

YOUR SCHOOL / COLLEGE NAME

FORMULA NOTES

Trigonometry Made Simple

Ratios, identities, heights and distances

SUBJECT **Mathematics**

CLASS / COURSE **Class 10 • CBSE**

PREPARED BY **Subject Teacher**

HOW TO USE THESE NOTES

These notes cover trigonometric ratios, standard values, identities and their application to heights and distances. Each chapter starts with a short overview, then lists the key definitions, explains the core concepts with examples, and ends with practice questions. Answers to the multiple-choice questions are at the end.

Study plan

- Read the overview and definitions first
- Work through the solved examples without looking at the answers
- Attempt the practice questions in timed conditions
- Revise using the summary sheet the night before the exam

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CHAPTER 1: TRIGONOMETRIC RATIOS

Trigonometry studies the relationship between the sides and angles of a right-angled triangle. For an acute angle A , the six ratios compare pairs of sides: the side opposite A , the side adjacent to A , and the hypotenuse.

Key Definitions

Term	Meaning
Hypotenuse	The side opposite the right angle; the longest side
Opposite side	The side facing the angle under consideration
Adjacent side	The side next to the angle, other than the hypotenuse
Reciprocal ratios	cosec, sec and cot are reciprocals of sin, cos and tan

The Six Ratios

If the sides opposite and adjacent to angle A are called perpendicular (P) and base (B), and the hypotenuse is H , then the ratios are defined as below. Because the ratios depend only on the angle, similar triangles give the same values.

Finding Other Ratios from One

Given one ratio, draw a right triangle with those sides, find the third side with Pythagoras' theorem and read off the remaining ratios.

- Draw and label the triangle
- Use $H^2 = P^2 + B^2$
- Write each ratio as a fraction in lowest terms

Important Formulas

Quantity	Formula	Note
$\sin A$	P / H	opposite $\div$ hypotenuse
$\cos A$	B / H	adjacent $\div$ hypotenuse
$\tan A$	P / B	$= \sin A / \cos A$
$\operatorname{cosec} A$	H / P	$= 1 / \sin A$
$\sec A$	H / B	$= 1 / \cos A$
$\cot A$	B / P	$= 1 / \tan A$

Solved Examples

Q1. If $\sin A = 3/5$, find $\cos A$ and $\tan A$.

Take $P = 3$, $H = 5$, so $B = \sqrt{(25 - 9)} = 4$. Hence $\cos A = 4/5$ and $\tan A = 3/4$.

Q2. If $\tan \theta = 1$, find $\sin \theta + \cos \theta$.

$\tan \theta = 1$ means $\theta = 45^\circ$, so $\sin \theta + \cos \theta = 1/\sqrt{2} + 1/\sqrt{2} = \sqrt{2}$.

Exam tip

Remember “Some People Have Curly Brown Hair Through Proper Brushing”: $\sin = P/H$, $\cos = B/H$, $\tan = P/B$.

Practice Questions

A. Multiple choice

1. $\sin A$ is equal to

- (a) B/H (b) P/H (c) P/B (d) H/P

2. If $\cos A = 12/13$, then $\sin A =$

- (a) $5/13$ (b) $12/5$ (c) $13/12$ (d) $5/12$

3. $\sec A$ is the reciprocal of

- (a) $\sin A$ (b) $\tan A$ (c) $\cos A$ (d) $\cot A$

4. $\tan A = \sin A \div$

- (a) $\cot A$ (b) $\cos A$ (c) $\sec A$ (d) $\operatorname{cosec} A$

B. Short answer

- If $\cot A = 8/15$, find $\sin A$.
- Why do the ratios not depend on the size of the triangle?
- Write the reciprocal of each basic ratio.

C. Long answer

- In triangle ABC right-angled at B , $AB = 24$ cm and $BC = 7$ cm. Find all six ratios of angle A .
- Prove that the trigonometric ratios of an angle are the same for similar right triangles.

CHAPTER 2: STANDARD ANGLES AND IDENTITIES

The values of the ratios at 0° , 30° , 45° , 60° and 90° are used constantly. Identities are equations true for every angle, and they allow expressions to be simplified and proved.

Key Definitions

Term	Meaning
Identity	An equation true for all values of the angle for which it is defined
Complementary angles	Two angles whose sum is 90°
Standard angles	0° , 30° , 45° , 60° and 90°

Table of Standard Values

The table can be rebuilt quickly: write 0, 1, 2, 3, 4 under the angles, divide each by 4 and take the square root to get sin; reverse the row for cos.

The Three Identities

From $H^2 = P^2 + B^2$ we obtain $\sin^2 A + \cos^2 A = 1$. Dividing by $\cos^2 A$ gives $1 + \tan^2 A = \sec^2 A$, and dividing by $\sin^2 A$ gives $1 + \cot^2 A = \operatorname{cosec}^2 A$.

