

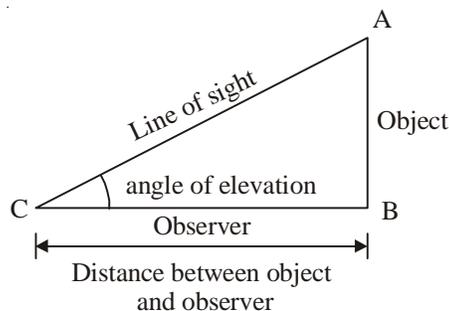
CHAPTER

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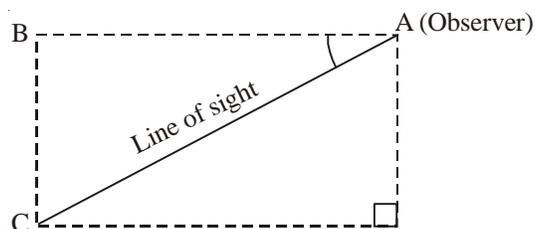
Some Applications of Trigonometry

KEY POINTS

- Applications of trigonometry involve finding heights of the objects and distance between them. Without actual measurement.
- **Angle of Elevation:** Let AB be an object standing vertically on a plane CB. C is the observer looking upto to A (the top of AB). AC is called the line of sight and $\angle ACB$ is angle is elevations.



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

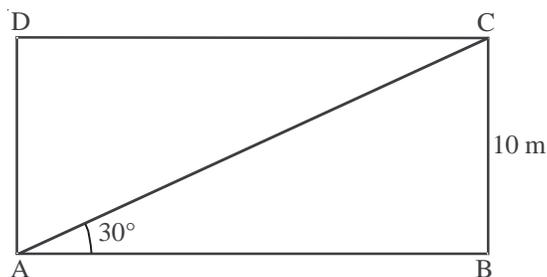


- If the observer moves towards the object the angle of elevation increases and if the observer moves away from the object, the angle of depression decreases.
- Numerically, angle of elevation is equal to angle of depression (both are measured with the same horizontal parallel planes).

VERY SHORT ANSWER TYPE QUESTIONS

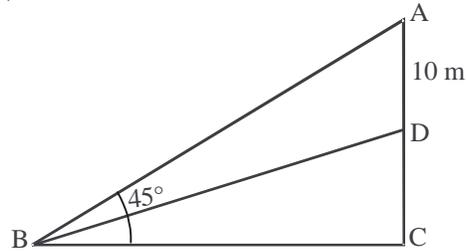
1. The length of the shadow of a tower on the plane ground is $\sqrt{3}$ times the height of the tower. The angle of elevation of sun is : (CBSE 2017)
 (a) 45° (b) 30° (c) 60° (d) 90°

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, the $l =$
 (a) 26 m (b) 16 m (c) 12 cm (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 against 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.



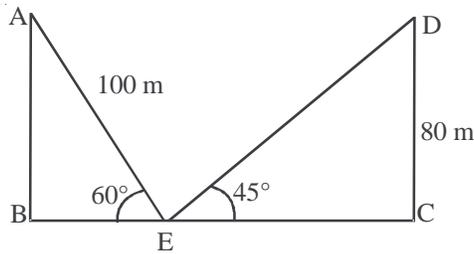
11. The length of the shadow of a pillar is $\sqrt{3}$ times its height. Find the angle of elevation of the source of light.

