6. 2.03 in expanded form = ...

(a) $2+\frac{3}{10}$ (b) $20+\frac{3}{10}$ (c) $2+\frac{3}{100}$ (d) $20+\frac{3}{100}$

7. 2.5 = ...

(a) $\frac{5}{2}$ (b) $\frac{25}{2}$ (c) $\frac{5}{10}$ (d) $\frac{1}{4}$

8. $\frac{13}{2}$ = ...

(a) 6 (b) 6.1 (c) 1.3 (d) 6.5

9. Which of the following decimals is largest?

(a) 0.5 (b) 0.05 (c) 0.51 (d) 0.005

10. Which of the following decimals is smallest?

(a) 2.13 (b) .213 (c) 21.3 (d) 213

11. 75g = ...kg

(a) .075kg (b) .75kg (c) 7.5kg (d) 75kg

12. 27mm = ...cm

(a) .27cm (b) 27cm (c) 2.7cm (d) .027cm

13. 2.5 +4.23 = ...

(a) 4.48 (b) 6.73 (c) 4.73 (d) 6.48

14. 15 + 3.84 = ...

(a) 3.99 (b) 18.99 (c) 3.84 (d) 18.84

15. 13.5 – 4.23 = ...

(a) 2.87 (b) 7.29 (c) 9.27 (d) 9.37

16. 20 – 12.56 = ...

(a) 7.44 (b) 8.44 (c) 9.44 (d) 6.44

17. 14.8 + 2.62 – 8.4 = ...

(a) 8.02 (b) 9.12 (c) 9.02 (d) 6.44

18. 5ℓ $7m\ell$ = ... ℓ

(a) 5.07ℓ (b) 5.7ℓ (c) 5.70ℓ (d) 5.007ℓ

19. 12kg 85g = ... kg

(a) 12.085kg (b) 12.85kg (c) 128.5kg (d) 12.0085kg

20. 235 paise = ...

(a) ₹235 (b) ₹23.5 (c) ₹2.35 (d) ₹.235

Learning Outcomes

After completion of this chapter students are now able to

- Know about decimal's place.
- Perform additions and substraction of decimals.
- Use decimals in practical life.
- Use decimals in lengths, capacity and weight.

ANSWER KEY

Exercise 6.1

1. (i) 72.14 (ii) 257.08 (iii) 8.256 (iv) 45.23 (v) 621.253 (vi) 12.008

2. (i) Twelve point five two. *or* Twelve and fifty two hundredths.

(ii) Seven point one four eight. *or* Seven and one hundred forty eight thousandths

(iii) Point two four. *or* Twenty four hundredths

(iv) Five point zero one eight. *or* Five and eighteen thousandths.

(v) Point zero zero nine. *or* Nine thousandths

4. (i) 40.2 (ii) 705.34 (iii) 10.053 (iv) .704 (v) .005

5. (i) 524.12 (ii) 2034.21 (iii) 61.023 (iv) 4.001 (v) 100.03

6. (i) $2+\frac{5}{10}$ (ii) $10+8+\frac{4}{10}+\frac{3}{100}$

(iii) $4+\frac{5}{100}$ (iv) $10+3+\frac{1}{10}+\frac{2}{100}+\frac{3}{1000}$

(v) $200+40+5+\frac{4}{10}+\frac{5}{100}+\frac{6}{1000}$ (vi) $20+\frac{5}{100}+\frac{7}{1000}$

Exercise 6.2

1. (i) $\frac{7}{5}$ (ii) $\frac{9}{4}$ (iii) $\frac{93}{5}$ (iv) $\frac{101}{25}$ (v) $\frac{108}{5}$

2. (i) 0.07 (ii) 1.2 (iii) 2.15 (iv) 0.018 (v) 24.5

3. (i) 2.5 (ii) 0.75 (iii) 5.6 (iv) 6.75 (v) 4.25

4.	(i)	8.5	(ii)	8.25	(iii)	15.2	(iv)	0.96	(v)	0.625
6.	(i)	1.3, 1.4, 1.5			(ii)	2.9, 3, 3.1			(iii)	5.1, 5.2, 5.3, 5.4
7.	(i)	0.7	(ii)	2.6	(iii)	1.32	(iv)	12.4	(v)	18.35
	(vi)	12	(vii)	5.061	(viii)	23.3	(ix)	13.08	(x)	2.3
8.	(i)	1.8, 1.9, 2, 2.5			(ii)	1.3, 3.1, 3.4, 4.3			(iii)	1.2, 1.24, 1.42, 1.8
9.	(i)	4.2, 4.12, 4.1, 4.01			(ii)	13, 1.3, 1.03, 1.003			(iii)	8.2, 8.1, 8.02, 8.002

Exercise 6.3

1.	(i)	₹0.35	(ii)	₹0.04	(iii)	₹2.40	(iv)	₹12.25	(v)	₹24.05
2.	(i)	0.05m	(ii)	0.62m	(iii)	1.35m	(iv)	5.20m	(v)	12.08m
3.	(i)	0.2cm	(ii)	2.8cm	(iii)	8.4cm				
4.	(i)	0.007km	(ii)	0.050km	(iii)	0.425km	(iv)	2.475km	(v)	3.225km
5.	(i)	0.005kg	(ii)	0.075kg	(iii)	0.423kg	(iv)	1.265kg	(iv)	5.418kg
6.	(i)	0.002ℓ	(ii)	0.080ℓ	(iii)	0.725ℓ	(iv)	3.423ℓ	(v)	8.020ℓ

Exercise 6.4

(1)	(i)	17.02	(ii)	36.97	(iii)	18.794	(iv)	11.13	(v)	14.54
	(vi)	37.084	(vii)	87.33	(viii)	93.413	(ix)	14.437	(x)	34.091
	(xi)	9.217	(xii)	23.298						
(2)	(i)	10.763	(ii)	8.188						
(3)	(i)	3.588	**(4)**	₹ 112.24	**(5)**	6km 035m	**(6)**	₹ 66.51		
(7)	6.685m		**(8)**	8.225kg	**(9)**	1km 100m				

Multiple Choice Questions

(1)	b	**(2)**	c	**(3)**	a	**(4)**	d	**(5)**	b
(6)	c	**(7)**	a	**(8)**	d	**(9)**	c	**(10)**	b
(11)	a	**(12)**	c	**(13)**	b	**(14)**	d	**(15)**	c
(16)	a	**(17)**	c	**(18)**	d	**(19)**	a	**(20)**	c

J2T5N7

7

ALGEBRA

Objectives

In this chapter you will learn

- To impart knowledge of variables.
- To use variables in different situations.
- To find the value of the equation.
- The practical use of equation in daily life.
- To make algebraic expressions.

7.1 Introduction

We have been dealing with numerals 0, 1, 2, 3, ... so far and the four operations addition, subtraction, multiplication and division. This branch of mathematics is called **Arithmetic**. We have also learnt about the two dimensional and three dimensional figures, study of which is called **Geometry**. Here we shall study a new branch of mathematics, called **Algebra**. It is an arabic word which means **"bringing together broken parts"**. Algebra evolved from the rules and operations of arithmetic.

7.2 Main features of Algebra

* The main feature of Algebra is the use of letters, which allow us to write rules and formulas in a general way. By using letters, one can talk about any number not just a particular number.

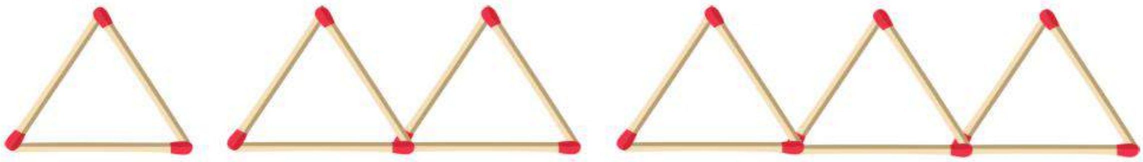
* These letters in algebra represent unknown numbers and are called **literals** or **variables**. The letters like a, b, c, ... p, q, r, ... x, y, z are called literals or variables. By learning methods of determining variables, we develop powerful rules for solving puzzles and many other daily life problems.

* Since letters stand for numbers, operations can be performed on them as on numbers. This leads to the study of algebraic expressions and their properties.

You will find that Algebra is quite interesting and useful in solving problems. Let us begin our study with following examples.

7.3 Identiying Patterns

Look at the match stick pattern



The table shows the number of matchsticks required to make 1, 2, 3, ... triangles.

Number of Triangles	1	2	3	4	5	–	–	8	–	–
Number of Matchsticks	3	6	9	12	15	–	–	24	–	–

It is observed that

1. One triangle is formed by using $3 \times 1 = 3$ matchsticks.
2. Two triangles are formed by using $3 \times 2 = 6$ matchsticks
3. Three triangles are formed by using $3 \times 3 = 9$ matchsticks.

Thus, the number of matchsticks required

$$= 3 \times \text{Number of triangles.}$$

Let's represent the number of triangles by the letter 'n'

Thus, the general rule for the number of matchsticks required for n number of triangles = $3 \times n$

This rule is very powerful and useful. By using this rule we do need to draw the pattern or make a rule, we can find number of matchsticks even for 100, 500, ... triangles.

* n is an example of a variable. Its value is not fixed. It can take any value 1, 2, 3, 4, ...

7.4 Variables and Constants

In the previous section, we have seen that the value of a letter is not fixed. It can take any numerical value such as 1, 2, 3, ... so on. The letters which stand for unknown numbers and can take any numerical value are called **variables**.

In other words, a letter whose value varies is called a variable.

Generally, we use small letters to denote a variable. The numbers 0, 1, 2, 3, ... have fixed values. They have a fixed numerical value and are called **constants**.

As numbers are the foundation stones of Arithmetic, variables are the foundation stones of Algebra

Example 1 : **If there are 10 pencils in a box. How will you write the total number of pencils in terms of number of boxes? Use 'n' for number of boxes.**

Solution : Let us make a table for number of pencils and boxes.

Number of boxes	1	2	3	-	-	10	-	-	n
Number of pencils	10×1=10	10×2=20	10×3=30	-	-	10×10=100	-	-	10n

It is observed that In a box there are 10 pencils,

In 2 boxes, there are $10 \times 2 = 20$ pencils

In 3 boxes, there are $10 \times 3 = 30$ pencils.

Thus, number of pencils in n boxes = (Number of pencils) × (Number of boxes) = $10 \times n = 10n$

Example 2 : **During a prayer for a school, 15 students stand in a row, If there are 'x' number of rows, give the rule to find the total number of students.**

Solution : Let us make a table for the number of students in rows.

Number of Rows	**1**	**2**	**3**	**-**	**-**	**8**	**-**	**-**	**x**
Number of Students	**15**	**30**	**45**	**-**	**-**	**120**	**-**	**-**	**15x**

It is observed from the table that

Total number of students in number of rows

= (Number of students) × (Number of Rows)

$= 15 \times x = 15x$

Example 3: **There are 16 keys on a telephone set. Give the rule to find the total number of keys in terms of the number of telephone sets, if 't' represents the number of sets.**

Solution : We know

Total number of telephone keys in number of telephone sets

= (Number of keys in a telephone set) × (Number of telephone sets)

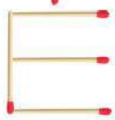
$= 16 \times t = 16t$

Exercise 7.1

1. Find the rule which gives the number of matchsticks required to make the following'n' matchstick patterns. Use a variables to write the rule:-

(i) A pattern of letter T as

(ii) A pattern of letter E as



(iii) A pattern of letter F as

(iv) A pattern of letter C as

(v) A pattern of letter S as

2. Students are sitting in rows. There are 12 students in a row. What is the rule which gives the number of students in 'n' rows? (Represent by table)

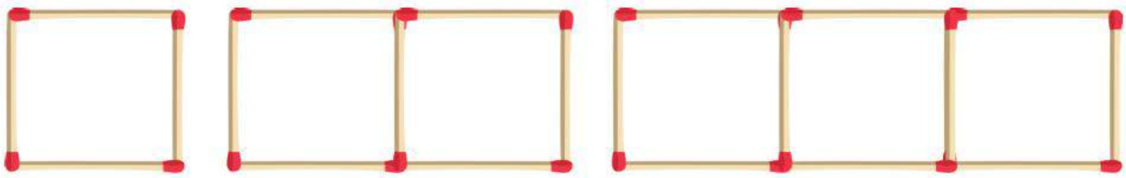
3. The teacher distributes 3 pencils to a student. What is the rule which gives the number of pencils, if there are 'a' number of students?

4. There are 8 pens in a pen stand. What is the rule that gives the total cost of the pens. If the cost of each pen is represented by a variable 'c'?

5. Gurleen is drawing pictures by joining dots. To make one picture, she has to join 5 dots. Find the rule that gives the number of dots, if the number of pictures is represented by the symbol 'p'.

6. The cost of a dozen bananas is ₹ 50. Find the rule of total cost of bananas if there are 'd' dozens bananas.

7. Look at the following matchsticks patterns of squares given below. The squares are not separate as there are two adjoined adjacent squares have a common match stick. Observe the patterns and find the rule that gives the number of matchsticks in terms of the number of squares.



(Hint: If you remove the vertical stick at the end you will get a patterns of C)

7.4.1 Operations on Literal Numbers or Variables

Since literal numbers or variables are used to represent numbers, they follow all the rules for four fundamental operations of numbers.

1. **Addition:-** Let x and y be two literals then the sum of x and y is written as $x + y$.
2. **Subtraction:-** Let x and y be two literals then the difference of these two literals is written as $x - y$ or $y - x$.
3. **Multiplication:-** Let x and y be two literals then the product of x and y is written as $x \times y$. Generally, we write xy. (As there may be confusion between x and '×').
4. **Division :-** Let x and y be two literals then 'x is divided by y' is written as $x \div y$ or $\frac{x}{y}$

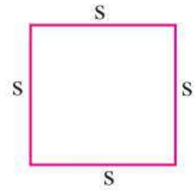
Let us consider the use of variables in some real life situations.

7.5 Algebra As Generalisation

Algebra is often referred to as generalised form of arithmetic. In mathematics, any rule or formula is generalised by expressing it through variables. Let's discuss its wider use in geometry and arithmetic.

7.5.1 Geometry

In earlier classes, we have studied the terms perimeter and area. Let us work about the general rules for them in terms of variables.



1. **Square:-** We know that a square has 4 sides of equal length. Let the length of each side is 's'.

Perimeter:-

$\therefore$ Perimeter of square = Sum of the lengths of the sides of the square

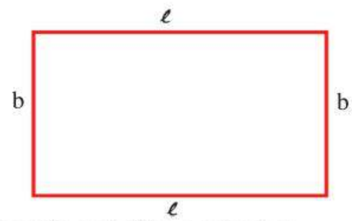
$= s + s + s + s = 4 \times s = 4s$

Perimeter also can be represented by another variable 'P'. Then the general rule for the perimeter of square is expressed as $P = 4s$

Area:- Let Area is represented as 'A'. We know, Area of Square = (Side) × (Side)

Thus, General rule for the area of square is expressed as $A = s \times s$

Thus, we get the rule for the Area of a square



2. **Rectangle:-** A rectangle is a closed figure having four sides. Its oppsite sides are equal in measurement.

Perimeter:- Let ℓ and b be length and breadth of rectangle and P be perimeter.

$\therefore$ Perimeter of rectange = Length + Breadth + Length + Breadth

Thus, we get the general rule for the perimeter of rectangle.

$P = \ell + b + \ell + b$

$= \ell + \ell + b + b$

$= 2\ell + 2b = 2(\ell + b)$

Area:- Let A be the area of rectangle

$\therefore$ Area of rectangle = (length) × (breadth)

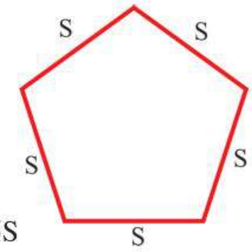
i.e $A = \ell \times b$

Thus, we get the general rule for the area of rectangle

Let us consider some examples of geometrical shapes.

Example 4: **Each side of regular pentagon is denoted by S. Express the perimeter of the regular pentagon using S.**

Solution : Each side of regular pentagon = S.



Perimeter of regular Pentagon

= Sum of all sides

$= S + S + S + S + S = 5 \times S = 5S$

Example 5: The diameter of a circle is twice its radius. If d is the diameter of the given circle and r is its radius. Express the diameter of the circle in terms of its radius.

Solution : Radius of circle = r

We know diameter of circle = twice of radius = $2 \times$ radius

$\therefore$ d = 2r

7.5.2. Arithmetic :

In the chapter of whole numbers, we have learnt some properties. Here we shall discuss those properties in form of algebra.

1. Commutative Property

- **Addition:-** If the order of numbers in addition is changed, it does not change their sum.

  e.g. $4 + 5 = 5 + 4 = 9$

  This property holds true for all set of numbers.

  Thus, we can form a general rule.

  Let a and b be two variables representing any two numbers. Then

  In this way, we **a + b = b + a**. We can verify this general rule for every pair of numbers.

  e. g. $a = 6$, $b = 7$ then $6 + 7 = 7 + 6 = 13$

- **Multiplication:-** If the order of numbers in multiplication is changed, it does not change their product

  e.g. $3 \times 7 = 7 \times 3 = 21$

  This property holds true for any set of numbers, Thus we can form a general rule.

  Let a and b two variables representing any two numbers then **a × b = b × a**

  We can verify this general rule for every pair of numbers.

  e.g. If $a = 8$, $b = 5$ then $8 \times 5 = 5 \times 8 = 40$

2. Associative Property

- **Addition:-** If three numbers can be added in any order, it does not change their sum.

  e. g $(3 + 4) + 5 = 7 + 5 = 12$

  $3 + (4 + 5) = 3 + 9 = 12$

  Thus, we can form a general rule.

  Let a, b and c be any three variables representing any three numbers. then

  (a + b) + c = a + (b + c)

- **Multiplication:-** If three numbers can be multiplied in any order, it does not change their product.

  e.g. $(2 \times 3) \times 4 = 6 \times 4 = 24$

  $2 \times (3 \times 4) = 2 \times 12 = 24$

Thus, we can form a general rule.

Let a, b and c be any three variables representing any three numbers. then

$\mathbf{a \times (b \times c) = (a \times b) \times c}$

3. Distributive Property

- **Multiplication over Addition:-** In this property, while multiplying two numbers we split the larger number into sum of two numbers and then multiply these numbers with smaller number one by one and then add.

  e.g. $5 \times 53 = 5 \times (50 + 3)$

  $= 5 \times 50 + 5 \times 3 = 250 + 15 = 265$

  In this multiplication, 5 is distributed over the addition of 50 and 3.

  It is always true for any three numbers. Thus, we can form a general rule.

  Let a, b and c be the variables representing any three numbers. then

  $\mathbf{a \times (b + c) = a \times b + a \times c}$

- **Multiplication over subtraction:-** In this property while multiplying two numbers, we break the larger number into difference of two numbers and then multiply these numbers with smaller number one by one and then subtract.

  e.g. $9 \times 48 = 9 \times (50 - 2)$

  $= 9 \times 50 - 9 \times 2 = 450 - 18 = 432$

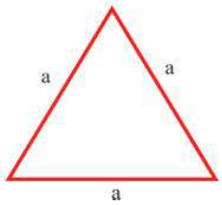
  In this multiplication, 9 is distributed over the subtraction of 50 and 2. It is always true for any three numbers. Thus, we can form a general rule.

  Let a, b, c be the variables representing three numbers. then

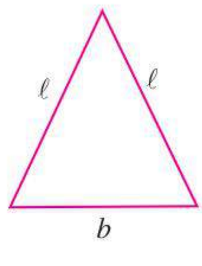
  $\mathbf{a \times (b - c) = a \times b - a \times c}$

Exercise 7.2

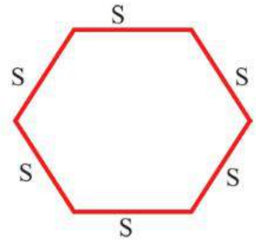
1. Each side of equilateral triangle is denoted by 'a' then express the perimeter of the triangle using 'a'.

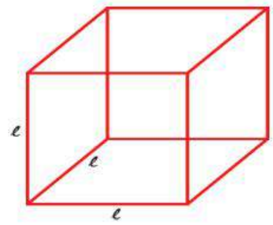


2. An isosceles triangle is shown. Express its perimeter in terms of 'ℓ' and 'b'



3. Each side of regular hexagon is denoted by 'S' then express the perimeter of the regular hexagon using 'S'.





4. The cube has 6 faces and all of them are identify squares. If ℓ is the length of an edge of a cube, find the total length of all edges of the cube in terms of 'ℓ'.

5. Write communtative property of addition using variables x and y.
6. Write associative property of multiplication using variables l, m and n.
7. Write distributive property of multiplication over addition in terms of variables p, q and r respectively.

7.6. Algebraic Expressions (Expressions with Variables)

In arithmetic, we come across many expressions such as $(6+5)\times 3$, $10+5\times 3-2$, $12\div 4\times 7-8$ etc. These expressions are formed by connecting the numbers with four operations i.e. addition, subtraction, multiplication and division. These are arithmetic expressions or expressions with numbers.

We can also make expression with variables. e.g 3a, $x-10$, $l+4$, $5m+3$ etc. are expressions with variables and numbers connecting by operations i.e. additon, subtraction, multiplication and division.

"A collection of variables and numbers connecting by one or more signs of operations (+ , – × , ÷) is called an algebraic expression".

Some examples of algebraic expressions are $5l$, $6m-2$, $4l+3$, $x+12$, $2l+3m$ etc. Each part of the algebraic expression along with (+ or –) is known as its **term**.

Algebraic Expressions	Number of Terms	Terms
7a	1	7a
15m + 12	2	15m, 12
4a + 2b – 3c	3	4a, 2b, – 3c
x^2-4x+5	3	x^2, $-4x$, 5

Note:- One important point must always be kept in mind that expression with numbers can be solved very easily.
like $5\times 2+3=10+3=13$
But expression with variables can not be solved, like $4x-3$ is in one variable x and value of x is unknown. So it is possible only if value of x is known.

e.g. If x = 2 then $4x - 3 = 4 \times 2 - 3 = 8 - 3 = 5$

Let us consider that how algebraic expressions are formed:

Algebraic Expressions	How these formed
$x + 5$	5 is added to x
$a - 8$	8 is subtracted from a
$3a$	a is multiplied by 3.
$\frac{\ell}{5}$	ℓ is divided by 5.
$2s + 3$	First s is multipled by 2 then 3 is added

7.6.1 Operations On Variables (Literals) and Numbers

We have learnt about operations on only variables or numbers. In this section, we shall learn about operations on variables and numbers taken together which is very useful in high classes algebra.

1. **Addtion of Variables and Numbers :-** Here, we shall discuss the addition of variables and numbers. Some expressions are as follows:

- 5 is added to x then sum is $x + 5$
- 8 is added to y then sum is $y + 8$
- a is added to b then sum is $b + a$

Note:- These above expressions can not be solved further, these have to be left as it is.

