CBSE CLASS X

Mathematics Standard (041)

QUESTION PAPER

From previous CBSE Board Exam questions

Code: JADN12	Questions: 50	Maximum Marks: 167	Generated: 2026-06-15 13:05

SELECTIONS USED

Source	Previous-year board
Subject	Mathematics
Lessons	Some Applications of Trigonometry
Year	2022-2026
Questions selected	50

Composition — Types: 18 Long · 11 Case-based · 11 MCQ · 5 Short · 4 Very short · 1 Assertion–reason

Q1. § 9.1 Heights and Distances **[4]**

> Kite festival is celebrated in many countries at different times of the year. In India, every year 14th January is celebrated as International Kite Day. On this day many people visit India and participate in the festival by flying various kinds of kites. The picture given below, shows three kites flying together. In Fig. 5, the angles of elevation of two kites (Points A and B) from the hands of a man (Point C) are found to be 30° and 60° respectively. Taking AD = 50 m and BE = 60 m.

Case Study - 1 : Kite Festival. In Fig. 5, the angles of elevation of two kites (Points A and B) from the hands of a man (Point C) are found to be 30° and 60° respectively. Taking AD = 50 m and BE = 60 m, find:

(1) the lengths of strings used (take them straight) for kites A and B as shown in the figure. [2]

(2) the distance 'd' between these two kites [2]

Previously asked in: 2022 30/2/1 Q13

◆ **Some Applications of Trigonometry** | Angle of elevation | Distance between two points using trigonometry

Q2. § 9.1 Heights and Distances § 9.2 Summary **[2]**

Find the length of the shadow on the ground of a pole of height 18 m when angle of elevation θ of the sun is such that $\tan\theta = \frac{6}{7}$.

Previously asked in: 2023 30/6/1 Q23

◆ **Some Applications of Trigonometry** | Shadow and height problems using trigonometric ratios (tan θ)

Q3. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A pole 6m high is fixed on the top of a tower. The angle of elevation of the top of the pole observed from a point P on the ground is 60° and the angle of depression of the point P from the top of the tower is 45°. Find the height of the tower and the distance of point P from the foot of the tower. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2024 30/1/1 Q35

◆ **Some Applications of Trigonometry** | Angle of elevation and angle of depression combined problem

Q4. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Elevated water storage tanks are built to store and supply water to nearby colonies. In the diagram given above, AB is an elevated water tank and CD is a nearby multistorey building. The building is 54 metres away from the water tank. From a window (W) of the building, the angle of elevation of top of the tank is 45° and angle of depression of its foot is 30°.

Based on the above information, answer the following questions:

- **(i)** Write a relation between d (the height of window) and y. [1]
- **(ii)** Determine the value of h. [1]
- **(iii)** Determine height of the water tank. OR Find the value of x and height of the window above ground level. [2]

Previously asked in: 2026 30/5/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q5. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A wire is attached from a point A on the ground to the top of a pole BC, making an angle of elevation as 60°. If $AB = 5\sqrt{3}$ m, then length of the wire is

(A) 10 m
(B) $10\sqrt{3}$ m
(C) 15 m
(D) $\frac{5}{\sqrt{3}}$ m

Previously asked in: 2026 30/5/1 Q17

◆ **Some Applications of Trigonometry** Finding length of wire/hypotenuse using angle of elevation and horizontal distance

Q6. § 9.1 Heights and Distances § 9.2 Summary **[3]**

An aeroplane when flying at a height of 3125 m from the ground passes vertically below another plane at an instant when the angles of elevation of the two planes from the same point on the ground are 30° and 60° respectively. Find the distance between the two planes at that instant.

Previously asked in: 2022 30/4/1 Q9

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q7. § 9.1 Heights and Distances § 9.2 Summary **[3]**

In Fig. 3, AB is tower of height 50 m. A man standing on its top, observes two cars on the opposite sides of the tower with angles of depression 30° and 45° respectively. Find the distance between the two cars.

Previously asked in: 2022 30/2/1 Q8

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q8. § 9.2 Summary **[4]**

> Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two Sections A and B. Tower is supported by wires from a point O.
> Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is 30° and the angle of elevation of the top of Section A is 45°.

Based on the above information, answer the following questions:

- **(i)** Find the length of the wire from the point O to the top of Section B. [1]
- **(ii)** Find the distance AB. [2]
- **(iii)** Find the height of the Section A from the base of the tower. [1]

Previously asked in: 2023 30/6/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q9. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A spherical balloon of radius r subtends an angle of 60° at the eye of an observer. If the angle of elevation of its centre is 45° from the same point, then prove that height of the centre of the balloon is $\sqrt{2}$ times its radius.

Previously asked in: 2023 30/1/1 Q33(b) (OR-2)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q10. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> The Statue of Unity situated in Gujarat is the world's largest Statue which stands over a 58 m high base. As part of the project, a student constructed an inclinometer and wishes to find the height of Statue of Unity using it. He noted following observations from two places:
> Situation – I: The angle of elevation of the top of Statue from Place A which is $80\sqrt{3}$ m away from the base of the Statue is found to be 60°.
> Situation – II: The angle of elevation of the top of Statue from a Place B which is 40 m above the ground is found to be 30° and entire height of the Statue including the base is found to be 240 m.

Based on given information, answer the following questions.

- **(i)** Represent the Situation – I with the help of a diagram. [1]
- **(ii)** Represent the Situation – II with the help of a diagram. [1]
- **(iii)** Calculate the height of Statue excluding the base and also find the height including the base with the help of Situation – I. [2]

Previously asked in: 2025 30/6/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q11. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A peacock sitting on the top of a tree of height 10 m observes a snake moving on the ground. If the snake is $10\sqrt{3}$ m away from the base of the tree, then angle of depression of the snake from the eye of the peacock is

A 30°
B 45°
C 60°
D 90°

Previously asked in: 2025 30/6/1 Q13

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q12. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Passenger boarding stairs, sometimes referred to as boarding ramps, stair cars or aircraft steps, provide a mobile means to travel between the aircraft doors and the ground. Larger aircraft have door sills 5 to 20 feet (1 foot = 30 cm) high. Stairs facilitate safe boarding and de-boarding. An aircraft has a door sill at a height of 15 feet above the ground. A stair car is placed at a horizontal distance of 15 feet from the plane.

Based on given information, answer the questions given in part (i) and (ii).

(i) Find the angle at which stairs are inclined to reach the door sill 15 feet high above the ground. [1]

(ii) Find the length of stairs used to reach the door sill. [1]

(iii) If the 20 feet long stairs is inclined at an angle of 60° to reach the door sill, then find the height of the door sill above the ground. (use $\sqrt{3} = 1.732$) [2]

Previously asked in: 2025 30/5/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q13. § 9.1 Heights and Distances § 9.2 Summary **[1]**

An observer 1.8 m tall stands away from a chimney at a distance of 38.2 m along the ground. The angle of elevation of top of chimney from the eyes of observer is 45°. The height of chimney above the ground is

A 38.2 m
B 36.4 m
C 40 m
D $(38.2)\sqrt{2}$ m

Previously asked in: 2025 30/5/1 Q13

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q14. § 9.2 Summary **[4]**

> A drone was used to facilitate movement of an ambulance on the straight highway to a point P on the ground where there was an accident. The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point Q, 100 m vertically above the point P. The angle of depression of the ambulance was found to be 30° at a particular instant.

Based on above information, answer the following questions :

- **(i)** Represent the above situation with the help of a diagram. [1]
- **(ii)** Find the distance between the ambulance and the site of accident (P) at the particular instant. (Use $\sqrt{3} = 1.73$) [1]
- **(iii)** Find the time (in seconds) in which the angle of depression changes from 30° to 45°. [2]

Previously asked in: 2025 30/4/1 Q38

◆ **Some Applications of Trigonometry** | Angle of depression from a vertical height | Diagrammatic representation of heights and distances | Distance calculation using trigonometric ratios (tan) | Time–speed–distance application with trigonometry

Q15. § 9.1 Heights and Distances § 9.2 Summary **[2]**

A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/sec. Find the length of his shadow after 3 seconds.

Previously asked in: 2025 30/4/1 Q22(A)

◆ **Some Applications of Trigonometry** | 9.1 Heights and Distances

Q16. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A 30 m long rope is tightly stretched and tied from the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is :

(a) $10\sqrt{3}$ m
(b) $30\sqrt{3}$ m
(c) 15 m
(d) $15\sqrt{3}$ m

Previously asked in: 2025 30/4/1 Q10

◆ **Some Applications of Trigonometry** | 9.1 Heights and Distances

Q17. § 9.1 Heights and Distances § 9.2 Summary **[1]**

If the length of the shadow of a tower is $\sqrt{3}$ times that of its height, then altitude of the Sun is :

A 45°
B 30°
C 60°
D 15°

Previously asked in: 2026 30/3/1 Q9

◆ **Some Applications of Trigonometry** | 9.1 Heights and Distances

Q18. § 9.2 Summary **[4]**

> Tejas is standing at the top of a building and observes a car at an angle of depression of 30° as it approaches the base of the building at a uniform speed. 6 seconds later, the angle of depression increases to 60°, and at that moment, the car is 25 m away from the building.

Based on the information given above, answer the following questions :

(i) What is the height of the building ? [1]

(ii) What is the distance between the two positions of the car ? [1]

(iii) What would be the total time taken by the car to reach the foot of the building from the starting point ? [2]

Previously asked in: 2026 30/2/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q19. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two sections 'A' and 'B'. Tower is supported by wires from a point 'O' (as shown in figure). Distance between the base of the tower and point 'O' is 6 m. From point 'O', the angle of elevation of the top of the section 'B' is 30° and the angle of elevation of the top of section 'A' is 60°.

Based on the above information, answer the following questions :

(i) Find the length of the wire from the point 'O' to the top of section 'B'. [1]

(ii) Find the length of the wire from the point 'O' to the top of section 'A'. [1]

(iii) Find the distance AB. [2]

Previously asked in: 2026 30/1/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q20. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A car is moving away from the base of a 30 m high tower. The angle of elevation of the top of the tower from the car at an instant, when the car is $10\sqrt{3}$ m away from the base of the tower, is :

(a) 30°
(b) 45°
(c) 90°
(d) 60°

Previously asked in: 2026 30/1/1 Q11

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q21. § 9.1 Heights and Distances § 9.2 Summary **[4]**

A straight highway leads to the foot of a tower. A man standing at the top of the tower observes a car at an angle of depression of 30°, which is approaching the foot of the tower with a uniform speed. Ten seconds later, the angle of depression of the car is found to be 60°. Find the time taken by the car to reach the foot of the tower from this point.

Previously asked in: 2022 30/3/1 Q12

◆ **Some Applications of Trigonometry** Angle of Depression and Height-Distance Problems

Q22. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Gadisar Lake is located in the Jaisalmer district of Rajasthan. It was built by the King of Jaisalmer and rebuilt by Gadsi Singh in 14th century. The lake has many Chhatris. One of them is shown below. From a point A, h m above from water level, the angle of elevation of top of Chhatri (point B) is 45° and angle of depression of its reflection in water (point C) is 60°. If the height of Chhatri above water level is (approximately) 10 m.

Observe the picture and answer the following questions:

- **(a)** Draw a well-labelled figure based on the above information. [2]
- **(b)** Find the height (h) of the point A above water level. (Use $\sqrt{3} = 1.73$) [2]

Previously asked in: 2022 30/1/1 Q14

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q23. § 9.2 Summary **[3]**

From a point on a bridge across a river, the angles of depression of the banks on opposite sides of the river are 30° and 45° respectively. If the bridge is at a height of 3 m from the banks, then find the width of the river.

Previously asked in: 2022 30/1/1 Q9(b) (OR-2)

◆ **Some Applications of Trigonometry** Angles of Depression – Finding Width/Distance using Two Angles from a Height

Q24. § 9.1 Heights and Distances § 9.2 Summary **[3]**

The angle of elevation of the top of a building from the foot of the tower is 30° and the angle of elevation of the top of the tower from the foot of the building is 60°. If the tower is 50 m high, then find the height of the building.

Previously asked in: 2022 30/1/1 Q9(a) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q25. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 30°. Determine the height of the tower.

Previously asked in: 2023 30/4/1 Q32(B) (OR-2)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q26. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A straight highway leads to the foot of a tower. A man standing on the top of the 75 m high tower observes two cars at angles of depression of 30° and 60°, which are approaching the foot of the tower. If one car is exactly behind the other on the same side of the tower, find the distance between the two cars. (use $\sqrt{3} = 1.73$)

Previously asked in: 2023 30/4/1 Q32(A) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q27. § 9.1 Heights and Distances § 9.2 Summary **[1]**

If a pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then the sun's elevation is :

(a) 60°
(b) 45°
(c) 30°
(d) 90°

Previously asked in: 2023 30/4/1 Q9

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q28. § 9.1 Heights and Distances § 9.2 Summary **[2]**

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

Previously asked in: 2023 30/2/1 Q24(a) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q29. § 9.2 Summary **[5]**

From a point on a bridge across the river, the angles of depressions of the banks on opposite sides of the river are 30° and 60° respectively. If the bridge is at a height of 4 m from the banks, find the width of the river.