12. In the figure, find the value of DC.

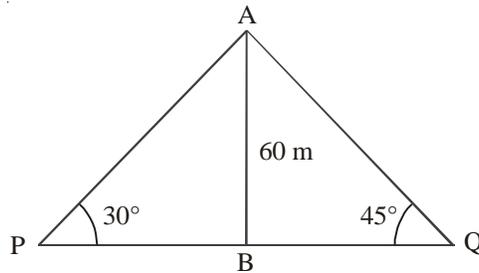


SHORT ANSWER TYPE QUESTIONS

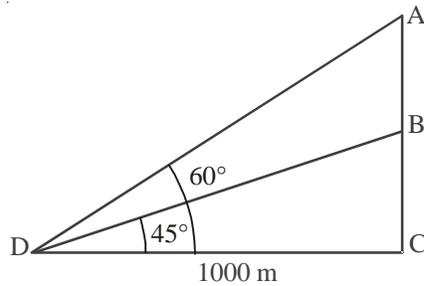
13. In the figure, find the value of BC.



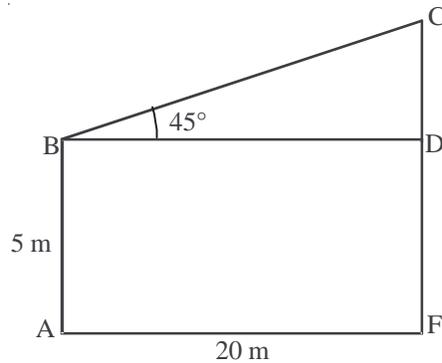
14. In the figure, two persons are standing at the opposite direction P & Q of the tower. If the height of the tower is 60 m then find the distance between the two persons.



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



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



17. 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.
18. State True/False.
If the length of the shadow of a tower is increasing, then the angle of elevation of the sun is also increasing.
19. If a man standing on the deck of a ship 3 m above the surface of sea observes a cloud and its reflection in the sea, then the angle of elevation of the cloud is equal to the angle of depression of its reflection.
20. The angle of elevation of the top of the tower is 30° . If the height of the tower is doubled, then the angle of elevation of its will also bed doubled.
21. From the top of a hill, the angles of depression of two consecutive stones due east are found to be at 30° and 45° . Find the height of the hill.
22. 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)
23. 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.
24. 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.
25. 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.

26. The upper part of a tree broken over by the wind makes an angle of 30° with the ground and the distance of the root from the point where the top touches the ground is 25 m. What was the total height of the tree?
27. 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.
28. The length of a string between kite and a point on the ground is 90 m. If the string makes an angle with the level ground and $\sin \alpha = \frac{3}{5}$. Find the height of the kite. There is no slack in the string.
29. An aeroplane, when 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.
30. 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.
31. From the top of a 7 m high building, the angle of elevation of the top of the tower is 60° and the angle of depression of the foot of the tower is 30° . Find the height of the tower.
32. 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

33. The angle of elevation of a cloud from a point 60 metres above a lake is 30° and the angle of depression of its reflection of the cloud in the lake is 60° . Find the height of the cloud.
34. 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 the bottom of a hill as 30° . Find the distance of the hill from the ship and height of the hill.
35. 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.

36. 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.
37. 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.
38. The angles of elevation of the top of a tower from two points on the ground at distances 9 m and 4 m from the base of the tower are in the same straight line with it are complementary. Find the height of the tower.
39. A boy standing on a horizontal plane finds a bird flying at a distance of 100 m from him at an elevation of 30° . A girl, standing on the roof of 20 m high building, finds the angle of elevation of the same bird to be 45° . Both the boy and girl are on the opposite sides of the bird. Find the distance of bird from the girl.
40. 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.
41. The angles of elevation and depression of the top and bottom of a light house from the top of a building 60 m high are 30° and 60° respectively. Find
- The difference between the height of the light house and the building.
 - distance between the light house and the building.
42. A fire in a building 'B' is reported on telephone in two fire stations P and 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?
43. A 1.2m tall girl spots a balloon on the eve of Independence Day, moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the of the girl at an instant is 60° . After some time, the angle of elevation reduces to 30° . Find the distance travelled by the balloon.

