CBSE NCERT Solutions for Class 9 Mathematics Chapter 12

Back of Chapter Questions

Exercise: 12.1

1. A traffic signal board, indicating 'SCHOOL AHEAD', is an equilateral triangle with side 'a'. Find the area of the signal board, using Heron's formula. If its perimeter is 180 cm, what will be the area of the signal board?

Solution:

Length of one side of traffic signal board = a cm

Hence, the perimeter of the traffic signal board = 3a cm

Semi-perimeter of the traffic signal board, $s = \frac{3a}{2}$ cm

By Heron's Formula

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

Area of traffic signal board $= \sqrt{\frac{3a}{2}\left(\frac{3a}{2}-a\right)\left(\frac{3a}{2}-a\right)\left(\frac{3a}{2}-a\right)}$

$$= \frac{\sqrt{3}a^2}{4}\ \text{cm}^2$$

Given, perimeter = 180 cm

$\Rightarrow 180 = 3a$

$\Rightarrow a = 60$ cm

Hence, the area of traffic signal board $= \frac{\sqrt{3}a^2}{4} = \frac{\sqrt{3}}{4} \times 60^2\ \text{cm}^2$

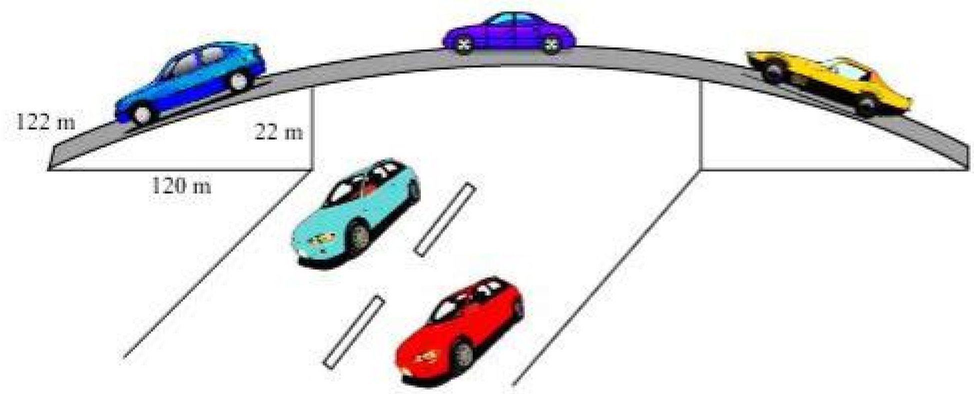
$= \sqrt{3} \times 900\ \text{cm}^2$

$= 900\sqrt{3}\ \text{cm}^2$

Thus, the area of the signal board is $900\sqrt{3}\ \text{cm}^2$

2. The triangular side walls of a flyover have been used for advertisements. The sides of the walls are 122 m, 22 m and 120 m (see Fig). The advertisements yield an earning of ₹ 5000 per m^2 per year. A company hired one of its walls for 3 months. How much rent did it pay?

Solution:



Length of sides of the triangle are 122 m, 22 m and 120 m

Perimeter of the triangle = (122 + 22 + 120) m

$\Rightarrow 2s = 264$ m

$\Rightarrow s = 132$ m

By Heron's Formula

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

Area of the given triangle $= \sqrt{132(132-122)(132-22)(132-120)}\ m^2$

$= \sqrt{132(10)(110)(12)}\ m^2 = 1320\ m^2$

Rent of 1 m^2 area per year = ₹ 5000

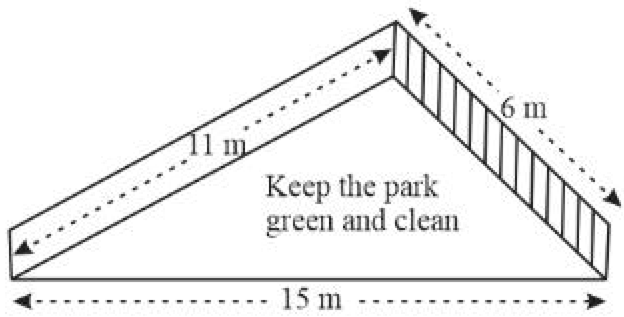
Rent of 1 m^2 area per month = ₹ $\frac{5000}{12}$

Rent of 1320 m^2 area for 3 months = ₹ $\left[\left(\frac{5000}{12}\right) \times 3 \times 1320\right]$

= ₹ 1650000

So, Company has to pay rent of ₹1650000

3. There is a slide in a park. One of its side walls has been painted in some colour with a message "KEEP THE PARK GREEN AND CLEAN" (see Fig.). If the sides of the wall are 15 m, 11 m and 6 m, find the area painted in colour.



