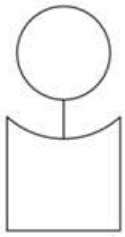
NCERT Solutions Class 6 Maths (Ganita Prakash)

Chapter 8 Playing with Constructions

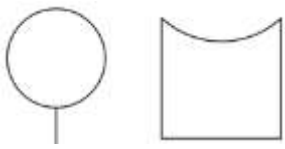
Artwork Construct (Page No. 190 – 191)

Question 1. A Person

Draw a figure in the given form to depict "A person". How will you draw this?



This figure has two components.



You might have figured out a way of drawing the first part. See this for drawing the second part.

The challenge here is to find out where to place the tip of the compass and the radius to be taken for drawing this curve. You can fix a radius in the compass and try placing the tip of the compass in different locations to see which point works for getting the curve. Use your estimate to determine where to keep the tip.

Solution: Step 1. We start with the base of the diagram. We take a line AB of length 4 cm as the base. (Fig. 1)

Fig. 1

Step 2. At A and B, draw perpendicular lines using a protractor. (Fig. 2)

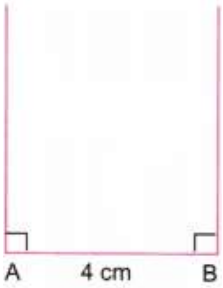


Fig. 2

Step 3. Using a ruler, mark points C and D such that AC = 4 cm and BD = 4 cm. Join C and D by a line. (Fig. 3)

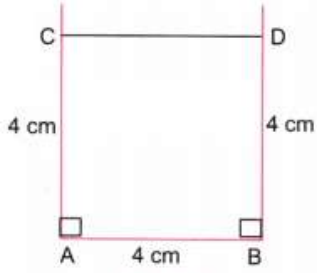


Fig. 3

Step 4. Using a ruler, take point M on the CD such that CM = 2 cm. M is the midpoint of CD. Using a protractor, draw a perpendicular to CD at M. Take a point P on this perpendicular such that PM = 2 cm. Distance PM can also be slightly less than or greater than 2 cm. (Fig. 4)

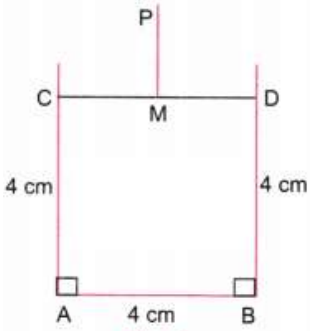


Fig. 4

Step 5. Join PD. With centre at P, draw an arc from D to C of a radius equal to PD. With centre at P, draw a circle of radius 1.5 cm. Extend PM to touch the arc. (Fig. 5)

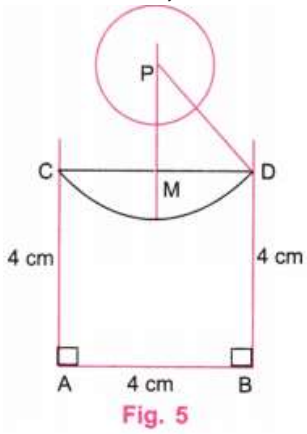


Fig. 5

Step 6. Erase the extra lines in Fig. 5 as in Fig. 6.

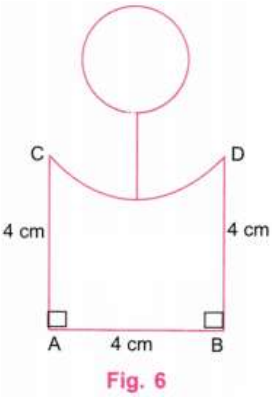


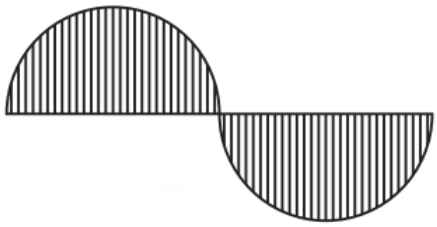
Fig. 6

Step 7. Fig. 6 represents the required depiction of the given “A person”.

Question 2. Wavy Wave

Construct this.

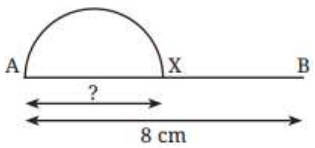
Draw a figure in the given form to depict a “Wavy Wave”, where the waves are half circles.



As the length of the central line is not specified, we can take it to be of any length.

Let us take AB to be the central line such that the length of AB is 8 cm. We write this as AB = 8 cm.

Here, the first wave is drawn as a half circle.



Solution: Step 1. We start with the central line AB of length 8 cm, say. (Fig. 1)

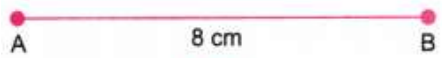


Fig. 1

Step 2. Since 8 ÷ 2 = 4, using a ruler, take point C on AB such that AC = 4 cm. C is the mid-point of AB.

Since 4 ÷ 2 = 2, using a ruler, take points D on AC and E bn CB such that AD = 2 cm and CE = 2 cm. D is the mid-point of AC and E is the mid-point of CB. (Fig. 2).

Fig. 2

Step 3. With centre at D, draw a semicircle above the line AB and of radius 2 cm. With the centre at E, draw a semicircle below the line AB and of radius 2 cm. (Fig. 3)

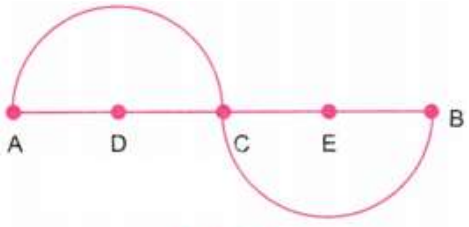


Fig. 3

Step 4. Draw vertical lines in the semicircles above and below the line AB. (Fig. 4)

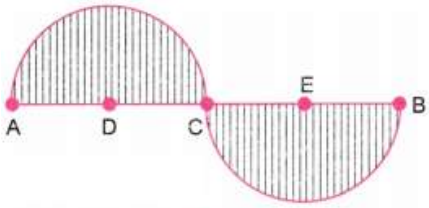
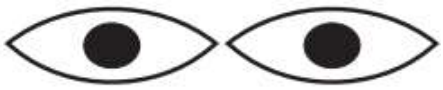


Fig. 4

Step 5. Fig. 4 represents the required depiction of the given “Wavy Wave”.

Question 3. Eyes
How do you draw these eyes with a compass?



Draw a figure in the given form to depict “Eyes”.

Solution: Step 1. Take a line AB of length 8.5 cm (4 cm + 0.5 cm + 4 cm) as a base. Take points C and D on AB such that AC = 4 cm and AD = 4.5 cm (4 cm + 0.5 cm). (Fig. 1)

Fig. 1

Step 2. Take points E and F on AB such that AE = 2 cm and FB = 2 cm. E is the mid-point of AC and F is the mid-point of DB. (Fig. 2)

Fig. 2

Step 3. Using a protractor, draw perpendiculars at E and F. (Fig. 3)

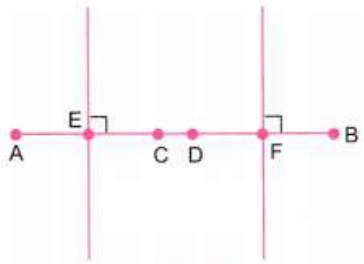


Fig. 3

Step 4. Using a ruler, take points G, H, I, and J such that EG, EH, FI, and FJ are all equal to 1.5 cm. Equal distances can also be slightly less than or greater than 1.5 cm (Fig. 4)

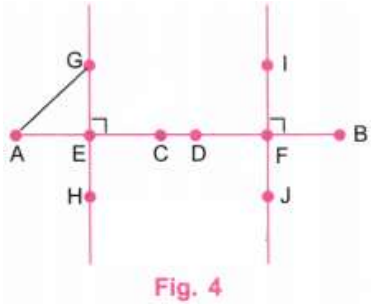


Fig. 4

Step 5. With the centre at G, draw an arc from A to C of a radius equal to AG. Similarly, with the centre at H, I, and J draw arcs of radius equal to AG. Erase the extra lines as shown in Fig. 5.