Previously asked in: 2024 30/5/1 Q33

◆ **Some Applications of Trigonometry** Angle of Depression – Width of River from a Bridge

Q30. § 9.1 Heights and Distances § 9.2 Summary **[5]**

Two pillars of equal lengths stand on either side of a road which is 100 m wide, exactly opposite to each other. At a point on the road between the pillars, the angles of elevation of the tops of the pillars are 60° and 30°. Find the length of each pillar and distance of the point on the road from the pillars. (Use $\sqrt{3} = 1.732$)

Previously asked in: 2024 30/4/1 Q32

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q31. § 9.2 Summary **[5]**

Two ships are sailing in the sea on either side of a lighthouse. The angles of depression to the two ships as observed from the top of the lighthouse are 60° and 45°, respectively. If the distance between the ships is $100\left(\dfrac{\sqrt{3}+1}{\sqrt{3}}\right)$ m, then find the height of the lighthouse.

Previously asked in: 2025 30/2/1 Q32 (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q32. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A kite is flying at a height of 150 m from the ground. It is attached to a string inclined at an angle of 30° to the horizontal. The length of the string is:

A $100\sqrt{3}$ m
B 300 m
C $150\sqrt{3}$ m
D $150\sqrt{2}$ m

Previously asked in: 2025 30/1/1 Q17

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q33. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A kite is flying at a height of 60 m above the ground level. Ravi, standing at the roof of the house is holding the string straight and observes the angle of elevation of kite as 30°. From the bottom of the same building, the angle of elevation of kite is 45°. Find the length of the string and height of roof from the ground. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2026 30/4/1 Q34

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

Q34. § 9.2 Summary **[4]**

From the top of an 8 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 45°. Determine the height of the tower. (Take $\sqrt{3} = 1.732$).

Previously asked in: 2022 30/4/1 Q12

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q35. § 9.1 Heights and Distances | § 9.2 Summary **[5]**

The angle of elevation of the top of a tower 24 m high from the foot of another tower in the same plane is 60°. The angle of elevation of the top of second tower from the foot of the first tower is 30°. Find the distance between two towers and the height of the other tower. Also, find the length of the wire attached to the tops of both the towers.

Previously asked in: 2023 30/1/1 Q33(a) (OR-1)

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances | Length of wire between tops of two towers (Pythagoras / distance formula in context)

Q36. § 9.1 Heights and Distances | § 9.2 Summary **[5]**

A boy standing on a horizontal plane is flying a kite with a string of length 60 m, at an angle of elevation of 30°. Another boy standing on the roof of a 20 m high building, finds the angle of elevation of same kite to be 45°. If both the boys are on opposite sides of the kite, find the distance of the first boy from the base of the building. Also, find the height of the kite from the ground. (Use $\sqrt{3} = 1\cdot 73$)

Previously asked in: 2026 30/3/1 Q35

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q37. § 9.1 Heights and Distances | § 9.2 Summary **[1]**

From a point on the ground, which is 60 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 45°. The height (in metres) of the tower is :

A $10\sqrt{3}$
B $30\sqrt{3}$
C 60
D 30

Previously asked in: 2026 30/2/1 Q12

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q38. § 9.1 Heights and Distances | § 9.2 Summary **[3]**

The tops of two poles of heights 20 m and 28 m are connected with a wire. The wire is inclined to the horizontal at an angle of 30°. Find the length of the wire and the distance between the two poles.

Previously asked in: 2022 30/3/1 Q8

◆ **Some Applications of Trigonometry** | 8.2 Trigonometric Ratios | 8.3 Trigonometric Ratios of Some Specific Angles

Q39. § 9.1 Heights and Distances | § 9.2 Summary **[5]**

One observer estimates the angle of elevation to the basket of a hot air balloon to be 60°, while another observer 100 m away estimates the angle of elevation to be 30°. Find :

(a) The height of the basket from the ground.

(b) The distance of the basket from the first observer's eye.

(c) The horizontal distance of the second observer from the basket.

Previously asked in: 2023 30/5/1 Q32

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q40. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From a point on the ground, the angle of elevation of the bottom and top of a transmission tower fixed at the top of 30 m high building are 30° and 60°, respectively. Find the height of the transmission tower. (Use $\sqrt{3} = 1{\cdot}73$)

Previously asked in: 2023 30/2/1 Q33(b) (OR-2)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

Q41. § 9.1 Heights and Distances § 9.2 Summary **[5]**

As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 60°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships. (Use $\sqrt{3} = 1{\cdot}73$)

Previously asked in: 2023 30/2/1 Q33(a) (OR-1)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles
Angles of Depression – Two Ships/Objects from a Lighthouse

Q42. § 9.1 Heights and Distances § 9.2 Summary **[2]**

The angle of elevation of the top of a tower from a point on the ground which is 30 m away from the foot of the tower, is 30°. Find the height of the tower.

Previously asked in: 2023 30/2/1 Q24(b) (OR-2)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

Q43. § 9.1 Heights and Distances § 9.2 Summary **[1]**

At some time of the day, the length of the shadow of a tower is equal to its height. Then, the Sun's altitude at that time is :

A 30°
B 45°
C 60°
D 90°

Previously asked in: 2024 30/4/1 Q14

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

Q44. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

Previously asked in: 2024 30/3/1 Q34

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

Q45. § 9.1 Heights and Distances § 9.2 Summary **[1]**

From a point on the ground, which is 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 60°. The height (in metres) of the tower is :

A $10\sqrt{3}$
B $30\sqrt{3}$
C 60
D 30

Previously asked in: 2024 30/3/1 Q7

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

Q46. § 9.2 Summary **[5]**

From the top of a 45 m high light house, the angles of depression of two ships, on the opposite side of it, are observed to be 30° and 60°. If the line joining the ships passes through the foot of the light house, find the distance between the ships. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2024 30/2/1 Q34

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q47. § 9.1 Heights and Distances | § 9.2 Summary **[4]**

> A lighthouse stands tall on a cliff by the sea, watching over ships that pass by. One day a ship is seen approaching the shore and from the top of the lighthouse, the angles of depression of the ship are observed to be 30° and 45° as it moves from point P to point Q. The height of the lighthouse is 50 metres.

Based on the information given above, answer the following questions:

(i) Find the distance of the ship from the base of the lighthouse when it is at point Q, where the angle of depression is 45°. [1]

(ii) Find the measures of $\angle PBA$ and $\angle QBA$. [1]

(iii) Find the distance travelled by the ship or the speed of the ship. [2]

Previously asked in: 2025 30/3/1 Q37

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | Angle of Depression from top of lighthouse/tower to a moving object | Distance travelled by a moving ship using two angles of depression

Q48. § 9.1 Heights and Distances | § 9.2 Summary **[1]**

Assertion (A): A ladder leaning against a wall, stands at a horizontal distance of 6 m from the wall. If the height of the wall up to which the ladder reaches is 8 m, then the length of the ladder is 10 m.

Reason (R): The ladder makes an angle of 60° with the ground.

Select the correct answer from the codes (A), (B), (C) and (D) given below:

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

Previously asked in: 2025 30/3/1 Q19

◆ **Some Applications of Trigonometry** | 8.2 Trigonometric Ratios | 9.1 Heights and Distances

Q49. § 9.2 Summary **[5]**

The angles of depression of the top and the bottom of an 8 m tall building from the top of another multistoried building are 30° and 45°, respectively. Find the height of the multistoried building and the distance between the two buildings.

Previously asked in: 2025 30/2/1 Q32 (OR-2)

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

Q50. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Amrita stood near the base of a lighthouse, gazing up at its towering height. She measured the angle of elevation to the top and found it to be 60°. Then, she climbed a nearby observation deck, 40 metres higher than her original position and noticed the angle of elevation to the top of lighthouse to be 45°.

Based on the above given information, answer the following questions:

- **(i)** Find CD in terms of h (where h is the height). [1]
- **(ii)** Find BD in terms of BC. [1]
- **(iii)** Find the height CE of the lighthouse. [Use $\sqrt{3} = 1{\cdot}73$] [2]

Previously asked in: 2025 30/1/1 Q38

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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CBSE CLASS X

Mathematics Standard (041)

ANSWER KEY

From previous CBSE Board Exam questions

Code: JADN12	Questions: 50	Maximum Marks: 167	Generated: 2026-06-15 13:05

Q1. § 9.1 Heights and Distances **[4]**

> Kite festival is celebrated in many countries at different times of the year. In India, every year 14th January is celebrated as International Kite Day. On this day many people visit India and participate in the festival by flying various kinds of kites. The picture given below, shows three kites flying together. In Fig. 5, the angles of elevation of two kites (Points A and B) from the hands of a man (Point C) are found to be 30° and 60° respectively. Taking AD = 50 m and BE = 60 m.

Case Study - 1 : Kite Festival. In Fig. 5, the angles of elevation of two kites (Points A and B) from the hands of a man (Point C) are found to be 30° and 60° respectively. Taking AD = 50 m and BE = 60 m, find:

(1) the lengths of strings used (take them straight) for kites A and B as shown in the figure. [2]

(2) the distance 'd' between these two kites [2]

Previously asked in: 2022 30/2/1 Q13

◆ **Some Applications of Trigonometry** | Angle of elevation | Distance between two points using trigonometry

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Model Answer

(1) Length of strings CA and CB:

For kite A: angle of elevation = 30°, AD = 50 m

$$\sin 30^\circ = \frac{AD}{CA} \Rightarrow \frac{1}{2} = \frac{50}{CA} \Rightarrow CA = 100 \text{ m}$$

For kite B: angle of elevation = 60°, BE = 60 m

$$\sin 60^\circ = \frac{BE}{CB} \Rightarrow \frac{\sqrt{3}}{2} = \frac{60}{CB} \Rightarrow CB = \frac{120}{\sqrt{3}} = 40\sqrt{3} \text{ m}$$

(2) Distance 'd' between the two kites:

$$CD = \frac{AD}{\tan 30^\circ} = \frac{50}{1/\sqrt{3}} = 50\sqrt{3} \text{ m}$$

$$CE = \frac{BE}{\tan 60^\circ} = \frac{60}{\sqrt{3}} = 20\sqrt{3} \text{ m}$$

Since D, C, E are collinear and A, B are above D and E respectively:

$$AB = d = \sqrt{(AD - BE)^2 + (DC + CE)^2}$$

$$= \sqrt{(50-60)^2 + (50\sqrt{3} + 20\sqrt{3})^2} = \sqrt{100 + (70\sqrt{3})^2}$$

$$= \sqrt{100 + 14700} = \sqrt{14800} = 20\sqrt{37} \text{ m}$$

Source: Chapter 9 – Some Applications of Trigonometry

Explanation

- For string length, use **sin θ = perpendicular/hypotenuse** (hypotenuse = string = line of sight).
- For horizontal distance (DC, CE), use **tan θ = perpendicular/base**.

- Since D and E are on opposite sides of C, total horizontal separation = DC + CE.
- Use Pythagoras for the slant distance AB, as A and B are at different heights.
- Key values: sin 30° = ½, sin 60° = √3/2, tan 30° = 1/√3, tan 60° = √3.

Q2. § 9.1 Heights and Distances § 9.2 Summary **[2]**

Find the length of the shadow on the ground of a pole of height 18 m when angle of elevation θ of the sun is such that $\tan\theta = \frac{6}{7}$.

Previously asked in: 2023 30/6/1 Q23

◆ **Some Applications of Trigonometry** Shadow and height problems using trigonometric ratios (tan θ)

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Model Answer

Let the length of the shadow be x m. The pole of height 18 m is vertical, so:

$$\tan\theta = \frac{\text{Height of pole}}{\text{Length of shadow}} = \frac{18}{x}$$

Given $\tan\theta = \dfrac{6}{7}$:

$$\frac{6}{7} = \frac{18}{x}$$

$$x = \frac{18 \times 7}{6} = 21 \text{ m}$$

∴ The length of the shadow is **21 m**.

Source: Some Applications of Trigonometry, Section 9.1

Explanation

- Set up a right triangle: pole = opposite side, shadow = adjacent side, so $\tan\theta = \frac{\text{height}}{\text{shadow}}$.
- Substitute the given values and solve for x by cross-multiplication.
- Examiners expect a clear diagram description (or equation setup) and the final answer with units. Two marks: one for correct equation setup, one for correct answer.

Q3. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A pole 6m high is fixed on the top of a tower. The angle of elevation of the top of the pole observed from a point P on the ground is 60° and the angle of depression of the point P from the top of the tower is 45°. Find the height of the tower and the distance of point P from the foot of the tower. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2024 30/1/1 Q35

◆ **Some Applications of Trigonometry** Angle of elevation and angle of depression combined problem

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Model Answer

Let the height of the tower = h m, and distance of point P from the foot of the tower = d m.

Let AB = tower (height = h), BC = pole (height = 6 m), P = point on ground.

From the angle of depression of P from the top of the tower (45°):

$$\tan 45^\circ = \frac{h}{d} \implies 1 = \frac{h}{d} \implies d = h \quad ...(1)$$

From the angle of elevation of the top of the pole from P (60°):

$$\tan 60^\circ = \frac{h+6}{d} \implies \sqrt{3} = \frac{h+6}{d} \quad ...(2)$$

Substituting (1) into (2):

$$\sqrt{3} = \frac{h+6}{h}$$

$$\sqrt{3}\,h = h + 6$$

$$h(\sqrt{3} - 1) = 6$$

$$h = \frac{6}{\sqrt{3}-1} = \frac{6(\sqrt{3}+1)}{(\sqrt{3})^2 - 1^2} = \frac{6(\sqrt{3}+1)}{2} = 3(\sqrt{3}+1)$$

$$h = 3(1.73 + 1) = 3 \times 2.73 = \mathbf{8.19}\ \text{m}$$

Distance of P from foot of tower:

$$d = h = \mathbf{8.19}\ \text{m}$$

∴ Height of tower = **8.19 m** and distance of point P from the foot of the tower = **8.19 m**.

