

# Trigonometry and Its Applications

Mathematics · Class 10 · Topic-wise Practice Worksheet

|                    |                 |                   |                         |
|--------------------|-----------------|-------------------|-------------------------|
| TIME<br>45 minutes | QUESTIONS<br>18 | TOTAL MARKS<br>24 | MAX. SCORE<br>____ / 24 |
|--------------------|-----------------|-------------------|-------------------------|

Name: \_\_\_\_\_ Class/Sec: \_\_\_\_\_ Date: \_\_\_\_\_

## INSTRUCTIONS

- There are **18 questions** in this worksheet. All questions are compulsory.
- Each question has four options (A), (B), (C) and (D). Exactly **one** option is correct.
- Questions 1–15 carry **1 mark** each. Questions 16–18 (Achievers Section) carry **3 marks** each.
- There is no negative marking. Use of a calculator is **not** allowed.
- Figures are not drawn to scale unless stated. Rough work may be done at the side of each page.

## Section A — Mathematical Reasoning

Q1–Q8 · 1 mark each

1. In a right-angled triangle,  $\sin \theta$  is defined as \_\_\_\_\_.

(A)  $\frac{\text{opposite side}}{\text{hypotenuse}}$

(B)  $\frac{\text{adjacent side}}{\text{hypotenuse}}$

(C)  $\frac{\text{opposite side}}{\text{adjacent side}}$

(D)  $\frac{\text{hypotenuse}}{\text{opposite side}}$

2. The value of  $\sin 30^\circ$  is \_\_\_\_\_.

(A)  $\frac{1}{\sqrt{2}}$

(B)  $\frac{\sqrt{3}}{2}$

(C) 1

(D)  $\frac{1}{2}$

3. The value of  $\tan 45^\circ$  is \_\_\_\_\_.

(A) 1

(B)  $\frac{1}{\sqrt{3}}$

(C) 0

(D)  $\sqrt{3}$

4. For any angle  $\theta$ ,  $\sin^2\theta + \cos^2\theta$  equals \_\_\_\_\_.

(A) 0

(B) 1

(C) 2

(D)  $\tan^2\theta$

5.  $\sec \theta$  is equal to \_\_\_\_\_.

(A)  $\frac{1}{\sin \theta}$

(B)  $\frac{1}{\tan \theta}$

(C)  $\frac{1}{\cos \theta}$

(D)  $\cos \theta$

6. The value of  $\tan 60^\circ$  is \_\_\_\_\_.

(A)  $\frac{1}{\sqrt{3}}$

(B) 1

(C)  $\frac{\sqrt{3}}{2}$

(D)  $\sqrt{3}$

7.  $\sin(90^\circ - \theta)$  is equal to \_\_\_\_\_.

(A)  $\cos \theta$

(B)  $\sin \theta$

(C)  $\tan \theta$

(D)  $-\sin \theta$

8. The angle of elevation of an object is measured from the horizontal when the object is \_\_\_\_\_.

(A) Below the eye level of the observer

(B) Above the eye level of the observer

(C) At the eye level of the observer

(D) Behind the observer

**Section B — Everyday Mathematics and Reasoning**

Q9–Q15 · 1 mark each

9. If  $\sin \theta = \frac{3}{5}$ , then  $\cos \theta$  equals \_\_\_\_\_.

(A)  $\frac{3}{4}$

(B)  $\frac{5}{4}$

(C)  $\frac{4}{5}$

(D)  $\frac{5}{3}$

10. The value of  $\sin 30^\circ \cos 60^\circ + \cos 30^\circ \sin 60^\circ$  is \_\_\_\_\_.

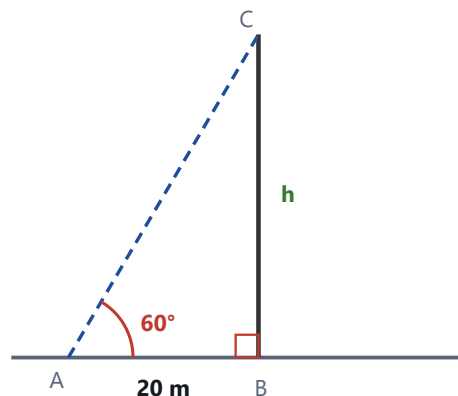
(A) 0

(B)  $\frac{1}{2}$

(C)  $\frac{\sqrt{3}}{2}$

(D) 1

11. In the figure, the angle of elevation of the top of a tower from a point 20 m from its foot is  $60^\circ$ . The height of the tower is \_\_\_\_\_.



