MATHEMATICS

Class-IX

Topic-11

HERON'S FORMULA

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CH-11

HERON'S FORMULA

A. HERON'S FORMULA

Heron (or **Hero**) **of Alexandria** (c. 10 – 70 AD) was an ancient Greek mathematician and engineer who was active in his native city of Alexandria, Roman Egypt. He is considered the greatest experimenter of antiquity and his work is representative of the Hellenistic scientific tradition.

Heron's works as an inventor truly reveal his genius but he is also accredited as a mathematician who delivered a lot to the field with his practical approach. From approximations of square roots and formulating the area of a triangle to his treatise in geometry, Heron's contributions are wide ranging.

The 'Metrica' is a series of three books, found by R.Schone in Istanbul in 1896, in which Heron focuses on calculating areas and volumes of bodies such as pyramids, cones, cylinders, prisms etc. 'Hero's formula' was found in this book which stated the area of a triangle with given sides.

If a, b, c denote the lengths of the sides of a triangle ABC. Then,

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

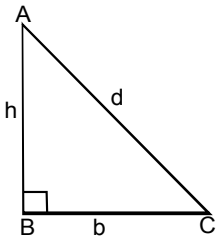
$s = \frac{a+b+c}{2}$ is the semi - perimeter of ΔABC.

(a) Perimeter and Area of a Triangle :

(i) Right-angled triangle

For an right-angled triangle, let **b** be the base, **h** be the perpendicular and **d** be the hypotenuse. Then Perimeter = b + h + d

Area = $\frac{1}{2}$ (Base × Height) = $\frac{1}{2}$ bh



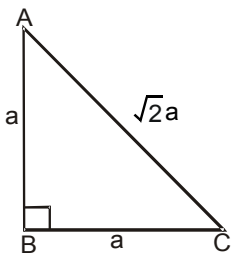
Hypotenuse, d = $\sqrt{b^2+h^2}$ [Pythagoras theorem]

(ii) Isosceles right-angled triangle

For an isosceles right-angled triangle, let **a** be the equal sides, then

Hypotenuse = $\sqrt{a^2+a^2} = \sqrt{2}\,a$

Perimeter = $2a + \sqrt{2}\,a$

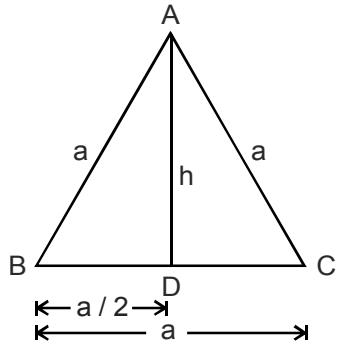


Area = $\frac{1}{2}$ (Base × Height) = $\frac{1}{2}$ (a × a) = $\frac{1}{2}$ a^2.

(iii) Equilateral triangle

For an equilateral triangle, let each side be **a**, and the height of the triangle is **h,** then

$\angle A = \angle B = \angle C = 60^\circ$



$\angle BAD = \angle CAD = 30^\circ$

AB = BC = AC = a (say)

$BD = DC = \frac{a}{2}$

$\left(\frac{a}{2}\right)^2 + h^2 = a^2 \Rightarrow h^2 = \frac{3a^2}{4}$

$\therefore$ Height (h) $= \frac{\sqrt{3}}{2}$ a

Area $= \frac{1}{2}$ (Base × Height) $= \frac{1}{2} \times a \times \frac{\sqrt{3}}{2} a = \frac{\sqrt{3}}{4} a^2$

Perimeter = a + a + a = 3a.

(b) Application of Heron's formula

With the help of heron's formula we can find the area of Quadrilateral whose all side and one diagonal is given to us, Quadrilateral whose all sides and angle between any two adjacent side is right angle, Trapezium whose all sides are given and we can find the area of Parallelogram and its types.

Solved Examples

Example. 1

The perimeter of a triangular field is 450 m and its sides are in the ratio 13 : 12 : 5. Find the area of the triangle.

Sol. Let a = 13x, b = 12x and c = 5x

$\therefore$ Perimeter = 450

13x + 12x + 5x = 450

30x = 450

x = 15

So, the sides of the triangle are :

a = 13 × 15 = 195 m, b = 12 × 15 = 180 m and c = 5 × 15 = 75 m

2s = 195 + 180 + 75

2s = 450

s = 225.

Hence, Area $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{225(225-195)(225-180)(225-75)} = \sqrt{225(30)(45)(150)} = 6750$ m².

Example. 2

The perimeter of an isosceles triangle is 42 cm and its base is $\frac{3}{2}$ times each of the equal sides. Find the length of each side of the triangle, area of the triangle and height of the triangle.