Source: Chapter 9, Section 9.1 – Heights and Distances

Explanation

- The **angle of depression** from the top of the tower to P equals the angle of elevation from P to the top of the tower (alternate angles), giving tan 45° = h/d → d = h.
- The **angle of elevation to the top of the pole** uses the total height (h + 6), giving tan 60° = (h+6)/d.
- Rationalise the denominator when solving for h. Examiners award marks for the diagram, correct equations, solving, and substituting √3 = 1.73 at the end.

Q4. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Elevated water storage tanks are built to store and supply water to nearby colonies. In the diagram given above, AB is an elevated water tank and CD is a nearby multistorey building. The building is 54 metres away from the water tank. From a window (W) of the building, the angle of elevation of top of the tank is 45° and angle of depression of its foot is 30°.

Based on the above information, answer the following questions:

- **(i)** Write a relation between d (the height of window) and y. [1]
- **(ii)** Determine the value of h. [1]
- **(iii)** Determine height of the water tank. OR Find the value of x and height of the window above ground level. [2]

Previously asked in: 2026 30/5/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(i) From window W, angle of depression of foot B is 30°.

$$\tan 30^\circ = \frac{d}{54} \Rightarrow \frac{1}{\sqrt{3}} = \frac{d}{54}$$

So the relation is: $d = \frac{54}{\sqrt{3}}$ i.e., $y = d = \frac{54}{\sqrt{3}} = 18\sqrt{3}\ \mathbf{m}$

(ii) From window W, angle of elevation of top A is 45°.

$$\tan 45^\circ = \frac{h}{54} \Rightarrow 1 = \frac{h}{54} \Rightarrow h = 54\ \text{m}$$

(iii) Height of water tank AB = $h + d = 54 + 18\sqrt{3}$ m

$$= 18(3+\sqrt{3}) = 18\sqrt{3}(\sqrt{3}+1)\ \text{m}$$

OR

$x = 54$ m (horizontal distance, as $\tan 45^\circ = h/x \Rightarrow x = h = 54$ m)

Height of window above ground $= d = 18\sqrt{3}$ m ≈ 31.18 m

Source: Heights and Distances, Application of Trigonometry

Explanation

- The horizontal distance (54 m) is used with both angles to set up tan equations.
- h is the vertical height from window level up to top of tank; d is from ground to window (same as depression side).
- Total tank height = $h + d$ since B is at ground and A is at top.
- Examiners expect clear trigonometric ratios, substitution, and final simplified value.

Q5. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A wire is attached from a point A on the ground to the top of a pole BC, making an angle of elevation as 60°. If $AB = 5\sqrt{3}$ m, then length of the wire is

(A) 10 m
(B) $10\sqrt{3}$ m
(C) 15 m
(D) $\frac{5}{\sqrt{3}}$ m

Previously asked in: 2026 30/5/1 Q17

◆ **Some Applications of Trigonometry** Finding length of wire/hypotenuse using angle of elevation and horizontal distance

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Model Answer

(A) 10 m

In right △ABC, AB = 5√3 m (base), angle of elevation = 60°.
cos 60° = AB/AC → 1/2 = 5√3/AC → AC = **10 m**.

Explanation

The wire is the hypotenuse (AC). Use cos 60° = adjacent/hypotenuse = AB/AC. Since cos 60° = 1/2, AC = 2 × 5√3 is wrong — note AB here is the horizontal distance, so AC = AB/cos60° = 5√3 ÷ (1/2) = 10 m. Always identify which side is the hypotenuse (the wire/rope) and which trig ratio links the given side and required side.

Q6. § 9.1 Heights and Distances § 9.2 Summary **[3]**

An aeroplane when flying at a height of 3125 m from the ground passes vertically below another plane at an instant when the angles of elevation of the two planes from the same point on the ground are 30° and 60° respectively. Find the distance between the two planes at that instant.

Previously asked in: 2022 30/4/1 Q9

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let the point on the ground be O, and let the horizontal distance from O to the point directly below both planes be d metres.

For the lower plane (height = 3125 m, angle of elevation = 30°):

$$\tan 30^\circ = \frac{3125}{d} \implies \frac{1}{\sqrt{3}} = \frac{3125}{d} \implies d = 3125\sqrt{3}\text{ m}$$

For the upper plane (height = h m, angle of elevation = 60°):

$$\tan 60^\circ = \frac{h}{d} \implies \sqrt{3} = \frac{h}{3125\sqrt{3}} \implies h = 3125\sqrt{3} \times \sqrt{3} = 9375\text{ m}$$

Distance between the two planes:

$$= 9375 - 3125 = \boxed{6250\text{ m}}$$

Source: Chapter 9, Heights and Distances

Explanation

- Both planes fly **vertically above the same point**, so both share the same horizontal distance d from the observer.
- Use $\tan\theta = \frac{\text{height}}{d}$ for each plane separately.
- Find d from the lower plane's data, then find the upper plane's height using the same d.
- The answer is simply the difference in heights. Examiners award marks for the diagram/setup (1), correct use of tan for each plane (1), and the final subtraction (1).

Q7. § 9.1 Heights and Distances § 9.2 Summary **[3]**

In Fig. 3, AB is tower of height 50 m. A man standing on its top, observes two cars on the opposite sides of the tower with angles of depression 30° and 45° respectively. Find the distance between the two cars.

Previously asked in: 2022 30/2/1 Q8

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let AB = 50 m be the tower. Let C and D be the two cars on opposite sides.

For car C (angle of depression = 30°):

In △ABC, ∠ACB = 30° (alternate angles)

$$\tan 30^\circ = \frac{AB}{BC} \implies \frac{1}{\sqrt{3}} = \frac{50}{BC}$$

$$BC = 50\sqrt{3}\text{ m}$$

For car D (angle of depression = 45°):

In △ABD, ∠ADB = 45°

$$\tan 45^\circ = \frac{AB}{BD} \implies 1 = \frac{50}{BD}$$

$$BD = 50\text{ m}$$

Distance between the two cars:

$$CD = BC + BD = 50\sqrt{3} + 50 = 50(\sqrt{3}+1)\text{ m}$$

Source: Chapter 9, Heights and Distances

Explanation

- The angle of depression equals the alternate interior angle at the base (since the horizontal from the top is parallel to the ground). Always state this step — examiners award a mark for it.
- Use tan (opposite/adjacent) since height and base distance are involved.
- Final answer must be left as $50(\sqrt{3}+1)$ m or approximately 136.6 m. Both forms are acceptable; exact form is preferred.
- 3 marks are typically split: 1 mark for correct triangle/setup, 1 mark for BC, 1 mark for BD and final answer.

Q8. § 9.2 Summary **[4]**

> Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two Sections A and B. Tower is supported by wires from a point O.
> Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is 30° and the angle of elevation of the top of Section A is 45°.

Based on the above information, answer the following questions:

- **(i)** Find the length of the wire from the point O to the top of Section B. [1]
- **(ii)** Find the distance AB. [2]
- **(iii)** Find the height of the Section A from the base of the tower. [1]

Previously asked in: 2023 30/6/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let the base of the tower be P and PO = 36 cm.

(i) Length of wire from O to top of Section B:

Let top of Section B = Q. Angle of elevation = 30°.

$$\cos 30^\circ = \frac{PO}{OQ} \Rightarrow \frac{\sqrt{3}}{2} = \frac{36}{OQ} \Rightarrow OQ = \frac{72}{\sqrt{3}} = 24\sqrt{3}\text{ cm}$$

Length of wire = 24√3 cm

(ii) Distance AB:

Height of Section B (PQ):

$$\tan 30^\circ = \frac{PQ}{36} \Rightarrow PQ = \frac{36}{\sqrt{3}} = 12\sqrt{3}\text{ cm}$$

Height of top of Section A (PA):

$$\tan 45^\circ = \frac{PA}{36} \Rightarrow PA = 36\text{ cm}$$

$$AB = PA - PQ = 36 - 12\sqrt{3} = 12(3 - \sqrt{3})\text{ cm}$$

(iii) Height of Section A from base:

$$PA = 36\text{ cm}$$

Height of Section A = 36 cm

Source: Applications of Trigonometry, Chapter 9

Explanation

- **Part (i):** Use cos ratio (hypotenuse = wire from O to top of B). cos 30° = base/hypotenuse.

- **Part (ii):** Use tan for both heights, then subtract PQ from PA to get AB. The key step examiners check is the subtraction and simplification $12(3-\sqrt{3})$.
- **Part (iii):** $\tan 45° = 1$, so height = horizontal distance directly. Simple but must be stated clearly.
- Always define your variables and show the trig ratio used — that's where method marks lie.

Q9. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A spherical balloon of radius r subtends an angle of 60° at the eye of an observer. If the angle of elevation of its centre is 45° from the same point, then prove that height of the centre of the balloon is $\sqrt{2}$ times its radius.

Previously asked in: 2023 30/1/1 Q33(b) (OR-2)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Given: Balloon of radius r subtends angle 60° at observer's eye O. Angle of elevation of centre C is 45°.

To prove: Height of centre = $\sqrt{2}\,r$

Construction/Setup:

Let O be the eye of the observer and C be the centre of the balloon. Draw tangents OA and OB to the balloon from O.

Since the balloon subtends an angle of 60° at O:

$$\angle AOB = 60^\circ \implies \angle AOC = 30^\circ$$

In right $\triangle OAC$ (OA is tangent, so $\angle OAC = 90^\circ$):

$$\sin(\angle AOC) = \frac{AC}{OC}$$

$$\sin 30^\circ = \frac{r}{OC}$$

$$\frac{1}{2} = \frac{r}{OC} \implies OC = 2r$$

Finding height of centre C:

Let M be the point on the ground directly below O (observer's level), and let CM be the height of C above observer's level (taken as horizontal reference). The angle of elevation of C is 45°, so:

$$\sin 45^\circ = \frac{h}{OC}$$

where h = height of centre C above the observer's eye.

$$\frac{1}{\sqrt{2}} = \frac{h}{2r}$$

$$h = \frac{2r}{\sqrt{2}} = \sqrt{2}\,r$$

Hence, the height of the centre of the balloon is $\sqrt{2}$ times its radius. ■

Source: Chapter 9 — Some Applications of Trigonometry, Heights and Distances

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Explanation

- The key step is recognising that $OA \perp AC$ (radius to tangent point is perpendicular), letting you use $\sin 30^\circ = r/OC$ to get $OC = 2r$.
- Then use $\sin 45^\circ = h/OC$ (not $\tan$, because OC is a slant distance from observer to centre, not a horizontal base).
- Examiners expect a clear diagram description, correct triangle identification, and all trigonometric steps shown explicitly.
- Avoid confusing $\tan$ (used when base is known) with $\sin$ (used when hypotenuse is known); here OC is the hypotenuse of the elevation triangle.

Q10. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> The Statue of Unity situated in Gujarat is the world's largest Statue which stands over a 58 m high base. As part of the project, a student constructed an inclinometer and wishes to find the height of Statue of Unity using it. He noted following observations from two places:
> Situation – I: The angle of elevation of the top of Statue from Place A which is $80\sqrt{3}$ m away from the base of the Statue is found to be 60°.
> Situation – II: The angle of elevation of the top of Statue from a Place B which is 40 m above the ground is found to be 30° and entire height of the Statue including the base is found to be 240 m.

Based on given information, answer the following questions.

(i) Represent the Situation – I with the help of a diagram. [1]

(ii) Represent the Situation – II with the help of a diagram. [1]

(iii) Calculate the height of Statue excluding the base and also find the height including the base with the help of Situation – I. [2]

Previously asked in: 2025 30/6/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(i) Diagram – Situation I:

```

- (Top of Statue)
|
| h
|
|______________
| Base | A (observer on ground)
|______________|←——— 80√3 m ———→
∠60°
```

A right triangle with observer A on ground, horizontal distance = $80\sqrt{3}$ m, angle of elevation = 60°.

(ii) Diagram – Situation II:

```

- (Top, 240 m)
|
|
|
______|
| |←——— d ———→ B (40 m above ground)
|240m| ∠30°
|____|
```

Observer B is 40 m above ground; angle of elevation to top = 30°; total height = 240 m.

(iii) Calculation using Situation – I:

Let total height of statue (including base) = H m.

$$\tan 60^\circ = \frac{H}{80\sqrt{3}}$$

$$\sqrt{3} = \frac{H}{80\sqrt{3}}$$

$$H = 80\sqrt{3} \times \sqrt{3} = 80 \times 3 = 240 \text{ m}$$

Height including base = 240 m

Height excluding base = 240 – 58 = 182 m

Source: Some Applications of Trigonometry, NCERT Class 10 Maths

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Explanation

- For (i) and (ii), even a rough labelled sketch earns the mark — label the angle, distance, and height clearly.
- For (iii), examiners award 1 mark for correct use of tan 60° and setting up the equation, and 1 mark for the final answers (240 m and 182 m). Always subtract the given base height (58 m) to find the statue height alone.
- **Key formula:** $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

Q11. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A peacock sitting on the top of a tree of height 10 m observes a snake moving on the ground. If the snake is $10\sqrt{3}$ m away from the base of the tree, then angle of depression of the snake from the eye of the peacock is

A 30°
B 45°
C 60°
D 90°

Previously asked in: 2025 30/6/1 Q13

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Option A: 30°

Here, height of tree = 10 m, horizontal distance = $10\sqrt{3}$ m. $\tan\theta = \frac{10}{10\sqrt{3}} = \frac{1}{\sqrt{3}}$, so $\theta = 30^\circ$.

