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Inhuman- Crime

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Index

1. NATURAL NUMBERS & WHOLE NUMBERS

1.1 NATURAL NUMBERS (REVISION)

The children are screaming in a classroom. Shall we visit that class?

"Hundred", "Hundred and ten", "Two hundred and ten", "Two hundred and twenty", "Two hundred and fifty", "Three hundred", "Five hundred" and "Thousand".

Why are they calling out numbers? What order is this?

It is a game. If one student calls out a number, another student calls out a number bigger than that number. A student who calls out the biggest number wins the game. Shall we listen again?

"Ten thousand", "Twenty thousand", "Fifty thousand", "One lakh", "Ten lakhs". You can also play.

"One crore", "Thousand crores", "One lakh crores", "One crore crores", "One crore crore crores", "One crore crore crore crore crores …".

All the students screamed "Crore crore crore …". It was announced that all have won the game. Can anyone lose this game? Can anyone claim that he will be the winner?

In Ascending order of numbers there is no end.

It is easy to tell a number bigger than a given number. If you say twenty, I can say twenty one. If I say hundred, you can say two hundred.

We know about Predecessor and Successor

PREDECESSOR	NUMBER	SUCCESSOR
999	1000	1001
54	55	56

A successor of a number is bigger than that number. It takes longer time to complete the game counting by successor method. We can do it faster through addition and multiplication.

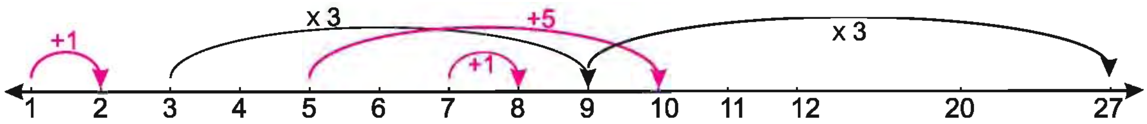
"Hundred", "Hundred and ten", "Hundred and fifty – Addition

"Hundred", "Two hundred", "Five hundred" – Multiplication

One natural number + Another natural number = A bigger natural number.

One natural number x Another natural number = A bigger natural number.

Let us see this in the following Number Line.



Exercise 1.1

1. Give a number bigger and smaller than the following numbers.

i) Ten thousand. **ii)** Twenty three. **iii)** Twenty lakhs. **iv)** Three crores. **v)** Hundred.

2. Write the following in ascending and descending order.

i) Ten lakhs, Twenty crores, Thirty thousand, Four hundred, Eight thousand.

ii)8888, 55555, 23456, 99, 1111111.

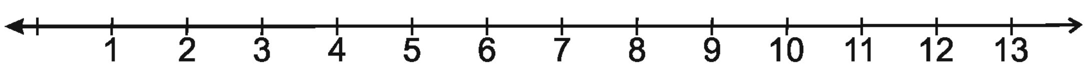
1.2 Small Numbers

Shall we play with small numbers now? Give a number smaller than the given number. The winner of the game is the one who gives the smallest number.

"Thousand", "Five hundred", "Hundred", "Fifty", "Forty".

"Zero", "Zero", "Zero".

It is very easy to win this game. When zero comes the game gets over.



Except zero, all the numbers have a predecessor. Predecessor of any number is smaller than that number.

Given number – Smaller number = A number smaller than the given number.

The counting numbers 1,2,3,... are called Natural numbers.

When there is nothing to count, it is zero. Zero is included with counting numbers to enable subtraction. Since they appear repeatedly in Mathematics they are given a specific name and symbol.

Numbers with more digits are seen not only in games, but also in many places around us. If anyone denote these numbers as "countless", it is wrong. These numbers are definitely countable. Since they are very large it is difficult to count.

Natural numbers are called counting numbers or positive integers.
We denote natural numbers as N={1,2,3,4,...}.

Similarly we denote the whole numbers as W={0, 1,2,3,4,...}.
The other name for the whole numbers is non-negative integers.

Exercise 1.2

1. Complete the following sequence

Crore, Ten lakhs, Lakhs, ...

2. Is there an end to the following sequence?

Thousand, Ten thousand, Lakh, ...

3. Is there any end to the following sequence?

i) Ten thousand, Twenty thousand, ...

ii) Ninety thousand, Lakh, ...

iii) Ninety thousand, Eighty thousand, ...

1.3 Numbers with more digits

There is a Neem tree near your house. Can you count the number of leaves? Is it in thousands or in lakhs? You cannot count accurately. It is easy to say in thousands and lakhs approximately.

Look at the tree. Assume that there are 9 big branches and in each big branch there are 5 small branches. Let us take a small branch and count the number of leaves. Assume that there are 48 leaves.

Total number of small branches = 9x 5 = 45.

There may be more than 5 small branches in few big branches. If approximately 50 small branches of 48 leaves are there, then the total number of leaves = 50 x 48 = 2400. Hence there may be more than 2000 leaves in the tree. It can be 4000 or 8000 but not in lakhs.

			Number of Zeros
10 ones	= 1 ten	= 10	1
10 tens	= 1 hundred	= 100	2
10 hundreds	= 1 thousand	= 1,000	3
10 thousands	= 1 ten thousand	= 10,000	4
10 ten thousands	= 1 lakh	= 1,00,000	5
10 lakhs	= 1 million	= 10,00,000	6
100 lakhs	= 1 crore (10 million)	= 1,00,00,000	7

1 is followed by 5 zeros in 1 lakh, 7 zeros in 1 crore, 8 zeros in 10 crores, 10 zeros in 1000 crores.

There are many digits in a big number. How many digits are there in a crore? 8 digits. In one lakh there are 6 digits and in one thousand? Four digits.

It is difficult to count the number of zeros if 1 lakh is written as 100000. We use comma to group the number of zeros and write it as follows.

Indian System		International System		
Ten thousand	= 10,000	Ten thousand	= 10,000	
One lakh	= 1,00,000	One lakh	= Hundred thousand	= 100,000
10 lakhs	= 10,00,000	10 lakhs	= One million	= 1,000,000
1 crore	= 1,00,00,000	One crore	= 10 millions	= 10,000,000
100 crores	= 1,00,00,00,000	Hundred crores	=One billion	= 1,000,000,000

Exercise 1.3

1. Discuss in groups how many leaves are there in a mango tree, a neem tree and a tamarind tree near your place.

2. How many thousands, hundreds, tens and ones are there in one lakh?

3. How many lakhs and thousands are there in one crore?

4. There are more than thousand labourers in a factory. Find the minimum amount needed if each gets Rs.1000 as bonus?

5. Find the value of

i) 6 x 6 = ; 6 x 6 x6 = ; 6 x 6 x 6 x 6 =

ii) 10 x 10 = ; 100 x 100 = ; 10,000 x 10,000 =

6. Show which is greater or smaller using the signs > or < for the following;

Eighty thousand, Ten thousand, Twenty thousand.

1.4 Method of Writing Numbers

How do we read numbers with more digits?

When 1234567 is written as 12, 34, 567 it is easy to read as 12 lakhs, 34 thousand and 567. Similarly the number 12345678 can be read easily when commas are added. (i.e) 1,23,45,678 can be read as 1 crore, 23 lakhs, 45 thousand and 678.

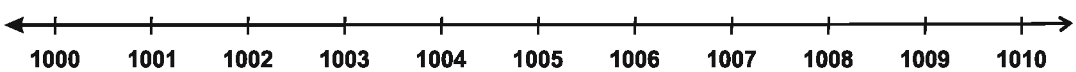
Numbers	Word Form (Number Name)
6	Six
66	Sixty six
666	Six hundred and sixty six
6,666	Six thousand, six hundred and sixty six
66,666	Sixty six thousand, six hundred and sixty six
6,66,666	Six lakhs, sixty six thousand, six hundred and sixty six
1,001	One thousand and one
10,011	Ten thousand and eleven
1,10,101	One lakh, ten thousand , One hundred and one

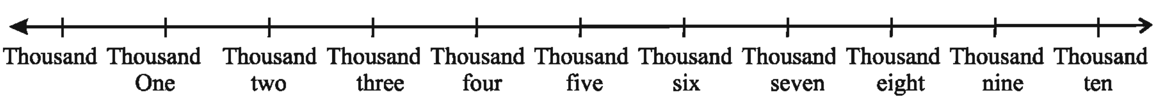
1.5 Activities of the Numbers

We know many concepts about numbers. Is it applicable to all numbers? Yes, whether a number has more or few digits, it is a number. It has the same property as any number.

Predecessor	Number	Successor
99,999	1,00,000	1,00,001
1,10,004	1,10,005	1,10,006
2,27,226	2,27,227	2,27,228
5,55,499	5,55,500	5,55,501

Number Line





1.5.1 Addition

1,10,110	1,10,110	1,10,110	1,10,110
+ 90	+ 990	+ 9,990	+ 99,990
1,10,200	1,11,100	1,20,100	2,10,100

1.5.2 Subtraction

1,10,110	1,10,110	1,10,110	1,10,110
− 90	− 990	− 9,990	− 99,990
1,10,020	1,09,120	1,00,120	10,120

1.5.3 Multiplication

5 lakhs x 6 = 30 lakhs
22 lakhs x 12 = (22 x 12) lakhs = 264 lakhs
1,00,005 x 5 = (1 lakh + 5) x 5 = 5 lakhs and twenty five

1,23,456 x 5 = ?

```
  1,23,456
x        5
----------
  6,17,280
----------
```

1,23,456 x 15 = ?

```
  1,23,456
x       15
----------
    617280
   123456
----------
 18,51,840
----------
```

We can multiply in the usual method. It is little difficult to check if we have written all the digits correctly. We have to be careful while writing and adding many numbers in order.

Importance should be given for the place value of numbers.

Example :

Number	Face Value (digit)	Place Value
456	4	Hundreds
23,456	2	Ten thousand
1,23,456	1	Lakh

When 1,23,456 is multiplied by 5, the result is definitely more than 5 lakhs.

1.5.4 DIVISION

98,76,543 ÷ 3 = ?

By the method of Continuous subtraction we can write the answer as 32,92,181. Division is possible for all numbers. But when the number of digits is more there is a possibility of making mistakes.

```
        3292181
    ------------
 3)  98,76,543
     9
     ---
      8
      6
     ---
      27
      27
     ---
       06
        6
     ---
        05
         3
     ---
         24
         24
     ---
          03
           3
     ---
           0
     ---
```

Let us see the method of division using numbers having more digits.

32,32,032 ÷ 16 = ?

Take it as (32 lakhs + 32 thousand + 32) ÷ 16.

Separate the number and divide as follows

32 lakhs ÷ 16 = 2 lakhs

32 thousand ÷ 16 = 2 thousand

32 ÷ 16 = 2

and write the answer as 2 lakhs, 2 thousand and two = 2,02,002.

18 lakhs ÷ 9 = 2 lakhs

18 lakhs ÷ 9 lakhs = 2

18 lakhs ÷ 9000 = 200

18 lakhs ÷ 90 = 20,000

Why to stop with crores?

Why the numbers bigger than crores are not named in our country?

How do you read this? 1234567891011

We can read it as one lakh twenty three thousand 456 crores 78 lakh 91 thousand and eleven which is not useful.

It is important to know that the value of this number is more than one lakh crore. 10 digit number is used only in cell phones. No one reads 98404 36985 as 984 crores, 4 lakhs, 36 thousand 985.

In postal address, no one reads pincode number 600113 as 6 lakhs one hundred and thirteen because it is not a number, but a number sequence. So 600113 is considered as a number sequence which is read as six, zero, zero, one, one, three.

Hence we don't add, subtract or multiply the pincode numbers, telephone numbers or bus numbers.

Exercise 1.4

1. The population of Nilgiri district is approximately 7 lakhs and five thousand. In Kanyakumari it is approximately sixteen lakhs. My friend says the population in Kanyakumari is twice as Nilgiri's. Is it true?

2. There are 462 students in a school. It was decided that each one gets a pen costing Rs. 18 as a gift. Is it enough to have Rs.7200 or Rs.10,000 ?

3. 52 students need Rs.5184 to go for an excursion. How much should be collected from each student?

4.

i.	ii.	iii.	iv.	v.	vi.
28,760	22,760	20,760	119,800	1,19,800	1,19,500
+38,530	+40,530	+40,530	- 88,565	- 89,565	- 89,565
______	______	______	______	______	______

5. i. 1,00,000 ÷ 100 =   iii. 10,000 ÷ 25 =   v. 5,55,555 ÷ 11 =

   ii. 1,00,000 ÷ 50 =   iv. 1,00,000 ÷ 200 =   vi. 90,909 ÷ 9 =

Points to remember

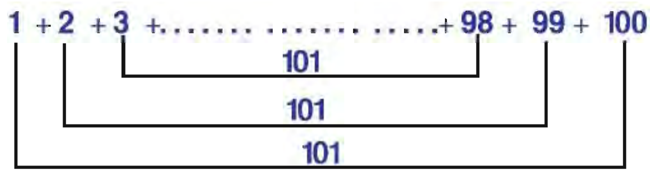
- N = {1,2,3,4,...} Natural numbers.
- W = {0,1,2,3,4,...} Whole numbers.
- There is no end if you extend a number line from zero.
- There is a successor for every whole number.
- You can add and multiply all the whole numbers.
- There is a predecessor for every whole number except zero.
- From any natural number we can subtract a smaller natural number or the same number.
- We can find the remainder, dividing a bigger number by a smaller number.
- All these are possible for any number having more digits.
- When we read 1,23,546 it is important to know that it is greater than one lakh twenty thousand and less than one lakh twenty five thousand.

2. DIVISORS AND FACTORS

2.1 ADDITION AND MULTIPLICATION

One day in 1784, a German teacher in his primary school felt tired as he entered the class. So he decided to give a difficult addition problem to his students and rest for a while. He asked them to find the total of "1 to 100".

Within a few seconds one particular student called out the answer 5050. The teacher was astonished and asked for the explanation. The explanation was as follows



100 numbers are equal to
50 pairs
100 ÷ 2 = 50

The above representation shows 50 pairs. The value of each pair is 101.
So altogether 50 x 101 = 5050.

The student who gave the above explanation was Gauss. He lived in the period 1777 to 1855 A.D. and was titled 'Emperor of mathematicians'. How is it possible to change an addition to multiplication? Is it possible always? Basically this is what Gauss understood.

$$1+2+3+\ldots+99+100 = (1+100)+(2+99)+(3+98)\ldots+(50+51)$$
$$= 101 \times 50$$
$$= 5050$$

Here the arrangement of numbers in a particular sequence is very important. Addition becomes easier when we rearrange them. This is possible for any sequence of natural numbers.

At the age of three Gauss was able to find mistakes in his father's office accounts.

Verify:

35 + 65 = 65+35 = 100
33 + 34 + 35 = 33+35+34 = 35 + 34 + 33
= 34+33+35 = 35 + 33 + 34
= 102
1777 + 1784 + 1855 = 1855 + 1777 + 1784 = 5416
5050 + 50 + 1050 = 50 + 1050 + 5050 = 6150

A sequence of numbers added in any order gives the same answer.

This will help us in many ways.

32 + 2057 + 68	=	2057 + (32 + 68)
	=	2057 + 100
	=	2157
125 + 250 + 125 + 250	=	(2x 250) + 125+ 125
	=	(2x 250) + 250
	=	3x 250
	=	750

If you want to add many numbers we have to do the following

i) Split the suitable numbers first.

ii) Add them separately.

iii) Finally add them all.

The above property is true for multiplication also.

Check them:	5 x 7 x 20	=	(20 x 5) x 7
		=	100 x 7 = 700
	125 x 20 x 8 x 50	=	(125 x 8) X (20 x 50)
		=	1000 x 1000 = 10,00,000

A sequence of numbers multiplied in any order gives the same result.

We must be careful while addition and multiplication are involved together.

What is the answer for 5 x 8 + 3?

If we multiply, 5 x 8 = 40 and add 3 we get 40 + 3 = 43 as the answer. If we add 8 +3 = 11 and then multiply we get 5 x 11 = 55 as the answer.
There is no two different answers for one problem. Therefore (5 x8) + 3 or 5 x (8+3) are correct.

You can see (.....) brackets used in the above examples.

Check them.

When both the operations addition and multiplication are involved it is important to use these ( ) brackets.

2.1.1 PROBLEMS INVOLED IN SUBTRACTION AND DIVISION

- Whole number + Whole number = Whole number
- Whole number x Whole number = Whole number
- This is called as closure property of addition and multiplication.
- Is there any closure property for subtraction and division?
- We should be careful about this.
- Is it possible to subtract a number from any number?

$5050 - 50 = 5000$

$5050 - 5050 = 0$

$50 - 5050 = ?$

While subtracting it is not always necessary to get the answer as a natural number, zero (or whole number). This is applicable for division also.

$5050 \div 50 = 101$

$5050 \div 5050 = 1$

$50 \div 5050 = ?$

- ☐ There is no closure property for division.
- ☐ Arrangement is very important for subtraction and division.

$(23 - 12) - 5 = 6$

$23 - (12 - 5) = 16$

The above given statements are not the same.

$23 - 12 = 11$ but

$12 - 23 = ?$

Arrangement is important for division.

$120 \div 12 = 10$

$12 \div 120 = ?$

Exercise 2.1

1. Add the following by simple method.

(i) $25 + 69 + 75$ (ii) $119 + 64 + 1 + 80$ (iii) $750 + 60 + 240 + 250$

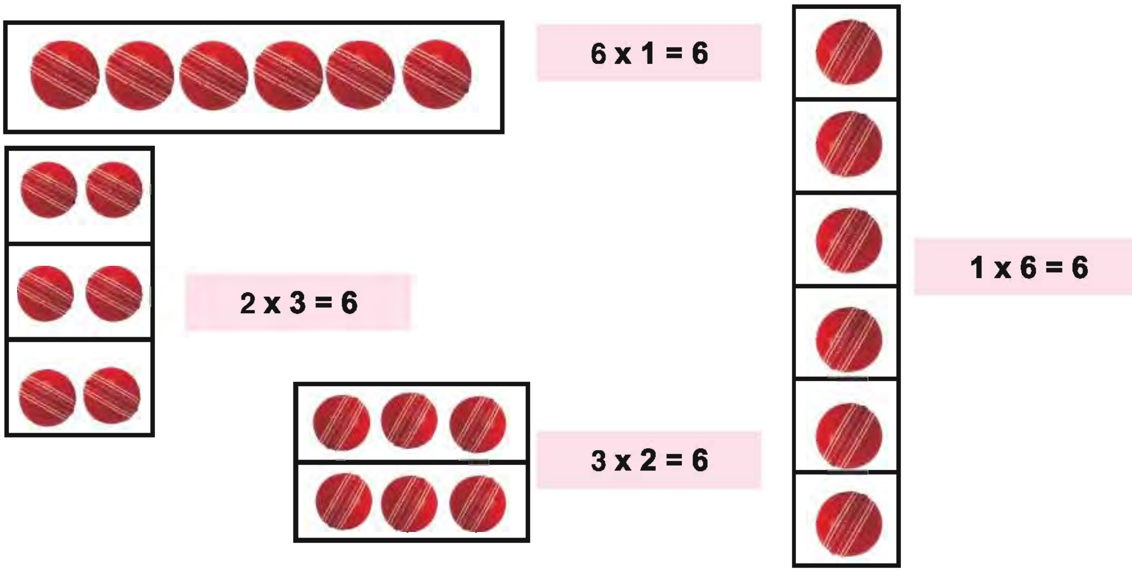
2. Answer the following $51 + 52 + \dots + 99 + 100$

3. Find the product using short methods.

(i) $25 \times 62 \times 4$ (ii) $5 \times 125 \times 2 \times 2$ (iii) $(75 \times 5) + (30 \times 5) + (25 \times 5)$

2.2 DIVISORS

Manoj has 6 cricket balls. He is trying to arrange them in a rectangular form.



Any natural number other than one can be written as a product of 2 or more numbers.

Can we arrange 6 balls in any other rectangular form?
The answer would be obtained by dividing 6 by a number smaller than 6.

1) 6 (6 6 ----------- 0 -----------	2) 6 (3 6 ----------- 0 -----------
3) 6 (2 6 ----------- 0 -----------	4) 6 (1 4 ----------- 2 -----------
5) 6 (1 5 ----------- 1 -----------	6) 6 (1 6 ----------- 0 -----------

It is found that by dividing 6 by some numbers the remainder is '0' and by some numbers the remainder is not zero.

Divisors of 6 are 1, 2, 3, 6.

All the numbers which divide a given number leaving 0 as remainder are called divisors of the given number.

Observe the following table

Number	Divisors	Expressing in different rectangular form
12	1, 2, 3, 4, 6, 12	1 x 12 ; 2 x 6 ; 3 x 4
17	1,17	1 x 17
25	1, 5, 25	1 x 25 ; 5 x 5
28	1, 2, 4, 7, 14, 28	1 x 28 ; 2 x 14 ; 4 x 7
31	1,31	1 x 31
35	1, 5, 7, 35	1 x 35 ; 5 x 7
42	1, 2, 3, 6, 7, 14, 21, 42	1 x 42 ; 2 x 21 ; 3 x 14 ; 6 x 7

The following are observed from the above table

★ 1 and number itself are divisors of any number.

★ Is there any number which has no divisor? No, because 1 is a divisor of all numbers.

★ Some numbers have many divisors. 42 has 8 divisors.

★ All the numbers from 1 to 10 except 7 are the divisors of 720.
Try to find more divisors.

★ Some numbers have only 2 divisors.

★ For Example : divisors of 7 are 1 and 7. Likewise prime numbers 11,13,17,19 have only two divisors.

Prime numbers are numbers which are divisible by 1 and itself.

2.2.1 FACTORS

In the previous section we have observed that 1 and the number itself were the divisor of any number along with other divisors. For Example : divisors of 45 are 1, 3, 5, 9, 15, 45. Here other than 1 and 45 the remaining numbers are called factors.

The divisors of a number other than 1 and the number itself are called the factors of that number.

Think Over:

"All factors are divisors". Are all divisors factors?

A prime number does not have any factors.

Can you factorise 7?

Numbers having more than two divisors are called composite numbers

2.2.2 METHODS OF FINDING PRIME NUMBERS

All even numbers are divisible by 2. Two is the only even prime number.
How to find whether a given number is a prime number? It is difficult. Why?
Is 200 divisible by 4? Yes by division.
Is 200 divisible by 9? No by division.
Is 131 divisible by 11? No.
Is 1137 divisible by 11?
Is 1234567 divisible by 133? Try to get the answer.

It is possible to find out whether a number is divisible by any number. But this is not enough to find out whether it is a prime number.

Prime numbers are only divisible by 1 and itself.

There is no other divisor for prime numbers proving the above is difficult for bigger numbers.

How many prime numbers are there from 1 to 100? Find them.

1. Form a tabular column for numbers 1 to 100.
2. Except 2, cross all the even numbers.
3. Next except 3, cross all the multiples of 3.
4. Next 5, because 4 and even number has already been crossed. Now cross all the multiples of 5.
5. Follow the same; the left out numbers are prime numbers.

A Greek mathematician Eratosthenes (BC 276 – BC 175) suggested this method for finding the prime numbers.

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	~~32~~	~~33~~	~~34~~	~~35~~	~~36~~	37	~~38~~	~~39~~	~~40~~
41	~~42~~	43	~~44~~	~~45~~	~~46~~	47	~~48~~	~~49~~	~~50~~
~~51~~	~~52~~	53	~~54~~	~~55~~	~~56~~	~~57~~	~~58~~	59	~~60~~
61	~~62~~	~~63~~	~~64~~	~~65~~	~~66~~	67	~~68~~	~~69~~	~~70~~
71	~~72~~	73	~~74~~	~~75~~	~~76~~	~~77~~	~~78~~	79	~~80~~
~~81~~	~~82~~	83	~~84~~	~~85~~	~~86~~	~~87~~	~~88~~	89	~~90~~
~~91~~	~~92~~	~~93~~	~~94~~	~~95~~	~~96~~	97	~~98~~	~~99~~	~~100~~

Totally there are 25 prime numbers.

1 has only one divisor, so 1 is neither a prime nor a composite number.

2.2.3 MULTIPLES

Observe the given table

Multiples

x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
7	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140
8	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
9	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180
10	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200

Example : 1

Write 4 multiples of 7 above 100
Answer: 105, 112, 119, 126.

105 is a multiple of 7, At the same time 7 is a divisor of 105. So a number is a multiple of its divisor.

Example : 2

Write 4 multiples of 5 just before 80 and 4 multiples of 5 just after 80 including 80.
Answer: 60, 65, 70, 75, 80, 85, 90, 95, 100.

Exercise 2.2

1. State true or false for the following

i. 4 is one of the divisors of 7.
ii. One of the factors of 21 is 3.
iii. 1 is one of the divisors of 24.
iv. 9 is one of the factors of 45.
v. One of the multiples of 5 is 105.

2. Choose the correct answer

i. Which of the following has all the divisors of 10?

(a) 1,2,5 (b) 2,5 (c) 1,2,5,10 (d) 2,10

ii. Which of the following has all the divisors of 4?

(a) 2,4 (b) 1,2 (c) 1,2,4 (d) 2

iii. 3 is the divisor of _____

(a) 18 (b) 19 (c) 20 (d) 29

iv. 4 is the multiple of _____

(a) 5 (b) 2 (c) 3 (d) 8

v. 15 ıs the multiple of _____

(a) 3 (b) 45 (c) 7 (d) 11

3. Find the divisors of the following

(i) 8 (ii) 15 (iii) 45 (iv) 121 (v) 14

4. Write all the multiples of 3 between 80 and 100.

5. Write all the multiples of 5 and 10 between 21 and 51. What do you understand from this?

6. Say true or false for the following

(i) 1 is the smallest prime number.

(ii) There are two even prime numbers.

(iii) 6 is a prime number.

(iv) 13 is a composite number.

(v) 61 is a prime number.

7. Choose the correct answer

(i) The prime factor of 24 is

(a) 3 (b) 4 (c) 6 (d) 12

(ii) The prime number between 5 and 11 is

(a) 6 (b) 7 (c) 8 (d) 10

(iii) Number of one digit prime numbers are

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

(iv) Number of prime numbers between 20 and 30 are

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

(v) The smallest two digit prime number is

(a) 37 (b) 7 (c) 11 (d) 10

8. Write all the prime numbers between 30 and 60

9. Are the addition, subtraction, multiplication and division of two prime numbers, is also a prime number? check with examples.

2.3 DIVISIBILITY

To find all the divisors of a natural number we should divide the number by all the numbers smaller than it, which is time consuming. Moreover the quotient or remainder is not important.

Our aim is to find whether it could be divided leaving 0 as the remainder. This could be found by simple methods.

Test of divisibility by 2

If we keep subtracting 2 from the odd numbers like 37, 453 we get a remainder. But, we get 0 as a remainder for even numbers such as 48, 376. So, all even numbers are divisible by 2.

Numbers ending with 0, 2, 4, 6 or 8 are divisible by 2.

Test of divisibility by 5

If we keep subtracting 5 from 1005 we get numbers such as 1000, 995, 900 whose last digit is 5 and 0 alternatively and finally it ends with 0.

If 5 is subtracted from a number ending with 7 (for e.g 237) we get numbers ending with 2, 7, 2, ... At last it ends with 2. So 237 is not divisible by 5.

Numbers ending with 0 or 5 are divisible by 5.

Test of divisibility by 10

If we keep subtracting 10 from 3010 we get numbers ending with 0 such as 3000, 2990, 2980.

Numbers ending with 0 are divisible by 10.

It is enough to see the last digit to know if a number is divisible by 2, 5, 10.

Test of divisibility by 4

Is 138 divisible by 4?

138 = 100 + 38; If we keep subtracting 4 from 100 we get 0 as the remainder. Therefore to know if 138 is divisible by 4 it is enough to find out if 38 is divisible by 4. Likewise 1792 = 1700 + 92. 92 is divisible by 4. So 1792 is divisible by 4. 2129 is not divisible by 4 (check), because 29 is not divisible by 4.

If the number formed by last two digits (unit and tenth digit) of a given number is divisible by 4, it will be divisible by 4.

Test of divisibility by 8

Is 1248 divisible by 8? 1248 = 1000 + 248. 1000 = 125 x 8. So it is enough to see if 248 is divisible by 8. 248 = 31 x 8. So 1248 is divisible by 8.

If the number formed by the last three digits of a given number is divisible by 8, the given number will be divisible by 8.

Are all numbers that are divisible by 2 are divisible by 4 also? For Example : 26 is divisible by 2 but not divisible by 4. Likewise all the numbers that are divisible by 4 need not be divisible by 8.

To test (i) if a number is divisible by 4, check only the last two digits.

(ii) If a number is divisible by 8 check only the last three digits.

Test of divisibility by 9

Is 45 divisible by 9?

45 = 10 + 10 + 10 + 10 + 5
= **9** + 1 + **9** + 1 + **9** + 1 + **9** + 1 + 5

If we keep subtracting 9 we get

= 1 + 1 + 1 + 1 + 5
= 4 + 5 = **9**

If the last 9 is subtracted the remainder is 0. So, 45 is divisible by 9.

Is 123 divisible by 9?

123 = 100 + 10 + 10 + 3
= (99+1) + (9+1) + (9+1) + 3
= (99+1) + (9+9+2) + 3

If 9 or multiples of 9 are subtracted we get 1 + 2 + 3 = 6. So, 123 is not divisible by 9.

Note that after subtracting 9 the remainder is the sum of the digits of the given number.

If the sum of the digits of a number is divisible by 9, the number is divisible by 9.

Given Number	Sum of the digits	Is it divisible by 9?	Verify by multiplication
61	6 + 1 = 7	No	61 = 6 x 9 + 7
558	5 + 5 + 8 = 18; 1 + 8 = 9	Yes	558 = 62 x 9
971	9 + 7 + 1 = 17; 1 + 7 = 8	No	971 = 107 x 9 + 8
54000	5 + 4 + 0 + 0 + 0 = 9	Yes	54000 = 6000 x 9

Test of divisibility by 3

If we keep subtracting 3 from 42 we get 0 as remainder (ie. 42, 39, 36, … 0). This can also be checked by another method.

$$42 = 10 + 10 + 10 + 10 + 2$$
$$= 9 + 1 + 9 + 1 + 9 + 1 + 9 + 1 + 2$$

Instead of subtracting 3, 9 can be subtracted (because 9 = 3 x 3). Finally we get,

$$= 1 + 1 + 1 + 1 + 2$$
$$= 4 + 2$$
$$= 6$$

Note that after subtracting 9 the remainder is the sum of the digits of the given number.

6 is divisible by 3. So, 42 is also divisible by 3.

If the sum of the digits of a number is divisible by 3, the number is divisible by 3.

Note: Numbers that are divisible by 2 and 3 are also divisible by 6.

Test of divisibility by 11

	Digits						Sum of the digits in the odd places	Sum of the digits in the even places	Difference
	6	5	4	3	2	1			
3 x 11					3	3	3	3	0
71 x 11				7	8	1	8 (7+1)	8	0
948 x 11		1	0	4	2	8	13(1+4+8)	2 (0+2)	11
5102 x 11		5	6	1	2	2	8	8	0
73241 x 11	8	0	5	6	5	1	7	18	11

From the above table we know that the difference between the sum of the digits in the odd places and sum of the digits in the even places is a multiple of 11.

If the difference between the sum of the digits in the odd places and sum of the digits in the even places is either 0 or multiples of 11, the number is divisible by 11.

Generally it is difficult to find if a number is divisible by 11. But, if the numbers are in a particular pattern, we know that they are divisible by 11. For Example : 121, 1331, 4994, 56265, 1234321, 4754574 are divisible by 11. How?

Exercise 2.3

1. State true or false for the following
   - (i) 120 is divisible by 3.
   - (ii) All the numbers that are divisible by 8 are also divisible by 2.
   - (iii) All the numbers that are divisible by 10 are also divisible by 5.

2. Tabulate if the numbers given below are divisible by 2, 3, 4, 5, 6, 8, 9, 10, 11

Numbers	DIVISIBILITY								
	2	3	4	5	6	8	9	10	11
77	No	No	No	No	No	No	No	No	Yes
896	Yes	No	Yes	No	No	Yes	No	No	No
918									
1,453									
8,712									
11,408									
51,200									
732,005									
12,34,321									

3. Fill the following tabular column with a suitable number.

The smallest number divisible by 2	7	6	0	4	3	1	2	
The biggest number divisible by 3						7	3	2
The smallest number divisible by 4				9	8	2	6	
The biggest number divisible by 5			4	3	1	9	6	
The smallest number divisible by 6		1		9	0	1	8	4
The biggest number divisible by 8	3	1	7	9	5		7	2
The smallest number divisible by 9				3	2	0		7
Any number divisible by 10	1	2	3	4	5	6	7	
Any number divisible by 11			8	6	9	4		4
The smallest number divisible by 3				5	6		1	0
Any number divisible by 11			9	2	3		9	3

4. Circle the numbers divisible by8.

   22, 35, 70, 64, 8, 107, 112, 175, 156

5. Check if the numbers divisible by 3 and 5 are also divisible by 15 with a suitable examples.

2.4 PRIME FACTORISATION

The method of expressing a number as a product of prime numbers is called prime factorization.

(i) Division method (ii) Factor tree method are the two methods to find the prime factors of the given numbers.

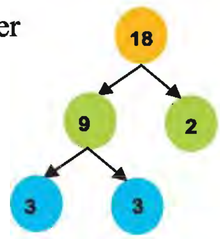
Factorise 18, 120 by division method and factor tree method.

Given number is 18

Division method

		Remainder
2	18	
3	9	-0
3	3	-0
	1	-0

Factor tree method



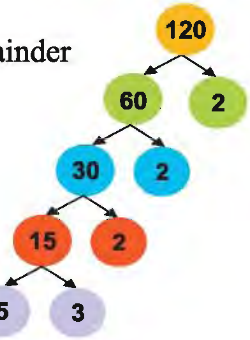
Prime factors of 18 are
$18 = 2 \times 3 \times 3$

Given number is 120

Division method

		Remainder
5	120	
3	24	-0
2	8	-0
2	4	-0
2	2	-0
	1	-0

Factor tree method



Prime factors of 120 are
$120 = 2 \times 2 \times 2 \times 3 \times 5$

Exercise 2.4

1. Express the following numbers as a product of prime factors.

(i)	6	(ii)	15	(iii)	21	(iv)	30	(v)	121
(vi)	145	(vii)	162	(viii)	170	(ix)	180	(x)	200

2. Which has more factors: 21 or 8? Find using a factor tree.

2.5 Greatest Common Divisor (G.C.D.) Least Common Multiple (L.C.M.)

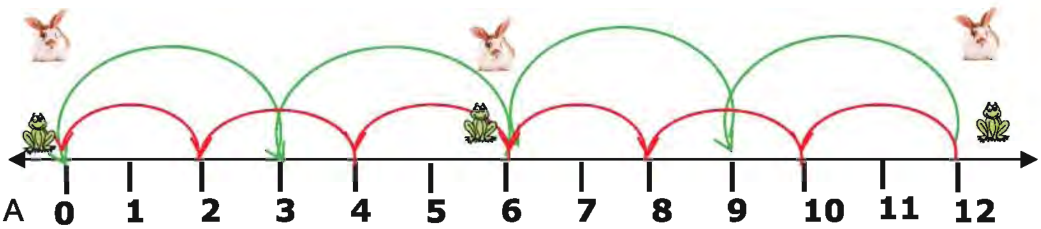
2.5.1 Least Common Multiple (L.C.M.)

A rabbit covers 3 feet in one jump. But a frog can cover only 2 feet in one jump.

Both of them start from the same point A.

