Chapter 9: Some Applications of Trigonometry Notes for Class 10

1. The Horizontal Line

The horizontal line is a straight, flat line drawn through the eye of the observer, perfectly parallel to the ground.

2. The Line of Sight

The line of sight is the straight line drawn from the observer's eye to the object they're looking at. If you're standing on the ground looking at the top of a tower, the line from your eye to the top of that tower is your line of sight.

3. Angle of Elevation

When the object is above the observer's horizontal level, like the top of a building, a flying kite, or a cloud, the observer tilts their line of sight upward. The angle between the horizontal line and this upward-tilted line of sight is called the angle of elevation.

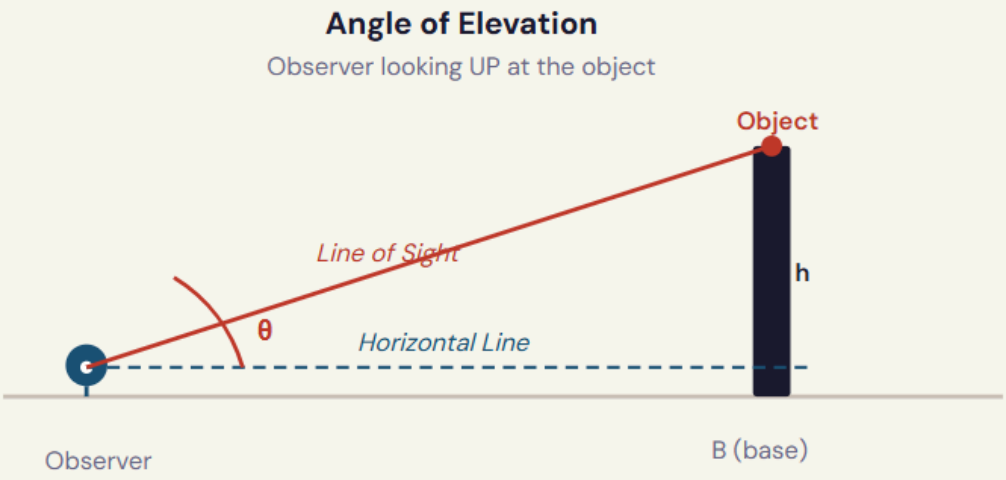

Fig. 1 — Angle of Elevation (θ): Observer at ground level looking upward at an object. The angle θ is formed between the horizontal line and the line of sight.

4. Angle of Depression

When the object is below the observer's horizontal level, like when you're standing on a rooftop looking down at a car on the street, the line of sight dips below the horizontal. The angle between the horizontal line and this downward line of sight is called the angle of depression.