Fig. 5

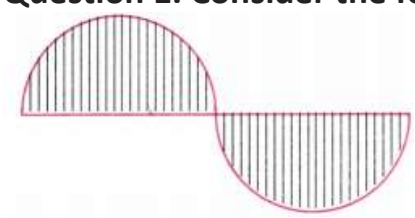
Step 6. At points E and F, draw two black dots of big size. (Fig. 6)


Fig. 6

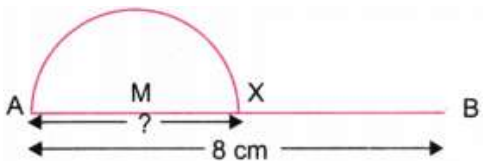
Step. 7. Figure represents the required depiction of “Eyes”.

Figure it Out (Page 191)

Question 1. Consider the following figure of a “Wave”.



As the length of the central line is not specified, we can take it to be of any length. Let us take AB to the central line such that the length of AB is 8 cm. Here the first wave is drawn as a half circle.



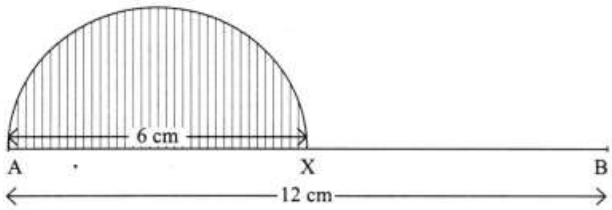
What radius should be taken in the compass to get this half-circle? What should be the length of AX?

Solution: We have AB = 8 cm.
Since the “Wavy Wave” has two equal half circles, we have AX = XB.
∴ X is the mid-point of AB.
∴ AX = 82 = 4 cm
∴ The length of AX is 4 cm.
Let M be the mid-point of AX.
∴ AM = MX = 82 = 2 cm

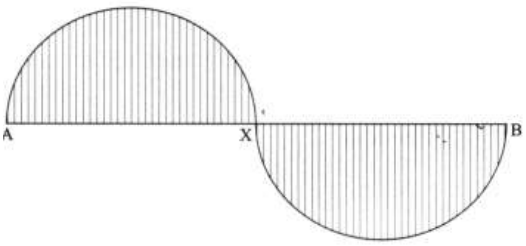
The center of the half circle is M.
∴ Radius of half circle = AM = 2 cm
∴ The radius of the half circle is 2 cm.

Question 2. Take a central line of a different length and try to draw the wave on it.

Solution: Let us take AB to be the central line such that the length of AB is 12 cm. That is, AB = 12 cm.
Now, the first wave is drawn as a half circle, using the diameter half of the central line AB, i.e., the radius half 6 of AX = 62 cm = 3 cm 2



Now, the second wave is drawn as the half circle with radius half of XB = 6 cm, i.e., of 3 cm in opposite direction to the first wave.



Question 3. Try to recreate the figure where the waves are smaller than a half circle (as appears in the neck of the figure 'A Person'). The challenge here is to get both the waves to be identical.

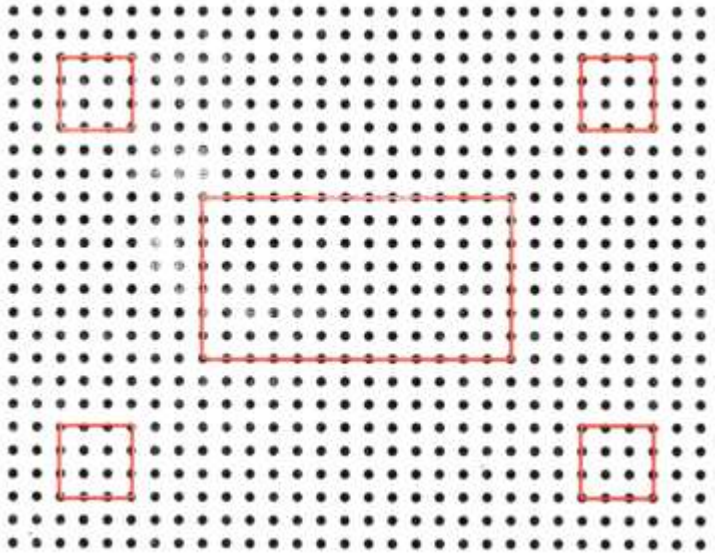
Solution: Do it yourself.

Figure it Out (Page 194)

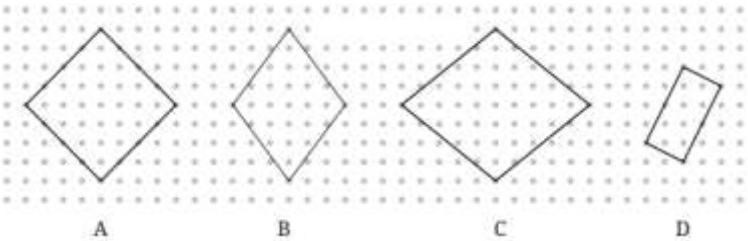
Question 1. Draw the rectangle and four squares configuration (shown in Fig. 8.3) on a dot paper. What did you do to recreate this figure so that the four squares are placed symmetrically around the rectangle? Discuss with your classmates.

Solution: Draw a rectangle using four dots and draw four squares to make sure all the

squares are equal in size and placed around the rectangle in symmetry.



Question 2. Identify if there are any squares in this collection. Use measurements if needed.



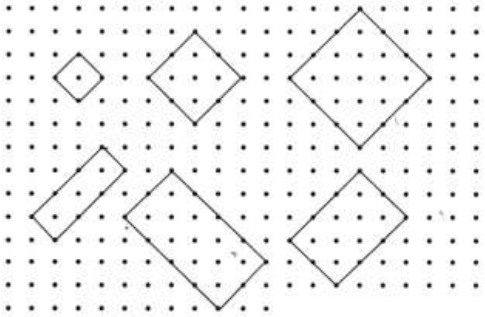
Think: Is it possible to reason out if the sides are equal or not, and if the angles are right or not without using any measuring instruments in the above figure? Can we do this by only looking at the position of corners in the dot grid?

Solution: Only A is a square

- All the sides are equal, and
- All the angles are 90°.

Question 3 Draw at least 3 rotated squares and rectangles on a dot grid. Draw them such that their comers are on the dots. Verify if the squares and rectangles that you have drawn satisfy their respective properties.

Solution:

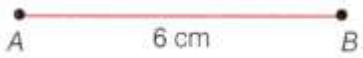


We can verify the properties of square and rectangles on the dot grid.
Check the length of the sides which align with the grid lines, by counting the number of dots between the comers or measure using a ruler. Further find the measure of each angle using a protractor and check whether it is 90°, i.e., the right angle or not.