Sol. Let the equal sides be a and unequal side be b.

$\therefore$ $2a + b = 42$

Given : $b = \frac{3}{2}a$

$2a + \frac{3}{2}a = 42$

$\frac{7}{2}a = 42$

$a = 12$ cm.

So, $b = \frac{3}{2}(12) = 18$ cm.

Also, perimeter = $2s = 42$ cm

$s = 21$ cm.

Area of triangle = $\sqrt{21(21-12)(21-12)(21-18)} = \sqrt{21(9)(9)(3)} = 27\sqrt{7}$ cm^2

Area of triangle = $\frac{1}{2}$ × base × height

$27\sqrt{7} = \frac{1}{2} \times 18 \times$ height

Height = $\frac{54\sqrt{7}}{18} = 3\sqrt{7}$ cm.

Example. 3

A triangle and 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.

Sol. $s = \frac{26+28+30}{2} = 42$ cm.

$\therefore$ Area of the triangle = $\sqrt{42(42-26)(42-28)(42-30)} = \sqrt{42(16)(14)(12)} = 336$ cm^2.

Let h be the height of the parallelogram.

It is given that the triangle and the parallelogram have the same base and same area.

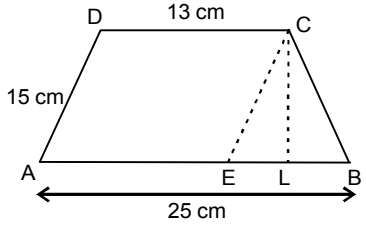
$\therefore$ Area of the parallelogram = 336 cm^2

$\Rightarrow$ Base × height = 336 $\Rightarrow$ 28 × h = 336 $\Rightarrow$ $h = \frac{336}{28} = 12$ cm.

Example. 4

Find the area of a trapezium whose parallel sides are 25 cm, 13 cm and other sides are 15 cm and 15 cm.

Sol. Let ABCD be the given trapezium in which AB = 25 cm, CD = 13 cm, BC = 15 cm and AD = 15 cm. Draw CE || AD.



Now, ADCE is a parallelogram is which AD || CE and AE || CD.

$\therefore$ AE = DC = 13 cm and BE = AB – AE = 25 – 13 = 12 cm.

In ΔBCE, we have

$$s = \frac{15+15+12}{2} = 21$$

$\therefore$ Area of $\Delta BCE = \sqrt{s(s-a)(s-b)(s-c)}$

$\Rightarrow$ Area of $\Delta BCE = \sqrt{21(21-15)(21-15)(21-12)}$

$\Rightarrow$ Area of $\Delta BCE = \sqrt{21\times 6\times 6\times 9}$

$= 18\sqrt{21}\ cm^2$ ...(i)

Let h be the height of ΔBCE, then

Area of $\Delta BCE = \frac{1}{2}$ (Base × Height)

$= \frac{1}{2} \times 12 \times h = 6h$ ..(ii)

From (i) and (ii), we have,

$6h = 18\sqrt{21}$

$\Rightarrow$ $h = 3\sqrt{21}$ cm

Clearly, the height of trapezium ABCD is same as that of ΔBCE.

$\therefore$ Area of trapezium $= \frac{1}{2}$ (AB + CD) × h

$\Rightarrow$ Area of trapezium $= \frac{1}{2}$ (25 + 13) × $3\sqrt{21}\ cm^2 = 57\sqrt{21}\ cm^2$.

Example. 5

Find the percentage increase in the area of a triangle if its each side is doubled.

Sol. Let a, b, c be the sides of the given triangle and s be its semi-perimeter.

$\therefore$ $s = \frac{1}{2}(a+b+c)$ ...(i)

The sides of the new triangle are 2a, 2b and 2c.

Let s' be its semi-perimeter.

$\therefore$ $s' = \frac{1}{2}(2a+2b+2c) = a+b+c = 2s$ [Using (i)]

Let Δ = Area of given triangle

$\Delta = \sqrt{s(s-a)(s-b)(s-c)}$ ... (ii)

And, Δ' = Area of new triangle

$\Delta' = \sqrt{s'(s'-2a)(s'-2b)(s'-2c)}$

$= \sqrt{2s(2s-2a)(2s-2b)(2s-2c)}$ [Using (i)]

$= \sqrt{16s(s-a)(s-b)(s-c)}$

$\Delta' = 4\Delta$ [Using (ii)]

$\therefore$ Increase in the area of the triangle

$= \Delta' - \Delta = 4\Delta - \Delta = 3\Delta$

$\therefore$ % increase in area $= \left(\frac{3\Delta}{\Delta}\times 100\right)\% = 300\%$.

