

## EXERCISE 12.1

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**Question 1:** Find the area of a triangle whose sides are respectively 150 cm, 120 cm and 200 cm.

**Solution:**

We know, Heron's Formula

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

Here, a = 150 cm

b = 120 cm

c = 200 cm

Step 1: Find s

$$s = (a+b+c)/2$$

$$s = (150+200+120)/2$$

$$s = 235 \text{ cm}$$

Step 2: Find the area of a triangle

$$\text{Area} = \sqrt{235 \times (235 - 150) \times (235 - 120) \times (235 - 200)}$$

$$= \sqrt{235 \times (85) \times (115) \times (35)}$$

$$= \sqrt{80399375}$$

$$= 8966.56$$

The area of a triangle is 8966.56 sq. cm.

**Question 2:** Find the area of a triangle whose sides are respectively 9 cm, 12 cm and 15 cm.

**Solution:**

We know, Heron's Formula

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

Here, a = 9 cm

b = 12 cm

c = 15 cm

Step 1: Find s

$$s = (a+b+c)/2$$

$$s = (9 + 12 + 15)/2$$

$$s = 18 \text{ cm}$$

Step 2: Find the area of the triangle

$$\text{Area} = \sqrt{(18(18-9)(18-12)(18-15))}$$

$$= \sqrt{18 \times 9 \times 6 \times 3}$$

$$= \sqrt{2916}$$

$$= 54$$

The area of a triangle is 54 sq. cm.

**Question 3:** Find the area of a triangle two sides of which are 18 cm and 10 cm and the perimeter is 42 cm.

**Solution:**

Given:

a = 18 cm, b = 10 cm, and perimeter = 42 cm

Let c be the third side of the triangle.

Step 1: Find the third side of the triangle, that is c

We know, perimeter = 2s,

$$2s = 42$$

$$s = 21$$

Again,  $s = (a+b+c)/2$

Put the value of s, and we get

$$21 = (18+10+c)/2$$

$$42 = 28 + c$$

$$c = 14 \text{ cm}$$

Step 2: Find the area of the triangle

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$= \sqrt{21(21-18)(21-10)(21-14)}$$

$$= \sqrt{21 \times 3 \times 11 \times 7}$$

$$= \sqrt{4851}$$

$$= 21\sqrt{11}$$

$$\text{Area} = 21\sqrt{11} \text{ square cm.}$$

**Question 4:** In a triangle ABC, AB = 15cm, BC = 13cm and AC = 14cm. Find the area of triangle ABC and hence its altitude on AC.

**Solution:**

Let the sides of the given triangle be AB = a, BC = b, and AC = c, respectively.

Here, a = 15 cm

b = 13 cm

c = 14 cm

From Heron's Formula;

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

$$s = (15+13+14)/2 = 21$$

$$\text{Area} = \sqrt{21(21-13)(21-14)(21-15)}$$

$$= \sqrt{21 \times 8 \times 7 \times 6}$$

$$= \sqrt{7056}$$

$$= 84$$

$$\text{Area} = 84 \text{ cm}^2$$

Let BE is perpendicular on AC

Now, the area of the triangle =  $\frac{1}{2} \times \text{Base} \times \text{Height}$

$$\frac{1}{2} \times \text{BE} \times \text{AC} = 84$$

$$\text{BE} = 12 \text{ cm}$$

Hence, the altitude is 12 cm.

**Question 5:** The perimeter of a triangular field is 540 m, and its sides are in the ratio 25:17:12. Find the area of the triangle.

**Solution:**

Let the sides of a given triangle be  $a = 25x$ ,  $b = 17x$ ,  $c = 12x$  respectively,

Given, Perimeter of the triangle = 540 cm

$$2s = a + b + c$$

$$a + b + c = 540 \text{ cm}$$

$$25x + 17x + 12x = 540 \text{ cm}$$

$$54x = 540 \text{ cm}$$

$$x = 10 \text{ cm}$$

So, the sides of a triangle are

$$a = 250 \text{ cm}$$

$$b = 170 \text{ cm}$$

$$c = 120 \text{ cm}$$

$$\text{Semi perimeter, } s = (a+b+c)/2$$

$$= 540/2$$

$$= 270$$

$$s = 270 \text{ cm}$$

From Heron's Formula;

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$= \sqrt{270(270-250)(270-170)(270-120)}$$

