2

When Lines Join

Straight and slanted

Malu came to the class with photos of her vacation tour. Appu looked at some of the photos for some time and said, "There's something common to all these."

These are the photos:

"What's it?", all his friends looking at the photos.

"In all these, there are things going upwards; some straight up, others slanted"

Did you note this in these photos?

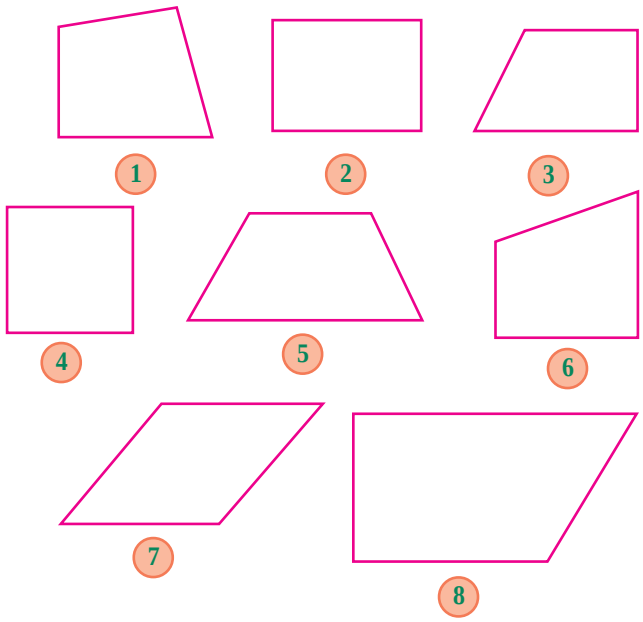
Leaning Tower

The photo shows a tower in the city of Pisa in Italy. It is famous as the *Leaning Tower of Pisa*.

Later the tower was found to lean slowly. Though the tower could have been strengthened, it was decided to maintain a slant, as a tourist attraction.

Four sides

Shown below are some figures with four sides (called *quadrilaterals*).



In these, some sides go straight up from the bottom line; and some are at a slant.

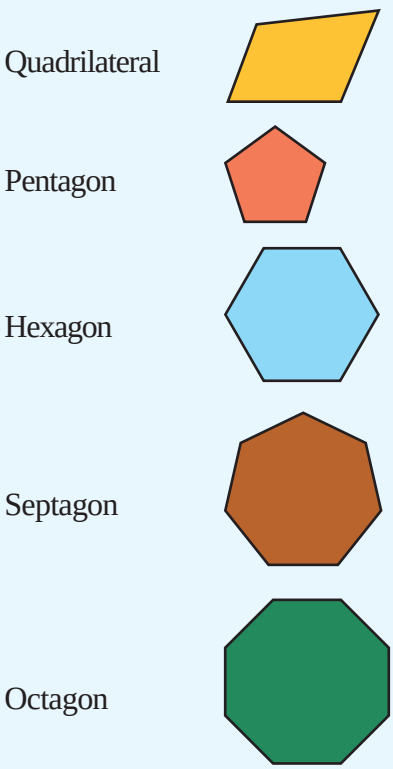
For example, look at the first one – left line goes straight up, while the right one is slanted to the left.

Look at the other figures and complete this table:

Figure	Upright	Slanted
1	Left line	Right line
2		
3		
4		
5		Left line, right line
6		
7		
8		

Polygons

Geometrical figures made up of lines are named according to the number of sides - those with four sides are quadrilaterals, those with five sides are pentagons, those with six sides are hexagons and so on.