From point A, the points of landing of the rabbit is at 3, 6, 9, 12,...

From point A, the points of landing of the frog is at 2, 4, 6 , 8,...



Both of them land at common points 6, 12 …. Here 6 is the LCM of 2 and 3.

> The smallest among the common multiples of two numbers is called their least common multiple (LCM).

We can find the LCM of given numbers by 2 methods

Common Multiple method

Step 1: List the multiples of the given numbers.

Step 2: Circle and write the common multiples

Step 3: The smallest common multiple is the LCM.

Given numbers: 16, 24

Multiples of 16: =16, 32, 48, 64, 80, 96, 112, 128, 144, 160,.....

Multiples of 24: = 24, 48, 72, 96, 120, 144, 168,....

Common multiples of 16 and 24 = 48, 96, 144, ...

(The smallest multiple among the common multiples is the LCM)

∴ The LCM of 16 and 24 = 48.

Factorisation method

Step1: Find the prime factors of the given numbers.

Step2: Circle the common prime factors

Step3: Find the product of the common factors. Multiply this product with independent factors.

Given numbers: 16, 24

Factors of 16

		Remainder
2	16	
2	8	-0
2	4	-0
2	2	-0
	1	-0

Factors of 24

		Remainder
2	24	
2	12	-0
2	6	-0
3	3	-0
	1	-0

Factors of 16 = 2 x 2 x 2 x 2

Factors of 24 = 2 x 2 x 2 x 3

LCM is the product of the common factors and independent factors.

LCM of 16 &24 = 2 x 2 x 2 x 2 x 3 = 48

2.5.2 Greatest Common Divisor (G.C.D.)

We know that different numbers have common divisors. Among the common divisors the greatest divisor is the G.C.D.

There are 2 methods to find the G.C.D. of the given numbers.

Common divisor method

Step 1: Find the divisors of the given numbers.

Step 2: Circle and write the common divisors

Step 3: Among the common divisors the greatest divisor is the G.C.D.

Given numbers: 30, 42

Divisors of 30 : 1, 2, 3, 5, 6, 10, 15, 30

Divisors of 42 : 1, 2, 3, 6, 7, 14, 21, 42

Common divisors : 1, 2, 3, 6

G.C.D. = 6

Given numbers = 35, 45, 60

Divisors of 35 : 1, 5, 7, 35

Divisors of 45 : 1, 3, 5, 9, 15, 45

Divisors of 60 : 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

Common divisors : 1, 5

G.C.D. : 5

Factorisation method

Step 1: Find the prime factors of the given numbers.

Step 2: Circle the common prime factors.

Step 3: Product of the common factors is the G.C.D. of the given numbers.

Given numbers: 30, 42

Prime factors of 30

		Remainder
2	30	
3	15	– 0
5	5	– 0
	1	– 0

Prime factors of 42

		Remainder
2	42	
3	21	–0
7	7	–0
	1	–0

Factors of 30: $= 2 \times 3 \times 5$

Factors of 42: $- 2 \times 3 \times 7$

(circle the common factors)

G.C.D = $2 \times 3 = 6$

Example : 3

Find the G.C.D. of 85, 45, 60 by factorization method.

Factors of 85

		Remainder
5	85	
17	17	-0
	1	-0

Factors of 45

		Remainder
3	45	
3	15	-0
5	5	-0
	1	-0

Factors of 60

		Remainder
2	60	
2	30	-0
3	15	-0
5	5	-0
	1	-0

Factors of 85 = (5) x 17

Factors of 45 = 3 x 3 x (5)

Factors of 60 = 2 x 2 x 3 x (5)

(Circle the common factors of all the three numbers)

G.C.D. of the given numbers = 5.

2.5.3 Relatively Prime Numbers

Let us form ordered pairs of any two numbers.

For Example : (5, 12), (9, 17), (11, 121), ...

G.C.D. of the ordered pair (3, 5) is 1. G.C.D. of the ordered pair (5, 15) is 5.

If the G.C.D. of any ordered pair is 1, then they are said to be relatively prime numbers.

(3, 5) are relatively prime numbers. (5, 15) are not relatively prime numbers.

Example : 4

Are the given ordered pairs relatively prime numbers?

(13, 17), (7, 21), (101, 201), (12, 13)

ANSWERS

1. (13, 17) – Relatively prime numbers as G.C.D. of (13, 17) is 1
2. (7, 21) – Not relatively prime numbers as G.C.D. of (7, 21) is 7
3. (101, 201) – Relatively prime numbers as G.C.D. of (101, 201) is 1
4. (12, 13) – Relatively prime numbers as G.C.D. of (12, 13) is 1.

Note: G.C.D. of any pair of consecutive numbers is 1.
So, they are said to be relatively prime numbers.

Exercise 2.5

1. State true or false for the following:
   (I) G.C.D. of 2, 3 is 1
   (ii) LCM of 4, 6 is 24
   (iii) (5, 15) are relatively prime numbers.
   (iv) G.C.D. of any two number is less than their L.C.M.

2. Choose the correct answer
   (i) The G.C. D. of 3, 6 is
   (a) 1 (b) 2 (c) 3 (d) 6
   (ii) The L.C.M. of 5, 15 is
   (a) 5 (b) 10 (c) 15 (d) none of these
   (iii) The G.C.D. of two prime numbers is
   (a) 1 (b) a prime number (c) a composite number (d) 0
   (iv) The G.C.D. and L.C.M. of the relatively prime numbers (3, 5) are
   (a) 1, 3 (b) 1, 5 (c) 1, 15 (d) 1, 8

3. Find the G.C.D. and L.C.M. of the following
   (i) 30, 42 (ii) 34, 102 (iii) 12, 42, 75 (iv) 48,72, 108.

4. Puspha bought 2 rice bags each weighing 75 kg and 60 kg. The rice must be completely filled in smaller bags of equal weight. What is the maximum weight of each bag?.

2.6. Relation between G.C.D. and L.C.M.

Observe the following table and fill in the blanks.

First number	Second number	Product	L.C.M.	G.C.D.	G.C.D. x L.C.M.
8	12	96	24	4	96
18	36	648	36	18	648
5	?	75	15	5	75
3	9	27	?	3	27

From the above table

Product of two numbers = G.C.D. x L.C.M.

Example : 5

The G.C.D. of 36, 156 is 12.

Find their L.C.M.

First number = 36

Second number = 156

G.C.D. = 12

$$\text{L.C.M.} = \frac{\text{Product of the two numbers}}{\text{G.C.D.}}$$

$$= \frac{36 \times 156}{12}$$

$$= 468$$

Example : 6

The G.C.D. and L.C.M. of two number are 3 and 72 respectively. If one number is 24. Find the other.

One number = 24.

G.C.D. = 3

L.C.M. = 72

$$\text{Other number} = \frac{\text{G.C.D. x L.C.M.}}{\text{One number}}$$

$$= \frac{3 \times 72}{24}$$

$$= 9$$

Exercise 2.6

1. Find the correct relationship between G.C.D. and L.C.M.

   (i) G.C.D. = L.C.M. (ii) G.C.D. $\leqslant$ L.C.M.

   (ii) L.C.M. $\leqslant$ G.C.d. (iv) L.C.M. > G.C.D.

2. The L.C.M. of 78, 39 is 78. Find their G.C.D.

3. The G.C.D. and L.C.M. of two numbers are 2 and 28 respectively. One number is 4. Find the other number.

To think

1. What is the G.C.D. of any two consecutive even numbers?
2. What is the G.C.D. of any two consecutive odd numbers?
3. What is the G.C.D. of any two consecutive numbers?
4. Is the sum of any two consecutive odd numbers divisible by 4? Verify with examples.
5. Is the product of any three consecutive numbers divisible by 6? Verify with examples

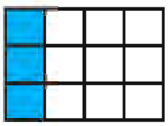
Points to remember

- Numbers can be added and multiplied in any order. (This is not applicable for subtraction and division)
- A number which divides a given number leaving '0' as remainder is called a divisor of the given number.
- 1 is a divisor for all numbers. A number is a divisor for itself.
- Numbers which are divisible by 1 and itself are called prime numbers. The remaining numbers are composite numbers.
- Divisibility of a number by 2, 3, 5, 6, 8, 9, 10, 11 can be easily found.
- The method of expressing a number as a product of prime numbers is called prime factorization.
- Among the common divisors of given numbers, the greatest divisor is the G.C.D.
- If the G.C.D. of any two numbers is 1 they are said to be relatively prime number.
- Among the common multiples of given numbers, the least is the L.C.M.
- The product of any two numbers is equal to the product of their G.C.D. and L.C.M.

3. FRACTIONS AND DECIMAL NUMBERS

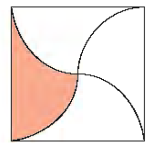
3.1 FRACTIONS – REVISION

A fraction is a part or parts of a whole which is divided into equal parts.

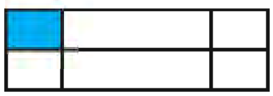


$\frac{3}{12}$

$\frac{2}{6}$



$\frac{1}{4}$



This is not $\frac{1}{6}$
(All the parts are are not equal)

This is not $\frac{1}{2}$
(Both the parts are not equal)

This is $\frac{2}{8}$
(All the parts are equal)

In a fraction, the number above the line is called the numerator and the number below the line is called the denominator.

$$\text{FRACTION} = \frac{\text{NUMERATOR}}{\text{DENOMINATOR}}$$

We know to divide the whole into quarter, half and three quarters

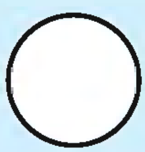
We denote them as $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$.

We call these numbers as fractions.

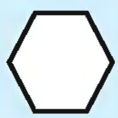
Do it yourself :

Shade the given shapes for the corresponding fraction in the following shapes.

$\frac{2}{7}$

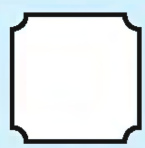


$\frac{3}{8}$



$\frac{1}{3}$

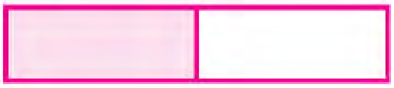
$\frac{3}{4}$



$\frac{1}{4}$

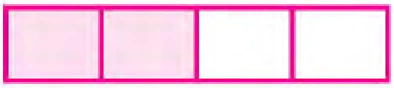
3.1.1 Equivalent Fractions (Revision)

Let us divide a rectangle into two equal parts and shade one part.



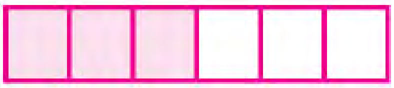
Shaded part = $\frac{1}{2}$

Let us divide the same rectangle into four equal parts and shade 2 parts.



Shaded part = $\frac{2}{4}$

Divide the same rectangle into 6 equal parts and shade 3 parts.



Shaded part = $\frac{3}{6}$

In all the above figures the shaded portions are equal but they can be represented by different fractions.

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

When two or more fractions represent the same part of a whole, the fractions are called equivalent fractions.

Activity-Equivalent Fractions:

In a card write the multiples of 1 to 10. Cut as strips as shown below.

These cards are called "multiple cards".

Let us now find the equivalent fractions of $\frac{2}{3}$

Solution:

Keep the multiple cards of the numerator and the denominator as shown in the figure.

2nd multiple card.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3rd multiple card.	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45

$$\frac{2}{3} = \frac{4}{6} = \frac{6}{9}$$

These fractions are called equivalent fractions.

When the numerator and the denominator are multiplied by the same number, we get equivalent fractions.

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

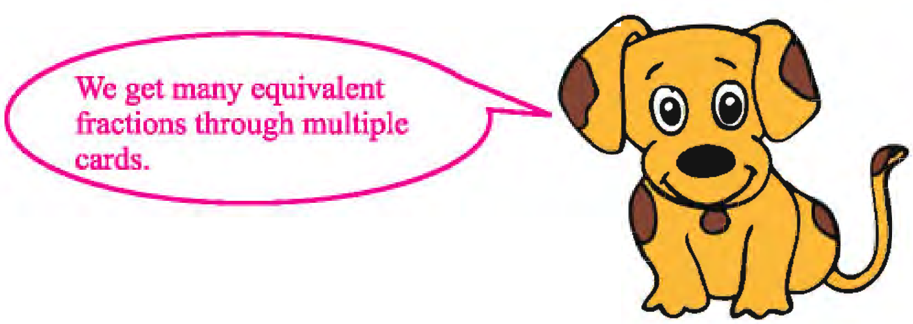
$$\frac{2}{3} = \frac{2 \times 3}{3 \times 3} = \frac{6}{9}$$

$$\frac{2}{3} = \frac{2 \times 5}{3 \times 5} = \frac{10}{15}$$

$$\frac{2}{3} = \frac{2 \times 9}{3 \times 9} = \frac{18}{27}$$

Therefore $\frac{2}{3} = \frac{2 \times 2}{3 \times 2} = \frac{2 \times 3}{3 \times 3} = \frac{2 \times 5}{3 \times 5} = \frac{2 \times 9}{3 \times 9} = \frac{2 \times 10}{3 \times 10}$

$$\frac{2}{3} = \frac{4}{6} = \frac{6}{9} = \frac{10}{15} = \frac{18}{27} = \frac{20}{30}$$



Example : 1

Find the missing numbers in the following equivalent fractions using the multiple cards.

$$\frac{4}{9} = \frac{8}{18} = \frac{\square}{45} = \frac{32}{\square}$$

4^{th} multiple card.	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
9^{th} multiple card.	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135

From the above figure

1. If the denominator is 45, the numerator is 20.
2. Similarly if the numerator is 32, the denominator is 72.

$$\therefore \frac{4}{9} = \frac{8}{18} = \frac{\boxed{20}}{45} = \frac{32}{\boxed{72}}$$

Example : 2

Write any 5 equivalent fractions to $\frac{3}{7}$

To get equivalent fractions multiply the numerator and the denominator by the same number.

$$\frac{3}{7} = \frac{3x2}{7x2} = \frac{3x4}{7x4} = \frac{3x5}{7x5} = \frac{3x9}{7x9} = \frac{3x10}{7x10}$$

$$\frac{3}{7} = \frac{6}{14} = \frac{12}{28} = \frac{15}{35} = \frac{27}{63} = \frac{30}{70}$$

3.1.2 Expressing the fractions in its lowest form (simplest form)

Now consider $\frac{15}{18}$

Divisors of 15 are 1, 3, 5, 15

Divisors of 18 are 1, 2, 3, 6, 9, 18

$$\frac{15}{18} = \frac{3x5}{3x6}$$

$$\frac{15}{18} = \frac{\cancel{3}x5}{\cancel{3}x6} = \frac{5}{6}$$ (We cancel 3 which is common.)

Divisors of 5 are 1, 5
Divisors of 6 are 1, 2, 3, 6

As there is no common divisor for 5 and 6 (except 1)

$\frac{5}{6}$ is the lowest form of $\frac{15}{18}$

Equivalent fractions have the same value. So they can be represented by a single number. So we express it in the lowest form where there is no common factor for the numerator and denominator.

Example : 3

Reduce $\frac{12}{16}$ into lowest terms

Factors of 12 are 2, 3, 4, 6
Factors of 16 are 2, 4, 8

There are two common factors 2,4.

Considering 2 as a factor,

$$\frac{12}{16} = \frac{2x6}{2x8} = \frac{6}{8}$$

Factors of 6 are 2, 3
Factors of 8 are 2, 4

$$\frac{6}{8} = \frac{\cancel{2}x3}{\cancel{2}x4} = \frac{3}{4}$$

Considering 4 as a factor,

$$\frac{12}{16} = \frac{4x3}{4x4} = \frac{3}{4}$$

There is no common factor for 3 and 4.

$\therefore$ The Lowest form of $\frac{12}{16} = \frac{3}{4}$

So, when there are more than one common factor, use the greatest common factor, to get the lowest term easily.

Example : 4

Write the lowest form of $\frac{24}{40}$

Factors of 24 are 2, 3, 4, 6, 8, 12

Factors of 40 are 2, 4, 5, 8, 10, 20

8 is the greatest common factor. $\therefore \frac{24}{40} = \frac{8x3}{8x5} = \frac{3}{5}$

Exercise : 3.1

1. Write 4 equivalent fractions for each of the following : (i) $\frac{5}{6}$ (ii) $\frac{3}{8}$ (iii) $\frac{2}{7}$ (iv) $\frac{3}{10}$
2. Pick out the equivalent fractions: $\frac{2}{5}, \frac{12}{16}, \frac{1}{3}, \frac{5}{15}, \frac{16}{40}, \frac{3}{4}, \frac{9}{12}$
3. Express the following in its lowest form:

   (i) $\frac{12}{14}$ (ii) $\frac{35}{60}$ (iii) $\frac{48}{64}$ (iv) $\frac{27}{81}$ (v) $\frac{50}{90}$
4. Find the missing number.

   (i) $\frac{1}{4} = \frac{?}{20} = \frac{3}{?}$ (ii) $\frac{3}{5} = \frac{21}{?} = \frac{?}{20}$ (iii) $\frac{5}{9} = \frac{35}{?} = \frac{?}{72}$

3.1.3 Comparison of fractions, addition, subtraction – Revision

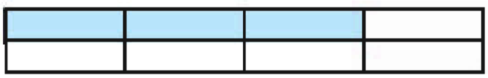
Like fractions have the same denominators.
$\left(\text{Eg: } \frac{2}{7}\ \frac{5}{7} \right)$

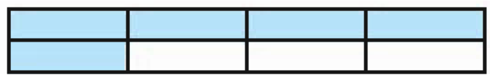
We have learnt to add, subtract and to compare the numbers. Similarly we can do it for the fractions also.

Comparison of fractions:

Which is greater? $\frac{3}{8}$ or $\frac{5}{8}$

Let us take a rectangle


$\frac{3}{8}$


$\frac{5}{8}$

From the figure, we observe that $\frac{3}{8} < \frac{5}{8}$. When fractions have the same denominator we can compare only the numerators and decide which fraction is greater.

$$\therefore \frac{3}{8} < \frac{5}{8}$$

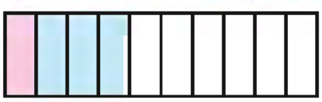
Example : 5

Which is greater ? $\frac{9}{11}$ or $\frac{7}{11}$

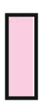
The denominators of $\frac{9}{11}$ and $\frac{7}{11}$ are same. So compare the numerators.

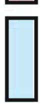
As 9>7, $\frac{9}{11} > \frac{7}{11}$

Addition of like fractions



In this figure

 Represents $\frac{1}{10}$

 Represents $\frac{3}{10}$

From the figure we can see that the total coloured part = $\frac{4}{10}$

$$\therefore \boxed{\frac{1}{10}+\frac{3}{10}=\frac{4}{10}}$$

We can see that both the fractions have same denominator.

Do it Yourself :

1. $\frac{3}{11}+\frac{1}{11}=?$
2. $\frac{3}{8}+\frac{4}{8}+\frac{2}{8}=?$
3. $\frac{1}{31}+\frac{15}{31}+\frac{7}{31}=?$

For addition of fractional numbers with the same denominator, all the numerators are added and the sum is written as numerator in the result, keeping the denominator same.

Subtraction of like fractions

In subtraction of like fractions, find out which is greater and subtract the smaller from the greater.

1. $\frac{2}{4}-\frac{1}{4}=\frac{2-1}{4}=\frac{1}{4}$ 2. $\frac{6}{7}-\frac{4}{7}=\frac{6-4}{7}=\frac{2}{7}$

Can we subtract greater fraction from smaller fraction?

Exercise 3.2

1. Find which is greater fraction:

(i) $\frac{3}{7},\frac{5}{7}$ (ii) $\frac{2}{12},\frac{7}{12}$ (iii) $\frac{6}{19},\frac{16}{19}$ (iv) $\frac{13}{34},\frac{31}{34}$ (v) $\frac{37}{137},\frac{33}{137}$

2. Add the following like fractions:

(i) $\frac{1}{4}+\frac{2}{4}=?$ (ii) $\frac{3}{7}+\frac{4}{7}=?$ (iii) $\frac{3}{13}+\frac{9}{13}=?$ (iv) $\frac{5}{7}+\frac{3}{7}+\frac{4}{7}=?$

(v) $\frac{5}{124}+\frac{43}{124}+\frac{33}{124}=?$ (vi) $\frac{23}{432}+\frac{23}{432}+\frac{32}{432}=?$

3. Simplify the following:

(i) $\frac{12}{13}-\frac{4}{13}=?$ (ii) $\frac{9}{17}-\frac{6}{17}=?$ (iii) $\frac{34}{39}-\frac{33}{39}=?$ (iv) $\left\{\frac{75}{47}+\frac{3}{47}\right\}-\frac{14}{47}=?$

(v) $\left\{\frac{125}{214}-\frac{25}{214}\right\}+\frac{50}{214}=?$ (vi) $\left\{\frac{24}{122}+\frac{2}{122}\right\}-\frac{13}{122}=?$

3.1.4 Unlike Fractions: Comparison, addition, subtraction.

Which is greater ? $\frac{1}{4}$ or $\frac{2}{5}$

Observe that the denominators are different.
Fractions having different denominators are called unlike fractions.
Convert the unlike fractions to like fractions to add, subtract and to compare.

How to convert the unlike fractions into like fractions ?

Consider the unlike fractions $\frac{1}{4}$ and $\frac{2}{5}$

Convert them into like fractions, without changing their values.
How to covert them in to like fractions without changing their values?
Convert unlike fractions into like fractions, by finding their equivalent fractions.

Equivalent fractions of $\frac{1}{4} \rightarrow \frac{1}{4} = \frac{2}{8} = \frac{3}{12} = \frac{4}{16} = \frac{5}{20} = \frac{6}{24} = \frac{7}{28}$

Equivalent fractions of $\frac{2}{5} \rightarrow \frac{2}{5} = \frac{4}{10} = \frac{6}{15} = \frac{8}{20} = \frac{10}{25} = \frac{12}{30} = \frac{14}{35}$

It is important to see, whether the denominators of the two fractions are same.

We can write $\frac{1}{4}$ as $\frac{5}{20}$ and $\frac{2}{5}$ as $\frac{8}{20}$ without changing their values.

Now $\frac{5}{20}$ and $\frac{8}{20}$ are like fractions.

As $\frac{8}{20} > \frac{5}{20}$, $\frac{2}{5} > \frac{1}{4}$

Example : 6

Which is greater? $\frac{1}{2}$ or $\frac{3}{5}$

$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12} = \frac{7}{14} = \frac{8}{16} = \frac{9}{18} = \frac{10}{20}$

$\frac{3}{5} = \frac{6}{10} = \frac{9}{15} = \frac{12}{20} = \frac{15}{25} = \frac{18}{30} = \frac{21}{35} = \frac{24}{40} = \frac{27}{45} = \frac{30}{50}$

Unlike fractions can be converted into like fractions by finding many sets of equivalent fractions. We can use any one pair of equivalent fractions to find which is greater.

$\frac{6}{10} > \frac{5}{10}$ Therefore $\frac{3}{5} > \frac{1}{2}$ **or** $\frac{12}{20} > \frac{10}{20}$ Therefore $\frac{3}{5} > \frac{1}{2}$

Activity

Prepare multiple cards for 1 to 10 as shown below

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45

Let us take $\frac{3}{4}$ and $\frac{2}{5}$ and convert them into like fractions

$\frac{3}{4}$	3	6	9	12	15	18	21	24	27	30
	4	8	12	16	20	24	28	32	36	40
$\frac{2}{5}$	2	4	6	8	10	12	14	16	18	20
	5	10	15	20	25	30	35	40	45	50

Keep the multiple cards of $\frac{3}{4}$ and $\frac{2}{5}$ as shown above.

Observe the denominators of multiple cards and find where they are equal.
20 and 40 are found in both the multiple cards.

Therefore we can write, $\frac{3}{4}=\frac{15}{20}$ and $\frac{2}{5}=\frac{8}{20}$

Using this activity, we can compare, add and subtract fractions.

3.1.5 Addition of unlike fractions

$\frac{1}{4}+\frac{2}{5}=?$

To add, convert the given fractions into like fractions.

Equivalent fractions of $\frac{1}{4}$ $\rightarrow \frac{1}{4}=\frac{2}{8}=\frac{3}{12}=\frac{4}{16}=\frac{5}{20}=\frac{6}{24}=\frac{7}{28}$

Equivalent fractions of $\frac{2}{5}$ $\rightarrow \frac{2}{5}=\frac{4}{10}=\frac{6}{15}=\frac{8}{20}=\frac{10}{25}=\frac{12}{30}=\frac{14}{35}$

$\frac{1}{4}=\frac{5}{20}$, $\frac{2}{5}=\frac{8}{20}$ $\quad \therefore \frac{1}{4}+\frac{2}{5}=\frac{5}{20}+\frac{8}{20}=\frac{13}{20}$

Example : 7

$\frac{2}{5}+\frac{5}{6}=?$ $\quad \frac{2}{5}=\frac{4}{10}=\frac{6}{15}=\frac{8}{20}=\frac{10}{25}=\frac{12}{30}=\frac{14}{35}$ $\quad \frac{5}{6}=\frac{10}{12}=\frac{15}{18}=\frac{20}{24}=\frac{25}{30}=\frac{30}{36}=\frac{35}{42}$

$\frac{2}{5}=\frac{12}{30}$, $\frac{5}{6}=\frac{25}{30}$ $\quad \therefore \frac{2}{5}+\frac{5}{6}=\frac{12}{30}+\frac{25}{30}=\frac{37}{30}$

Let us take the examples given above,

$$\frac{1}{4}+\frac{2}{5}=\frac{5}{20}+\frac{8}{20}$$

(i.e) $\frac{1}{4}$ is equivalent to $\frac{5}{20}$

$\frac{2}{5}$ is equivalent to $\frac{8}{20}$

(i.e) $$\frac{1x5}{4x5}+\frac{2x4}{5x4}=\frac{5}{20}+\frac{8}{20}=\frac{13}{20}$$

Similarly, $$\frac{2}{5}+\frac{5}{6}=\frac{2x6}{5x6}+\frac{5x5}{6x5}$$

$$=\frac{12}{30}+\frac{25}{30}=\frac{37}{30}$$

To add unlike fractions, we can use the following steps.

$$\frac{1}{4}+\frac{2}{5}$$

Step: 1 Multiply the two denominators $\frac{1}{4}+\frac{2}{5}=\frac{\quad}{4x5}$

Step: 2 Multiply the numerator of each fraction by the denominator of other fraction. $\frac{1x5}{4x5}+\frac{2x4}{5x4}=\frac{(1x5)+(2x4)}{4x5}$

Step: 3 $\frac{1}{4}+\frac{2}{5}=\frac{5+8}{4x5}=\frac{13}{20}$

Example : 8

$$\frac{3}{8}+\frac{5}{7}=\frac{(3x7)+(5x8)}{8x7}$$

$$=\frac{21+40}{56}$$

$$=\frac{61}{56}$$

Example : 9

$$\frac{11}{10}+\frac{4}{9}=\frac{(11x9)+(4x10)}{10 x 9}$$

$$=\frac{99+40}{90}$$

$$=\frac{139}{90}$$

3.1.6 Subtraction

Subtraction is similar to addition

To subtract,

(i) Convert the given fractions into like fractions.

(ii) Subtract the numerators

Example : $\frac{4}{5} - \frac{1}{3} = ?$

Step 1: Convert into like fractions

$$\frac{4}{5} = \frac{4 \times 3}{5 \times 3} = \frac{12}{15}, \quad \frac{1}{3} = \frac{5 \times 1}{5 \times 3} = \frac{5}{15},$$

$\frac{12}{15}$, $\frac{5}{15}$ are like fractions of $\frac{4}{5}$ and $\frac{1}{3}$ respectively

Step 2 : Subtraction

$$\frac{4}{5} - \frac{1}{3} = \frac{12}{15} - \frac{5}{15} = \frac{7}{15}$$

$$\therefore \frac{4}{5} - \frac{1}{3} = \frac{7}{15}$$

Exercise:3.3

1. Which is greater?

(i) $\frac{5}{7}, \frac{3}{8}$ (ii) $\frac{2}{10}, \frac{7}{12}$ (iii) $\frac{6}{5}, \frac{2}{4}$ (iv) $\frac{6}{9}, \frac{4}{3}$ (v) $\frac{3}{2}, \frac{3}{7}$

2. Simplify the following:

(i) $\frac{3}{4} + \frac{2}{3} = ?$ (ii) $\frac{3}{8} + \frac{2}{4} = ?$ (iii) $\frac{3}{5} + \frac{9}{9} = ?$ (iv) $\frac{5}{3} + \frac{3}{8} + \frac{4}{3} = ?$

(v) $\frac{3}{10} + \frac{4}{100} = ?$ (vi) $\frac{3}{4} + \frac{2}{5} + \frac{4}{8} = ?$

3. Simplify the following:

(i) $\frac{2}{3} - \frac{1}{4} = ?$ (ii) $\frac{9}{10} - \frac{3}{5} = ?$ (iii) $\frac{3}{4} - \frac{3}{8} = ?$ (iv) $\frac{6}{7} - \frac{1}{4} = ?$ (v) $\left\{\frac{8}{9} - \frac{1}{9}\right\} - \frac{2}{9} = ?$

3.1.7 Improper fractions and mixed fractions

$\frac{3}{4}, \frac{1}{2}, \frac{9}{10}, \frac{5}{6}$ { In these fractions, denominator is greater than the numerator. They are called proper fractions.

If the numerator is greater than the denominator, the fraction is called an improper fraction. } (e.g) $\frac{5}{4}, \frac{6}{5}, \frac{41}{30}$

What is meant by $\frac{5}{4}$?

Velu, Appu, Vasu and Kala had 5 dosas with them. How to divide them equally ?

First we can give 1 dosa each to all the four. Then the remaining 5^{th} dosa can be divided into 4 equal parts, and each one can be given 1 part.

The total quantity of dosa received by Velu, Appu, Vasu and Kala= 1 whole dosa + $\frac{1}{4}$ dosa

$= 1 + \frac{1}{4}$ dosa

This can be written as $1\frac{1}{4}$

How else can you divide the dosa among them?

Each dosa can be divided into 4 equal parts and each one would receive five $\frac{1}{4}$ parts.

Each one would have got $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$ = five $\frac{1}{4} = \frac{5}{4}$

But the dosa received by each in each method must be same.

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

$1\frac{1}{4}$ is called mixed fraction.

A mixed fraction has one natural number and one proper fraction.

Any improper fraction can be converted into mixed fraction.

Note: Mixed fraction = Natural number + proper fraction.

$4\frac{1}{2} = 4 + \frac{1}{2}$ and $22\frac{1}{3} = 22 + \frac{1}{3}$

3.1.8 Conversion of improper fractions into mixed fractions.

Example : 10

$$\frac{7}{3} = \frac{3}{3} + \frac{3}{3} + \frac{1}{3}$$

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

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

Divide 7 by 3

3) 7 (2
   6

   1

Divisor = 3
Quotient = 2
Remainder = 1

$$\text{Mixed fraction} = \text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}}$$

Think over!
There are two groups of people. In the first group, 4 apples are shared equally among 3 people and in the second group 3 apples are shared equally among 4 people. Which group you will join, if you want to get more apples?

Do it yourself : Convert the following improper fractions into mixed fractions.

(i) $\frac{11}{3}$ (ii) $\frac{23}{7}$ (iii) $\frac{22}{5}$

3.1.9: Conversion of mixed fractions into improper fractions.

Example : 11

Convert $3\frac{2}{7}$ into improper fraction.

$$3\frac{2}{7} = 3 + \frac{2}{7} = 1 + 1 + 1 + \frac{2}{7}$$

$$= \frac{7}{7} + \frac{7}{7} + \frac{7}{7} + \frac{2}{7}$$

$$= \frac{7+7+7+2}{7} = \frac{23}{7}$$

$$3\frac{2}{7} = \frac{23}{7}$$

$$\text{Improper fraction} = \frac{(\text{Natural number x denominator}) + \text{Numerator}}{\text{Denaominator}}$$

$$3\frac{2}{7} = \frac{(3 \times 7) + 2}{7}$$

$$= \frac{21+2}{7} = \frac{23}{7}$$

∴ The improper fraction of $3\frac{2}{7}$ is $\frac{23}{7}$

All non negative numbers can be considered as fractions. In these numbers, denominator can be considered as 1

Discuss: What kind of fractions are these?

$\frac{7}{7}$, $\frac{0}{7}$ and $\frac{1}{7}$

Do it yourself

Convert the following mixed fractions into improper fractions

$1\frac{1}{3}$, $2\frac{3}{5}$, $3\frac{5}{7}$, $1\frac{4}{10}$

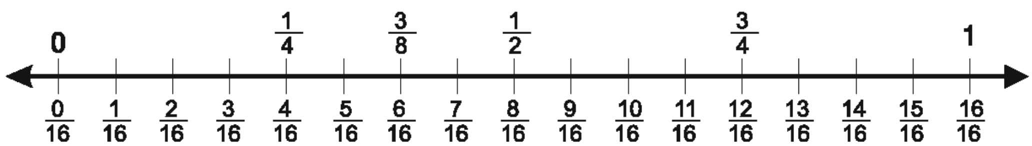
3.1.10 Fractions on number line

We have $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$ between 0 and 1

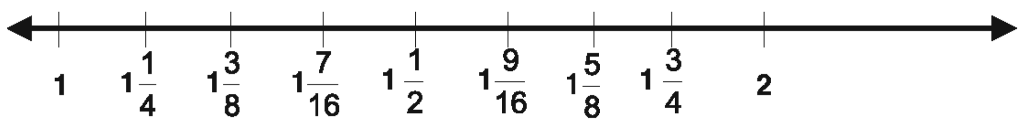
$\frac{3}{8}$ lies between $\frac{1}{4}$ and $\frac{1}{2}$

$\frac{7}{16}$ lies between $\frac{3}{8}$ and $\frac{1}{2}$

$\frac{9}{16}$ lies between $\frac{1}{2}$ and $\frac{3}{4}$



Similarly, there are many fractions between 1 and 2



Similarly, we can draw number lines between 101 and 102 , 134 and 135, 2009 and 2010.

On a number line, there are plenty of fractions. Moreover, when you add or subtract two fractions, we get a number or a fraction on the number line.

Between any two whole numbers we get many fractions.

Actually, between any two fractions, we can find a fraction! Thus many new fractions can be obtained! If each one of you find hundred fractions, there will be always a few more new fractions.

3.1.11 Miscellaneous Problems

Example : 12

There are 20 balls in a box. How many balls should be taken from the box, if you want to take three quarters of them?

Solution:

Total No.of balls = 20

Balls to be taken = $\frac{3}{4} \times 20$

= 3 x 5

= 15 balls

Example : 13

There are 60 students in a class. $\frac{2}{5}$ of them are boys. Find the number of boys

Solution

Total number of students = 60

$$\text{No. of boys} = \frac{2}{5} \times 60$$
$$= 2 \times 12$$
$$= 24 \text{ boys}$$

Exercise: 3.4

1. Find any ten fractions between 0 and $\frac{1}{4}$.
2. There are 50 goats in a village. $\frac{2}{5}$ of them were lost. How many goats were lost?
3. The population of a village is 1000. One fourth of them are children. Find the number of adults.

Points to remember:

- When a whole is divided into a number of equal parts, we get fractions.
- When we multiply numerators and denominators of fractions by the same number, we get equivalent fractions.
- To compare, add or subtract the like fractions, we can take only the numerators and perform the operation.
- To compare, add or subtract unlike fractions, convert them into equivalent fractions.
- We can find a fraction between any two fractions on the number line.

