Some Applications of Trigonometry

Standard difficulty · 20 questions · 40 marks · Time: 44 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. From a point on the ground 15 m from the foot of a clock tower, the angle of elevation of its top is 45°. Its height is:

(a) 15 m **(b)** 30 m **(c)** 15√3 m **(d)** 5√3 m

2. The angle of elevation of the top of a lighthouse 60 m high, from a point on level ground, is 60°. How far is the point from its foot?

(a) 60√3 m **(b)** 60 m **(c)** 20√3 m **(d)** 120 m

3. A kite is flying at a height of 63 m. Its string makes an angle of 30° with the ground. Taking the string as straight, its length is:

(a) 42√3 m **(b)** 63 m **(c)** 63√2 m **(d)** 126 m

4. A ladder 18 m long leans against a wall and makes an angle of 30° with the ground. How high up the wall does it reach?

(a) 9 m **(b)** 9√2 m **(c)** 9√3 m **(d)** 18 m

5. The angle of elevation of an object is measured from:

(a) the horizontal, upwards **(b)** the horizontal, downwards
(c) the ground at the object **(d)** the vertical, upwards

6. A vertical pole 21 m tall casts a shadow 21 m long. The angle of elevation of the sun is:

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

7. From the top of a cliff 75 m high, the angle of depression of a boat at sea is 45°. How far is the boat from the foot of the cliff?

(a) 150 m **(b)** 75√3 m **(c)** 25√3 m **(d)** 75 m

8. Assertion (A): A building is 23 m from a point on level ground, and the angle of elevation of its top from there is 45°. So it is 23 m tall.
Reason (R): sin 30° = 1/2.

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

Section B — Short answer — 8 × 2 = 16 marks

9. A tree breaks in a storm. The broken part bends so that its top touches the ground 2 m from the foot of the tree, making an angle of 60° with the ground. Find the height of the tree before it broke.

10. The angles of elevation of the top of a tower from two points on the ground, on the same side and in line with its foot, are 30° and 60°. The points are 26 m apart. Find the height of the tower.

11. From a window 18 m above the ground, the angle of elevation of the top of a building across the road is 60° and the angle of depression of its foot is 45°. Find the height of the building.

12. Two poles of equal height stand on either side of a road 64 m wide. From a point on the road between them, the angles of elevation of their tops are 60° and 30°. Find the height of the poles and where the point is.

13. A flagstaff stands on top of a building 7 m high. From a point on the ground, the angles of elevation of the bottom and the top of the flagstaff are 45° and 60°. Find the length of the flagstaff.

14. From the top of a tower, a man sees a car moving towards the foot of the tower at a steady speed. The angle of depression of the car changes from 30° to 60° in 16 minutes. How much longer will the car take to reach the tower?

15. A statue 4 m tall stands on a pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and that of the top of the pedestal is 45°. Find the height of the pedestal.

16. The angle of elevation of the top of a tower from a point 45 m from its foot is 30°. By how much must the tower be raised so that the angle of elevation becomes 60°?

Section C — Word problems — 4 × 4 = 16 marks

17. An aeroplane flies horizontally at a height of 1,620 m. From a point on the ground, the angle of elevation of the plane changes from 60° to 30° in 30 seconds. Find its speed.

18. From the top of a lighthouse 80 m above the sea, the angles of depression of two ships on the same side, one behind the other, are 30° and 45°. How far apart are the ships?

19. Priya stands on a bridge 19 m above a river. The angles of depression of the two banks, on opposite sides, are 30° and 45°. How wide is the river?

20. The angle of elevation of the top of a building from the foot of a tower is 30°, and that of the top of the tower from the foot of the building is 60°. The tower is 93 m high. How high is the building?

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Answer key

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Q	Answer	Working
1	**(a) 15 m**	height = 15 × tan 45° = 15 m
2	**(c) 20√3 m**	distance = 60 ÷ tan 60° = 20√3 m
3	**(d) 126 m**	length = 63 ÷ sin 30° = 126 m
4	**(a) 9 m**	height = 18 × sin 30° = 9 m
5	**(a) the horizontal, upwards**	—
6	**(b) 45°**	tan θ = 21 ÷ 21, so θ = 45°
7	**(d) 75 m**	the angle of depression equals the angle of elevation from the boat: distance = 75 ÷ tan 45°
8	**(b) Both A and R are true, but R is not the correct explanation of A.**	A is true: tan 45° = 1, so height = distance = 23. R is true but does not explain A.
9	**(4 + 2√3) m**	standing part = 2 tan 60° = 2√3; broken part = 2/cos 60° = 4; total = 4 + 2√3
10	**13√3 m (the nearer point is 13 m from the foot)**	h = x√3 and h = (x + 26)/√3, so 3x = x + 26, x = 13, h = 13√3
11	**(18 + 18√3) m**	45° gives the road width = 18; the part above the window = 18 tan 60° = 18√3
12	**16√3 m; 16 m from the first pole and 48 m from the second**	h = x√3 = (64 − x)/√3, so 3x = 64 − x, x = 16
13	**7(√3 − 1) m**	45° gives the distance = 7; building + flagstaff = 7 tan 60° = 7√3
14	**8 minutes**	with height h, the distances are h√3 and h/√3; the car covers 2h/√3 in 16 minutes, and h/√3 is half of that
15	**2(√3 + 1) m**	pedestal p = distance (45°); p + 4 = p√3, so p = 4/(√3 − 1) = 2(√3 + 1)
16	**30√3 m**	now 45 tan 30° = 15√3; needed 45 tan 60° = 45√3; raise by 45√3 − 15√3 = 30√3
17	**36√3 m/s**	horizontal distances 1620/√3 and 1620√3; it flies 1620√3 − 1620/√3 = 1080√3 m in 30 s
18	**80(√3 − 1) m**	distances 80 cot 30° = 80√3 and 80 cot 45° = 80
19	**19(√3 + 1) m**	19 cot 30° + 19 cot 45° = 19√3 + 19
20	**31 m**	distance = 93 ÷ tan 60° = 31√3; building = 31√3 × tan 30° = 31