Example. 6

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

Sol. The sides of a triangular piece are 20 cm, 50 cm and 50 cm.

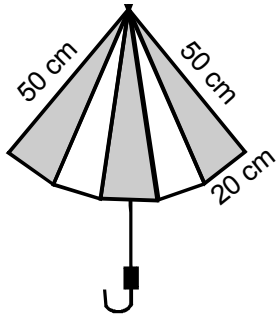
$$s = \frac{a+b+c}{2} = \frac{20+50+50}{2} = 60 \text{ cm.}$$

Area of one triangular piece = $\sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{60(60-20)(60-50)(60-50)} = \sqrt{60\times40\times10\times10}$

$= \sqrt{240000} = 200\sqrt{6}$ cm²

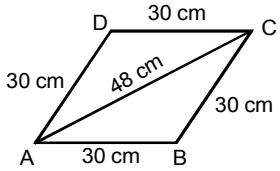
Area of cloth of each colour for five triangular pieces = $5 \times 200\sqrt{6} = 1000$ cm².



Example. 7

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 grazing ?

Sol. Clearly, triangles ABC and ADC are congruent.



$\therefore$ Area of ΔABC = Area of ΔADC

Let s be the semi - perimeter of ΔABC and ΔADC. Then,

$$s = \frac{30+30+48}{2} = 54 \text{ m.}$$

$\therefore$ Area of ΔABC = Area of ΔADC

$= \sqrt{54(54-30)(54-30)(54-48)} = \sqrt{54(24)(24)(6)} = 432$ m²

So, area of rhombus ABCD = 2 (Area of ΔABC) = 2 (432) = 864 m²

$\therefore$ Area of grass field each cow will graze = $\frac{864}{18} = 48$ m².

Example. 8

The sides of a quadriangular 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. [Take $\sqrt{14} = 3.751$]

Sol. Area of $\Delta ADC = \frac{1}{2}$ (AD × DC) = $\frac{1}{2} \times 24 \times 7\text{m}^2 = 84$ m²

In ΔADC, we have

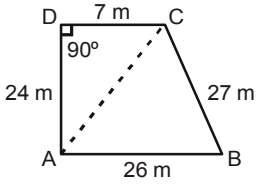
$AC^2 = AD^2 + CD^2$

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

$\Rightarrow$ $AC^2 = 25^2$

$\Rightarrow$ AC = 25 m.

Thus, in ΔABC,we have



a = BC = 27 m, b = CA = 25 m and c = AB = 26 m

Let 2s be the perimeter of ΔABC. Then,

$2s = a + b + c$

$2s = 27 + 25 + 26 = 78$

$\Rightarrow \quad s = 39$ m

$\therefore$ Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{39 \times 12 \times 14 \times 13}$

$\Rightarrow$ Area of $\Delta ABC = \sqrt{13 \times 3 \times 3 \times 4 \times 2 \times 7 \times 13} = 78\sqrt{14}$ cm^2 = 292.57 m^2

Area of quadrilateral ABCD = 84 + 291.57 = 376.57 m^2.

Check Your Level

1. Find the area of the triangles whose sides are 25 m, 60 m and 65 m

2. Two sides of a triangular field are 85 m and 154 m and its perimeter is 324 m. Find its area.

3. Find the area of a triangle whose sides are 50 m, 78 m and 112 m and also find the length of the perpendicular from the opposite vertex to the side of length 112 m.

4. Find the area of a trapezium whose parallel sides are 11 m and 25 m and the two non parallel sides are 15 m and 13 m.

5. Find the area of a quadrilateral piece of land one of whose diagonals is 32 m long and the length of the perpendiculars from the other two vertices are 20 m and 12 m.

Answers

1. 750 m^2 **2.** 2772 m^2 **3.** 1680 m^2 ,30m **4.** 216 m^2

5. 512 m^2

Exercise Board Level

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : [01 MARK EACH]

1. The base of a right triangle is 8 cm and hypotenuse is 10 cm. Find its area ?

2 An isosceles right triangle has area 8 cm^2. Find the length of its hypotenuse.

3. The perimeter of an equilateral triangle is 60 m. Find its area ?

4. The sides of a triangle are 56 cm, 60 cm and 52 cm long. Find the area of the triangle ?

5. Find the area of an equilateral triangle with side $2\sqrt{3}$ cm.

6. Find the length of each side of an equilateral triangle having an area of $9\sqrt{3}$ cm^2 ?

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : [02 MARKS EACH]

7. Find the area of an isosceles triangle having base 2 cm and the length of one of the equal sides 4 cm ?

8. The sides of a triangle are 35 cm, 54 cm and 61 cm, respectively. The length of its longest altitude ?

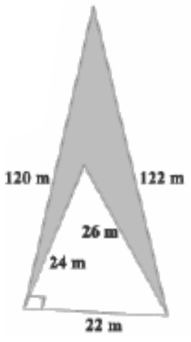
9. The sides of a triangular field are 41 m, 40 m and 9 m. Find the number of rose beds that can be prepared in the field, if each rose bed, on an average needs 900 cm^2 space.