$$= \sqrt{270 \times 20 \times 100 \times 150}$$

$$= \sqrt{81000000}$$

$$= 9000$$

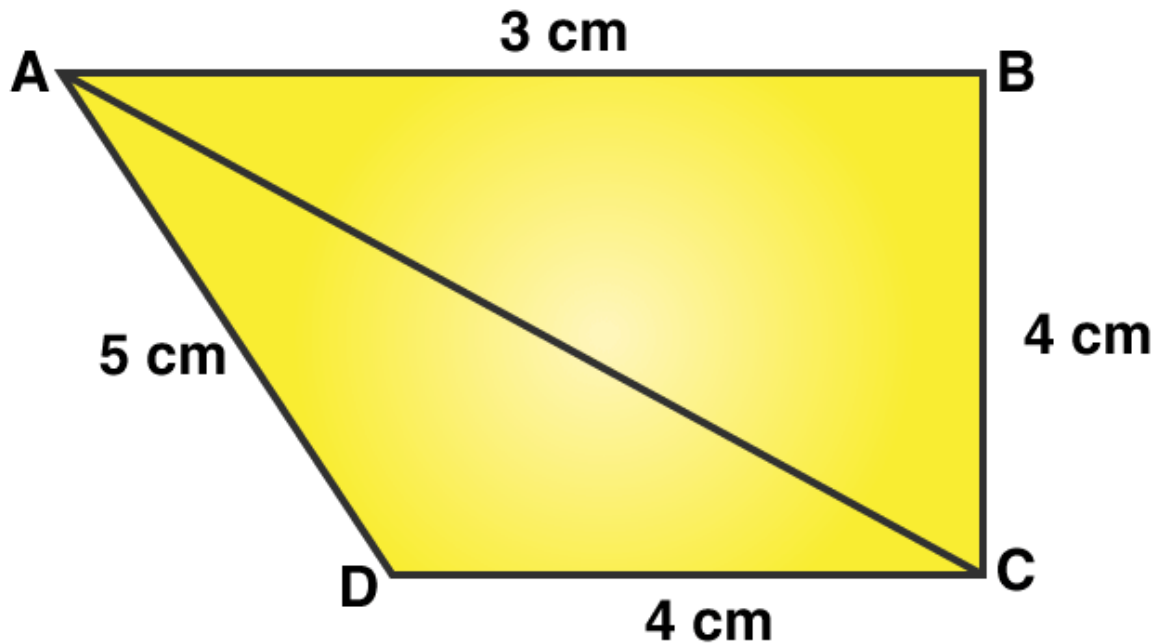
Hence, the area of the triangle is  $9000 \text{ cm}^2$ .

## EXERCISE 12.2

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Question 1: Find the area of the quadrilateral ABCD in which AB = 3 cm, BC = 4 cm, CD = 4 cm, DA = 5 cm and AC = 5 cm.

Solution:



Area of the quadrilateral ABCD = Area of  $\triangle ABC$  + Area of  $\triangle ADC$  ....(1)

$\triangle ABC$  is a right-angled triangle, which is right-angled at B.

Area of  $\triangle ABC$  =  $\frac{1}{2} \times \text{Base} \times \text{Height}$

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

$$= \frac{1}{2} \times 3 \times 4$$

$$= 6$$

Area of  $\triangle ABC$  = 6 cm<sup>2</sup> .....(2)

Now, In  $\triangle CAD$ ,

Sides are given, apply Heron's Formula.

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

$$\text{Perimeter} = 2s = AC + CD + DA$$

$$2s = 5 \text{ cm} + 4 \text{ cm} + 5 \text{ cm}$$

$$2s = 14 \text{ cm}$$

$$s = 7 \text{ cm}$$

$$\text{Area of the } \triangle CAD = \sqrt{7 \times (7-5) \times (7-4) \times (7-5)}$$

$$= \sqrt{7 \times 2 \times 3 \times 2}$$

$$= 2 \sqrt{21}$$

$$= 9.16$$

$$\text{Area of the } \triangle CAD = 9.16 \text{ cm}^2 \dots (3)$$

Using equations (2) and (3) in (1), we get

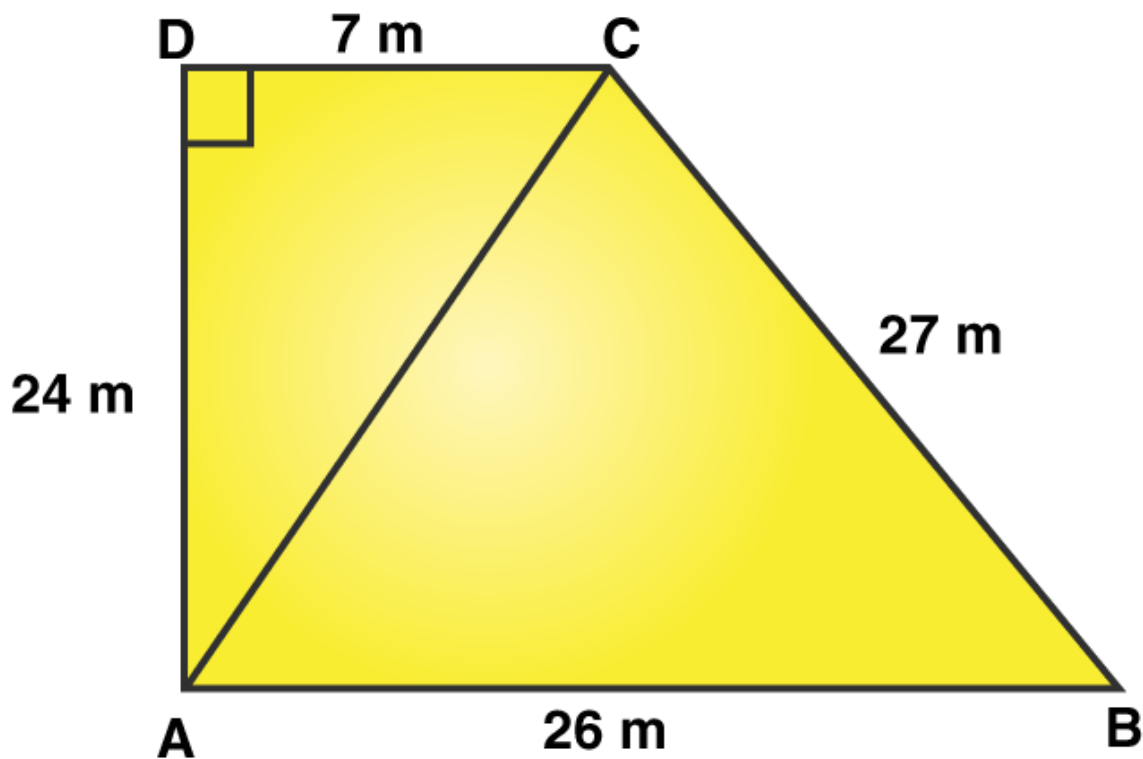
$$\text{Area of quadrilateral ABCD} = (6 + 9.16) \text{ cm}^2$$