Example 6: **Write the following algebraic expressions:-**

(i) 9 is added to m (ii) 3 more than x (iii) 10 is added to p

Solution : (i) 9 is added to m = $m + 9$

(ii) 3 more than x = $x + 3$

(iii) 10 is added to p = $p + 10$

2. **Subtraction of Varibles and Numbers:-** Here, we shall discuss the subtraction of variables and numbers. Some expressions are as follows:-

- Subtract 3 from a = $a - 3$
- Subtract 6 from x = $x - 6$
- Subtract x from 4 = $4 - x$

Note:- Leave these expressions as it is, it cannot be solved further.

Example 7: **Write the following algebraic expressions:-**

(i) Subtract 1 from y (ii) Decrease l by 8 (iii) Subtract a from 5

Solution : (i) Subtract 1 from y = $y - 1$

(ii) Decrease l by 8 = $l - 8$

(iii) Subtract a from 5 = $5 - a$

3. **Multiplication of Variables and Numbers:-** Here, we shall discuss the multiplication or product of variables and numbers. Some expressions are as follows:

- Multiply a by 3 = a × 3 = 3a (In short form)
- The product of 5 and x = 5 × x = 5x
- l times m = $l \times m = lm$

Example 8: **Write the following expressions:-**

(i) Multiply 5 by p (ii) Product of 4 and z. (iii) Twice of l

Solution : (i) Multiply 5 by p = 5 × p = 5p

(ii) Product of 4 and z = 4 × z = 4z

(iii) Twice of l = Two times $l = 2 \times l = 2l$

4. **Division of literals and Numbers:-** Here, we shall discuss the division or quotient of variables and numbers. Some expressions are as follows:-

- b divided by 2 = b ÷ 2 = $\frac{b}{2}$
- y divided by 3 = y ÷ 3 = $\frac{y}{3}$
- Quotient of l by m = $l \div m = \frac{l}{m}$

Example 9: **Write the following expressions:-**

(i) x divided by 8 (ii) 3 divided by k. (iii) Quotient of a by 2

Solution : (i) x divided by 8 = x ÷ 8 = $\frac{x}{8}$

(ii) 3 divided by k = 3 ÷ k = $\frac{3}{k}$

(iii) Quotient of a by 2 = a ÷ 2 = $\frac{a}{2}$

Now the applications of four basic operations are illustrated through following examples:

Example 10: **Study the following expressions and tell how are they formed?**

(i) a – 8 (ii) l + 1 (iii) 2m (iv) $\frac{a}{5}$ (v) 3z + 9 (vi) 5p – 8

Solution : (i) a – 8 = 8 is Subtracted from a

(ii) l + 1 = 1 is added to l

(iii) 2m = Twice of m

(iv) $\frac{a}{5}$ = a is divided by 5

(v) $3z + 9$ = First z is multipled by 3 then 9 is added to the product

(vi) $5p - 8$ = First p is multipled by 5 then 8 subtracted from the product

Example 11: Give expressions for the following:-

(i) 12 is subtracted from x

(ii) 8 is added to y

(iii) p is multiplied by – 2

(iv) a is multiplied by –5 and 3 is added to the result

(v) ℓ is multiplied by 2 and then divided by 7.

Solution : (i) 12 is subtracted from x = $x - 12$

(ii) 8 is added to y = $8 + y$ or $y + 8$

(iii) p is multiplied by – 2 = $p \times (-2) = -2p$

(iv) a is multiplied by –5 and 3 is added to the result = $a \times (-5) + 3 = -5a + 3$

(v) ℓ is multiplied by 2 and then divided by 7= $(\ell \times 2) \div 7 = \frac{2\ell}{7}$

7.6.2.Use of Algebraic Expressions In Life:-

In last section, we have learnt the algebraic expressions using fundamental operatons. In this section we shall discuss the use of algebraic expressions in our daily life. Let us consider some examples.

Example 12: Find the number which is 12 more than a.

Solution : The required number = 12 more than a

= $12 + a$ or $a + 12$

Example 13: Write the number which is 8 less than x.

Solution : The required number = 8 less than x

= $x - 8$

Exampe 14: Vasu's present age is x years. Express the following in algebraic form.

(i) What will be Vasu's age after 6 years?

(ii) What will his age 3 years ago?

(iii) If Vasu's mother's age is 3 times his present age, what is the age of Vasu's mother?

(iv) If Vasu's elder brother Ankit is 10 years older than him. What is Ankit's age?

(v) Find his father's age, if he is 7 years more than twice of present age of Vasu?

Solution : Given Vasu's present age = x years

(i) After 6 years, Vasu's age = 6 years more than his present age (x)

= $(x + 6)$ years

(ii) 3 years ago, Vasu's age = 3 years less than his present age (x)

= $(x - 3)$ years

(iii)	Vasu's mother's age	=	3 times Vasu's present age
		=	$3 \times x = 3x$
(iv)	Ankit's age	=	10 years more than Vasu's present age
		=	$(10 + x)$ or $(x + 10)$ years
(v)	Father's age	=	Twice Vasu's present age + 7
		=	$(2x + 7)$ years

Example 15: The length of a room is 5 metres less than 3 times the breadth of the room. What is the length, if the breadth is b metres?

Solution : Given length of the room = 5 metres less than 3 times breadth

= 3 times breadth – 5 = 3 × breadth – 5

= $(3b - 5)$ metres

Exercise 7.3

1. Pick the algebraic expressions and the arithmetic expressions from the following:

(i) $2l - 3$ (ii) $5 \times 3 + 8$ (iii) $6 - 3x$ (iv) $5l$

(v) $2 \times (21 - 18) + 9$ (vi) $\frac{6a}{5} + 2$ (vii) $7 \times 20 \div 5 + 3$ (viii) 8

2. Write the terms for the following expressions:

(i) $2y + 5z$ (ii) $6x - 3y + 8$ (iii) $7a$ (iv) $3l - 5m + 2n$ (v) $\frac{2\ell}{3} + x$

3. Tell how the following expressions are formed.

(i) $a + 11$ (ii) $12 - x$ (iii) $3z + 8$ (iv) $6 - 5l$ (v) $\frac{5a}{4}$

4. Give expressions for the following:

(i) 10 is added to p (ii) 5 is subtracted from y (iii) d is divided by 3

(iv) l is multiplied by – 6 (v) m is subtracted from 1 (vi) 11 is added to 3x

(vii) y is multiplied by – 2 and then 2 is added to the result

(viii) c is divided by 5 and then 7 is multiplied to the result

(ix) x is multiplied by 3 then subtracted this result from y

(x) a is added to b then c is multiplied with this result

5. Write the number which is 15 less than y.

6. Write the number which is 3 more than a.

7. Find the number which is 1 more than twice of x.

8. Find the number which is 7 less than 5 times of y.

9. Somi's present age is 'a' years. Express the following in algebraic form:

(i) Her age after 15 years.

(ii) Her age 2 years ago.

(iii) If Somi's father's age is 5 more than twice of her present age, express her father's age.

(iv) If Somi's sister is 4 years younger to her. Express her sister's age.

(v) If Somi's mother is 3 less than 3 times her present age. Express her mother's age.

10. The length of a floor is 10 more than two times of breadth what is the length if breadth is l metres.

7.7 What Is An Equation ?

We have studied that algebraic expressions contain variables and constants. In the last section, We have learnt to change mathematical statements to algebraic expressions.

Let us consider a small puzzle:

Think of a number and add 5 to get 8. What is the number?

We can easily say that the number must be 3. If we use a variables (Literals) suppose 'x' in place of unknown number we can write this puzzle as follows : (Unknown number) + 5 = 8

ie. $x + 5 = 8$ This is an equation

Let us review some following statements:

(i) A number x increased by 7 is 12.

$\Rightarrow \quad x + 7 = 12$

(ii) A number x when decreased by 3 is 10

$\Rightarrow \quad x - 3 = 10$

(iii) Three times a number *l* gives 27.

$\Rightarrow \quad 3l = 27$

(iv) A number 'a' divided by 2 gives 6.

$\Rightarrow \quad \frac{a}{2} = 6$

(v) Sum of a number p and four times the number q is 18.

$\Rightarrow \quad p + 4q = 18$

Each of the above statement is a statement of equality. When the above statements written mathematically, contains one variables as in (i), (ii), (iii), (iv) or two variables as in (v) Each one of them is an equaltion.

"An equation is a mathematical statement equating two expressions. The expression on the left side of the equal sign is called Left Hand Side (LHS) and the expression on the right side of the equal sign is called Right Hand Side (RHS). The expressions on either side of equal sign are called members of the equation".

Those equations which have one or more variables (unknown values) and their highest power is 1 are called **linear equation**. Here, we shall study linear equations having only one variable.

Example 16: **Write the following mathematical statements as algebraic equations:-**

(i) The sum of a and 8 gives 13.

(ii) Twice of a number p gives 14.

(iii) One-fourth of a number is 16.

(iv) 5 more than 3 times of y gives 23.

(v) 2 less than from four times a number gives 26.

Solution : (i) The sum of a and 8 = a + 8

It gives 13

$\therefore$ The equation is a + 8 = 13

Aliter : Direct Method :

Sum of a and 8 = 13

$\Rightarrow$ a + 8 = 13

(ii) Twice of a number p = 2 × p = 2p

It is 14.

$\therefore$ The equation is 2p = 14

Aliter

Twice of a number p = 14

ie. 2 × p = 14 $\Rightarrow$ 2p = 14

(iii) One-fourth of a number = 16

$\Rightarrow$ $\frac{1}{4}$ × (number) = 16

Let the number be x

$\therefore$ The equation is $\frac{1}{4} \times x = 16$

$\Rightarrow$ $\frac{x}{4} = 16$

(iv) 3 times of y = 3 × y = 3y

5 more than 3 times of y = 3y + 5

It is 23

$\therefore$ The equation is 3y + 5 = 23

Aliter

5 more than 3 times of y = 23

i.e 3 times of y + 5 = 23

3 × y + 5 = 23 $\Rightarrow$ 3y + 5 = 23

(v) 2 less than from four times a number = 26

$\Rightarrow$ 4 times number – 2 = 26

$\Rightarrow$ 4 × (number) – 2 = 26

Let the number be a

$\therefore$ The equation is 4 × a – 2 = 26

$\Rightarrow$ 4a – 2 = 26

7.8 Solution of An Equation

To find the solution of an equation means to find a number which when substituted for the variable in the equation, makes its LHS equal to RHS. This number which satisfies the equation is called the **solution** or **root** of the equation.

To solve an equation or to find the solution (root) of an equation, we can follow these methods:

1. Trial and Error Method
2. Systematic Method
3. Transposition Method

7.8.1 Trial and Error Method

In this method, we try different values for the variable (unknown number) to make both sides of an equation equal. When we get a particular value of the variable which makes LHS equal to RHS. This particular value is said to be the root of the equation.

Example 17: Solve $x + 6 = 9$

Solution : We try different values of x to make LHS = RHS

Value of x	LHS = x + 6	RHS = 9	LHS = RHS
1	$1 + 6 = 7$	9	NO
2	$2 + 6 = 8$	9	NO
3	$3 + 6 = 9$	9	YES

From the above table, we find that LHS = RHS when $x = 3$

$\therefore$ Solution is $x = 3$

Example 18: Solve $3x - 2 = 13$

Solution : We try different values of x to make LHS = RHS

Value of x	LHS = 3x – 2	RHS = 13	LHS = RHS
1	$3 \times 1 - 2 = 3 - 2 = 1$	13	NO
2	$3 \times 2 - 2 = 6 - 2 = 4$	13	NO
3	$3 \times 3 - 2 = 9 - 2 = 7$	13	NO
4	$3 \times 4 - 2 = 12 - 2 = 10$	13	NO
5	$3 \times 5 - 2 = 15 - 2 = 13$	13	YES

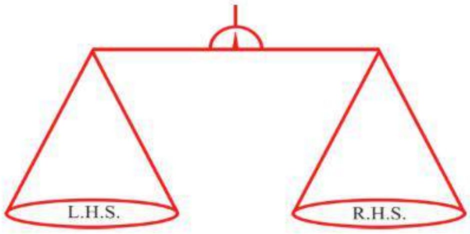
From the above table, we find that LHS = RHS when $x = 5$

$\therefore$ Solution is $x = 5$

7.8.2 Systematic method

The method of trial and error to solve linear equations can be time consuming. It is not a proper way to find the solution of an equation.

An equation behaves like a weighing balance. Both sides of equation are balanced in the same manner as the scales of a balance. When the weights in both sides are equal, the weighing balance is balanced.

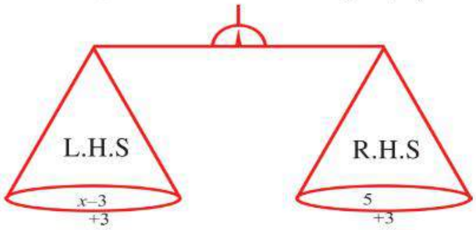


We can add equal weights to both sides or remove equal weigths from both sides then also the two sides will be in balance. Here we have four rules (axioms) for balancing linear equations.

Rule 1:- If we add the same number (quantity) on both sides of an equation, the equality holds true.

e.g. Take an equation $x - 3 = 5$

If we add on 3 both sides, no effect on the weight (equation)



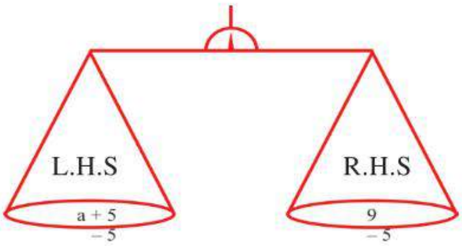
i.e. $(x - 3) + 3 = 5 + 3$

$\Rightarrow$ $x = 8$

Rule 2: If we subtract same number from both sides of an equation, the equality holds true

e.g. $a + 5 = 9$

If we subtract 5 from both sides, no effect on the weight (equation)



i.e $(a + 5) - 5 = 9 - 5$

$\Rightarrow$ $a = 4$

Rule 3:- If we multiply both sides of an equation by the same number, the equality holds true.

e.g. $\frac{x}{2} = 7$

If we multiply by 2 to both sides, no effect on the equation i.e $\frac{x}{2} \times 2 = 7 \times 2$

$\Rightarrow$ $x = 14$

Rule 4:- If we divide both sides of an equation by the same number, the equality holds true

e.g. $7l = 21$

If we divide both sides by 7, no effect on the equation

ie. $\frac{7l}{7} = \frac{21}{7}$

$\Rightarrow$ $l = 3$

Now, let us consider some examples using these rules.

Example 19: Solve:- $a - 8 = 4$

Solution : Given equation is $a - 8 = 4$

Adding 8 on both sides, we get

$a - 8 + 8 = 4 + 8$

$\Rightarrow$ $a = 12$ is the required solution.

Example 20: Solve:- $3x - 1 = 14$

Solution : Given equation is $3x - 1 = 14$

Adding 1 on both sides, we get

$3x - 1 + 1 = 14 + 1$

$\Rightarrow$ $3x = 15$

Dividing both sides by 3, we get

$\frac{3x}{3} = \frac{15}{3}$

$\Rightarrow$ $x = 5$ is the required solution.

Example 21: Solve:- $2x + 5 = 21$

Solution : Given equation is $2x + 5 = 21$

Subtracting 5 from both sides, we get

$2x + 5 - 5 = 21 - 5$

$\Rightarrow$ $2x = 16$

Dividing both sides by 2, we get

$\frac{2x}{2} = \frac{16}{2}$

$\Rightarrow$ $x = 8$ is the required solution.

7.8.3 Method of Transposition a number

We know that to solve a linear equation, we add, subtract, multiply or divide both sides of the equation by the same number.

Transposing a number (i.e. changing the side of the number) is the same as adding or subtracting the number, multiplying or dividing by the number to both sides of the equation ; we change the sign '+' into '–' and vice-versa, 'x' into '÷' and vice-versa.

Consider:- equation $x - 2 = 6$ .... (i)

Adding 2 to both sides, we get

$x - 2 + 2 = 6 + 2$

$x = 6 + 2$ ....(ii)

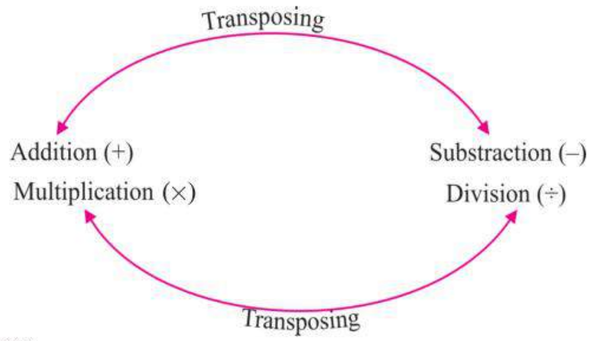
Comparing equation (i) and (ii), we observe that the number 2 is shifted from LHS to RHS of the equation but with sign changed i.e.**'–' Sign to '+' sign**. This process is known as **transposition**.

• Consider an equation $3a = 12$ .... (i)

Dividing both sides by 3, we get

$$\frac{3a}{3} = \frac{12}{3}$$

$a = \frac{12}{3}$ or $12 \div 3$ .... (i)



Comparing equation (i) and (ii), we observe that the number 3 is shifted from LHS to RHS of the equation but with operation changed i.e. **Multiply to Divide.** This process is known as transposition.

Example 22:- Solve the following equation:-

(i) $x + 2 = 11$ (ii) $y - 3 = 8$ (iii) $4x = 24$ (iv) $\frac{a}{3} = 6$ (v) $3b - 2 = 19$

Solution : (i) Given equation : $x + 2 = 11$

$\Rightarrow$ $x = 11 - 2$ (Transposing + 2 to other side, it becomes – 2)

$\therefore$ $x = 9$ is the required answer.

(ii) Given equation : $y - 3 = 8$

$\Rightarrow$ $y = 8 + 3$ (Transposing – 3 to other side, it becomes + 3)

$\therefore$ $y = 11$ is the required solution.

(iii) Given equation : $4x = 24$

$\Rightarrow$ $x = \frac{24}{4}$ (Transposing 'multiplication', it becomes 'division')

$\therefore$ $x = 6$ is the required solution

(iv) Given equation : $\frac{a}{3} = 6$

$\Rightarrow$ $a = 6 \times 3$ (Transposing 'division', it becomes 'multiplication')

$\therefore$ $a = 18$ is the required answer

(v) Give equation : $3b - 2 = 19$

$\Rightarrow$ $3b = 19 + 2$ (Transposing – 2, it becomes + 2)

$\Rightarrow \quad 3b = 21$

$\Rightarrow \quad b = \frac{21}{3}$ (Transposing 'Multiplication', it becomes 'division')

$\therefore$ b = 7 is the required solution.

Exercise 7.4

1. Write the following statements as algebraic equations:-

(i) The sum of x and 3 gives 10.

(ii) 5 less than a number 'a' is 12.

(iii) 2 more than 5 times of p gives 32.

(iv) Half of a number is 10.

(v) Twice of a number added to 3 gives 17.

2. Write the LHS and RHS for the following equations:-

(i) $l + 5 = 8$ (ii) $13 = 2m + 3$ (iii) $\frac{t}{4} = 6$ (vi) $2h - 5 = 13$ (v) $\frac{5x}{7} = 15$

3. Solve the following equations by trial and error method:

(i) $x + 2 = 7$ (ii) $5p = 20$ (iii) $\frac{a}{5} = 2$ (iv) $2l - 4 = 8$ (v) $3x + 2 = 11$

4. Solve the following equations by systematic method.

(i) $z - 4 = 10$ (ii) $a + 3 = 15$ (iii) $4m = 20$ (iv) $3x - 3 = 15$ (v) $4x + 5 = 13$

5. Solve the following equation by transposition:

(i) $x - 5 = 6$ (ii) $y + 2 = 3$ (iii) $5x = 10$ (iv) $\frac{a}{6} = 4$ (v) $4y - 2 = 30$

6. Solve the following equations:

(i) $x + 7 = 11$ (ii) $x - 3 = 15$ (iii) $x - 2 = 13$ (iv) $6x = 18$

(v) $3x = 24$ (vi) $\frac{x}{4} = 7$ (vii) $\frac{x}{8} = 5$ (viii) $2x - 5 = 17$

(ix) $4x + 5 = 21$ (x) $5x - 2 = 13$

Multiple Choice Questions

1. Each side of square is represented by 's' then perimeter of square is :

(a) 4 + s (b) s – 4 (c) 4s (d) s

2. Write commutative property of multiplication using variables x and y

(a) xy = yx (b) x + y = y + x (c) x + y (d) xy

3. How many terms in expression $7l - 3$?

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

4. 5 is subtracted from m = ...

(a) $5 - m$ (b) $m + 5$ (c) $5 + m$ (d) $m - 5$

5. Multiply p by 3 then 2 is added = ...

(a) $2p + 3$ (b) $3p - 2$ (c) $3p + 2$ (d) $2p - 3$

6. If Armaan 's present age is x years then what will be his age after 4 years?

(a) $x - 4$ (b) $x + 4$ (c) $4x$ (d) $4 - x$

7. Write as algebraic equation : 7 more than 4 times of y gives 23.

(a) $4 + 7y = 23$ (b) $7 + y = 23$ (c) $4y - 7 = 23$ (d) $4y + 7 = 23$

8. Find x if $x - 3 = 2$

(a) 3 (b) 6 (c) 5 (d) 2

9. Solve; $4l - 3 = 5$

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

10. If $\frac{a}{4} = 5$ then a = ...

(a) 5 (b) 20 (c) 4 (d) 18

Learning Outcomes

After completion of this chapter the students are now able to

- Learn the concept of variables.
- Use variables in different situation.
- Know the meaning of equation.
- Find the value of the equation.
- Make algebraic expressions from the statement.

ANSWER KEY

Exercise 7.1

1. (i) 2n (ii) 4n (iii) 3n (iv) 3n (v) 5n **2.** 12n **3.** 3a

4. 8c **5.** 5p **6.** 50d **7.** $1 + 3x$ or $3x + 1$

Exercise 7.2

1. 3a **2.** $2l + b$ **3.** 6S **4.** $12l$ **5.** $x + y = y + x$

6. $l \times (m \times n) = (l \times m) \times n$ **7.** $p \times (q + r) = p \times q + p \times r$

Exercise 7.3

1. Algebraic expressions : (i), (iii), (iv), (vi) Arithmetic expressions : (ii), (v), (vii), (viii)

2. (i) 2y, 5z (ii) 6x, –3y, 8 (iii) 7a (iv) 3l, –5m, 2n (v) $\frac{2l}{3}$, x

3. (i) a is increased by 11 (ii) x is subtracted from 12
(iii) Three times of z is increased by 8 (iv) 5 times ℓ is subtracted from 6
(v) 5 times a is divided by 4.

