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Untouchability is Inhuman and a Crime

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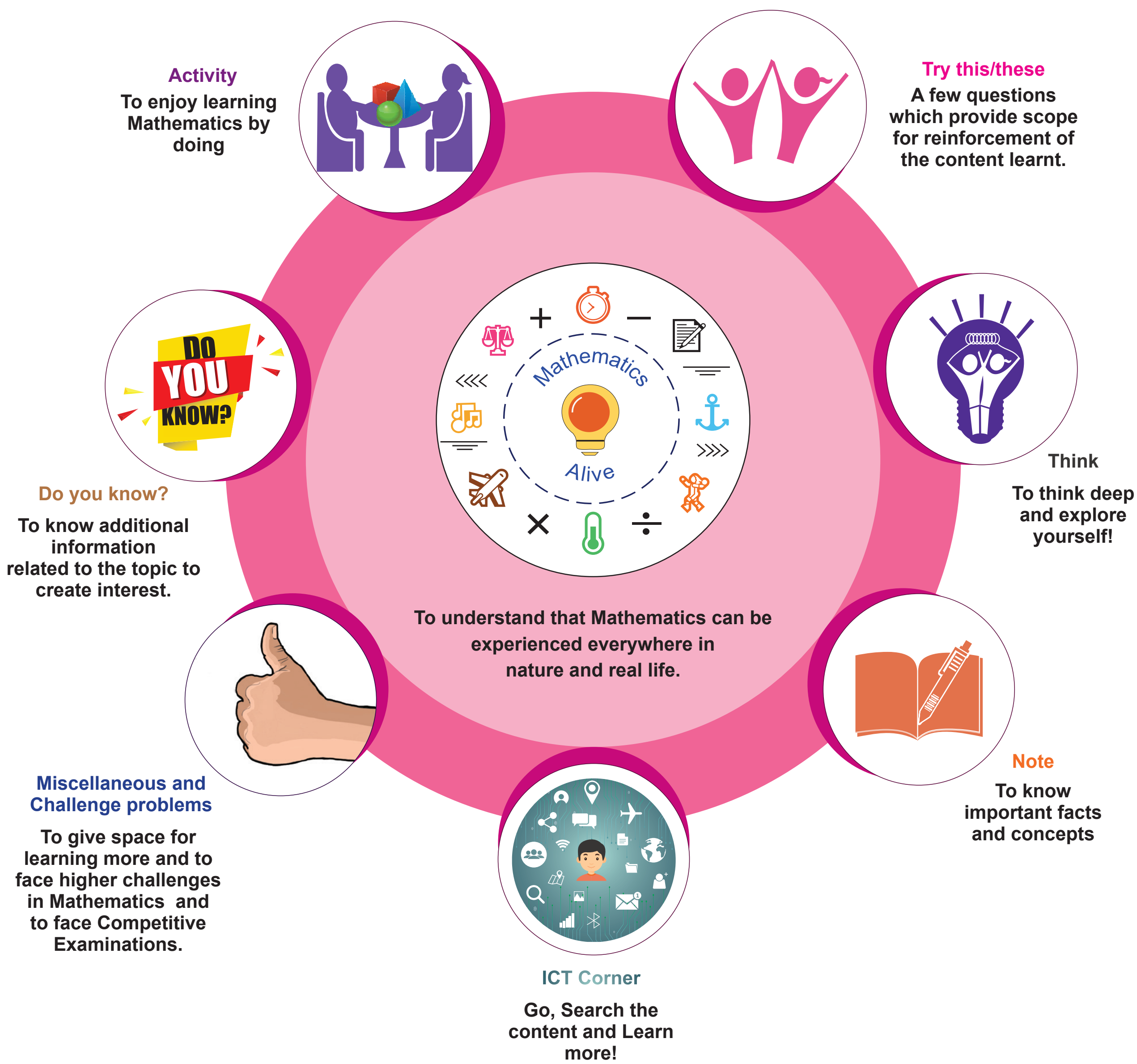
Mathematics is a unique symbolic language in which the whole world works and acts accordingly. This text book is an attempt to make learning of Mathematics easy for the students community.

Mathematics is not about numbers, equations, computations or algorithms; it is about understanding

— William Paul Thurston



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The main goal of Mathematics in School Education is to mathematise the child's thought process. It will be useful to know how to mathematise than to know a lot of Mathematics.

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B542_6_MAT_EM_T3

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CHAPTER 1

FRACTIONS

Learning Objectives

- To add and subtract unlike fractions.
- To understand improper and mixed fractions.
- To express improper fractions into mixed fractions and vice versa.
- To do fundamental operations on mixed fractions.

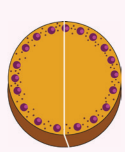
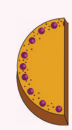
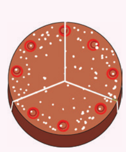
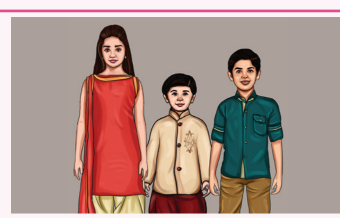
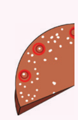
E58TN5

Recap

I Fractions

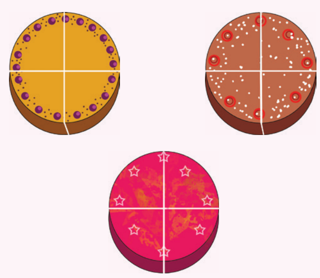
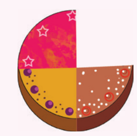
On Anbu's birthday function, his father, mother and uncle have bought one cake each of equal size. At the time of cutting a cake, two friends were present for the celebration. He divided the cake into 2 equal pieces and gave the pieces to them. After some time, three of his friends arrived. He took another cake and divided it into 3 equal pieces and gave the pieces to them. Still he has one more cake at home. Anbu wanted to share it among his four family members. Third cake is divided into 4 equal pieces and given to them.

Following table shows how Anbu divided the cake equally according to the number of persons.

Division of Cake	Number of persons shared	Each one's share
		 $\frac{1}{2}$ or **one half** of the cake
		 $\frac{1}{3}$ or **one third** of the cake
		 $\frac{1}{4}$ or **one fourth** of the cake

In the above situation, each of 3 cakes was divided equally according to the number of persons attended the function. When Anbu shared one cake to 4 persons, each one got quarter of the cake which was comparatively smaller than the share got by one person when it was divided equally between 2 and 3 persons. When the number of persons increases the size of the cake becomes smaller.

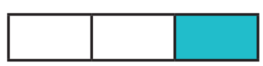
Suppose all the three cakes of equal size are shared equally with the family members of Anbu, what would be each one's share?

Division of Cake	Number of persons shared	Each one's share
		 $\frac{3}{4}$ or **three fourth** of the cake

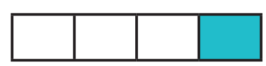
Each one would get $\frac{3}{4}$ of the cake. Here we have divided the whole into equal parts, each part is called a ***Fraction***. We say a fraction as selected part(s) out of total number of equal parts of an object or a group.

Each one's share of dividing one cake between 2, 3 and 4 persons respectively can be represented as follows.

$\frac{1}{2}$



$\frac{1}{3}$



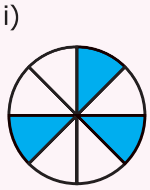
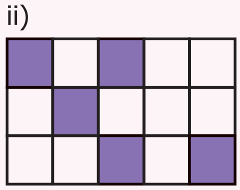
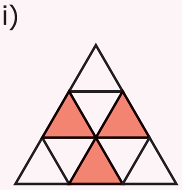
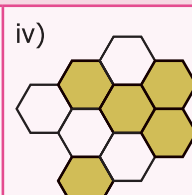
$\frac{1}{4}$

Think

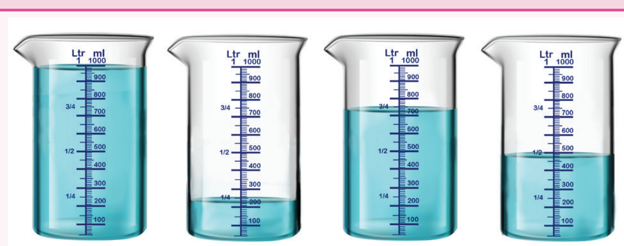
If all the three cakes are divided among the total participants of the function what would be each one's share? Discuss.

Try these

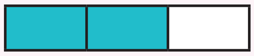
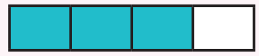
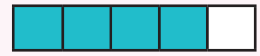
1. Observe the following and represent the shaded parts as fraction.

i)	ii)	iii)	iv)
			

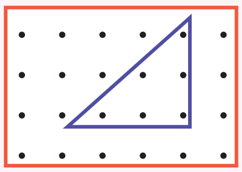
2. Look at the following beakers. Express the quantity of water as fractions and arrange them in ascending order.



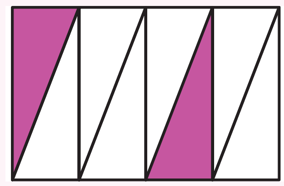
3. Write the fraction of shaded part in the following.

i)    ii)    iii) 

4. Write the fraction that represents the dots in the triangle.



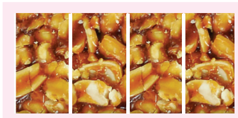
5. Find the fractions of the shaded and unshaded portions in the following.



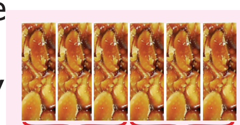
II Equivalent Fractions

Murali has one peanut bar. He wants to share it equally with Rani. So he divided it into two equal pieces, each one has got 1 piece out of 2, which is half of the peanut bar. They both decided to have half of their share in the morning break and another half in the evening break. Now the total number of pieces becomes 4. Each one has 2 pieces out of 4. That is $\frac{2}{4}$ which is nothing but half of the peanut bar. Look at the figures. In both the type of sharing, they got only the same half of the peanut bar. Therefore, $\frac{1}{2} = \frac{2}{4}$. Hence, $\frac{2}{4}$ is ***equivalent to*** $\frac{1}{2}$.

$\frac{1}{2}$ $\frac{1}{2}$



$\frac{2}{4}$ $\frac{2}{4}$



$\frac{3}{6}$ $\frac{3}{6}$

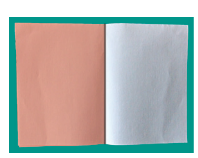
If the peanut bar had been divided into 6 equal pieces, each one would have got $\frac{3}{6}$. What about each one's share if it is divided into 8 equal pieces? $\frac{4}{8}$ We can observe that $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8}$. How do we get these equivalent fractions of $\frac{1}{2}$?

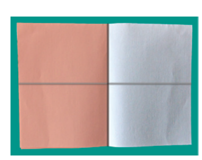
$$\frac{1}{2} \times \frac{2}{2} = \frac{2}{4} \qquad \frac{1}{2} \times \frac{3}{3} = \frac{3}{6}$$

Hence, to get equivalent fractions of the given fraction, the numerator and denominator are to be multiplied by the same number.

Activity

Take a rectangular paper. Fold it into two equal parts. Shade one part, write the fraction. Again fold it into two halves. Write the fraction for the shaded part. Continue this process 5 times and write the fraction of the shaded part. Establish the equivalent fractions of $\frac{1}{2}$ in the folded paper to your friends.





Example 1 Find three equivalent fractions of $\frac{3}{4}$ and $\frac{2}{7}$.

Solution

Equivalent Fraction of $\frac{3}{4}$	Equivalent Fraction of $\frac{2}{7}$
$\frac{3}{4}=\frac{3\times2}{4\times2}=\frac{6}{8}$	$\frac{2}{7}=\frac{2\times2}{7\times2}=\frac{4}{14}$
$\frac{3}{4}=\frac{3\times3}{4\times3}=\frac{9}{12}$	$\frac{2}{7}=\frac{2\times3}{7\times3}=\frac{6}{21}$
$\frac{3}{4}=\frac{3\times4}{4\times4}=\frac{12}{16}$	$\frac{2}{7}=\frac{2\times4}{7\times4}=\frac{8}{28}$

Equivalent fractions of $\frac{3}{4}$: $\frac{3}{4}=\frac{6}{8}=\frac{9}{12}=\frac{12}{16}$

Equivalent fractions of $\frac{2}{7}$: $\frac{2}{7}=\frac{4}{14}=\frac{6}{21}=\frac{8}{28}$

Try these

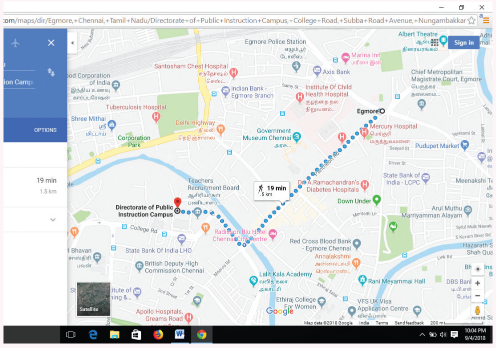
Find the unknown in the following equivalent fractions

i) $\frac{3}{5}=\frac{9}{\square}$ ii) $\frac{\square}{7}=\frac{16}{28}$ iii) $\frac{\square}{3}=\frac{10}{15}$ iv) $\frac{42}{48}=\frac{\square}{8}$

1.1 Introduction

Fractions are used in life situations such as

- To express time as quarter past 3, half past 4, quarter to 5.
- To say the quantum of work completed as quarter / half / three quarters of the work completed.
- To say the distance between two places as half a kilometre / two and half kilometre.
- To express the quantity of ingredients to be used in a recipe as half of the rice taken, half of the dhal taken etc.

Mathematics Alive - Fractions in Real Life	
	
Nine-Tenths of water on the earth is salty.	The distance between Chennai Egmore and the Directorate of Public Instruction Campus (DPI) is nearly $1\frac{1}{2}$ kilometre.

1.2 Comparison of Unlike Fractions

Think about the situation 1

Murugan has scored $\frac{7}{10}$ in Science and $\frac{9}{10}$ in Mathematics test. In which subject he has performed better? It is quite easy to say his performance is better in Mathematics. But can you find, the better performance of Murugan between the two test scores such as $\frac{9}{10}$ and $\frac{13}{20}$ in Mathematics. We need to convert both the marks as like fractions.

The equivalent fraction of $\frac{9}{10}$ is $\frac{18}{20}$. Now we can compare the first test score with that of the second test score because both the scores are out of 20 marks. Here $18 > 13$. So, $\frac{18}{20} > \frac{13}{20}$. Thus, Murugan has performed better in the first test.

Think about the situation 2

In a Hockey tournament, Team A played 6 matches and won 5 matches out of it. Team B played 5 matches and won 4 matches out of it. If both the teams performed consistently in this way, find out which team will win the tournament?

From these we need to see which is greater $\frac{5}{6}$ or $\frac{4}{5}$? How can we find this? The total number of matches played by each team differs. By finding the equivalent fractions of $\frac{5}{6}$ and $\frac{4}{5}$, we can equalize the number of matches played by team A and team B.

$$\frac{5}{6} = \frac{10}{12} = \frac{15}{18} = \frac{20}{24} = \frac{25}{30} \qquad \frac{4}{5} = \frac{8}{10} = \frac{12}{15} = \frac{20}{25} = \frac{24}{30}$$

Note that the common denominator of equivalent fraction is 30, which is 5×6. It is the common multiple of both 5 and 6.

Here $\frac{25}{30} > \frac{24}{30}$. So Team A will win the game.

Note

To compare two or more unlike fractions, we have to convert them into 'like fractions'. These 'like fractions' are the equivalent fractions of the given fractions. The denominator of the 'like fractions' is the Least Common Multiple (LCM) of the denominators of the given unlike fractions.

Example 2 Madhu ate $\frac{2}{5}$ of the chocolate bar and Nandhini ate $\frac{1}{3}$ of the chocolate bar. Who has eaten more?

Solution

The portion of the chocolate eaten by Madhu $= \frac{2}{5}$

The portion of the chocolate eaten by Nandhini $= \frac{1}{3}$

Here the portions of the chocolates eaten by both differ.

To make it same, their equivalent fractions are to be found.

Finding the equivalent fractions of $\frac{2}{5}$ and $\frac{1}{3}$ having common denominators are the same as finding the least common multiple of the denominators of the given fractions.

Hence $\frac{2}{5}=\frac{2\times 3}{5\times 3}=\frac{6}{15}$ and $\frac{1}{3}=\frac{1\times 5}{3\times 5}=\frac{5}{15}$ So, $\frac{6}{15} > \frac{5}{15}$

Therefore, we can conclude that Madhu has eaten more chocolates.

Note

The process of finding the like fractions of the given unlike fractions can be made easier by finding the common multiples of the denominators of the unlike fractions.

Example 3 Vinotha, Mugilarasi, Senthamizh were participating in the water filling competition. Each one was given a bottle of equal volume to fill water in it within 30 seconds. If Vinotha filled $\frac{1}{2}$ portion of her bottle, Senthamizh filled $\frac{3}{4}$ portion of her bottle and Mugilarasi filled $\frac{1}{4}$ portion of her bottle, then who would get the first, second and third prize?

Solution The equivalent fractions need to be written until the denominator becomes 4 which is the LCM of 2 and 4.

Equivalent fraction of $\frac{1}{2}$ is $\frac{2}{4}$

Vinotha's portion	Mugilarasi's portion	Senthamizh's portion
$\frac{1}{2}=\frac{2}{4}$	$\frac{1}{4}$	$\frac{3}{4}$

Here $\frac{1}{4}<\frac{2}{4}<\frac{3}{4}$. Therefore, Senthamizh would get the first prize, Vinotha would get the second prize and Mugilarasi would get the third prize.

Example 4 Arrange $\frac{2}{3},\frac{1}{6},\frac{4}{9}$ in ascending order.

Solution Equivalent fractions of $\frac{2}{3}$ are $\frac{4}{6},\frac{6}{9},\frac{8}{12},\frac{10}{15},\frac{12}{18},\cdots$

Equivalent fractions of $\frac{1}{6}$ are $\frac{2}{12},\frac{3}{18},\cdots$

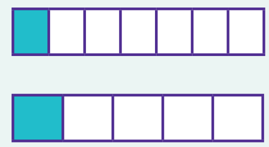
Equivalent fraction of $\frac{4}{9}$ is $\frac{8}{18},\cdots$

Therefore $\frac{3}{18}<\frac{8}{18}<\frac{12}{18}$

The ascending order of given fractions is $\frac{1}{6},\frac{4}{9},\frac{2}{3}$.

DO YOU KNOW?

Comparison of Unit Fractions: ***Unit fractions*** are fractions having 1 as its numerator. For example compare $\frac{1}{7}$ and $\frac{1}{5}$. One can conclude that $\frac{1}{5} > \frac{1}{7}$ by observing the diagram. So, in unit fraction the larger the denominator the smaller will be the fraction. Hence, we conclude that if the numerators are the same in two fractions, the fraction with the smaller denominator is greater of the two.



Try these

1. Shade the rectangle for the given pair of fractions and say which is greater among them.

i) $\frac{1}{3}$ and $\frac{1}{5}$		ii) $\frac{2}{5}$ and $\frac{5}{8}$	
Shade $\frac{1}{3}$	Shade $\frac{1}{5}$	Shade $\frac{2}{5}$	Shade $\frac{5}{8}$
$\frac{1}{3}$ is ________ than $\frac{1}{5}$. That is $\frac{1}{3}$ ________ $\frac{1}{5}$.		$\frac{2}{5}$ is ________ than $\frac{5}{8}$. That is $\frac{2}{5}$ ________ $\frac{5}{8}$.	

2. Which is greater $\frac{3}{8}$ or $\frac{3}{5}$?
3. Arrange the fractions in ascending order: $\frac{3}{5}, \frac{9}{10}, \frac{11}{15}$
4. Arrange the fractions in descending order: $\frac{9}{20}, \frac{3}{4}, \frac{7}{12}$

1.3 Addition and Subtraction of Unlike Fractions

Think about the situation

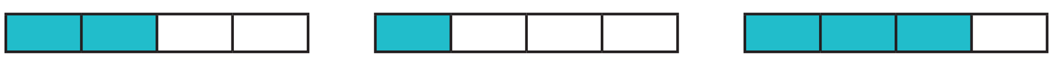
Venkat went to buy milk. He bought $\frac{1}{2}$ litre first and then he bought $\frac{1}{4}$ litre. He wanted to find how much milk he bought altogether? In order to find the total quantity of milk, he has to add $\frac{1}{2}$ and $\frac{1}{4}$. That is $\frac{1}{2}+\frac{1}{4}$. To add or subtract two unlike fractions, first we need to convert them into like fractions.

Example 5 The teacher had given the same situation mentioned above and asked two students Ravi and Arun to solve it. They came out with the answers for $\frac{1}{2}+\frac{1}{4}$.

Solution

Ravi's way	Arun's way
Common Multiple of 2 and 4 = 4. Equivalent Fractions of $\frac{1}{2}=\frac{1\times2}{2\times2}=\frac{2}{4}$ Now, add $\frac{1}{2}+\frac{1}{4}=\frac{2}{4}+\frac{1}{4}$ $=\frac{2+1}{4+4}=\frac{3}{8}$ Therefore Venkat has bought $\frac{3}{8}$ litres of milk.	Common Multiple of 2 and 4 = 4. Equivalent Fractions of $\frac{1}{2}=\frac{1\times2}{2\times2}=\frac{2}{4}$ Now, add $\frac{1}{2}+\frac{1}{4}=\frac{2}{4}+\frac{1}{4}$ $=\frac{2+1}{4}=\frac{3}{4}$ Therefore Venkat has bought $\frac{3}{4}$ litres of milk.

The teacher concludes that Arun's way is correct. This can be verified by the following diagram.



$$\frac{2}{4} \quad + \quad \frac{1}{4} \quad = \quad \frac{3}{4}$$

In the above illustration note that while adding two like fractions the total number of parts (denominator) remains the same and the two shaded parts (numerator) are added.

Example 6 Add $\frac{2}{3}$ and $\frac{3}{5}$.

Solution These are unlike fractions, aren't they ? So first we need to convert them into like fractions ? Is it possible ? Yes, always. How do we do so ? The common multiple of 3 and 5 is 15. Hence, we find the equivalent fractions of $\frac{2}{3}$ and $\frac{3}{5}$ with denominator 15.

$$\frac{2}{3}=\frac{2\times5}{3\times5}=\frac{10}{15} \qquad \frac{3}{5}=\frac{3\times3}{5\times3}=\frac{9}{15}$$

$$\frac{2}{3}+\frac{3}{5}=\frac{10}{15}+\frac{9}{15}=\frac{19}{15}$$

In the above example, the common denominator is 15 (3×5). Now we observe that the numerator and denominator of the first fraction is multiplied by 5 which is the denominator of the second fraction. In the same way, the second fraction is multiplied by 3 which is the denominator of the first fraction. Now in finding the numerator of both the like fractions, we need to multiply the numerator of the first fraction by 5 and the numerator of the second by 3. In the denominator, 3×5 and 5×3 are of course the same. Thus, the technique of finding the like fraction is called ***Cross Multiplication*** technique.

That is $\frac{2}{3}+\frac{3}{5}=\frac{(2\times5)+(3\times3)}{3\times5}=\frac{10+9}{15}=\frac{19}{15}$

Example 7 Simplify : $\frac{3}{7}+\frac{2}{3}$

Solution By Cross Multiplication technique, $\frac{3}{7}+\frac{2}{3}=\frac{(3\times 3)+(2\times 7)}{7\times 3}=\frac{9+14}{21}=\frac{23}{21}$.

Think about the situation

Vani has $\frac{3}{4}$ litre of water in her bottle. She drank $\frac{1}{2}$ litre of it. How much water is left in the bottle? To find the amount of water remaining in her bottle, the amount of water consumed by her must be subtracted from the amount of water she had initially. That is $\frac{3}{4}-\frac{1}{2}$. This is solved in the following example.

Example 8 Simplify: $\frac{3}{4}-\frac{1}{2}$

Solution Common multiple of 2 and 4 is 4

Equivalent fraction of $\frac{1}{2}$ is

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

Now, $\frac{3}{4}-\frac{1}{2}=\frac{3}{4}-\frac{2}{4}=\frac{3-2}{4}=\frac{1}{4}$

Therefore, Vani has $\frac{1}{4}$ amount of water in the bottle. This can be verified by the following diagram.

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

Example 9 Find the difference between $\frac{3}{4}$ and $\frac{2}{7}$.

Solution To find the difference, first we should know, which is bigger between the two given fractions ? How do we find out ?

We know that comparing 'like fractions' is easy, but these are unlike fractions. So, let us convert them into 'like fractions' and compare. Again, we use common multiple 28 (4×7) to get equivalent fractions of $\frac{3}{4}$ and $\frac{2}{7}$ as $\frac{21}{28}$ and $\frac{8}{28}$. Here, $\frac{21}{28}>\frac{8}{28}$ and hence $\frac{3}{4}>\frac{2}{7}$.

Therfore, $\frac{3}{4}-\frac{2}{7}=\frac{21}{28}-\frac{8}{28}=\frac{13}{28}$.

This can also be done by Cross Multiplication technique as $\frac{3}{4}-\frac{2}{7}=\frac{(3\times 7)-(2\times 4)}{4\times 7}=\frac{21-8}{28}=\frac{13}{28}$.

Try these

i) $\frac{2}{3}+\frac{5}{7}$ ii) $\frac{3}{5}-\frac{3}{8}$

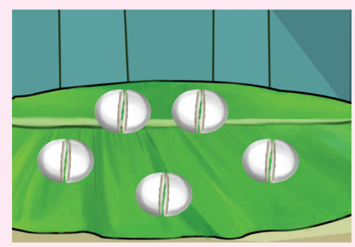
Activity

Using the given fractions $\frac{1}{5}, \frac{1}{6}, \frac{1}{10}, \frac{1}{15}, \frac{2}{15}, \frac{4}{15}, \frac{1}{30}, \frac{7}{30}$ and $\frac{9}{30}$ fill in the missing ones in the given 3×3 square in such a way that the addition of fractions through rows, columns and diagonals give the same total $\frac{1}{2}$.

	$\frac{1}{30}$	
	$\frac{1}{6}$	
$\frac{2}{15}$		

1.4 Improper and Mixed Fractions

Think about the situation



Iniyan had 5 idlis for his breakfast. When he was about to eat, his friend Abdul came. He wanted to share it equally with his friend Abdul. Both of them have taken 2 each and $\frac{1}{2}$ of the remaining idli.

Each one has eaten 2 full idlis and $\frac{1}{2}$ idli. This can be represented as $2+\frac{1}{2}=2\frac{1}{2}$. This representation is called a ***mixed fraction***. Thus, a ***mixed fraction*** is the sum of a whole number and a proper fraction. Also we can express an improper fraction as a mixed fraction by dividing the numerator by denominator to get quotient and remainder. Thus, any mixed fraction can be written as

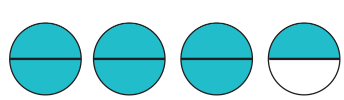
$$\text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}} = \text{Quotient}\frac{\text{Remainder}}{\text{Divisor}}.$$

Another way to share these idlis is as follows: Now can you see how many halves are there in 5 idlis. There are 10 halves. If we share these $\frac{1}{2}$ idlis each time, then Iniyan and Abdul has eaten 5 halves each. That is $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}=\frac{5}{2}$ which is same as $2\frac{1}{2}=2+\frac{1}{2}=\frac{(2\times 2)+1}{2}=\frac{5}{2}$. Thus, any improper fraction can be written as mixed fraction as

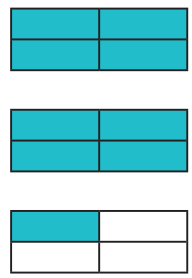
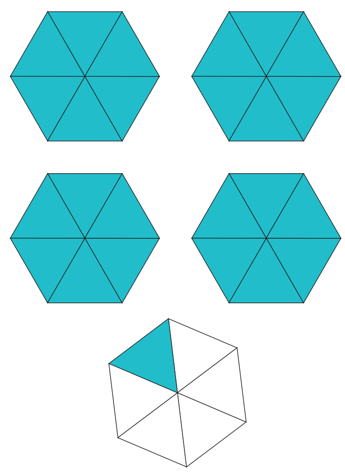
$$\text{Improper fraction} = \frac{\text{(Whole number X Denominator) + Numberator}}{\text{Denominator}}.$$

Try these

1. Complete the following table. The first one is done for you.

Mixed Fraction	Diagrams	Improper Fraction
i) **3** circles are **completely shaded.** $\frac{1}{2}$ of another circle is shaded. That is totally $3\frac{1}{2}$ circles are shaded.		Each circle is divided into halves. There are totally **7 half circles shaded** which is equal to $\frac{7}{2}$.

Try these

Mixed Fraction	Diagrams	Improper Fraction
ii) ______ rectangles are **completely shaded**. ______ portion of another rectangle is shaded. That is totally ________ rectangles are shaded.		Each rectangle is divided into $\frac{1}{4}$ or quarters or **one fourth**. There are totally______ quarters of rectangles shaded which is equal to ______ .
iii) ______ hexagons are **completely shaded**. ______ portion of another hexagon is shaded. That is totally ________ hexagons are shaded.		Each hexagon is divided into $\frac{1}{6}$ or **one sixth**. There are totally______ one sixths of hexagons shaded which is equal to ________ .

Example 10 Convert $5\frac{3}{7}$ into an improper fraction.

Solution Improper fraction $= \dfrac{\text{(Whole number X Denominator) + Numberator}}{\text{Denominator}}$.

$$5\frac{3}{7} = \frac{(5\times 7)+3}{7}$$

$$= \frac{35+3}{7} = \frac{38}{7}$$

Think

i) Are $5\frac{2}{3}$ and $5\frac{4}{6}$ equal?

ii) $\frac{3}{2} \neq 3\frac{1}{2}$ Why?