Constructing Squares and Rectangles Construct (Pago 197)

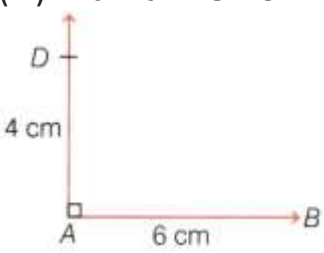
Question 1. Draw a rectangle with sides of length 4 cm and 6 cm. After drawing, check if it satisfies both the rectangle properties.

Solution: Rectangle with sides 4 cm and 6 cm.
Steps:
(i) Draw a,straight line AB = 6 cm using a ruler.

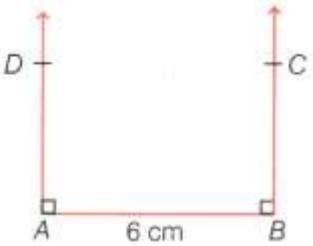


(ii) Place the protractor on point A and mark a 90° angle from AB.

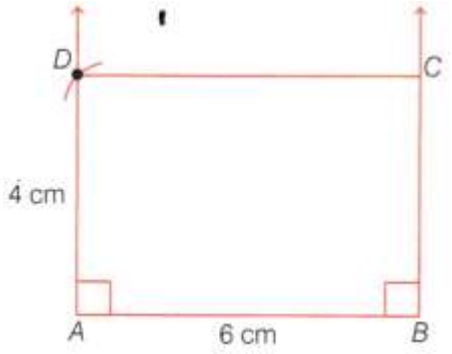
(iii) Draw a line from A along this angle and measure AD 4 cm.



(iv) Repeat the same process at point B to draw a line BC perpendicular to AB and also 4 cm long.



(v) Join points D and C to complete the rectangle ABCD.



(vi) Verify that AB and CD are equal as well as AD and BC and all angles are 90°.

Question 2. Draw a rectangle of sides 2 cm and 10 cm. After drawing, check if it satisfies both the rectangle properties.

Solution: The same solution of Question 1 only changes the length is 2 cm and 10 cm respectively.

Question 3. Is it possible to construct a 4-sided figure in which—
1. all the angles are equal to 90° but
2. opposite sides are not equal?

Solution:
No, it is not possible. When we draw a figure whose all angle is 90° it always forms a rectangle.

An Exploration in Rectangles Construct (Page 199)

Question 1. Breaking Rectangles
Construct a rectangle that can be divided into 3 identical squares.

Solution:
We shall draw a rectangle of the form shown in Fig. 1.

Fig. 1

Step 1. Let us keep the vertical side of the rectangle to 3 cm. Since the rectangle is to be

divided into three identical squares, the length of the rectangle must be 3 cm + 3 cm + 3 cm = 9 cm.

Step 2. Using a ruler, draw a line AB equal to 9 cm. (Fig. 2).

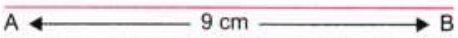


Fig. 2

Step 3. Using a ruler, find points P and Q on AB such that AP = 3 cm and PQ = 3 cm. Here, QB is also 3 cm. (Fig. 3).

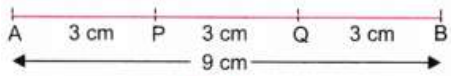


Fig. 3

Step 4. Using a protractor, draw perpendicular lines at A, P, Q, and B. (Fig. 4).

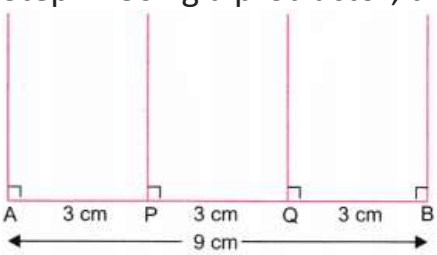


Fig. 4

Step 5. Using a ruler, mark points A', P', Q', and B' on perpendiculars at A, P, Q, and B respectively such that AA' = PP' = QQ' BR' = 3 cm. (Fig. 5).

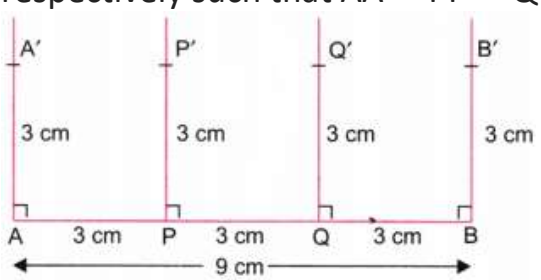


Fig. 5

Step 6. Join A' and P', P' and Q', and Q' and B' using a ruler. Erase the lines above A', P', Q', and B'. (Fig. 6).

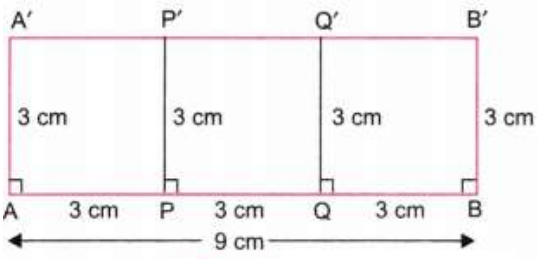


Fig. 6

Step 7. ABB'A' is the required rectangle which is divided into 3 identical squares APP'A', PQQ'P', and QBB'Q'.

Question 2. Give the lengths of the sides of a rectangle that cannot be divided into: (Page 201)
(i) Two identical squares
(ii) Three identical squares.

Solution: (i) Let the smaller side of a rectangle be x cm. If the larger side of the rectangle is 2x cm (x cm + x cm), then this rectangle can be divided into two identical squares of side x cm. (Fig. 1)

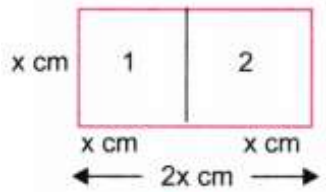


Fig. 1

Let us consider a rectangle of sides 4 cm and 6 cm. Here, 6 is not equal to 8 (4 + 4), so, it cannot be divided into two identical squares as shown in Fig. 2

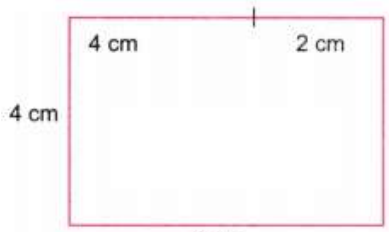


Fig. 2

(ii) Let the smaller side of a rectangle be x cm. If the larger side of the rectangle is 3x cm (x cm + x cm + x cm), then this rectangle can be divided into three identical squares of side x cm. (Fig. 3)

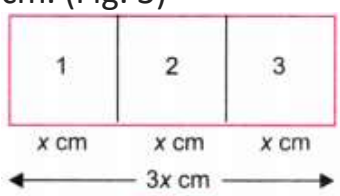


Fig. 3

Let us consider a rectangle of sides 3 cm and 8 cm. Here, 8 is not equal to 9 (3 + 3 + 3), so, it cannot be divided into three identical squares as shown in Fig. 4.

