

### Exercise 4.7

If the sides of a triangle are 3 cm, 4 cm, and 6 cm long, determine whether the triangle is a right-angled triangle.

**Solution:**

We have,

Sides of triangle as

$$AB = 3 \text{ cm}$$

$$BC = 4 \text{ cm}$$

$$AC = 6 \text{ cm}$$

On finding their squares, we get

$$AB^2 = 3^2 = 9$$

$$BC^2 = 4^2 = 16$$

$$AC^2 = 6^2 = 36$$

Since,  $AB^2 + BC^2 \neq AC^2$

So, by converse of Pythagoras theorem the given sides cannot be the sides of a right triangle.

**1. The sides of certain triangles are given below. Determine which of them are right triangles.**

(i)  $a = 7 \text{ cm}$ ,  $b = 24 \text{ cm}$  and  $c = 25 \text{ cm}$

(ii)  $a = 9 \text{ cm}$ ,  $b = 16 \text{ cm}$  and  $c = 18 \text{ cm}$

(iii)  $a = 1.6 \text{ cm}$ ,  $b = 3.8 \text{ cm}$  and  $c = 4 \text{ cm}$

(iv)  $a = 8 \text{ cm}$ ,  $b = 10 \text{ cm}$  and  $c = 6 \text{ cm}$

**Solutions:**

(i) Given,

$$a = 7 \text{ cm}, b = 24 \text{ cm and } c = 25 \text{ cm}$$

$$\therefore a^2 = 49, b^2 = 576 \text{ and } c^2 = 625$$

$$\text{Since, } a^2 + b^2 = 49 + 576 = 625 = c^2$$

Then, by converse of Pythagoras theorem

The given sides are of a right triangle.

(ii) Given,

$$a = 9 \text{ cm}, b = 16 \text{ cm and } c = 18 \text{ cm}$$

$$\therefore a^2 = 81, b^2 = 256 \text{ and } c^2 = 324$$

$$\text{Since, } a^2 + b^2 = 81 + 256 = 337 \neq c^2$$

Then, by converse of Pythagoras theorem

The given sides cannot be of a right triangle.

(iii) Given,

$$a = 1.6 \text{ cm}, b = 3.8 \text{ cm and } C = 4 \text{ cm}$$

$$\therefore a^2 = 2.56, b^2 = 14.44 \text{ and } c^2 = 16$$

$$\text{Since, } a^2 + b^2 = 2.56 + 14.44 = 17 \neq c^2$$

Then, by converse of Pythagoras theorem

The given sides cannot be of a right triangle.

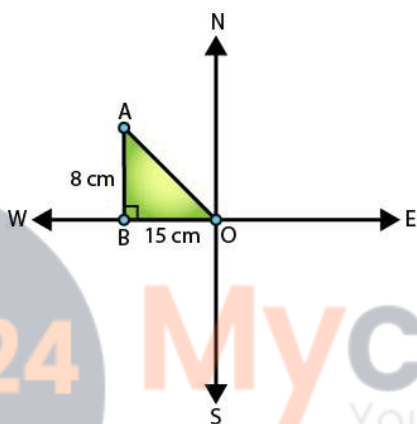
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- (iv) Given,  
 $a = 8$  cm,  $b = 10$  cm and  $c = 6$  cm  
 $\therefore a^2 = 64$ ,  $b^2 = 100$  and  $c^2 = 36$   
Since,  $a^2 + c^2 = 64 + 36 = 100 = b^2$   
Then, by converse of Pythagoras theorem  
The given sides are of a right triangle

2. A man goes 15 metres due west and then 8 metres due north. How far is he from the starting point?

**Solution:**

Let the starting point of the man be O and final point be A.

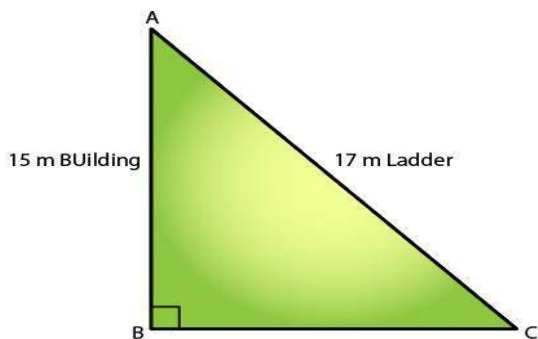


In  $\triangle ABO$ ,  
by Pythagoras theorem  $AO^2 = AB^2 + BO^2$   
 $\Rightarrow AO^2 = 8^2 + 15^2$   
 $\Rightarrow AO^2 = 64 + 225 = 289$   
 $\Rightarrow AO = \sqrt{289} = 17\text{m}$

$\therefore$  the man is 17m far from the starting point.