Solution:

From the figure, it is clear that the area to be painted is a triangle having sides 11 m, 6 m and 15 m

Perimeter of the triangle $= (11 + 6 + 15)$ m

$\Rightarrow 2\text{ s} = 32\text{ m}$

$\Rightarrow \text{s} = 16\text{ m}$

By Heron's formula

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

$= \sqrt{16(16-11)(16-6)(16-15)}\text{ m}^2$

$= \sqrt{16 \times 5 \times 10 \times 1}\text{ m}^2$

$= 20\sqrt{2}\text{ m}^2$

Thus, area painted in colour is $20\sqrt{2}\text{ m}^2$

4. Find the area of a triangle two sides of which are 18 cm and 10 cm and the perimeter is 42 cm.

Solution:

Let the third side of the triangle be c.

Given, the perimeter of the triangle = 42 cm

$\Rightarrow$ 18 cm + 10 cm + c = 42 cm (no need to write cm in the equation)

$\Rightarrow$ c = 14 cm

$s = \dfrac{\text{perimeter}}{2} = \dfrac{42}{2} = 21\text{ cm}$

By Heron's formula

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

$= \sqrt{21(21-18)(21-10)(21-14)}\text{ cm}^2$

$= \sqrt{21(3)(11)(7)}\text{ cm}^2$

$= 21\sqrt{11}\text{ cm}^2$

5. Sides of a triangle are in the ratio of 12: 17: 25 and its perimeter is 540 cm. Find its area.

Solution:

Let the sides of triangle be 12x, 17x, and 25x.

Perimeter of this triangle = 540 cm

$\Rightarrow 12x + 17x + 25x = 540$ cm

$\Rightarrow 54x = 540$ cm

$\Rightarrow x = 10$ cm

Sides of triangle will be 120 cm, 170 cm, and 250 cm.

$$s = \frac{(120 + 170 + 250)}{2} = 270 \text{ cm}$$

By Heron's formula

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

$= \sqrt{270(270-120)(270-170)(270-250)}\ \text{cm}^2$

$= \sqrt{270 \times 150 \times 100 \times 20}\ \text{cm}^2$

$= 9000\ \text{cm}^2$

6. An isosceles triangle has perimeter 30 cm and each of the equal sides is 12 cm. Find the area of the triangle.

Solution:

Let third side of this triangle be c

Perimeter of triangle = 30 cm

$\Rightarrow 12 \text{ cm} + 12 \text{ cm} + c = 30 \text{ cm}$

$\Rightarrow c = 6$ cm

$\Rightarrow s = \frac{30}{2} = 15$ cm

By Heron's formula

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

$= \sqrt{15(15-12)(15-12)(15-6)}\ \text{cm}^2$

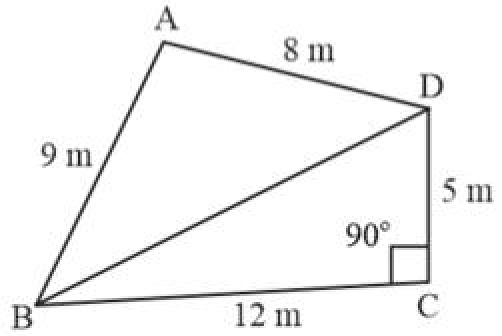
$= \sqrt{15 \times 3 \times 3 \times 9}\ \text{cm}^2$

$= 9\sqrt{15}\ \text{cm}^2$

Exercise: 12.2

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

Solution:



Let ABCD be the given quadrilateral.

