THIS IS THE WAY TO MAKE GRAPHS

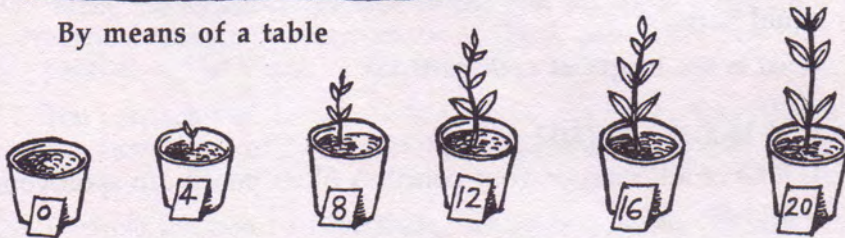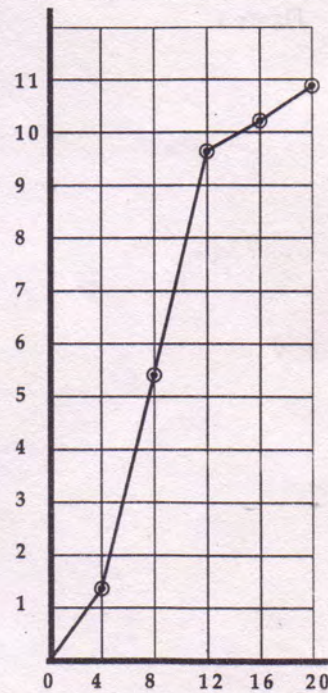| Day	Length of plant (cm)
0	0.0
4	1.4
8	5.4
12	9.6
16	10.2
20	10.9

By means of a table

Sunita planted a tree. In the first four days it grew 1.4 cm. After that it grew faster, becoming more than 9 cm long in 12 days. But then its rate of growth slowed down.

In words

By means of a picture

By means of a graph

There are many ways of giving information - in words, through a picture, with the help of a table, etc. As an example, some ways of depicting the growth of a plant (the increase in its length) are shown in the illustration above. One such way is through a graph. A graph is a good way to present information in a simple and easy-to-understand manner.

We shall learn to make and read graphs in this chapter.

Exercise 1

Through a graph

Huma drew a 1 cm x 1 cm square. She then drew squares with sides 2 cm, 3 cm, 4 cm and 5 cm long.

She decided to measure the perimeter of these squares. Do you remember how you measured the perimeter in the chapter "Area"?

Huma measured the perimeter of her squares and noted the measurements in a table.
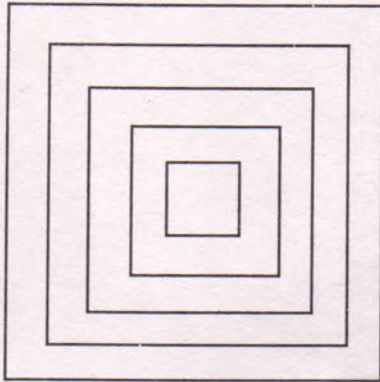

Figure 1

Table 1

No	Length of side of square (cm)	Perimeter of square (cm)
1.	1	4
2.	2	8
3.	3	12
4.	4	16
5.	5	20

On studying the figures in her table, Huma concluded that the perimeter of a square increases when the length of its side increases. But she wondered whether the perimeter increased randomly or according to some rule. She decided to find out. Using the figures in Table 1, she plotted a graph to try and understand the relationship between the length of the side of a square and its perimeter.

Let us plot the same graph. Take a graph paper from the kit copy in your workbook. The thick lines form 1 cm x 1 cm squares. The sides of these squares have been further divided into ten equal parts.

What is the length of each part? (1)

How to make a graph

1. First of all, sharpen your pencil. A blunt pencil can spoil your graph.

2. Use a scale to draw the lines of your graph. To begin with you have to make two lines - one horizontal and one vertical. Leave a gap of 1 cm from the bottom of the graph paper and draw your horizontal line. Similarly, leave a gap of 1 cm from the left edge of the graph paper and draw your vertical line. Both lines should be drawn on the thick lines of the graph paper (Figure 2). The horizontal line is called the X axis and the vertical line is the Y axis. If you remember, you drew the X and Y axis in the chapter "Learning How to Make Maps".
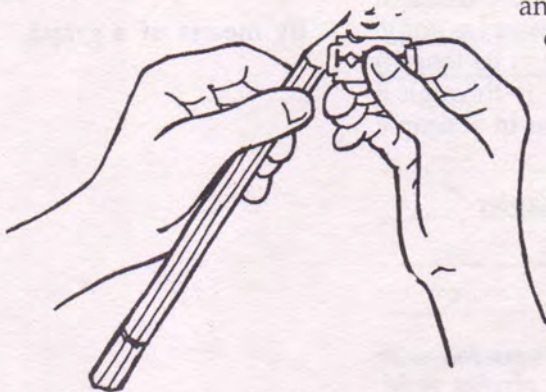
The point where both these lines meet is called the origin. You should always mark the origin at the lower left hand corner of your graph paper.

3. The next step is to identify the two measurements you will use to make your graph. What we wish to see is how the perimeter of a square changes when the length of its side changes.

4. You can give the length of the side of the square in centimetres on the X axis. So write "Length of side of square (cm)" below the X axis.