3. A ladder 17 m long reaches a window of a building 15 m above the ground. Find the distance of the foot of the ladder from the building.

**Solution:**



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In  $\triangle ABC$ , by Pythagoras theorem

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

$$\Rightarrow 15^2 + BC^2 = 17^2$$

$$225 + BC^2 = 289$$

$$BC^2 = 289 - 225$$

$$BC^2 = 64$$

$$\therefore BC = 8 \text{ m}$$

Therefore, the distance of the foot of the ladder from building = 8 m

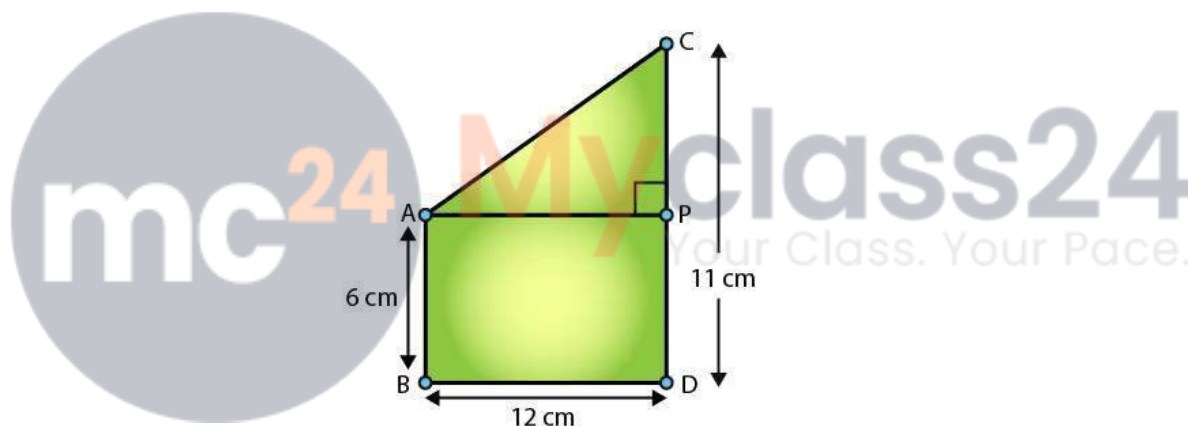
**4. Two poles of heights 6 m and 11 m stand on a plane ground. If the distance between their feet is 12 m, find the distance between their tops.**

**Solution:**

Let CD and AB be the poles of height 11m and 6m.

Then, it is seen that  $CP = 11 - 6 = 5\text{m}$ .

From the figure, AP should be 12m (given)



In triangle APC, by applying Pythagoras theorem, we have

$$AP^2 + PC^2 = AC^2$$

$$12^2 + 5^2 = AC^2$$

$$AC^2 = 144 + 25 = 169$$

$$\therefore AC = 13 \text{ (by taking sq. root on both sides)}$$

Thus, the distance between their tops = 13 m.

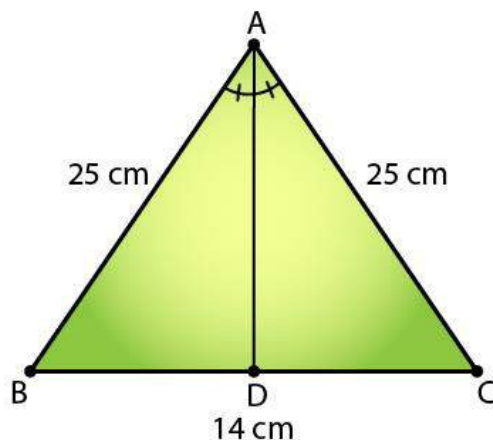
**5. In an isosceles triangle ABC,  $AB = AC = 25 \text{ cm}$ ,  $BC = 14 \text{ cm}$ . Calculate the altitude from A on BC.**