Join BD

In ΔBCD

Applying Pythagoras Theorem

$\Rightarrow BD^2 = BC^2 + CD^2 = (12)^2 + (5)^2$

$= 144 + 25$

$\Rightarrow BD^2 = 169$

$\Rightarrow BD = 13$ m

Area of $\Delta BCD = \frac{1}{2} \times BC \times CD = \left[\frac{1}{2} \times 12 \times 5\right] m^2 = 30\ m^2$

For Δ ABD

$$s = \frac{\text{perimeter}}{2} = \frac{9 + 8 + 13}{2} = 15\ m$$

By Heron's formula, area of triangle $\Delta ABD = \sqrt{s(s-a)(s-b)(s-c)}$

Area of the triangle $= \sqrt{15(15-9)(15-8)(15-13)}\ m^2 = 6\sqrt{35}\ m^2$

Thus, Area of $\Delta ABD = (6 \times 5.916)\ m^2 = 35.496\ m^2$

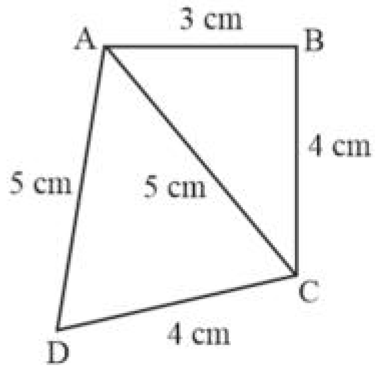
Area of quadrilateral ABCD = Area of ΔABD + Area of ΔBCD

$= (35.496 + 30) m^2$

$= 65.496\ m^2$

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

Solution:



For ΔABC

$AC^2 = AB^2 + BC^2 \Rightarrow (5)^2 = (3)^2 + (4)^2$

It satisfies the PYTHAGORAS THEOREM

Hence, ΔABC is a right-angled triangle, right-angled at B

Area of $\Delta ABC = \left[\frac{1}{2} \times AB \times BC\right] = \left[\frac{1}{2} \times 4 \times 3\right] cm^2 = 6\ cm^2$

For ΔACD

$$s = \frac{\text{perimeter}}{2} = \frac{(5+4+5)}{2} cm = 7cm$$

By Heron's formula, area of triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

Area of the triangle $= \sqrt{7(7-5)(7-4)(7-5)}\ cm^2 = 2\sqrt{21}\ cm^2$

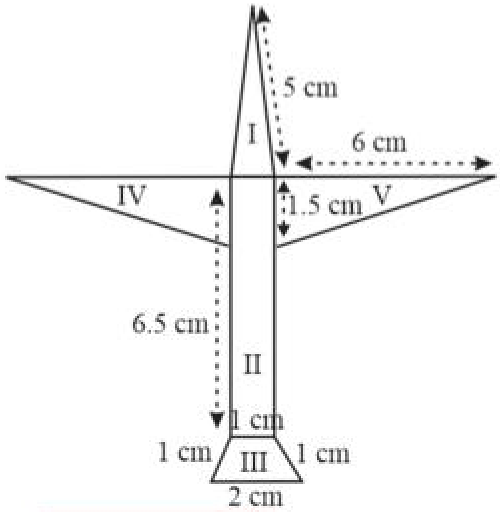
Area of $\Delta ACD = (2 \times 4.583) cm^2 = 9.166\ cm^2$

Area of the quadrilateral ABCD = Area of ΔABC + Area of ΔACD

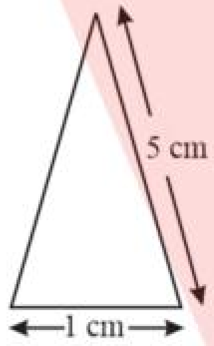
$= (6 + 9.166)\ cm^2$

$= 15.166\ cm^2$

3. Radha made a picture of an aeroplane with coloured paper as shown in Fig. Find the total area of the paper used.



Solution:



For Triangle I

This triangle is an isosceles triangle.

Perimeter = 2s = (5 + 5 + 1)cm = 11 cm

$\Rightarrow s = \frac{11}{2}$ cm = 5.5 cm

By Heron's formula, area of triangle = $\sqrt{s(s-a)(s-b)(s-c)}$

Area of the Triangle I = $\sqrt{5.5(5.5-5)(5.5-1)(5.5-5)}$ cm²

$= \sqrt{5.5(0.5)(4.5)(0.5)}$ cm²

= 2.488 cm²

For quadrilateral II

This quadrilateral is a rectangle.

Area of quadrilateral II = 1 cm × 6.5 cm = 6.5 cm²

For quadrilateral III

This quadrilateral is a trapezium.