Example 11 Convert $\frac{17}{3}$ into a mixed fraction.

Solution

$$\begin{array}{r} 5 \leftarrow \text{Quotient} \\ \text{Divisor} \rightarrow 3\overline{)17} \\ -15 \\ \hline 2 \leftarrow \text{Remainder} \end{array}$$

$$\frac{17}{3} = \text{Quotient} \frac{\text{Remainder}}{\text{Divisor}} = 5\frac{2}{3}$$

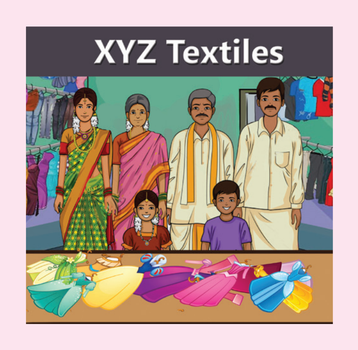
Try these

i) Convert $3\frac{1}{3}$ into improper fraction.

ii) Convert $\frac{45}{7}$ into mixed fraction.

1.5 Addition and Subtraction of Mixed Fractions

Think about the situation



In a joint family of Saravanan, during pongal festival celebration, his grandfather, his father and himself wanted to wear the same colour shirt. The cloth needed for stitching 3 shirts are $2\frac{3}{4}$ m, $2\frac{1}{2}$ m and $1\frac{1}{4}$ m respectively. How many metres of cloth has to be purchased in total?

So the total length of the cloth bought by his father is $2\frac{3}{4}+2\frac{1}{2}+1\frac{1}{4}$. This is solved in the following example.

Example 12 Saravanan's father bought $2\frac{3}{4}$ m, $2\frac{1}{2}$ m and $1\frac{1}{4}$ m of cloth. Find the total length of the cloth bought by him?

Solution Total length of the cloth = $\left(2\frac{3}{4}+2\frac{1}{2}+1\frac{1}{4}\right)$ m

First we add whole numbers: 2 + 2 + 1 = 5 m

Then, add the fractions: $\left(\frac{3}{4}+\frac{1}{2}+\frac{1}{4}\right)=\frac{3}{4}+\frac{2}{4}+\frac{1}{4}=\frac{3+2+1}{4}=\frac{6}{4}=\frac{3\times\cancel{2}}{2\times\cancel{2}}=\frac{3}{2}=1\frac{1}{2}$ m

Therefore, the total length of the cloth bought = $5+1+\frac{1}{2}$ = $6\frac{1}{2}$ m

Example 13 Add: $3\frac{2}{4}+7\frac{2}{5}$

Solution

$$3\frac{2}{4}+7\frac{2}{5}=3+\frac{2}{4}+7+\frac{2}{5}$$
$$=3+7+\left(\frac{2}{4}+\frac{2}{5}\right)$$
$$=10+\left(\frac{10}{20}+\frac{8}{20}\right)$$
$$=10+\frac{18}{20}=10+\frac{9}{10}=10\frac{9}{10}$$

E5HPPS

Think about the situation

One day Anitha's mother bought $5\frac{1}{2}$ litres of milk. She has used only $3\frac{1}{4}$ litres of milk to prepare payasam. How much milk is left? That is $5\frac{1}{2}-3\frac{1}{4}$.

Example 14 In the above situation, find the quantity of milk left over. So, subtract $3\frac{1}{4}$ from $5\frac{1}{2}$

Solution The quantity of milk left over = $5\frac{1}{2}-3\frac{1}{4}$

Here, note that 5 > 3 and $\frac{1}{2}>\frac{1}{4}$

The whole numbers 5 and 3 and the fractional numbers $\frac{1}{2}$ and $\frac{1}{4}$ can be subtracted separately.

Note

This method is applicable only when both integral and fractional parts of minuend is greater than that of the subtrahend.

So $5\frac{1}{2}-3\frac{1}{4}=(5-3)+\left(\frac{1}{2}-\frac{1}{4}\right)$

$= 2+\left(\frac{2}{4}-\frac{1}{4}\right)$ (Since the equivalent fraction of $\frac{1}{2}$ is $\frac{2}{4}$)

$= 2+\frac{1}{4}=2\frac{1}{4}$ litres

Example 15 Simplify: $9\frac{1}{4}-3\frac{5}{6}$

Solution Here 9 > 3 and $\frac{1}{4}<\frac{5}{6}$, So we proceed as follows:

We convert the mixed fraction into improper fraction and then subtract.

$9\frac{1}{4}=\frac{(9\times 4)+1}{4}=\frac{37}{4}$

and $3\frac{5}{6}=\frac{(3\times 6)+5}{6}=\frac{23}{6}$

Common multiple of 4 and 6 is 12.

Now, $\frac{37}{4}-\frac{23}{6}=\frac{37\times 3}{12}-\frac{23\times 2}{12}$

$=\frac{111}{12}-\frac{46}{12}=\frac{65}{12}=5\frac{5}{12}$

Try these

i) Find the sum of $5\frac{4}{9}$ and $3\frac{1}{6}$

ii) Subtract $7\frac{1}{6}$ from $12\frac{3}{8}$.

iii) Subtract the sum of $6\frac{1}{6}$ and $3\frac{1}{5}$ from the sum of $9\frac{2}{3}$ and $2\frac{1}{2}$.

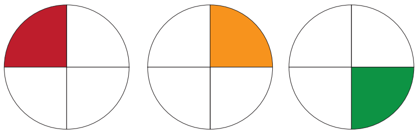
1.6 Multiplication of Fractions

Think about the situation 1 (Multiplication of a fraction by a whole number)

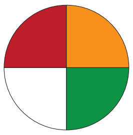
Sunitha wanted to give $\frac{1}{4}$ *kg* of sweets to each of her 3 friends. So she went to a sweet stall and she asked the salesman to give three $\frac{1}{4}$ *kg* packets of sweets, how much sweet did she buy?

Solution Weight of three $\frac{1}{4}$ *kg* packets of sweets $=\frac{1}{4}+\frac{1}{4}+\frac{1}{4}=\frac{1+1+1}{4}=\frac{3}{4}$ *kg*

We can illustrate this in the following diagram. In each of these the shaded part is $\frac{1}{4}$ of a circle. Can you find the shaded parts in 3 circles together?



To know the fraction of shaded part in all the three circles, we add the fractions which are represented in each of the circles. So $3\times\frac{1}{4}=\frac{3}{4}$.



The adjacent circle represents $\frac{3}{4}$ parts of the circle.

Think about the situation 2 (Multiplication of a fraction using the operator 'of')

Kannan has 30 beads and Kanmani has one sixth **of** it. How many beads does Kanmani have?

Solution The number of beads that Kanmani has = $\frac{1}{6}$ **of** 30 beads

$$= \frac{1}{6} \times 30 = \frac{30}{6}$$

$$= 5 \text{ beads}$$

Think about the situation 3 (Multiplication of a fraction by another fraction)

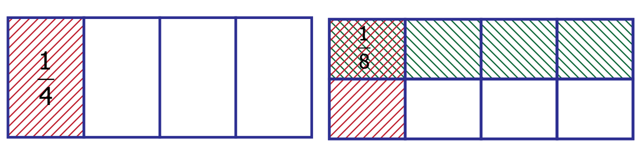
Sunitha bought three $\frac{1}{4}$ kg sweet packets for her three friends from a sweet stall. But 6 of her friends had come to her home. So she decided to divide each $\frac{1}{4}$ kg sweet packets into halves. If she has done in that way, what would be the weight of the sweet packet that each one of her friend will receive?

Solution The weight of the sweet packets that each one of her friends will receive } = half **of** $\frac{1}{4}$ kg

$$= \frac{1}{2} \text{ of } \frac{1}{4} \; kg$$

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

The product $\frac{1}{2}$ and $\frac{1}{4}$ means $\frac{1}{2}$ **of** $\frac{1}{4}$. This can be illustrated as follows. We shade 1 part out of 4 parts which represents $\frac{1}{4}$. Now divide this horizontally into 2 equal parts and shade one part of it.



Here, the double shaded part represents the product $\frac{1}{8}$ and it is got by finding the product of the numerators and the product of denominators as follows:

$$\frac{1}{2} \times \frac{1}{4} = \frac{1 \times 1}{2 \times 4} = \frac{1}{8}$$

Example 16 Maruthu, a milk man has 4 bottles of milk each containing $1\frac{1}{2}$ litres. How much milk does he have in all?

Solution Since Maruthu has 4 bottles of milk and each containing $1\frac{1}{2}$ litres, he has 4 times of $1\frac{1}{2}$ litres of milk.

$$1\frac{1}{2} \times 4 = \left(1 + \frac{1}{2}\right) \times 4 = 4 + \frac{4}{2}$$

$$= 4 + 2 = 6 \text{ litres.}$$

E5RKRF

Example 17 A man wants to fill $3\frac{3}{4}$ *kg* of rice equally in 3 bags. How much rice does each bag contain?

Solution Each bag contains $\frac{1}{3}$ of $3\frac{3}{4}$ *kg* of rice.

That is $\frac{1}{3}\times 3\frac{3}{4} = \frac{1}{3}\times\left(3+\frac{3}{4}\right) = \left(\frac{3}{3}\right)+\left(\frac{1}{3}\times\frac{3}{4}\right)$

$= 1+\frac{1}{4} = 1\frac{1}{4}$ *kg*

Think

$2\frac{1}{4}\times 3$ is not equal to $6\frac{1}{4}$. Why?

Example 18 In a juice shop, if a man prepared $1\frac{1}{2}$ litres of juice from 1 *kg* of oranges, then how many litres of juice can be prepared from $12\frac{3}{4}$ *kg* of oranges?

Solution The quantity of juice prepared from 1*kg* of oranges $= 1\frac{1}{2}$ litres

The quantity of juice prepared from $12\frac{3}{4}$ *kg* of oranges $= 12\frac{3}{4}\times 1\frac{1}{2}$

$= \frac{51}{4}\times\frac{3}{2} = \frac{153}{8}$

$= 19\frac{1}{8}$ litres

Try these

i) Simplify: $35\times\frac{3}{7}$

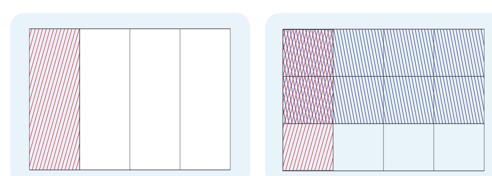
ii) Find the value of $\frac{1}{5}$ of 15.

iii) Find the value of $\frac{1}{3}$ of $\frac{3}{4}$

iv) Multiply $7\frac{3}{4}$ by $5\frac{1}{2}$

Activity

Take a paper. Fold it into 4 parts vertically of equal width. Shade one part of it with red. Then, fold it into 3 parts horizontally of equal width. Shade two parts of it with blue. Now, you count the number of shaded grids which have both the colours.



(Hint:The number of grids shaded in both colours out of the total number of grids gives the product $\frac{2}{12}$ of $\frac{2}{3}$ and $\frac{1}{4}$)

1.7 Division of Fractions

Think about the situation 1

A camp was organized in a school in which12 students participated. The camp leader wanted to divide them into groups of 2 students. How many groups were there?

There were 6 groups which was got by the division of 12 by 2.

That is 12 ÷ 2 = 6 which means there are six 2's in 12.

If the camp leader distributes 6 litres of water in $\frac{1}{2}$ litre water bottles to the students, then how many students will get water bottles? This means finding how many $\frac{1}{2}$ litres are there in 6 litres. For this we need to calculate $6 \div \frac{1}{2}$.

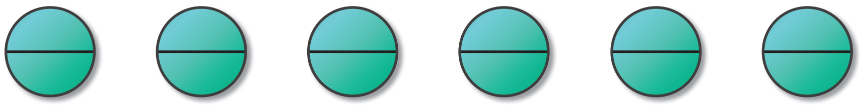
Solution Let us describe the situation

Amount of water	Picture	Amount of water distributed	Method of finding it	Number of persons received
6 litres		1 litre	$6 \div 1$	6
6 litres		$\frac{1}{2}$ litre	$6 \div \frac{1}{2}$	12
6 litres		$\frac{1}{4}$ litre	$6 \div \frac{1}{4}$	24

This means that if you share 6 litres of water into 1 litre bottles, 6 persons can get water. If you share in $\frac{1}{2}$ litre water bottles, 12 persons can get water. If you share it in $\frac{1}{4}$ litre water bottles, 24 persons can get water. That is

$6 \div 1 = 6$	$6 \div \frac{1}{2} = 12$	$6 \div \frac{1}{4} = 24$

We can illustrate this in the following diagram. We divide each circle into halves such that each part is $\frac{1}{2}$ of the whole. The number of such halves would be $6 \div \frac{1}{2}$. In the figure how many halves do you see? There are 12 halves. So $6 \div \frac{1}{2} = 6 \times 2 = 12$.

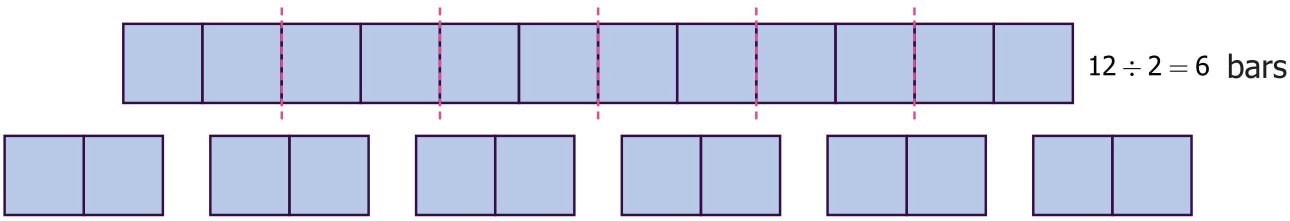


As one circle has 2 halves, 6 circles will have 12 halves = 6×2. Therefore, $6 \div \frac{1}{2} = 6 \times 2 = 12$

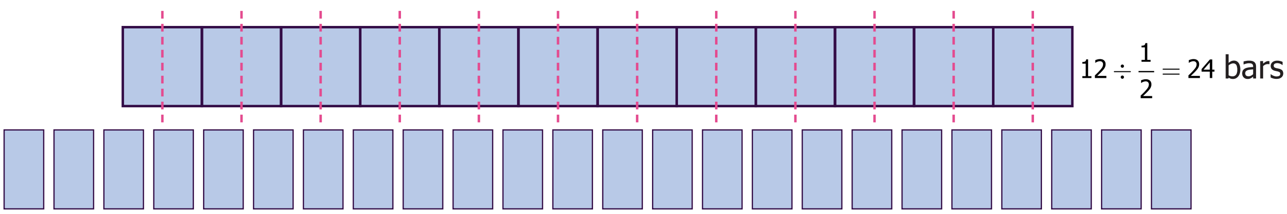
Here, we can observe that, dividing a whole number 6 by a fraction $\frac{1}{2}$ is the same as multiplying a whole number 6 by 2, where 2 is the ***reciprocal*** of $\frac{1}{2}$. Generally, dividing a number by a fraction is the same as multiplying that number by the reciprocal of the fraction.

Let us discuss the same situation in another way. Let us take a bar of length 12 cm

How many 2 cm bars are there in a 12 cm bar?



Now find how many $\frac{1}{2}$ cm bars are there in a 12 cm bar?



Let us observe and complete the following:

i) $\frac{3}{7} \times \frac{7}{3} = \frac{21}{21} = 1$ ii) $\frac{1}{9} \times 9 = \frac{9}{9} = 1$ iii) $8 \times \frac{1}{8} = \frac{8}{8} = ?$ iv) $\frac{13}{4} \times ? = 1$ v) $\frac{4}{3} \times ? = 1$

From the above, we can see that ***the Product of a fraction and its reciprocal is always 1***.

Example 19 Kandan shares $\frac{1}{2}$ piece of a cake between 2 persons. What will be the share of each?

Solution To know the share, we need to find $\frac{1}{2} \div 2$

$$\frac{1}{2} \div 2 = \frac{1}{2} \times \frac{1}{2} \text{ (reciprocal of 2 is } \frac{1}{2}\text{)}$$

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

Try these

i) How many 6s are there in 18?

ii) How many $\frac{1}{4}$ s are there in 5?

iii) $\frac{1}{3} \div 5 = ?$

Example 20 Divide $4\frac{1}{2}$ by $3\frac{1}{2}$

Solution

$$4\frac{1}{2} \div 3\frac{1}{2} = \frac{9}{2} \div \frac{7}{2}$$

$$= \frac{9}{2} \times \frac{2}{7} \text{ (reciprocal of } \frac{7}{2} \text{ is } \frac{2}{7}\text{)}$$

$$= \frac{9}{7}$$

Example 21 An oil tin contains $7\frac{1}{2}$ litres of oil which is poured in $2\frac{1}{2}$ litres bottles. How many bottles are required to fill $7\frac{1}{2}$ litres of oil?

Solution The number of bottles required = $\frac{15}{2} \div \frac{5}{2} = \frac{15}{2} \times \frac{2}{5}$ (reciprocal of $\frac{5}{2}$ is $\frac{2}{5}$)

= 3 bottles

Example 22 A rod of length 6m is cut into small rods of length $1\frac{1}{2}\,m$ each. How many small rods can be cut?

Solution

The number of small rods $= 6 \div 1\frac{1}{2}$

$= 6 \div \frac{3}{2}$

$= 6 \times \frac{2}{3}$ (reciprocal of $\frac{3}{2}$ is $\frac{2}{3}$)

$=$ 4 rods

Try these

i) Find the value of $5 \div 2\frac{1}{2}$.

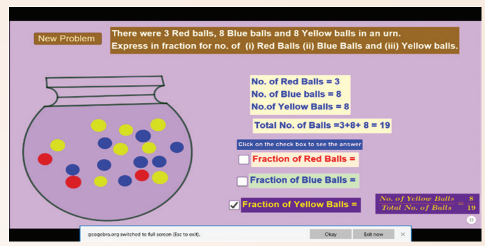
ii) Simplify: $1\frac{1}{2} \div \frac{1}{2}$

iii) Divide $8\frac{1}{2}$ by $4\frac{1}{4}$.

ICT CORNER

Fractions

Expected Outcome



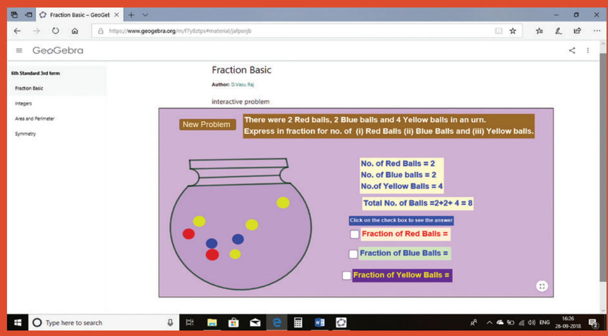
Step 1

Open the Browser by typing the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Fraction Basic" will open. Click on New Problem and solve the problem.

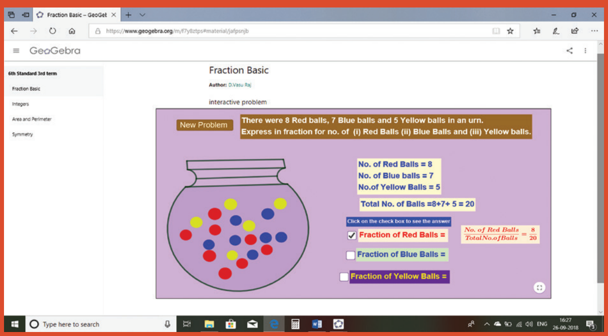
Step 2

Click the check boxes on right hand side bottom to check respective answers

Step1



Step2



Browse in the link:

Fraction Basic: https://ggbm.at/jafpsnjb or Scan the QR Code.

B542_6_MAT_EM_T3

This puzzle involves fraction in Tamil song and its explanation

கட்டியால் எட்டு கட்டி
கால்அரை முக்கால் மாற்று
வியாபாரி சென்று விட்டார்
சிறுபிள்ளை மூன்று பேர்கள்
கட்டியும் புக் கொணாது
கணக்கிலும் பிச கொணாது
கட்டியாய் பகர வல்லார்
கணக்கினில் வல்லா ராவார்

Explanation

A jaggery merchant had 8 jaggery balls with different weights such as $\frac{1}{4}\ kg$ $\frac{1}{2}\ kg$ and $\frac{3}{4}\ kg$. He called his 3 children and asked them to share those jaggery balls equally. How did the children share it equally among themselves? (Hint: The number of jaggery balls with the given weights are 5, 2 and 1 respectively.).

Exercise 1.1

1. Fill in the blanks

i) $7\frac{3}{4}+6\frac{1}{2}=$ ________

ii) The sum of a whole number and a proper fraction is called ________

iii) $5\frac{1}{3}-3\frac{1}{2}=$ ________

iv) $8\div\frac{1}{2}=$ ________

v) The number which has its own reciprocal is ________

E61GT3

2. Say True or False

i) $3\frac{1}{2}$ can be written as $3+\frac{1}{2}$.

ii) The sum of any two proper fractions is always an improper fraction.

iii) The mixed fraction of $\frac{13}{4}$ is $3\frac{1}{4}$.

iv) The reciprocal of an improper fraction is always a proper fraction.

v) $3\frac{1}{4}\times3\frac{1}{4}=9\frac{1}{16}$

3. Answer the following:

i) Find the sum of $\frac{1}{7}$ and $\frac{3}{9}$.

ii) What is the total of $3\frac{1}{3}$ and $4\frac{1}{6}$?

iii) Simplify : $1\frac{3}{5}+5\frac{4}{7}$.

iv) Find the difference between $\frac{8}{9}$ and $\frac{2}{7}$.

v) Subtract $1\frac{3}{5}$ from $2\frac{1}{3}$.

vi) Simplify : $7\frac{2}{7}-3\frac{4}{21}$.

4. Convert mixed fractions into improper fractions and vice versa:

i) $3\frac{7}{18}$ ii) $\frac{99}{7}$ iii) $\frac{47}{6}$ iv) $12\frac{1}{9}$

5. Multiply the following:

i) $\frac{2}{3}\times 6$ ii) $8\frac{1}{3}\times 5$ iii) $\frac{3}{8}\times\frac{4}{5}$ iv) $3\frac{5}{7}\times 1\frac{1}{13}$

6. Divide the following:

i) $\frac{3}{7}\div 4$ ii) $\frac{4}{3}\div\frac{5}{9}$ iii) $4\frac{1}{5}\div 3\frac{3}{4}$ iv) $9\frac{2}{3}\div 1\frac{2}{3}$

7. Gowri purchased $3\frac{1}{2}$ kg of tomatoes, $\frac{3}{4}$ kg of brinjal and $1\frac{1}{4}$ kg of onion. What is the total weight of the vegetables she bought?

8. An oil tin contains $3\frac{3}{4}$ litres of oil of which $2\frac{1}{2}$ litres of oil is used. How much oil is left over?

9. Nilavan can walk $4\frac{1}{2}$ km in an hour. How much distance will he cover in $3\frac{1}{2}$ hours?

10 Ravi bought a curtain of length $15\frac{3}{4}$ m. If he cut the curtain into small pieces each of length $2\frac{1}{4}$ m, then how many small curtains will he get?

Objective Type Questions

11. Which of the following statement is incorrect?

a) $\frac{1}{2}>\frac{1}{3}$ b) $\frac{7}{8}>\frac{6}{7}$ c) $\frac{8}{9}<\frac{9}{10}$ d) $\frac{10}{11}<\frac{9}{10}$

12. The difference between $\frac{3}{7}$ and $\frac{2}{9}$ is

a) $\frac{13}{63}$ b) $\frac{1}{9}$ c) $\frac{1}{7}$ d) $\frac{9}{16}$

13. The reciprocal of $\frac{53}{17}$ is

a) $\frac{53}{17}$ b) $5\frac{3}{17}$ c) $\frac{17}{53}$ d) $3\frac{5}{17}$

14. If $\frac{6}{7}=\frac{A}{49}$, then the value of A is

a) 42 b) 36 c) 25 d) 48

15. Pugazh has been given four choices for his pocket money by his father. Which of the choices should he take in order to get the maximum money?

a) $\frac{2}{3}$ of ₹150 b) $\frac{3}{5}$ of ₹150 c) $\frac{1}{5}$ of ₹150 d) $\frac{1}{5}$ of ₹150

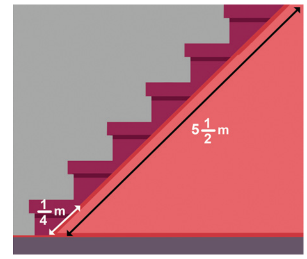
Exercises 1.2

Miscellaneous Practice problems

1. Sankari purchased $2\frac{1}{2}$ m cloth to stich a long skirt and $1\frac{3}{4}$ m cloth to stitch blouse. If the cost is ₹120 per metre then find the cost of cloth purchased by her.

2. From his office, a person wants to reach his house on foot which is at a distance of $5\frac{3}{4}$ km. If he had walked $2\frac{1}{2}$ km, how much distance still he has to walk to reach his house?

3. Which is smaller? The difference between $2\frac{1}{2}$ and $3\frac{2}{3}$ or the sum of $1\frac{1}{2}$ and $2\frac{1}{4}$.



4. Mangai bought $6\frac{3}{4}$ *kg* of apples. If Kalai bought $1\frac{1}{2}$ times as Mangai bought, then how many kilograms of apples did Kalai buy?

5. The length of the staircase is $5\frac{1}{2}$ *m*. If one step is set at $\frac{1}{4}$ *m*, then how many steps will be there in the staircase?

Challenge Problems

6. By using the following clues, find who am I?

   i) Each of my numerator and denominator is a single digit number.

   ii) The sum of my numerator and denominator is a multiple of 3.

   iii) The product of my numerator and denominator is a multiple of 4.

7. Add the difference between $1\frac{1}{3}$ and $3\frac{1}{6}$ and the difference between $4\frac{1}{6}$ and $2\frac{1}{3}$.

8. What fraction is to be subtracted from $9\frac{3}{7}$ to get $3\frac{1}{5}$?

9. The sum of two fractions is $5\frac{3}{9}$. If one of the fractions is $2\frac{3}{4}$, find the other fraction.

10. By what number should $3\frac{1}{16}$ be multiplied to get $9\frac{3}{16}$?

11. Complete the fifth row in the Leibnitz triangle which is based on subraction.

$\frac{1}{1}$

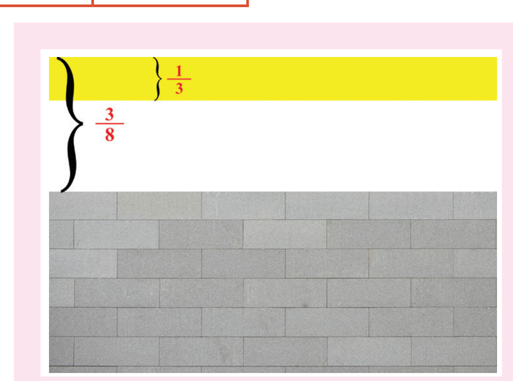
$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{3}$ $\frac{1}{6}$ $\frac{1}{3}$

$\frac{1}{4}$ $\frac{1}{12}$ $\frac{1}{12}$ $\frac{1}{4}$

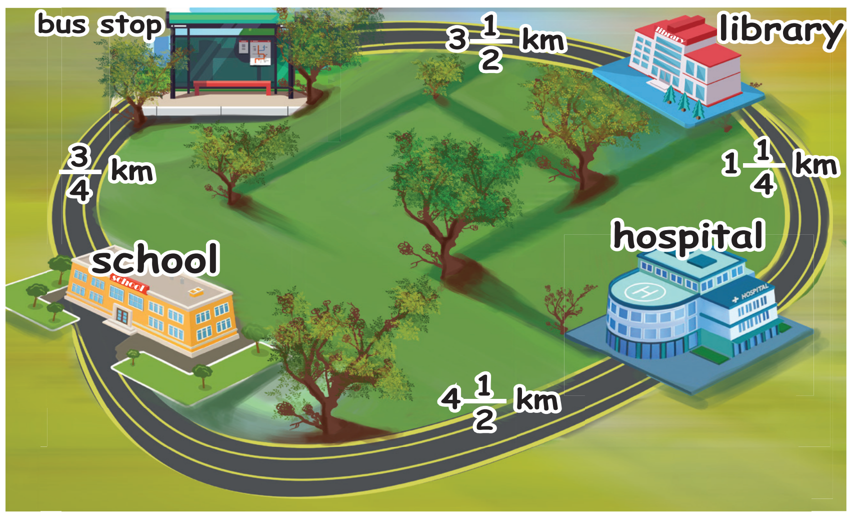
$\frac{1}{5}$ $\square$ $\square$ $\square$ $\frac{1}{5}$

12) A painter painted $\frac{3}{8}$ of the wall of which one third is painted in yellow colour. What fraction is the yellow colour of the entire wall?



13) A rabbit has to cover $26\frac{1}{4}$ m to fetch its food. If it covers $1\frac{3}{4}$ m in one jump, then how many jumps will it take to fetch its food?

14) Look at the picture and answer the following questions:



i) What is the distance from School to Library via Bus stop?

ii) What is the distance between School and Library via Hospital?

iii) Which is the shortest distance between (i) and (ii)?

iv) The distance between School and Hospital is ________ times the distance between School and Bus stop.

Summary

- Fractions is a part of a whole. The whole may be a single object or a group of objects.
- Equivalent fractions are got by multiplying the numerator and denominator of a given fraction by the same number.
- Unlike fractions can be added or subtracted by converting them into 'like fractions'.
- Mixed fraction is the sum of a whole number and a proper fraction.
- Product of two fractions $= \dfrac{\text{Product of their numerators}}{\text{Product of their denominators}}$.
- The numerator and denominator of a fraction are interchanged to get its reciprocal.
- Dividing a number by a fraction is the same as multiplying that number by the reciprocal of the fraction.