$$= 15.16 \text{ cm}^2.$$

**Question 2:** The sides of a quadrilateral field, taken in order, are 26 m, 27 m, 7 m, and 24 m, respectively. The angle contained by the last two sides is a right angle. Find its area.

**Solution:**





Here,

$AB = 26$  m,  $BC = 27$  m,  $CD = 7$  m,  $DA = 24$  m

AC is the diagonal joined at A to C point.

Now, in  $\triangle ADC$ ,

From Pythagoras theorem,

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

$$AC^2 = 24^2 + 7^2$$

$$AC = 25$$

Now, area of  $\triangle ABC$

All the sides are known, Apply Heron's Formula.

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle



Perimeter of  $\triangle ABC = 2s = AB + BC + CA$

$$2s = 26 \text{ m} + 27 \text{ m} + 25 \text{ m}$$

$$s = 39 \text{ m}$$

$$\text{Area of a triangle} = \sqrt{39 \times (39 - 25) \times (39 - 26) \times (39 - 27)}$$

$$= \sqrt{39 \times 14 \times 13 \times 12}$$

$$= \sqrt{85176}$$

$$= 291.84$$

$$\text{Area of a triangle ABC} = 291.84 \text{ m}^2$$

Now, for the area of  $\triangle ADC$ , (Right angle triangle)

$$\text{Area} = \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \frac{1}{2} \times 7 \times 24$$

$$= 84$$

Thus, the area of a  $\triangle ADC$  is  $84 \text{ m}^2$

Therefore, the area of rectangular field ABCD = Area of  $\triangle ABC$  + Area of  $\triangle ADC$

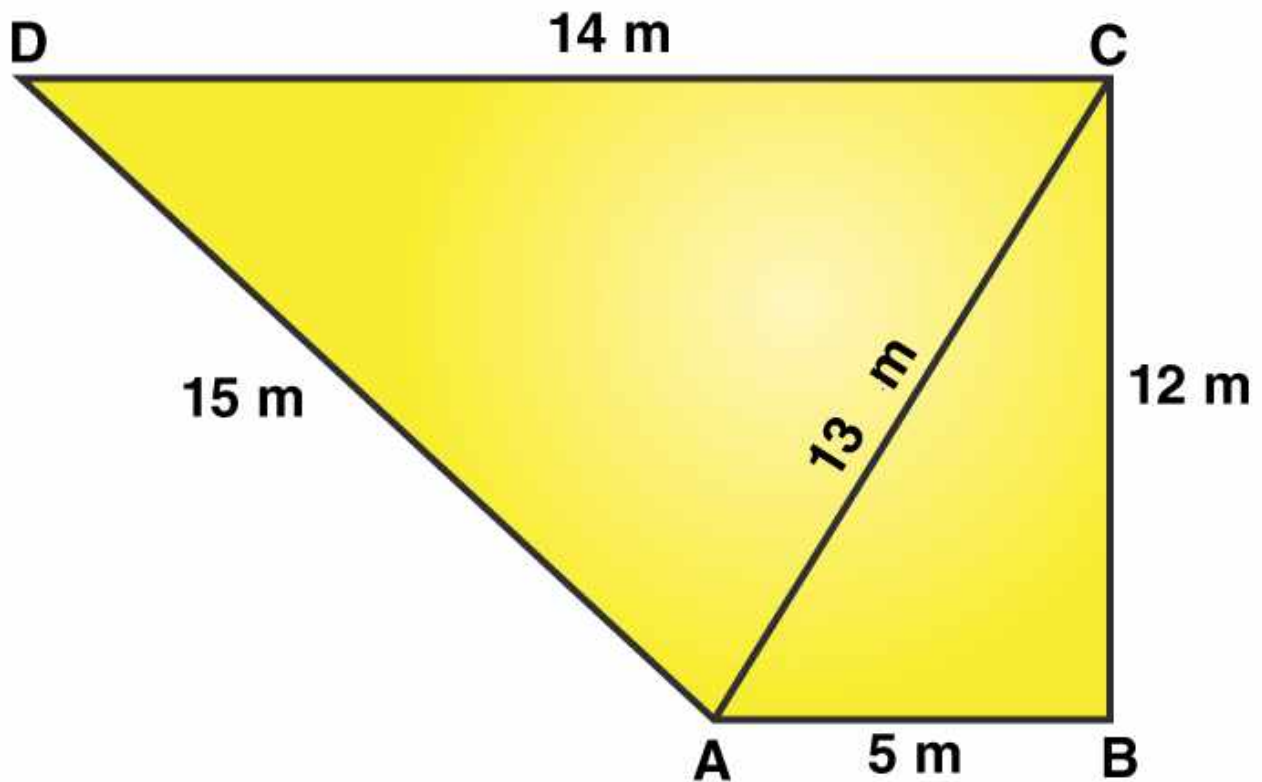
$$= 291.84 \text{ m}^2 + 84 \text{ m}^2$$