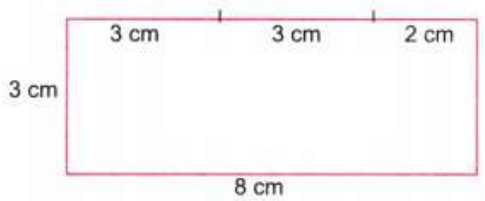
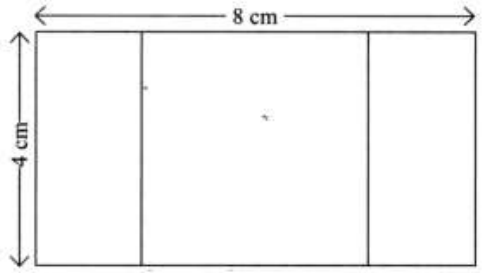


Fig. 4

An Exploration in Rectangles Construct (Page No. 201 – 203)

Question 1. A Square within a Rectangle.
Construct a rectangle of sides 8 cm and 4 cm. How will you construct a square inside, as shown in the figure, such that the centre of the square is the same as the centre of the

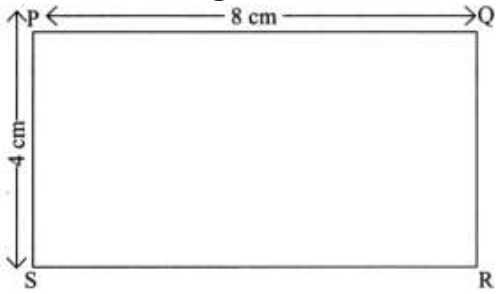
rectangle ?



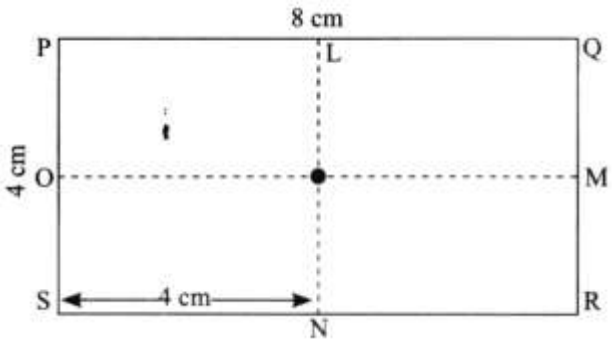
Hint: Draw a rough figure. What will be the sidelength of the square? What will be the distance between the comers of the square and the outer rectangle?

Solution:

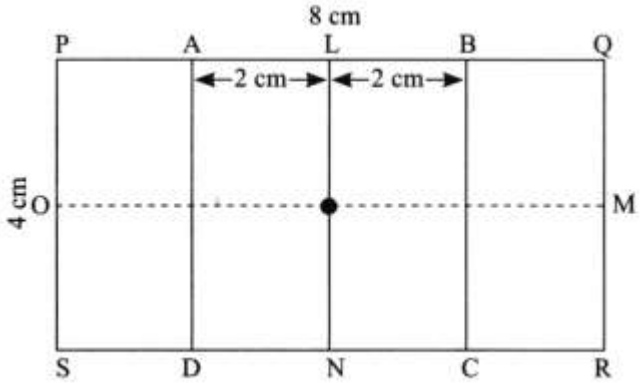
Draw a rectangle PQRS of sides 8 cm and 4 cm.



Next, draw lines LN and MO from the midpoints of opposite sides such that they intersect side PQ at L, QR at M, RS at N, and PS at O respectively.



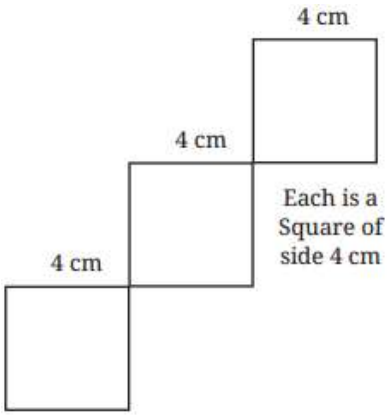
Since the centre of square and rectangle is same and the width of rectangle is 4 cm, so we draw a square of side 4 cm with the centre of rectangle and named as ABCD.



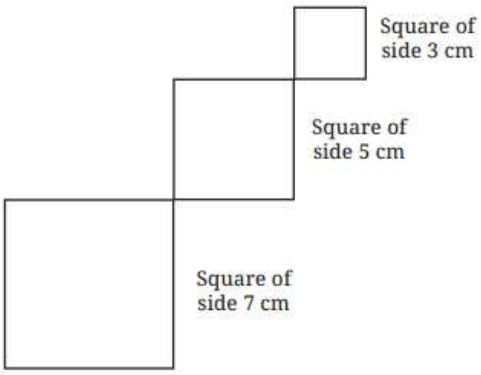
∴ The side length of the square is 4 cm and the distance between the comers of the square and the outer rectangle = PL – AL = 4 cm – 2 cm = 2 cm.

Question 2. Falling Squares.

Construct the 'Falling Squares" figure shown below:



Make sure that the squares are aligned the way they are shown. Now, try this.



Solution: In the given figure, there are three falling squares and the side of each square is 4 cm.

Step 1. Using a ruler, draw a line AB equal to 4 cm. Using a protractor, draw perpendicular lines at A and B.

Using a ruler, mark point C on a perpendicular line at A such that AC = 4 cm.

Using a ruler, mark points D and E on a perpendicular line at B such that BD = 4 cm and DE = 4 cm. (Fig. 1).

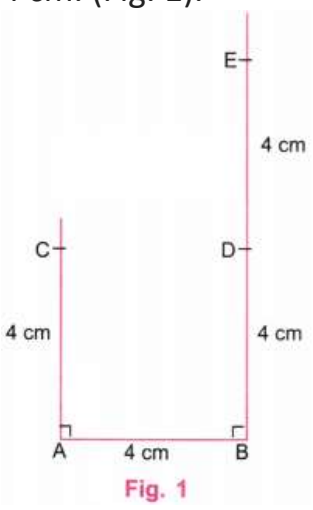


Fig. 1

Step 2. Join C and D. Produce CD to F such that DF = 4 cm. Using a protractor, draw a perpendicular line at F. Using a ruler, mark points G and H on a perpendicular line at F such that FG = 4 cm and GH = 4 cm. (Fig. 2).

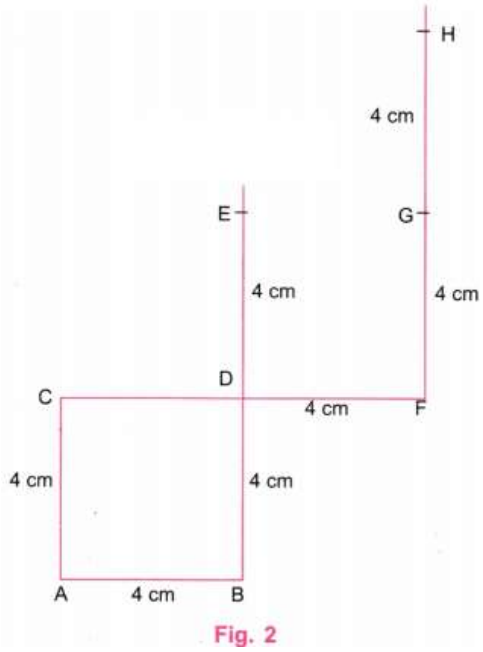


Fig. 2

Step 3. Join E and G. Produce EG to I such that GE = 4 cm. Using a protractor, draw a perpendicular line at I. Using a ruler, mark point J on the perpendicular line at I such that IJ = 4 cm. Join H and J. Erase extra lines in the figure. (Fig. 3).