44. The angle of elevation of the cloud from a point 60 m above take is 30° and the angle of depression of the reflection of the cloud in the take is 60° . Find the height of the cloud. (CBSE, 2011 C)
45. The pillars of equal heights stand on either side of a roadway 150 m wide From a joinj 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)
46. 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.
47. A moving boat is observed from the top of a 150 m high diff 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/w. (CBSE 2017)
48. From the top of a 120 m hight 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. (CBSE, 2017)
49. From the top of a tower h metre high, the angles of depression of two objects, which are in the line with the foot of the tower are α & β ($\beta > \alpha$). Find the distance between the two objects. (NCERT, Exemplar)
50. A window of a house is h metres above the ground. From the window the angles of elevation and depression of the top and bottom of another house situated on the opposite side of the lane are found to be α & β respectively. Prove that the height of the house is $h(1 + \tan \alpha \times \tan \beta)$ metres.

(NCERT Exemplar)

ANSWERS AND HINTS

- | | |
|---------------|---------------|
| 1. (b) | 2. (c) |
| 3. (b) | 4. (c) |
| 5. (c) | 6. 50 m |
| 7. 60° | 8. 30° |

- | | |
|---|-------------------------------------|
| 9. 100 m | 10. $20(\sqrt{3}+1)$ m |
| 11. 30° | 12. 60 m |
| 13. 130 m | 14. $60(\sqrt{3}+1)$ m |
| 15. $1000(\sqrt{3}-1)$ m | 16. 25 m |
| 17. 45 | 18. False |
| 19. False | 20. False |
| 21. 1.37 km. | 22. $75\sqrt{3}$ m |
| 23. 13.65 m | 24. 315.8 m |
| 25. 94.8 m | 26. 43.3 m |
| 27. 100 m | 28. 120 m |
| 29. 1268 m | 30. 9.6 m |
| 31. 28 m | 32. 10 m |
| 33. 120 m | 34. 40 m, 17.32 m |
| 36. 864 km/hour | 37. 29.28 m |
| 38. 6 m | 39. $30\sqrt{2}$ m |
| 40. 115.5 m | 41. 20 m, 34.64 m |
| 42. Station P, 14.64 km | 43. $58\sqrt{3}m$ |
| 44. 120 m | |
| 45. height = 64.95 m, distance (Position) = 112.5 m | |
| 46. $10(\sqrt{3}+1)$ m | 47. 1902 m/h |
| 48. 189.28 m | 49. $h(\cot \alpha - \cot \beta)$ m |

PRACTICE-TEST

Heights and Distances

Time : 1 Hr.

M.M.: 20

SECTION-A

1. A pole which is 6 m high cast a shadow $2\sqrt{3}$ on the ground. What is the sun's angle of elevation. 1
2. The height of a tower is 100 m. When the angle of elevation of sun is 30° , then what is the shadow of tower? 1
3. The angle of elevation of the sun, when the shadow of a pole h meters high is $\sqrt{3} h$ is.
(a) 30° (b) 45° (c) 60° (d) 90°
4. An observer 1.5 metre tall is 20.5 metre away from a tower 22 metres high. The angle of elevation of the top of the tower from the eye of the observer is,
(a) 30° (b) 45° (c) 60° (d) 0° 1

SECTION-B

5. From a point on the ground 20 m away from the foot of a tower the angle of elevation is 60° . What is the height of tower? 2
6. The ratio of height and shadow of a tower is $1 : \frac{1}{\sqrt{3}}$. What is the angle of elevation of the sun? 2
7. The angle of elevation of the top of a tower is 30° . If the height of the tower is tripled, then prove that the angle of elevation would be doubled. 2

SECTION-C

8. The tops of the two towers of height x and y standing on level ground, subtend angles of 30° and 60° respectively at the centre of the line joining their feet, then find $x : y$. 3
9. The angle of elevation of the top of a rock from the top and foot of a 100 m high tower are 30° and 45° respectively. Find the height of the rock. 3

SECTION-D

- 10 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 base of the hill as 30° . Find the distance of the hill from the ship and height of the hill. 4

Mathematics-X

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