10. The perimeter of an isosceles triangle is 32 cm. The ratio of the equal side to its base is 3 : 2. Find the area of the triangle

11. A field in the form of a parallelogram has sides 60 m and 40 m and one of its diagonals is 80 m long. Find the area of the parallelogram.

TYPE (III) : LONG ANSWER TYPE QUESTIONS: [03 MARK EACH]

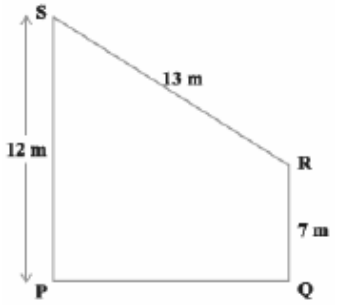
12. Calculate the area of the shaded region in given figure.



13. The perimeter of a triangular field is 420 m and its sides are in the ratio 6 : 7 : 8. Find the area of the triangular field

14. A rhombus shaped sheet with perimeter 40 cm and one diagonal 12 cm, is painted on both sides at the rate of Rs 5 per cm^2 . Find the cost of painting.

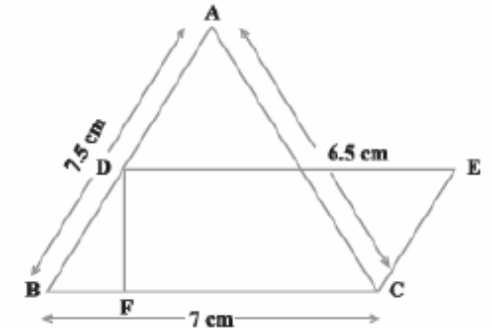
15. Find the area of the trapezium PQRS with height PQ given in given figure.



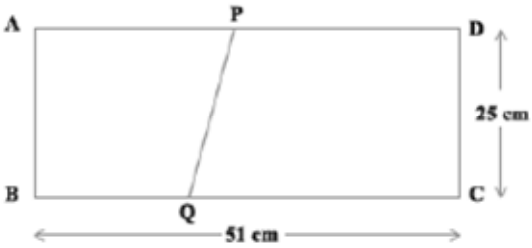
16. The perimeter of a triangle is 50 cm. One side of a triangle is 4 cm longer than the smaller side and the third side is 6 cm less than twice the smaller side. Find the area of the triangle.

17. The area of a trapezium is 475 cm^2 and the height is 19 cm. Find the lengths of its two parallel sides if one side is 4 cm greater than the other.

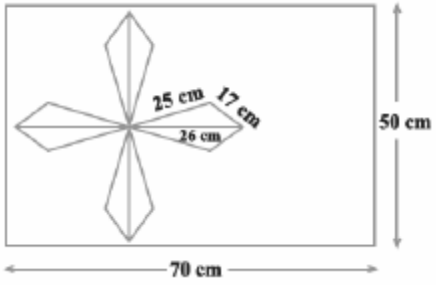
18. In Figure, ΔABC has sides AB = 7.5 cm, AC = 6.5 cm and BC = 7 cm. On base BC a parallelogram DBCE of same area as that of ΔABC is constructed. Find the height DF of the parallelogram.



19. The dimensions of a rectangle ABCD are 51 cm × 25 cm. A trapezium PQCD with its parallel sides QC and PD in the ratio 9 : 8, is cut off from the rectangle as shown in the Figure. If the area of the trapezium PQCD is $\frac{5}{6}$th part of the area of the rectangle, find the lengths QC and PD.



20. A design is made on a rectangular tile of dimensions 50 cm × 70 cm as shown in given figure. The design shows 8 triangles, each of sides 26 cm, 17 cm and 25 cm. Find the total area of the design and the remaining area of the tiles.



TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS **[04 MARK EACH]**

21. From a point in the interior of an equilateral triangle, perpendiculars are drawn on the three sides. The lengths of the perpendiculars are 14 cm, 10 cm and 6 cm. Find the area of the triangle

22. If each side of a triangle is doubled, then find the ratio of area of the new triangle thus formed and the given triangle.

