CHAPTER 4

# SOME APPLICATIONS OF TRIGONOMETRY

## KEY POINTS

1. **Line of Sight :** The line of sight is the line drawn from the eyes of an observer to a point in the object viewed by the observer.

2. **Angle of Elevation :** The angle of elevation is the angle formed by the line of sight with the horizontal, when it is above the horizontal level *i.e.* the case when we raise our head to look at the object.

3. **Angle of Depression :** The angle of depression is the angle formed by the line of sight with the horizontal when it is below the horizontal *i.e.* case when we lower our head to look at the object.

## MULTIPLE CHOICE QUESTIONS

1. The length of the shadow of a man is equal to the height of man. The angle of elevation is

   (a) 90° (b) 60°

   (c) 45° (d) 30°

2. The length of the shadow of a pole 30*m* high at some instant is $10\sqrt{3}$ m. The angle of elevation of the sun is

   (a) 30° (b) 60°

   (c) 45° (d) 90°

3. Find the angle of depression of a boat from the bridge at a horizontal distance of 25m from the bridge, if the height of the bridge is 25m.

(a) 45° (b) 60°

(c) 30° (d) 15°

4. The tops of two poles of height 10m and 18m are connected with wire. If wire makes an angle of 30° with horizontal, then length of wire is

(a) 10m (b) 18m

(c) 12m (d) 16m

5. From a point 20m away from the foot of the tower, the angle of elevation of the top of the tower is 30°. The height of the tower is

(a) $20\sqrt{3}\ m$ (b) $\frac{20}{\sqrt{3}}m$

(c) $40\sqrt{3}\ m$ (d) $\frac{40}{\sqrt{3}}m$

6. The ratio of the length of a tree and its shadow is $1 : \frac{1}{\sqrt{3}}$. The angle of elevation of the sun is

(a) 30° (b) 45°

(c) 60° (d) 90°

7. A kite is flying at a height of $50\sqrt{3}\ m$ above the level ground, attached to string inclined at 60° to the horizontal, the length of string is

(a) 100 m (b) 50 m

(c) 150 m (d) 75 m

8. In given fig. 2 the perimeter of rectangle *ABCD* is

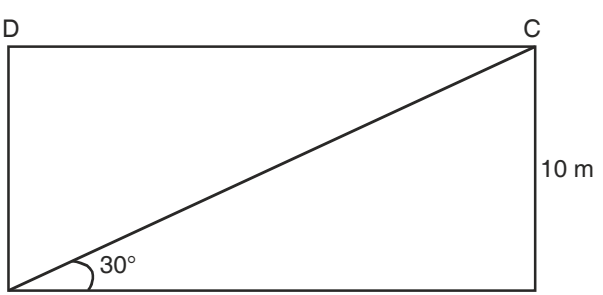


Fig. 2

(a) 40 m (b) $20\left(\sqrt{3}+1\right)$ m

(c) 60 m (d) $10\left(\sqrt{3}+1\right)$ m

9. A tree is broken at a height of 10 m above the ground. The broken part touches the ground and makes an angle of 30° with the horizontal. The height of the tree is

(a) 30 m (b) 20 m

(c) 10 m (d) 15 m

10. In the shadow of a tree is $\frac{1}{\sqrt{3}}$ times the height of the tree, then find the angle of elevation of the sun.

(a) 30° (b) 45°

(c) 60° (d) 90°

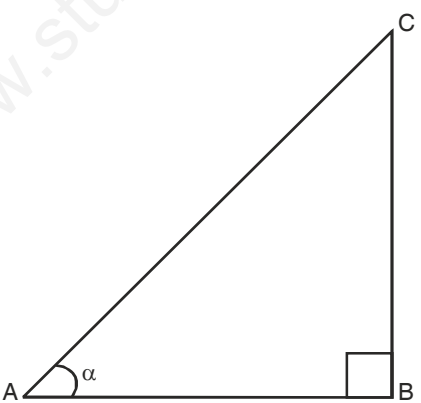


**Fig. 3**

11. In given fig. 4 *D* is mid point of *BC*, $\angle CAB = \alpha_1$ and $\angle DAB = \beta_2$ then tan $\alpha_1$ : tan $\beta_2$ is equal to