$$= 375.8 \text{ m}^2$$

**Question 3:** The sides of a quadrilateral, taken in order as 5, 12, 14, and 15 meters, respectively, and the angle contained by the first two sides is a right angle. Find its area.

**Solution:**





Here,  $AB = 5$  m,  $BC = 12$  m,  $CD = 14$  m and  $DA = 15$  m

Join the diagonal AC.

Now, the area of  $\triangle ABC = \frac{1}{2} \times AB \times BC$

$$= \frac{1}{2} \times 5 \times 12 = 30$$

The area of  $\triangle ABC$  is  $30 \text{ m}^2$

In  $\triangle ABC$ , (right triangle).

From Pythagoras theorem,

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

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

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

$$\text{or } AC = 13$$

Now in  $\triangle ADC$ ,

All sides are known, apply Heron's Formula:

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

$$\text{Perimeter of } \triangle ADC = 2s = AD + DC + AC$$

$$2s = 15 \text{ m} + 14 \text{ m} + 13 \text{ m}$$

$$s = 21 \text{ m}$$

$$\text{Area of } \triangle ADC = \sqrt{21 \times (21 - 13) \times (21 - 14) \times (21 - 15)}$$

$$= \sqrt{21 \times 8 \times 7 \times 6}$$

$$= 84$$

$$\text{Area of } \triangle ADC = 84 \text{ m}^2$$

$$\text{Area of quadrilateral ABCD} = \text{Area of } \triangle ABC + \text{Area of } \triangle ADC$$

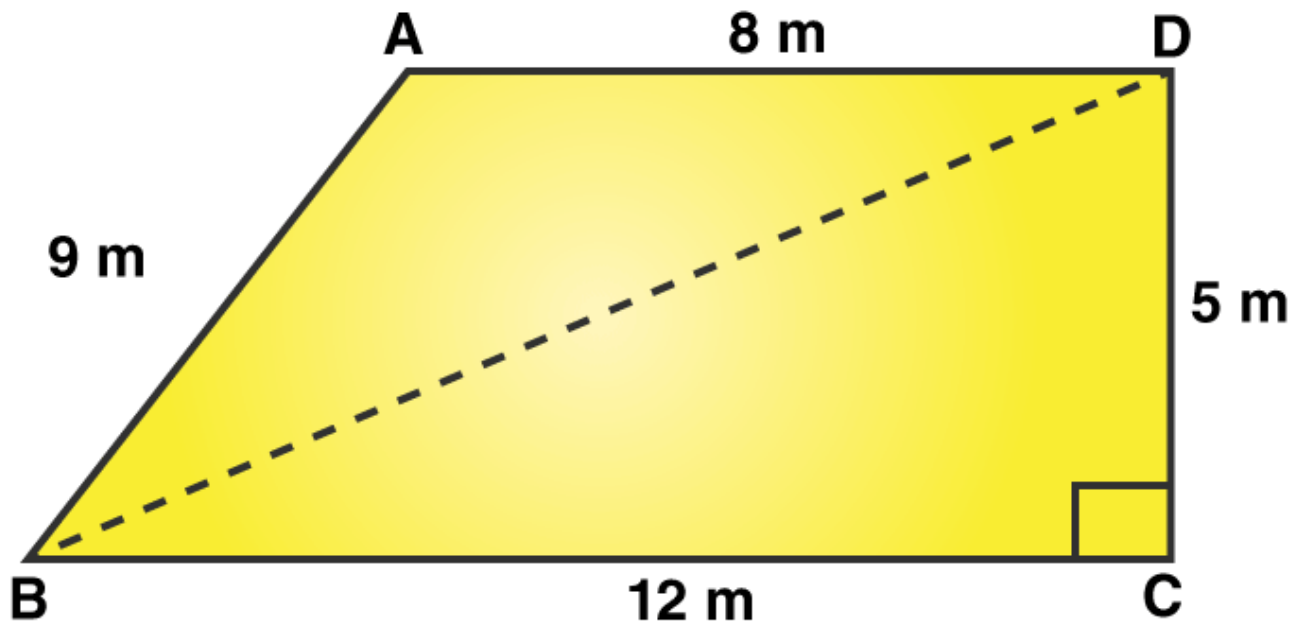
$$= (30 + 84) \text{ m}^2$$

$$= 114 \text{ m}^2$$

**Question 4:** A park in the shape of a quadrilateral ABCD has  $\angle C = 90^\circ$ ,  $AB = 9 \text{ m}$ ,  $BC = 12 \text{ m}$ ,  $CD = 5 \text{ m}$ ,  $AD = 8 \text{ m}$ . How much area does it occupy?

