

NTSE

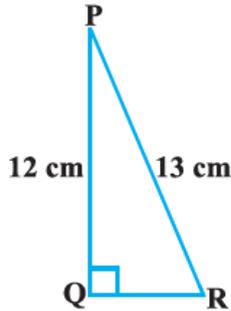
NCERT Solutions for Class 10
MATHS – Introduction To Trigonometry



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1. In Figure, find $\tan P - \cot R$.



Sol. In right angled ΔPQR ,

$$PR^2 = PQ^2 + QR^2$$

[Pythagoras Theorem]

$$\Rightarrow (13)^2 = (12)^2 + QR^2$$

$$\Rightarrow 169 - 144 = QR^2$$

$$\Rightarrow 25 = QR^2$$

$$\Rightarrow QR = 5 \text{ cm}$$

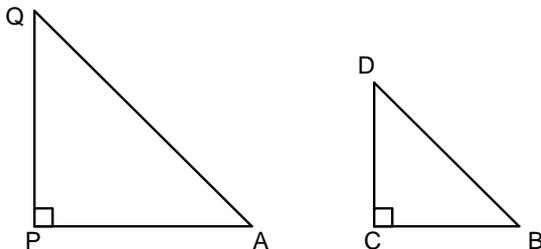
$$\tan P = \frac{QR}{PQ} = \frac{5}{12}$$

$$\cot R = \frac{QR}{PQ} = \frac{5}{12}$$

$$\text{So, } \tan P - \cot R = \frac{5}{12} - \frac{5}{12} = 0$$

2. If $\angle A$ and $\angle B$ are acute angles such that $\cos A = \cos B$, then show that $\angle A = \angle B$.

Sol. Given that $\cos A = \cos B$



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$$\Rightarrow \frac{AP}{AQ} = \frac{BC}{BD}$$

$$\Rightarrow \frac{AP}{BC} = \frac{AQ}{BD} = k \quad \dots\dots(i)$$

Let $AP = k(BC)$ and $AQ = k(BD)$

Now in ΔAPQ and ΔBCD

$$\begin{aligned} \frac{PQ}{CD} &= \frac{\sqrt{AQ^2 - AP^2}}{\sqrt{BD^2 - BC^2}} = \frac{\sqrt{(k \cdot BD)^2 - (k \cdot BC)^2}}{\sqrt{BD^2 - BC^2}} \\ &= \frac{k\sqrt{BD^2 - BC^2}}{\sqrt{BD^2 - BC^2}} = k \quad \dots\dots(ii) \end{aligned}$$

From equation (i) and (ii) we get

$$\frac{AP}{BC} = \frac{AQ}{BD} = \frac{PQ}{CD} \quad \text{So, } \Delta APQ \sim \Delta BCD$$

Hence $\angle A = \angle B$

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.

Sol. Given that : $3 \cot A = 4 \Rightarrow \cot A = \frac{4}{3}$

Let $\cot A = \frac{4k}{3k}$, where k is any non-zero real number.

In ΔABC , by Pythagoras theorem we have

$$\begin{aligned} AC^2 &= AB^2 + BC^2 \\ &= (3k)^2 + (4k)^2 \\ &= 25k^2 \\ AC &= 5k \end{aligned}$$

Therefore,

$$\frac{1 - \tan^2 A}{1 + \tan^2 A} = \frac{1 - \left(\frac{3}{4}\right)^2}{1 + \left(\frac{3}{4}\right)^2} = \frac{1 - \frac{9}{16}}{1 + \frac{9}{16}} = \frac{7}{25}$$

and

**Success
STORY**

I still wonder how one man has such a deep understanding of an examination. It becomes the truth what ever Vipin Sir says about NTSE.

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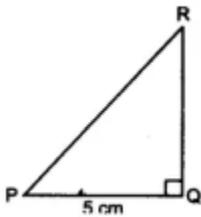


$$\cos^2 A - \sin^2 A = \left(\frac{4}{5}\right)^2 - \left(\frac{3}{5}\right)^2 = \frac{16}{25} - \frac{9}{25} = \frac{7}{25}$$

Hence, $\frac{1 - \tan^2 A}{1 + \tan^2 A} = \cos^2 A - \sin^2 A$

4. In ΔPQR , right-angled at Q, $PR + QR = 25$ cm and $PQ = 5$ cm. Determine the values of $\sin P$, $\cos P$ and $\tan P$.