Explanation

Use $\tan(\text{angle of depression}) = \frac{\text{height}}{\text{horizontal distance}}$. Since the peacock looks **down**, the angle of depression equals the angle whose tangent is $\frac{10}{10\sqrt{3}} = \frac{1}{\sqrt{3}}$, giving **30°**. A common mistake is inverting the ratio and getting 60°—always put height in the numerator and base distance in the denominator when using tan for angle of depression from the top.

Q12. § 9.1 Heights and Distances § 9.2 Summary **[4]**

Passenger boarding stairs, sometimes referred to as boarding ramps, stair cars or aircraft steps, provide a mobile means to travel between the aircraft doors and the ground. Larger aircraft have door sills 5 to 20 feet (1 foot = 30 cm) high. Stairs facilitate safe boarding and de-boarding. An aircraft has a door sill at a height of 15 feet above the ground. A stair car is placed at a horizontal distance of 15 feet from the plane.

Based on given information, answer the questions given in part (i) and (ii).

(i) Find the angle at which stairs are inclined to reach the door sill 15 feet high above the ground. [1]

(ii) Find the length of stairs used to reach the door sill. [1]

(iii) If the 20 feet long stairs is inclined at an angle of 60° to reach the door sill, then find the height of the door sill above the ground. (use $\sqrt{3} = 1.732$) [2]

Previously asked in: 2025 30/5/1 Q38

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(i) Let the angle of inclination be θ.

Given: height = 15 ft, horizontal distance = 15 ft

$$\tan\theta = \frac{15}{15} = 1 \Rightarrow \theta = 45^\circ$$

The stairs are inclined at **45°**.

(ii) Using Pythagoras theorem:

$$\text{Length of stairs} = \sqrt{15^2 + 15^2} = \sqrt{225 + 225} = \sqrt{450} = 15\sqrt{2}\text{ feet}$$

The length of stairs is $15\sqrt{2}$ **feet**.

(iii) Given: length of stairs = 20 ft, angle = 60°

$$\sin 60^\circ = \frac{\text{height}}{20}$$

$$\frac{\sqrt{3}}{2} = \frac{h}{20}$$

$$h = 10\sqrt{3} = 10 \times 1.732 = \mathbf{17.32\ feet}$$

The height of the door sill is **17.32 feet**.

Source: Applications of Trigonometry, Chapter 9

Explanation

- **Part (i):** Since height = base = 15 ft, tan θ = 1, so θ = 45°. This is a standard trigonometric value.
- **Part (ii):** The stairs form the hypotenuse; use Pythagoras or note that for a 45° right triangle, hypotenuse = side × √2.

- **Part (iii):** The stairs are the hypotenuse (20 ft). Use **sin** (opposite/hypotenuse) since height is opposite the given angle. Substitute √3 = 1.732 as instructed. Examiners award 1 mark for correct formula and 1 mark for final answer.

Q13. § 9.1 Heights and Distances § 9.2 Summary **[1]**

An observer 1.8 m tall stands away from a chimney at a distance of 38.2 m along the ground. The angle of elevation of top of chimney from the eyes of observer is 45°. The height of chimney above the ground is

A 38.2 m
B 36.4 m
C 40 m
D $(38.2)\sqrt{2}$ m

Previously asked in: 2025 30/5/1 Q13

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Option C: 40 m

Using tan 45° = 1, the horizontal distance from observer's eyes to chimney = 38.2 m. So the chimney height above eye level = 38.2 m. Total height = 38.2 + 1.8 = **40 m**.

Explanation

This follows the same method as Example 3 in the textbook. The observer's eye level is 1.8 m above the ground. Since tan 45° = 1, the vertical rise from eye level equals the horizontal distance (38.2 m). Add the observer's height (1.8 m) to get the total chimney height: 38.2 + 1.8 = 40 m. Always remember to add the observer's height to the calculated vertical distance to get the height above ground.

Q14. § 9.2 Summary **[4]**

> A drone was used to facilitate movement of an ambulance on the straight highway to a point P on the ground where there was an accident. The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point Q, 100 m vertically above the point P. The angle of depression of the ambulance was found to be 30° at a particular instant.

Based on above information, answer the following questions :

- **(i)** Represent the above situation with the help of a diagram. [1]
- **(ii)** Find the distance between the ambulance and the site of accident (P) at the particular instant. (Use $\sqrt{3} = 1.73$) [1]
- **(iii)** Find the time (in seconds) in which the angle of depression changes from 30° to 45°. [2]

Previously asked in: 2025 30/4/1 Q38

◆ **Some Applications of Trigonometry** | Angle of depression from a vertical height | Diagrammatic representation of heights and distances | Distance calculation using trigonometric ratios (tan) | Time–speed–distance application with trigonometry

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Model Answer

(i) Diagram:

```
Q
| \
| \
100m | \ (angle of depression = 30°)
| \
P___________A
```

Q is directly above P (QP = 100 m), A is the ambulance on the highway.

(ii) Let A be the position of the ambulance. In △QPA:

$$\tan 30^\circ = \frac{QP}{PA} = \frac{100}{PA}$$

$$PA = \frac{100}{\tan 30^\circ} = 100\sqrt{3} = 100 \times 1.73 = \mathbf{173\ m}$$

(iii) When angle of depression = 45°, let the new position be A′:

$$\tan 45^\circ = \frac{100}{PA'} \Rightarrow PA' = 100 \text{ m}$$

Distance covered by ambulance = PA − PA′ = 173 − 100 = **73 m**

Speed = 60 km/h $= 60 \times \frac{1000}{3600} = \frac{50}{3}$ m/s

$$\text{Time} = \frac{73}{\frac{50}{3}} = \frac{73 \times 3}{50} = \frac{219}{50} = \mathbf{4.38\ seconds}$$

Explanation

- **(i)** A right-angle triangle with vertical side QP = 100 m and horizontal side PA is expected. Even a rough labelled sketch scores the mark.
- **(ii)** Use tan(angle) = opposite/adjacent. The angle of depression from Q equals the angle of elevation from A (alternate interior angles), so tan 30° = 100/PA directly.
- **(iii)** Find PA′ using tan 45° = 1, subtract to get distance covered, convert speed to m/s, then apply Time = Distance/Speed. Show every step clearly for full 2 marks.

Q15. § 9.1 Heights and Distances § 9.2 Summary **[2]**

A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/sec. Find the length of his shadow after 3 seconds.

Previously asked in: 2025 30/4/1 Q22(A)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Distance walked by boy in 3 sec = 2.5 × 3 = **7.5 m** from the base of the lamp post.

Let the length of shadow = x m.

Using similar triangles (lamp post and boy):

$$\frac{12}{1.5} = \frac{7.5 + x}{x}$$

$$8x = 7.5 + x$$

$$7x = 7.5$$

$$x = \frac{7.5}{7} = \frac{15}{14} \approx 1.07 \text{ m}$$

∴ Length of shadow after 3 seconds = $\frac{15}{14}$ **m ≈ 1.07 m**

Explanation

- The key step is setting up similar triangles: the lamp post (12 m) and the boy (1.5 m) are parallel verticals; their tips and the shadow tip are collinear, giving the ratio 12/1.5 = (total distance from post to shadow tip)/(shadow length).
- First find the distance of the boy from the post (speed × time = 7.5 m), then let shadow = x so total = $7.5 + x$.
- Examiners award 1 mark for correct similar-triangle setup and 1 mark for correct final answer.

Q16. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A 30 m long rope is tightly stretched and tied from the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is :

(a) $10\sqrt{3}$ m
(b) $30\sqrt{3}$ m
(c) 15 m
(d) $15\sqrt{3}$ m

Previously asked in: 2025 30/4/1 Q10

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(d) $15\sqrt{3}$ m

Using $\sin 60^\circ = \dfrac{\text{height}}{\text{hypotenuse}}$: height $= 30 \times \sin 60^\circ = 30 \times \dfrac{\sqrt{3}}{2} = 15\sqrt{3}$ m.

Explanation

The rope is the hypotenuse (30 m) and makes 60° with the ground. The pole (opposite side) = hypotenuse × sin 60°. Students sometimes confuse sin and tan here — use sin because hypotenuse is known, not the base.

Q17. § 9.1 Heights and Distances § 9.2 Summary **[1]**

If the length of the shadow of a tower is $\sqrt{3}$ times that of its height, then altitude of the Sun is :

A 45°
B 30°
C 60°
D 15°

Previously asked in: 2026 30/3/1 Q9

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Option B: 30°

Let height of tower = h, shadow length = √3h. Then tan θ = h/(√3h) = 1/√3, so θ = 30°.

Explanation

The altitude of the Sun equals the angle of elevation from the tip of the shadow to the top of the tower. Using tan θ = height/shadow = h/(√3h) = 1/√3 gives θ = 30°. Remember: tan 30° = 1/√3.

Q18. § 9.2 Summary **[4]**

> Tejas is standing at the top of a building and observes a car at an angle of depression of 30° as it approaches the base of the building at a uniform speed. 6 seconds later, the angle of depression increases to 60°, and at that moment, the car is 25 m away from the building.

Based on the information given above, answer the following questions :

(i) What is the height of the building ? [1]

(ii) What is the distance between the two positions of the car ? [1]

(iii) What would be the total time taken by the car to reach the foot of the building from the starting point ? [2]

Previously asked in: 2026 30/2/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let AB = height of building, C and D be the two positions of the car (C nearer, D farther). CB = 25 m.

(i) Height of the building:

From $\triangle ABC$: $\tan 60° = AB/BC$
$\Rightarrow AB = 25\sqrt{3}$ m

(ii) Distance between the two positions:

From $\triangle ABD$: $\tan 30° = AB/BD$
$\Rightarrow BD = AB/\tan 30° = 25\sqrt{3} \times \sqrt{3} = 75$ m

Distance CD = BD − BC = 75 − 25 = **50 m**

(iii) Total time to reach foot of building from D:

Speed of car = CD/time = 50/6 = 25/3 m/s

Total distance from D to B = 75 m

Total time = 75 ÷ (25/3) = 75 × 3/25 = **9 seconds**

Explanation

- Examiner expects correct tan ratio setup for both angles.
- Height comes directly from the nearer triangle (60°, 25 m).
- For part (iii), find speed from the 50 m in 6 s, then apply it to the full 75 m — many students forget to use the total distance DB, not just DC.

Q19. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two sections 'A' and 'B'. Tower is supported by wires from a point 'O' (as shown in figure). Distance between the base of the tower and point 'O' is 6 m. From point 'O', the angle of elevation of the top of the section 'B' is 30° and the angle of elevation of the top of section 'A' is 60°.

Based on the above information, answer the following questions :

(i) Find the length of the wire from the point 'O' to the top of section 'B'. [1]

(ii) Find the length of the wire from the point 'O' to the top of section 'A'. [1]

(iii) Find the distance AB. [2]

Previously asked in: 2026 30/1/1 Q37

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Given: PO = 6 m, angle of elevation of B = 30°, angle of elevation of A = 60°

(i) Length of wire OB:

In △OPB: cos 30° = PO/OB

$$OB = \frac{PO}{\cos 30^\circ} = \frac{6}{\frac{\sqrt{3}}{2}} = \frac{12}{\sqrt{3}} = 4\sqrt{3}\text{ m}$$

(ii) Length of wire OA:

In △OPA: cos 60° = PO/OA

$$OA = \frac{PO}{\cos 60^\circ} = \frac{6}{\frac{1}{2}} = 12\text{ m}$$

(iii) Distance AB:

$$PB = PO \times \tan 30^\circ = 6 \times \frac{1}{\sqrt{3}} = 2\sqrt{3}\text{ m}$$

$$PA = PO \times \tan 60^\circ = 6 \times \sqrt{3} = 6\sqrt{3}\text{ m}$$

$$AB = PA - PB = 6\sqrt{3} - 2\sqrt{3} = 4\sqrt{3}\text{ m}$$

Source: Applications of Trigonometry, Chapter 9

Explanation

- For wire length, use **cos θ = base/hypotenuse** (hypotenuse = wire = OB or OA).
- For heights PB and PA, use **tan θ = height/base**.
- AB = PA − PB since B is below A on the same vertical tower.
- Examiner awards 1 mark each for (i) and (ii), and in (iii): 1 mark for finding both heights correctly + 1 mark for the subtraction. Show all steps clearly.

Q20. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A car is moving away from the base of a 30 m high tower. The angle of elevation of the top of the tower from the car at an instant, when the car is $10\sqrt{3}$ m away from the base of the tower, is :

(a) 30°
(b) 45°
(c) 90°
(d) 60°

Previously asked in: 2026 30/1/1 Q11

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(d) 60°

Using $\tan\theta = \dfrac{\text{height}}{\text{distance}} = \dfrac{30}{10\sqrt{3}} = \dfrac{3}{\sqrt{3}} = \sqrt{3}$, so $\theta = 60^\circ$.

Explanation

Set up a right triangle: tower height = 30 m (perpendicular), base distance = $10\sqrt{3}$ m. Apply tan(angle of elevation) = opposite/adjacent = $30/10\sqrt{3} = \sqrt{3}$, which corresponds to 60°. This is a direct application of Example 1-style problems from Chapter 9.

Q21. § 9.1 Heights and Distances § 9.2 Summary **[4]**

A straight highway leads to the foot of a tower. A man standing at the top of the tower observes a car at an angle of depression of 30°, which is approaching the foot of the tower with a uniform speed. Ten seconds later, the angle of depression of the car is found to be 60°. Find the time taken by the car to reach the foot of the tower from this point.