**Solution:**





Here,  $AB = 9$  m,  $BC = 12$  m,  $CD = 5$  m,  $DA = 8$  m.

And  $BD$  is a diagonal of  $ABCD$ .

**In the right  $\triangle BCD$ ,**

From Pythagoras theorem;

$$BD^2 = BC^2 + CD^2$$

$$BD^2 = 12^2 + 5^2 = 144 + 25 = 169$$

$$BD = 13 \text{ m}$$

$$\text{Area of } \triangle BCD = \frac{1}{2} \times BC \times CD$$

$$= \frac{1}{2} \times 12 \times 5$$

$$= 30$$

$$\text{Area of } \triangle BCD = 30 \text{ m}^2$$

**Now, In  $\triangle ABD$ ,**

All sides are known, Apply Heron's Formula:

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

Where, a, b and c are sides of a triangle

$$\text{Perimeter of } \triangle ABD = 2s = 9 \text{ m} + 8 \text{ m} + 13 \text{ m}$$

$$s = 15 \text{ m}$$

$$\text{Area of the } \triangle ABD = \sqrt{15 \times (15 - 9) \times (15 - 8) \times (15 - 13)}$$

$$= \sqrt{15 \times 6 \times 7 \times 2}$$

$$= 6\sqrt{35}$$

$$= 35.49$$

$$\text{Area of the } \triangle ABD = 35.49 \text{ m}^2$$

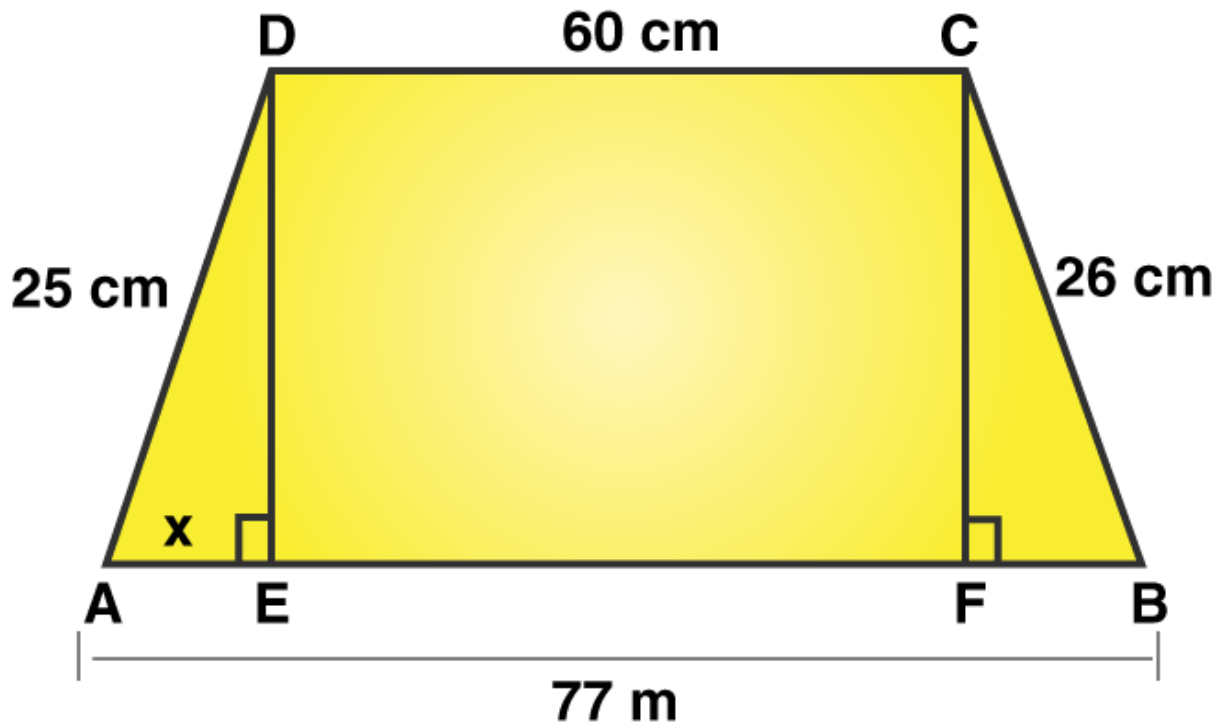
$$\text{Area of quadrilateral ABCD} = \text{Area of } \triangle ABD + \text{Area of } \triangle BCD$$

$$= (35.496 + 30) \text{ m}^2$$

$$= 65.5 \text{ m}^2.$$

**Question 5:** Two parallel sides of a trapezium are 60 m and 77 m and the other sides are 25 m and 26 m. Find the area of the trapezium.