Sol. In right angled ΔPQR



$$PR^2 = PQ^2 + QR^2$$

$$\Rightarrow (5)^2 = (PR + QR)(PR - QR)$$

$$\Rightarrow 25 = 25(PR + QR)(PR - QR)$$

$$\Rightarrow PR - QR = 1 \quad \dots\dots(i)$$

and $PR + QR = 25 \quad \dots\dots(ii)$

On adding equation (i) and (ii), we get

$$2PR = 26 \quad \Rightarrow \quad PR = \frac{26}{2} = 13 \text{ cm}$$

From equation (i),

$$PR - QR = 1 \quad \Rightarrow \quad QR = 13 - 1$$

$$QR = 12 \text{ cm}$$

$$\sin P = \frac{QR}{PR} = \frac{12}{13}$$

$$\cos P = \frac{PQ}{PR} = \frac{5}{13}$$

$$\tan P = \frac{QR}{PQ} = \frac{12}{5}$$

5. State whether the following are true or false. Justify your answer.

(i) The value of $\tan A$ is always less than 1.

(ii) $\sec A = \frac{12}{5}$ for some value of angle A.

(iii) $\cos A$ is the abbreviation used for the cosecant of angle A.

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(iv) $\cot A$ is the product of \cot and A .

(v) $\sec \theta = \frac{4}{3}$ for some angle θ .

- Sol.**
- (i) False, because $\tan 60^\circ = \sqrt{3} > 1$. Also if opposite side $>$ adjacent side then the value is greater than 1.
 (ii) True, because $\sec A \geq 1$. Also hypotenuse is always greater than adjacent side.
 (iii) False, because $\cos A$ abbreviation is used for cosine A .
 (iv) False, because the term $\cot A$ is single not a product. $\cot A$ is used for cotangent of angle A .
 (v) False, because $-1 \leq \sin \theta \leq 1$.

6. If $\tan 2A = \cot(A - 18^\circ)$, where $2A$ is an acute angle, find the value of A .

Sol. We have $\tan 2A = \cot(A - 18^\circ)$

$$\Rightarrow \cot(90^\circ - 2A) = \cot(A - 18^\circ) \quad [\because \cot(90^\circ - \theta) = \tan \theta]$$

$$\Rightarrow 90^\circ - 2A = A - 18^\circ$$

$$\Rightarrow 2A + A = 90^\circ + 18^\circ$$

$$\Rightarrow 3A = 108^\circ$$

$$\Rightarrow A = \frac{108}{3} = 36^\circ$$

7. If $\tan A = \cot B$, prove that $A + B = 90^\circ$.

Sol. $\tan A = \cot B$

$$\Rightarrow \tan A = \tan(90^\circ - B) \quad [\because \tan(90^\circ - \theta) = \cot \theta]$$

$$\Rightarrow A = 90^\circ - B$$

$$\Rightarrow A + B = 90^\circ$$

Proved.

8. If $\sec 4A = \operatorname{cosec}(A - 20^\circ)$, where $4A$ is an acute angle, find the value of A .

Sol. We have $\sec 4A = \operatorname{cosec}(A - 20^\circ)$

$$\Rightarrow \operatorname{cosec}(90^\circ - 4A) = \operatorname{cosec}(A - 20^\circ) \quad [\because \operatorname{cosec}(90^\circ - \theta) = \sec \theta]$$

$$\Rightarrow 90^\circ - 4A = A - 20^\circ \Rightarrow 90^\circ + 20^\circ = 5A$$

$$\Rightarrow 110^\circ = 5A$$

$$\Rightarrow \frac{110}{5} = A$$

$$\Rightarrow A = 22^\circ$$

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9. Evaluate:

- (i) $\frac{\sin^2 63^\circ + \sin^2 27^\circ}{\cos^2 17^\circ + \cos^2 73^\circ}$
 (ii) $\sin 25^\circ \cos 65^\circ + \cos 25^\circ \sin 65^\circ$

Sol. (i) $\frac{\sin^2 63^\circ + \sin^2 27^\circ}{\cos^2 17^\circ + \cos^2 73^\circ} \quad [\because \cos(90^\circ - \theta) = \sin \theta \text{ and } \sin(90^\circ - \theta) = \cos \theta]$

$$= \frac{\sin^2 63^\circ + \sin^2 (90^\circ - 63^\circ)}{\cos^2 (90^\circ - 73^\circ) + \cos^2 73^\circ}$$

$$= \frac{\sin^2 63^\circ + \cos^2 63^\circ}{\cos^2 73^\circ + \cos^2 73^\circ} = 1. \quad [\because \sin^2 \theta + \cos^2 \theta = 1]$$