4. (i) p + 10 (ii) y – 5 (iii) $\frac{d}{3}$ (iv) –6l (v) 1 – m
(vi) 3x + 11 (vii) –2y + 2 (viii) $\frac{7c}{5}$ (ix) y – 3x (x) (a + b) c

5. y – 15 **6.** a + 3 **7.** 2x + 1 **8.** 5y – 7

9. (i) a + 15 (ii) a – 2 (iii) 2a + 5 (iv) a – 4 (v) 3a – 3 **10.** 2l + 10

Exercise 7.4

1. (i) x + 3 = 10 (ii) a – 5 = 12 (iii) 5p + 2 = 32 (iv) $\frac{x}{2} = 10$ (v) 2x + 3 = 17

2. (i) LHS = l + 5, RHS = 8 (ii) LHS = 13, RHS = 2m + 3
(iii) LHS = $\frac{t}{4}$, RHS = 6 (iv) LHS = 2h – 5, RHS = 13 (v) LHS = $\frac{5x}{7}$, RHS = 15

3. (i) x = 5 (ii) p = 4 (iii) a = 10 (iv) l = 6 (v) x = 3

4. (i) z = 14 (ii) a = 12 (iii) m = 5 (iv) x = 6 (v) x = 2

5. (i) x = 11 (ii) y = 1 (iii) x = 2 (iv) a = 24 (v) y = 8

6. (i) x = 4 (ii) x = 18 (iii) x = 15 (iv) x = 3 (v) x = 8
(vi) x = 28 (vii) x = 40 (viii) x = 11 (ix) x = 4 (x) x = 3

Multiple Choice Questions

1. c **2.** a **3.** c **4.** d **5.** c **6.** b **7.** d **8.** c **9.** d **10.** b

P7W2A1

8

BASIC GEOMETRICAL CONCEPTS

Objectives

In this chapter you will learn

- About point, line, line segment and ray.
- About curve i.e. simple, open and closed curve.
- About polygon i.e. triangle and quadrilateral and their parts.
- About circle and its parts.
- To correlate these geometrical concepts with the surroundings.

8.1 Introduction

Geometry, a branch of Mathematics, concerned with position, size and shape of figures.

The word 'Geometry' has been derived from Greek word **"Geo"** and **"metron"**. **Geo means earth** and **metron means measurement**. In earlier days, Geometry was used in various fields of our life e.g art, architecture, measurement etc, we learn about the construction of geometrical figures and study their basic properties.

Just as numbers are basic elements or foundation blocks of arithmetic and algebra has numbers, alphabets and the four fundamental operations as its basic elements; Geometry too has its own basic elements or foundation blocks. In this section, we shall learn about some of these. There are three basic elements **point, line and plane.** These terms cannot be precisely defined. However, we can give some ideas to illustrate the meaning of these terms.

8.2 Point

A small dot marked by a sharp pencil on a sheet of paper or a tiny prick made by a fine needle or pin on a paper, *Bindi* are examples of a point.

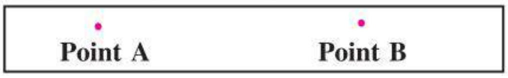

Sharped end of a pencil


Tips of Compasses


Pointed end of a needle

A point is just a location marker. It depicts the exact position of an object. A point has no length, breadth or height i.e. it does not have any size.

A point is represented by a single capital letter of the alphabet such as A, B, C, ... P, Q, R etc and read as 'point A, 'point B' (as shown)



8.3 Line

A line is a collection of points which can be extended infinitely on both the sides. It has only length neither breadth nor thickness. There are two ways of naming a line.

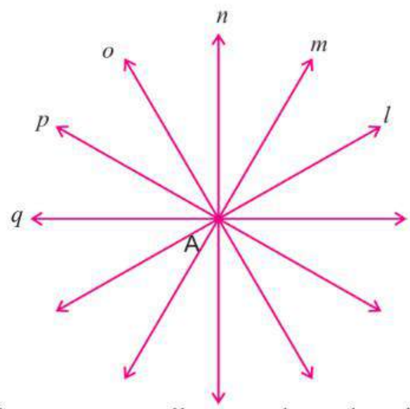
(i) A line can be named by writing a single small letter of the alphabet such as ℓ, m etc.

(ii) By taking two points say A and B on the line named as $\overleftrightarrow{AB}$

A line has some properties as follows:

- A line has no end points. The arrows show that the line goes an endlessly in all directions.
- A line has infinite many points on it.

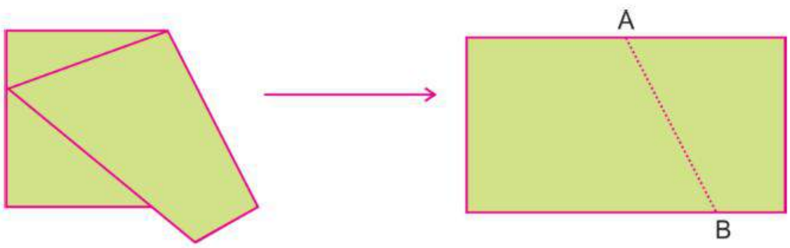
- Only one line can be drawn through two points.
- Line cannot have definite length.
- Infinite lines can be drawn through a given point.



In the figure, lines ℓ, *m, n, o, p, q* all passes through a given point A.

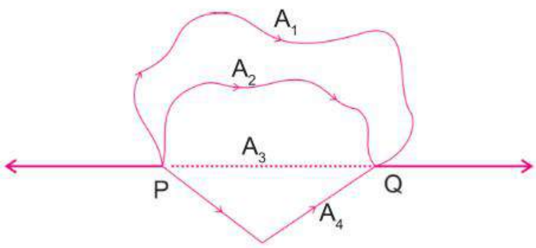
8.3.1 LINE SEGMENT

Fold a piece of paper and then unfold it. You get a crease on the paper.



The crease you get is the representation of a line segment. This line segment has two end points, A and B.

Now consider two points P and Q. There are several possible ways to reach from P to Q as shown as A_1, A_2, A_3 and A_4. The shortest path is represented by dotted line, (A_3) which is straight. So, the straight path from P to Q is a segment (portion) of line passing through P and Q.



Since, there is only one line passing through P and Q. It is obvious that there is only one line segment joining P and Q.

A line segment is a part of a line that is bounded by two distinct end points. It is the shortest distance between two points.

A line segment from P to Q is represented by $\overline{PQ}$ or $\overline{QP}$. There are infinite points on a line segment.

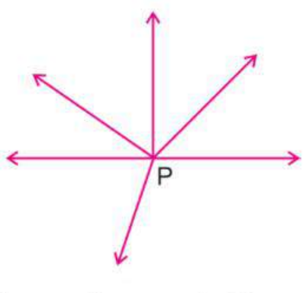
8.3.2 Ray

It is a part of a line which has only one end point and can be extended indefinitely in one direction. $\overrightarrow{AB}$ is a ray with initial point A and extended indefinitely from A to B.

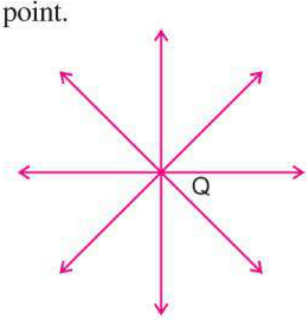
$\overrightarrow{BA}$ is a ray with initial point B and extended indefinitely from B to A.

$\overrightarrow{AB}$ and $\overrightarrow{BA}$ are two different rays.

Infinite number of rays can be drawn from a point.



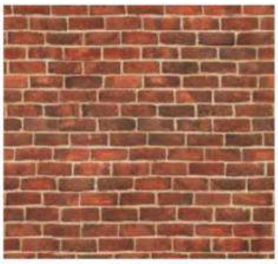
Infinite rays from a point P



Infinite rays from a point Q

8.4 Plane

We come across a lot of flat surfaces in our everyday life like top of a table, surface of a wall, surface of a blackboard.



So every solid has a surface which is flat or curved. It may be smooth or rough. In Geometry, we take totally flat or curved surfaces.

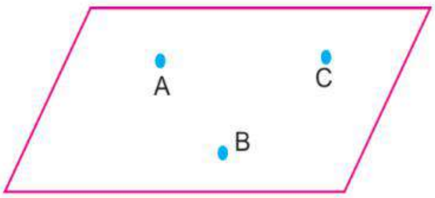
A plane is a flat surface which extends endlessly in all directions. It has no boundary. It has length and breadth but no height.

As plane extends indefinitely in all directions, we cannot draw it on a plain paper, only a portion of a plane is drawn.

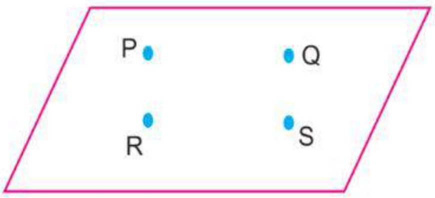
A plane can be named in two ways:

(i) By writing a single small letter such as p or q. It is read as 'plane p' or 'plane q'.

(ii) By writing three or more capital letters say A, B and C. But not on the same line. It is read as 'plane ABC'.



Plane A B C

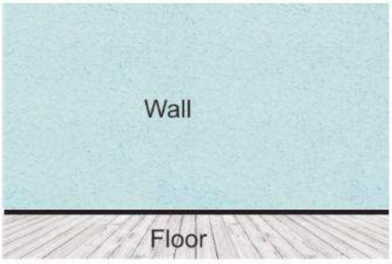


Plane P Q R S

8.4.1 Properties of Points and Lines in a Plane

1. Any two points on the same plane can be connected with one and only one line passing through them. This line wholly lies in the plane.

2. Two planes intersects in a line, e.g. wall and floor of a room intersect in a line called edge.

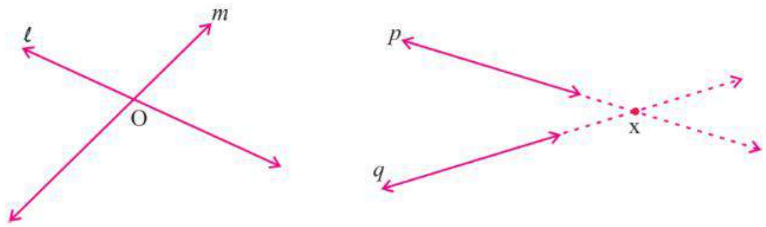


3. If we consider two lines in a plane, there can be two possibilities.
   (i) They may cut each other in the plane.
   (ii) They are parallel to each other i.e. they do not cut each other.

8.5 Intersecting Lines

In a plane two lines that meet at a point are called **intersecting lines** and the point is called the **point of intersection**.

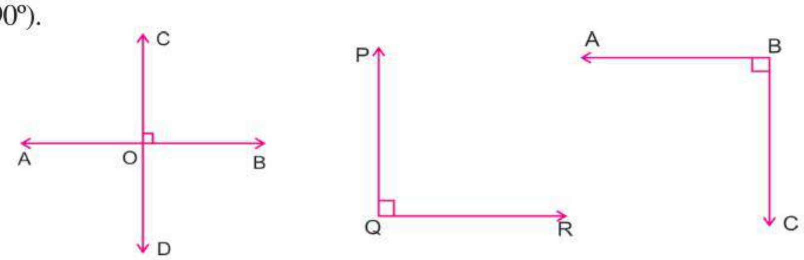
(i) ℓ and m are intersecting lines and O is the point of intersection.



(ii) After extending p and q lines, they intersect at x, point of intersection.

8.5.1 Perpendicular lines

In a plane two lines are said to be perpendicular to each other if the angle formed by them is a right angle (90º).



(i) (ii) (iii)

symbol of perpendicular is '⊥'

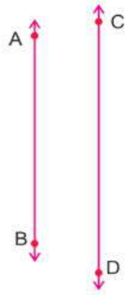
(i) Lines AOB and COD are perpendicular to each other as ∠COB = 90º, we write COD⊥ AOB are read as 'CD is perpendicular to AB'. Or AOB ⊥ COD as AB is perpendicalar to CD.

(ii) PQ⊥QR as ∠PQR = 90º Or RQ ⊥ PQ as ∠RQP = 90º

(iii) AB⊥BC as ∠ABC = 90º Or BC ⊥ AB as ∠CBA = 90º

8.6. Parallel lines

In a plane, the lines which never meet even after extending are known as **parallel lines.** The distance between the set of parallel lines remain same.

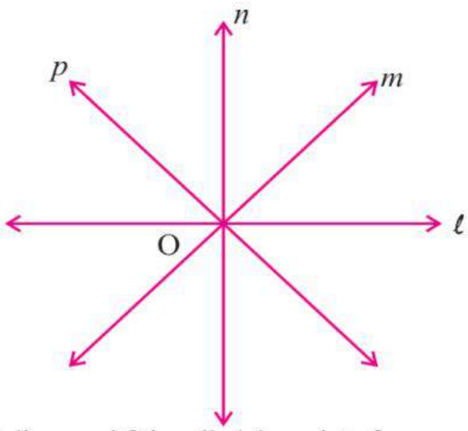


$p \| q$ AB||CD

The opposite edge of a ruler (scale) or blackboard, railway lines are best examples of parallel lines.

8.7 Concurrent lines

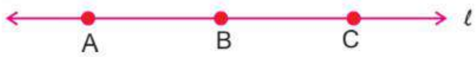
Three or more lines in a plane when pass through a same point are called concurrent lines and that point is called the **point of concurrence**.



Lines ℓ, m, n, p pass through O are called concurrent lines and O is called the point of concurrence.

8.8 Collinear Points

Three or more points in a plane are said to be collinear, if they all lie on the same line.



Collinear Points

Non-Collinear points

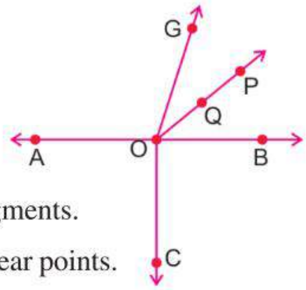
Let's illustrate some examples:

Example 1: **From the given figure, name**

(i) Any four rays.

(ii) Any four line segments.

(iii) Set of collinear points.



Solution : (i) $\overrightarrow{OQ}$, $\overrightarrow{OP}$, $\overrightarrow{OG}$, $\overrightarrow{OA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$, $\overrightarrow{QP}$ are rays.

(ii) OQ, QP, OP, OG, OA, OB, OC, AB are line segments.

(iii) A, O, B are collinear points or O, Q, P are collinear points.

Example 2 : From the given figure name.

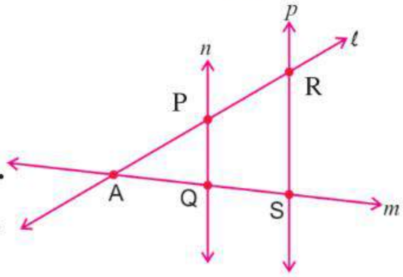
(i) Pair of parallel lines.

(ii) Pairs of intersecting lines.

(iii) Lines whose point of intersection is Q.

(iv) Lines whose point of intersection is A.

(v) Collinear points



Solution : (i) Pair of parallel lines : n and p

(ii) Pairs of intersecting lines : ℓ and m, n and ℓ, p and ℓ, n and m, p and m.

(iii) Q is the point of intersection of n and m.

(iv) A is the point of intersection of ℓ and m.

(v) Set of collinear points : A, P, R and A, Q, S.

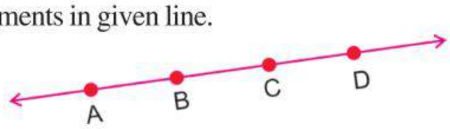
Exercise 8.1

1. Give the examples of :

   (i) A point (ii) A line segment (iii) Parallel lines

   (iv) Intersecting lines (v) Concurrent lines

2. Name the line segments in given line.



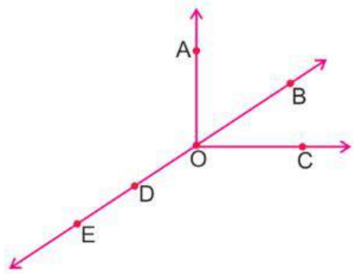
3. How many lines can pass through a point?
4. How many points lie on a line?
5. How many lines pass through two points?
6. Use the figure to name.

   (i) Five points

   (ii) A line

   (iii) Four rays

   (iv) Five line segments



7. Name the given ray in all possible ways.

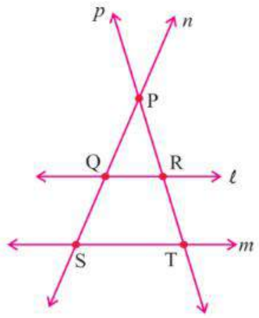
8. Use the figure to name :

(i) Pair of parallel lines.

(ii) All pairs of intersecting lines.

(iii) Lines whose point of intersection is S.

(iv) Collinear points.



9. Use the figure to name:

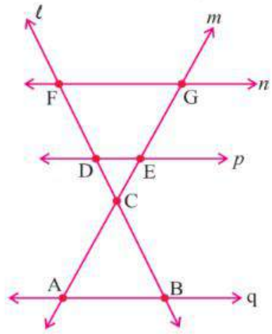
(i) All pairs of parallel lines.

(ii) All pairs of intersecting lines.

(iii) Lines whose point of intersection is D.

(iv) Point of intersection of lines *m* and *p*.

(v) All sets of collinear points.



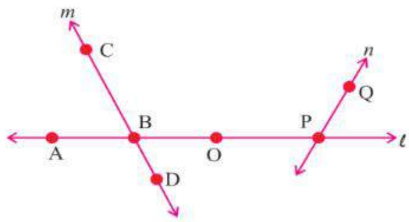
10. Use the figure to name:

(i) Line containing point P.

(ii) Lines whose point of intersection is B.

(iii) Point of intersection of lines *m* and ℓ.

(iv) All pairs of intersecting lines.



11. State which of the following statements are True (T) or False (F):

(i) Two lines in a plane, always intersect at a point.

(ii) If four lines intersect at a point, those are called concurrent lines.

(iii) Point has a size because we can see it as a thick dot on the paper.

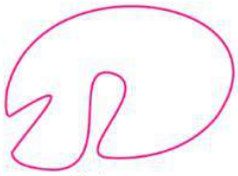
(iv) Through a given point, only one line can be drawn.

(v) Rectangle is a part of the plane.

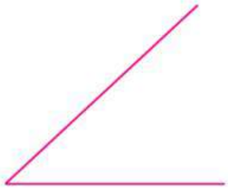
8.9 Curves

Look at the figures

(i) (ii) (iii)



(iv)



(v)

(vi)

You may have drawn several such drawings, names on sand, walls or mirror. All these drawings are curves.

Take a pencil and a paper. Put the sharp tip of the pencil on the paper and move it aimlessly from one point to other without lifting the pencil. The pictures obtained as a result are called curves.

Generally 'curve' means 'not straight'.

But in mathematics a curve can be straight figure (v), (vi).

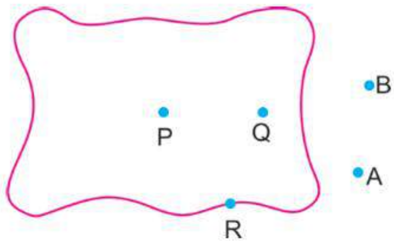
Simple Curve : If a curve does not cross itself, then it is called simple curve. figure (i), (iv), (v), (vi).

Open Curve : A curve which does not cut itself is called an open curve.

Figure (i), (ii), (iii), (v)

Closed Curve : A curve whose initial and terminating point lies on same point is called a closed curve. (Figure (iv) is a closed curve), there are three parts.

- **Interior of the curve :** Part of curve made by all those points that are enclosed by the curve is called interior of the curve. Points P, Q are inside (interior) of the curve.



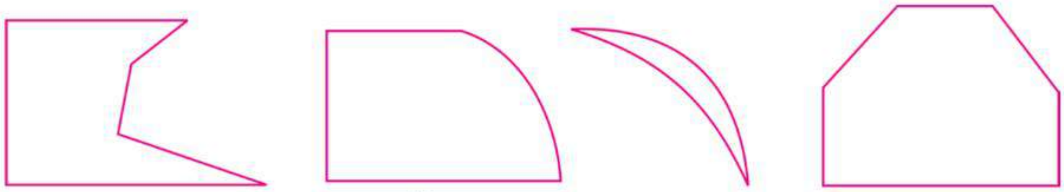
- **On the Boundary of the curve :** Part of the curve made by all those points that are on the curve is called the boundary of the curve. In figure point R is on the boundary of the curve.
- **Exterior of the curve :** Part of the curve made by all those points that are not enclosed by the curve is called the exterior of the curve. In figure, A and B are the points exterior to the curve.

For Example : Your school has a boundary, your class rooms are inside the school boundary and your school gate is on the boundary. There is a road outside the boundary of your school.

- A curve divides the plane in three disjoint parts.

8.10 Polygons

Can you identify the difference between the following closed curves?



(i) (ii) (iii) (iv)

Figure (i) and (iv) are made up of line segments while figure (i) and (iii) are not.

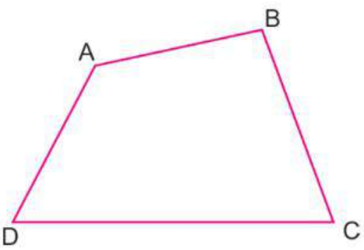
The figures which are entirely made up of line segments are known as polygons, thus figure (i) and (iv) are polygons.

Polygon means ‘Poly’ and ‘gon’. ‘Poly’ means ‘many’ and ‘gon’ means ‘sides’. So ‘Polygon’ means ‘having many sides’.

“A polygon is simple closed curve having three or more line segments. such that.”

- No two line segments intersect except at their end points.
- No two line segments with a common end point are coincident.

The line segments forming a polygon are called its**sides** and the end points of the line segments are called its **vertices.**



Sides : The line segments which form a polygon are called its sides. AB, BC, CD, DA are the sides of the polygon ABCD.

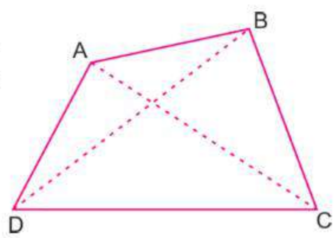
Vertices : The meeting point of a pair of sides of a polygon is called its vertex. In the polygon ABCD, sides AB and BC intersect at B, BC and CD intersect at C and so on. So A, B, C and D are the vertices of the polygon ABCD.

Adjacent Sides: Any two sides with a common end-point (vertex) are called the adjacent sides of the polygon. AB and BC have common vertex B. So AB and BC are adjacent sides.

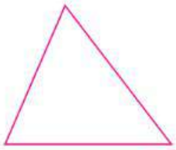
Similarly AB and AD; AD and DC; DC and CB are pairs of adjacent sides.

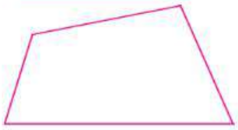
Adjacent vertices : The end-points of the same side of a polygon are known as adjacent vertices. Side AB has end points A and B. So A and B are adjacent vertices. Similarly A, D; D, C; C, B are pairs of adjacent vertices.

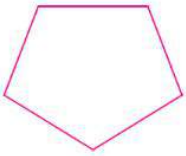
Diagonals : The line segments obtained by joining non-adjacent vertices are called the diagonals of the polygon. AC and BD are the diagonals of the polygon ABCD.

