Perimeter and area of plane figures
Hello students,
This programme is the second part of the chapter “measurement of length”.

In the first part we talked about the importance of measuring length, the different units of length and how we perform calculations with the different units.

In this lesson, we shall see how to use the measurement of length in calculating perimeter and area of plane figures.
Perimeter

Let's begin with perimeter.

The perimeter is the distance or length all around a two-dimensional shape or figure.
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For example, if I measure the distance all around this whiteboard, I will obtain its perimeter.
Perimeter = 3+7+3+7
= 20 units

**Add** the lengths of **ALL** the sides
The perimeter is the distance all around
= 4m + 4m + 3m +11m + 3m + 15m + 7m
= 44m
Before moving further in this chapter, let me ask you these questions:

Can you think about where perimeter is used in the real life?

Think about the playground of your school. If you run all around it, what will be the distance you have covered?

In fact, the distance you have covered is none other than the perimeter of the playground.
Word problems based on perimeter
A man wants to fence his rectangular garden which is 15m long and 8 m wide. Find the minimum length of fencing he needs to buy.

The minimum length of fencing he needs to buy is the perimeter of the garden. 
Perimeter = 15 m + 8m + 15m + 8m = 46m
An athlete runs thrice all round the track shown below, everyday in the month of November. Find the total distance he covered in kilometers.
The distance covered in 1 turn = perimeter of the triangular track
= 150m + 120m + 215m
= 485 m

The distance covered in 3 turns = 485 X 3 = 1 455m

Distance covered in November = 30 X 1 455
= 43 650 m
= 43.65 km (43 650 ÷ 1000)
Area

The term 'area' refers to the amount of space inside the boundaries of a figure.

We frequently use area in our daily life. For instance, if you want to paint the walls of your room, you have to know the area to be painted so as to buy the adequate amount of paint.

Calculating area of a room is important to determine the number of tiles needed or the size of a new carpet to be fitted into the room.

In fact many people such as builders, architects, farmers or engineers need to calculate areas as part of their daily job.
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For example, If you ask an architect to design a new house for you, he must first know the area of the land where you want to build the house and most important the area of the house you want.

You must have seen farmers working in their vegetables fields. In fact they use area to decide on the amount of seeds or fertilizers to use.

As such, there are many other sectors where areas are the basic requirements.
Area of plane figures

So now let’s have a look of how to calculate the area of different 2-D figures

The area of a shape can be determined by placing it over a grid and count the number of squares that it covers.

Look at this figure which has been placed over a grid

We can count the squares inside the rectangle and thus obtain an area of 15 square units.
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However we do not always have complete squares and thus it may cause some inconveniences in counting the number of squares.
So we shall concentrate on using different formula to calculate the area of different plane figures
Squares and Rectangles

To find the area of a square or a rectangle, we use the formula:

\[
\text{Area} = \text{length} \times \text{width}
\]

As a square has all sides equal, its area is often calculated as

\[
\text{Area of a square} = \text{length} \times \text{length} = (\text{length})^2
\]
Examples
Calculate the area of the following rectangle

area = length X width
= 5 X 3
= 15
But what about the unit of area
In this example the length is 5 cm and width is 3 cm
If we divide the length in 5 equal parts of 1 cm each and the width into 3 equal parts of 1 cm each, we shall have 15 squares of length 1 cm in the rectangle
In other words area = 15 squares of length 1 cm.
So we read the area as 15 square cm or cm square (cm²).
Similarly, if the dimension would have been in m, then area would be 15 m²
This applies for any other units of length
Examples

Area = 5 cm x 5 cm
= 25 cm²

Area = 5 cm x 4 cm
= 20 cm²
Area of composite figures

Calculate the area of the following figure:

we first divide the figure into two

The rectangle A has an area of

\[4 \text{ cm} \times 7 \text{ cm} = 28 \text{ cm}^2\]

The rectangle B has an area of

\[4 \text{ cm} \times 2 \text{ cm} = 8 \text{ cm}^2\]

If we combine these we will have a total area of

\[28 \text{ cm}^2 + 8 \text{ cm}^2 = 36 \text{ cm}^2\]
Area of triangles

Consider the following rectangle,

Area of the rectangle is \( \text{length} \times \text{width} \)

Cut the rectangle into two equal parts as shown on the diagram and consider the triangle obtained. The area is half that of the rectangle, so area of the triangle is \( \frac{1}{2} \times \text{length} \times \text{width} \). However, for triangle we take the length as the base and the width as the perpendicular height.
Formula for area of triangles

\[ \text{Area} = \frac{1}{2} \times \text{base} \times \text{perpendicular height} \]

Note:
In triangles, it is very important to identify the perpendicular height.
Example

Find the area of the following triangles.