(ii) $\sin 25^\circ \cos 65^\circ + \cos 25^\circ \sin 65^\circ$
 $= \sin 25^\circ \cos (90^\circ - 25^\circ) + \cos 25^\circ \sin (90^\circ - 25^\circ)$
 $= \sin^2 25^\circ + \cos^2 25^\circ = 1.$

10. Choose the correct option. Justify your choice.

- (i) $9 \sec^2 A - 9 \tan^2 A =$
 (A) 1 (B) 9 (C) 8 (D) 0
 (ii) $(1 + \tan \theta + \sec \theta)(1 + \cot \theta - \operatorname{cosec} \theta) =$
 (A) 0 (B) 1 (C) 2 (D) -1
 (iii) $(\sec A + \tan A)(1 - \sin A) =$
 (A) $\sec A$ (B) $\sin A$ (C) $\operatorname{cosec} A$ (D) $\cos A$
 (iv) $\frac{1 + \tan^2 A}{1 + \cot^2 A} =$
 (A) $\sec^2 A$ (B) -1 (C) $\cot^2 A$ (D) $\tan^2 A$

Sol. (i) $9 \sec^2 A - 9 \tan^2 A = 9(\sec^2 A - \tan^2 A) = 9 \times 1 = 9$ **Correct option is (B)**
 $[\because \sec^2 A - \tan^2 A = 1]$

(ii) $(1 + \tan \theta + \sec \theta)(1 + \cot \theta - \operatorname{cosec} \theta) = \left(\frac{1}{1} + \frac{\sin \theta}{\cos \theta} + \frac{1}{\cos \theta} \right) \left(\frac{1}{1} + \frac{\cos \theta}{\sin \theta} - \frac{1}{\sin \theta} \right)$

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

$$[\because \sin^2 \theta + \cos^2 \theta = 1]$$

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

Did you know?



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Correct Option is (C)

$$\begin{aligned} \text{(iii)} \quad (\sec A + \tan A)(1 - \sin A) &= \left(\frac{1}{\cos A} + \frac{\sin A}{\cos A} \right) \left(\frac{1 - \sin A}{1} \right) = \left(\frac{1 + \sin A}{\cos A} \right) \left(\frac{1 - \sin A}{1} \right) \\ &= \frac{(1)^2 - (\sin A)^2}{\cos A} = \frac{1 - \sin^2 A}{\cos A} = \frac{\cos^2 A}{\cos A} = \cos A \quad [\because 1 - \sin^2 A = \cos^2 A] \end{aligned}$$

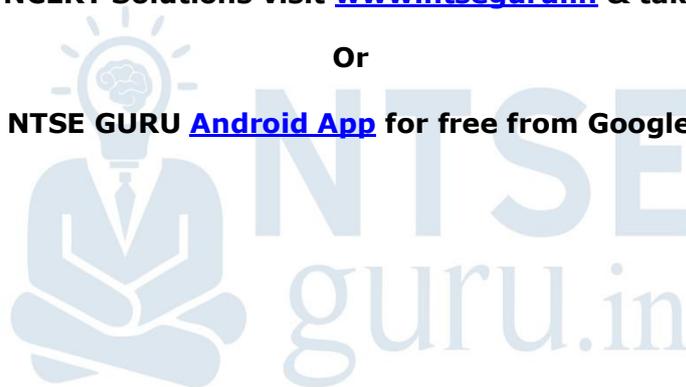
Correct option is (D)

$$\begin{aligned} \text{(iv)} \quad \frac{1 + \tan^2 A}{1 + \cot^2 A} &= \frac{\sec^2 A}{\operatorname{cosec}^2 A} = \frac{\frac{1}{\cos^2 A}}{\frac{1}{\sin^2 A}} = \frac{1}{\cos^2 A} \times \frac{\sin^2 A}{1} = \tan^2 A \\ & \quad [\because 1 + \tan^2 A = \sec^2 A \text{ and } 1 + \cot^2 A = \operatorname{cosec}^2 A] \end{aligned}$$

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