**Solution:**



Given:  $AB = 77$  m,  $CD = 60$  m,  $BC = 26$  m and  $AD = 25$  m

AE and CF are diagonals.

DE and CF are two perpendiculars on AB.

Therefore, we get,  $DC = EF = 60$  m

Let's say,  $AE = x$

Then  $BF = 77 - (60 + x)$

$BF = 17 - x \dots (1)$

**In the right  $\triangle ADE$ ,**

From Pythagoras theorem,

$$DE^2 = AD^2 - AE^2$$

$$DE^2 = 25^2 - x^2 \dots (2)$$

**In right  $\triangle BCF$**

From Pythagoras theorem,

$$CF^2 = BC^2 - BF^2$$

$$CF^2 = 26^2 - (17 - x)^2$$

[Using (1)]

Here,  $DE = CF$

So,  $DE^2 = CF^2$

$$(2) \Rightarrow 25^2 - x^2 = 26^2 - (17-x)^2$$

$$625 - x^2 = 676 - (289 - 34x + x^2)$$

$$625 - x^2 = 676 - 289 + 34x - x^2$$

$$238 = 34x$$

$$x = 7$$

$$(2) \Rightarrow DE^2 = 25^2 - (7)^2$$

$$DE^2 = 625 - 49$$

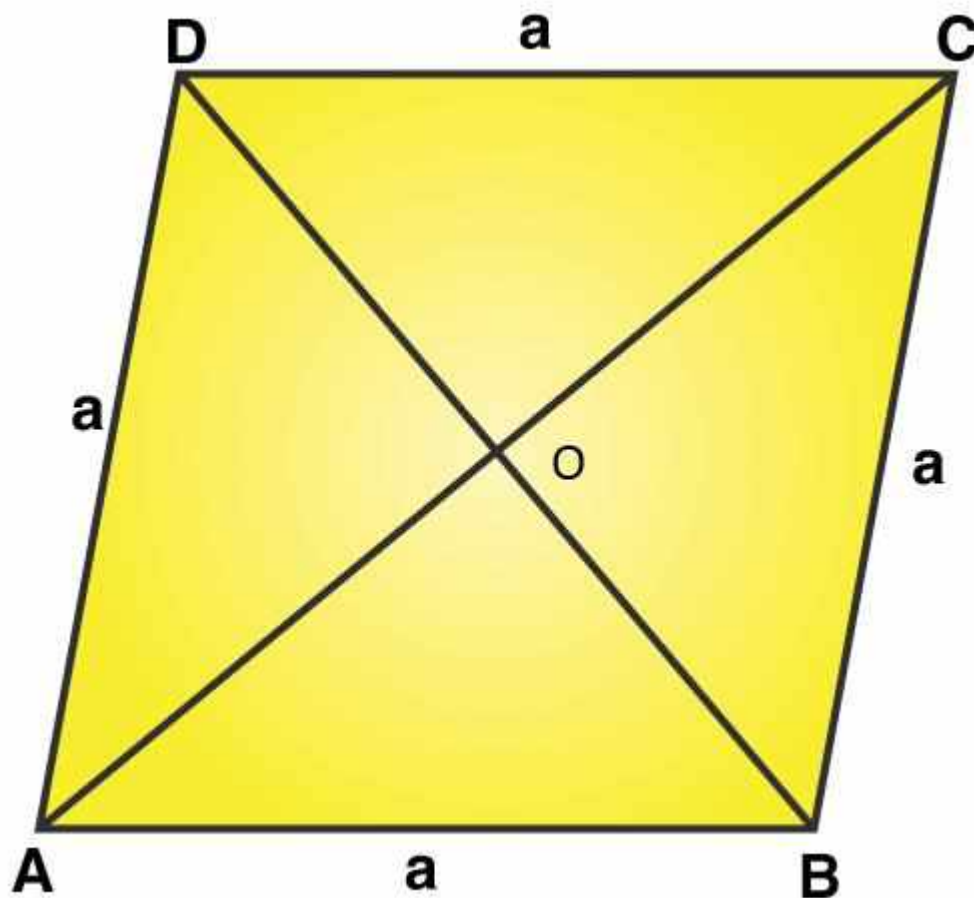
$$DE = 24$$

$$\text{Area of trapezium} = \frac{1}{2} \times (60 + 77) \times 24 = 1644$$

*Area of trapezium is  $1644 \text{ m}^2$  (Answer)*

**Question 6: Find the area of a rhombus whose perimeter is 80 m and one of whose diagonal is 24 m.**

**Solution:**



The perimeter of a rhombus = 80 m (given)

We know, Perimeter of a rhombus =  $4 \times \text{side}$

Let  $a$  be the side of a rhombus.

$$4 \times a = 80$$

$$\text{or } a = 20$$

One of the diagonal,  $AC = 24$  m (given)

Therefore  $OA = \frac{1}{2} \times AC$

$$OA = 12$$

In  $\triangle AOB$ ,

Using Pythagoras theorem:

$$OB^2 = AB^2 - OA^2 = 20^2 - 12^2 = 400 - 144 = 256$$

$$\text{or } OB = 16$$

Since the diagonal of the rhombus bisect each other at 90 degrees.

