Lesson - 8

Perimeter and Area

E6A5R6

School Garden

On Saturday after school hours, the students of class-VI along with their teacher came out to build a garden in the school courtyard. According to the plan they already made a fence out of bamboo, surrounding the garden. The teacher asked, what is the length of the fence?

In response Rahul and Salima started to measure the length of the fencing by a measuring tape. Four ends of the fencing is marked as A, B, C and D. They got the measure from A to B as 10 meters from B to C as 7 metres and from, C to D, as 7 metres and D to A as 8 metres. Now,let us see, how Rahul and Salima found out the perimeter (total length) of the fencing.

Total length of the fencing

= AB + BC+CD+DA

= 10 m + 7 m + 7 m + 8 m

= 32 m

Then the teacher made them understand that the total length of the fencing is the **Perimeter** of the garden.

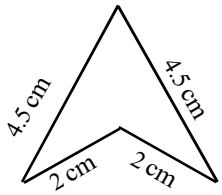
The idea of perimeter is widely used in our daily life.

Let us know: Perimetre is the total distance covered along the boundary forming a closed figure when you go round the figure once.

For example -

- To fence the boundary of the flower garden in front of the house. That means to know the length of the wire required for fencing.
- An engineer who plans to build a compound wall an all sides of a house.
- To prepare the kabaddi court.

Find the perimeter of the following figures and insert in the table.



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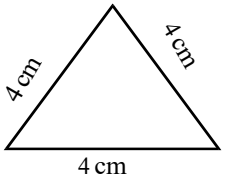

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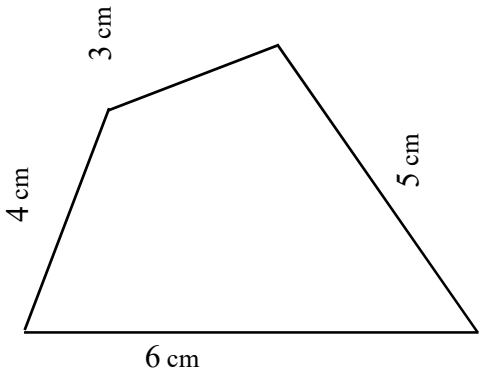

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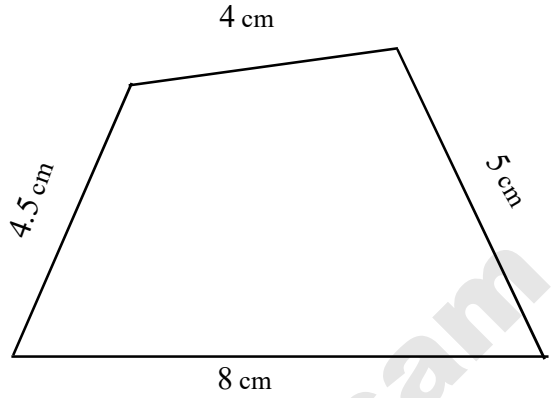

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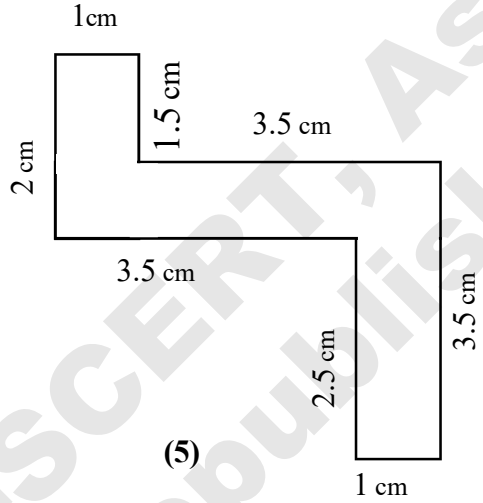


(5)

Figure number	Perimeter (cm)
1	
2	
3	
4	
5	

Perimeter of a rectangle

The teacher asked the students by taking Mathematics book in her hand that, can the perimeter of the cover page of mathematics book be found without actually measuring it? She asked the students to think about it.

Rima and Bidisha started to measure the perimeter of the mathematics book.

Let us observe how they have done this.

They measure the four sides of the cover page of the book with the help of a measuring tape.

The measures are as follows Length = 27 cm, Breadth = 20 cm.

$\therefore$ Perimeter of the cover page of the book = Length + Breadth + Length + Breadth

= 27cm +20 cm +27 cm +20 cm

= (27+20+27+20) cm

= 94 cm.

Let us try

Students are asked to form groups of 2 and find the perimeter of the cover page of a book in their bags.

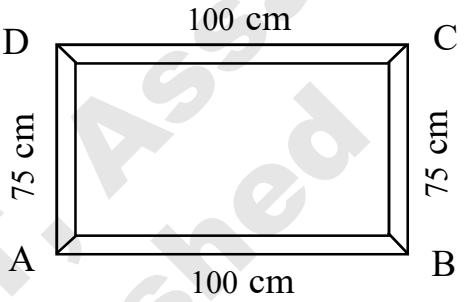
Sewali and Mousumi took the measurement of the 4 edges of the black board in their classroom by using a measuring tape. The measures they got are as follows-

AB = 100 cm

BC = 75 cm

CD = 100 cm

DA = 75 cm



Total length of the 4 edges = (AB +BC+CD+DA)

= 100 cm + 75 cm +100 cm + 75 cm = 350 cm

Let us try to understand,

Perimeter of the black board = Total length of the 4 edges of the black board.

