

2

Pythagoras Theorem



Let's study.

- Pythagorean triplet
- Theorem of geometric mean
- Application of Pythagoras theorem
- Similarity and right angled triangles
- Pythagoras theorem
- Apollonius theorem



Let's recall.

Pythagoras theorem :

In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of remaining two sides.

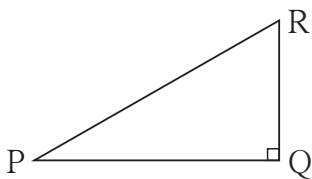


Fig. 2.1

In ΔPQR $\angle PQR = 90^\circ$

$$l(PR)^2 = l(PQ)^2 + l(QR)^2$$

We will write this as,

$$PR^2 = PQ^2 + QR^2$$

The lengths PQ, QR and PR of ΔPQR can also be shown by letters r, p and q. With this convention, referring to figure 2.1, Pythagoras theorem can also be stated as $q^2 = p^2 + r^2$.

Pythagorean Triplet :

In a triplet of natural numbers, if the square of the largest number is equal to the sum of the squares of the remaining two numbers then the triplet is called Pythagorean triplet.

For Example: In the triplet (11, 60, 61) ,

$$11^2 = 121, \quad 60^2 = 3600, \quad 61^2 = 3721 \quad \text{and} \quad 121 + 3600 = 3721$$

The square of the largest number is equal to the sum of the squares of the other two numbers.

$\therefore$ 11, 60, 61 is a Pythagorean triplet.

Verify that (3, 4, 5), (5, 12, 13), (8, 15, 17), (24, 25, 7) are Pythagorean triplets.

Numbers in Pythagorean triplet can be written in any order.



(II) Property of $45^\circ-45^\circ-90^\circ$

If the acute angles of a right angled triangle are 45° and 45° , then each of the perpendicular sides is $\frac{1}{\sqrt{2}}$ times the hypotenuse.

See Figure 2.3. In ΔXYZ ,

$$XY = \frac{1}{\sqrt{2}} \times ZY$$

$$XZ = \frac{1}{\sqrt{2}} \times ZY$$

$$\therefore XY = XZ = \frac{1}{\sqrt{2}} \times ZY$$

If $ZY = 3\sqrt{2}$ cm then we will find XY and ZX

$$XY = XZ = \frac{1}{\sqrt{2}} \times 3\sqrt{2}$$

$$XY = XZ = 3\text{cm}$$

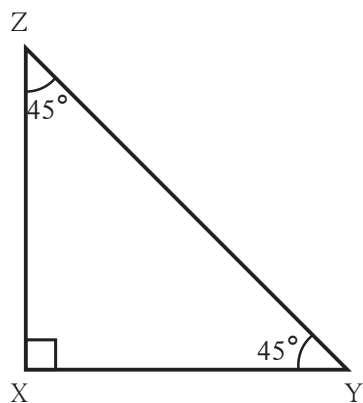


Fig. 2.3

In 7th standard we have studied theorem of Pythagoras using areas of four right angled triangles and a square. We can prove the theorem by an alternative method.

Activity:

Take two congruent right angled triangles. Take another isosceles right angled triangle whose congruent sides are equal to the hypotenuse of the two congruent right angled triangles. Join these triangles to form a trapezium

$$\text{Area of the trapezium} = \frac{1}{2} \times (\text{sum of the lengths of parallel sides}) \times \text{height}$$

Using this formula, equating the area of trapezium with the sum of areas of the three right angled triangles we can prove the theorem of Pythagoras.

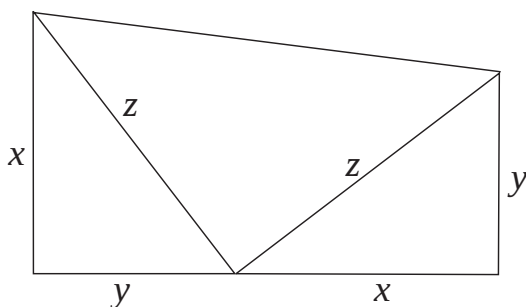


Fig. 2.4





Let's learn.

Now we will give the proof of Pythagoras theorem based on properties of similar triangles. For this, we will study right angled similar triangles.

Similarity and right angled triangle

Theorem : In a right angled triangle, if the altitude is drawn to the hypotenuse, then the two triangles formed are similar to the original triangle and to each other.