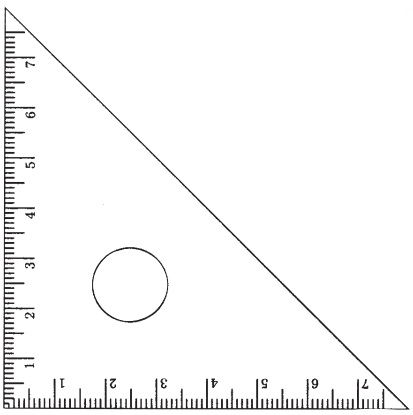


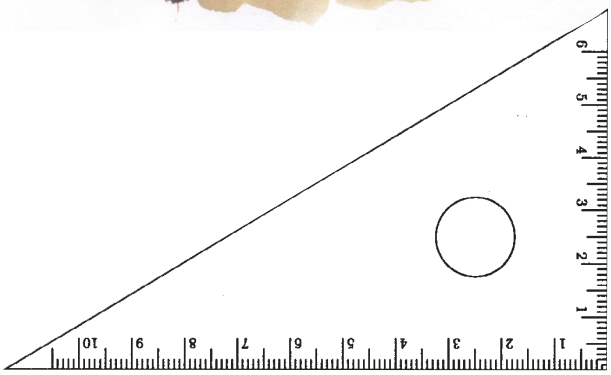
Set squares

Ramu is trying to cut out a rectangle from a wooden plank. See the tool he uses to make a side straight up from the other.

It is called a set square.

Your geometry box also has a pair of set squares.





- What are their uses?

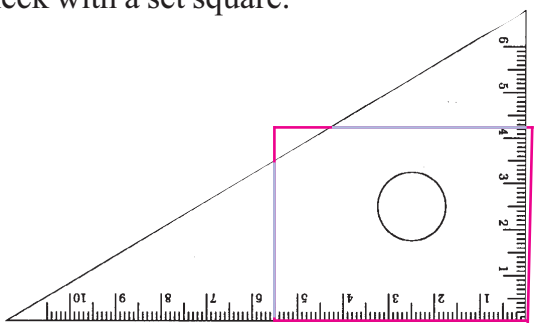
Let's check

Look at this Quadrilateral:

Are the left and right lines straight up from the bottom?

Not very sure, are you?

Let's check with a set square.



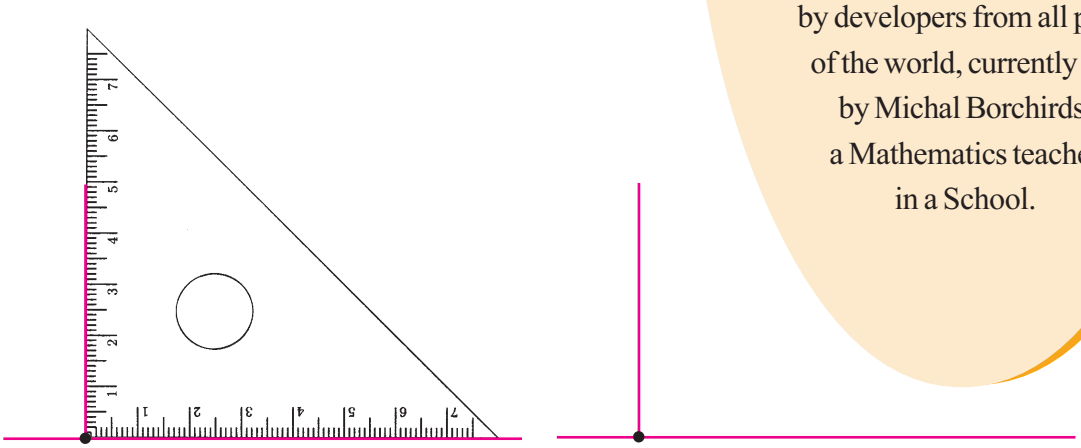
The right line is a bit slanted to the right.

Let's draw!

This figure shows a line with a small dot (point) on it.

We want to draw a line straight up to this line; and also through the point.

For this also, we can use a set square.



The line we draw now meets our needs.

The set square has three corners; and we used one of these to draw the line straight up. This corner of the set square is special. An edge through this corner is straight up from the other. It is called the square corner.

GeoGebra

GeoGebra is a software used to teach and learn geometry at different levels, starting from school geometry. It is available for various operating.

We use GeoGebra 4, under **GNU/Linux**.

It was created in 2001 by Markus Hohenwater, a teacher at University of Salzberg, Austria.

It is continuously improved by developers from all parts of the world, currently led by Michal Borchirds, a Mathematics teacher in a School.