*Angle of elevation of the top of a tower from a point 20 m away*

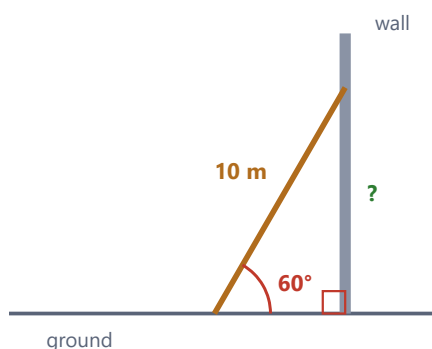
(A)  $20\sqrt{3}$  m

(B)  $\frac{20}{\sqrt{3}}$  m

(C) 20 m

(D) 40 m

12. A ladder 10 m long leans against a wall, making an angle of  $60^\circ$  with the ground. The height it reaches on the wall is \_\_\_\_\_.



A 10 m ladder leaning against a wall at  $60^\circ$  to the ground

- (A) 5 m  
(B)  $5\sqrt{3}$  m  
(C)  $10\sqrt{3}$  m  
(D)  $\frac{10}{\sqrt{3}}$  m
13. One row of the table below is **incorrectly** matched. Which row is it?

| Row | Ratio           | Value      |
|-----|-----------------|------------|
| (A) | $\cos 0^\circ$  | 1          |
| (B) | $\sin 90^\circ$ | 1          |
| (C) | $\cos 60^\circ$ | $1/2$      |
| (D) | $\tan 30^\circ$ | $\sqrt{3}$ |

Table 5.1 — Standard trigonometric values

- (A) (A)  
(B) (B)  
(C) (C)  
(D) (D)
14. The expression  $1 - \cos^2\theta$  simplifies to \_\_\_\_\_.
- (A)  $\sec^2\theta$   
(B)  $\tan^2\theta$   
(C)  $\sin^2\theta$   
(D)  $\cot^2\theta$
15. If  $\tan \theta = 1$  and  $\theta$  is acute, then  $\theta =$  \_\_\_\_\_.
- (A)  $0^\circ$   
(B)  $30^\circ$   
(C)  $60^\circ$   
(D)  $45^\circ$

### Achievers Section

Q16–Q18 · 3 marks each

16. The angle of elevation of the top of a tower from a point on the ground is  $30^\circ$ . On walking 20 m towards the tower, the elevation becomes  $60^\circ$ . The height of the tower is \_\_\_\_\_.
- (A)  $10\sqrt{3}$  m  
(B) 10 m  
(C)  $20\sqrt{3}$  m  
(D) 20 m
17. The value of  $\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta}$  when  $\theta = 30^\circ$  is \_\_\_\_\_.
- (A) 2  
(B) 4  
(C)  $\sqrt{3}$   
(D)  $\frac{4}{\sqrt{3}}$

18. Consider the three statements below.

(i) The value of  $\sin \theta$  can be greater than 1 for some angle  $\theta$ .

(ii)  $\tan \theta$  is not defined when  $\theta = 90^\circ$ .

(iii)  $\cos 0^\circ = \sin 90^\circ$ .

Which of them are **true**?

(A) (i) and (ii) only

(B) (ii) and (iii) only

(C) (i) and (iii) only

(D) All three

# Answer Key

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|    |   |    |   |    |   |    |   |    |   |
|----|---|----|---|----|---|----|---|----|---|
| 1  | A | 2  | D | 3  | A | 4  | B | 5  | C |
| 6  | D | 7  | A | 8  | B | 9  | C | 10 | D |
| 11 | A | 12 | B | 13 | D | 14 | C | 15 | D |
| 16 | A | 17 | B | 18 | B |    |   |    |   |

## Solutions

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1. **Answer: (A)**  $\frac{\text{opposite side}}{\text{hypotenuse}}$

By definition  $\sin \theta = \frac{\text{opposite side}}{\text{hypotenuse}}$ . The adjacent side over the hypotenuse gives  $\cos \theta$ , and the opposite over the adjacent gives  $\tan \theta$ .

2. **Answer: (D)**  $\frac{1}{2}$

From the standard 30–60–90 triangle with sides 1,  $\sqrt{3}$  and 2, the side opposite  $30^\circ$  is 1 and the hypotenuse 2, so  $\sin 30^\circ = \frac{1}{2}$ .

3. **Answer: (A)** 1

In an isosceles right triangle the two legs are equal, so the opposite and adjacent sides for  $45^\circ$  are the same length and  $\tan 45^\circ = 1$ .

4. **Answer: (B)** 1

Applying Pythagoras to a right triangle and dividing by the square of the hypotenuse gives the fundamental identity  $\sin^2 \theta + \cos^2 \theta = 1$ , true for every angle.

