Standard VI

MATHEMATICS

Part - 1

Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT)
2016

KT 29-1/Maths. 6(E) Vol-I

THE NATIONAL ANTHEM

Jana-gana-mana adhinayaka, jaya he
Bharatha-bhagya-vidhata.
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchala-Jaladhi-taranga
Tava subha name jage,
Tava subha asisa mage,
Gahe tava jaya gatha.
Jana-gana-mangala-dayaka jaya he
Bharatha-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he!

PLEDGE

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give respect to my parents, teachers and all elders and treat everyone with courtesy.

I pledge my devotion to my country and my people. In their well-being and prosperity alone lies my happiness.

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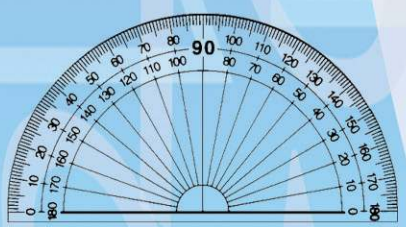
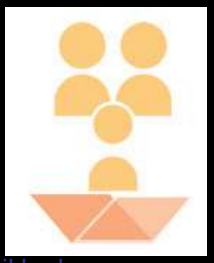
Dear children,

In five years, we have learnt many
basic ideas of mathematics
Numbers, Shapes, Fractions, ...
Thus we have seen something of the different
branches of mathematics.
From this springboard, let's leap ahead
into the wide world of math
with confidence

Dr. P. A. Fathima
Director
SCERT



TEXTBOOK DEVELOPMENT



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Contents

Certain icons are used in this textbook for convenience

Computer Work

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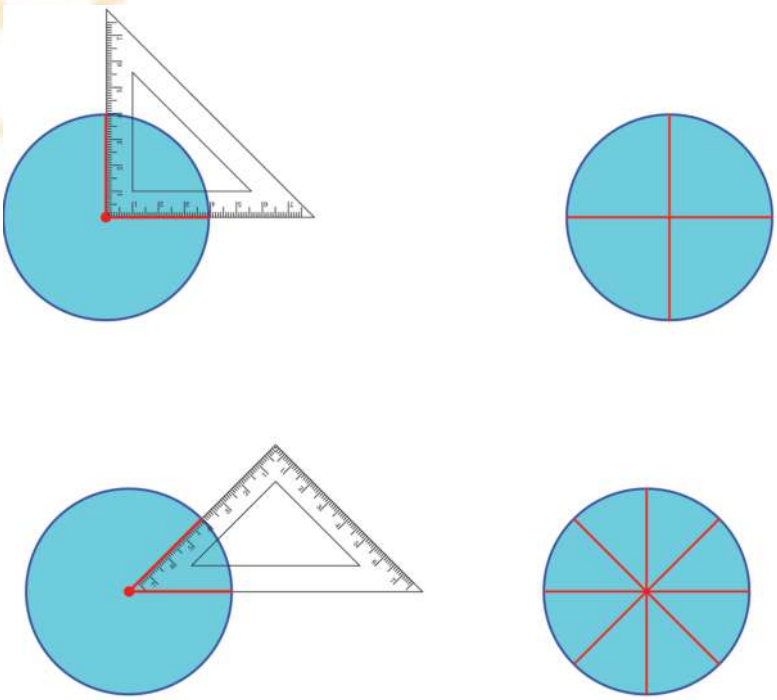
1 Angles

Angles in a circle

Remember dividing a circle into equal parts using set squares?

(The lesson, **Part Number** of the class 5 textbook)

See these pictures:



You also know how to divide a circle into equal parts using the corners of the other set square, don't you?

Look at the angles made at the centre of the circle in each case. If we make the angle larger, does the number of parts increase or decrease?

Measure of an angle

We have seen in class 5 how we can divide a circle into three equal parts, using a set square (The section, **Three parts**, of the lesson, **Part Number**)

So using corners of a set square, we can divide a circle into three, four or six parts.

Can we make five equal parts?

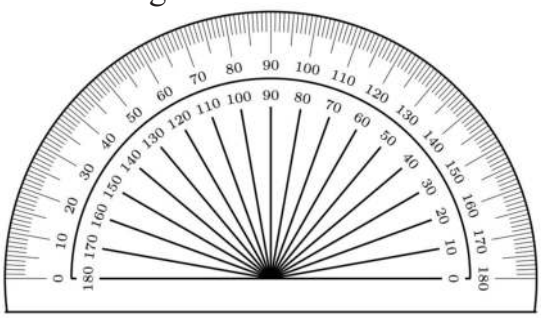
Using corners of a set squares, we cannot make such an angle at the centre.

We need some other method to draw and measure angles of different sizes. Measure lengths of lines starting with small lengths such as millimetre and centimetre.

In the same way, we use a small angle to measure all other angles. This angle is got by dividing a circle into 360 equal parts.

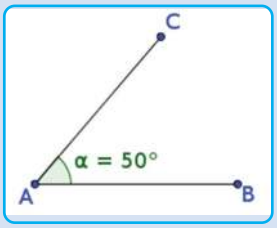
The measure of this angle is said to be 1 degree; and it is written 1°. An angle twice as large as this is said to have measure 2°, thrice as large to have measure 3° and so on.

There is a device in your geometry box to measure angles of different sizes.



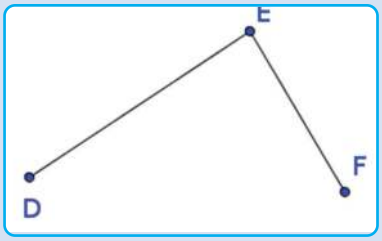
It is called a protractor.
See the lines drawn on it?

Let's see how we measure an angle in GeoGebra. First mark three points A, B, C. Select the Angle tool and click on B, A, C in this order. (Test what happens if you click in some other order)



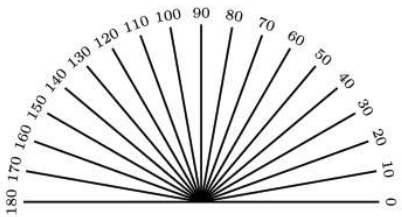
We can get the measure of the angle by clicking on the lines AB, AC also.

To get the measure of the angle shown below, in what order should we click?



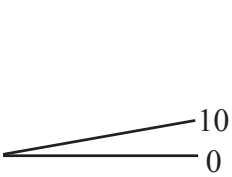
At the end of each line, we see two numbers, one below the other.

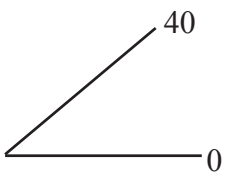
Look at the numbers below:



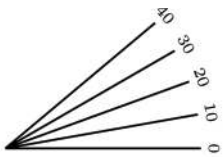
These numbers are the degree measure of the angles made by these lines with the bottom line marked 0.

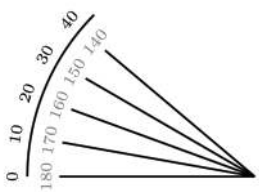
For example, the angle made by this bottom line and the line just above it is of measure 10^{o} (10 degrees). The angle made by the bottom line and the line marked 40 is of measure 40^{o}.





In other words, an angle of 40^{o} made by 4 angles of 10^{o} each.

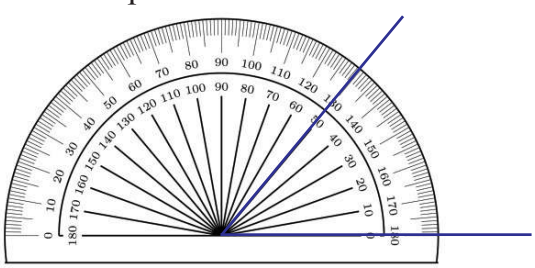


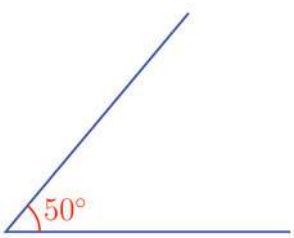


Another round of numbers is given on top to draw and measure angles on the left.

How can we measure an angle using protractor?

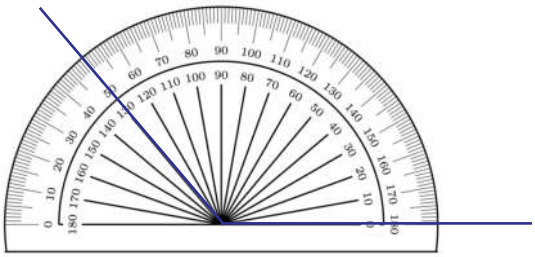
Look at this picture.

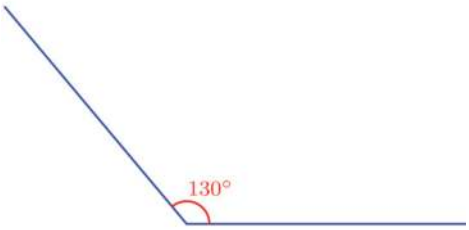


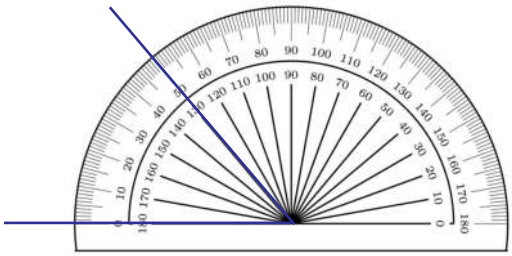


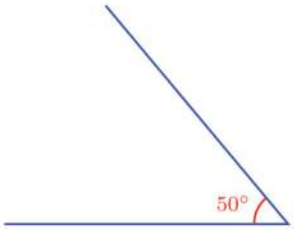
Note also how the angle is marked.

Here are some more examples:

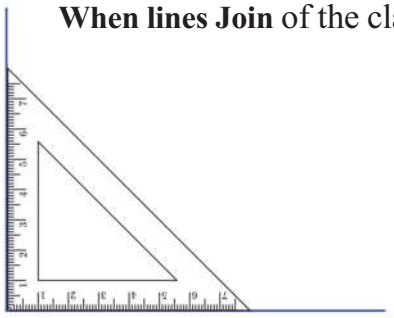




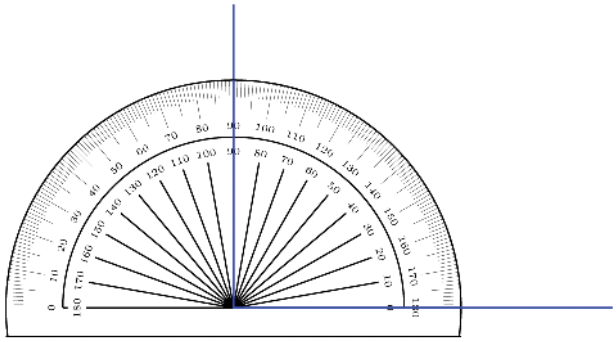




Now draw a line and at one end, draw a line straight up using the square corner of a set square (The section, **Let's draw** of the lesson, **When lines Join** of the class 5 textbook).



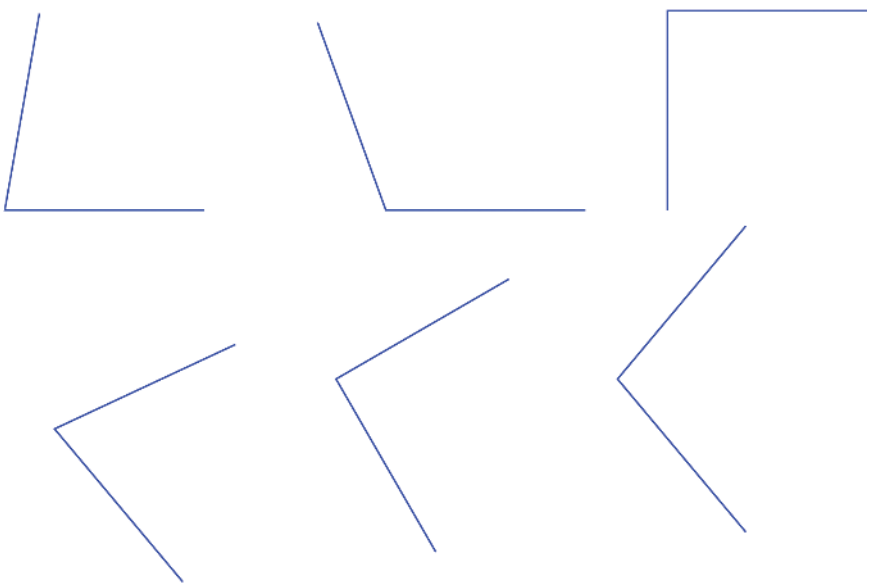
Next, measure this angle using a protractor.



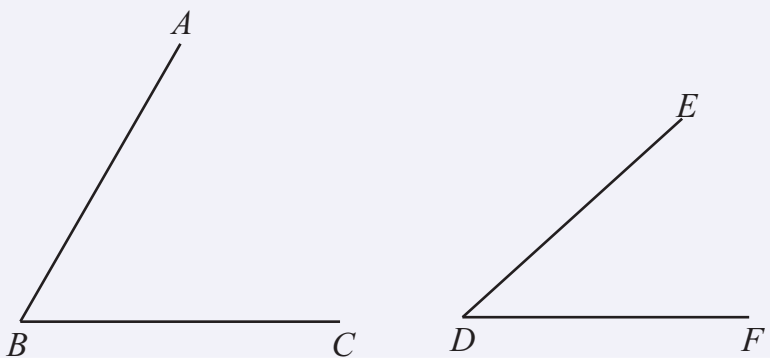
So the angle at a square corner is 90° Such an angle is also called a right angle.

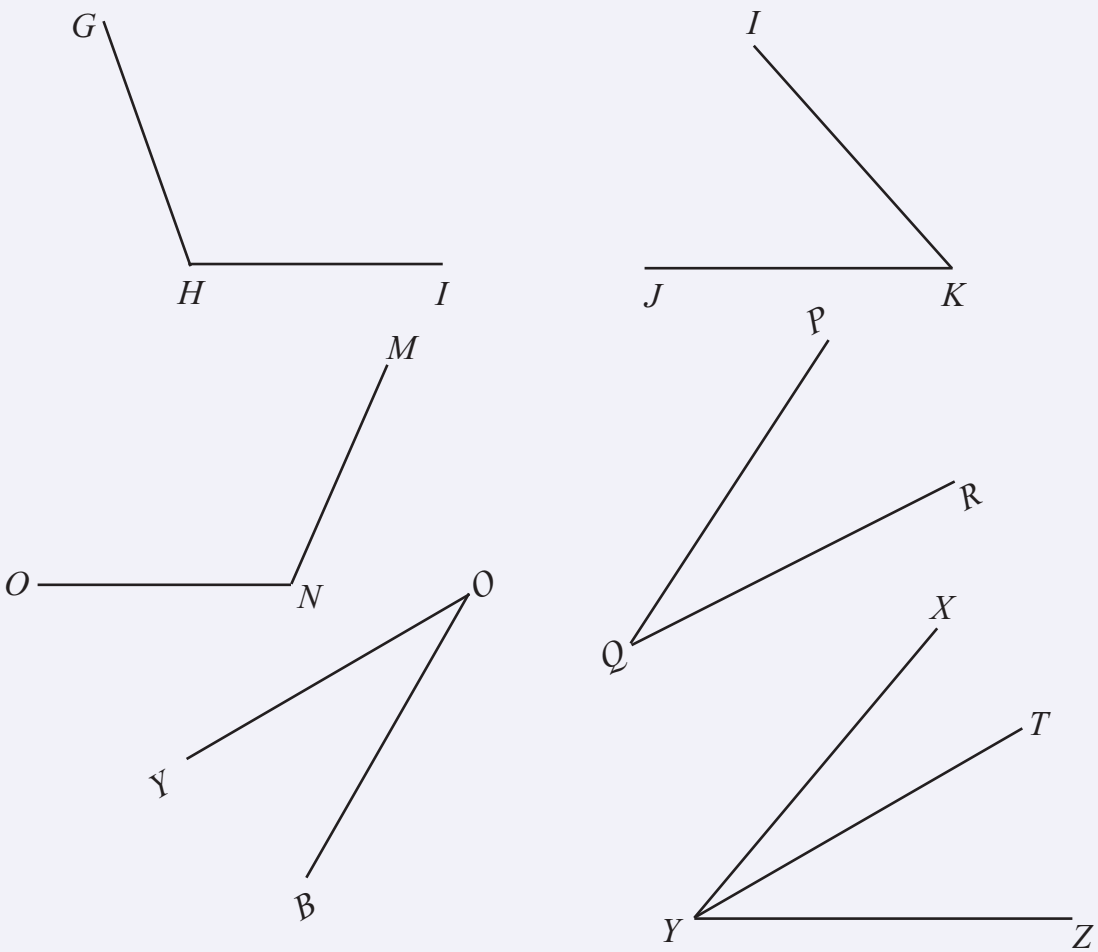
In a figure, we mark a right angle like this:

Without actually measuring the angles below, can you say which are less than 90°, which are more than 90° and which are exactly 90°?