5. Similarly, you can show the perimeter of the square on the Y axis. So write "Perimeter of square (cm)" in the margin of the Y axis. The Y axis should be at least 20 cm long for this graph.

6. Mark the origin as 0. Mark 1 cm divisions on the X axis, beginning from the origin, and number them 1, 2, 3, 4, 5 and so on.

7. We have to show the perimeter of the square on the Y axis. Look at the perimeter figures in Table 1. The largest square has a perimeter of 20 cm. So divide the Y axis into twenty 1 cm divisions, beginning from the origin, and number them 1 to 20.

You are now ready to mark the entries in your table on your graph paper. Each square has two numbers, one for the length of its side and the other for its perimeter. The two numbers together give you a point on the graph. Since you have five squares, you will have five points on your graph. You get your graph line by joining these five points with straight lines.

Points of a graph

Table 1 shows that the square with a side of 1 cm length has a perimeter of 4 cm. How do these two numbers get you a single point on the graph?

1. Since the length of the side of the first square is 1 cm, draw a vertical line at the 1-cm mark of the X axis. This line will be parallel to the Y axis.

2. The perimeter of the square is 4 cm. So draw a horizontal line at the 4-cm mark of the Y axis. This line will be parallel to the X axis.

3. Encircle the point where these two lines intersect. This is your first graph point of your first square.

Now, mark the graph point for the second square. What are the two numbers for this square? Find them in Table 1. The table shows the length of the side of the second square is 2 cm and its perimeter is 8 cm. Now, repeat the same three steps:

> 1. Draw a vertical line on the X axis at the 2-cm mark, parallel to the Y axis.
>
> 2. Draw a horizontal line on the Y axis at the 8-cm mark, parallel to the X axis.
>
> 3. Encirle the point where these two lines intersect.

In the same way, draw the graph points for the three remaining squares.

Joining the points to get the graph line

You now have five points on your graph paper. What will the line joining them look like? Will it be a straight line? If you think it is a
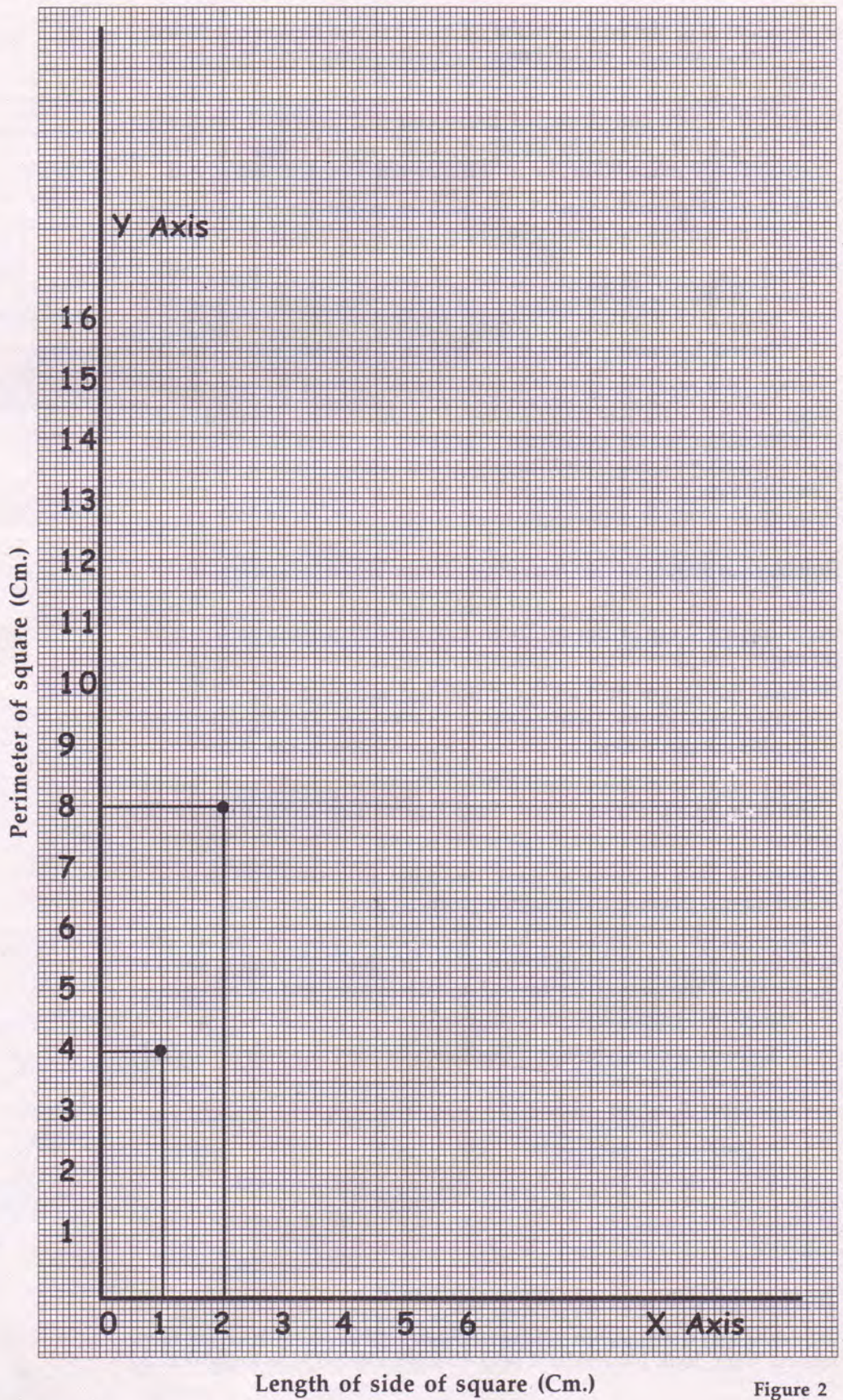
Figure 2

Length of side of square (Cm.)