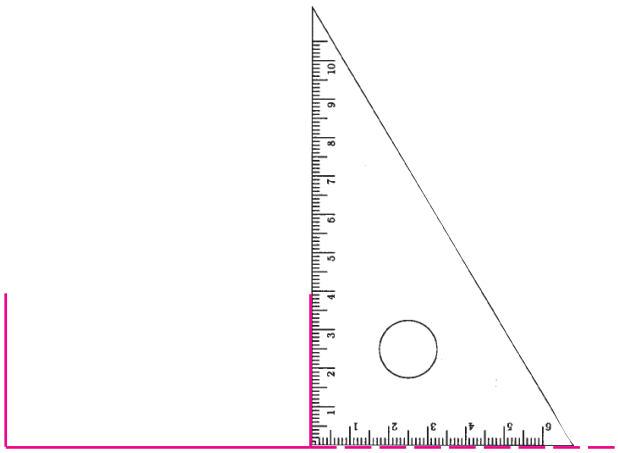
Now draw such a figure in your notebook.

Draw a line and two lines straight up from it.

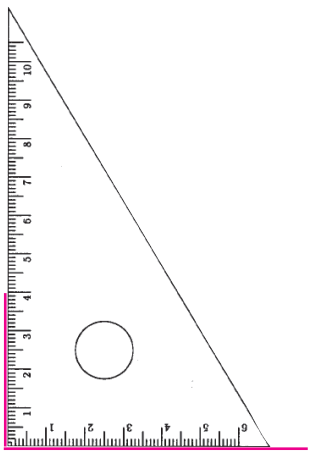
How many such lines can you draw?

From the end point of a line, how do we draw an upright line?

Let's first see how we draw such a line through the left end point.



Do you see why we extend the line to the right?



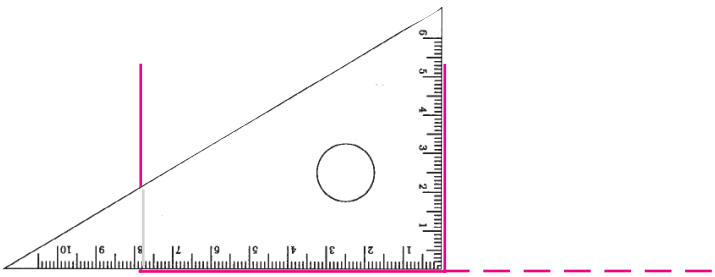
Now from the right end point.

Quadrilaterals

Start GeoGebra selection by `Application` → `Education` → `Geogebra`. Then select `Tools` → `polygon tools` → `polygon`. Click at four positions and then the first position within the GeoGebra window. We get a quadrilateral. Make different quadrilaterals like this.

Click the **Move** tool from the tool bar and then drag the left and right sides to make them upright.

We can also draw it like this:

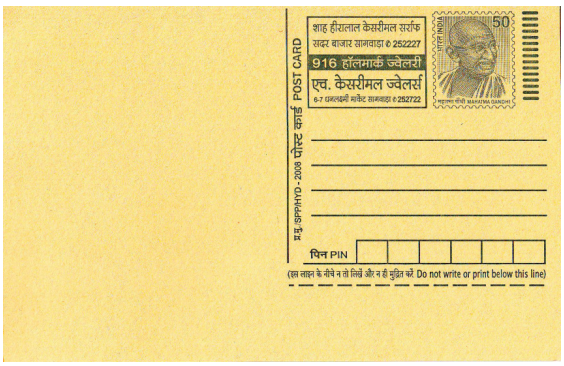


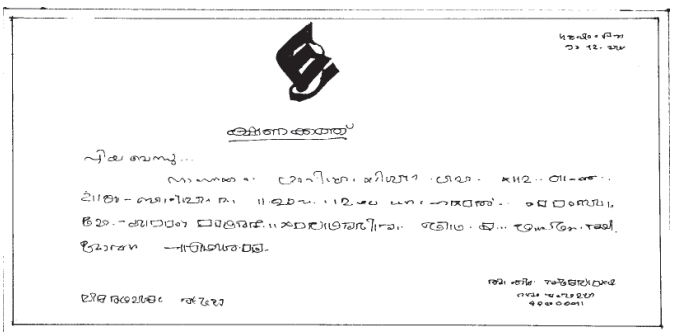
Now try these problems:

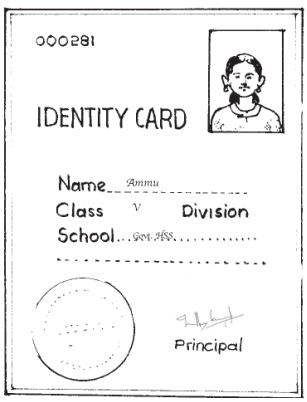
- Draw a line 6 centimetres long. From the left end point, draw an upright line, 3 centimetres high. From the right end point, draw an upright line, 4 centimetres high. Join the top ends of these lines.
- Draw a line 7 centimetres long and from each end point, draw upright lines, both 4 centimetres high. Draw a line joining the top ends of these lines. Measure its length.

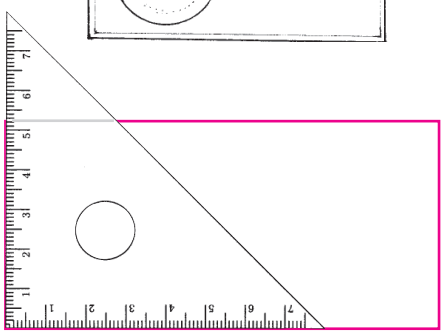
Look at the figure you got. Isn't it a rectangle? What are its length and breadths?

Here are some things of rectangular shape:









Measure the sides of some such objects.

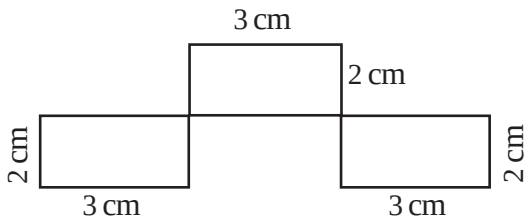
Opposite sides of a rectangle have the same of length, right?

What can we say about the corners?

A rectangle has square corners.

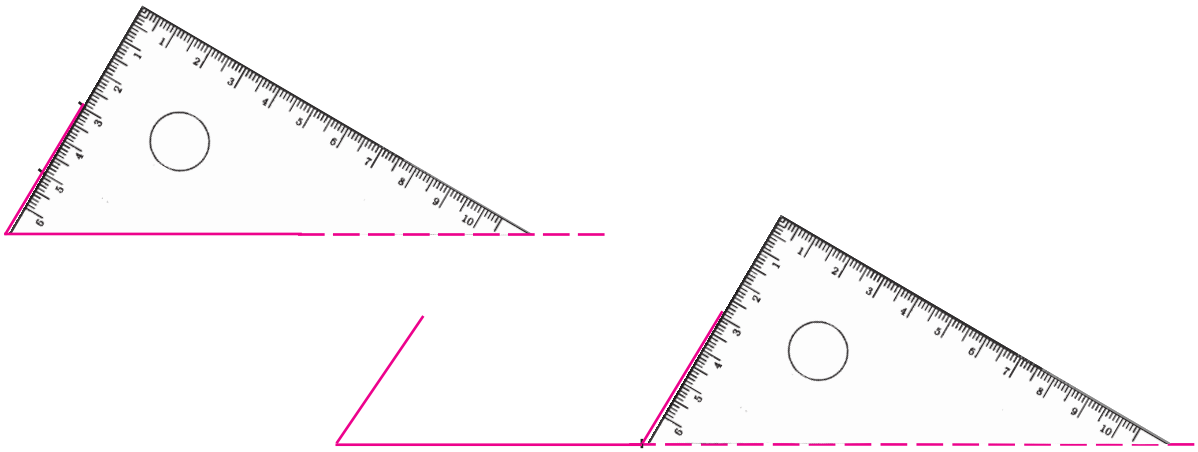
Let's draw rectangles!

- Draw a rectangle with nearby sides 6 and 5 centimetres long.
- Draw a rectangle with all sides 5 centimetre long
- The figure on the right is drawn using a ruler and a set square. Draw this figure in the same size.