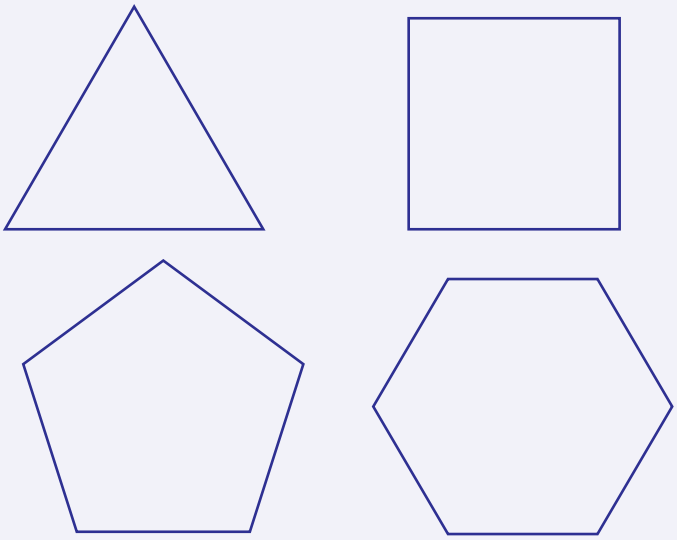


1. Measure all angles below and write names and size in degrees below each:



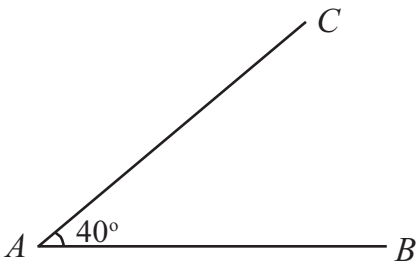


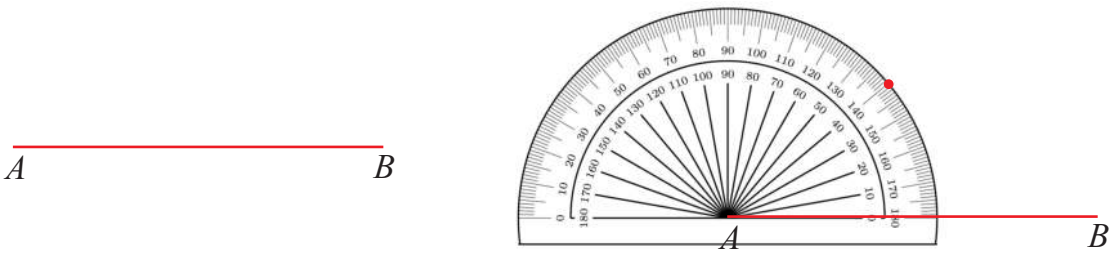
2. Measure and write all angles of the figure below:

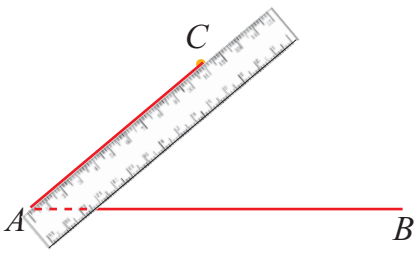


Drawing an angle

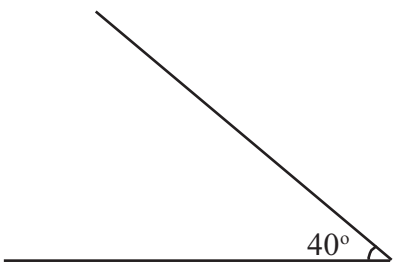
Let's see how we can draw an angle like this:





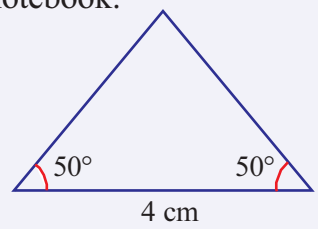


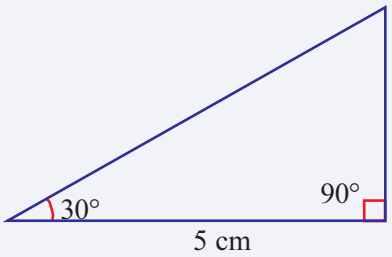
Now can you draw this angle?



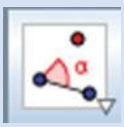
1. A rectangle has four angles. What is the degree measure of each?
2. Draw a rectangle of length 5 centimetres and breadth 3 centimetres using a ruler and a protractor.

3. Draw the figures shown below with the specified measures, in your notebook:

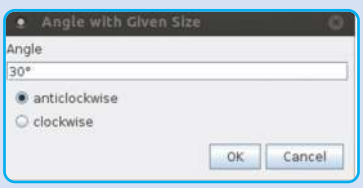




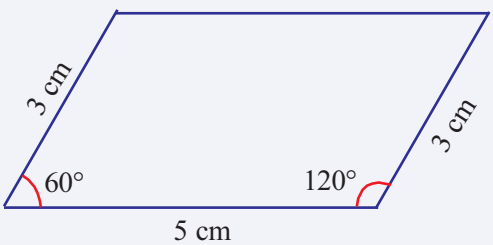
Drawing angles

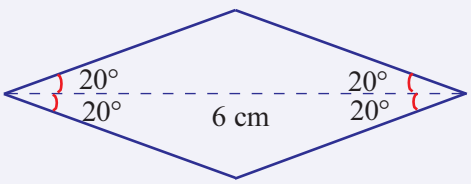


Draw a line AB in GeoGebra. Select the Angle with Giving size tool and click on B, A in this order. In the dialogue box give the measure of the angle needed and click OK.



We get a new point B′. Join A and B′.





Circle division

An angle of 1° is got by dividing a circle into 360 equal parts. Putting this the other way round, by drawing 1° degree angles at the centre, we can divide a circle into 360 equal parts.

If we take two each of these angles together, we get 2° angles; and 180 equal parts of the circle.

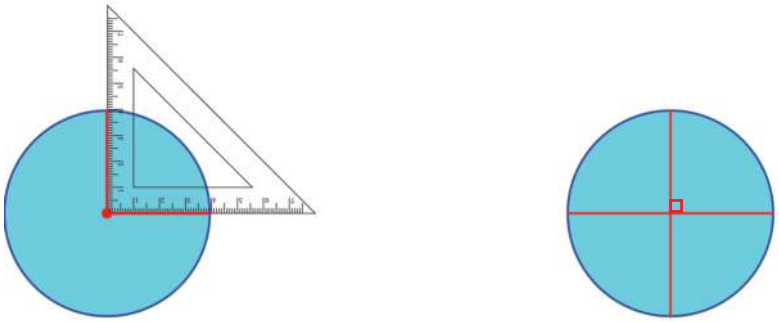
What if take the angles three at a time.

How much would be each angle?

And how many equal parts of the circle?

So, to divide the circle into 30 equal parts, how many of the 360 parts should we take together?

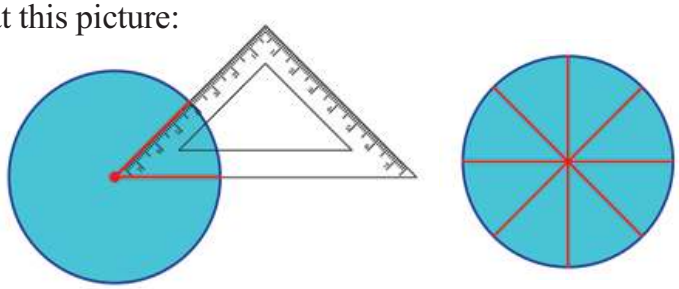
When we divide a circle into 4 equal parts, how much is each angle, in degrees?



$$360 \div 4 = 90$$

We have divided a circle into equal parts using other corners of set squares. How many equal parts did we get in each case?

Look at this picture:



Using this corner of set square, we have divided the circle into 8 equal parts.

So, how much is each angle at the centre?

$$360 \div 8 = 45$$

Thus the angle at this corner of the set square is 45°?

In the same way, the angle at the other non-square corner of this set square is also 45°.

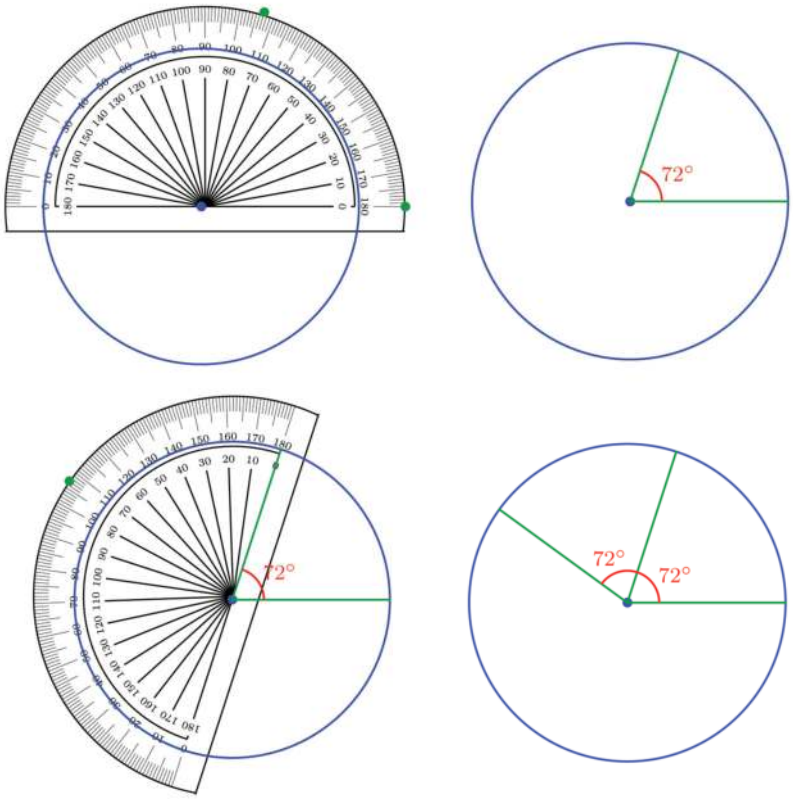
Now find the angles at the corners of the other set square.

Now let's look at our earlier problem of dividing a circle into five equal parts.

To divide a circle into 5 equal parts, what should be the size of the angle at the centre?

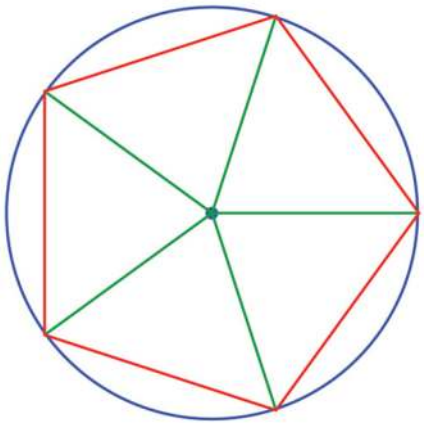
$$360 \div 5 = 72$$

Draw angles of 72° at the centre of a circle:



Continuing like this, can't we divide a circle into five equal parts.

Now can you draw this figure?



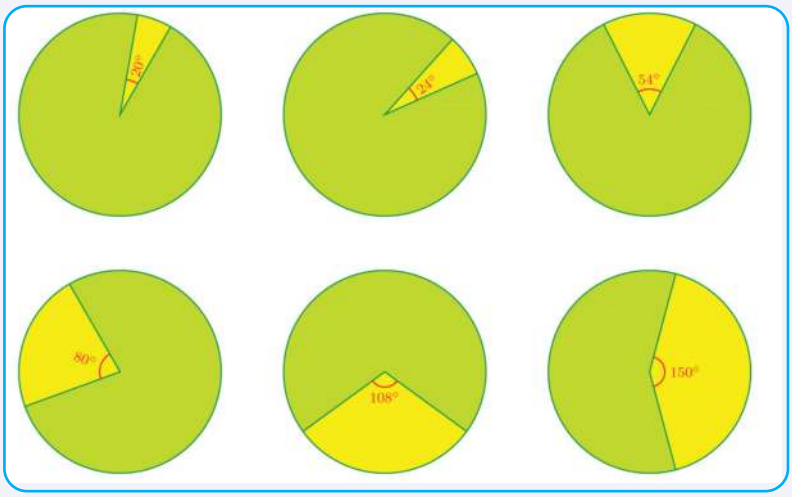
What is the name of this figure?

Like this, draw figures of 6, 8, 9, 10, 12 sides inside a circle.

1. Can you draw angles of sizes given below, using set square? (See the section, **Joining angles**, of the lesson, **When Lines Join**, in to the class 5 textbook)

   (i) 75° (ii) 105° (iii) 135° (iv) 15°

2. In the figures below, calculate the fraction of the whole circle the green and yellow parts are:



3. Draw circles and mark the fractional parts given below. Colour them also:

   (i) $\frac{3}{8}$ (ii) $\frac{2}{5}$

   (iii) $\frac{4}{9}$ (iv) $\frac{5}{12}$

   (v) $\frac{5}{24}$

Angles in a clock

The hands of a clock make different angles at different times: What is the angle between them at 3o' clock? And at 9o' clock? The hour hand rotates through 360° in 12 hour. So it rotate through $360^{\circ} \div 12 = 30^{\circ}$ in an hour. So at 1o' clock, the angle between the hands is 30°. What is the angle at 2o' clock?

And at 4o' clock?

Looking back

Learning outcomes	What I can	With teacher's help	Must Improve
• Measuring an angle using a protractor.			
• Drawing an angle of specified size.			
• Drawing geometric figure using the idea of angle measurement.			

2 Average

Donation math

Children in class 6A decided to raise 1000 rupees to buy books for the library. There are 40 children in the class. And they decided that all of them should give the same amount. How much should each give?

To compute this, we need only divide 1000 by 40, right?

There are 30 children in class 6B. They raised 1200 rupees for a medical fund. Can you calculate how much each gave?

Here, the amounts given may not be the same. So, we cannot say exactly how much each gave.

Yet, we can say something about the amount each gave.

If all had given the same amount, each would have given 40 rupees.

If all had given less than 40 rupees, they could not have raised 1200 rupees.

In the same way, all could not have given more than 40 rupees.

So, we can say something like these:

If all had given the same amount, then each would have given 40 rupees; if some had given less than 40 rupees, then some others must have given more than 40 rupees.

Here we say that the average amount each kid gave is 40 rupees.

Average problems

Manikuttan supplies milk to the society each day. Last week, he supplied 56 litres in all. How much did he give each day of this week on average?

The amount given on all days may not be the same. Average per day means how much he would have given each day, had he given the same amount on all days. So, the average in this case is $56 \div 7 = 8$ litres.

As mentioned at the beginning, this does not mean he supplied exactly 8 litres each day.

It might be 7 litres one day and 9 litres another day. It might be slightly more or less than 8 litres each day.

But it is very much unlikely that he gave only 1 litre one day and 15 litres another day.

On five days, a man spends 300 rupees, 250 rupees, 270 rupees, 280 rupees and 290 rupees. How much did he spend each day on average?

How much did he spent in all?

And in how many days?

To get the average expenditure per day, we have to divide the total amount spent by the number of days.

See the length of cloth needed to make shirts for some kids in Sudheer's class.

	Name	Length (cm)
1	Sudheer	110
2	Ravi	130
3	Ramesh	120
4	Suhail	140
5	Joseph	100

There are 23 boys in the class. How much should be bought to make shirts for all?

We can use the average length of 120 centimetre to calculate the total length of cloth needed. But would it be right to cut out a 120 centimetre piece for each?

How do we compute this?

If the length of cloth is the same for all, we can calculate exactly how much is for 23 kids.

By the table, the total length needed for five is 600 centimetres.

If it is the same amount for all, we can say each needs 120 centimetres.

In other words, the average length needed for each is 120 centimetres.

Since they are all in the same class, there wouldn't be much difference among the lengths needed for them.

So, we can estimate the total length of cloth needed as 23×120 centimetres = 2760 centimetres, or 27 metres and 60 centimetres.

1. The number of children who attended class from Monday to Friday are 34, 35, 32, 33, 31. What is the average number of children who attended classes each day?

2. The table shows the amount of electricity used in Majeed's house for some months. What is the average amount of electricity used per month? Which are the months on which usage is more than the average?

Month	Unit
January	85
February	90
March	75
April	82
May	78

3. The weights of players in a team are 68 kilograms, 72 kilograms, 80 kilograms, 70 kilograms, 60 kilograms, 70 kilograms. What is the average weight of a player in the team?

4. The total income of a man in 8 days is 1840 rupees. What is his average income per day?

Which is better?

Ouseph and Abu grow different types of coconut trees. Ouseph has 20 trees and Abu has 18. See how many coconuts each got last year:

	January	April	August	November
Ouseph	160	280	200	260
Abu	200	264	240	160

Which kind gives more coconuts?

Can we decide this by comparing just the total numbers each got?

So, how do we decide?

Let's compute the average number of coconuts per tree for each kind.

How many coconuts per tree did Ouseph got on average?

And Abu?

Computing like this, we can decide which kind of tree gives better yield.

1. During the Forest Fest celebration, two divisions of class V decided to plant trees as a Haritha Club activity. 35 children of class VA planted 245 saplings and 30 children of class VB planted 240. On the basis of average number of saplings planted per kid, which division did a better job?
2. The table shows the number of members and the amount of water used in a month of three households:

Number of members	Water used in a month (litres)
6	18000
4	16000
5	16500

How much water did one person in the first household use on average?

What about the other households?

According to these figures, in which household used most water per person?

Some other problems

Milk math

Ramu checked his sale of milk for some days and calculated the average income to be 150 rupees per day. If he continues like this, how much can he expect from the sale of milk in June?

There are 30 days in June. So if we get 150 rupees per day on average during the month, he would get $150 \times 30 = 4500$ rupees.

Trade math

The incomes for five days of a trade are 6435 rupees, 6927 rupees, 6855 rupees, 7230 rupees and 6562 rupees. After the sixth day, he calculated the average income as 6500 rupees per day. How much did he get on the sixth day?

The amount got each day for the first 5 days is given. Adding all these, we can get the total income for these 5 days. Since the average income is 6500 rupees per day for the first six days, the total income can be calculated by multiplying by 6. Now can't we find the income on the sixth day?

1. Children were asked to donate books to the school library. Using the given details, fill up the table below.

Class	Number of children	Number of books	Average
6A	30	120	4
6B	40	240	.....
6C	.....	175	5
6D	32	.....	10

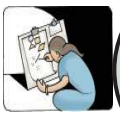
The sum of 7 consecutive natural numbers is 70. What are the numbers? The sum of 8 consecutive natural number is 92. What are the numbers? Can the sum of 9 consecutive numbers be 58?

2. The average age of a child in a class of 35 is 11. The average age, including the teacher is 12. How old is the teacher?

3. The average weight of a kid in a group of 10 is 35 kilograms. When Sonu also joined them, the average became 36 kilograms. How much does Sonu weigh?