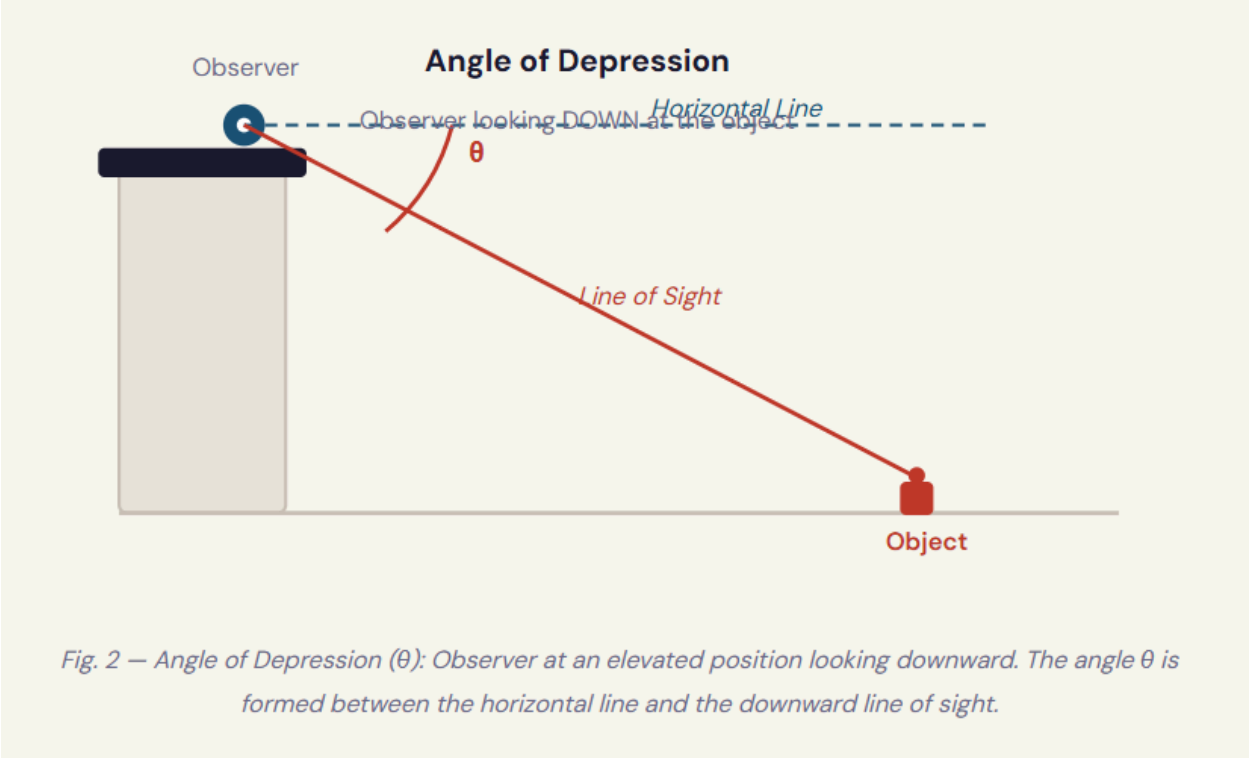

Fig. 2 — Angle of Depression (θ): Observer at an elevated position looking downward. The angle θ is formed between the horizontal line and the downward line of sight.

5. Trigonometric Ratios: Standard Angle Values

You must know these values cold before solving any problem. The three angles that appear in almost every NCERT exercise problem are 30°, 45°, and 60°. The angles 0° and 90° appear occasionally in special cases.

Ratio	0°	30°	45°	60°	90°
sin θ	0	1/2	1/√2	√3/2	1
cos θ	1	√3/2	1/√2	1/2	0

tan θ	0	1/√3	1	√3	∞ (undefined)
cosec θ	∞	2	√2	2/√3	1
sec θ	1	2/√3	√2	2	∞
cot θ	∞	√3	1	1/√3	0

6. How to Solve Any Heights & Distances Problem

Here's the four-step method that works for every single problem in this chapter.

Step 1: Identify every number in the problem : angles (like 30°, 60°) and distances (like '20 m away').

Step 2: Draw the Diagram. Mark the observer, the object, the line of sight, and all known values. Label the unknown as x or h.

Step 3: Apply tan (or sin)

Form the right-angled triangle. Use tan θ = opp/adj (most common) or sin θ = opp/hyp when the string/rope is given.

Step 4: Solve & Verify

Substitute the angle value from the table. Solve for the unknown. Check if the answer makes physical sense.

7. Previous Year Questions

Q1: CBSE 2017

The ratio of the height of a tower to the length of its shadow on the ground is √3 : 1. What is the angle of elevation of the sun?

Solution: Let the tower height = √3 units and shadow length = 1 unit.

Let θ be the angle of elevation.

tan θ = Height / Shadow = √3 / 1 = √3

tan 60° = √3

⇒ θ = 60°

Angle of elevation of the sun = 60°

Q2: A ladder 10 m long just reaches the top of a wall. If the ladder makes an angle of 30° with the wall, find the height of the wall.

Solution: Ladder = hypotenuse = 10 m.

Angle with wall = 30°. Height = adjacent side to this angle.
cos 30° = height / ladder ⇒ √3/2 = h/10
⇒ h = 10 × √3/2 = 5√3 m
Height of the wall = 5√3 m ≈ 8.66 m

Q3: A circus artist is climbing a 20 m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the height of the pole if the angle made by the rope with the ground level is 30°.
Solution: Rope AC = 20 m (hypotenuse). ∠ACB = 30°.
AB = height of pole (opposite side).
sin 30° = AB / AC
⇒ 1/2 = AB/20
⇒ AB = 10 m
Height of the pole = 10 m

