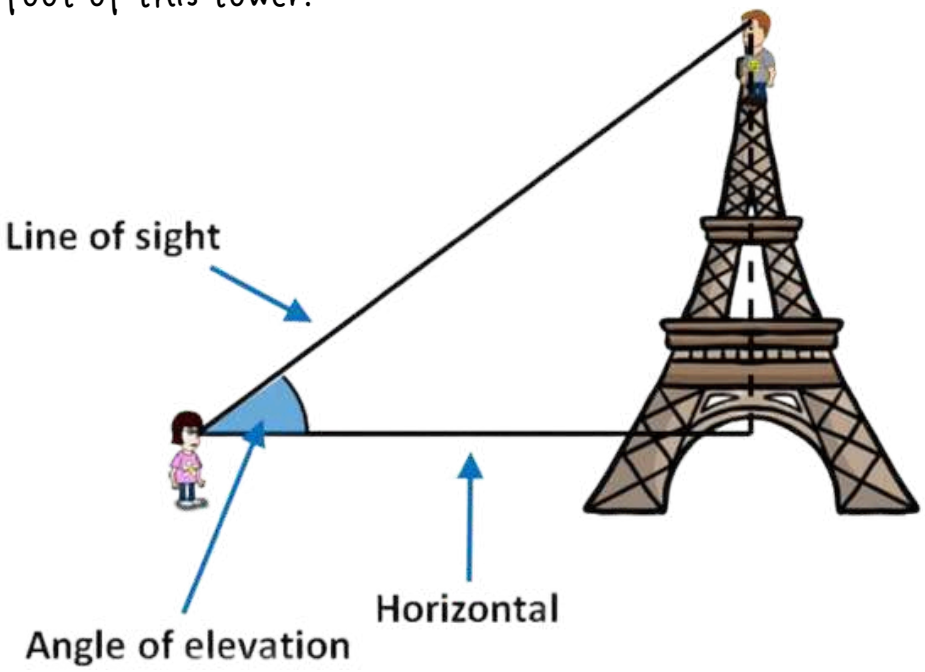
Some Applications Of Trigonometry

Heights and Distances

- In the last chapter, we learnt about six trigonometric ratios. This chapter basically talks about the application of trigonometry in real life situations.
- Trigonometry is used for finding the "Heights and Distances" of various objects, without actually measuring them.
  For this chapter, you must have studied the previous chapter and should have basic knowledge of all trigonometric ratios.

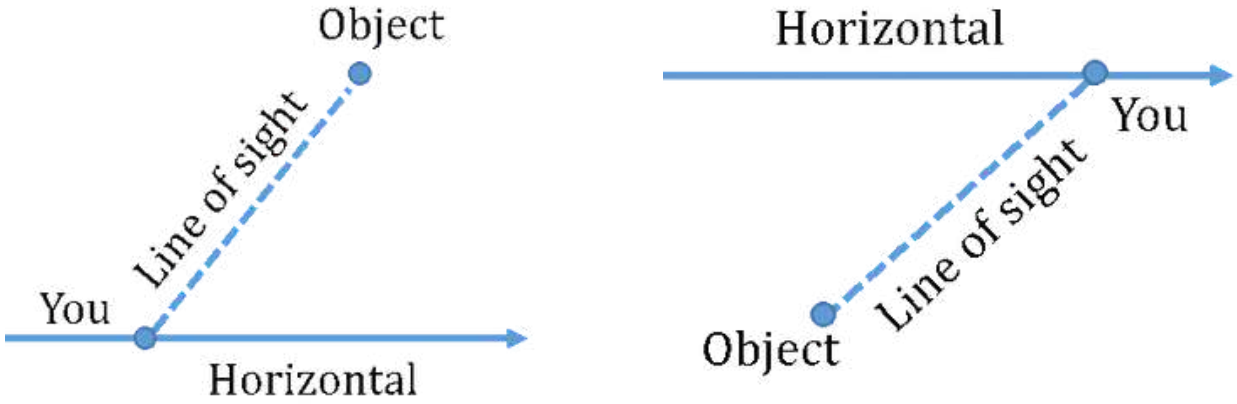
Example:

Consider, the given below diagram of a girl looking at a boy who is at the top of this tower. Now, using the concept of Trigonometry, we can easily tell the distance of this boy from the girl who is on the ground. Also, we can find the height of the tower without actually measuring it. Similarly, the distance of this girl from the foot of the tower can also be determined easily using Trigonometry.....
Besides this, the angle which is formed from the eyes of the girl standing on the ground can also be found, if we know the height of tower and the distance of girl from the foot of this tower.

