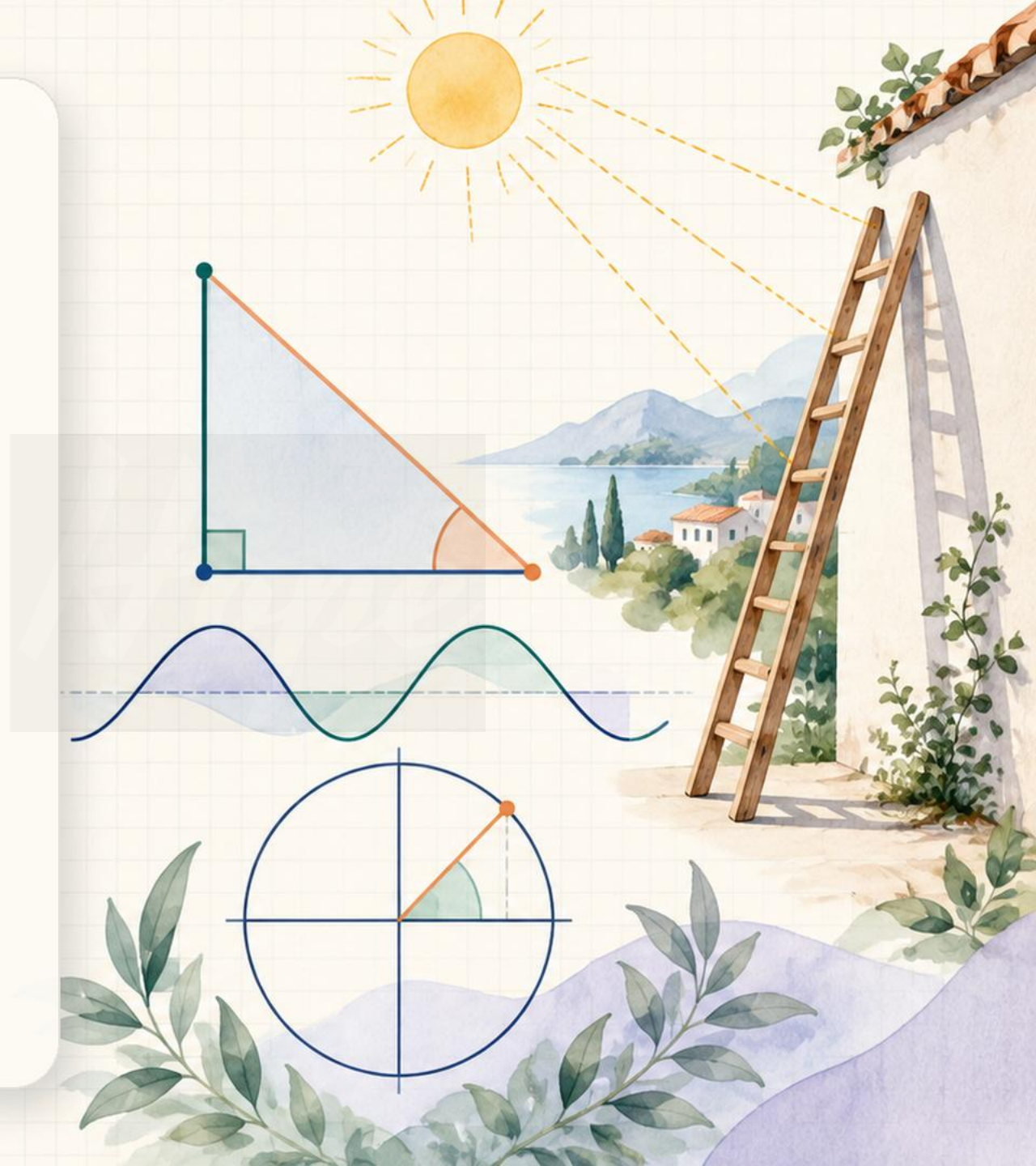


MATHEMATICS • CLASS 10

CHAPTER 8

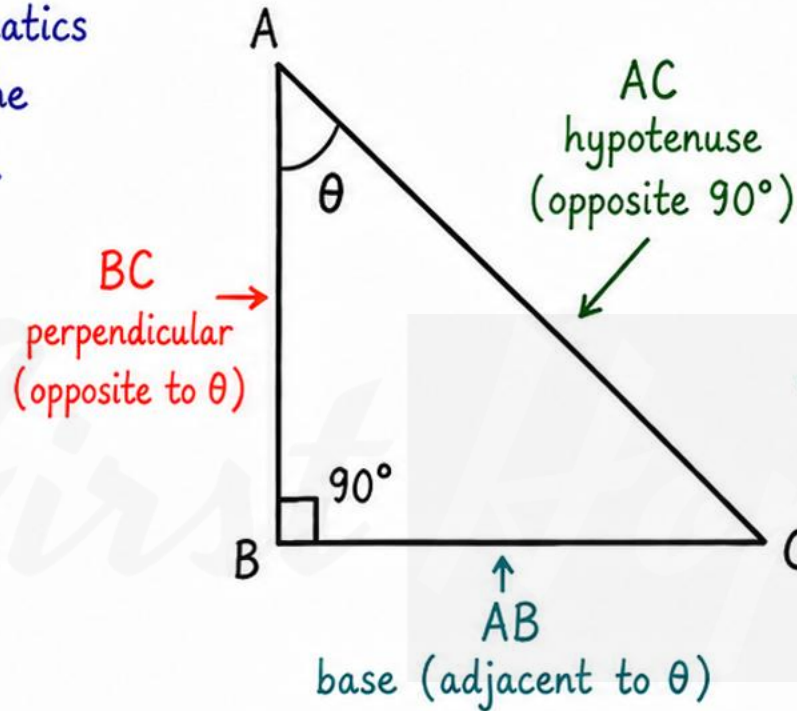
Introduction to Trigonometry

CHAPTER NOTES

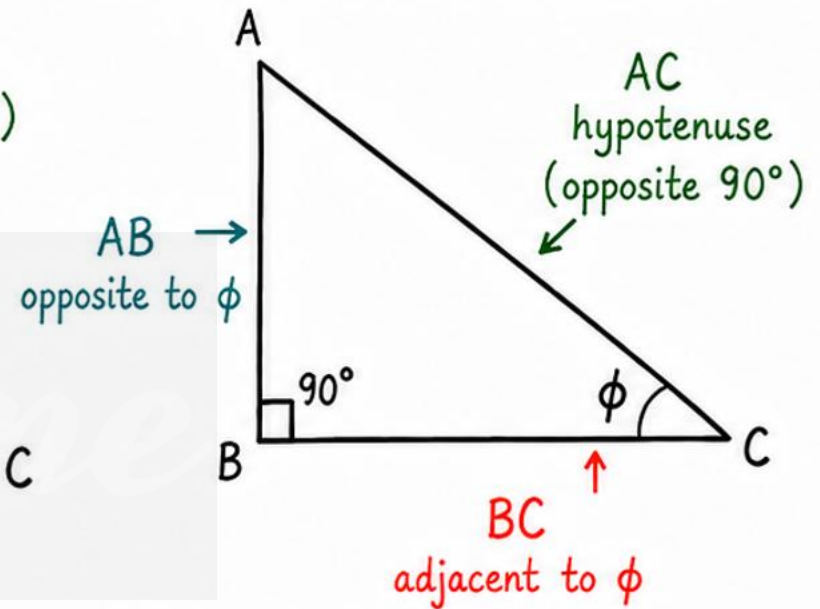


INTRODUCTION TO TRIGONOMETRY

- Trigonometry is the branch of mathematics that studies relationships between the sides and angles of a right triangle.
- Consider the right triangle ABC with angle $B = 90^\circ$.
 - AC is the hypotenuse.
(It is opposite the right angle.)
 - BC is the perpendicular (opposite side) to reference angle A ($= \theta$).
 - AB is the base (adjacent side) to reference angle A.