23. A field is in the shape of a trapezium having parallel sides 90 m and 30 m. These sides meet the third side at right angles. The length of the fourth side is 100 m. If it costs Rs 4 to plough $1m^2$ of the field, find the total cost of ploughing the field.

Exercise-1

SUBJECTIVE QUESTIONS

Subjective Easy, only learning value problems

Section (A) : Heron's formula

A-1. Calculate the area of the triangle whose sides are 18 cm, 24 cm and 30 cm in length. Also, find the length of the altitude corresponding to the smallest side of the triangle.

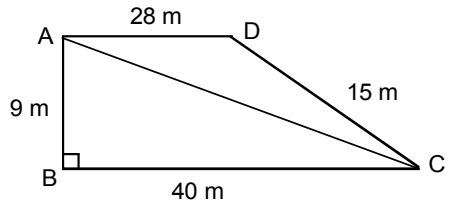
A-2. The sides of a triangle are 10 cm, 24 cm and 26 cm. Find its area and the longest altitude.

A-3. Two sides of a triangular field are 85 cm and 154 cm in length, and its perimeter is 324 cm. Find (i) the area of the field, and (ii) the length of the perpendicular from the opposite vertex on the side measuring 154 cm.

A-4. The sides of a triangular field are 165 cm, 143 cm and 154 cm. Find the cost of ploughing it at 12 paise per sq.cm.

A-5. If the height of an equilateral triangle is 3 cm. Then find the area of the triangle.

A-6. Students of a school staged a rally for cleanliness campaign. They walked through the lanes in two groups. One group walked through the lanes AB, BC and CA; while other through AC, CD and DA (figure). Then they cleaned the area enclosed within their lanes. If AB = 9 m, BC = 40 m, CD = 15 m, DA = 28 m and $\angle B = 90^\circ$. Which group cleaned more area and how much ? Find the total area cleaned by the students.



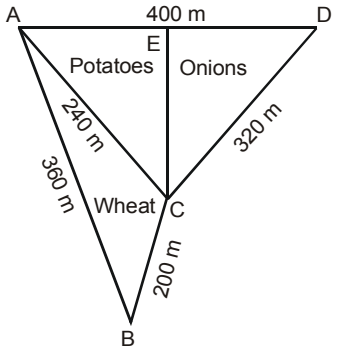
A-7. The perimeter of a right angle triangle is 40 cm. Its hypotenuse is 17 cm. Find the sides containing the right angle. Also find the area of the triangle using heron's formula.

A-8. Find the perimeter and area of the quadrilateral ABCD in which AB = 17 cm, AD = 9 cm, CD = 12 cm, $\angle ACB = 90^\circ$ and AC = 15 cm.

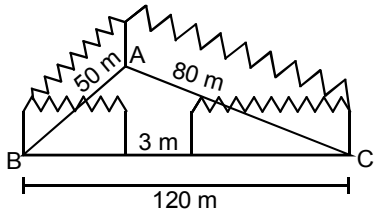
A-9. The perimeter of an isosceles triangle is 32 cm. The ratio of one of the equal sides to the base is 3:2. Find the area of the triangle.

A-10. Rajesh has a triangular field with sides 240 m, 200 m, 360 m, where he grew wheat. In another triangular field with sides 240 m, 320 m, 400 m adjacent to the previous field, he wanted to grow potatoes and onions as shown in figure. He divided the field in two parts by joining the mid-point of the longest side to the opposite vertex and grew potatoes in one part and onions in the other part. How much area (in hectares) has been used for wheat, potatoes and onions ?

[$\sqrt{2}$ = 1.41 and 1 hectare = 10000 m^2]



A-11. A triangular park ABC has sides 120 m, 80 m and 50 m. A gardener Ramu has to put a fence all around it and also plant grass inside. How much area does he need to plant? Find the cost of fencing it with barbed wire at the rate of Rs. 20 per meter leaving a space 3 m wide for a gate on one side.



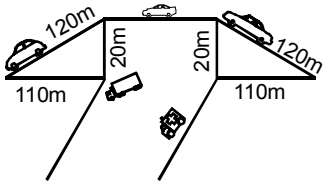
A-12. A field is in the shape of a trapezium whose parallel sides are 60 m and 77 m. The non-parallel sides are 25 m and 26 m. Find the area of the field.