- Convert everything to sin and cos when stuck
- Work on the more complicated side
- Use $(a + b)(a - b) = a^2 - b^2$ to simplify

Ratio	0°	30°	45°	60°	90°
sin	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
cos	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0
tan	0	$1/\sqrt{3}$	1	$\sqrt{3}$	not defined

Table: Standard values

Solved Examples

Q1. Evaluate $2 \tan^2 45^\circ + \cos^2 30^\circ - \sin^2 60^\circ$.

$$2(1) + 3/4 - 3/4 = 2.$$

Q2. Prove $(1 - \cos^2 A) \operatorname{cosec}^2 A = 1$.

$$1 - \cos^2 A = \sin^2 A, \text{ and } \sin^2 A \times \operatorname{cosec}^2 A = 1.$$

Exam tip

In proofs, write the identity you are using in the margin — it shows the examiner your reasoning even if algebra slips.

Practice Questions

A. Multiple choice

1. $\sin 30^\circ =$

- (a) $1/2$ (b) $\sqrt{3}/2$ (c) 1 (d) 0

2. $\tan 60^\circ =$

- (a) 1 (b) $1/\sqrt{3}$ (c) $\sqrt{3}$ (d) 0

3. $\sin^2 A + \cos^2 A =$

- (a) 0 (b) 1 (c) 2 (d) $\tan A$

4. $\sec^2 A - \tan^2 A =$

- (a) 0 (b) 1 (c) -1 (d) 2

B. Short answer

6. Evaluate $\sin 60^\circ \cos 30^\circ + \sin 30^\circ \cos 60^\circ$.
7. Write the three fundamental identities.
8. If $A = 30^\circ$, verify that $\cos 2A = \cos^2 A - \sin^2 A$.

C. Long answer

9. Prove that $(\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2 = 7 + \tan^2 A + \cot^2 A$.
10. Prove that $(1 + \tan^2 A)/(1 + \cot^2 A) = \tan^2 A$.

CHAPTER 3: HEIGHTS AND DISTANCES

Trigonometry lets us find heights and distances that cannot be measured directly — a tower, a building or the width of a river — using an angle and one known length.

Key Definitions

Term	Meaning
Line of sight	The line from the observer's eye to the object
Angle of elevation	Angle between the horizontal and the line of sight to an object above
Angle of depression	Angle between the horizontal and the line of sight to an object below

Method

Draw a neat figure, mark the right angle and the given angle, choose the ratio that links the known side to the unknown side, and solve. Angles of elevation from a point and depression to that point are equal (alternate angles).

- Draw and label the figure
- Choose tan when height and base are involved
- Use $\sqrt{3} \approx 1.732$ only at the final step

Solved Examples

Q1. A tower stands vertically. From a point 30 m from its foot, the angle of elevation of the top is 60° .

Find the height.

$$\tan 60^\circ = h/30, \text{ so } h = 30\sqrt{3} \approx 51.96 \text{ m.}$$

Q2. From the top of a 75 m lighthouse, the angle of depression of a boat is 30° . How far is the boat from the lighthouse?

$$\tan 30^\circ = 75/d, \text{ so } d = 75\sqrt{3} \approx 129.9 \text{ m.}$$

Exam tip

Most heights-and-distances problems use tan; if the slant length (rope, ladder) appears, switch to sin or cos.

Practice Questions

A. Multiple choice

1. If the angle of elevation of the sun increases, the shadow
- (a) Increases (b) Decreases (c) Stays same (d) Doubles

2. A ladder makes 60° with the ground and reaches $6\sqrt{3}$ m up a wall. Its length is

- (a) 12 m (b) 6 m (c) 18 m (d) 9 m

3. Angle of elevation and depression between two points are

- (a) Supplementary (b) Equal (c) Complementary (d) Unrelated

4. For height and horizontal distance, use

- (a) sin (b) cos (c) tan (d) sec

B. Short answer

11. Define angle of elevation with a diagram.

12. A kite string 60 m long makes 60° with the ground. Find the height of the kite.

13. Why are the angles of elevation and depression equal?

C. Long answer

14. Two poles of equal height stand on either side of a 80 m road. From a point between them, the angles of elevation are 60° and 30° . Find the height of the poles.

15. The shadow of a tower is 40 m longer when the sun's altitude is 30° than when it is 60° . Find the height of the tower.

QUICK REVISION SHEET

Chapter	Term	Remember
Trigonometric Ratios	Hypotenuse	The side opposite the right angle; the longest side
Trigonometric Ratios	Opposite side	The side facing the angle under consideration
Trigonometric Ratios	Adjacent side	The side next to the angle, other than the hypotenuse
Standard Angles and Identities	Identity	An equation true for all values of the angle for which it is defined
Standard Angles and Identities	Complementary angles	Two angles whose sum is 90°
Standard Angles and Identities	Standard angles	0° , 30° , 45° , 60° and 90°
Heights and Distances	Line of sight	The line from the observer's eye to the object
Heights and Distances	Angle of elevation	Angle between the horizontal and the line of sight to an object above
Heights and Distances	Angle of depression	Angle between the horizontal and the line of sight to an object below

ANSWER KEY

Chapter	Question	Answer
1	1	b
1	2	a
1	3	c
1	4	b
2	1	a
2	2	c
2	3	b
2	4	b
3	1	b
3	2	a
3	3	b
3	4	c