# UNIQUE STUDY POINT

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| **Class:** X | **Subject:** Mathematics | **Session:** 2024-25 |
| **Chapter:** 09 - Some Applications of Trigonometry | **Time:** 1½ Hours | **Max. Marks:** 40 |

**General Instructions:**

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A comprises of 10 MCQs of 1 mark each.
4. Section B comprises of 4 questions of 2 marks each.
5. Section C comprises of 3 questions of 3 marks each.
6. Section D comprises of 1 question of 5 marks.
7. Section E comprises of 2 Case Study Based questions of 4 marks each.
8. Use of Calculators is not permitted.

## SECTION A - Multiple Choice Questions (1 mark each)

**1.** If 300 m high pole makes an angle of elevation at a point on ground which is 300 m away from its foot, then the angle of elevation is:

(a) 60°
(b) 90°
(c) 30°
(d) 45°

**2.** The angle of depression of a bike parked on the road from the top of a 90 m high pole is 60 degrees. The distance of the bike from the pole is:

(a) 20√3 m
(b) 90 m
(c) 15√3 m
(d) 30√3 m

**3.** A stone is 15√3 m away from a tower 15 m high, then the angle of elevation of the top of the tower from the stone is:

(a) 45°
(b) 60°
(c) 30°
(d) 90°

**4.** The ratio of the length of a tower and its shadow is √3 : 1. The altitude of the sun is:

(a) 0°
(b) 60°

(c) 30°
(d) 45°

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

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

**6.** The tops of two poles of heights 20 m and 14 m are connected by a wire. If the wire makes an angle of 30° with the horizontal, then the length of the wire is

(a) 8 m
(b) 10 m
(c) 12 m
(d) 14 m

**7.** If the angle of depression of an object from a temple is 30°, and the distance of the object from the temple is 45 m, then the height of the temple is:

(a) $45\sqrt{3}$ m
(b) $15\sqrt{3}$ m
(c) 20 m
(d) $20\sqrt{3}$ m

**8.** If two towers of heights $h_1$ and $h_2$ subtend angles of 60° and 30° respectively at the mid-point of the line joining their feet, then $h_1 : h_2$ =

(a) 1 : 2
(b) 1 : 3
(c) 2 : 1
(d) 3 : 1

**In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:**

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

**9. Assertion (A):** If the length of shadow of a vertical pole is equal to its height, then the angle of elevation of the sun is 45°.

**Reason (R):** According to Pythagoras theorem, $h^2 = l^2 + b^2$, where h = hypotenuse, l = length and b = base.

**10. Assertion (A):** The ladder 20 m long makes an angle 60° with the wall, then the height of the point where the ladder touches the wall is 15 m.

**Reason (R):** For an angle θ, cos θ = Adjacent Side / Hypotenuse

## SECTION B - Short Answer Questions (2 marks each)

**11.** The angle of depression of a car standing on the ground, from the top of a 85 m high tower is 45°. Find the distance of the car from the base of the tower.

**12.** A pole casts a shadow of length $2\sqrt{3}$ m on ground, when the sun's elevation is 60°. Find the height of the pole.

**13.** The figure shows the observation of point C from point A. Find the angle of depression from A.

[Given: Vertical height = $5\sqrt{3}$ m, Horizontal distance = 5 m]

**14.** The shadow of a flagstaff is three times as long as the shadow of the flagstaff when the sunrays meet the ground at an angle of 60°. Find the angle between the sunrays and the ground at the time of longer shadow.

## SECTION C - Short Answer Questions (3 marks each)

**15.** A man rowing a boat away from a lighthouse 150 m high takes 2 minutes to change the angle of elevation of the top of lighthouse from 45° to 30°. Find the speed of the boat. (Use $\sqrt{3} = 1.732$)

**16.** A man on the deck of a ship, 12 m above water level, observes that the angle of elevation of the top of a cliff is 60° and the angle of depression of the base of the cliff is 30°. Find the distance of the cliff from the ship and the height of the cliff. [Use $\sqrt{3} = 1.732$]

**17.** As observed from the top of a 100 m high light house from the sea-level, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same side of the light house, find the distance between the two ships [Use $\sqrt{3} = 1.732$]

## SECTION D - Long Answer Question (5 marks)

**18.** At a point A, 20 metres above the level of water in a lake, the angle of elevation of a cloud is 30°. The angle of depression of the reflection of the cloud in the lake, at A is 60°. Find the distance of the cloud from A.

## SECTION E - Case Study Based Questions (4 marks each)

**19.** A 1.2 m tall girl spots a balloon moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the eyes of the girl at any instant is 60°. After 30 seconds, the angle of elevation reduces to 30°.