Perimeter of square (Cm.)

straight line, use your ruler to join the points. But keep a few things in mind while doing so.

Place the ruler on the graph paper in such a way that as many points lie as near to it as possible. Shift or rotate the ruler to find the best position. Draw a straight line in this position. This is your graph line (Figure 3).

If your graph line is not straight, you may have made a mistake in charting the points. Try and identify your mistake and rectify it.

More information from a straight line graph

The graph of the length of the side of a square and its perimeter is always a straight line. A straight line can give you a lot of additional information. Let's see how.

You made your graph with the data of five squares. If your graph is correct and neatly drawn, it can give you information about more squares as well. This is possible because every point on the straight line carries information about other squares. Every point describes the standard relationship between the length of the side of a square and its perimeter. For example, what will the perimeter of a square be, with a 4.5-cm-long side? This figure is not given in your table but you can find out from your graph.

Which is the axis for the length of the side of a square in your graph? Draw a vertical line on the X axis at the 4.5-cm mark. Ensure that this line is parallel to the Y axis. Mark the point where this line intersects the graph line as A (Figure 3). This point A has the information that you are looking for. It will tell you the perimeter of a square with a 4.5cm-long side. Can you guess how?

Draw a vertical line parallel to the X axis from point A to the Y axis. Where does this line cut the Y axis? Take the reading of this point and find its actual value from the scale for the Y axis. This is the perimeter of the square with a 4.5-cm long side.

Extending a straight line graph

Suppose you want to find the perimeter of a square with a 6-cm long side. Can you find the answer from your graph? To do this, extend your graph line with the help of a scale.

Now find the perimeter of a square with a 6-cm long side. (2)

Extend the graph line downwards to the origin.

Does the line pass through the origin? (3)

Can the origin be a point of this graph line? (4)

What will be the length of the side of the square at the origin? (5)

What will be the perimeter of a square with a side 0 cm long? (6)

At which point on the graph paper will you show a square with a side and perimeter of 0 cm? (7)

Y Axis

Perimeter of square (Cm.)

X Axis

Length of side of square (Cm.)

Figure 3
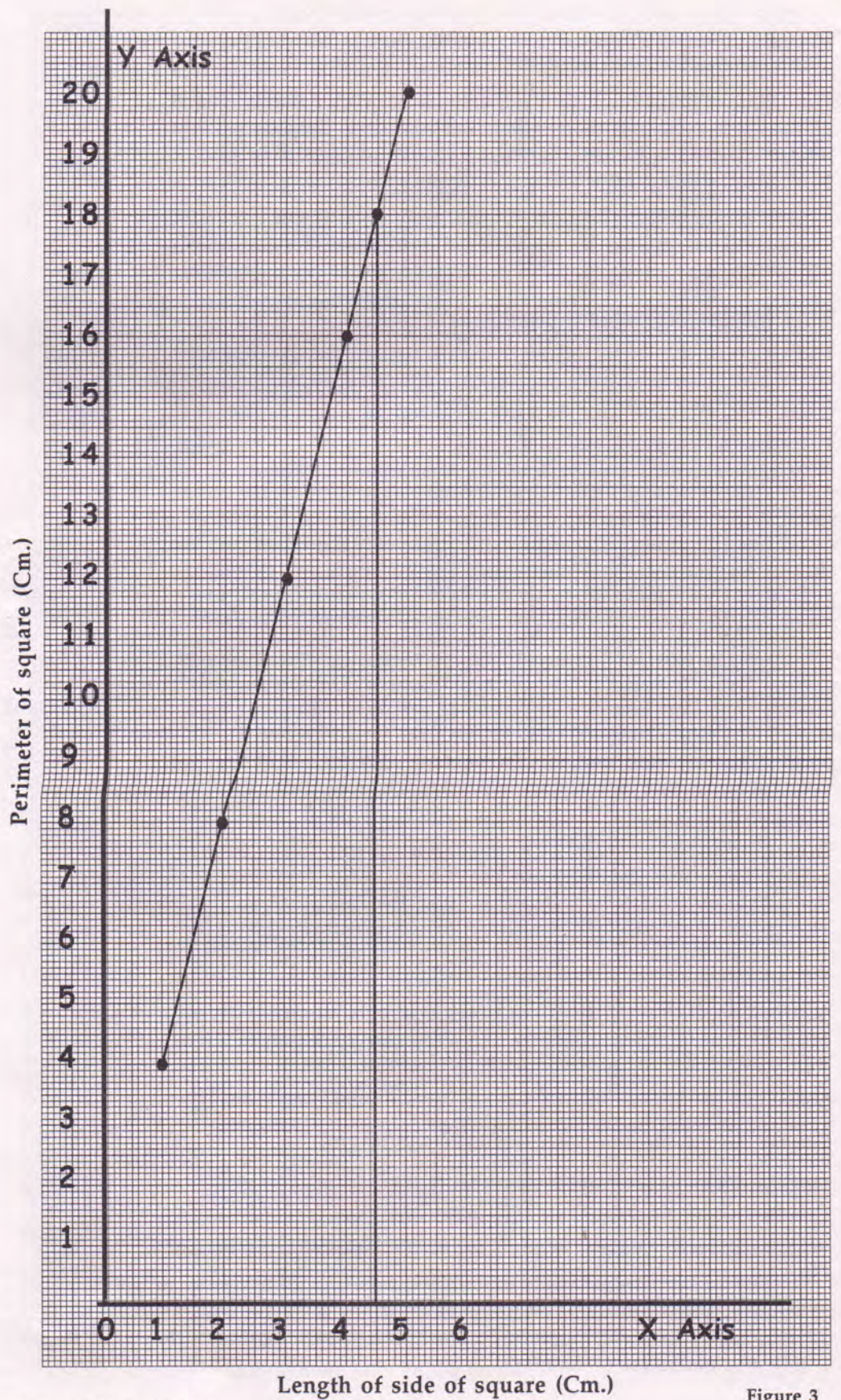
Exercise 2
Relationship between the side of a square and its diagonal:
Make a square with a 1 cm side on the square-lined paper in your kit copy. Measure its diagonal with a scale.

