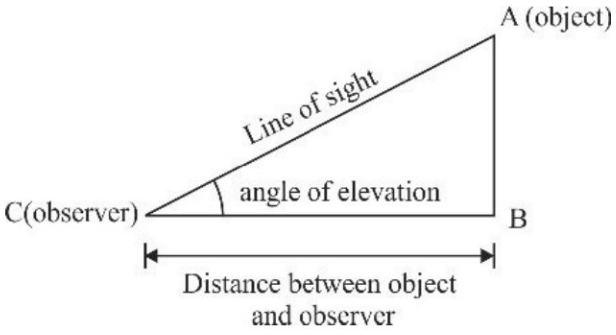
CHAPTER

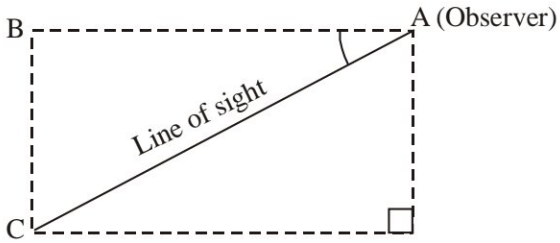
9 Some Applications of Trigonometry

KEY POINTS

- **Angle of Elevation:** Let AB be height of object. C is the observer looking upto to A (the top of AB). AC is called the line of sight and ∠ACB is angle of elevation.



- **Angle of Depression :** Let A is the observer looking at C (the object) from a height BC. AC is line of sight and ∠BAC is angle of depression.



- If the observer moves towards the object the angle of elevation increases and if the observer moves away from the object, the angle of elevation decreases.
- Numerically, angle of elevation is equal to angle of depression (both are measured with the same horizontal parallel planes).

VERY SHORT ANSWER TYPE QUESTIONS

1. The length of the shadow of a tower on the plane ground is $\sqrt{3}$ times the height of the tower. The angle of elevation of sun is :

(a) 45° (b) 30° (c) 60° (d) 90°

2. The tops of the poles of height 16 m and 10 m are connected by a wire of length l metres. If the wire makes an angle of 30° with the horizontal, then l =

(*a*) 26 m (b) 16 m (c) 12 m (d) 10 m

3. A pole of height 6 m casts a shadow $2\sqrt{3}$ m long on the ground. the angle of elevation of the sun is (CBSE 2017)

(a) 30° (b) 60° (c) 45° (d) 90°

4. A ladder leaning aginast a wall makes an angle of 60° with the horizontal. If the foot of the ladder is 2.5 m away from the wall, then the length of the ladder is —

(CBSE 2016)

(a) 3 m (b) 4 m (c) 5 m (d) 6 m

5. If a tower is 30 m high, casts a shadow $10\sqrt{3}$ m long on the ground, then the angle of elevation of the sun is: (CBSE, 2017)

(a) 30° (b) 45° (c) 60° (d) 90°

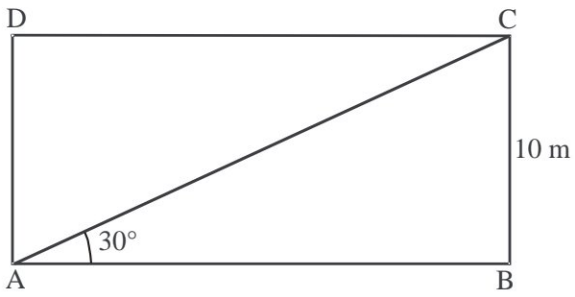
6. A tower is 50 m high. When the sun's altitude is 45° then what will be the length of its shadow?

7. The length of shadow of a pole 50 m high is $\frac{50}{\sqrt{3}}$ m. find the sun's altitude.

8. Find the angle of elevation of a point which is at a distance of 30 m from the base of a tower $10\sqrt{3}$ m high.

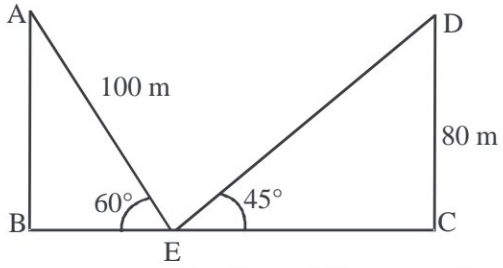
9. A kite is flying at a height of $50\sqrt{3}$ m from the horizontal. It is attached with a string and makes an angle 60° with the horizontal. Find the length of the string.

10. In the given figure find the perimeter of rectangle ABCD.

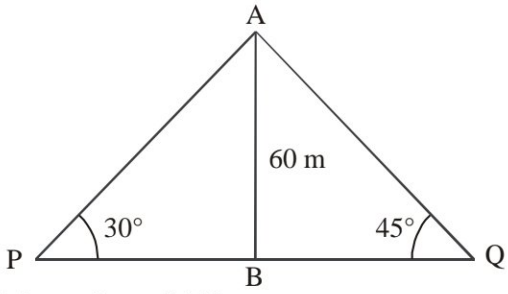


SHORT ANSWER TYPE QUESTIONS

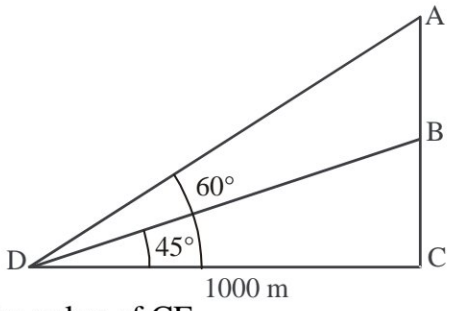
11. In the figure, find the value of BC.