Previously asked in: 2022 30/3/1 Q12

◆ **Some Applications of Trigonometry** Angle of Depression and Height-Distance Problems

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Model Answer

Diagram: Let AB = h (height of tower), C and D be the initial and later positions of the car, with D closer to the foot B.

Setting up equations:

In △ABD (angle of depression = 60°):

$$\tan 60^\circ = \frac{h}{BD} \Rightarrow \sqrt{3} = \frac{h}{BD} \Rightarrow BD = \frac{h}{\sqrt{3}}$$

In △ABC (angle of depression = 30°):

$$\tan 30^\circ = \frac{h}{BC} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BC} \Rightarrow BC = h\sqrt{3}$$

Distance covered in 10 seconds:

$$CD = BC - BD = h\sqrt{3} - \frac{h}{\sqrt{3}} = \frac{3h-h}{\sqrt{3}} = \frac{2h}{\sqrt{3}}$$

Time to travel remaining distance BD:

$\text{Speed} = \frac{CD}{10} = \frac{2h}{10\sqrt{3}}$

$$\text{Time} = \frac{BD}{\text{speed}} = \frac{\frac{h}{\sqrt{3}}}{\frac{2h}{10\sqrt{3}}} = \frac{h}{\sqrt{3}} \times \frac{10\sqrt{3}}{2h} = 5 \text{ seconds}$$

The car will reach the foot of the tower in 5 seconds.

Source: Chapter 9 (Some Applications of Trigonometry), Exercise 9.1

Explanation

- Note: The textbook (Q.15) uses **6 seconds**, giving answer **3 seconds**. This question uses **10 seconds**, giving **5 seconds**. The method is identical — only the numbers differ.
- Key step: angles of depression from the top equal angles of elevation from the base (alternate angles), so use tan directly in the right triangles.
- The ratio CD : BD = 2 : 1, so time for BD = half the time for CD. Examiners award marks for correct tan equations, correct CD, correct speed ratio, and final answer.

Q22. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Gadisar Lake is located in the Jaisalmer district of Rajasthan. It was built by the King of Jaisalmer and rebuilt by Gadsi Singh in 14th century. The lake has many Chhatris. One of them is shown below. From a point A, h m above from water level, the angle of elevation of top of Chhatri (point B) is 45° and angle of depression of its reflection in water (point C) is 60°. If the height of Chhatri above water level is (approximately) 10 m.

Observe the picture and answer the following questions:

- **(a)** Draw a well-labelled figure based on the above information. [2]
- **(b)** Find the height (h) of the point A above water level. (Use $\sqrt{3} = 1.73$) [2]

Previously asked in: 2022 30/1/1 Q14

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(a) Well-labelled figure:

```
B (Top of Chhatri)
|
|
| (10–h)
|
A ————————— D
| \ 45°↑
h | \
| 60°↓ \
Water ————————————
|
C (Reflection of B)
```

- A is at height h above water level.
- B is the top of Chhatri, height = 10 m above water.
- C is the reflection of B, depth = 10 m below water.
- AD is the horizontal distance. Angle of elevation ∠BAD = 45°, angle of depression ∠CAD = 60°.

(b) Finding h:

Let AD = horizontal distance = d.

From the figure:

- $BD = (10 - h)$ (B is above A by this amount)
- $CD = (10 + h)$ (C is the reflection, so 10 m below water, total vertical distance from A = $10 + h$)

From angle of elevation (∠BAD = 45°):

$$\tan 45^\circ = \frac{10 - h}{d} \Rightarrow d = (10 - h) \quad \cdots (1)$$

From angle of depression (∠CAD = 60°):

$$\tan 60^\circ = \frac{10+h}{d} \Rightarrow \sqrt{3}\,d = (10+h) \quad \cdots (2)$$

Substituting (1) in (2):

$$\sqrt{3}(10-h) = 10+h$$

$$10\sqrt{3} - \sqrt{3}\,h = 10+h$$

$$10\sqrt{3} - 10 = h + \sqrt{3}\,h = h(1+\sqrt{3})$$

$$h = \frac{10(\sqrt{3}-1)}{\sqrt{3}+1} = \frac{10(\sqrt{3}-1)^2}{(\sqrt{3}+1)(\sqrt{3}-1)} = \frac{10(3-2\sqrt{3}+1)}{2} = \frac{10(4-2\times 1.73)}{2}$$

$$h = \frac{10(4-3.46)}{2} = \frac{10\times 0.54}{2} = \frac{5.4}{2} \approx \boxed{2.7\text{ m}}$$

The height of point A above water level is approximately 2.7 m.

Source: Case Study — Trigonometry (Heights and Distances), Chapter 9

Explanation

- **(a)** The diagram must show: point A at height h, point B (top of Chhatri) at height 10 m, point C (reflection) at depth 10 m below water, horizontal line AD, and both angles clearly marked. Examiners award marks for correct labelling and positioning.
- **(b)** Key insight: The reflection C is as far *below* water as B is *above*, so vertical distance from A to C = (10 + h). Set up two tan equations and solve simultaneously. Rationalise using $(\sqrt{3}-1)^2 = 4 - 2\sqrt{3}$ to get the numerical answer.

Q23. § 9.2 Summary **[3]**

From a point on a bridge across a river, the angles of depression of the banks on opposite sides of the river are $30°$ and $45°$ respectively. If the bridge is at a height of 3 m from the banks, then find the width of the river.

Previously asked in: 2022 30/1/1 Q9(b) (OR-2)

◆ **Some Applications of Trigonometry** | Angles of Depression – Finding Width/Distance using Two Angles from a Height

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Model Answer

Let P be the point on the bridge, D the foot directly below P on the river bed, and A, B the two banks. Given: PD = 3 m, angle of depression to one bank = 30°, to the other = 45°.

In right △APD (∠A = 30°):

$$\tan 30^\circ = \frac{PD}{AD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{3}{AD} \Rightarrow AD = 3\sqrt{3}\text{ m}$$

In right △BPD (∠B = 45°):

$$\tan 45^\circ = \frac{PD}{BD} \Rightarrow 1 = \frac{3}{BD} \Rightarrow BD = 3\text{ m}$$

Width of the river:

$$AB = AD + BD = 3\sqrt{3} + 3 = 3(\sqrt{3} + 1)\text{ m}$$

Source: Chapter 9, Example 7

Explanation

- The angle of depression from P equals the angle of elevation from the bank to P (alternate interior angles), so ∠A = 30° and ∠B = 45° inside the right triangles.
- Use **tan** because you know the perpendicular height (opposite side) and need the horizontal distance (adjacent side).
- The examiner expects a neat diagram description, both triangles solved separately, and the final addition clearly shown. Writing $3(\sqrt{3} + 1)$ m as the answer is sufficient; no decimal approximation needed unless asked.

Q24. § 9.1 Heights and Distances § 9.2 Summary **[3]**

The angle of elevation of the top of a building from the foot of the tower is $30°$ and the angle of elevation of the top of the tower from the foot of the building is $60°$. If the tower is 50 m high, then find the height of the building.

Previously asked in: 2022 30/1/1 Q9(a) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let the height of the building be h m and the horizontal distance between the tower and building be d m.

From the foot of the building (angle of elevation of tower = 60°):

$$\tan 60^\circ = \frac{50}{d} \implies \sqrt{3} = \frac{50}{d} \implies d = \frac{50}{\sqrt{3}}$$

From the foot of the tower (angle of elevation of building = 30°):

$$\tan 30^\circ = \frac{h}{d} \implies \frac{1}{\sqrt{3}} = \frac{h}{d} \implies h = \frac{d}{\sqrt{3}}$$

Substituting the value of d:

$$h = \frac{1}{\sqrt{3}} \times \frac{50}{\sqrt{3}} = \frac{50}{3} = 16\frac{2}{3} \text{ m}$$

The height of the building is $\frac{50}{3}$ m ≈ 16.67 m.

Source: Exercise 9.1, Q.9, Chapter 9

Explanation

- Set up **two right triangles** sharing the same base d (horizontal distance between foot of tower and foot of building).
- Use $\tan 60^\circ$ to find d from the tower's height (given = 50 m), then use $\tan 30^\circ$ to find the building's height.
- The answer $\frac{50}{3}$ m is exact; examiners accept this or its decimal equivalent.
- Draw a neat labelled diagram — it fetches 1 mark in most CBSE marking schemes.

Q25. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 30°. Determine the height of the tower.

Previously asked in: 2023 30/4/1 Q32(B) (OR-2)

◆ Some Applications of Trigonometry | 9.1 Heights and Distances

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Model Answer

Let AB = 7 m (building), CD = height of cable tower, BD = horizontal distance between them.

Draw AE ∥ BD, so AE = BD and ED = AB = 7 m.

Step 1: Find BD using angle of depression (30°)

From A, angle of depression of foot D = 30°.
In △ABD, ∠ADB = 30° (alternate angles):

$$\tan 30^\circ = \frac{AB}{BD} \implies \frac{1}{\sqrt{3}} = \frac{7}{BD} \implies BD = 7\sqrt{3}\ \text{m}$$

So AE = $7\sqrt{3}$ m.

Step 2: Find CE using angle of elevation (60°)

From A, angle of elevation of top C = 60°.
In △AEC:

$$\tan 60^\circ = \frac{CE}{AE} \implies \sqrt{3} = \frac{CE}{7\sqrt{3}} \implies CE = 7\sqrt{3} \times \sqrt{3} = 21\ \text{m}$$

Step 3: Total height of tower

$$CD = CE + ED = 21 + 7 = \boxed{28\ \text{m}}$$

The height of the cable tower is **28 m**.

Source: Chapter 9, Section 9.1 (Heights and Distances)

Explanation

- The key construction is drawing AE horizontal (parallel to BD), splitting the tower height into two parts: ED = 7 m (equal to building height) and CE (found using tan 60°).
- Angle of depression = 30° gives the horizontal distance BD via tan 30°; this same distance is AE used in the second triangle.
- Examiners award marks for: correct diagram (1), correct use of tan 30° to find BD (1–2), correct use of tan 60° to find CE (1–2), and final addition (1). Always show both triangles separately and write the final answer clearly.
- Note: The textbook (Q.12 in Exercise 9.1) has **45°** for angle of depression, giving a different answer (7+7√3 m). This question uses **30°**, so the answer is **28 m**.

Q26. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A straight highway leads to the foot of a tower. A man standing on the top of the 75 m high tower observes two cars at angles of depression of $30°$ and $60°$, which are approaching the foot of the tower. If one car is exactly behind the other on the same side of the tower, find the distance between the two cars. (use $\sqrt{3} = 1.73$)

Previously asked in: 2023 30/4/1 Q32(A) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let AB = 75 m be the tower. Let C and D be the two cars on the highway, with D farther from the tower.

Diagram: Tower AB vertical; C and D on the ground with D beyond C from the tower. Angles of depression to C and D are 60° and 30° respectively.

In right △ABC (angle of depression = 60°):

$$\tan 60^\circ = \frac{AB}{BC}$$

$$\sqrt{3} = \frac{75}{BC}$$

$$BC = \frac{75}{\sqrt{3}} = \frac{75\sqrt{3}}{3} = 25\sqrt{3}\text{ m}$$

In right △ABD (angle of depression = 30°):

$$\tan 30^\circ = \frac{AB}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{75}{BD}$$

$$BD = 75\sqrt{3}\text{ m}$$

Distance between the two cars:

$$CD = BD - BC = 75\sqrt{3} - 25\sqrt{3} = 50\sqrt{3}\text{ m}$$

$$CD = 50 \times 1.73 = \mathbf{86.5\ m}$$

Source: Chapter 9 (Some Applications of Trigonometry), Exercise 9.1

Explanation

- **Key idea:** Angle of depression from the top = angle of elevation from the car to the top (alternate angles with the horizontal). So use tan directly in the right triangle formed by tower height and ground distance.
- The car at 60° is *closer* (smaller distance BC); the car at 30° is *farther* (larger distance BD). Distance between cars = BD − BC.
- Always rationalize $\frac{75}{\sqrt{3}}$ to get $25\sqrt{3}$.
- Substitute $\sqrt{3} = 1.73$ only at the final step.

- Draw and label the diagram — it typically carries 1 mark in CBSE.

Q27. § 9.1 Heights and Distances § 9.2 Summary **[1]**

If a pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then the sun's elevation is :

(a) $60°$
(b) $45°$
(c) $30°$
(d) $90°$

Previously asked in: 2023 30/4/1 Q9

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

(a) 60°

Here, pole height = 6 m, shadow length = $2\sqrt{3}$ m. $\tan\theta = \dfrac{6}{2\sqrt{3}} = \dfrac{3}{\sqrt{3}} = \sqrt{3}$, so $\theta = 60^\circ$.

Explanation

Set up a right triangle where the pole is the opposite side and the shadow is the adjacent side. Using $\tan\theta = \frac{\text{height}}{\text{shadow}}$ gives $\sqrt{3}$, which corresponds to 60°. Remember: $\tan 60^\circ = \sqrt{3}$, $\tan 45^\circ = 1$, $\tan 30^\circ = \frac{1}{\sqrt{3}}$.

Q28. § 9.1 Heights and Distances § 9.2 Summary **[2]**

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

Previously asked in: 2023 30/2/1 Q24(a) (OR-1)

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Let the height of the tower be h and the length of its shadow be $\sqrt{3}\,h$.

Let θ be the angle of elevation of the sun.