And  $OB = OD$

Therefore,  $BD = 2 OB = 2 \times 16 = 32$  m

$$\text{Area of rhombus} = \frac{1}{2} \times BD \times AC = \frac{1}{2} \times 32 \times 24 = 384$$

$$\text{Area of rhombus} = 384 \text{ m}^2.$$

**Question 7: A rhombus sheet, whose perimeter is 32 m and whose diagonal is 10 m long, is painted on both the sides at the rate of Rs 5 per  $\text{m}^2$ . Find the cost of painting.**

**Solution:**

The perimeter of a rhombus = 32 m

We know, Perimeter of a rhombus =  $4 \times \text{side}$

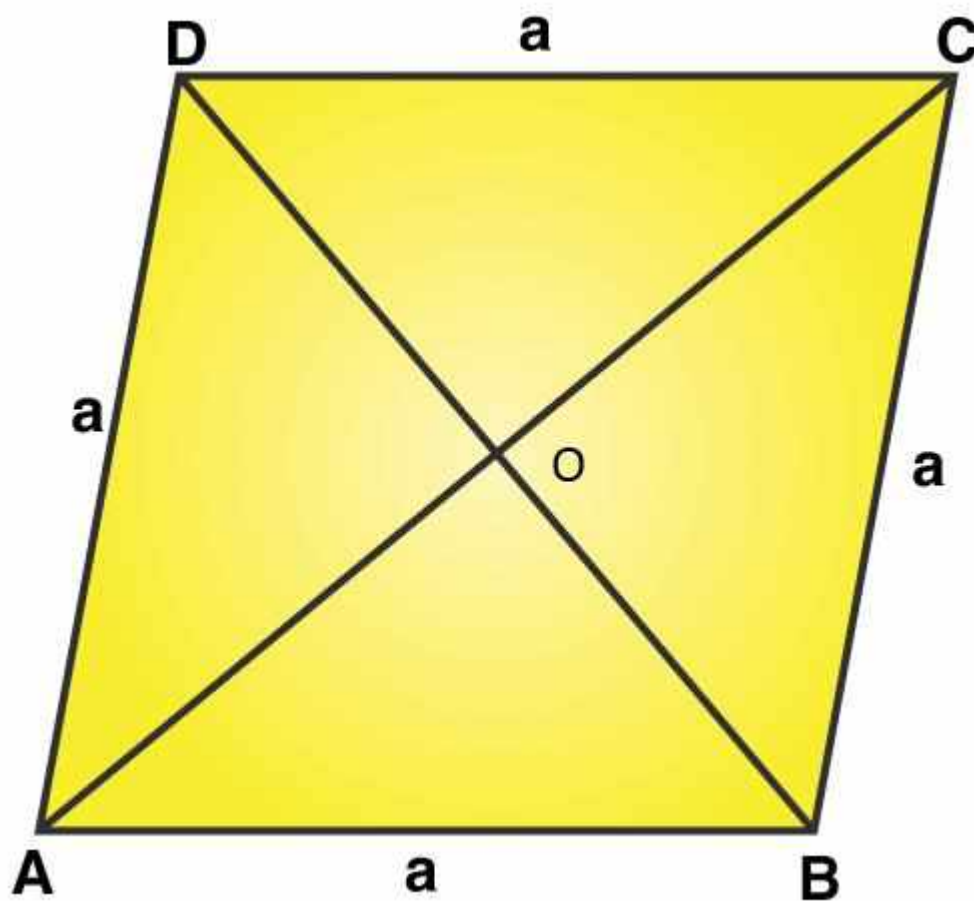
$$\Rightarrow 4 \times \text{side} = 32$$

$$\text{side} = a = 8 \text{ m}$$

Each side of the rhombus is 8 m

$AC = 10$  m (Given)





Then,  $OA = \frac{1}{2} \times AC$

$$OA = \frac{1}{2} \times 10$$

$$OA = 5 \text{ m}$$

In right triangle AOB,

From Pythagoras theorem;

$$OB^2 = AB^2 - OA^2 = 8^2 - 5^2 = 64 - 25 = 39$$

$$OB = \sqrt{39} \text{ m}$$

And,  $BD = 2 \times OB$

$$BD = 2\sqrt{39} \text{ m}$$

$$\text{Area of the sheet} = \frac{1}{2} \times BD \times AC = \frac{1}{2} \times (2\sqrt{39} \times 10) = 10\sqrt{39}$$