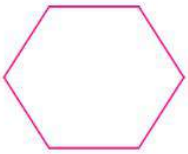


Polygons are further divided into various categories, depending upon the number of line segments they have

(i)  A three-sided polygon is called a **Triangle.**

(ii)  A four-sided polygon is called a **Quadrilateral.**

(iii)  A five-sided polygon is called a **Pentagon.**

(iv)  A six-sided polygon is called a **Hexagon.**

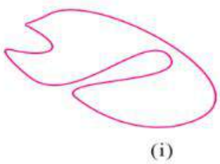
Similarly seven, eight, nine and ten sided polygons are called heptagon, octagon, nonagon and decagon respectively.

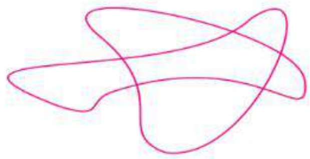
Regular Polygon : If all sides of a polygon are equal and all angles are also equal, then it is called a regular polygon.

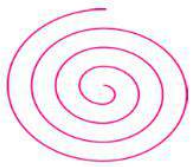
Exercise 8.2

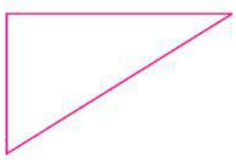
1. (a) Which of the following are simple curves ?

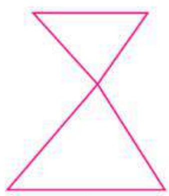
(b) Classify the following as open or closed curve.


(i)


(ii)


(iii)

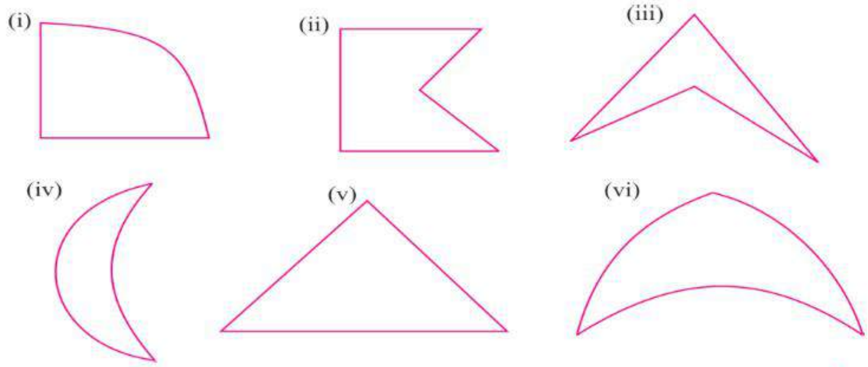

(iv)

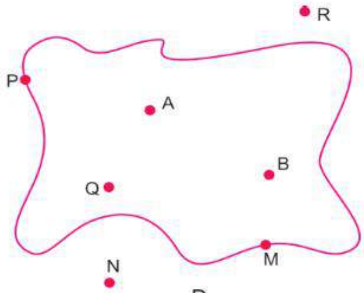

(v)


(vi)

(vii) (viii)

2. Identify the polygons:





3. Draw any polygon and shade its interior.

4. Name the points which are:

(i) In the interior of the closed figure.

(ii) In the exterior of the closed figure.

(iii) On the boundary of the closed figure.

5. In the given figure, name:

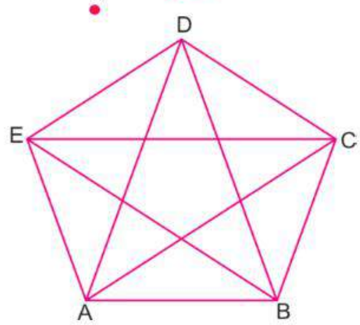
(i) The vertices

(ii) The sides

(iii) The diagonals

(iv) Adjacent sides of AB

(v) Adjacent vertices of E.

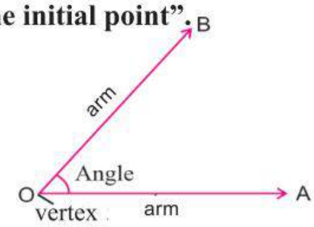


8.11 Angle

In our daily life, we come across many physical objects that have two edges (arms) joined together by a hinge. For example, two fingers of a hand, two hands of a clock, two sharp parts of scissors are inclined towards each other and have an opening (angle) between them.

Such objects give us the concept of an angle in Geometry.

"An angle is a figure formed by two rays with the same initial point".

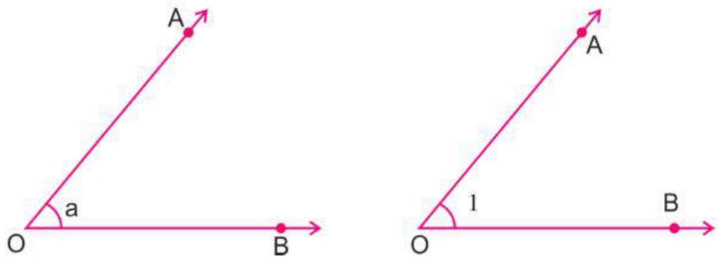


The common initial point is called the vertex of the angle and the rays forming the angle are called its arms.

In the figure, the common initial point O is the vertex and rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are the arms of the angle.

8.11.1 Naming an Angle

The symbol '∠' is used to denote an angle. There are several ways of naming an angle.



(i) The vertex is written in the middle and any two points on the arms of the angle are written as two extreme letters.

Thus, the given angle can be named as ∠AOB or ∠BOA.

(ii) Only the letter at the vertex of the angle alone can be written to name the angle.

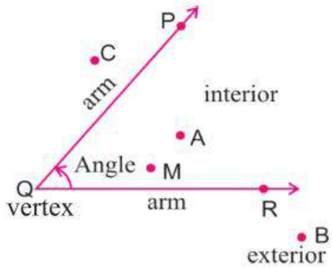
Thus, the given angle can also be named as ∠O.

(iii) We can place a number 1, 2, 3......... etc. or a small letter a, b, c..... etc. near the small curve connecting the two arms of angle (as shown) and name the angle using that number or letter.

Thus, the given angle can also be named as ∠a or ∠1.

- **In naming an angle, the letter at the vertex should be in the middle.**

8.11.2 Interior and Exterior of an angle



An angle divides all the points in a plane into three parts.

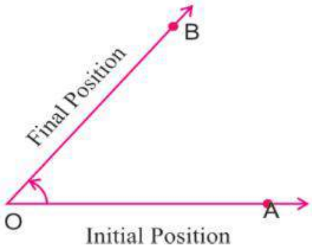
(i) The part of the plane which is within the arms of an angle produced indefinitely is called the **interior** of the angle. In the figure, points A and M are in the interior of ∠PQR.

(ii) The part of the plane which is outside the arms of an angle produced indefinitely is called the **exterior** of the angle. In the figure, points B and C are in the exterior of ∠PQR.

(iii) The part of the plane made by all those points that are on the angle is called the **boundary** of the angle. In the figure P, Q, R are on the boundary on ∠PQR.

8.11.3 Angles as rotation of a ray

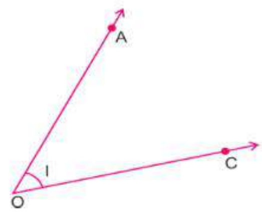
An angle can also be described by rotating a ray. Let there be a ray $\overrightarrow{OA}$ with initial point O. Suppose we rotate it and it occupies the final position $\overrightarrow{OB}$. We say that ∠AOB has been described by rotating a ray with O as vertex.



Its magnitude is the amount of rotation through which one of the arms must be rotated about the vertex to bring it to the position of the other arm.

Let us consider some examples.

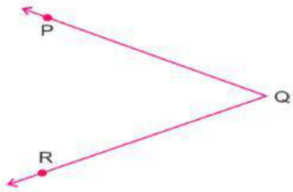
Example 3 : **Name the given angle in all ways.**



Solution : ∠AOC or ∠COA or ∠O.

Or ∠1

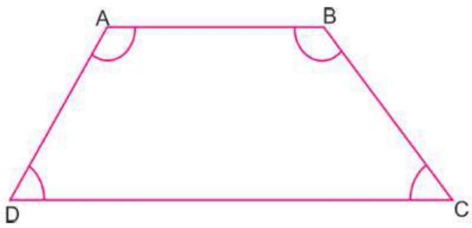
Example 4 : **Name the vertex and the arms of given ∠PQR.**



Solution : Vertex = Q

Arms of ∠PQR = $\overrightarrow{QP}$ and $\overrightarrow{QR}$

Example 5 : **Name all the angles of given figure.**



Solution : There are four angles in the given figure.

(i) ∠DAB or ∠BAD(A as vertex, AB and AD are arms)

(ii) ∠ABC or ∠CBA (B as vertex, BC and BA are arms)

(iii) ∠BCD or ∠DCB(C as vertex, CB and CD are arms)

(iv) ∠CDA or ∠ADC (D as vertex, DC and DA are arms)

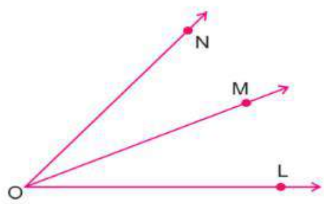
Example 6 : **Name all the angles in given figure.**

Solution : Clearly, there are three angles formed in the given figure

(i) ∠LOM or ∠MOL

(ii) ∠MON or ∠NOM

(iii) ∠NOL or ∠LON

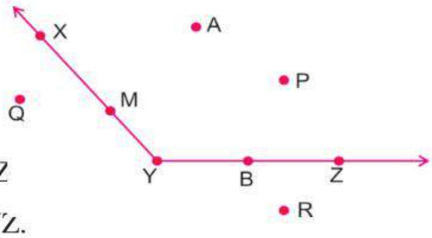


Example 7 : **In the given figure, name the points that lie :**

(i) In the interior of ∠XYZ

(ii) In the exterior of ∠XYZ

(iii) On ∠XYZ



Solution : (i) Points A and P are in interior of ∠XYZ

(ii) Points Q are R in the exterior of ∠XYZ.

(iii) Points X, M, Y, B and Z are on ∠XYZ.

Example 8 : **In the given figure, write another name for the following angles.**

(i) ∠1 (ii) ∠2 (iii) ∠3 (iv) ∠a (v) ∠b

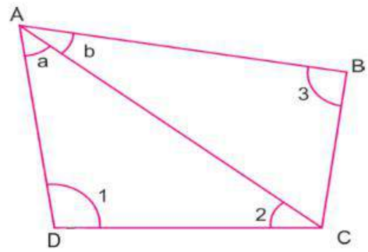
Solution : (i) ∠1 = ∠ADC or ∠CDA

(ii) ∠2 = ∠ACD or ∠DCA

(iii) ∠3 = ∠CBA or ∠ABC

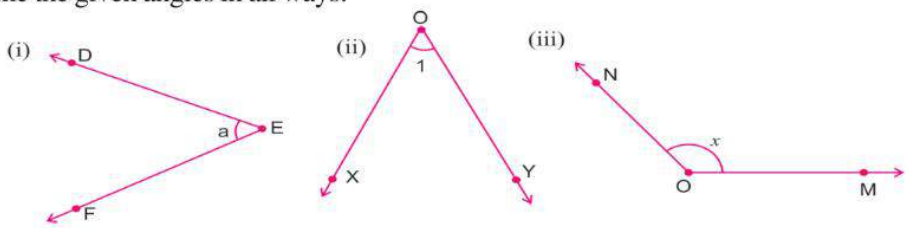
(iv) ∠a = ∠DAC or ∠CAD

(v) ∠b = ∠BAC or ∠CAB

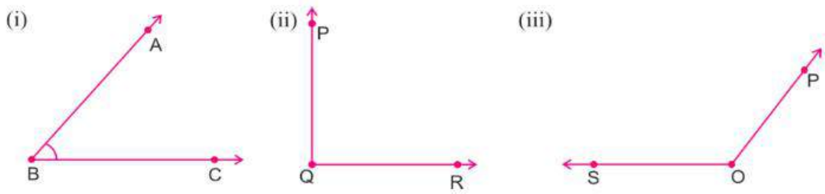


Exercise 8.3

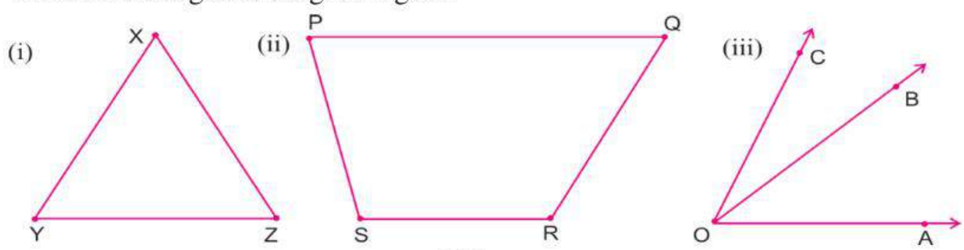
1. Name the given angles in all ways:



2. Name the vertex and the arms of given angles:



3. Name all the angles of the given figure:



W1I2R9

9

UNDERSTANDING ELEMENTARY SHAPES

Objectives

In this chapter you will learn

- To compare line segments in different ways.
- To measure line segments, angles etc.
- To understand angles by examples in the surroundings.
- To understand about polygons.
- To understand about 3D shapes from the surroundings.

9.1 Introduction

In the previous chapter, we have studied some basic geometrical concepts such as point, line, ray, line segments, angle, triangle etc.

The basic shapes around us are either made up of straight lines or curved lines. They have corners, edges, planes, they may be open or closed curves. We can organise them into line segments, angles, polygons, circles etc. All these shapes have different sizes and measurements. Let us learn to measure and compare these shapes.

9.2 Measuring And Comparing line Segments

We know that a line segment is a part of line with two end points.

Thus, two points in a plane determine exactly one segment. The measure of line segment i.e. shortest distane between these two points is called its length. It is measured in metres, centimetres, millimeteres etc. A line segment has fixed length of a line but no breadth or thickness. The fixed length of a line segment makes its measurement and comparison possible.

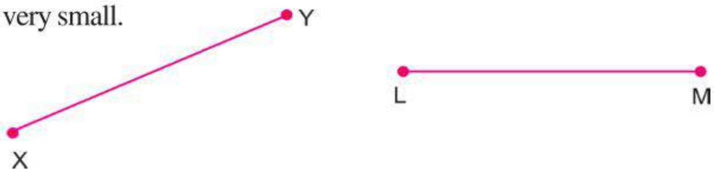
9.2.1 Comparing line segments

Comparing two line segments means finding the shorter or longer line segment among them. We can compare two line segments by different methods.

Method 1. **Comaprison by observation :**

Look at the line segments AB and CD.

Just by observing them, we can easily find out that line segments AB is shorter than CD. i.e. AB<CD. But this is not always possible, If the difference between their lengths is very small.



Here both the line segments XY and LM appear to be of the same length and It is difficult to say which one is longer or shorter by just looking at them.

So we need some accurate methods for comparison.

Method 2. **Comaprison by Tracing : Let us compare AB and CD by tracing method**

Trace AB on a tracing paper and place it on CD in such a way that the point A coincides with point C.

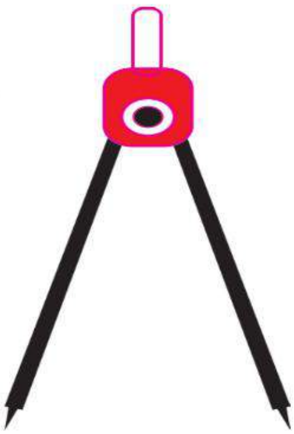
There can be three posibilities

(i) B is between C and D. We say that AB is shorter than CD i.e. AB<CD

(ii) B is exactly on D. We say that AB is equal to CD i.e. AB = CD.

(iii) B is beyond D. We say that AB is longer than CD i.e. AB>CD.

Method 3. **Comaprison by Divider :**

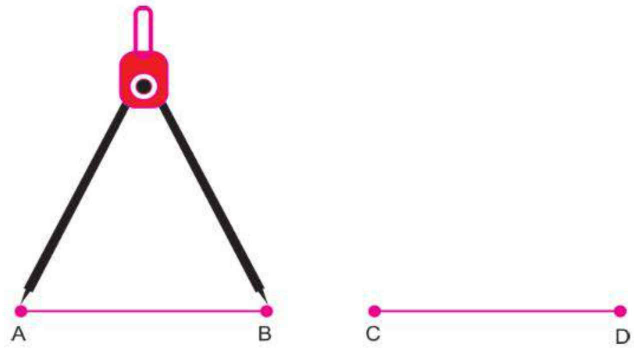


Look in your gemoetry box you will notice an object with two pointed arms, hinged together with the help of a knob,this object is known as a divider.

Let us compare the two line segments AB and CD using a divider.

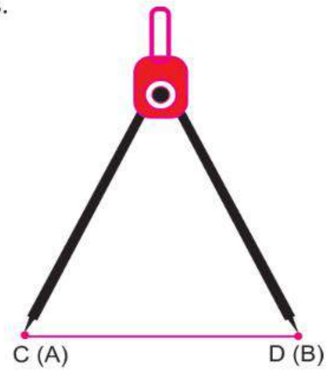
Place the needle of one hand of the divider at A and open other hand carefully so that it coincides with B.

Now, lift the divider carefully so that the opening of two arms remains unchanged. Place one of the needle at C of line segments CD and other arm is free to fall at any

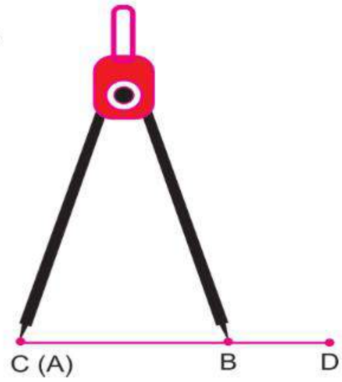


point on CD. Now, there are three possibilities.

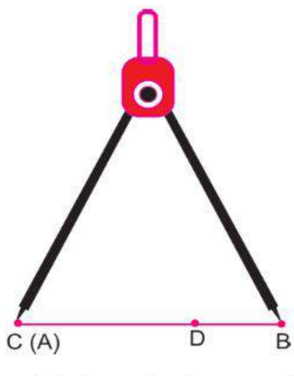
(i) The other arm falls exacity at D, then AB = CD.



(ii) The other arm falls between C and D such that AB< CD.



(iii) The other arm falls beyond D such that AB>CD.



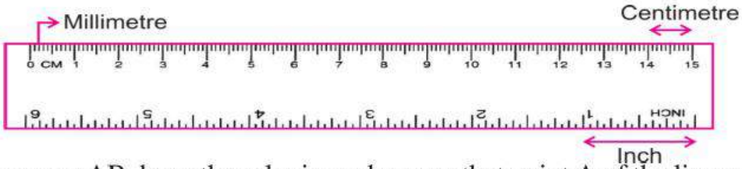
These methods are not useful where we want to know by how much a line segment is longer or shorter than the other. Now let us learn to measure the lengths of the line segments.

9.2.2. Measurement of line segment

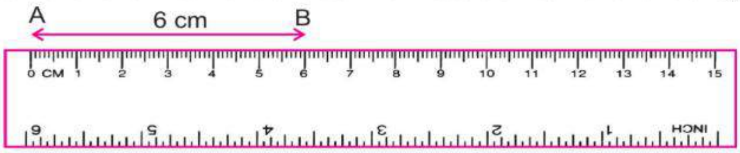
Method 1. Measuring by ruler

To measure line segments, we use a scale that has centimetre marks on one edge and inch marks on the other edge.

Observe that each centimeter (cm) is divided into ten equal parts and each part is called millimetre (mm).



To measure AB, keep the ruler in such a way that point A of the line segment coincides with the 'o' mark of the ruler. Then read the mark on the ruler against point B.



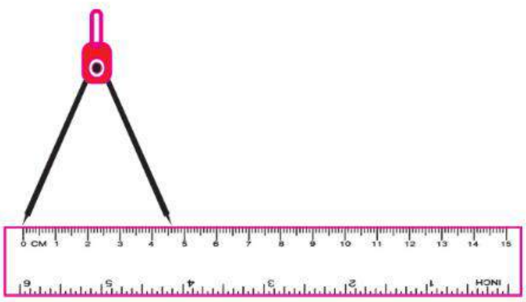
Hence, the length of line segment AB = 6cm

Method 2. Measuring by both ruler and divider

Let us use a ruler and a divider to measure the length of AB.

Open the arms of divider in such a way that one of its arms is at A and the other is at B.

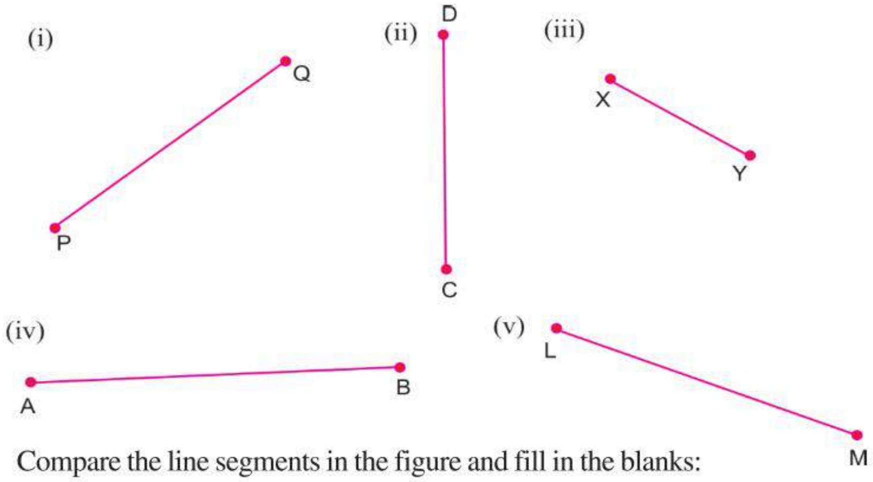
Now, lift the divider without disturbing its arms and place it on the ruler such that one of its arms is at mark '0'. Read the mark against the other arm of the divider.



The other arm of the divider is at 4.5 cm mark of the ruler. Thus lenght = 4.5cm.

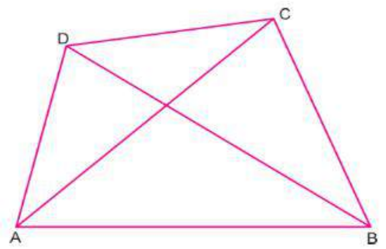
Exercise 9.1

1. Measure the line segments using a ruler and a divider:



2. Compare the line segments in the figure and fill in the blanks:

   (i) AB ____ AB
   (ii) CD ____ AC
   (iii) AC ____ AD
   (iv) BC ____ AC
   (v) BD ____ CD

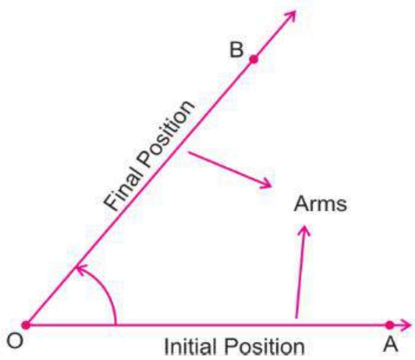


3. Draw any line segment AB. Take any point C between A and B. Measure the lengths of AB, BC and AC. Is AB = AC + CB ?

4. Draw a line segment AB = 5cm and AC = 9cm in such a way that points A, B, C are collinear. What is the length of BC?

9.3 Measuring Angles

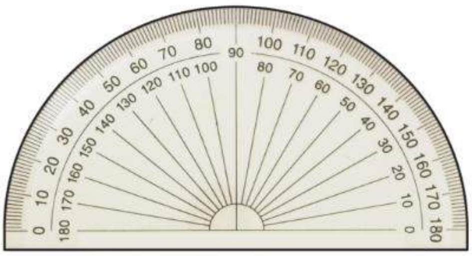
In the previous chapter, we have learnt that an angle is a figure formed by two rays with the same initial point. An angle can also be described by rotating a ray over another ray.