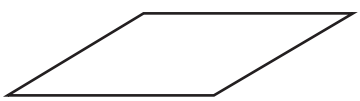
Tilting rectangle

Ammu draw some rectangles using a set square. Then she had a mischievous idea. Why not draw with another corner? This is how she drew:



And this is what she got:

Seeing this, Rahim used the third corner to draw a figure like this.

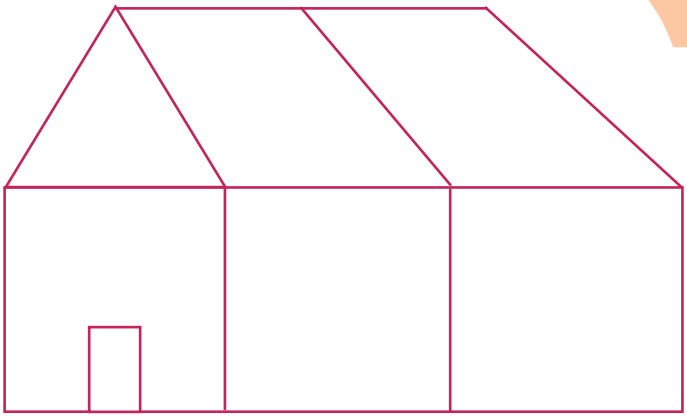


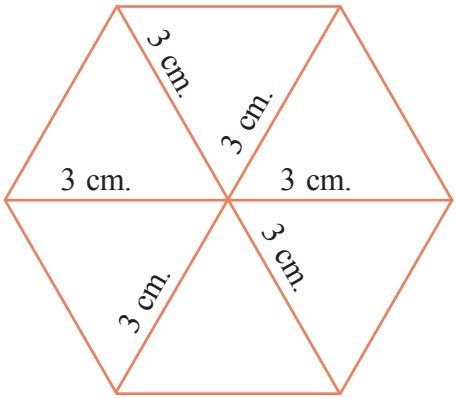
In both of these, the left and right lines are slanted.

Are the slants the same?

New shapes

- The picture on the right is drawn using various corners of a set square. Can you draw it in your notebook?





- Rahim put a dot on a paper and drew lines from it, using only one corner of a set square, to make this picture.

  How many sides does this figure have?

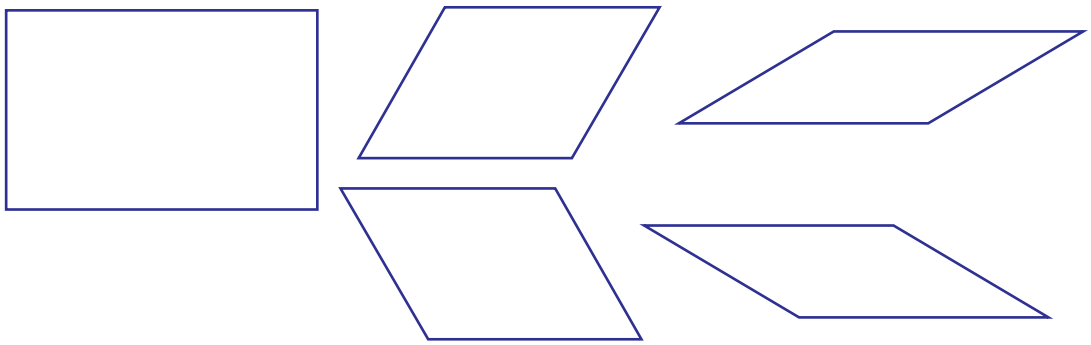
  Can you do this in your notebook?

- Using the other corners of a set square, draw similar figures around a point.

  How many sides does each of these figures have?

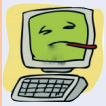
Upright and slanted

All these are drawn using different corners of a set square.



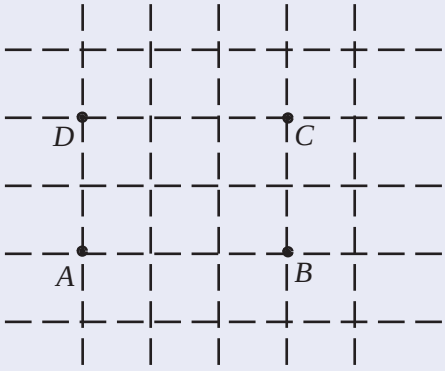
Measure the sides of each and write the lengths near them.