In the same way, make squares with sides 2, 3, 4 and 5 cm long. Measure their diagonals and note them in Table 2. (8)

Table 2

Length of side of square (cm)	Diagonal of square (cm)
1.0	
2.0	
3.0	
4.0	
5.0	
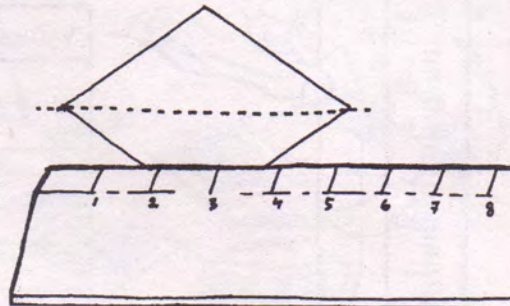
Now draw a graph with these figures. Take care to follow all the necessary steps while drawing the graph. (9)

How to choose the axis
What will you show on the X axis? Keep in mind a simple rule to decide this.

You should show the measurement that changes, and causes a change in the other measurement, on the X axis.

In this exercise, you change the length of the side of a square to see what difference it makes to the length of its diagonal. So, you should show the length of the side on the X axis and the length of the diagonal on the Y axis.

Look at your graph and answer the following questions:

What is the length of the diagonal of a square with a 3.5-cm long side? (10)

If a square has a 6-cm long diagonal, what is the length of its side? (11)

Extend the straight line of your graph at both ends and answer the following questions:

If the side of a square is 7.5 cm long, what is the length of its diagonal? (12)

If the diagonal of a square is 1 cm long, how long is its side? (13)

**Will this graph pass through the origin? (14)**

Experiment 1
How much water?
Take a measuring cylinder from your kit. If you have studied

the chapter "Volume" you will know that a measuring cylinder is used to measure the volume of liquids.

In this experiment you should fill the measuring cylinder with water, pouring a little at a time and noting the volume of water and the height of the water column each time you add water. You should then plot a graph with these figures.

First, make the following table in your exercise book.
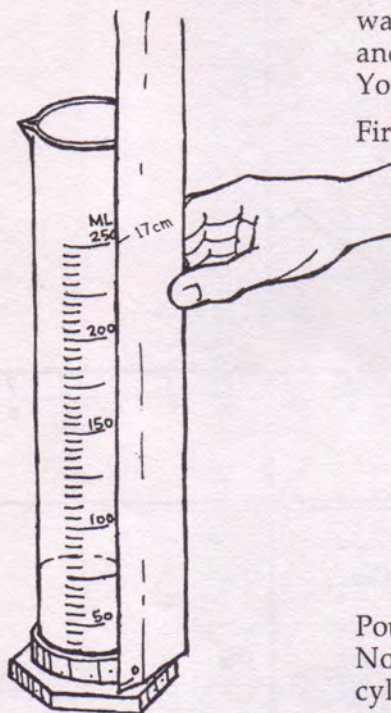
Table 3

Volume of water (ml)	Height of water column (cm)
25	
50	
75	
...	
...	
...	
250	

Pour water to the 25 ml mark in your 250 ml measuring cylinder. Note the height of the column of water from the base of the cylinder.

Keep adding 25 ml water to the cylinder and measure the height of the water column each time. Repeat this process until the measuring cylinder is filled with water.

Let's make a graph

You must now plot a graph of the volume of water and its column height from the measurements in Table 3.

What measurement will you show on the X axis and why? (15)

What measurement will you show on the Y axis and why? (16)

Choosing a scale

In the chapter "Learning to make maps" you chose a scale to show distances on the map. With the help of the scale you were able to show large fields on the map.

In this case you must choose a scale for your graph to show the volume of water on the X axis and the column height on the Y axis.

What is the length of the X axis on your graph paper?