CHAPTER 2

INTEGERS

E6ACUQ

Learning Objectives

- To understand the necessity for extension of whole numbers to negative numbers.
- To know that the collection of zero, positive and negative numbers forms integers.
- To represent integers on the number line.
- To compare and arrange integers in ascending and descending order.

2.1 Introduction

We already have learnt about natural numbers, whole numbers and their properties which were dealt in the first term. Now we shall know about another set of numbers.

Think about the situation

The teacher sees that Yuvan and Subha are ready to play a game with a deck of playing cards. Two different coloured tokens (blue and yellow here) are taken so that they represent the position on a number strip which is numbered from 0 to 20 with 0 as the starting point and which can be extended further.

Consider the cards A, J, Q, K and cards from 2 to 10. Here, let A, J, Q and K denote the numbers 1,11,12 and 13 respectively. We have two designs ♠ ♣ in black colour and two designs ♥ ♦ in red colour inside a deck of cards. Let the joker card represent 0.

Rules for the game

i) If a black card is picked, the player should move the token forward and if a red card is picked, the player should move the token backward as per the number shown on the card.

ii) Whoever reaches the number 20 first will be declared as the winner.
(more students can play this game by choosing different coloured tokens)

Observe the following conversation

Yuvan : Subha, I have chosen the blue token.

Subha : Okay, Then I shall take the yellow token.

Yuvan : The number strip is ready as shown below and let both the tokens be placed at the starting position 0. Shall we start playing?

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Subha : Yes. I shall pick a card first. I have picked a black card and it shows 5. So I will move forward to keep my yellow token at 5 on the number strip.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Yuvan : Now, I pick ...It is black card again and it shows A on it. I will keep my blue token by moving one step forward at 1 on the number strip.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Subha : I pick a red card now and it shows 2 on it.
I need to move backward by 2 steps and I shall keep my token at 3.
Is it correct, Yuvan?

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Yuvan : Fine Subha. Now, I too have picked the red card and it shows A again. Oh, no..! I will move backward by one step to be again at the starting position 0.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Subha : I am 3 steps ahead of you! Now, I have the red card showing 4 on it. I need to move 4 places backward from 3. But,where shall I keep my token, Yuvan? I moved 3 places only but need one more place behind 0. There is no number on the left of 0.

				?	0	1	2	3	4	5	6	7	8	9	10	11	12	13	...	20

Subha : Shall I mark it as 1 again?

Yuvan : No, Subha. That won't be correct. We know that 1 already exists to the right of 0.

Subha : Then, what should I do? I can't move to the left of '0'.
Is the game over or shall I pick another card to continue?

The Teacher intervenes ...

Teacher : Yuvan and Subha, why can't you think of extending the number strip to the left of 0 as ∗1, ∗2 ,∗3 and so on such that the distance between ∗1 and 0 is the same as the distance between 0 and 1 and also the distance between ∗2 and 0 is the same as the distance between 0 and 2 and extending likewise?

Subha : Yes Teacher, I understand that the ∗ will now indicate that the numbers are on the left of 0, and also the numbers are less than 0.

Teacher : To sustain the interest in the game, continue playing with a small addition in the rule as whoever reaches ∗20 first, will also be considered as the winner!

Yuvan : So Subha, you shall keep it at ∗1.

∗20	...	∗8	∗7	∗6	∗5	∗4	∗3	∗2	∗1	0	1	2	3	4	5	6	7	8	...	20

Yuvan : What, if you pick the red card again which shows 4 ?

Subha : I am clear Yuvan. I will move backward 4 places from ∗1 to keep my token at ∗5.

∗20	...	∗8	∗7	∗6	∗5	∗4	∗3	∗2	∗1	0	1	2	3	4	5	6	7	8	...	20

Yuvan : Well said...! What can you say, assuming that I am at 5?

Subha : Yes, Yuvan. We will be at the same distance but on the opposite sides of '0'. Am I right?

Yuvan : Yes. you are right but your value is less than mine as you go to the left of '0'.

Think

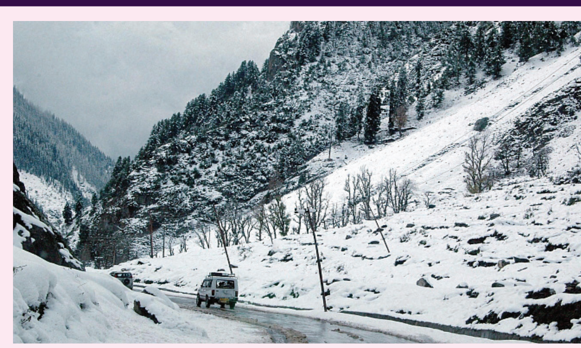
Who will win finally? Which is the factor that will decide the winner? How far can you extend the numbers on both sides of the strip?

From the above game, we understand that there is a need to go beyond 0 on to its left! We also observe that as 1 is to the right of 0, there should exist ∗1 to its left with the same distance as 1 and it extends on both sides in the same way.

We generalise this ∗ symbol to '–' (minus or negative sign) to denote the numbers less than '0' which conveys the meaning as less, deficit, reduce, down, left, etc.,

MATHEMATICS ALIVE – INTEGERS IN REAL LIFE

Mariana Snailfishes live in the Mariana Trench at 26,200 feet below the sea level.

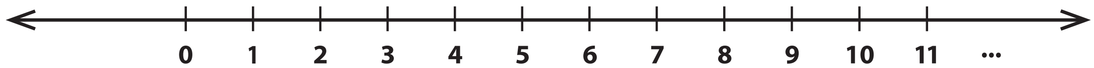


Temperature in the Ladakh region of India records at –14°C below 0°C on an average in the month of January every year.

2.2 Introduction of Integers and its representation on a number line

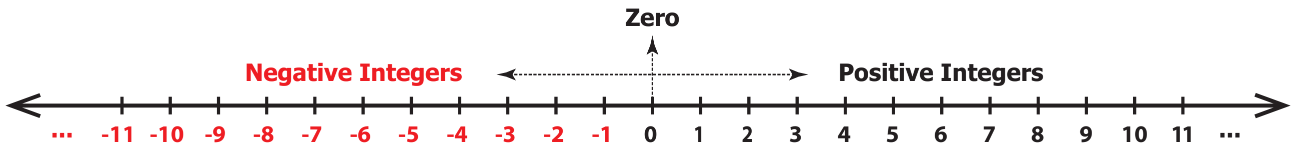
We know that when zero is included to the set of natural numbers then the set of numbers is called as ***Whole numbers***.

Now, let us recall the number line which shows the representation of whole numbers.



Whole numbers

We have seen the need to extend the number line beyond 0 to its left. We call the numbers –1, –2, –3, … (to the left of zero) as negative numbers or negative integers and the numbers 1, 2, 3,… (to the right of zero) as ***positive numbers*** or ***positive integers.*** Hence, the new set of numbers …, -3, -2, -1, 0, 1, 2, 3,… are called ***Integers.*** It is denoted by the letter '**Z**'. The ***Integers*** are shown in the number line below.



The 'plus' and 'minus' sign before a number tells, on which side the number is placed from zero. '–' symbol in front of a number is read as 'negative' or 'minus'. For example, –5 is read as negative 5 or minus 5.

Note

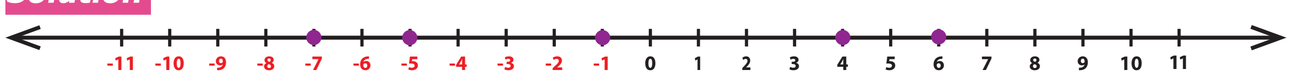
- The number line can be shown both in horizontal and vertical directions.
- The number 0 is neither positive nor negative and hence has no sign.
- Natural numbers are also called as ***positive integers*** and Whole numbers are also called as ***non-negative integers***.
- The positive and the negative numbers together are called as ***Signed numbers***. They are also called as ***Directed numbers***.
- A number without a sign is considered as a positive number.
  For example, 5 is considered as +5.

DO YOU KNOW?

The letter '**Z**' was first used by the Germans, because the word for Integers in the German language is "**Zahlen**" which means "**number**".

Example 1 Draw a number line and mark the integers 6, –5, –1, 4 and –7 on it.

Solution

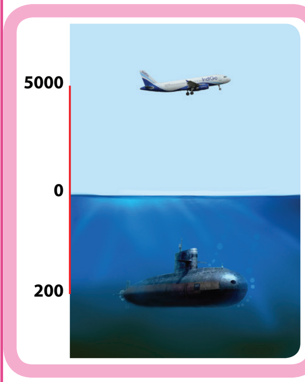
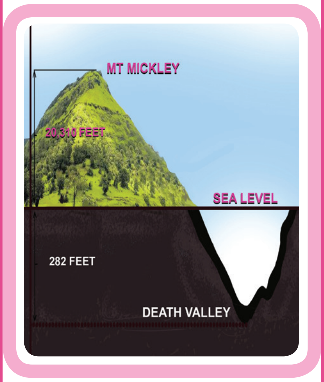
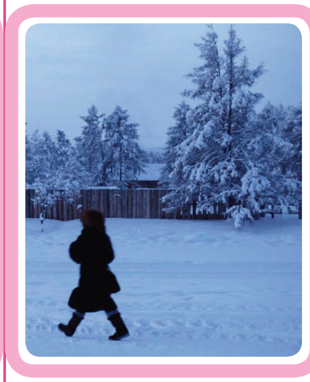


Try these

1 Read the following numbers orally.
   i) +24   ii) –13   iii) –9   iv) 8
2 Draw a number line and mark the following integers.
   i) 0   ii) –6   iii) 5   iv) –8
3 Are all natural numbers integers?
4 Which part of the integers are not whole numbers?
5 How many units should you move to the left of 3 to reach –4?

E6J8HD

2.2.1 More situations on Integers

			
An aeroplane is flying at a height of 5,000m above the sea level and a submarine is at 200m below sea level.	The height of the peak Mt.McKinley is 20,310 feet above the sea level and the death valley is 282 feet below the sea level.	The depth at which sharks are found in the deep sea say at 800 m below the sea level.	The temperature at the hill station Oymyakon, the coldest place in Russia going – 45°C below 0°C.

Activity

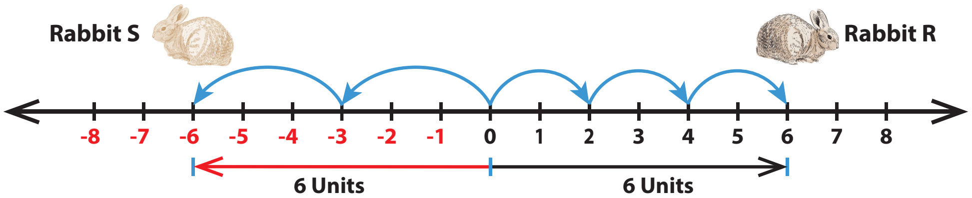
Ask your parents / grandparents about the depth at which the various types of vegetables (seeds) should be planted, for their better and efficient growth. For the same, draw a number line indicating the depth of various vegetable seeds. (Draw the planting chart!).

2.2.2 Opposite of a number

The idea of opposite of a number is not a new one. A few situations like, a man makes a profit of ₹500 or he loses ₹500 by selling an article; credit and debit of ₹75000 in a cash transaction of a business are 'opposite' to each other.

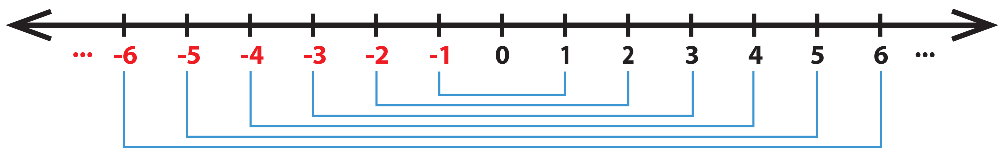
Think about the situation

Suppose two rabbits R and S jump along a number line (like) on the opposite sides of 0. Rabbit R jumps 2 steps 3 times to the right of 0 and Rabbit S jumps 3 steps 2 times to the left of 0 as shown in the figure below. Where will both of them stand on the number line? Are they at equal distance from 0?



Clearly, the rabbit R stands at 6 and the rabbit S stands at –6 on the number line. The distance from 0 to 6 on the number line is 6 units and the distance from 0 to –6 on the number line is also 6 units.The numbers 6 and –6 are at the same distance from 0 on the number line. That is, the rabbits R and S stand at the same distance from 0, but in opposite directions.

Here, 6 and −6 are ***opposite*** to each other. That is, two numbers that are at the same distance from 0 on the number line, but are on the opposite sides of it, are ***opposite*** to each other. For every positive integer, there is a corresponding negative integer and vice versa. The opposite of each integer is shown in the figure.



Opposites

Note

The opposite of the opposite of a number is the number itself. For example −(−5) read as negative of negative 5 or minus of minus 5 is equal to 5 itself.

Now, it is easy to write the opposite of the numbers −7, 12, −225 and 6000. Note that, the opposite of a positive integer is negative, and the opposite of a negative integer is positive, whereas the opposite of zero is zero.

Number	Its opposite
12 or +12	−12
−7	+7 or − (−7) = 7
−225	+225
6000 or +6000	−6000

The "opposites" are naturally more convenient to relate and understand with many of our daily-life situations like saving-spending, credit-debit, height above-below, where

i) the saving is treated as positive and the spending is treated as negative.

ii) a credit is considered positive whereas a debit is considered negative.

iii) the height above the sea level is regarded as positive and the height below the sea level is regarded as negative.

Example 2 Represent the following situations as integers:

i) A gain of ₹1000 ii) 20°C below 0°C iii) 1990 BC (BCE)

iv) A deposit of ₹15847 v) 10 kg below normal weight

Solution

i) As gain is positive, ₹1000 is denoted as + ₹1000.

ii) 20°C below 0°C is denoted as −20°C.

iii) A year in BC (BCE) can be considered as a negative number and a year in AD (CE) can be considered as a positive number. Hence, 1990 BC (BCE) can be represented as −1990.

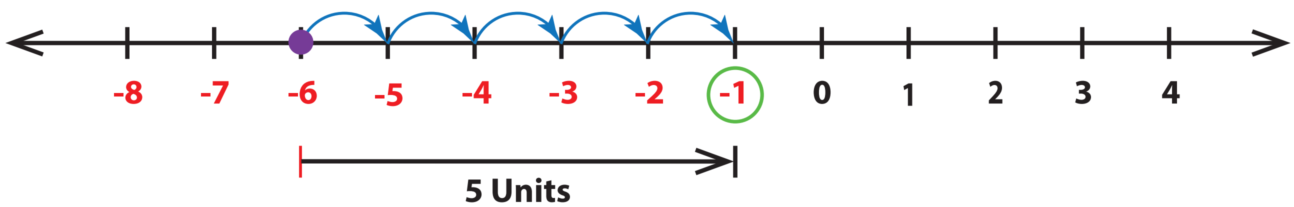
iv) A deposit of ₹15847 is denoted as + ₹15847.

v) 10 kg below normal weight is denoted as −10 kg.

Example 3 Using the number line, write the integer which is 5 more than −6.

Solution

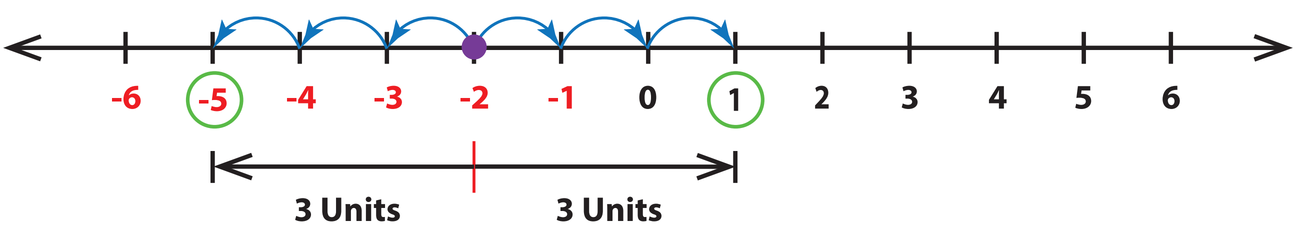
From −6, we can move 5 units to its right to reach −1 as shown in the figure.



Example 4 Find the numbers on the number line that are at a distance of 3 units in the opposite directions to −2.

Solution

From −2, we can move 3 units to the left and right as shown in the figure.



The required numbers are: 1 on the right of −2 and −5 to the left of −2.

Try these

1 Find the opposite of the following numbers:

i) 55 ii) −300 iii)+5080 iv) −2500 v) 0

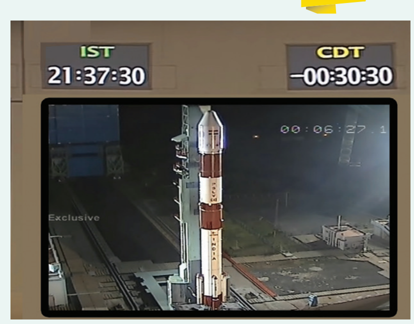
2 Represent the following situations as integers.

i) A loss of ₹2000
ii) 2018 AD (CE)
iii) Fishes found at 60 m below the sea level
iv) 18°C below 0°C
v) Gaining 13 points
vi) A jet plane at a height of 2500 m

3 Suppose in a building, there are 2 basement floors. If the ground floor is denoted as zero, how can we represent the basement floors?

DO YOU KNOW?

ISRO Scientists often find it convenient to designate a given time as zero time and then refer to the time before and time after as being negative and positive respectively. This practice is followed in the launching of rockets. If the time to take off is 1 minute, then it is 1 minute before the launch and hence denoted as -1 minute.



2.3 Ordering of Integers

We have already seen the ordering of numbers in the set of natural and whole numbers. The ordering is possible for integers also.

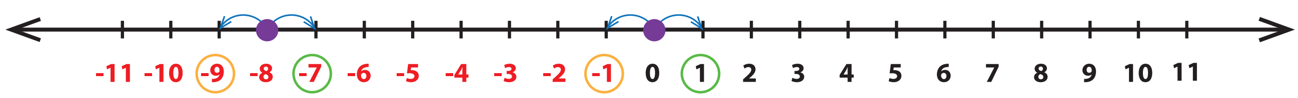
2.3.1 Predecessor and Successor of an Integer

Recall that for a given number its predecessor is one less than it and its successor is one more than it. This applies for integers also.

Example 5 Find the predecessor and successor of i) 0 and ii) −8 on a number line.

Solution

Place the given numbers on the number line then move one unit to their right and left to get the successor and the predecessor respectively.



We can see that the successor of 0 is +1 and the predecessor of 0 is −1 and the successor of −8 is −7 and the predecessor of −8 is −9.

Note

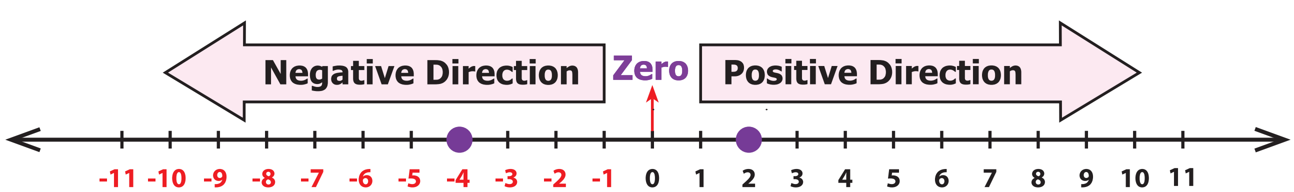
- Every positive integer is greater than each of the negative integers. Example: $3 > -5$
- 0 is less than every positive integer but greater than every negative integer. Example: $0<2$ but $0> -2$

2.3.2 Comparing Integers

Ordering of integers is to compare them. It is very easy to compare and order integers by using a number line.

When we move towards the right of a number on the number line, the numbers become larger. On the other hand, when we move towards the left of a number on the number line, the numbers become smaller.

We know that $4 < 6$, $8 > 5$ and so on. Now let us consider two integers say −4 and 2. Mark them on the number line as shown below.

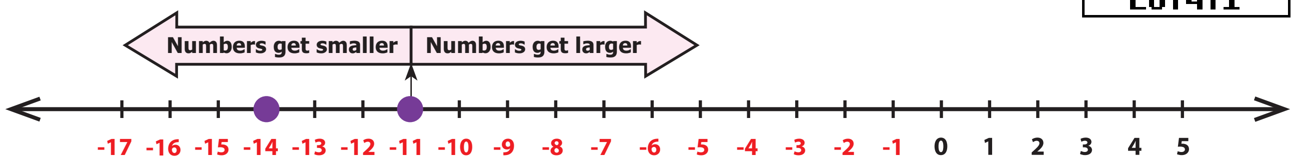


Fix −4 now. See whether 2 is to the right or the left of −4. In this case, 2 is to the right of−4 and in the positive direction. So, $2 > -4$ or otherwise $-4 < 2$.

Example 6 Compare −14 and −11

Solution

Draw number line and plot the numbers −14 and −11 as follows.



Fixing −11, we find −14 is to the left of −11. So, −14 is smaller than −11. That is, −14 < −11.

Think

For two numbers, say 3 and 5, we know that 5 > 3. Will there be a change in the inequality if both the numbers have negative sign before them?

Activity

Take two cards from a deck of playing cards and identify, which is greater between them, assuming that the Joker card represents zero, black cards represent positive integers, red cards represent negative integers and the cards A, J, Q and K represent 1,11,12 and 13 respectively.

Example 7 Arrange the following integers in ascending order:

−15, 0, −7, 12, 3, −5, 1, −20, 25, 18

Solution

Step 1: First, separate the positive integers as 12, 3, 1, 25, 18 and the negative integers as −15, −7, −5, −20

Step 2: We can easily arrange positive integers in ascending order as 1, 3, 12, 18, 25 and negative integers in ascending order as −20, −15, −7, −5.

Step 3: As 0 is neither positive nor negative, it stays at the middle and now the arrangement −20, −15, −7, −5, 0, 1, 3, 12, 18 and 25 is in ascending order.

Try these

i) Is −15 < −26? Why?

ii) Which is smaller −3 or −5? Why?

iii) Which is greater 7 or −4? Why?

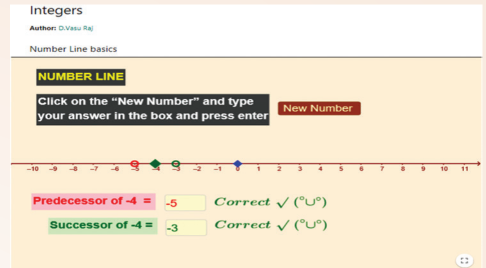
iv) Which is the greatest negative integer?

v) Which is the smallest positive integer?

Integers

ICT CORNER

Expected Outcome



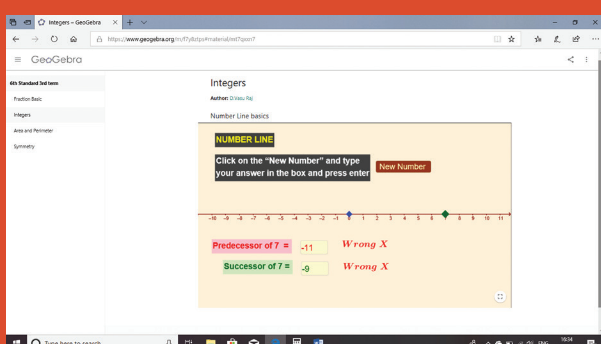
Step 1

Open the Browser by typing the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Integers" will open. There is a worksheet under the title Number Line basics.

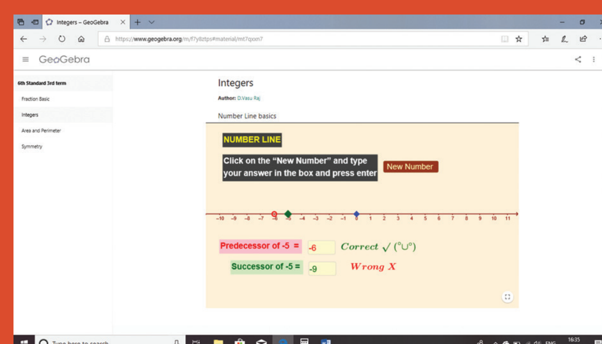
Step 2

Click on the "New Number" to get new question and type your answer in the respective check boxes, next to Predecessor and Successor and press enter..

Step1



Step2



Browse in the link:

Integers: https://ggbm.at/mt7qxxn7 or Scan the QR Code.

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Exercise 2.1

1. Fill in the blanks

i) The potable water available at 100m below the ground level is denoted as __________ m.

ii) A swimmer dives to a depth of 7 feet from the ground into the swimming pool. The integer that represents this, is _______ feet.

iii) −46 is to the_____ of −35 on the number line.

iv) There are ______ integers from−5 to +5 (both inclusive).

v) ______ is an integer which is neither positive nor negative.

2. Say True or False

E72ZZN

i) Each of the integers −18, 6, −12, 0 is greater than −20.
ii) −1 is to the right of 0.
iii) −10 and 10 are at equal distance from 1.
iv) All negative integers are greater than zero.
v) All whole numbers are integers.

3. Mark the numbers 4, −3, 6, −1 and −5 on the number line.

4. On the number line, which number is

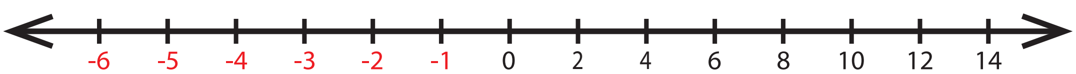
i) 4 units to the right of −7? ii) 5 units to the left of 3?

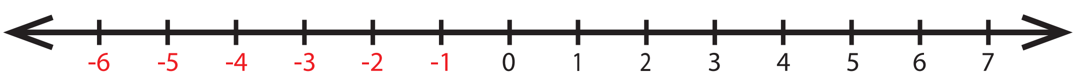
5. Find the opposite of the following numbers.

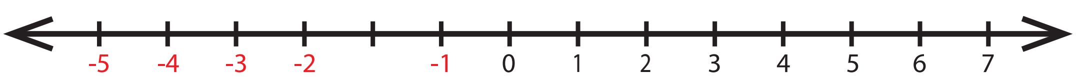
i) 44 ii) −19 iii) 0 iv) −312 v) 789

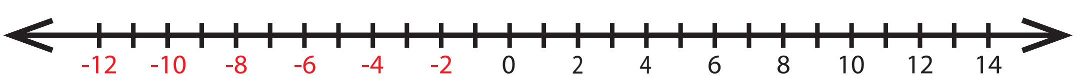
6. If 15 *km* east of a place is denoted as + 15 *km*, what is the integer that represents 15 *km* west of it?

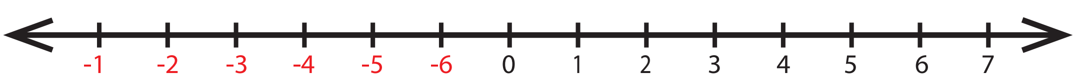
7. From the following number lines, identify the correct and the wrong representations with reason.

i) 

ii) 

iii) 

iv) 

v) 

8. Write all the integers between the given numbers.

i) 7 and 10 ii) −5 and 4 iii) −3 and 3 iv) −5 and 0

9. Put the appropriate signs as <, > or = in the box.

i) −7 ☐ 8 ii) −8 ☐ −7 iii) −999 ☐ −1000

iv) −111 ☐ −111 v) 0 ☐ −200

10. Arrange the following integers in ascending order.

i) −11, 12, −13, 14, −15, 16, −17, 18, −19, −20
ii) −28, 6, −5, −40, 8, 0, 12, −1, 4, 22
iii) −100, 10, −1000, 100, 0, −1, 1000, 1, −10

11. Arrange the following integers in descending order.
    i) 14, 27, 15, −14, −9, 0, 11, −17
    ii) −99, −120, 65, −46, 78, 400, −600
    iii) 111, −222, 333, −444, 555, −666, 7777, −888

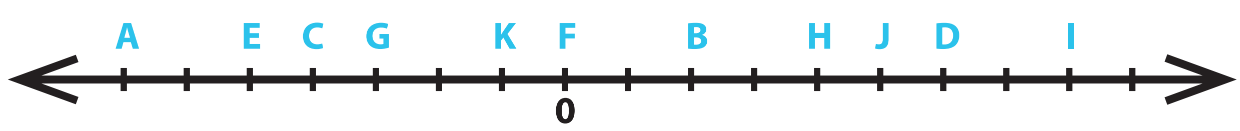
Objective Type Questions

12. There are ___________ positive integers from −5 to 6.
    a) 5 b) 6 c) 7 d) 11
13. The opposite of 20 units to the left of 0 is
    a) 20 b) 0 c) −20 d) 40
14. One unit to the right of −7 is..........
    a) +1 b) −8 c) −7 d) −6
15. 3 units to the left of 1 is
    a) −4 b) −3 c) −2 d) 3
16. The number which determines marking the position of any number to its opposite on a number line is
    a) −1 b) 0 c) 1 d) 10

Exercise 2.2

Miscellaneous Practice Problems

1. Write two different real life situations that represent the integer −3.
2. Mark the following numbers on a number line
    i) All integers which are greater than −7 but less than 7.
    ii) The opposite of 3.
    iii) 5 units to the left of −1.
3. Construct a number line that shows the depth of 10 feet from the ground level and its opposite.
4. Identify the integers and mark on the number line that are at a distance of 8 units from −6.
5. Answer the following questions from the number line given below .

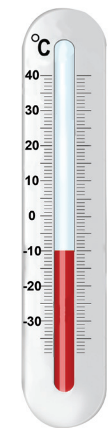


    i) Which integer is greater : G or K ? Why ?
    ii) Find the integer that represents C.
    iii) How many integers are there between G and H?
    iv) Find the pairs of letters which are opposite of a number.
    v) Say True or False : 6 units to the left of D is −6.