If we take reference angle C:



SELECTION RULE: To name the sides with respect to a reference angle:

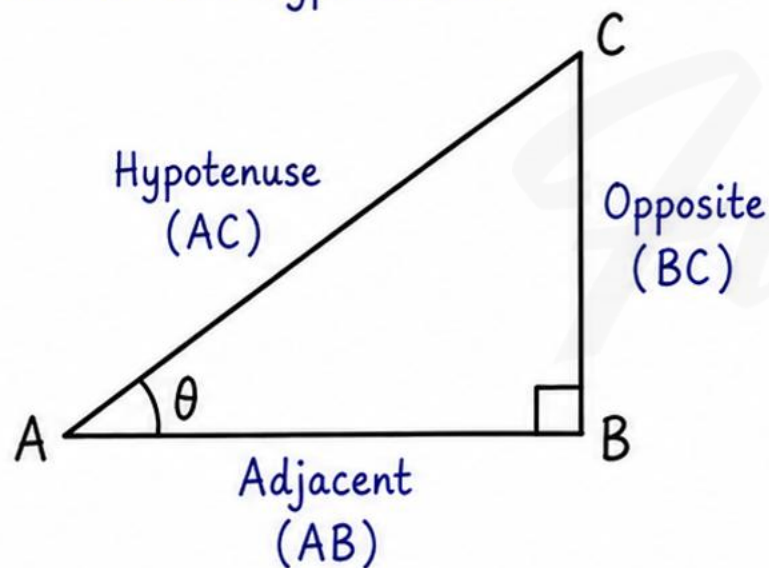
- ① First, mark the reference angle.
- ② Then, identify the hypotenuse (it is always opposite the right angle).
- ③ Next, the side opposite the reference angle is the opposite side.
- ④ The remaining side (neither hypotenuse nor opposite) is the adjacent side.

IMPORTANT POINTS

- In this discussion, we consider only acute angles ($0^\circ < \theta < 90^\circ$).
- The trigonometric ratios for 0° and 90° will be defined using limiting positions of a right triangle.

THE SIX TRIGONOMETRIC RATIOS

In a right-angled triangle ABC, right-angled at B, let $\angle A = \theta$. Then BC is the side opposite $\angle A$, AB is the side adjacent to $\angle A$ and AC is the hypotenuse.



All lengths are positive for an acute angle θ ($0^\circ < \theta < 90^\circ$). Therefore, all six trigonometric ratios are positive.

$$1. \sin \theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{BC}{AC}$$

$$4. \operatorname{cosec} \theta = \frac{\text{hypotenuse}}{\text{opposite}} = \frac{AC}{BC}$$

$$2. \cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{AB}{AC}$$

$$5. \sec \theta = \frac{\text{hypotenuse}}{\text{adjacent}} = \frac{AC}{AB}$$

$$3. \tan \theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{BC}{AB}$$

$$6. \cot \theta = \frac{\text{adjacent}}{\text{opposite}} = \frac{AB}{BC}$$

Reciprocal Relations:

$$\sin \theta \cdot \operatorname{cosec} \theta = 1 \quad \cos \theta \cdot \sec \theta = 1 \quad \tan \theta \cdot \cot \theta = 1$$

Quotient Relations:

$$\tan \theta = \frac{\sin \theta}{\cos \theta} \quad \text{and} \quad \cot \theta = \frac{\cos \theta}{\sin \theta}$$

RATIOS DEPEND ONLY ON THE ANGLE

THEOREM – Trigonometric Ratios and Similarity

For a fixed acute angle A , every trigonometric ratio has the same value in every right triangle containing angle A , regardless of size.

Consider right triangles $\triangle APM$, $\triangle AQN$, and $\triangle ABC$ in the figure.

Each has $\angle A$ as a common acute angle.