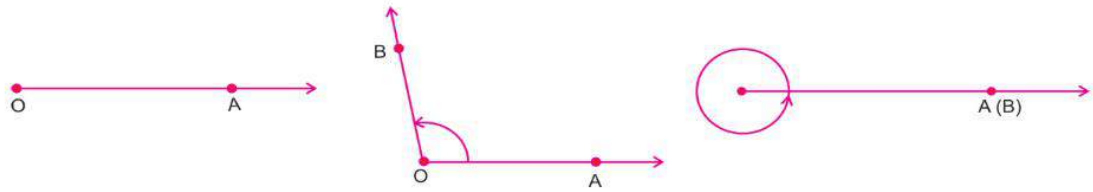
The magnitude or the size of an angle is the amount of rotation through which one of the arms must be rotated about the vertex to bring it to the position of the other arm.

The magnitude of an angle depends upon the opening or inclination between the two rays that form the angle. If two angles have different inclination, then we say that they have different magnitudes. The magnitudes of an angle can be measured with the help of Protactor in degrees.

Protactor : Look into your geometry box, there is a geometrical instrument that looks like the letter D. The angles are marked from 0º to 180º on the edge in clockwise direction as well as in anticlockwise direction.



Degree measure of angles : Consider a ray OA. Rotate this ray starting from its initial position, keeping the point O fixed. When the ray comes back to its initial position, we say that the ray has completed one revolution.



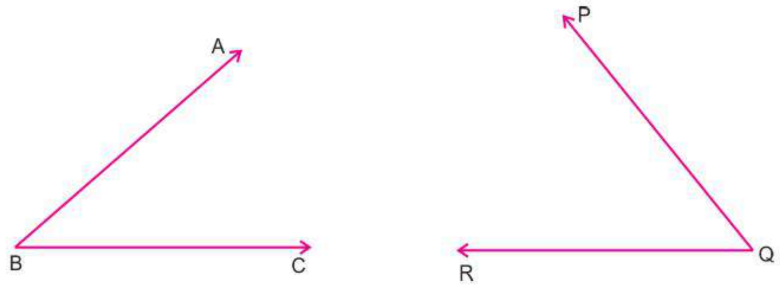
(i) (ii) (iii)

One revolution is divided into 360 equal parts and each point is called 'one degree.'

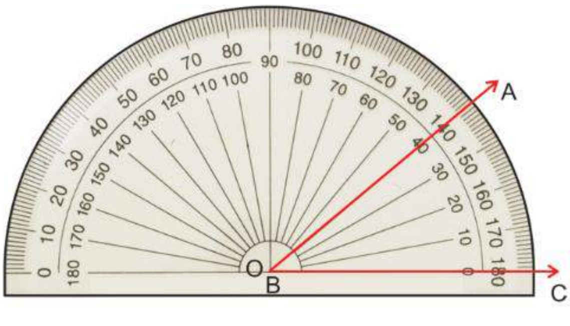
The standard unit for measuring an angle is 'degree'. It is denoted as : 'o'

Thus, we say that one complete revolution or complete angle is 360º.

Let us measure angle ∠ABC and ∠PQR.

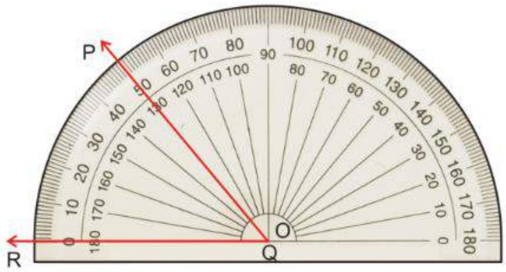


Place the protractor in such a way that the mid point O of the baseline coincides with B and the baseline exactly overlaps on ray $\overrightarrow{BC}$. Since $\overrightarrow{BC}$ is on the right of vertex (mid point of baseline) O. Start counting from 0º on the right side of B and read the mark with which arm AB coincides. It coincides with 40º mark. So ∠ABC = 40º.



Similarly to measure ∠PQR. Place the protractor in such a way that the mid point O at the baseline coincides with point Q and the baseline overlaps exactly on QR. Since QR is on the left of Vertex O, so start counting from left side of Q and read the mark with which arm PQ coincides. It coincides with 50º mark.

$\therefore \angle PQR = 50^\circ$

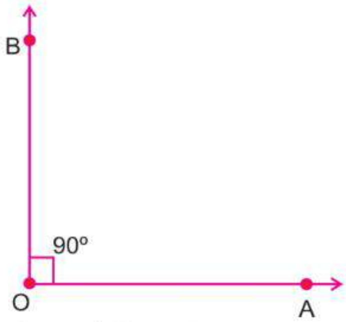


9.3.1. Types of Angles

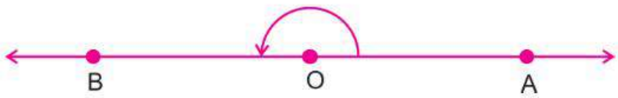
In geometry, angles can be classified according to their magnitude.

Zero Angle : An angle whose measure is 0º called a zero angle. When a ray does not move at all, we say, it has moved through an angle of 0º.

Right Angle : An angle whose measure is 90º called a right angle. Two lines that meet at a Right angle are said to be perpendicular. It is also written as OB⊥OA. '⊥' is the symbol of perpendicular.

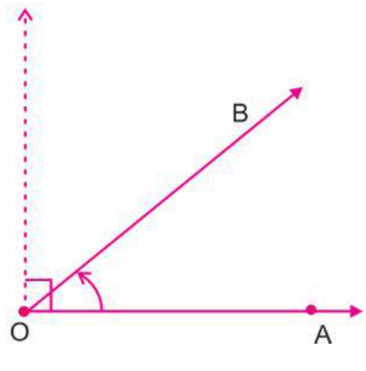


Straight Angle : An angle whose measure is 180º called a straight angle.

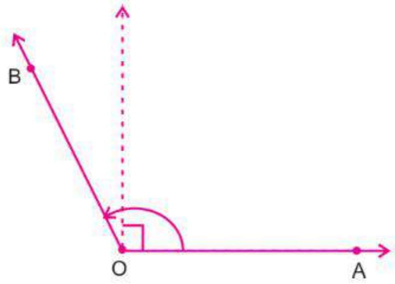


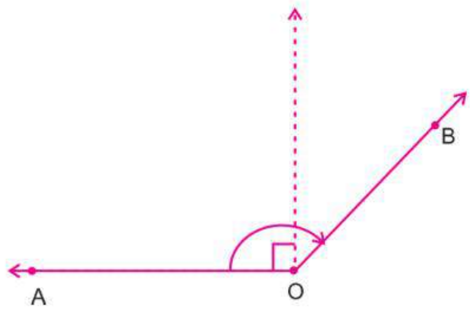
Two right angles make one straight line.

Acute Angle : An angle whose measure is between 0º and 90º is called an acute angle. Thus, an acute angle is more than a Zero angle but less than a right angle.



Obtuse Angle : An angle whose measure is between 90º and 180º is called an obtuse angle. Thus an obtuse angle is more than a right angle but less than a straight angle.

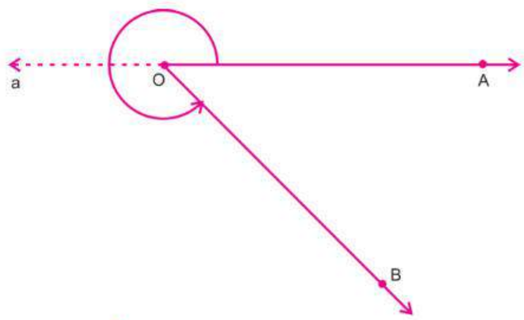




Complete Angle : An angle whose measure is 360º called a complete angle. When a ray completes one full revolution. It has moved through an angle of 360º.

Reflex Angle : An angle whose measure is between 180º and 360º is called a reflex angle.

Thus, a reflex angle is more than a straight angle but less than a complete angle.



Let us consider some examples:

Example 1. **Classify the following angles as acute, right, obtuse, straight or reflex angle:**

(i) 89º	**(ii) 101º**	**(iii) 62º**	**(iv) 180º**
(v) 91º	**(vi) 215º**	**(vii) 90º**	**(viii) 181º**
(ix) 18º	**(x) 130º**		

Solution : (i) 89º is between 0º and 90º.

∴ It is an acute angle.

(ii) 101º is between 90º and 180º.

∴ It is an obtuse angle.

(iii) 62º is between 0º and 90º.

∴ It is an acute angle.

(iv) 180º is straight angle.

(v) 91º is between 90º and 180º.

∴ It is an obtuse angle.

(vi) 215º is between 180º and 360º.

∴ It is an reflex angle.

(vii) 90º is a right angle.

(viii) 181º is between 180º and 360º.

∴ It is a reflex angle.

(ix) 18º is between 0º and 90º.

∴ It is an acute angle.

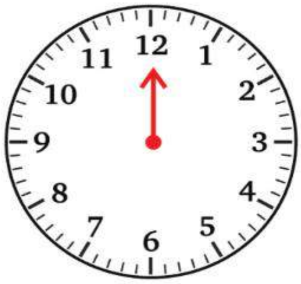
(x) 130º is between 90º and 180º.

∴ It is an obtuse angle.

9.4. Angles in terms of revolution

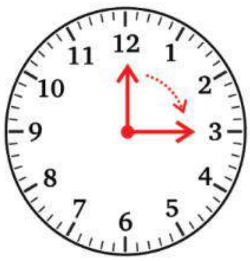
Let us express the angle in terms of revolution on clock face by an activity.

Types of angles through wall clock.



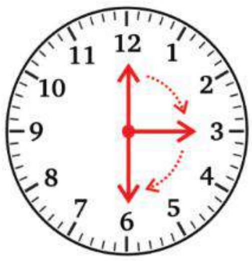
When the minute hand of a clock is at 12 and has not moved, we say that the minute hand has turned by zero angle. Thus, zero angle involves no revolution.

The movement of the minute hand from 12 to 12 is given below.



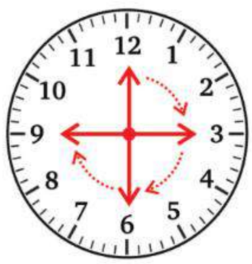
12 to 3

1 right angle = $\frac{1}{4}$ of a revolution.



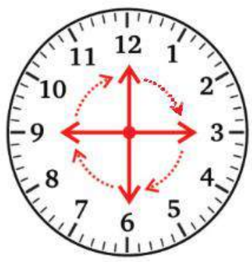
12 to 6

2 right angles straight angle = $\frac{1}{2}$ of a revolution.



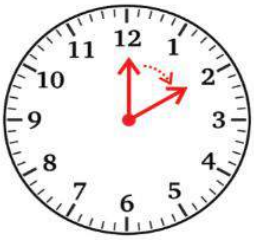
12 to 9

3 right angles = $\frac{3}{4}$ of a revolution



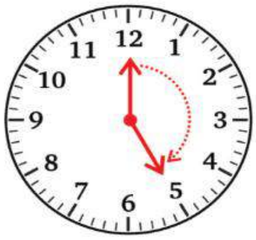
12 to 12

4 right angles = complete angle $\frac{4}{4}$ or 1 revolution.



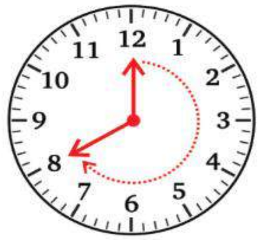
12 to 2

acute angle (less than $\frac{1}{4}$ of a revolution.)



12 to 5

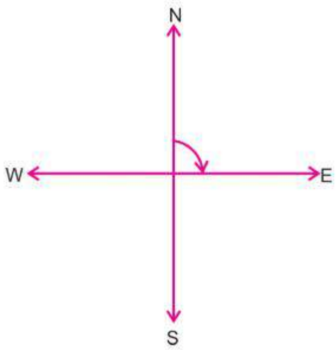
obtuse angle (more than $\frac{1}{4}$ but less than $\frac{1}{2}$ of a revolution).



12 to 8

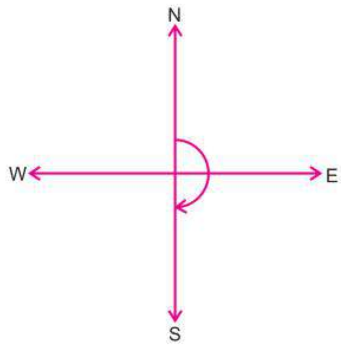
reflex angle (more than $\frac{1}{2}$ but less than 1 complete revolution).

Let us explain the kind of angles through direction. A person is facing north. The turns he takes to face the other direction are given below:



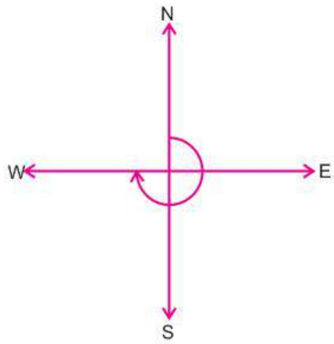
North to East

1 right angle = $\frac{1}{4}$ of a revolution



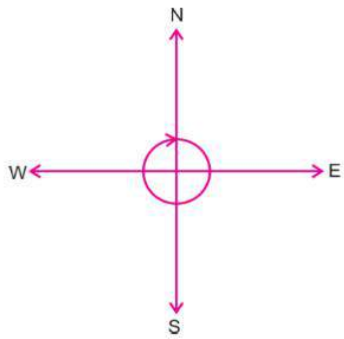
North to South

2 right angles = $\frac{1}{2}$ of a revolution



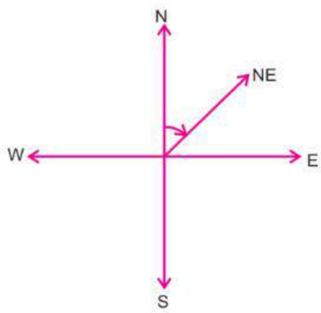
North to West

3 right angles = $\frac{3}{4}$ of a revolution



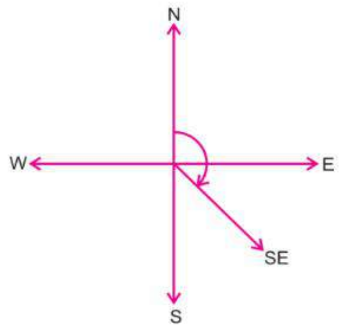
North to North

4 right angles = $\frac{4}{4}$ of a revolution



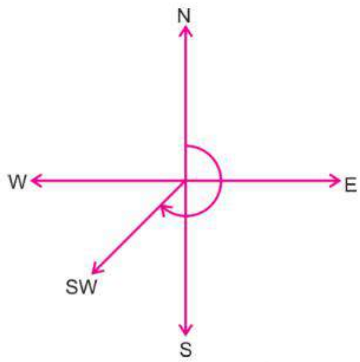
North to North-East

acute angle = less than $\frac{1}{4}$ of a revolution



North to South-East

obtuse angle = more than $\frac{1}{4}$ but less than $\frac{1}{2}$ of a revolution.



North to South-West reflex angle.

more than $\frac{1}{2}$ but less than 1 complete revolution.

Example 2. **By what fraction of a revolution does the minute hand of a clock move, when it goes from (i) 12 to 3 (ii) 2 to 8 (iii) 3 to 12**

Solution : (i) 12 to 3 : Quarter or $\frac{1}{4}$ (ii) 2 to 8 : Half or $\frac{1}{2}$

(iii) 3 to 12 : 3 Quarters or $\frac{3}{4}$.

Example 3. **At which point does the hour hand of a clock stop if it starts at:**

(i) 12 and make $\frac{1}{2}$ revolution clockwise.

(ii) 4 and make $\frac{1}{4}$ revolution clockwise.

(iii)7 and make $\frac{3}{4}$ revolution clockwise.

Solution : (i) For 1 revolution, the hour hand takes 12 hours.

For $\frac{1}{2}$ of a revolution, the hour hand takes

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

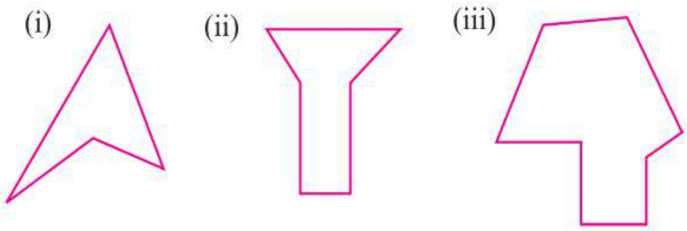
$\therefore$ If hour hand starts at 12 and make $\frac{1}{2}$ revolution clockwise it will stop at 6.

(ii) For 1 revolution, the hour hand takes 12 hours. For $\frac{1}{4}$ of a revolution, the hour hand takes $\frac{1}{4} \times 12 = 3$ hours

So, if hour hand starts at 4 and makes $\frac{1}{4}$ revolution clockwise, it will stop at 7.

A polygon is called a concave polygon if the measure of atleast one of the angles is a reflex (more than 180°) angle.

If a line segment joining any two points in the interior of a polygon does not lie within it, then it is a concave polygon.



These are figures of concave polygons.

Play way Activity on Concave and Convex Polygons :

⇒ Take one thread and hold it in the form of a circle or make a circle by tying its both ends.

⇒ Call one student and say him/her to insert fingers inside the circle and stretch the thread in outward direction.

You will get a convex polygon.

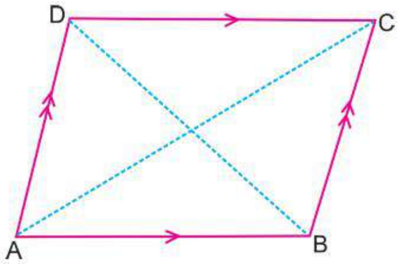
Call one more student and say him/her to place one or more fingers in the outer of thread and push it inside.

You will get a concave polygon.

9.9 Types of Quadrilateral

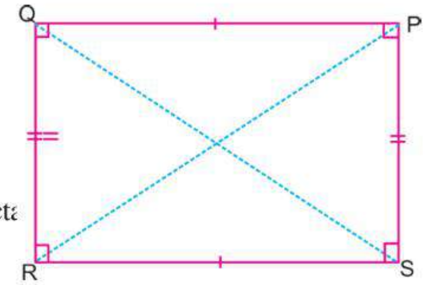
We have already studied in the previous chapter about the basic elements of a quadrilateral, such as sides, angles, diagonals, vertices, interior and exterior part etc. Here we will study the types of quadrilateral.

* **Parallelogram:-** A quadrilateral in which both pairs of opposite sides are equal or parallel is called parallelogram.
  In the given figure. ABCD is a parallelogram in which.
  AB = DC, AD = BC
  or AB ∥ DC, AD ∥ BC



Observe it carefully and measure its sides angles and diagonals, you get the following properties of parallelogram

* Opposite sides are equal.
* Opposite sides are parallel.
* Opposite angles are equal.
* Diagonals bisect each other.
* **Rectangle:-** A parallelogram in which each angle is right angle is called rectangle.



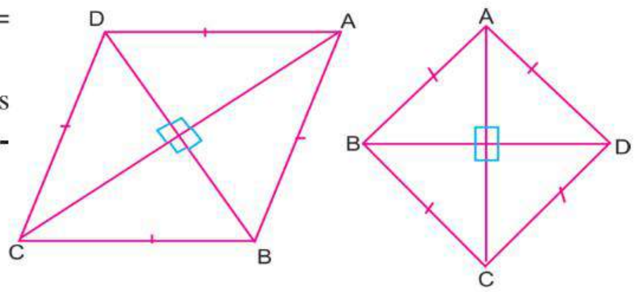
In the given figure, PQRS is a rectange in which

PQ = RS, PS = RQ and $\angle P = \angle Q = \angle R = \angle S = 90^\circ$

Observe it carefully and measure its sides, angles and diagonals, you get the following properties of recta

* Opposite sides are equal.
* Each angle is 90º.
* Diagonals bisect each other.
* Diagonals are equal in length.
* **Rhombus:-** A quadrilateral having all sides are equal is called a rhombus. **Or**
  A parallelogram having adjacent sides equal is called rhombus.

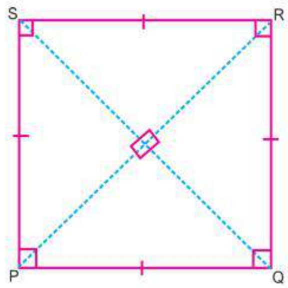
In the given figures, ABCD is a rhombus in which AD ∥ BC, AB ∥ CD and AB = BC = CD = DA



Observe it carefully and measure its sides angles and diagonals, you get the following properties of rhombus.

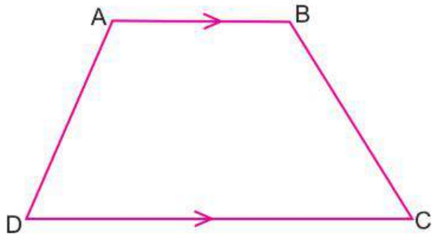
* All sides are equal.
* Opposite angles are equal.
* Diagonals bisect each other at 90º.

* **Square:-** A rhombus with each angle is 90º is called a square
  In the given figure, PQRS is a square in which PQ = QR = RS = SP and
  $\angle P = \angle Q = \angle R = \angle S = 90^\circ$

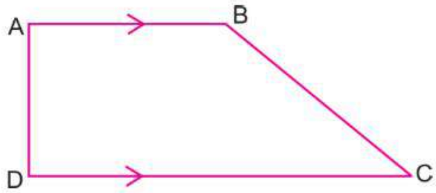


Observe it carefully and measure its sides angles and diagonals, you get the following properties of square.

* All sides are equal.
* Each angle is right angle 90º.
* Diagonals are equal in length..
* Diagonals bisect such other at right angle.
* **Trapezium:-** A quadrilateral in which one pair of oppsite sides is parallel, is called a trapezium.
  In the given figure, ABCD is a trapezium in which AB ‖ DC.