3.2 DECIMAL NUMBERS

Introduction:

We have learnt about very big numbers (a number with more number of digits) and fractions which are less than 1. We often use fractions like $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$. By addition or subtraction of fractions we got fractions like $\frac{3}{8}, \frac{5}{8}, \frac{7}{16}$. Very small numbers also can be written as fractions.

Why can't we use fractions to represent all small numbers? It is because of the difficulties in using fractions.

$\frac{2}{3} + \frac{3}{4} = ?$

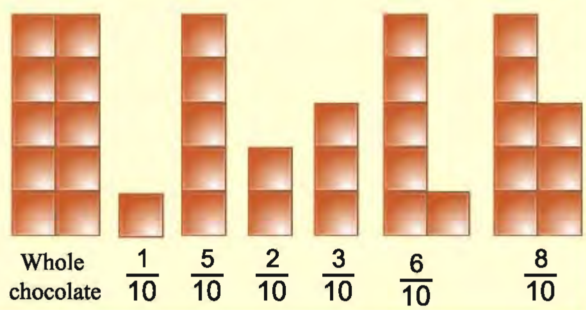
We convert them into like fractions by finding equivalent fractions and then add.
It is easy if all the fractions are in the form of $\frac{1}{10}, \frac{1}{100}, \frac{1}{1000}$ ....

$\frac{15}{100} + \frac{235}{1000}$ can be easily added as $\frac{150}{1000} + \frac{235}{1000} = \frac{385}{1000}$

It was easy to use multiples of 10 in measurements. It will be easy if small numbers can be written as fractions with multiples of ten as denominators.

3.2.1 One Tenths ($\frac{1}{10}$)

Kannan has 6 chocolate bars,each with 10 connected pieces.
He gave some pieces to his friends.
He finds that
1 piece out of 10 from the first chocolate
5 pieces out of 10 from the second chocolate
2 pieces out of ten from the third
3 pieces out of ten from the fourth
6 pieces out of ten from the fifth
8 pieces out of ten from the sixth remaining.



We can write them as
$\frac{1}{10}, \frac{5}{10}, \frac{2}{10}, \frac{3}{10}, \frac{6}{10}, \frac{8}{10}$ in fractions
This can be written as **0.1**, 0.5 , 0.2 , 0.3 , 0.6 , 0.8 in decimals

0.1 is read as zero point one. The point between the numbers is called the decimal point.

Fractions with powers of ten as denominators are called decimal fractions.

3.2.2 Decimal numbers - Definition

A decimal number has two parts namely an integral part and a decimal part.

Example:

A. Decimal Number = 0.6 = 0 + 0.6 Integral part = 0 : Decimal Part = 6
B. Decimal Number = 7.2 = 7 + 0.2 Integral part = 7 : Decimal Part = 2

In a decimal number the digits to the left of the decimal point is the integral part. The digits to the right of the decimal point is the decimal part.

The value of all the decimal parts is less than 1.

Example : 13

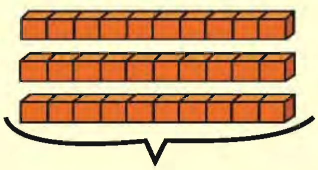


Fig.1

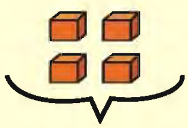


Fig.2

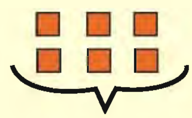


Fig.3

In figure 1 each wooden bar represents ten units.
In figure 2 each wooden bar represents one unit.
In figure 3 each wooden bar represents $\frac{1}{10}$ units.

Tens (10)	ones (1)	one tenths ($\frac{1}{10}$)
3	4	6

(i.e) $30 + 4 + \frac{6}{10} = 34 + 0.6 = 34.6$

It is read as thirty four point six

Example : 14

How to read decimal numbers?

S.No	Decimal Number	Integral Part	Decimal Part	Methods of reading numbers
1	6.5	6	5	Six point five
2	12.6	12	6	Twelve point six
3	91.8	91	8	Ninety one point eight

Do you know?
In olden days we used Ana, Chakkram, Kasu, Panam to denote money. Only from 1957 the decimal method of Rupees and paisa was introduced.

All whole numbers can be considered as decimals. 5 can be written as 5.0.
The zero to the extreme right of the decimal point has no value.

3.2.3 Place value of decimal numbers.

In decimal system, The place value of the integral part increases in powers of ten from right to left. The place value of the decimal part decreases in powers of ten from left to right.

Example : 15

Find the place value of the digits in the decimal number 67.8

Solution

Tens (10)	ones (1)	one tenths($\frac{1}{10}$)
6	7	8

Do it yourself: Find the place value of 32.7 , 78.6 , 201.0

Example : 16

Write the decimal numbers for the following:

1) Four ones and 3 tenths
2) Seventy two and 6 tenths.

Solution: i) Four ones and 3 tenths

$$4 + \frac{3}{10} = 4 + 0.3 = 4.3$$

ii) Seventy two and 6 tenths

$$72 + \frac{6}{10} = 72 + 0.6 = 72.6$$

Example : 17

Change the following fractions into decimal fractions.

(i) $30 + 8 + \frac{4}{10}$ (ii) $400 + 80 + \frac{6}{10}$

Solution:

(i) $30 + 8 + \frac{4}{10}$ (ii) $400 + 80 + \frac{6}{10}$

$= 38 + 0.4 = 38.4$ $= 480 + 0.6 = 480.6$

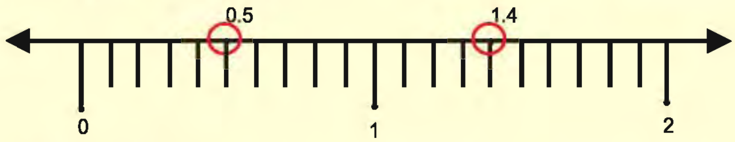
3.2.4 Representation of decimal numbers on the number line.

We know how to represent numbers and fractions on the number line. In a similar way we can represent decimal numbers on the number line.

Example : 18

Represent 0.5 , 1.4 on the number line

Solution

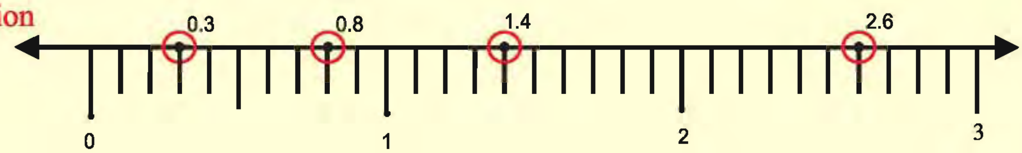


There are 10 equal parts between 2 whole numbers. The length of each equal part is $\frac{1}{10}$ part. So five tenths is the 5^{th} part from zero.

Example : 19

Represent 0.3 , 0.8 , 1.4 , 2.6 on the number line.

Solution



Do it yourself

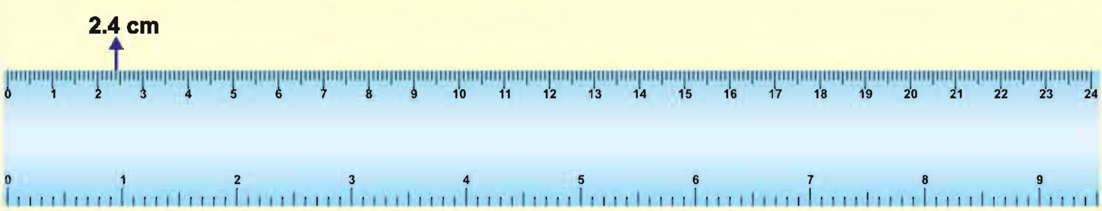
Represent 0.9 , 1.2 on the number line

Do you know ?

In cricket we denote 4 overs and 2 balls as 4.2 overs. This 4.2 is not a decimal number.

Example : 20

You can mark 2.4 cm on a scale like this



Exercise 3.5

1) Fill in the blanks
   - i) The decimal fraction of 0.7 is----------
   - ii) The integral part of 12.8 is------------------
   - iii) The digit in the one's place of 60.1 is---------------
   - iv) The place value of 4 in 9.4 is--------------
   - v) The point between the integral part and the decimal part of the decimal number is called------------

2) Complete the following table

Tens (10)	Ones (1)	One-tenths ($\frac{1}{10}$)	Decimal Nos
2	3	4	
6	9	2	
8	2	8	

3) Complete the following table

Decimal Nos.	Integral part	Decimal part	Value of the decimal part	Number name
7.6				
28.5				
24.0				
5.06				

4) Write the decimal for each of the following
   - **i)** One hundred and twenty four and six tenths
   - **ii)** Eighteen and three tenths
   - **iii)** Seven and four tenths

5) Represent the following decimal numbers on a number line

   (i) 0.7 (ii) 1.9 (iii) 2.1

6) Convert the following fractions into decimal numbers.

   (i) $\frac{2}{10}$ (ii) $3 + \frac{7}{10}$ (iii) $700 + 80 + 6 + \frac{3}{10}$

Activity

1. Divide the students of a class into groups. Ask them to visit a hotel, grocery shop, ration shop etc. Collect the price list and discuss.

2. Let them measure the length and breadth of different objects at home. Prepare a table using decimal numbers.

3.2.5 One-hundredths – Introduction

Mahesh measured the length of a black board in his class using a ruler. The length is 345 cm. Shall we help him to write the length of the blackboard in metres?

You know that 100cm = 1m

$\therefore$ 1cm = $\frac{1}{100}$ m so 345 cm = 300 cm + 45 cm

$= 3\text{ m} + \frac{45}{100}\text{ m}$

$= \mathbf{3}\text{m} + \mathbf{0.45}\text{ m} = \mathbf{3.45}\text{ m}$

Therefore 345cm is converted into a decimal number as 3.45m.

We know what is one-tenths. Can we find one-tenths of one-tenths?
Let us see that in the following figure

Fig 1

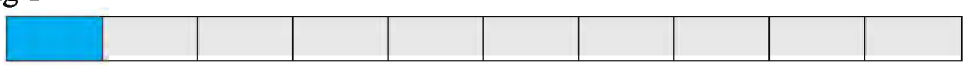
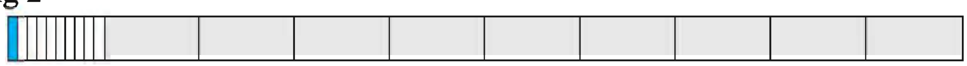


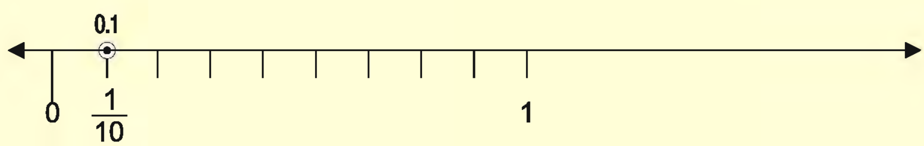
Fig 2

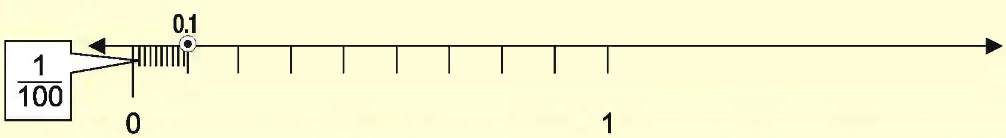


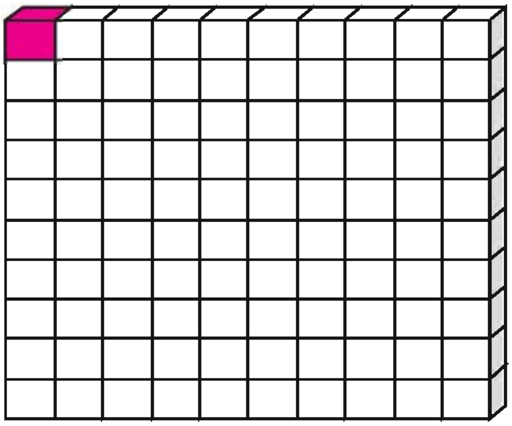
The shaded portion in fig 1 is $\frac{1}{10}$ and the shaded portion in fig 2 is $\frac{1}{100}$.

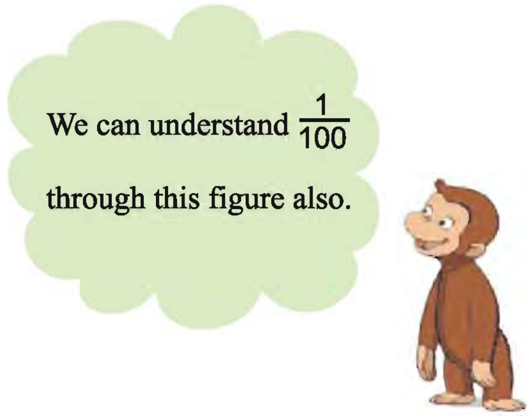
Example : 21

Represent $\frac{1}{10}$ and $\frac{1}{100}$ on the number line









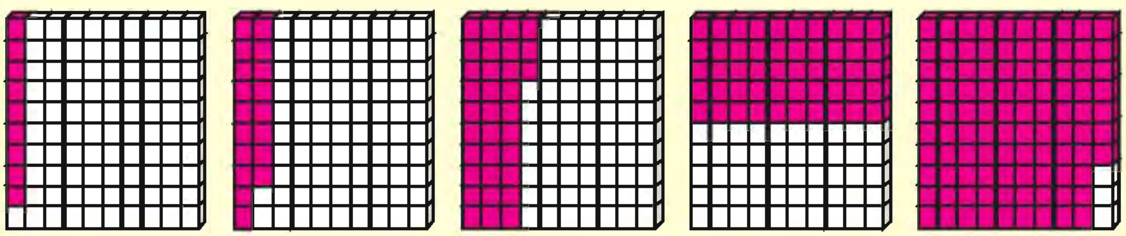
The shaded region in the figure is one-hundredths.

Fractional form = $\frac{1}{100}$

Decimal form = 0.01

Example : 22

Using the following figures, Convert into Fractional and Decimal forms.



S.No	Shaded Portions	Fractional form	Decimal form
1	9 squares	$\frac{9}{100}$	0.09
2	18 squares	$\frac{18}{100}$	0.18
3	33 squares	$\frac{33}{100}$	0.33
4	50 squares	$\frac{50}{100}$	0.50
5	97 squares	$\frac{97}{100}$	0.97

Example : 23

Convert into decimals (i) $\frac{4}{100}$ (ii) $\frac{36}{100}$ (iii) $6 + \frac{7}{10} + \frac{8}{100}$

Solution

(i) $\frac{4}{100} = 0.04$

(ii) $\frac{36}{100} = 0.36$

(iii) $6 + \frac{7}{10} + \frac{8}{100} = 6 + \frac{70}{100} + \frac{8}{100}$

$= 6 + \frac{78}{100}$

$= 6 + 0.78 = 6.78$

Do it Yourself

Convert into decimal numbers

(i) $\frac{6}{100}$ (ii) $\frac{36}{100}$ (iii) $200 + 80 + 9 + \frac{3}{100}$

Example : 24

Write the decimal number: Eighteen and forty five hundredths.

Solution

Eighteen and forty five hundredths $= 18 + \frac{45}{100} = 18 + 0.45 = 18.45$

Example : 25

Convert the following decimal numbers into fractions

(i) 0.09 (ii) 0.83

Solution

(i) $0.09 = \frac{9}{100}$ (ii) $0.83 = \frac{83}{100}$

Do you know?

While reading decimal numbers, the digits to the Right of decimal point must be read individually. For Example : 8.29 must be read as "Eight point two nine"

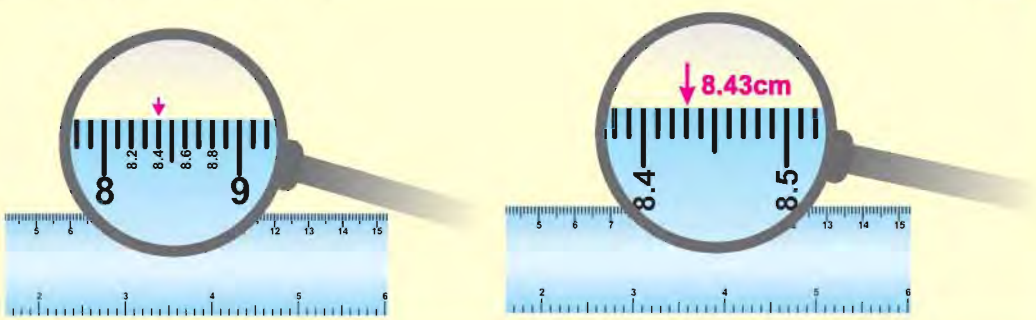
Do it yourself

Convert into fractions

a) 1.45 b) 0.13

Example : 26

Let us mark 8.43 cm on a scale



Exercise 3.6

1) State whether the following are true or false:

   i) Non negative integers can be considered as decimals

   ii) Fractional form of 3.76 is $3 + \frac{76}{10}$

   iii) The place value of 3 in 82.03 is $\frac{3}{100}$

   iv) The place value of 0 in 70.12 is 70

2) Write as decimal numerals

   i) Twenty three and eighteen-hundredths

   ii) Nine and five-hundredths

3) Find the place value of the underlined digits in the following decimal numbers.

   i) $\underline{9}227.42$ ii) $208.0\underline{6}$ iii) $34\underline{3}.17$ iv) $166.\underline{2}4$

4) Convert the following fractions into decimals

   i) $20 + 3 + \frac{4}{10} + \frac{7}{100}$ ii) $137 + \frac{5}{100}$ iii) $\frac{3}{10} + \frac{9}{100}$

5) Convert the following decimals into fractions

   i) 106.86 ii) 1.20 iii) 76.45 iv) 0.02

3.2.6 Addition and subtraction of decimals

The process of adding decimals is similar to that of adding whole numbers. The place value is important. It is important to arrange the digits one below the other according to place values.

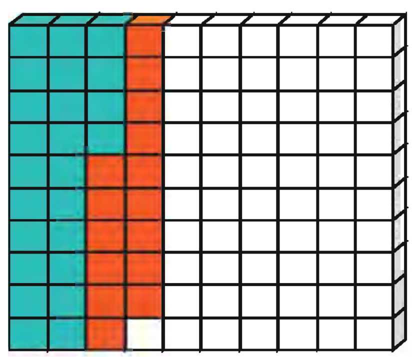
While adding 7235 with 47 we arrange the numbers as

```
 7235
+  47
-----

-----
```

Not as

```
7235
+47
-----

-----
```

Observe the figure



0.24 and 0.15 are shaded in two different colours.
Now the sum of 0.24 and 0.15 is 0.39
(i.e.) 3 tenths and 9 hundredths

Method: 1

	Ones	decimal point ●	one-tenths	one-hundredths
	0	●	2	4
	0	●	1	5
Sum	0	●	3	9

Method:
Arrange the decimal numbers according to place values as we arrange in whole numbers. Then add or subtract.

$\therefore$ 0.24 + 0.15 = 0.39

Method :2

$$\begin{array}{r} 0.24 \\ +\ 0.15 \\ \hline 0.39 \\ \hline \end{array}$$

$\therefore$ 0.24 + 0.15 = 0.39

Example : 27

(i)
$$\begin{array}{r} 0.5 \\ +\ 0.5 \\ \hline 1.0 \\ \hline \end{array}$$

(ii)
$$\begin{array}{r} 0.75 \\ +\ 0.25 \\ \hline 1.00 \\ \hline \end{array}$$

(iii)
$$\begin{array}{r} 0.75 \\ +\ 0.50 \\ \hline 1.25 \\ \hline \end{array}$$

Note that in the problem (iii), while adding 0.75 and 0.5, 0.5 is written 0.50

Example : 28

Simplify (i) 7.3 + 11.46 (ii) 6.07 + 29

Solution

(i)
$$\begin{array}{r} 7.30 \\ +\ 11.46 \\ \hline 18.76 \\ \hline \end{array}$$

(ii)
$$\begin{array}{r} 6.07 \\ +\ 29.00 \\ \hline 35.07 \\ \hline \end{array}$$

$\therefore$ 7.3 + 11.46 = 18.76 $\therefore$ 6.07+29 = 35.07

Example : 29

(i) Subtract 1.52 from 3.29

Solution:
$$\begin{array}{r} 3.29 \\ -\ 1.52 \\ \hline 1.77 \\ \hline \end{array}$$

(ii) Subtract 120-12.02

Solution:
$$\begin{array}{r} 120.00 \\ -\ 12.02 \\ \hline 107.98 \\ \hline \end{array}$$

Exercise 3.7

1) Fill in the blanks

(i) 7.25 + 3.50 = ______ (ii) 8.18 − 5.00 = ______

(iii) 9.69 − 1.11 = ______ (iv) 5.83 − 3.14 = ______

2) Add: (i) 9.005 + 300 (ii) 142.36 + 158.25

3) Subtract: (i) 9.756 − 6.79 (ii) 250 − 202.54

Action plan

A student has made mistakes in all his sums in the home work. Discuss in groups to find the method of correcting his mistakes.

(i) 6.7 + 2.5

```
  6.7
+ 2.5
-----
 8.12  X
```

(ii) 8.9 + 4.3

```
  8.9
+ 4.3
-----
12.12  X
```

(iii) 48.3 + 17.6

```
  48.3
+ 17.6
------
 515.9  X
```

(iv) 38.3 − 17.9

```
  38.3
− 17.9
------
  21.6  X
```

(v) 28.4 − 4

```
 28.9
−  4
-----
 28. 5  X
```

(vi) 9.4 − 6.7

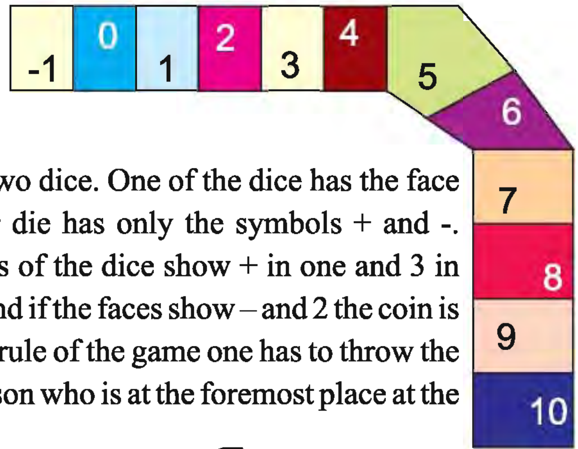
```
  9.4
− 6.7
-----
  3.3  X
```

Points to remember:

- Decimal fractions are fractions having ten or powers of ten as denominators
- A decimal number has two parts namely (i) integral part (ii) decimal part
- They are separated by a decimal point
- All non negative integers can be considered as decimal numbers.
- In a decimal number, the zeros to the extreme right of decimal point has no value
- While adding or subtracting decimals, arrange the decimal numbers according to the place values as we do in whole numbers.

4. Integers

Activity



4.1 Problem in a Number Game.

Malliga and Victor play a game with two dice. One of the dice has the face numbers from 1 to 6 as usual. But the other die has only the symbols + and -. According to the rule of the game, if the faces of the dice show + in one and 3 in other, the coin is to be moved 3 steps forward and if the faces show – and 2 the coin is to be moved 2 steps backward. Also as per the rule of the game one has to throw the dice twice in each round. The winner is the person who is at the foremost place at the end of 5^{th} round.

Malliga played first. He got + and 3 in his first throw and – and 2 in the second throw. So, he moved the coin 3 steps forward and 2 steps backward then he placed the coin in the box 1. Then Victor played and he got + and 5 in first throw, - and 3 in second throw. So he placed the coin in box 2.

	Initial Position of the coin	Numbers in first throw	Numbers in second throw	Final Position of the coin
Malliga	0	+, 3	–, 2	1
Victor	0	+, 5	–, 3	2

They continued to play. At the end of the 5^{th} round the position is as follows.

	Initial Position of the coin	Numbers in first throw	Numbers in second throw	Final Position of the coin
Malliga	7	–, 3	–, 2	2
Victor	4	–, 6	+, 3	?

Victor had a problem to continue. He tried to go 6 steps backward from 4. But after 0 it is not possible. So, he went 3 steps forward and he kept coin in box 3. He declared that he was the winner.

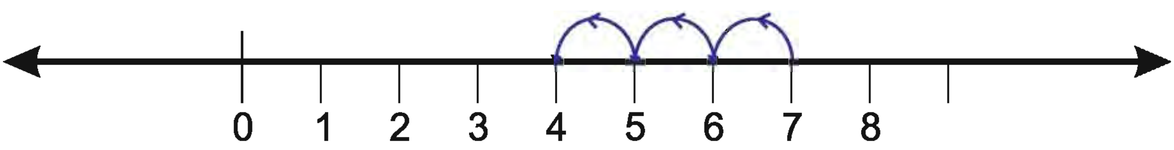
But, Malliga did not accept it. She said, "you are wrong. If you are not able to move – 6 from 4, you must move +3 first and then -6. Your coin will be in box 1. So, I am only the winner."

Can you guess the winner?

How to solve this problem?

Note: The solution is given in the last page of this unit:

What is the real problem in this game? We shall understand it by the number line. To find 7-3, we should move 3 units left from 7. The answer is 4.

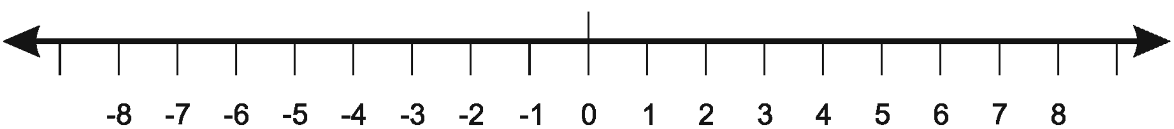


But, to find 4-6, we cannot move 6 units left from 4. Because there are no numbers before 0. Can we find the answer if we move beyond 0 leftwards?

4.2 Integers – Introduction

The numbers on left of 0 are decreasing as they are increasing on right of 0. We represent the numbers on left of zero with the symbol "-". The numbers can be written on left side of the number line as we write the Natural numbers on the right side.

Since the numbers on left of 0 are less than 0 they are called negative integers. The numbers on right of 0 are called positive integers.



Usually, we don't write + for positive integers. The numbers +5 and 5 are one and the same. But negative integers are preceeded with – sign.

We use many such numbers in our daily life.

A shopkeeper sells an article and gains Rs.500. It is represented as +500 Rupees gain. If an article is sold with loss of Rs.200, It is represented as -200 rupees loss.

The average temperature of Tamilnadu = +30°C

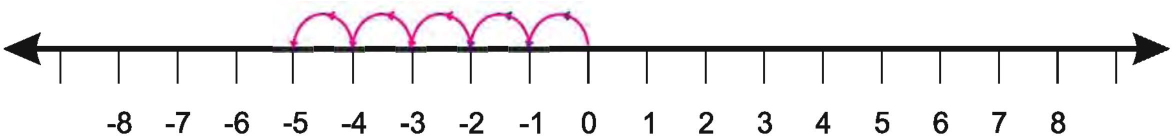
The average temperature of Antartica = -25°C

Positive integers, zero and Negative integers altogether constitute Integers.

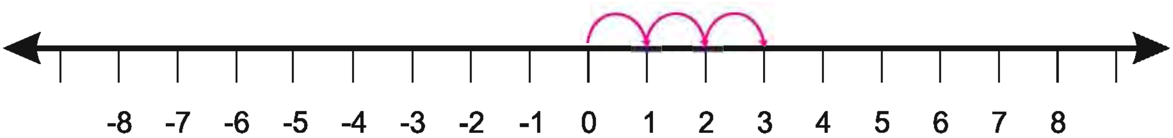
4.3 The position of integers on Number line.

First let us learn the method of marking numbers on the Number line.

-5 is marked on the number line after moving 5 units left of 0.

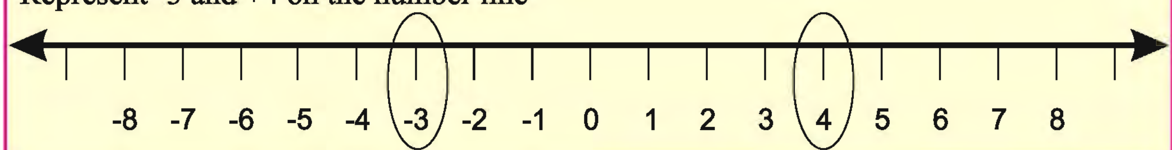


Similarly +3 is marked on the numbers after moving 3 units right of 0.



Example : 1

Represent -3 and +4 on the number line



Do it Yourself

Represent on the Number line:
+7,-2,-6,-1,8, -10

Here, smaller numbers alone are considered on the number line. But the number line extends on both the sides.

We have learnt that 5 > 1 in integers.

5 > 1 and 5 lies to the right of 1

3 > 0 and 3 lies to the right of 0

∴ 0 > -2 as 0 lies to the right of -2

-3 > -5 as -3 lies to the right of -5.

In other words,

Since -6 lies right of -8, we write -6 > -8

Since -2 lies right of -5, we write -2 > -5

So,

On number line, from right to left the numbers are getting decreased.

Every positive number is greater than a negative number.
Zero is less than a positive number.
Zero is greater than a negative number.

Is '0' negative? or Is '0' positive?
If not ' 0' is ……………..

Do it Yourself

Fill with proper symbols using < and >

1) 6 ☐ 4   2) 5 ☐ 0   3) 4 ☐ -6   4) -3 ☐ -1   5) -1 ☐ 4

Example : 2

Find the predecessor and successor of the following.

–7, –3, 0, 4, 7

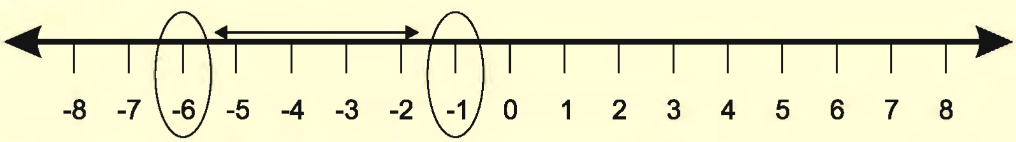
Solution

Predecessor	Integer	Successor
–8	–7	–6
–4	–3	–2
–1	0	1
3	4	5
6	7	8

Example : 3

Using the number line, write the integer between -6 and -1. Which of them is the largest? Which of them is the smallest?

Solution



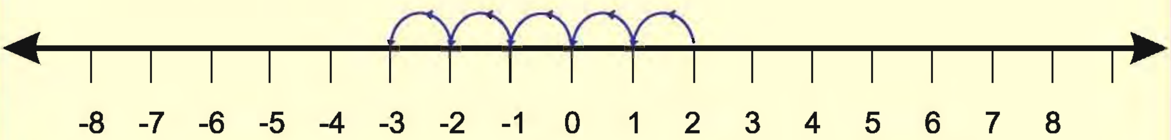
From the number line, the integers between -6 and -1 are -5, -4, -3, -2.
Since -2 lies right of -5, -2 > -5.
Largest integer = -2
Smallest integer = -5.

Example : 4

On the number line, (i) How many units are to be moved from 2 to reach -3? (ii) How many units are to be moved from -5 to reach 4?

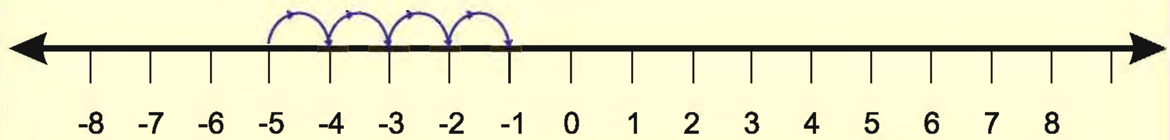
Solution:

(i) Represent the given number on a number line.



So, move five units left of 2 to reach -3.

(ii) Represent the given number on a number line



So, move four units right of -5 to reach -1.

Exercise 4.1

1. Say whether True or False.
   - (i) Zero is less than every positive number.
   - (ii) Towards the left side of 0, the numbers are getting decreased.
   - (iii) -5 is on the right side of -4 on the number line.
   - (iv) -1 is the least negative number.
   - (v) Every positive number is greater than the negative numbers

2. Identify the larger and smaller integer from the following using number line.
   (i) 7,3 (ii) -5, -3 (iii) -3, 2 (iv) 7, - 3 (v) 1, -4 (vi) -4, -7
3. List the integers between the given number using number line
   (i) 3, -3, (ii) -4, 2 (iii) -1, 1 (iv) -5, -2 (v) -4, 3 (vi) -2, 2
4. Answer the following using number line.
   - (i) What is the number when we move 3 units right of -2?
   - (ii) What is the number when we move 7 units leftward from 3?
   - (iii) How many units are to be moved from 5 to reach -3?
   - (iv) How many units are to be moved from -6 to reach -1?

4.4 Addition and subtraction of integers

We can add integers as we do in Natural numbers. But in integers we have already + and – signs. So, we should differenciate the addition and subtraction operation signs from the sign of the number. For Example : in (+5) + (+3) the second + sign represents the operation addition. But first and third + signs represent the sign of the number

Addition of two positive numbers is easy. (+5) + (+3) and 5 + 3 are one and the same. Since the answer for 5 + 3 is 8, we understand (+5) + (+3) = 8.

How to add two negative integers ? On a number line, when 1 is added to any number we get a number which lies in the immediate right of it. We know if 1 is added to a number 3 we get a new number 4, which lies to the right side of 3. What happens if (+1) is added to (-1)? Is it not 0 (zero)! That is the required number. So, (-1) + (+1) = 0. Using this concept we shall easily learn the addition and subtraction of positive and negative integers.

4.4.1. Addition using colour balls

We can easily understand the addition and subtraction of integers using balls of two different colours. Let us assume that green ball represents (+1) and red ball represents (-1). The integers are represented using colour balls in the following table.

Colour balls	Integers
⊕⊕⊕⊕⊕⊕⊕	+7
⊕⊕⊕⊕	+4
⊖⊖⊖	–3
⊖⊖⊖⊖⊖	–5
⊕⊕⊕	+3

We can understand that addition is nothing but union.

(a) Add +7 and +4.

⊕⊕⊕⊕⊕⊕⊕ + ⊕⊕⊕⊕ = ⊕⊕⊕⊕⊕⊕⊕⊕⊕⊕⊕

i.e, (+7) + (+4) = (+11)

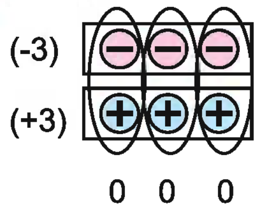
(b) Add -3 and -5

⊖⊖⊖ + ⊖⊖⊖⊖⊖ = ⊖⊖⊖⊖⊖⊖⊖⊖

i.e, (-3) + (-5) = (-8)

As we did earlier, we use the concept (-1) + (+1) = 0. That is, a green ball and a red ball are coupled and can be removed.

⊕ + ⊖ = 0



(-3) + (+3) = 0

Do it Yourself

(-2) + (+2) = ☐

(-1) + (+1) = ☐

(-5) + (+5) = ☐

(-8) + (+8) = ☐

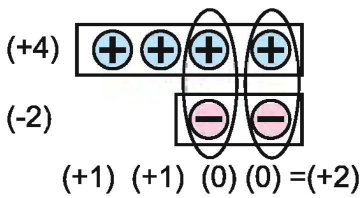
Sum of a positive number and its negative is zero Hence they are called additive inverse of each other.

Here, 3 and -3 are additive inverse of each other.
Now let us consider red balls and green balls of different numbers.