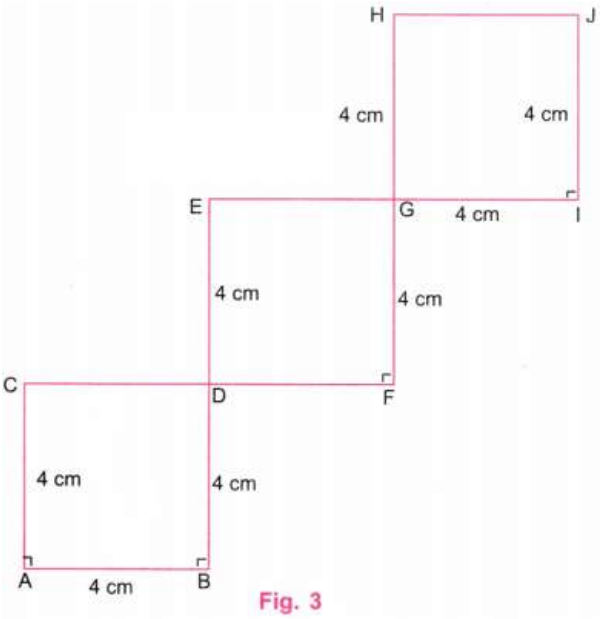
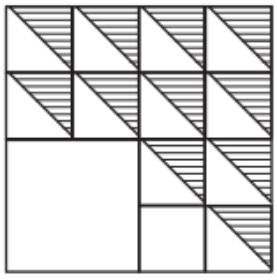


Fig. 3

Step 4. Fig. 3 is the required figure of three “falling squares” each of side 4 cm.

Question 3.Shadings

Construct the figure given below. Choose the measurement of your choice. Note that the larger 4-sided figure is square and so tire the smaller ones.



Solution: Step 1. Using a ruler, draw a line AB equal to 8 cm. Because, 8 ÷ 4 = 2, we shall draw smaller squares of side 2 cm. Using a protractor, draw perpendicular lines at A and B. Using a ruler, mark point P on the perpendicular line at A such that AP = 8 cm. Using a ruler, mark point Q on the perpendicular line at B such that BQ = 8 cm. Join P and Q using a ruler. Erase the lines above P and Q (Fig. 1).

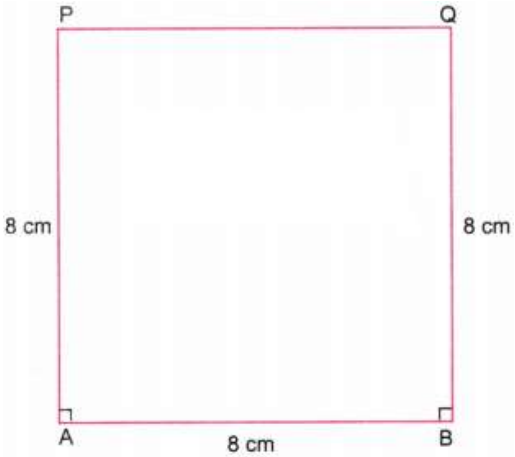


Fig. 1

Step 2. On the lines AB, BQ, QP, and PA, mark points at distances of 2 cm, using a ruler. Draw horizontal lines and vertical lines to get 16 squares. (Fig. 2)

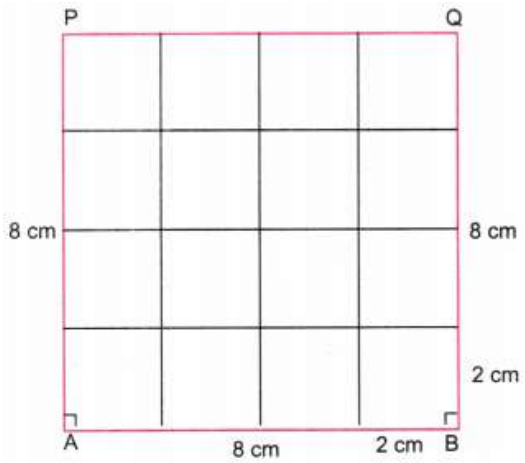


Fig. 2

Step 3. From comer A, erase the inner sides of four squares to get a square of side 4 cm with one comer at A. Draw parallel diagonals of the remaining 12 small squares of side 2 cm each. (Fig. 3)

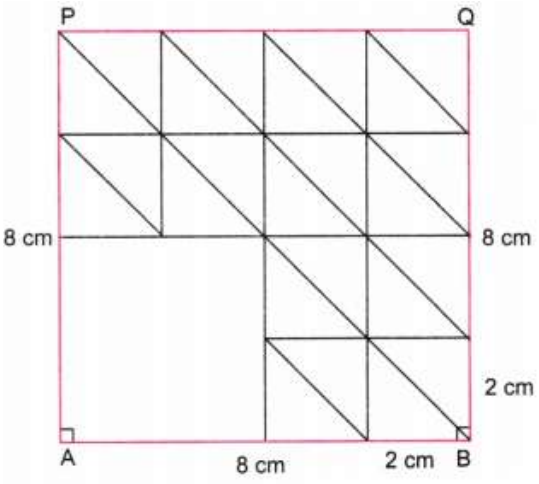


Fig. 3

Step 4. In the 12 small squares, draw horizontal lines in the portion above the diagonals. (Fig. 4)

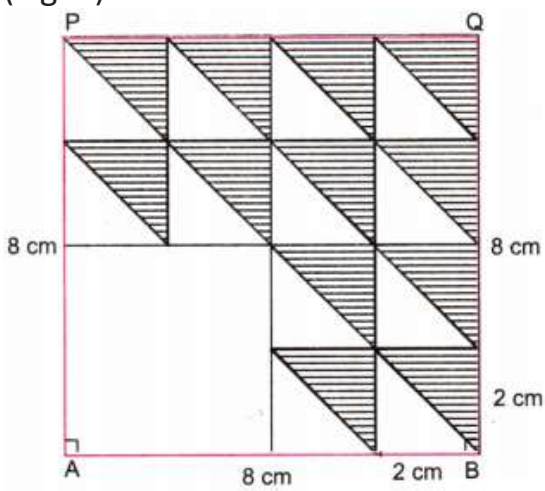
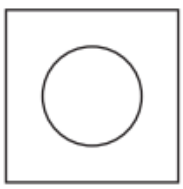


Fig. 4

Step 5. Fig. 4 is the required figure having 12 small squares in a square.

Question 4. Square with a Hole



Observe that the circular hole is the same as the centre of the square.
Construct a "Square with a Hole" as shown in the given figure. The centre of the hole is the same as the center of the square.
Hint: Think where the centre of the circle should be.

Solution: The centre of a square is the point of intersection of its diagonals. This centre is also the centre of the hole in the figure.

Step 1. Using a ruler, draw a line AB equal to 5 cm, say. Using a protractor, draw perpendicular lines at A and B. Using a ruler, mark point P on the perpendicular line at A such that AP = 5 cm. Using a ruler, mark point Q on the perpendicular line at B such that BQ = 5 cm. Join P and Q using a ruler. Erase the lines above P and Q (Fig. 1).

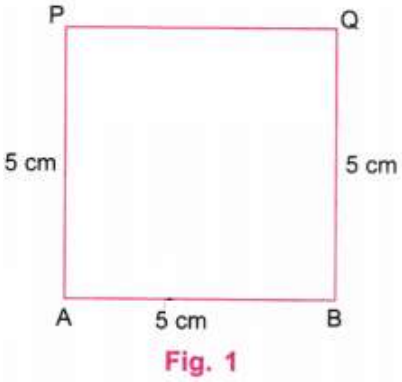


Fig. 1

Step 2. Draw diagonals AQ and BP using a ruler. Let the diagonals intersect at C. This point is the centre of the square ABQP. Erase the diagonals AQ and BP. (Fig. 2).