Given : In $\triangle ABC$, $\angle ABC = 90^\circ$,
seg $BD \perp$ seg AC , $A-D-C$

To prove: $\triangle ADB \sim \triangle ABC$
 $\triangle BDC \sim \triangle ABC$
 $\triangle ADB \sim \triangle BDC$

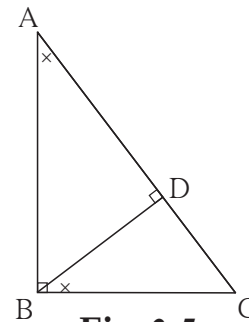


Fig. 2.5

Proof : In $\triangle ADB$ and $\triangle ABC$

$\angle DAB \cong \angle BAC$... (common angle)

$\angle ADB \cong \angle ABC$... (each 90°)

$\triangle ADB \sim \triangle ABC$... (AA test) ... (I)

In $\triangle BDC$ and $\triangle ABC$

$\angle BCD \cong \angle ACB$ (common angle)

$\angle BDC \cong \angle ABC$ (each 90°)

$\triangle BDC \sim \triangle ABC$ (AA test) ... (II)

$\therefore \triangle ADB \sim \triangle BDC$ from (I) and (II) (III)

$\therefore$ from (I), (II) and (III), $\triangle ADB \sim \triangle BDC \sim \triangle ABC$ (transitivity)

Theorem of geometric mean

In a right angled triangle, the perpendicular segment to the hypotenuse from the opposite vertex, is the geometric mean of the segments into which the hypotenuse is divided.

Proof : In right angled triangle PQR, seg $QS \perp$ hypotenuse PR

$\triangle QSR \sim \triangle PSQ$ (similarity of right triangles)

$$\frac{QS}{PS} = \frac{SR}{SQ}$$

$$\frac{QS}{PS} = \frac{SR}{QS}$$

$$QS^2 = PS \times SR$$

$\therefore$ seg QS is the 'geometric mean' of seg PS and SR.

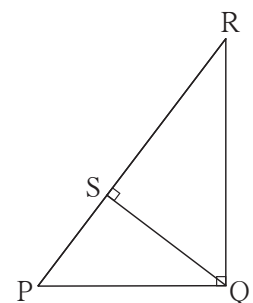


Fig. 2.6



Pythagoras Theorem

In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of remaining two sides.

Given : In ΔABC , $\angle ABC = 90^\circ$

To prove : $AC^2 = AB^2 + BC^2$

Construction : Draw perpendicular seg BD on side AC.

A-D-C.

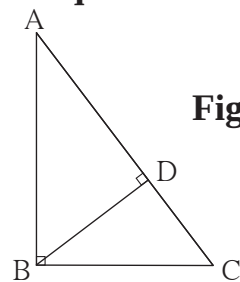


Fig. 2.7

Proof : In right angled ΔABC , seg $BD \perp$ hypotenuse AC (construction)

$\therefore \Delta ABC \sim \Delta ADB \sim \Delta BDC$ (similarity of right angled triangles)

$\Delta ABC \sim \Delta ADB$

$$\frac{AB}{AD} = \frac{BC}{DB} = \frac{AC}{AB} \text{ - corresponding sides}$$

$$\frac{AB}{AD} = \frac{AC}{AB}$$

$$AB^2 = AD \times AC \text{ (I)}$$

Adding (I) and (II)

$$\begin{aligned} AB^2 + BC^2 &= AD \times AC + DC \times AC \\ &= AC (AD + DC) \\ &= AC \times AC \text{ (A-D-C)} \end{aligned}$$

$$\therefore AB^2 + BC^2 = AC^2$$

$$\therefore AC^2 = AB^2 + BC^2$$

Similarly, $\Delta ABC \sim \Delta BDC$

$$\frac{AB}{BD} = \frac{BC}{DC} = \frac{AC}{BC} \text{ -corresponding sides}$$

$$\frac{BC}{DC} = \frac{AC}{BC}$$

$$BC^2 = DC \times AC \text{ (II)}$$

Converse of Pythagoras theorem

In a triangle if the square of one side is equal to the sum of the squares of the remaining two sides, then the triangle is a right angled triangle.

Given : In ΔABC , $AC^2 = AB^2 + BC^2$

To prove : $\angle ABC = 90^\circ$

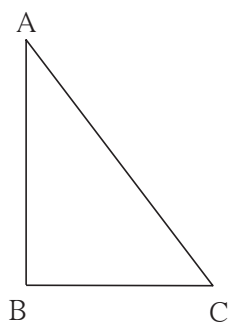


Fig. 2.8

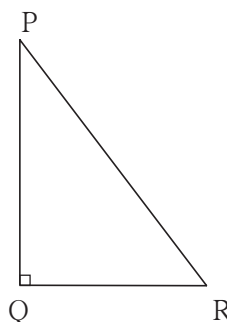


Fig. 2.9

Construction : Draw ΔPQR such that, $AB = PQ$, $BC = QR$, $\angle PQR = 90^\circ$.

Proof : In ΔPQR , $\angle Q = 90^\circ$

$$PR^2 = PQ^2 + QR^2 \quad \dots\dots\dots (\text{Pythagoras theorem})$$

$$= AB^2 + BC^2 \quad \dots\dots\dots (\text{construction}) \quad \dots\dots(I)$$

$$= AC^2 \quad \dots\dots\dots (\text{given}) \quad \dots\dots(II)$$

$$\therefore PR^2 = AC^2$$

$$\therefore PR = AC \quad \dots\dots\dots (III)$$

$$\therefore \Delta ABC \cong \Delta PQR \quad \dots\dots\dots (\text{SSS test})$$

$$\therefore \angle ABC = \angle PQR = 90^\circ$$



Remember this!