(a) Add: (+4) , (-2)

(+4) + (-2) = (+2) + (+2) + (-2)
= (+2) + 0
= +2

∴ (+4) + (- 2) = + 2



Do it Yourself

(-5) + (+2) = ☐

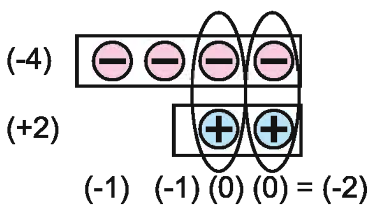
(+4) + (-3) = ☐

(-2) + (+7) = ☐

(-3) + (-5) = ☐

(b) Add: (-4) + (+2)

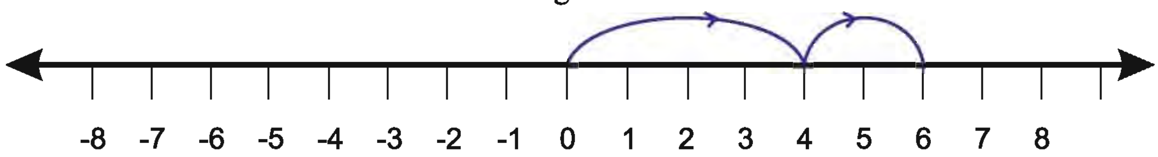
(-4) + (+2) = (-2) + (-2) + (+2)
= (-2) + 0
= -2



We have added the numbers using colour balls. Now, we shall do addition using number line.

4.4.2. Addition of integers using number line

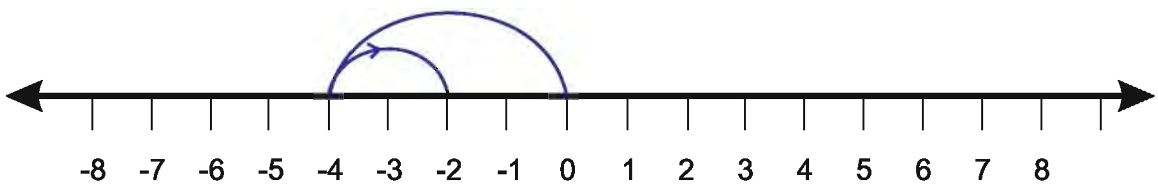
Now we shall learn to add +4 and +2 using a number line.



Since to add (+4) and (+2) starting from 4 we should move 2 units towards right, and we get +6.

$\therefore \quad (+4) + (+2) = (+6)$

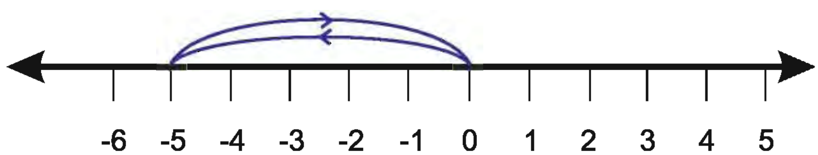
Now we shall add -4 and +2.



Since to add (-4) and (+2), starting from -4 we should move 2 units towards right and we get -2.

$\therefore \quad (-4) + (+2) = (-2)$

Now, we shall add -5 and +5.



Do it Yourself

(-5) + (+2) = ☐

(-3) + (+6) = ☐

(+1) + (+4)= ☐

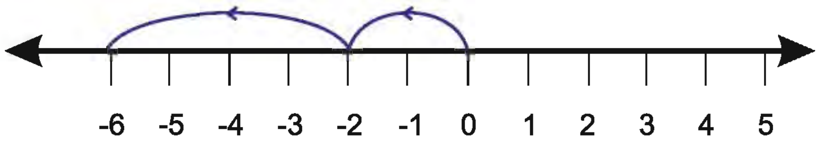
(-3) + (+5) = ☐

Since to add (-5) and (+5), starting from -5 we should move 5 units towards right and we get 0. So, (-5) + (+5) = 0

Note: Move towards right for positive numbers and towards left for negative numbers.

We have already learnt using colour balls, when we add a negative and a positive of the same number (that is, additive inverse) we get 0. Just now we confirmed the same using number line. Here 5 and -5 are additive inverse of each other.

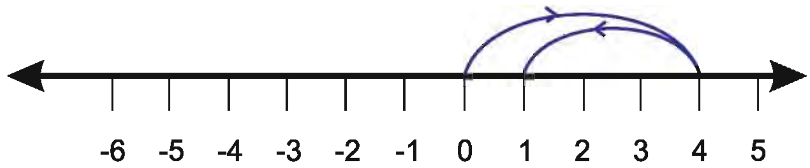
Now, we shall add -2 and -4. That is, (-2) + (-4). Now we should start from -2. The number to be added is -4. So, we should move towards left.



Since (-2) and (-4) are to be added, we should start from (-2) and move 4 units towards left. We reach -6.

$\therefore$ (-2) + (-4) = -6

Now, we shall add (+4) and (-3) using a number line,



Since (+4) and (-3) are to be added,
we should start from 4 and move 3 units towards left.
We reach (+1).

$\therefore$ (+4) + (-3) = (+1)

Do it Yourself

(-5) + (-2) = ☐

(-3) + (+6) = ☐

(+1) + (+4) = ☐

(+3) + (-5) = ☐

4.4.3 Subtraction using colour balls

We have already learnt addition of integers. Similarly subtraction also can be done. We should find the additive inverse of the number to be subtracted and then it should be added with the number.

Example : 5

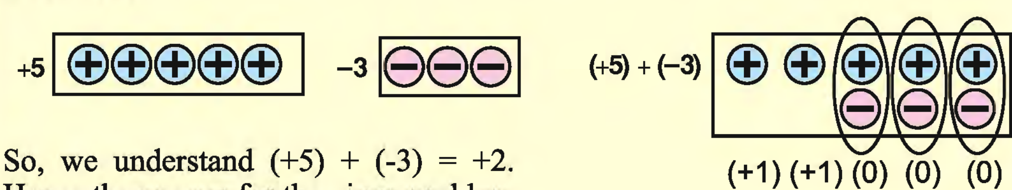
Find (+5) – (+3)

+3 is to be subtracted. Additive inverse of +3 is -3.

Given: (+5) – (+3)

> **Note**
> As (-3) +3=0
> Additive inverse of +3 is -3.

The answer will not be changed if we change it as (+5) + (-3). But we know, how to do (+5) + (-3).



The value is +2,

So, we understand (+5) + (-3) = +2. Hence the answer for the given problem is the same.

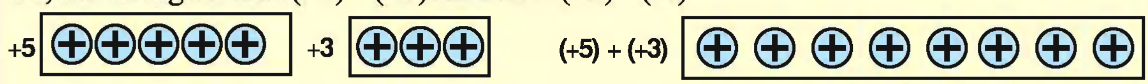
(ie) **(+5) – (+3) = +2**

Example : 6

Find (+5) – (-3).

Additive inverse of -3 is +3.

So, it is enough to find (+5) + (+3) instead of (+5) – (-3).



Its value is +8

(+5) + (+3) = +8

So, (+5)– (–3) = +8

Do it Yourself

(i) (–4) – (–3), (ii) (+7) – (+2), (iii) (–7) – (+3), (iv) (–5) – (+4)

4.4.4 Subtraction of integers using number line

To subtract an integer from another integer it is enough to add the additive inverse of the second number.

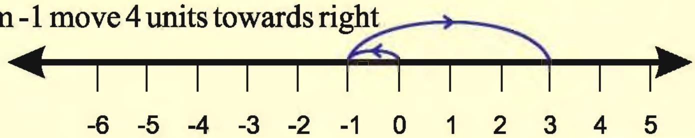
Example : 7

Solve using number line: (-1) – (-4).

Additive inverse of -4 = +4.

Instead of subtracting as (-1) - (-4) we can add it as (-1) + (+4).

Starting from -1 move 4 units towards right



Now we reach +3. So (-1) – (-4) = +3

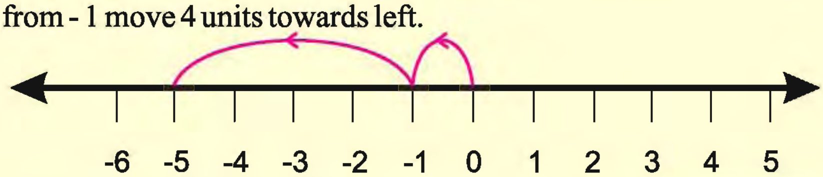
Example : 8

Solve using number line: (-1) – (+4)

Additive inverse of +4 = -4

Instead of subtracting as (-1) - (+4) we can add it as (-1) + (-4).

Starting from - 1 move 4 units towards left.



Now we reach -5. So (-1)-(+4) = -5

Exercise 4.2

1. Add using number line

   (i) 8 + (-4)   (ii) (-1) + (-9)   (iii) (-5) + (7)   (iv) 3+ (-6)   (v) (+4) + (-7).

2. Find using number line.

   (i) What is the number 4 more than -3?

   (ii) What is the number 3 less than -7?

3. Add

   (i) (-10) + (+17)   (ii) (+20) + (-13)   (iii) (-50) + (-20)

   (iv) (+40)+(+70)   (v) (+18) + (-75)   (vi) (+75) + (-75)

   (vii) (-30) + (12)   (viii) (-30) + (-22)

4. Simplify

   (i) 5 + (-7) + (8) + (-9)   (ii) (-13) + (12) + (-7) + (18)

5. Find the answer

   (i) (+7) - (-3)   (ii) (-12) - (+5)   (iii) (-52) - (-52)   (iv) (+40)-(+70)

Solution to the problem in first page of this unit.

If the number line is extended and the negative numbers are to be added, then Malliga will win the game. In the last round, Victor has to move the coin from 6 steps from 4 towards left and reaches -2 then move 3 steps towards right and reaches 1. But Malliga's coin is at box 2. So, she is only the winner.

Points to remember

1. Positive numbers, negative numbers and zero altogether constitute the integers.
2. In the number line, the numbers on the right of 0 are increasing and the numbers on the left of 0 are decreasing.
3. If the sum of two numbers is zero, then they are additive inverse of each other.
4. Sum of two positive numbers is positive. The sum of two negative numbers is negative.
5. The sum of a positive number and a negative number is either positive or negative or zero.
6. Subtracting an integer from another integer is same as adding the additive inverse of the second to the first number.

5. Constants, Variables, Expressions and Equations.

5.1 Introduction

You would have played many games eagerly and enthusiastically. Now, shall we play with numbers?

Divide the students in the class into small groups. Each group should think of a two digit number. Then ask them to do the following calculations.

Step 1: Multiply the two digit number by 2.

Step 2: Add 4 to the result.

Step 3: Multiply the result by 5.

Step 4: Finally subtract 20

From the final answer the number selected by a group can be found. The result obtained by dividing the final answer by 10 is the original number. This is applicable for all the groups.

For Example :

If the final answer is 380. Now divide 380 by 10.

Therefore, the selected number is 38.

How do we find this? Let us list the answers for the different numbers taken by the group. Observe the pattern formed.

Check

1. $38 \times 2 = 76$
2. $76 + 4 = 80$
3. $80 \times 5 = 400$
4. $400 - 20 = 380$

For Example:

Selected number = 23; **23x2=46; 46+4=50; 50x5=250; 250−20=230**

If the selected number is 23 the result is 230.

Let us verify this with a few more examples.

Selected number = 25, Result obtained = 250

Selected number = 40, Result obtained = 400

Selected number = 37, Result obtained = 370

Now we are able to see the relation between the selected number and its result.

Note: The algebraic explanation for the above is given at the end of the chapter.

Do it Yourself

Try the above game with three and four digit numbers. Create and solve a few more mathematical games.

Exercise 5.1

1.Find the missing number in the sequence. 5, 10, 15, _ , 25, 30.

(i) 20 (ii) 2 (iii) 22 (iv) 23

2. Choose the next three shapes from the pattern

○ △ □ ○ △ — — —

(i) ○ △ □ (ii) □ ○ △ (iii) △ ○ □

(iv) ○ □ △

3.

First number	1	2	3	4	5	6
Second number	10	20	30	40	50	60

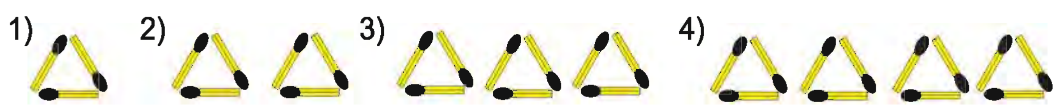
What is the pattern obtained from the table?

(i) Second number = 10 + first number. **(ii)** Second number = 10 – first number

(iii) Second number = 10 ÷ first number. **(iv)** Second number = 10 x first number

5.2 Introduction of constants and variables through patterns

Latha made the following triangular patterns with the match sticks she had.



To find out the total match sticks used for the above formation she prepared the following table.

Number of triangles	1	2	3	4	....	
Number of match sticks used.	3	6	9	12	....	
	3×1	3×2	3×3	3×4	....	

From the above table she found a relation between the number of triangles and the number of match sticks used. That is

Number of match sticks used = 3 x number of triangles

Here according to the number of triangles formed there is a change in the number of match sticks used. We find that the number of match sticks used to form a triangle is always the same. Likewise a quantity which takes a fixed numerical value is called a constant. But number of triangles keep changing. Therefore we denote the number of triangles by the letter x.

Therefore number of match sticks used = 3 x x = $3x$

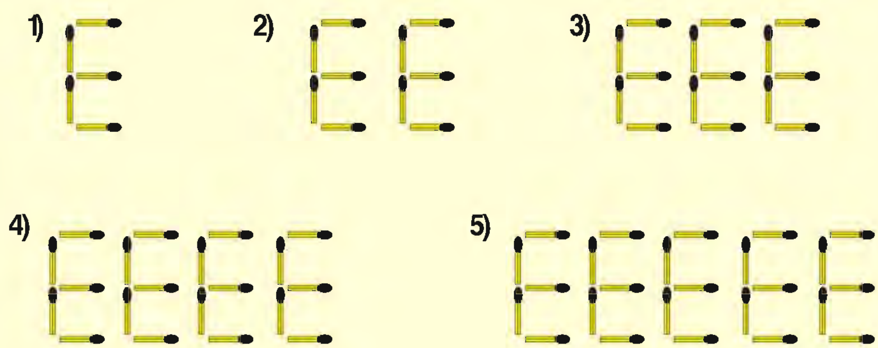
The above reduced law can be taken as "Laws of Patterns"

A quantity which takes different numerical values is called a variable. Usually variables are denoted by small letters.

a, b, c, ... x, y, z

Example : 1

Let us see the formation of letter E with the help of match sticks. We need 5 match sticks to form letter E



Number of E formation	1	2	3	4	5	....	
Number of match sticks used	5	10	15	20	25	....	
	5×1	5×2	5×3	5×4	5×5	....	

Law obtained from the above table.

Number of match sticks used = 5 x (Number of E formation)

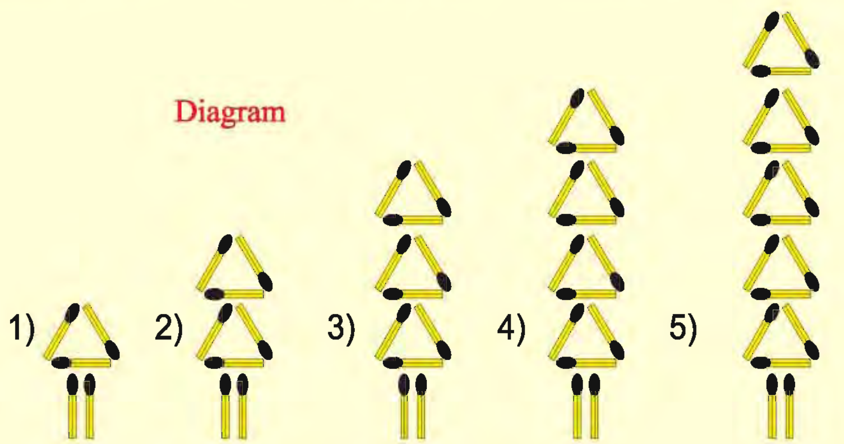
Number of E formation is denoted as the variable x.

Therefore, number of match sticks used = 5 x x = $5x$

Example : 2

Look at the pattern of the Asoka tree given. The base is always formed with two match sticks. The top portion of the tree differs in multiples of 3.

Diagram



Number of top portions	1	2	3	4	5	....	
Number of match sticks needed for the top portion	3	6	9	12	15	....	
	3×1	3×2	3×3	3×4	3×5	....	
Number of match sticks needed for the base	2	2	2	2	2	....	
Total number of match sticks used	3×1+2	3×2+2	3×3+2	3×4+2	3×5+2	....	

Law obtained from the above table,

Number of match sticks used = (3 x Number of top portions) + (Number of match sticks used for the base)

If the number of triangular formations is denoted as the variable x,

Number of match sticks used $= 3 \times x + 2 = 3x + 2$

Exercise 5.2

1. Choose the correct answer:

a)

First number	16	26	36	46	56	66
Second number	10	20	30	40	50	60

Choose the law in which the above pairs are based on?

(i) Second number = first number +6

(ii) Second number = first number -6

(iii) Second number = first number ÷ 6

(iv) Second number = first number x 6

b)

First number	1	2	3	4	5
Second number	9	10	11	12	13

Choose the law in which the above pairs are based on?

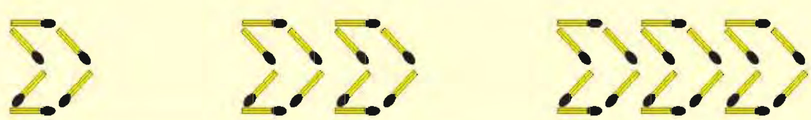
(I) Second number = first number x 5. (ii) Second number = first number - 8

(iii) Second number = first number + 8 (iv) Second number = first number x 8

2. If a box contains 40 apples, the total number of apples depends on the number of boxes given. Form an algebraic term (Consider the number of boxes as 'x').

3. If there are 12 pencils in a bundle, the total number of pencils depends on the number of bundles given. Form an algebraic term (Consider the number of bundles as 'b').

4. From the following pattern given, form an algebraic term.



5.3 Role of variables in the number system

Commutative property of addition of two numbers.

1 + 2 = 2 + 1 = 3
4 + 3 = 3 + 4 = 7
4 + 5 = 5 + 4 = 9 . . . .

When the numbers are added in any order the value remains the same. So, this can be denoted using variables a+b = b+a where a and b are any two whole numbers.

Do it Yourself

If a, b, c are variables in the set of whole numbers, verify the following laws

1. a x b = b x a
2. a x (b + c) = (a x b) + (a x c)

5.4 Expressions

We have studied the following in the previous classes.

11 = (1 x 10) + 1,
12 = (1 x 10) + 2
20 = (2 x 10) + 0
....

In the above numerical expressions we have used only numbers 1, 2, 3 . . . .

To form numerical expressions we use addition, subtraction, multiplication and division signs.

For Example :, in the numerical expression (4 x 10) + 5 we have multiplied 10 with 4 and added 5 to the result.

Few more numerical expressions are : (2 x 10) – 7, 3 + (7 x 6), (- 5 x 40) + 8, (6 x 2) + 4

A variable can take any numerical value.

All operation's +, -, x, ÷ used for numbers are also applicable for variable.

Example : 3

Write the algebraic expression for the following statements:

Situation	Introduction of variables	Algebraic expression
1. Length of a rectangle is 3 more than its breadth.	Let the breadth of the rectangle b 'x' units	Length of the rectangle is $(x+3)$ units
2. Raghu is 10 years younger than sedhu.	Let the age of Sedhu be 'x' years	Raghu's age is (x-10) years
3. Ramkumar is 2 times as old as Nandhagopal	Let the age of Nandhagopal be 'x' year	Ramkumar's age is (2x) years
4. Cost of one pen is Rs.9 less than the cost of one note book	Let the cost of one note book be Rs. 'y'.	Cost of one pen is Rs.(y-9)
5. The diameter of a circle is twice its radius	Let the radius of the circle be 'r' units.	Diameter of the circle is 2 r units

Example : 4

Write the algebraic expression for the following statements

Mathematical operations	Statements	Algebraic expression
Addition	Add 10 to a number	$x + 10$
Subtraction	Subtract 9 from a number	$x - 9$
Multiplication	5 times a number	$5x$
Division	One fourth of a person's monthly income	$\frac{x}{4}$
Less than	10 less than a given number	$x - 10$
Greater than	15 more than a given number	$y + 15$
Multiples	3 times Raghu's age	$3z$

Example : 5

Write the following expression in words

$3m+4, 3m-4, \frac{3m}{4}, \frac{4m}{3}$.

Solution:

I. $3m+4$ Add 4 to 3 times a number

II. $3m-4$ Subtract 4 from 3 times a number

III. $\frac{3m}{4}$ One fourth of 3 times a number

IV. $\frac{4m}{3}$ One third of 4 times a number

$-3x + 4x = x$

Exercise 5.3

1. Write an expression for the following statements
   - **(i)** Add 7 to x
   - **(ii)** Subtract 10 from y
   - **(iii)** Subtract 8 from $3y$
   - **(iv)** Multiply x with (-7) and add (-5) to it.

2. Write the following expression in statement form

   (i) $2y + 5$ (ii) $2y - 5$ (iii) $\frac{2y}{5}$ (iv) $\frac{5y}{2}$

3. Write an expression containing y, 7 and a numerical operation.
4. If Mangai is 'z' years old, answer the following (form algebraic expressions)
   - **(i)** What will be the age of Mangai after 5 years ?
   - **(ii)** How old is Mangai's grand father, if he is 7 times as old as Mangai?
   - **(iii)** How old is Mangai's father if he is 5 more than 3 times as old as Mangai?
5. A rabbit covers a distance of 30 feet by walk and then runs with the speed of 2 feet per second for 't' seconds. Frame an algebraic expressions for the total distance covered by the rabbit.
6. The cost of 1 pen is Rs.10. What is the cost of 'y' pens?
7. Sachin saves Rs.x every day. How much does he save in one week?

5.5 Formation and solving Equations

We can identify whether two numerical expressions are equal or not from the following: $7 + (30 + 7) = (40 - 2) + 6$
Is it true? Ans: Yes
Other than = sign, we can utilize the symbols like >, <, ≠. also,

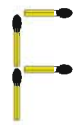
1) $135 \times (74 + 32) > 134 \times (72 + 34)$
2) $(20 - 10) \times 8 < (10 + 20) \times 8$
3) $(5 + 7) \times 6 \neq 5 + (7 \times 6)$

Check the above

When we use 'equal to' sign between two expressions we get an equation. (Both the expressions should not be numerical expressions).
Instead if we use signs like >, <, ≠ it is an inequation. For example,
(1) $3x - 7 = 10$ (equation) (2) $4x + 8 > 23$ (inequation) (3) $2x - 1 < 11$ (inequation)

Example:

Number of 'F' Formation	1	2	3	4	5 ....
Number of match sticks used	4	8	12	16	20 ......
	4×1	4×2	4×3	4×4	4×5 ....



If variable 'x' represent the number of sticks used in the formation of 'F', then, we get the following equation from the above table.

$x = 4$, $2x = 8$, $3x = 12$, $4x = 16$, $5x = 20$
$6x = 24$, $7x = 28$, $8x = 32$ ....

From the above table the value of 'x' which satisfies the equation $3x = 12$ is 4.

Now, let us solve the equation $3x = 12$ by substitution method.

Equation	Value of the variable	Substituting the value of the variable		Solution / Not a solution
$3x = 12$	$x = 1$	$3 \times 1 = 3$	(False)	Not a solution
	$x = 2$	$3 \times 2 = 6$	(False)	Not a solution
	$x = 3$	$3 \times 3 = 9$	(False)	Not a solution
	$x = 4$	$3 \times 4 = 12$	(True)	Solution
	$x = 5$	$3 \times 5 = 15$	(False)	Not a solution
	$x = 6$	$3 \times 6 = 18$	(False)	Not a solution

Result for the equation $3x = 12$ is 4.

Example : 6

Write an algebraic expression for the following statement:

Statement	Algebraic expression
1) 10 added to a number gives 20	$y + 10 = 20$
2) Two times a number is 40	$2x = 40$
3) 5 subtracted from a number gives 20	$x - 5 = 20$
4) A number divided by 6 gives the quotient 5 leaving no remainder.	$\frac{x}{6} = 5$
5) 8 subtracted from twice a number gives 10	$2y - 8 = 10$
6) 6 added to twice a number is 42	$42 = 2x + 6$

Example : 7

Complete the following table

Equation	Value of the variable	Substituting the value of the variable		Solution / Not a solution
(i) $x + 3 = 8$	$x = 4$	$4 + 3 = 7 \neq 8$	(False)	Not a solution
(ii) $x - 4 = 7$	$x = 11$	$11 - 4 = 7$	(True)	Solution
(iii) $3x = 12$	$x = 3$	$3 \times 3 = 9 \neq 12$	(False)	Not a solution
(iv) $\frac{x}{7} = 6$	$x = 42$	$\frac{42}{7} = 6;$	(True)	Solution

Example : 8

Using the table find the value of the variable which satisfies the equation $x + 7 = 12$.

x	1	2	3	4	5	6	7	8	9	10	11
$x + 7$	8	9	10	11	12	13	14	15	16	17	18

From the table, solution for $x + 7 = 12$ is $x = 5$.

Exercise 5.4

1. Choose the correct answer:

   a) Which of the following is an equation?

   (i) $3 + 7 = 8 + 2$ (ii) $x < \frac{4}{3}$ (iii) $3x + 1 = 10$ (iv) $4 \times 7 = 28$

   b) Which equation has y = 4 as solution?

   (i) $2y + 3 = 0$ (ii) $y - 7 = 2$ (iii) $y + 3 = 7$ (iv) $y + 4 = 0$

   c) Which is the variable in the equation 2s – 4 = 10?

   (i) 2 (ii) 10 (iii) -4 (iv) s

2. Match

	Equation	solution
a)	$y - 2 = 0$	(i) $y = 0$
b)	$2y = 6$	(ii) $y = 2$
c)	$2 = y + 2$	(iii) $y = 3$

3. Complete the table

Equation	Value of the variable	Substituting the value of the variable	Solution / Not a solution
$x - 8 = 12$	$x = 4$		
$x - 8 = 12$	$x = 6$		
$x - 8 = 12$	$x = 20$		
$x - 8 = 12$	$x = 15$		

4. Complete the table

Equation	Value of the variable	Substituting the value of the variable	Solution / Not a solution
$y + 7 = 15$	$y = 6$		
$y + 7 = 15$	$y = 7$		
$y + 7 = 15$	$y = 8$		
$y + 7 = 15$	$y = 9$		

5. Complete the table

S.No	Equation	Value of the variable	Substituting the value of the variable	Solution / Not a solution
(i)	$x - 3 = 0$	$x = 2$		
(ii)	$y + 7 = 2$	$y = -2$		
(iii)	$n + 8 = -18$	$n = 28$		
(iv)	$3 - p = 10$	$p = -7$		

6. Using the numbers given in the brackets find the value of the variable which satisfies the given equation.

(i) $x + 7 = 12$ (3, 4, 5, 6)
(ii) $x - 10 = 0$ (7, 8, 9, 10)
(iii) $3x = 27$ (6, 12, 9, 8)
(iv) $\frac{p}{7} = 5$ (21, 14, 7, 35)
(v) $\frac{r}{10} = 2$ (18, 19, 20, 21)

7. Find the value of 'y' which satisfies the equation $y - 3 = 9$.

8. Complete the following table and find the value of the variable that satisfies $3z = 30$

z	5	6	7	8	9	10	11	12	13	14	15
3z			21					36			

9. Complete the following table and find the value of the variable that satisfies $\frac{P}{4} = 3$

P	4	8	12	16	20	24
$\frac{P}{4}$		2			5	

Point to remember

- Variable has no constant value. It take various values according to the given situation.
- Variables are denoted by small letters a, b, c …. x, y, z….
- Expressions can be related using variables.
- In arithmetic and geometry formulae are obtained using variables.
- If we equate one expression with another expression we get an equation. (One expression must be a non numerical expression).
- Value of the variable that satisfies the equation is the solution for the equation.

Note: Algebraic Explanation for the group game

Algebraic explanation for the group game given in the beginning of the chapter.

Let the number selected by the friend be 'x' multiply the selected number by 2, 2x; and 4 (2x +4); Multiply by 5 (5 x (2x + 4) = 10x + 20)

Subtract 20 (10x + 20 – 20 = 10x)

Now the number selected can be found by dividing 10x by 10. ($\frac{10x}{10} = x$)

Finally we get the number selected.

Mathematical puzzles

1. I am a number. Go round the corners of the given figure 4 times. When you add my value with the number of corners you have crossed you get 46. Find my value.

2. I am a number. After crossing all the boxes given in the figure, the total of my value and the number of boxes crossed is 60. Find my value.

3. I am a two digit number. Moreover I am a multiple of 11. When I am divided by 7, I leave no remainder. When 4 is added to the quotient 15 is obtained. What is my value ?

6. RATIO, PROPORTION AND DIRECT VARIATION

In this chapter let us see how we use arithmetic in our day-to-day life directly or indirectly.

6.1. Introduction :

Some information about Ishwarya and Krithika are given below:

S.No.	Informations	Ishwarya	Krithika
1.	Age	17 years	15 years
2.	Height	136 cm	123 cm
3.	Weight	31 Kg	29 Kg
4.	Quantity of drinking water	5 Litres	3 Litres
5.	Studying Time	4 hours	3 hours
6.	Playing Time	2 hours	2 hours
7.	No. of note books used	13	14
8.	Speed of cycling	10 Km/hr	15 Km/hr

From the above table we can compare their information easily. Ratio is used to compare two quantities of the same kind.
From the above table we can easily find out

1. Ratio of their ages **17 : 15**
2. Ratio of their Height **136 : 123**
3. Ratio of their Weight **31 : 29**
4. Ratio of their Quantity of drinking water **5 : 3**
5. Ratio of their study hours **4 : 3**
6. Ratio of their Playing hours **2 : 2**
7. Ratio of their No.of notebooks used **13 : 14**
8. Ratio of their Speed of cycling. **10 : 15**

6.2. Ratio:

- Ratio is a comparison of two quantities of same units.
- The ratio of two quantities **a** and **b** is written as **a : b** . It is read as " a is to b" The symbol **":"** is read as **" is to"**
- The ratio of b and a is written as **b : a.**
- It is understood that **a : b** is different from **b : a.**
- When compared the units of a and b must be the same.
- The units of a and b are always positive.

For Example : If 1 m and 90 cm are given, we can compare only after converting them into same units.

(i.e) after converting 1m as 100cm, we compare it with 90cm and write the ratio as 100 : 90.

Comparison of bigger numbers may be difficult. It is necessary to reduce them into their lowest terms. We write the ratios as fractions and reduce them into their lowest terms.

Example : 1

S.No.	Quantity	Ratio form	Fractional form	Reduced form
1	Ratio of 15 men and 10 women	15 : 10	$\frac{15}{10}$	3 : 2
2	Ratio of 500 gm and 1 Kg	500 : 1000	$\frac{500}{1000}$	1 : 2
3	Ratio of 1 m 25 cm and 2 m	125 : 200	$\frac{125}{200}$	5 : 8

Example : 2

1 A student has 11 notes books and 7 textbooks. Find the ratio of the notebooks to that of the text books.

Solution: Number of note books = 11

Number of text books = 7

Ratio of the notebooks to the text books = 11 : 7

Example : 3

The cost of a pen is Rs.8 and the cost of a pencil is Rs. 2.50

Find (1) The ratio of the cost of a pen to that of a pencil

(2) The ratio of the cost of a pencil to that of a pen.

Solution: The cost of a pen = Rs.8.00 = 8.00x 100 = 800 paise

The cost of a pencil = Rs.2.50 = 2.50 x100 = 250 paise

S.No.	Quantity	Ratio form	Fractional form	Reduced form
1.	Ratio of the cost of a pen to that of a pencil	800:250	$\frac{800}{250}$	16:5
2.	Ratio of the cost of a pencil to that of a pen	250:800	$\frac{250}{800}$	5:16

Example : 4

In a Village of 10,000 people, 4,000 are Government Employees and the remaining are self-employed. Find the ratio of.

i) Government employees to people of the village.

ii) Self employed to people of the village

iii) Government employees to self employees.

Solution:

Number of people in the village = 10,000

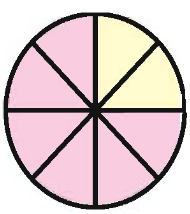
Number of Government employees = 4,000

$\therefore$ Self employed = 10,000 – 4,000 = 6,000

S.No.	Quantity	Ratio form	Fractional form	Lowest form of the Ratio.
1.	Government employees to people of the village	4000:10000	$\frac{4000}{10000}$	2:5
2.	Self employed to people of the village.	6000:10000	$\frac{6000}{10000}$	3:5
3.	Government employees to self employed.	4000:6000	$\frac{4000}{6000}$	2:3

6.3. Equivalent ratios:-

Let us divide an apple into eight equal parts and share it among two people in the ratio 6 : 2



6 : 2 can be simplified as 3 : 1

So, 6 : 2 and 3 : 1 are equal.

Hence like equivalent fractions we can say this as equivalent ratios

So, in the ratio a : b if the terms 'a' and 'b' are multiplied by the same non zero number, we get equivalent ratios.

Example : 5

Write any 5 equivalent ratios for 5 : 7

Solution:

Given ratio = 5 : 7

The ratio in fractional form = $\frac{5}{7}$

The equivalent fractions of $\frac{5}{7}$ are $\frac{10}{14}$, $\frac{15}{21}$, $\frac{20}{28}$, $\frac{25}{35}$, $\frac{55}{77}$

∴ the equivalent ratios of 5 : 7 are

10 : 14, 15 : 21, 20 : 28, 25 : 35 and 55 : 77

Exercise : 6.1

1) Say whether the following are true or false

i) The ratio of 4 pens to 6 pens is 4 : 6

ii) In a class of 50 students, the ratio between 30 girls and 20 boys is 20 : 30

iii) 3 : 2 and 2 : 3 are equivalent ratios

iv) 10 : 14 is an equivalent ratio of 5 : 2

2) Choose the correct answer:

i) The fractional form of 3 : 4 is ----------

(1) $\frac{4}{3}$ (2) $\frac{3}{4}$ (3) $\frac{1}{3}$ (4) 3.4

ii) The equivalent fraction of 7 : 8 is - - - - - - -

(1) 14:16 (2) 8:9 (3) 6:7 (4) 8:7

iii) Simplified form of 16 : 32 - - - - -

(1) $\frac{16}{32}$ (2) $\frac{32}{16}$ (3) 1:2 (4) 2:1

iv) If 2 : 3, 4 : _ are equivalent ratios, then the missing term is

(1) 2 (2) 3 (3) 4 (4) 6

v) The ratio of 1 cm to 2 mm is

(1) 1:20 (2) 20:1 (3) 10:2 (4) 2:10

3) Simplify the following ratios:

(i) 20:45 (ii) 100:180 (iii) 144:216

4) Write 4 equivalent ratios for the following:

(i) 3:5 (ii) 3:7 (iii) 5:9

5) Write the ratio of the following and simplify:

(i) The ratio of 81 to 108 ii) The ratio of 30 minutes to 1 hour and 30 minutes.

(iii) The ratio of 60 cm to 1.2 m

6) Seema's monthly income is Rs.20,000 and her savings is Rs.500 Find the ratio of

i) the monthly income to the savings

ii) the monthly income to the expenses

iii) savings to the expenses.

7) Out of 50 students in a class, 30 are boys. Find the ratio of

i) Boys to the total number of students

ii) Girls to the total number of students

iii) Boys to the Girls

8) From the given figure, find the ratio of

i) Number of triangles to Number of circles

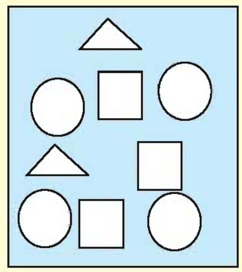
ii) Number of circles to Number of squares

iii) Number of triangles to Number of squares

iv) Number of circles to total number of figures.

v) Number of triangles to total number of figures.

vi) Number of squares to total number of figures.



