Class 11 Maths Chapter 3: Trigonometric Functions - Notes, Important Questions and MCQs (2026-27)

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Class 11 Maths Chapter 3, Trigonometric Functions, extends trigonometry from right triangles to angles of any size, using radian measure and the unit circle.

These notes cover angles in degrees and radians, trigonometric functions of real numbers, signs in different quadrants, domain and range, and the important sum, difference, double angle, triple angle and transformation formulas.

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Chapter Overview

An angle is the measure of rotation of a ray about its initial point. Anticlockwise rotation gives a positive angle and clockwise a negative angle.

Trigonometric functions are defined using a point on the unit circle, so they apply to all real numbers. Their periodic nature makes them useful in physics, engineering and signal analysis.

Important Topics and Concepts

Degree and Radian Measure

- One degree is 1/360 of a complete revolution; 1° = 60′ and 1′ = 60″.
- One radian is the angle subtended at the centre by an arc equal in length to the radius.
- π radians = 180°; 1 radian ≈ 57°16′; 1° = π/180 radian ≈ 0.01746 radian.

- Radian measure = (π/180) × degree measure; degree measure = (180/π) × radian measure.
- Arc length l = rθ, where θ is in radians.

Trigonometric Functions of a Real Number

- For a point (a, b) on the unit circle at angle x: cos x = a and sin x = b.
- sin x = 0 when x = nπ; cos x = 0 when x = (2n + 1)π/2, where n is an integer.
- tan x = sin x/cos x (x ≠ (2n+1)π/2), cot x = cos x/sin x (x ≠ nπ), sec x = 1/cos x, cosec x = 1/sin x.
- Identities: $\sin^2x + \cos^2x = 1$; $1 + \tan^2x = \sec^2x$; $1 + \cot^2x = \operatorname{cosec}^2x$.

Signs in Quadrants (ASTC)

- Quadrant I (0 to π/2): all functions positive.
- Quadrant II (π/2 to π): sin and cosec positive.
- Quadrant III (π to 3π/2): tan and cot positive.
- Quadrant IV (3π/2 to 2π): cos and sec positive.
- Memory aid: “All Students Take Coffee”.

Domain, Range and Periodicity

- sin x and cos x: domain R, range [−1, 1], period 2π.
- tan x: domain R − {(2n+1)π/2}, range R, period π.
- cot x: domain R − {nπ}, range R, period π.
- sec x: domain R − {(2n+1)π/2}, range R − (−1, 1).
- cosec x: domain R − {nπ}, range R − (−1, 1).
- sin(−x) = −sin x (odd); cos(−x) = cos x (even).

Sum and Difference Formulas

- cos(x + y) = cos x cos y − sin x sin y; cos(x − y) = cos x cos y + sin x sin y.
- sin(x + y) = sin x cos y + cos x sin y; sin(x − y) = sin x cos y − cos x sin y.
- tan(x + y) = (tan x + tan y)/(1 − tan x tan y); tan(x − y) = (tan x − tan y)/(1 + tan x tan y).
- cot(x + y) = (cot x cot y − 1)/(cot y + cot x).
- Allied angles: cos(π/2 − x) = sin x; sin(π/2 − x) = cos x; cos(π − x) = −cos x; sin(π − x) = sin x; cos(π + x) = −cos x; sin(π + x) = −sin x; cos(2π − x) = cos x; sin(2π − x) = −sin x.

Double and Triple Angle Formulas

- sin 2x = 2 sin x cos x = 2 tan x/(1 + $\tan^2x$).
- cos 2x = $\cos^2x - \sin^2x$ = $2\cos^2x - 1$ = $1 - 2\sin^2x$ = (1 − $\tan^2x$)/(1 + $\tan^2x$).
- tan 2x = 2 tan x/(1 − $\tan^2x$).
- sin 3x = 3 sin x − 4 $\sin^3x$; cos 3x = 4 $\cos^3x$ − 3 cos x.
- tan 3x = (3 tan x − $\tan^3x$)/(1 − 3 $\tan^2x$).