6. If G is 3 and C is −1, what numbers are A and K on the number line?

7. Find the integers that are 4 units to the left 0 and 2 units to the right of −3.

Challenge Problems

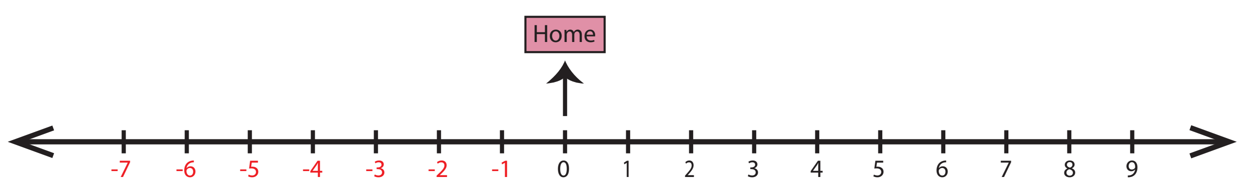


8. Is there the smallest and the largest number in the set of integers? Give reason.

9. Look at the Celsius Thermometer and answer the following questions:
   - i) What is the temperature that is shown in the Thermometer?
   - ii) Where will you mark the temperature 5^0 C below 0^0 C in the Thermometer?
   - iii) What will be the temperature, if 10^0 C is reduced from the temperature shown in the Thermometer?
   - iv) Mark the opposite of 15^0 C in the Thermometer.

10. P, Q, R and S are four different integers on a number line. From the following clues, find these integers and write them in ascending order.
    - i) S is the least of the given integers.
    - ii) R is the smallest positive integer.
    - iii) The integers P and S are at the same distance from 0.
    - iv) Q is 2 units to the left of integer R.

11. Assuming that the home to be the starting point, mark the following places in order on the number line as per instructions given below and write their corresponding integers.



Places: Home, School, Library, Playground, Park, Departmental Store, Bus Stand, Railway Station, Post Office, Electricity Board.

Instructions:

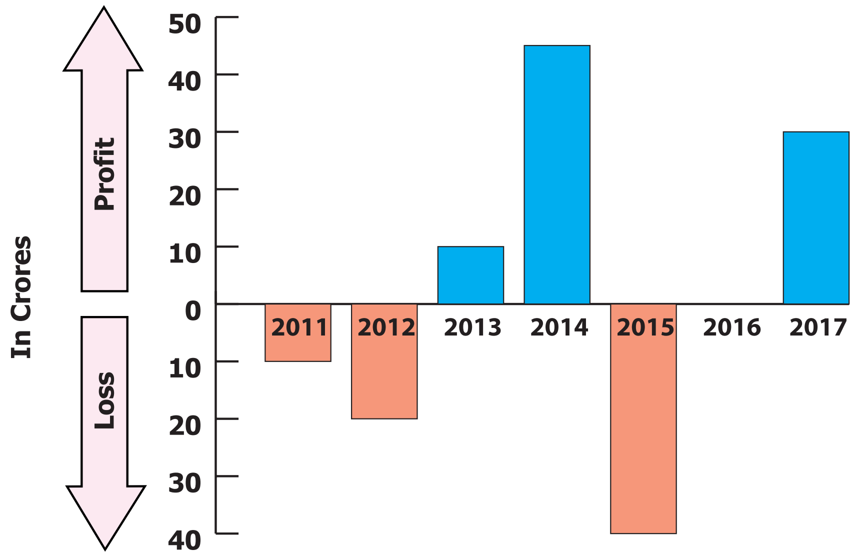
- i) Bus Stand is 3 units to the right of Home.
- ii) Library is 2 units to the left of Home.
- iii) Departmental Store is 6 units to the left of Home.
- iv) Post Office is 1 unit to the right of the Library.
- v) Park is 1 unit right of Departmental Store.
- vi) Railway Station is 3 units left of Post Office.
- vii) Bus Stand is 8 units to the right of Railway Station.
- viii) School is next to the right of Bus Stand.
- ix) Playground and Library are opposite to each other.
- x) Electricity Board and Departmental Store are at equal distance from Home.

12. Complete the table using the following hints:

C1: the first non-negative integer.
C3: the opposite to the second negative integer.
C5: the additive identity in whole numbers.
C6: the successor of the integer in C2.
C8: the predecessor of the integer in C7.
C9: the opposite to the integer in C5.

C1	C2 -5	C3
C4 6	C5	C6
C7 -7	C8	C9

13. The following bar graph shows the profit (+) and loss (−) of a small scale company (in crores) between the years 2011 to 2017.



i) Write the integer that represents a profit or a loss for the company in 2014?
ii) Denote by an integer on the profit or loss in 2016.
iii) Denote by integers on the loss for the company in 2011 and 2012.
iv) Say True or False: The loss is minimum in 2012.
v) Fill in: The amount of loss in 2011 is ________ as profit in 2013.

Summary

- The set of numbers ..., -3, -2, -1, 0, 1, 2, 3,... is called Integers. It is denoted by the letter Z.
- The number 0 is neither positive nor negative
- Two numbers that are at the same distance from 0 on the number line, but are on the opposite sides of it, are opposite to each other.
- Natural numbers are called as positive integers and Whole numbers are called as non-negative integers.
- Positive and negative numbers together are called as Signed numbers. Signed numbers are also called as Directed numbers.

CHAPTER
3

PERIMETER AND AREA

E7BH2B

Learning Objectives

- To understand the concept of perimeter and area of closed shapes.
- To calculate the perimeter and area of square, rectangle, right angled triangle and their combined shapes.
- To understand the usage of units appropriately for area and perimeter.

3.1 Introduction

We come across many situations in our day to day life which deal with shapes, their boundaries and surfaces. For example,

- A fence built around a land.
- Frame of a photograph.
- Calculating the surface of the wall to know the quantity of the paint required.
- Wrapping the textbooks and notebooks with brown sheets.
- Calculating the number of tiles to be laid on the floor.

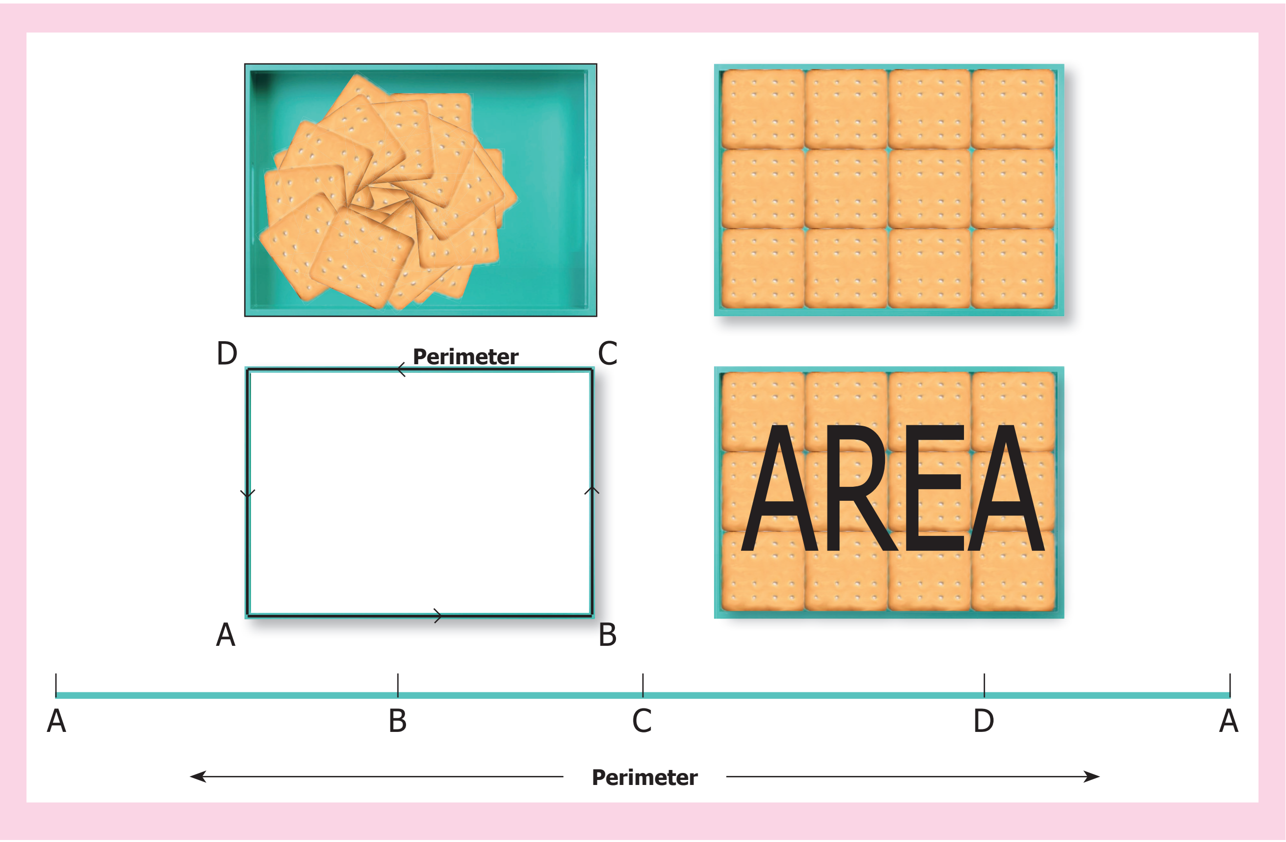
Some situations need to be handled tactfully and efficiently for the following reasons.

- Using the optimum space to build a dining hall, kitchen, bedroom etc., in constructing a house in the available land and planning of materials required.
- Arranging the things like cot, television, cup-board, table etc., in the proper place within the available space at home.
- Reducing the expenses in all the above activities.

In this context, learning of perimeter and area will be of great importance.

Think about the situation

Apoorva and her brother return from school. Their mother serves them some biscuits. While they eat them one by one, Apoorva arranges the biscuits on a tray. She finds that the tray can hold only 12 biscuits. If she has to extend spreading the remaining biscuits also in the same manner, she will need a bigger tray in size because, already 12 biscuits occupied the surface of the tray completely. The total length of the visible borders of the tray is said to be the ***perimeter*** and the surface occupied by the biscuits is said to be the ***area*** of the tray. Let us discuss about the perimeter and area in detail in this chapter.



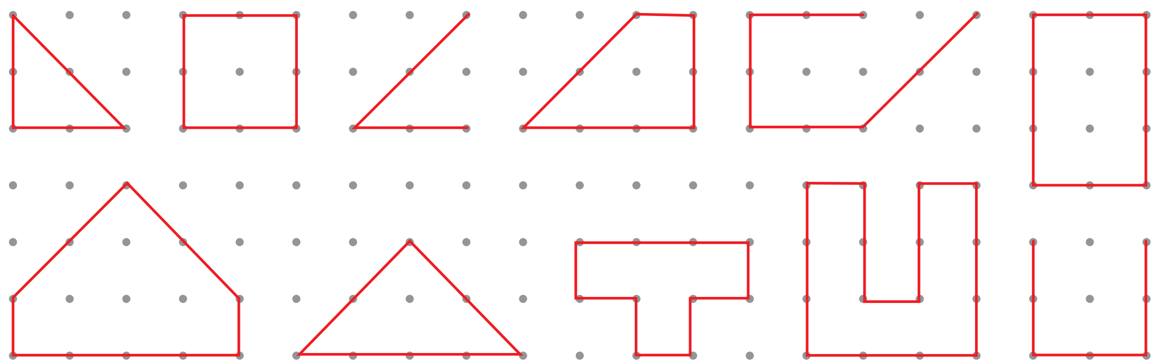
MATHEMATICS ALIVE – PERIMETER AND AREA IN REAL LIFE

	
Carpenters measure the length of wood required to make a chair	Mason fixing the tiles on the floor.

3.2 Perimeter

Activity

Observe the following shapes and answer the questions given below:



i) Mark the closed shapes as '✓' and open shapes as 'x'.

ii) Find the measure of the boundary of closed shapes by using a ruler.

iii) Which closed shape has the shortest boundary?

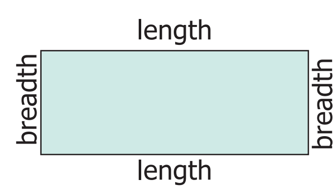
iv) Which closed shape has the longest boundary?

The length of the boundary of any closed shape is called its ***perimeter***. Hence, 'the measure around' of a closed shape is called its ***perimeter***. The unit of perimeter is the unit of length itself. The units of length may be expressed in terms of metre, millimetre, centimetre, kilometre, inch, feet, yard etc.,

DO YOU KNOW?

The word perimeter is derived from the Greek words 'peri' and 'metron', where 'peri' means 'around' and 'metron' means 'measure'.

3.2.1 Perimeter of a Rectangle



Perimeter of a rectangle = Total boundary of the rectangle

= length + breadth + length + breadth

= 2 length + 2 breadth

= 2 (length + breadth)

Let us denote the length, breadth and the perimeter of a rectangle as l, b and P respectively.

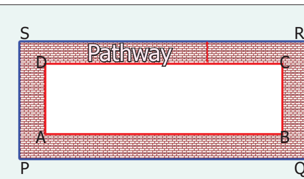
Perimeter of the rectangle, P= 2 x (l + b) *units*

Note

In a rectangle the opposite sides are equal in length.

DO YOU KNOW?

For the pathway shown in the figure, the outer boundary of the pathway is PQRS and its inner boundary is ABCD.



Example 1 If the length of a rectangle is 12 *cm* and the breadth is 10 *cm*, then find its perimeter.

Solution l = 12 *cm*

b = 10 *cm*

P = 2 (l + b) *units*

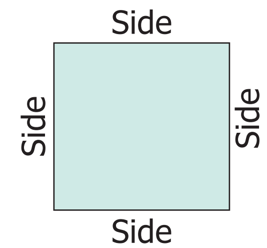
= 2 (12 + 10)

= 2 × 22

= 44 *cm*

Perimeter of the rectangle is 44 *cm*.

3.2.2 Perimeter of a Square



Perimeter of a square = Total boundary of the square

= side + side + side + side

= (4 × side) *units*

If the side of a square is 's' units, then

Perimeter of the square, P = (4 × *s*) *units* = 4*s* *units*.

Note

- In a square, all the sides are equal in length.
- The perimeter of a regular shape with any number of sides = number of sides x length of a side

Example 2 The side of a square is 5 *cm*. Find its perimeter.

Solution s = 5 *cm*

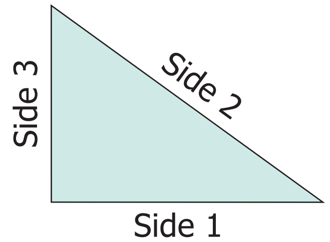
P = (4 × s) *units*

= 4 × 5

= 20 *cm*

Perimeter of the square is 20 *cm*.

3.2.3 Perimeter of a Triangle



Perimeter of a triangle = Total boundary of the triangle

= side 1 + side 2 + side 3

If three sides of a triangle are taken as a, b and c, then the Perimeter of the triangle, P = (a + b + c) *units*.

Example 3 Find the perimeter of a triangle whose sides are 3 *cm*, 4 *cm* and 5 *cm*.

Solution a = 3 *cm*

b = 4 *cm*

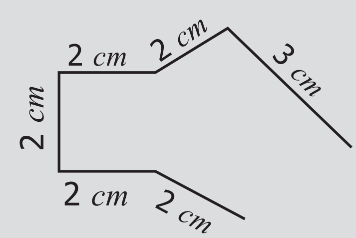
c = 5 *cm*

P = (a + b + c) *units*

= 3 + 4 + 5 = 12 *cm*

Perimeter of the triangle is 12 *cm*.

Think



Is the perimeter of the given shape possible? Why?

Try these

i) Draw a shape with perimeter 16 cm in a dot sheet.
ii) What is the perimeter of a rectangle if the length is twice its breadth?
iii) What would be the perimeter of a square if its side is reduced to half?
iv) What is the perimeter of a triangle if all sides are equal in length?

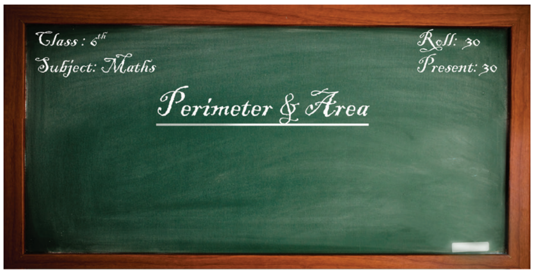
Activity

Choose any five items like Table, A4 sheet, Note-book., etc in the classroom. Guess the approximate length of each side by observation and write down the estimated perimeter of the item. Then, measure by using ruler and record the actual perimeter and find the difference in the following table (to the nearest cm).

Item	Estimated Perimeter	Actual Perimeter	Difference

Example 4 Find the length of the rectangular black board whose perimeter is 6 m and the breadth is 1 m.

Solution Perimeter of the black board, P= 6 m



Breadth of the black board, b=1 m

length, l =?

$2\ (l + b) = 6$

$2\ (l + 1) = 6$

$$l + 1 = \frac{6}{2}$$

$$= 3$$

$$l = 3 - 1$$

$$= 2\ m$$

The length of the black board is 2 m.

Example 5 Find the side of a square shaped postal stamp of perimeter 8 cm.

Solution Perimeter of the square, P= 8 cm

$4 \times S = 8$

$$S = \frac{8}{4}$$

$$= 2\ cm$$

The side of the stamp is 2 cm.

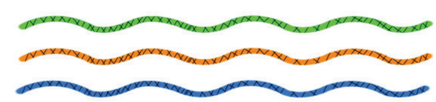
Example 6 Find the side of the equilateral triangle of perimeter 129 cm.

Solution Perimeter of the equilateral triangle, P = 129 cm

$$a + a + a = 129$$
$$3 \times a = 129$$
$$a = \frac{129}{3}$$
$$= 43\ cm$$

The side of the equilateral triangle is 43 cm.

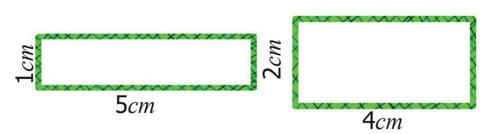
Example 7 Thendral, Tharani and Thanam are given a thread piece each of length 12 cm. They are asked to make a rectangle, a square and a triangle respectively with the thread for their Math activity. In how many ways, can they make the respective shapes?



Solution **Thendral**

Perimeter of the rectangle, P = 12 cm

$$2\,(l + b) = 12$$
$$l + b = \frac{12}{2} = 6\,cm$$



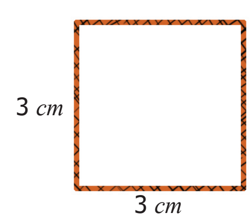
The possible pairs of measures whose sum is 6 are (5,1) and (4, 2).

Hence, Thendral can make a rectangle in 2 ways. She can make a rectangle of length 5 cm and breadth 1 cm and another one with length 4 cm and breadth 2 cm.

Tharani

Perimeter of the square, P = 12 cm

$$4 \times s = 12$$
$$s = \frac{12}{4} = 3\ cm$$



Hence, Tharani can make only one square of side 3 cm.

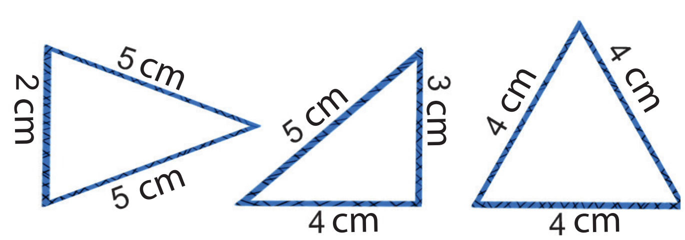
Thanam

Perimeter of the triangle, P = 12 cm

$$a + b + c = 12\ cm$$

The possible triplets of measures whose sum is 12 and also satisfying the triangle inequality are (2, 5, 5) ; (3, 4, 5) ; (4, 4, 4).

Hence, Thanam can make 3 triangles of sides 2 cm, 5 cm & 5 cm; 3 cm, 4 cm & 5 cm and 4 cm, 4 cm & 4 cm.



Think

Can different shapes have the same perimeter?

Example 8 Find the cost of fencing a square plot of side 12 m at the rate of ₹15 per metre.

Solution

Side of a square plot = 12 m

Perimeter of the square plot = $(4 \times s)$ *units*

= $4 \times 12 = 48$ m

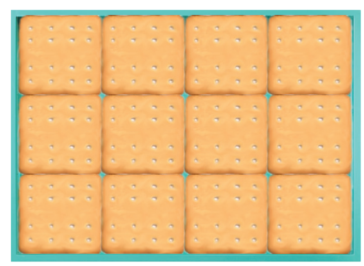
Cost of fencing the plot at the rate of ₹15 per metre = 48×15 = ₹720

Try these

i) Find the breadth of the rectangle with perimeter 14 m and length 4 m.

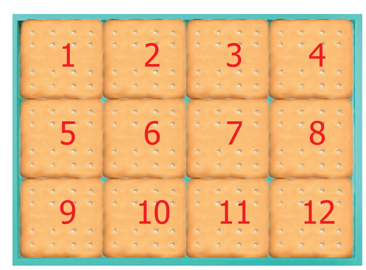
ii) The perimeter of an isoseles triangle is 21 cm. Find the measure of equal sides given that the third side is 5 cm.

3.3 Area



Recall the 'Apoorva and her biscuits arrangement' in the beginning of this chapter. We do not know the measure of the side of the biscuit. But we know it is in the shape of a square. Let its side be 1 unit. The tray can hold 12 square biscuits (square units). That is, 12 square biscuits (square units) occupy the entire surface of the tray. This space of the tray is called the ***Area*** of the tray. Thus, the area of any closed shape is the surface occupied by the number of unit squares within its boundary. Suppose each side of a biscuit is of 1 inch length, then the area of the tray is 12 square inches.

3.3.1 Area of a Rectangle



As the above tray is in the shape of a rectangle, split it into small and uniform squares called unit squares. There are 4 unit squares along its length and 3 unit squares along its breadth. Totally, 12 square biscuits occupy this rectangle and so the area of this rectangle is 12 square units.

Suresh brought a groundnut burfi packet to school as snacks to eat during the break. As he peeled off the cover, he saw that there are 3 rows and each row has 5 square pieces. What he sees here is that the total number of small squares in the given burfi is 15. So, the area of the given rectangular burfi is 15 square burfi pieces.

Tamizhazhagi wants to share a chocolate bar with her friends on her birthday. The chocolate bar that she has bought has 5 square pieces horizontally and 4 square pieces vertically. She finds that there are 20 identical unit square chocolate pieces so that she can give it to 19 of her friends and have 1 for herself.

Here, the total number of square chocolate pieces is 20, which represents the area of the whole chocolate bar.

The total number of squares in all these cases can be arrived by multiplying the number of squares along its length with the number of squares along its breadth instead of counting them.

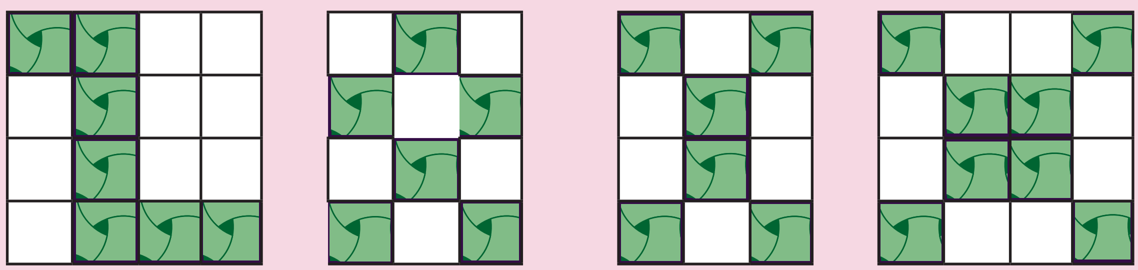
> **Note**
> 'Square units' can also be written as 'unit^2'.

Therefore the area of any rectangle = (length x breadth) square units.

= (l x b) sq. units.

Try these

Find the number of tiles required to fill the area of following figures.



i) ii) iii) iv)

Example 9 Find the area of a rectangle of length 12 *cm* and breadth 7 *cm*.

Solution

Length of the rectangle, l = 12 *cm.*

Breadth of the rectangle, b = 7 *cm.*

Area of the rectangle A = (l x b) *sq. units.*

= 12 x 7 = 84 *sq. cm.*

3.3.2 Area of a Square

If the length and breadth of a rectangle are equal, then it becomes a square.

Area of the rectangle = (length x breadth) square units.

= (side x side) *sq. units.*

= (s x s) *sq. units.*

= Area of a square

Therefore area of a square = (s x s) *sq. units.*

> **Note**
> When the rectangle is made into a square then length (l)=breadth (b)=side (s)

Example 10 Find the area of a square of side 15 *cm.*

Solution

Side of the square, s = 15 *cm*

Area of the square, A = (s x s) *sq. units.*

= 15 x 15

= 225 sq. *cm*. (or) 225 cm^2

3.3.3 Area of a Right Angled Triangle

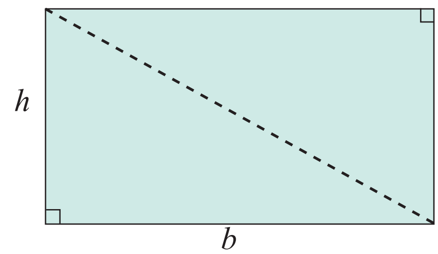
In a right angled triangle one of the sides containing the right angle is treated as its base (b units) and the other side as its height (h units).

When a rectangular sheet is cut along its diagonal, two right angled triangles are obtained.

Area of two right angled triangles = Area of the rectangle

2 x Area of a right angled triangle = $l \times b$

Area of the right angled triangle = $\frac{1}{2}$ $(l \times b)$ *sq. units.*

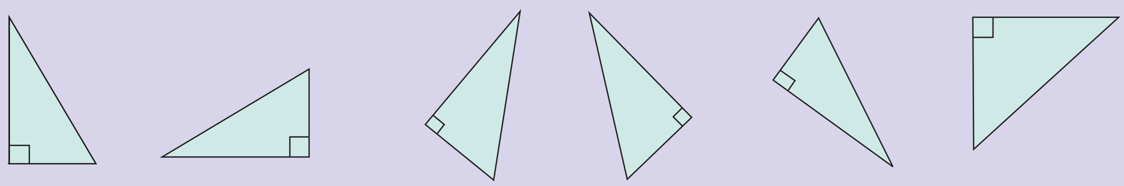


The length and breadth of the rectangle are respectively the base (b) and height (h) of the right angled triangle.

Hence, area of the right angled triangle = $\frac{1}{2}$ $(b \times h)$ *sq. units.*

Activity

Mark the base and height of the following right angled triangles.



Example 11 Find the area of a right angled triangle whose base is 18 *cm* and height is 12 *cm*.

Solution

Base, b = 18 *cm*

Height, h = 12 *cm*

Area, A = $\frac{1}{2}$ $(b \times h)$ *sq. units*

$= \frac{1}{2}(18 \times 12)$

= 108 *sq. cm*. (or) 108 cm^2

E7KS3Y

Try these

Draw the following in a graph sheet.

i) Two different rectangles whose areas are 16 cm^2 each.

ii) A shape with perimeter 14 *cm* and area 12 *sq. cm*.

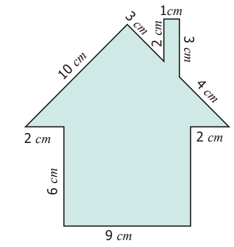
iii) A shape with area 36 *sq. cm*.

iv) Form different shapes using 4 *unit* squares and find their perimeter and area. (Sides of the squares must fit exactly)

3.4 Perimeter and Area of Combined Shapes

A ***Combined shape*** is the combination of several closed shapes. The perimeter is calculated by adding all the outer sides (boundaries) of the combined shape. The area is calculated by adding all the areas of closed shapes from which the combined shape is formed.

Example 12 Find the perimeter of the given figure.



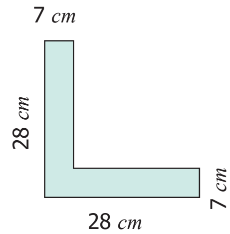
Solution

Perimeter = Total length of the boundary

= (6 + 2 + 10 + 3 + 2 + 1 + 3 + 4 + 2 + 6 + 9) cm

= 48 cm

Example 13 Find the perimeter and the area of the following 'L' shaped figure.

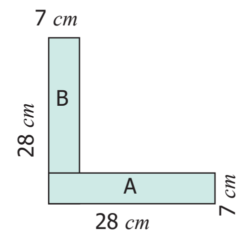


Solution

Perimeter = (28 + 7 + 21 + 21 + 7 + 28) cm.

= 112 cm.

To find the area of the L shaped figure, it is divided into two rectangles A and B.



Rectangle-A	Rectangle-B
l = 28 cm	l = 21 cm
b = 7 cm	b = 7 cm
A = l x b sq. cm	A = l x b sq. cm.
= 28 x 7	= 21 x 7
= 196 sq. cm	= 147 sq. cm

The area of the 'L' shaped figure = (196 + 147) $sq.\ cm$

= 343 $sq.\ cm$.

Activity

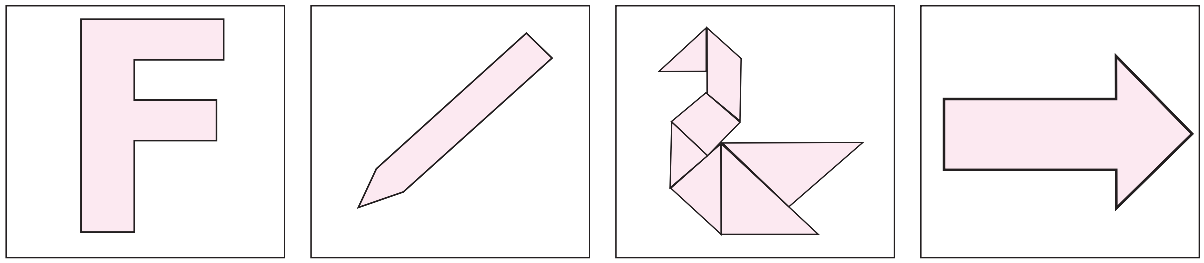
Find the area of the given 'L' shaped rectangular figure by dividing it into squares of equal sizes.

