TENDER HEART HIGH SCHOOL, SECTOR-33 B, CHD.

Ms. Reena

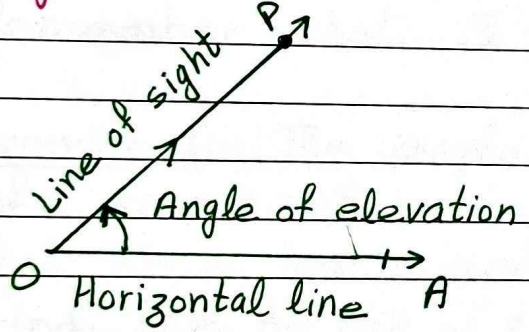
Class 10, Mathematics **Date: 7.10.2024**

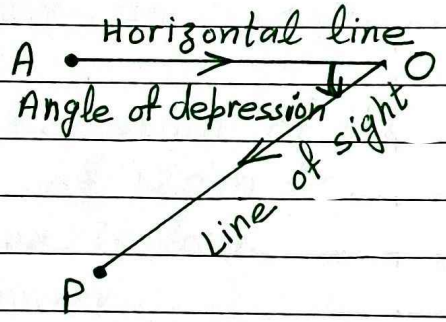
Chapter — Heights and Distances

Introduction :-

→ In this chapter, we will learn the practical use of trigonometry in our day-to-day life. We will see how trigonometry is used for finding the height and distances of various objects i.e. mountain (pillar or minar), breadth of a river, etc., which are otherwise very difficult to measure.

Angle of elevation and angle of depression





Line of sight :-

When the eye of a person at a point O looks at an object P, then the line OP is called the line of sight.

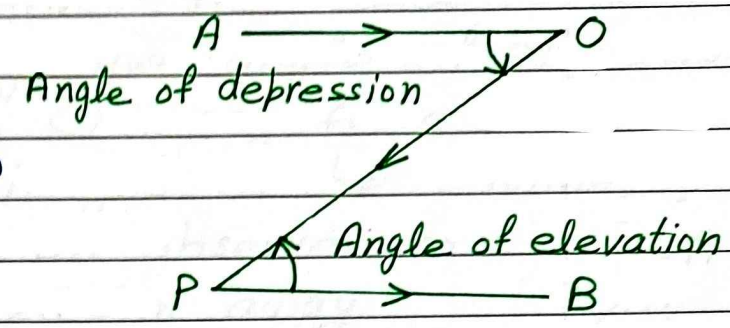
Angle of Elevation :-

Suppose a man from a point 'O', looks up at an object P, placed above the level of his eye. Then, ∠POA is called the angle of elevation at P as seen from O.

Angle of Depression :-

Suppose a man from a point 'O', looks down at an object P, placed below the level of his eye. Then, ∠AOP is the angle of depression of P as seen from O.

→ Angle of depression of P as seen from O = Angle of elevation of O as seen from P



⇒ $\angle AOP = \angle BPO$

Note:- In problems on heights and distances, usually, we find

$\frac{\text{required side}}{\text{known side}}$ = a certain t-ratio of a known angle.

Remember that $\sqrt{2} = 1.414$ and $\sqrt{3} = 1.732$

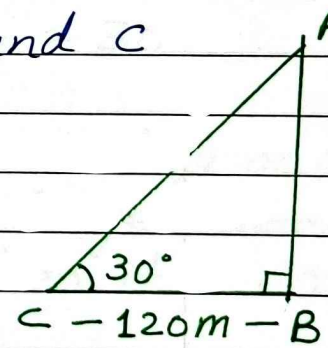
Example 1:- The angle of elevation of the top of a tower at a distance of 120m from its foot on a horizontal plane is found to be 30°. Find the height of the tower.

Solution:- Let AB be the tower and C be the point of observation.

∴ BC = 120m

Since, angle of elevation is 30°

∴ $\angle ACB = 30°$



In ΔABC, $\frac{AB}{BC} = \frac{\text{Perp.}}{\text{Base}} = \tan\theta$

⇒ $\frac{AB}{120} = \tan 30°$

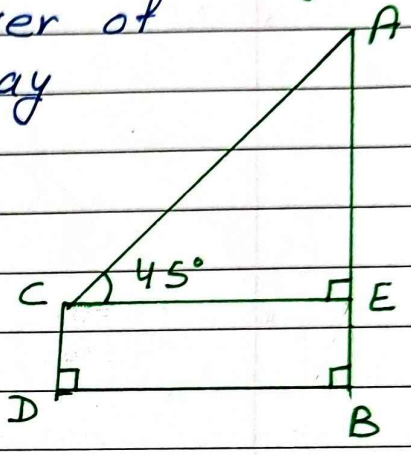
⇒ $AB = 120 \times \frac{1}{\sqrt{3}} = \frac{120}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{120\sqrt{3}}{3} = 40\sqrt{3}$

$= 40 \times 1.732 = 69.28\,m$

Example 2:- An observer 1.5m tall is 28.5m away from a chimney. The angle of elevation of the top of the chimney from his eye is 45°. What is the height of the chimney?

Solution:- Let CD be an observer of height 1.5m which is 28.5 m away from a chimney AB of height h metres



$CD = 1.5m$ and $DB = 28.5m$

From C, draw $CE \perp AB$, then CDBE is a rectangle.

$AE = AB - BE = AB - CD = h - 1.5$

and $CE = DB = 28.5m$

Given, angle of elevation $\angle ACE = 45°$

From right angled $\triangle ACE$, we get

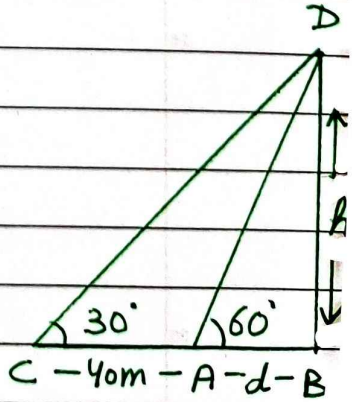
$$\tan 45° = \frac{AE}{CE} \Rightarrow 1 = \frac{h - 1.5}{28.5}$$

$\Rightarrow h - 1.5 = 28.5 \Rightarrow h = 30$

Hence, the height of the chimney = 30m

Example 3:- The shadow of a tower standing on a level ground is found to be 40m longer when the sun's altitude is 30° than when it is 60°. Find the height of the tower.

Solution:- Let the height of the tower BD be h metres and the length of its shadow be 'd' metres when the sun's altitude i.e. elevation is 60°.



When the sun's altitude is 30°, then the length of shadow of the tower is 40m longer.

i.e. BD = h metres, AB = d metres and CA = 40 metres.

From right angled ΔABD, we get

$$\tan 60^\circ = \frac{h}{d} \Rightarrow h = \sqrt{3}d \quad \text{---- (i)}$$

From right angled ΔBCD, we get

$$\tan 30^\circ = \frac{h}{40+d} \Rightarrow \frac{1}{\sqrt{3}} = \frac{\sqrt{3}d}{40+d} \quad \text{[using (i)]}$$

$$\Rightarrow 3d = 40+d \Rightarrow 2d = 40$$

$$\Rightarrow d = 20$$

From (i), $h = 20\sqrt{3} = 20 \times 1.732 = 34.64$

Hence, the height of the tower is 34.64 m

Angle of inclination	Angle of elevation	Angle of depression
Formed between the vertical or horizontal as defined by the situation.	Formed by looking up from the horizontal	Formed by looking down from the horizontal.
The angle of inclination with the vertical is 42°.	The angle of elevation is 36°.	The angle of depression is 23°.