Transformation Formulas

- cos x + cos y = 2 cos((x+y)/2) cos((x−y)/2).
- cos x − cos y = −2 sin((x+y)/2) sin((x−y)/2).
- sin x + sin y = 2 sin((x+y)/2) cos((x−y)/2).
- sin x − sin y = 2 cos((x+y)/2) sin((x−y)/2).
- Product to sum: 2 cos x cos y = cos(x+y) + cos(x−y); −2 sin x sin y = cos(x+y) − cos(x−y); 2 sin x cos y = sin(x+y) + sin(x−y); 2 cos x sin y = sin(x+y) − sin(x−y).

Values of Trigonometric Functions

Angle	0	π/6	π/4	π/3	π/2	π	3π/2	2π
sin	0	1/2	1/√2	√3/2	1	0	−1	0
cos	1	√3/2	1/√2	1/2	0	−1	0	1
tan	0	1/√3	1	√3	not defined	0	not defined	0

Important Definitions and Terms

Term	Meaning
Radian	Angle subtended by an arc equal to the radius.
Periodic function	Function that repeats values after a fixed interval.
Period	Smallest positive interval after which a function repeats.
Quadrant	One of four regions of the coordinate plane.
Allied angles	Angles like π/2 ± x, π ± x, 2π − x related to x.
Compound angle	Sum or difference of two angles, e.g. x + y.
Odd function	f(−x) = −f(x), e.g. sin x.
Even function	f(−x) = f(x), e.g. cos x.

Short Answer Questions

Q1. Convert 40°20′ into radians.

40°20′ = 40⅓° = (121/3)°. Radians = (121/3) × π/180 = 121π/540.

Q2. Convert 6 radians into degrees.

6 × 180/π ≈ 6 × 57.27 ≈ 343°38′ (using π ≈ 22/7).

Q3. Find the arc length when r = 21 cm and θ = 60°.

θ = π/3, so l = rθ = 21 × π/3 = 7π ≈ 22 cm.

Q4. Find sin 765°.

765° = 2 × 360° + 45°, so sin 765° = sin 45° = 1/√2.

Q5. If cos x = −3/5 and x lies in quadrant III, find sin x.

$\sin^2 x = 1 - 9/25 = 16/25$; in quadrant III sine is negative, so sin x = −4/5.

Q6. Find the value of sin 15°.

sin(45° − 30°) = sin45 cos30 − cos45 sin30 = (√3 − 1)/(2√2).

Q7. Prove sin 2x = 2 sin x cos x.

Put y = x in sin(x + y) = sin x cos y + cos x sin y to get sin 2x = 2 sin x cos x.

Q8. Find tan 75°.

tan(45° + 30°) = (1 + 1/√3)/(1 − 1/√3) = (√3 + 1)/(√3 − 1) = 2 + √3.

Long Answer Questions

Q1. Prove that $\cos 4x = 1 - 8 \sin^2 x \cos^2 x$.

$\cos 4x = 1 - 2 \sin^2 2x$ (using $\cos 2\theta = 1 - 2 \sin^2 \theta$ with $\theta = 2x$).

$\sin 2x = 2 \sin x \cos x$, so $\sin^2 2x = 4 \sin^2 x \cos^2 x$.

Hence $\cos 4x = 1 - 8 \sin^2 x \cos^2 x$.

Q2. Prove that $(\cos 7x + \cos 5x)/(\sin 7x - \sin 5x) = \cot x$.

Numerator: $\cos 7x + \cos 5x = 2 \cos 6x \cos x$.

Denominator: $\sin 7x - \sin 5x = 2 \cos 6x \sin x$.

Ratio = $\cos x / \sin x = \cot x$.

Q3. Find $\sin(x/2)$, $\cos(x/2)$ and $\tan(x/2)$ if $\tan x = -4/3$ and x lies in quadrant II.

In quadrant II, $\cos x = -3/5$. Since $\pi/2 < x < \pi$, $x/2$ lies in quadrant I, so all half-angle values are positive.