= (100 + 75 +100 + 75) cm = (2×100 + 2 × 75) cm

= 2 × (100 + 75) cm = 2 × (length + breadth)

As the black board is of rectangular shape = length + breadth + length + breadth

= 2 length +2 breadth

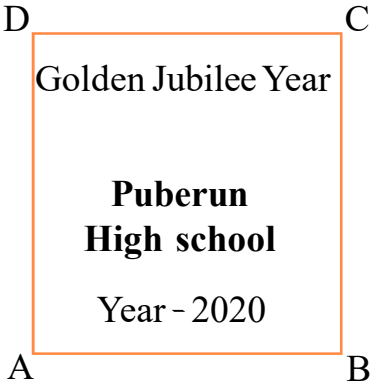
= 2 (length + breadth)

So, perimeter of rectangle = 2 (length + breadth)

or, $(\text{length} + \text{breadth}) = \frac{\text{Perimeter}}{2}$

Perimeter of a square

For the celebration of Golden Jubilee year, the school authority brought a squared board, in which 'Golden Jubliee Year' is written. The students want to decorate the boundary of the squared board as given in the adjacent figure using LED light. The Head Teacher asked Aminesh (a student) to measure the boundary so that they could know the length of the light garland required (in metre) for decoration. Aminesh measured the length of AB by tape and found that it was 1.5m long. As all the 4 sides of board are equal, So, AB=BC=CD=DA= 1.5 m.



That means, the sum of the lengths of AB, BC, CD and DA will be the perimeter of the squared board. This will be the length of the LED light garland.

So, Perimeter of the board = (AB +BC+CD+DA)

= 1.5 m + 1.5 m +1.5 m + 1.5 m

= 4 × 1.5 m

= 4 × length of one side

As the board is of squared shape.

∴ **Perimeter of square = 4** × length of one side

One the other hand, Length of one side = **Perimeter ÷ 4**

A square is also a rectangle. But for a rectangle, the measure of its two adjacent siders are different. But in case of square, the length of its adjacent sides are equal. So, a square is a special kind of rectangle. What will you get, if the measure of the 4 sides of the rectangle are same? Think for yourself.

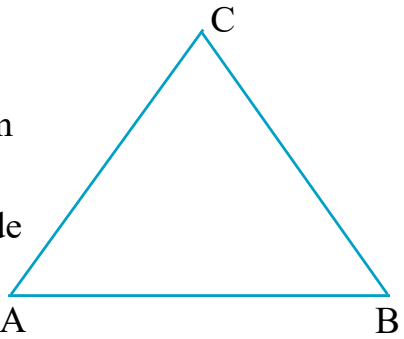
Now, observe the figure of regular triangle or equilateral triangle shown in the adjacent side. Observe that the, length of every side of it is 5 cm. So, AB=BC=CA= 5 cm

∴ Perimeter of an equilateral triangle = AB+BC+CA

= 5 cm + 5 cm + 5 cm

= 3 × 5 cm

= 3 × length of one side



Hence,

Perimeter of an equilateral triangle = 3 × length of one side.

Let us find the perimeter

Example 1 : Length of a rectangular play ground = 230 m

Its breadth = 150 m. What is its perimeter?

Solution : Length of the play ground = 230 m

Breadth of the play ground = 150 m

∴ Perimeter of the play ground = 2 (Length + Breadth)

= 2 × (230 + 150) m

= 2 × 380 m

= 760 m

Example 2 : Find the perimeter of a square if the length of its each side is 3.6.

Solution : Length of each side = 3.6 cm

Perimeter of a square = 4 × length of one side

$\therefore$ Perimeter of the required square = 4 × 3.6 cm = 14.4 cm

Example 3 : Measure of one side of a squared garden is 16 m. Find the total cost of fencing at the rate of Rs. 125 per metre.

Solution : Measure of one side of the garden = 16 m

$\therefore$ Perimeter of the garden = 4 ×16 m

= 64 m

Cost of 1m of fencing = Rs. 125

$\therefore$ Cost of 64 m of fencing = 64 × Rs. 125 = Rs. 8000

Example 4 : Find the perimeter of an equilateral triangle of side 12 cm.

Solution : Length of one side = 12 cm

$\therefore$ Perimeter of an equlateral triangle = 3 × length of one side

= 3 ×12 cm

= 36 cm

Example 5 : Find the length of the side of the square whose perimeter is 72 cm

Solution : Perimeter of a square = 4 × length of one side

$\therefore$ Length of one side = Perimeter ÷ 4

= 72 cm ÷ 4

= 18 cm

Example 6 : Perimeter of a rectangular flower garden is 400 metre and its breadth is 50 metre. Find the length of the garden.

Solution : We know that, for a rectangle, Length + Breadth $= \frac{\text{Perimeter}}{2}$

$= \frac{400}{2}$

= 200

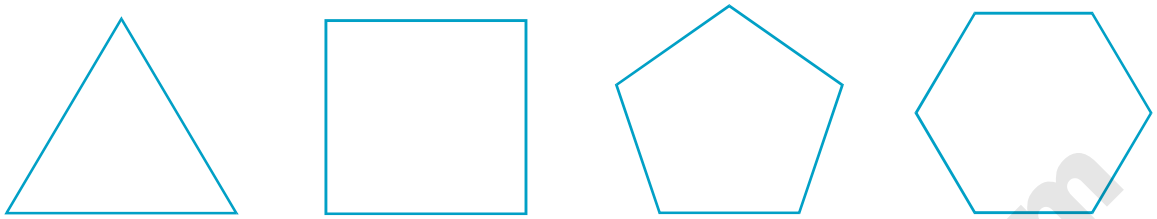
We have, Breadth = 50 m

$\therefore$ Length = (200 – 50) m

= 150 m

Perimeter of regular Polygon

Observe the following figures.



Equilateral Triangle Square Regular Pentagon Regular Hexagon

Measures of the sides of each of the polygons of the given figures are same. Each of them is a polygon. Their perimeter depends upon the number of sides they have. **For example-**

Perimeter of regular triangle or equilateral triangle = 3 × length of one side.

Perimeter of regular quadrilateral or square = 4 × length of one side.

Perimeter of regular pentagon = 5 × length of one side.