**Solution:**

Given,

$$\triangle ABC, AB = AC = 25 \text{ cm and } BC = 14.$$

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In  $\triangle ABD$  and  $\triangle ACD$ , we see that

$$\angle ADB = \angle ADC$$

[Each =  $90^\circ$ ]

$$AB = AC$$

[Given]

$$AD = AD$$

[Common]

Then,  $\triangle ABD \cong \triangle ACD$

[By RHS condition]

Thus,  $BD = CD = 7$  cm

[By corresponding parts of congruent triangles]

Finally,

In  $\triangle ADB$ , by Pythagoras theorem

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

$$\Rightarrow AD^2 + 7^2 = 25^2$$

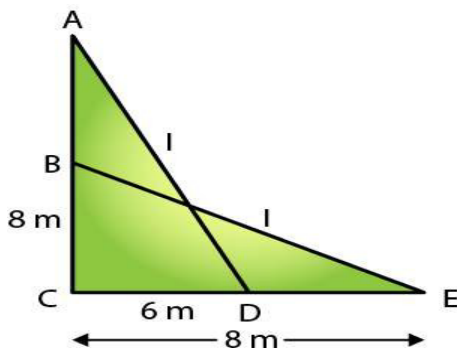
$$AD^2 = 625 - 49 = 576$$

$$\therefore AD = \sqrt{576} = 24 \text{ cm}$$

**6. The foot of a ladder is 6 m away from a wall and its top reaches a window 8 m above the ground. If the ladder is shifted in such a way that its foot is 8 m away from the wall, to what height does its tip reach?**

**Solution:**

Let's assume the length of ladder to be,  $AD = BE = x$  m



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So, in  $\triangle ACD$ , by Pythagoras theorem

We have,

$$\begin{aligned}AD^2 &= AC^2 + CD^2 \\ \Rightarrow x^2 &= 8^2 + 6^2 \dots (i)\end{aligned}$$

Also, in  $\triangle BCE$ , by Pythagoras theorem

$$\begin{aligned}BE^2 &= BC^2 + CE^2 \\ \Rightarrow x^2 &= BC^2 + 8^2 \dots (ii)\end{aligned}$$

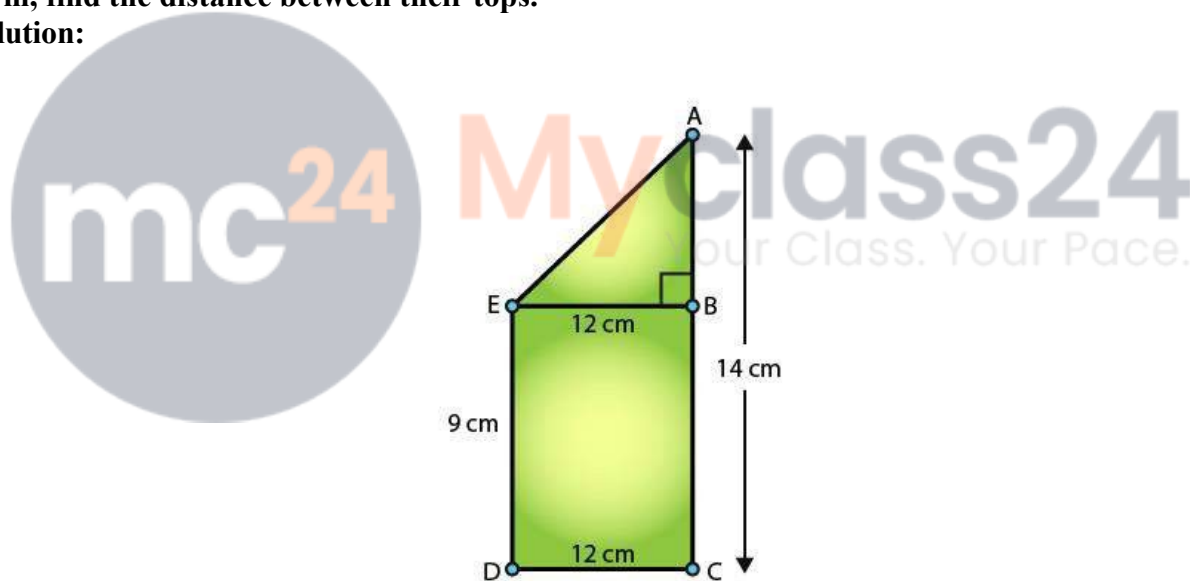
Compare (i) and (ii)

$$\begin{aligned}BC^2 + 8^2 &= 8^2 + 6^2 \\ \Rightarrow BC^2 + 6^2 & \\ \Rightarrow BC &= 6 \text{ m}\end{aligned}$$

Therefore, the tip of the ladder reaches to a height of 6m.