Think

Can you find the area of 'L' shaped figure as the difference between two areas.

Try these

Measure using ruler and find the perimeter of each of the following diagram.

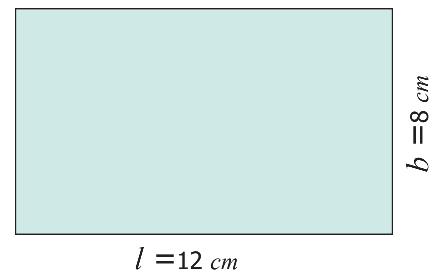


Activity

Form all possible shapes of perimeter 80 cm with 9 identical squares, each of side 4 cm.

3.4.1 Impact on Removing / Adding a portion from / to a given shape

Consider a rectangle of sides 8 cm and 12 cm.



Length, l = 12 cm; Breadth b = 8 cm.

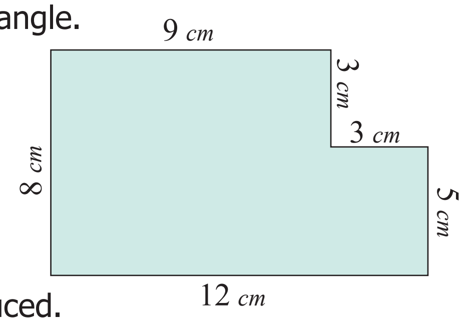
Area, A = (l x b) $sq.$ $units.$
= 12 x 8
= 96 $sq.$ $cm.$

Perimeter, P = 2 (l + b) $units.$
= 2 (12 + 8)
= 40 cm.

Find the area and perimeter of the rectangle in the following situations and observe the changes.

Situation 1

A square of side 3 cm is cut at a corner of the rectangle.



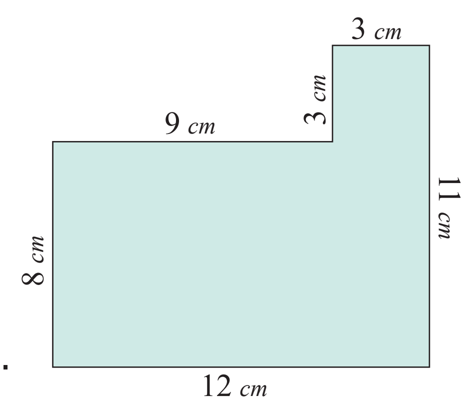
Area, A = (l x b) – (s x s) $sq.$ $units.$
= (12 x 8) – (3 x 3)
= 87 $sq.$ $cm.$

Perimeter, P = (Total boundary) $units.$
= 8+12+5+3+3+9 = 40 cm.

The perimeter is not changed. But the area is reduced.

Situation 2

A square of side 3 cm is attached to the rectangle.



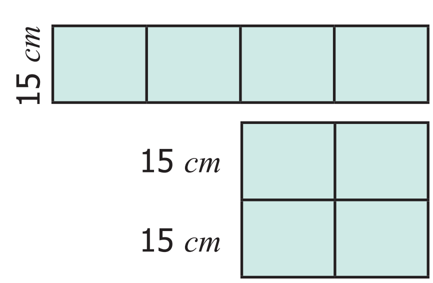
Area, A = (l x b) + (s x s) $sq.$ $units.$
= (12 x 8) + (3 x 3)
= 105 $sq.$ $cm.$

Perimeter, P = (Total boundary) units.
= 8+12+11+3+3+9 = 46 cm.

Here both the perimeter and the area are increased.

Example 14 Four identical square floor mats of side 15 cm are joined together to form either a rectangular mat or a square mat. Which mat will have a larger area and a longer perimeter?

Solution Perimeter of a rectangle, P = 2 (l + b) $units.$
= 2 (60+15) cm. = 150 cm.



Area of a rectangle, A = (l x b) $sq.$ $units.$
= 60 x 15 = 900 $sq.$ cm.

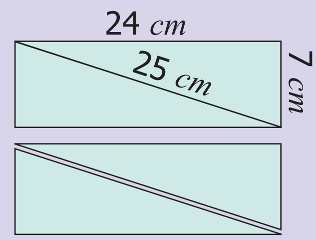
Perimeter of a square, P = (4 × s) $units$
= (4 x 30) cm = 120 cm

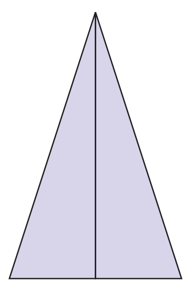
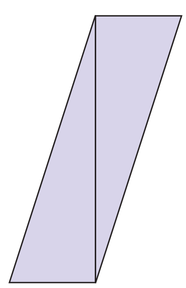
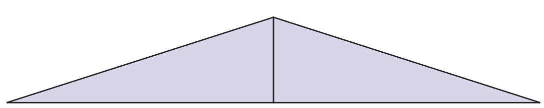
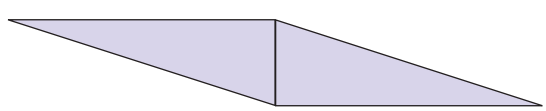
Area of a square, A = (s x s) $sq.$ $units.$
= 30 x 30 = 900 $sq.$ cm.

There is no change in their areas. But, the rectangular mat will have longer perimeter.

Activity

Cut a rectangular sheet along one of its diagonals. Two identical scalene right angled triangles are obtained. Join them along their sides of identical length in all possible ways. Six different shapes can be obtained. Four of them are given. Find the remaining two shapes. Find the perimeter of all the six shapes and fill in the table.



Sl. No.	Shape obtained	Perimeter
1		
2		
3		
4		
5		
6		

Based on the above activity answer the following questions:

i) Are the perimeters same for all the shapes?

ii) Which shape has the longest perimeter?

iii) Which shape has the shortest perimeter?

iv) Are the areas of all the shapes same? Why?

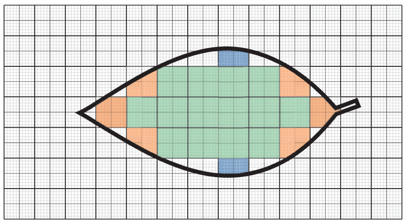
- Shapes with the same perimeter may have different areas.
- Shapes with the same area may have different perimeters.

E7UN5L

3.5 Area of Irregular Shapes

The area of the shapes like triangle, square etc., are found by standard formulae. But we can find the approximate area of shapes like leaves as follows.

Place a leaf on a graph sheet and trace its boundary. Now observe the squares of size 1 cm x 1 cm inside of this boundary. We get complete squares (Green), partial but bigger than half squares (Orange) and half squares (Blue). The smaller than half squares which have negligible area are omitted.



Now the approximate area of the leaf

= (Number of full squares + Number of more than half squares

+ $\frac{1}{2}$ x Number of half squares) $sq.\ units$

= $(14 + 6 + \frac{1}{2} \times 2)\ sq.\ cm$

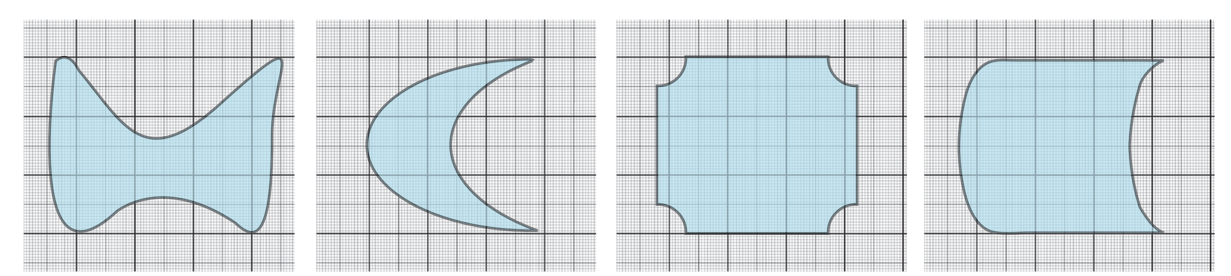
= $21\ sq.\ cm$

Note

You will learn to find the actual area of irregular shapes like leaves in your higher classes.

Try these

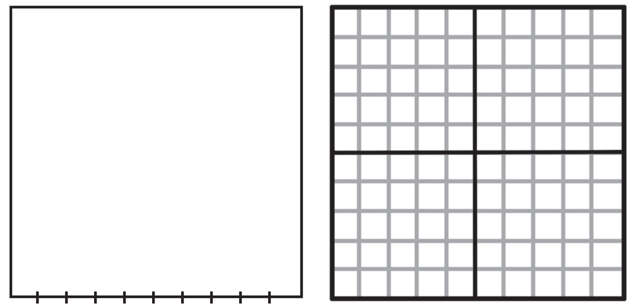
Find the approximate area of the following figures:



3.6 Expressing the Area in Square Units

Consider a square of side 1 cm. Therefore, its area is 1 $sq.\ cm$ (1 cm^2). Divide one of its sides into 10 equal parts. One such part is equal to 1 mm. We know that 1 cm = 10 mm. That is a square of side 1 cm is made up of 100 small squares with 1 mm square area each. Therefore, the side of this square is 10 mm and the area of this square = side x side =10 mm x 10 mm = 100 $sq.\ mm$ (100 mm^2). Therefore, the area of a square with 1 cm side is 1 cm^2 = 100 mm^2.

Similarly, the other conversions can also be done. For example,



i) $1\ cm^2 = 10\ mm \times 10\ mm$
$= 100\ mm^2$

ii) $1\ m^2 = 100\ cm \times 100\ cm$
$= 10{,}000\ cm^2$

iii) $1\ km^2 = 1000\ m \times 1000\ m$
$= 10{,}00{,}000\ m^2$

Example 15 Fill in the blanks.

i) $2\ cm^2$ = ______ mm^2

ii) $18\ m^2$ = ______ cm^2

iii) $5\ km^2$ = ______ m^2

Solution

i) $2\ cm^2 = 2 \times 100 = 200\ mm^2$

ii) $18\ m^2 = 18 \times 10000 = 1{,}80{,}000\ cm^2$

iii) $5\ km^2 = 5 \times 1000000 = 50{,}00{,}000\ m^2$

DO YOU KNOW?

1 acre = $4046.86\ m^2$
1 hectare = $10{,}000\ m^2$

Try these

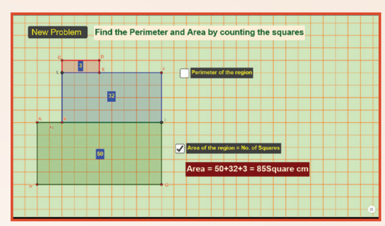
Fill in the blanks

i) $7\ cm^2$ = ______ mm^2 ii) $10\ m^2$ = ______ cm^2 iii) $3\ km^2$ = ______ m^2

Perimeter and Area

ICT CORNER

Expected Outcome



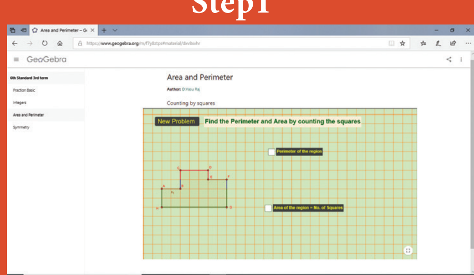
Step – 1

Open the Browser by typing the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Perimeter and Area" will open. There is a worksheet under the title Counting by squares.

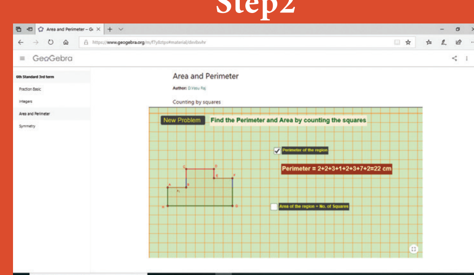
Step - 2

Click on New Problem and find the perimeter and Area of the shape by counting along the squares. Click on the respective check boxes to check your answer.

Step1



Step2



Browse in the link:

Perimeter and Area: https://ggbm.at/dxv8xvhr or Scan the QR Code.

B542_6_MAT_EM_T3

Exercise 3.1

1. The table given below contains some measures of the rectangle. Find the unknown values.

S. No	Length	Breadth	Perimeter	Area
i)	5 cm	8 cm	?	?
ii)	13 cm	?	54 cm	?
iii)	?	15 cm	60 cm	?
iv)	10 m	?	?	120 $sq.\ m$
v)		4 $feet$	?	20 $sq.\ feet$

2. The table given below contains some measures of the square. Find the unknown values.

S. No	Side	Perimeter	Area
i)	6 cm	?	?
ii)	?	100 m	?
iii)	?	?	49 $sq.\ feet$

E84J79

3. The table given below contains some measures of the right angled triangle. Find the unknown values.

S. No	Base	Height	Area
i)	20 cm	40 cm	?
ii)	5 $feet$	?	20 $sq.\ feet$
iii)	?	12 m	24 $sq.\ m$

4. The table given below contains some measures of the triangle. Find the unknown values.

S. No	Side 1	Side 2	Side 3	Perimeter
i)	6 cm	5 cm	2 cm	?
ii)	?	8 m	3 m	17 m
iii)	11 $feet$	?	9 $feet$	28 $feet$

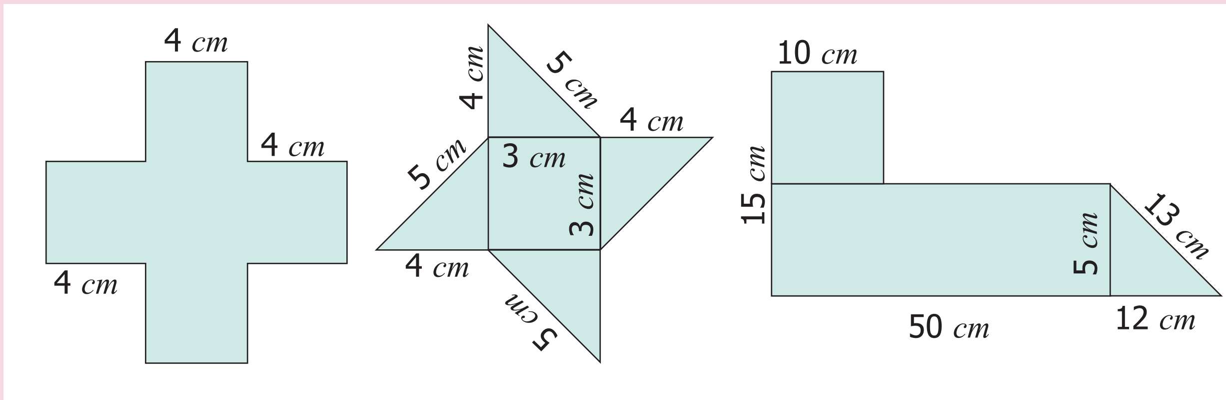
5. Fill in the blanks.

i) 5 cm^2 = ______ mm^2

ii) 26 m^2 = ______ cm^2

iii) 8 km^2 = ______ m^2

6. Find the perimeter and area of the following shapes.

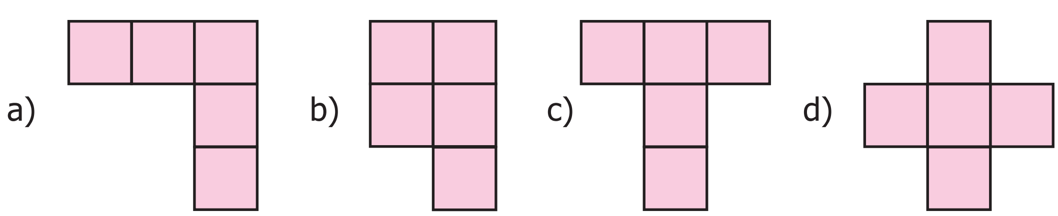


(i) (ii) (iii)

7. Find the perimeter and the area of the rectangle whose length is 6 m and breadth is 4 m.
8. Find the perimeter and the area of the square whose side is 8 cm.
9. Find the perimeter and the area of a right angled triangle whose sides are 6 *feet*, 8 *feet* and 10 *feet*.
10. Find the perimeter of
    - i) A scalene triangle with sides 7 m, 8 m, 10 m.
    - ii) An isosceles triangle with equal sides 10 cm each and third side is 7 cm.
    - iii) An equilateral triangle with side 6 cm.
11. The area of a rectangular shaped photo is 820 $sq.\ cm.$ and its width is 20 cm. What is its length? Also find its perimeter.
12. A square park has 40 m as its perimeter. What is the length of its side? Also find its area.
13. The scalene triangle has 40 cm as its perimeter and whose two sides are 13 cm and 15 cm, find the third side.
14. A field is in the shape of a right angled triangle whose base is 25 m and height 20 m. Find the cost of levelling the field at the rate of ₹45 per sq. m^2.
15. A square of side 2 cm is joined with a rectangle of length 15 cm and breadth 10 cm. Find the perimeter of the combined shape.

Objective Type Questions

16. The following figures are of equal area. Which figure has the least perimeter?



17. If two identical rectangles of perimeter 30 cm are joined together, then the perimeter of the new shape will be

    a) equal to 60 cm b) less than 60 cm

    c) greater than 60 cm d) equal to 45 cm

18. If every side of a rectangle is doubled, then its area becomes _____ times.

    a) 2 b) 3 c) 4 d) 6

19. The side of a square is 10 cm. If its side is tripled, then by how many times will its perimeter increase?

    a) 2 times b) 4 times c) 6 times d) 3 times

20. The length and breadth of a rectangular sheet of a paper are 15 cm and 12 cm respectively. A rectangular piece is cut from one of its corners. Which of the following statement is correct for the remaining sheet?

    a) Perimeter remains the same but the area changes

    b) Area remains the same but the perimeter changes

    c) There will be a change in both area and perimeter.

    d) Both the area and perimeter remains the same.

Exercise 3.2

Miscellaneous Practice Problems

1. A piece of wire is 36 cm long. What will be the length of each side if we form

   i) a square ii) an equilateral triangle.

2. From one vertex of an equilateral triangle with side 40 cm, an equilateral triangle with 6 cm side is removed. What is the perimeter of the remaining portion?
3. Rahim and Peter go for a morning walk, Rahim walks around a square path of side 50 m and Peter walks around a rectangular path with length 40 m and breadth 30 m. If both of them walk 2 rounds each, who covers more distance and by how much?
4. The length of a rectangular park is 14 m more than its breadth. If the perimeter of the park is 200 m, what is its length? Find the area of the park.
5. Your garden is in the shape of a square of side 5 m. Each side is to be fenced with 2 rows of wire. Find how much amount is needed to fence the garden at ₹ 10 per metre.

Challenge Problems

6. A closed shape has 20 equal sides and one of its sides is 3 cm. Find its perimeter.
7. A rectangle has length 40 cm and breadth 20 cm. How many squares with side 10 cm can be formed from it.
8. The length of a rectangle is three times its breadth. If its perimeter is 64 cm, find the sides of the rectangle.

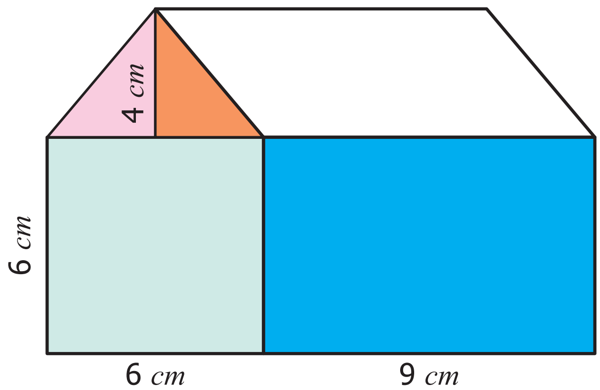
9. How many different rectangles can be made with a 48 *cm* long string? Find the possible pairs of length and breadth of the rectangles.

10. Draw a square B whose side is twice of the square A. Calculate the perimeters of the squares A and B.

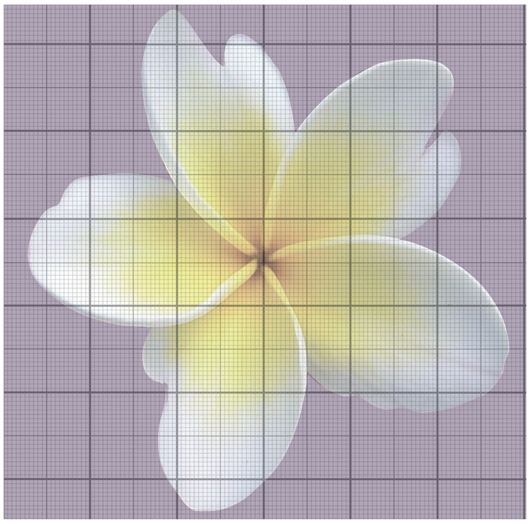
11. What will be the area of a new square formed if the side of a square is made one-fourth?

12. Two plots have the same perimeter. One is a square of side 10 *m* and another is a rectangle of breadth 8 *m*. Which plot has the greater area and by how much?

13. Look at the picture of the house given and find the total area of the shaded portion.



14. Find the approximate area of the flower in the given square grid.



Summary

- The perimeter of any closed figure is the total length of its boundary.
- Perimeter of the rectangle, P= 2 x (l + b) *units*.
- Perimeter of the square, P = (4 x S) *units*.
- Perimeter of the triangle, P = (a + b + c) *units*.
- Perimeter of the shape with equal sides = Number of sides x Length of a side.
- The area is the measure of the region/surface occupied by a closed figure.
- Area of a rectangle, A = length x breadth = (l x b) *sq. units*.
- Area of a square, A = side x side = (s x s) *sq. units*.
- Area of the right angled triangle, A = $\frac{1}{2}$ (b x h) *sq. units*.
- The perimeter of a combined shape is the sum of the length of all outer sides of the shapes.
- The area of a combined shape is the sum of all the areas of regular/simpler shapes by which the combined shape is formed.

CHAPTER 4

SYMMETRY

E8DF8H

Learning Objectives

- To identify symmetrical objects in our surroundings.
- To understand the types of symmetry.

4.1 Introduction

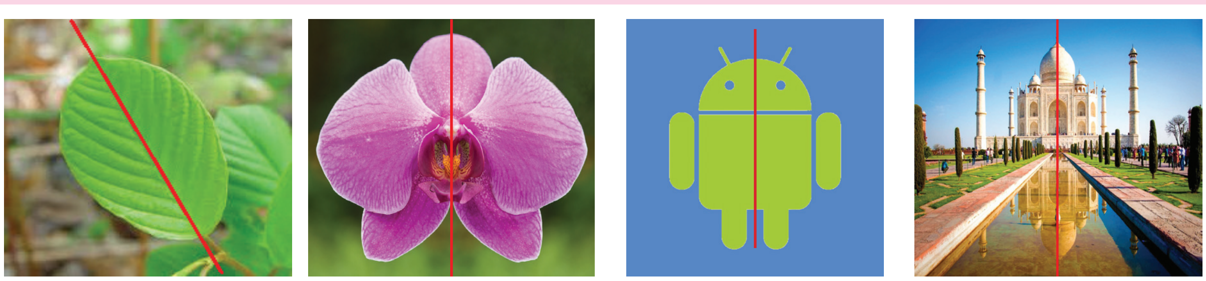
Looking at our surroundings, we see that most of the objects appear with certain beauty. Do you know why these objects look beautiful? The balanced harmony at a perfect ratio makes these objects look beautiful. This kind of organized pattern is called ***symmetry***. Symmetry plays a vital role in many fields of work like making toys, drawings, kolams, household goods, manufacturing vehicles, construction of buildings etc.,

MATHEMATICS ALIVE – SYMMETRY IN REAL LIFE

Symmetrical plants in the garden

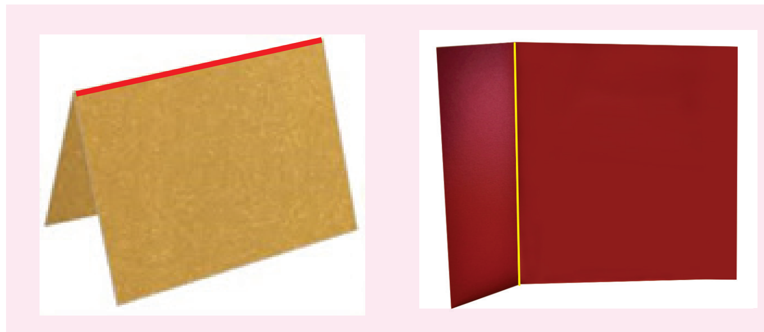
Rotational Symmetry in Hibiscus flower

4.2 Line of Symmetry

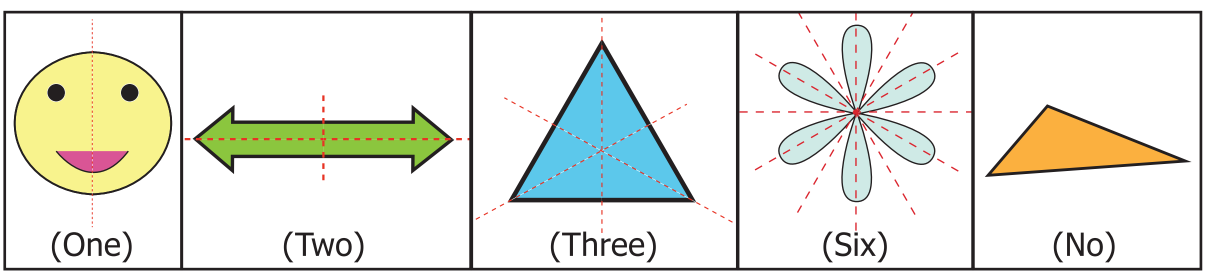


In the given figures, the red coloured line divides each figure into two equal halves and suppose we fold them along that line, we will see that one half of each figure exactly coincides with the other half. Such figures are symmetrical about that line and that line is called ***the line of symmetry or the axis of symmetry.***

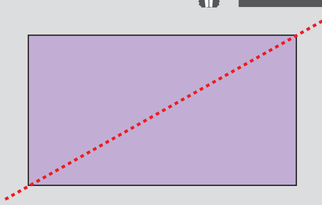
Look at the given invitation cards, the fold line of the first card divides it into two equal halves and each half exactly coincides. Hence it is a line of symmetry but in the second card, the fold line does not divide it into two equal halves. So,it is not a line of symmetry.



A figure may have one, two, three or more lines of symmetry or no line of symmetry.



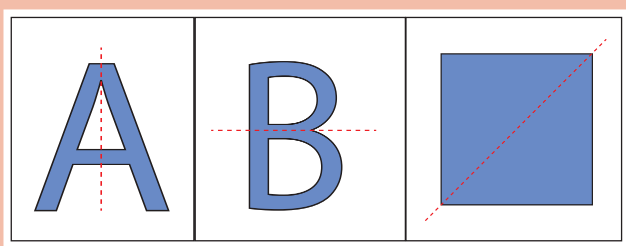
Think



The diagonal of a rectangle divides it into two equal halves but it is not a line of symmetry. Why?

Note

The line of symmetry can be vertical, horizontal or slant.



DO YOU KNOW?

The word "symmetry" comes from the Greek word "symmetros" which means "having a common measure".

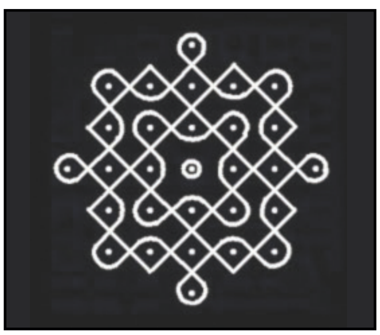
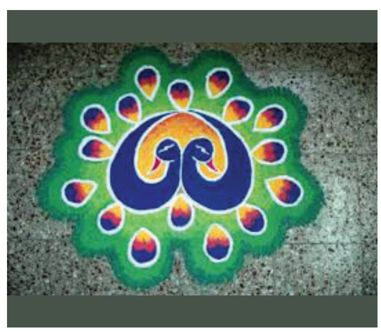
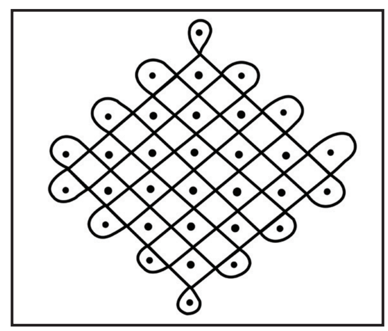
Some examples for Symmetry

Symmetry can be found anywhere in nature as well as in man-made objects. A few of them are leaves, insects, flowers, animals, note books, bottles, architecture, designs and shapes, etc., We observe a few symmetrical things in our surroundings as follows.

In flowers	In Insects	In Artificial work
		
Sun flower	Butterfly	Grill Gate

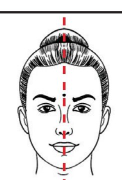
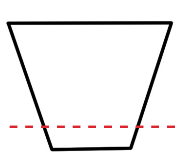
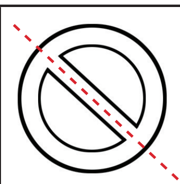
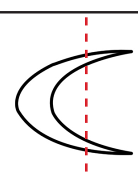
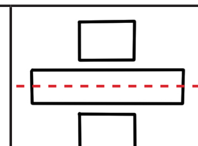
Symmetry in *Kolams*

In Tamilnadu, our people usually decorate their corridors by beautiful *kolams* using rice flour. Those *kolams* look beautiful as most of them are symmetrical.

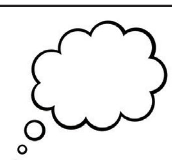
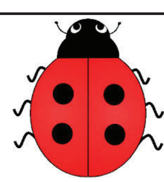
  

Try these

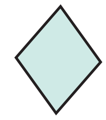
1. Is the dotted line shown in each figure a line of symmetry? If yes put ✓ otherwise put x. Justify your answer.

