Pythagoras theorem

Understanding: Pythagoras Theorem

- The Pythagoras Theorem applies only to right-angled triangles.
- In a right-angled triangle, the side opposite the right angle is called the hypotenuse.
- The other two sides are called the base and perpendicular.

Statement of the Theorem

- In a right-angled triangle,

  $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$

Formula

- $h^2 = b^2 + p^2$

where h = hypotenuse, b = base, p = perpendicular

Use of the Theorem

- To check whether a triangle is right-angled
- To find the missing side of a right-angled triangle

A right triangle has a right angle. An important theorem called Pythagoras Theorem relating to a right triangle is states as follows:

In a right triangle, the square of the hypotenuse equals the sum of the squares of its remaining two sides.

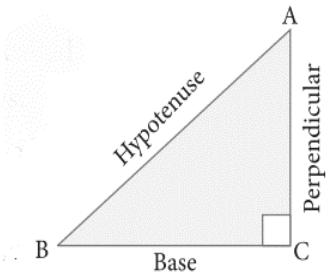
In a right triangle ABC right-angled at C i.e., AB is the hypotenuse and AC and BC are the other two sides of the triangle, we have

$(AB)2 = (BC)^2 + (CA)^2$

i.e., $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$

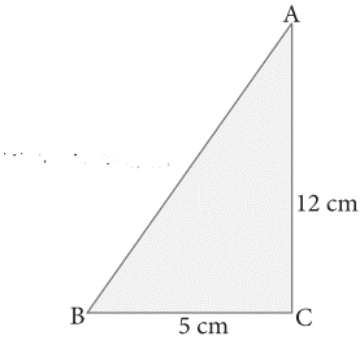
i.e., $c^2 = a^2 + b^2$, where a = BC,

b = CA and c = AB



Let us understand with an example:

Example: A ladder is placed in such a way that its foot is at a distance of 5m from a wall and its top reaches a window 12 m above the ground. Determine the length of the ladder.



Solution:

Let AB be the ladder and B be the window.

Thus, BC = 5m and AC = 12m.

Since ABC is a right triangle, right-angled at C

$AB^2 = AC^2 + BC^2$ (Pythagoras theorem)

i.e., $AB^2 = 5^2 + (12)^2 = 25 + 144 = 169$

or $AB \times AB = 13 \times 13$ or $AB = 13$cm

Hence, the length of the ladder is 13 m.

Example

Perpendicular = 6 cm, Hypotenuse = 10 cm

$b^2 = 10^2 - 6^2 = 100 - 36 = 64$

$b = \sqrt{64} = 8$ cm

Base = 8 cm

Example

Check whether a triangle with sides 6 cm, 8 cm, and 10 cm is a right triangle

Check: $10^2 = 6^2 + 8^2 \rightarrow 100 = 36 + 64 = 100$

Yes, it is a right-angled triangle

Example

In a triangle, base = 9 cm, perpendicular = 12 cm

$h^2 = 9^2 + 12^2 = 81 + 144 = 225$

$h = \sqrt{225} = 15$ cm

Hypotenuse = 15 cm

Summary Points

- Pythagoras theorem is used only for right-angled triangles.
- $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$.
- It helps in finding any one side if the other two are known.
- Can be used to check if a triangle is right-angled.
- Always apply square and square root operations carefully.