Similarly, perimeter of regular polygon having n sides = n × length of one side. From these, we can easily find the length of one side, if the perimeter and number of sides of the regular polygon is known to us.

$$\therefore \text{ Length of one side.} = \frac{\text{Perimeter of the regular polygon}}{\text{Number of sides}}$$

$$\text{Similarly, Number of sides} = \frac{\text{Perimeter of the regular polygon}}{\text{Length of one sides}}$$

Both the length of the sides of a regular polygon and measure of their angles are equal

Example 1 : Length of one side of a regular pentagon is 4.5 cm. Find its perimeter.

Solution : Length of one side = 4.5 cm

Number of side = 5

$\therefore$ Perimeter of regular pentagon = 5 × length of one side

= 5 × 4.5 cm = 22.5 cm

Example 2 : Perimeter of a regular polygon is 390 cm and the length of its side is 65 cm. Find its number of sides.

Solution : Length of one side = 65 cm

$$\therefore \text{ Number of side} = \frac{\text{Perimeter of the regular polygon}}{\text{Length of one side}}$$

$$= \frac{390}{65} = 6 \text{ Number}$$

$\therefore$ Required number of sides = 6

Do it yourself

1. Measure of each side of the following figures are given. Find their perimeter (Draw the figures on your note book)

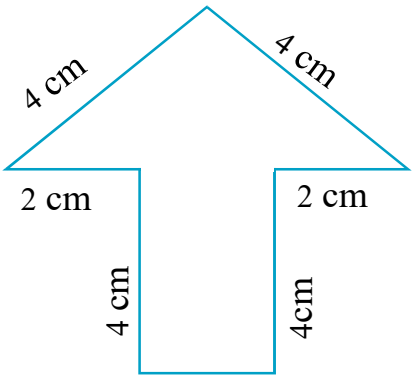


Figure-(a)

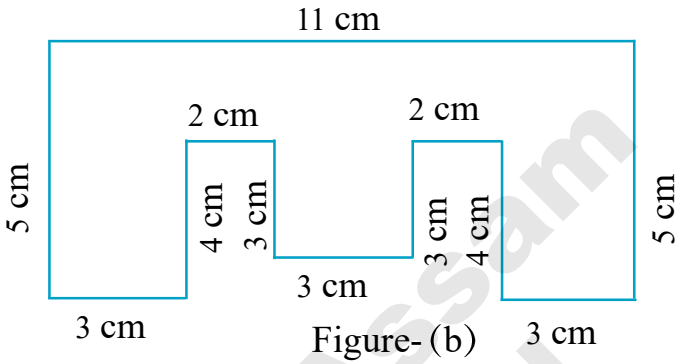


Figure- (b)

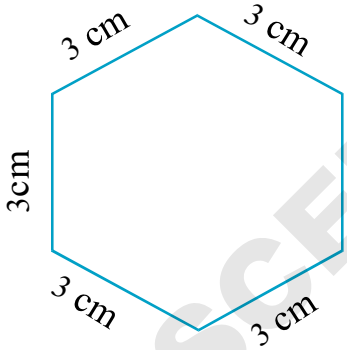


Figure- (c)

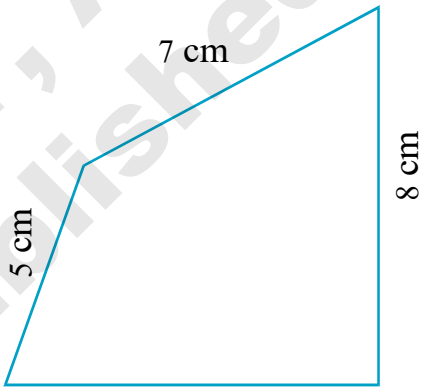


Figure- (d)

2. If the length and breadth of a rectangle are 60 cm and 20 cm respectively, then find its perimeter.
3. If the perimeter of a rectangular floor is 400 m and its length is 150 m, find the breadth of the floor.
4. If the length of a rectangular park is 200 metre, its breadth is150 metre, then find the cost of the fencing at the rate of Rs. 20 per metre.
5. If the perimeter of a regular triangle as well as regular quadrilateral is 36 cm, Find the length of their sides.
6. Perimeter of a regular pentagon is 125 cm. Find the measure of the length of each of its sides.
7. Total cost of fencing of a squared playground at the rate of Rs. 35 per meters is Rs. 4480. Find the measure of each side of the play ground.
8. Length of a rectangle is twice its breadth. If the breadth of the rectangle is 17 cm, then find its perimeter.
9. Ajay runs around a square field of side 60 metre. Bimla runs around a field

which is the shape of a regular pentagon of side 50 metre. Who covers more distance and by how much?

10. A piece of string is 60 cm long. What will be the length of each side if the string is used to form. (a) a square, (b) an equilateral triangle (c) a regular pentagon (d) a regular hexagon?
11. Length of a squared park is 250 metre. From this 2 metre is left for making a gate. Find the cost of fencing that park if the rate is Rs. 20 per metre.
12. Measures of the two sides of a triangle are 14 cm and 16 cm. If the perimetre of the triangle is 40 cm, then find the measure of the third side.
13. A wire forms a rectangle of size 18 m × 10 m. If with the same wire a square is formed, then what will be the length of that square?
14. A wire of length 24 cm is with you. With this wire form 5 different rectangles and find the length and breadth of each of the rectangle thus formed.
15. Length of a regular decagon is 10 cm. Find its perimeter.

Area

Look at the 2 closed figures given below. They occupy some region of a flat surface. Can you tell which one occupies more region? Try to find the area of the space enclosed by the figures by counting the squares enclosed.