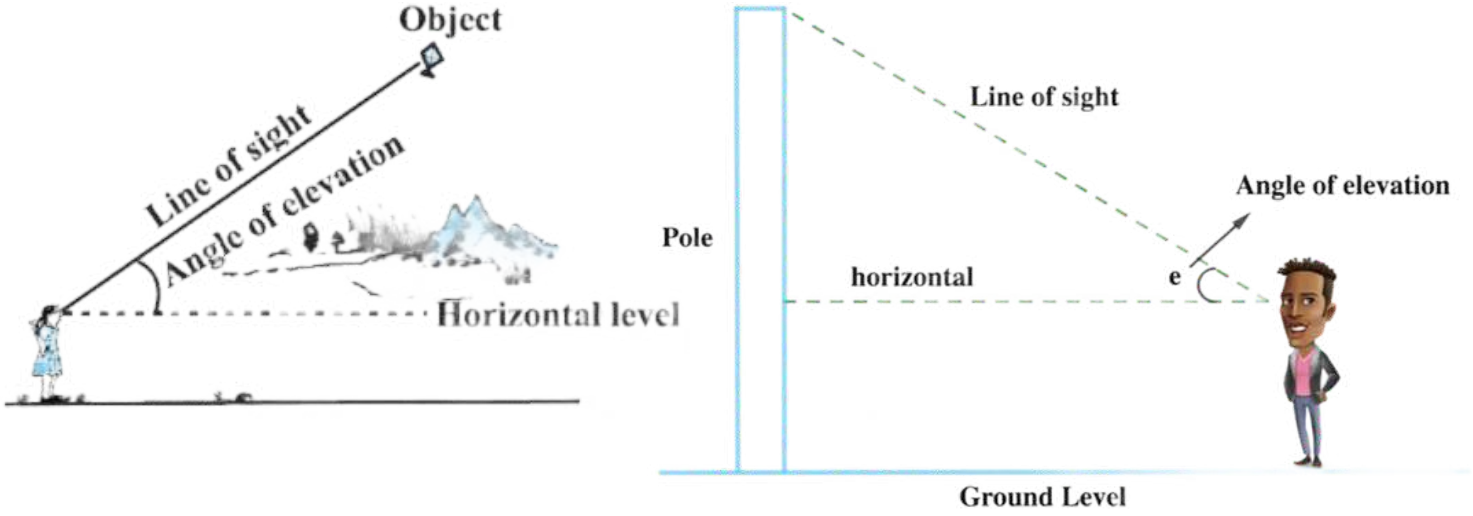


Some Basic Terms :

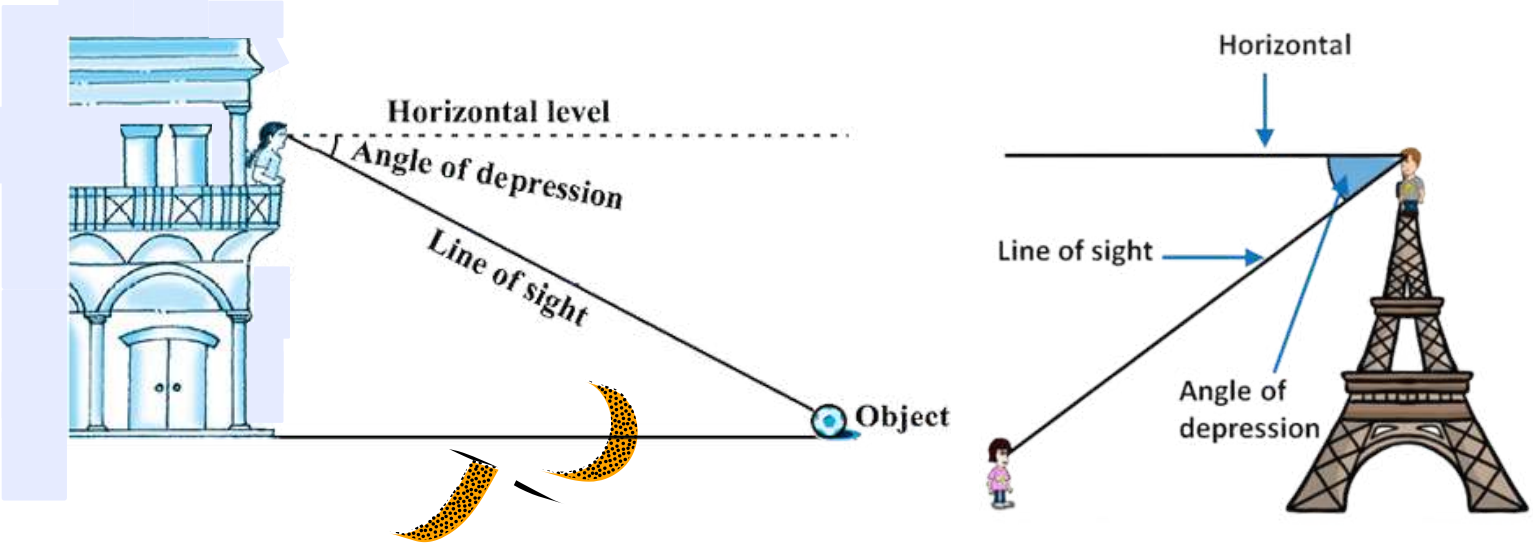
(1) Line of Sight : It is the line drawn from the eye of an observer to the point in the object viewed by the observer.