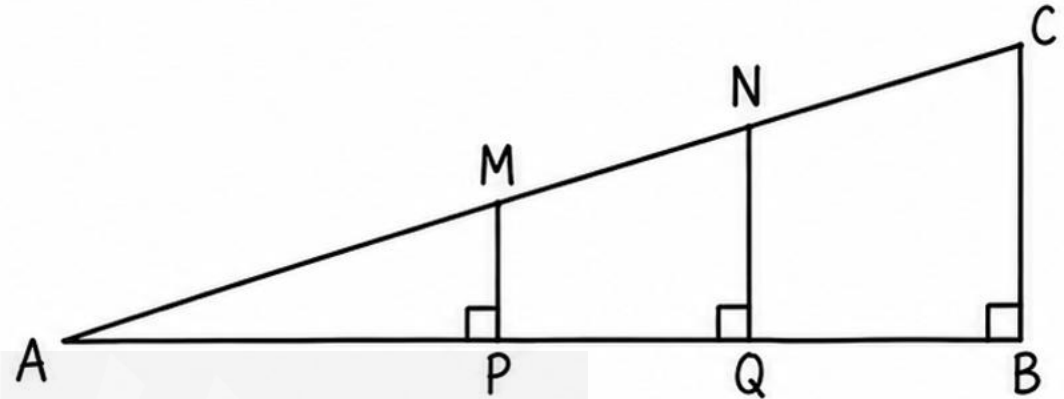
Also, $\angle APM = \angle AQN = \angle ABC = 90^\circ$.

Therefore, by AA similarity criterion,

$$\triangle APM \sim \triangle AQN \sim \triangle ABC$$

Since similar triangles have corresponding sides in the same ratio, a scale factor k multiplies all corresponding sides equally.

Thus, in any ratio, the factor k appears in both numerator and denominator and cancels out.



$$\tan A = \frac{PM}{AP} = \frac{QN}{AQ} = \frac{BC}{AB}$$

$$\sin A = \frac{PM}{AM} = \frac{QN}{AN} = \frac{BC}{AC}$$

$$\cos A = \frac{AP}{AM} = \frac{AQ}{AN} = \frac{AB}{AC}$$

Hence, every trigonometric ratio for angle A is the same in all right triangles containing angle A , no matter their size.

Therefore, trigonometric ratios depend only on angle A , not on the size of the triangle.

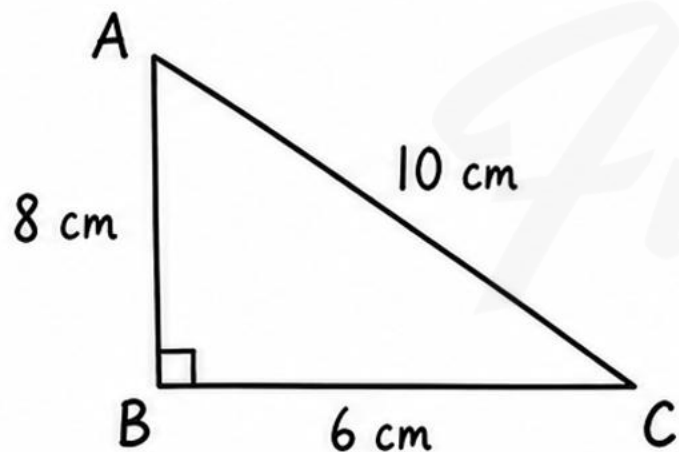
FINDING ALL SIX RATIOS

EXAMPLE - Ratios from Three Sides

In right triangle ABC, $\angle B = 90^\circ$,

AB = 8 cm, BC = 6 cm, AC = 10 cm.

Find all six trigonometric ratios of angle A.



First, identify the sides relative to angle A.

- Opposite side to $\angle A$ is BC = 6 cm.
- Adjacent side to $\angle A$ is AB = 8 cm.
- Hypotenuse is AC = 10 cm.

$$\sin A = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{6}{10} = \boxed{\frac{3}{5}}$$

$$\cos A = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{8}{10} = \boxed{\frac{4}{5}}$$

$$\tan A = \frac{\text{opposite}}{\text{adjacent}} = \frac{6}{8} = \boxed{\frac{3}{4}}$$

$$\operatorname{cosec} A = \frac{\text{hypotenuse}}{\text{opposite}} = \frac{10}{6} = \boxed{\frac{5}{3}}$$

$$\sec A = \frac{\text{hypotenuse}}{\text{adjacent}} = \frac{10}{8} = \boxed{\frac{5}{4}}$$

$$\cot A = \frac{\text{adjacent}}{\text{opposite}} = \frac{8}{6} = \boxed{\frac{4}{3}}$$

Reciprocal checks:

$$\sin A \cdot \operatorname{cosec} A = \frac{3}{5} \times \frac{5}{3} = 1$$

$$\tan A \cdot \cot A = \frac{3}{4} \times \frac{4}{3} = 1$$



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