**7. Two poles of height 9 m and 14 m stand on a plane ground. If the distance between their feet is 12 m, find the distance between their tops.**

**Solution:**



Comparing with the figure, it's given that  
 $AC = 14 \text{ m}$ ,  $DC = 12 \text{ m}$  and  $ED = BC = 9 \text{ m}$

Construction: Draw  $EB \perp AC$

Now,

It's seen that  $AB = AC - BC = (14 - 9) = 5 \text{ m}$

And,  $EB = DC = 12 \text{ m}$  [distance between their feet]

Thus,

In  $\triangle ABE$ , by Pythagoras theorem, we have

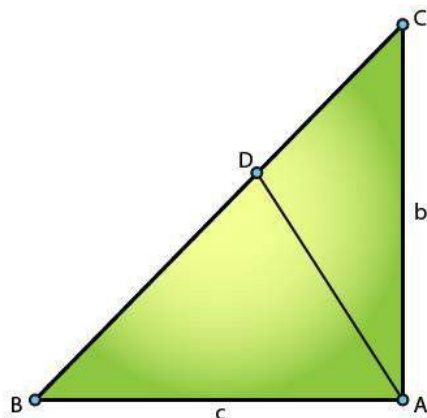
$$\begin{aligned}AE^2 &= AB^2 + BE^2 \\ AE^2 &= 5^2 + 12^2 \\ AE^2 &= 25 + 144 = 169\end{aligned}$$

$$\Rightarrow AE = \sqrt{169} = 13 \text{ m}$$

Therefore, the distance between their tops = 13 m

**8. Using Pythagoras theorem determine the length of AD in terms of b and c shown in Fig. 4.219**

**Solution:**



We have,

In  $\triangle BAC$ , by Pythagoras theorem, we have

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

$$\Rightarrow BC^2 = c^2 + b^2$$

$$\Rightarrow BC = \sqrt{c^2 + b^2}$$

In  $\triangle ABD$  and  $\triangle CBA$

$$\angle B = \angle B$$

[Common]

$$\angle ADB = \angle BAC$$

[Each  $90^\circ$ ]

Then,  $\triangle ABD \sim \triangle CBA$

[By AA similarity]

Thus,

$$AB/ CB = AD/ CA$$

[Corresponding parts of similar triangles are proportional]

$$c/ \sqrt{c^2 + b^2} = AD/ b$$

$$\therefore AD = bc/ \sqrt{c^2 + b^2}$$

**9. A triangle has sides 5 cm, 12 cm and 13 cm. Find the length to one decimal place, of the perpendicular from the opposite vertex to the side whose length is 13 cm.**

**Solution:**

From the fig.  $AB = 5\text{cm}$ ,  $BC = 12 \text{ cm}$  and  $AC = 13 \text{ cm}$ .

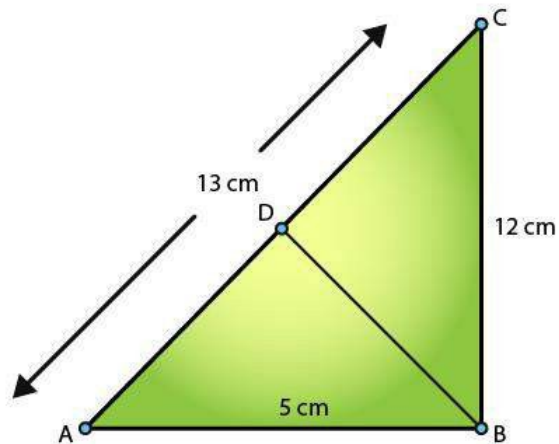
$$\text{Then, } AC^2 = AB^2 + BC^2.$$

$$\Rightarrow (13)^2 = (5)^2 + (12)^2 = 25 + 144 = 169 = 13^2$$

This proves that  $\triangle ABC$  is a right triangle, right angled at B.