Perpendicular height of the trapezium = $\sqrt{(1)^2-(0.5)^2}$ cm

$= \sqrt{0.75}$ cm $= 0.866$ cm

Area of trapezium $= \left[\frac{1}{2} \times (\text{sum of parallel sides}) \times (\text{distance between them})\right]$

Area of quadrilateral III $= \left[\frac{1}{2} \times (1 + 1) \times 0.866\right] = 0.866\ \text{cm}^2$

Area of Triangle IV = Area of Triangle V $= \left[\frac{1}{2} \times 6 \times 1.5\right] = 4.5\ \text{cm}^2$

Total paper used $= [(2.488) + (6.5) + (0.866) + (4.5) \times 2]\ \text{cm}^2 = 19.287\ \text{cm}^2$

4. A triangle and a parallelogram have the same base and the same area. If the sides of the triangle are 26 cm, 28 cm and 30 cm, and the parallelogram stands on the base 28 cm, find the height of the parallelogram.

Solution:

For triangle

Perimeter of triangle $= (26 + 28 + 30)$ cm $= 84$ cm

$\Rightarrow 2s = 84$ cm

$\Rightarrow s = 42$ cm

By Heron's formula, area of the triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

Area of the triangle $= \sqrt{42(42-26)(42-28)(42-30)}\ \text{cm}^2$

$= \sqrt{42(16)(14)(12)} = 336\ \text{cm}^2$

Let height of parallelogram be h

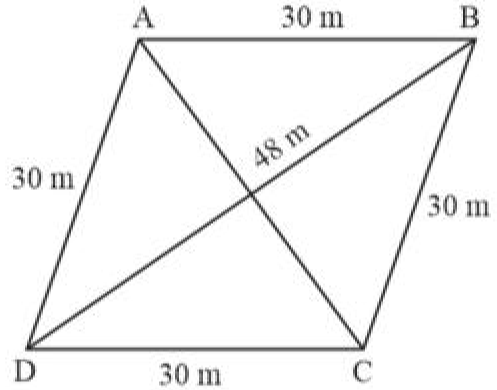
Area of parallelogram = Area of triangle

$h \times 28 = 336 \Rightarrow h = 12\text{cm}$

So, the height of the parallelogram is 12 cm

5. A rhombus shaped field has green grass for 18 cows to graze. If each side of the rhombus is 30 m and its longer diagonal is 48 m, how much area of grass field will each cow be getting?

Solution:



Let ABCD be a rhombus shaped field.

For ΔBCD

$$s = \frac{\text{perimeter}}{2} = \frac{(30 + 48 + 30)}{2} = 54 \text{ m}$$

By Heron's formula, area of the triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

Area of the triangle $= \sqrt{54(54-30)(54-48)(54-30)}\ \text{m}^2$

$= \sqrt{54(24)(6)(24)}\ \text{m}^2$

$= 432\ \text{m}^2$

Area of rhombus $= 2 \times (\text{area of } \Delta\ \text{BCD}) = 2 \times 432 = 864\ \text{m}^2$

Area of field is $864\ \text{m}^2$

Area of the grazing for 1 cow $= \frac{864}{18} = 48\ \text{m}^2$

Each cow will be getting $48\ \text{m}^2$ of grass

6. An umbrella is made by stitching 10 triangular pieces of cloth of two different colours (see Fig.), each piece measuring 20 cm, 50 cm and 50 cm. How much cloth of each colour is required for the umbrella?

Solution:

For each triangular piece

semi perimeter, $s = \frac{20+50+50}{2} = 60$ cm

By Heron's formula

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

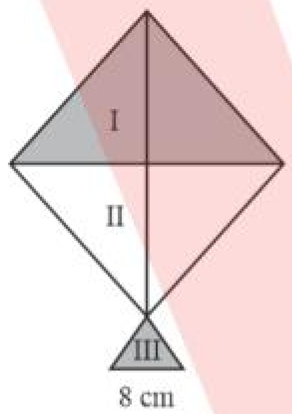
Area of each triangular piece $= \sqrt{60(60-50)(60-50)(60-20)}\ \text{cm}^2$

$= \sqrt{60(10)(10)(40)}\ \text{cm}^2 = 200\sqrt{6}\ \text{cm}^2$

Since, there are 5 triangular pieces made of each different colours cloth.

Hence, area of each colour cloth required $= 5 \times 200\sqrt{6}\ \text{cm}^2 = 1000\sqrt{6}\ \text{cm}^2$

7. A kite in the shape of a square with a diagonal 32 cm and an isosceles triangle of base 8 cm and sides 6 cm each is to be made of three different shades as shown in Fig. How much paper of each shade has been used in it?