4. There are 8 teachers in a school. When a 35 year old teacher was transferred and another teacher joined, the average age ws increased by 2 years. How old is the new teacher?
5. The average rainfall per month during 2014 in a place was calculated to be 23 centimetres. The total rainfall there during June, July and August was 150 centimetres.
   i) What is the average rainfall per month during these three months?
   ii) What was the total rainfall during the entire year of 2014?
   iii) What is the average rainfall per month during the other 9 months?
6. When a person calculated his expenses from Sunday to Thursday, he found the average expenditure to be 400 rupees per day. Including Friday, the average increased to 430 rupees per day. How much did he spent on Friday? Including Saturday, the average decreased to 390 rupees per day. How much did he spend on Saturday?
7. 40 children of class VI donated 50 rupees on average to the Mutual Aid Fund. 30 children of class V donated 800 rupees in all. If we consider both classes together, how much did each donate on average?
8. Three groups of 10 kids. The average weight of a kid in each group is 35 kilograms. One more kid joined each group.
   i) The average weight of a kid in the first group is still 35 kilograms.
   ii) The average weight of a kid in the second group is now 36 kilograms.
   iii) The average weight of a kid in the third group is now 34 kilograms.

   Compute the weight of the new kid in each group.



In your class, are the boys or girls taller on average? Calculate the average height, considering all kids in the class. Compare it with the average height of boys and girls.

Write any five consecutive natural numbers and find their sum. Does the middle number have any relation with the sum? What if we take 9 consecutive natural numbers? Does the same relation hold for any odd number of numbers?

What if the number of numbers is even?

How about taking consecutive odd numbers or consecutive even numbers?

Looking back

Learning outcomes	What I can	With teacher's help	Must Improve
• Explaining the idea of average and its uses.			
• Making better estimates on the basis of average.			
• Comparing two groups by computing the averages.			
• Solving problems using the idea of average.			

3 Fractions

Multiplication and times

A bottle can hold 250 millilitres. How much water do we need to fill three such bottles?

$$3 \times 250 \text{ millilitres} = 750 \text{ millilitres}$$

We can say this in words

750 millilitres is 3 time as much as 250 millilitres.

Using only numbers, we have

$$3 \text{ times as much as } 250 = 3 \times 250 = 750$$

A packet can hold 500 grams of sugar. How much sugar do we need to fill four packets?

$$4 \times 500 \text{ grams} = 2000 \text{ grams}$$

How about stating this as we did earlier?

4 times as much as 500 grams is 2000 grams.

And using only numbers?

$$4 \text{ times as much as } 500 = 4 \times 500 = 2000$$

2000 grams means 2 kilograms, right?

And 500 grams is $\frac{1}{2}$ kilograms.

So,

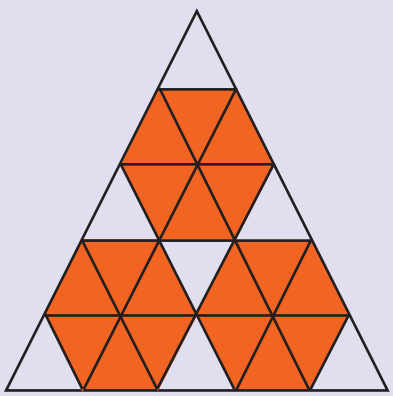
$$4 \text{ times as much as } \frac{1}{2} \text{ kilogram is 2 kilograms}$$

Using only numbers

$$4 \text{ times as much as } \frac{1}{2} \text{ is 2.}$$

What part?

In the picture, what fraction of the triangle is colourd red?



The large triangle is divided into how many small triangles?

Of these, how many are coloured red?

So the red coloured part is $\frac{18}{25}$ of the large triangle.

Let's look at it this way. The red coloured portion is made up of 3 equal parts; and each of these has 6 small triangles. So the part coloured red is

$$3 \times \frac{6}{25} = \frac{18}{25}$$

Just as we write 4×500 for 4 times 500, we can write 4 times $\frac{1}{2}$ as

$$4 \times \frac{1}{2}$$

That is,

$$4 \times \frac{1}{2} = 4 \text{ times } \frac{1}{2} = 2$$

Let's say our water problem in litres instead of millilitres.

250 millilitres means a quarter litre; thrice a quarter makes a three-quarter. So,

$$3 \text{ times } \frac{1}{4} \text{ litre is } \frac{3}{4} \text{ litre}$$

Using only numbers,

$$3 \text{ time } \frac{1}{4} \text{ is } \frac{3}{4}$$

How about writing this as multiplication?

$$3 \times \frac{1}{4} = 3 \text{ times } \frac{1}{4} = \frac{3}{4}$$

Another problem: If five strings $\frac{1}{4}$ metre long are laid end to end, what would be the total length?

Four quarter metres make one metre.

One more quarter makes one and a quarter metre.

Let's say this in words and as multiplication

$$5 \text{ times } \frac{1}{4} \text{ is, } 1\frac{1}{4}$$

And as multiplication?

$$5 \times \frac{1}{4} = 1\ \frac{1}{4}$$

Like this, find the answer to each of the problems below and then write it in words and as multiplication of numbers

1. i) What is the total weight of two pieces of pumpkin, each weighing 250 grams?

ii) What if the weight is put in kilograms?

2. i) What is the total length of four pieces of ribbon, each of length 75 centimetres.

ii) What if the length is put in metres?

3. (i) One cup can hold $\frac{1}{3}$ litre of milk. How much milk can we pour in two cups?

(ii) In four cups?

Multiplication and part

A six metre long string is cut into two equal pieces. How long is each peace?

Half of six metres is three metres.

Half is written $\frac{1}{2}$. So,

$\frac{1}{2}$ of six metres is 3 metres.

Using only numbers, we can say

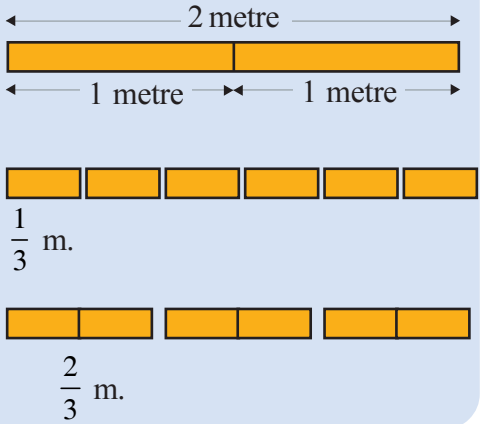
$\frac{1}{2}$ of 6 is 3

Part of numbers is also written as multiplication; that is

$$\frac{1}{2} \times 6 = \frac{1}{2} \text{ of } 6 = 3$$

What about cutting a 2 metre long ribbon into three equal parts?

The length of each piece is $\frac{2}{3}$ metre) (The section, **Measuring parts**, of the lesson, **Part Number**, in the class 5 textbook).



Different ways

If three litres of milk is equally divided among four persons, how much would each get?

One-fourth of three litres, which is three quarters of a litre.

We can also think like this.

If one litre is divided among four, each gets a quarter litre.

With three litres, this division can be done thrice. So, each gets three times a quarter litre, which is three quarters of a litre.

Thus a quarter of three litres and three times a quarter litre are equal.

As multiplication,

$\frac{1}{4} \times 3 = 3 \times \frac{1}{4}$

That is,

$\frac{1}{3}$ of 2 is $\frac{2}{3}$

This also we write as multiplication

$\frac{1}{3} \times 2 = \frac{1}{3}$ of $2 = \frac{2}{3}$

What is a quarter of five kilograms?

A quarter of four kilograms is one kilogram; a quarter of the remaining one kilogram is a quarter kilogram. One and a quarter kilogram in all.

That is,

$\frac{1}{4}$ of 5 kilogram is $1\ \frac{1}{4}$ kilogram.

Writing this as multiplication,

$\frac{1}{4} \times 5 = \frac{1}{4}$ of $5 = 1\frac{1}{4}$

Like this, find the answer to each of the problem below and then write it in words and as multiplication of numbers.

1. (i) Nine litres of milk is equally shared by four kids. How much does each get?
   (ii) What if it were shared by three?
2. (i) Six kilograms of rice is packed into four identical bags. How much rice is in each bag?
   (ii) What if it were packed into two bags?
3. (i) An eight metre long string is cut into three equal parts. What is the length of each piece?
   (ii) What if it were cut into six equal parts?

4. (i) A rectangle of area seven square centimetres is cut into three equal rectangles. What is the area of each?

   (ii) What if it were cut into four?

5. (i) Twelve children are divided into four equal groups. How many children are there in each group?

   (ii) What if they were divided into three groups?

Multiplication method

If 4 strings of length $\frac{1}{3}$ metre were laid end to end, what would be the total length?

3 strings of $\frac{1}{3}$ metre make 1 metre; one more string makes $1\frac{1}{3}$ metres.

Thus, 4 times $\frac{1}{3}$ metre is $1\frac{1}{3}$ metres.

Using only numbers, 4 times $\frac{1}{3}$ is $1\frac{1}{3}$.

As multiplication,

$$4 \times \frac{1}{3} = 1\frac{1}{3}$$

We can also think like this: 4 times $\frac{1}{3}$ metre means,

4 pieces of $\frac{1}{3}$ metres.

$$\frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{1+1+1+1}{3} = \frac{4}{3} = 1\frac{1}{3}.$$

Similarly, how do we calculate 4 times $\frac{2}{3}$?

$$\frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{4 \times 2}{3} = \frac{8}{3} = 2\frac{2}{3}$$

How do we calculate 10 times $\frac{2}{3}$ like this?

$$\frac{2}{3} \times 10 = \frac{2 \times 10}{3} = \frac{20}{3} = 6\frac{2}{3}$$

Now look at this problem:

A bottle can hold $\frac{3}{4}$ litre of milk. How many litres of milk is there in 7 such bottles?

We want to calculate 7 times $\frac{3}{4}$.

$$7 \times \frac{3}{4} = \frac{3 \times 7}{4} = \frac{21}{4}$$

How do we split $\frac{21}{4}$?

We divide 21 by 4 and write like this:

$$21 = (5 \times 4) + 1$$

So,

$$\frac{21}{4} = \frac{(5 \times 4) + 1}{4} = \frac{5 \times 4}{4} + \frac{1}{4} = 5 + \frac{1}{4} = 5\frac{1}{4}$$

Thus 7 bottles contain $5\frac{1}{4}$ litres in all.

1. An iron block weighs $\frac{1}{4}$ kilogram.
   (i) What is the weight of 15 such blocks?
   (ii) What about 16 blocks?
2. Each of some iron rods, of length 2 metres is cut into five equal pieces.
   (i) What is the length of each piece?
   (ii) What is the total length of 4 such pieces?
   (iii) What about 10 such pieces?

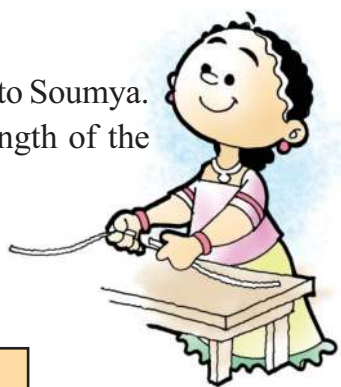
3. There are some cans, each containing 5 litres of milk. The milk in each vessel is used to fill 6 identical bottles.

   (i) How much milk is there in each bottle?

   (ii) How much milk in 3 such bottles?

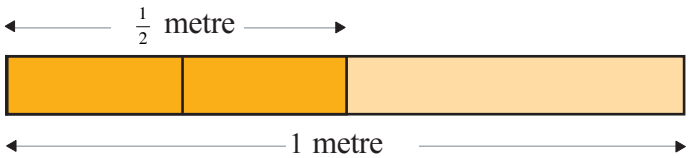
   (iii) In 12 bottles?

Part of part

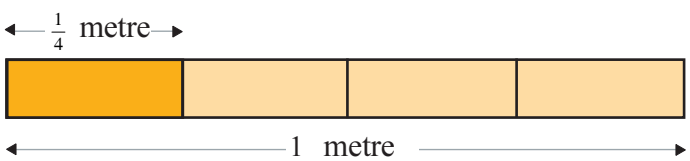


Suhara has a 1 metre long silk ribbon. She gave half of it to Soumya. She in term gave half of this to Reena. What is the length of the piece Reena got?

Suhara got half of a metre. What is half of this?



If both halves are halved, we can see this quickly:

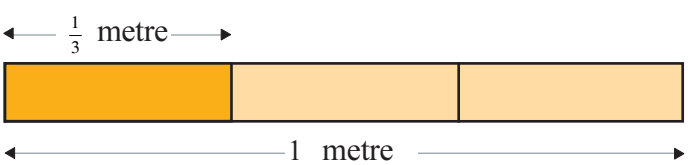


Reena got $\frac{1}{4}$ metre. That is, half of half is a quarter.

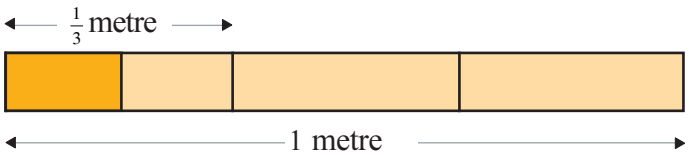
How about writing this as multiplication?

$$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

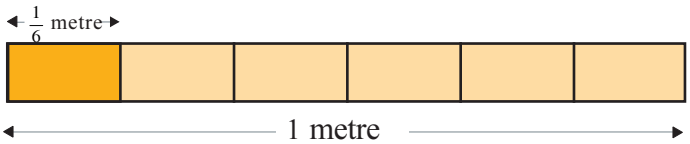
Like this, if a metre is cut into three equal pieces, then each piece is $\frac{1}{3}$ metre.



What is half of $\frac{1}{3}$ metre?



The picture shows four pieces; but they are not of the same length. To get equal pieces, let's divide the other two one-third metres also into two equal parts:



Now we have six equal pieces. And we need the length of one piece. It is $\frac{1}{6}$ metre, right? So,

half of a third is a sixth.

As multiplication,

$$\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$$

Like this, what $\frac{1}{4}$ of $\frac{1}{3}$ metre?

Let's think without any picture.

To get $\frac{1}{3}$ metre, one metre must be divided into 3 equal parts. And we want $\frac{1}{4}$ of one such part.

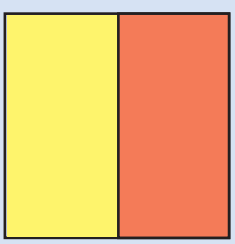
To get equal parts, we must divide each of the first three parts into how many equal parts?

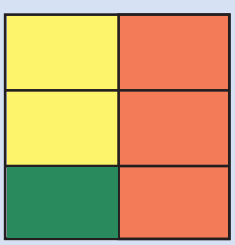
So how many parts in all?

What is the length of one part?

Rectangle division

A rectangle is vertically divided into two equal parts.





Now suppose we divide this horizontally into three equal parts.

The green part is a third of the yelllow part. That is, a third of half.
It is also a sixth of the whole rectangle.
A third half is a sixth.

$$\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$$

So what is $\frac{1}{4}$ of $\frac{1}{3}$?

As multiplication,

$$\frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$$

Look at the way we got the answer. How did we get 12 here?

Including that also, we write

$$\frac{1}{3} \times \frac{1}{4} = \frac{1}{3 \times 4} = \frac{1}{12}$$

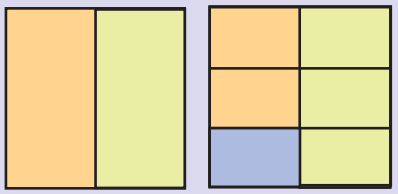
Can you calculate $\frac{1}{6}$ of $\frac{1}{4}$ in head, like this?

1. A string of length one metre is cut into five equl parts. What is the length of half of one such piece? How many centimetres?
2. One litre of milk fills two identical bottles. A quarter of the milk in one bottle is used to make a cup of tea. How much milk was used to make tea? How many millilitres?
3. One kilogram yam is cut into three equal pieces. One of the pieces is halved. What is the weight of this piece?
4. Half the children in a class are girls. A thrid of them are in the Math Club. What fraction of the total class are they?
5. Calculate the following in your head. Write them as products.

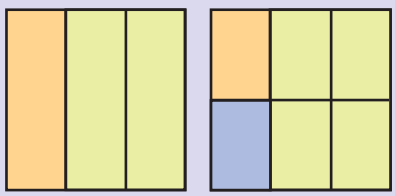
   (i) $\frac{1}{4}$ of $\frac{1}{2}$

Vertically and Horizontally

$\frac{1}{3}$ of $\frac{1}{2}$ is $\frac{1}{6}$



And in reverse?



$\frac{1}{2}$ of $\frac{1}{3}$ is also $\frac{1}{6}$

(ii) $\frac{1}{2}$ of $\frac{1}{4}$

(ii) $\frac{1}{5}$ of $\frac{1}{3}$

(iv) $\frac{1}{3}$ of $\frac{1}{5}$

(v) $\frac{1}{6}$ of $\frac{1}{3}$

(vi) $\frac{1}{3}$ of $\frac{1}{6}$

Times in part

Two litres of milk is used to fill three bottles of the same size. A quarter of one such bottle is poured into a glass. How much milk is in the glass?

Milk distribution

A can is full of milk. It is used to fill three identical bottles. Each bottle is used to fill four cups. What fraction of the milk in the can does each cup contain?

Each bottle of $\frac{1}{3}$ has 2 litres.

That is, $\frac{2}{3}$ litre.

The glass contains $\frac{1}{4}$ of this.

That is $\frac{1}{4}$ of $\frac{2}{3}$ litre.

How do we calculate this?

$\frac{2}{3}$ means $\frac{1}{3}$ of 2.

So, $\frac{1}{4}$ of $\frac{2}{3}$ means $\frac{1}{4}$ of $\frac{1}{3}$ of 2.

$\frac{1}{4}$ of $\frac{1}{3}$ is $\frac{1}{4} \times \frac{1}{3} = \frac{1}{4 \times 3} = \frac{1}{12}$

So, $\frac{1}{4}$ of $\frac{2}{3}$ is $\frac{1}{12}$ of 2.