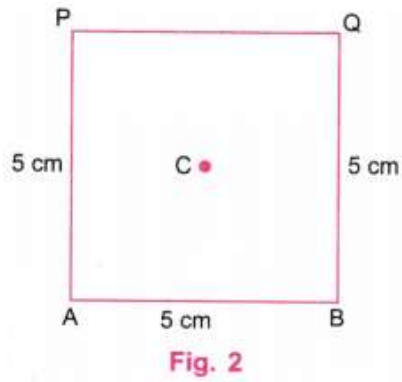


Fig. 2

Step 3. With centre at C and a radius of 1.5 cm, say, draw a circle using a compass. (Fig. 3)

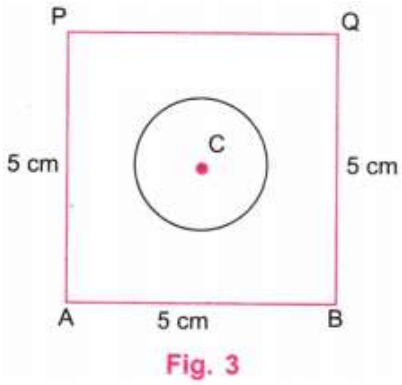
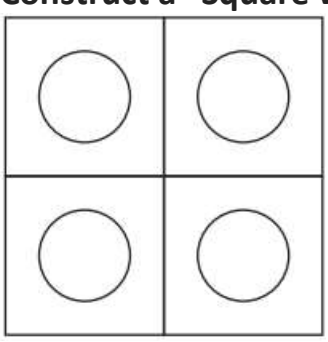


Fig. 3

Step 4. Fig. 3 is the required "Square with a Hole".

Question 5. Square with more Holes

Construct a "Square with Four Holes" as shown in the given figure.



Solution: In the figure, the centre of a circle is the same as that of the corresponding square.

Step 1. Using a ruler, draw a line AB equal to 8 cm, say. Using a protractor, draw perpendicular lines at A and B. Using a ruler, mark point P on the perpendicular line at A such that AP = 8 cm. Using a ruler, mark point Q on the perpendicular line at B such that BQ = 8 cm. Join P and Q using a ruler. Erase the lines above P and Q. (Fig. 1)

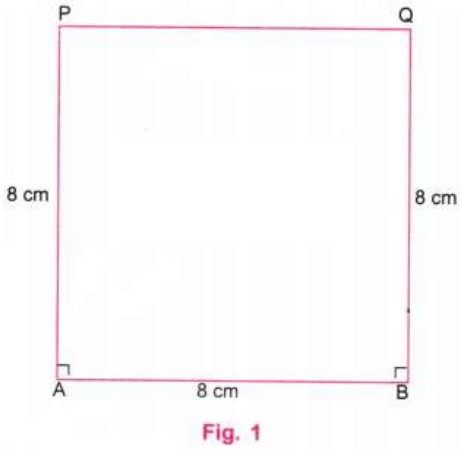


Fig. 1

Step 2. Using a ruler, find points C, D, E, and F such that AC = 4 cm, BD = 4 cm, QE = 4 cm, and PF = 4 cm. Join C and E and also F and D. (Fig. 2)

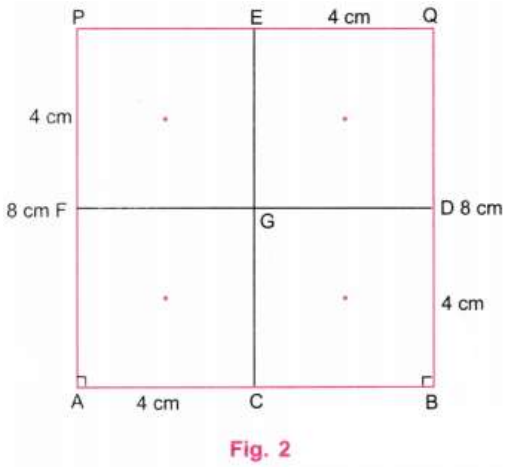


Fig. 2

Step 3. Let G be the intersection of lines FD and CE. Find the centres of squares ACGF, CBDG, DQEG, and GEPF by joining their respective diagonals. (Fig. 3)

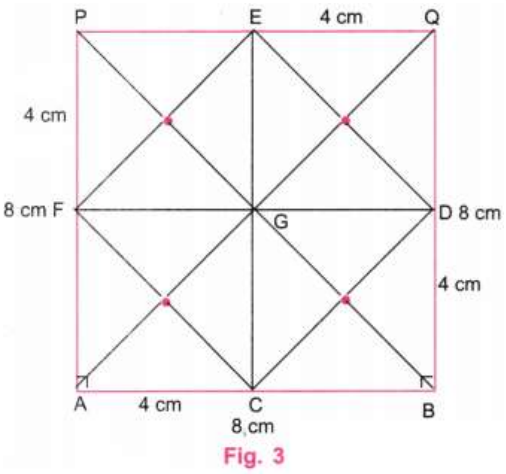


Fig. 3

Step 4. Erase the extra lines used for finding the centres of the smaller circles. With centre at centres of small squares, draw four circles of radius 1.3 cm, say. (Fig. 4)

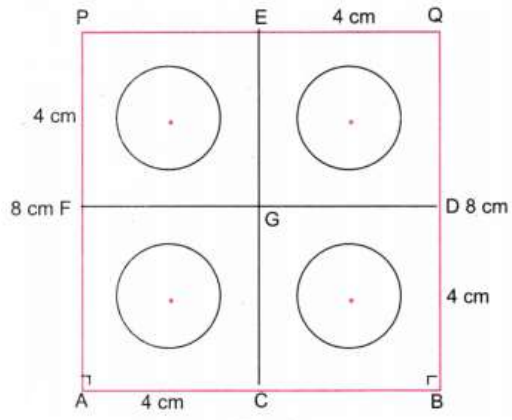
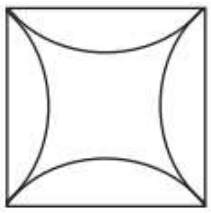


Fig. 4

Step 5. Fig. 4 is the required "'Square with Four Holes".

Question 6. Square with Curves
This is a square with 8 cm sidelengths.



Construct a "Square with Curves ", taking a square of side 8 cm as shown in the figure.
Hint: Think where the tip of the compass can be placed to get all 4 arcs to bulge uniformly from each of the sides. Try it out!

Solution: In the given figure, the centres of the four arcs are outside the square.