The area of the sheet is  $10\sqrt{39} \text{ m}^2$

Therefore, the cost of printing on both sides of the sheet, at the rate of Rs. 5 per  $\text{m}^2$

$$= \text{Rs. } 2 \times (10\sqrt{39} \times 5) = \text{Rs. } 625.$$

**EXERCISE VSAQS****PAGE NO: 12.23****Question 1: Find the area of a triangle whose base and altitude are 5 cm and 4 cm, respectively.****Solution:**

Given: Base of a triangle = 5 cm and altitude = 4 cm

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{altitude}$ 

$$= \frac{1}{2} \times 5 \times 4$$

$$= 10$$

*The area of the triangle is 10 cm<sup>2</sup>.***Question 2: Find the area of a triangle whose sides are 3 cm, 4 cm and 5 cm, respectively.****Solution:**

Given: Sides of a triangle are 3 cm, 4 cm and 5 cm, respectively

Apply Heron's Formula:

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{Semi Perimeter, } s = \frac{(a+b+c)}{2}$$

**Where, a, b and c are sides of a triangle**

$$S = (3+4+5)/2 = 6$$

Semi perimeter is 6 cm

Now,

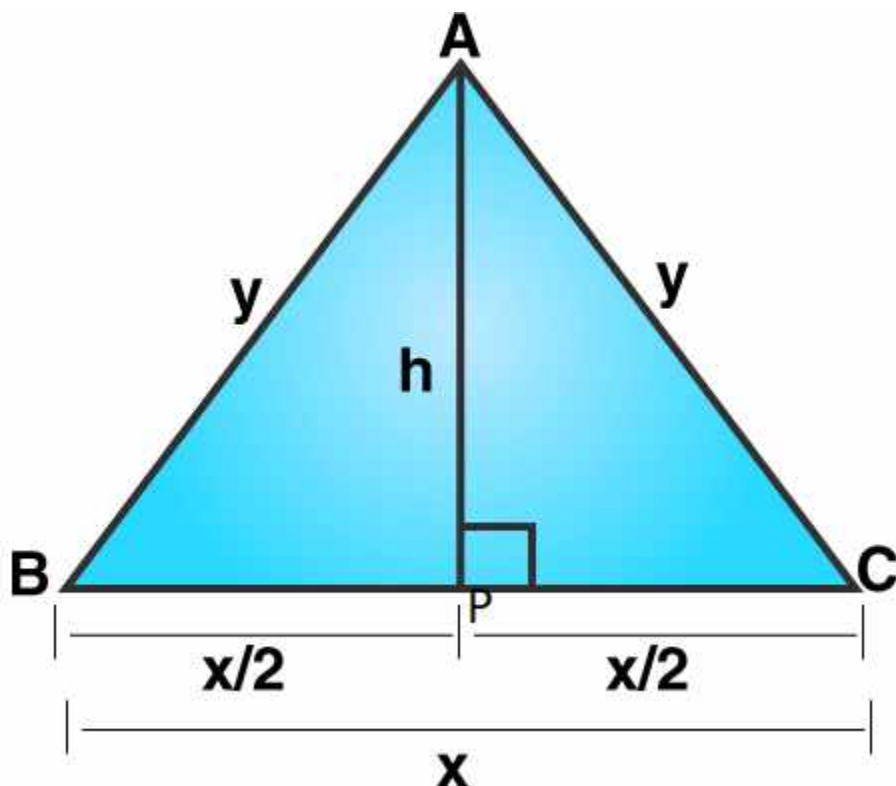
$$\text{Area} = \sqrt{6 \times (6-3) \times (6-4) \times (6-5)}$$

$$= \sqrt{6 \times 3 \times 2 \times 1}$$

$$= \sqrt{36}$$

$$= 6$$

*The area of the given triangle is 6 cm<sup>2</sup>.***Question 3: Find the area of an isosceles triangle having the base x cm and one side y cm.****Solution:**



In right triangle APC,

Using Pythagoras theorem,

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

$$y^2 = h^2 + (x/2)^2$$

$$\text{or } h^2 = y^2 - (x/2)^2$$

$$\text{or } h = \sqrt{y^2 - x^2/4}$$

Now, Area =  $\frac{1}{2} \times \text{Base} \times \text{Height}$

$$= \frac{1}{2} \times (\sqrt{y^2 - x^2/4})$$

$$= \frac{x}{4} \sqrt{4y^2 - x^2}$$

**Question 4:** Find the area of an equilateral triangle having each side 4 cm.

**Solution:** Each side of an equilateral triangle =  $a = 4$  cm

Formula for Area of an equilateral triangle =  $(\sqrt{3}/4) \times a^2$

$$= (\sqrt{3}/4) \times 4^2$$

$$= 4\sqrt{3}$$

The area of an equilateral triangle is  $4\sqrt{3} \text{ cm}^2$ .

**Question 5:** Find the area of an equilateral triangle having each side x cm.

**Solution:**

Each side of an equilateral triangle = a = x cm

Formula for Area of an equilateral triangle =  $(\sqrt{3}/4) \times a^2$

$$= (\sqrt{3}/4) \times x^2$$

$$= x^2 \sqrt{3}/4$$

The area of an equilateral triangle is  $\sqrt{3}x^2/4 \text{ cm}^2$ .