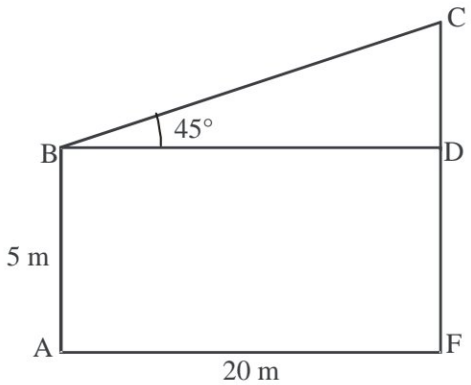
12. In the figure, two persons are standing at the opposite direction P & Q of the tower. If the height of the tower is 60 m then find the distance between the two persons.



13. In the figure, find the value of AB.



14. In the figure, find the value of CF.



15. If the horizontal distance of the boat from the bridge is 25 m and the height of the bridge is 25 m, then find the angle of depression of the boat from the bridge.

16. The string of a kite is 150 m long and it makes an angle 60° with the horizontal. Find the height of the kite above the ground. (Assume string to be tight)

17. The shadow of a vertical tower on level ground increases by 10 m when the altitude of the sun changes from 45° to 30°. Find the height of the tower.

(Use $\sqrt{3} = 1.73$)

18. An aeroplane at an altitude of 200 m observes angles of depression of opposite points on the two banks of the river to be 45° and 60°, find the width of the river. (Use $\sqrt{3} = 1.732$)

19. The angle of elevation of a tower at a point is 45°. After going 40 m towards the foot of the tower, the angle of elevation of the tower becomes 60°. Find the height of the tower. (Use $\sqrt{3} = 1.732$)

20. The upper part of a tree broken over by the wind makes an angle of 30° with the ground and the distance of the foot of the tree from the point where the top touches the ground is 25 m. What was the total height of the tree?

21. A vertical flagstaff stands on a horizontal plane. From a point 100 m from its foot, the angle of elevation of its top is found to be 45°. Find the height of the flagstaff.

22. The length of a string between kite and a point on the ground is 90 m. If the string makes an angle α with the level ground and $\sin\alpha = \frac{3}{5}$. Find the height of the kite. There is no slack in the string.

23. An aeroplane, flying 3000 m high, passes vertically above another plane at an instant when the angle of elevation of two aeroplanes from the same point on the ground are 60° and 45° respectively. Find the vertical distance between the two planes. (Use $\sqrt{3} = 1.732$)

24. A 7 m long flagstaff is fixed on the top of a tower on the horizontal plane. From a point on the ground, the angle of elevation of the top and the bottom of the flagstaff are 45° and 30° respectively. Find the height of the tower.

(Use $\sqrt{3} = 1.732$)

25. Anand is watching a circus artist climbing a 20m long rope which is tightly stretched and tied from the top of vertical pole to the ground. Find the height of the pole if the angle made by the rope with the ground level is 30°.

LONG ANSWER TYPE QUESTIONS

26. A man standing on the deck of a ship, 10 m above the water level observes the angle of elevation of the top of a hill as 60° and angle of depression of the bottom of the hill as 30°. Find the distance of the hill from the ship and height of the hill.

27. From a window 60 m high above the ground of a house in a street, the angle of elevation and depression of the top and the foot of another house on the opposite side of the street are 60° and 45° respectively. Show that the height of opposite house is $60(1+\sqrt{3})$ metres.

28. The angle of elevation of an aeroplane from a point A on the ground is 60°. After a flight of 30 seconds, the angle of elevation changes to 30°. If the plane is flying at a constant height of $3600\sqrt{3}$ m, find the speed in km/hour of the plane.

29. A bird is sitting on the top of a tree, which is 80 m high. The angle of elevation of the bird, from a point on the ground is 45°. The bird flies away from the point of observation horizontally and remains at a constant height. After 2 seconds, the angle of elevation of the bird from the point of observation becomes 30°. Find the speed of flying of the bird. (Use $\sqrt{3} = 1.732$)

30. The shadow of a tower standing on a level ground is found to be 30 m longer when the sun altitude is 30° longer when the sun altitude is 30° than when it is 60°. Find the height of the tower.

31. The angle of elevation of the top of a building from the foot of a tower is 30°. The angle of elevation of the top of the tower from the foot of the building is 60°. If the tower is 60 m high, find the height of the building. **(CBSE 2020)**

32. An observer from the top of a light house, 100 m high above sea level, observes the angle of depression of a ship, sailing directly towards him, changes from 30° to 60°. Determine the distance travelled by the ship during the period of observation. (Use $\sqrt{3} = 1.732$)

33. The angles of elevation and depression of the top and bottom of a light house from the top of a 60 m high building are 30° and 60° respectively. Find

(i) The difference between the height of the light house and the building.