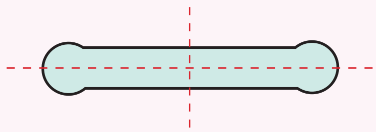
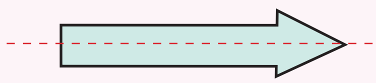
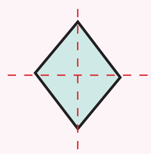
2. Check the following figures for symmetry? Write YES or NO.

				Q	

Example 1 Draw the lines of symmetry for the given figures and also find the number of lines of symmetry.

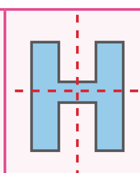
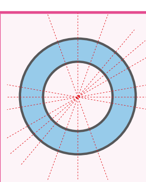
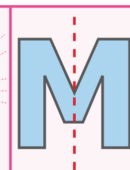
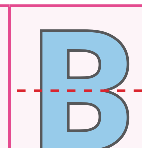
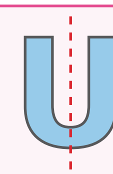
i)  ii)  iii) 

Solution

S.No	Draw the line of symmetry	Number of lines of symmetry
i)		2
ii)		1
iii)		2

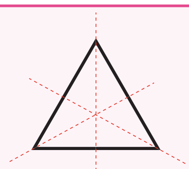
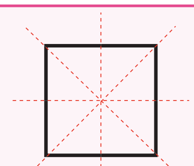
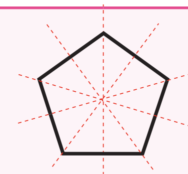
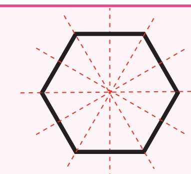
Example 2 Draw the lines of symmetry for each of the letters in the word **RHOMBUS** and also find the number of lines of symmetry. (**Note:** Here the letter 'O' is in circle shape.)

Solution

Letters							
Number of lines of symmetry	0	2	infinite	1	1	1	0

Example 3 Draw the lines of symmetry for an equilateral triangle, a square, a regular pentagon and a regular hexagon and also find the number of lines of symmetry.

Solution

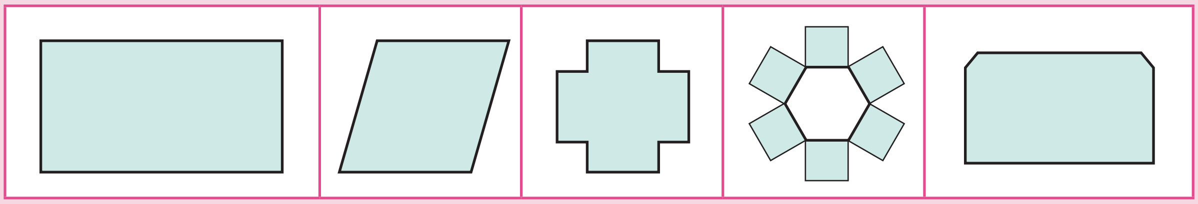
i) 	ii) 	iii) 	iv) 
An equilateral triangle has 3 lines of symmetry	A square has 4 lines of symmetry	A regular pentagon has 5 lines of symmetry	A regular hexagon has 6 lines of symmetry

Note

The number of lines of symmetry of each regular polygon (a closed figure having equal sides and equal angles) is equal to its number of sides.

Try these

1. Draw the following figures in a paper. Cut out each of them and fold so that the two parts of each figure exactly coincide.



   i) Which of the above figures have one, two or more lines of symmetry?

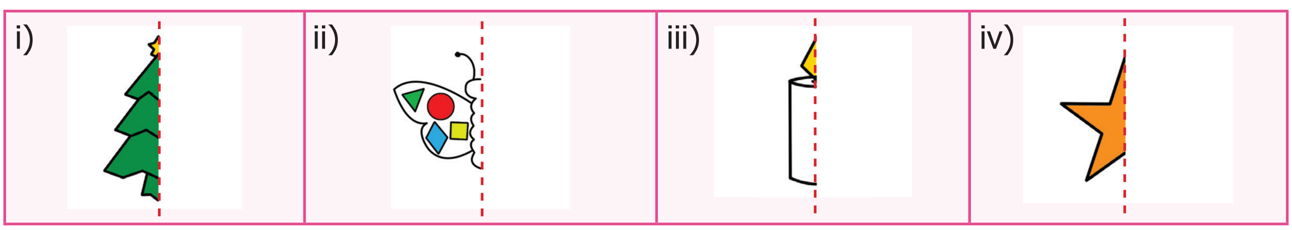
   ii) Which of the above figures do not have any line of symmetry?

2. Write the numbers from 0 to 9.

   i) Which numbers have a line of symmetry?

   ii) List out the numbers which do not have a line of symmetry.

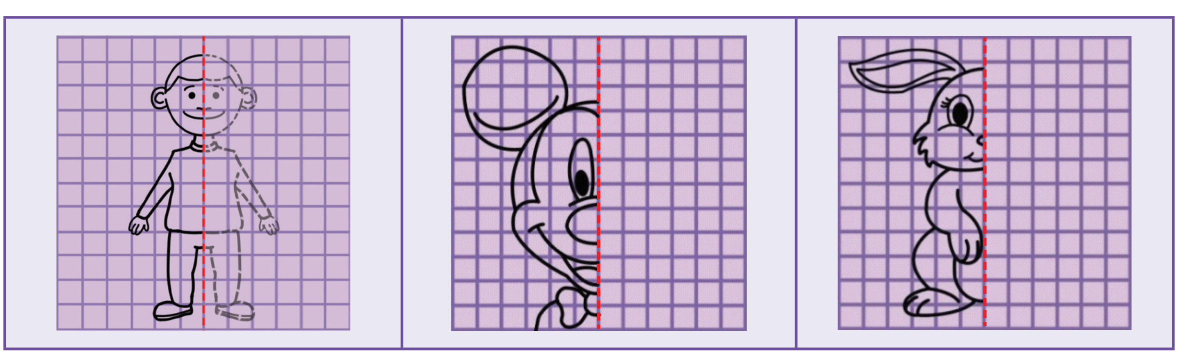
Example 4 Complete the other half of the following figures such that the dotted line is a line of symmetry.



Solution

Activity

Complete the other half of the following figures such that the dotted line is the line of symmetry.



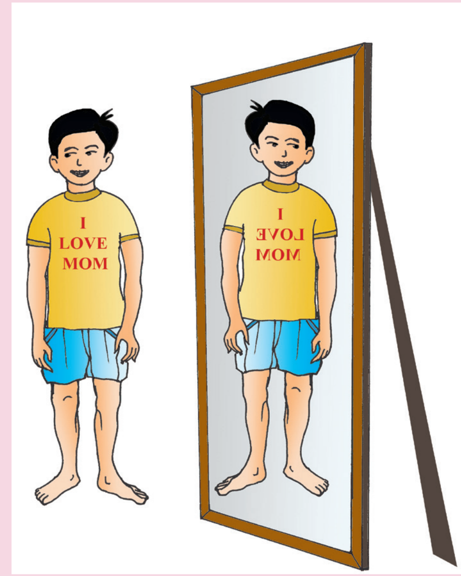
4.3 Reflection Symmetry

Standing in front of a mirror, Kumaran was getting ready to celebrate his birthday. He noticed a beautiful sentence **I LOVE MOM** written on his T-shirt which was presented by his uncle.

In these words, he saw **I** and **MOM** were looking the same in the mirror. But the word **LOVE** did not appear the same.It looked as **ƎVO⅃**.

Out of curiosity, he took out some alphabet cards and started checking which of the alphabets would look the same in the mirror. He found a few alphabets **A, H and I** look the same in the mirror, because they have lines of symmetry.

Already we know that a line of symmetry divides the figure into two equal halves. When you keep a mirror along the line of symmetry the other half of the figure gets reflected by the mirror and it looks the same. This is known as ***reflection symmetry*** or ***mirror symmetry***.



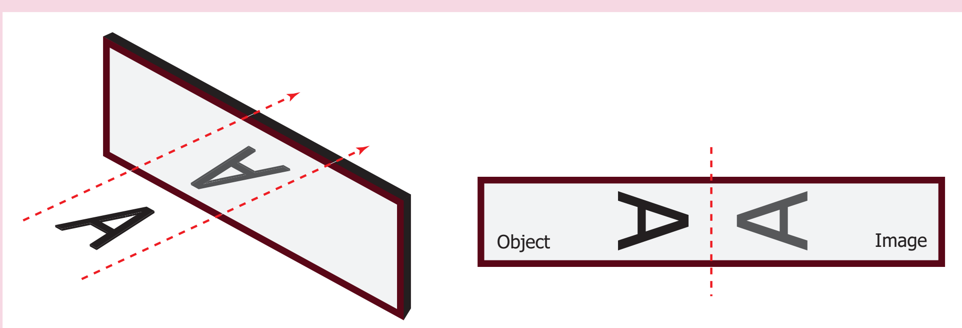
Think

Which other capital letters of English alphabets look like the same in the mirror?

Note

A shape has **reflection symmetry** if it has a **line of symmetry**.

When an object is seen in a mirror, the image obtained on the other side of the mirror is called its ***reflection***. The following figure shows the reflection of the English alphabet A. Let us assume that there is a line between A and its image in the place of a mirror.



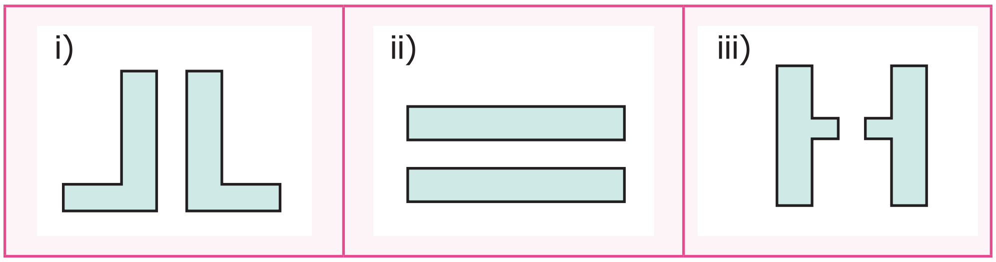
E8HBAJ

We observe that an object and its mirror image are symmetrical with reference to the mirror line. If the paper is folded, the mirror line becomes the line of symmetry.

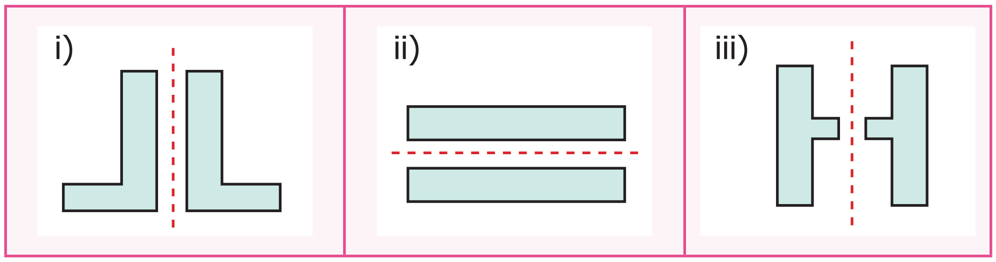
Note

- The object and its image will lie at the same distance from the mirror.
- The only difference is that the left side is on the right and vice-versa.

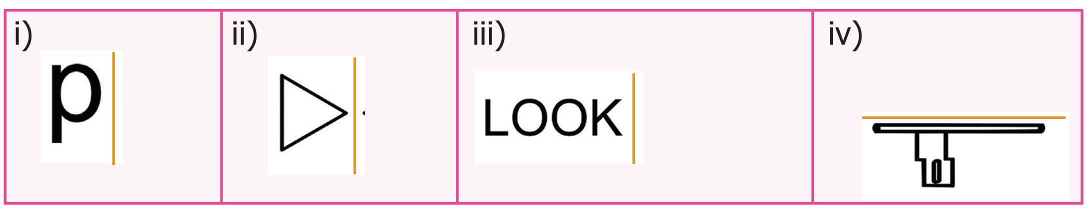
Example 5 Assuming one shape is the reflection of the other, draw the mirror line for each of the given figures.



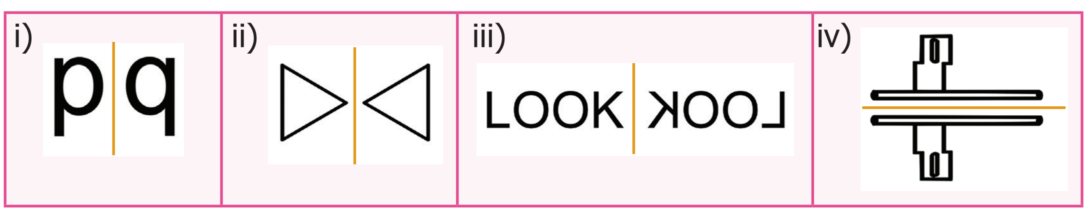
Solution



Example 6 Draw the reflection image of the following figures about the given line.

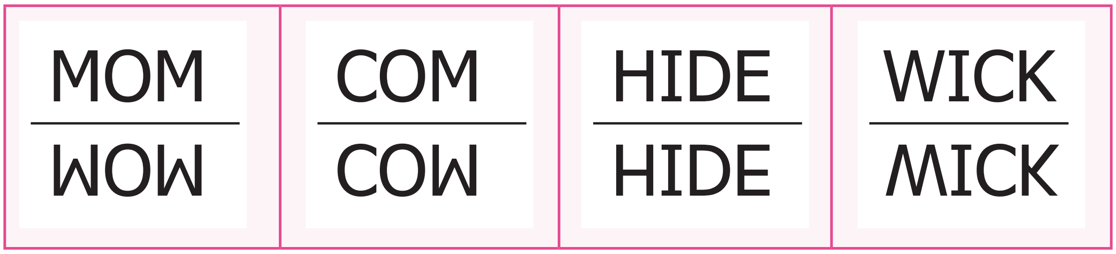


Solution

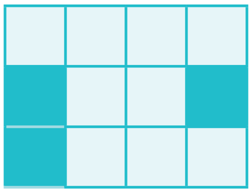


Example 7 What words will you see if a mirror is placed below the words **MOM, COM, HIDE** and **WICK**?

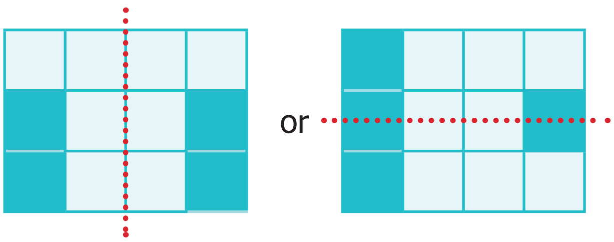
Solution



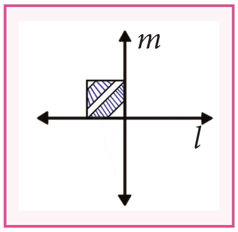
Example 8 Colour any one box in the given grid sheet so that it has reflection symmetry and draw the lines of symmetry.



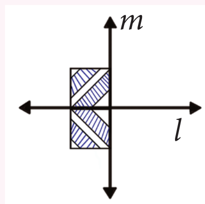
Solution



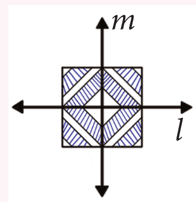
Example 9 In the given figure first reflect the shaded part about the line 'l' and then reflect it about the line 'm'.



Solution



Reflection about 'l'



Reflection about 'm'

Activity

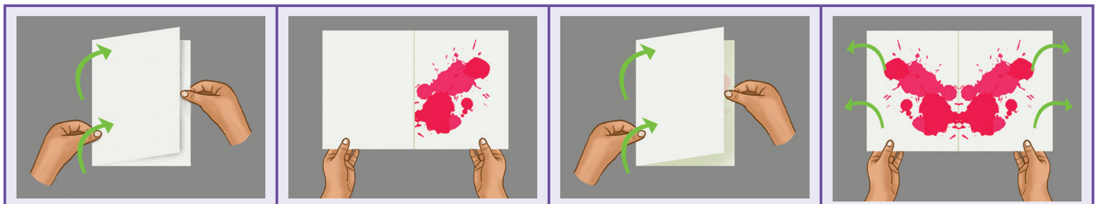
Symmetrical figures by ink blots

Step 1: Take a sheet of paper and fold it into half to make the crease.

Step 2: Put some ink blots on one side of the crease of the paper.

Step 3: Fold the paper along the crease and press it.

Step 4: Open the paper, you will find an imprint of the ink blots on the other part also which is symmetrical about the crease.



Step 1	Step 2	Step 3	Step 4

Try these

1. Find the password:

   "Kannukkiniyal has a new game app in her laptop protected with a password. She has decided to challenge her friends with this paragraph which contains that password".

   If you follow the steps given below, you will find it.

   Steps:

   i) Write the above paragraph in capital letters.

   ii) Turn that paper upside down and look at it in the mirror.

   iii) The word which remains unchanged in the mirror is the password.

2. Form words using the letters **B, C, D, E, H, I, K, O** and **X**. Write those words in paper in capital letters. Turn it upside down and look at them in the mirror.

   i) List the letters which have horizontal and vertical line of symmetry.

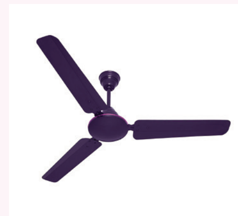
   ii) Do the words **HIKE, DICE, COOK** remain unchanged in the mirror?

   iii) The words which you have found that remain unchanged in the mirror are

   __________, __________, __________. . . .

4.4 Rotational Symmetry

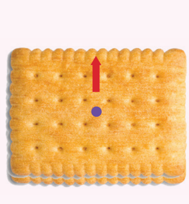
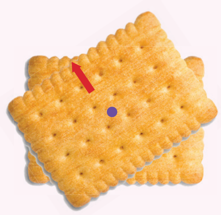
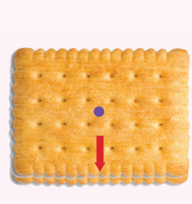
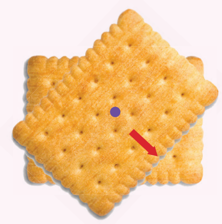
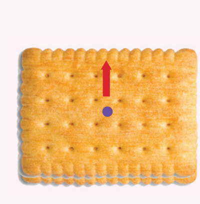
We have already learnt about rotation. **Rotation** means turning around a centre. The paper windmill, merry-go-round, fan, tops, wheels of vehicles, fidget spinner are few examples of rotating objects that we see in our life.

			
Paper wind mill	Wheels	Fan	Merry-go-round

When one rotation is completed, the rotating object comes back to the position where it started. During a complete rotation, the object moves through 360°.

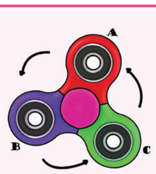
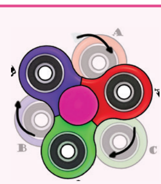
Think about the situation

1) Take two rectangular biscuits from the same packet and put one on the other. Holding one biscuit firmly rotate the other on it about the centre.

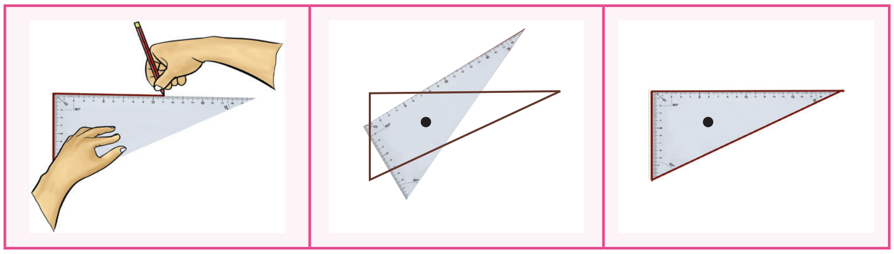
				
Initial position	Rotation	First Match	Rotation	Second Match

How many times does it fit exactly on the other in a complete rotation? Two times.

2) In the example given below, if you rotate the fidget spinner about the centre, there are three positions in which the fidget spinner matches exactly the same in a full rotation.

						
Initial position	Rotation	I-Match	Rotation	II-Match	Rotation	III-Match

3) Place a set square (containing angles 60°, 30° and 90°) on a paper and draw an outer line around it. What type of triangle do you get? Yes, Scalene triangle. If you rotate it about the centre, there is only one position in which the set square fits exactly inside the outer line.



E8H7C7

In the above situations 1 and 2, the total number of times the rectangular biscuit and the fidget spinner matches exactly with itself in one complete rotation is 2 and 3. This is called the ***order of rotational symmetry.*** In situation 3, the set square matches itself only once in one complete rotation and hence has no rotational symmetry.

An object is said to have a ***rotational symmetry*** if it looks the same after being rotated about its centre through an angle less than 360° (If the order of rotation of an object is atleast two).

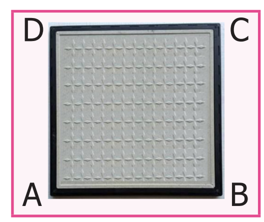
Think

Can you identify the object which does not have rotational symmetry in the above situations? Why?

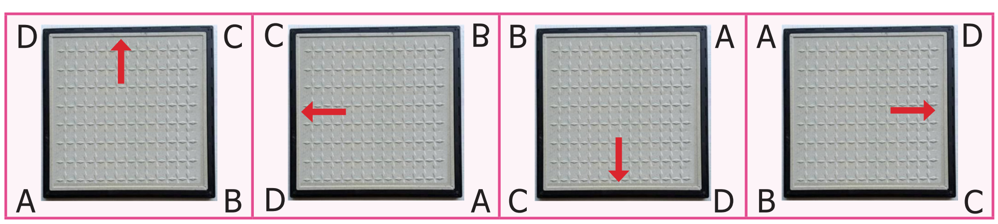
Example 10 A man-hole cover of a water sump is in square shape.

i) In how many ways we can fix that to close the sump?

ii) What is its order of rotational symmetry?



Solution



i) We can fix it in 4 ways as shown above.

ii) The order of rotational symmetry is 4.

Think

Suppose, the man hole cover of the water sump is in circular shape.

i) The number of ways to close that circular lid is

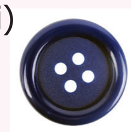
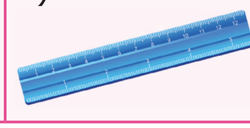
____

ii) What is its order of rotational symmetry?

Activity

Find the order of rotational symmetry by fixing the relevant shape in different ways.

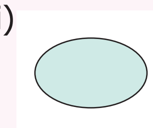
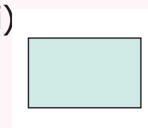
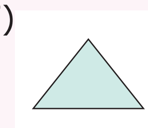
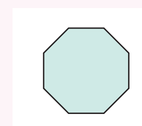
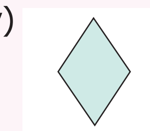
Example 11 Find the order of rotation for the following figures.

i)	ii)	iii)	iv)
			

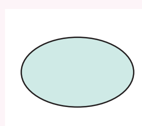
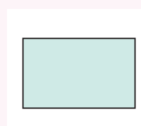
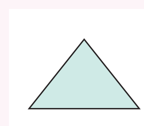
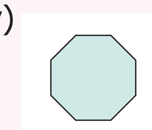
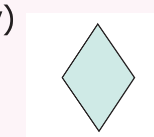
Solution

Figures	i) 	ii) 	iii) 	iv) 
Order of rotation	4	5	2	5

Example 12 Find the order of rotation for the following shapes.

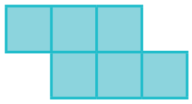
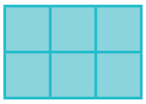
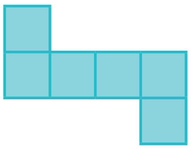
i)	ii)	iii)	iv)	v)
				

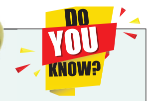
Solution

Shapes	i) 	ii) 	iii) 	iv) 	v) 
Order of rotation	2	2	3	8	2

Example 13 Join six identical squares so that atleast one side of a square fits exactly with any other square and have rotational symmetry (any three ways).

Solution



The opening in the given spanner has six sides, so it is a hexagon. The spanner has rotational symmetry of order 6 and fits a hexagonal bolt in any of six positions.

4.5 Translational Symmetry

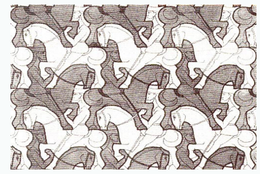
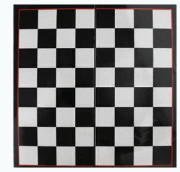
Look at the following figures:

			
Kolam design	Tyre grip design	Saree design	Bracelet design

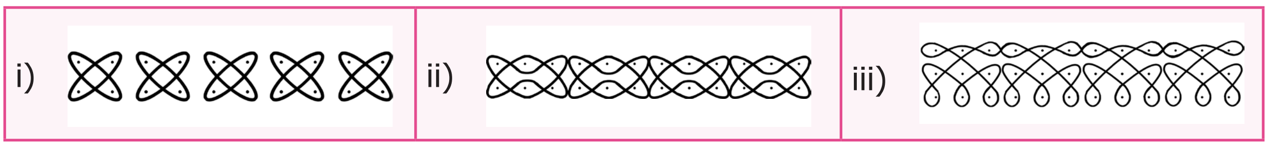
Here a particular pattern or design is continued throughout. The pattern changes its place without rotation or reflection. The exact image is found without changing its orientation.

Thus, ***translation symmetry*** occurs when a pattern slides to a new position. The sliding movement involves neither rotation nor reflection.

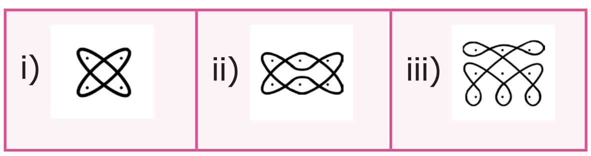
DO YOU KNOW?

	
Translation symmetry in art.	A chess board is seemed to follow translation of black and white squares .

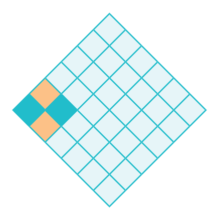
Example 14 Which pattern is translated in the given *kolams*?



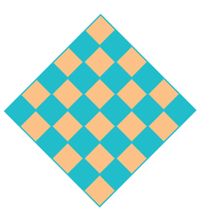
Solution



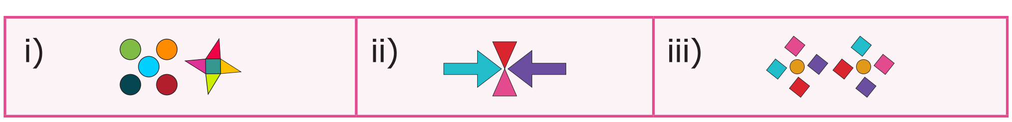
Example 15 Using the given pattern, colour and complete the boxes in such a way that it posseses translation symmetry.



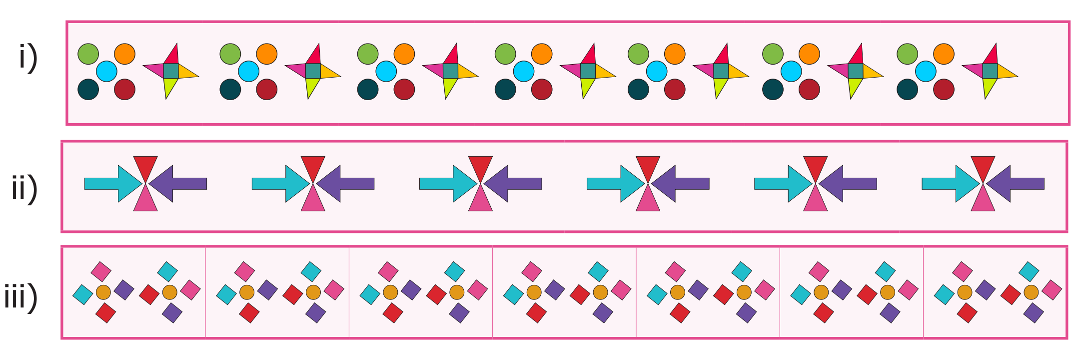
Solution



Example 16 Translate the given pattern and complete the design in the rectangular strip.



Solution



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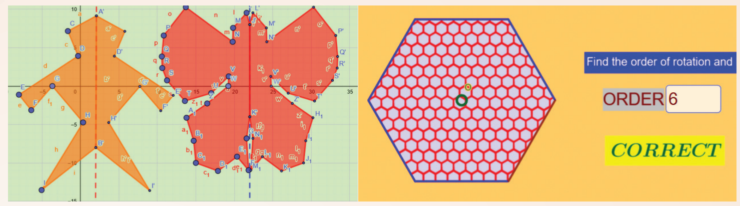
Symmetry

ICT CORNER

Expected Outcome



Step – 1

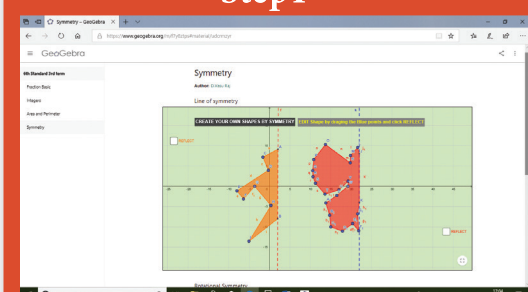
Open the Browser by typing the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Symmetry" will open. There are two worksheets under the title "Line of Symmetry" and "Rotational Symmetry".

In the Line of Symmetry drag the points on left side of both the figures and click reflect to see full figure

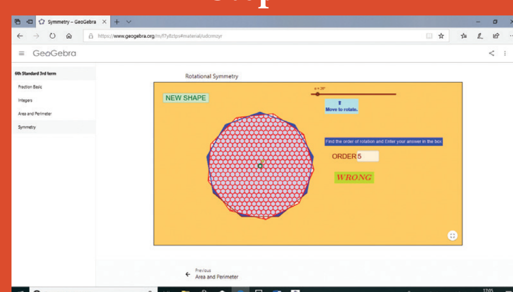
Step - 2

In Rotational Symmetry click on New Shape and find the order of rotational symmetry. Type your answer in the box and hit enter key to see whether your answer is right.