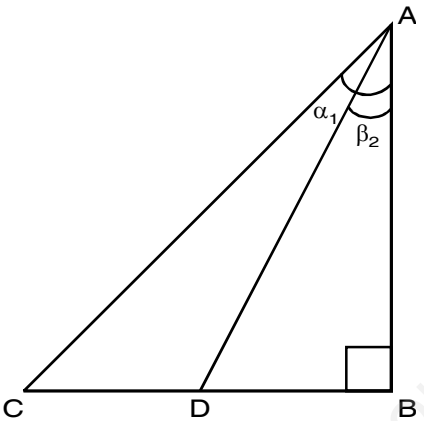


**Fig. 4**

(a) 2 : 1 (b) 1 : 2

(c) 1 : 1 (d) 1 : 3

12. In given fig. 5, $\tan\theta = \frac{8}{15}$ if *PQ* = 16 m, then the length of *PR* is

(a) 16 m (b) 34 m

(c) 32 m (d) 30 m

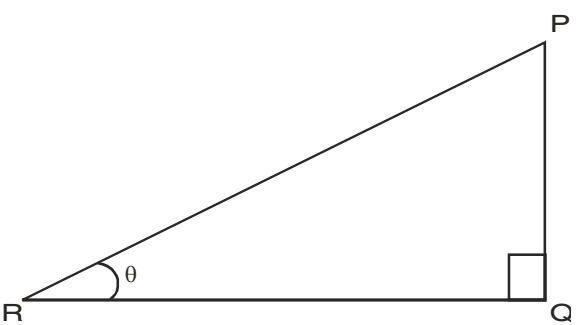


**Fig. 5**

13. The height of a tower is 50 m. When angle of elevation changes from 45° to 30°, the shadow of tower becomes $x$ metres more, the value of $x$ is

(a) 50 m (b) $50\left(\sqrt{3}-1\right)$ m

(c) $50\sqrt{3}$ m (d) $\frac{50}{\sqrt{3}}$ m

14. The angle of elevations of a building from two points on he ground 9m and 16m away from the foot of the building are complementary, the height of the building is

(a) 18 m (b) 16 m

(c) 10 m (d) 12 m

## LONG ANSWER TYPE QUESTIONS

15. A pole of height 5m is fixed on the top of the tower. The angle of elevation of the top of the pole as observed from a point $A$ on the ground is 60° and the angle of depression of the point $A$ from the top of the tower is 45°. Find the height of tower. $\left(\text{Take } \sqrt{3} = 1.732\right)$

16. From a point on the ground the angle of elevations of the bottom and top of a water tank kept on the top of the 30m high building are 45° and 60° respectively. Find the height of the water tank.

17. The shadow of a tower standing on the level ground is found to be 60m shorter when the sun's altitude changes from 30° to 60°, find the height of tower.

18. The angle of elevation of a cloud from a point $\lambda$ metres above a lake is $\alpha$ and the angle of depression of its reflection in the lake is $\beta$, prove that the distance of the cloud from the point of observation is $\frac{2\lambda \sec\alpha}{\tan\beta - \tan\alpha}$.

19. The angle of elevation of a bird from a point on the ground is 60°, after 50 seconds flight the angle of elevation changes to 30°. If the bird is flying at the height of $500\sqrt{3}$ m. Find the speed of the bird.

20. The angle of elevation of a jet fighter plane from a point $A$ on the ground is 60°. After a flight of 15 seconds, the angle of elevation changes to 30°.

If the jet is flying at a speed of 720 km/h. Find the constant height at which the jet is flying. $\left(\text{Take } \sqrt{3} = 1.732\right)$.