Note anything about the lengths of opposite sides?



Rectangles with computer

Let's see how we can draw a rectangle of specified lengths for sides using GeoGebra. For example, a rectangle of sides 3 and 2 centimetres.



Click **view** and select **Grid**. We get cross-cross lines as above. Click **New point** and mark the points A, B, C, D. With the **Polygon** tool, click on A, B, C, D in that order. We get a rectangle. The lengths of the sides can be displayed using the **Distance** tool. Clicking the **Move** tool and dragging the sides, we can change the lengths.

Word and meaning

The word "angle" comes from the Greek word "ankylos" meaning "bent" or "not straight." The joint between the foot and the leg is called "ankle" and comes from the same root.

Do all figures look the same?

What are the differences?

In the rectangle, the left and right sides are straight up.

In the other figures, they are slanted.

Do they have the same slant in all figures?

Every figure has four corners.

A corner is made where two sides meet.

In the language of math, we say

Two lines meeting at a point, form an angle.

So we can say that each of these figures has four angles; and the angles are different.

Look at the various angles in some of the letters:

V E F W X Z Y

These letters are made using only straight lines.

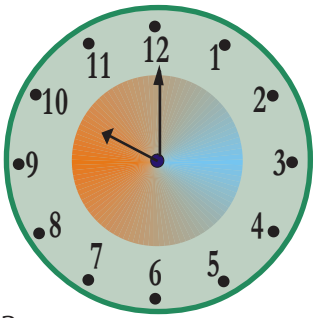
Can you find the others?

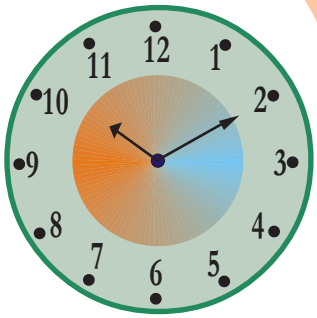
How many angles does each have?

You can see angles in classroom, home and outside.

Draw them in your notebook.

Spread and angle





Look at these pictures of clocks.

They show different times.

The hands of a clock make an angle.

Look at the gap between the hands in both clocks; are they the same?

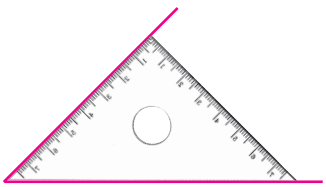
The hands of the second clock are spread more apart. That is the angle has increased a bit.

The second clock shows 10 : 10

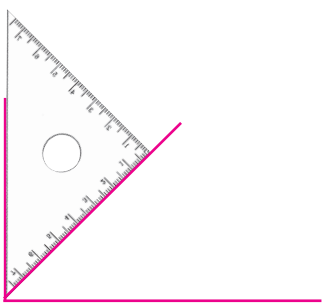
What happens when the time is 10 : 15?

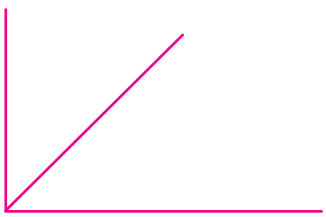
Joining angles

Look at this angle, drawn using a corner of a set square.



With the same corner again, draw another angle on the top like this.



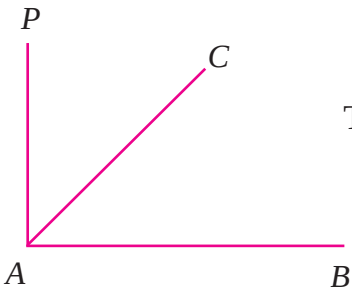


How many angles do we have now?

Two? Or Three?

Spreading angles

We can show the change in the spread of an angle using GeoGebra. Use the **Circle with Centre through Point** tool to draw a circle. The centre of the circle will be named A and a point on it B. Mark two other points C and D on the circle. Use the **Segment between Two Points** tool to join the points A and B . Now we hide the circle, point A and point B. For this, first right click on the circle and in the drop-down menu, unselect **Show Object**. In the same way, hide the points A and B. Now by dragging C or D, we can change the spread of the angles.