In the right triangle formed:

$$\tan\theta = \frac{\text{height of tower}}{\text{length of shadow}} = \frac{h}{\sqrt{3}\,h} = \frac{1}{\sqrt{3}}$$

Since $\tan 30^\circ = \dfrac{1}{\sqrt{3}}$, we get $\theta = 30^\circ$.

The angle of elevation of the sun is 30°.

Source: Chapter 9, Heights and Distances (Exercise 9.1)

Explanation

- Draw the right triangle with the tower as the perpendicular side and the shadow as the base.
- Use $\tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{h}{\sqrt{3}h}$; the h cancels, leaving $\frac{1}{\sqrt{3}}$.
- Recall the standard value: $\tan 30^\circ = \frac{1}{\sqrt{3}}$, so $\theta = 30^\circ$.
- Always state the final answer clearly; examiners award the last mark for the correct conclusion.

Q29. § 9.2 Summary **[5]**

From a point on a bridge across the river, the angles of depressions of the banks on opposite sides of the river are 30° and 60° respectively. If the bridge is at a height of 4 m from the banks, find the width of the river.

Previously asked in: 2024 30/5/1 Q33

◆ **Some Applications of Trigonometry** | Angle of Depression – Width of River from a Bridge

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Model Answer

Diagram: Let P be the point on the bridge, D the foot of the vertical from P to the river level. Let A and B be the two banks, with angles of depression 30° and 60° respectively. PD = 4 m.

AB = AD + DB is the width of the river.

In right △APD (angle of depression = 30°, so ∠PAD = 30°):

$$\tan 30^\circ = \frac{PD}{AD}$$

$$\frac{1}{\sqrt{3}} = \frac{4}{AD}$$

$$AD = 4\sqrt{3}\text{ m}$$

In right △PBD (angle of depression = 60°, so ∠PBD = 60°):

$$\tan 60^\circ = \frac{PD}{BD}$$

$$\sqrt{3} = \frac{4}{BD}$$

$$BD = \frac{4}{\sqrt{3}} = \frac{4\sqrt{3}}{3}\text{ m}$$

Width of the river:

$$AB = AD + BD = 4\sqrt{3} + \frac{4\sqrt{3}}{3} = \frac{12\sqrt{3} + 4\sqrt{3}}{3} = \frac{16\sqrt{3}}{3}\text{ m}$$

$$\boxed{AB = \frac{16\sqrt{3}}{3}\text{ m}}$$

Source: Chapter 9, Section 9.1 Heights and Distances (cf. Example 7)

Explanation

- This is a direct application of Example 7 in the textbook, but with height **4 m** and angles **30° and 60°** (instead of 3 m, 30° and 45°).
- Key step: the angle of depression from the bridge equals the angle of elevation from the bank (alternate interior angles), so use tan directly in each right triangle.
- Don't forget to **rationalize** $\frac{4}{\sqrt{3}}$ to get $\frac{4\sqrt{3}}{3}$, then add the two distances carefully.

- Examiners award marks for the diagram, correct trig equations, correct individual distances, and the final addition — show each step.

Q30. § 9.1 Heights and Distances § 9.2 Summary **[5]**

Two pillars of equal lengths stand on either side of a road which is 100 m wide, exactly opposite to each other. At a point on the road between the pillars, the angles of elevation of the tops of the pillars are 60° and 30°. Find the length of each pillar and distance of the point on the road from the pillars. (Use $\sqrt{3} = 1.732$)

Previously asked in: 2024 30/4/1 Q32

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Diagram: Let AB and CD be two pillars of equal height h m. Let P be the point on the road between them, with BP = x m, so PD = (100 − x) m.

In △ABP (angle of elevation = 60°):

$$\tan 60^\circ = \frac{AB}{BP} \implies \sqrt{3} = \frac{h}{x} \implies h = x\sqrt{3} \quad \cdots (1)$$

In △CDP (angle of elevation = 30°):

$$\tan 30^\circ = \frac{CD}{PD} \implies \frac{1}{\sqrt{3}} = \frac{h}{100 - x} \implies h = \frac{100 - x}{\sqrt{3}} \quad \cdots (2)$$

From (1) and (2):

$$x\sqrt{3} = \frac{100 - x}{\sqrt{3}}$$

$$3x = 100 - x \implies 4x = 100 \implies x = 25 \text{ m}$$

Height of each pillar:

$$h = 25\sqrt{3} = 25 \times 1.732 = 43.3 \text{ m}$$

Distances:

- Distance from pillar AB = BP = **25 m**
- Distance from pillar CD = PD = 100 − 25 = **75 m**

∴ The length of each pillar is **43.3 m**, and the point P is **25 m** from one pillar and **75 m** from the other.

Source: Chapter 9, Exercise 9.1 (Q.10 variant), Heights and Distances

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Explanation

- Set up **two right triangles** sharing the point P; label distances as x and (100 − x).
- Use **tan** for both elevation angles since you have opposite (height) and adjacent (horizontal distance).
- Equate the two expressions for h to find x, then substitute back.
- Examiners award marks for: diagram/setup (1), correct equations (1+1), solving for x (1), final height with √3 value (1).
- Note: the pillar with the **larger** elevation angle (60°) is **closer** to P — a quick sanity check.

Q31. § 9.2 Summary **[5]**

Two ships are sailing in the sea on either side of a lighthouse. The angles of depression to the two ships as observed from the top of the lighthouse are 60° and 45°, respectively. If the distance between the ships is $100\left(\frac{\sqrt{3}+1}{\sqrt{3}}\right)$ m, then find the height of the lighthouse.

Previously asked in: 2025 30/2/1 Q32 (OR-1)

◆ Some Applications of Trigonometry | 9.1 Heights and Distances

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Model Answer

Let the height of the lighthouse = h m.

Let the lighthouse be AB, with ships at C and D on either side.

- Angle of depression to ship C = 60° → ∠ACB = 60° (alternate angles)
- Angle of depression to ship D = 45° → ∠ADB = 45°

In right △ABC (angle 60°):

$$\tan 60^\circ = \frac{h}{BC} \Rightarrow \sqrt{3} = \frac{h}{BC} \Rightarrow BC = \frac{h}{\sqrt{3}}$$

In right △ABD (angle 45°):

$$\tan 45^\circ = \frac{h}{BD} \Rightarrow 1 = \frac{h}{BD} \Rightarrow BD = h$$

Total distance between ships:

$$BC + BD = \frac{h}{\sqrt{3}} + h = h\left(\frac{1}{\sqrt{3}} + 1\right) = h \cdot \frac{\sqrt{3}+1}{\sqrt{3}}$$

Given: $BC + BD = 100\left(\frac{\sqrt{3}+1}{\sqrt{3}}\right)$

$$h \cdot \frac{\sqrt{3}+1}{\sqrt{3}} = 100 \cdot \frac{\sqrt{3}+1}{\sqrt{3}}$$

$$\boxed{h = 100 \text{ m}}$$

The height of the lighthouse is **100 m**.

Source: Some Applications of Trigonometry, Chapter 9

Explanation

- **Key concept:** Angle of depression from the top equals the angle of elevation from the ship's position (alternate interior angles with the horizontal). Use tan ratio in each right triangle.
- **Common mistake:** Forgetting that the ships are on *opposite sides*, so their distances add up (not subtract).
- **Examiner expects:** Diagram/setup (1 mark), two tan equations (2 marks), sum = given distance (1 mark), final answer (1 mark). Always state the conclusion clearly.

Q32. § 9.1 Heights and Distances § 9.2 Summary **[1]**

A kite is flying at a height of 150 m from the ground. It is attached to a string inclined at an angle of 30° to the horizontal. The length of the string is:

A $100\sqrt{3}$ m
B 300 m
C $150\sqrt{3}$ m
D $150\sqrt{2}$ m

Previously asked in: 2025 30/1/1 Q17

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Option B: 300 m

Using $\sin 30^\circ = \dfrac{\text{height}}{\text{string length}}$, we get $\dfrac{1}{2} = \dfrac{150}{L}$, so $L = 300$ m.

Explanation

The height (150 m) is the side opposite the 30° angle, and the string is the hypotenuse. Use $\sin\theta =$ opposite/hypotenuse. $\sin 30^\circ = \frac{1}{2}$, giving $L = 150 \times 2 = 300$ m. Don't confuse with tan or cos here.

Q33. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A kite is flying at a height of 60 m above the ground level. Ravi, standing at the roof of the house is holding the string straight and observes the angle of elevation of kite as $30°$. From the bottom of the same building, the angle of elevation of kite is $45°$. Find the length of the string and height of roof from the ground. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2026 30/4/1 Q34

◆ **Some Applications of Trigonometry** 9.1 Heights and Distances

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Model Answer

Diagram: Let the ground be at point A. The kite is at point K, 60 m above the ground. The building stands vertically; roof is at point R, ground level at point B (foot of building).

Let height of roof = h m. Height of kite above roof = (60 − h) m.
Horizontal distance between kite and building = d m.

From the bottom of the building (point B), angle of elevation = 45°:

$$\tan 45^\circ = \frac{60}{d}$$

$$1 = \frac{60}{d} \implies d = 60 \text{ m}$$

From the roof (point R), angle of elevation = 30°:

$$\tan 30^\circ = \frac{60 - h}{d}$$

$$\frac{1}{\sqrt{3}} = \frac{60 - h}{60}$$

$$60 - h = \frac{60}{\sqrt{3}} = 20\sqrt{3}$$

$$h = 60 - 20\sqrt{3} = 60 - 20 \times 1.73 = 60 - 34.6 = 25.4 \text{ m}$$

Length of string (from roof R to kite K):

$$\sin 30^\circ = \frac{60 - h}{\text{string}}$$

$$\frac{1}{2} = \frac{20\sqrt{3}}{\text{string}}$$

$$\text{String} = 40\sqrt{3} = 40 \times 1.73 = 69.2 \text{ m}$$

∴ **Height of roof = 25.4 m; Length of string = 69.2 m.**

Source: Chapter 9 — Heights and Distances, Section 9.1

Explanation

- Two right triangles are formed: one from the ground (angle 45°) and one from the roof (angle 30°), both looking at the same kite at 60 m height.
- From the ground triangle, find horizontal distance first (tan 45° = 1 makes it straightforward).
- Use that distance in the roof triangle to find the roof height.
- For the string length, use sin 30° with the vertical height difference (60 − h) as the opposite side — the string is the hypotenuse from Ravi's position to the kite.
- Always substitute √3 = 1.73 numerically at the end as the question requires.

Q34. § 9.2 Summary **[4]**

From the top of an 8 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 45°. Determine the height of the tower. (Take $\sqrt{3} = 1.732$).

Previously asked in: 2022 30/4/1 Q12

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

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Model Answer

Diagram: Let AB = 8 m be the building, CD be the cable tower. Draw BE ∥ AC. Then BE = AC (horizontal distance) and CE = AB = 8 m.

Step 1: Find horizontal distance (AC)

Angle of depression of foot of tower = 45°
In △ABC (right-angled at C):

$$\tan 45^\circ = \frac{AB}{AC} \Rightarrow 1 = \frac{8}{AC} \Rightarrow AC = 8\text{ m}$$

So BE = AC = 8 m.

Step 2: Find DE (height above building level)

Angle of elevation of top of tower = 60°
In △BED (right-angled at E):

$$\tan 60^\circ = \frac{DE}{BE} \Rightarrow \sqrt{3} = \frac{DE}{8} \Rightarrow DE = 8\sqrt{3}\text{ m}$$

Step 3: Total height of tower

$$CD = CE + DE = 8 + 8\sqrt{3} = 8(1 + \sqrt{3})$$

$$= 8(1 + 1.732) = 8 \times 2.732 = \mathbf{21.856\ m}$$

The height of the cable tower is $8(1 + \sqrt{3})$ m ≈ 21.856 m.

Source: Chapter 9, Exercise 9.1 (Q.12), Heights and Distances

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Explanation

- Draw a horizontal line from the top of the building to create two separate right triangles — this is the key construction step examiners look for.
- Angle of **depression** (45°) gives the horizontal distance; angle of **elevation** (60°) gives the extra height above the building.
- Total tower height = height of building + extra height = 8 + 8√3.
- Always substitute √3 = 1.732 and compute the numerical value when the question asks for it.
- The textbook Q.12 uses a 7 m building; this variant uses 8 m — the method is identical.

Q35. § 9.1 Heights and Distances § 9.2 Summary **[5]**

The angle of elevation of the top of a tower 24 m high from the foot of another tower in the same plane is 60°. The angle of elevation of the top of second tower from the foot of the first tower is 30°. Find the distance between two towers and the height of the other tower. Also, find the length of the wire attached to the tops of both the towers.

Previously asked in: 2023 30/1/1 Q33(a) (OR-1)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances
Length of wire between tops of two towers (Pythagoras / distance formula in context)

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Model Answer

Let tower AB = 24 m (first tower), tower CD = h m (second tower), and distance between them = BC = d m.

Step 1: Find distance between towers (d)

From foot of tower CD (point C), angle of elevation of top of AB = 60°.

In $\triangle$ABC:

$$\tan 60^\circ = \frac{AB}{BC} \Rightarrow \sqrt{3} = \frac{24}{d} \Rightarrow d = \frac{24}{\sqrt{3}} = 8\sqrt{3}\text{ m}$$

Step 2: Find height of second tower (h)

From foot of tower AB (point B), angle of elevation of top of CD = 30°.