Solution:

For triangle I and triangle II

We know that

Area of square $= \frac{1}{2} \times (\text{diagonal})^2$

Area of the square $= \frac{1}{2} \times (32)^2 = 512\ \text{cm}^2$

Area of Ist shade = Area of IInd shade $= 256\ \text{cm}^2$

For triangle III

Semi perimeter $= \frac{(6+6+8)}{2} = 10$ cm

By Heron's formula

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

Area of IIIrd triangle $= \sqrt{10(10-6)(10-6)(10-8)}$

$= \sqrt{10 \times 4 \times 4 \times 2}\ \text{cm}^2$

$= 4 \times 2\sqrt{5}\ \text{cm}^2$

$= 8\sqrt{5}\ \text{cm}^2$

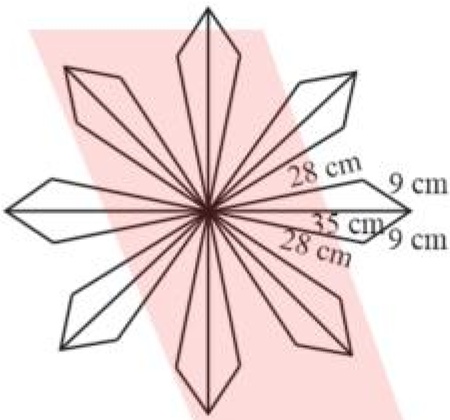
$= 8 \times 2.24\ \text{cm}^2$

$= 17.92\ \text{cm}^2$

Area of paper required for IIIrd shade $= 17.92\ \text{cm}^2$

Incomplete Solution

8. A floral design on a floor is made up of 16 tiles which are triangular, the sides of the triangle being 9 cm, 28 cm and 35 cm (see Fig.). Find the cost of polishing the tiles at the rate of 50p per cm^2



Solution:

We may observe that

Semi perimeter of each triangular shaped tile, $s = \frac{35+28+9}{2} = 36$ cm

By Heron's formula

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

Area of each tile $= \sqrt{36(36-35)(36-28)(36-9)}$

$= \sqrt{36 \times 1 \times 8 \times 27}\ \text{cm}^2$

$= 36\sqrt{6}\ \text{cm}^2$

$= (36^{o} \times 2.45)\ \text{cm}^2$

$= 88.2\ \text{cm}^2$

Area of 16 tiles $= (16 \times 88.2)\ \text{cm}^2 = 1411.2\ \text{cm}^2$

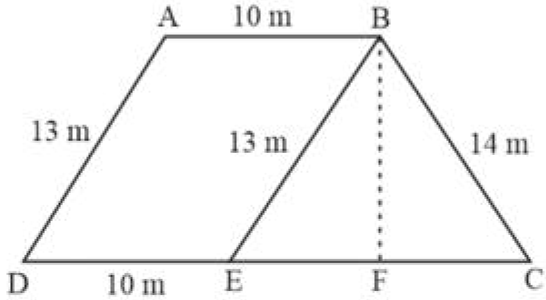
Cost of polishing per cm^2 area $= 50$ p

Cost of polishing $1411.2\ \text{cm}^2$ area $=$ ₹ $(1411.2 \times 0.50) =$ ₹ 705.60

So, it will cost ₹ 705.60 while polishing all the tiles.

9. A field is in the shape of a trapezium whose parallel sides are 25 m and 10 m. The non-parallel sides are 14 m and 13 m. Find the area of the field.

Solution:



Draw a line BE parallel to AD and draw a perpendicular BF on CD.

Now we may observe that ABED is a parallelogram.

BE = AD = 13 m

ED = AB = 10 m

EC = 25 − ED = 15 m

For ΔBEC

Semi perimeter, $s = \frac{(13+14+15)}{2} = 21$ m

By Heron's formula

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

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

$= \sqrt{21(8)(7)(6)}\ m^2 = 84\ m^2$

Area of ΔBEC $= \frac{1}{2} \times EC \times BF$

$\Rightarrow 84 = \frac{1}{2} \times 15 \times BF$

$\Rightarrow BF = \frac{168}{15}$ cm = 11.2 m

Area of ABED = BF × DE = 11.2 × 10

$= 112\ m^2$

Area of field = 84 + 112

$= 196\ m^2$