(i)



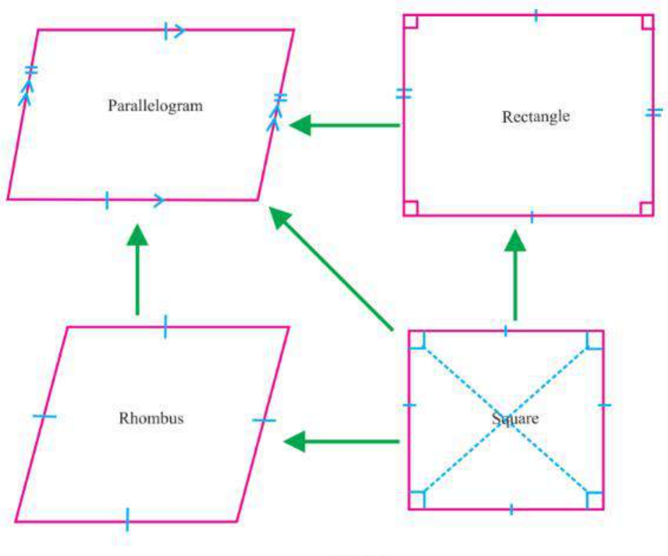
(ii)

Isosceles Trapezium:- A quadrilateral in which a pair of opposite sides is parallel and the other two sides are equal is called an isosceles trapezium In above figures (ii), if AB ‖ DC and AD = BC then ABCD is an isosceles trapezium

Observe it carefully and measure its sides angles and diagonals

* A pair of opposite sides is parallel
* Diagonals do not bisect

Table of Quadrilaterals



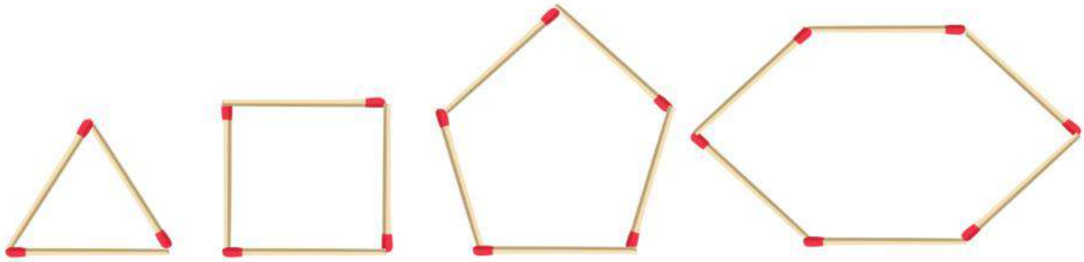
ACTIVITY

To make closed geometrical shapes like triangle, quadrilateral pentagon and Hexagon, using match sticks.

Pre-requisite: Knowledge of geometerical shapes.

Material Required :- Match sticks, glue, paper.

Procedure : Paste match sticks as shown in following Figures.



Observation:

1. Three closed match sticks makes Triangle.
2. Four closed match sticks makes Quadrilatral.
3. Five closed match sticks makes Pentagon.
4. Six closed match sticks makes Hexagon.

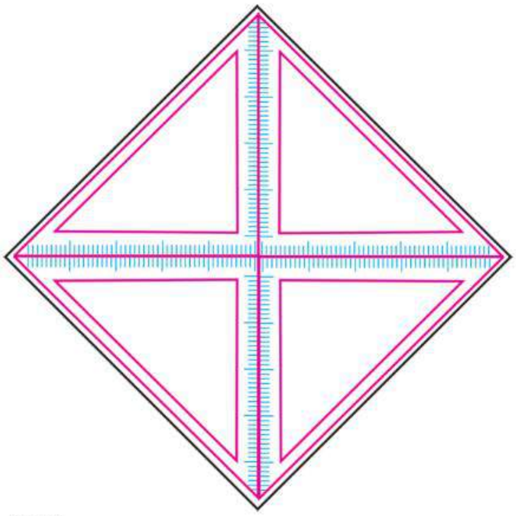
ACTIVITY

Make the following shapes using a pair of set squares (i) square (ii) rectangle (iii) parallelogram (iv) rhombus (v) trapezium

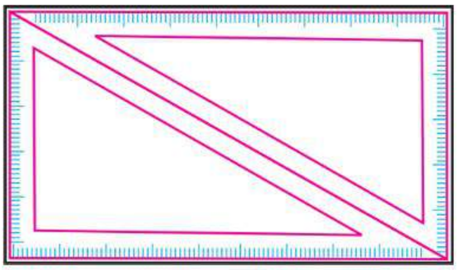
Material Required:- Set squares.

Procedure:-

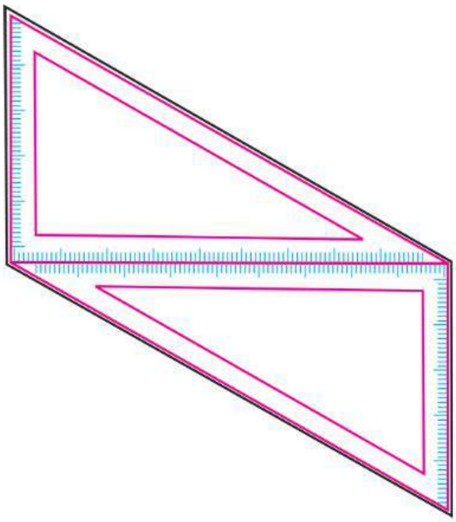
(i) **Square:-** Take four set squares of 45° – 45° – 90° and place them as shown.



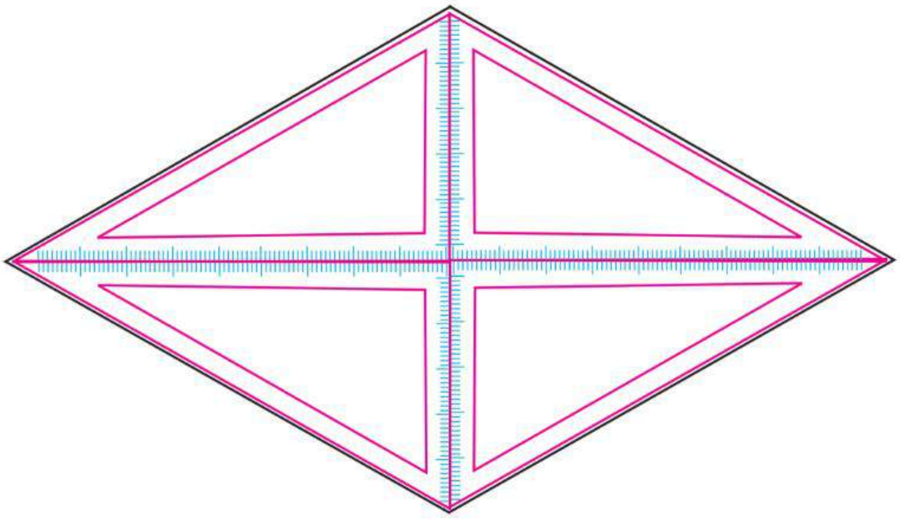
(ii) **Rectangle:-** Take two set suqares of $30^\circ - 60^\circ - 90^\circ$ and place them as shown.



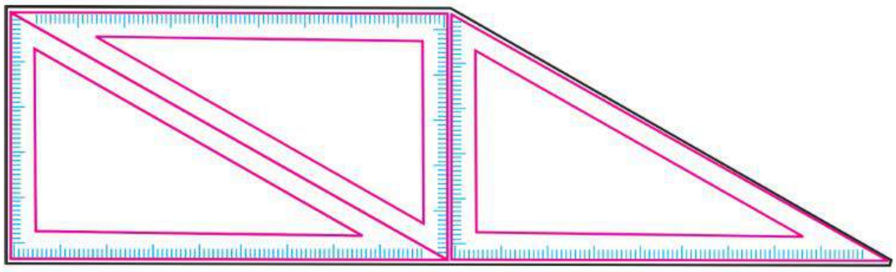
(iii) **Parallelogram:-** Take two set squares of $30^\circ - 60^\circ - 90^\circ$ in a different position and place them as shown.



(iv) **Rhombus:-** Take four set squares of $30^\circ - 60^\circ - 90^\circ$ and place them as shown.

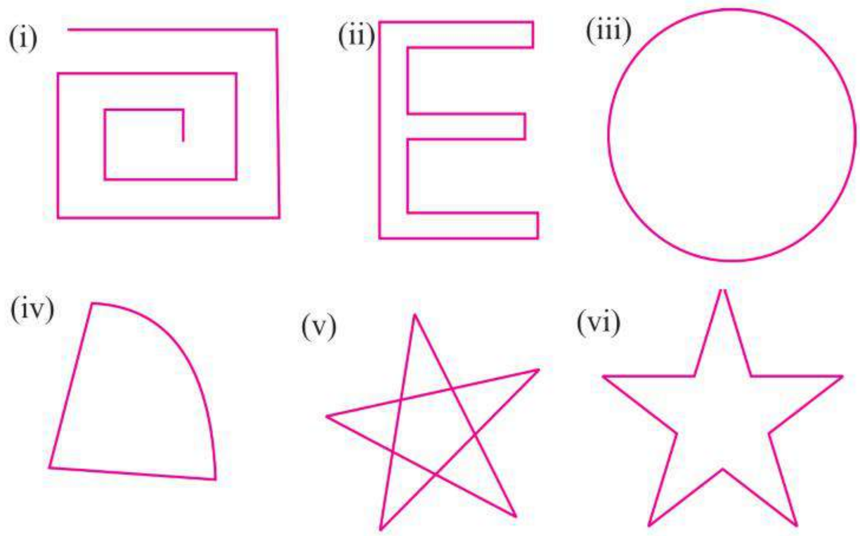


(v) **Trapezium :-** Take three set squares of 30º-60º-90º or 45º – 45º-90º and place them as shown.

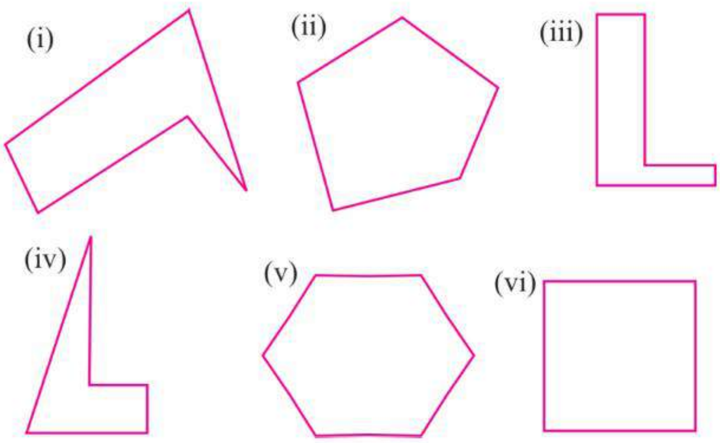


Exercise 9.5

1. Which of the followings are polygons and there is no polygon. Give the reason :



2. Classify the following as concave or convex polygons :



3. Tick in the boxes, if the property holds true for a particular quadrilateral otherwise croes out 'x'

Quadrilateral Properties	Rectangle	Paralelogram	Rhombus	Trapezium	Square
All sides are equal					
Only opposite are sides equal					
Diagonals are equal					
Diagonals bisect each other					
Diagonals are perpendicular to each other					
Each angle is 90º					

4. Fill in the blanks:-

(i) .... is a quadrilateral with only one pair of opposite sides parallel.

(ii) .... is a quadrilateral with all sides equal and diagonals of equal length.

(iii) A polygon with atleast one angle is reflex is called ....

(iv) .... is a regular quadrilateral.

(v) .... is a quadrilateral with opposide sides equal and diagonals of unequal length.

5. State True or False:-

(i) A rectangle is always a rhombus.

(ii) The diagonals of a rectangle are perpendicular to each other.

(iii) A square is a parallelogram.

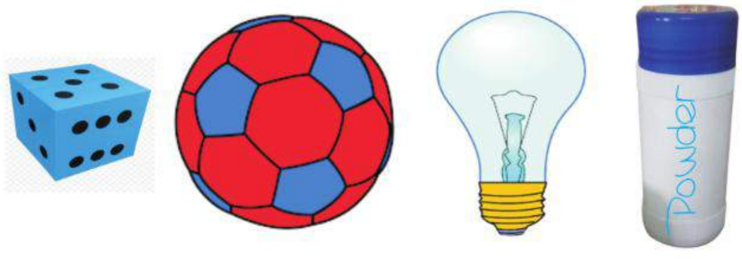
(iv) A trapezium is a parallelogram.

(v) Opposite sides of a parallelogram are parallel.

9.10 Three Dimensional Shapes

You have learnt about flat shapes or two dimensional shapes or plane figure such as triangle, quadrilateral circle etc. These shapes lie in one plane. Now you will learn about solid shapes or three dimensional shapes. These shapes lie in more than one plane.

In our daily life, we see many solid shapes, some of them are.



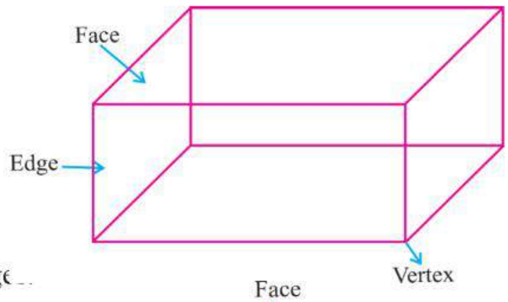
Three dimensional figures have 3 dimensions i.e length, breadth and height. A three dimensional figure or shape can be better described, if its faces (flat surfaces) , vertices and edges are known.

- The surface of a solid shape is called a face.
- The line where two faces meet is called an edge.
- The point where three edges meet is called a corner or vertex.

The various types of three dimensional figures are as follows:-

* **Cuboid:-** Objects such as a match box, brick, geometry box etc. look like a cuboid. These are made of six rectangular plane regions.

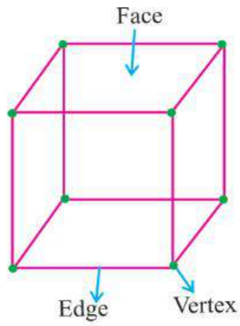
"A cuboid is a solid bounded by six rectangular plane regions."



A cuboid has 6 faces, 8 vertices and 12 edge..

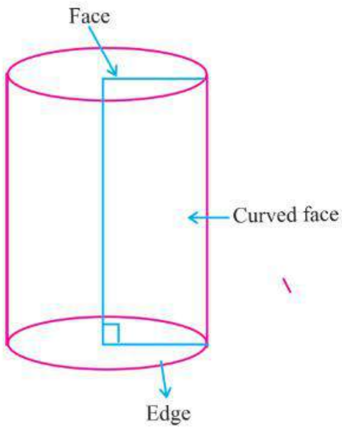
* **Cube:-** A cuboid whose length, breadth and height are and equal is called a cube. Objects such, as dice, sugar cubes etc. look like a cube.

A cube has 6 faces, 8 vertices and 12 edges. All the faces of cube are equal.



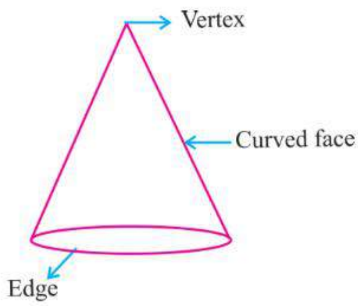
* **Cylinder:-** Objects such as drum, glass, circular pipes, look like a cylinder. These solids have a curved (lateral) surface with identical circular ends. Such solids are right circular cylinders.

A cylinder has 2 plane faces (top and bottom) and 1 curved face. It has 2 circular edges. It has no vertex.



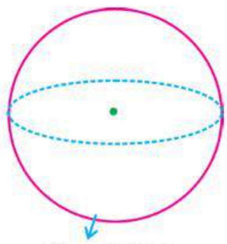
* **Cone:-** Objects such as ice-cream cone, joker cap, birthday cap look like a cone.

A cone has 1 plane face which is its base and 1 curved faces It has 1 edge and 1 vertex.



* **Sphere:-** Objects such as globe, ball, sun etc. look like a sphere. A sphere is the set of all points in a 3-dimensional space which are at equal distance from a fixed point.

  It has one curved surface, no vertex and no edge.

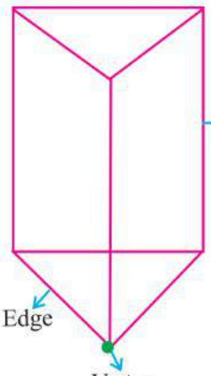


* **Prism:-** A solid object with ends that are parallel and of the same size and shape, and with faces whose opposite edges are equal and parallel

  A triangular prism is made up of two congruent triangles at each end and three congruent rectangles

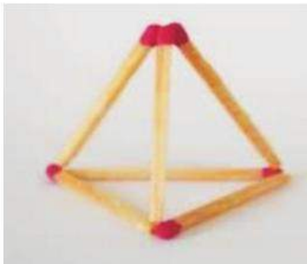
  It has 5 faces, 9 edges and 6 vertices.

  Cubes and Cuboids are also prisms. They are called square prism and rectangular prism respectively.



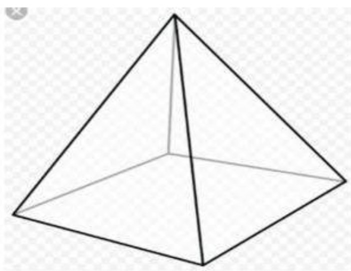
* **Pyramid:-** A pyramid is a solid figure having a rectilinear base and the side faces as triangles.

  Side faces have a common point which is called the vertex of the pyramid.



- A pyramid having a triangular base is called a triangular pyramid. It has 4 faces, 4 verties and 6 edges.
- A pyramid having a square base is called a square pyramid. It has 5 faces, 8 edges, 5 vertices.

  A triangular Pyramid which has a base and all three lateral surfaces are equilateral triangles is called a tetrahedron.



Exercise 9.6

1. Give two examples of each of the following shapes from your surroundings:-

(i) Cube (ii) Cuboid (iii) Cone (iv) Cylinder (v) Sphere

2. Classify the following as plane figures and solid figures:

(i) Rectangle (ii) Sphere (iii) Cylinder (iv) Circle (v) Cube

(vi) Cuboid (vii) Triangle (viii) Cone (ix) Square (x) Prism

3. Write the name of shapes in the base of the following solids:

(i) Cube (ii) Cylinder (iii) Tetrahedron (iv) Cuboid (v) Square Pyramid

4. Fill in the table:-

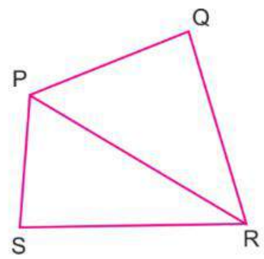
Shape	Number of flat faces	Number of Curved faces	Number of Vertices	Number of Edges
(i) Cuboid				
(ii) Cube				
(iii) Cylinder				
(iv) Cone				
(v) Sphere				
(vi) Triangular Prism				
(vii) Square Pyramid				
(viii) Tetrahedron				

Multiple Choice Questions

1. In the given figure, which of the following is true?

(a) PR = PQ (b) PR > QR

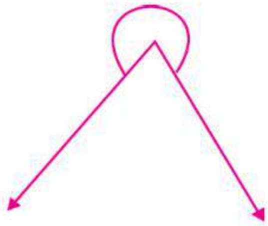
(c) PS > PR (d) PR < PQ



2. Which angle is represented in the given figure?

(a) Reflex (b) Acute

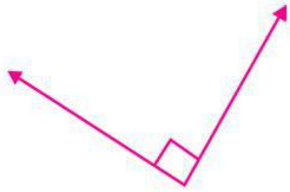
(c) Obtuse (d) Right angle



3. Which angle is represented in the given figure?

(a) Acute (b) Right angle

(c) Obtuse (d) Reflex



4. Which of the following is the example of perpendicular lines?

(a) Railway lines (b) Line Segment forming letter 'x'

(c) Adjacent edges of a table (d) Line segment forming line 'M'

5. Which of the following forms triangles?

(a) 60º, 72º, 48º (b) 73º, 54º, 59º

(c) 60º, 51º, 70º (d) 100º, 42º, 39

6. Which of the following are sides of a triangle?

(a) 1, 2, 3 (b) 2, 2, 7 (c) 3, 4, 2 (d) 5, 6, 12

7. A parallelogram having adjacent sides equal is called a ....

(a) Trapezium (b) Rhombus (c) Rectangle (d) Square

8. Which of the following is not true for rectangle?

(a) Diagonals are equal (b) Diagonals bisect each other

(c) Each angle is 90º (d) All sides are equal

9. Which of the following is not true?

(a) Every rhombus is a parallelogram

(b) Each square is a rhombus.

(c) Each rectangle is a square.

(d) Each square is parallelogram

10. A cuboid has .... edges.

(a) 10 (b) 6 (c) 12 (d) 8

Learning Outcomes

After completion of this chapter the students are now able to

- Compare line segments in different ways
- Measure line segments, angles etc.
- Understand about angles with examples from the surroundings
- Understand about polygons
- Understand about 3D shaps from surroundings

ANSWER KEY

Exercise 9.1

1. (i) 4.4 cm (ii) 3.6 cm (iii) 2.5 cm (iv) 5.8 cm (v) 5cm

2. (i) AB = AB (ii) CD < AC (iii) AC > AD (iv) BC < AC (v) BD > CD

Exercise 9.2

1. (i) Acute angle (ii) Obtuse angle (iii) Reflex angle (iv) Straight angle
(v) Acute angle (vi) Right angle (vii) Obtuse angle (viii) Right angle
(ix) Reflex angle (x) Acute angle

2. (i) Acute angle (ii) Obtuse angle (iii) Right angles (iv) Zero angle
(v) Obtuse angle (vi) Reflex angle (vii) Complete angle (viii) Reflex angle
(ix) Acute angle (x) Straight angle

3. (i) 60° (ii) 125° (iii) 110° (iv) 80° (v) 120°
(vi) 105° (vii) 80° (viii) 135° (ix) 88° (x) 90°

4. (i) 180° (ii) 60° (iii) 360°

5. (i) $\frac{1}{2}$ (ii) $\frac{1}{4}$ (iii) $\frac{1}{2}$ (iv) $\frac{3}{4}$ (v) $\frac{3}{4}$ (iv) $\frac{5}{12}$

6. (i) 1 (ii) 2 (iii) 2 (iv) 1 (v) 1 (vi) 3
(vii) 3 (viii) 1 (ix) 2 (x) 3

7. (i) 3 (ii) 8 (iii) 8 (iv) 2

8. (i) $\frac{3}{4}$ (ii) $\frac{1}{2}$ (iii) $\frac{3}{4}$ (iv) $\frac{1}{2}$

9. (i) 90° (ii) 180° (iii) 60°

11. (i) T (ii) F (iii) T (iv) T

12. (i) acute angle (ii) straight angle or 180º (iii) obtuse angle

Exercise 9.3

1. (ii), (iii), (v) **2.** (ii), (iii) **3.** 90º **4.** (i) T (ii) T (iii) T

Exercise 9.4

1. (i) Isosceles (ii) Equilateral (iii) Scalene (iv) Isosceles
(v) Scalene (vi) Equilateral

2. (i) Obtuse angled (ii) Right angled (iii) Acute anlged (iv) Right angled
(v) Obtuse angled (vi) Acute angled

3. (i), (iii), (iv)

4. (i) Scalene (ii) Isosceles (iii) Scalene (iv) Equilateral
(vi) Isosceles (vi) Scalene

5. (i) Scalene, acute angled (ii) Isosceles, right angled
(iii) Isosceles, obtuse angled (iv) Equilateral, acute angled
(v) Scalene, obtuse angled.