OBJECTIVE QUESTIONS

Single Choice Objective, straight concept/formula oriented

Section (A) : Heron's formula

1. The triangular side walls of a flyover have been used for advertisements from both sides. The sides of each wall are 120 m, 110 m and 20 m. The advertisement yield and earning of Rs. 100 per m^2 per year. Find the amount of revenue earned in one year. [Take $\sqrt{7}$ = 2.65]

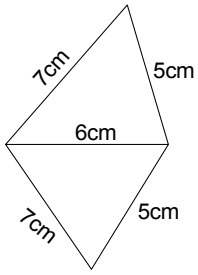


(A) Rs. 3, 37, 500 (B) Rs. 3, 97, 500 (C) Rs. 5, 73, 300 (D) Rs. 4, 73, 500

2. If the adjacent sides of a parallelogram ABCD measure 34 cm and 20 cm, and the diagonal AC measures 42 cm, then its area in cm^2 is :

(A) 796 (B) 672 (C) 692 (D) none of these

3. The lengths of four sides and a diagonal of the given quadrilateral are indicated in the diagram. If A denotes the area of quadrilateral, then A in cm^2 is :



(A) $12\sqrt{6}$ (B) $\sqrt{6}$ (C) $6\sqrt{6}$ (D) $3\sqrt{6}$

4. If the sides of a triangle are doubled, then its area :

(A) Remains the same (B) Becomes doubled
(C) Becomes three times (D) Becomes four times

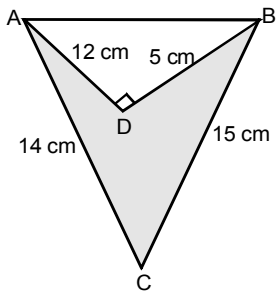
5. Find the cost of painting of a rhombus sheet, whose perimeter is 32 m and whose one diagonal is 10 m long is painted on both sides at the rate of Rs. 5 per m^2. [Use $\sqrt{39}$ = 6.25]

(A) Rs. 500 (B) Rs. 600 (C) Rs. 625 (D) Rs. 650

6. Find the height of the trapezium in which parallel sides are 25 cm and 10 cm and non parallel sides are 14 cm and 13 cm.

(A) 13 cm (B) 14 cm (C) 11.2 cm (D) 13.2 cm

7. Calculate the area of the shaded portion.



(A) 30 cm^2 (B) 84 cm^2 (C) 144 cm^2 (D) 54 cm^2

8. The unequal side of an isosceles triangle is 6 cm and its perimetre is 24 cm. Find its area.

(A) $6\sqrt{2}$ cm^2 (B) $12\sqrt{2}$ cm^2 (C) $18\sqrt{2}$ cm^2 (D) $24\sqrt{2}$ cm^2

9. A triangle and a parallelogram have the same base and same area. If the sides of the triangle are 15 cm, 14 cm and 13 cm and the parallelogram stand on the base 15 cm, find the height of the parallelogram.

(A) 5 cm (B) 5.6 cm (C) 6 cm (D) 6.2 cm

10. In triangle if each side of triangle is halfed then what is the % change in its area.

(A) 75% increase (B) 75% decrease (C) 25% increase (D) 25% decrease

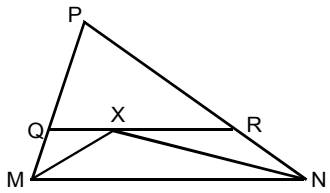
Exercise-2

OBJECTIVE QUESTIONS

1. All the 3 sides of a right triangle are integers and one side has a length 11 units. Area of the triangle in square units lies between

(A) 1 and 100 (B) 100 and 200 (C) 200 and 300 (D) More than 300

2. In the figure given PM = 10 cm, MN = 15 cm and PN = 17 cm. Also QM = QX and XR = RN. Perimeter of the ΔPQR, is :



(A) 32 (B) 27 (C) 25 (D) 21

3. A triangle EFG is inscribed in a unit square ABCD with E on AB, F on DA, G on CD such that AE = DF = CG = 1/3. The area of the triangle EFG is :

(A) $\frac{5}{18}$ (B) $\frac{1}{3}$ (C) $\frac{5}{9}$ (D) $\frac{4}{9}$

4. A triangle of area 9y cm^2 has been drawn such that its area is equal to the area of an equilateral triangle of side 6 cm. Then, the value of y is :

(A) $\sqrt{2}$ cm (B) $\sqrt{3}$ cm (C) 2 cm (D) 3 cm

5. A plot of land is in the shape of a right angled isosceles triangle. The length of the hypotenuse is $50\sqrt{2}$ m. The cost of fencing it at Rs. 3 per metre will be :