5. **Answer: (C)**  $\frac{1}{\cos \theta}$

The secant is the reciprocal of the cosine:  $\sec \theta = \frac{1}{\cos \theta}$ . Similarly  $\operatorname{cosec} \theta = \frac{1}{\sin \theta}$  and  $\cot \theta = \frac{1}{\tan \theta}$ .

6. **Answer: (D)**  $\sqrt{3}$

In the 30–60–90 triangle the side opposite  $60^\circ$  is  $\sqrt{3}$  and the adjacent side is 1, so  $\tan 60^\circ = \sqrt{3} \approx 1.73$ .

7. **Answer: (A)**  $\cos \theta$

The two acute angles of a right triangle add to  $90^\circ$ , so the side opposite one is adjacent to the other. Hence  $\sin(90^\circ - \theta) = \cos \theta$ .

8. **Answer: (B)** Above the eye level of the observer

The line of sight rises above the horizontal when the object lies **above the observer's eye level**, and the angle between the two is the angle of elevation. Looking downwards gives an angle of depression instead.

9. **Answer: (C)**  $\frac{4}{5}$

Using  $\sin^2 \theta + \cos^2 \theta = 1$ ,  $\cos^2 \theta = 1 - \frac{9}{25} = \frac{16}{25}$ , so  $\cos \theta = \frac{4}{5}$  for an acute angle. The triangle is the familiar 3–4–5 one.

10. **Answer: (D)** 1

Substituting the standard values:  $(\frac{1}{2})(\frac{1}{2}) + (\frac{\sqrt{3}}{2})(\frac{\sqrt{3}}{2}) = \frac{1}{4} + \frac{3}{4} = 1$ . This is  $\sin(30^\circ + 60^\circ) = \sin 90^\circ = 1$ .

11. **Answer: (A)**  $20\sqrt{3}$  m

In right  $\triangle ABC$ ,  $\tan 60^\circ = \frac{h}{20}$ , so  $h = 20 \tan 60^\circ = 20\sqrt{3} \text{ m} \approx 34.6 \text{ m}$ .

12. **Answer: (B)**  $5\sqrt{3}$  m

The height is the side opposite the  $60^\circ$  angle, so height =  $10 \sin 60^\circ = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3} \text{ m} \approx 8.66 \text{ m}$ . The foot of the ladder stands  $10 \cos 60^\circ = 5 \text{ m}$  from the wall.

13. **Answer: (D)** (D)

$\tan 30^\circ = \frac{1}{\sqrt{3}} \approx 0.58$ , not  $\sqrt{3}$  — the value  $\sqrt{3}$  belongs to  $\tan 60^\circ$ . So row **(D)** is wrong; the other three values are correct.

**14. Answer: (C)**  $\sin^2\theta$

Rearranging the identity  $\sin^2\theta + \cos^2\theta = 1$  gives  $1 - \cos^2\theta = \sin^2\theta$ .

**15. Answer: (D)**  $45^\circ$

$\tan \theta = 1$  means the opposite and adjacent sides are equal, which happens in an isosceles right triangle. So  $\theta = 45^\circ$ .

**16. Answer: (A)**  $10\sqrt{3}$  m

Let the height be  $h$ . From the far point the distance is  $\frac{h}{\tan 30^\circ} = h\sqrt{3}$ , and from the near point it is  $\frac{h}{\tan 60^\circ} = \frac{h}{\sqrt{3}}$ . The difference is the 20 m walked:  $h\sqrt{3} - \frac{h}{\sqrt{3}} = 20$ , that is  $\frac{3h - h}{\sqrt{3}} = 20$ , so  $\frac{2h}{\sqrt{3}} = 20$  and  $h = 10\sqrt{3}$  m  $\approx 17.3$  m.

**17. Answer: (B)** 4

Combining the two fractions over the common denominator  $\sin \theta(1 + \cos \theta)$  gives  $\sin^2\theta + (1 + \cos \theta)^2 = \sin^2\theta + 1 + 2\cos \theta + \cos^2\theta = 2 + 2\cos \theta = 2(1 + \cos \theta)$ . Cancelling  $(1 + \cos \theta)$ , the expression equals  $\frac{2}{\sin \theta} = 2 \operatorname{cosec} \theta$ . At  $\theta = 30^\circ$ ,

$\sin \theta = \frac{1}{2}$ , so the value is 4.

**18. Answer: (B)** (ii) and (iii) only

Statement (i) is false: the opposite side can never exceed the hypotenuse, so  $\sin \theta$  always lies between  $-1$  and  $1$ .

Statement (ii) is true, because  $\tan \theta = \frac{\sin \theta}{\cos \theta}$  and  $\cos 90^\circ = 0$ . Statement (iii) is true, since both equal 1. So only **(ii) and (iii)** hold.