21. From a window 20m high above the ground in a street, the angle of elevation and depression of the top and the foot of another house opposite side of the street are 60° and 45° respectively. Find the height of opposite house.

22. An aeroplane flying at a height of 1800m observes angles of depressions of two points on the opposite bank of the river to be 60° and 45°, find the width of the river.

23. The angle of elevation of the top of the tower from two points *A* and *B* which are 15m apart, on the same side of the tower on the level ground are 30° and 60° respectively. Find the height of the tower and distance of point *B* from he base of the tower. $\left(\text{Take } \sqrt{3} = 1.732\right)$

24. The angle of elevation of the top of a 10m high building from a point *P* on the ground is 30°. A flag is hoisted at the top of the building and the angle of elevation of the top of the flag staff from *P* is 45°. Find the length of the flag staff and the distance of the building from point *P.*

25. The angle of elevation of a bird from a point 12 metres above a lake is 30° and the angle of depression of its reflection in the lake is 60°. Find the distance of the bird from the point of observation.

26. The shadow of a vertical tower on level ground increases by 10 mtrs. When sun's attitude changes from 45° to 30°. Find the height of the tower, upto one place of decimal $\left(\sqrt{3} = 1.73\right)$.

27. A man on a cliff observes a boat at an angle of depression of 30°, which is approaching the shore to point '*A*' immediately beneath the observer with a uniform speed, 12 minutes later, the angle of depression of the boat is found to be 60°. Find the time taken by the boat to reach the shore.

28. A man standing on the deck of a ship, 18m above the water level observes that the angle of elevation and depression of the top and the bottom of a cliff are 60° and 30° respectively. Find the distance of the cliff from the ship and height of the cliff.

29. A person standing on the bank of a river observes that the angle of elevation of the top of a tree standing on the opposite bank is 60°. When

he moves 40m away from the bank he finds the angle of elevation to be 30°. Find the height of the tree and the width of the river.

30. An aeroplane, when 300 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.

31. The angle of depression of the top and bottom of a 10m tall building from the top of a tower are 30° and 45° respectively. Find the height of the tower and distance between building and tower.

32. A boy standing on a horizontal plane, finds a bird flying at a distance of 100m from him at an elevation of 30°. A girl, standing on the root of 20m 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.

33. A man standing on the deck of a ship, which is 10m above the water level observes the angle of elevation of the top of the hill as 60° and the angle of depression of the base of the hill is 30°. Calculate the distance of the hill from the ship and the height of the hill.

34. The angle of elevation of a building from two points *P* and *Q* on the level ground on the same side of the building are 36° and 54° respectively. If the distance of the points *P* and *Q* from the base of the building are 10m and 20m respectively, find the height of the building. $\left(\text{Take } \sqrt{2} = 1.414\right)$

## ANSWERS

1. *c*
2. *b*
3. *a*
4. *d*
5. *b*
6. *c*
7. *a*
8. *b*
9. *a*
10. *c*
11. *a*
12. *b*
13. *b*
14. *d*

15. 6.83 m

16. $30\left(\sqrt{3}-1\right)$ m

17. $30\sqrt{3}$ m

19. 20 m/sec.

20. 2598 m

21. $20\left(\sqrt{3}+1\right)$ m

22. $600\left(3+\sqrt{3}\right)$ m

23. Height = 12.97 m, distance = 7.5 m

24. Length of flag staff = $10\left(\sqrt{2}-1\right)$ m, Distance of the building = $10\sqrt{3}$ m.

25. $24\sqrt{3}$ m

26. 13.6 mts.

27. 18 minutes

28. $18\sqrt{3}$ m, 72 m

29. Height = 34.64 m, Width of the river = 20 m.

30. $1000\left(3-\sqrt{3}\right)$ m

31. Height = $5\left(3+\sqrt{3}\right)$ m, distance = $5\left(3+\sqrt{3}\right)$ m

32. 30 m

33. Distance = $10\sqrt{3}m$, Height of the hill = 40 m

34. 14.14 m