(A) less than Rs. 300 (B) less than Rs. 400 (C) more than Rs. 500 (D) more than Rs. 600

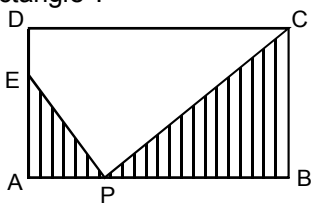
6. The perimeter of an isosceles triangle is equal to 14 cm, the lateral side is to the base in the ratio 5 : 4. The area of the triangle is :

(A) $\frac{1}{2}\sqrt{21}$ cm^2 (B) $\frac{3}{2}\sqrt{21}$ cm^2 (C) $\sqrt{21}$ cm^2 (D) $2\sqrt{21}$ cm^2

7. In a trapezium ABCD with bases AB and CD, where AB = 52, BC = 12, CD = 39 and DA = 5. The area of the trapezium ABCD, is :

(A) 182 (B) 195 (C) 210 (D) 260

8. ABCD is a rectangle with AB = 12 cm and BC = 7 cm. Point E is on AD with DE = 2 cm. Point P is on AB. How far to the right of point. A should point P be placed so that the shaded area comprises exactly 40% of the area of the rectangle ?



(A) 8 (B) 8.4 (C) 8.2 (D) 8.6

9. Given an isosceles trapezium ABCD in order with AB = 6, CD = 12 and area 36 sq. units. Length of the side BC is :

(A) 6 (B) 5 (C) 4.5 (D) 5.5

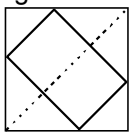
10. The length of the side of a rhombus is 10 units and its diagonals differ by 4. The area of the rhombus is:

(A) 108 (B) 96 (C) 84 (D) 48

11. The side lengths of trapezium are $\sqrt[4]{3}$, $\sqrt[4]{3}$, $\sqrt[4]{3}$ and $2 \times \sqrt[4]{3}$. Its area in the ratio of two relatively prime positive integers, m and n. The value of (m + n) is equal to :

(A) 5 (B) 7 (C) 9 (D) 13

12. A rectangle is inscribed in a square creating four isosceles right triangle. If the total area of these four triangles is 200. The length of the diagonal of the rectangle is :

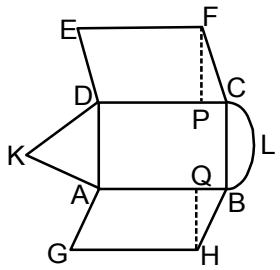


(A) 10 (B) 15 (C) 20 (D) 25

13. The cost of levelling a rectangular ground at Rs.1.25 per sq. metre is Rs 900. If the length of the ground is 30 metres, then the width is :
(A) 330 metres (B) 34 metres (C) 24 metres (D) 18 metres

14. A rectangular lawn 60 metres by 40 metres has two roads each 5 metres wide running in the middle of it, one parallel to length and the other parallel to breadth. The cost of gravelling the roads at 60 paise per sq. metre is :
(A) Rs. 300 (B) Rs. 280 (C) Rs. 285 (D) Rs. 250

15. A child draws the figure of an aeroplane as given. Here the wings EDCF and AGHB are parallelograms, the tail ADK is an isosceles triangle, the cockpit BLC is a semi-circle and the portion ABCD is a square. Let FP $\perp$ CD & HQ $\perp$ AB, AB = 6 cms. KD = 5 cms FP = HQ = 2 cms The area of the figure is:[π = 3.14]



(A) 86.14 cm^2 (B) 87.25 cm^2 (C) 84.63 cm^2 (D) 91.56 cm^2

16. The area of a rhombus is 28 cm^2 and one of its diagonals in 4cm. Its perimeter is :
(A) $4\sqrt{53}$ cm (B) 36 cm (C) $2\sqrt{53}$ cm (D) $\sqrt{53}$ cm

17. The area of a trapezium shaped field is 960 m^2 the distance between two parallel sides is 30 m. and one of the parallel side is 20 m. Find the length of other parallel side.
(A) 44 m. (B) 22 m. (C) 88 m. (D) 11 m.