In $\triangle$BCD:

$$\tan 30^\circ = \frac{CD}{BC} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{8\sqrt{3}} \Rightarrow h = \frac{8\sqrt{3}}{\sqrt{3}} = 8\text{ m}$$

Step 3: Find length of wire (AC) joining tops of both towers

$$AC = \sqrt{BC^2 + (AB - CD)^2} = \sqrt{(8\sqrt{3})^2 + (24 - 8)^2}$$

$$= \sqrt{192 + 256} = \sqrt{448} = 4\sqrt{28} = 8\sqrt{7}\text{ m}$$

Results: Distance between towers = $8\sqrt{3}$ m, height of second tower = 8 m, length of wire = $8\sqrt{7}$ m.

Source: Chapter 9, Section 9.1 Heights and Distances

Explanation

- Draw a clear diagram and label both towers before solving — examiners award a mark for the diagram.
- Use tan ratio since you know the opposite (height) and adjacent (distance) sides.
- For the wire length, apply Pythagoras on the right triangle formed by the horizontal distance and the **difference** in heights (since tops are at different levels).
- Keep exact surd form unless told to approximate; $\sqrt{448} = \sqrt{64 \times 7} = 8\sqrt{7}$.

Q36. § 9.1 Heights and Distances § 9.2 Summary **[5]**

A boy standing on a horizontal plane is flying a kite with a string of length 60 m, at an angle of elevation of 30°. Another boy standing on the roof of a 20 m high building, finds the angle of elevation of same kite to be 45°. If both the boys are on opposite sides of the kite, find the distance of the first boy from the base of the building. Also, find the height of the kite from the ground. (Use $\sqrt{3} = 1 \cdot 73$)

Previously asked in: 2026 30/3/1 Q35

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

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Model Answer

Let the height of the kite from the ground = h m.

For Boy 1 (on ground):

String length = 60 m, angle of elevation = 30°

$$\sin 30^\circ = \frac{h}{60} \implies \frac{1}{2} = \frac{h}{60} \implies h = 30 \text{ m}$$

∴ **Height of kite from ground = 30 m**

For Boy 2 (on roof of 20 m building):

Height of kite above Boy 2's level = 30 − 20 = 10 m
Angle of elevation = 45°

$$\tan 45^\circ = \frac{10}{d} \implies 1 = \frac{10}{d} \implies d = 10 \text{ m}$$

where d = horizontal distance of kite from the building.

Total distance of Boy 1 from base of building:

Let horizontal distance of kite from Boy 1 = x.

$$\cos 30^\circ = \frac{x}{60} \implies \frac{\sqrt{3}}{2} = \frac{x}{60} \implies x = 30\sqrt{3} \text{ m}$$

Since both boys are on opposite sides of the kite:

$$\text{Distance of Boy 1 from base of building} = x + d = 30\sqrt{3} + 10$$

$$= 30 \times 1.73 + 10 = 51.9 + 10 = \mathbf{61.9 \text{ m}}$$

Height of kite from ground = 30 m; Distance of Boy 1 from base of building = 61.9 m.

Source: Chapter 9, Section 9.1 Heights and Distances

Explanation

- Use **sin** for Boy 1 (string is hypotenuse, height is opposite side).
- For Boy 2, subtract building height from kite height to get the vertical difference, then use **tan 45° = 1**.
- Use **cos 30°** to find the horizontal distance from Boy 1 to the point below the kite.
- Since the boys are on **opposite sides**, add the two horizontal distances to get the total distance between Boy 1 and the building base.

- Examiners expect a clear diagram (optional but helpful), labelled equations, and substitution of $\sqrt{3} = 1.73$ at the final step.

Q37. § 9.1 Heights and Distances § 9.2 Summary **[1]**

From a point on the ground, which is 60 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 45°. The height (in metres) of the tower is :

A $10\sqrt{3}$
B $30\sqrt{3}$
C 60
D 30

Previously asked in: 2026 30/2/1 Q12

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Option C: 60

Using $\tan 45^\circ = \frac{\text{height}}{\text{distance}} = \frac{h}{60}$, and since $\tan 45^\circ = 1$, we get $h = 60$ m.

Explanation

Apply $\tan(\text{angle of elevation}) = \frac{\text{opposite}}{\text{adjacent}} = \frac{h}{60}$. Since $\tan 45^\circ = 1$, height = 60 m directly. No surds involved — a common trap is confusing this with 30° or 60° cases.

Q38. § 9.1 Heights and Distances § 9.2 Summary **[3]**

The tops of two poles of heights 20 m and 28 m are connected with a wire. The wire is inclined to the horizontal at an angle of 30°. Find the length of the wire and the distance between the two poles.

Previously asked in: 2022 30/3/1 Q8

◆ Some Applications of Trigonometry | 8.2 Trigonometric Ratios | 8.3 Trigonometric Ratios of Some Specific Angles

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Model Answer

Let the two poles AB = 20 m and CD = 28 m be standing vertically. The wire connects their tops, i.e., A and C.

Difference in heights = 28 − 20 = **8 m** = CE (where E is the point on CD such that AE is horizontal).

In right $\triangle$AEC, the wire AC is inclined at 30° to the horizontal.

Length of wire (AC):

$$\sin 30^\circ = \frac{CE}{AC}$$

$$\frac{1}{2} = \frac{8}{AC}$$

$$AC = 16 \text{ m}$$

Distance between the poles (AE = BD):

$$\cos 30^\circ = \frac{AE}{AC}$$

$$\frac{\sqrt{3}}{2} = \frac{AE}{16}$$

$$AE = 8\sqrt{3} \text{ m}$$

$\therefore$ The length of the wire is **16 m** and the distance between the poles is $8\sqrt{3}$ **m**.

Source: Chapter 9 — Some Applications of Trigonometry

Explanation

- The key step is finding the **vertical difference** between the two poles (28 − 20 = 8 m), which becomes the "opposite side" in the right triangle formed by the wire, the vertical height difference, and the horizontal distance.
- Use **sin 30°** for the wire length (hypotenuse) and **cos 30°** for the horizontal distance (distance between poles).
- Examiners expect a clear diagram description or labelling, correct trig ratio setup, and both answers stated explicitly.

Q39. § 9.1 Heights and Distances § 9.2 Summary **[5]**

One observer estimates the angle of elevation to the basket of a hot air balloon to be 60°, while another observer 100 m away estimates the angle of elevation to be 30°. Find :

(a) The height of the basket from the ground.

(b) The distance of the basket from the first observer's eye.

(c) The horizontal distance of the second observer from the basket.

Previously asked in: 2023 30/5/1 Q32

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Setup: Let the two observers stand on the ground. Let the basket be at height h m. Let the horizontal distance from the first observer (60°) to the point directly below the basket be d m. The second observer is 100 m farther away, so their horizontal distance is $(d + 100)$ m.

From first observer:

$$\tan 60^\circ = \frac{h}{d} \Rightarrow \sqrt{3} = \frac{h}{d} \Rightarrow d = \frac{h}{\sqrt{3}} \quad \cdots (1)$$

From second observer:

$$\tan 30^\circ = \frac{h}{d+100} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{d+100} \Rightarrow d + 100 = h\sqrt{3} \quad \cdots (2)$$

Substituting (1) into (2):

$$\frac{h}{\sqrt{3}} + 100 = h\sqrt{3}$$

$$100 = h\sqrt{3} - \frac{h}{\sqrt{3}} = h\left(\frac{3-1}{\sqrt{3}}\right) = \frac{2h}{\sqrt{3}}$$

$$h = \frac{100\sqrt{3}}{2} = 50\sqrt{3} \text{ m}$$

(a) Height of the basket:

$$h = 50\sqrt{3} \approx 86.6 \text{ m}$$

(b) Distance of basket from first observer's eye (line of sight):

$$d = \frac{50\sqrt{3}}{\sqrt{3}} = 50 \text{ m}$$

$$\text{Line of sight} = \frac{h}{\sin 60^\circ} = \frac{50\sqrt{3}}{\frac{\sqrt{3}}{2}} = 100 \text{ m}$$

(c) Horizontal distance of second observer from the basket:

$$d + 100 = 50 + 100 = 150 \text{ m}$$

Source: Chapter 9 — Heights and Distances, Section 9.1

Explanation

- **Key method:** Set up two right triangles sharing the same height h and solve simultaneous equations using tan of each angle.
- Examiners award marks for: correct diagram/setup (1 mark), forming both equations (1 mark), solving for h (1 mark), part (b) using sin or the Pythagorean relationship for the hypotenuse (1 mark), part (c) direct substitution (1 mark).
- For (b), the "distance from the observer's eye" means the **line of sight** (hypotenuse), not the horizontal distance. Use $\sin 60^\circ = h/\text{hypotenuse}$.
- Always verify: $d = 50$ m, $d + 100 = 150$ m, and check $\tan 30^\circ = 50\sqrt{3}/150 = 1/\sqrt{3}$ ✓

Q40. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From a point on the ground, the angle of elevation of the bottom and top of a transmission tower fixed at the top of 30 m high building are 30° and 60°, respectively. Find the height of the transmission tower. (Use $\sqrt{3} = 1{\cdot}73$)

Previously asked in: 2023 30/2/1 Q33(b) (OR-2)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Diagram: Let P be the point on the ground, AB = 30 m be the building, and BC = h be the transmission tower. Let PA = d.

Step 1: In △PAB (angle of elevation to bottom of tower = 30°):

$$\tan 30^\circ = \frac{AB}{PA} \Rightarrow \frac{1}{\sqrt{3}} = \frac{30}{d}$$

$$d = 30\sqrt{3} \text{ m}$$

Step 2: In △PAC (angle of elevation to top of tower = 60°, AC = AB + BC = 30 + h):

$$\tan 60^\circ = \frac{AC}{PA} \Rightarrow \sqrt{3} = \frac{30 + h}{30\sqrt{3}}$$

$$30 + h = \sqrt{3} \times 30\sqrt{3} = 90$$

$$h = 90 - 30 = 60 \text{ m}$$

Therefore, the height of the transmission tower = 60 m.

(Using $\sqrt{3} = 1.73$, the distances are consistent; the tower height is exactly 60 m.)

Source: Chapter 9, Exercise 9.1 (Q.7 variant), Heights and Distances

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Explanation

- The key is setting up **two separate right triangles** from the same point P: one to the base of the tower (bottom of tower = top of building) and one to the top of the tower.
- Use tan for both since you have opposite (height) and adjacent (horizontal distance) sides.
- Find the horizontal distance from the first triangle, then substitute into the second.
- Examiners award marks for: correct diagram (1 mark), correct equation for tan 30° (1 mark), correct equation for tan 60° (1 mark), solving for d (1 mark), and final answer h = 60 m (1 mark).

Q41. § 9.1 Heights and Distances § 9.2 Summary **[5]**

As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 60°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships. (Use $\sqrt{3} = 1{\cdot}73$)

Previously asked in: 2023 30/2/1 Q33(a) (OR-1)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles
Angles of Depression – Two Ships/Objects from a Lighthouse

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Model Answer

Diagram: Let AB = 75 m be the lighthouse. Let C and D be the two ships, with D farther from the lighthouse. Angles of depression to D and C are 30° and 60° respectively.

In right △ABC (nearer ship, angle of depression = 60°):

$$\tan 60^\circ = \frac{AB}{BC}$$

$$\sqrt{3} = \frac{75}{BC} \implies BC = \frac{75}{\sqrt{3}} = 25\sqrt{3}\text{ m}$$

In right △ABD (farther ship, angle of depression = 30°):

$$\tan 30^\circ = \frac{AB}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{75}{BD} \implies BD = 75\sqrt{3}\text{ m}$$

Distance between the two ships:

$$CD = BD - BC = 75\sqrt{3} - 25\sqrt{3} = 50\sqrt{3}\text{ m}$$

$$= 50 \times 1.73 = \boxed{86.5\text{ m}}$$

Source: Chapter 9, Heights and Distances (Exercise 9.1, Q.13)

Explanation

- The angle of depression from the top of the lighthouse equals the angle of elevation from the ship to the top (alternate angles), so tan is applied directly with height = 75 m.
- The ship closer to the lighthouse makes a **larger** angle of depression (60°), and the farther ship makes a smaller angle (30°) — a common point students get wrong.
- CD = BD − BC is the key final step.
- Always substitute √3 = 1.73 at the end and state the unit (metres).

Q42. § 9.1 Heights and Distances § 9.2 Summary **[2]**

The angle of elevation of the top of a tower from a point on the ground which is 30 m away from the foot of the tower, is 30°. Find the height of the tower.

Previously asked in: 2023 30/2/1 Q24(b) (OR-2)

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Let AB be the height of the tower and BC = 30 m be the distance from the foot.

In right △ABC, ∠ACB = 30°

$$\tan 30^\circ = \frac{AB}{BC}$$

$$\frac{1}{\sqrt{3}} = \frac{AB}{30}$$

$$AB = \frac{30}{\sqrt{3}} = \frac{30\sqrt{3}}{3} = 10\sqrt{3}\text{ m}$$

∴ The height of the tower is $10\sqrt{3}$ m.

Source: Exercise 9.1, Q.4; Chapter 9 — Some Applications of Trigonometry

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Explanation

- Draw a right triangle with the tower as the vertical side (AB), the ground distance as the base (BC = 30 m), and angle of elevation at C = 30°.
- Use **tan** because you have the opposite side (height) and adjacent side (distance).
- Rationalise $\frac{30}{\sqrt{3}}$ by multiplying numerator and denominator by $\sqrt{3}$ to get $10\sqrt{3}$.
- Examiner expects: diagram description (optional but good), correct trig ratio, clear working, and the final answer in simplified surd form.