Based on the above information, answer the following questions. (Take $\sqrt{3} = 1.732$)

(i) Find the distance travelled by the balloon during the interval. (2 marks)

(ii) Find the speed of the balloon. (2 marks)

**OR**

(ii) If the elevation of the sun at a given time is 30°, then find the length of the shadow cast by a tower of 150 feet height at that time. (2 marks)

**20.** Anita purchased a new building for her business. Being in the prime location, she decided to make some more money by putting up an advertisement sign for a rental ad income on the roof of the building.

From a point P on the ground level, the angle of elevation of the roof of the building is 30° and the

angle of elevation of the top of the sign board is 45°. The point P is at a distance of 24 m from the base of the building.

On the basis of the above information, answer the following questions:

(i) Find the height of the building (without the sign board). (2 marks)

**OR**

Find the height of the building (with the sign board) (2 marks)

(ii) Find the height of the sign board. (1 mark)

(iii) Find the distance of the point P from the top of the sign board. (1 mark)

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# DETAILED ANSWER KEY - PAPER 11

## SECTION A - Answers to MCQs

**1. Answer: (d) 45°**

**Explanation:** Height = Distance = 300 m

tan θ = Height/Distance = 300/300 = 1

Therefore, θ = 45°

**2. Answer: (d) 30√3 m**

**Explanation:** Height of pole = 90 m, Angle of depression = 60°

tan 60° = 90/Distance

√3 = 90/Distance

Distance = 90/√3 = 90√3/3 = 30√3 m

**3. Answer: (c) 30°**

**Explanation:** Height of tower = 15 m, Distance = 15√3 m

tan θ = 15/(15√3) = 1/√3

Therefore, θ = 30°

**4. Answer: (b) 60°**

**Explanation:** Tower : Shadow = √3 : 1

tan θ = √3/1 = √3

Therefore, θ = 60°

**5. Answer: (c) 12 m**

**Explanation:** Height difference = 16 - 10 = 6 m

sin 30° = 6/l

1/2 = 6/l

l = 12 m

**6. Answer: (c) 12 m**

**Explanation:** Height difference = 20 - 14 = 6 m

sin 30° = 6/length of wire

1/2 = 6/l

l = 12 m

**7. Answer: (b) 15√3 m**

**Explanation:** Distance = 45 m, Angle of depression = 30°

tan 30° = Height/45

1/√3 = Height/45

Height = 45/√3 = 45√3/3 = 15√3 m

**8. Answer: (d) 3 : 1**

**Explanation:** Let distance to midpoint = x

For $h_1$: tan 60° = $h_1/x \rightarrow h_1 = x\sqrt{3}$

For $h_2$: tan 30° = $h_2/x \rightarrow h_2 = x/\sqrt{3}$

$h_1/h_2 = (x\sqrt{3})/(x/\sqrt{3}) = \sqrt{3} \times \sqrt{3} = 3$

Therefore, $h_1 : h_2 = 3 : 1$

**9. Answer: (c) Assertion (A) is true but reason (R) is false.**

**Explanation:** When shadow length = pole height, tan θ = height/shadow = 1, so θ = 45° (A is true)

Reason mentions Pythagoras theorem which is not the correct explanation for angle of elevation (R is not the correct explanation)

**10. Answer: (d) Assertion (A) is false but reason (R) is true.**

**Explanation:** cos 60° = height/20

1/2 = height/20

height = 10 m (not 15 m, so A is false)

The formula for cos θ is correct (R is true)

## SECTION B - Answers to Short Answer Questions

**11. Solution:**

Given: Height of tower = 85 m, Angle of depression = 45°

Let distance of car from base = d

tan 45° = 85/d

1 = 85/d

**d = 85 m**

**12. Solution:**

Given: Shadow length = 2√3 m, Sun's elevation = 60°

Let height of pole = h

tan 60° = h/(2√3)

√3 = h/(2√3)

h = 2√3 × √3 = 2 × 3 = 6 m

**Height of pole = 6 m**

**13. Solution:**

Given: Vertical height AB = $5\sqrt{3}$ m, Horizontal distance BC = 5 m

$\tan\theta = AB/BC = 5\sqrt{3}/5 = \sqrt{3}$

$\theta = 60°$

**Angle of depression from A = 60°**

**14. Solution:**

Given: At 60°, let shadow length = x, then longer shadow = 3x

Let height of flagstaff = h

When angle = 60°: $\tan 60° = h/x \rightarrow h = x\sqrt{3}$

For longer shadow: $\tan\theta = h/(3x) = x\sqrt{3}/(3x) = \sqrt{3}/3 = 1/\sqrt{3}$

Therefore, $\theta = 30°$

**Angle = 30°**

## SECTION C - Answers to Short Answer Questions

**15. Solution:**

Given: Height of lighthouse = 150 m

At 45°: $\tan 45° = 150/d_1 \rightarrow d_1 = 150$ m

At 30°: $\tan 30° = 150/d_2 \rightarrow 1/\sqrt{3} = 150/d_2 \rightarrow d_2 = 150\sqrt{3} = 150 \times 1.732 = 259.8$ m