Exercise-3

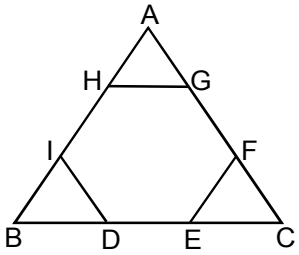
NTSE PROBLEMS (PREVIOUS YEARS)

1. A triangle with integral sides has perimeter 8 units. The area of the triangle is _____ sq units. **[UP NTSE Stage - 1 2012]**
(A) 2 (B) $2\sqrt{2}$ (C) $3\sqrt{2}$ (D) 4

2. Area of triangle ABC whose sides are 24 m. 40 m. and 32 m. is : **[Raj. NTSE Stage-1 2013]**
(A) 96 m^2 (B) 384 m^2 (C) 43 m^2 (D) 192 m^2

3. The perimeters of a regular hexagon and a square are equal. The ratio of the area of the square to the area of the hexagon is : **[Harayana NTSE Stage-1 2014]**
(A) 3 : $\sqrt{2}$ (B) 2 : $3\sqrt{3}$ (C) 1 : $\sqrt{3}$ (D) 3 : $2\sqrt{3}$

4. In the figure given below, ABC is an equilateral triangle. D, E, F, G, H and I are the trisector points of the sides as shown. If the side of the triangle ABC is 6 cm, then the area of the regular hexagon DEFGHI is **[Raj. NTSE Stage-1 2014]**



(A) $3\sqrt{3}$ cm^2 (B) $4\sqrt{3}$ cm^2 (C) $5\sqrt{3}$ cm^2 (D) $6\sqrt{3}$ cm^2

5. If every side of a triangle is doubled then a new triangle is formed. The ratio of areas of these two triangles is **[Raj. NTSE Stage-1 2016]**

(A) 1 : 2 (B) 1 : 3 (C) 1 : 4 (D) 2 : 3

6. Equilateral triangles I, II, III and IV are such that the altitude of triangle I is the side of triangle II, the altitude of triangle II is the side of triangle III and the altitude of the triangle is the side of triangle IV. If the area of triangle I is 2 cm^2 , then the area (in cm^2) of triangle IV is:

[Haryana NTSE Stage-1 2016]

(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{9}{16}$ (C) $\frac{27}{32}$ (D) $\frac{45}{64}$

7. ΔABC is an equilateral triangle, we have BD = EG = DF = DE = EC, then the ratio of the area of the shaded portion to area of ΔABC is **[Delhi NTSE Stage-1 2016]**

(A) $\frac{4}{11}$ (B) $\frac{7}{9}$ (C) $\frac{5}{12}$ (D) $\frac{6}{7}$

8. The height of an equilateral triangle is $\sqrt{6}$ cm. Its area is : **[MP NTSE Stage - 1 2016]**

(A) $2\sqrt{2}$ cm^2 (B) $6\sqrt{2}$ cm^2 (C) $2\sqrt{3}$ cm^2 (D) $3\sqrt{3}$ cm^2

Answer Key

Exercise Board Level

TYPE (I)

1. 24 **2.** $-\sqrt{32}$ **3.** $100\sqrt{3}$ m² **4.** 1344 cm²

5. 5.196 cm² **6.** 6 cm

TYPE (II)

7. $-\sqrt{15}$ cm² **8.** $24\sqrt{5}$ **9.** 2000 **10.** $32\sqrt{2}$ cm²

11. $600\sqrt{15}$ m².

TYPE (III)

12. 1074 m² **13.** $2100\sqrt{15}$ m² **14.** Rs. 960 **15.** 114 m²

16. $20\sqrt{30}$ m² **17.** 23 cm and 27 cm **18.** 3 cm

19. QC = 45 cm, PD = 40 cm

20. Total area of design = 1632 cm², Remaining area of tile = 1869 cm²

TYPE (IV)

21. $300\sqrt{3}$ cm² **22.** 4 : 1 **23.** Rs. 19200

Exercise-1

SUBJECTIVE QUESTIONS

Section (A)

A-1. 24 cm **A-2.** 24 cm. **A-3.** 2772 cm², 36 cm **A-4.** Rs. 1219.68

A-5. $3\sqrt{3}$ cm² **A-6.** 306 m². **A-7.** 8 cm, 15 cm, 60 cm². **A-8.** 46 cm, 114 cm².

A-9. $32\sqrt{2}$ cm² **A-10.** 2.26 hectares, 1.92 hectares and 1.92 hectares.

A-11. Rs. 4940. **A-12.** 1644 m².

OBJECTIVE QUESTIONS

Section (A)

A-1. (B) **A-2.** (B) **A-3.** (A) **A-4.** (D) **A-5.** (C)

A-6. (C) **A-7.** (D) **A-8.** (C) **A-9.** (B) **A-10.** (B)

Exercise-2

OBJECTIVE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ans.	D	B	A	B	C	D	C	B	B	B	D	C	C	C	A	A	A

Exercise-3

Ques.	1	2	3	4	5	6	7	8
Ans.	B	B	D	D	C	C	B	C