Step1



Step2



Browse in the link:

Symmetry: https://ggbm.at/udcrmzyror Scan the QR Code.

B542_6_MAT_EM_T3

Exercise 4.1

1. Fill in the blanks

i) The reflected image of the letter 'q' is ________

ii) A rhombus has _________ lines of symmetry.

iii) The order of rotational symmetry of the letter 'z' is _______

iv) A figure is said to have rotational symmetry, if the order of rotation is atleast _______

v) ____________ symmetry occurs when an object slides to new position.

E963DU

2. Say True or False

i) A rectangle has four lines of symmetry.

ii) A shape has reflection symmetry if it has a line of symmetry.

iii) The reflection of the name **RANI** is **INAЯ**

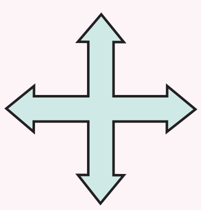
iv) Order of rotation of a circle is infinite.

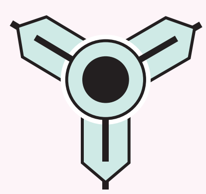
v) The number 191 has rotational symmetry.

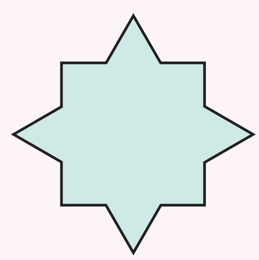
3. Match the following shapes with their number of lines of symmetry.

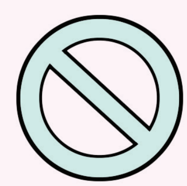
i)	Square	a)	No line of symmetry
ii)	Parallelogram	b)	One line of symmetry
iii)	Isosceles triangle	c)	Two lines of symmetry
iv)	Rectangle	d)	Four lines of symmetry

4. Draw the lines of symmetry of the following.

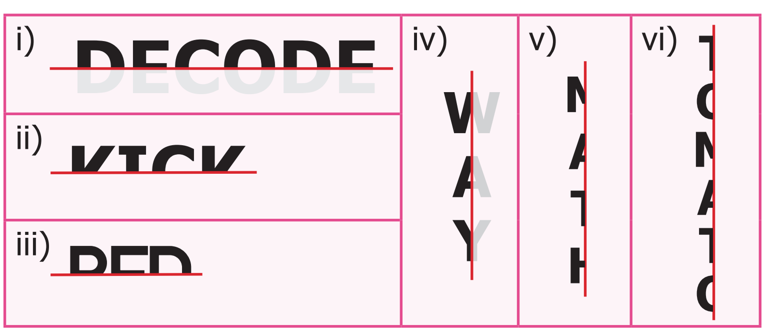
i) 

ii) 

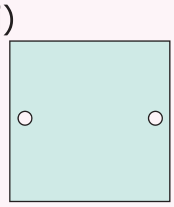
iii) 

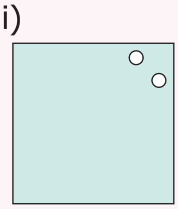
iv) 

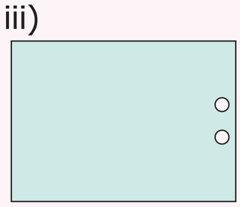
5. Using the given horizontal line / vertical line as a line of symmetry, complete each alphabet to discover the hidden word.

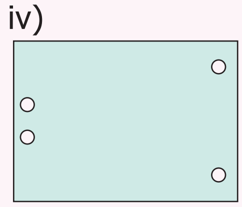


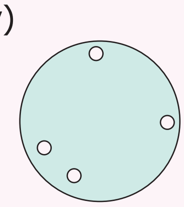
6. Draw a line of symmetry of the given figures such that one hole coincide with the other hole(s) to make pairs.

i) 

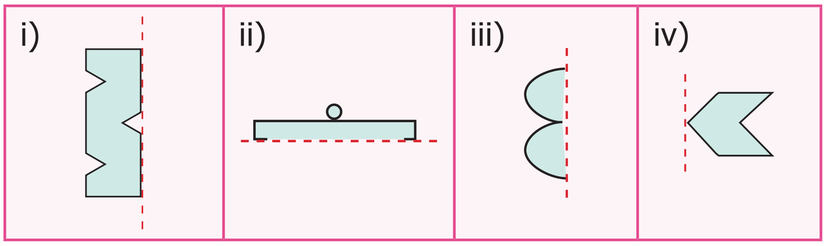
ii) 

iii) 

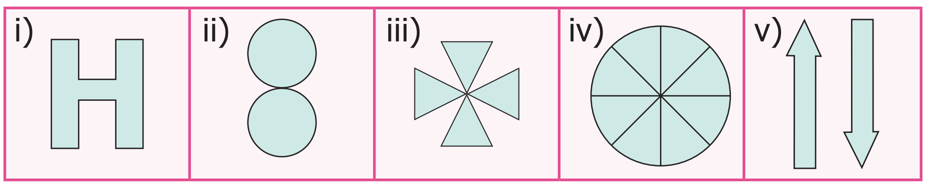
iv) 

v) 

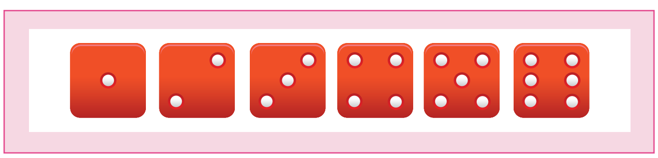
7. Complete the other half of the following figures such that the dotted line is the line of symmetry.



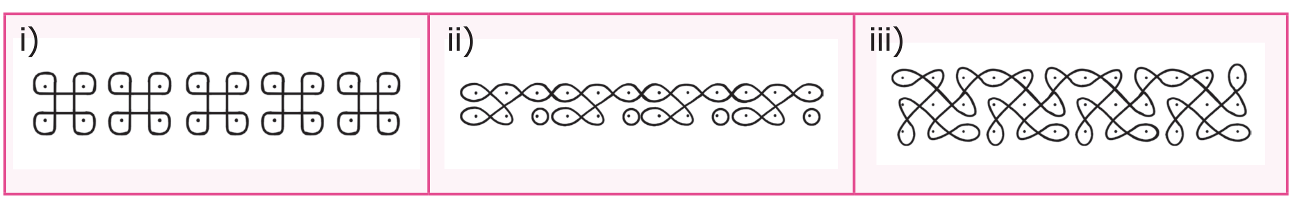
8. Find the order of rotation for each of the following.



9. A standard die has six faces which are shown below. Find the order of rotational symmetry of each face of a die?



10. What pattern is translated in the given border *kolams*?



Objective Type Questions

11. Which of the following letter does not have a line of symmetry?

a) A b) P c) T d) U

12. Which of the following is a symmetrical figure ?

a)  b)  c)  d) 

13. Which word has a vertical line of symmetry?

a) DAD b) NUN c) MAM d) EVE

14. The order of rotational symmetry of 818 is ______

a) 1 b) 2 c) 3 d) 4

15. The order of rotational symmetry of  is ______

a) 5 b) 6 c) 7 d) 8

Exercise 4.2

Miscellaneous Practice Problems

1. Draw and answer the following.

i) A triangle which has no line of symmetry

ii) A triangle which has only one line of symmetry

iii) A triangle which has three lines of symmetry

2. Find the alphabets in the box which have

i) No line of symmetry

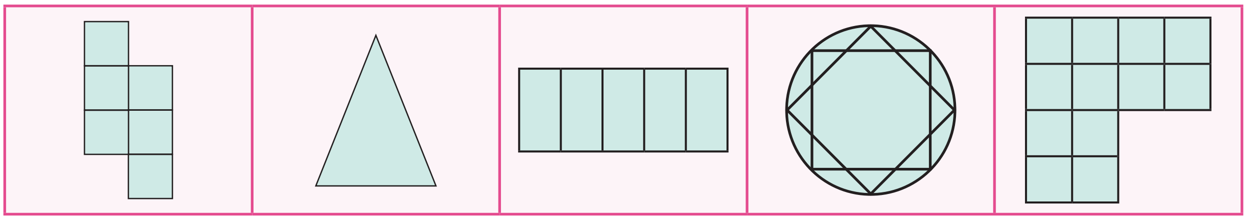
ii) Rotational symmetry

iii) Reflection symmetry

iv) Reflection and rotational symmetry

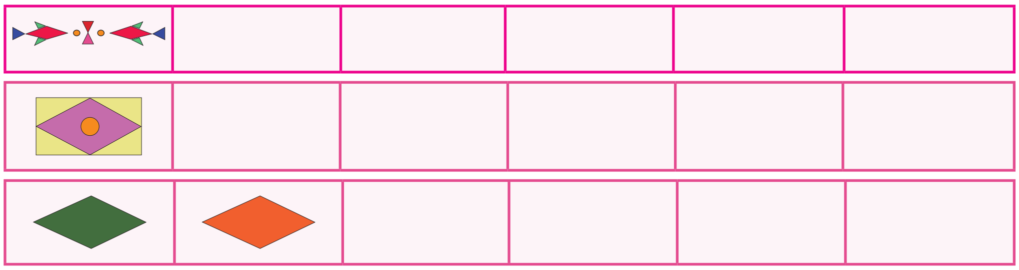
A	M	P	E
D	I	K	O
N	X	S	H
U	V	W	Z

3. For the following pictures, find the number of lines of symmetry and also find the order of rotation.



4. The three digit number **101** has rotational and reflection symmetry. Give five more examples of three digit numbers which have both rotational and reflection symmetry.

5. Translate the given pattern and complete the design in rectangular strip?

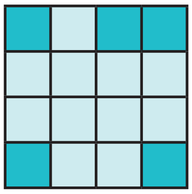


Challenge Problems

6. Shade one square so that it possesses

i) One line of symmetry

ii) Rotational symmetry of order 2



7. Join six identical squares so that atleast one side of a square fits exactly with any other side of the square and have reflection symmetry (any three ways).

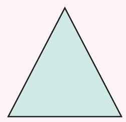
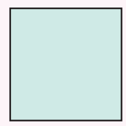
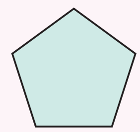
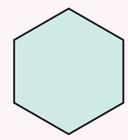
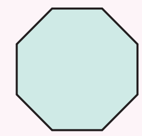
8. Draw the following :

i) A figure which has reflection symmetry but no rotational symmetry.

ii) A figure which has rotational symmetry but no reflection symmetry.

iii) A figure which has both reflection and rotational symmetry.

9. Find the line of symmetry and the order of rotational symmetry of the given regular polygons and complete the following table and answer the questions given below.

Shape	Equilateral triangle 	Square 	Regular pentagon 	Regular hexagon 	Regular octagon 
Number of lines of symmetry					
Order of rotational symmetry					

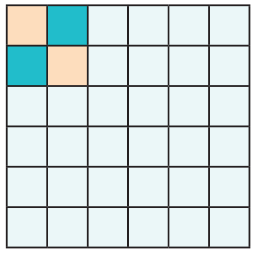
i) A regular polygon of 10 sides will have ______ lines of symmetry.

ii) If a regular polygon has 10 lines of symmetry, then its order of rotational symmetry is ________

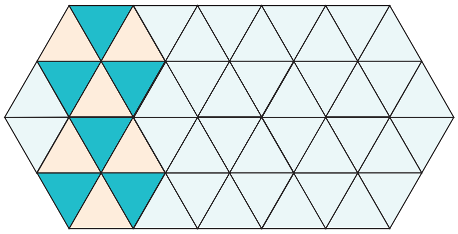
iii) A regular polygon of 'n' sides has ________ lines of symmetry and the order of rotational symmetry is ________.

10. Colour the boxes in such a way that it posseses translation symmetry.

i)



ii)



Summary

- The line that divides any figure into two equal halves such that each half exactly coincides with the other is known as the **line of symmetry** or **axis of symmetry.**
- A shape has **reflection symmetry** if it has a **line of symmetry**.
- An object is said to have a **rotational symmetry** if it looks the same after being rotated about its centre through an angle less than 360°.
- The total number of times a figure coincides with itself in one complete rotation is called the **order of rotational symmetry.**
- **Translation symmetry** occurs when an object slides to a new position. The sliding movement involves neither rotation nor reflection.

CHAPTER 5

INFORMATION PROCESSING

Learning Objectives

- To perceive iterative processes and patterns.
- To see Euclid's game as an iterative process.
- To learn to devise and follow algorithms.
- To learn the advantage of ordering information.

E9BBRK

5.1 Introduction

Everyday morning, waking up, brushing teeth, doing physical exercise, drinking milk, having bath, having breakfast and then getting ready to school are some of the activities we do.

Everyday such activities happen. Don't they?

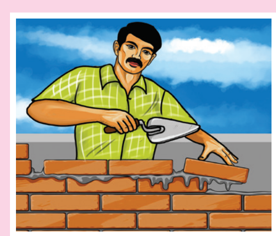
Do we see a pattern getting repeated? In our life, there are many such repeating patterns. In fact , "EAT" ; " STUDY" ; " PLAY" ; " SLEEP" is a pattern repeated daily, isn't it?

When we go on doing same activities again and again, it gives rise to a new form.

Let us see some more examples for repeated processes.

- We can see that some patterns are getting repeated in kolams, so as to get larger kolams.

- In the construction of a wall, a mason places the bricks one upon another and adds plaster to them in an organized manner repeatedly. After some days we can see that a nice wall is getting constructed.



- Bees make hives which are formed by the increasing pattern of hexagons where they can store optimum amount of honey and feed themselves during winter.

- Take a spot of red paint, add a little bit of green paint to it. The change in colour cannot be seen immediately. Add a little more, now, you can see a slight change in the colour. A little more ....., Hey! don't you see a different colour now? You add green paint drop by drop to red paint, you finally get a new colour. The activities explained above follow ***iterative processes***.

Hence, an ***iterative process*** is a procedure that is repeated many times which gives rise to a new form.

MATHEMATICS ALIVE – INFORMATION PROCESSING IN REAL LIFE

Fibonacci sequence in nature

Orderly arrangement of fruits in the shop

5.2 Iterative Process in Numbers

The above iterative processes can be seen in our daily life. It can be seen in number sequences also. The numbers may increase or decrease following a pattern.

1. Observe the following sequences and find the pattern that generates each one of them.

   - 1, 3, 5, 7, ... The pattern which generates these numbers is 1, 1+2, 3+2, 5+2...
   - 50, 48, 46, 44,... The pattern which generates these numbers is 50, 50-2, 48-2, 46-2...
   - 2, 4, 6,... The pattern which generates these numbers is 1x2, 2x2 ; 3x2, ...
   - 1, 4, 9, 16... The pattern which generates these numbers is 1x1, 2x2 , 3x3...
   - 2, 6, 12, 20, 30,... The pattern which generates these numbers is 1x2, 2x3, 3x4, 4x5, ...
   - 2, 4, 8,16,... The pattern which generates these numbers is 2x1, 2x2, 2x2x2...

2. Observe the pattern, 1, 10, 100, ... When the number of zeros increase the value also increases.

3. In the same way, can you guess the next number in the special number sequence given below?

1, 1, 2, 3, 5, 8, 13, 21, 34,...

Yes it is 55, how? You have got it by adding 21 and 34. Haven't you?

Are you able to recognize the pattern in the above sequence? Yes, if we add the previous two consecutive terms, we get the next term as

1+1 =2, 1+2=3, 2+3=5, 3+5=8 , 5+8=13,...

This special pattern of numbers is called the ***Fibonacci sequence***. Each term in the Fibonacci sequence is called a ***Fibonacci number***.

4. ***Lucas numbers*** form a sequence of numbers like the Fibonacci numbers and they are closely related to the Fibonacci numbers. Instead of starting with 1 and 1, Lucas numbers start with 1 and 3. The Lucas sequence is 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, ... In all the above patterns of numbers, we can see the iterative processes.

Try these

i) Find the 10^{th} term of the Fibonacci sequence.

ii) If the 11^{th} term of the Fibonacci sequence is 89 and 13^{th} term is 233 then, what is the 12^{th} term?

E9EYFH

Fibonacci numbers in nature

We come across the existence of Fibonacci sequence in many natural phenomena like spiral in a shell, arrangement of petals in flowers, branches of a tree, seeds in the head of a sunflower, petals on a daisy, the cells in the bee-hive, etc. Mathematical patterns are found in the distinct marking on animals and the structure of seashells also.

Note

We can also begin the Fibonacci sequence with 0 and 1, instead of 1 and 1.

Think

Are two consecutive Fibonacci numbers relatively prime?

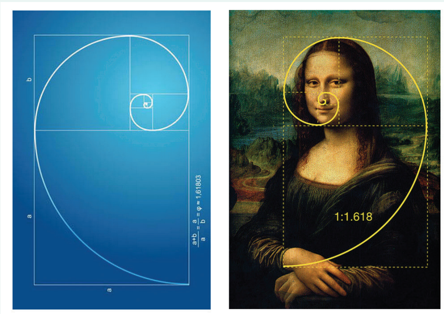
DO YOU KNOW?

Golden Ratio:

Consider the ratio of successive Fibonacci numbers $\frac{3}{2}=1.5$, $\frac{5}{3}=1.66$, $\frac{8}{5}=1.6$, $\frac{13}{8}=1.625$, $\frac{21}{13}=1.6153,...)$ you can see the pattern, getting closer to 1.618 and that is denoted by Φ called the Golden Ratio (Φ=1.618). It is observed that shapes having Golden Ratio appear beautiful.

DO YOU KNOW?

The Portrait of Mona Lisa has Fibonacci spiral pattern. This is one of the reasons for the enhanced beauty of Mona Lisa.



5.3 Euclid's game

Ammu and Balu are playing a game. Each one can choose any number and they write it down on a piece of paper. If Ammu picks up the number greater than what Balu picked up, then Ammu will find the difference of the two numbers. That difference will be shown to Balu. Now Balu takes the chance to find the difference between the number what he has and the number shown to him by Ammu. They will continue the process until the difference and the numbers they have become equal. Finally, the person who gets the number equal to the difference wins the game Let us see how it works

Ammu	:	(34,19)	34-19=15
Balu	:	(19,15)	19-15=4
Ammu	:	(15, 4)	15-4=11
Balu	:	(11, 4)	11-4=7
Ammu	:	(7, 4)	7-4=3
Balu	:	(4, 3)	4-3=1
Ammu	:	(3, 1)	3-1=2
Balu	:	(2, 1)	2-1=1
Ammu	:	(1, 1)	same numbers

Suppose Ammu picked the number 34 and Balu picked the number 19. Ammu first finds the difference between 34 and 19 which gives 15. She shows the difference to Balu. Now Balu has 19 and she has 15, the difference is 4. He shows to Ammu and so on. (the bigger number should be kept first to find the difference). So Ammu wins.

E9K7T8

Now suppose they start with Ammu (24, 18).

It goes: (24, 18) $\xrightarrow{\text{Ammu}}$ (18, 6) $\xrightarrow{\text{Balu}}$ (12, 6) $\xrightarrow{\text{Ammu}}$ (6, 6). Ammu wins again!

If they start with Ammu (18, 6), we get (18, 6) ⟶ (12, 6) ⟶ (6, 6) Balu wins!

Play the game with your friends and see for what pairs of numbers the first player (Ammu) wins, and when the second player wins.

Now we can notice something interesting! Begin with any pair of numbers. Can you say anything about the pair of numbers. Remember that we stop the process when both the numbers are same. It is the Highest Common Factor (HCF) of the two numbers we started with. So what we have seen here is an iterative process which leads us to the HCF of two given numbers. The HCF of a and b (here $a>b$) is the same as for a and a-b.

Example 1

Find the HCF of two numbers 16 and 28.

Solution

Now the HCF of 16,28

16 = 2 x 2 x 2 x 2

28 = 2 x 2 x 7

HCF of (16, 28) = 2 x 2 = 4

Now the HCF of (16 , 28-16)

16 = 2 x 2 x 2 x 2

12 = 2 x 2 x 3

HCF of (16, 12) = 2 x 2 = 4

Therefore HCF of (16, 28) = HCF of (16, 28-16).

Hence, HCF of two numbers a and b, $a > b$, is same as the HCF of a and $a - b$.

Euclidean algorithm

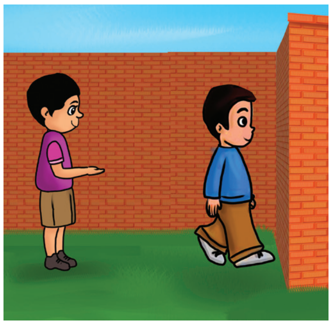
Let us take a number 12.

If we divide 12 by 7 then, we get quotient=1, remainder=5 and 12 can be written as 12 = (1 x 7) + 5.

If we divide 12 by 2 then, we get quotient=6, remainder=0 and 12 can be written as 12 = (2 x 6) + 0.

From this, we observe that, if a number 'a' is divided by some number 'b' then we get the quotient 'q' and remainder 'r', and 'a' can be written in a unique way as $a = (b \times q) + r$. That is, Dividend = (Divisor x Quotient) + Remainder. This is called the Euclidean algorithm.

5.4 Following and Devising Algorithms



Do you know the robot game? One child acts as a robot. Another child gives instructions to the child enacting as robot. The robot child should follow instructions. If the robot child stands at the wall by facing it, the instructor has to say, "move forward'. The robot child can only try to move forward, but can't. The robot child cannot say "it is not possible". This humorous activity shows that instructions are mechanically followed by robots. Unlike robots, human brain is capable of thinking and modifying algorithms based on situations.

Think about the situation

Recipe for preparing lemonade for a group of 6 members.

E9NUH5

- ➢ Squeeze 3 half lemons in a bowl.
- ➢ Add 5 glasses of normal water into the bowl.
- ➢ Add 4 teaspoons of sugar into the lemon juice.
- ➢ Stir the content well.
- ➢ Filter the content.
- ➢ Pour the filtered content into 6 glasses and serve.

Using the above instructions, prepare lemonade for 12 members, 24 members and 3 members.

Example 2

Follow the instructions in the given puzzle to arrive at the same number (36).

Instructions

- ➢ Think of a number from 1 to 9.
- ➢ Multiply it by 9.
- ➢ If you have two digit number, add the digits together.
- ➢ Subtract 3 from the answer.
- ➢ Multiply the number by itself.

Solution

Let us take a number: 6

Multiply it by 9 : 9 x 6 = 54

Add the digits together : 5 + 4 = 9

Subtract 3 from the answer : 9 – 3 = 6

Multiply the number by itself : 6 x 6 = 36

Try for number other than 6.

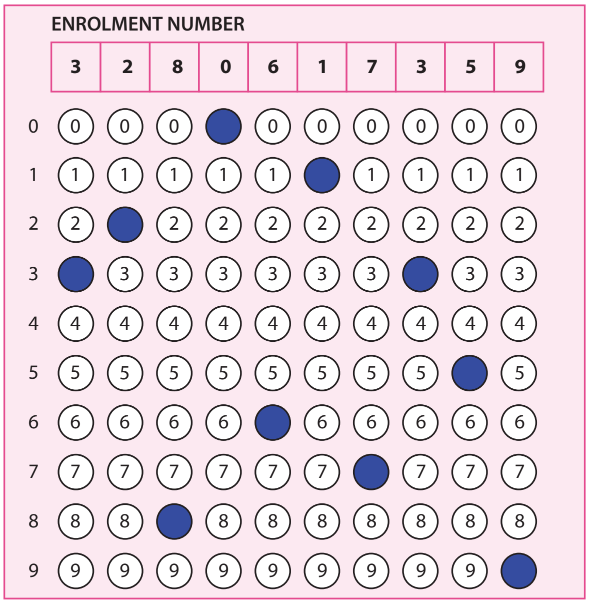
Example 3

You need to read the instructions carefully before filling the OMR sheet. The given OMR sheet is shaded based on the following instructions.

Instructions

- ➢ Observe the enrolment number written on the top row.
- ➢ The digits are to be shaded from left to right.
- ➢ Shade the corresponding bubbles under each of the number boxes.
- ➢ Only one digit is to be shaded in each column.
- ➢ Use only ball point pen for shading the bubbles.

Solution



This activity is very important as children need to fill OMR for various examinations like **NAS, NMMS**.

Example 4

Observe the given 4 x 4 square grid and follow the instructions given below to appreciate the uniqueness of the arrangement of numbers that gives the total 139.

Instructions

- Add the numbers horizontally.
- Add the numbers vertically.
- Add the numbers diagonally.
- Add the numbers in the four corners of the square.
- Divide the square into four 2 x 2 squares and add all the numbers in each of the squares.

22	12	18	87
88	17	9	25
10	24	89	16
19	88	23	11

Each of the above instructions gives the same answer. Doesn't it?

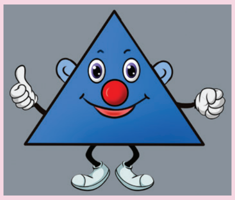
In all the above examples, we note that delivering instructions as well as following them are interesting.

Try these

1. The teacher should give oral instructions to the students to draw the geometrical figure already drawn by him / her.

   i) Draw a square. In the middle of the square, draw a circle in such a way that the circle does not touch any side of the square. Divide the circle into four equal parts. Shade the bottom right part of the circle. Ask the students to show that figure drawn by them.

   ii) Draw a triangle on a piece of paper. Make it crazy looking by adding some features. Give instructions to your friend to draw it exactly the same.



2. Suppose your friend wants to come to your house from his / her house. Give clear instructions in order, to reach your house.

5.5 Arranging things and putting them in order

In day-to-day life, sorting things such as arranging books on shelves, lining up foot wears in racks, segregating vegetables in trays, keeping household things in an almirah, arranging provisions in a cupboard, listing out expenditure etc, become inevitable. These activities help us to recall the things available, to have an easy access, avoid wastage and so on. Similar kind of arrangements are available in numbers also. Example : Calendar.

Discuss the following situations in groups

Situation 1

Suppose you need to arrange 100 books of same size in a shelf. The shelf has 10 rows and each row can accommodate 10 books. Besides, each book has an ID number written on it. How will you arrange the books based on their ID numbers, the smallest number should be on the left top row and the greatest ID number must on the right bottom row.

Discuss the following questions

i) Are there different ways to arrange the books?

ii) How do you know that one method is better than the other?

iii) If two persons together do the arrangement, how will you divide the work between them?

iv) If the books do not have any numbers written on them, how will you arrange them?

v) Is arranging them by number better than arranging them by size? why?

Situation 2

Suppose you have saved some coins in your piggy bank. If you want to know the amount saved, what can you do?

i) What are the ways to count the amount?

ii) Which is the easy way to count?

iii) Can the coins be arranged by their value?

Situation 3

Have you seen the garbage being sorted out in the streets? Some materials are bio-degradable and some are not bio-degradable like hospital wastes, plastics, glass materials and other wastes. How are the garbages sorted?

Note

The teacher may discuss this with students to create more awareness on segregating of waste, at the source.

Example 5 Observe the calendar showing the month of January 2019.

Answer the following questions

i) Sort out the prime and composite numbers from the calendar.

ii) Sort out the odd and even numbers.

iii) Sort out the multiples of 6; multiples of 4; the common multiples of 4 and 6 and LCM of the two numbers.

iv) Sort out the dates which fall on Monday.

January 2019

Su	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Solution

i) Prime numbers = 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31

Composite numbers = 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 21, 22, 24, 25, 26, 27, 28, 30

ii) Odd numbers = 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31

Even numbers = 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28

iii) Multiples of 6 = 6, 12, 18, 24, 30,

Multiples of 4 = 4, 8, 12, 16, 20, 24, 28

Common multiples = 12, 24

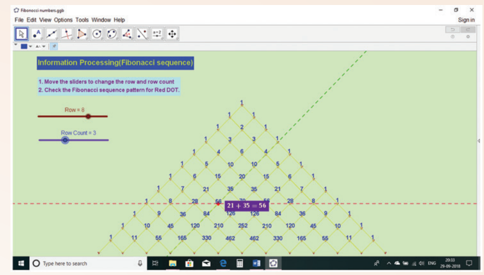
LCM = 12

iv) Monday falls on = 7,14,21,28

Information Processing

ICT CORNER

Expected Outcome



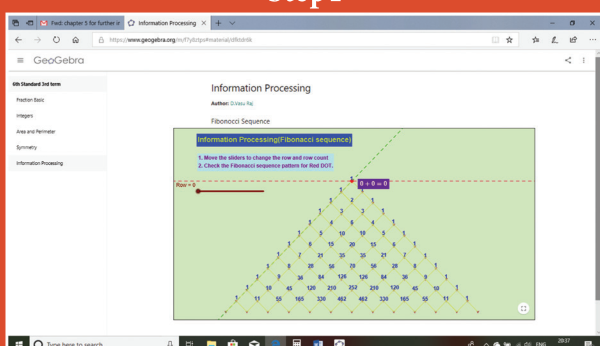
Step 1

Open the Browser by typing the URL Link given below (or) Scan the QR Code. GeoGebra work sheet named "Information Processing" will open. There is a worksheet under the title Fibonacci Sequence.

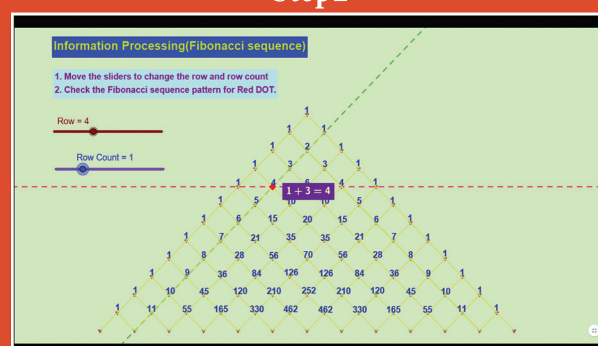
Step 2

Move the sliders to move Red point vertically and horizontally along the numbers and check how Fibonacci sequence is formed.