That is,

$$\frac{1}{12} \times 2 = \frac{2}{12} = \frac{1}{6}$$

Thus the glass has $\frac{1}{6}$ litre of milk.

Here, we calculated $\frac{1}{4}$ of $\frac{2}{3}$.

Thus we can write $\frac{1}{4} \times \frac{2}{3}$.

So,

$$\frac{1}{4} \times \frac{2}{3} = \frac{2}{12} = \frac{1}{6}$$

And how did we calculate this?

$$\frac{2}{3} \times \frac{1}{4} = 2 \times \frac{1}{3} \times \frac{1}{4}$$

$$= 2 \times \frac{1}{3 \times 4}$$

$$= 2 \times \frac{1}{12}$$

$$= \frac{2}{12} = \frac{1}{6}$$

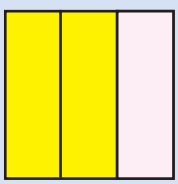
Another problem:

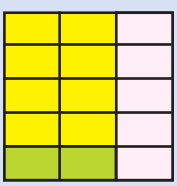
$\frac{1}{2}$ kilogram of rice is equally filled in 4 bags. If we take 3 such bags together, how much rice do we get?

Each bag has $\frac{1}{4}$ of $\frac{1}{2}$ kilograms.

Square math

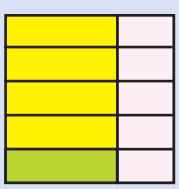
A square is vertically divided into three equal parts.





Again, it is horizontally divided into five equal parts.

The part of the picture coloured green is $\frac{2}{15}$ of the whole square. And also $\frac{1}{5}$ of the part coloured yellow.



Thus $\frac{1}{5}$ of $\frac{2}{3}$ is,

$$\frac{2}{3} \times \frac{1}{5} = \frac{2}{15}$$

That is, $\frac{1}{4} \times \frac{1}{2} = \frac{1}{4 \times 2} = \frac{1}{8}$

3 bags contain 3 times as much; $3 \times \frac{1}{8} = \frac{3}{8}$

Three bags contain $\frac{3}{8}$ kilograms (375 grams).

One bag contains a quarter of half kilogram. Three such bags make three quarters of half kilogram.

Thus we see that $\frac{3}{4}$ of $\frac{1}{2}$ is $\frac{3}{8}$.

As multiplication, $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.

Look again at the way we calculated this:

$$\frac{3}{4} \times \frac{1}{2} = 3 \times \frac{1}{4} \times \frac{1}{2}$$

$$= 3 \times \frac{1}{4 \times 2}$$

$$= 3 \times \frac{1}{8} = \frac{3}{8}$$

Can you find $\frac{2}{5}$ of $\frac{1}{3}$ metre like this?

We divide $\frac{1}{3}$ metre into 5 equal parts and put 2 such pieces end to end. What is this length?

2 times $\frac{1}{5}$ of $\frac{1}{3}$ metre.

As multiplication,

$$\frac{2}{5} \times \frac{1}{3} = 2 \times \frac{1}{5} \times \frac{1}{3}$$

$$= 2 \times \frac{1}{15}$$

$$= \frac{2}{15}$$

Now how do we find $\frac{4}{5}$ of $\frac{2}{3}$?

First find $\frac{1}{5}$ of $\frac{2}{3}$ and then 4 times this.

How do we find the $\frac{1}{5}$ of $\frac{2}{3}$ in this?

We have to find $\frac{1}{5}$ of $\frac{1}{3}$ of 2.

$$\frac{1}{5} \times \frac{2}{3} = \frac{1}{5} \times \frac{1}{3} \times 2 = \frac{1}{5 \times 3} \times 2 = \frac{1}{15} \times 2 = \frac{2}{15}$$

Now we need only find 4 times $\frac{2}{15}$.

$$4 \times \frac{2}{15} = \frac{8}{15}$$

If we do all multiplication only at the end, we write

$$\frac{4}{5} \times \frac{2}{3} = 4 \times \frac{1}{5} \times \frac{1}{3} \times 2$$

$$= 4 \times \frac{1}{5} \times \frac{1}{3} \times 2$$

$$= 4 \times \frac{1}{5 \times 3} \times 2$$

$$= \frac{4 \times 2}{5 \times 3}$$

$$= \frac{8}{15}$$

Can't we find $\frac{4}{9}$ of $\frac{3}{5}$ like this?

$$\frac{4}{9} \times \frac{3}{5} = \frac{4 \times 3}{9 \times 5} = \frac{12}{45} = \frac{4}{15}$$

Another way

We can do $\frac{4}{9} \times \frac{3}{5}$ like this also.

$$\frac{4}{9} \times \frac{3}{5} = \frac{4 \times 3}{9 \times 5} = \frac{4 \times 3}{3 \times 3 \times 5}$$

$$= \frac{4}{3 \times 5} = \frac{4}{15}$$

1. Draw the line AB, 12 centimetres long. Mark C on it such that AC is $\frac{2}{3}$ of AB. Mark D such that AD is $\frac{1}{4}$ of AC. What fraction of AB is AD?

2. A two metre long rope is cut into five equal pieces. What is the length of three quarters of one piece? How many centimetres is this?

3. Three litres of water is used to fill four identical bottles. One bottle is ued to fill five identical cups. How much water is in one cup? How many millilitres is this?

4. A five kilogram pumpkin is cut into five equal pieces. Each piece is further cut into two. What is the weight of each such piece? How many grams is this?

5. Calculate each of the following using multiplication.

   (i) $\frac{3}{7}$ of $\frac{2}{5}$ (ii) $\frac{3}{5}$ of $\frac{2}{7}$

   (iii) $\frac{2}{3}$ of $\frac{3}{4}$ (iv) $\frac{5}{6}$ of $\frac{3}{10}$

Part in times

A bottle can hold one and a half litres of water. Four such bottles of water is poured into a jar. How much water is there in the jar?

Two bottles make three litres; four bottles, six litres.

Here, what we calculate is 4 time $1\frac{1}{2}$.

As multiplication, we write

$$4 \times 1\frac{1}{2} = 6$$

Suppose we pour in 3 bottles containing $2\frac{1}{4}$ litres each.

If they were 2 litre bottles, we would have got 6 litres. Here each bottle contain $\frac{1}{4}$ litre more.

So, we have to add $\frac{3}{4}$ litres more; that is $6\frac{3}{4}$ litres.

How about writing this as multiplication?

$$\begin{aligned} 3 \times 2\frac{1}{4} &= 3 \times \left(2 + \frac{1}{4}\right) \\ &= (3 \times 2) + \left(3 \times \frac{1}{4}\right) \\ &= 6 + \frac{3}{4} = 6\frac{3}{4} \end{aligned}$$

We can do this in another way. We can write $2\frac{1}{4}$ litres as $\frac{9}{4}$ litres; that is, $\frac{1}{4}$ of 9 litres. We want to calculate 3 times this.

So,

$$\begin{aligned} 3 \times 2\frac{1}{4} &= 3 \times \frac{9}{4} \\ &= \frac{27}{4} = 6\frac{3}{4} \end{aligned}$$

In this way, we can calculate 5 times $3\frac{1}{2}$:

$$\begin{aligned} 5 \times 3\frac{1}{2} &= 5 \times \frac{7}{2} \\ &= \frac{5 \times 7}{2} \\ &= \frac{35}{2} = 17\frac{1}{2} \end{aligned}$$

Let's look at another thing.

Six metres is three times two metres.

What about seven metres?

Three times two metres and then one more metre. In other words, three times two metres and then half of two metres.

So, we can say seven metres is three and a half times two metres.

Written as multiplication,

$$3\frac{1}{2}\times 2=\left(3+\frac{1}{2}\right)\times 2=(3\times 2)+\left(\frac{1}{2}\times 2\right)=6+1=7$$

In the same way, two and a quarter times five means, two times five and a quarter of five together; that is ten with one and a quarter, which makes eleven and a quarter.

$$\begin{aligned}2\frac{1}{4}\times 5 &= \left(2+\frac{1}{4}\right)\times 5\\ &= (2\times 5)+\left(\frac{1}{4}\times 5\right)\\ &= 10+1\frac{1}{4}\\ &= 11\frac{1}{4}\end{aligned}$$

We can also do it like this:

$$\begin{aligned}2\frac{1}{4}\times 5 &= \frac{9}{4}\times 5\\ &= \frac{9\times 5}{4}\\ &= \frac{45}{4}=11\frac{1}{4}\end{aligned}$$

Now let's see how we can calculate $3\frac{1}{2}$ times $2\frac{1}{4}$

$$3\frac{1}{2}\times 2\frac{1}{4}=\frac{7}{2}\times\frac{9}{4}=\frac{63}{8}=7\frac{7}{8}$$

We can calculate 3 times $2\frac{1}{4}$ and $\frac{1}{2}$ of $2\frac{1}{4}$ separately and add.

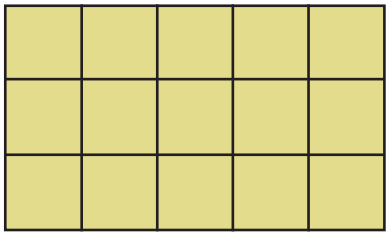
1. $1\frac{1}{2}$ metres of cloth is needed for a shirt. How much cloth is needed for five such shirts?
2. The price of one kilogram of okra is 30 rupees. What is the price of $2\frac{1}{2}$ kilograms?
3. A man walks one and a half kilometres in one hour. How many kilometres does he walk in one and a half hours at this speed?
4. Rony has 36 stamps. Zaheera says she has $2\frac{1}{4}$ times as much. How many stamps does she have?
5. Calculate the following:

   (i) 4 times $5\frac{1}{3}$ (ii) 4 $\frac{1}{3}$ times 5

   (iii) $1\frac{1}{2}$ times $\frac{2}{3}$ (iv) $\frac{2}{5}$ of $2\frac{1}{2}$

   (v) $2\frac{1}{2}$ times $5\frac{1}{2}$ (vi) 4 $\frac{1}{3}$ of $4\frac{1}{2}$

Fractional area

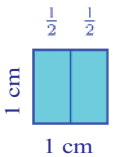


You have learnt about area of rectangles in class 5.

What is the area of a rectangle of length 5 centimetres and breadth 3 centimetres, in square centimetres.

The area of a square of side one centimetre is one square centimetre, isn't it? How do we measure the area of smaller rectangles?

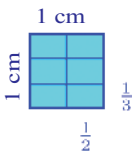
Look at this picture:



A square of side one centimetre is divided into two equal parts. Each such rectangle is $\frac{1}{2}$ of the square.

So, we can say each has area $\frac{1}{2}$ square centimetre.

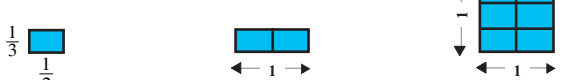
What are the lengths of its sides?



Now suppose we divide our square again into three equal parts.

Each rectangle is $\frac{1}{6}$ of the whole square; its area is $\frac{1}{6}$ square centimetre. Thus the area of a rectangle of sides $\frac{1}{2}$ centimetre and $\frac{1}{3}$ centimetre are $\frac{1}{6}$ square centimetre.

We can see this in another way. We can make a square of side 1 centimetre, by stacking 6 rectangles of sides $\frac{1}{2}$ centimetre and $\frac{1}{3}$ centimetre.

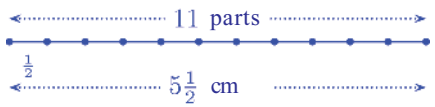


What is the area of a rectangle of length $5\frac{1}{2}$ centimetre and breadth $3\frac{1}{3}$ centimetre?

We first divide the bottom side into $\frac{1}{2}$ centimetre parts.

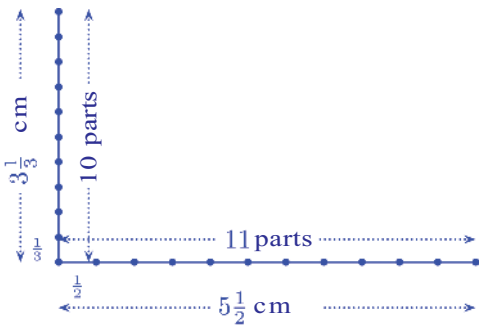
How many parts do we get?

10 lines of $\frac{1}{2}$ centimetres make 5 centimetres; to get $5\frac{1}{2}$ centimetres, we need one more

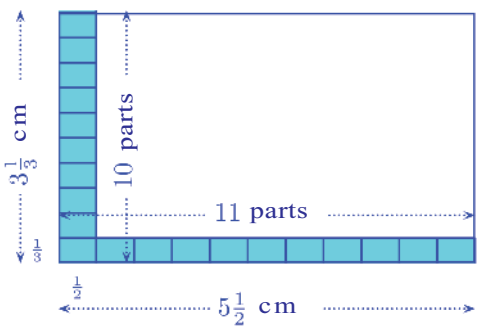


Next, we divide the left side of the rectangle into $\frac{1}{3}$ centimetre parts.

9 lines of $\frac{1}{3}$ centimetre make 3 centimetres; to get $3\frac{1}{3}$ centimetre, we need one more

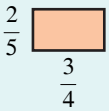


Thus we can fill part of the rectangle using rectangles of sides $\frac{1}{2}$ centimetre and $\frac{1}{3}$ centimetre.

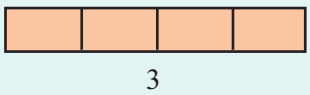


Area again!

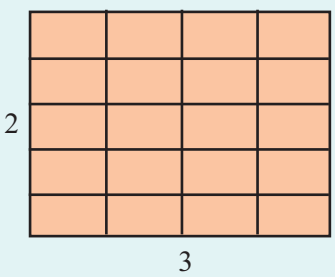
What is the area of a rectangle of sides $\frac{3}{4}$ centimetre and $\frac{2}{5}$ centimetre?



Placing 4 of them side by side we get a rectangle like this;



Stacking 5 such rectangles one over another, we get a larger rectangle;



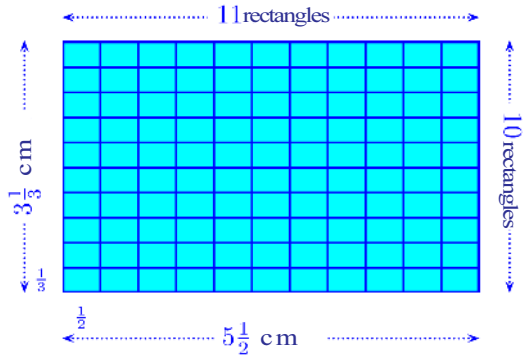
What is the area of this rectangle?
How many small rectangles are in it?
So, what fraction of the whole rectangle is each small rectangle?
Thus we see that the area of each small reactangle is $\frac{1}{20}$ of 6 square centimetres.
How much is it?

$$6 \text{ sq.cm} \times \frac{1}{20} = \frac{6}{20} \text{ sq.cm.}$$

This we can simplify as $\frac{3}{10}$ square centimetre.

Any way, the area is $\frac{3}{4} \times \frac{2}{5}$, isn't it?

How many such rectangles do we need to fill the whole large rectangle?



$11 \times 10 = 110$ rectangles in all; the area of each is $\frac{1}{6}$ square centimetre. Total area is

$$\frac{1}{6} \times 110 = \frac{55}{3} = 18\frac{1}{3} \text{ square centimetre}$$

Here, we calculated $\frac{1}{6} \times 11 \times 10$. This can write like this;

$$\frac{1}{6} \times 11 \times 10 = \frac{1}{2} \times \frac{1}{3} \times 11 \times 10 = \frac{11}{2} \times \frac{10}{3} = 5\frac{1}{2} \times 3\frac{1}{3}$$

So, the area of a rectangle is the product of length and breadth, even if they are fractions.

1. The length and breadth of some rectangles are given below. Calculate their areas.

   (i) $4\frac{1}{2}$ cm, $3\frac{1}{4}$ cm

   (ii) $6\frac{3}{4}$ m, $5\frac{1}{3}$ m (iii) $1\frac{1}{3}$ m, $\frac{3}{4}$ m

2. What is the area of a square of side $1\frac{1}{2}$ metre?

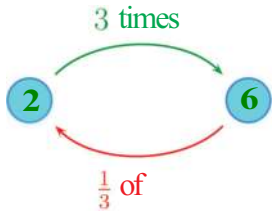
3. The perimeter of a square is 14 metres. What is its area?

Back and forth

A small jar can hold 2 litres of water and a large jar, 6 litres. So, the large jar can hold 3 times as much as the small one.

Saying it in reverse, the small jar can hold $\frac{1}{3}$ as much as the large one.

That is 3 times 2 is 6; on the other hand, $\frac{1}{3}$ of 6 is 2.



What about a jar of 4 litres and a jar of 6 litres?

How much times 4 is 6?

4 and its half 2 make 6; that is

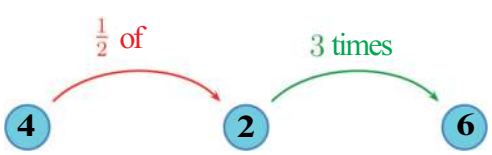
6 is $1\frac{1}{2}$ times 4.

How do we say it in reverse?

Let's think like this.

$1\frac{1}{2}$ means 3 times $\frac{1}{2}$. So $1\frac{1}{2}$ times 4 means 3 times $\frac{1}{2}$ of 4.

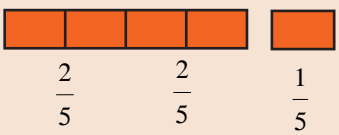
$\frac{1}{2}$ of 4 is 2, and 3 times 2 is 6.



Take a strip of paper and cut it into 5 equal parts.

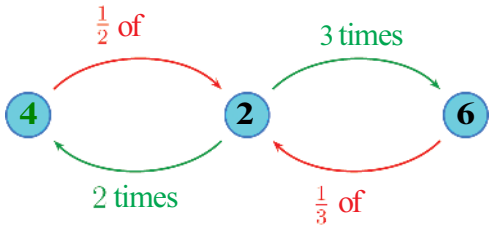
Take two such pieces and put them together?