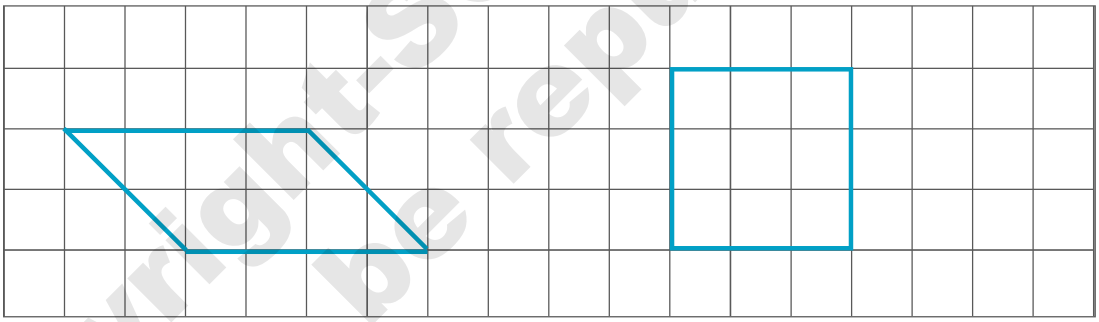


figure I figure II

Figure I- How many squares of the graph paper is covered by this figure (In counting, consider 2 half squares as 1 full square)

Figure II- How many squares of the graph paper is covered by this figure?

Figure II- Did you not get 1 more square? What do you understand? In figure- II, number of squares are more. That means? it covers more space, isn't it? How many squares of the graph paper does it cover?

Remember : We can get the total space covered by a figure by counting the number of squares it occupies. This is known as the area of that figure.

We get to know, how to find the area of regular shapes. Now, let us observe, how to find the area of irregular shapes.

There is a small problem, the squares do not always fit exactly into the area you measure. We get over this difficulty by adopting a covention.

- The area of one full square is taken as 1 square unit.
- If more than half of a square is in a region, just count it as one square.
- If exactly half the square is counted, take its area as $\frac{1}{2}$ square unit.
- If portions of the area that are less than half a square, then ignore it.

Such a convention gives a fair estimate of the desired area.

Activity : Let us try to find the area. Look at the two figures given below. Each figure is covered by full squares, half squares, more than half filled squares and less than half-filled squares. count those and maintain the record.

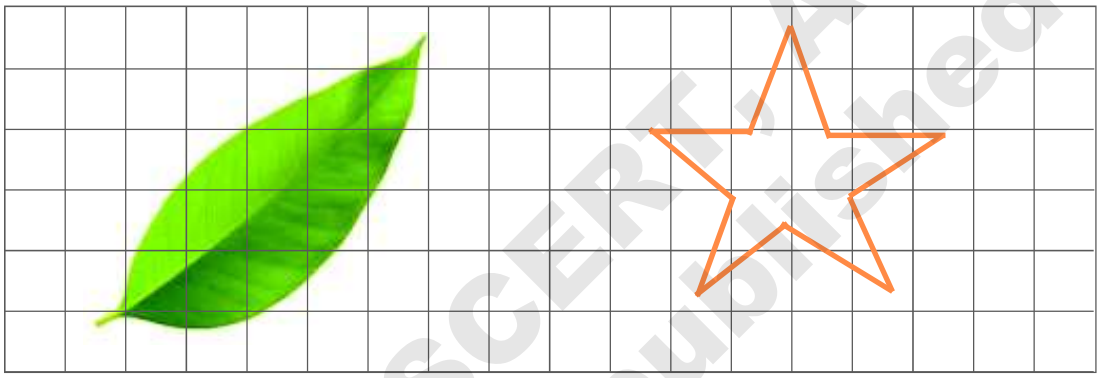


figure (a) figure (b)

For figure (a)

Covered	**Number**	**Area estimate (Sq. units)**
(i) Fully filled squares	5	5
(ii) More than half filled squares	6	6
(iii) Half-filled squares	0	0
(iv) Less than half-filled squares	6	....

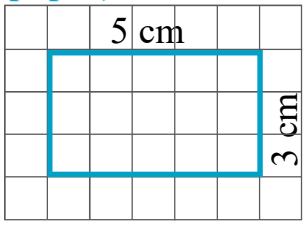
Total area = 5 + 3 = 11 Sq. units

Similarly, by counting squares, estimate the area of the figure (b)

Area of a rectangle : (with the help of the squared paper)

The area of the rectangle = 15 Sq. cm
= 5 × 3 Sq. cm
= Length × Breadth

∴ Area of a rectangle = Length × Breadth



Example 1: The length and breadth of a rectangular flower garden is 20 m and 15 m respectively. What is the cost of ploughing the garden at the rate of Rs. 120 per square metre?

Solution :

Length of the garden = 20 m.

Breadth of the garden = 15 m

Area of the garden = 20 m × 15 m = (20 × 15) Sqm.

= 300 Sqm.

∴ Cost of ploughing 1 sqm of land = Rs. 120

∴ Total cost of ploughing 300 Sqm of land = Rs. 300 ×120 = Rs. 36,000

Example 2 ः A floor is 5 m long and 4m wide. A square shaped carpet of sides 3 m is laid on the floor. Find the area of the floor that is not carpeted.

Solution :

Length of the floor = 5 m

Breadth of the floor = 4 m

∴ Area of the floor = 5m × 4 m = (5 × 4) Sqm

= 20 Sqm

Again, the length of the side of the carpet = 3 m

Area of the carpet = 9 Sqm

∴ Area of the floor which is not carpeted = Area of the floor – Area of carpet

= 20 Sqm –9 Sqm

= 11 Sqm

Example 3 : If the length of a rectangular board is 190 cm and its area is 22800 sqm, then find the breadth of the board.

Solution : Length of the board = 190 cm

Area of the board = 22800 Sqm

$\therefore$ Area of the board = Length × Breadth

$\therefore$ Its breadth $= \dfrac{\text{Area of the board}}{\text{Its length}}$

$= \dfrac{22800 \text{ Sqm}}{190 \text{ cm}}$

$= 120$ cm

$$\begin{array}{r|l} & 120 \\ \hline 190 & 22800 \\ & -190\downarrow \\ \hline & 380 \\ & -380\downarrow \\ \hline & 0 \end{array}$$

Example 4 : The area of a rectangle is 600 sqcm and its breadth is 20 cm. Find the perimeter of the rectangle.

