos A - \sin A + 1}{\cos A + \sin A - 1}\right) = \operatorname{cosec} A + \cot A$, **using** $\cot^2 A + 1 = \operatorname{cosec}^2 A$

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

$$\Rightarrow \frac{\cot A - 1 + \operatorname{cosec} A}{\cot A + 1 - \operatorname{cosec} A}$$

$$\Rightarrow \frac{\cot A + \operatorname{cosec} A - 1}{\cot A + 1 - \operatorname{cosec} A}$$

$$1 = \operatorname{cosec}^2 A - \cot^2 A$$

Identity

$$\frac{\cot A + \operatorname{cosec} A - 1}{1 + \cot A - \operatorname{cosec} A}$$

$$\Rightarrow \frac{(\cot A + \operatorname{cosec} A) - (\operatorname{cosec}^2 A - \cot^2 A)}{(1 + \cot A - \operatorname{cosec} A)}$$

$$[(\operatorname{cosec} A - \cot A) \times (\operatorname{cosec} A + \cot A)]$$

$$\Rightarrow \frac{(\operatorname{cosec} A + \cot A)[1 - (\operatorname{cosec} A - \cot A)]}{(1 + \cot A - \operatorname{cosec} A)}$$

$$\Rightarrow \frac{(\operatorname{cosec} A + \cot A)(1 - \operatorname{cosec} A + \cot A)}{(1 + \cot A - \operatorname{cosec} A)} = (\operatorname{cosec} A + \cot A)$$

$$= \text{RHS}$$

Q. Prove that:

$(\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2 = 7 + \tan^2 A + \cot^2 A$

LHS $\rightarrow (\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2$

$\Rightarrow \sin^2 A + \operatorname{cosec}^2 A + 2(\sin A \cdot \operatorname{cosec} A) + \cos^2 A + \sec^2 A + 2(\cos A \cdot \sec A)$

$\Rightarrow (\sin^2 A + \cos^2 A) + \operatorname{cosec}^2 A + \sec^2 A + 2 + 2$

$\Rightarrow 5 + 1 + \cot^2 A + 1 + \tan^2 A$

$\Rightarrow 7 + \tan^2 A + \cot^2 A = \text{RHS}$

Q. Prove that:

$$\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A} = 1 + \sec A \operatorname{cosec} A$$

LHS

$$\Rightarrow \frac{\tan A}{1 - \frac{1}{\tan A}} + \frac{1/\tan A}{1 - \tan A}$$

$$\Rightarrow \frac{\tan A}{\frac{\tan A}{\tan A} - \frac{1}{\tan A}} + \left(\frac{1}{\tan A(1-\tan A)} \times \frac{-1}{-1}\right)$$

$$\Rightarrow \frac{\tan A}{\frac{(\tan A - 1)}{\tan A}} + \frac{-1}{\tan A(\tan A - 1)} \Rightarrow \frac{\tan^2 A}{\tan A - 1} - \frac{1}{\tan A(\tan A - 1)}$$

$$\frac{\tan^2 A}{\tan A - 1} - \frac{1}{\tan A(\tan A - 1)}$$

$$\Rightarrow \frac{\tan^3 A - 1^3}{\tan A(\tan A - 1)}$$

$$\left[a^3 - b^3 = (a-b)(a^2 + b^2 + ab) \right]$$

$$\Rightarrow \frac{(\tan A - 1)(\tan^2 A + 1 + \tan A)}{\tan A(\tan A - 1)} = \frac{\tan^2 A + 1 + \tan A}{\tan A}$$

$$\Rightarrow \frac{\tan^2 A}{\tan A} + \frac{1}{\tan A} + \frac{\tan A}{\tan A}$$

$$\Rightarrow \tan A + \cot A + 1$$

$$\left(\frac{\sin A}{\cos A} + \frac{\cos A}{\sin A}\right) + 1$$

$$\frac{\sin^2 A + \cos^2 A}{\cos A \sin A} + 1$$

$$= \frac{1 \times 1}{\cos A \sin A} + 1 = \sec A \operatorname{cosec} A + 1$$

$$= \text{RHS}$$

Q. Prove that:

$$\left(\frac{\sin A}{1+\cos A}\right)+\frac{1+\cos A}{\sin A}=2\operatorname{cosec} A$$

LHS →

$$\frac{\sin^2 A+(1+\cos A)^2}{(1+\cos A)\sin A}=\frac{\sin^2 A+1+\cos^2 A+2\cos A}{\sin A(1+\cos A)}$$

$$=\frac{1+1+2\cos A}{\sin A(1+\cos A)}$$

$$=\frac{2[1+\cos A]}{\sin A(1+\cos A)}=\frac{2}{\sin A}=2\operatorname{cosec} A$$

$$=\text{RHS}$$

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Q. Prove that:

$$\sqrt{sec^2\theta + cosec^2\theta} = tan\theta + cot\theta$$

$1 + tan^2\theta = sec^2\theta$

$1 + cot^2\theta = cosec^2\theta$

$LHS = \sqrt{1 + tan^2\theta + 1 + cot^2\theta}$

$\Rightarrow \sqrt{2 + tan^2\theta + cot^2\theta}$

$\Rightarrow \sqrt{2 \times (tan\theta)\left(\frac{1}{tan\theta}\right) + tan^2\theta + cot^2\theta}$

$\Rightarrow \sqrt{tan^2\theta + cot^2\theta + 2\,tan\theta \cdot cot\theta}$

$\Rightarrow \sqrt{(tan\theta + cot\theta)^2} = tan\theta + cot\theta$

$= RHS$

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Homework

1. **Prove that:** $1 + \frac{\cot^2 A}{1+\operatorname{cosec} A} = \operatorname{cosec} A$

$\cot^2 A = \operatorname{cosec}^2 A - 1$

2. $(\operatorname{cosec} A - \cot A)^2 = \frac{1-\cos A}{1+\cos A}$

3. If $3\cot A = 4$, check whether $\frac{1-\tan^2 A}{1+\tan^2 A} = \cos^2 A - \sin^2 A$ or not.

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