6.4. Proportion:-

If the simplified form of two ratios are equal, they form a proportion.
We use "=" or ": :" to denote a proportion.
If a, b, c, d are in proportion, then a : b = c : d or a: b :: c : d

Example : 6

1. Show that the ratios (i) 2 : 3, 8 : 12, (ii) 25 : 45, 35 : 63 are in proportion.

Solution:

	Ratio form	Fractional form	Simplified form
i.	2:3	$\frac{2}{3}$	2:3
	8:12	$\frac{8}{12}=\frac{2}{3}$	2:3

∴ 2:3, 8:12 are in proportion

	Ratio form	Fractional form	Simplified form
ii.	25:45	$\frac{25}{45}=\frac{5}{9}$	5:9
	35:63	$\frac{35}{63}=\frac{5}{9}$	5:9

∴ 25:45, 35:63 are in proportion.

Note: In the above example, multiply 45 by 35 and 25 by 63
We get 25 x 63 = 45 x 35 = 1575.

If a : b and c : d are in proportion then a x d = b x c
The proportion is written as a : b :: c : d
If 4 numbers are in proportion, the product of extremes is equal to the product of means.

Example : 7

Show that 12 : 9, 4 : 3 are in proportion.
Solution : The product of the extremes = 12 x 3 = 36
The product of the means = 9 x 4 = 36
∴ 12 : 9, 4 : 3 are in proportion
(i.e) 12 : 9 : : 4 : 3

Example : 8

Find the missing term in 3 : 4 = 12 : ____
Solution :
The product of the extremes = The product of the means
Therefore 3 x _____ = 4 x 12; By dividing both the sides by 3
we get the missing term = 4 x 4 =16

Example : 9

If the cost of a book is Rs.12, find the ratio of 2, 5, 7 books to their cost.
What do you observe from this ?

No. of books	Total cost	Ratio	Fractional form	Simplified Form
2	2x12 = 24	2:24	$\frac{2}{24}$	1:12
5	5x12 = 60	5:60	$\frac{5}{60}$	1:12
7	7x12 = 84	7:84	$\frac{7}{84}$	1:12

From the table above, we find that the ratio of the number of books to the cost of books are in proportion.

6.5. DIRECT VARIATION:-

Two quantities are said to be in direct variation if an increase (or decrease) in one quantity results in increase (or decrease) in the other quantity. (i.e) If two quantities vary always in the same ratio then they are in direct variation.

Example : 10

Shabhana takes 2 hours to travel 35 km. How much distance she would have travelled in 6 hours?

Solution: When time increases the distance also increases.

Therefore, they are in direct variation

Time (hrs)	Distance (km)
2	35
6	?

2 : 6 = 35 : □

missing term = $\frac{6 \times 35}{2}$ =105

Shabana has travelled 105 km in 6 hours.

Example : 11

The cost of uniforms for twelve students is Rs.3,000. How many students can get uniforms for Rs.1250.

Solution:

No. of students	Cost of the uniform. Rs.
12	3,000
?	1,250

When money spent decreases the number of uniforms also decreases.

They are in direct variation

12 : □ = 3000 : 1250

Missing term = $\frac{12 \times 1250}{3000}$ = 5

5 students can be given uniforms for Rs.1,250.

Example : 12

In a village of 1,21,000 people the ratio of men to women is 6 : 5

Find the number of men and women?

Solution: Number of people in the village = 1,21,000

Ratio of men to women = 6 : 5

Total number of parts = 6 + 5 = 11

Parts	No. of people
11	121000
6	?
5	?

11 parts = 1,21,000

∴ 1 part = $\frac{1,21,000}{11}$ = 11,000

∴ Number of men in the village = 6 x 11,000 = 66,000

Number of women in the village = 5 x 11,000 = 55,000

Exercise 6 . 2

1) State whether the following ratios are in proportion.

i	1:5	and	3:15	(Yes / No)
ii	2:7	and	14:4	(Yes / No)
iii	2:9	and	18:81	(Yes / No)
iv	15:45	and	25:5	(Yes / No)
v	30:40	and	45:60	(Yes / No)

2) Choose the correct answer

i) Which of the following pair of ratios form a proportion.

1) 3:4, 6:8 2) 3:4, 8:6 3) 4:3, 6:8 4) 4:8, 6:3

ii) Find the missing term if 2: 5 = ______: 50

1) 10 2) 20 3) 30 4) 40

iii) If the cost of 6 balls is Rs.30 then the cost of 4 balls is

1) Rs.5 2) Rs.10 3) Rs.15 4) Rs.20

iv) If 5,6,10, ______ form a proportion (in the same order), the missing term is

1) 60 2) 50 3) 30 4) 12

v) When you divide 100 in the ratio 3 : 2, we get ------

1) 30, 20 2) 60, 40 3) 20, 30 4) 40, 60

3) Sarath buys 9 cricket bats for Rs.1,350. How much will Manoj spend to buy 13 cricket bats at the same rate.

4) Rahim and Bhashir decides to share the gift money of a competition in the ratio 7 : 8. If they receive Rs.7,500, find the share of each.

5) There are 1,00,000 voters in a city. If the ratio of male to female voters is 11 : 9, find the number of men and women voters in the city.

6) If a person reads 20 pages from a book in 2 hours, how many pages will he read in 8 hours at the same speed?

7) If 15 people can repair a road of length 150 metres, how many people are needed to repair a road of length 420 metres.

8) The scale of a graph is 1 cm = 200 km. (The distance 1 cm in the graph denotes 200 km in actual length). What would be the length of 3600 km on the graph?

Points to remember:

- The comparison of two quantities of the same unit is called ratio.
- When the terms of a ratio are multiplied by the same number, we get equivalent ratios.
- The equality of two ratios is called a proportion.
- In a proportion, the product of extremes = product of means.
- If two quantities vary always in the same ratio, then they are in direct variation.

7. METRIC MEASURES

Find how many kilograms are there in 1padi.

7.1 INTRODUCTION

Priyas's grand mother said, “There is not even one padi of rice in the house. Buy some rice when you are back from school”. Priya asked her teacher “We measure rice using Kilogram but, what is one padi of rice?” Many students in the class said that they have also heard about this. The teacher explained “when India was ruled by the British, the measures used by the Britishers and the ancient Indians were in practice. But, after Independence it was decided to use only Metric measures throughout the country and people started using the same”.

“Why did we change to metric? What is the speciality about it?” asked Nilavan.

The teacher thought for a while and said “Everybody has a scale with you isn't it? It is marked with inches on one side and centimetres on the other side. You all know about this. 12 inches make a feet.

Moreover 100 cm make one metre.

Which is easier?

Students screamed “feet, Metre”.

Teacher formed the following table.

Measurement of length			
British tradition		Metric Measure	
12 inches	1 feet	10 Millimetre	1 Centimetre
660 feet	1 furlong	100 Centimetre	1 Metre
8 furlong	1 Mile	1000 Metre	1 Kilometre

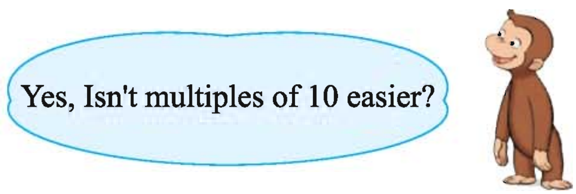
Teacher asked “Which is easier among these two measures? Students answered “Metric measures” in a loud voice.

Measurement of weight			
British tradition		Metric Measure	
28 grams	= 1 Ounce	1000 Milligram	= 1 Gram
16 Ounce	= 1 Pound	1000 Grams	= 1 Kilogram
2000 Pound	= 1 tonne	1000 Kilograms	= 1 tonne

Again the teacher questioned “Which is easier?”. The children answered Metric measures.

Measurement of Volume			
British tradition		Metric Measure	
29 ml	= 1 liquid ounce	1000 Milli litre	= 1 litre
20 liquid ounce	= 1 pint	1000 litre	= 1 Kilo litre
2 pints	= 1 quart		
4 quarts	= 1 gallon		

Before the teacher could question, the children screamed out “Metric measures”.



7.1.1 MEASURES – REVISION

Most of the measures used us in our day-to-day life are based on business – that is to purchase goods from the shop. Some goods are got in numbers. For Example :, 4 Choclates, 5 Mysorepaks, 2 Ice creams, 6 Bananas. But, we buy cloth using measurement of length. Vegetables, rice, dal are the provisions bought using measurement of weight. Liquids like milk and oil are bought using measurement of volume.

Usually we measure length in metres, weight in grams and volume in litres.

- Stretch out your hands to show the measurement of 1 metre.
- List out the goods that weight more or less 1 gram.
- Take any bottle and check whether it can be filled with one litre of water.

When we measure the distance between the school and your house metre is a small unit, whereas when you measure the length of a pencil metre is a big unit.

Likewise to purchase rice, gram is a very small unit. But it is a big unit when you buy gold.

To measure water in a pot, litre is a big unit. But it is a smaller unit while measuring water in a pond.

Though the measures 1 metre, 1 gram, 1 litre are easily understood by every one, they are not sufficient to measure in all situations. So, we use higher and lower multiples of these units. They are usually in powers of 10 or fractions with denominators in powers of 10.

Metric Measures

1000 Metre	= 1 Kilometre
100 Metre	= 1 Hectametre
10 Metre	= 1 Decametre
1 Metre	
$\frac{1}{10}$ Metre	= 1 Decimetre
$\frac{1}{100}$ Metre	= 1 Centimetre
$\frac{1}{1000}$ Metre	= 1 Millimetre

Likewise try to frame tables for grams and litres.

Here the measures hectametre, decametre and decimetre are not very much in use in our day-to-day life.

Kilometre, Metre, Centimetre and Millimetre are used to measure length. Kilogram and gram are used to measure weight. Kilolitre and litre are used to measure volume.

Exercise 7.1

1. Which is better unit to measure a bucket of water? (Litre/Millilitre).
2. What is the approximate weight of an egg?
3. What is the approximate length of a snake guard?
4. What is the approximate time you require to cover a distance of 1 Kilometre by walk?

7.2 PROBLEMS INVOLVING MEASURES

Any measure is a number. So it can be added, subtracted, multiplied and divided.

If the quantities are in two different units convert them to the lower unit and continue with the four operations – addition, subtraction, multiplication and division.

Example : 1

Three points A,B,C are in the same straight line. If AB = 12 cm 4 mm; AC = 20 cm 2 mm. Find BC = ?

20 cm 2 mm

A 12 cm 4 mm B ? C

Solution:

AC = 20 cm2mm = (20 x 10)mm + 2 mm = 202 mm

AB = 12 cm4 mm = (12 x 10)mm + 4 mm = 124 mm

BC = AC – AB = 202 mm – 124 mm = 78 mm

= 7 cm 8 mm

10mm = 1cm

Example : 2

If 200 ml of milk is required for a child, how many litres of milk are required for a class containing 40 children.

Solution:

One child requires 200 ml.

Therefore, for 40 children 40 x 200 = 8000 ml.

(i.e) 8 litres of milk is required.

1000 ml = 1 litre

Example : 3

350 grams of rice is required for one day meal in our house. I bought 5 kilograms of rice. How long will it last.

5 Kilogram = 5000 grams

$5000 \div 350 = 14$, Remainder 100

$\therefore$ after 14 days, 100 grams of rice will be left.

So, the rice will last for 14 days.

```
350)5000(14
     350
    ----
     1500
     1400
    ----
      100
```

Exercise 7.2

1. Fill in the blanks
   i) 1 cm = ______ mm ii) 3 km = ______ m
   iii) 1.5 m = ______ cm iv) 750 m = _____ km
   v) 5 cm 3 mm = ______ mm

2. Convert into Lower unit
   i) 4 km 475 m
   ii) 10 m 35 cm
   iii) 14 cm 7 mm

3. What is the length of the cloth required for 12 shirts, if the shirt requires 2 m 25 cm?

4. A person has three rods measuring 3 m 2 cm, 2 m 15 cm, 7 m 25 cm. If all the three rods are joined, find the length of the single rod obtained.

5. Fill in the blanks
   i) 2000 g = _____ kg ii) 7 kg = ______ g

6. Convert the following into the lower unit
   i) 10 g 20 cg ii) 3 kg 4 g

7. Salim has 3 iron balls each weighing 4 kg 550 g; 9 kg 350 g; 4 kg 250 g. What is the total weight of all the three iron balls.

8. If the weight of one iron chair is 5 kg 300 g, find the weight of 7 such chairs.

9. If Sugar weighing 100 kg is filled equally in bags of 500 g each, how many such bags are required.

10. Two vessels contain water measuring 14 *l* 750 *ml* and 21 *l* 250 *ml* each. What is the total quantity of water?

11. There is 75 *l* of gingely oil in Jamal's shop. He sold 37 *l* 450 *ml*. Find the quantity of gingely oil left.

12. A flask contains 250 *ml* of acid. How many litres of acid is there in 20 such flasks?

8. MEASURES OF TIME

INTRODUCTION :

Let us observe our activities from morning to evening.

We fix certain timings for morning routines, going to school, studying, playing etc., Our ancestors used to calculate time by just looking at the sun, to perform their duties. But that would not be possible during cloudy days and rainy seasons.

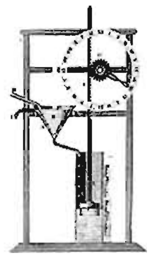
In olden days, they used many different clock instruments to find time. Egyptians used shadow clock, Britishers used candle clock, Chinese used rope clock, Europeans used oil clock and Indians used water clock. Sand clock was used by many other countries.

Shadow Clock

Candle Clock

Sand Clock

Water Clock



Rope Clock

In course of time mechanized clocks were introduced by rectifying the faults in these clocks. As time is very important in our life, it is necessary to learn about time.

6.1 UNITS OF TIME

Seconds, minute, hour, day, week, month and year are the units of time. Let us learn about these units now:

1 minute = 60 Seconds
1 hour = 60 minutes = 60 x 60seconds
= 3600 Seconds
1 day = 24 hours = 1440 minutes (24 x 60)
= 86,400 seconds (24 x 60 x 60)

60 seconds = 1 minute
1 Sec = $\frac{1}{60}$ minute
60 minutes = 1 hour
1 minute = $\frac{1}{60}$ hour

Example : 1

Convert 120 Seconds into minutes

Solution:

120 seconds = 120 x $\frac{1}{60}$ = $\frac{120}{60}$ = 2 minutes

$\therefore$ 120 Seconds = 2 minutes

$\because$ 60 seconds = 1 minute

1 second = $\frac{1}{60}$ minute

Example : 2

Convert 360 minutes into hours

60 minutes = 1 hour

$\therefore$ 1 minute $= \frac{1}{60}$ hour

Solution :

360 minutes $= 360 \times \frac{1}{60} = \frac{360}{60} = 6$ hours

$\therefore$ 360 minutes = 6 hours.

Example : 3

Convert 3 hours 45 minutes into minutes

Solution: 1 hour = 60 minutes

3 hours = 3 x 60 = 180 minutes

$\therefore$ 3 hours and 45 minutes = 180 minutes + 45 minutes

= 225 minutes.

Example : 4

Convert 5400 seconds into hours

Solution: 5400 Seconds $= 5400 \times \frac{1}{3600}$ hour $= \frac{9}{6} = \frac{3}{2} = 1\frac{1}{2}$ hours.

$\therefore$ 5400 seconds $= 1\frac{1}{2}$ hours.

Do it yourself

1) Convert the duration of the lunch break into seconds.
2) Convert Play time in the evening into hours.

Example : 5

Convert 2 hours 30 minutes 15 seconds into seconds.

Solution

1 hour = 3600 seconds $\Rightarrow$ 2 hours = 2 x 3600 = 7200 seconds

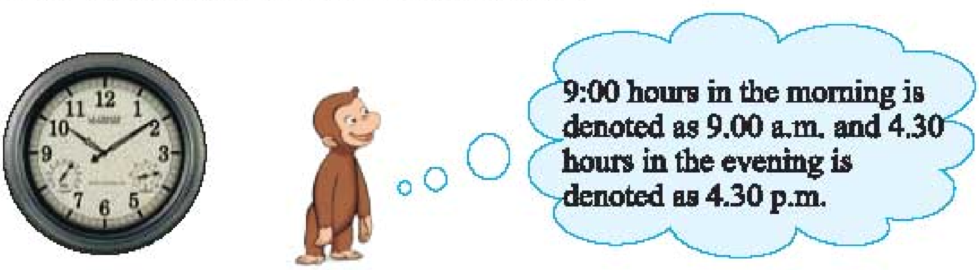
1 minute = 60 seconds $\Rightarrow$ 30 minutes = 30 x 60 = 1800 seconds

$\therefore$ 2 hours 3 minutes 15 seconds = 7200 + 1800 + 15

= 9015 seconds.

We normally denote time from 12 mid-night to 12 noon as a.m. (Ante meridian) and the time from 12 noon to 12 mid-night is noted as p.m. (Post meridian).

Note : We denote 4 hours and 30 minutes as 4 : 30 (or) 4.30. Even though we are using the decimal point it is not a usual decimal number.



Exercise 8.1

1. Fill in the blanks
   - **i)** 1 hour = ____________ minutes
   - **ii)** 24 hours = ____________ day
   - **iii)** 1 minute = ____________ seconds
   - **iv)** 7 hours and 15 minutes in the morning is denoted as ---------------------------
   - **v)** 3 hours and 45 minutes in the evening is denoted as ---------------------------

2. Convert into seconds
   - i) 15 minutes
   - ii) 30 minutes 12 seconds
   - iii) 3 hours 10 minutes 5 seconds
   - iv) 45 minutes 20 seconds

3. Convert into minutes
   - i) 8 hours
   - ii) 11 hours 50 minutes
   - iii) 9 hours 35 minutes
   - iv) 2 hours 55 minutes

4. Convert into hours :
   - i) 525 minutes
   - ii) 7200 seconds
   - iii) 11880 seconds
   - iv) 3600 seconds

8.2 Railway time :

Observe the following table :
Have you seen a table like this anywhere else?

Sl.No	Train Number	Name of the Train	Place of Departure	Destination	Departure Time	Arrival Time
1.	2633	Kanyakumari Express	Egmore	Kanyakumari	17.25 hrs.	6.30 hrs.
2.	2693	Muthunagar Express	Egmore	Tuticorin	19.45hrs.	6.15hrs
3.	6123	Nellai Express	Egmore	Nagercoil	19.00 hrs	8.10hrs.
4.	2637	Pandian Express	Egmore	Madurai Junction	21.30 hrs	6.15 hrs.
5.	6177	Rock Fort Express	Egmore	Trichirappalli	22.30 hrs	5.25 hrs.
6.	2635	Vaigai Express	Egmore	Madurai	12.25 hrs	20.10 hrs.
7.	2605	Pallavan Express	Egmore	Trichirappalli	15.30 hrs	20.50 hrs.

Observe the timing given in the above table. How many hours are there in a day ?

Ans : 24 hours.

We generally call 24 hour clock time as railway time. Railway timings are not expressed in a.m. and p.m.. All timings are expressed as just hours. In the above table, departure time and arrival time of some expresses are more than 12.00 hours. While converting these hours into ordinary timings we should subtract 12 from the hours column.

Shall we learn to convert timings ?

Example : 6

1. Convert into railway timings

(i) 8.00 a.m. (ii) 10.25 p.m. (iii) 12 noon.

Solution

(i) 8.00 a.m. = 8.00 hours.

(ii) 10.25 p.m. = 10.25
+ 12.00

= 22.25 hours.

(iii) 12.00 noon = 12.00 hours

2. Express in ordinary timings

(i) 23.10 hours (ii) 24 hours

(iii) 9.20 hours.

Solution

i) 23.10 hours = 23.10 - 12.00 = 11.10p.m.

ii) 24 hours = 24.00 = 12.00midnight

iii) 9.20 hours = 9.20 a.m.

Do it yourself

List your daily routines in railway timings and convert them into ordinary timings.

Exercise : 8.2

1. Express in railway timings
   (i) 6.30 a.m. (ii) 12.00 midnight (iii) 9.15 p.m. (iv) 1.10 p.m.
2. Express in ordinary timings
   (i) 10.30 hours (ii) 12.00 hours. (iii) 00.00 hours. (iv) 23.35 hours

8.4 Calculating time interval

Deepa said to her friend Jancy that she studied for 3 hours from 8.00 a.m. to 11.00 a.m. How did Deepa calculate the duration of time as 3 hours ?

Example : 7

Find the duration of time from 4.00 a.m. to 4.00 p.m.

Solution : 4.00 p.m. = 4 hrs. 00 min + 12 hrs. 00 min.
= 16 hrs. 00 min = 16 hrs.

∴ duration of time = 4.00 p.m. – 4.00 a.m.
= 16.00 hrs - 4.00 hrs. = 12 hours.

Example : 8

Cheran Express departs from Chennai at 22.10 hours and reaches Salem at 02.50 hours the next day. Find the journey time.

Solution :

Arrival at Salem =02.50 hrs.

Departure time from Chennai (Previous day) =22.10 hrs.

Journey time = (24.00 – 22.10) + 2.50 = 1.50 + 2.50 = 4.40

$\therefore$ Journey time = 4 hours 40 minutes.

Example : 9

A boy went to school at 9.00 a.m. After school, he went to his friends house and played. If he reached back home at 5.30 p.m., find the duration of time he was out of his house.

Solution :

Starting time from home = 9.00 a.m.

Duration between starting time and 12.00 noon = 12.00 – 9.00

= 3.00 hours.

Reaching time (home) = 5.30 p.m.

$\therefore$ Duration of time he was out of his house = 3.00+5.30 = 8.30 hours.

Exercise : 8.3

1. Calculate the duration of time

   (i) from 3.30 a.m. to 2.15 p.m. (ii) from 6.45 a.m. to 5.30 p.m.

2. Nellai Express departs from Tirunelvelli at 18.30 hours and reaches Chennai Egmore at 06.10 hours. Find the running time of the train.

3. Sangavi starts from her uncle's house at 10.00 hours and reaches her house at 1.15 p.m. What is the duration of time to reach her house?

LEAP YEAR

Rama was celebrating his birth day happily. His friend Dilip was sitting aloof at a corner. Rama asked Dilip "why are you sad?" Dilip replied "I can't invite you every year for my birth day". When Rama asked 'why', Dilip said "I can celebrate my birth day only once in 4 years". Rama exclaimed "Why is that so ?"

"Because my birthday falls on 29^{th} February" replied Dilip.

Satish asked "29^{th} February ! what are you talking Dilip ? But February has only 28 days". "Yes Satish, usually it is 28 days. But once in 4 years February has 29 days. We call that year as a leap year. There are 366 days in a leap year and 365 days in an ordinary year" Dilip said.

"Why do we have an extra day in a leap year ?.

"I don't know. Let us find out from our teacher" replied Dilip.

Both went to meet their teacher and expressed their doubt. The teacher explained the reason as follows:

You know that the earth takes one year to make one complete revolution around the sun and 365 days make 1 year. But in fact the earth takes 365.25 days to make one revolution. So this extra 0.25 day is added in February once in 4 years (0.25 x 4 = 1). Such a year is known as leap year. So February has 29 days in a leap year.

Find it yourself

1. Which century are we in ?
2. Which is a millennium year ?

1 day	= 24 hours
1 week	= 7 days
1 year	= 12 months
1 year	= 365 days
1 leap year	= 366 days
10 years	= 1 decade
100 years	= 1 century
1000 years	= 1 millennium

How will you identify a leap year ?

A year which is exactly divisible by 4 is a leap year.

But the years which are multiples of 100, should be exactly divisible by 400 to be a leap year.

The years 1900, 1800, 1700, 1500 or not leap years why ?

Because, These Numbers leave remainders when we divide by 400.

But 1200, 1600, 2000, 2400 are all leap years as they leave no remainder when divided by 400

Example : 10

Which of the following are leap years?

(i) **1400** (ii) **1993** (iii) **2800** (iv) **2008**

Solution : **(i)** Divide 1400 by 400

1400 ÷ 400 gives

Quotient 3, Remainder 200

$\therefore$ 1400 is not a leap year

```
        3
400 ) 1400
      1200
      ----
       200
```

(ii) Divide 1993 by 4

1993 ÷ 4 gives Quotient 498, remainder 1

∴ 1993 is not a leap year.

```
     498
 4 ) 1993
     16
     ---
      39
      36
     ---
      33
      32
     ---
       1
```

(iii) Divide 2800 by 400

2800 ÷ 400 Quotient = 7, Remainder =0

∴ 2800 is a leap year

```
        7
 400 ) 2800
       2800
       ----
          0
```

(iv) Divide 2008 by 4

2008 ÷ 4 Quotient = 502, Remainder = 0

∴ 2008 is a leap year.

```
     502
 4 ) 2008
     20
     ---
      08
      08
     ---
       0
```

Example : 11

Find the number of days from 15^{th} August to 27^{th} October.

Solution :

There are 31 days in August.

Number of days in August = 31-14	= 17 days
Number of days inSeptember	= 30 days
Number of days in October	= 27 days
Total	= 74 days.

> Note :
>
> Since it is given from 15^{th} August" Subtract 14 days (Prior to 15^{th}) from 31 (The total number of days of the month)

Example : 12

Convert 298 days into weeks.

Solution : 298 days = $\frac{298}{7}$ weeks

∴298 days = 42 weeks and 4 days.

> 1 week = 7 days.
>
> 1 day= $\frac{1}{7}$ week

Example : 13

Find the number of days between 12^{th} January 2004 and 7^{th} March 2004.

Solution :

Find whether the given year is a leap year or not.

2004 ÷ 4

Quotient: 501, remainder =0.

∴ 2004 is a leap year and has 29 days in February.

Number of days in January	= 31-12	= 19 days.
Number of days in February	= 29 days	
Number of days in March	= 6 days.	
Total number of days	= 54 days.	

∴ Number of days between 12^{th} January 2004 and 7^{th} March 2004 are 54 days.

Exercise : 8.4

1.Fill in the blanks.

(i) 1 week = ________days.

(ii) In a leap year, February has_______days.

(iii) 3 days =________ hours.

(iv) 1 year =_________months.

(v) 1 hour =__________seconds.

2.Which of the following are leap years ?

(i) 1992 (ii) 1978 (iii) 2003 (iv)1200 (v) 1997

3.Find the number of days from 4^{th} January 1996 to 8^{th} April 1996

4.Convert into weeks.

(i) 328 days (ii) 175 days.

Activity :

Divide the class into different groups. Ask them to compare their ages and find out the eldest. Compare all the groups and find the eldest and youngest in the class.

Points to remember:

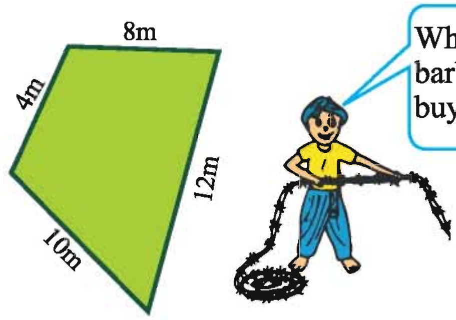
- Seconds, minutes, hours, day, week, month and year are the units of time.
- 12.00 midnight to 12.00 noon is forenoon.
- 12 .00 noon to 12.00 mid night is afternoon.
- 12 hours in forenoon and 12 hours in afternoon together gives 24 hours of railway timings.
- An ordinary year has 365 days. But a leap year has 366 days.

9. Perimeter and Area

9.1 Perimeter

Introduction:

Rahman is a farmer. He has to fence his field.



What length of the barbed wire I should buy to fence my field?

Can you help Rahman?
Total length of the boundaries should be found.
The length of each boundary is given in the figure.

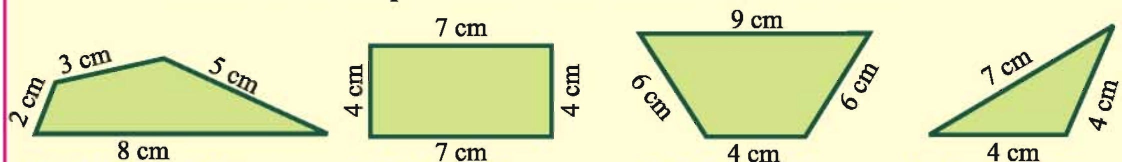
I found the answer
I should buy 8 m + 12 m + 10 m + 4 m = 34 m barbed wire.

The perimeter of a closed figure is the total measure of the boundary.

Example : 1

Find the perimeter of the following shapes.

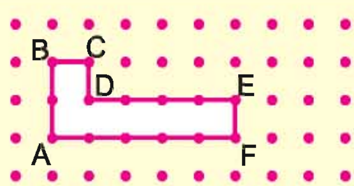
Perimeter of the shape = Sum of the measure of all the sides.



8 + 5 + 3 + 2 = 18 cm | 4 + 7 + 4 + 7 = 22 cm | 4 + 6 + 9 + 6 = 25 cm | 4 + 4 + 7 = 15 cm

Example : 2

The distance between two consecutive points is 1 unit.
Find the perimeter of ABCDEF.



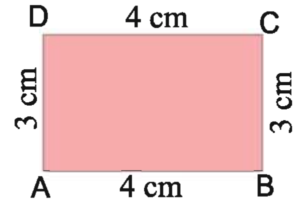
Solution:
The distance between A to B is 2 units. In the same way,

adding the lengths of all the sides, we get 2 + 1 + 1 + 4 + 1 + 5 = 14 units.

∴ The perimeter of the given figure = 14 units

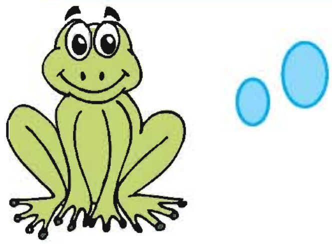
9.1.1 Perimeter of a rectangle and a square

We can find the perimeter of a rectangle ABCD easily as 4 + 3 + 4 + 3 = 14 cm



But in general, the perimeter of rectangles with different lengths and breadths is length + breadth + length + breadth

> Perimeter of a rectangle = 2 x length + 2 x breadth
> = 2 (length + breadth)
> = 2 (l + b) units
> where 'l' denotes the length and
> 'b' denotes the breadth.



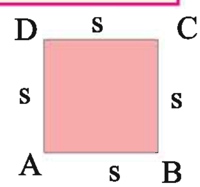
> We use the first letters 'l' of length and 'b' of breadth in the formula
> Perimeter of a rectangle = 2 (l+b) units
> We can denote length and breadth by any other letters also.

Example : 3

Find the perimeter of a rectangle, whose length is 5 cm and breadth is 3 cm.
Solution:

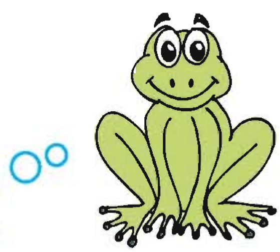
Perimeter of a rectangle = 2 (length + breadth)
= 2 (5 + 3) = 2 x 8 = 16 cm

Perimeter of a square



Every square is a rectangle whose length and breadth are equal.
Perimeter of a square = 2 x side + 2 x side
= 4 x side
= 4s units 's' is the side.

> We use the first letter 's' of the word 'side' to denote the side.

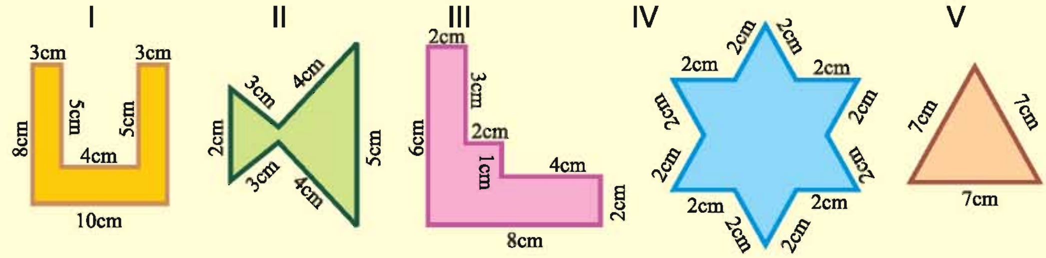


Example : 4

Find the perimeter of a square whose side is 20 cm.
Perimeter of a square = 4 x side = 4 x 20 = 80 cm

Exercise 9.1

1. Find the perimeter of the following shapes.



2. Find the perimeter of the following figure.
(Take the distance between any to consecutive points as 1 unit)

3. Draw different shapes with perimeter 8 units in the following doted sheet.
(Take the distance between any to consecutive points as 1 unit)

4. Find the perimeter of a rectangle of length 4 cm and breadth 7 cm.

5. The perimeter of a square is 48 cm. Find its side .

9.2 Area

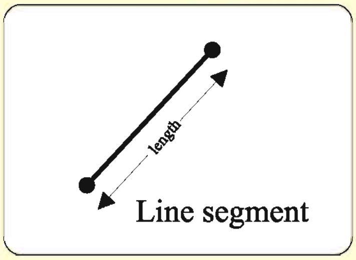
Introduction:

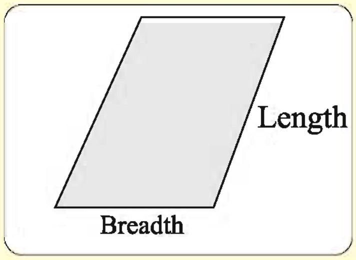
In the figure, look at the books on the table. Every book occupies a space. There is no space for the fourth book. The space that each book occupies is the area of that book.

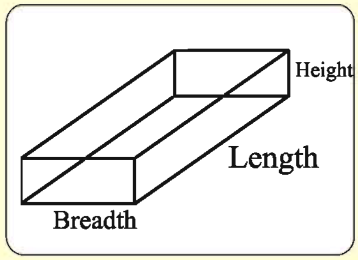
The area of an object is the space occupied by it on a plane surface.

Only two dimensional and three dimensional objects will have area.

Example : 5



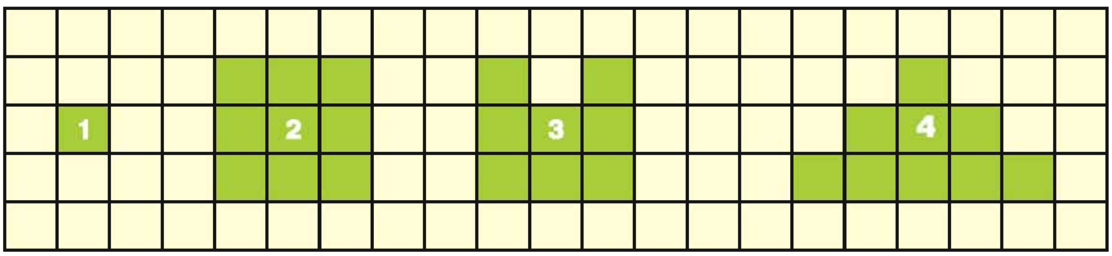




Line segment	Newspaper	Cardboard box
Only one dimension	Two dimensions	Three dimensions
No Area	Can you find its area?	The box has 6 surfaces. We can find the area of each surface.

How to calculate the area?

Count the number of green coloured squares in each of the following shapes.



Shape 1 = 1 square, Shape 2 = 9 squares,
Shape 3 = 8 squares, Shape 4 = 9 squares.

Look at shape 1

The square of side 1 unit is called "Unit square".

The area occupied by it is 1 square unit (1 sq. unit).

Area of unit square = 1 unit x 1 unit = 1 sq. unit.