If you take 1 ml equal to 1 cm, will you be able to show a volume of 250 ml on your X axis? (17)

So it is important to choose a proper scale to show the volume on the X axis. Remember three things while doing so:

1. Choose a scale that will enable you to show your largest

measurement on the graph paper.

2. Choose a scale so that your graph covers the entire paper. This makes it easier to read the graph.

3. Choose a scale that makes it easier for you to do your calculations.

For example, if we take 1 cm of the X axis to equal 20 ml of water, then we can easily show all the readings for the volume of water on the X axis. The largest volume of 250 ml will fall on the 12.5 cm point of the X axis. So mark each successive cm point on the X axis 20, 40, 60, 80, 100, etc.
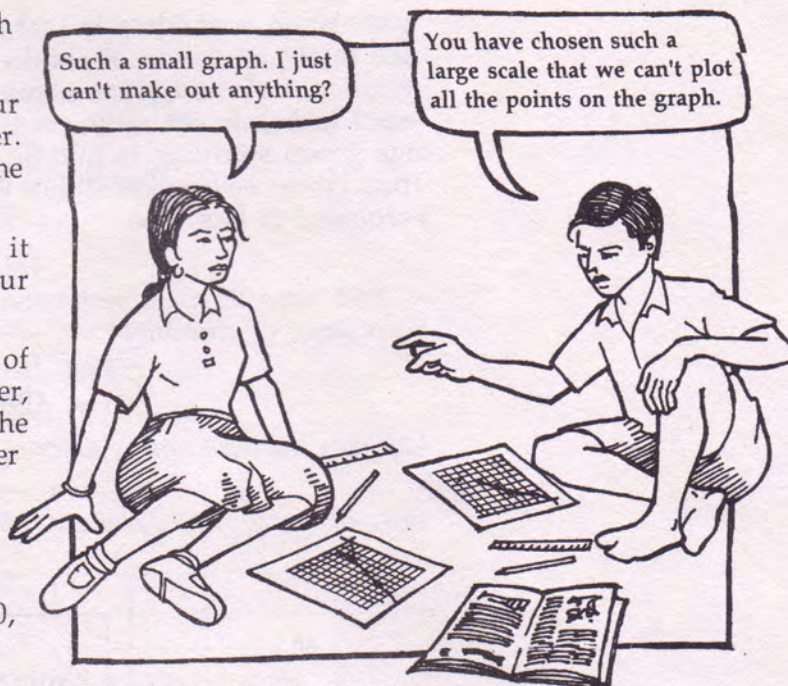
Where will you show the following volumes on the X axis: 30 ml, 50 ml, 54 ml, 86 ml? (18)

Now you need to choose the right scale for the Y axis. Keep in mind the three points given above as well as the range of your measurements while choosing a scale for the Y axis.

On the top right corner of your graph write:

Scale of graph

X axis : 1 cm = ... ml

Y axis : 1 cm = ... cm

Now plot the graph with the figures in Table 3. When you have plotted all the ten points, look at them carefully. Is it possible to make a straight line graph with these points? To find out, place a ruler along the points and adjust it to see in which position it touches the maximum number of points. Draw your graph line in this position with a pencil.

Does your graph line pass through the origin? Why? (19)

Exercise 3

You may have seen graphs in newspapers and magazines. If you learn to read these graphs you can get a lot of useful information from them. We have plotted two graphs till now. Let us now practice reading some readymade graphs.

Two graphs are given below.

Graph A (Figure 4) shows the percentage of students enrolled in middle schools in India. By percentage of students enrolled we mean the number of children between the age of 11 and 14 years that are enrolled in middle schools out of the total

population of children in that age group. For example, in 1981 the total population of children between the age of 11 to 14 years in our country was about 4,98,00,000 (Four crores ninety eight lakhs). In the same year, the number of children in this age group studying in middle schools was about 2,07,00,000 (two crores seven lakhs). So, we calculate the percentage of enrolment in this way:

$$\text{Percentage of enrolment} = \frac{\text{Total number of children studying in middle schools}}{\text{Total population of children between 11 and 14 years}} \times 100$$

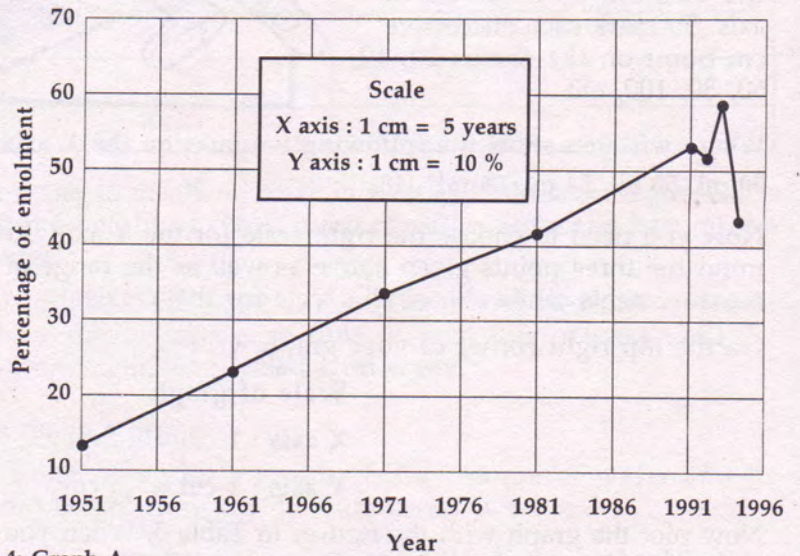$$= \frac{20700000}{49800000} \times 100 = 42\%$$