(1) (a) Similarity and right angled triangle

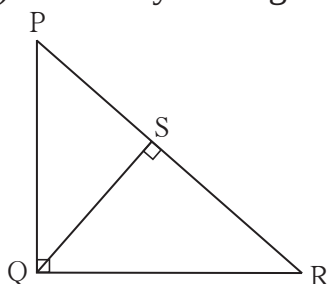


Fig. 2.10

In ΔPQR $\angle Q = 90^\circ$, $\text{seg } QS \perp \text{seg } PR$,
 $\Delta PQR \sim \Delta PSQ \sim \Delta QSR$. Thus all the
 right angled triangles in the figure are
 similar to one another.

(b) Theorem of geometric mean

In the above figure, $\Delta PSQ \sim \Delta QSR$

$$\therefore QS^2 = PS \times SR$$

$\therefore$ seg QS is the geometric mean of seg PS and seg SR

(2) Pythagoras Theorem:

In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of remaining two sides.

(3) Converse of Pythagoras Theorem:

In a triangle, if the square of one side is equal to the sum of the squares of the remaining two sides, then the triangle is a right angled triangle

(4) Let us remember one more very useful property.

In a right angled triangle, if one side is half of the hypotenuse then the angle opposite to that side is 30° .

This property is the converse of $30^\circ-60^\circ-90^\circ$ theorem.



Solved Examples

Ex. (1) See fig 2.11. In $\triangle ABC$, $\angle B = 90^\circ$, $\angle A = 30^\circ$, $AC = 14$, then find AB and BC

Solution :

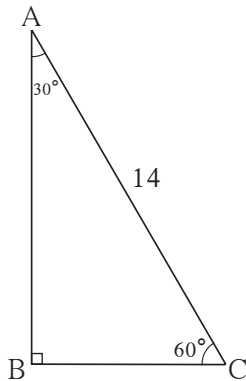


Fig. 2.11

In $\triangle ABC$,

$$\angle B = 90^\circ, \angle A = 30^\circ, \therefore \angle C = 60^\circ$$

By $30^\circ - 60^\circ - 90^\circ$ theorem,

$$BC = \frac{1}{2} \times AC$$

$$BC = \frac{1}{2} \times 14$$

$$BC = 7$$

$$AB = \frac{\sqrt{3}}{2} \times AC$$

$$AB = \frac{\sqrt{3}}{2} \times 14$$

$$AB = 7\sqrt{3}$$

Ex. (2) See fig 2.12, In $\triangle ABC$, seg $AD \perp$ seg BC , $\angle C = 45^\circ$, $BD = 5$ and $AC = 8\sqrt{2}$ then find AD and BC .

Solution : In $\triangle ADC$

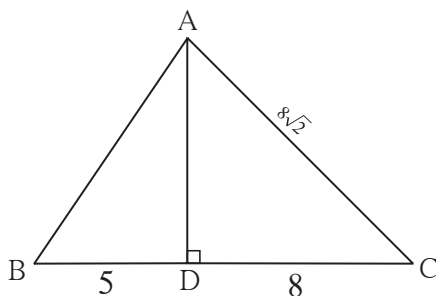


Fig. 2.12

$$\angle ADC = 90^\circ, \angle C = 45^\circ, \therefore \angle DAC = 45^\circ$$

$$AD = DC = \frac{1}{\sqrt{2}} \times 8\sqrt{2} \dots \text{by } 45^\circ - 45^\circ - 90^\circ \text{ theorem}$$

$$DC = 8 \quad \therefore AD = 8$$

$$BC = BD + DC$$

$$= 5 + 8$$

$$BC = 13$$

Ex. (3) In fig 2.13, $\angle PQR = 90^\circ$, seg $QN \perp$ seg PR , $PN = 9$, $NR = 16$. Find QN .

Solution : In $\triangle PQR$, seg $QN \perp$ seg PR

$$NQ^2 = PN \times NR \dots \text{theorem of geometric mean}$$

$$\therefore NQ = \sqrt{PN \times NR}$$

$$= \sqrt{9 \times 16}$$

$$= 3 \times 4$$

$$= 12$$

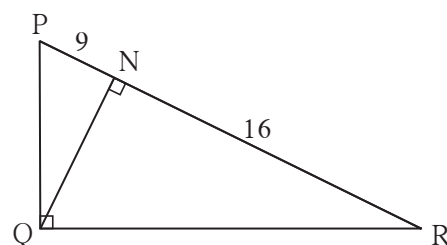


Fig. 2.13

Solution : In Δ PQR, $\angle$ PQR = 90° , seg QS $\perp$ seg PR

$$\begin{aligned} QS &= \sqrt{PS \times SR} \dots\dots\dots (\text{theorem of geometric mean}) \\ &= \sqrt{10 \times 8} \\ &= \sqrt{5 \times 2 \times 8} \\ &= \sqrt{5 \times 16} \\ &= 4\sqrt{5} \\ \therefore x &= 4\sqrt{5} \end{aligned}$$