Q4: CBSE 2020
An observer 1.5 metres tall is 20.5 metres away from a tower 22 metres high. Determine the angle of elevation of the top of the tower from the eye of the observer.
Solution: Effective vertical height above observer's eye = 22 − 1.5 = 20.5 m.
Horizontal distance = 20.5 m.
tan θ = 20.5 / 20.5 = 1
⇒ tan 45° = 1 ⇒ θ = 45°
Angle of elevation = 45°

Q5: CBSE 2019 & 2022
The shadow of a tower standing on a level ground is found to be 40 m longer when the Sun's altitude is 30° than when it is 60°. Find the height of the tower.
Solution: Let: AB = h (tower), BC = x (shadow at 60°),
BD = x + 40 (shadow at 30°).
tan 60° = h/x h = √3x
tan 30° = h/(x+40) ⇒ h = (x+40)/√3
√3x = (x+40)/√3 ⇒ 3x = x+40 ⇒ x = 20 m ⇒ h = 20√3 m
Height of the tower = 20√3 m ≈ 34.64 m

Q6: CBSE 2021
A vertical tower stands on a horizontal plane and is surmounted by a flagstaff of height 7 m. From a point on the plane, the angle of elevation of the bottom of the

flagstaff is 30° and that of the top of the flagstaff is 45°. Find the height of the tower. (Use $\sqrt{3} = 1.732$)

Solution:

Let: AB = tower (h), BC = flagstaff = 7 m, D = point, AD = d (horizontal).

$\tan 30° = h/d \Rightarrow d = h\sqrt{3}$

$\tan 45° = (h+7)/d \Rightarrow d = h+7$

$h\sqrt{3} = h+7$

$\Rightarrow h(\sqrt{3}-1) = 7 \Rightarrow h = 7/(\sqrt{3}-1)$

$h = 7(\sqrt{3}+1)/2 = 7(2.732)/2 \approx 9.56$ m

Height of tower = $7(\sqrt{3}+1)/2 \approx 9.56$ m

Q7: CBSE 2023

Two poles of equal heights are standing opposite each other on either side of a road 80 m wide. From a point between them on the road, the angles of elevation of the tops of the poles are 60° and 30° respectively. Find the height of the poles and the distances of the point from the poles.

Solution:

Let: AB = CD = h. O = point on road. OB = a, OD = b. a + b = 80 m.

$\tan 60° = h/a \Rightarrow h = a\sqrt{3}$ …(i)

$\tan 30° = h/b \Rightarrow h = b/\sqrt{3}$ …(ii)

$a\sqrt{3} = b/\sqrt{3} \Rightarrow 3a = b.$

Also $a+b = 80 \Rightarrow a+3a = 80 \Rightarrow a = 20$ m, $b = 60$ m

$h = 20\sqrt{3}$ m

Height = $20\sqrt{3}$ m. Distances: 20 m (from 60° pole) and 60 m (from 30° pole).

Q9: CBSE 2019 & 2023

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 45°. Determine the height of the cable tower.

Solution:

Let: AB = building = 7 m. CE = cable tower.

Observer at A. Horizontal distance = d.

Depression to foot (45°): $\tan 45° = 7/d \Rightarrow d = 7$ m

Elevation to top (60°): $\tan 60° = DE/7 \Rightarrow DE = 7\sqrt{3}$ m

Total tower height = $DE + AB = 7\sqrt{3} + 7 = 7(\sqrt{3} + 1)$ m

Height of cable tower = $7(\sqrt{3} + 1)$ m ≈ 19.12 m

8. Chapter Summary at a Glance

Concept	Definition	Key Formula
Horizontal Line	A line through the observer's eye, parallel to the ground.	Reference for all angles
Line of Sight	The line from the observer's eye to the object being viewed.	Forms the hypotenuse of the right triangle
Angle of Elevation	The angle between the horizontal line and the upward line of sight.	$\tan\theta = h/d$
Angle of Depression	The angle between the horizontal line and the downward line of sight.	$\text{Tan } \theta = h/d$
Height (h)	The vertical distance; the perpendicular side of the right triangle.	h = d \times tanθ
Horizontal Distance (d)	The base of the right triangle from the observer to the foot of the object.	$d = h/\tan\theta$
Using sinθ	Used when the hypotenuse (rope, string, ladder, etc.) is given.	$\text{Sin}\theta = h / L$