Figure 4: Graph A

What does the X axis of Graph A show? (20)

What does the Y axis show? (21)

What is the scale of the graph? (22)

From the graph, find out the enrolment percentage in 1970 and 1993. (23)

In which year was the enrolment percentage the highest? (24)

What changes have occurred in the enrolment percentage from 1950 to 1993? (25)

If the percentage of children enrolled in middle schools increases, how will it affect our country and our children? (26)

Graph B (Figure 5) shows the sex ratio in our country. This ratio tells us the number of women per thousand men. So if a country has 1,000 men and 1,020 women, the sex ratio of that country would be 1,020. If nature had its way, the number of women in any country would be slightly more than the number of men.

That means the sex ratio would be slightly over 1,000. The average sex ratio in developed countries is around 1,052. But the average sex ratio in developing countries is only about 962. The overall sex ratio of the entire world in 1992 was 990.

What does the X axis of Graph B show? (27)

What does the Y axis show? (28)

What is the scale of the graph? (29)

Use the graph to find out the sex ratios in India from 1901 to 1991. (30)

In which year was the sex ratio the highest? (31)

When was the sex ratio the lowest? (32)

What changes have taken place in the sex ratio between 1901 and 1991? (33)

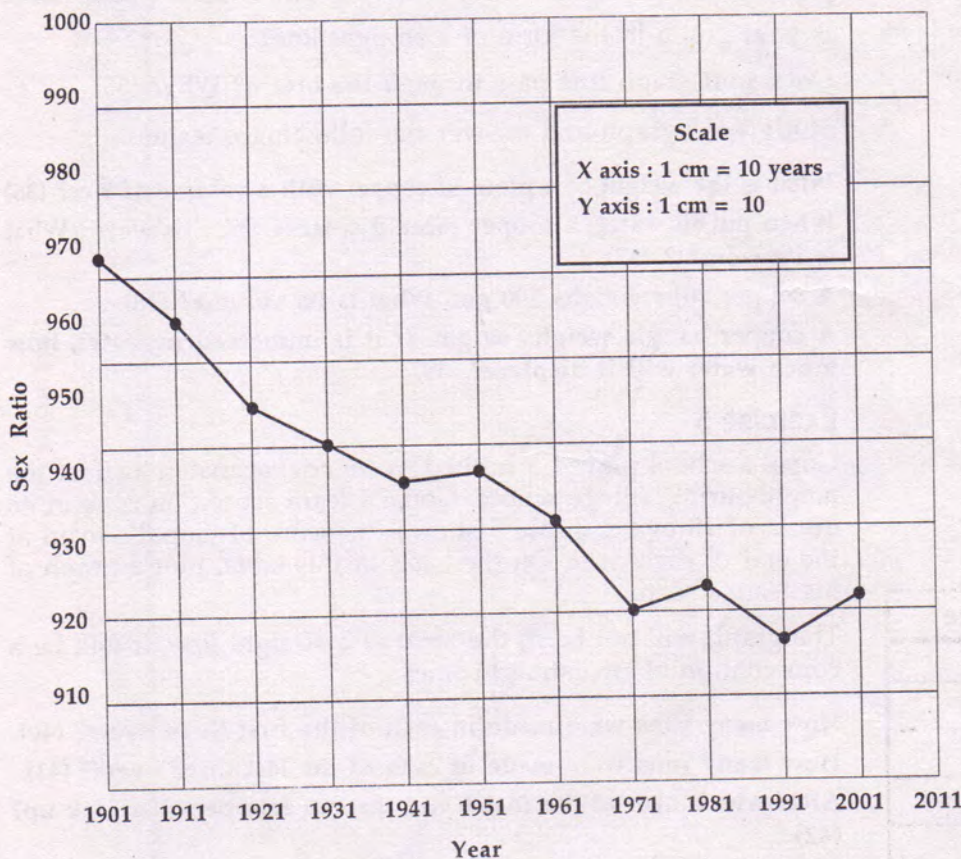Discuss the reasons for the low sex ratio in India with your teacher. (34)

Scale
X axis : 1 cm = 10 years
Y axis : 1 cm = 10

Figure 5: Graph B

Exercise 4

Suman performed an experiment with pieces of copper. She took a piece of copper with a volume of 4 cc. She weighed it and noted the weight in Table 4. Similarly, she weighed copper pieces with volumes of 8, 12, 16, 20 and 24 cc. She noted these weights too in the table.

Use the figures in this table to plot a graph of the volume and weight of copper pieces.

Table 4

No.	Volume of copper (cc)	Weight of copper (gm)
1.	4	36
2.	8	71
3.	12	108
4.	16	144
5.	20	181
6.	24	216

While choosing your scale ensure that the largest figure can be shown on the graph paper and that your graph covers the entire paper. Also, you should find it easy to make your calculations.

Is your graph in the form of a straight line?

