Class 10 Mathematics · Chapter 9: Some Applications of Trigonometry

Answer key and marking scheme · 20 marks · about 40 minutes · based on NCERT

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1. In a heights problem, the horizontal distance d from the foot of a tower and the angle of elevation θ of its top are known, and the height h is wanted. The ratio to use is [1]

(a) $\sin\theta = \frac{h}{d}$ (b) $\tan\theta = \frac{h}{d}$

(c) $\cos\theta = \frac{h}{d}$ (d) $\sec\theta = \frac{h}{d}$

Answer: (b) h is the side opposite θ and d is the side adjacent to it; both are legs of the right triangle, so the ratio relating them is tan θ = h/d.

2. The angle of elevation of the top of a mobile tower, seen by an observer, is the angle between [1]

(a) the line of sight and the horizontal through the observer's eye (b) the line of sight and the tower

(c) the tower and the ground (d) the line of sight and the vertical through the observer's eye

Answer: (a) Both angles of elevation and depression are measured from the horizontal through the eye, up to the line of sight. Option (d) measures from the vertical, which is the usual slip.

3. An escalator in a metro station is 14 m long and makes an angle of 30° with the horizontal. The vertical height it lifts a passenger through is [1]

(a) 7√3 m (b) 14√3 m

(c) 7 m (d) $\frac{14}{\sqrt{3}}$ m

Answer: (c) The escalator is the hypotenuse and the height is opposite the 30° angle, so height = 14 sin 30° = 14 × 1/2 = 7 m. 7√3 m is the horizontal run (cos 30°).

4. A vertical pole casts a shadow on level ground equal to its own height. The angle of elevation of the Sun is [1]

(a) 30° (b) 60°

(c) 90° (d) 45°

Answer: (d) tan θ = height / shadow = 1, and tan 45° = 1, so θ = 45°.

5. Meena, standing on her balcony, looks down at a scooter parked on the road. The angle between her line of sight and the horizontal through her eye is called the [1]

(a) angle of elevation (b) angle of depression

(c) line of sight (d) right angle

Answer: (b) The scooter is below the horizontal level of her eye, so the angle her line of sight makes with the horizontal is an angle of depression.

6. A guy-rope runs from the top of a vertical tent pole to a peg on level ground 6 m from the foot of the pole, and makes an angle of 30° with the ground. Find the height of the pole and the length of the rope. (Use √3 ≈ 1.73.) [2]

Height = 6 tan 30° = 6/√3 = 2√3 m ≈ 3.46 m. Rope = 6 ÷ cos 30° = 12/√3 = 4√3 m ≈ 6.92 m.

- height = 6 tan 30° = 2√3 ≈ 3.46 m (1)
- rope = 6 ÷ cos 30° = 4√3 ≈ 6.92 m (1)

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7. A straight loading plank 2.8 m long rests from the ground to the floor of a truck and makes an angle of 30° with the ground. Find the height of the truck's floor above the ground and the horizontal distance from the foot of the plank to the truck. (Use $\sqrt{3} \approx 1.73$.) [2]

The plank is the hypotenuse. Height = 2.8 sin 30° = 2.8 × 1/2 = 1.4 m. Horizontal distance = 2.8 cos 30° = 2.8 × $\sqrt{3}/2 = 1.4\sqrt{3}$ m ≈ 2.42 m.

- height = 2.8 sin 30° = 1.4 m (1)
- horizontal distance = 2.8 cos 30° = $1.4\sqrt{3} \approx 2.42$ m (1)

8. In a heights problem, a distance comes out as $\frac{24}{\sqrt{3}-1}$ m. Write it in the form $a(\sqrt{3}+1)$ m and find its value. (Use $\sqrt{3} \approx 1.73$.) [2]

Multiply numerator and denominator by $(\sqrt{3}+1)$: $24(\sqrt{3}+1)/(3-1) = 12(\sqrt{3}+1)$ m ≈ 12 × 2.73 = 32.76 m.

- rationalises with $(\sqrt{3}+1)$ to get $12(\sqrt{3}+1)$ (1)
- value ≈ 32.76 m (1)

9. AB is a building 12 m tall and CD a tower, both standing on level ground 20 m apart (B and D the feet). From the top A of the building, the angle of elevation of the top C of the tower is 45°. Let AE be the horizontal through A, meeting CD at E. (i) Explain why AE = 20 m and ED = 12 m. (ii) Find the height of the tower. [3]

(i) AB and ED are vertical, BD and AE horizontal, so ABDE is a rectangle; opposite sides are equal, so AE = BD = 20 m and ED = AB = 12 m. (ii) In right ΔAEC, tan 45° = CE/AE, so CE = 20 m. Tower CD = CE + ED = 20 + 12 = 32 m.

- ABDE is a rectangle, so AE = BD and ED = AB (1)
- CE = 20 tan 45° = 20 m (1)
- CD = 32 m (1)

10. From the top of a watch-tower in a forest, two deer on opposite sides of the tower, in a straight line with its foot, are seen at angles of depression of 60° and 45°. The deer are 60 m apart. Find the height of the watch-tower. (Use $\sqrt{3} \approx 1.73$.) [3]

Let the height be h. The deer are at h cot 60° = $h/\sqrt{3}$ and h cot 45° = h from the foot. The foot lies between them, so the distances add: $h/\sqrt{3} + h = 60$, giving $h(1+\sqrt{3}) = 60\sqrt{3}$ and $h = 60\sqrt{3}/(\sqrt{3}+1) = 60\sqrt{3}(\sqrt{3}-1)/2 = 30(3-\sqrt{3})$ m ≈ 30 × 1.27 = 38.1 m.

- distances $h/\sqrt{3}$ and h from the foot (1)
- opposite sides, so adds: $h/\sqrt{3} + h = 60$ (1)
- $h = 30(3-\sqrt{3}) \approx 38.1$ m (1)

11. A cyclist rides along a straight level road towards a tower. At one point the angle of elevation of its top is 30°; after he rides 60 m further, it is 45°. Find the height of the tower. (Use $\sqrt{3} \approx 1.73$.) [3]

Let the height be h. First distance from the foot = h cot 30° = $h\sqrt{3}$; second = h cot 45° = h. Their difference is the 60 m ridden: $h\sqrt{3} - h = 60$, so $h = 60/(\sqrt{3}-1) = 60(\sqrt{3}+1)/2 = 30(\sqrt{3}+1)$ m ≈ 30 × 2.73 = 81.9 m.

- writes the two distances $h\sqrt{3}$ and h (1)
- forms $h\sqrt{3} - h = 60$ (1)
- $h = 30(\sqrt{3}+1) \approx 81.9$ m (1)