6. (i) 3 (ii) 3 (iii) 3 (iv) 6
(v) Scalene triangle (vi) Acute angled (vii) Isosceles triangle (viii) obtuse angled triangles
(ix) Equilateral triangle (x) Right angled triangle

7. (i) T (ii) F (iii) F (iv) F (v) T (vi) F

Exercise 9.5

4. (i) Trapezium (ii) Square (iii) Concave polygon (iv) Square (v) Parallelogram

5. (i) F (ii) F (iii) T (iv) F (v) T

Exercise 9.6

2. Plane figures (i), (iv), (vii), (ix)
Solid figures (ii), (iii), (v), (vi), (viii), (x)

3. (i) Square (ii) Circle (iii) Equilaterial triangle
(iv) Rectangle (v) Square

Multiple Choice Questions

(1) b **(2)** a **(3)** b **(4)** c **(5)** a **(6)** c **(7)** b **(8)** d **(9)** c **(10)** c

P9Z4N7

10

PRACTICAL GEOMETRY

Objectives

In this chapter you will learn

- About geometrical tools.
- To describe the understanding of angles and their constructions.
- To classify the angles according to their measures.
- About Construction of angle bisectors, perpendicular bisectors etc.

10.1 Introduction

Look at the shape and design of your rooms, bathrooms, floor, garden, verandahs etc. Architects, masons need to draw these shapes with accurate measurements, as the construction of entire work is based upon it. Such constructions are known as **geometrical constructions**.

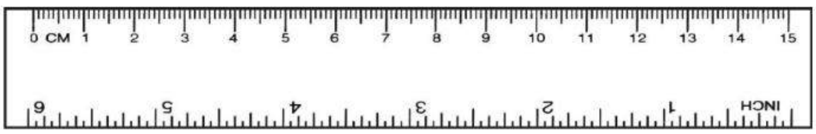
The skill of geometrical constructions of various shapes is not only useful for a mason or architect,it is also useful in many other occupations like tailoring, fashion designing, engineering etc.

In this chapter, you will learn about the construction of geometrical shapes. Let us first learn more about the **tools** in your **geometrical box** which will be used in constructing these shapes.

10.2 Basic Geometrical Tools

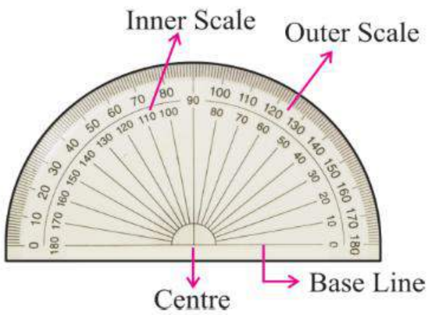
*** The Ruler:-** A ruler is smaller than a metre scale. It has straight edges and is usually of length **30 cm (a feet app.)** or **15cm (6 inches app)**. Each centimetre is further divided into 10 small equal small divisions called **millimetres**.

It has centimetre and millimetre marks on one edge and has inch marks on other edge. The marks on the ruler are called **graduations** and the ruler is called a **graduated ruler**.



We use the ruler **to draw and measure the line segments**.

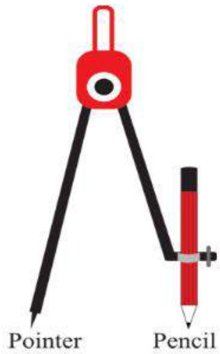
*** The Protractor:-** A protractor is a **semicircular** device, with a straight edge and a curved edge which is marked with 180 equal small divisions, each denoting 1º. It has two scales, outer scale and inner scale. The **inner scale** is marked from 0º to 180º from **right to left**. The **outer scale** is marked from 0º to 180º from **left to right**. It has a 0-180 line parallel to the straight edge, is called a **base line**. The mid point of base line is called the **centre** of the protractor.It looks like a english alphabet D. So usually it is called 'D' also.



We use a protractor to **draw and measure the angles**.

*** The Compasses:-** The instrument compasses has two metal arms, which are hinged together. One of the arms has a metal end point (pointer) and the other arm has screw arrangement which can hold a pencil tightly. The end point of the pencil can be adjusted at any distance from the metallic end point.

A compasses is used to **mark off equal lengths, draw arcs and circles**.

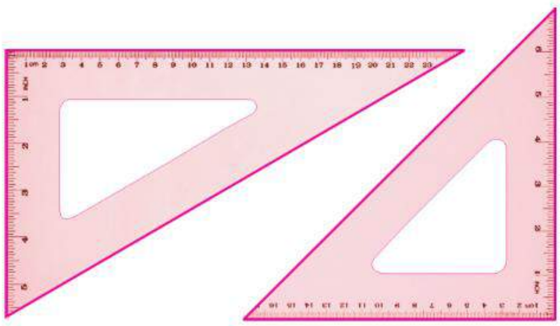


*** The Divider:-** The instrument divider has two pointed metal arms hinged at one end with the helps of a knob. The distance between the arms can be adjusted by opening and closing the arms.

A divider is used to **compare line segments of different lengths**.

*** Set-Squares:-** In the geometrical box, there are two triangular shaped insturments called set squares. In one, the angles are of 30º–60º–90º called **30º set square** and in other, the angles are of 45º – 45º – 90º called as **45º set square**. Two perpendicular edges in these set-squares are usually graduated, one in centimetre and other in inches.

Set-squares are used to draw **perpendicular, parallel lines and many angles** such as 30º , 45º , 60º , 75º etc.



While constructing geometrical shapes, the following points should be kept in mind.

- Use rulers with fine edges and pencils with fine tip.
- Always draw thin lines and mark the points lightly.
- Preferably, Keep two pencils in your tool box one small for the compasses and other for drawing lines and marking points.
- Make sure that the pencil tip and the metal tip of the compasses are at the same level, while using the compasses.

Exercise 10.1

1. What is the use of insturment ruler?
2. What is the use of protractor?
3. What is the use of Compasses?
4. Construct the following angles using set-squares:
   (i) 30º (ii) 45º (iii) 60º (iv) 75º (v) 90º

10.3. Construction of a line segment

In the previous chapter, we have already learnt the technique of measuring line segments and comparing line segments by observation and by using a divider. Here, we shall construct a line segment in two ways.

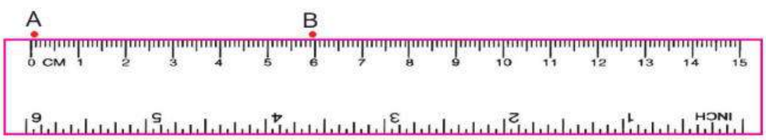
(i) By using a scale (ii) By using compasses.

(i) Construction of a line segment using a ruler:- A simple method to construct a line segment by using a ruler and a pencil given below :

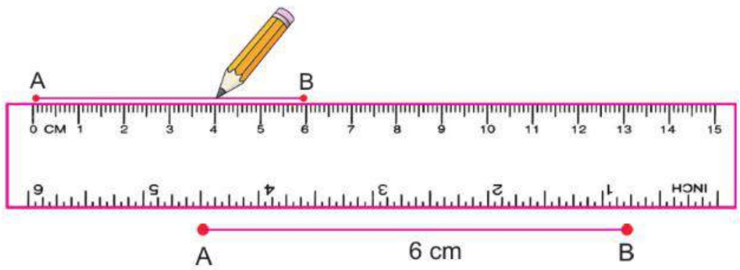
Let us draw a line segment of length 6cm.

Step of Construction:-

1. Place the ruler on a paper and hold it firmly.
2. Mark a point A with the pencil against 0 of the ruler and another point B against 6cm mark of the ruler.



3. Join the two points A and B by moving the pencil along the ruler.



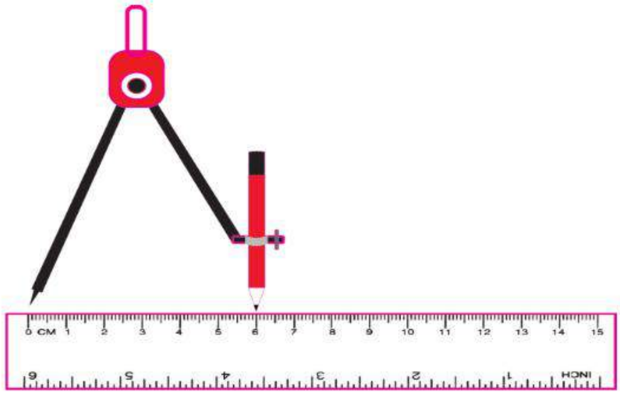
Thus AB = 6cm is the required line segment.

The another method would be to use compasses for the construction of a line segment.

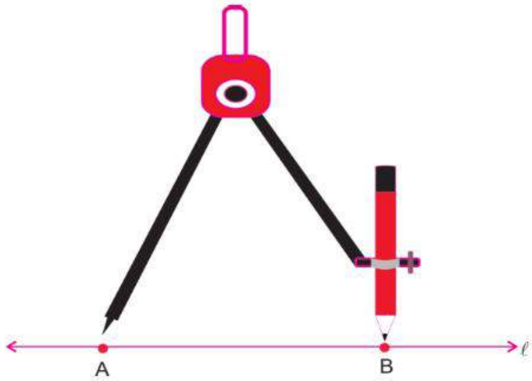
(ii) Construction of a line segment using a ruler and Compasses:- To construct a line segment of given length using compasses, we follow the following steps:-

1. Draw a line ℓ and mark a point A on it.

2. Place the metal point of the compasses at zero mark on the ruler and open it out that the pencil point is on the mark 6.



3. Without disturbing the opening of the compasses, place its needle at point A and draw an arc to cut the line ℓ at point B.



4. AB is the required line segment of length 6cm.

10.3.1 Construction of a copy of a given line segment

Suppose a line segment XY is given

We want to draw a line segment AB whose length is equal to line segment XY.

Normally we measure the length of line segment XY with the ruler and then draw another line segment AB of the same measurement.

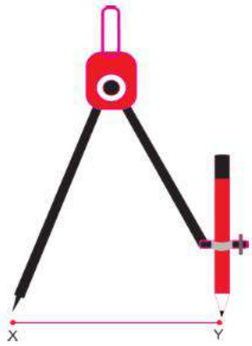
(But this method do not always give a line segment of accurate length.) We use ruler and compass to draw an accurate copy of a line segment.

• Construction using a ruler and compasses

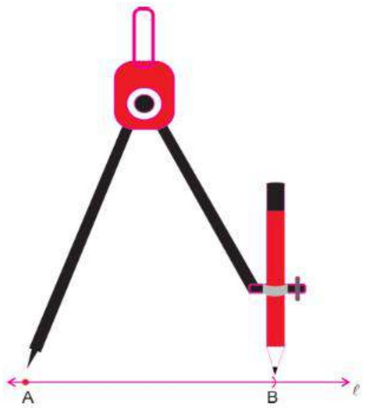
Given a line segment XY.

Step 1:- Draw a line ℓ and mark a point A on it.

Step 2:- Take the compasses and measure XY.



Step 3:- Without disturbing the compasses, place the needle of the compasses at point A on line ℓ and draw an arc, which intersects the line at point B.



Step 4:- AB is the required line segment which is equal to the length of XY.

Thus AB = XY

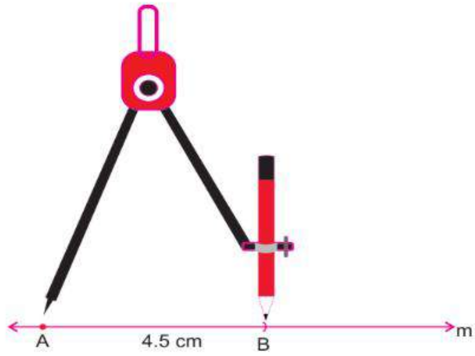
10.3.2. Construction of a line segment whose length is the sum of the length of the two given segments

Let AB and BC be two line segments of length 4.5cm and 3cm respectively. We can construct a line segment AC of length AB + BC i.e. 4.5 + 3 = 7.5cm using a ruler and compasses.

Steps of Construction:-

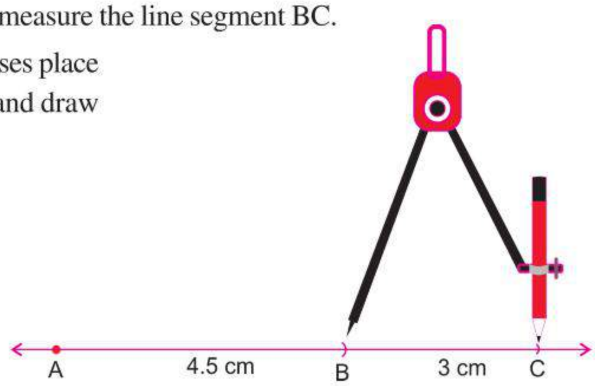
Step 1:- Draw a line *m* longer than combined length of AB and BC. Mark a point A on it.

Step 2:- Take the compasses and measure AB. Without disturbing the compasses place its needle at A and draw an arc intersecting line *m* at B.



Step 3:- Again adjust the compass and measure the line segment BC.

Step 4:- Without disturbing the compasses place the pointer at B on the line m and draw an arc cutting the line m at C.



Step 5:- Thus AC is the required line segment whose length is equal to the sum of lengths of line segments AB and BC.

i.e. AC = AB + BC = 4.5 + 3 = 7.5cm.

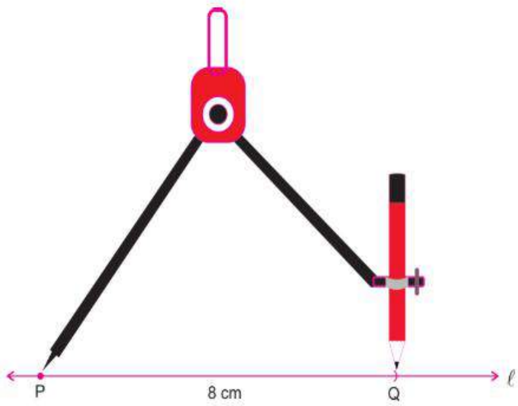
10.3.3 Construction of a line segment equal to the difference of the lengths of two given line segments

Let PQ and PR be two line segments of length 8cm and 3.2cm respectively. We can construct a line segment RQ of length PQ – PR i.e. 8 – 3.2 = 4.8cm using a ruler and compasses.

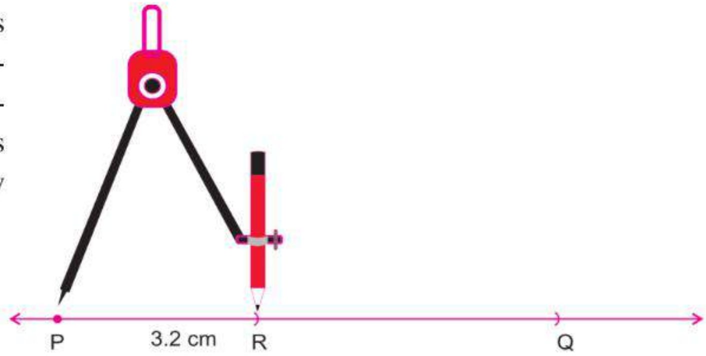
Steps of Construction

Step 1:- Draw a line ℓ and mark point P on it.

Step 2:- Take the compasses and measures PQ. Without disturbing the compasses place its needle at P and draw an arc intersecting ℓ at Q.



Step 3:- Again adjust the compasses and measure the line segment PR. Without disturbing the compasses, place its needle (pointer) at P draw an arc intersecting ℓ at R.



Step 4:- RQ is the required line segment whose length is equal to the difference of lengths of line segments PQ and PR

ie. RQ = PQ − PR = 8 − 3.2 = 4.8cm

Exercise 10.2

1. With the help of a ruler, construct line segments of given lengths:

   (i) 5cm (ii) 6.5cm (iii) 5.2cm (iv) 6.8cm (v) 9.7cm (vi) 8.4cm

2. Draw line segments given in Q.1 by using a ruler and compasses.
3. Construct AB of length 8.4cm. From it cut off AC of length 5.3cm. Measure BC.
4. Draw two line segments AB and CD of lengths 8.4cm and 4.5cm respectively. Construct the line segments of the following lengths:-

   (i) AB + CD (ii) AB – CD (iii) 2CD

5. Draw two line segments PQ and RS of lengths 6.4cm and 3.6cm respectively. Construct the line segment of the following lengths:

   (i) PQ + RS (ii) PQ – RS (iii) 2PQ (iv) 2RS (v) 3RS

6. Draw a line segment PQ of any length Now without measuring it, draw a copy of PQ.

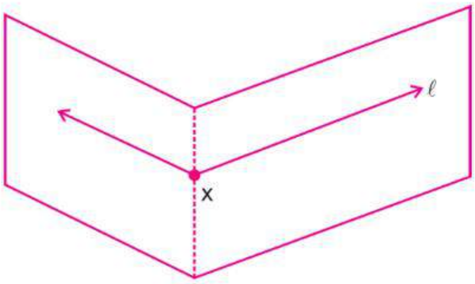
10.4. Construction of a Perpendicular at a point on the line

Given a line ℓ with a point X on it. Let us draw a perpendicular passing through this point X on line ℓ.

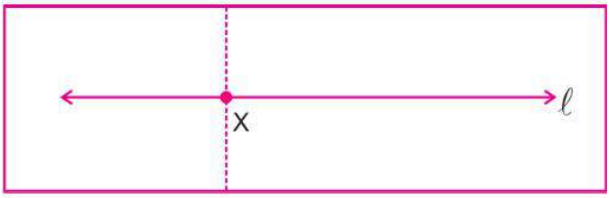
There are many methods to draw a perpendicular on a line which are as follows:

(a) By Paper Folding

1. Draw this line on a trace paper.
2. Now, fold the tracing paper in such a way that the lines across the folding exactly overlap each other.

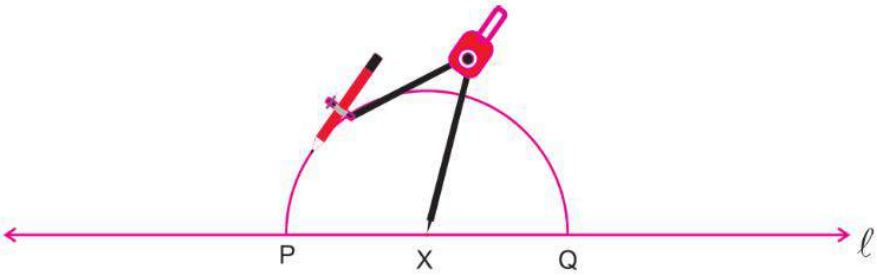


3. Adjust the fold such that the crease passes through the point X.
4. On opening the paper, the crease you get is the required perpendicular to the line ℓ passing throughst X.

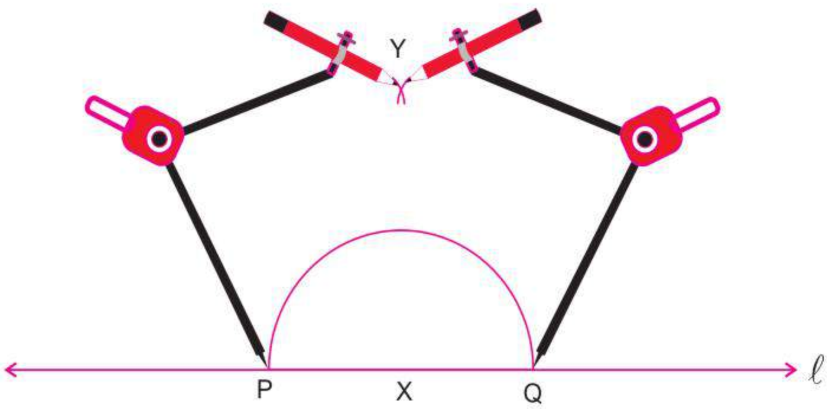


(b) By ruler and compasses :

1. Draw a line ℓ and mark a point X on it.
2. Draw an arc from X to the line ℓ of any suitable radius which intersects line ℓ at Pand Q.

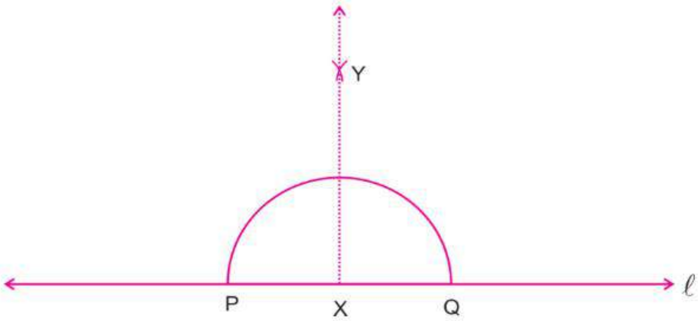


3. Draw arcs of any radius which is more than half of arc made in step (2) from P and Q which intersect at Y.



4. Join XY.

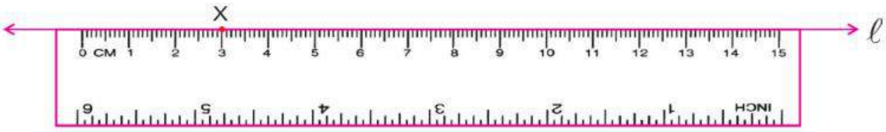
Thus XY is perpendicular to PQ or line ℓ or $XY \perp PQ$

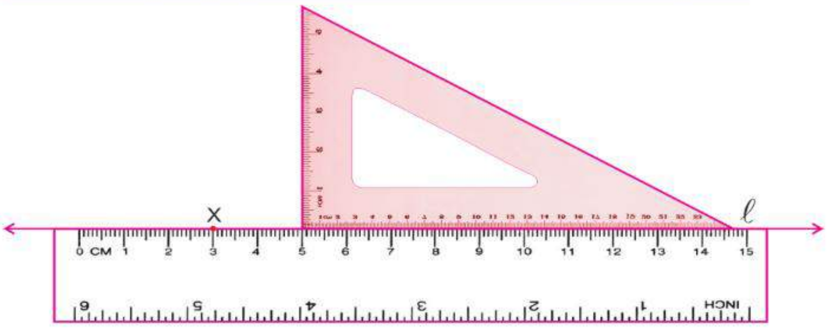


Here X is called **foot of perpendicular**.