Does your graph line pass through the origin? Why? (35)

Study your graph and answer the following questions:

What is the weight of a piece of copper with a volume of 3 cc? (36)

When put in water, a copper piece displaces 17 cc of water. What is its weight? (37)

A copper cube weighs 100 gm. What is its volume? (38)

A copper bangle weighs 60 gm. If it is immersed in water, how much water will it displace? (39)

Exercise 5

Gopal's school played a limited overs cricket match against the neighbouring village school. Gopal's team scored 36 runs in its quota of 10 overs. Table 5 shows the score of Gopal's team at the end of each over. On the basis of this table, plot a graph of his team's score.

The graph will not be in the form of a straight line. It will be a combination of two straight lines.

How many runs were made in each of the first three overs? (40)

How many runs were made in each of the last three overs? (41)

After which over of the match did the run rate per over pick up? (42)

**Does your graph line pass through the origin? Why? (43)**

Exercise 6

Figure 6 shows a graph of the length of the side of a square and its area. A total of 10 squares were taken and their sides were 1, 2, 3, ... 10 cm long respectively.

What kind of a graph line is this? (44)

Table 5

Overs	Score
1	3
2	6
3	9
4	12
5	16
6	20
7	24
8	28
9	32
10	36

Why does the graph line pass through the origin? (45)

What will be the area of a square with a 3.5-cm long side? (46)

What will be the area of a square with an 8.7-cm long side? (47)
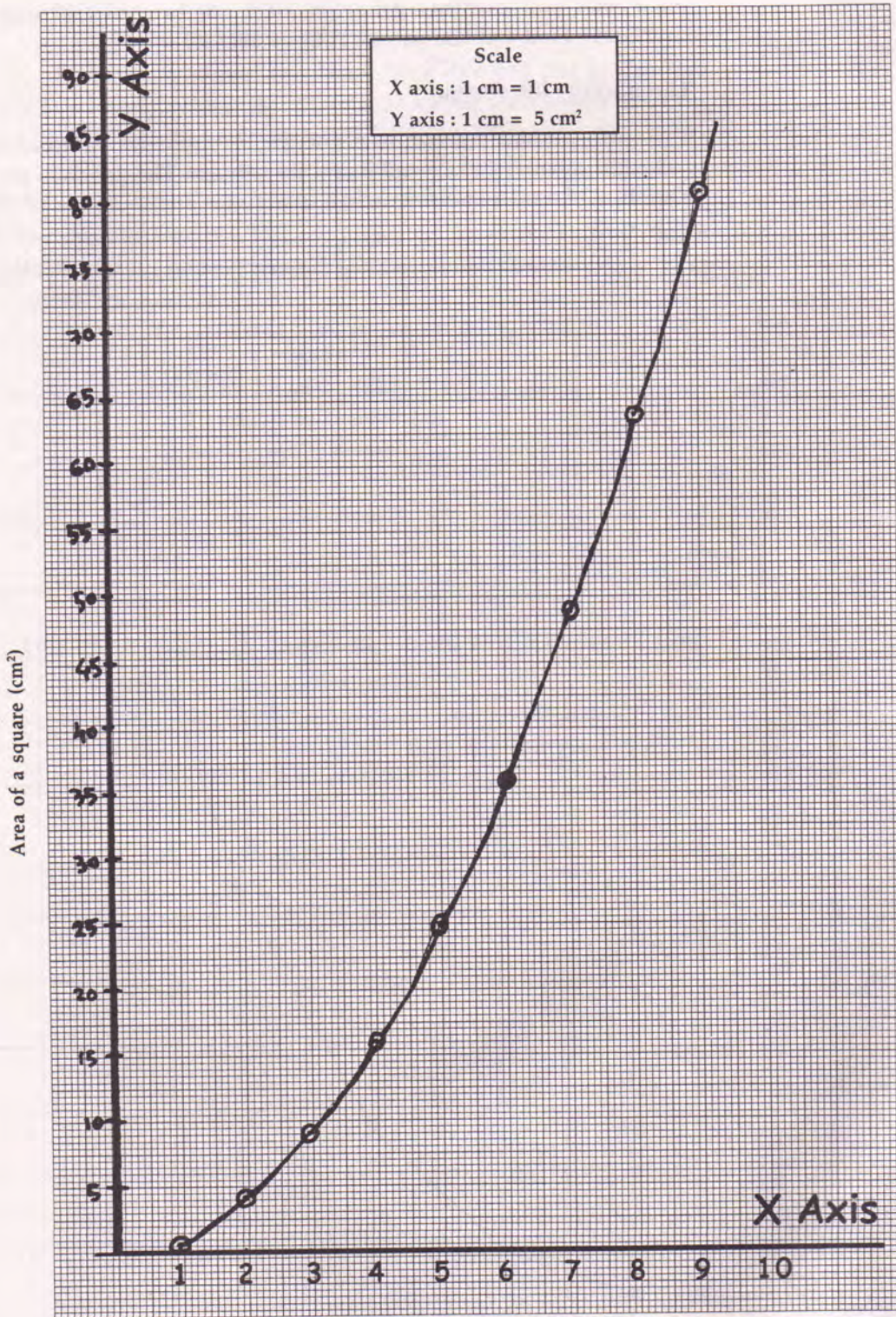
Length of the side of a square (cm)