(2) Angle of Elevation : It is the angle formed by the line of sight with the horizontal level when observed from bottom to top.
(नीचे से ऊपर बनता है।)



(3) Angle of Depression : It is the angle formed by the line of sight with the horizontal level when observed from top to bottom.
(ऊपर से नीचे बनता है।)



*सुनो इस Chapter के Questions solve करने के लिए the main thing is to draw a rough Diagram while reading question. Kyuki गलती होने के chances कम हो जाते हैं।

Let's Practice :

Example: The angle of elevation of the top of a tower from a point on the ground, which is 30m away from the foot of the tower is 30°. Find the height of the tower.

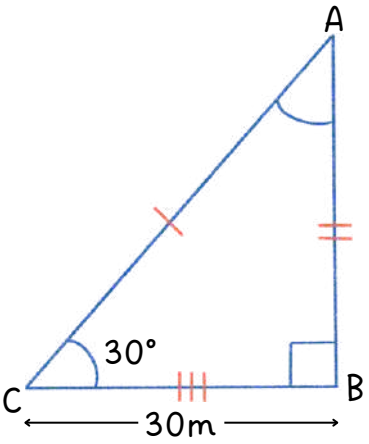
SOLUTION: Let AB be the tower of height h metres and the angle of elevation from the point C is 30°.

Now, In ΔABC, $\tan 30° = \frac{AB \rightarrow P}{BC \rightarrow B}$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{AB}{30}$$

$$\Rightarrow \quad AB = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{30\sqrt{3}}{\sqrt{3}}$$

$$\Rightarrow \quad AB = 10\sqrt{3}$$



Therefore, the height of the tower is $10\sqrt{3}$ m

Example: A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle 30° with it. The distance between the tree to that point is 8m. Find the height of the tree.

SOLUTION: Let AC was the original tree. Due to storm, it was broken into two parts. The broken part A'B is making an angle of 30° with the ground.