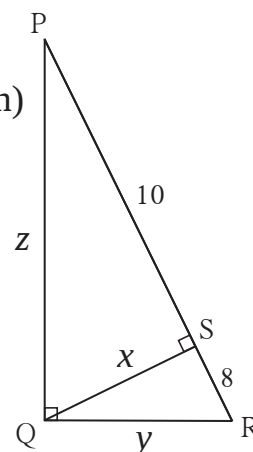


Fig. 2.14

In $\triangle PSQ$, by Pythagoras theorem

$$\begin{aligned} QR^2 &= QS^2 + SR^2 \\ &= (4\sqrt{5})^2 + 8^2 \\ &= 16 \times 5 + 64 \\ &= 80 + 64 \\ &= 144 \\ \therefore QR &= 12 \end{aligned}$$

$$\begin{aligned} PQ^2 &= QS^2 + PS^2 \\ &= (4\sqrt{5})^2 + 10^2 \\ &= 16 \times 5 + 100 \\ &= 80 + 100 \\ &= 180 \\ &= 36 \times 5 \\ \therefore PQ &= 6\sqrt{5} \end{aligned}$$

Hence $x = 4\sqrt{5}$, $y = 12$, $z = 6\sqrt{5}$

Ex. (5) In the right angled triangle, sides making right angle are 9 cm and 12 cm.
Find the length of the hypotenuse

Solution: In $\triangle PQR$, $\angle Q = 90^\circ$

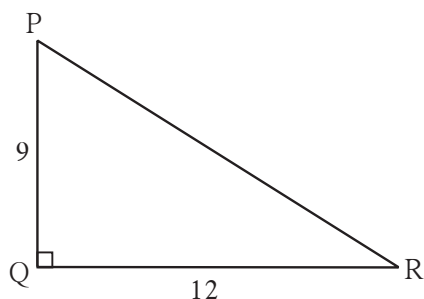


Fig. 2.15

$$\begin{aligned} PR^2 &= PQ^2 + QR^2 \text{ (Pythagoras theorem)} \\ &= 9^2 + 12^2 \\ &= 81 + 144 \\ PR^2 &= 225 \\ PR &= 15 \\ \text{Hypotenuse} &= 15 \text{ cm} \end{aligned}$$

Ex. (6) In ΔLMN , $l = 5$, $m = 13$, $n = 12$. State whether ΔLMN is a right angled triangle or not.

Solution : $l = 5$, $m = 13$, $n = 12$
 $l^2 = 25$, $m^2 = 169$, $n^2 = 144$
 $\therefore m^2 = l^2 + n^2$

$\therefore$ by converse of Pythagoras theorem ΔLMN is a right angled triangle.

Ex. (7) See fig 2.16. In ΔABC , seg $AD \perp$ seg BC . Prove that:
 $AB^2 + CD^2 = BD^2 + AC^2$

Solution : According to Pythagoras theorem, in ΔADC

$$AC^2 = AD^2 + CD^2$$

$$\therefore AD^2 = AC^2 - CD^2 \dots (I)$$

In ΔADB

$$AB^2 = AD^2 + BD^2$$

$$\therefore AD^2 = AB^2 - BD^2 \dots (II)$$

$$\therefore AB^2 - BD^2 = AC^2 - CD^2 \dots \dots \dots \text{from I and II}$$

$$\therefore AB^2 + CD^2 = AC^2 + BD^2$$

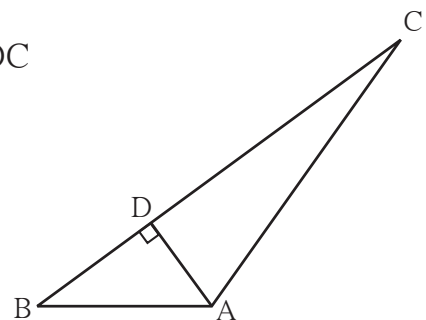


Fig. 2.16

Practice set 2.1

1. Identify, with reason, which of the following are Pythagorean triplets.

- (i)(3, 5, 4) (ii)(4, 9, 12) (iii)(5, 12, 13)
 (iv) (24, 70, 74) (v)(10, 24, 27) (vi)(11, 60, 61)

2. In figure 2.17, $\angle MNP = 90^\circ$,
 seg $NQ \perp$ seg MP , $MQ = 9$,
 $QP = 4$, find NQ .

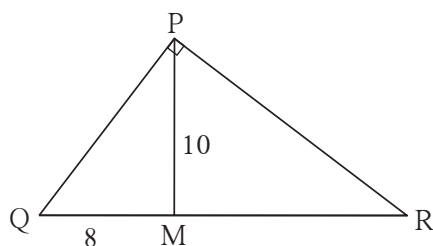


Fig. 2.18

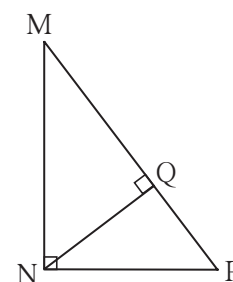


Fig. 2.17

3. In figure 2.18, $\angle QPR = 90^\circ$,
 seg $PM \perp$ seg QR and $Q-M-R$,
 $PM = 10$, $QM = 8$, find QR .

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- For finding AB and BC with the help of information given in figure 2.20, complete following activity.