It is $\frac{2}{5}$ of the strip. Take two more pieces and put them together with the first two.



Now we have two $\frac{2}{5}$'s. That is, two times $\frac{2}{5}$. What remain is half of $\frac{2}{5}$. Put it also with the others. Then we have 2 times $\frac{2}{5}$ and $\frac{1}{2}$ of $\frac{2}{5}$; that is $2\frac{1}{2}$ times. This is the whole strip. What do we see here?

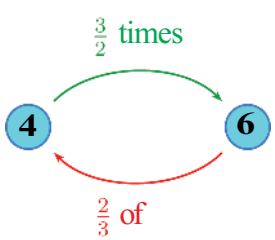
So in reverse, we can take $\frac{1}{3}$ of 6 to get 2 and then 2 times 2 to get 4.



Thus 4 is 2 times $\frac{1}{3}$ of 6; that is $\frac{2}{3}$ of 6.

How about combining all these?

3 times $\frac{1}{2}$ is $\frac{3}{2}$ times; 2 times $\frac{1}{3}$ to $\frac{2}{3}$.



Writing these as multiplication,

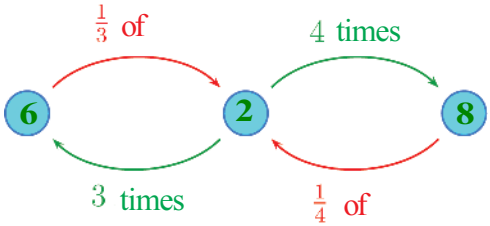
$$\frac{3}{2} \times 4 = 6 \qquad \frac{2}{3} \times 6 = 4$$

Let's look at another such calculation: 6 and its one third, that is 2, make 8; that is, 8 is $1\frac{1}{3}$ of 6.

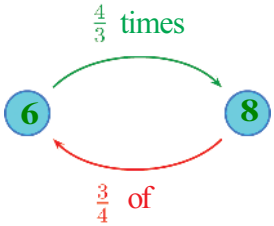
We can also say like this: $\frac{1}{3}$ of 6 is 2 and 4 times 2 is 8.

How do we say in reverse?

$\frac{1}{4}$ of 8 is 2 and 3 times 2 is 6.



Let's put these together:



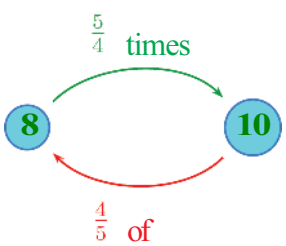
And we can write the multiplications

$\frac{4}{3} \times 6 = 8$ $\qquad$ $\frac{3}{4} \times 8 = 6$

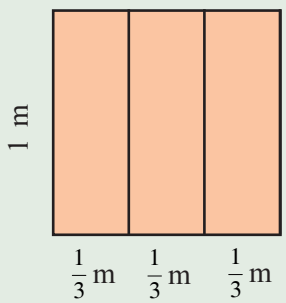
One more calculation: 8 and its $\frac{1}{4}$, that is 2, make 10; that is, 10 is $1\frac{1}{4}$ times 8.

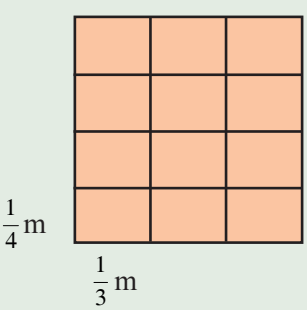
We can say $\frac{5}{4}$ instead of $1\frac{1}{4}$. Thus 10 is $\frac{5}{4}$ times 8.

In reverse, 8 is 4 times $\frac{1}{5}$ of 10.

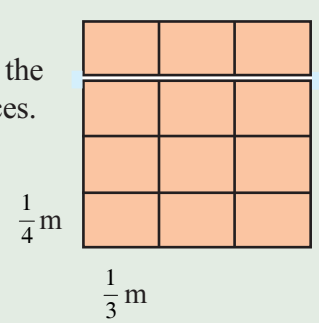


A square of side 1 metre can be divided vertically into 3 equal parts and horizontally into 4 equal parts.

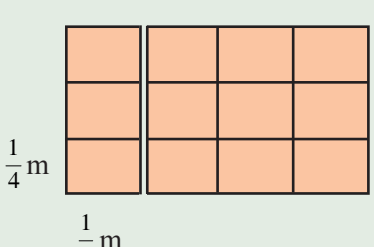




Now cut out the top three pieces.



Stack these pieces on the left as below:



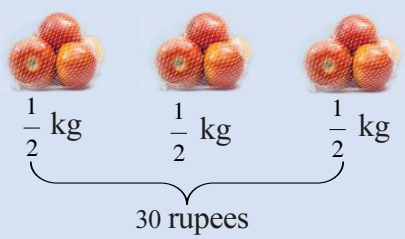
What are the length and breadth of this rectangle? And its area?

$$\frac{5}{4} \times 8 = 10, \qquad \frac{4}{5} \times 10 = 8$$

Did you notice something in all these?

To say in reverse, we need only turn the fraction upside down.

Instead of saying "turn the fraction upside down", we can say, "interchanging the numerator and denominator". The fraction thus got is called the reciprocal.



Price of $1\frac{1}{2}$ kilogram is 30 rupees.

Price of $\frac{1}{2}$ kilogram is 10 rupees.

Price of 1 kilogram is 20 rupees.

Now look at this problem:

The price of $1\frac{1}{2}$ kilogram of tomatoes is 30 rupees. What is the price of one kilogram?

There are several ways to do this. One way is this

- $1\frac{1}{2}$ is 3 times $\frac{1}{2}$
- The price of $1\frac{1}{2}$ kilogram of tomatoes is 3 times that of $\frac{1}{2}$ kilograms.
- The price of $\frac{1}{2}$ kilogram is $30 \div 3 = 10$ rupees.
- The price of 1 kilogram is $2 \times 10 = 20$ rupees.

We can also think like this.

- 2 times $1\frac{1}{2}$ is 3.
- The price of 3 kilograms is $2 \times 30 = 60$ rupees.
- The price of 1 kilogram is $60 \div 3 = 20$ rupees.

We can do this directly, using reciprocal:

- 30 rupees is $\frac{3}{2}$ times the price of 1 kilogram.
- The price of 1 kilogram is $\frac{2}{3}$ of 30 rupees.
- $30 \times \frac{2}{3} = 20$ rupees.

1. The length of one string is 4 metres and the length of another string is 14 metres.
   (i) What fraction of the longer string is the shorter string?
   (ii) How much times of the shorter string is the longer string?
2. One iron block weighs 6 kilogram and another, 26 kilogram.
   (i) What fraction of the weight of the heavier block is the lighter block?
   (ii) How much times of the weight of the lighter block is the heavier block?
3. A pumpkin is cut into three equal pieces. Two pieces together weigh one kilogram. What is the weight of the whole pumpkin?
4. $1\frac{1}{2}$ litres of water is needed to fill $\frac{3}{4}$ of a can. How much water is needed to fill it completely?
5. There are three pieces of ribbon. Two of the pieces and half the third piece, laid end to end, make one metre. What is the length of a piece, in centimetres?

Fraction division

The area of a rectangle is 85 squaremetre and the length of one of its sides is 5 metres. What is the length of the other side?

We want to find out which number should be multiplied by 5 to get 85.

For that, we should divide 85 by 5.

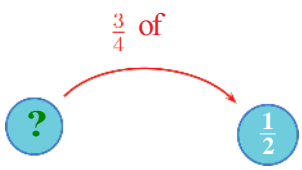
$$85 \div 5 = 17$$

So, the other side is of length 17 metres.

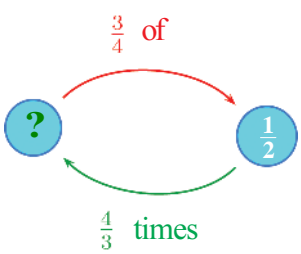
Suppose the question is like this:

The area of a rectangle is $\frac{1}{2}$ squaremetre and the length of one side is $\frac{3}{4}$ metre. What is the length of the other side?

We have seen that area of a rectangle is the product of the length of the sides, even if they are fractions. So in this problem, $\frac{3}{4}$ multiplied by some number gives $\frac{1}{2}$. What is this number?



We can use reciprocal to reverse this. The number is $\frac{4}{3}$ times $\frac{1}{2}$.



That is,

$$\frac{1}{2} \times \frac{4}{3} = \frac{2}{3}$$

Thus the other side is $\frac{2}{3}$ metre.

Here we see that $\frac{2}{3}$ is the number which should be multiplied by $\frac{3}{4}$ to get $\frac{1}{2}$.

As in the case of natural numbers, we write this also as division.

$$\frac{1}{2} \div \frac{3}{4} = \frac{2}{3}$$

Let's look at another problem:

To fill $\frac{3}{4}$ of a vessel, $1\frac{1}{2}$ litres of water is needed.

How much water would it be, if it is completely filled?

We an think in terms of reciprocals. $\frac{3}{4}$ of the vessel is $1\frac{1}{2}$ litres. The full vessel is $\frac{4}{3}$ times $1\frac{1}{2}$ litre.

$$1\frac{1}{2} \times \frac{4}{3} = 2$$

We can also think like this: The problem says the capacity of the vessel, multiplied by $\frac{3}{4}$ gives $1\frac{1}{2}$. So the question is, by what number $\frac{3}{4}$ should be multiplied to get $1\frac{1}{2}$. And it is easy to see that it is 2.

This also, we can write as division:

$$1\frac{1}{2} \div \frac{3}{4} = 2$$

Generally speaking, division by a fraction is just multiplication by the reciprocal.

Let's look at a few more examples:

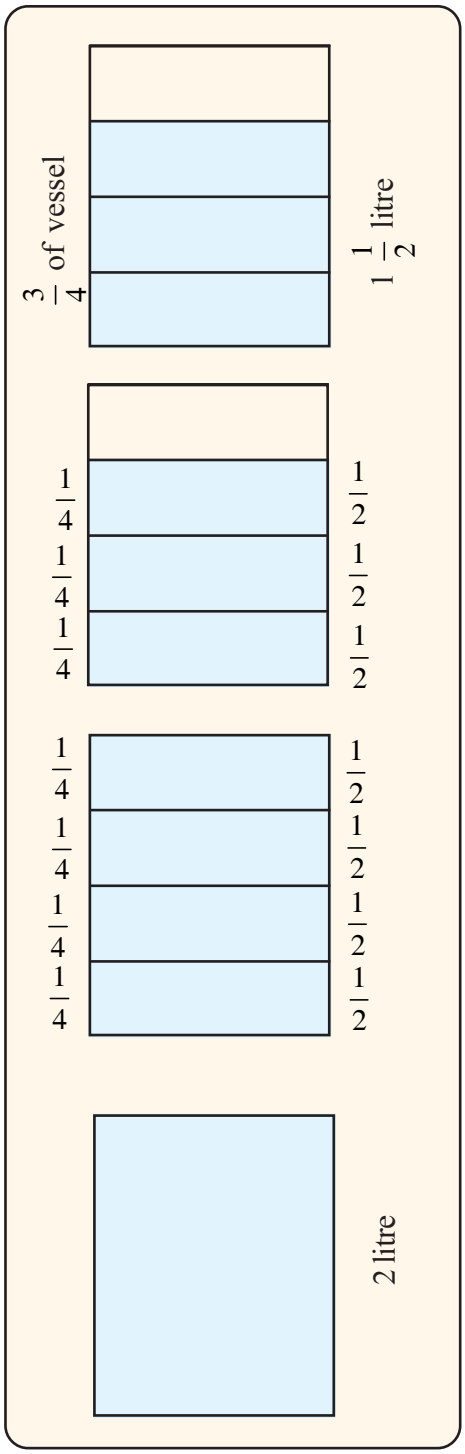
A 10 metre string can be cut into how many $\frac{1}{2}$ metre pieces?

The question is, how many times $\frac{1}{2}$ is 10.

We can easily see that it is 20 times.

Thus there are 20 pieces of string.

We can also think like this: One piece is $\frac{1}{2}$ metre; so the total length of 10 metres is half the number of pieces.



So the question is this:

$\frac{1}{2}$ of a number is 10; what is the number?

The number is 2 times 10, that is 20.

We can also put it as a division:

Which number multiplied by $\frac{1}{2}$ gives 10?

To get the number, 10 must be divided by $\frac{1}{2}$.

$$10 \div \frac{1}{2} = 10 \times \frac{2}{1} = 20$$

Now look at this problem:

12 litres of oil is to be stored in $\frac{3}{4}$ litre bottles. How many bottles are needed?

Each bottle is $\frac{3}{4}$ litre. So 12 litres is $\frac{3}{4}$ of the number of bottles. If we think like this, the question becomes this:

$\frac{3}{4}$ of a number 12; what is the number?

We can use reciprocal to find the number.

$$12 \times \frac{4}{3} = 16$$

So, 16 bottles are needed.

We can also think in terms of division?

What number multiplied by $\frac{3}{4}$ gives 12?

And the method of finding the number like this:

$$12 \div \frac{3}{4} = 12 \times \frac{4}{3} = 16$$

Now describe each of these problems either using division or reciprocals and find the answer.

(1) A 16 metre rod is cut into $\frac{2}{3}$ metre pieces. How many pieces do we get?

(2) $5\frac{1}{4}$ litres of water is to be stored in $\frac{3}{4}$ litre bottles. How many bottles do we need?

(3) $12\frac{1}{2}$ kilograms of sugar is to be packed in $2\frac{1}{2}$ kilogram bags. How many bags do we need?

(4) The area of a rectangle is $12\frac{1}{2}$ square centimetres and the length of one of its sides is $3\frac{3}{4}$ centimetres. What is the length of the other side?

(5) From $11\frac{1}{2}$ metre rope, $2\frac{1}{2}$ metre pieces are cut out. How many pieces do we get? What is the length of the remaining piece?

Looking back

Learning outcomes	What I can	With teacher's help	Must Improve
• Describing times and part as multiplication.			
• Explaining the multiplication of a natural number and fraction as times or part and finding the product.			
• Explaining multiplication of fraction as part of part and finding the product.			
• Justifying the method of calculating the area of rectangles with fractions as lengths of sides.			
• Using reciprocals in stating times or part in reverse.			
• Interpreting multiplication by reciprocal as division.			
• Solving practical problems involving multiplication and division of fraction.			

4 Volume

Large and small

Athira has collected many things and has arranged them into different lots.

Look at two things from the first lot.

Which is bigger?

How did you find out?

Now look at two things from the second lot:

How do we find out which is bigger?

To find out the bigger of two sticks, we need only measure their lengths.

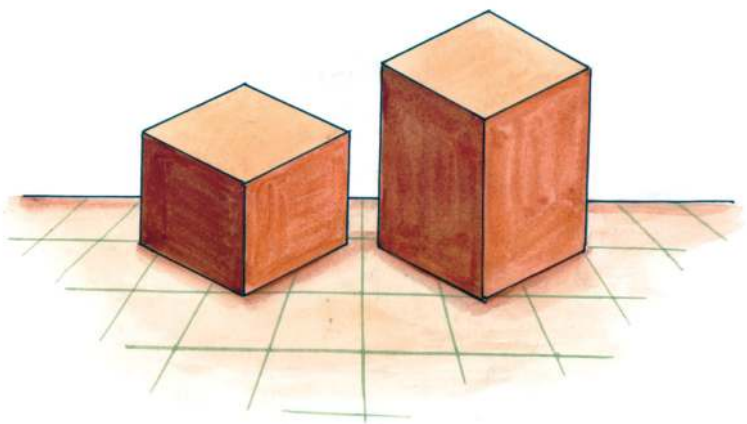
What about two rectangles?

We have to calculate their area, right?

Rectangle blocks

Look at two wooden blocks from Athira's collection.

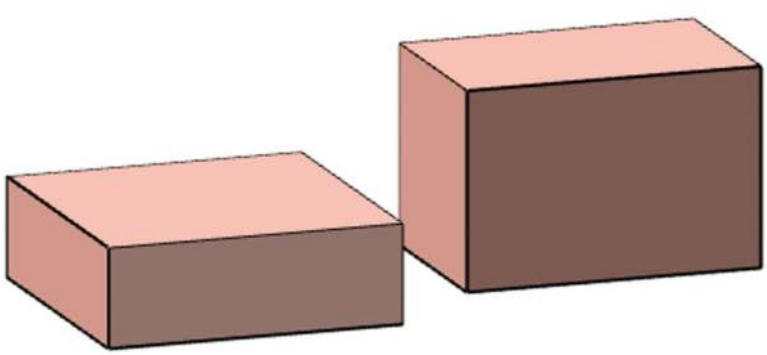
Which is larger?



How did you decide?

Now look at these two.

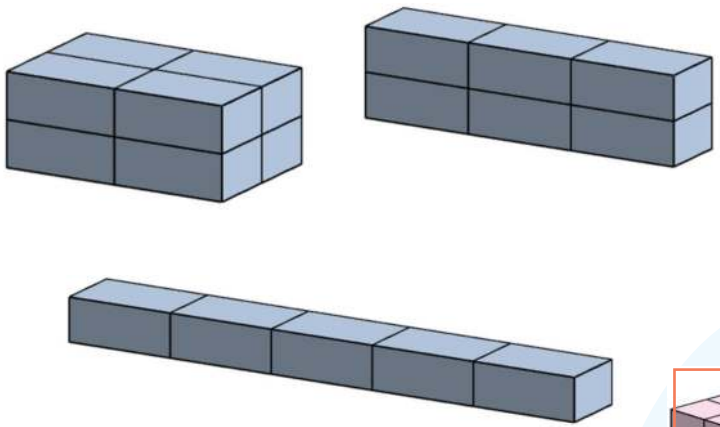
Which is larger?



Let's see how we can decide.

