

## CHAPTER-9

### HEIGHTS & DISTANCES

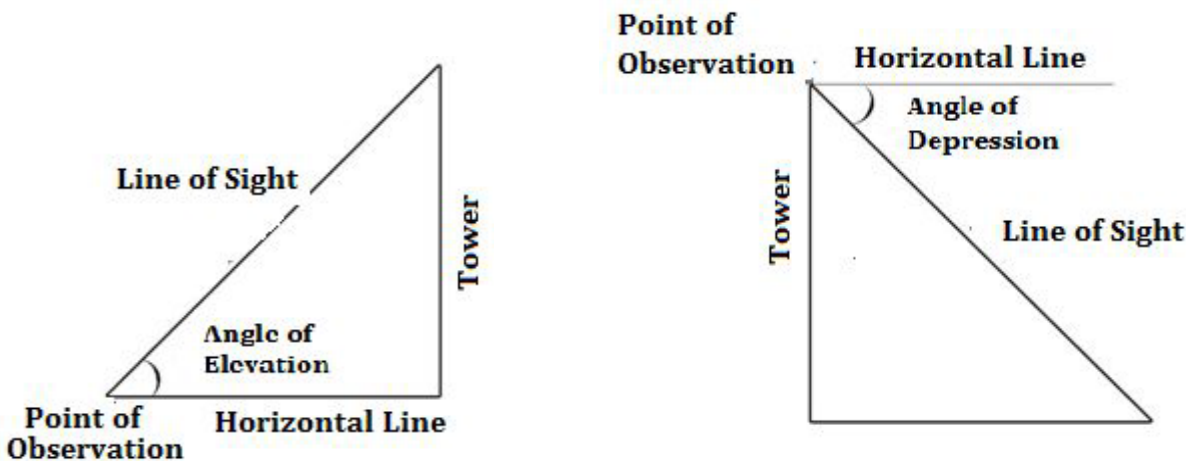
#### DAY 1

#### INTRODUCTION

Sometimes we are required to find the height of a lower building tree, width of a river etc. through we cannot measure them easily, we can determine them by using knowledge of trigonometric ratios.

Suppose we wish to determine the height of a tree without actually measuring it we could stand on the ground at a point P at some distance, say 18m, from the foot Q of the tree suppose  $\angle QPR = 30^\circ$  then we can find the height QR of the tree by using trigonometric ratios. Before we proceed to solve problems of the above type, first we have to define a few terms.

- **Point of Observation:** The point from where any object is observed.
- **Line of sight:-** Suppose we are viewing an object standing on the ground. Then the line of sight to the object is the line from Point of observation (our eyes) to the object.
- **Horizontal Line:-** The line parallel to ground from point of observation.
- **Angle of Elevation:-** If the object is above the horizontal level of the eyes, we have to turn our head upwards to view the object. In this process, an angle made by the eyes is called the angle of elevation of the object from our eyes.
- **Angle of Depression:-** If the object is below the horizontal level of the eyes. We have to turn our head downwards to view the object. In this process an angle made by the eyes is called the angle of depression of the object from our eyes.



#### Remarks:-

- Numerically angle of elevation is equal to the angle of depression.
- The angle of elevation and the angle of depression both are measured with the horizontal line.

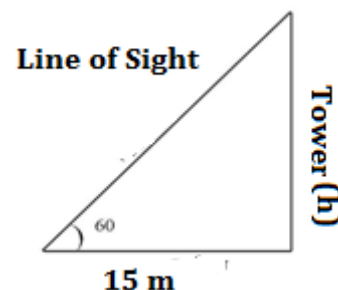
1. A tower stands vertically on the ground. From a point on the ground, which is 15m away from the foot of the tower, the angle of elevation of the top of the tower is found to be  $60^\circ$ . Find the height of the tower. [Example 1]

**Sol :-** Let  $h$  be the height of the tower.

In given Right triangle,

$$\frac{P}{B} = \tan 60^\circ$$

$$\Rightarrow \frac{h}{15} = \sqrt{3} \quad \Rightarrow h = 15\sqrt{3} \text{ m}$$



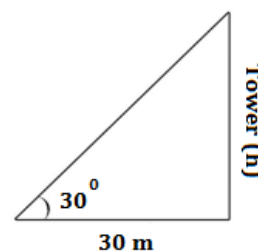
2. The angle of elevation of the top of a tower from a point on the ground, which is 30m away from the foot of the tower is  $30^\circ$ . Find the height of the tower. [Ex 9.1, Q4]

**Sol:-** Let  $h$  be the height of the tower.

In given Right triangle,

$$\frac{P}{B} = \tan 30^\circ$$

$$\Rightarrow \frac{h}{30} = \frac{1}{\sqrt{3}} \quad \Rightarrow h = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{30\sqrt{3}}{3} = 10\sqrt{3} \text{ m}$$



3. An observer 1.5m tall is 28.5m away from a chimney. The angle of elevation of the top of the chimney from her eyes is  $45^\circ$ . What is the height of the chimney? [Example 4]

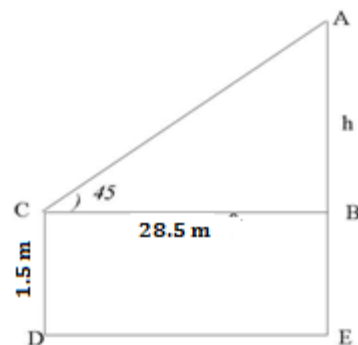
**Sol:-** Let  $AB = h$  and  $AE = h + 1.5$  be the height of the chimney.

In given Right  $\triangle ABC$ ,

$$\frac{P}{B} = \tan 45^\circ$$

$$\Rightarrow \frac{h}{28.5} = 1 \quad \Rightarrow h = 28.5$$

$\therefore$  Height of the chimney  $AE = h + 1.5 = 28.5 + 1.5 = 30 \text{ m}$



### EXERCISE

- Ex 9.1, Q 1,2,4,5
- The angle of elevation of the top of a tower from a point on the ground, which is 50m away from the foot of the tower is  $60^\circ$ . Find the height of the tower.