$$\therefore \angle \text{BAC} = \boxed{}$$

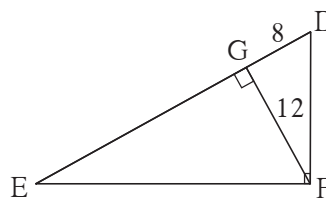
$$\therefore AB = BC = \boxed{} \times AC$$

$$= \boxed{} \times \sqrt{8}$$

$$= \boxed{} \times 2\sqrt{2}$$

==

7. In figure 2.21, $\angle DFE = 90^\circ$,
 $FG \perp ED$, If $GD = 8$, $FG = 12$,
 find (1) EG (2) FD and (3) EF



8. Find the diagonal of a rectangle whose length is 35 cm and breadth is 12 cm.

-

10*. Walls of two buildings on either side of a street are parallel to each other. A ladder 5.8 m long is placed on the street such that its top just reaches the window of a building at the height of 4 m. On turning the ladder over to the other side of the street, its top touches the window of the other building at a height 4.2 m. Find the width of the street.



Let's learn.

Application of Pythagoras theorem

In Pythagoras theorem, the relation between hypotenuse and sides making right angle i.e. the relation between side opposite to right angle and the remaining two sides is given.

In a triangle, relation between the side opposite to acute angle and remaining two sides and relation of the side opposite to obtuse angle with remaining two sides can be determined with the help of Pythagoras theorem. Study these relations from the following examples.

Ex. (1) In $\triangle ABC$, $\angle C$ is an acute angle, seg $AD \perp$ seg BC . Prove that:

$$AB^2 = BC^2 + AC^2 - 2BC \times DC$$

In the given figure let $AB = c$, $AC = b$, $AD = p$, $BC = a$, $DC = x$,

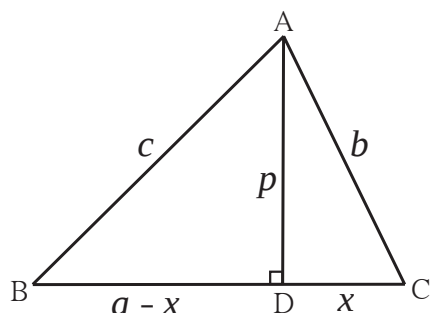


Fig. 2.23

$$\therefore BD = a - x$$

In $\triangle ADB$, by Pythagoras theorem

$$c^2 = (a-x)^2 + \boxed{}$$

$$c^2 = a^2 - 2ax + x^2 + \boxed{} \dots\dots\dots (I)$$

In $\triangle ADC$, by Pythagoras theorem

$$b^2 = p^2 + \boxed{}$$

$$p^2 = b^2 - \boxed{} \dots\dots\dots (II)$$

Substituting value of p^2 from (II) in (I),

$$c^2 = a^2 - 2ax + x^2 + b^2 - x^2$$

$$\therefore c^2 = a^2 + b^2 - 2ax$$

$$\therefore AB^2 = BC^2 + AC^2 - 2BC \times DC$$

Ex. (2) In $\triangle ABC$, $\angle ACB$ is obtuse angle, seg $AD \perp$ seg BC . Prove that:

$$AB^2 = BC^2 + AC^2 + 2BC \times CD$$

In the figure seg $AD \perp$ seg BC

Let $AD = p$, $AC = b$, $AB = c$,

$BC = a$ and $DC = x$.

$$DB = a + x$$

In $\triangle ADB$, by Pythagoras theorem,

$$c^2 = (a + x)^2 + p^2$$

$$c^2 = a^2 + 2ax + x^2 + p^2 \dots\dots\dots (I)$$

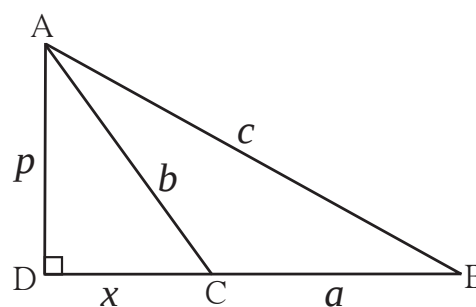


Fig. 2.24



Similarly, in ΔADC

$$b^2 = x^2 + p^2$$

$$\therefore p^2 = b^2 - x^2 \quad \dots\dots\dots (II)$$

$\therefore$ substituting the value of p^2 from (II) in (I)

$$\therefore c^2 = a^2 + 2ax + b^2$$

$$\therefore AB^2 = BC^2 + AC^2 + 2BC \times CD$$

Apollonius theorem

In ΔABC , if M is the midpoint of side BC, then $AB^2 + AC^2 = 2AM^2 + 2BM^2$

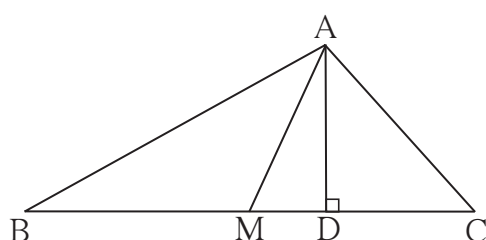


Fig. 2.25

Given : In ΔABC , M is the midpoint of side BC.