Solution : Are of the rectangle = 600 Sqm

Its breadth = 20cm

$\therefore$ We know, that the area of a rectangle = Length × Breadth

$\therefore$ Its length $= \dfrac{\text{Area}}{\text{Breadth}}$

$= \dfrac{600 \text{ Sqm}}{20 \text{ cm}}$

$= 30$ cm

Again, Perimeter of the rectangle = 2 (Length + Breadth)

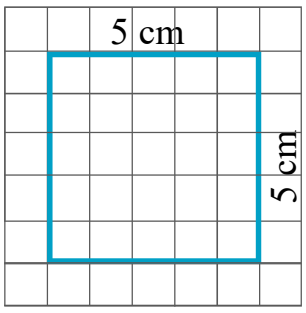
$= 2 (30 + 20)$ cm $= 2 \times 50$ cm

$= 100$ cm

Area of a Square

If the length and breadth of a rectangle are equal then it will become a square.

Let us find the area of a square having side 5 cm



Area of a square = 25 Sqm (as it covers 25 squares)

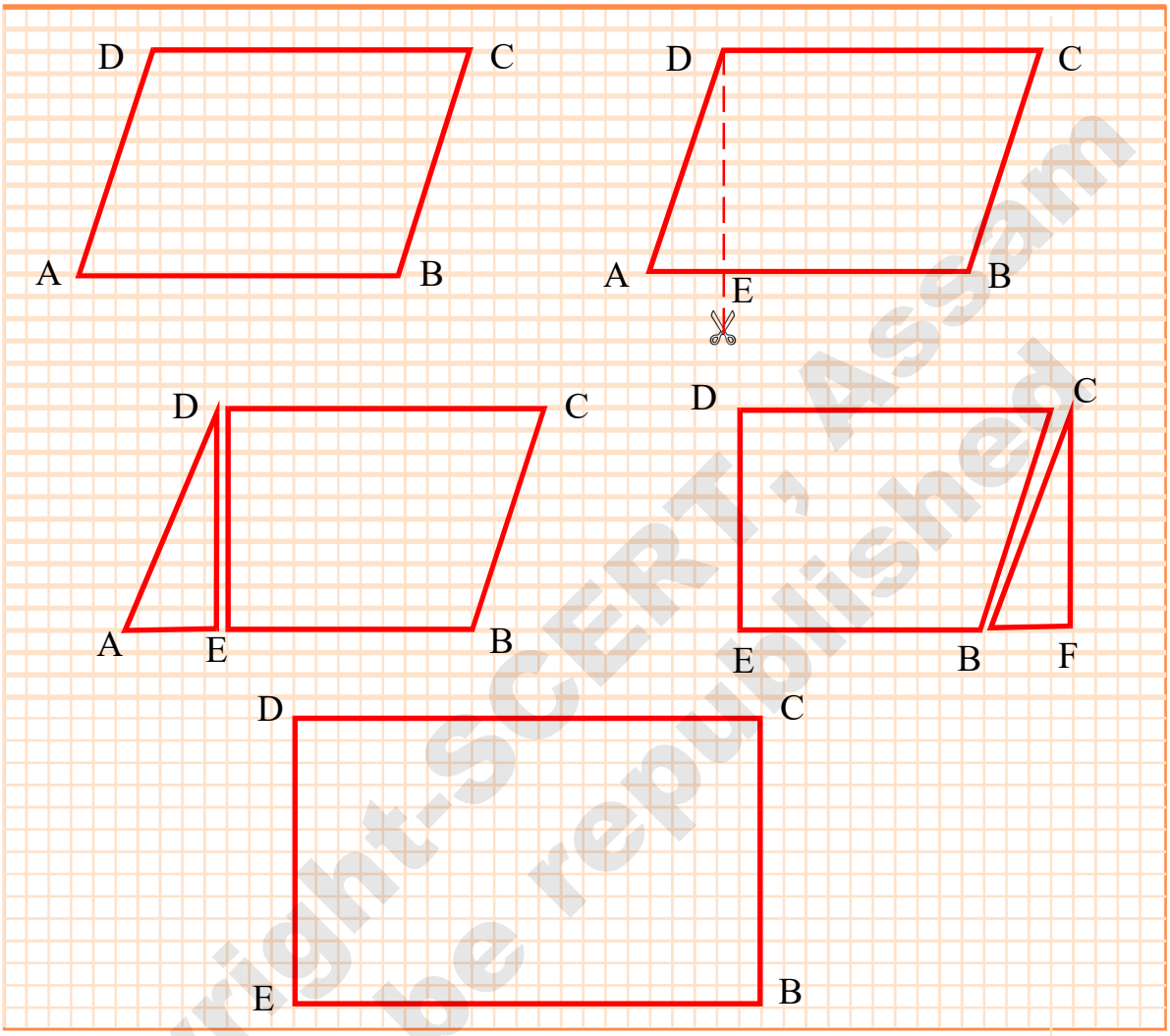
= 5 × 5 Sqcm

= Side × Side

$\therefore$ Area of a square = Side × Side

Area of a Parallelogram

We have a quadrilateral having the shape of a parallelogram, other than rectangle and square. We shall find the area of the parallelogram by using a graph paper.



ABCD is a parallelogram drawn on the graph paper. From the vertex D of the parallelogram draw a right angled triangle AED and get it separated by folding or cutting. Now put the triangle AED an the oppsite side of the parallelogram in such a way that AD coincides with BC and thus we get the rectangle DEFC. So, it is clear that, the area of the rectangle DEFC is equal to the area of the parallelogram. The length of the rectangle is same as the base of the parallelogram and breadth of the rectangle is same as the height of the parallelogram.

So,

Area of the rectangle ABCD = Area of the rectangle DEFC

= Length × Breadth

But the length and breadth of the rectangle is same as the base and height of the rectangle.

