

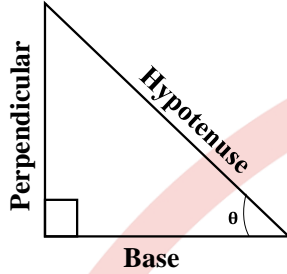
# MATH RAILWAY (JE) 16 JANUARY 2019

## BASIC OF TRIGONOMETRY

$$\sin \theta = \frac{\text{Perpendicular}}{\text{Hypotenuse}} \quad \text{cosec} \theta = \frac{\text{Hypotenuse}}{\text{Perpendicular}}$$

$$\cos \theta = \frac{\text{Base}}{\text{Hypotenuse}} \quad \text{sec} \theta = \frac{\text{Hypotenuse}}{\text{Base}}$$

$$\tan \theta = \frac{\text{Perpendicular}}{\text{Base}} \quad \text{cot} \theta = \frac{\text{Base}}{\text{Perpendicular}}$$



## Some useful Formulae

$$\sin \theta = \frac{1}{\text{cosec} \theta} \text{ or } \sin \theta \times \text{cosec} \theta = 1$$

$$\cos \theta = \frac{1}{\text{sec} \theta} \text{ or } \cos \theta \times \text{sec} \theta = 1$$

$$\tan \theta = \frac{1}{\text{cot} \theta} \text{ or } \tan \theta \times \text{cot} \theta = 1$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}; \text{cot} \theta = \frac{\cos \theta}{\sin \theta}$$

1. If  $4 \sin \theta = 3$ , then find  $\tan \theta$ .

यदि  $4 \sin \theta = 3$  है, तो  $\tan \theta$  ज्ञात कीजिये।

2. If  $x \cdot \cos \theta = y$ , then find  $\cot \theta$ .

यदि  $x \cdot \cos \theta = y$  है, तो  $\cot \theta$  ज्ञात कीजिये।

3. If  $a \cdot \tan \theta = b$ , then find  $\frac{a \sin \theta + b \cos \theta}{a \sin \theta - b \cos \theta}$ .

यदि  $a \cdot \tan \theta = b$  है, तो  $\frac{a \sin \theta + b \cos \theta}{a \sin \theta - b \cos \theta}$  ज्ञात कीजिये।

4. If  $\cot \theta = \frac{4}{3}$ , then find the value of  $\frac{1 - \cos \theta}{1 + \cos \theta}$ .

यदि  $a \cdot \tan \theta = b$  है, तो  $\frac{a \sin \theta + b \cos \theta}{a \sin \theta - b \cos \theta}$  ज्ञात कीजिये।

5. If  $\frac{\tan \theta + \cot \theta}{\tan \theta - \cot \theta} = 2, (0 < \theta < 90)$  then the value of  $\sin \theta$ .

यदि  $\frac{\tan \theta + \cot \theta}{\tan \theta - \cot \theta} = 2, (0 < \theta < 90)$ , तो  $\sin \theta$  का मान ज्ञात कीजिए।

## Value of Trigonometric ratio on specific angles

	0°	30°	45°	60°	90°
<b>sin</b>	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
<b>cos</b>	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
<b>tan</b>	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	$\infty$
<b>cosec</b>	$\infty$	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
<b>sec</b>	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	$\infty$
<b>cot</b>	$\infty$	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

6.  $\sin^2 60^\circ + \cos^2 30^\circ + \tan^2 45^\circ + \text{cosec}^2 30^\circ - \sec^2 60^\circ + \text{cot}^2 30^\circ = ?$

7. If  $x \cdot \sin 60^\circ \tan 30^\circ - \tan 45^\circ = \text{cosec} 60^\circ \text{cot} 30^\circ - \sec^2 45^\circ$ , then find the value of  $x$ .

यदि  $x \sin 60^\circ \tan 30^\circ - \tan 45^\circ = \text{cosec} 60^\circ \text{cot} 30^\circ - \sec^2 45^\circ$ , तो  $x$  का मान ज्ञात कीजिये।

8. If  $\tan(A+B) = \sqrt{3}$  and  $\cos(A-B) = \frac{\sqrt{3}}{2}$ , then value of  $\sin 2A + \tan 3B$  is-

यदि  $\tan(A+B) = \sqrt{3}$  और  $\cos(A-B) = \frac{\sqrt{3}}{2}$ , तो  $\sin 2A + \tan 3B$  है -

## Trigonometric ratio in Quadrants

$$\sin(90 - \theta) = \cos \theta$$

$$\cos(90 - \theta) = \sin \theta$$

$$\tan(90 - \theta) = \cot \theta$$

$$\text{cosec}(90 - \theta) = \sec \theta$$

$$\sec(90 - \theta) = \text{cosec} \theta \quad \text{cot}(90 - \theta) = \tan \theta$$

$$\sin(90 + \theta) = \cos \theta$$

$$\cos(90 + \theta) = -\sin \theta$$

$$\tan(90 + \theta) = -\cot \theta$$

$$\text{cosec}(90 + \theta) = \sec \theta$$

$$\sec(90 + \theta) = -\text{cosec} \theta$$

$$\text{cot}(90 + \theta) = -\tan \theta$$

$$\sin(180 - \theta) = \sin \theta$$

$$\cos(180 - \theta) = -\cos \theta$$

$$\tan(180 - \theta) = -\tan \theta$$

$$\text{cosec}(180 - \theta) = \text{cosec} \theta$$

$$\sec(180 - \theta) = -\sec \theta$$

$$\text{cot}(180 - \theta) = -\cot \theta$$

9. If  $12 \tan \theta + 5 = 0$  and  $\theta$  lies in IV quadrant, then find the value of  $10 \cos \theta - 5 \sin \theta$