To prove : $AB^2 + AC^2 = 2AM^2 + 2BM^2$

Construction: Draw seg $AD \perp$ seg BC

Proof : If seg AM is not perpendicular to seg BC then out of $\angle AMB$ and $\angle AMC$ one is obtuse angle and the other is acute angle

In the figure, $\angle AMB$ is obtuse angle and $\angle AMC$ is acute angle.

From examples (1) and (2) above,

$$AB^2 = AM^2 + MB^2 + 2BM \times MD \quad \dots\dots (I)$$

$$\text{and } AC^2 = AM^2 + MC^2 - 2MC \times MD$$

$$\therefore AC^2 = AM^2 + MB^2 - 2BM \times MD \quad (\because BM = MC) \quad \dots\dots\dots (II)$$

$\therefore$ adding (I) and (II)

$$AB^2 + AC^2 = 2AM^2 + 2BM^2$$

Write the proof yourself if seg $AM \perp$ seg BC.

From this example we can see the relation among the sides and medians of a triangle.

This is known as Apollonius theorem.

Solved Examples

Ex. (1) In the figure 2.26, seg PM is a median of ΔPQR . $PM = 9$ and $PQ^2 + PR^2 = 290$, then find QR.

Solution : In ΔPQR , seg PM is a median.

M is the midpoint of seg QR.

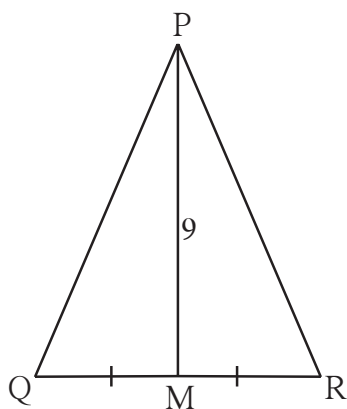


Fig. 2.26

$$QM = MR = \frac{1}{2} QR$$

$$PQ^2 + PR^2 = 2PM^2 + 2QM^2 \text{ (by Apollonius theorem)}$$

$$290 = 2 \times 9^2 + 2QM^2$$

$$290 = 2 \times 81 + 2QM^2$$

$$290 = 162 + 2QM^2$$

$$2QM^2 = 290 - 162$$

$$2QM^2 = 128$$

$$QM^2 = 64$$

$$QM = 8$$

$$\therefore QR = 2 \times QM$$

$$= 2 \times 8$$

$$= 16$$

Ex. (2) Prove that, the sum of the squares of the diagonals of a rhombus is equal to the sum of the squares of the sides.

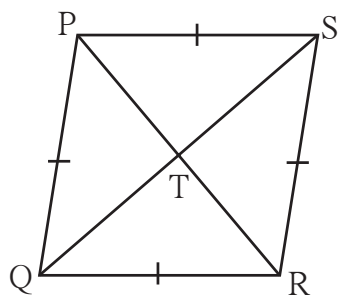


Fig. 2.27

Given : □ PQRS is a rhombus. Diagonals PR and SQ intersect each other at point T

To prove : $PS^2 + SR^2 + QR^2 + PQ^2 = PR^2 + QS^2$

Proof : Diagonals of a rhombus bisect each other .

$\therefore$ by Apollonius' theorem,

$$PQ^2 + PS^2 = 2PT^2 + 2QT^2 \dots\dots\dots (I)$$

$$QR^2 + SR^2 = 2RT^2 + 2QT^2 \dots\dots\dots (II)$$

$\therefore$ adding (I) and (II) ,

$$PQ^2 + PS^2 + QR^2 + SR^2 = 2(PT^2 + RT^2) + 4QT^2$$

$$= 2(PT^2 + PT^2) + 4QT^2 \dots\dots\dots (RT = PT)$$

$$= 4PT^2 + 4QT^2$$

$$= (2PT)^2 + (2QT)^2$$

$$= PR^2 + QS^2$$

(The above proof can be written using Pythagoras theorem also.)

Practice set 2.2

1. In $\triangle PQR$, point S is the midpoint of side QR. If $PQ = 11$, $PR = 17$, $PS = 13$, find QR.
2. In $\triangle ABC$, $AB = 10$, $AC = 7$, $BC = 9$ then find the length of the median drawn from point C to side AB
3. In the figure 2.28 seg PS is the median of $\triangle PQR$ and $PT \perp QR$.