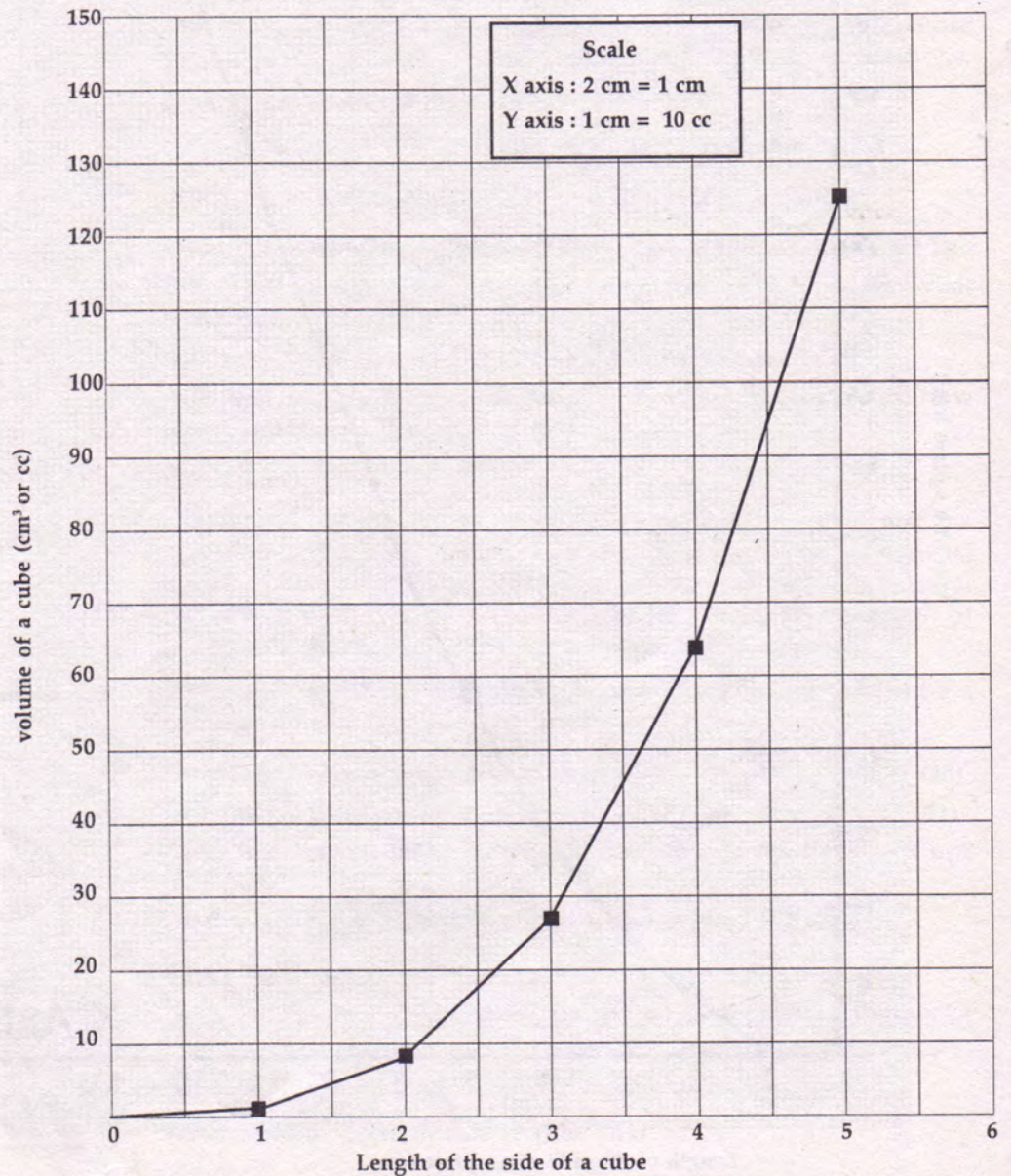What will be the length of the side of a square whose area is 20 sq cm? (48)

What will be the length of the side of a square whose area is 70 sq cm? (49)

How will you use this graph to find out the square root of numbers? Find out the square root of 55. (50)

Questions for revision

1. Rajesh plotted a graph to show the relationship between the length of the side of a cube and its volume. The graph is given below. Answer the following questions on the basis of this graph:

    a) What measurement has Rajesh plotted on which axis?

Scale
X axis : 2 cm = 1 cm
Y axis : 1 cm = 10 cc

volume of a cube (cm³ or cc)

Length of the side of a cube

b) What is the scale of his graph?

c) What is the volume of a cube with a side 2 cm long?

d) What will be the approximate length of the side of a cube with a volume of 100 cc?

e) What will be the volume of a cube with a 2.5-cm long side?

f) Can you extend this graph line like you did in Exercise 1 and find out the volumes of cubes with 6-cm and 7- cm long sides? Give reasons for your answer.

g) Can you express the relationship between the length of the side of a cube and its volume in the form of a formula?

2. On the basis of the figures given in the table below, plot a graph to show the relationship between the diameter of a circle and its circumference.

Diameter of circle (cm)	Circumference of circle (cm)
1.0	3.2
2.0	6.3
3.0	9.4
4.0	12.6
5.0	15.7

3. This graph shows the growth of a plant over a period of time.

a) What is the scale of the graph?

b) What is the height of the plant on the 8th and 12th day?

c) On the basis of this graph, describe the growth of the plant in four or five sentences.