यदि  $12 \tan \theta + 5 = 0$  और  $\theta$  IV चतुर्थांश में है, तो  $10 \cos \theta - 5 \sin \theta$  का मान है।

10.  $\frac{\cos(90^\circ + \theta) \cdot \sec(360^\circ - \theta) \cdot \tan(180^\circ - \theta)}{\text{cosec}(360^\circ - \theta) \cdot \sin(180^\circ + \theta) \cdot \text{cot}(90^\circ - \theta)} = ?$

11.  $\frac{\cot 30^\circ - \cot 75^\circ}{\tan 15^\circ - \tan 60^\circ} = ?$

12. If  $\sin 17^\circ = \frac{x}{y}$ , then find the value of  $\sec 17^\circ - \sin 73^\circ$

यदि  $\sin 17^\circ = \frac{x}{y}$ , तो  $\sec 17^\circ - \sin 73^\circ$  का मान ज्ञात कीजिए।

## Trigonometric Identities

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$\text{cosec}^2 \theta - \cot^2 \theta = 1$$

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

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \text{ or } \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$\text{cot}(A+B) = \frac{\text{cot} A \cdot \text{cot} B - 1}{\text{cot} A + \text{cot} B}$$

$$\text{cot}(A-B) = \frac{\text{cot} A \cdot \text{cot} B + 1}{\text{cot} B - \text{cot} A}$$

$$\tan(45^\circ + A) = \frac{1 + \tan A}{1 - \tan A} = \frac{\cos A + \sin A}{\cos A - \sin A}$$

$$\tan(45^\circ - A) = \frac{1 - \tan A}{1 + \tan A} = \frac{\cos A - \sin A}{\cos A + \sin A}$$

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

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

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

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

$$2 \sin A \sin B = \cos(A-B) - \cos(A+B)$$

$$2 \cos A \cos B = \cos(A-B) + \cos(A+B)$$

$$2 \sin A \cos B = \sin(A+B) + \sin(A-B)$$

$$2 \cos A \sin B = \sin(A+B) - \sin(A-B)$$

$$\sin^2 A - \sin^2 B = \sin(A+B) \cdot \sin(A-B)$$

$$\cos^2 A - \cos^2 B = \cos(A+B) \cdot \cos(A-B)$$

$$\sin 3A = 3 \sin A - 4 \sin^3 A$$

$$\cos 3A = 4 \cos^3 A - 3 \cos A$$

$$\tan 3A = \frac{3 \tan A - \tan^3 A}{1 - 3 \tan^2 A}$$

$$\sin C + \sin D = 2 \sin \left( \frac{C+D}{2} \right) \cdot \cos \left( \frac{C-D}{2} \right)$$

$$\sin C - \sin D = 2 \cos \left( \frac{C+D}{2} \right) \cdot \sin \left( \frac{C-D}{2} \right)$$

$$\cos C + \cos D = 2 \cos \left( \frac{C+D}{2} \right) \cdot \cos \left( \frac{C-D}{2} \right)$$

$$\cos C - \cos D = 2 \sin \left( \frac{C+D}{2} \right) \cdot \sin \left( \frac{D-C}{2} \right)$$

$$\sin q \cdot \sin 2q \cdot \sin 4q = \frac{1}{4} \sin 3q$$

$$\sin(60^\circ - q) \cdot \sin q \cdot \sin(60^\circ + q) = \frac{1}{4} \sin 3q$$

$$\cos q \cdot \cos 2q \cdot \cos 4q = \frac{1}{4} \cos 3q$$

$$\cos(60^\circ - q) \cdot \cos q \cdot \cos(60^\circ + q) = \frac{1}{4} \cos 3q$$

$$\tan q \cdot \tan 2q \cdot \tan 4q = \tan 3q$$

$$\tan(60^\circ - q) \cdot \tan q \cdot \tan(60^\circ + q) = \tan 3q$$

$$\text{If } \sin q + \operatorname{cosec} q = 2 \text{ then } \sin^n q + \operatorname{cosec}^n q = 2$$

$$\text{If } \tan q + \cot q = 2 \text{ then } \tan^n q + \cot^n q = 2$$

$$\text{If } \cos q + \sec q = 2 \text{ then } \cos^n q + \sec^n q = 2$$

If  $A + B + C = 180^\circ$  then,

$$\tan A + \tan B + \tan C = \tan A \times \tan B \times \tan C$$

If  $A + B + C = 180^\circ$  then

$$\cot A \cdot \cot B + \cot B \cdot \cot C + \cot C \cdot \cot A = 1$$

If  $A + B + C = 180^\circ$  then

$$\sin 2A + \sin 2B + \sin 2C = 4 \sin A \cdot \sin B \cdot \sin C$$



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