We have denoted the side of a small square as 1 unit. The area of the squares of sides in mm, cm, m, km can be expressed as follows:

1 mm x 1 mm = 1 sq. mm
1 cm x 1 cm = 1 sq. cm
1 m x 1 m = 1 sq. m
1 km x 1 km = 1 sq. km

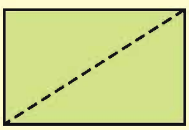
Exercise 9.2

Look at the following table. Tick(✓) the suitable unit to find the area of each.

Objects	Square cm	Square m	Square km
Hand kerchief			
A page of a book			
The door of a class room			
Area of the land surface of Chennai city			
Saree			

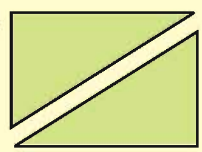
9.2.1. Area of different shapes

Activity:

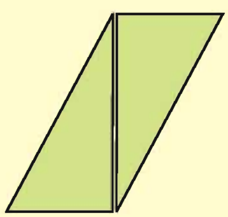


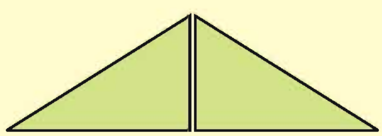
Take a rectangular piece of paper. Fold it diagonally and cut it into two triangles.

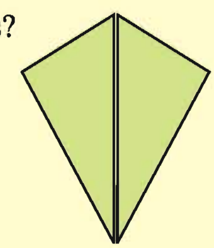
Different shapes are formed by joining the sides of the triangles in various ways.



They all are in different shapes.
What can be said about their areas?







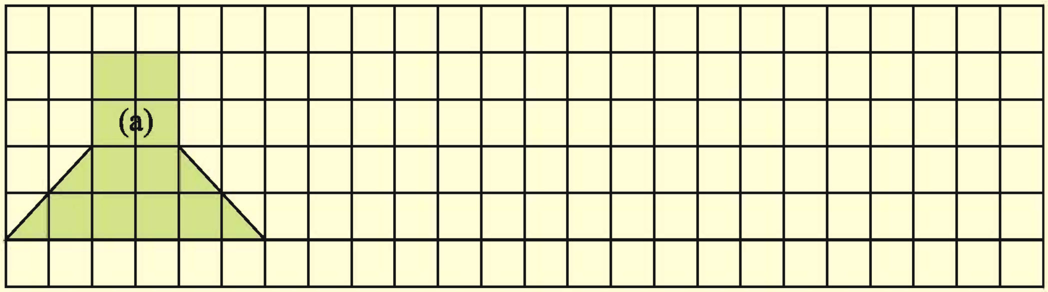
All shapes will be equal in area as they are formed with the same two pieces of a paper.

Can you form two more shapes like this?

Areas of these figures can be found by counting the number of unit squares in them.

Example : 6

Find the area of the given shape



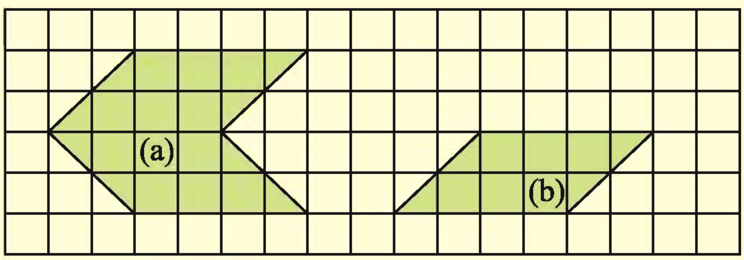
The area of each small square is 1 sq. cm.

Therefore area of the shape = 10 full squares + 4 half squares
= 10 full squares + 2 full squares
= 12 full squares
= 12 sq. cm.

A note to teacher
Give practice to draw a few more shapes on graph sheets and to find their areas.

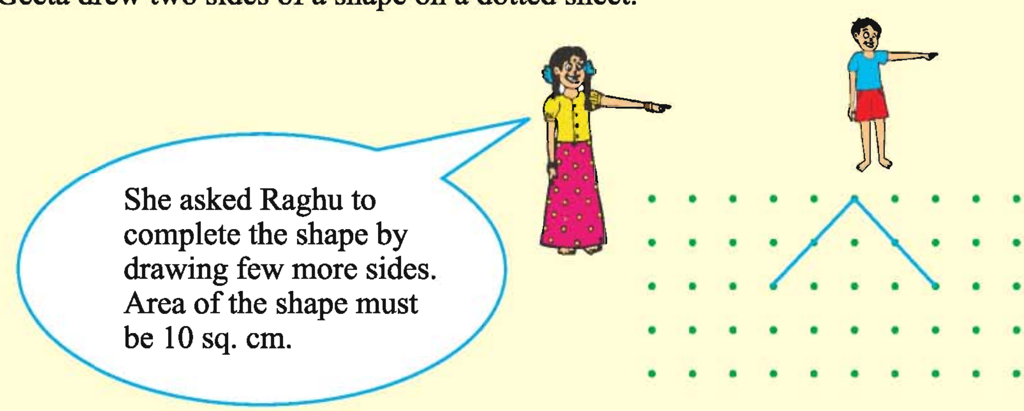
Exercise 9.3

1. Find the area of the given shapes



2. Draw two different shapes of area 10 square units on a dotted sheet.

3. Geeta drew two sides of a shape on a dotted sheet.

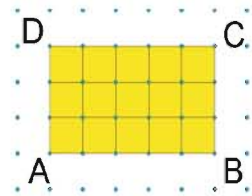


How did Raghu complete the shape? There can be many solutions for this.

In How many ways can you complete these shapes?

9.3 Area of a rectangle, square and a triangle

Area of a rectangle



The area of a rectangle connecting the dots can be found as 15 sq. units by counting the number of small squares.

How to calculate the area of the rectangle without counting the number of squares?

The length of the rectangle is the distance between A and B = 5 units
Therefore, there are 5 small squares on the line AB

The breadth of the rectangle is the distance between B and C = 3 units.
There are 3 rows of 5 squares in each.

Now the area of the rectangle = Total number of squares.
= Number of squares in 3 rows.
= 5 + 5 + 5
= 5 x 3
= length x breadth sq. units

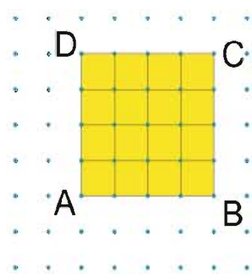
Usually we denote length as '*l*', breadth as '*b*'
∴ Area of the rectangle = *l* x *b* sq. units

Example : 7

Find the area of a rectangle whose length is 8 cm and breadth 5 cm

Area of a rectangle = length x breadth = 8 cm x 5 cm = 40 sq. cm

Area of a square



We know that in a rectangle if the length is equal to the breadth, it is a square.They are called the sides of a square.

∴ Length = breadth = side of the square

∴ Area of a square = length x breadth
= side x side sq. units
(Formula for area of the rectangle is also suitable for area of square)

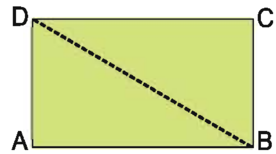
If you denote the side as ‘s’ then the area of the square = *s* x *s* sq. units.

Example : 8

Find the area of a square of side 7 cm.

Area of a square = side x side = 7cm x 7cm = 49 sq. cm.

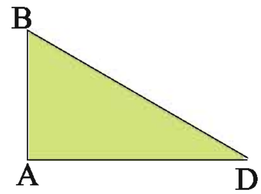
Area of a right triangle

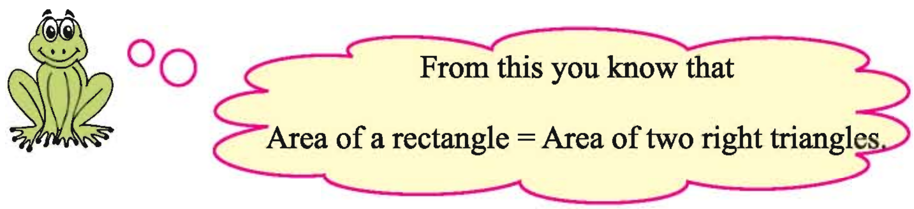


Take a rectangular shaped card-board and cut it through a diagonal. We get 2 right triangles.

Area of a right triangle= half the area of the rectangle

$= \frac{1}{2}$ x (length x breadth) sq. units





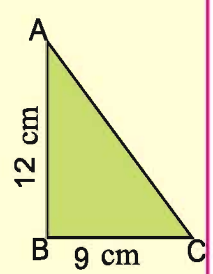
The length and breadth of the rectangle becomes the base and height of the right triangle. Length is used as the base and breadth is used as the height.

Hence, area of a right triangle = $\frac{1}{2}$ x (base x height) sq. units.

If base is denoted as 'b' and height as 'h', then the area of a right triangle = $\frac{1}{2}$ (b x h) sq.units.

Example : 9

Find the area of the following right triangle.



Solution:

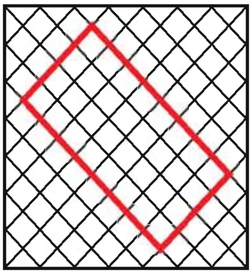
Area of a right triangle = $\frac{1}{2}$ x base x height

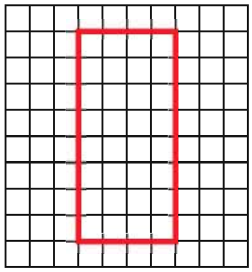
Base of triangle = 9 cm

Height = 12 cm

$\therefore$ Area of a right triangle = $\frac{1}{2}$ x 9 x 12 = 54 sq.cm.

Which of the following shapes has greater area?



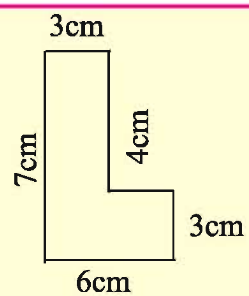


Area of both the shapes are equal. We get the second shape by rotating the first shape.

The area of the shapes do not change when they are rotated or moved from their places.

Example : 10

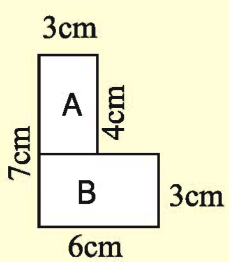
Find the area of the following shape.



Solution: There are three methods to solve this problem

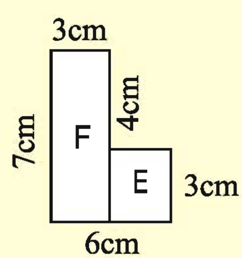
I method

Area of (A) = 4 x 3 = 12 sq. cm.
Area of (B) = 6 x 3 = 18 sq. cm.
Therefore, area of the shape = 30 sq. cm.



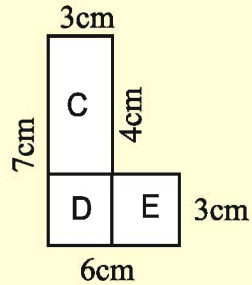
II method

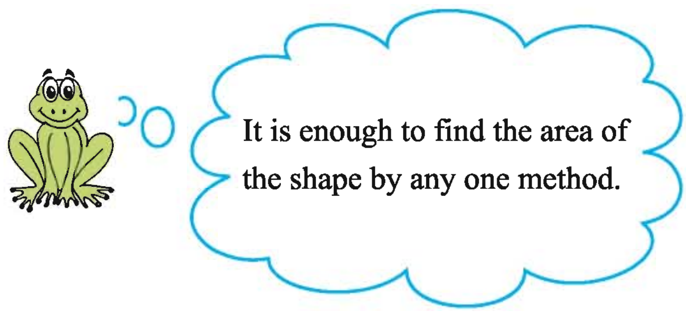
Area of (F) = 7 x 3 = 21 sq. cm.
Area of (E) = 3 x 3 = 9 sq. cm.
Therefore, area of the shape = 30 sq. cm.



III method

Area of (C) = 4 x 3 = 12 sq. cm.
Area of (D) = 3 x 3 = 9 sq. cm.
Area of (E) = 3 x 3 = 9 sq. cm.
Therefore, area of the shape = 30 sq. cm.





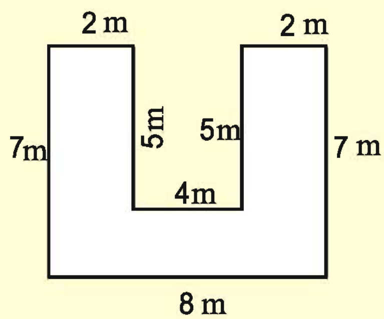
Exercise 9.4

1. Fill in the blanks:

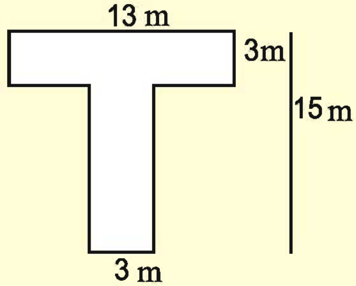
S.No	Length of the rectangle (l)	Breadth of the rectangle (b)	Perimeter of the rectangle	Area of the rectangle
(i)	7 cm	5 cm	-	-
(ii)	10 cm	-	28 m	-
(iii)	-	6m	-	72 sq.m
(iv)	9m	-	-	63 sq.m

2. Find the area of the following shapes.

(i)

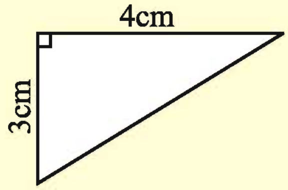


(ii)

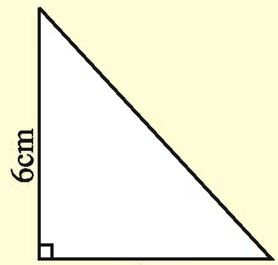


3. Find the area of the following right triangles

(i)



(ii)



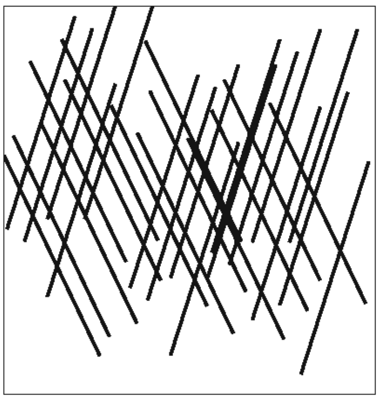
Pints to Remember

1. The Perimeter of a closed figure is the total measure of the boundary.
2. The Perimeter of a rectangle = 2 x $(l + b)$ units.
3. The Perimeter of a Square = 4 x s units.
4. The area of an object is the space occupied by it on a plane surface.
5. The area of a rectangle = l x b sq. units.
6. The area of a square = s x s sq. units.
7. The area of a right angled triangle = $\frac{1}{2}$ x (base x height).
8. The area of a shape do not change when they are rotated or move from their places.

10. POINT, LINE, LINE SEGMENT AND PLANE

Vani and Selvi started playing with a few long sticks. When it was Selvi's turn she had to take one stick without disturbing the other sticks. She loses her game even if there is a slight shake in the other sticks. Oh! What a different game.

Many questions arose in the mind of the third person who was observing this game. Try to answer the following questions.



- All those sticks are line segments – what can be done with these?
- If these line segments are arranged close to each other. How far can it be extended? Which is the longest line in the world?
- If a lamp post is fixed in our Village, how high will it be? How far will it go piercing the sky? If it is sent piercing the earth, will it come through the other side?
- What do we get finally if we keep breaking the sticks?
- Railway tracks and electric wire above our heads do not touch each other however far they are extended. They keep moving in a very friendly manner. Do they meet anywhere?
- Using line segments tower shaped figures can be formed? Can we form a circle?

Geometry is a branch of Mathematics which answers such type of questions. Geometry gives the idea of various shapes and figures.

We know about different kinds of lines. Some are small and some are big. Some meet each other but some do not meet. Few lines keep extending. The length of small lines can be measured. Is there a small line without any length? If so, its length should be 0 cm! Such a line can be consider as a point.

So, a line is made up of many points.

We can name

i) A line with definite length as line segment

ii) Which extends indefinitely on both directions as lines

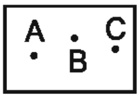
iii) Which extends indefinitely in one direction as a ray.

10.1 POINTS

Point is not something new to us. You would have seen Rangoli designs being drawn using points either everyday or during festival seasons such as Pongal etc.

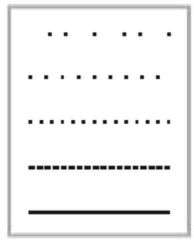
> A point indicates a definite position.

A point is smaller than a tip of a pencil or a pen used by us. Therefore a point has no length, breadth, height or thickness.

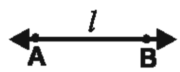


Points are usually denoted by capital letters A, B, C and so on.

10.2 LINE



Observe the given figure carefully. As the space in between the points decreases they join to form a line. A line is a set of points closely arranged without gap.



Mark points A, B on a sheet of paper using a scale draw a line passing through these points. This is a straight line.

It is represented as $\overleftrightarrow{AB}$ or line 'l'.

When we represent a straight line as $\overleftrightarrow{AB}$ it means

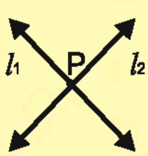
(i) The line passes through the points A, B.

(ii) The line extends on either side of A and B.

Observe the names given for the following straight lines.

This is $\overleftrightarrow{PQ}$ or a straight line PQ

This is a straight line l



Lines l_1 and l_2 are two straight lines passing through the point P.

Do it yourself

- Draw a straight line XY.
- Draw a straight line and mark three points A, B, C.
- Draw 3 straight lines passing through the point R.

10.3 RAY

A ray starts from a fixed point and extends indefinitely in the other direction.

A Ray is denoted as $\overrightarrow{AB}$

1. Starting point of the ray is A.
2. The ray passes through the points A, B.
3. The ray extends through the point B.

Do it yourself

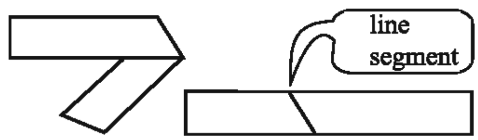
1) Draw a ray XY.

2) From a point P draw $\overrightarrow{PA}$, $\overrightarrow{PB}$, $\overrightarrow{PC}$, $\overrightarrow{PD}$

A Ray is a straight line with a starting point and extends indefinitely in one direction.

10.4 LINE SEGMENT

If a sheet of paper is folded and then opened, the folded part represents a line segment.



Mark points X, Y, Z on the straight line $\overleftrightarrow{AB}$.

Consider AX a part of the straight line, which starts at A and ends at X. So, it has a particular length. This is called as a line segment. It can be denoted as line segment AX. Few more line segments from the above figure are AY, AB, XY, XB, YB, XZ.

Therefore line segment is a part of a line. It has a starting point and an end point. A line segment has a definite length.

10.5 PLANE

Straight lines, points and rays can be represented in a sheet of paper or on the black board. Isn't it? Likewise floor, wall, black board, card board and top portion of the table are few examples for a plane.

A plane is a flat surface which extends indefinitely in all directions.

How many points are required to form a plane?

It is enough to have three points that do not lie on the same straight line.

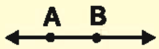
Discuss:

If 3 students hold 3 pencils with their tips in the same direction, a note book can be placed on it. Now hold all the 3 pencils in a same straight line. Will the note book stand erectly? Why?

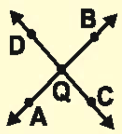
Exercise 10.1

1. 

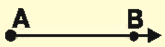
is a ______________

2. 

The points on the straight line are ______________

3. 

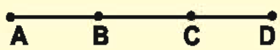
The lines $\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$ intersect at a point ______________

4. 

is called ______________

5. 

On PQ, Q is a ______________

6. 

Name the line segments in the figure. ______________

10.6 RELATION BETWEEN POINTS AND LINES

Points which lie on the same straight line are called collinear points.

1.Draw a straight line passing through the points A, B

A• •B

2.Check whether you can draw a straight line passing through the points A, B, C

A•

B• C•

Draw a straight line passing through the points P, Q, R.

P Q R

Do you know:

1.Sun, Moon and earth lie on the same straight line during Solar and Lunar eclipse.

2.When it is 6 o'clock, the centre point and numbers 12 and 6 lie on the same straight line.

1. You can draw a straight line passing through the two points A, B.
2. Since A, B, C are not on the same straight line, a straight line cannot be drawn.
3. A straight line can be drawn through P, Q, R, as they lie on the same straight line. P, Q, R are collinear points.

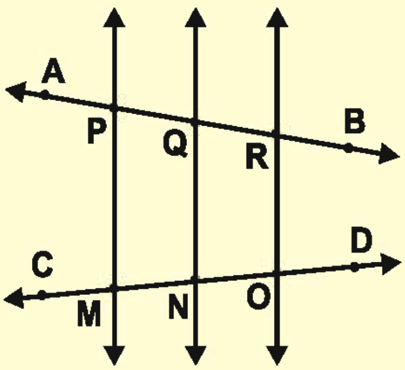
So, the following statements are true.

1. A straight line can be drawn through any two given points.

2. It is not always possible to draw a straight line passing through any 3 points.

3. But a straight line can be drawn passing through 3collinear points .

Example : 1



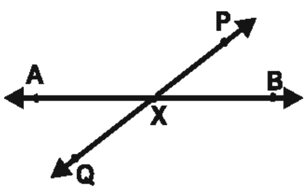
Name the collinear points from the figure?

Solution:

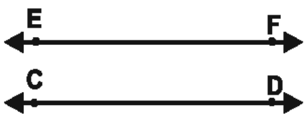
1. Collinear points on the straight line AB are P, Q, R.
2. Collinear points on the straight line CD are M, N, O.

10.6.2 PARALLEL LINES

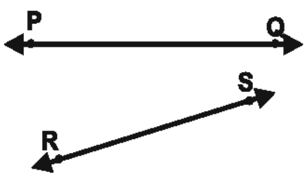
Observe the straight lines given below



Lines $\overleftrightarrow{AB}$, $\overleftrightarrow{PQ}$ meet at a point *X*. '*X*' is the point of intersection of these two straight lines. So, these lines are called intersecting lines.



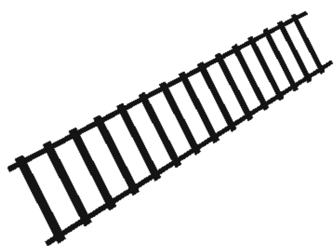
Lines $\overleftrightarrow{CD}$, $\overleftrightarrow{EF}$ do not meet each other at any point. So, they are called parallel lines.



Straight lines $\overleftrightarrow{PQ}$, $\overleftrightarrow{RS}$ do not meet each other at any point. But, they will meet at a point. Why?

- Non parallel lines intersect at a point.
- Lines which do not intersect each other are called parallel lines.

Observe a railway track



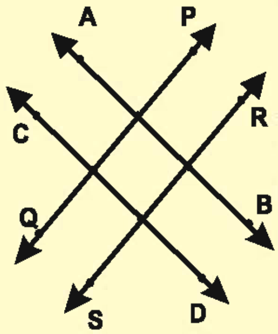
The tracks do not meet each other. Isn't? This is an example for parallel lines.

The two opposite edges of a note book are parallel lines.

Example : 2

Do it yourself

List a few examples for parallel lines from your class room.



Name the parallel lines in the figure.

Solution:

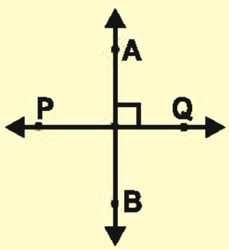
$\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$ are parallel lines, $\overleftrightarrow{PQ}$, $\overleftrightarrow{RS}$ are also parallel lines. This can be denoted using the symbol $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$ and $\overleftrightarrow{PQ} \parallel \overleftrightarrow{RS}$

10.6.3 PERPENDICULAR LINES

Normally, we would have seen perpendicular pillars in buildings. We would have observed that these pillars stand perpendicular to the floor. We already know these are perpendiculars.

When two lines are perpendicular lines, it is denoted by the symbol $\perp$.

Example : 3

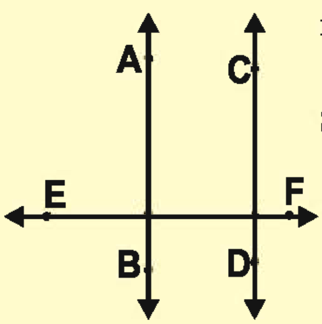


From the figure the two perpendicular lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{PQ}$ can be denoted as $\overleftrightarrow{AB} \perp \overleftrightarrow{PQ}$.

Do you know:

Flag posts, Cell phone tower, Tall buildings are all perpendicular to the floor.

Example : 4



Find the parallel lines and perpendicular lines from the following figure.

Solution:

$\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$ are parallel lines.

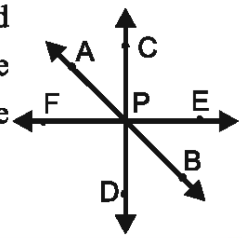
(ie) $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$.

$\overleftrightarrow{AB}$, $\overleftrightarrow{EF}$ and $\overleftrightarrow{CD}$, $\overleftrightarrow{EF}$ are perpendicular lines.

(ie) $\overleftrightarrow{AB} \perp \overleftrightarrow{EF}$ and $\overleftrightarrow{CD} \perp \overleftrightarrow{EF}$

10.6.4 CONCURRENT LINES

Example : 5

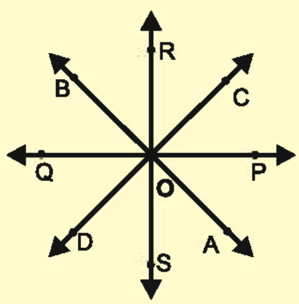


We know that two non-parallel lines intersect at a point. If a third line is drawn passing through the same point, these 3 straight lines are called **concurrent lines**. In the figure lines $\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$, $\overleftrightarrow{EF}$ pass through one point. Here point 'P' is the **point of concurrency**.

Three or more lines passing through a point are called 'Concurrent Lines'. The point through which the lines pass is called 'Point of Concurrency'.

1. The junction of many roads is an Example : for point of concurrency.
2. If we draw more than 2 diameters for a circle, all the diameters meet at the centre of the circle. These are concurrent lines.
3. The spokes of the wooden wheel of a bullock cart are concurrent lines.

Example : 6



From the given figure, find out the concurrent lines and point of concurrency.

Solution:

$\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$, $\overleftrightarrow{PQ}$, $\overleftrightarrow{RS}$ are concurrent lines.

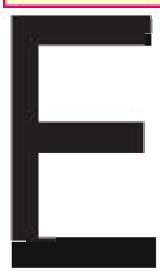
These lines pass through the point 'O'.

Therefore 'O' is the point of concurrency.

Do it yourself

Check if there are concurrent lines at road junction of your village or in the things used by you.

Discuss:



Does the letter 'E' contain parallel lines, perpendicular lines, intersecting lines, concurrent lines and point of concurrency?

Group Game:

The teacher should arrange the students in a straight line. As the teacher calls out 'parallel lines', 'perpendicular lines', etc. the students should stretch and fold their arms accordingly. As the teacher increases the speed, the student who performs wrong is sent out. The student who performs correctly till the end is the winner.

Exercise 10.2

1. Collinear points are points that lie on the ______.

2. 3 points lying on the same straight line are called ______.

3. ______ lines can be drawn passing through one point.

4. Through the two given points _______ line can be drawn.

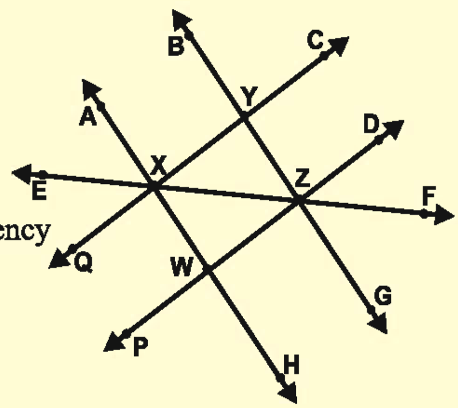
5. From the given figure list out

a. Intersecting lines

b. Parallel lines

c. Collinear points

d. Concurrent lines and their point of concurrency



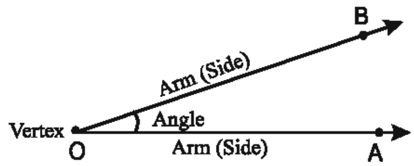
Points to Remember

1. Points indicate a definite position.
2. A line is a set of points closely arranged.
3. A straight line extends in both the direction.
4. A ray is a line with a starting point.
5. A line segment is a part of a line between two points.
6. A plane is a flat surface which extends indefinitely in all directions.
7. Two non-parallel lines intersect at a point.
8. Lines which do not intersect at any point are called parallel lines.
9. Two lines which intersect each other at right angles are called perpendicular lines.
10. Three or more points which lie on the same straight line are called collinear points.
11. Three or more lines passing through a point are called concurrent lines.

11. Angles and Triangles

11.1 Angles

Mark a point 'O' on a sheet of paper. From 'O' draw two rays $\overrightarrow{OA}$, $\overrightarrow{OB}$ as shown in the figure.

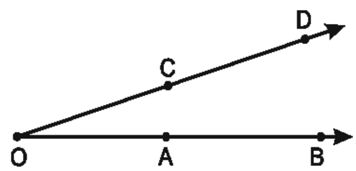


(fig 1).

In this figure both the rays start from a single point 'O'. An angle is formed at 'O'. Two rays $\overrightarrow{OA}$, $\overrightarrow{OB}$ are called as arms (or sides) of the angle. The common point 'O' is called as the 'vertex' of the angle. The angle is represented by a small curve as shown in the figure 1.

So, an angle is formed when two rays are drawn from a common point.

The angle shown in fig. 1 is represented as $\angle AOB$ or $\angle BOA$. We read it as angle AOB or angle BOA. Vertex of the angle is always written in the middle. Sometimes the angle is represented as $\angle O$.



(fig 2).

Observe the following figure (fig. 2)

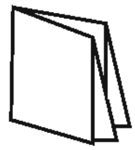
We know that rays are named by two points – one at its start and one on the remaining portion. So, $\overrightarrow{OA}$, $\overrightarrow{OB}$ represent the same ray. Likewise $\overrightarrow{OC}$, $\overrightarrow{OD}$ also represent the same ray. Therefore, the angles can be represented by the following ways.

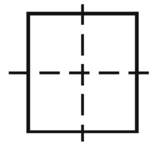
(fig 3).

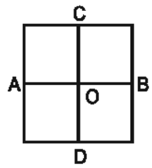
$\angle O$, $\angle COA$, $\angle DOA$, $\angle COB$, $\angle DOB$, $\angle AOC$, $\angle AOD$, $\angle BOC$, $\angle BOD$

In fig. 3, with 'O' as the centre, $\overrightarrow{OA}$ rotates in the anti-clockwise direction and reaches $\overrightarrow{OB}$. The rotation made by the ray is called the measure of that angle.

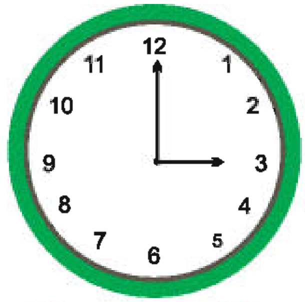
Right angle:





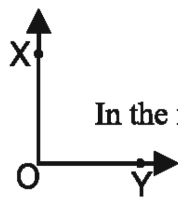


Fold a piece of paper as shown in the figure and unfold it. We get two intersecting line segments. Name these as AB and CD. These line segments make four angles at the point of intersection 'O'. We see that the four angles $\angle AOC, \angle BOC$, $\angle DOB, \angle AOD$ are equal.

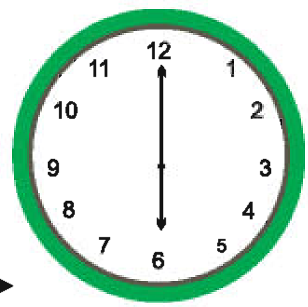


The measure of the angle at 3 o'clock.

Each of them is called a right angle. Right angle measures 90°.



In the fig. $\angle XOY$ is a right angle

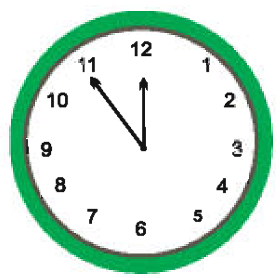


Straight Angle:

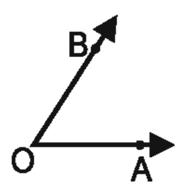
An angle whose measure is 180° is called a straight angle.

Measure of the angle at 6 o'clock.

Acute Angle:



An angle whose measure is greater than 0° but less than 90° is called an acute angle
Example: 2°, 10°, 37°, 18°, 89°.

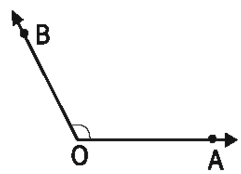


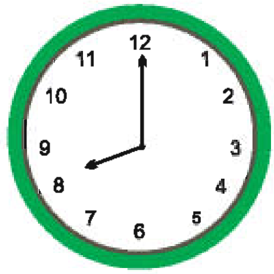
Measure of the angle at 11.55

Obtuse angle:

An angle whose measure is greater than 90° and less than 180° is called an obtuse angle

Example: 91°, 96°, 142°, 160°, 178°

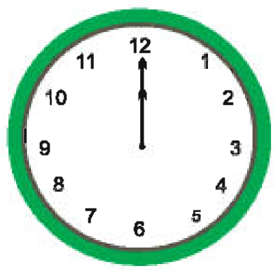




Measure of the angle at 8 o'clock.

Zero angle:

If both the rays coincide, the angle formed is 0°.



Measure of the angle at 12 o'clock.

Exercise 11.1

1. State whether the given angles are acute, right or obtuse angle.

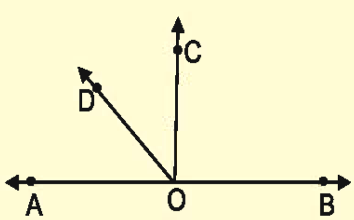
(i) 45° (ii) 138° (iii)100° (iv)175°

2. What is the measure of the angle formed by the hour hand and minute hand of a clock for the following timings?

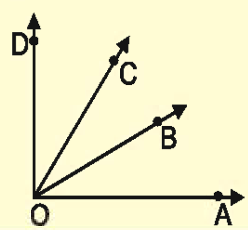
(i)12.10 (ii) 4.00 (iii)9.00 (iv)7.45

3. Name the angles and write its kind.

(i)



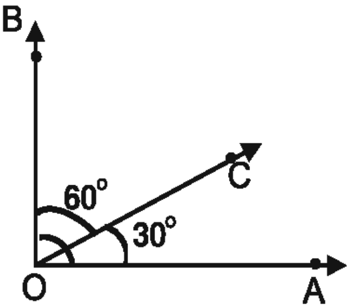
(ii)



11.2 Complementary angles and Supplementary angles

Complementary angles:

In the figure given $\angle AOB = 90^\circ$, we know that it is a right angle. The other angles are $\angle AOC = 30^\circ$, $\angle COB = 60^\circ$. Sum of $\angle AOC$ and $\angle COB$ is 90°.



(i.e) $30^\circ + 60^\circ = 90^\circ$

30° and 60° are complementary angles.

If the sum of the measures of two angles is 90°, then they are called complementary angles.

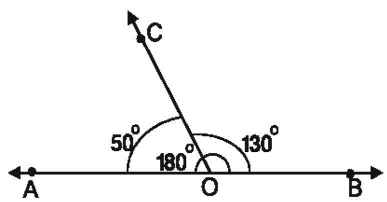
For Example :
When a ladder is leaning on a wall, the angles made by the ladder with the floor and the wall are always complementary.