$\cos^2(x/2) = (1 + \cos x)/2 = 1/5$, so $\cos(x/2) = 1/\sqrt{5}$; $\sin^2(x/2) = (1 - \cos x)/2 = 4/5$, so $\sin(x/2) = 2/\sqrt{5}$.

$\tan(x/2) = \sin(x/2)/\cos(x/2) = 2$.

MCQs with Answers

1. π radians equal:(a) 90° (b) 180° (c) 270° (d) 360°Answer: (b) 180°

2. In quadrant III, which is positive?(a) sin (b) cos (c) tan (d) secAnswer: (c) tan

3. Range of sin x:(a) R (b) [0,1] (c) [−1,1] (d) (−1,1)Answer: (c) [−1,1]

4. Period of tan x:(a) π/2 (b) π (c) 2π (d) 4πAnswer: (b) π

5. cos(π − x) =(a) cos x (b) −cos x (c) sin x (d) −sin xAnswer: (b) −cos x

6. sin 3x =(a) 3 sin x − 4 sin³x (b) 4 sin³x − 3 sin x (c) 3 sin x + 4 sin³x (d) sin³xAnswer: (a) 3 sin x − 4 sin³x

7. cos 2x in terms of sin x:(a) 1 − 2sin²x (b) 2sin²x − 1 (c) 1 + 2sin²x (d) sin²xAnswer: (a) 1 − 2sin²x

8. sin(−x) =(a) sin x (b) −sin x (c) cos x (d) −cos xAnswer: (b) −sin x

9. tan 45° =(a) 0 (b) 1 (c) √3 (d) 1/√3Answer: (b) 1

10. Arc length formula:(a) l = r/θ (b) l = rθ (c) l = θ/r (d) l = 2πrAnswer: (b) l = rθ

Quick Revision Points

- π rad = 180°; 1 rad ≈ 57°16′.
- l = rθ (θ in radians).
- $\sin^2 x + \cos^2 x = 1$; $1 + \tan^2 x = \sec^2 x$; $1 + \cot^2 x = \operatorname{cosec}^2 x$.
- ASTC rule for signs.
- sin, cos: range [−1,1], period 2π; tan, cot period π.
- sin(x ± y), cos(x ± y), tan(x ± y).

- Allied angle formulas.
- sin 2x, cos 2x, tan 2x.
- sin 3x, cos 3x, tan 3x.
- Sum-to-product and product-to-sum formulas.

Chapter Summary

Angles can be measured in degrees or radians, with π radians equal to 180°. Trigonometric functions are defined for all real numbers using the unit circle; their signs depend on the quadrant and they repeat periodically.

Sum and difference formulas lead to double angle, triple angle and transformation formulas. These identities are essential tools for simplification and proofs in later chapters and in calculus.

Exam Tips and PYQ Pattern

- Memorise the values table and ASTC rule – they save time in every question.
- Convert degrees to radians before using $l = r\theta$.
- For proofs, start from the more complicated side.
- Group formulas by type: compound, double, triple, transformation.
- Check the quadrant before choosing the sign of a function.
- Trigonometric equations are not part of the 2026-27 rationalised syllabus – focus on identities.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 11 Mathematics textbook, prescribed in the CBSE 2026-27 syllabus.

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Yes. Use the free PDF link at the top of this page – no signup needed.

What is a radian?

The angle subtended at the centre of a circle by an arc equal in length to the radius.

What is the ASTC rule?

All functions positive in quadrant I, sin in II, tan in III and cos in IV.

Are trigonometric equations in the 2026-27 syllabus?

No. The rationalised syllabus has removed trigonometric equations; focus on functions and identities.

Conclusion

Trigonometric Functions is formula-heavy but very scoring. Learn the values table and formula groups, practise proofs and download the free PDF for quick revision.

More Notes: Class 11 Maths Chapter 2: Relations and Functions notes | Class 11 Maths Chapter

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE maths educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 11 Maths textbook, Mathematics (Class XI) (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 28 November 2026.