Size of a rectangle block

Look at these rectangular blocks:



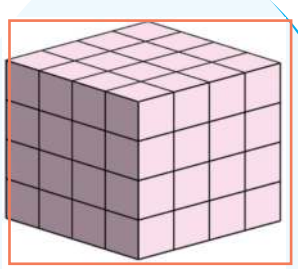
They are all made by stacking smaller blocks of the same size.

Which of them is the largest?

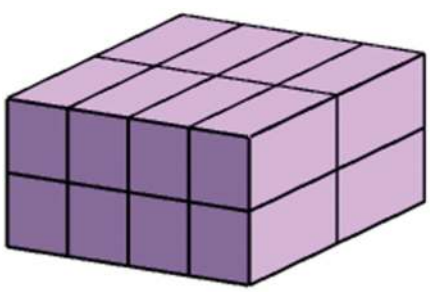
We need only count the little blocks in each, right?

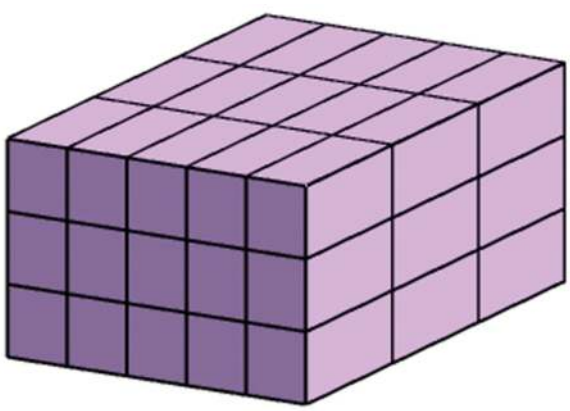
Can you find how many little blocks make up each of large blocks below?

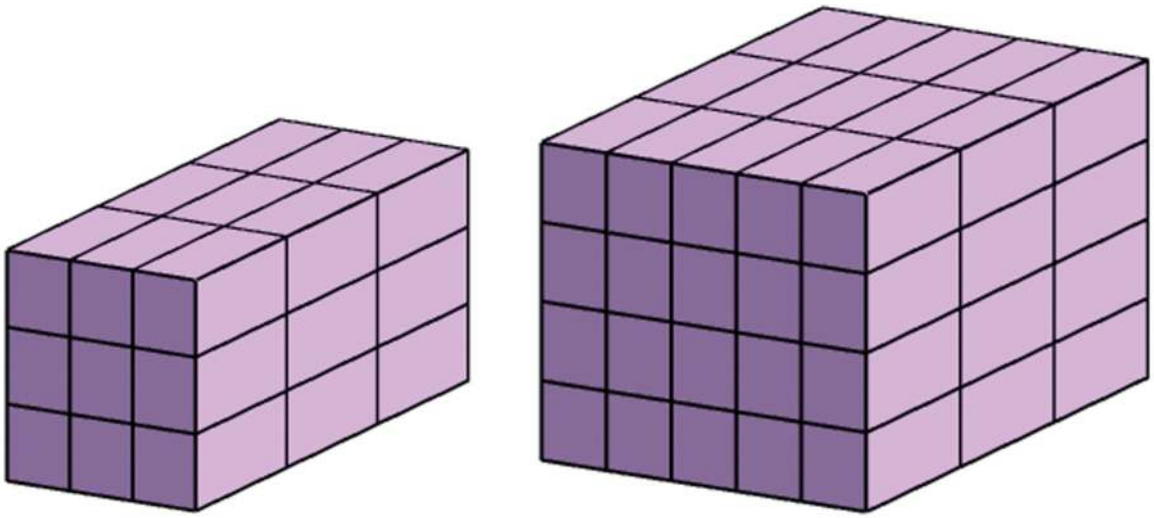
Is there a quick way to find the number of little blocks in each, without actually counting all?



This rectangular block contains 64 smaller blocks. If one small block is removed from each corner of the large block above, how many would be left?



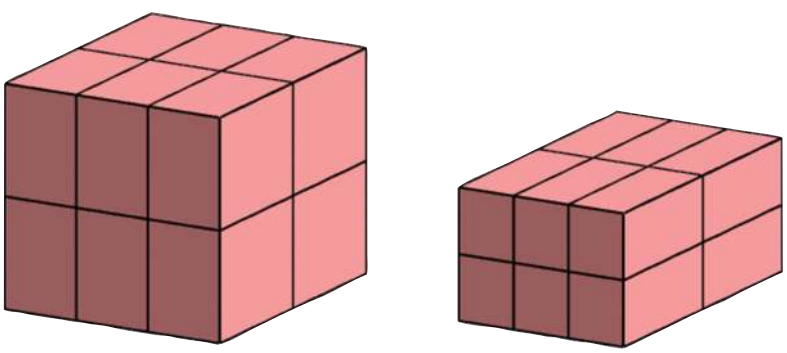




Which of these is the largest?

And the smallest?

Look at these blocks:



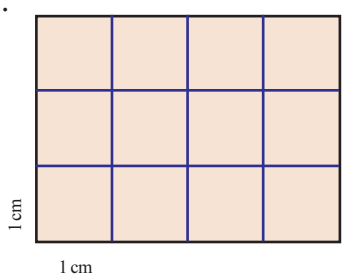
How many small blocks are there in each?

Do they have the same size?

To compare sizes by just counting, what kind of little blocks should be used in both?

Size as number

Look at this picture:



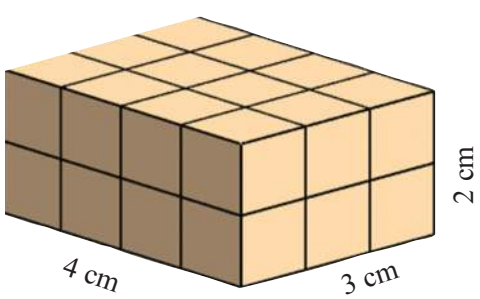
What is the area of the rectangle?

How many small squares of side 1 centimetre are in it?

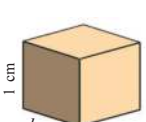
$$4 \times 3 = 12$$

The area of a square of side 1 centimetre is 1 square centimetre; the area of the whole rectanlge is 12 square centimetres.

Now look at the rectangular block:



It is made by stacking cubes of side 1 centimetre.



How many?

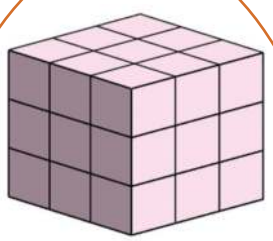
So, the size of this block is equal to 24 such cubes.

Size measured like this is called volume in mathematics.

We say that a cube of length, breadth and height 1 centimetre has a volume of 1 cubic centimetre.

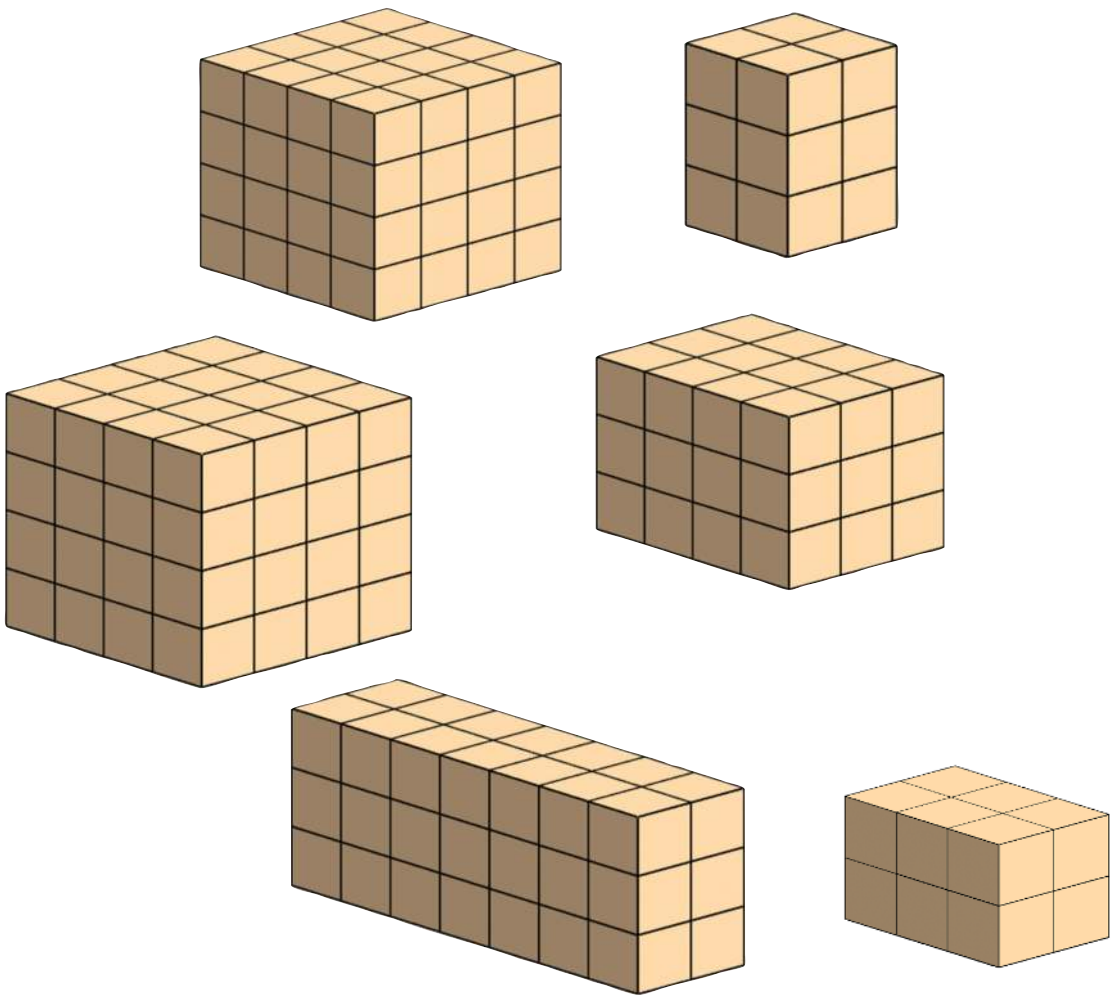
24 such cubes make up the large block in the picture.

Its volume is 24 cubic centimetre.



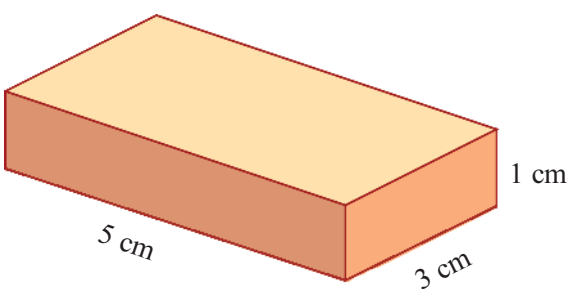
All sides of the large cube shown above are painted. How many small cubes would have no paint at all?

All blocks shown below are made up of cubes of side 1 centimetre.
Calculate the volume of each:



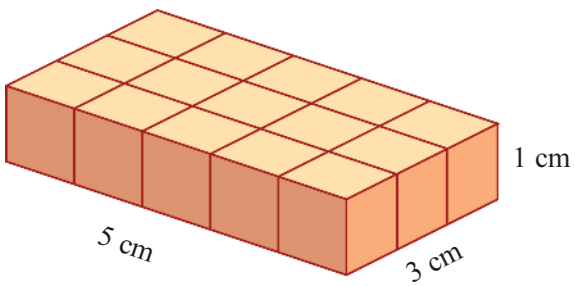
Volume calculation

See this rectangular block:



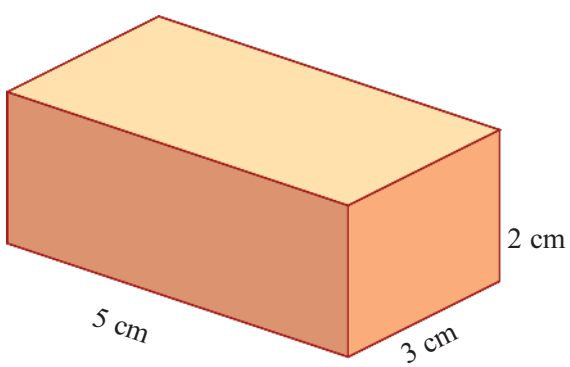
How do we calculate its volume?

For that, we must find out how many cubes of side 1 centimetre we need to make it.

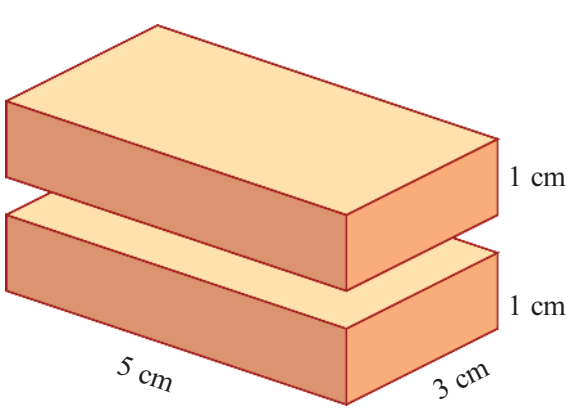


So, its volume is 15 cubic centimetres.

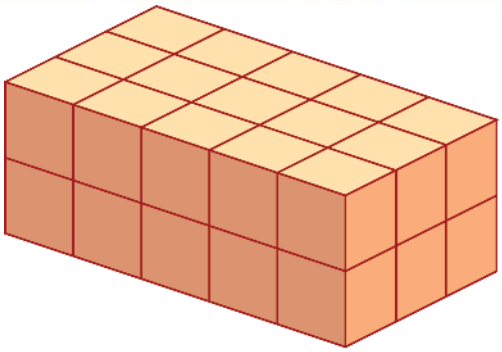
What about this block?



This can be made by stacking one over another, two blocks seen first:

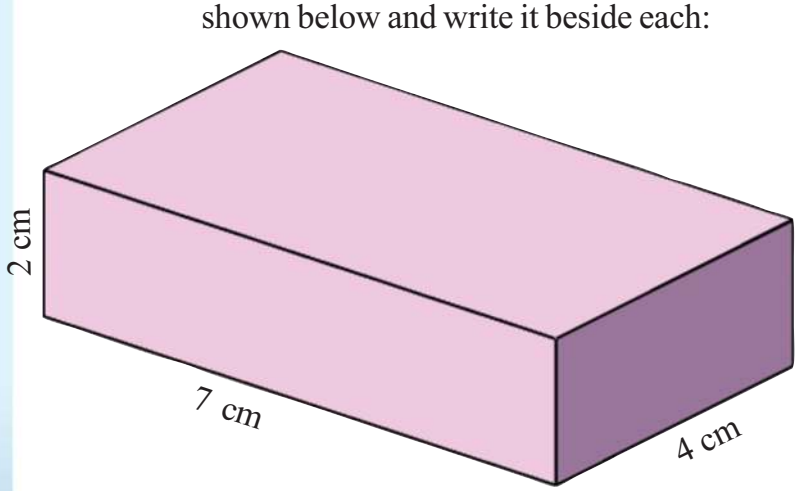


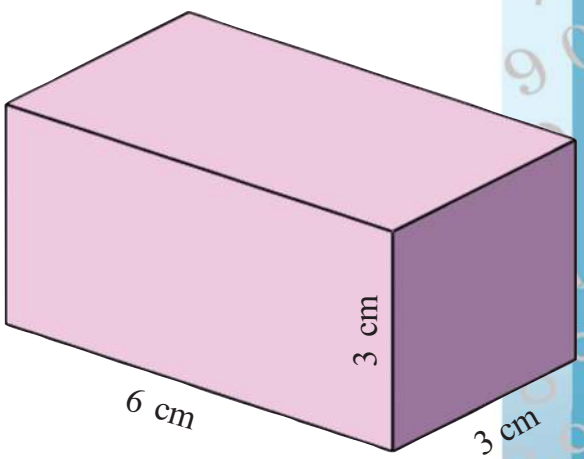
So, to make it, how many cubes of side 1 centimetre do we need?

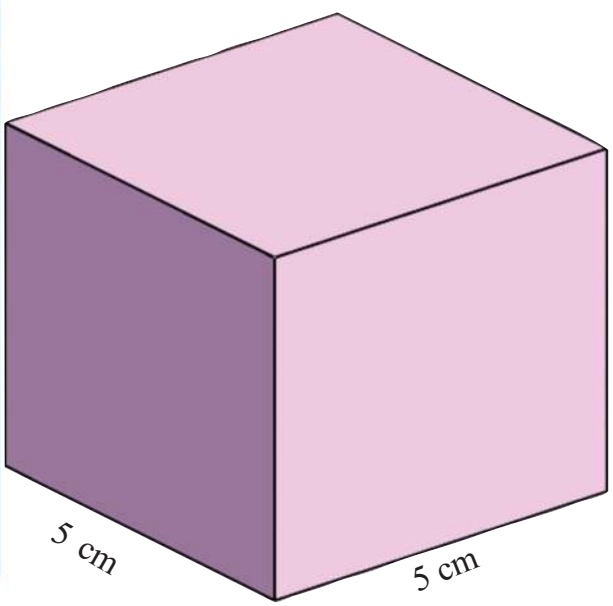


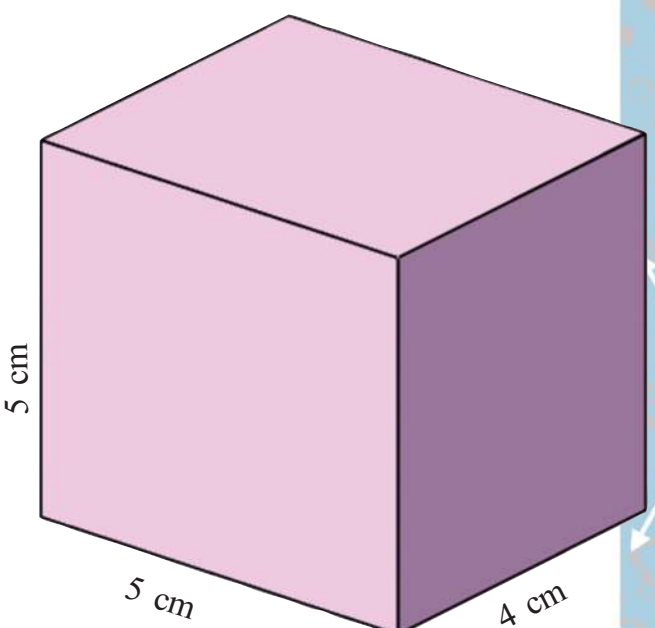
Thus the volume of this block is 30 cubic centimetres.