Hence, the area of the parallelogram = Base × Height

Let us know : Height of the parallelogram is the perpendicular distance between the two parallel sides of the parallelogram.

Considering any side of the parallelogram as base and drawing a perpendicular on it from the opposite vertex of that side, we get the height of the parallelogram. And then also we can find the area of the parallelogram.

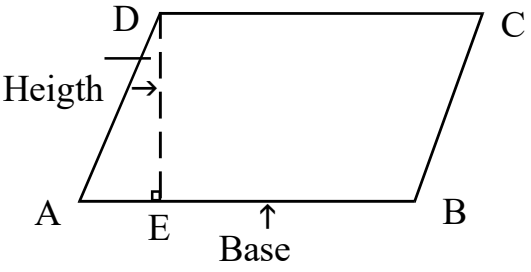


Figure-I

In the figure- I base of the parallelogram is AB and its height is DE.

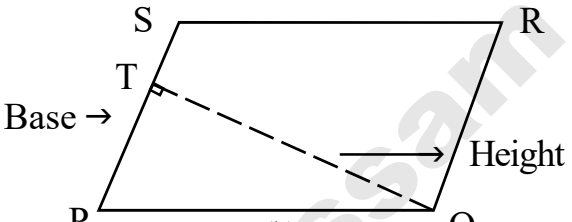
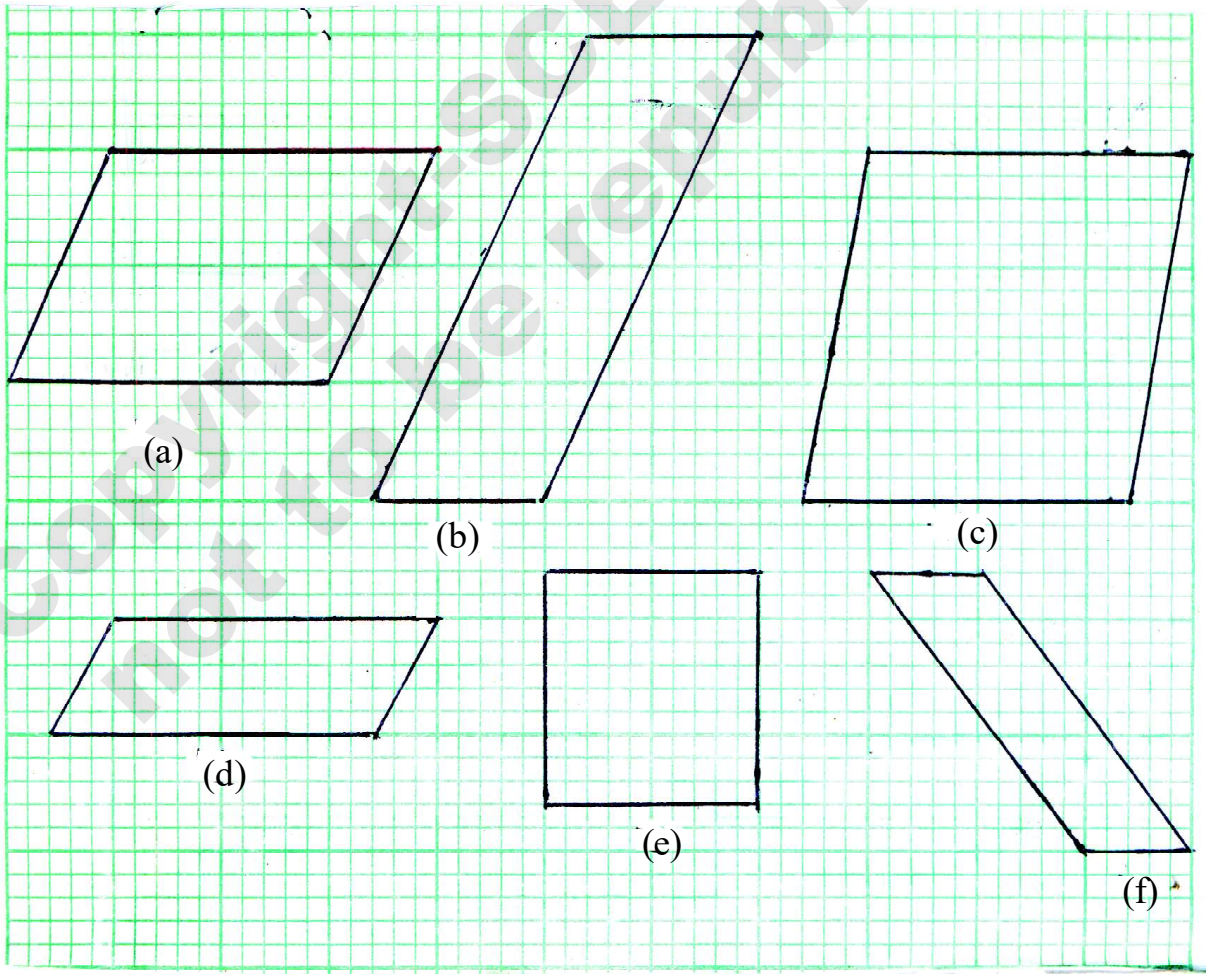


Figure -II

In the figure- II base of the parallelogram is PQRS is PS and its height is QT.

Do it yourself : Find the area of the following parallelograms by counting the squares covered by the shapes.



Parallelogram	Base	Height	Area
(a)	15 units	10 units	15 ×10 sq units =150 sq units
(b)			
(c)			
(d)			
(e)			
(f)			

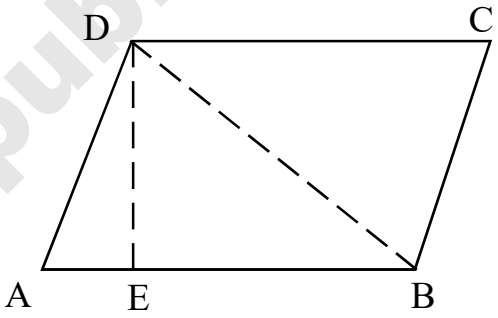
Area of a Triangle

Let us observe how we find the area of a triangle from the area of a parallelogram.