(ii) distance between the light house and the building.

34. A fire in a building 'B' is reported on telephone in two fire stations P an Q, 20 km apart from each other on a straight road. P observes that the fire is at an angle of 60° to the road, and Q observes, that it is at an angle of 45° to the road. Which station should send its team to start the work at the earliest and how much distance will this team has to travel?

35. The angle of elevation of the cloud from a point 10 m above a lake is 30° and the angle of depression of the reflection of the cloud in the lake is 60°. Find the height of the cloud from the surface of lake. **(CBSE 2020)**

36. Two pillars of equal heights stand on either side of a roadway 150 m wide. From a point on the roadway between the pillars, the angles of elevation of the top of the pillars are 60° and 30°. Find the height of pillars and the position of the point. **(CBSE, 2011)**

37. The angle of elevation of the top of tower from certain point is 30°. If the observer moves 20 m towards the tower the angle of elevation of the top increases by 15°. Find the height of the tower.

38. A moving boat is observed from the top of a 150 m high cliff moving away form the cliff. The angle of depression of the boat changes form 60° to 45° in 2 minutes. Find the speed of the boat in m/h. (Take $\sqrt{3} = 1.732$)

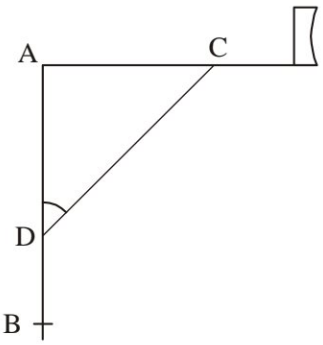
39. From the top of a 120 m high tower a man observes two cars on the opposite sides of the tower and in straight line with the base of tower with angles of depression as 60° and 45°. Find the distance between the cars.

(Use $\sqrt{3} = 1.732$)

40. A vertical tower of height 20 m stands on a horizontal plane and is surmounted by a vertical flag-staff of height h. At a point on the plane, the angle of elevation of the bottom and top of the flag staff are 45° and 60° respectively. Find the value of h.

(CBSE 2020)

41. The rod AC of a TV disc antenna is fixed at right angles to the wall AB and a rod CD is supporting the disc as shown in the figure. If AC = 1.5 m long and CD = 3 m, find (*i*) $\tan\theta$ (*ii*) $\sec\theta + \text{cosec}\,\theta$. **(CBSE 2020)**



42. At a point on level ground, the angle of elevation of a vertical tower is found to be α such that $\tan\alpha = \frac{1}{3}$. After walking 200 m towards the tower, then angle of elevation β becomes such that $\tan\beta = \frac{3}{4}$, find the height of the tower.

43. A vertically straight tree, 20m high, is broken by the wind in such a way that its top just touches the ground and makes an angle of 60° with the ground. At what height from the ground did the tree break?

44. If the angle of elevations of a cloud from a point *h* meters above a lake be 30° and the angle of depression of its reflection in the lake be 60°. Prove that the height of cloud is 2h, also find the distance of observer from cloud.

45. The angles of elevation of the top of a tower of height h meter from two points P and Q at a distance of x m and y m from the base of the tower respectively and in the same straight line with it, are 60° and 30°, respectively prove that height of tower be $\sqrt{xy}\ m$.

46. Two poles of heights 18 m and 30 m stand vertically on the ground. The tops of two poles are connected by a wire, which is inclined to the horizontal at an angle of 60°. Find the length of wire and the distance between the poles.

47. The angles of depression of the top and bottom of a 10 m tall pole from the top of a transimission tower are 45° and 60° respectively. Find the height of the transmission tower and the distance between the pole and tower.

(Use $\sqrt{3} = 1.732$)

48. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making and angle of 30° with it. The height of the breaking point from the ground is 10 m. Find the total height of the tree.

ANSWERS AND HINTS

1. (b)
2. (c)
3. (b)
4. (c)
5. (c)
6. 50 m
7. 60°
8. 30°
9. 100 m
10. $20\left(\sqrt{3}+1\right)$ m
11. 130 m
12. $60\left(\sqrt{3}+1\right)$ m
13. $1000\left(\sqrt{3}-1\right)$m
14. 25 m
15. 45°
16. $75\sqrt{3}m$
17. 13.65 m
18. 315.46 m
19. 94.64 m
20. $25\sqrt{3}$ m
21. 100 m
22. 54 m
23. 1268 m
24. 9.562 m
25. 10 m
26. $10\sqrt{3}$ m, 40 m
28. 864 km/hr
29. 29.28 m/s
30. $15\sqrt{3}$ m
31. 20 m
32. 115.46 m
33. 20 m, $20\sqrt{3}$ m
34. Station P, 7.4 km (approx)
35. 20 m
36. height = 64.95 m, distance (Position) = 37.5m from the pillar having angle of elevation 60°