Step 1. Using a ruler, draw a line AB equal to 8 cm. Using a protractor, draw perpendicular lines at A and B. Using a ruler, mark point P on the perpendicular line at A such that AP = 8 cm. Using a ruler, mark point Q on the perpendicular line at B such that BQ = 8 cm. Join P and Q using a ruler. Erase the lines above P and Q. (Fig. 1)

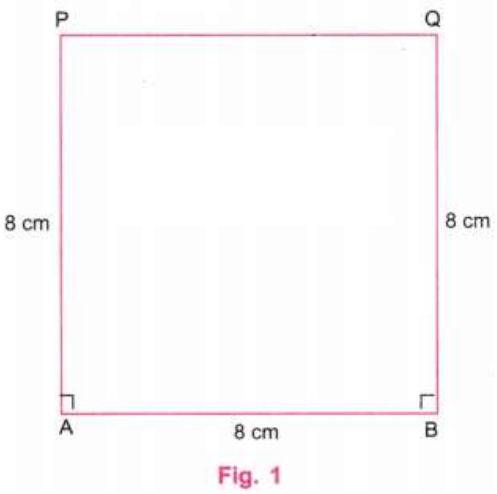


Fig. 1

Step 2. Using a ruler, mark points C, D, E, and F such that AC = 4 cm, BD = 4 cm, QE = 4 cm, and PF = 4 cm. Join C and E and also D and F. Extend these lines outside the square. (Fig. 2)

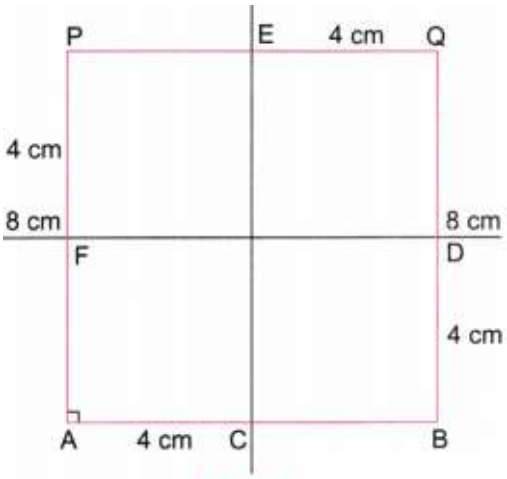


Fig. 2

Step 3. Extend DF and take points G and H on it so that DG and FH are equal to 4 cm. Extend CE and take points I and J on it so that Cl and EJ are equal to 4 cm. The distance 4 cm can be taken slightly less than or greater than 4 cm. Join B and G. (Fig. 3)

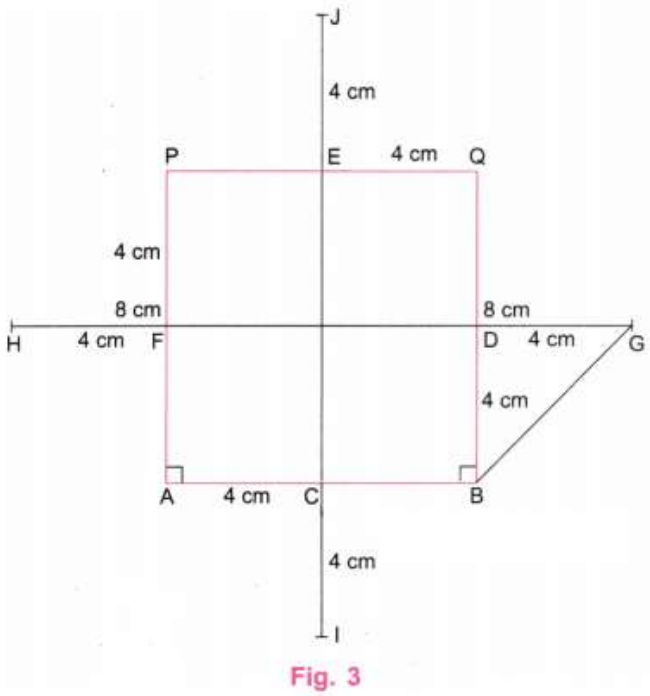


Fig. 3

Step 4. With centres at G, H, I, and J and a radius equal to BG, draw four arcs inside the square as shown in the given figure. Erase the extra lines. (Fig. 4).

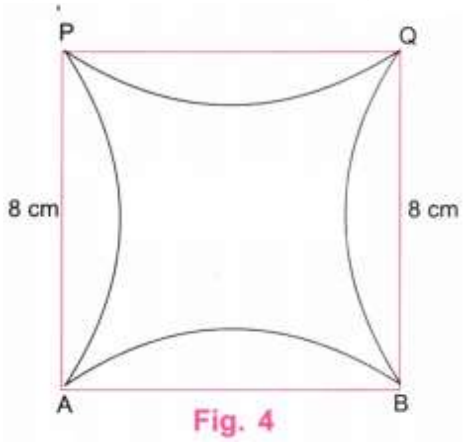


Fig. 4

Step 5. Fig. 4 is the required “Square with Curves” with the square of side 8 cm.

Exploring Diagonals of Rectangles and Squares Construct (Page No. 211)

Question 1. Construct a rectangle in which one of the diagonals divides the opposite angles into 50° and 40°.

Solution: We shall draw a rectangle of the form shown in Fig. 1.

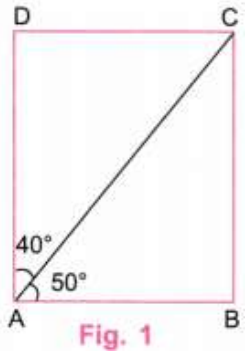


Fig. 1

Step 1. Using a ruler, draw a line AB equal to 4 cm, say. (Fig. 2.)

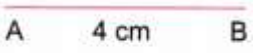


Fig. 2

Step 2. Using a protractor, mark dots C and D at angles 50° and 90° (50° + 40°), keeping the central point of the protractor at A. (Fig. 3)

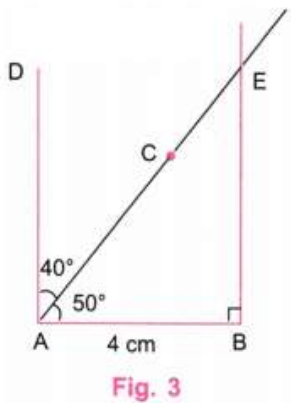


Fig. 3

Step 3. Using a protractor, draw a perpendicular line to AB at B and let it intersect the extended line AC at E. (Fig 3)

Step 4. Using a protractor, draw a perpendicular line to BE at E and let it intersect the extended line AD at F. (Fig 4)

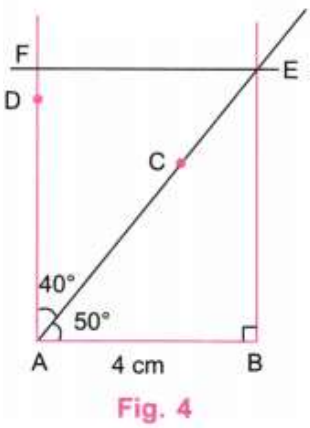


Fig. 4

Step 5. Erase the extra lines in Fig. 4. (Fig. 5)

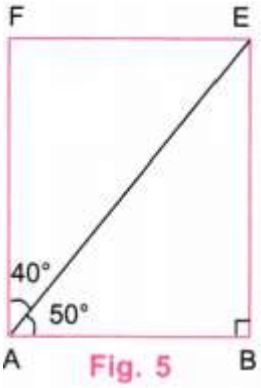


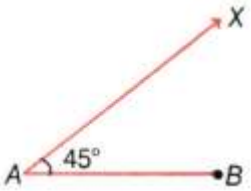
Fig. 5

Step 6. Fig. 5 is the required rectangle in which one of the diagonals divides the opposite angles into 50° and 40°.

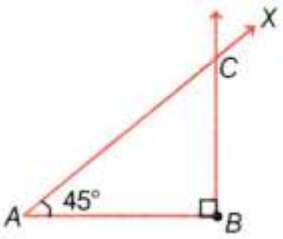
Question 2. Construct a rectangle in which one of the diagonals divides the opposite angles into 45° and 45°. What do you observe about the sides?