(a)

\[
\text{Area} = \frac{1}{2} \times b \times h \\
= \frac{1}{2} \times 4 \times 5 \\
= 10 \text{ cm}^2
\]

(b)

\[
\text{Area} = \frac{1}{2} \times b \times h \\
= \frac{1}{2} \times 10 \times 6 \\
= 30 \text{ cm}^2
\]
Parallelograms

A Parallelogram is a flat shape with opposite sides parallel and equal in length.
Area of parallelogram

If we cut the blue part of the parallelogram and place it to its right as shown on the diagram. We obtain a rectangle whose area is length \( \times \) width

In this case area = \( b \times h \)

So area of a parallelogram is

\[ \text{base} \times \text{perpendicular height} \]
Example

Area = base X perpendicular height
      = 6 X 8
      = 48 cm$^2$
Rhombus
A rhombus is a parallelogram with all sides equal

Now since a rhombus is a parallelogram, its area is also is base x height

\[ \text{Area of rhombus} = \text{base} \times \text{height} \]
Kites
A kite has 2 pairs of equal adjacent sides and its diagonals meet each other at right angle.
Line of symmetry

height
base
vertical diagonal

height
$\frac{1}{2}$ horizontal diagonal
Since we have two pairs of equal sides in a kite, the vertical diagonal is a line of symmetry. So we have two equal triangles on both sides of the vertical diagonal.

Now the area of triangle is

The base of the triangles is the vertical diagonal, while the height of the triangle is the horizontal diagonal

Hence the area of one of the triangle

\[= \frac{1}{2} \times \frac{1}{2} \text{horizontal diagonal} \times \text{vertical diagonal} \]

\[= \frac{1}{4} \times \text{horizontal diagonal} \times \text{vertical diagonal} \]

Therefore the area of the kite = 2x area of the triangle

\[= 2 \times \frac{1}{4} \text{horizontal diagonal} \times \text{vertical diagonal} \]

\[= \frac{1}{2} \times \text{product of the diagonals} \]
Examples

1. Find the area of the kite.

Solution
Area = \( \frac{1}{2} \times \) product of the diagonals
= \( \frac{1}{2} \times 12 \times 5 \) cm\(^2\)
= 30 cm\(^2\)

2. Find the area of the given figure.

Solution
Area = \( \frac{1}{2} \times \) product of the diagonals
= \( \frac{1}{2} \times 5 \times 8 \) cm\(^2\)
= 20 cm\(^2\)
Trapeziums
A trapezium is a quadrilateral having one pair of parallel sides.

The parallel sides are $a$ and $b$ while $h$ is called the perpendicular height.
To find the area of a trapezium, we cut it into 2 parts and then join the two parts to form a parallelogram.

The new figure formed consists of 2 trapezia joined together to now form a parallelogram.

Area of parallelogram = base × height

\[ = (a + b) \times \frac{1}{2} \times h \]

So,

Area of trapezium = \( \frac{1}{2} \times (a + b) \times h \)

\[ = \frac{1}{2} \times \text{(sum of parallel sides)} \times h \]
Examples

Calculate the area of the following figures.

(a) 1.6 m

2 m

4 m

Solution

Area = \frac{1}{2} \times \text{(sum of parallel sides)} \times h

= \frac{1}{2} \times (1.6 + 4) \times 2

= 5.6 \text{ m}^2

(b) 2.9 cm

0.9 cm

1.3 cm

Solution

Area = \frac{1}{2} \times \text{(sum of parallel sides)} \times h

= \frac{1}{2} \times (2.9 + 1.3) \times 0.9

= 1.89 \text{ cm}^2
Conversion from one unit of area to another

Consider a square of length 1 cm.
The area of a square of length 1 cm is \(1 \text{ cm} \times 1 \text{ cm} = 1 \text{ cm}^2\). Now since \(1 \text{ cm} = 10 \text{ mm}\), the area of the same square is \(10 \text{ mm} \times 10 \text{ mm} = 100 \text{ mm}^2\).
So \(1 \text{ cm}^2 = 100 \text{ mm}^2\)

Similarly, a square of length 1 m has an area of \(1 \text{ m} \times 1 \text{ m} = 1 \text{ m}^2\) which is equivalent to \(100 \text{ cm} \times 100 \text{ cm} = 10 000 \text{ cm}^2\).

For a square of length 1 km, we shall an area of \(1000 \text{ m} \times 1000 \text{ m} = 1 000 000 \text{ m}^2\)
However for large areas, specially when we are measuring plots of land we use the hectares (Ha).
\(1 \text{ Ha} = 10 000 \text{ m}^2\).
So \(1 000 000 \text{ m}^2 = 100 \text{ Ha}\)
We can use the following conversion figure to convert one unit of area to another.
Convert the followings:

a) 15 cm\(^2\) to mm\(^2\)
   \[15 \text{ cm}^2 = 15 \times 100\]
   \[= 1500 \text{ mm}^2\]

b) 4.5 m\(^2\) to cm\(^2\)
   \[4.5 \text{ m}^2 = 4.5 \times 10000\]
   \[= 45000 \text{ cm}^2\]

c) 2 ½ Ha to m\(^2\)
   \[2 \frac{1}{2} \text{ Ha} = \frac{5}{2} \times 10000\]
   \[= 25000 \text{ m}^2\]
Questions for practice
Summary

In this lesson we have learned

✓ Perimeter of plane figures
✓ Area of plane figures
✓ Conversion of units of area
Perimeter

https://www.mathsisfun.com/definitions/perimeter.html
http://www.icoachmath.com/math_dictionary/perimeter.html
https://www.mathworksheets4kids.com/perimeter.php
https://www.education.com/worksheets/perimeter
https://www.youtube.com/watch?v=AAY1bsazcgM
Area

http://www.math.com/tables/geometry/areas.htm

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