Let  $BD$  be the length of perpendicular from B on AC.

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So, area of  $\triangle ABC = \frac{(BC \times BA)}{2}$  [Taking BC as the altitude]  
 $= \frac{(12 \times 5)}{2}$   
 $= 30 \text{ cm}^2$

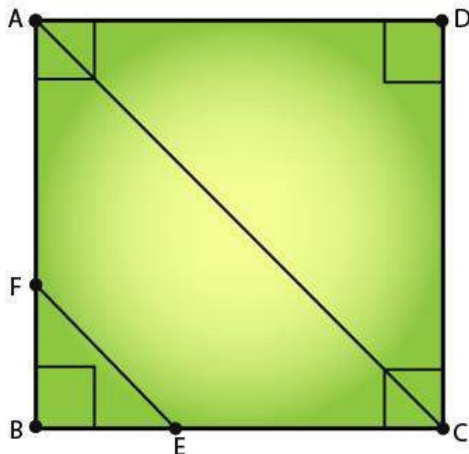
Also, area of  $\triangle ABC = \frac{(AC \times BD)}{2}$  [Taking BD as the altitude]  
 $= \frac{(13 \times BD)}{2}$

$\Rightarrow \frac{(13 \times BD)}{2} = 30$   
 $BD = \frac{60}{13} = 4.6$  (to one decimal place)

**10. ABCD is a square. F is the mid-point of AB. BE is one third of BC. If the area of  $\triangle FBE = 108\text{cm}^2$ , find the length of AC.**

**Solution:**

Given,  
 ABCD is a square. And, F is the mid-point of AB.  
 BE is one third of BC.  
 Area of  $\triangle FBE = 108\text{cm}^2$   
 Required to find: length of AC



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Let's assume the sides of the square to be  $x$ .

$$\Rightarrow AB = BC = CD = DA = x \text{ cm}$$

And,  $AF = FB = x/2 \text{ cm}$

So,  $BE = x/3 \text{ cm}$

Now, the area of  $\Delta FBE = 1/2 \times BE \times FB$

$$\Rightarrow 108 = (1/2) \times (x/3) \times (x/2)$$

$$\Rightarrow x^2 = 108 \times 2 \times 3 \times 2 = 1296$$

$$\Rightarrow x = \sqrt{1296}$$

[taking square roots of both the sides]

$$\therefore x = 36 \text{ cm}$$

Further in  $\Delta ABC$ , by Pythagoras theorem, we have

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

$$\Rightarrow AC^2 = x^2 + x^2 = 2x^2$$

$$\Rightarrow AC^2 = 2 \times (36)^2$$

$$\Rightarrow AC = 36\sqrt{2} = 36 \times 1.414 = 50.904 \text{ cm}$$

Therefore, the length of  $AC$  is  $50.904 \text{ cm}$ .

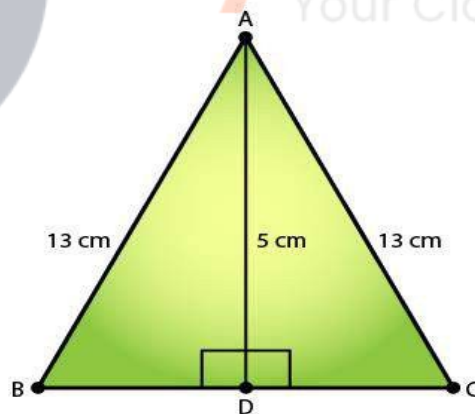
**11. In an isosceles triangle  $ABC$ , if  $AB = AC = 13 \text{ cm}$  and the altitude from  $A$  on  $BC$  is  $5 \text{ cm}$ , find  $BC$ .**