Solution: Draw a horizontal line segment AB. This will be one side of the rectangle.

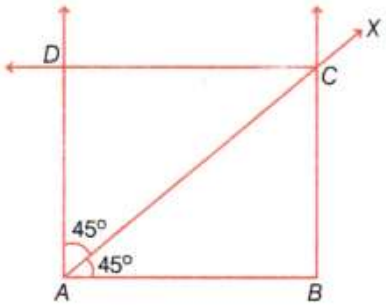
(i) At point A, use a protractor to measure and draw AX a 45° angle.



(ii) At point B, measure and draw a 90° angle. Draw a line segment BC extending from B at this angle meeting AX at C.



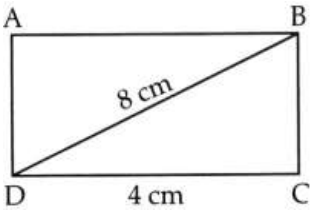
(iii) At Point A and C, Draw a 90° angle which meets at the point D.



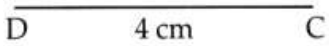
ABCD is the required rectangle. Here, diagonal AC divides the opposite angles A and C into 45° and 45°.
Observation You will notice that when the diagonals divide the opposite angles into 45° and 45°, so the sides of the rectangle will be equal, forming a square.

Question 3. Construct a rectangle one of whose sides is 4 cm and the diagonal is of length 8 cm.

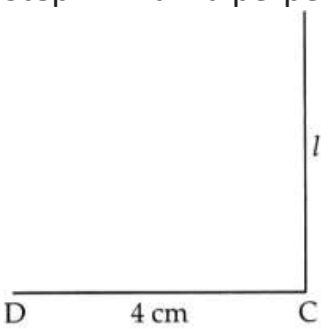
Solution: First, draw a rough diagram



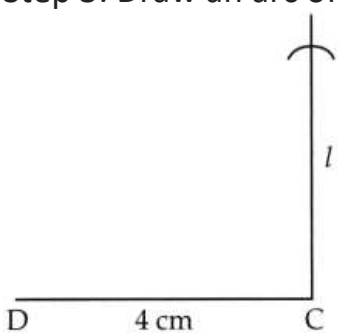
Step 1: The base CD measuring length 4 cm can be easily constructed.



Step 2: Draw a perpendicular to line DC at the point C. Let us call this line l.

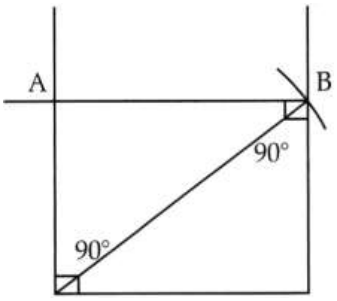


Step 3: Draw an arc of radius 8 cm with point D as the center.



To locate the point B,

Step 4: Draw perpendiculars to DC and BC passing through D and B, respectively. The point where these lines intersect is the fourth point A.



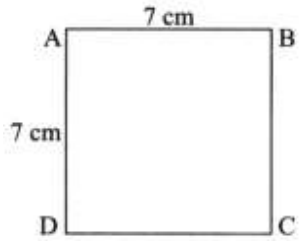
It satisfies all conditions of the rectangle.

Question 4. Construct a rectangle one of whose sides is 3 cm and the diagonal is of length 7 cm.
Solution: Do yourself.

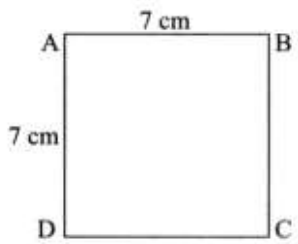
Points Equidistant from Two Given Points Construct (Page No. 215)

Question 1. Construct a bigger house in which all the sides are of length 7 cm.
Solution:

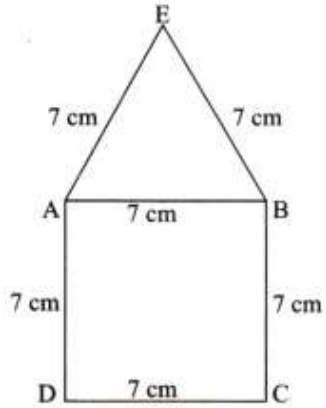
First draw a square of side 7 cm, named as ABCD.



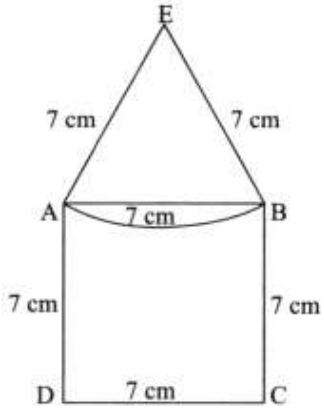
Now, using a compass draw arcs above the side AB of radius 7 cm from points A and B. Let the arcs intersect at point E.



Joint A to E and B to E by straight lines



Now, take 7 cm radius in the compass and from E, draw the arc touching A and B as shown in the figure.

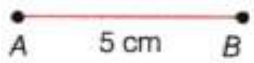


Question 2. Try to recreate 'A Person', 'Wavy Wave', and 'Eyes' from the section Artwork, using ideas involved in the 'House' construction.
Solution: Do yourself.

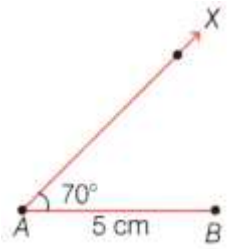
Question 3. Is there a 4-sided figure in which all the sides are equal in length but is not a square? if such a figure exists, can you construct it?

Solution: Yes, there is a 4-sided figure where all sides are equal in length but is not a square. This figure is known as a rhombus.
Steps:

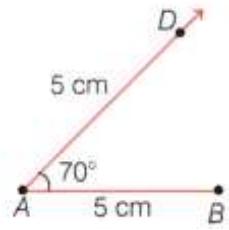
(i) Draw a line segment AB of any length.
Let it will be 5 cm.



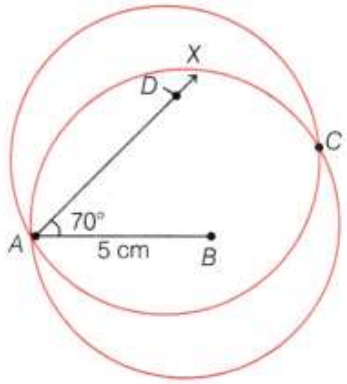
(ii) Draw any angle less than 90° at point A. Let will be 70°.



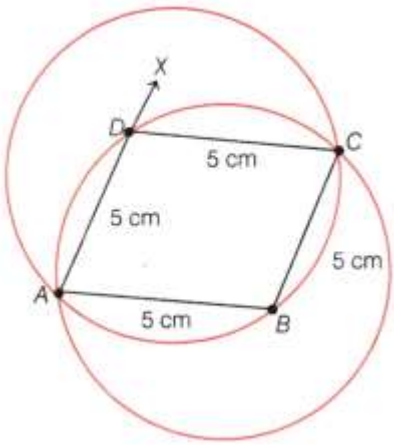
(iii) Mark the point D using ruler of length 5 cm and ray AX.



(iv) Now, draw two circles of radius 5 cm at point D and B and they will intersect at point C.



(v) Join BC and DC.



ABCD is required 4-sided figure.