- Draw a parallelogram ABCD.
- Join the diagonal BD, we get two triangles of same area.
- Draw a perpedicular DE on AB from the vertex D.
- Area of $\Delta ABD = \frac{1}{2} \times$ Area of parallelogram ABCD

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

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



Let us observe, how we find the area of triangle from a rectangle also.

PQRS is a rectangle. PR is a diagonal which divides the square into 2 triangles of equal area. Each part is a right angled triangle.

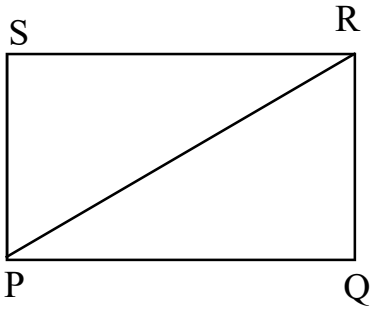
Area of ΔPQR + Area of ΔPRS = Area of rectangle PQRS.

Area of ΔPQR +Area of ΔPQR = Area of rectangle PQRS

2 Area of ΔPQR =PQ $\times$ QR

$\therefore$ Area of $\Delta PQR = \frac{1}{2} \times PQ \times QR$

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



The perpendicular drawn from any vertex of a triangle to its opposite side is called the height or altitude of the triangle.

Let us do :

Example 1 : Find the area of the parallelogram whose base is 20 cm and the height is 14 cm.

Solution : Base of the parallelogram = 20 cm

Height of the parallelogrm = 14 cm

$\therefore$ Area of the parallelogram = Base × Height

= 20 cm × 14 cm = (20 × 14) sqcm

= 280 sq cm

Example 2 : Area of a parallelogram 225 sq cm and its height is 10 cm. Find its base.

Solution : Height of the parallelogram = 10 cm

Area of the parallelogram = 225 sq cm

Base × Height = 225 sq cm

Base × 10 cm = 225 sq cm

$\therefore$ Base $= \frac{225 \text{ sq cm}}{10 \text{ cm}} = 22.5$ cm

Example 3 : Base of a triangle is 40 cm. If the height of the triangle is 12 cm, then find its area.

Solution : Base of the triangle = 40 cm

Height = 12 cm

Area of the triangle $= \frac{1}{2} \times$ Base × Height

$= \frac{1}{2} \times 40 \text{ cm} \times 12 \text{ cm}$

= 20 cm × 12 cm

= 240 sq cm.

Example 4 : Height of a triangle is 23 cm and its area is 161 sqcm, find the height of the triangle.

Solution : Base of the triangle = 23cm

Area of the triangle = 161 sq cm.

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

$$\therefore \text{ Height of the triangle} = \frac{2 \times \text{Area}}{\text{Its Base}}$$

$$\therefore \qquad = \frac{2 \times 161}{23} \text{ cm}$$

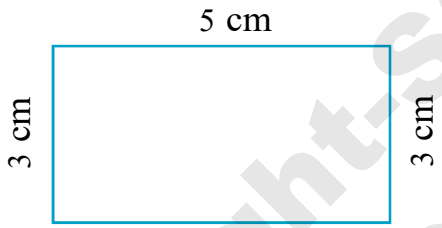
$$= 14 \text{ cm}$$

Lets play a game

- Form groups of four.
- Each group will take a thread of length 36 cm. Frame different shapes of quadrilateral on Geo-board using this thread.
- Count the number of squares covered by the quadrilaterals of each type.

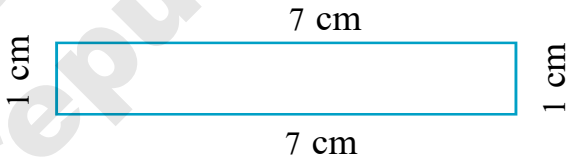
Whether you found any difference is the area covered by each of the rectangles having the same perimeter? Which shape has the biggest area? Find all 'these'.

Let us find the perimeter and area of the following figures.



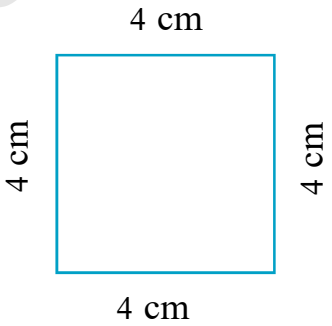
Perimeter = cm

Area = sqcm



Perimeter = cm

Area = sqcm



Perimeter = cm

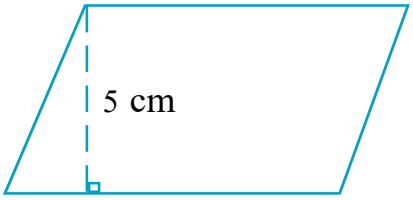
Area = sqcm

Whether all the quadrilaterals on the above have the same perimeter? What about their area?

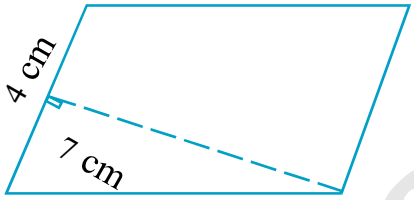
Remember : Amongst the quadrilaterals of same perimeter, maximum area can be found in square.

Exercise :

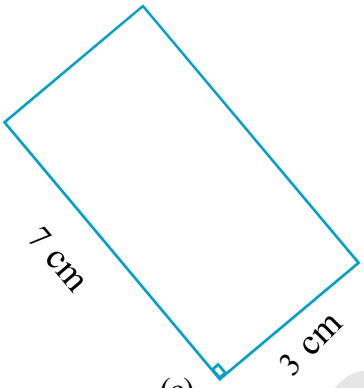
1. Find the area of the each of the following parallelograms.