Distance travelled = $d_2 - d_1 = 259.8 - 150 = 109.8$ m

Time = 2 minutes = 120 seconds

Speed = 109.8/120 = 0.915 m/s

**Speed of boat = 0.915 m/s or approximately 54.9 m/min**

**16. Solution:**

Given: Man's height above water = 12 m

Let distance from ship to cliff = x

For base of cliff (angle of depression 30°): $\tan 30° = 12/x$

$1/\sqrt{3} = 12/x \rightarrow x = 12\sqrt{3} = 12 \times 1.732 = 20.784$ m

For top of cliff (angle of elevation 60°): Let height above man = h

$\tan 60° = h/x \rightarrow \sqrt{3} = h/20.784 \rightarrow h = 20.784\sqrt{3} = 36$ m

Total height of cliff = 12 + 36 = 48 m

**Distance of cliff = 20.784 m ≈ 20.8 m**

**Height of cliff = 48 m**

**17. Solution:**

Given: Height of lighthouse = 100 m

For ship at 45°: $\tan 45° = 100/d_1 \rightarrow d_1 = 100$ m

For ship at 30°: $\tan 30° = 100/d_2 \rightarrow 1/\sqrt{3} = 100/d_2 \rightarrow d_2 = 100\sqrt{3} = 173.2$ m

Distance between ships = $d_2 - d_1 = 173.2 - 100 = 73.2$ m

**Distance between the two ships = 73.2 m**

## SECTION D - Answer to Long Answer Question

### 18. Solution:

Given: Point A is 20 m above water level

Angle of elevation to cloud = 30°

Angle of depression to reflection = 60°

Let height of cloud above water = H

Height of cloud above A = H - 20

Depth of reflection below water = H

Distance of reflection from A = H + 20

Let horizontal distance = x

From elevation: $\tan 30° = (H - 20)/x \rightarrow 1/\sqrt{3} = (H - 20)/x \rightarrow x = (H - 20)\sqrt{3}$

From depression: $\tan 60° = (H + 20)/x \rightarrow \sqrt{3} = (H + 20)/x \rightarrow x = (H + 20)/\sqrt{3}$

Equating: $(H - 20)\sqrt{3} = (H + 20)/\sqrt{3}$

$3(H - 20) = H + 20$

$3H - 60 = H + 20$

$2H = 80 \rightarrow H = 40$ m

$x = (40 - 20)\sqrt{3} = 20\sqrt{3}$ m

Distance of cloud from A = $\sqrt{[x^2 + (H - 20)^2]} = \sqrt{[(20\sqrt{3})^2 + 20^2]}$

$= \sqrt{[1200 + 400]} = \sqrt{1600} = 40$ m

**Distance of cloud from A = 40 m**

## SECTION E - Answers to Case Study Based Questions

### 19. Solution:

Given: Girl's height = 1.2 m, Balloon height = 88.2 m

Height from eye level = 88.2 - 1.2 = 87 m

**(i) Distance travelled by balloon:**

At 60°: $\tan 60° = 87/d_1 \rightarrow \sqrt{3} = 87/d_1 \rightarrow d_1 = 87/\sqrt{3} = 87/1.732 \approx 50.23$ m

At 30°: $\tan 30° = 87/d_2 \rightarrow 1/\sqrt{3} = 87/d_2 \rightarrow d_2 = 87\sqrt{3} = 87 \times 1.732 \approx 150.68$ m

Distance travelled = $d_2 - d_1 = 150.68 - 50.23 = 100.45$ m

**Distance travelled ≈ 100.45 m**

**(ii) Speed of balloon:**

Time = 30 seconds

Speed = 100.45/30 ≈ 3.35 m/s

**Speed ≈ 3.35 m/s**

**OR**

**(ii) Shadow length for 150 feet tower at 30° elevation:**

tan 30° = 150/shadow

1/√3 = 150/shadow

shadow = 150√3 = 150 × 1.732 = 259.8 feet

**Shadow length ≈ 259.8 feet**

**20. Solution:**

Given: Distance from P = 24 m

Angle to roof = 30°, Angle to top of sign = 45°

**(i) Height of building (without sign board):**

tan 30° = h/24

1/√3 = h/24

h = 24/√3 = 24√3/3 = 8√3 ≈ 13.86 m

**Height of building ≈ 13.86 m or 8√3 m**

**OR**

**Height of building (with sign board):**

tan 45° = H/24

1 = H/24

H = 24 m

**Total height = 24 m**

**(ii) Height of sign board:**

Height of sign board = Total height - Building height

= 24 - 8√3 = 24 - 13.86 = 10.14 m

**Height of sign board ≈ 10.14 m**

**(iii) Distance from P to top of sign board:**

Distance = $\sqrt{(24^2 + 24^2)} = \sqrt{(576 + 576)} = \sqrt{1152} = 24\sqrt{2} \approx 33.94$ m

**Distance ≈ 33.94 m or 24√2 m**

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