Example : 1

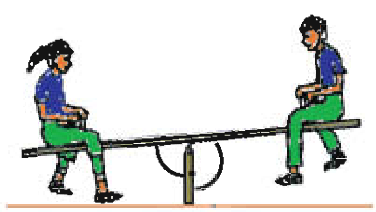
The complement of $40^\circ = 90^\circ - 40^\circ = 50^\circ$
The complement of $66^\circ = 90^\circ - 66^\circ = 24^\circ$
The complement of $35^\circ = 90^\circ - 35^\circ = 55^\circ$

Supplementary angles

In the given figure the angle formed by AB with 'O' is a straight angle (ie) 180°.
Here $\angle AOC = 50^\circ$, $\angle COB = 130^\circ$.
Moreover the sum of these two is 180°.
(i.e) $130^\circ + 50^\circ = 180^\circ$
130° and 50° are supplementary angles.



If the sum of the measures of two angles is 180° then they are called supplementary angles.



Example: The angles formed at the centre point of a see-saw are always supplementary angles.

Supplement of $40^\circ = 180^\circ - 40^\circ = 140^\circ$
Supplement of $110^\circ = 180^\circ - 110^\circ = 70^\circ$

Supplement of $78^\circ = 180^\circ - 78^\circ = 102^\circ$
Supplement of $66^\circ = 180^\circ - 66^\circ = 114^\circ$

Exercise 11.2

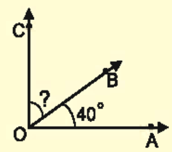
1. Find the complementary angles for the following.

   (i) 37° (ii) 42° (iii) 88° (iv) 0° (v) 16°

2. Find the supplementary angles for the following.

   (i) 6° (ii) 27° (iii) 88° (iv) 104° (v) 116° (vi) 146° (vii) 58 °
   (viii)179°

3. Find the measures of the angle from the figure.
   $\angle$BOC = ____________.



4. State whether true or false.

   (i) Measure of a straight angle is 180°
   (ii) If the sum of the measures of two angles is 90°, then they are called complementary angles.
   (iii) Complement of 26° is 84°.
   (iv) If the sum of the measures of two angles is 180°, then it is called a right angle.
   (v) Complement of an acute angle is an acute angle.
   (vi) The supplement of 110° is 70°.

5. State whether the given angles are complementary or supplementary

   (i) 25°, 65° (ii) 120°, 60° (iii) 45°, 45° (iv) 100°, 80°

6. (i) Find the angle which is equal to its complement?
   (ii) Find the angle which is equal to its supplement?

7. Fill in the blanks.

   (i) Supplement of a right angle is ……………..
   (ii) Supplement of an acute angle is ………………..
   (iii) Supplement of an obtuse angle is ………………..
   (iv) complement of an acute angle is ……………..

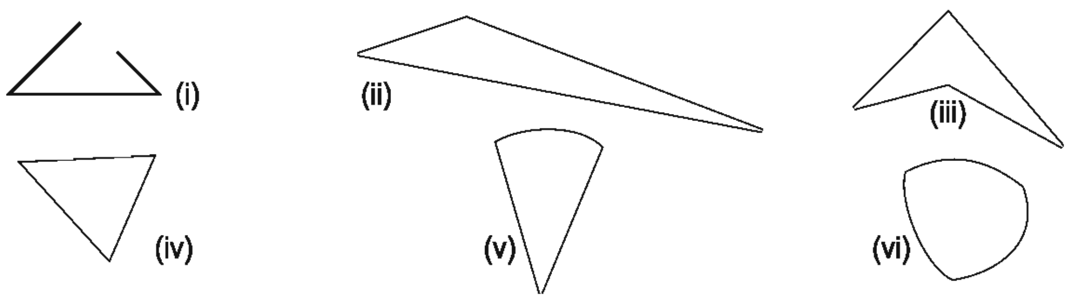
11.3 Triangles

We know angles and triangles. What is the relation between them?

We have already learnt that a three sided (line segments) closed plane figure is called a triangle. Then we wonder why is it called a **triangle** ?

When the three sides of a triangle meet they form three angles also! So it is called a triangle.

Find which of the following are triangles?



Types of triangles

Triangles are classified according to the measures of their sides and angles.

Measure the sides and angles of the following triangles and fill the table given

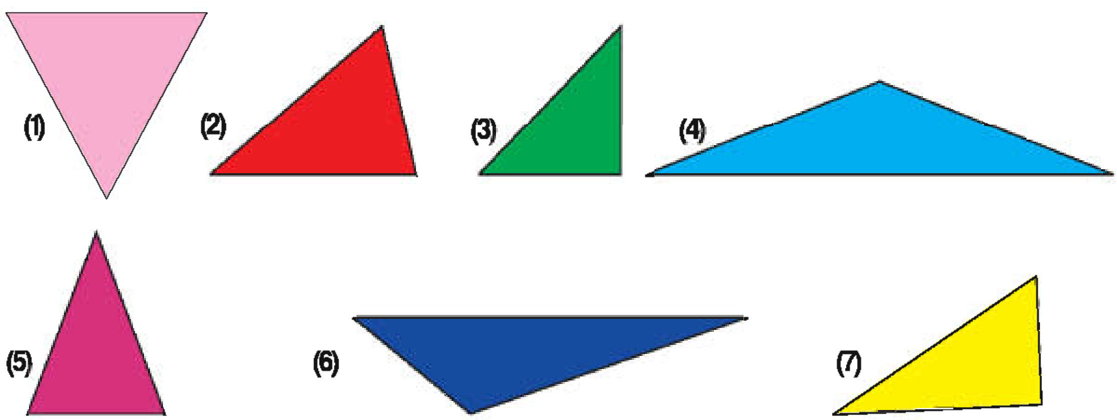


Figure	Measure of the angle	sum of the measure of the angles	Nature of the angles	Measure of the sides	Kinds of Triangles
1	60°, 60°, 60°	180°	Three angles are equal	3 cm, 3 cm, 3 cm	Equilateral triangles
2					
3					
4					
5					
6					
7					

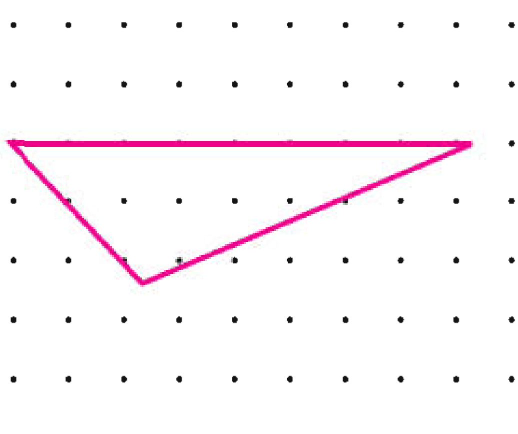
In the above triangles, compare the sum of any two sides with the third side.

From this, we come to know

•

- If the measure of three angles of a triangle are equal then its sides are also equal.
- If the measure of two angles of a triangle are equal then its two sides are equal.
- If the measure of two sides of a triangle are equal then its two angles are equal.
- If the measure of the angles are different then the measure of its sides are also different.
- If the measure of the sides are different then the measure of its angles are also different.
- Sum of the three angles of a triangle is 180°
- Sum of any two sides of a triangle is greater than the third side.

The above points are applicable to all triangles.



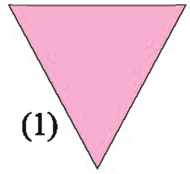
Do it yourself

Using rubber bands in a Geo board try to form various triangle and observe their properties.

Classification of triangles on the basics of sides:

If all the three sides of a triangle are equal then it is called an equilateral triangle.
Example: fig(1)

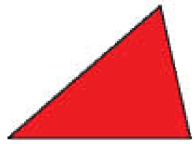
(1)



If any two sides of a triangle are equal then it is called an isosceles triangle.

Example: Figures (3), (4), (5).

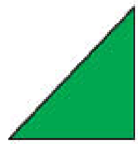
(2)



If all the three sides of a triangle are unequal then it is called a scalene triangle

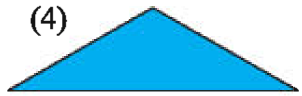
Example: Figures (2), (6), (7)

(3)



Classification of triangle on the basis of angles:
If each angle of a triangle is an acute angle, it is called an acute angled triangle

(4)

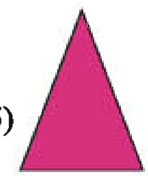


Example: Figures (1), (2), (5).

In a triangle, if any one angle is a right angle, then the triangle is called a right angled triangle.

Example: Figures (3), (7)

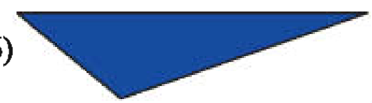
(5)



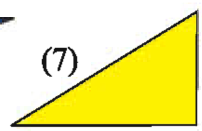
In a triangle, if one angle is an obtuse angle, then the triangle is called an obtuse angled triangle.

Example: figures (4), (6)

(6)



(7)



A few questions may arise now.

1. What type of triangle is it if it has a right angle and an obtuse angle?
2. Is it possible for a triangle to have either two obtuse angles or two right angles?

According to question 1 if a right angle and an obtuse angle is present in the same triangle the sum of the angles will always be more than 180˚. (why?)
So, such a triangle is not possible.

Example : 2

Write the type of triangle, based on their sides

(i) In Δ ABC, AB = 7 cm, BC = 8 cm, CA = 6 cm
(ii) In Δ PQR, PQ = 5 cm, QR = 4 cm, PR = 4 cm

Solution:
(i) All the three sides are unequal. So Δ ABC is a scalene triangle.
(ii) QR = PR = 4 cm. Two sides are equal. So Δ PQR is an isosceles triangle.

Example : 3

Can a triangle be drawn using measurements 4 cm, 10 cm and 5 cm? Give reason.

Solution:
10 + 4 = 14 is greater than 5.
10 + 5 = 15 is greater than 4.
4 + 5 = 9 is less than 10.

A triangle cannot be formed, because the sum of two sides is less than the third side.

Example : 4

Determine the kind of triangle if the three angles are
(I) $60^\circ, 45^\circ, 75^\circ$ (ii) $20^\circ, 90^\circ, 70^\circ$ (iii) $104^\circ, 35^\circ, 41^\circ$

Solution:
(i) Each angle is less than 90°. So it is an acute angled triangle.
(ii) One angle measures 90°. It is a right angled triangle.
(iii)One angle is greater than 90°. So it is an obtuse angled triangle.

Example : 5

Can we draw a triangle with angles $30^\circ, 80^\circ, 85^\circ$?

Solution:
The sum of the measure of the three angles is $30^\circ + 80^\circ + 85^\circ = 195^\circ$.
But the sum of the measure of the angles of a triangle is 180°.
Therefore a triangle cannot be formed using the given angles.

Example : 6

Can 100°, 120° be any two angles of a triangle?

Solution:
Sum of the given angles is $100^\circ + 120^\circ = 220^\circ$. This is greater than 180°, but the sum of the measures of the angles of a triangle should always be 180°. Even though the third angle is not known it is not possible to form a triangle with the given measures.

Therefore a triangle cannot have two obtuse angles.

Exercise 11.3

1. Fill in the blanks:

   (i) The sum of the three angles of a triangle is ....

   (ii) In an equilateral triangle .... sides are equal.

   (iii) The triangle in which two sides are equal is called .... Triangle.

   (iv) If a triangle has one right angle it is called a .... Triangle.

   (v) In a triangle the sum of the measure of any two sides is .... than the third side.

   (vi) Triangles can be classified into .... kinds according to their sides.

   (vii) Triangles can be classified into .... kinds according to their angles.

2. What are the six parts of a triangle?

3. Classify the triangle based on their angles.

Serial number	$\angle A$	$\angle B$	$\angle C$	Type
(i)	30°	45°	105°	
(ii)	25°	90°	65°	
(iii)	62°	45°	73°	
(iv)	120°	30°	30°	

4. Can we have a triangle whose degree measures as:

(i) $30^\circ, 60^\circ, 90^\circ$

(ii) $40^\circ, 100^\circ, 40^\circ$

(iii) $60^\circ, 70^\circ, 20^\circ$

(iv) $50^\circ, 75^\circ, 65^\circ$

(v) $90^\circ, 90^\circ, 0^\circ$

5. Classify the triangles based on their sides

Serial number	AB cm	BC cm	CA cm	Type
(i)	5	2	5	
(ii)	3	3	3	
(iii)	6	7	3	
(iv)	4	5	7	

6. State if the following could be the possible lengths of the sides of a triangle

(i) 3 cm, 6 cm, 9 cm (ii) 10 cm, 6 cm, 3 cm (iii) 15 cm, 10 cm, 8 cm

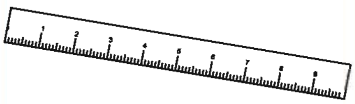
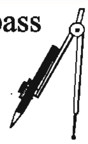
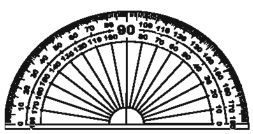
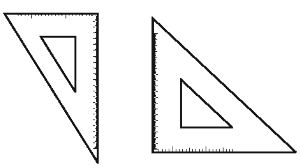
(iv) 12 cm, 20 cm, 8 cm

12-Practical Geometry

In our daily life we come across many shapes. These shapes contain many lines and angles. Many shapes are drawn as pictures. To draw these pictures we use instruments such as a ruler, compass, divider, protractor and set squares. All these instruments are in the geometry box.

12.1 Geometrical instrument box:

The instruments found in the geometry box are ruler, compass, divider, protractor and a pair of set squares.

S.No	Name and Diagram	Description	Uses
1	Ruler 	One edge of the ruler is graduated in centimetres and the other in inches	1. To draw lines 2. To measure the length of the line segment
2	Compass 	One side has a sharp edge and the other has a provision to insert a pencil	To draw a circle or a arc of the circle with the given measurement.
3	Divider 	Sharp edges on both the sides	1. To measure the length of a line segment 2. To compare the lengths of two given line segments.
4	Protractor 	It is in a semi-circular shape. The graduation starts from 0° on the right side and ends with 180° on the left side and vice versa	1. To measure angle 2. To construct angles
5	Pair of set squares 	1. One set square has $45^\circ, 45^\circ, 90^\circ$ at the vertices 2. The other has 30°, $60^\circ, 90^\circ$ at the vertices	1. To draw perpendicular lines 2. To draw parallel lines

POINTS TO REMEMBER

1. In the instrument box all the instruments should have fine edges and tips.
2. It is better to have two sharp edged pencils, one to insert in the compass and the other to draw lines and mark points.
3. There should be an eraser and a sharpner also in the geometry box.

12.2 To draw and measure line segments

We know

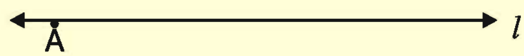
- A line segment is the shortest distance that connects two given points, but a line has no end points.
- The line segment AB can be written as $\overline{AB}$ or line segment AB.
- Length of the line segment AB = length of the line segment BA ($\overline{AB} = \overline{BA}$).
- A line segment can be measured either with a ruler or a divider.

Construction of a Line Segment:

Example : 1

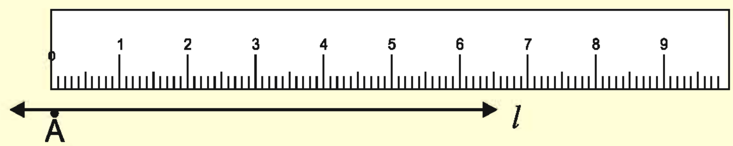
Draw a line segment AB = 5.8 cm using a ruler.

Step 1:



Draw a line "*l*" and mark a point A on it.

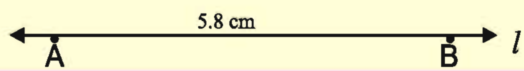
Step 2:



Fix a ruler on the line. Fix it in such a way that the zero on the scale and the point " A" coincides.

Step 3:

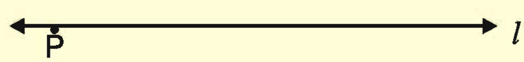
1. From A, measure 5.8 cm
2. Mark the point as B
3. $\overline{AB}$ = 5.8 cm is the required line segment



Example : 2

With the help of a ruler and compass draw a line segment $\overline{PQ}$ = 2.5 cm

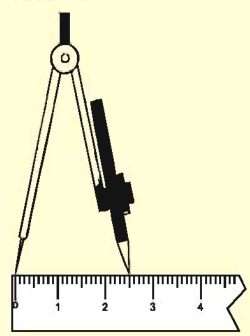
Step 1:



Draw a line "*l*" and mark a point P on it.

Step 2:

With the help of a compass measure 2.5cm as shown in the figure.

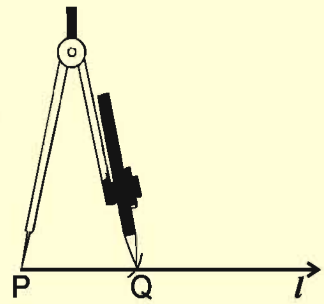


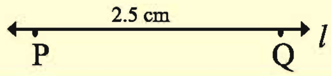
Step 3:

(I) Place the sharp edge of the compass at P

(ii) Then with the pencil point draw a small arc on l to cut the line. Mark the point as Q.

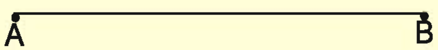
(iii) $\overline{PQ}$ = 2.5 cm is the required line segment

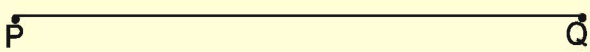




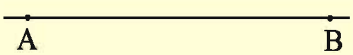
Exercise 12.1

1. With the help of a ruler and a compass find the length of the following line segments.

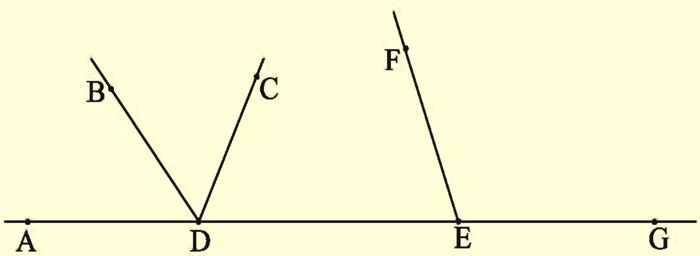
i) 

ii) 

2. Find the length of the following line segments.

i) 

AB = -------

ii) 

AD =
BD =
CD =
AE =

DE =
EF =
EG =
DG =
AG =

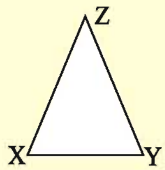
3. Draw a line segment for the following measurements using a ruler.

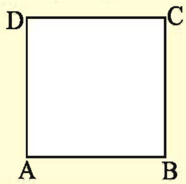
(i) CD = 7.5 cm (ii) MN = 9.4 cm (iii) RS = 5.2 cm

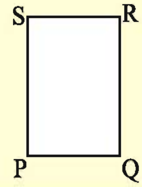
4. With the help of a ruler and a compass draw line segment for the following measurements.

(i) XY = 7.8 cm (ii) PQ = 5.3 cm (iii) AB = 6.1 cm

5. Find the perimeter for the following figures.

i) 

ii) 

iii) 

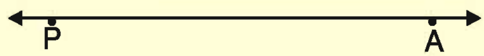
12.3 Constructing and Measuring Angles.

The unit for measurement of an angle is degree.

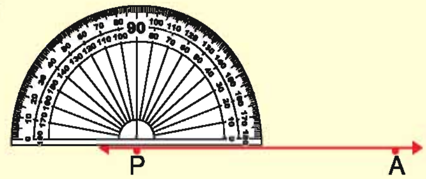
Example : 3

Construct an acute angle of 60 °

Step 1: Draw a line segment PA.

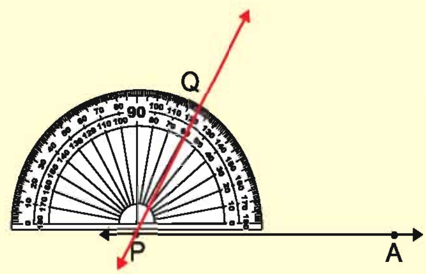


Step 2: (i) Place the protractor on the line segment PA
(ii) Place the mid point of the protractor at point P as shown in the figure.



Step 3: (i) On PA from the right start counting from 0 ° in the ascending order (anti clock wise direction) and finally mark a point Q using a sharp pencil at the point showing 60 ° on the semi-circular edge of the protractor.
(ii) Remove the protractor and join PQ
(iii) We get the required angle

m∠APQ = 60 °



Example : 4

Construct an obtuse angle 125 °

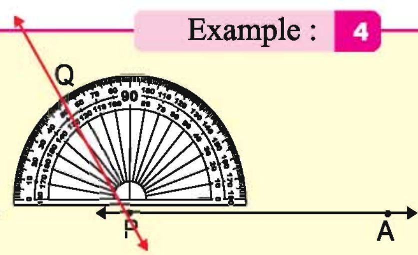
Follow the procedure given in example3 for step 1 and step 2

Step 3:

(i) On PA from the right start counting from 0 ° in the ascending order (anticlockwise direction) and finally mark a point Q using a sharp pencil at the point between 120 ° and 130 ° showing 125 ° on the semi-circular edge of the protractor.

(ii) Remove the protractor and join PQ

We get the required angle m∠APQ = 125 °



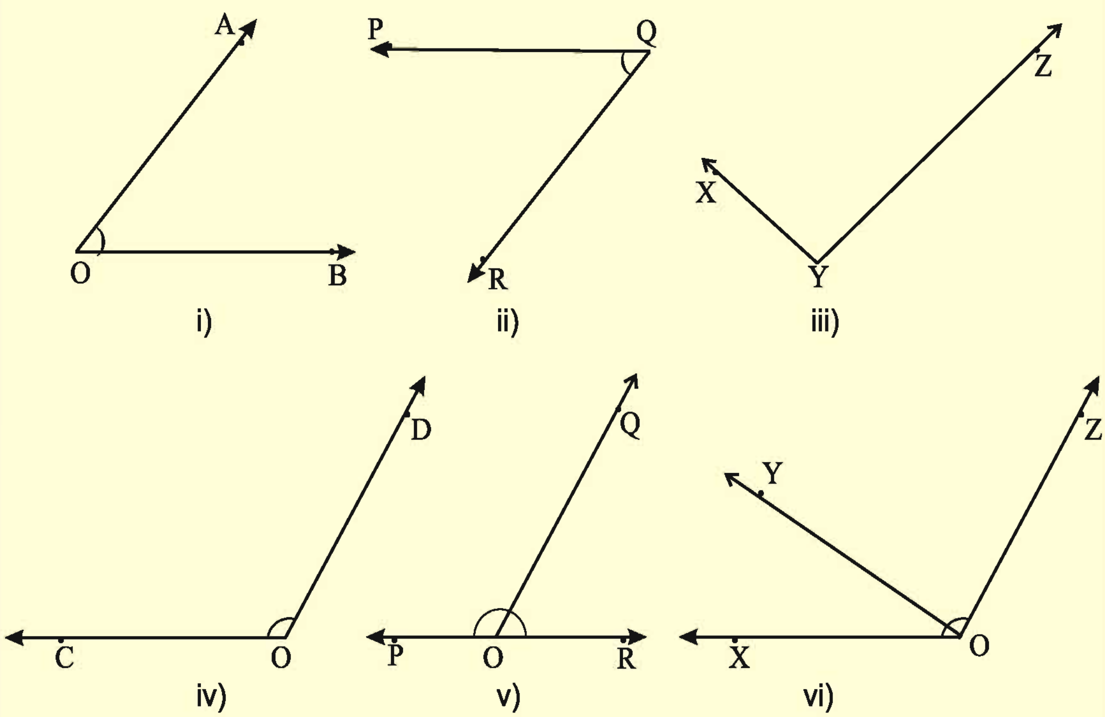
Exercise 12.2

1. Draw and name the following angles.

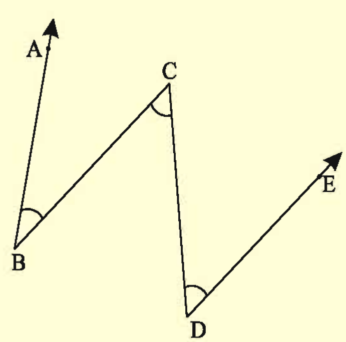
i) 65° ii) 35° iii) 110° iv) 155° v) 69°

2. Draw and measure the angles made by the hour hand and minute hand of a clock when it shows 9 o' clock, 4 o' clock and 12 o' clock respectively.

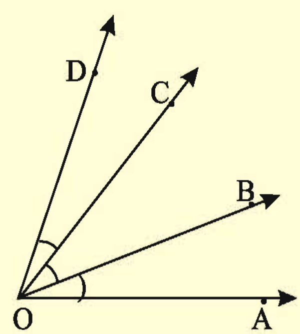
3. Measure and name the angles for the following figures.



4. From the given figure measure and write m∠ABC , m∠BCD , m∠ CDE

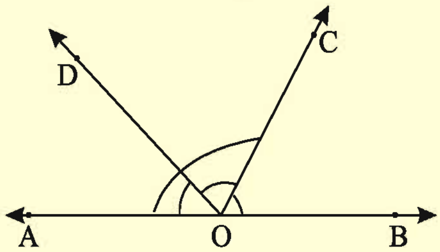


5. Measure the following six angles in the figure given below



1. m∠ AOB
2. m∠ AOC
3. m∠ AOD
4. m∠ BOC
5. m∠ BOD
6. m∠ COD

6. Measure and name the angles in the following figure.

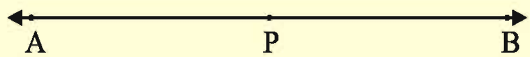


12.4 Construction of Perpendicular lines and parallel lines

Example : 5

Using a set square and a ruler construct a line perpendicular to the given line at a point on it.

Step 1



(i) Draw a line AB with the help of a ruler

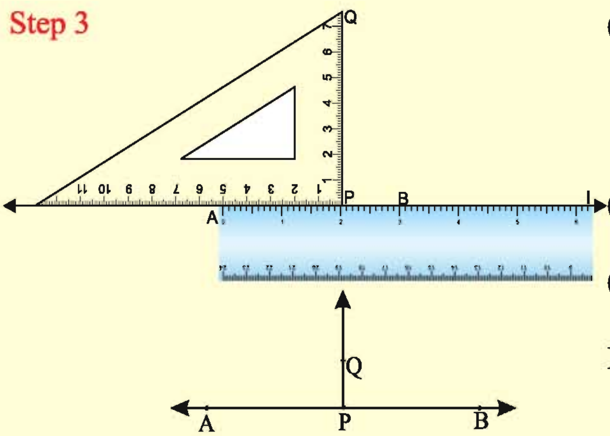
(ii) Mark a point P on it

Step 2

(i) Place a ruler on the line AB

(ii) Place one edge of a set square containing the right angle along the given line AB as shown in the figure.

Step 3



(i) Pressing the ruler tightly with the left hand, slide the set square along the ruler till the edge of the set square touches the point P.

(ii) Through P, draw a line PQ along the edge.

(iii) PQ is the required line perpendicular to AB

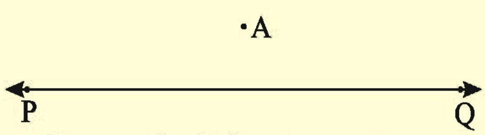
Measure and check if

$m\angle APQ = m\angle BPQ = 90^\circ$

Example : 6

Using a set square and a ruler draw a line perpendicular to the given line through a point above it.

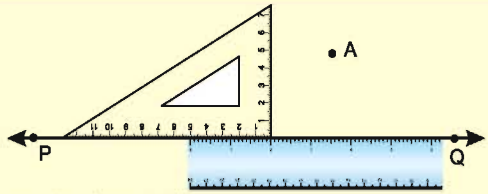
Step 1:



(i) Draw a line PQ using a ruler

(ii) Mark a point A above the given line

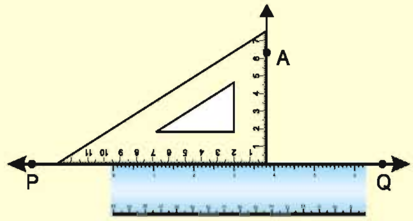
Step 2



(i) Place the ruler on the line PQ

(ii) Place one edge of a set square containing the right angle along the given line PQ as shown in the figure.

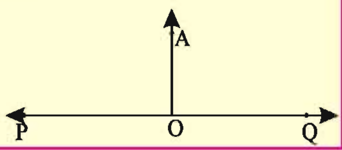
Step 3



(I) Pressing tightly the ruler with the left hand, slide the set square along the ruler till the edge of the set square touches the point A

(ii) Through A draw a line AO along the edge.

(iii) AO is the required line perpendicular to PQ



Measure and check : $m\angle POA = m\angle QOA = 90^\circ$

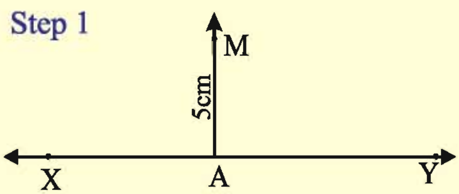
Example : 7

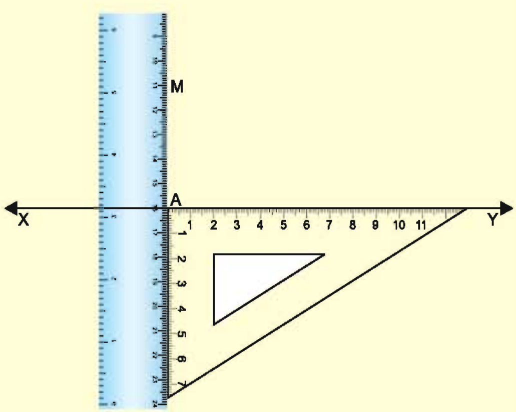
Using a set square and a ruler draw a line parallel to a given line through a point at a distance of 5cm above it.

(i) Draw a line XY using ruler and mark a point A on it.

(ii) Draw AM = 5 cm with the help of a set square.

Step 1



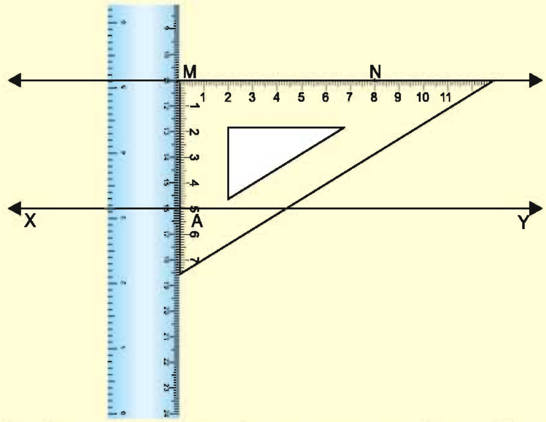


Step 2

Place the set square on the line segment XY

(i) Place the scale as shown in the figure

Step 3



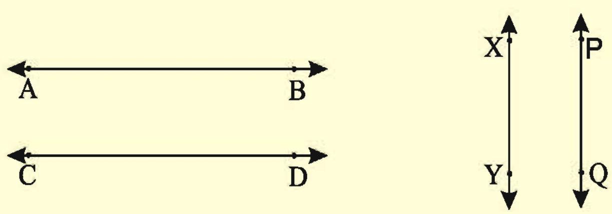
(i) Pressing tightly the ruler, slide the set square along the ruler till the edge of the set square touches the point M.

(ii) Through M, draw a line MN along the edge.

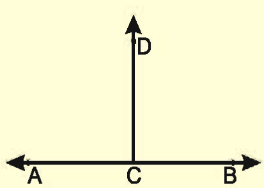
(iii) MN is the required line parallel to XY through M.

Exercise 12.3

1. Find the distance between the given parallel lines



2. Find the length of the perpendicular lines AB and CD



3. Draw a line segment measuring 5.6 cm. Mark a point P on it. Through P draw a line perpendicular to the given line.

4. Draw a line segment measuring 6.2 cm. Mark a point A above it. Through A draw a line perpendicular to the given line.

5. Draw a line segment measuring 7.1 cm. Mark a point M below the line segment. Through M draw a line perpendicular to the given line segment.

6. Draw a line segment measuring 5.2 cm. Mark a point B above it at a distance of 4.3cm. Through B draw a line parallel to the given line segment.

7. Draw a line segment. Mark a point Q below it at a distance of 5.1cm. Through Q draw a line parallel to the given line segment.

Points to Remember

- Line segment is the shortest distance that connects the two given points.
- A line segment has 2 end points
- A line segment AB is denoted as $\overline{AB}$
- A line has no end points.
- Length of the line segment AB = length of the line segment BA. (ie) $\overline{AB} = \overline{BA}$
- The unit for measurement of an angle is degree.
- The angle between two perpendicular lines is 90 $^\circ$.

13. Data Handling

13.1 Data

You must have seen your teacher writing information regarding attendance of the students on the black board.

Information regarding number on roll and attendance		Boys	Girls	Total
Class : 6 Day : Monday	Number on Roll	20	20	40
	No.of students present	20	18	38

In the same way, the marks obtained by students of a class in a particular examination, the maximum and minimum temperature of different places in a state are collection of information in the form of numerical figures.

> Any collection of information in the form of numerical figures giving the required information is called a data.

13.1.1 Collection of data

To submit information to the Government, the data of the mode of transport of 40 children of a school was collected.

They tabulated the same as follows

S.No.	Mode of transport	S.No.	Mode of transport	S.No.	Mode of transport	S.No.	Mode of transport
1	Bus	11	Bus	21	Bus	31	Bus
2	Train	12	Cycle	22	Cycle	32	Cycle
3	Cycle	13	Walk	23	Walk	33	Train
4	Bus	14	Bus	24	Walk	34	Bus
5	Walk	15	Walk	25	Walk	35	Bus
6	Walk	16	Walk	26	Bus	36	Walk
7	Train	17	Bus	27	Bus	37	Walk
8	Bus	18	Bus	28	Walk	38	Walk
9	Cycle	19	Train	29	Cycle	39	Train
10	Bus	20	Cycle	30	Bus	40	Bus

13.1.2. Raw data (unclassified data)

It is difficult to find how many different modes of transports are used by the students. How many of them use each mode? etc. from the above table. It is just a collection of data. They are not classified to give specific information.

13.1.3. Classification of data

From the above unclassified data, we come to know that many students use bus, cycle and train as a mode of transport or they come by walk.

From the information collected from students the modes of transport are listed one below the other as shown in the table. A mark is made against each mode for each student using it. Finally we count the number of marks to get the number of students using each mode.

Bus	IIIIIIIIIIIIIIII	16
Train	IIIII	5
Cycle	IIIIIII	7
By walk	IIIIIIIIIIII	12
Total		40

' I ' is called a 'tally mark'. It is difficult to count if there are more number of tally marks.

Therefore to make it easier to count, we change it as follows.

Mode of Transport	Tally Mark	Number of students
Bus	卌 卌 卌 I	16
Train	卌	5
Cycle	卌 II	7
By walk	卌 卌 II	12
	Total	40

After 4 tally marks the fifth tally mark is entered as a cross line cutting across diagonally all the 4 tally marks as shown (𝍸) and it is counted as 5. We can calculate the number of students coming by bus as 5 + 5 + 5 + 1 = 16. In the same way we can find the remaining data also.

The raw data is rearranged and tabulated to get classified or tabulated data.

Example : 1

Information was collected from 20 students of a class regarding competitions they like to participate.

No. of the student	Competetion	No. of the student	Competetion	No. of the student	Competetion	No. of the student	Competetion
1.	Cricket	6	Kabadi	11	Ball Badminton	16	Ball Badminton
2.	Kabadi	7	Cricket	12	Kabadi	17	Ball Badminton
3.	Foot Ball	8	Cricket	12	Foot Ball	17	Football
4.	Foot Ball	9	Kabadi	14	Ball Badminton	19	Ball Badminton
5.	Kabadi	10	Foot Ball	15	Kabadi	20	Football

Tabulate the above information using tally mark.