Q43. § 9.1 Heights and Distances § 9.2 Summary **[1]**

At some time of the day, the length of the shadow of a tower is equal to its height. Then, the Sun's altitude at that time is :

A $30°$
B $45°$
C $60°$
D $90°$

Previously asked in: 2024 30/4/1 Q14

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Option B: 45°

When shadow length = height of tower, $\tan\theta$ = height/shadow = 1, so $\theta = 45°$.

Explanation

Let tower height = h; shadow length = h. Sun's altitude = angle of elevation θ, so $\tan\theta = h/h = 1 \Longrightarrow \theta = 45°$. Remember: $\tan 45° = 1$ is a standard trigonometric value.

Q44. § 9.1 Heights and Distances § 9.2 Summary **[5]**

From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

Previously asked in: 2024 30/3/1 Q34

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Diagram: Let AB = 20 m (building), BC = tower, P = point on ground, PB = horizontal distance.

Step 1: In △PAB, angle of elevation of bottom of tower (top of building) = 45°.

$$\tan 45^\circ = \frac{AB}{PA} \implies 1 = \frac{20}{PA} \implies PA = 20 \text{ m}$$

Step 2: Let height of tower BC = h m. Then total height PC = (20 + h) m.

In △PAC, angle of elevation of top of tower = 60°.

$$\tan 60^\circ = \frac{AC}{PA} \implies \sqrt{3} = \frac{20+h}{20}$$

Step 3: Solving:

$$20\sqrt{3} = 20 + h$$

$$h = 20\sqrt{3} - 20 = 20(\sqrt{3} - 1) \text{ m}$$

∴ **Height of the tower** = $20(\sqrt{3} - 1)$ **m ≈ 14.64 m**

Source: Exercise 9.1, Q.7; Chapter 9 — Some Applications of Trigonometry

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Explanation

- The key is setting up **two separate right triangles** from the same point P: one to the base of the tower (top of building) and one to the top of the tower.
- Since 45° elevation gives tan 45° = 1, the horizontal distance equals the building height (20 m) — this is the crucial first step.
- Examiners expect a **labelled diagram**, both tan equations shown clearly, and the final answer simplified to $20(\sqrt{3} - 1)$ m. Writing the decimal approximation is optional but appreciated.

Q45. § 9.1 Heights and Distances § 9.2 Summary **[1]**

From a point on the ground, which is 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 60°. The height (in metres) of the tower is :

A $10\sqrt{3}$
B $30\sqrt{3}$
C 60
D 30

Previously asked in: 2024 30/3/1 Q7

◆ Some Applications of Trigonometry | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

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Model Answer

Option B: $30\sqrt{3}$ **m**

Using $\tan 60^\circ = \frac{h}{30}$, we get $\sqrt{3} = \frac{h}{30}$, so $h = 30\sqrt{3}$ m.

Explanation

This directly applies $\tan(\text{angle of elevation}) = \frac{\text{height}}{\text{base distance}}$. The base is 30 m and angle is 60°, so multiply 30 by $\tan 60^\circ = \sqrt{3}$. This mirrors Example 1 of Chapter 9 (where base = 15 m gave $15\sqrt{3}$). Don't confuse with Exercise Q4 (which has the same base but angle 30°, giving a different answer).

Q46. § 9.2 Summary **[5]**

From the top of a 45 m high light house, the angles of depression of two ships, on the opposite side of it, are observed to be 30° and 60°. If the line joining the ships passes through the foot of the light house, find the distance between the ships. (Use $\sqrt{3} = 1.73$)

Previously asked in: 2024 30/2/1 Q34

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

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Model Answer

Diagram: Let AB = 45 m be the lighthouse. Ships are at C and D on opposite sides, with foot of lighthouse at B. Angle of depression to C = 60°, angle of depression to D = 30°.

For Ship C (angle of depression = 60°):

In $\triangle$ABC,

$$\tan 60^\circ = \frac{AB}{BC}$$

$$\sqrt{3} = \frac{45}{BC}$$

$$BC = \frac{45}{\sqrt{3}} = \frac{45\sqrt{3}}{3} = 15\sqrt{3}\text{ m}$$

For Ship D (angle of depression = 30°):

In $\triangle$ABD,

$$\tan 30^\circ = \frac{AB}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{45}{BD}$$

$$BD = 45\sqrt{3}\text{ m}$$

Distance between the two ships:

$$CD = BC + BD = 15\sqrt{3} + 45\sqrt{3} = 60\sqrt{3}\text{ m}$$

$$= 60 \times 1.73 = \boxed{103.8\text{ m}}$$

Source: Some Applications of Trigonometry, Chapter 9

Explanation

- Since the ships are on **opposite sides**, distances BC and BD are **added** (not subtracted).
- The angle of depression from the top equals the angle of elevation from the ship's position (alternate angles with horizontal), so directly use tan in the right triangle formed.
- Always rationalize $\frac{45}{\sqrt{3}}$ to get $15\sqrt{3}$ — examiners check this step.
- Substitute $\sqrt{3} = 1.73$ only in the final step to avoid rounding errors midway.
- Drawing a neat labelled diagram typically earns 1 mark on its own.

Q47. § 9.1 Heights and Distances | § 9.2 Summary **[4]**

> A lighthouse stands tall on a cliff by the sea, watching over ships that pass by. One day a ship is seen approaching the shore and from the top of the lighthouse, the angles of depression of the ship are observed to be 30° and 45° as it moves from point P to point Q. The height of the lighthouse is 50 metres.

Based on the information given above, answer the following questions:

(i) Find the distance of the ship from the base of the lighthouse when it is at point Q, where the angle of depression is 45°. [1]

(ii) Find the measures of $\angle PBA$ and $\angle QBA$. [1]

(iii) Find the distance travelled by the ship or the speed of the ship. [2]

Previously asked in: 2025 30/3/1 Q37

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | Angle of Depression from top of lighthouse/tower to a moving object | Distance travelled by a moving ship using two angles of depression

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Model Answer

Let A be the top of the lighthouse, B be the base, height AB = 50 m.

(i) Distance of ship at Q (angle of depression = 45°):

In △ABQ: tan 45° = AB/BQ

$$1 = \frac{50}{BQ} \Rightarrow BQ = 50 \text{ m}$$

(ii) Measures of ∠PBA and ∠QBA:

Since AB ⊥ BP (base is horizontal), both ∠PBA and ∠QBA = **90°**.

(iii) Distance travelled by the ship (PQ):

In △ABP: tan 30° = AB/BP

$$\frac{1}{\sqrt{3}} = \frac{50}{BP} \Rightarrow BP = 50\sqrt{3} \text{ m}$$

Distance travelled = PQ = BP − BQ

$$= 50\sqrt{3} - 50 = 50(\sqrt{3} - 1) \text{ m} \approx 50(1.732 - 1) = 36.6 \text{ m}$$

Source: Chapter 9 – Some Applications of Trigonometry

Explanation

- **Part (i):** Straightforward tan ratio with 45°; tan 45° = 1 so BQ = height = 50 m.
- **Part (ii):** ∠PBA and ∠QBA are the angles at base B in the respective right triangles, both equal 90° since the lighthouse is vertical and the ground is horizontal.
- **Part (iii):** Find BP using tan 30°, then subtract BQ from BP. Remember to simplify and rationalize. Examiners expect the expression $50(\sqrt{3} - 1)$ m clearly shown.

Q48. § 9.1 Heights and Distances § 9.2 Summary **[1]**

Assertion (A): A ladder leaning against a wall, stands at a horizontal distance of 6 m from the wall. If the height of the wall up to which the ladder reaches is 8 m, then the length of the ladder is 10 m.

Reason (R): The ladder makes an angle of 60° with the ground.

Select the correct answer from the codes (A), (B), (C) and (D) given below:

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

Previously asked in: 2025 30/3/1 Q19

◆ **Some Applications of Trigonometry** 8.2 Trigonometric Ratios 9.1 Heights and Distances

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Model Answer

(C) Assertion (A) is true, but Reason (R) is false.

Assertion is true: by Pythagoras theorem, ladder = $\sqrt{6^2 + 8^2} = \sqrt{100} = 10$ m. Reason is false: the angle the ladder makes with the ground is $\tan^{-1}(8/6) \approx 53^{\circ}$, not 60°.

Explanation

- Verify the Assertion using the Pythagoras theorem (no trigonometry needed).
- To check Reason, use $\tan\theta = \text{opposite}/\text{adjacent} = 8/6 = 4/3$; this gives $\approx 53^{\circ}$, not 60°. So Reason is false, making option (C) correct.
- In Assertion-Reason questions, always verify both statements independently before choosing the option.

Q49. § 9.2 Summary **[5]**

The angles of depression of the top and the bottom of an 8 m tall building from the top of another multistoried building are 30° and 45°, respectively. Find the height of the multistoried building and the distance between the two buildings.

Previously asked in: 2025 30/2/1 Q32 (OR-2)

◆ **Some Applications of Trigonometry** | 8.3 Trigonometric Ratios of Some Specific Angles | 9.1 Heights and Distances

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Model Answer

Diagram: Let PC = multi-storeyed building, AB = 8 m tall building. Draw PQ horizontal from P. Angles of depression to top (B) and bottom (A) of AB are 30° and 45° respectively.

By alternate angles: ∠PBD = 30° and ∠PAC = 45°, where BD ∥ AC (horizontal distances).

Let PD = h m (height above B), so PC = PD + DC = h + 8.
Also, AC = BD (distance between buildings).

In right △PAC:

$$\tan 45^\circ = \frac{PC}{AC} \Rightarrow 1 = \frac{PC}{AC} \Rightarrow AC = PC$$

In right △PBD:

$$\tan 30^\circ = \frac{PD}{BD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BD} \Rightarrow BD = h\sqrt{3}$$

Since AC = BD and PC = h + 8:

$$h + 8 = h\sqrt{3}$$

$$h(\sqrt{3} - 1) = 8 \Rightarrow h = \frac{8}{\sqrt{3} - 1} \times \frac{\sqrt{3} + 1}{\sqrt{3} + 1} = 4(\sqrt{3} + 1)\ \mathrm{m}$$

Height of multi-storeyed building:

$$PC = 4(\sqrt{3} + 1) + 8 = 4\sqrt{3} + 4 + 8 = 4(\sqrt{3} + 3)\ \mathrm{m}$$

Distance between buildings:

$$AC = PC = 4(\sqrt{3} + 3)\ \mathrm{m}$$

Source: Chapter 9 – Heights and Distances, Example 6

Explanation

- Draw a clear labelled diagram — examiners award 1 mark for it.
- The key step is using **alternate interior angles** to convert angles of depression into angles of elevation inside the right triangles (∠QPB = ∠PBD = 30°, etc.).
- Set up two tan equations, then solve simultaneously using AC = BD and PC = PD + 8.
- Rationalise the denominator when computing PD — leave answer in surd form as $4(\sqrt{3} + 3)$ m.
- Both the height and the distance come out equal here, which is a good self-check.

Q50. § 9.1 Heights and Distances § 9.2 Summary **[4]**

> Amrita stood near the base of a lighthouse, gazing up at its towering height. She measured the angle of elevation to the top and found it to be 60°. Then, she climbed a nearby observation deck, 40 metres higher than her original position and noticed the angle of elevation to the top of lighthouse to be 45°.

Based on the above given information, answer the following questions:

(i) Find CD in terms of h (where h is the height). [1]

(ii) Find BD in terms of BC. [1]

(iii) Find the height CE of the lighthouse. [Use $\sqrt{3} = 1{\cdot}73$] [2]

Previously asked in: 2025 30/1/1 Q38

◆ **Some Applications of Trigonometry** 8.3 Trigonometric Ratios of Some Specific Angles 9.1 Heights and Distances

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Model Answer

Let CE = height of lighthouse, CD = horizontal distance, DE = h (height above D), so CE = CD + DE...

Setup: Let BC = h (height of lighthouse above observation deck level), so BE = h. Let CD = horizontal distance from Amrita to lighthouse base.

(i) From point B (observation deck), angle of elevation = 45°:

$$\tan 45^\circ = \frac{BE}{BD} \Rightarrow 1 = \frac{h}{BD} \Rightarrow BD = h$$

$$\therefore CD = BD = h$$

(ii) From point B, angle of elevation = 45°:

$$\tan 45^\circ = \frac{BE}{BD} = 1 \Rightarrow BD = BE = BC$$

$$\therefore BD = BC$$

(iii) From point A (ground level), angle of elevation = 60°. AB = 40 m, so AE = h + 40:

$$\tan 60^\circ = \frac{h+40}{CD} \Rightarrow \sqrt{3} = \frac{h+40}{h}$$

$$\sqrt{3}\,h = h + 40 \Rightarrow h(\sqrt{3} - 1) = 40$$

$$h = \frac{40}{\sqrt{3} - 1} = \frac{40(\sqrt{3} + 1)}{2} = 20(\sqrt{3} + 1)$$

$$h = 20(1.73 + 1) = 20 \times 2.73 = 54.6 \text{ m}$$

$$\therefore CE = h + 40 = 54.6 + 40 = \mathbf{94.6 \text{ m}}$$

Explanation

- The key is setting **BC = h** (lighthouse height above deck level B) and noting CD = BD since tan 45° = 1.
- For part (iii), from A the full height seen is **(h + 40)** over horizontal distance **h**, giving the equation with √3.
- Rationalize the denominator properly. Examiners check the rationalization step and correct substitution of √3 = 1.73.
- Label all parts clearly — examiners award step marks for correct tan ratio setup, equation, and final answer.

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