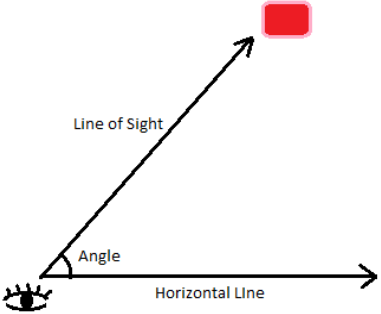
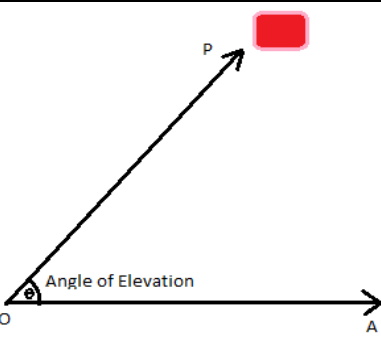
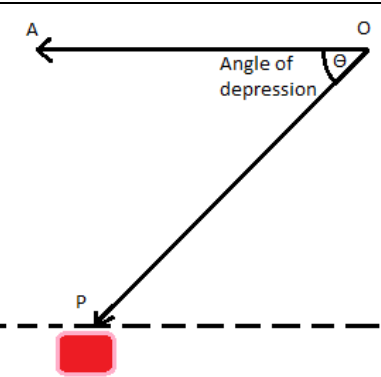


## SOME APPLICATIONS OF TRIGONOMETRY

### HEIGHT AND DISTANCES

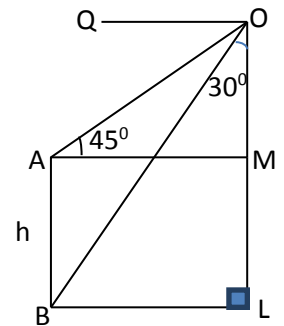
#### KEY POINTS

<p><b>Line of sight</b> Line segment joining the object to the eye of the observer is called the line of sight.</p>	 <p>The diagram shows an eye icon on the left. A horizontal arrow points to the right, labeled "Horizontal Line". A diagonal arrow points upwards and to the right, labeled "Line of Sight". A red square representing an object is at the tip of the "Line of Sight" arrow. The angle between the "Horizontal Line" and the "Line of Sight" is labeled "Angle".</p>
<p><b>Angle of elevation</b> When an observer sees an object situated in upward direction, the angle formed by line of sight with horizontal line is called angle of elevation.</p>	 <p>The diagram shows a point O at the bottom left. A horizontal arrow points to the right, ending at point A, labeled "Angle of Elevation". A diagonal arrow points upwards and to the right, ending at point P, labeled "Line of Sight". A red square representing an object is at point P. The angle at O between the horizontal line OA and the line of sight OP is labeled "Angle of Elevation".</p>
<p><b>Angle of depression</b> When an observer sees an object situated in downward direction the angle formed by line of sight with horizontal line is called angle of depression.</p>	 <p>The diagram shows a point O at the top right. A horizontal arrow points to the left, ending at point A, labeled "Angle of depression". A diagonal arrow points downwards and to the left, ending at point P, labeled "Line of Sight". A red square representing an object is at point P. A dashed horizontal line extends from point P to the left. The angle at O between the horizontal line OA and the line of sight OP is labeled "Angle of depression".</p>

## LEVEL- I

1. A pole 6m high casts a shadow  $2\sqrt{3}$ m long on the ground, then find the sun's elevation?
2. If length of the shadow and height of a tower are in the ratio 1:1. Then find the angle of elevation.
3. An observer 1.5m tall is 20.5 metres away from a tower 22m high. Determine the angle of elevation of the top of the tower from the eye of the observer.
4. A ladder 15m long just reaches the top of vertical wall. If the ladder makes an angle  $60^\circ$  with the wall, find the height of the wall
5. In a rectangle ABCD,  $AB = 20\text{cm}$   $\angle BAC = 60^\circ$  then find the length of the side AD.
6. Find the angle of elevation of the sun's altitude when the height of the shadow of a vertical pole is equal to its height:
7. From a point 20m away from the foot of a tower, the angle of elevation of top of the tower is  $30^\circ$ , find the height of the tower.
8. In the adjacent figure, what are the angles of elevation and depression of the top and bottom of a pole from the top of a tower h m high:

Ans  $45^\circ, 60^\circ$



## LEVEL -II

9. The length of the shadow of a pillar is  $\sqrt{3}$  times its height. Find the angle of elevation of the source of light.
10. A vertical pole 10m long casts a shadow  $10\sqrt{3}$ m long. At the same time tower casts a shadow 90m long. Determine the height of the tower.
11. A ladder 50m long just reaches the top of a vertical wall. If the ladder makes an angle of  $60^\circ$  with the wall, find the height of the wall.
12. Two poles of height 6m and 11m stands vertically on the ground. If the distance between their feet is 12m. Find the distance between their tops.
13. The shadow of tower, when the angle of elevation of the sun is  $45^\circ$  is found to be 10m longer than when it is  $60^\circ$ . Find the height of the tower.