All the students have chosen any one of the games.

We can tabulate it as follows:-

Cricket	|||	3
Kabadi	𝍸 |	6
Foot Ball	𝍸 |	6
Ball Badminton	𝍸	5
	Total	20

Example : 2

The classified data of the number of students who were absent in a class room in a particular week is given.

If each student is denoted by a tally mark, answer the following:-

<table>
<tr><th>Days</th><th>No. of students (tally marks)</th></tr>
<tr><td>Monday</td><td>~~||||~~</td></tr>
<tr><td>Tuesday</td><td>||||</td></tr>
<tr><td>Wednesday</td><td>||</td></tr>
<tr><td>Thursday</td><td></td></tr>
<tr><td>Friday</td><td>|</td></tr>
<tr><td>Saturday</td><td>~~||||~~ |||</td></tr>
</table>

1 How many students were absent on each day of the week?

Answer: Monday – 5, Tuesday – 4, Wednesday – 2, Thursday – 0 , Friday – 1, Saturday - 8

2 Which day had maximum number of absentees?

Answer : Saturday

3 Which day had minimum number of absentees?

Answer : Thursday

Do it yourself

Ask the students to collect and tabulate the information about the different types of houses in villages.

Type of house	Tally mark	Total no. of houses
Thatched house		
Tiled house		
Asbestos house		
Concrete house		

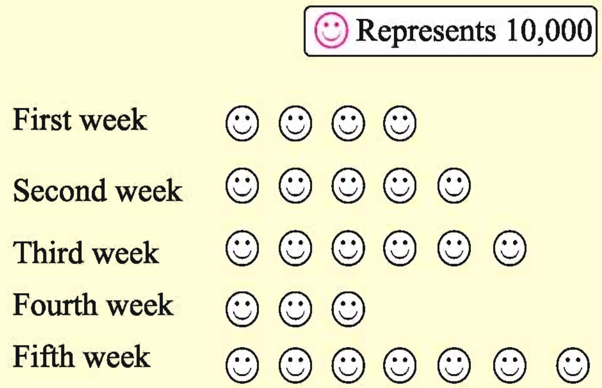
1) Which type of houses are more in number?
2) Which type of houses are less in number?
3) Are there two or more type of houses in the same number? If so, name them.

13.2.Drawing Pictographs:

Information are easily understood when represented by pictures.

Example : 3

The following picture shows the number of people who visited the tourism trade fair in 5 weeks.



Questions:

1 How many of them visited the fair in the 1st week?

2 Which week had maximum visitors?

3 Which week had minimum visitors?

4 Find the total number of visitors who enjoyed the fair?

Solution:

1 40,000 people visited in the first week.

2 Maximum people visited in the fifth week

3 Minimum people visited in the fourth week

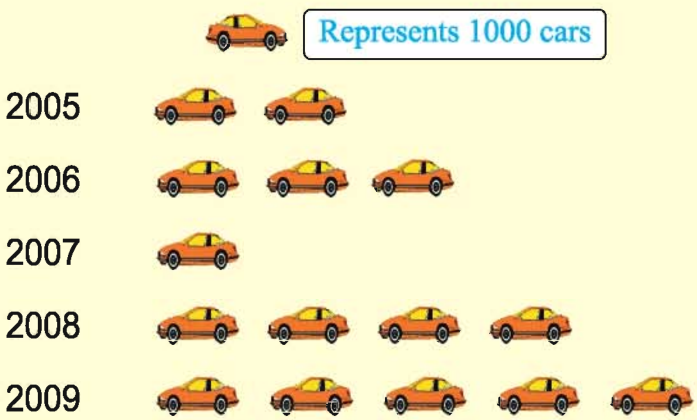
4 Total number of visitors in the fair = 2,50,000

Example : 4

The manufacturing of cars in a car factory during the years 2005 to 2009 is given in the following table.

Year	No. of cars
2005	2000
2006	3000
2007	1000
2008	4000
2009	5000

The following pictograph represents the above information.



Pictograph of the manufacture of cars in a car factory during the years 2005 to 2009.

Questions:

1 In which year the minimum number of cars were manufactured?
2 Find the year in which the number of cars manufactured was 3000
3 Find the total number of cars manufactured upto 2008 (inclusive of 2008).
4 Find the total number of cars manufactured in 2008 and 2009.

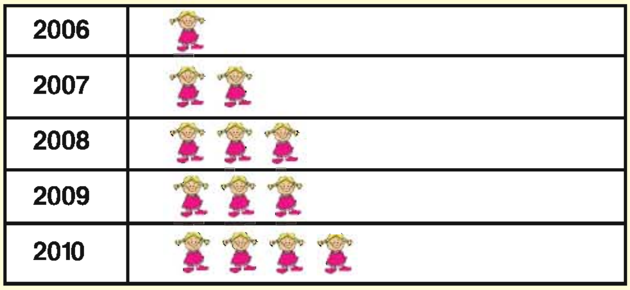
Solution :

1 Minimum number of cars were manufactured in 2007
2 3000 cars were manufactured in 2006.
3 10,000 cars were manufactured up to 2008
(2000 + 3000 + 1000 + 4000 = 10,000)
4 9000 cars were manufactured in 2008 and 2009.

Exercise 13.1.

I. See the pictograph and answer the questions

 represents 200 girls



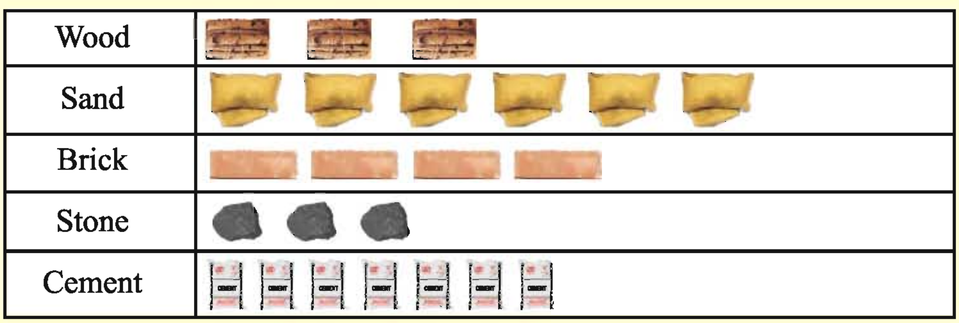
Pictograph of the total number of girls studied in a high school in the years 2006 to 2010.

Questions:

1 Find the year in which the minimum numbers of girls studied.
2 Find the year in which the maximum number of girls studied.
3 Find the years in which the number of girls studied was 600.
4 Find the difference between the maximum number of students and minimum number of students.
5 Say true or false
    1 Equal number of girls studied in the year 2008 and 2009

II. See the pictograph and answer the following questions.

Each picture represents Rs. 10,000



Pictograph shows the expense in constructing a house.

Questions:

1 What information is given by the pictograph?
2 How much did he spend for sand?
3 What is the total amount spent for bricks and stones?
4 State the item on which maximum amount was spent?
5 What is the total expense of constructing a house?

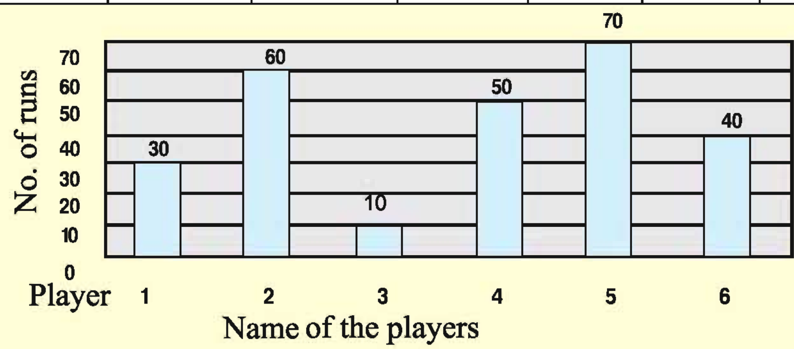
13.3. BAR DIAGRAM

- Through bar diagrams the statistical data can be understood easily.
- It can be used to compare two items easily.
- A bar diagram consists of many rectangular bars.
- The bars are drawn between the horizontal line and the vertical line. The interval between the bars must be equal and the thickness of the bars must be same

Example : 5

The total number of runs scored by a few players in one-day match in India is given
Draw the bar diagram.

Players	1	2	3	4	5	6
No. of runs	30	60	10	50	70	40



Represent the number of players on the horizontal line and represent the number of runs on the vertical line

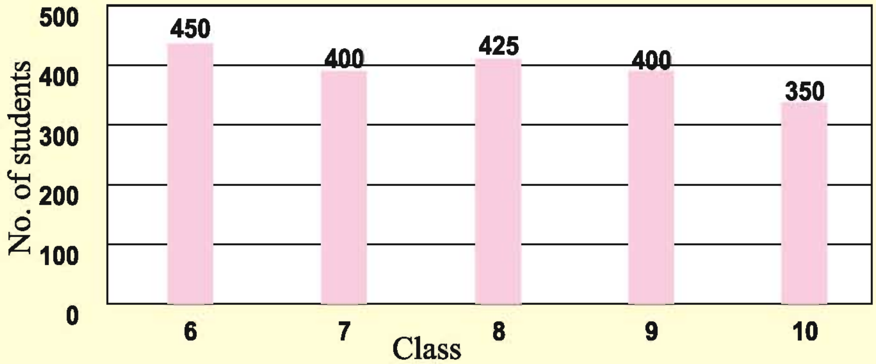
Scale - In vertical line 1 cm = 10 runs

Example : 6

The number of students in each class of a high school is given below.

Draw a bar diagram.

Class	6	7	8	9	10
No. of students	450	400	425	400	350



The number of students should be written on the vertical line and the classes 6 to 10 must be given on the horizontal line.

1 cm on the vertical line = 100 students.

Exercise – 13.2

1. Construct a bar graph to represent the following information. Number of absentees in a week in a corporation high school are given

Class	6	7	8	9	10
Absentees	8	12	9	15	6

2) The number of students taking part in various games in a higher secondary school are given below. Draw a bar diagram

Game	Foot Ball	Net Ball	Basket Ball	Cricket	Athletics
No. of Student	25	30	15	20	10

3) The savings of a student is given in the table. Draw a bar diagram.

Month	June	July	August	September	October	November	December
Amount (Rs)	20	35	25	15	10	40	30

4) Draw a bar diagram to represent the most popular television programmes.

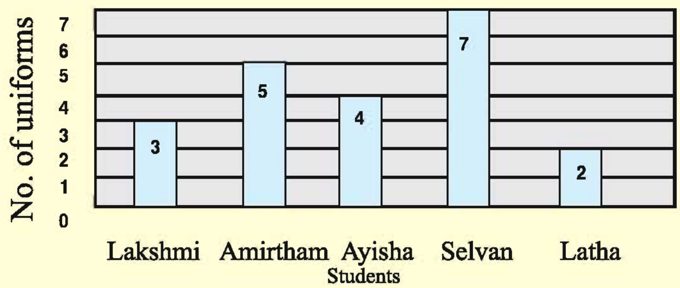
Television programme	Cartoon	Games	Pogo	Animal Planet	Tourism	News
No. of viewers	150	100	125	200	100	250

13. 4. Reading bar diagrams

Example : 7

The number of uniform sets a few 6 standard students have with them are given in the table followed by a bar diagram.

Name of the students	Lakshmi	Amirtham	Ayisha	Selvan	Latha
Number of uniforms	3	5	4	7	2



From the above bar diagram, answer the following:-

1 What is the name of the student having maximum number of uniform? (Selvan)

2 How many uniforms does Ayisha have? (4)

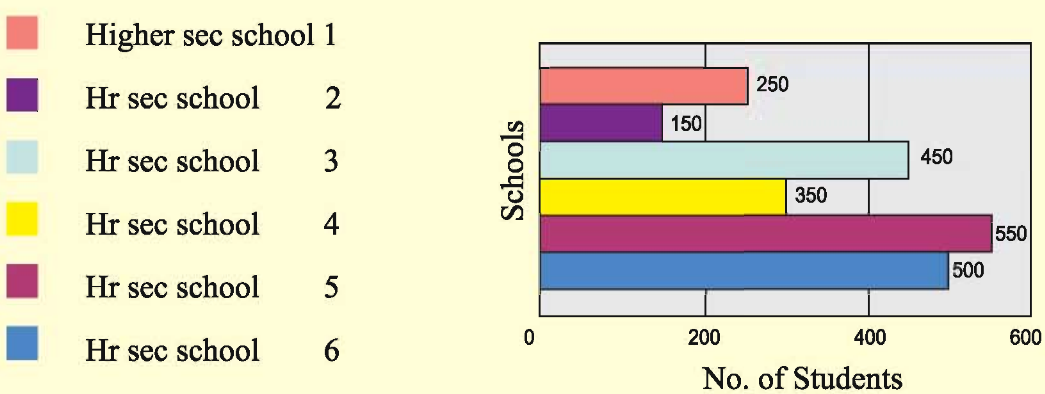
3 Who has the minimum number of uniforms? (Latha)

4 The information is given about _______ students. (5)

5 How many students have more than two sets of uniform? (4)

Example : 8

The bar diagram is given to represent the names of the schools and the number of students who took part in an examination conducted by a Municipal Higher Secondary School. Answer the following questions:



1 Name the school from which maximum number of students participated (Hr sec school 5)

2 How many schools took part in the examination? (6)

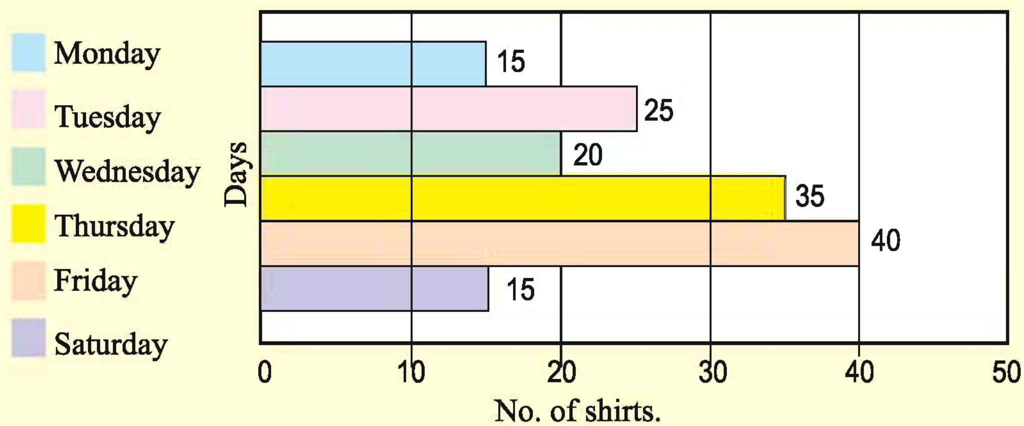
3 Name the school from which minimum number of students participated (Hr sec school – 4)

4 Name the school from which 350 students participated (Hr sec school – 4)

5 How many students participated from Hr sec school – 6 ? (500)

Exercise 13.3

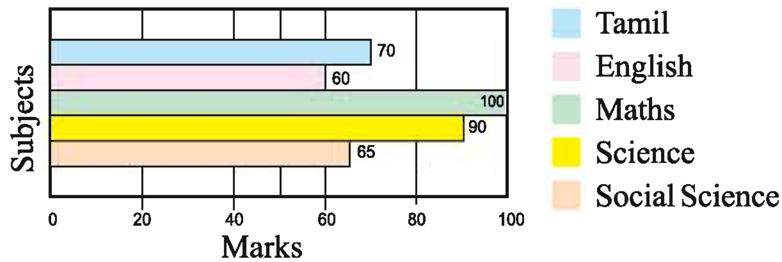
The bar diagram represents the number of shirts produced in a tailoring unit in 6 days. Answer the following.



Questions:

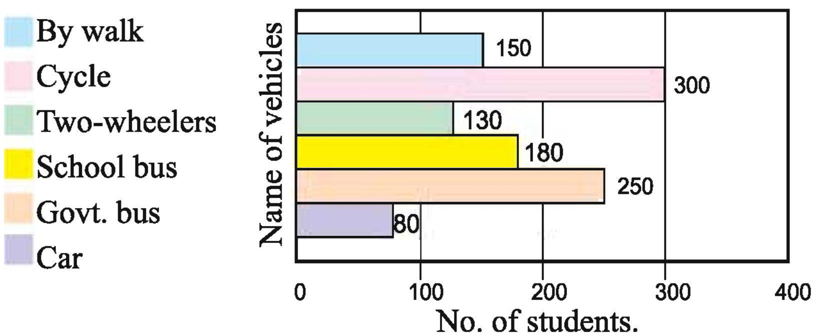
1 On which day of the week the maximum number of shirts were produced ? How many ?
2 What is the number of shirts produced on Tuesday ?
3 On which days of the week, were equal number of shirts produced?
4 What is the information given by the bar graph ?
5 How many shirts does one cm represent on the horizontal line?

II. The marks scored by a student in half yearly examination are given below. Answer the following questions:



1. What is the information given by the bar diagram?
2. How much did the student score in Science ?
3. Name the subject in which he has scored the maximum marks?
4. What is the total marks scored by him in both the languages together ?
5. Form a table to show the marks scored by the student in all the 5 subjects.

III. The bar diagram represents the number of students using different modes of transport. Answer the following questions.



Questions:

1 Which mode of transport is mostly used by the students?
2 What is the information given by the bar diagram ?
3 How many students come by walk to school ?
4 How many students were represented by 1 cm on the horizontal line ?
5 Name the mode of transport used by the minimum number of students?

Points to remember

1 Data is a collection of numerical figures giving required information.
2 The information which is collected initially is called the raw data or unclassified data.
3 The classified and tabulated information help us to get a better understanding of the data collected.
4 Pictographs are used to represent information through pictures.

Answers

Exercise1.1

1) (i) Thousand, 20 Thousand (ii) 12, 27 (iii) 1 lakhs, 30 lakhs (iv) 2 crore, 5 crore 1 lakhs (v) 97, 109 (similarly we can give many more answer)
2) (i) Four Hundred, Eight Thousand, Thirty Thousand, Ten lakhs, Twenty crores (Ascending Order)
Twenty crores, Ten lakhs, Thirty Thousand, Eight Thousand, Four Hundred (Descending Order)
(ii) 99, 8888, 23456, 55555, 1111111 (Ascending Order)
1111111, 55555, 23456, 8888, 99 (Descending Order)

Exercise1.2

1) Ten Thousand, Thousand, Hundred, Ten, One 2) No
3) (i) No (ii) No (iii) Yes

Exercise1.3

2) One Lakh = 100 Thousands = 1000 Hundreds = 10000 Tens = 100000 Ones
3) One Crore = 100 Lakhs = 10000 Thousands
4) Rs.10 lakhs 5) (i) 36, 216, 1296 (ii) 100, 10,000, 10,00,00,000.
6) Eighty Thousand > Twenty Thousands > Ten Thousand,
Ten Thousand < Twenty Thousands < Eighty Thousand

Exercise1.4

1) Yes (7 lakhs, 5 Thousand x 2 = 14 Lakhs 10 Thousand)
2) 10,000 Enough. (Science 462 x 18 = 7,668 < 10,000)
7200 not enough (Science 462 x 18 = 7,668 > 7,200)
3) Rs. 100
4) (i) 67,290 (ii) 63, 290 (iii) 61,290 (iv) 31,235 (v) 30,235 (vi) 29,935
5) (i) 1,000 (ii) 2,000 (iii) 400 (iv) 500 (v) 50,505 (vi) 10,101

Exercise 2.1

1) (i)169 (ii) 264 iii) 1300 (2) 3775 (3)(i)6200 (ii) 2500 (iii) 650

Exercise 2.2

1) (i) False (ii) True (iii) True (iv) True (v) True
2) (i) c (ii) c (iii) a (iv) b (v) a
3) (i) 1,2,4,8 (ii) 1,3,5,15 (iii) 1,3,5,9,15,45 (iv) 1,11,121 (v) 1,2,7,14
4) 81,84,87,90,93,96,99
5) (i) 25,30,35,40,45,50 (ii) 30,40,50, all multiples of 10 are multiples 5 also
6) (i) False (ii) False (iii) False (iv) False (v) True
7) (i) a (ii) b (iii) d (iv) b (v) c
8) 31,37,41,43,47,53,59
9) No

Exercise 2.3

1) i) True ii) True iii) True

2)

	Divisibility								
Numbers	2	3	4	5	6	8	9	10	11
918	Yes	Yes	No	No	Yes	No	Yes	No	No
1,453	No	No	No	No	No	No	No	No	No
8,712	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
11,408	Yes	No	Yes	No	No	Yes	No	No	No
51,200	Yes	No	Yes	Yes	No	Yes	No	Yes	No
732,005	No	No	No	Yes	No	No	No	No	No
12,34,321	No	No	No	No	No	No	No	No	Yes

3) 76043120, 9732, 98260, 431965, 1190184, 31795872, 32067, 12345670, 869484, 56010,923593

4) 64,8,112 (5) Yes

Exercise 2.4

1. (i) 2 x 3 (ii) 3 x 5 (iii) 3 x 7 (iv) 2 x 3 x 5 (v) 11 x 11 (vi) 5 x 29
(vii) 2x3 x 3 x 3 x 3 (viii) 2 x 5 x 17 (ix) 2 x 2 x 3 x 3 x 5 (x) 2x 2x 2x 5x5

Exercise 2.5

1) i) True ii) False iii) False iv) True

2) i) (c) ii) (c) iii) (a) iv) (c)

3) i) 6 , 210 ii) 34 , 102 iii) 3 , 900 iv) 12 , 432

4) 15 kg

Exercise 2.6

1) (iv) 2) 39 3) 14

Exercise 3.1

1. (i) $\frac{10}{12}, \frac{15}{18}, \frac{20}{24}, \frac{30}{36}$ (ii) $\frac{9}{24}, \frac{15}{40}, \frac{21}{56}, \frac{6}{16}$ (iii) $\frac{6}{21}, \frac{14}{49}, \frac{12}{42}, \frac{16}{56}$

iv) $\frac{6}{20}, \frac{9}{30}, \frac{12}{40}, \frac{15}{50}$ 2. $\frac{2}{5}, \frac{16}{40}$ $\frac{3}{4}, \frac{9}{12}, \frac{12}{16}$ 3. (i) $\frac{6}{7}$ (ii) $\frac{7}{12}$ (iii) $\frac{3}{4}$ (iv) $\frac{1}{3}$ (v) $\frac{5}{9}$

4. (i) 5 , 12 (ii) 35 , 12 (iii) 63 , 40

Exercise 3.2

1. (i) $\frac{5}{7}$ (ii) $\frac{7}{12}$ (iii) $\frac{16}{19}$ (iv) $\frac{31}{34}$ (v) $\frac{37}{137}$

2. (i) $\frac{3}{4}$ (ii) $\frac{7}{7} = 1$ (iii) $\frac{12}{13}$ (iv) $\frac{12}{7}$ (v) $\frac{81}{124}$ (vi) $\frac{13}{72}$

3. (i) $\frac{8}{13}$ (ii) $\frac{3}{17}$ (iii) $\frac{1}{39}$ (iv) $\frac{64}{47}$ (v) $\frac{75}{107}$ (vi) $\frac{13}{122}$

Exercise 3.3

1. (i) $\frac{5}{7}$ (ii) $\frac{7}{12}$ (iii) $\frac{6}{5}$ (iv) $\frac{4}{3}$ (v) $\frac{3}{2}$

2. (i) $\frac{17}{12}$ (ii) $\frac{7}{8}$ (iii) $\frac{8}{5}$ (iv) $\frac{27}{8}$ (v) $\frac{17}{50}$ (vi) $\frac{33}{20}$

3. (i) $\frac{5}{12}$ (ii) $\frac{3}{10}$ (iii) $\frac{3}{8}$ (iv) $\frac{17}{28}$ (v) $\frac{5}{9}$

Exercise 3.4

1. $\frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}, \frac{1}{10}, \frac{1}{20}, \frac{1}{50}, \frac{1}{100}, \frac{1}{200}$ 2) 20 Goats 3) 750 Adults

Exercise 3.5

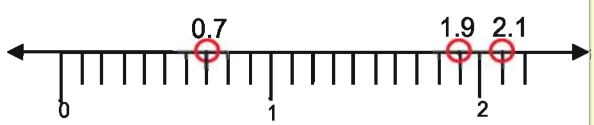
1) (i) $\frac{7}{10}$ (ii) 12 (iii) 0 (iv) $\frac{1}{10}$ (v) Decimal Point

2) 23.4 69. 2 82.8

3)

Decimal Nos	Integral Part	Decimal Part	Value of the Decimal Part	Number Name
7.6	7	6	0.6	Seven units and six-tenths
28.5	28	5	0.5	Twenty eight and five-tenths
24.0	24	0	0	Twenty Four

4) (i) 124.6 (ii) 18.3 (iii) 7.4

5) 

6) (i) 0.2 (ii) 3.7 (iii) 786.3

Exercise 3.6

1) (i) True (ii) False (iii) True (iv) False
2) (i) 23.18 (ii) 9.05
3) (i) 9 Thousand (ii) 6 hundredths (iii) 3-Ones (iv) 2 tenths
4) (i) 23.47 (ii) 137.05 (iii) 0.39
5) (i) $106+\frac{86}{100}$ (ii) $1+\frac{2}{10}$ (iii) $76+\frac{45}{100}$ (iv) $\frac{2}{100}$

Exercise 3.7

1) (i) 10.75 (ii) 3.18 (iii) 8.58 (iv) 2.69
2) (i) 309.005 (ii) 300.61 3) (i)2.966 (ii) 47.46

Exercise 4.1

1) (i) True (ii) True (iii) False (iv) False (v) True
2) (i) $7 > 3$ (ii) $-3 > -5$ (iii) $2 > -3$ (iv) $7 > -3$ (v) $1 > -4$ (vi) $-4 > -7$
3) (i) −2, −1, 0, 1, 2 (ii) −3, −2, −1, 0, 1 (iii) 0 ஈ) −4, −3 (iv) −3, −2, −1, 0, 1, 2 (v) −1, 0, 1
4) (i) 1 (ii) −4 (iii) 8 units (iv) 5 units

Exercise 4.2

1) (i) 4 (ii) −10 (iii) 2 (iv) −3 (v) −3

2) (i) 1 (ii) −10

3) (i) 7 (ii) 7 (iii) −70 (iv) 110 (v) −57 (vi) 0
(vii) −18 (viii) −52

4) (i) −3 (ii) 10

5) (i) 10 (ii) −17 (iii) 0 (iv) −30

Exercise 5.1

1 (i) 20 2 (ii) □ ○ △ 3 (iv) Second number = 10 x First number

Exercise 5.2

1) a) (ii) b) (iii)

2) $40x$ 3) 12b 4) $6x$

Exercise 5.3

1) (i) $x+7$ (ii) y-10 (iii) 3y-8 (iv) $-7x - 5$

2) i) Add 5 with twice y
ii) Subtract 5 from twice y
iii) Divide twice y by 5
iv) Divide 5 times y by 2

3) y+7, 7y, y-7, 7-y, $\frac{y}{7}$, $\frac{7}{y}$ 4) i) z+5 ii) 7z iii) 3z+5 5) 2t+30 (6) 10y (7) $7x$

Exercise 5.4

1) a) iii b) iii c) iv

2) a) ii b) iii c) i

3) Not a solution. Not a solution. Is a solution. Not a solution

4) 6 + 7 = 13 Not a solution. 7 + 7 = 14 Not a solution. 8 + 7 = 15 Is a solution. 9 + 7 = 16 Not a solution

5) i) 2 − 3 = −1 Not a solution ii) − 2 +7 = 5 Not a solution
iii) 28 + 8 = 36 Not a solution iv) 3 − (−7) = 10 Is a solution

6) (i) 5 (ii) 10 (iii) 9 (iv) 35 (v) 20 7) y = 12

8) 15, 18, 24, 27, 30, 33, 39, 42, 45 ; z = 10 9) 1, 3, 4, 6 ; p = 12

Exercise 6.1

1. (i) True (ii) False (iii) False (iv) False

2. (i) 2 (ii) 1 (iii) 3 (iv) 4 (v) 3

3. (i) 4:9 (ii) 5:9 (iii) 2:3 4) (i) 6:10, 9:15, 12:20, 24:40
(ii) 6:14, 12:28, 15:35, 30:70 (iii) 10:18, 15:27, 30:54, 40:72

5. (i) 3:4 (ii) 1:3 (iii) 1:2 6. (i) 40:1 (ii) 40:39 (iii) 1:39 7.(i) 3:5 (ii) 2:5
(iii) 3:2

8. (i) 1:2 (ii) 4:3 (iii) 2:3 (iv) 4:9 (v) 2:9 (vi) 1:3

Exercise 6.2

1) (i) True (ii) False (iii) True (iv) False (v) True

2) (i) 1 (ii) 2 (iii) 4 (iv) 4 (v) 2 3) Rs. 1950

4) 3500, 4000 5) Male 55,000, Female45,000 6) 80 7) 42 8) 18 cm

Exercise 7.2

1) (i) 10 mm (ii) 3000 m (iii) 150 cm (iv) 0.75 km (v) 53 mm
2) (i) 4475 m (ii) 1035 cm (iii) 147 mm 3) 27 m
4) 1242 cm (or) 12 m 42cm
5) (i) 2 kg (ii) 7000 g 6) (i) 1020 cg (ii) 3004 g 7) 18 kg 150 g
8) 37 kg 100 g 9)200 packets 10) 36 *l* 11) 37 *l* 550 *ml*
12) 5 *l*

Exercise 8.1

1) (i) 60 (ii) 1 (iii) 60 (iv) 7.5 a.m (v) 3.45 p.m
2) (i) 900 seconds (ii) 1812 seconds (iii) 11,405 seconds (iv) 2720 seconds
3) (i) 480 minutes (ii) 710 minutes (iii) 575 minutes (iv) 175 minutes
4) (i) 8 hours 45 minutes (ii) 2 hours (iii) 3 hours 18 minutes (iv) 1 hour

Exercise 8.2

1) (i) 6.30 hours (ii) 0 hour (iii) 21.15 hours (iv) 13.10 hours
2) (i) 10.30 a.m (ii) 12 noon (iii) Midnight 12 (iv) 11.35 p.m

Exercise 8.3

1) (i) 10 hours 45 minutes (ii) 10 hours 45 minutes 2) 11 hours 40 minutes
3) 3 hours 15 minutes

Exercise 8.4

1) (i) 7 (ii) 29 (iii) 72 (iv) 12 (v) 3600
2) (i), (iv) 3) 96 4) (i) 46 weeks and 6 days (ii) 25 weeks

Exercise 9.1

1) (I) 46 cm (II) 21 cm (III) 28 cm (IV) 24 cm (V) 21 cm
2) 16 units 4) 22 cm 5) 12 cm

Exercise 9.2

1) sq.cm, sq.cm, sq.m, sq.km, sq.m

Exercise 9.3

1.a) 16 sq. units b) 8 sq. units

Exercise 9.4

1) (i) 24 cm, 35 sq.cm (ii) 4 cm, 40 sq.cm (iii) 12m, 36m (iv) 7m, 32m
2) (i) 36 sq.m (ii) 75 sq.m 3) (i) 6 sq.cm (ii) 18 sq.cm

Exercise 10.1

1) Straight line 2) A, B 3) Q 4) Ray AB 5) Starting Point 6) AB; AC; AD; BC; BD; CD

Exercise 10.2

1) Straight line 2) Collinear points 3) Many 4) Only One

5) (a) ($\overleftrightarrow{AH}$, $\overleftrightarrow{CQ}$), ($\overleftrightarrow{AH}$, $\overleftrightarrow{DP}$), ($\overleftrightarrow{AH}$, $\overleftrightarrow{EF}$), ($\overleftrightarrow{BG}$, $\overleftrightarrow{CQ}$), ($\overleftrightarrow{BG}$, $\overleftrightarrow{DP}$), ($\overleftrightarrow{BG}$, $\overleftrightarrow{EF}$), ($\overleftrightarrow{CQ}$, $\overleftrightarrow{EF}$), ($\overleftrightarrow{DP}$, $\overleftrightarrow{EF}$)

(b) ($\overleftrightarrow{AH}$, $\overleftrightarrow{BG}$), ($\overleftrightarrow{CQ}$, $\overleftrightarrow{DP}$)

(c) A, X, W, H are the collinear points on $\overleftrightarrow{AH}$

B, Y, Z, G are the collinear points on $\overleftrightarrow{BG}$

C, Y, X, Q are the collinear points on $\overleftrightarrow{CQ}$

D, Z, W, P are the collinear points on $\overleftrightarrow{DP}$

E, X, Z, F are the collinear points on $\overleftrightarrow{EF}$

(d) $\overleftrightarrow{AH}$, $\overleftrightarrow{CQ}$, $\overleftrightarrow{EF}$ are concurrent line passing through X

$\overleftrightarrow{BG}$, $\overleftrightarrow{DP}$, $\overleftrightarrow{EF}$ are concurrent line passing through Z

Exercise 11.1

1. (i) Acute angle (ii) Obtuse angle (iii) Obtuse angle (iv) Obtuse angle
2. (i) Acute angle (ii) Obtuse angle (iii) Right angle (iv) Acute angle
3. (i) ∠AOB Straight angle ∠DOB Obtuse angle ∠COB Right Angle

   ∠AOD Acute angle ∠DOC Acute angle ∠AOC Right angle

   (ii) ∠AOB Acute angle ∠AOC Acute angle ∠AOD Right angle

   ∠BOC Acute angle ∠COD Acute angle

Exercise 11.2

1) (i) 53^0 (ii) 48^0 (iii) 2^0 (iv) 90^0 (v) 74^0

2) (i) 174^0 (ii) 153^0 (iii) 92^0 (iv) 76^0 (v) 64^0 (vi) 34^0 (vii) 122^0 (viii) 1^0

3) 50^0

4) (i) True (ii) True (iii) False (iv) False (v) True (vi) True

5) (i) Complementary (ii) Supplementary (iii) Complementary (iv) Supplementary

6) (i) 45° (ii) 90°

7) (i) Right angle (ii) Obtuse angle (iii) Acute angle (iv) Acute angle

Exercise 11.3

1) (i) 180° (ii) all three (iii) an isosceles (iv) right angled (v) greater
(vi) 3 (vii) 3

2) Three angles and three sides

3) (i) obtuse angled triangle (ii) right angled triangle (iii) acute angled triangle
(iv) obtuse angled triangle

4) (i) yes (ii) yes (iii) no (iv) no (v) no

5) (i) isosceles triangle (ii) equilateral triangle (iii) scalene triangle
(iv) scalene triangle

6) (i) impossible (ii) impossible (iii) possible (iv) impossible

Exercise 13.1

I) 1. 2006 2. 2010 3. 2008, 2009 4. 600 5.true

II) 1) The pictograph shows the expenses in constructing a house.
2) Rs. 60,000 3) Rs. 70, 000 4) Cement Rs. 70, 000
5) Total expense Rs. 2, 30, 000

Exercise 13.3

I) 1) Friday, 40 2) 25 3) Monday, Saturday
4) The bar graph shows the number of shirts produced in 6 days.

II) 1) The bar diagram shows the marks scored by a student in half-yearly examination.
2) 90 3) Maths 4) 130

5)

Subject	Tamil	English	Maths	Science	Social Science
Marks	70	60	100	90	65

III) 1) cycle
2) the bar diagram shows the number of students using different modes of transport.
3) 150
4) 100 students
5) car