Step1



Step2



Browse in the link:

Information Processing: https://ggbm.at/dfktdr6k or Scan the QR Code.

B542_6_MAT_EM_T3

Exercise 5.1

1. Study and complete the following pattern

i) 1 x 1 = 1

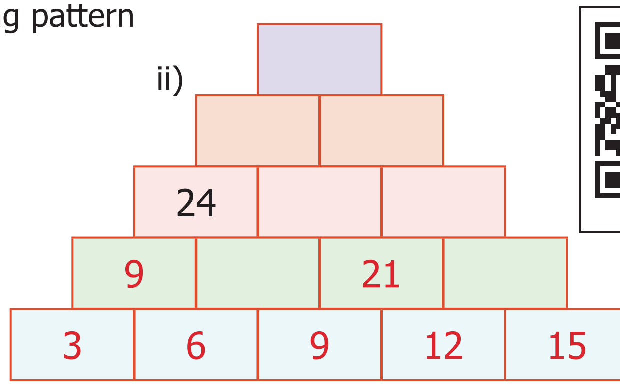
11 x 11 = 121

111 x 111 = 12321

1111 x 1111 = ?

11111 x 11111 = ?

ii)



E9U3UV

2. Find next three numbers in the following number patterns.

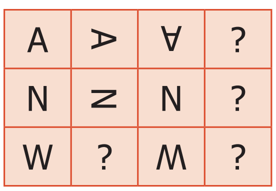
i) 50, 51, 53, 56, 60, … ii) 77, 69, 61, 53,…

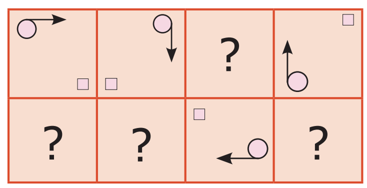
iii) 10, 20, 40, 80, … iv) $\frac{21}{33}, \frac{321}{444}, \frac{4321}{5555}, \ldots$

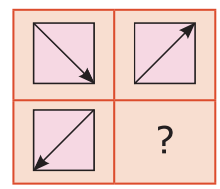
3. Consider the Fibonacci sequence 1, 1, 2, 3, 5, 8,13, 21, 34, 55,… Observe and complete the following table by understanding the number pattern followed. After filling the table discuss the pattern followed in addition and subtraction of the numbers of the sequence.

Steps	Pattern 1	Pattern 2
i)	1+3 = 4	5 -1 =4
ii)	1+3+8=__________	?
iii)	1+3+8+21 =__________	?
iv)	?	?

4. Complete the following patterns.

i) 

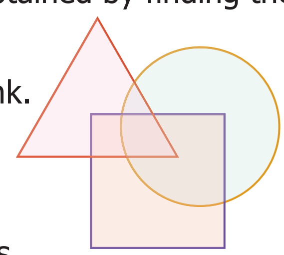
ii) 

iii) 

5. Find HCF of the following pair of numbers by Euclid's game.

i) 25 and 35 ii) 36 and 12 iii) 15 and 29

6. Find HCF of 48 and 28. Also find the HCF of 48 and the number obtained by finding their difference.



7. Give instructions to fill in a bank withdrawal form issued in a bank.

8. Arrange the name of your classmates alphabetically.

9. Follow and execute the instructions given below.

i) Write the number 10 in the place common to the three figures

ii) Write the number 5 in the place common for square and circle only.

iii) Write the number 7 in the place common for triangle and circle only.

iv) Write the number 2 in the place common for triangle and square only.

v) Write the numbers 12, 14 and 8 only in square, circle and triangle respectively.

10. Fill in the following information.

Candidate's EMIS No

1. Name of the candidate in Capital Letters followed by initial leaving one box blank. (Do not write Miss/Master)

2. Class Date of birth

Date Month Year

3. Father's name in Capital Letters followed by initial leaving one box blank. (Do not write Mr./Dr./Prof)

4. Mother's Name in Capital Letters followed by initial leaving one box blank. (Do not write Mrs./Dr./Prof)

5. Sex (Put ✓mark) **6. Area to which candidates resides. (Put ✓mark)**

Male Female Rural Urban

Objective Type Questions

11. The next term in the sequence 15, 17, 20, 22, 25,... is

    a) 28 b) 29 c) 27 d) 26

12. What will be the 25th letter in the pattern? ABCAABBCCAAABBBCCC,...

    a) B b) C c) D d) A

13. The difference between 6th term and 5th term in the Fibonacci sequence is

    a) 6 b) 8 c) 5 d) 3

14. The 11th term in the Lucas sequence 1, 3, 4, 7, ... is

    a) 199 b) 76 c) 123 d) 47

15. If the Highest Common Factor of 26 and 54 is 2, then HCF of 54 and 28 is...

    a) 26 b) 2 c) 54 d) 1

Exercise 5.2

Miscellaneous Practice problems

1. Find HCF of 188 and 230 by Euclid's game.
2. Write the numbers from 1 to 50. From that find the following.
   i) The numbers which are neither divisible by 2 nor 7.
   ii) The prime numbers between 25 and 40.
   iii) All square numbers upto 50.
3. Complete the following pattern

   i) 1+2+3+4 = 10
   2+3+4+5 = 14
   $\square$+4+5+6 = $\square$
   4+5+6+$\square$ = $\square$

   ii) 1+3+5+7 = 16
   $\square$+5+7+9 = 24
   5+7+9+$\square$ = $\square$
   7+9+$\square$+13 = $\square$

   iii) AB, DEF, HIJK, $\square$, STUVWX

   iv) 20, 19, 17, $\square$, 10, 5

4. Complete the table by using the following instructions.
   A: It is the 6th term in the Fibonacci sequence.
   B: The predecessor of 2.
   C: LCM of 2 and 3.
   D: HCF of 6 and 20
   E: The reciprocal of 1/5.
   F: The opposite number of –7.
   G: The first composite number.
   H: Area of a square of side 3 cm.
   I: The number of lines of symmetry of an equilateral triangle.
   After completing the table, what do you observe? Discuss.

A	B	C
D	E	F
G	H	I

5. Assign the number for English alphabets as 1 for A, 2 for B upto 26 for Z.

   Find the meaning of

7	15	15	4

13	15	18	14	9	14	7

6. Replace the letter by symbols as + for A, – for B, × for C and ÷ for D.
Find the answer for the pattern 4B3C5A30D2 by doing the given operations.

7. Observe the pattern and find the word by hiding the numbers
1H2O3W 4A5R6E 7Y8O9U?

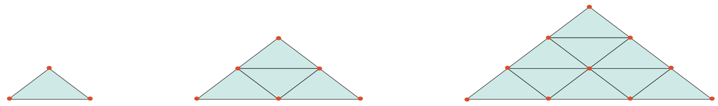
8. Arrange the following from the eldest to the youngest. What do you get?

A - refers to parents	L - refers to you	F - refers to grandparents
I - refers to elder sister	Y - refers to younger brother	M - refers to uncle

Challenge problems

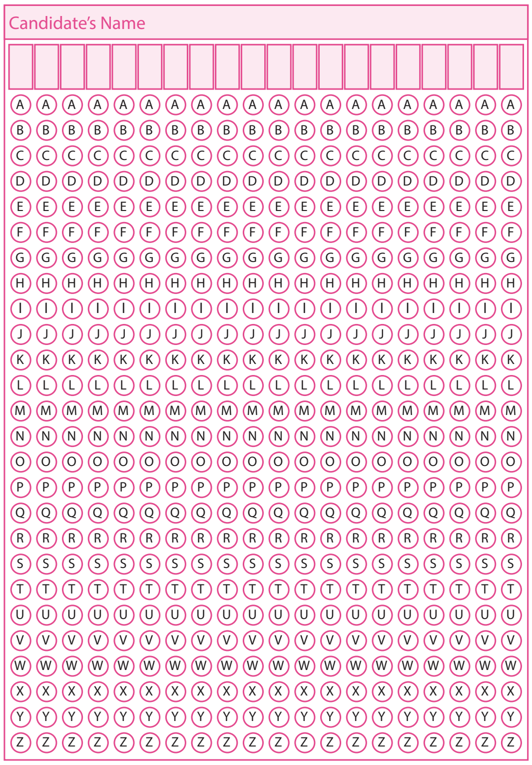
9. Prepare a daily time schedule for evening study at home.

10. Observe the geometrical pattern and answer the following questions



i) Write down the number of sticks used in each of the iterative pattern.

ii) Draw the next figure in the pattern also find the total number sticks used in it.



11. Find HCF of 28,35,42 by Euclid's game.

12. Follow the given instructions to fill your name in the OMR sheet.

- The name should be written in capital letters from left to right.
- One alphabet is to be entered in each box.
- If any empty boxes are there at the end they should be left blank.
- Ball point pen is to be used for shading the bubbles for the corresponding alphabets.

13. Consider the Postal Index Number (PIN) written on the letters as follows:604506; 604516; 604560; 604506; 604516; 604516; 604560; 604516; 604505; 604470; 604515; 604520; 604303; 604509; 604470. How the letters can be sorted as per Postal Index Numbers?

Summary

- An Iterative process is a procedure that is repeated many times to give new results.
- The Fibonacci sequence is 1, 1, 2, 3, 5, 8, 13, 21, 34,...
- If a number '*a*' is divided by some number '*b*' then we get the quotient '*q*' and remainder '*r*', and '*a*' can be written in a unique way as $a = (b \times q) + r$. that is., Dividend = (Divisor x Quotient) + Remainder. This is called the Euclidean algorithm.

ANSWERS

Chapter 1 Fractions

Exercise 1.1

1. i) $14\frac{1}{4}$ ii) Mixed Fraction iii) $1\frac{5}{6}$ iv) 16 v) 1
2. i) True ii) False iii) True iv) True v) False
3. i) $\frac{10}{21}$ ii) $7\frac{1}{2}$ iii) $7\frac{6}{35}$ iv) $\frac{38}{63}$ v) $\frac{11}{15}$ vi) $4\frac{2}{21}$
4. i) $\frac{61}{18}$ ii) $14\frac{1}{7}$ iii) $7\frac{5}{6}$ iv) $\frac{109}{9}$
5. i) 4 ii) $41\frac{2}{3}$ iii) $\frac{3}{10}$ iv) 4
6. i) $\frac{3}{28}$ ii) $2\frac{2}{5}$ iii) $1\frac{3}{25}$ iv) $5\frac{4}{5}$
7. $5\frac{1}{2}\,kg$
8. $1\frac{1}{4}\,l$
9. $15\frac{3}{4}\,km$
10. 7
11. d) $\frac{10}{11} < \frac{9}{10}$
12. a) $\frac{13}{63}$
13. c) $\frac{17}{53}$
14. a) 42
15. c) $\frac{4}{5}$ of ₹150

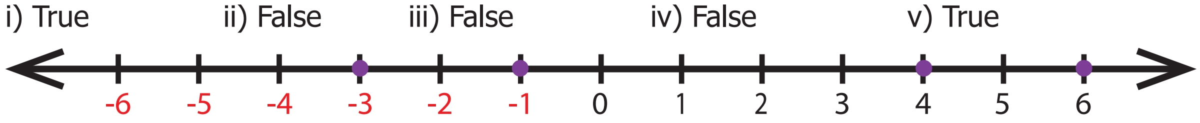
Exercise 1.2

1. ₹510
2. $3\frac{1}{4}\,km$
3. The difference between $2\frac{1}{2}$ and $3\frac{2}{3}$ is smaller
4. $10\frac{1}{8}\,kg$
5. 22 steps
6. $\frac{4}{8}$ & many answers
7. $3\frac{2}{3}$
8. $6\frac{8}{35}$
9. $2\frac{7}{12}$
10. 3
11. $\frac{1}{20}, \frac{1}{30}, \frac{1}{20}$
12. $\frac{1}{8}$
13. 15
14. i) $4\frac{1}{4}\,km$ ii) $5\frac{3}{4}\,km$ iii) Via Bus Stand iv) 6 times

Chapter 2 Integers

Exercise 2.1

1. i) −100 ii) −7 iii) left iv) 11 v) 0
2. i) True ii) False iii) False iv) False v) True
3.



4. i) −3 ii) −2
5. i) −44 ii) +19 or 19 iii) 0 iv) 312 v) −789
6. i) −15 km
7. i) Wrong, Integers are not continuously marked
   ii) Correct, Integers are correctly marked.
   iii) Wrong, Integer −2 is marked wrongly.
   iv) Correct, Integers are marked at equal distance.
   v) Wrong, negative integers marked wrongly.

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8. i) 8, 9 ii) −4, −3, −2, −1, 0, 1, 2, 3 iii) −2, −1, 0, 1, 2 iv) −4, −3, −2, −1

9. i) −7 < 8 ii) −8 < −7 iii) −999 >−1000 iv) −111 = −111 v) 0 > −200

10. i) −20, −19,−17, −15, −13, −11, 12, 14, 16, 18
    ii) −40, −28, −5, −1, 0, 4, 6, 8, 12, 22
    iii) −1000, −100, −10, −1,0, 1, 10, 100, 1000

11. i) 27, 15, 14, 11, 0, −9, −14, −17
    ii) 400, 78, 65, −46, −99, −120, −600
    iii) 777, 555, 333, 111, −222,−444, −666, −888

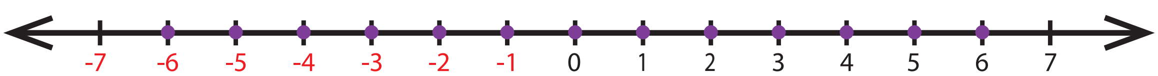
12. c) 7 13) a) 20 14) d) −6 15) c) −2 16) b) 0

Exercise 2.2

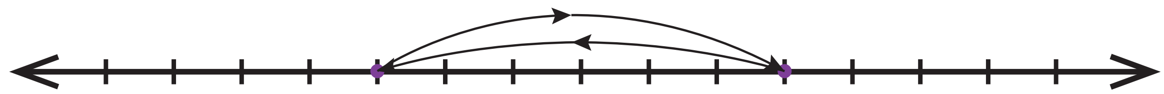
1. i) a sapling planted at a depth of 3m ii) a pit which is 3m deep

2.

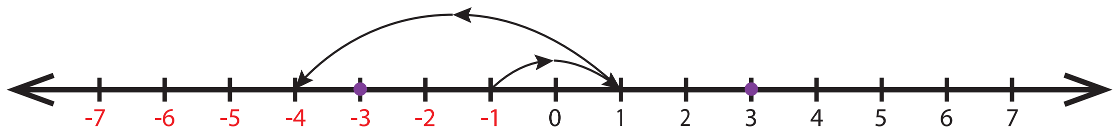
i)



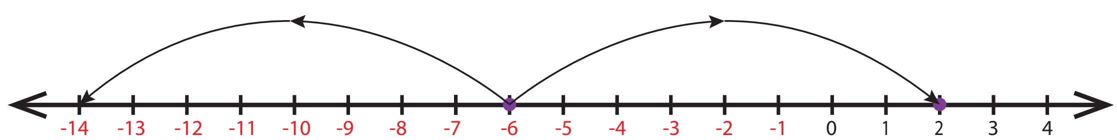
ii)



iii)



4.



5. i) K (−1) ii) −4 iii) 6 (−2, −1, 0, 1, 2, 3) iv) 2 pairs v) False, 0

6. −3, 7 7. −4, −1

8. No, as the number line number extends on both sides without any end, we cannot find the smallest (−) and the largest (+) number

9. i) – 10°C ii) At −5°C iii)−20°C iv) −15°C

10. S<Q<0<R<P

11. i) 3 ii) −2 iii) −6 iv) −1 v) −5
    vi) −4 vii) 4 viii) 4 ix) 5 x) 2

12. C1: 0, C3: 2, C5: 0, C6: -4, C8: -8, C9: 0

13. i) + 45 ii) 0 iii) −10 & – 20 iv) False v) the same

Chapter 3 Perimeter and Area

Exercise 3.1

1. i) 26 cm, 40 cm^2 ii) 14 cm, 182 cm^2 iii) 15 cm, 225 cm^2 iv) 12 m, 44 cm v) 5 feet, 18 feet

2. i) 24 cm, 36 cm^2 ii) 25 m, 625 cm^2 iii) 7 feet, 28 feet

3. i) 400 cm^2 ii) 8 feet iii) 4 m

4. i) 13 m ii) 6 m iii) 8 feet

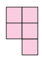
5. i) 500 ii) 2,60,000 iii) 80,00,000

6. i) 48 cm, 80 cm^2 ii) 36 cm, 49 cm^2 iii) 150 cm, 380 cm^2

7. 20 m, 24 m^2 8. 32 cm, 64 cm^2 9. 24 feet, 24 sq. feet

10. i) 25 m ii) 27 cm iii) 18 cm

11. 41 cm, 122 cm 12. 10 m, 100 m^2 13. 12 cm 14. 250 m^2, ₹11250/- 15. 54 cm

16. b)  17. b) less than 60 cm 18. c) 4 times 19. d) 3 times

20. c) Both the area & perimeter are changed

Exercise 3.2

1. i) 9 cm ii) 12 cm 2. 114 cm

3. Rahim, 120 m 4. 57 m, 2451 m^2 5. ₹400/- 6. 60 cm

7. 8 8. 8 cm, 24 cm 9. 12, (1,23), (2,22), (3,21), (4,20), (5,19), (6,18), (7,17), (8,16), (9,15), (10,14), (11,13), (12,12)

10. Perimeter of square B is twice that of square A

11. Area of the new square is reduced to 1/16 times to that of original area

12. Square plot by 4 m^2 13. 102 cm^2 14. 15.5 sq.units

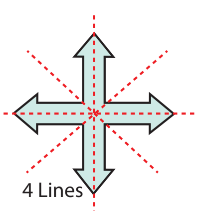
Chapter 4 Symmetry

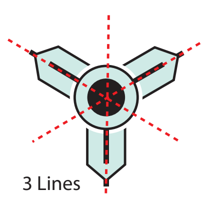
Exercise 4.1

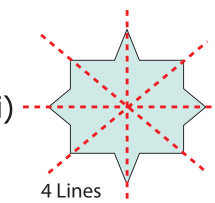
1. i) P ii) Two iii)Two iv) Two v) Translation

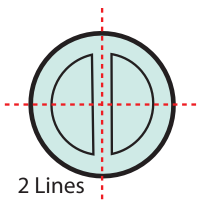
2. i) False ii) True iii) False iv) True v) False

3. i) d ii) a iii) b iv) c

4. i) 

ii) 

iii) 

iv) 

5. i) DECODE ii) KICK iii) BED iv) W
A
Y v) M
A
T
H vi) T
O
M
A
T
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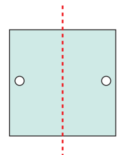
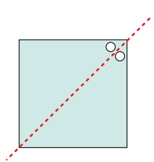
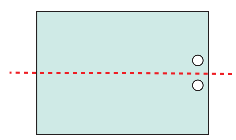
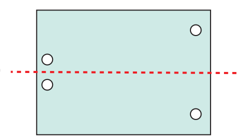
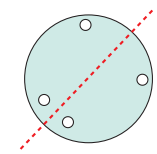
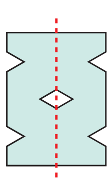
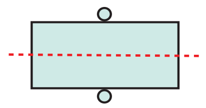
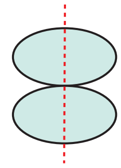
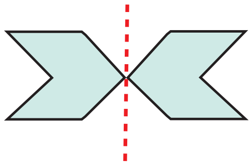
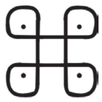
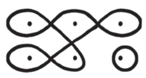
6. i)  ii)  iii)  iv)  v) 

7. i)  ii)  iii)  iv) 

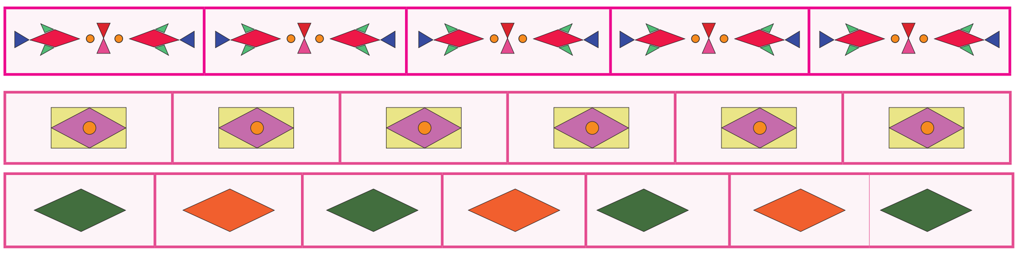
8. i) 2 ii) 2 iii) 4 iv) 8 v) 2

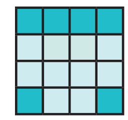
9. i) 4 ii) 2 iii) 2 iv) 4 v) 4 vi) 2

10. i)  ii)  iii)  11. b) P 12. c) 

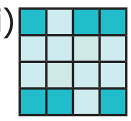
13. c) MAM 14. b) 2 15. a) 5

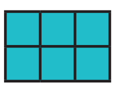
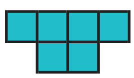
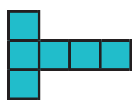
Exercise 4.2

1. i) Scalene triangle ii) Isosceles triangle iii) Equilateral triangle
2. i) P, N, S, Z ii) I, O, N, X, S, H, Z iii) A, M, E, D, I, K, O, X, H, U, V, W iv) I, O, X, H
3. i) 0, 2 ii) 1, 0 iii) 2, 2 iv) 8, 8 v) 1, 0
4. I8I, III, 808, 8I8, 888
5. 

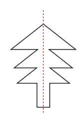
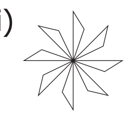
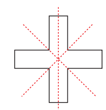
6. i) 

(Many answers)

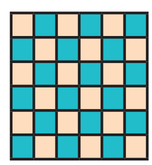
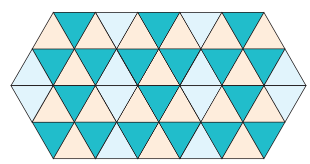
ii) 

7. i)  ii)  iii) 

(Many answers)

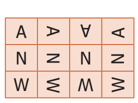
8. i)  ii)  iii) 

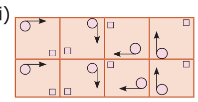
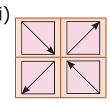
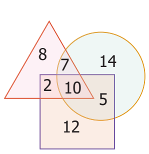
(Many answers)

9. i) 10 ii) 10 iii) n, n
10. i)  ii) 

Chapter 5 Information processing

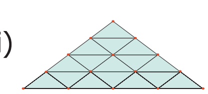
Exercise 5.1

1. i) 1234321; 123454321
   ii) 144, 60, 84, 36, 48, 15, 27
2. i) 65,71,78 ii) 45,37,29
   iii) 160, 320, 640 iv) $\frac{54321}{66666}, \frac{654321}{777777}, \frac{7654321}{8888888}$
3. ii) 12, 13-1=12 iii) 33, 34-1=33
   iv) 1+3+8+21+55=88, 89-1=88
4. (i) 

(ii)  (iii) 
5. i) 5 ii) 12 iii) 1 6. 4
9. 

11. c) 27 12. a) B 13. d) 3
14. a) 199 15. b) 2

Exercise 5.2

1. 2
2. i) 9, 11, 13, 15, 17, 19, 23, 25, 27, 29, 31, 33, 37, 39, 41, 43, 45, 47
   ii) 29, 31, 37 iii) 1,4, 9, 16, 25, 36, 49
3. i) 3, 18; 7, 22 ii) 3; 11,32; 11, 40
   iii) MNOPQ iv) 14
4. A-8, B-1, C-6, D-2, E-5, F-7, G-4, H-9, I-3
5. GOOD MORNING 6. 4 7. HOW ARE YOU?
8. FAMILY 10. i) 3, 9, 18 ii)  30
11. 7
13. 604 is common for all postal index numbers. Compare the remaining 3 digits, 303, 470, 505, 506 (two), 509, 510, 515, 516 (four), 520, 560 (Two)

MATHEMATICAL TERMS

Algorithm	வழிமுறை / படிமுறை
Approximate	தோராயமாக
Area	பரப்பளவு
Ascending order	ஏறுவரிசை
Asymmetrical	சமச்சீரற்ற
Axis of symmetry	சமச்சீர் அச்சு
Base	அடிப்பக்கம்
Boundary	எல்லை
Breadth	அகலம்
Closed figure	மூடிய உருவம்
Combined shapes	கூட்டு வடிவங்கள்
Consecutive	அடுத்தடுத்த
Descending order	இறங்குவரிசை
Directed number	திசை எண்
Distance	தொலைவு
Equilateral triangle	சமபக்க முக்கோணம்
Equivalent fraction	சமான பின்னம்
Estimated value	உத்தேச மதிப்பு
Fraction	பின்னம்
Fraction bars	பின்ன பட்டைகள்
Golden ratio	தங்க விகிதம்
Half squares	அரை சதுரங்கள்
Height	உயரம்
Horizontal line	கிடைமட்டக் கோடு
Improper fraction	தகா பின்னம்
Inner boundary	உட்புற எல்லை
Instruction	அறிவுறுத்துதல்
Integers	முழுக்கள்
Inverse	எதிர்மறை / நேர்மாறு
Irregular shapes	ஒழுங்கற்ற வடிவங்கள்
Iterative pattern	தொடர் வளர் அமைப்பு
Iterative process	தொடர் வளர் செயல்முறை
Largest	மிகப் பெரிய
Length	நீளம்
Like fraction	ஓரின பின்னம்
Line of symmetry	சமச்சீர்க் கோடு
Measure	அளவை
Mixed fraction	கலப்பு பின்னம்
Natural number	இயல் எண்
Negative integers	குறை முழுக்கள்
Negative number	குறை எண்
Non-negative integers	குறையற்ற முழுக்கள்
Number line	எண் கோடு
Opposite number	எதிரெண்
Outer boundary	வெளிப்புற எல்லை
Oval shape	நீள் வடிவம்
Perimeter	சுற்றளவு
Positive integers	மிகை முழுக்கள்
Positive number	மிகை எண்
Predecessor	முன்னி
Proper fraction	தகு பின்னம்
Reciprocal	தலைகீழி
Rectangle	செவ்வகம்
Reflection	எதிரொளிப்பு
Reflection symmetry	எதிரொளிப்பு சமச்சீர்
Regular hexagon	ஒழுங்கு அறுங்கோணம்
Regular pentagon	ஒழுங்கு ஐங்கோணம்
Regular shapes	ஒழுங்கு வடிவம்
Reshape	உருமாற்றம்
Resize	அளவு மாற்றம்
Rhombus	சாய்சதுரம்
Right angled triangle	செங்கோண முக்கோணம்
Rotation	சுழற்சி
Rotational symmetry	சுழல் சமச்சீர்
Sequence	தொடர் வரிசை
Side	பக்கம்
Signed number	குறியீட்டு எண்
Slant	சாய்வாக
Smallest	மிகச்சிறிய
Sorting	வகைப்படுத்துதல் / முறைப்படுத்துதல்
Square	சதுரம்
Square units	சதுர அலகுகள்
Successor	தொடரி
Surface	மேற்பகுதி / தளம்
Symmetry	சமச்சீர்
Translation	இடப் பெயர்வு
Translational symmetry	இடப் பெயர்வு சமச்சீர்
Triangle	முக்கோணம்
Unit fraction	ஓரலகு பின்னம்
Unit square	ஓரலகு சதுரம்
Unlike fraction	வேற்றின பின்னம்
Vertical line	குத்துக் கோடு
Whole number	முழு எண்

VI MATHEMATICS - TERM - III

TEXT BOOK DEVELOPMENT TEAM

Reviewer
Prof. R. Ramanujam
IMSC, Chennai

Academic Coordinator
B. Tamilselvi
Deputy Director, SCERT, Chennai

Group In-charge
Dr. V. Ramaprabha
Senior Lecturer, DIET, Thiruvallur.

Text Book Co-ordinator
V. Ilayarani Mohan
Assistant Professor, SCERT, Chennai

Content Writers
D. Iyappan
Lecturer, DIET, Vellore

S. K. Saravanan
Lecturer, DIET, Krishnagiri

M. Sellamuthu
P.G. Assistant, GHSS, Lakshmipuram, Tiruvallur

G. Kamalanathan
B.T.Assistant, GHSS, Arpakkam, Kancheepuram

K. Gunasekar
B.T.Assistant, PUMS, Valavanur west, Villupuram

G. Palani
B.T.Assistant, GHS, Jagadab, Krishnagiri

V. S. Mariamanonmani
B.T.Assistant, GGHS, Devikapuram,
Thiruvannamalai.

Content Readers
Dr. M.P. Jeyaraman
Assistant Professor,
L.N. Govt. Arts College, Ponneri

Dr. K. Kavitha
Assistant Professor,
Bharathi Women's College, Chennai

Art and Design Team

Illustration
K. Dhanas Deepak Rajan

K. Nalan Nancy Rajan

M. Charles

Layout Artist
C. Jerald Wilson

R. Mathan Raj

C. Prasanth

P. Arun Kamaraj

M. Yesu Rathinam

A. Adison Raj

In-House
Manohar Radhakirishnan
Rajesh Thangappan

Wrapper Design
Kathir Arumugam

Typist
L. Suganthini, SCERT Chennai

Co-ordinator
Ramesh Munisamy

ICT Co-ordinator
Vasuraj D
B.T.Assistant (Rtd.,)

QR Code Management Team
R. Jaganathan, PUMS, Ganesapuram- Polur
N. Jagan, GBHSS, Uthiramerur, Kancheepuram
J.F. Paul Edwin Roy, PUMS, Rakkipatti, Salem

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