### LEVEL –III

14. The angle of depression of the top and bottom of a tower as seen from the top of a 100m high cliff are  $30^\circ$  and  $60^\circ$  respectively. Find the height of the tower.
15. From a window (9m above ground) of a house in a street, the angles of elevation and depression of the top and foot of another house on the opposite side of the street are  $30^\circ$  and  $60^\circ$  respectively. Find the height of the opposite house and width of the street.
16. From the top of a hill, the angle of depression of two consecutive kilometer stones due east are found to be  $30^\circ$  and  $45^\circ$ . Find the height of the hill.
17. Two poles of equal heights are standing opposite each other on either side of the road, which is 80m wide. From a point between them on the road the angles of elevation of the top of the poles are  $60^\circ$  and  $30^\circ$ . Find the heights of pole and the distance of the point from the poles.
18. The angle of elevation of a jet fighter from a point A on the ground is  $60^\circ$ . After a flight of 15 seconds, the angle of elevation changes to  $30^\circ$ . If the jet is flying at a speed of 720km/ hr, find the constant height at which the jet is flying.
19. A window in a building is at a height of 10m above the ground. The angle of depression of a point P on the ground from the window is  $30^\circ$ . The angle of elevation of the top of the building from the point P is  $60^\circ$ . Find the height of the building.
20. A boy, whose eye level is 1.3m from the ground, spots a balloon moving with the wind in a horizontal line at same height from the ground. The angle of elevation of the balloon from the eyes of the boy at any instant is  $60^\circ$ . After 2 seconds, the angle of elevation reduces to  $30^\circ$  if the speed of the wind at that moment is  $29\sqrt{3}$  m/s, then find the height of the balloon from the ground.
21. A man on the deck on a ship 14m above water level observes that the angle of elevation of the top of a cliff is  $60^\circ$  and the angle of depression of the base of the cliff is  $30^\circ$ . Calculate the distance of the cliff from the ship and the height of the cliff.
22. A tower is 50m high. It's shadow is x m shorter when the sun's altitude is  $45^\circ$  than when it is  $30^\circ$ . Find x correct to the nearest 10.

## SELF EVALUATION/HOTS

23. An airplane when flying at a height of 3125m from the ground passes vertically below another Plane at an instant when the angle of elevation of the two planes from the same point on the ground are  $30^\circ$  and  $60^\circ$  respectively. Find the distance between the two planes at that instant.
24. From the top of a building 60m high, the angles of depression of the top and bottom of a vertical lamp post are observed to be  $30^\circ$  and  $60^\circ$  respectively. Find [i] horizontal distance between the building and the lamp post [ii] height of the lamp post.
25. A vertical tower stands on a horizontal plane and is surmounted by a vertical flag staff of height  $h$  m. At a point on the plane, the angles of elevation of the bottom and the top of the flag staff are  $\alpha$  and  $\beta$ , respectively. Prove that the height of the tower is  $\frac{h \tan \alpha}{\tan \beta - \tan \alpha}$
26. The angle of elevation of a cloud from a point 60m above a lake is  $30^\circ$  and the angle of depression of the reflection of the cloud in the lake is  $60^\circ$ . Find the height of the cloud from the surface of the lake.
27. A round balloon of radius  $r$  subtends an angle  $\alpha$  at the eye of the observer whose angle of elevation of centre is  $\beta$ . Prove that the height of the Centre of the balloon is  $(r \sin \beta \cdot \operatorname{Cosec} \frac{\alpha}{2})$
28. A person standing on the bank of a river observes that the angle of elevation of top of building of an organization working for conservation of wild life. Standing on the opposite bank is  $60^\circ$ . When he moves 40m away from the bank, he finds the angle of elevation to be  $30^\circ$ . Find the height of the building and width of the river.
- (a) Why do we need to conserve the wild life?  
(b) Suggest some steps that can be taken to conserve wild life.

## Activities

- a. To make mathematical instrument eliminator ( or Sextant) for measuring the angle of elevation and depression of an object
- b. To Calculate the height of an object making use of Clinometer ( or Sextant)