To talk about these three angles, let's give them names.

The first angle we draw can be called *CAB* or *BAC*; and the second one, *PAC* or *CAP*. We use the symbol $\angle$ to denote an angle. Thus the first angle can be written $\angle CAB$ (read "angle *C*, *A*, *B*").

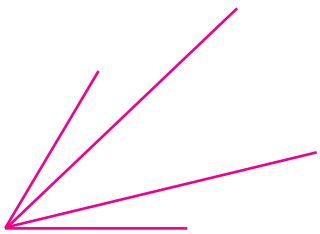
The second angle is $\angle PAC$.

What's the name of the third angle?

Which of these three is the largest?

And the smallest?

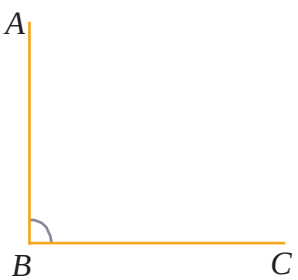
Two angles shown on the right are drawn using different corners of a set square.

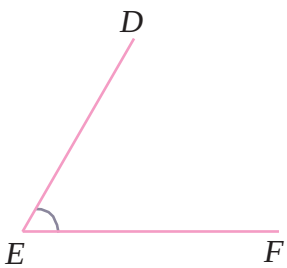


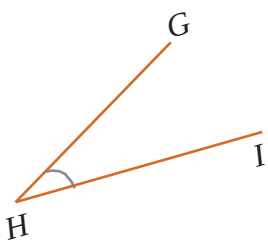
We can draw the first angle within the second.

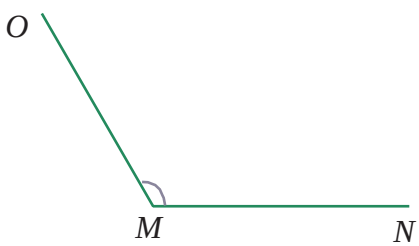
So, the first one is smaller than the second.

Some angles are shown below:









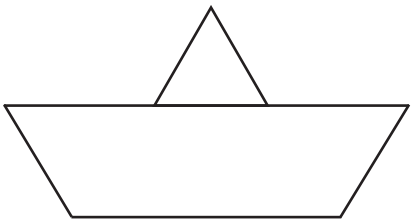
Which is the smallest among these?

And the largest?

Write the names of all these in order of their sizes.

Let's do it!

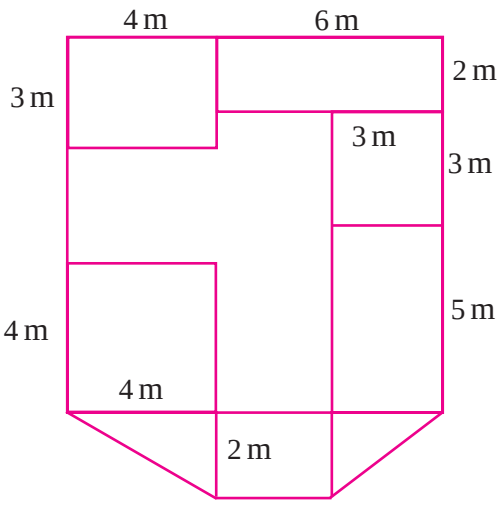
- How many angles are there in this picture?



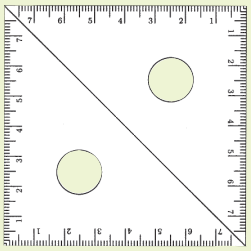
- The floor plan of a house is as shown on the right.

  2 metres in the actual floor is taken as 1 centimetre in this plan.

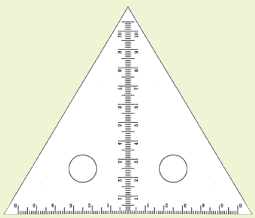
  Can you draw it in your notebook, taking 1 centimetre for 1 metre?



Set square fun



The picture shows two set squares of the same type put together. What is the speciality of this rectangle?



Two set squares of the other kind can be put together like this. What is the speciality of this triangle?

Try to make other shapes using set squares.