Prove that,

$$(i) PR^2 = PS^2 + QR \times ST + \left(\frac{QR}{2}\right)^2$$

$$ii) PQ^2 = PS^2 - QR \times ST + \left(\frac{QR}{2}\right)^2$$

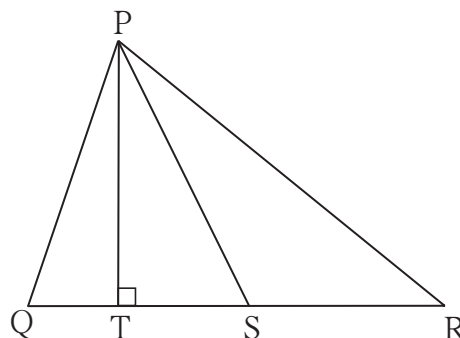


Fig. 2.28

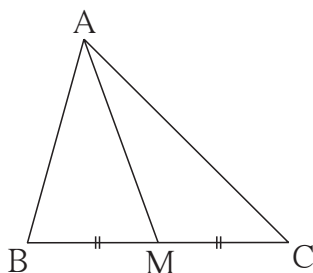


Fig. 2.29

4. In $\triangle ABC$, point M is the midpoint of side BC.

$$\text{If, } AB^2 + AC^2 = 290 \text{ cm}^2,$$

$AM = 8 \text{ cm}$, find BC.

- 5*. In figure 2.30, point T is in the interior of rectangle PQRS,

Prove that, $TS^2 + TQ^2 = TP^2 + TR^2$

(As shown in the figure, draw seg AB $\parallel$ side SR and A-T-B)

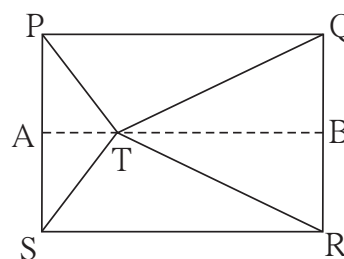


Fig. 2.30

Problem set 2

1. Some questions and their alternative answers are given. Select the correct alternative.
 - (1) Out of the following which is the Pythagorean triplet?

(A) (1, 5, 10) (B) (3, 4, 5) (C) (2, 2, 2) (D) (5, 5, 2)
 - (2) In a right angled triangle, if sum of the squares of the sides making right angle is 169 then what is the length of the hypotenuse?

(A) 15 (B) 13 (C) 5 (D) 12



- (3) Out of the dates given below which date constitutes a Pythagorean triplet ?
 (A) 15/08/17 (B) 16/08/16 (C) 3/5/17 (D) 4/9/15
- (4) If a, b, c are sides of a triangle and $a^2 + b^2 = c^2$, name the type of triangle.
 (A) Obtuse angled triangle (B) Acute angled triangle
 (C) Right angled triangle (D) Equilateral triangle
- (5) Find perimeter of a square if its diagonal is $10\sqrt{2}$ cm.
 (A) 10 cm (B) $40\sqrt{2}$ cm (C) 20 cm (D) 40 cm
- (6) Altitude on the hypotenuse of a right angled triangle divides it in two parts of lengths 4 cm and 9 cm. Find the length of the altitude.
 (A) 9 cm (B) 4 cm (C) 6 cm (D) $2\sqrt{6}$ cm
- (7) Height and base of a right angled triangle are 24 cm and 18 cm find the length of its hypotenuse
 (A) 24 cm (B) 30 cm (C) 15 cm (D) 18 cm
- (8) In $\triangle ABC$, $AB = 6\sqrt{3}$ cm, $AC = 12$ cm, $BC = 6$ cm. Find measure of $\angle A$.
 (A) 30° (B) 60° (C) 90° (D) 45°

2. Solve the following examples.

- (1) Find the height of an equilateral triangle having side $2a$.
- (2) Do sides 7 cm, 24 cm, 25 cm form a right angled triangle? Give reason.
- (3) Find the length a diagonal of a rectangle having sides 11 cm and 60cm.
- (4) Find the length of the hypotenuse of a right angled triangle if remaining sides are 9 cm and 12 cm.
- (5) A side of an isosceles right angled triangle is x . Find its hypotenuse.
- (6) In $\triangle PQR$; $PQ = \sqrt{8}$, $QR = \sqrt{5}$, $PR = \sqrt{3}$. Is $\triangle PQR$ a right angled triangle?
 If yes, which angle is of 90° ?

3. In $\triangle RST$, $\angle S = 90^\circ$, $\angle T = 30^\circ$, $RT = 12$ cm then find RS and ST .

4. Find the diagonal of a rectangle whose length is 16 cm and area is 192 sq.cm.

5*. Find the length of the side and perimeter of an equilateral triangle whose height is $\sqrt{3}$ cm.

6. In $\triangle ABC$ seg AP is a median. If $BC = 18$, $AB^2 + AC^2 = 260$ Find AP .



- 7★. $\triangle ABC$ is an equilateral triangle. Point P is on base BC such that $PC = \frac{1}{3} BC$, if $AB = 6$ cm find AP.