Like this, calculate the volume of each of the rectangular blocks shown below and write it beside each:









So, now, you know how to calculate the volume of a rectangular block, dont' you?

The volume of a rectangular block is the product of its length, breadth and height.

1. The length, breadth and height of a brick are 21 centimetres, 15 centimetres and 7 centimetres. What is its volume?
2. A rectangular cube of iron is of side 8 centimetres. What is its volume? 1 cubic centimetre of iron weighs 8 grams. What is the weight of the large cube?

Volume and length

A wooden block of length 8 centimetres and breadth 4 centimetres has a volume of 180 cubic centimetres. What is its height?

Volume is the product of length, breadth and height.

So in this problem, the product of 9 and 4 multiplied by the height is 180.

That is, 36 multiplied by the height gives 180.

So to find out the height, we need only divide 180 by 36.

The table shows measurement of some rectangular blocks. Calculate the missing measures.

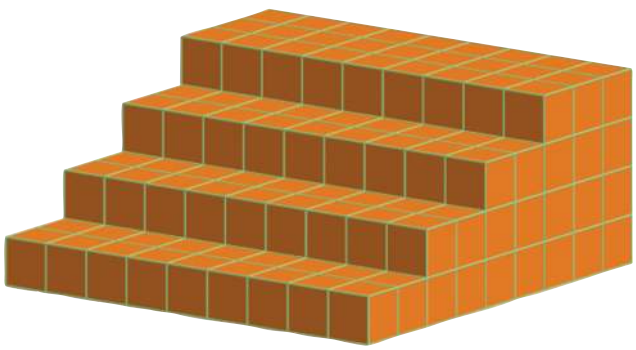
Area and volume

What is the area of a rectangle of length 8 centimetres and breadth 2 centimetres? What about the volume of a rectangular block of length 8 centimetres, breadth 2 centimetres and height 1 centimetre?

	Length	Breadth	Height	Volume
1	3 cm	8 cm	7 cm	 cc
2	6 cm	4 cm	5 cm	 cc
3	6 cm	4 cm	... cm	48 cc
4	8 cm	... cm	2 cm	48 cc
5	... cm	2 cm	2 cm	48 cc
6	... cm	2 cm	4 cm	80 cc
7	14 cm	... cm	5 cm	210 cc

New shapes

We can make shapes other than rectangular block, by stacking cubes. For example, see this:



It is made by stacking cubes of side 1 centimetre. Can you calculate its volume?

How many cubes are there at the very bottom?

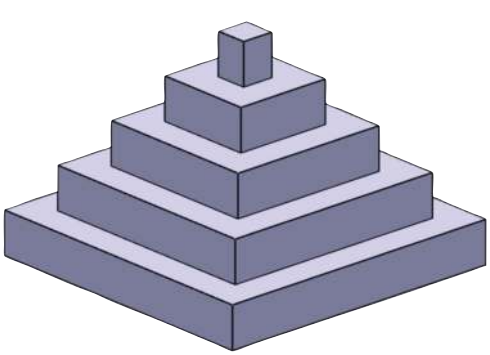
And in the step just above it?

Thus we can count the number of cubes in each step.

How many cubes in all?

What is the volume of the stairs?

Now look at this figure:



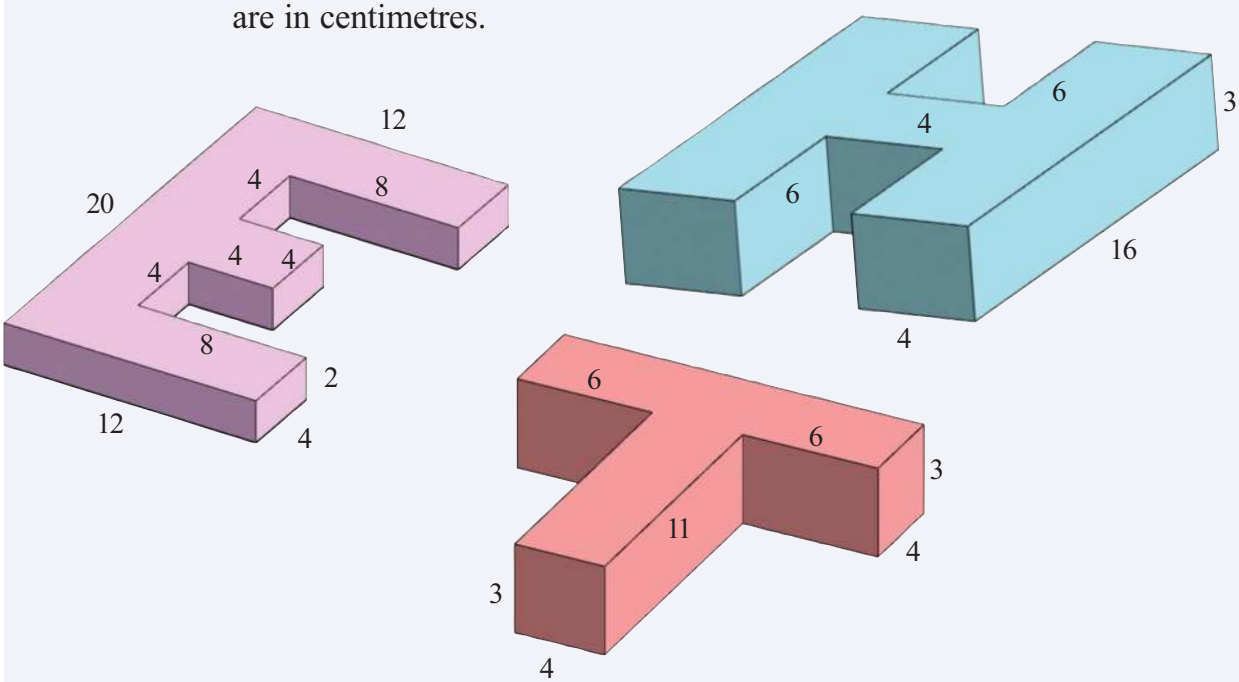
What is the volume of a rectangular block of length 4 centimetre, breadth 3 centimetre and height 1 centimetre? If the length, breadth and height are doubled, what happens to the volume?

It is made by stacking square blocks. The bottom block is of side 9 centimetres. As we move up, the sides decrease by 2 centimetres at each step.

All blocks are of height 1 centimetre. What is the volume of this tower?

Just calculate the volume of each square block and add. Try it!

Calculate the volumes of the figures shown below. All lengths are in centimetres.



Large measures

What is the volume of a cube of side 1 metre?

1 metre means 100 centimetres?

So, we must calculate the volume of a cube of side 100 centimetres.

How much is it?

We say that the volume of cube of 1 metre is 1 cubic metre.

So,

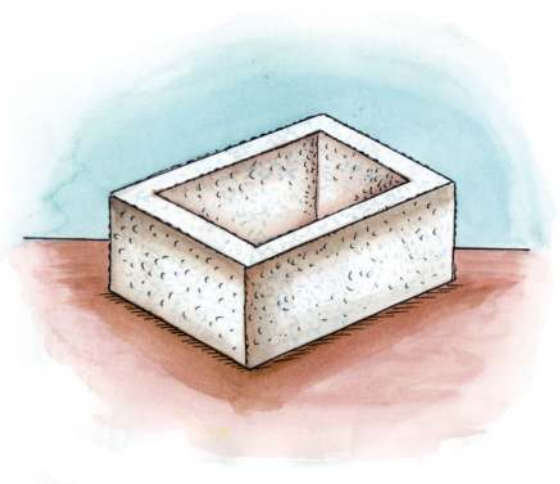
1 cubic metre = 1000000 cubic centimetre.

Volume of large objects are often said as cubic metres.

1. A truck is loaded with sand, 4 metre long, 2 metre wide and 1 metre high. The price of 1 cubic metre of sand is 1000 rupees. What is the price of this truck load?
2. What is the volume in cubic metres of a platform 6 metre long, 1 metre wide and 50 centimetre high?
3. What is the volume of a piece of wood which is 4 metres long, $\frac{1}{2}$ metre wide and 25 centimetre high? The price of 1 cubic metre of wood is 60000 rupees. What is the price of this piece of wood?

Capacity

Look at this hollow box:



It is made with thick wooden planks. Because of the thickness, its inner length, breadth and height are less than the outer measurements.

The inner length, breadth and height are 40 centimetres, 20 centimetres and 10 centimetres.

So, a rectangular block of these measurement can exactly fit into the space within this box.

The volume of this rectangular block is the volume whithin the box.

This volume is called the capacity of the box.

Thus the capacity of this box is;

$$40 \times 20 \times 10 = 8000 \text{ cc}$$

So, what is the capacity of a box whose inner length, breadth and height are 50 centimetres, 25 centimetres and 20 centimetres?

Liquid measures

What is the capacity of a cubical vessel of inner side 10 centimetres?

$$10 \times 10 \times 10 = 1000 \text{ cubic centimetres}$$

1 litre is the amount of water that fills this vessel. That is

$$1 \text{ litre} = 1000 \text{ cubic centimetres}$$

We can look at this in another way. If a cube of side 10 centimetres in completely immersed in a vessel, filled with water then the amount of water that overflows would be 1 litre.

So, how many litres of water does if a vessel of length 2 centimetres, breadth 15 centimetres and height 10 centimetres contain?

Let's look at another problem:

A rectangular tank of length 4 metres and height $2\frac{1}{2}$ metres can contain 15000 litres of water. What is the breadth of the tank?

If we find the product of length, breadth and height in metres, we get the volume in cubic metres.

Here the volume is given to be 15000 litres.

That is, 15 cubic metres.

Litre and cubic metre

1 litre is 1000 cubic centimetres and 1 cubic metres is 1000000 cubic centimetres. So, 1 cubic metre is 1000 litres.

In the water

A vessel is filled with water. If a cube of side 1 centimetre is immersed into it, how many cubic centimetre of water would overflow? What if 20 such cubes are immersed?

The product of length and height is

$4 \times 2\frac{1}{2} = 10$

So, breadth multiplied by 10 is 15.

From this, we can calculate the width as $\frac{15}{10} = 1\frac{1}{2}$ metre.

Now suppose this tank contains 6000 litres of water. What is the height of the water?

The amount of water is 6 cubic metres. So, the product of the length and breadth of the tank and the height of the water, all in metres is 6.

Product of length and breadth is; $4 \times 1\frac{1}{2} = 6$

So, height is $6 \div 6 = 1$ metre.

Raising water

A swimming pool is 25 metres long, 10 metres wide and 2 metre deep. It is half filled. How many litres of water does it contain now?

$25 \times 10 \times 1 = 250$ cubic metres

$= 250000$ litre

Suppose the water level is increased by 1 centimetre. How many more litres of water does it contain now?

1. The inner sides of a cubical box are of length 4 centimetres. What is its capacity? How many cubes of side 2 centimetres can be stacked inside it?
2. The inner side of a rectangular tank are 70 centimetres, 80 centimetres, 90 centimetres. How many litres of water can it contain?
3. The length and breadth of a rectangular box are 90 centimetres and 40 centimetres. It contains 180 litres of water. How high is the water level?

4. The inner length, breadth and height of a tank are 80 centimetres, 60 centimetres and 15 centimetres, and it contains water 15 centimetre high. How much more water is needed to fill it?

5. The panchayat decided to make a rectangular pond. The length, breadth and depth were decided to be 20 metres, 15 metres and 2 metres. The soil dug out was removed in a truck which can carry a load of length 3 metres, breadth 2 metres and height 1 metre. How many truck loads of soil have to be moved?

6. The inner length and breadth of an aquarium are 60 centimetres and 30 centimetres. It is half filled with water. When a stone is immersed in it, the water level rose by 10 centimetres. What is the volume of the stone?

7. A rectangular iron block has height 20 centimetres, breadth 10 centimetres and height 5 centimetres. It is melt and recast into a cube. What is the length of a side of this cube?

8. A tank $2\frac{1}{2}$ metre long and 1 metre wide is to contain 10000 litres. How high must be the tank?

9. From the four corners of a square piece of paper of side 12 centimetres, small squares of side 1 centimetre are cut off. The edges of this are bent up and joined to form a container of height 1 centimetre. What is the capacity of the container? If squares of side 2 centimetres are cut off, what would be the capacity?

Looking back

Learning outcomes	What I can	With teacher's help	Must Improve
• Formulating a method to compute the volume of a rectangular block and to explain it logically.			
• Explaining the relation between cubic centimetre, cubic metre, millilitre and litre.			
• Explaining the method to calculate the capacity of a rectangular vessel.			
• Solving practical problems involving volume and capacity.			

5 Decimal Forms

Measuring length

What is the length of this pencil?
6 centimetres and 7 millimetres.

How about putting it in millimetres only? 67 millimetres.

Can you say it in centimetres only?

One centimetre means 10 millimetres.

Putting it the other way round, one millimetre is a tenth of a centimetre.

That is, $\frac{1}{10}$ centimetre

$$1 \text{ millimetre } = \frac{1}{10} \text{ centimetre}$$

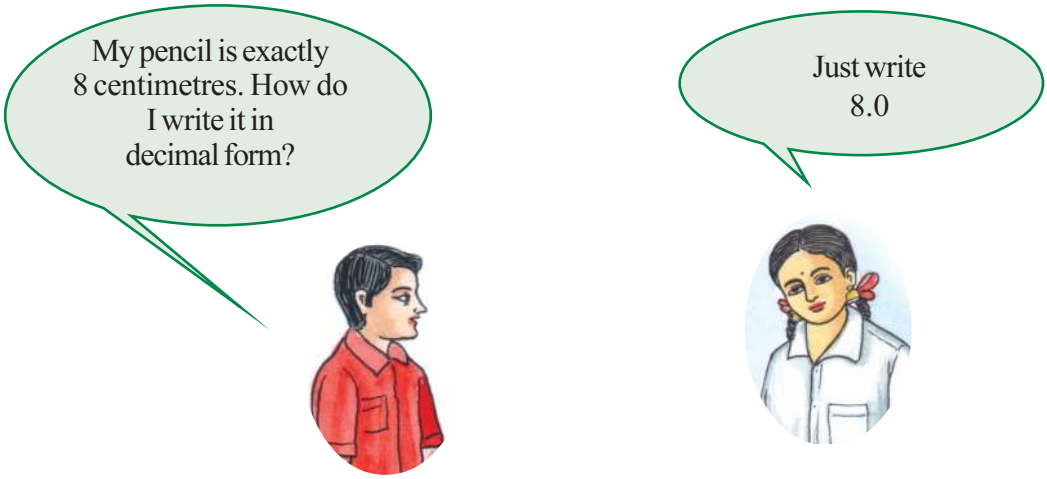
So, 7 millimetres is $\frac{7}{10}$ centimetres.
Now can't you say the length of the pencil in just centimetres?

6 centimetres, 7 millimetres $= 6\ \frac{7}{10}$ centimetres.

> We also write this as 6.7 centimetre. To be read 6 point 7 centimetre. It is called the decimal form of $6\ \frac{7}{10}$ centimetres.

Like this, 7 centimetre, 9 millimetre is $\frac{9}{10}$ centimetre.
And we write it as 7.9 centimetre in decimal form.

Now measure the length of your pencil and write it in decimal form.



Since in 8 centimetres, there is no millimetre left over, we may write it as 8.0 centimetres also.

Lengths less than one centimetre is put as only millimetres. How do we write such lengths as centimetres?

For example, 6 millimetres means $\frac{6}{10}$ centimetres and so we write it as 0.6 centimetres (read 0 point 6 centimetres)

Like this, 4 millimetre = $\frac{4}{10}$ centimetre = 0.4 centimetre.

Different measures

Lengths greater than one centimetre are usually said in metres.

How many centimetres make a metre?

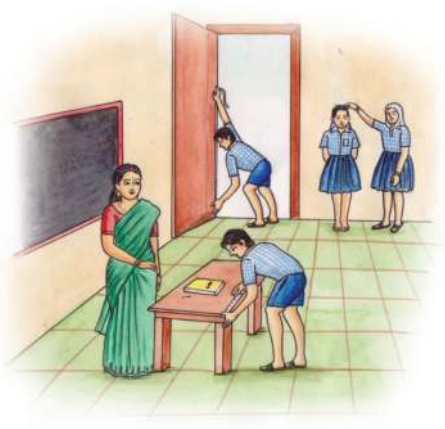
In reverse, what fraction of a metre is a centimetre?

$$1 \text{ centimetre} = \frac{1}{100} \text{ metre.}$$

Sajin measured the length of a table as 1 metre and 13 centimetres. How do we say it in metres only?

13 centimetres means $\frac{13}{100}$ of a metre.

That is, $\frac{13}{100}$ metre.



1 metre and 13 centimetre means $1\frac{13}{100}$ metre. We can write this us 1.13 metres in decimal form.

Like this,

3 metres, 45 centimetres = $3\frac{45}{100}$ metre = 3.45 metres.

Now how do we write 34 centimetres in terms of a metre?

34 centimetre = $\frac{34}{100}$ metre = 0.34 metre.

Vinu measured the length of a table as 1 metre, 12 centimetres, 4 millimetres.

How do we say it in terms of a metre?

12 centimetres means 120 millimetres.

With 4 millimetres more, it is 124 millimetres.

1 millimetre is $\frac{1}{1000}$ of a metre.

So, 124 millimetres = $\frac{124}{1000}$ metre.

1 metre and 124 millimetre together is $1\frac{124}{1000}$ metre.

Its decimal form is 1.124 metre.

Thus 5 metre, 32 centimetres, 4 millimetres in decimal form is,

5 metre, 324 millimetre = $5\frac{324}{1000}$ = 5.324 metre.