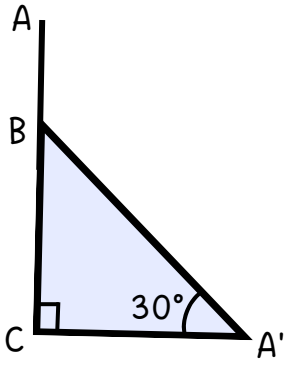
Now, In $\Delta A'BC$, we have

$$\tan 30° = \frac{BC \rightarrow P}{A'C \rightarrow B}$$

$$\frac{1}{\sqrt{3}} = \frac{BC}{8} \Rightarrow BC = \frac{8}{\sqrt{3}} m$$

Also, $$\cos 30° = \frac{A'C \rightarrow B}{A'B \rightarrow H}$$

$$\frac{\sqrt{3}}{2} = \frac{8}{A'B} \Rightarrow A'B = \frac{16}{\sqrt{3}} m$$



Height of the tree = A'B + BC

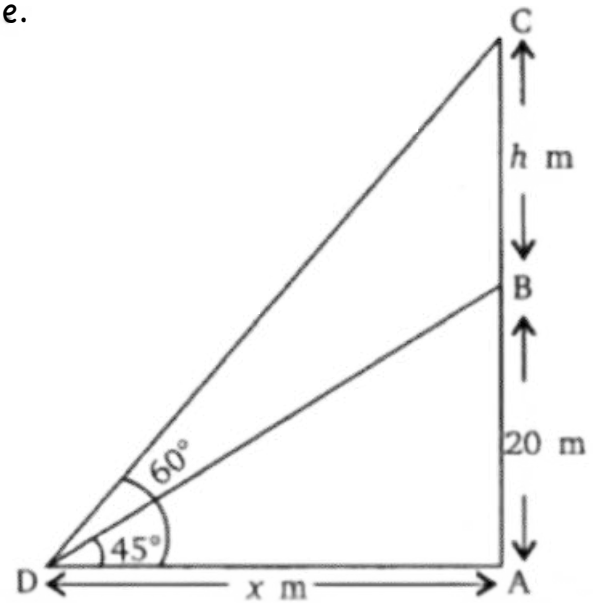
$$= \frac{16}{\sqrt{3}} + \frac{8}{\sqrt{3}} = \frac{24}{\sqrt{3}} m$$

$$= \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{24\sqrt{3}}{3} = 8\sqrt{3} m$$

Therefore, the height of the tree is $8\sqrt{3}$ m

Example: From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20m high building are 45° and 60° respectively. Find the height of the tower.

SOLUTION: Let AB be the building, BC be the tower, and D be the point on the ground where both angles are made.



Now, In ΔABD

$$\tan 45° = \frac{BC}{CD} \begin{matrix} \rightarrow P \\ \rightarrow B \end{matrix}$$

$$1 = \frac{20}{CD} \Rightarrow CD = 20m$$

Also, In ΔACD

$$\tan 60° = \frac{AC}{CD}$$

$$\Rightarrow \sqrt{3} = \frac{AB + BC}{CD}$$

$$\Rightarrow \sqrt{3} = \frac{AB + 20}{20}$$

$$\Rightarrow 20\sqrt{3} = AB + 20$$

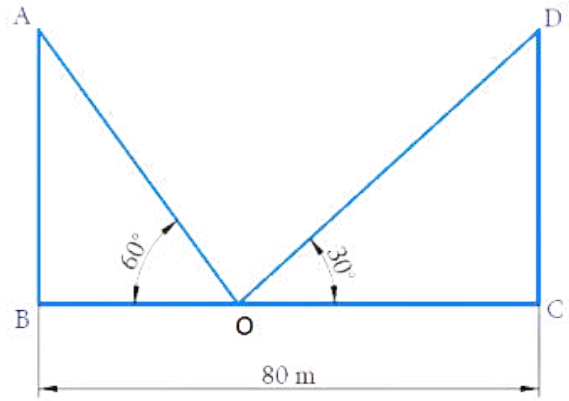
$$\Rightarrow AB = 20\sqrt{3} - 20$$

$$\Rightarrow AB = 20(\sqrt{3} - 1)m$$

Therefore, the height of the transmission tower is $20(\sqrt{3} - 1)m$.

Ques: Two poles of equal heights are standing opposite each other on either side of the road, which is 80 m wide. From a point between them on the road, the angles of elevation of the top of the poles are 60° and 30°, respectively. Find the height of the poles and the distances of the point from the poles

Solution:



Let the height of the poles be x

Therefore AB = DC = x

In ΔAOB,

tan 60° = AB/BO

$\sqrt{3}$ = x / BO

BO = x / $\sqrt{3}$ ....(i)

In ΔOCD,

tan 30° = DC / OC

1/$\sqrt{3}$ = x / (BC - OB)

1/$\sqrt{3}$ = x / (80 - x/$\sqrt{3}$) [from (i)]

80 - x/$\sqrt{3}$ = $\sqrt{3}$x

x/$\sqrt{3}$ + $\sqrt{3}$x = 80

x (1/$\sqrt{3}$ + $\sqrt{3}$) = 80

x (1 + 3) / $\sqrt{3}$ = 80

x (4/$\sqrt{3}$) = 80

x = 80$\sqrt{3}$ / 4

x = 20$\sqrt{3}$

Height of the poles x = 20$\sqrt{3}$ m.

Distance of the point O from the pole AB

BO = x/$\sqrt{3}$

= 20$\sqrt{3}$/$\sqrt{3}$

= 20

Distance of the point O from the pole CD

OC = BC - BO

= 80 - 20

= 60

The height of the poles is 20$\sqrt{3}$ m and the distance of the point from the poles is 20 m and 60 m.