(a)



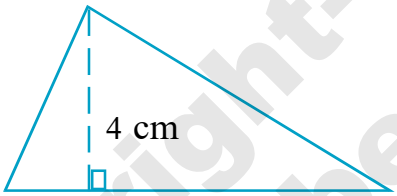
(b)



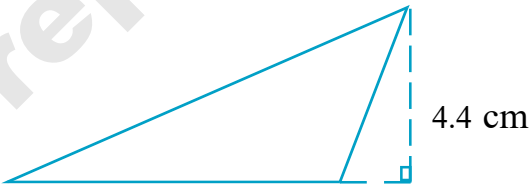
(c)

(d)

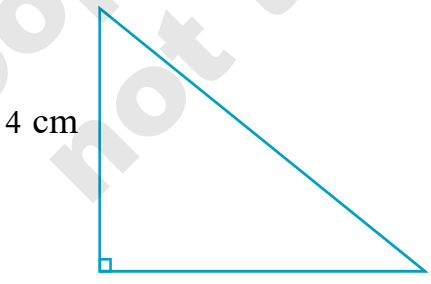
2. Find the area of each of the following triangles.



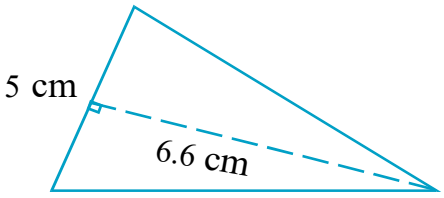
(a)



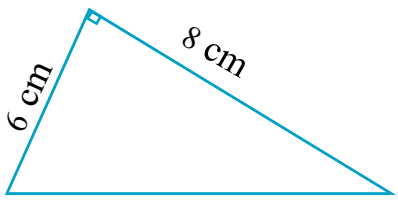
(b)



(c)

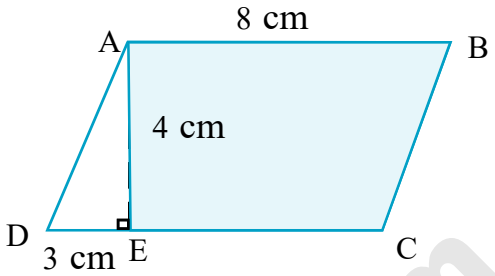


(d)



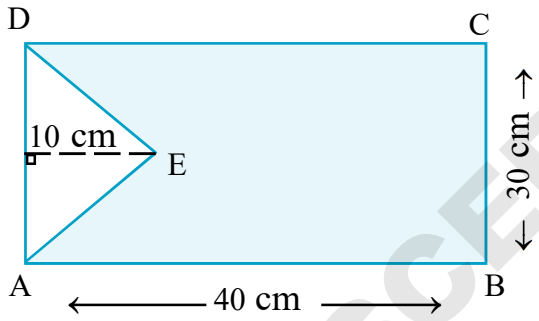
(e)

3. For the parallelogram ABCD, AB=8 cm, AE=4 cm, DE= 3 cm, Find area of the coloured region.

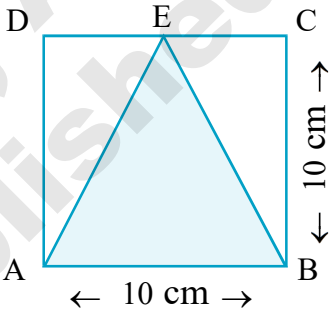


4. Find the area of the triangle whose length of the base is 40 cm and the height is 12 cm.
5. Find the area of the coloured portions.

(i)



(ii)

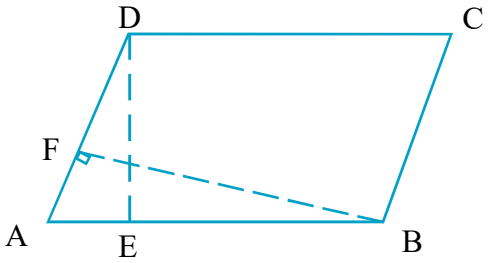


6. Choose different lengths and breadths of some rectangles. Find the area of those rectangles which have the perimeter 16 cm.

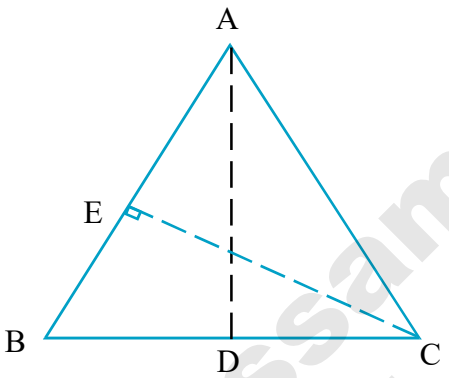
Length (cm)	Breadth (cm)	Area (sqcm)

7. Area of the rectangle ABCD is 225 sqcm and its height is 10 cm. Find its base.

8. Parallelogram ABCD has AB= 8 cm, AD=5 cm, DE=7 cm, then find BF.



9. ABC is an isosceles triangle, whose AB= AC=7.5 cm, BC=9 cm, AD = 6 cm. Find the area of the ΔABC. Also find the height CE.



10. Area of a rectangle is 540 sqcm and its length is 36 cm. Find the breadth of the rectangle.

11. Height of a parallelogram is half of its base. If the base is16 cm, find its area.

Answers :

1. (a) 35 sqcm (b) 28 sqcm (c) 21 sqcm (d) 40 sqcm
2. (a) 12 sqcm (b) 11.44 sqcm (c) 11.6 sqcm (d) 16.5 sqcm
   (e) 24 sqcm
3. 26 sqcm
4. 240 sqcm
5. (i) 1050 sqcm (ii) 50 sqcm
6.

Length (cm)	Breadth (cm)	Area (sqcm)
7	1	7
6	2	12
5	3	15

7. 22.5 sqcm
8. 11.2 sqcm
9. 27 sqcm 7.2 cm
10. 15 sqcm
11. 128 sqcm