Millimetre and metre

1 m = 100 cm

1 cm = 10 mm

1 m = 1000 mm

So,

1 cm = $\frac{1}{100}$ m

1 mm = $\frac{1}{10}$ cm

1 mm = $\frac{1}{1000}$ m

We can write other measurements also in the decimal form.

One gram is $\frac{1}{1000}$ of a kilogram.

So, 5 kilograms and 315 grams we can write as $5\frac{315}{1000}$ kilograms.

Its, decimal form is 5.315 kilograms.

Like this,

4 grams 250 milligrams $= 4\ \frac{250}{1000}$ gram $=$ 4.250 grams.

A millilitre is $\frac{1}{1000}$ litre.

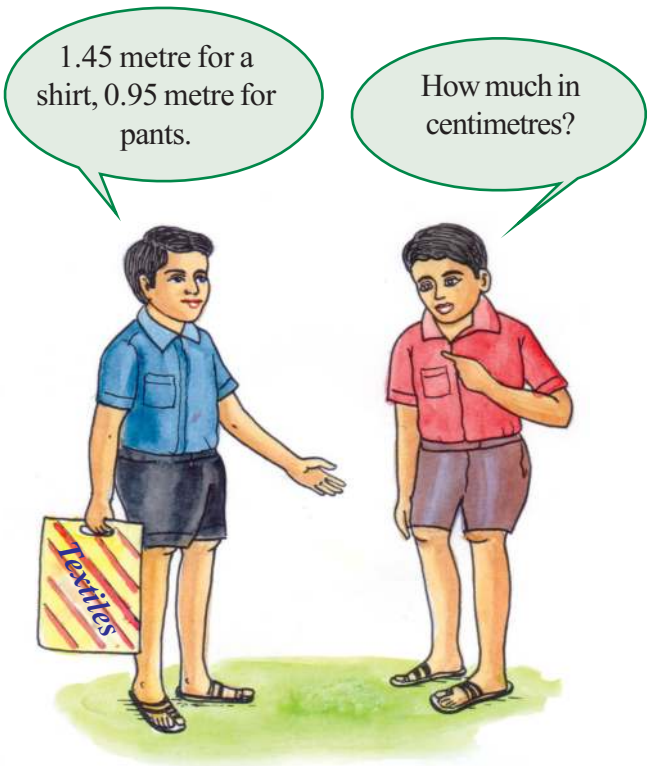
So,

725 millilitre $= \frac{725}{1000}$ litre $=$ 0.725 litre.

Write the following measurements in fractional and in decimal form.

Measurements	Fraction form	Decimal form
4 cm 3mm	mm	cm
5 mm	cm	cm
10 m 25 cm	m	m
2 kg 125 g	kg	kg
16 *l* 275 m*l*	*l*	*l*
13 *l* 225 m*l*	*l*	*l*
325 m*l*	*l*	*l*

In reverse



1.45 metre as a fraction is $1\frac{45}{100}$ metre.

How much in metre and centimetre?

1 metre 45 centimetre.

That is 145 centimetrs.

So, 1.45 metre means 145 centmetres.

Like this, how about writing 0.95 metre in centimetre?

How much centimetre is this?

Next try converting 0.425 kilograms into grams?

$$0.425 \text{ kilograms} = \frac{425}{1000} \text{ kilograms} = 425 \text{ gram.}$$

Fill up the table.

7.4 cm	$7\frac{4}{10}$ cm	7 cm 4 mm = 74 mm
3.2 cm	.... cm	.... cm .... mm = ... mm
.... cm	.... cm	7 mm
3.41 m	.... m	.... m. .... cm = ... cm
.... m	$\frac{62}{10}$ m	.... cm
5.346 kg	.... kg	.... kg .... g = ... g
.... kg	.... kg	425 g
2.375 *l*	.... *l*	.... *l* .... m*l* = ... m*l*
1.350 *l*	.... *l*	.... *l* .... m*l* = ... m*l*
.... *l*	$\frac{625}{1000}$ *l*	.... m*l*

One fractions, many from

The heights of the children in a class are recorded. Ravi is 1 metre, 34 centimetre tall. This was written 1.34 metres. Naufal is 1 metre, 30 centimetres tall and this was written 1.30 metres.

Lissi had a doubt!

30 centimetres means $\frac{30}{100}$ metre. This can be written $\frac{3}{10}$ metre.

So, why not write Ravi's height as 1.3 metres?

"Both are right," the teacher said.

Since, $\frac{3}{10} = \frac{30}{100}$, we can write the decimal form of $\frac{3}{10}$ as 0.3 or 0.30.

Then Ravi had a doubt: Since $\frac{3}{10} = \frac{300}{1000}$, we can write, 30 centimetres as 0.300 metres.

"It is also right," the teacher continued. How we write decimals is a matter of convenience.

For example, look at some lengths measured in metre and centimetre.

1 metre 25 centimetres

1 metre 30 centimetres

1 metre 32 centimetres

It is convenient to write these like this:

1.25 metre

1.30 metre

1.32 metre

If we measure millimetres also like this:

1 metre 25 centimetres 4 millimetres

1 metre 30 centimetres

1 metre 32 centimetres

It is better to write them as:

1.254 metre

1.300 metre

1.320 metre

Like this how can we write the decimal form of 2 kilogram, 400 gram?

What about 3 litres, 500 millilitres?

Place value

We have seen how we can write various measurements as fractions and in decimal forms.

If we look at just the numbers denoting these measurements, we see that they are fractions with 10, 100, 1000 so on as denominators.

For example, just as we wrote 2 centimetres, 3 millimetres as $2\ \frac{3}{10}$ and then as 2.3, we can write $2\ \frac{3}{10}$ as 2.3, whatever, be the measurement. That is, 2.3 is the decimal form of $2\ \frac{3}{10}$.

Similarly, 4.37 is the decimal from of $4\ \frac{37}{100}$.

We can write

$$2\ \frac{3}{10} = 2.3$$
$$4\ \frac{37}{100} = 4.37$$

and so son.

On the otherhand, numbers in decimal form can be written as fractions:

$$247.3 = 247\ \frac{3}{10} = 247 + \frac{3}{10}$$

The number 247 in this can be split into hundreds, tens and ones:

$$247 = (2 \times 100) + (4 \times 10) + (7 \times 1)$$

So, we can write 247.3 as

$$247.3 = (2 \times 100) + (4 \times 10) + (7 \times 1) + \left(3 \times \frac{1}{10}\right)$$

How about 247.39?

First we write

$$247.39 = 247\ \frac{39}{100} = 247 + \frac{39}{100}$$

Then split $\frac{39}{100}$ like this:

$$\frac{39}{100} = \frac{30+9}{100} = \frac{30}{100} + \frac{9}{100} = \frac{3}{10} + \frac{9}{100} = \left(3 \times \frac{1}{10}\right) + \left(9 \times \frac{1}{100}\right)$$

So, we can write 247.39 like this

$$247.39 = (2 \times 100) + (4 \times 10) + (7 \times 1) + \left(3 \times \frac{1}{10}\right) + \left(9 \times \frac{1}{100}\right)$$

In general, we can say this:

In a decimal form, we put the dot to separate the whole number part and the fraction part. Digits to the left of the dot denote multiples of one, ten, hunded and so on; digits on the right denote multiples of tenth, hundredth, thousandth and so on.

For example, 247.39 can be split like this:

Place value	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$
Digits	2	4	7	3	9

Can you split the numbers below like this.

1.42 16.8 126.360 1.064 3.002 0.007

Fraction and decimal

$\frac{1}{2}$ centimetres means, 5 millimetres. Its decimal form is 0.5 centimetre. So the decimal form of the fraction $\frac{1}{2}$ is 0.5

$\frac{1}{2} = \frac{5}{10}$ right?

Similarly, what is the decimal form of $\frac{1}{5}$?

Measurements again

Let's look at the decimal form of some measurements again. For example, what is the decimal form of 23 metre, 40 centimetre.
As seen earlier,

$$23 \text{ metre } 40 \text{ centimetre } = 23\ \frac{40}{100} \text{ metre} = 23.40 \text{ metre}$$

Looking at just the numbers;

$$\frac{40}{100} = \frac{4}{10}$$

$$23\frac{40}{100} = 23\frac{4}{10} = (2 \times 10) + (3 \times 1) + \left(4 \times \frac{1}{10}\right) = 23.4$$

So, we can write 23 metre, 40 centimetre either as 23.40 metre or as 23.4 metre.

What about 23 metre, 4 centimetre?

$$23 \text{ metre } 4 \text{ centimetres} = 23 \ \frac{4}{100} \text{ metre}$$

Writing just the numbers,

$$23 \ \frac{4}{100} = (2 \times 10) + (3 \times 1) + \left(4 \times \frac{1}{100}\right)$$

$$= (2 \times 10) + (3 \times 1) + \left(0 \times \frac{1}{10}\right) + \left(4 \times \frac{1}{100}\right)$$

$$= 23.04$$

Here the 0 just after the dot shows that the fractional part of the number has no tenths (The 0 in 307 shows that, after 3 hundreds, this number has no tens, right?)

Thus we write 23 metres, 4 centimetres as 23.04 metres.

How about 23 metres and 4 millimetres?

23 metres 4 millimetres

$= 23\frac{4}{1000}$ metres

Some other fractions

We cannot write $\frac{1}{4}$ as a fraction with denominator 10. But we have $\frac{1}{4} = \frac{25}{100}$.

So the decimal form of $\frac{1}{4}$ is 0.25.

What is the decimal form of $\frac{3}{4}$?

And $\frac{3}{8}$?

Writing only the numbers,

$$23\ \frac{4}{1000} = (2 \times 10) + (3 \times 1) + \left(4 \times \frac{1}{1000}\right)$$

$$= (2 \times 10) + (3 \times 1) + \left(0 \times \frac{1}{10}\right) + \left(0 \times \frac{1}{100}\right) + \left(4 \times \frac{1}{1000}\right)$$

$$= 23.004$$

Thus,

23 metre 4 millimetres = 23.004 metre

Fill up this table.

Measurement	Fraction	Decimal
45 cm	..... m	..... m
315 g	..... kg	..... kg
455 m*l*	..... *l*	..... *l*
..... cm	$\frac{5}{100}$ m	..... m
..... g	$\frac{42}{1000}$ kg	..... m
..... m*l*	..... *l*	0.035 *l*
3 kg 5 g	..... kg	..... kg
2 *l* 7 m*l*	..... *l*	..... *l*
3 m 4 cm	..... m	..... m
3 m. 4 mm	..... m	..... m
4 kg 50 g	..... kg	..... kg
4 kg 5 g	..... kg	..... kg
4 kg 5 mg	..... kg	..... kg
2 m*l*	..... *l*	..... *l*
..... m*l*	..... *l*	0.02 *l*
..... m*l*	$\frac{200}{1000}$ *l*	..... *l*

More and less

Sneha's height is 1.36 metre and Meena's height is 1.42 metre. Who is taller?

In the sports meet, Vinu jumped 3.05 metres and Anu, 3.5 metres. Who won?

Vinu jumped 3 metres, 5 centimetres and Anu jumped 3 metres, 50 centimetres, right? So who won?

Largest number

Which is the largest number among 4836, 568,97? What about these? 0.4836, 0.568, 0.97

We can also look at it like this. Both numbers have 3 in one's place.

The number 3.05 has zero in the tenth's place while 3.50 has 5 in the tenth's place. So 3.50 is the larger number.

Similarly which is the largest among 2.400 kilogram, 2.040 kilogram, 2.004 kilogram?

What about 0.750 litre and 0.075 litre.

1. Find the larger in each of the pairs given below:
   i) 1.7 centimetre, 0.8 centimetre
   ii) 2.35 kilogram, 2.47 kilogram
   iii) 8.050 litre, 8.500 litre
   iv) 1.005 kilogram, 1.050 kilogram

v) 2.043 kilometre, 2.430 kilometre

vi) 1.40 metre, 1.04 metre

vii) 3.4 centimetre, 3.04 centimetre

viii) 3.505 litre, 3.055 litre

2. Arrange each set of numbers below from the smallest to the largest.

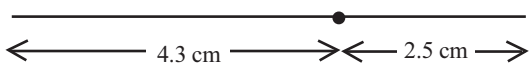
i) 11.4, 11.45, 11.04, 11.48, 11.048

ii) 20.675, 20.47, 20.743, 20.074, 20.74

iii) 0.0675, 0.064, 0.08, 0.09, 0.94

Addition and subtraction

A 4.3 centimetre long line is drawn and then extended by 2.5 centimetres.



What is the length of the line now?

We can put the length in millimetres and add

4.3 cm = 43 mm

2.5 cm = 25 mm

Total length 43 + 25 = 68 mm

$$\begin{array}{r} 43 \; + \\ 25 \\ \hline 68 \end{array}$$

Which of 11.4, 11.47, 11.465 the largest?

We can write 11.4 as 11.400 and 11.47 as 11.470. Now can't we find the largest?

Turning this back into centimetres, we get 6.8 centimetres.

We can do this directly, without changing to millimetres.

$$\begin{array}{r} 4.3 \; + \\ 2.5 \\ \hline 6.8 \end{array}$$

What if we want to add 4.3 centimetres and 2.8 centimetres?

If we change into millimetres and add, we get 71 millimetres.

And turing back into centiemtes, it becomes 7.1 centimetres.

Can we do this also directly, without changing to millimetres?

Let's add in terms of place value.

1	$\frac{1}{10}$
4	3
2	8
6	11

+

The answer is 6 ones and 11 tenths; that is, 7 ones and 1 tenth. This we can write 7.1

$$\begin{array}{r} 4.3 \\ +\ 2.8 \\ \hline 7.1 \end{array}$$

How do we add 4.3 metres and 2.56 metres?

We can change both to centimetres and add

4.3 m = 430 cm

2.56 m = 256 cm

$$\begin{array}{r} 430 \\ +\ 256 \\ \hline 686 \end{array}$$

The length is 430 + 256 = 686 centimetres.

Changing back to metres, it is 6.86 metres.

We can add directly, without changing to centimetres (when we do this, it is convenient to write 4.3 as 4.30)

$$\begin{array}{r} 4.30 \\ +\ 2.56 \\ \hline 6.86 \end{array}$$

What if we want to add 4.3 metres and 2.564 metre?

We can change both to millimetres and add

4300 mm + 2564 mm = 6864 mm

6864 mm = 6.864 mm

$$\begin{array}{r} 4300 \\ +\ 2564 \\ \hline 6864 \end{array}$$

Or directly add.

$$\begin{array}{r} 4.300 \\ +\ 2.564 \\ \hline 6.864 \end{array}$$

Generally speaking, to add measurements given in decimal form, it is better to make the number of digits in the decimal parts same; for this, we need only add as many zeros as needed.

Now look at this; if from a 12.4 centimetre long stick, a 3.2 centimetre piece is cut off, what is the length of the remaining part?

3 centimetres subtracted from 12 centimetres is 9 centimetres.

2 millimetres subtracted from 4 millimetres is 2 millimetres.

We can write it like this;

$$\begin{array}{r} 12.4 \\ -\ 3.2 \\ \hline 9.2 \end{array}$$

The answer four kids got in adding 3.4 centimetres and 0.54 centimetres.

Anup	3.94	cm
Razia	57.4	cm
Alex	0.574	m
Ramya	0.394	m

Whose answer is correct?

How do we subtract 3.9 centimetres from 15.6 centimetres?

We cannot subtract 9 millimetres from 6 millimetres. So we look at 15.6 centimetres as 14 centimetres and 16 millimetre. 9 millimetres subtracted from 16 millimetres gives 7 millimetres.

Let's write according to place values and subtract.

1	$\frac{1}{10}$
15	6
3	9

−

1	$\frac{1}{10}$
14	16
3	9
11	7

−

$$\begin{array}{r} 15.6 \\ -\ 3.9 \\ \hline 11.7 \end{array}$$

Another example: A sack contains 16.8 kilograms sugar. From this, 3.750 kilogram is put in a bag. How much sugar remains in the sack?

Write 16.8 kilogram as 16.8000 kilograms and try it.

1. Sunitha and Suneera divided a ribbon between them. Sunitha got 4.85 metre and Suneera got 3.75 metre. What was the length of the original ribbon?
2. The sides of a triangle are of lengths 12.4 centimetre, 16.8 centimetre, 13.7 centimetre. What is the perimeter of the triangle?
3. A sack has 48.75 kilograms of rice in it. From this 16.5 kilograms was given to Venu and 12.48 kilograms to Thomas. How much rice is now in the sack?
4. Which number added to 16.254 gives 30?

5. Faisal travelled 3.75 kilometres on bicycle, 12.5 kilometres in a bus and the remaining distance on foot. He travelled 17 kilometres in all. What distance did he walk?
6. Mahadevan's home is 4 kilometre from the school. He travels 2.75 kilometre of this distance in a bus and the remaining on foot. What distance does he walk?
7. Susan bought a bangle weighing 7.4 grams and a necklace weighing 10.8 grams. She bought a ring also and the total weight of all three is 20 grams. What is the weight of the ring?
8. From a 10.5 metre rod, an 8.05 centimetre piece is cut off. What is the length of the remaining piece?
9. We add 10.864 and the number got by interchanging the digits in its tenth's and thousand's this place. What do we get? What is the difference of these two numbers?
10. When 12.45 is added to a number and then 8.75 subtracted, the result was 7.34. What is the original number?

Quantities of some items are written using fraction.

Onion $1\frac{2}{5}$ kilogram

Tomato $1\frac{3}{4}$ kilogram

Chilly $\frac{1}{4}$ kilogram

How much is the total weight? Do it by writing in decimal form which way is easier?

Looking back

Learning outcomes	What I can	With teacher's help	Must Improve
• Writing metric measures in decimal form			
• Writing measurements in decimal form as whole numbers.			
• Describing numbers in decimal from in terms of place values.			
• Comparing measurements given in decimal form.			
• Solving practical problems involving sums and differences of measurements in decimal form.			