- 8.** From the information given in the figure 2.31, prove that
 $PM = PN = \sqrt{3} \times a$

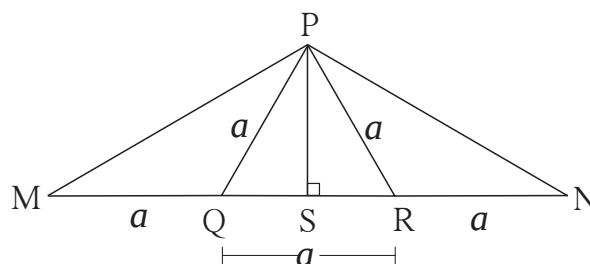


Fig. 2.31

9. Prove that the sum of the squares of the diagonals of a parallelogram is equal to the sum of the squares of its sides.
10. Pranali and Prasad started walking to the East and to the North respectively, from the same point and at the same speed. After 2 hours distance between them was $15\sqrt{2}$ km. Find their speed per hour.

- 11★.** In $\triangle ABC$, $\angle BAC = 90^\circ$,
seg BL and seg CM are medians
of $\triangle ABC$. Then prove that:
 $4(BL^2 + CM^2) = 5 BC^2$

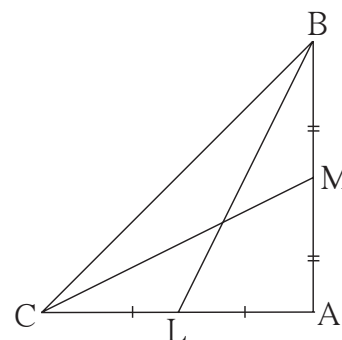


Fig. 2.32

12. Sum of the squares of adjacent sides of a parallelogram is 130 sq.cm and length of one of its diagonals is 14 cm. Find the length of the other diagonal.

- 13.** In $\triangle ABC$, seg $AD \perp$ seg BC
 $DB = 3CD$. Prove that :
 $2AB^2 = 2AC^2 + BC^2$

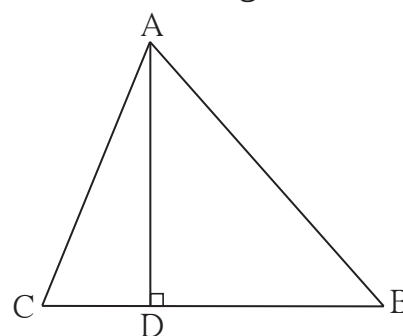


Fig. 2.33

- 14***. In an isosceles triangle, length of the congruent sides is 13 cm and its base is 10 cm. Find the distance between the vertex opposite the base and the centroid.

15. In a trapezium ABCD,
 $\text{seg AB} \parallel \text{seg DC}$
 $\text{seg BD} \perp \text{seg AD}$,
 $\text{seg AC} \perp \text{seg BC}$,
 If $AD = 15$, $BC = 15$
 and $AB = 25$. Find $A(\square \text{ ABCD})$

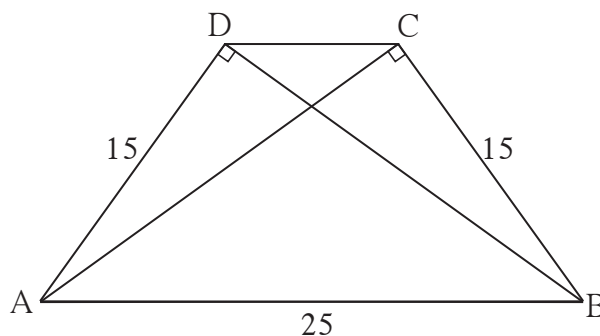


Fig. 2.34

- 16*. In the figure 2.35, $\triangle PQR$ is an equilateral triangle. Point S is on seg QR such that $QS = \frac{1}{3} QR$.
 Prove that : $9 PS^2 = 7 PQ^2$

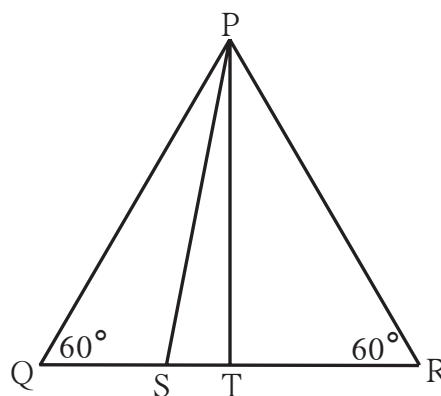


Fig. 2.35

- 17*. Seg PM is a median of $\triangle PQR$. If $PQ = 40$, $PR = 42$ and $PM = 29$, find QR.
 18. Seg AM is a median of $\triangle ABC$. If $AB = 22$, $AC = 34$, $BC = 24$, find AM



ICT Tools or Links

Obtain information on 'the life of Pythagoras' from the internet. Prepare a slide show.