**Solution:**

Given,

An isosceles triangle  $ABC$ ,  $AB = AC = 13 \text{ cm}$ ,  $AD = 5 \text{ cm}$

Required to find:  $BC$



In  $\Delta ADB$ , by using Pythagoras theorem, we have

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

$$5^2 + BD^2 = 169$$

$$BD^2 = 169 - 25 = 144$$

$$\Rightarrow BD = \sqrt{144} = 12 \text{ cm}$$

Similarly, applying Pythagoras theorem in  $\Delta ADC$  we can have,

$$AC^2 = AD^2 + DC^2$$

$$13^2 = 5^2 + DC^2$$

$$\Rightarrow DC = \sqrt{144} = 12 \text{ cm}$$

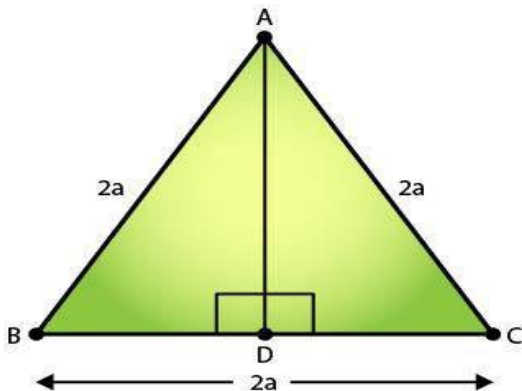
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Thus,  $BC = BD + DC = 12 + 12 = 24$  cm

12. In a  $\triangle ABC$ ,  $AB = BC = CA = 2a$  and  $AD \perp BC$ . Prove that

(i)  $AD = a\sqrt{3}$                       (ii)  $\text{Area}(\triangle ABC) = \sqrt{3} a^2$

**Solution:**



(i) In  $\triangle ABD$  and  $\triangle ACD$ , we have

$$\angle ADB = \angle ADC = 90^\circ$$

$$AB = AC$$

[Given]

$$AD = AD$$

[Common]

$$\text{So, } \triangle ABD \cong \triangle ACD$$

[By RHS condition]

$$\text{Hence, } BD = CD = a$$

[By C.P.C.T]

Now, in  $\triangle ABD$ , by Pythagoras theorem

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

$$AD^2 + a^2 = 2a^2$$

$$AD^2 = 4a^2 - a^2 = 3a^2$$

$$AD = a\sqrt{3}$$

(ii)  $\text{Area}(\triangle ABC) = \frac{1}{2} \times BC \times AD$

$$= \frac{1}{2} \times (2a) \times (a\sqrt{3})$$

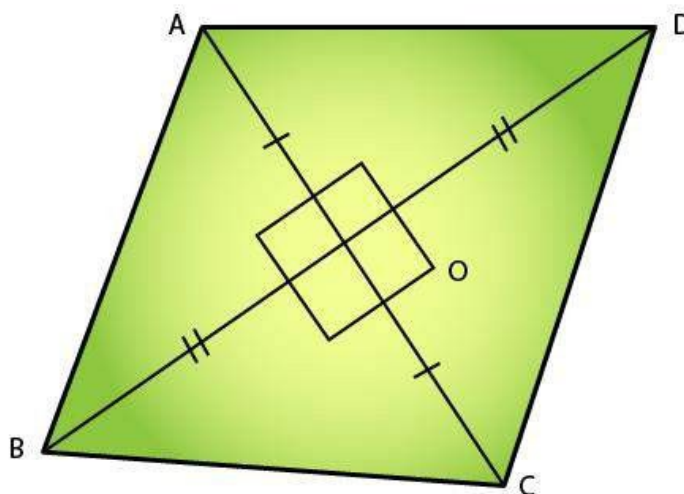
$$= \sqrt{3} a^2$$

13. The lengths of the diagonals of a rhombus is 24cm and 10cm. Find each side of the rhombus.

**Solution:**

Let ABCD be a rhombus and AC and BD be the diagonals of ABCD.

So, AC = 24cm and BD = 10cm



We know that diagonals of a rhombus bisect each other at right angle. (Perpendicular to each other)

So,

$AO = OC = 12\text{cm}$  and  $BO = OD = 3\text{cm}$

In  $\triangle AOB$ , by Pythagoras theorem, we have

$$AB^2 = AO^2 + BO^2$$

$$= 12^2 + 3^2$$

$$= 144 + 9$$

$$= 153$$

$$\Rightarrow AB = \sqrt{153} = 13\text{cm}$$

Since, the sides of rhombus are all equal.

Therefore,  $AB = BC = CD = AD = 13\text{cm}$ .

