Sec 60°: Definition, Formula & Real-World Applications

Discover the formula, derivation, and real-world applications of Sec 60° in physics, engineering, and daily life. Learn how to solve problems step-by-step.

Introduction

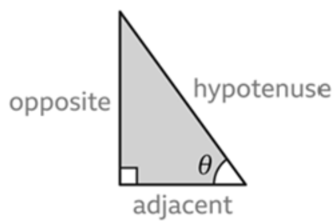
Consider a ladder making an angle of 60° with the ground and leaning against a wall. How can we find the base distance between the ladder and the wall if we know the height of the ladder. This idea, specifically secant, is important to trigonometry. Sec 60° is a basic number that is utilized in everything from engineering to physics computations.

In this article, we'll explore:

- What is Sec 60°?
- What is the value of sec 60°?
- Where is sec 60° applied in real life?

Secant

Secant, represented as Sec, is the reciprocal of the cosine function. Mathematically, for any angle θ in a right triangle:



$$Sec\ \theta = \frac{1}{\cos\theta} = \frac{Hypotenuse}{Adjacent\ side}$$

What is Sec 60°?

The value of the cos trigonometric function for an angle of 60° between the hypotenuse and the adjacent is known as Sec 60 degree. The formal notation for the secant of a sixty-degree angle is sec 60°.

Value of Sec 60°

We know that Sec 60° is the reciprocal of cos 60°. In a right-angled triangle, when the angle between the adjacent side and the hypotenuse is 60°, the measure of length of the hypotenuse is equal to twice the measure of length of the adjacent side. In such case,

$$Cos\ 60° = \frac{Adjacent\ side}{hypotenuse}$$

$$Cos\ 60° = \frac{Adjacent\ side}{2 \times Adjacent\ side}$$

$Cos\ 60° = \frac{1}{2}$

$Sec\ 60° = \frac{1}{\cos 60°} = \frac{1}{\frac{1}{2}} = 2$

Therefore, the value of Sec 60° is 2.

Value of Sec 60° in radians

We know that

θ in radians = $\frac{\pi}{180°} \times \theta$ in degrees

$= 60° \times \left(\frac{\pi}{180°}\right)$

$= \frac{1}{3} \times \pi = \frac{\pi}{3}$

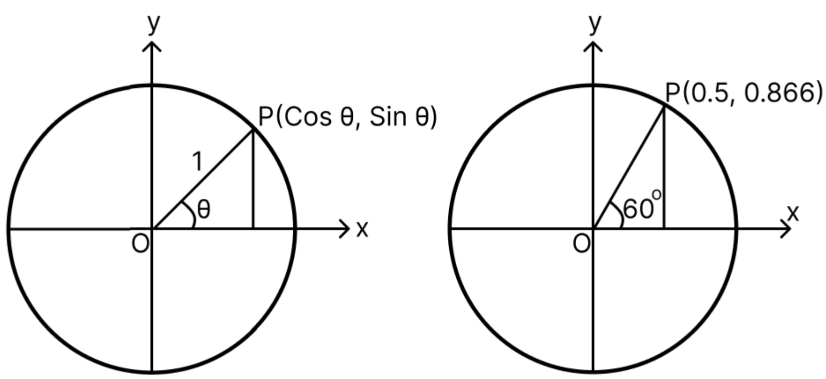
$Sec\ 60° = Sec\frac{\pi}{3} = 2$

Value of Sec 60° using a unit circle

On a unit circle, the hypotenuse is always 1 since the radius of the unit circle is 1. We know that

$Cos\ \theta = \frac{Adjacent\ side}{hypotenuse}$

Since the hypotenuse is equal to 1, cos θ = adjacent side of the right-angled triangle, i.e., x- coordinate of point P. Similarly, y-coordinate of point P will be Sin θ.



As θ approaches $60°$, y-coordinate becomes $\frac{\sqrt{3}}{2} = 0.866$ and x-coordinate, i.e., cos θ becomes $\frac{1}{2} = 0.5$. The value of $Cos\ 60° = 0.5$. Therefore, the value of $Sec\ 60° = \frac{1}{0.5} = 2$.

Value of Sec 60° using trigonometric identities

$Sec\ 60°$ can be represented using trigonometric identities as follows:

- $\text{Sec } 60° = \frac{1}{\sqrt{1-\sin^2 60°}} = 2$
- $Sec\ 60° = \frac{1}{Cos\ 60°} = \frac{1}{0.5} = 2$
- $\text{Sec } 60° = \sqrt{1 + \tan^2 60°}$
- $\text{Sec } 60° = \frac{\sqrt{\cot^2 60° + 1}}{Cot\ 60°} = 2$
- $\text{Sec } 60° = \frac{\text{cosec } 60°}{\sqrt{\text{cosec}^2\, 60° - 1}} = 2$

Examples to Make It Easy

Example 1: Find the value of $\cos 60° + \sin 60°$.

Solution: $\cos 60° + \sec 60° = \frac{1}{2} + 2 = \frac{5}{2}$

Example 2: Solve $\cos^2\ 60° + \sec^2\ 60°$.

Solution: $\cos^2 60° + \sec^2 60° = \left(\frac{1}{2}\right)^2 + (2)^2 = \frac{1}{4} + 4 = \frac{17}{4}$

Example 3: A ladder makes an angle of $60°$ with the ground and is leaning against a wall. If the length of the ladder is 5 m, find the base distance between the ladder and the wall.

Solution:

Using the cosine formula: $\text{Sec } \theta = \frac{Hypotenuse}{Adjacent\ side} = \frac{\text{length of the ladder}}{\text{Base distance}}$

$$Sec\ 60° = \frac{5}{Base\ distance}$$

$$2 = \frac{5}{Base\ distance}$$

$$Base\ Distance = \frac{5}{2} = 2.5 \text{ m}$$

Therefore, the distance between the ladder and the wall is 2.5 m.

Practice Questions

Test yourself with these problems:

1. Using the value of Sec 60°, find the value of $3 - 2\sec^2 60°$.
2. Find the value of 4Sec 0° if the value of 2sec 0° is $\frac{1}{2}$.
3. The arm of crane makes an angle of $60°$ with a beam. If the length of the arm of the crane is 8 m, find the horizontal distance between the crane's arm and the beam.

Real-Life Applications of Sec 60°:

1. **Civil engineering:** Used in analysis of forces that act on beams.
2. **Aerospace and aviation**: Used in analysis of approach angles and altitudes.
3. **Astronomy:** Used in telescope to find the angle of celestial bodies.
4. **Construction:** Used in construction of roads to establish ramps, highway slopes and angles.

Conclusion

Sec 60° is a straightforward yet effective idea with many practical uses. Knowing cosine makes computations simpler and more effective, whether you're analyzing motion, building buildings, or tackling physics difficulties. Gaining proficiency in this basic trigonometric function can be beneficial in a variety of everyday, scientific, and technical contexts.

Frequently asked questions (FAQs)

1. **What is the value of sec 60°?**
   The value of sec 60° always equals 2.

2. **Why is sec 60° equal to 2?**
   We know that $\cos 60° = \frac{1}{2}$ and sec is the reciprocal of cos. Therefore, $Sec\ \theta = \frac{1}{\cos\theta} = \frac{1}{0.5} = 2$.

3. **How is Sec 60° used in real life?**
   Sec 60° is used in everyday applications such as motion analysis, road design, aerodynamics, etc.

4. **Does the value of cos 60° change in radians?**
   No, sec 60° is equivalent to sec $\frac{\pi}{3}$ radians, and its value always remains 2.