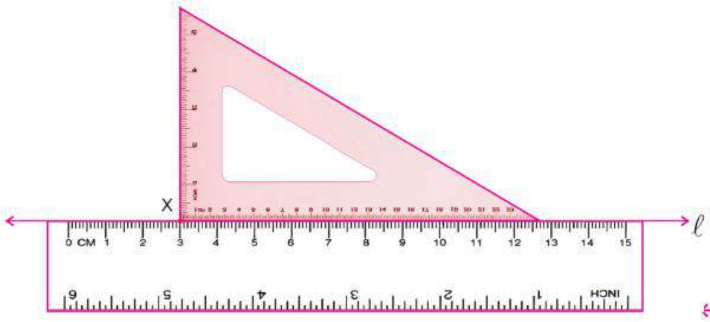
(c) Construction using a set square and a ruler:

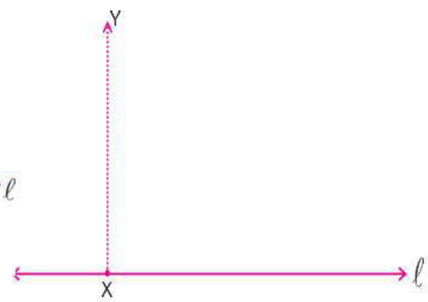
1. Draw a line ℓ and mark a point X on it.
2. Place one of the edges of a ruler along the line ℓ and hold if firmly.





3. Place the set square in such a way that one of its edges contaning the right angle coincides with the ruler.
4. Holding the ruler, slide the set square along the line ℓ till the vertical side reaches the point X.





5. Firmly hold the set square in this position. Draw XY along its vertical edge.

   Now XY is the required perpendicular to ℓ. ie. $XY \perp \ell$.

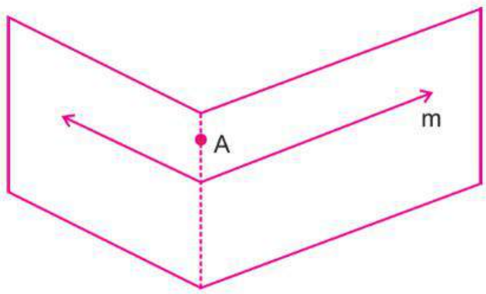
10.4.1. Construction of an Altitude to a line from a given point which is not on the line

Given a line *m* with a point A which is not lying on it. Let us draw an altitude passing through this point A on line *m*.

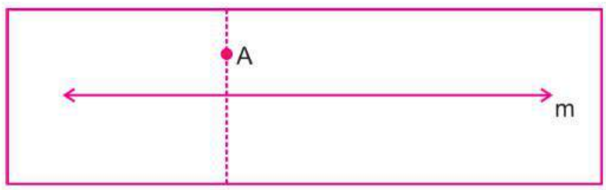
There are many methods to draw altitude which are as follows:

(a) By Paper Folding

1. Draw this line *m* on a trace paper.
2. Now, fold the trace paper in such a way that the lines across the folding exactly overlap each other

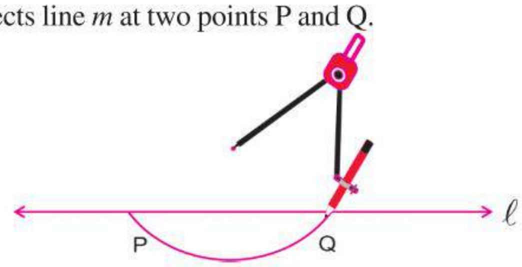


3. Adjust the fold such that the crease passes through the point A.
4. On opening the paper, you get a crease which is the required altitude to the line *m* passing through A.

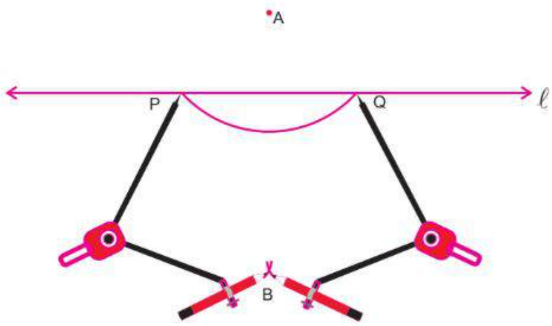


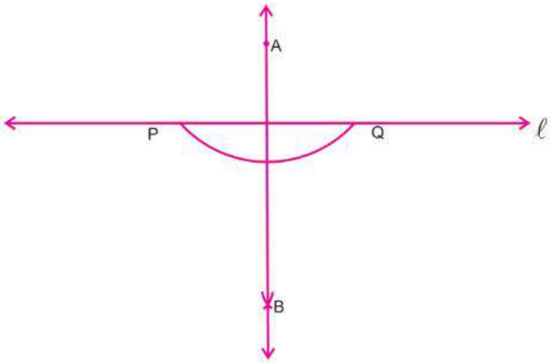
(b) By Ruler and Compasses

1. Draw a line m and mark a point A not lying on it.
2. From point A draw an arc which intersects line *m* at two points P and Q.



3. Using any radius and taking P and Q as centre, draw two arcs that intersect at point say B. on the other side (as shown in figure).
4. Join AB to obtain altitude to the line *m*.



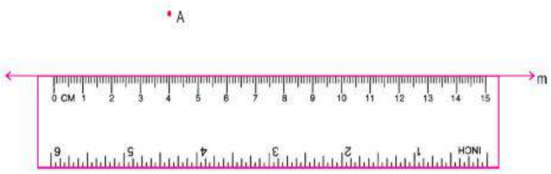


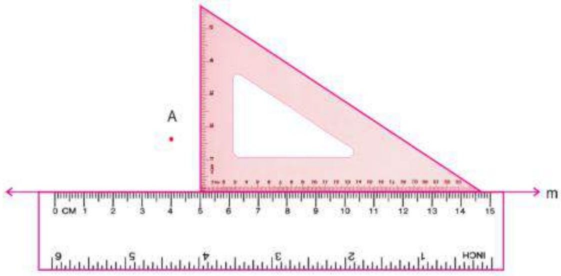
Thus AB is altitude to line *m*.

i.e AB ⊥ *m*

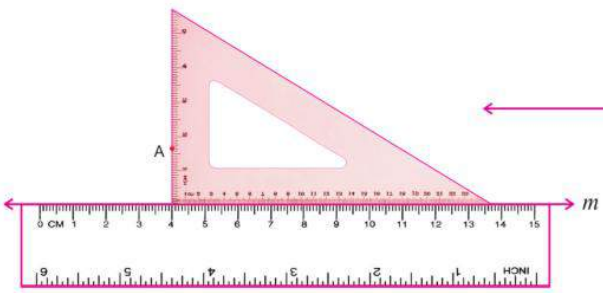
(c) Construction using a set square and a ruler

1. Draw a line *m* and mark a point A which is not lying on it.
2. Place one of the edge of a ruler along the line *m* and hold it firmly.





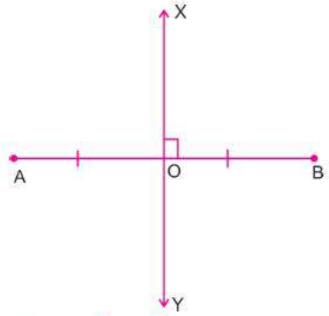
3. Place the set square in such a way that one of its edges containing the right angle coincides with the ruler.
4. Holding the ruler firmly, slide the set square along the line *m* till its vertical side reaches the point A.



5. Firmly hold the set square in this position, Draw AB along its vertical edge

   Now AB is the required altitude to *m* i.e. AB ⊥ *m*.

10.5 Perpendicular Bisector



A line which **is perpendicular to a line segment at its mid point is called perpendicular bisector** of that line segment. It is also called the **line of symmetry**.

In the given figure, line XY is perpendicular bisector of line segment AB i.e. AO = OB and $\angle XOB = \angle XOA = 90^{\circ}$

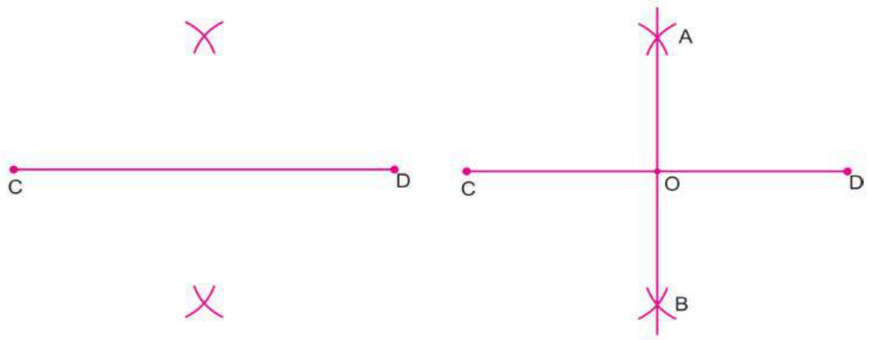
10.5.1. Construction of the perpendicular bisector of a line segment

Given a line segment CD of 6.4cm. Let us draw perpendicular bisector of this line segment.

Step of Construction:

1. Draw a line segment CD = 6.4cm

2. Taking C as centre, draw arcs on both sides of CD, by taking radius more than half of CD. (as shown in figure)
3. Now take D as a centre and draw arcs of same radius as before, intersecting the previous drawn arcs at A and B respectively.
4. Join AB intersecting CD at O. Then O bisects the line segment as shown.



Thus AB is the required perpendicular bisector of CD.

Exercise 10.3

1. Draw a line *r* and mark a point P on it. Construct a line perpendicular to *r* at point P.

(i) Using a ruler and compasses

(ii) Using a ruler and a set square.

2. Draw a line *p* and mark a point *z* above it. Construct a line perpendicular to p, from the point *z*.

(i) Using a ruler and composses.

(ii) Using a ruler and a set square.

3. Draw a line AB and mark two points P and Q on either side of line AB , Construct two lines perpendicular to AB, from P and Q using a ruler and compasses.
4. Draw a line segment of 7cm and draw perpendicular bisector of this line segment.
5. Draw a line segment PQ = 6.8cm and draw its perpendicular bisector XY which bisect PQ at M. Find the length of PM and QM. Is PM = QM?
6. Draw perpendicular bisector of line segment AB =5.4cm. Mark point X anywhere on perpendicular bisector Join X with A and B. Is AX = BX?
7. Draw perpendicular bisectors of line segment of the following lengths :

   (i) 8.2cm (ii) 7.8cm (iii) 6.5cm
8. Draw a line segment of length 8cm and divide it into four equal parts using compasses. Measure each part.

10.6 Circle

We have already studied about circle and its parts radius, chord, centre, diameter etc.

A circle is a closed plane curve in which every point on the circle is at a constant distance from a fixed point inside the circle. The fixed point is known as the **centre** and the constant distance from centre to the circle is called **radius**.

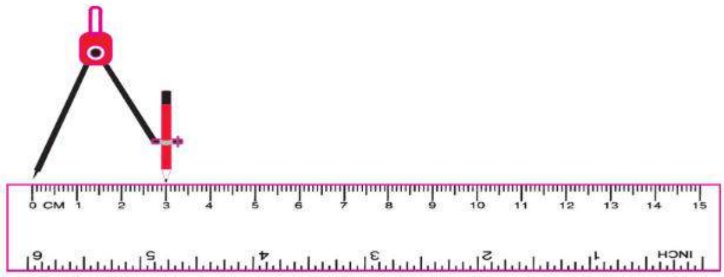
Bangle, coin, wheel, chapatti etc are all circular in shape.

Here, we will learn the construction of a circle with given centre.

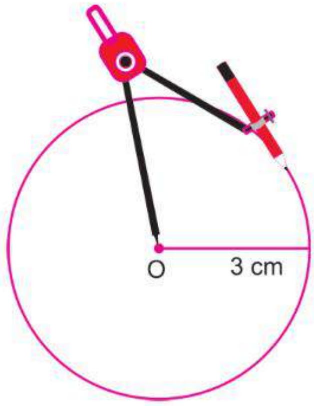
10.6.1. Construction of a Circle of a given radius

Let us construct a circle of radius 3cm.

1. Mark a point O on a paper or notebook, where a circle is to be drawn.
2. Take Compasses fixed with sharp pencil and measure 3cm using a scale as shown in figure.



3. Without disturbing the opening of the compasses, keep the needle at point O and draw complete arc by holding the compasses from its knob. After completing one round, we get the desired circle.



Exercise 10.4

1. Draw a circle of the following radius :

   (i) 3.5cm (ii) 4cm (iii) 2.8cm (iv) 4.7cm (v) 5.2cm
2. Draw a circle of the diameter 6cm.
3. With the same centre O, draw two concentric circles of radii 3.2cm and 4.5cm.
4. Draw a circle of radius 4.2cm with centre at O. Mark three points A, B and C such that point A is on the circle, B is in the interior and C is in the exterior of the circle.
5. Draw a circle of radius 3cm and draw any chord. Draw the perpendicular bisector of the chord. Does the perpendicualr bisector passes through the centre?

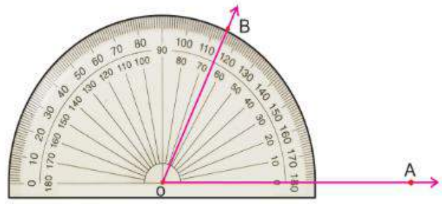
10.7. Angles

You have already learnt about the various types of angles. In this section, you will learn about the construction of angles of given measure by using a protractor and the construction of some specific angles with the help of compasses.

Let us construct an angle of 65°.

Step of Construction

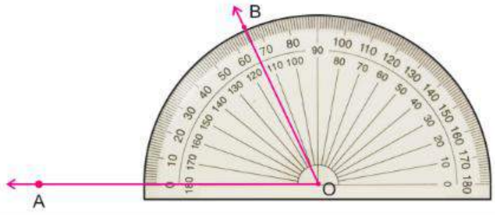
1. Draw a ray OA.
2. Place the protractor on OA such that its centre lies on the initial point O and 0-180 base line along OA.



3. Mark a point B on the paper against the mark of 65° (inner scale) on the protractor.
4. Remove the protractor and Join OB.

Thus required angle $\angle AOB = 65^\circ$

If ray $\overrightarrow{OA}$ lies to the left of the centre (mid point) of the baseline, start reading the angle on the outer scale from 0º and mark B at 65º. Join OB, then $\angle AOB = 65^\circ$



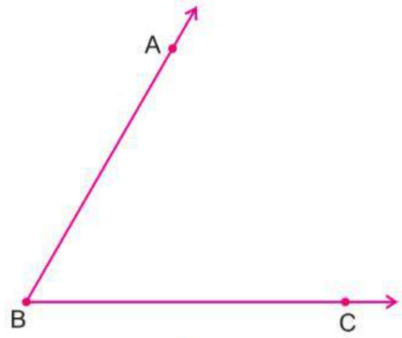
Remember word LORI - Left Outer Right Inner

When the direction of ray is towards left, read the outer scale and when the direction of ray is towards right, read the inner scale.

10.7.2. Construction of an angle equal to a given angle

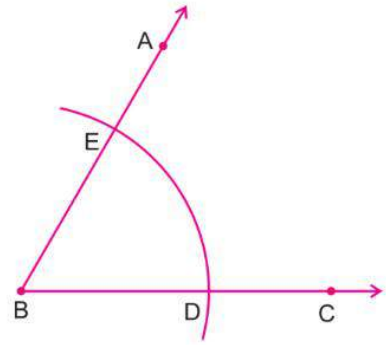
Suppose you are asked to copy an angle, whose measure is not known. A better method is to use compasses and a ruler.

Let us construct $\angle PQR$ equal to given $\angle ABC$.

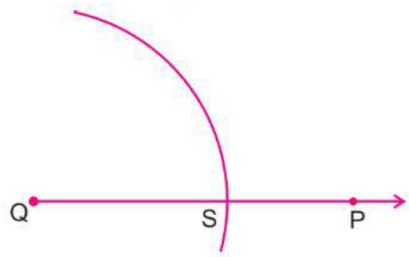


Step of Construction

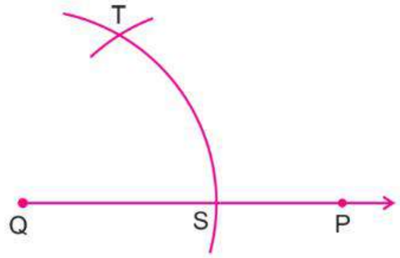
1. Taking B as centre and draw an arc of any radius intersecting the arms of $\angle ABC$ at points D and E.



2. Draw a ray QP, with Q as centre and the same radius as above, draw an arc intersecting ray QP at S.

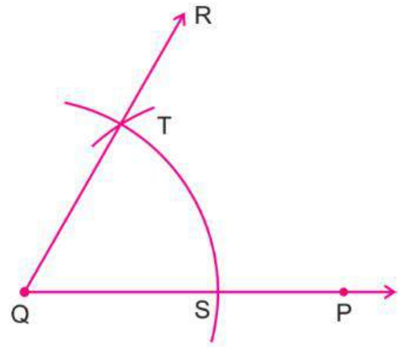


3. Now measure the distance between D and E with compasses, taking S as centre and take radius equal to DE, draw an arc to intersect the arc drawn above at a point T.



4. Join QT and produce it to form a ray QR.

5. $\angle PQR$ is the required angle equal to $\angle ABC$.



6. Verify it by measuring the angles with the help of protractor.

10.8. Angle Bisector

Any line that divides an angle into two equal parts is known as the angle bisector of the given angle. In this section you will learn its construction.

10.8.1. Construction of an Angle Bisector

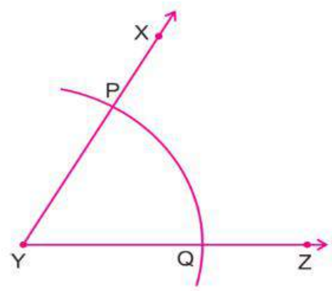
Bisecting an angle means drawing a ray in the interior of the angle, with its initial point at the vertex of the angle such that it divides the angle into two equal parts.

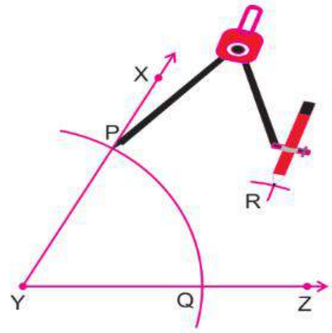
Now construct the angle bisector of $\angle XYZ$.

Steps of construction

1. Draw $\angle XYZ$ of any measure.

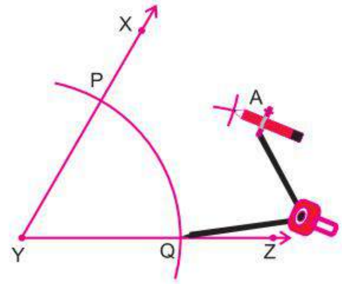
2. Take Y as centre and any convenient radius, draw an arc intersecting XY and YZ at P and Q respectively.

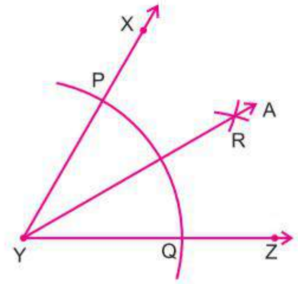




3. Draw an arc from P with radius more than half of PQ .

4. Draw an arc from Q with same radius as in step 2, which intersects the arc of step 3 at R.





5. Join YR and produce to any point A. Thus ray YA is angle bisector of $\angle XYZ$

   Measure $\angle XYA$ and $\angle AYZ$, you will find that $\angle XYA = \angle AYZ$

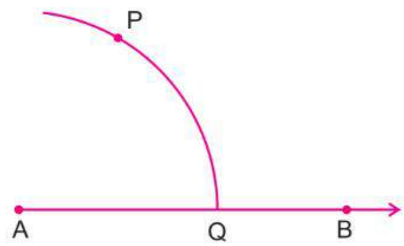
10.9. Construction of angles of special measures by compasses

In this section, we will learn the construction of some angles of special measures like 30º, 45º, 60º, 90º, 120º etc with the help of ruler and compasses.

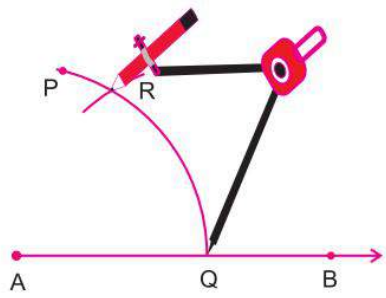
* Construction of 60º angles

In order to construct angle of 60º with the help of ruler and compasses only, we follow the following steps :

1. Draw any ray AB.
2. Draw an arc PQ of any radius from point A, which intersect AB at Q.

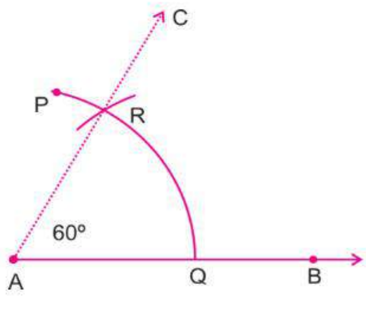


3. By taking same radius, draw an arc from point Q which intersect arc PQ at R.



4. Join AR and produce it to get AC.

5. Thus $\angle BAC = 60^\circ$

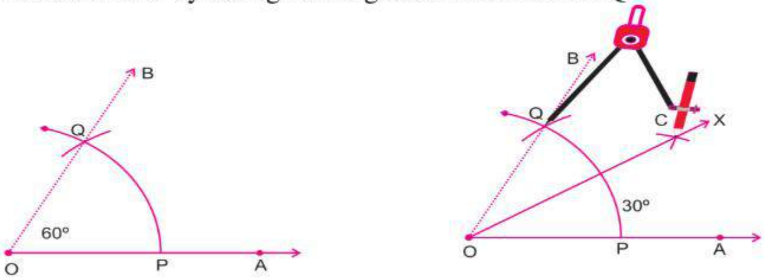


* Construction of 30º angles

Since 30º is half of 60º i.e. $30^\circ = \frac{1}{2} \times 60^\circ$ So to construct 30º angle, we bisect the angle 60º.

Step of Construction :

1. Draw an angle $\angle AOB = 60^\circ$ as shown in figure with the help of compasses.
2. Draw an arc from P by taking radius greater than half of PQ



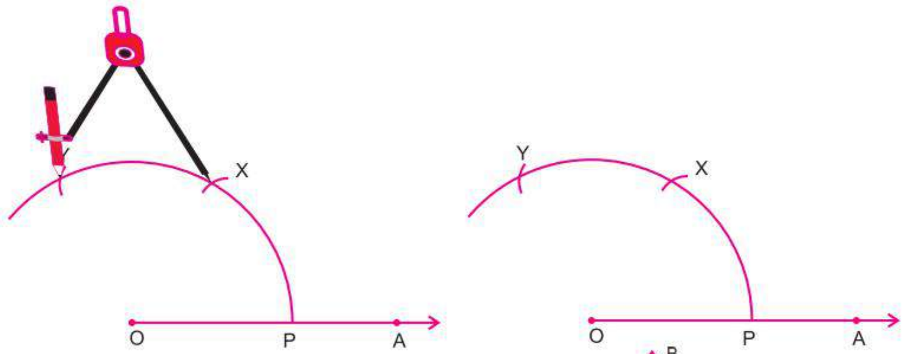
3. Similarly draw an arc from Q with same radius which intersect the previous arc at C.
4. Join OC and produce it to X.
5. Thus $\angle AOC = 30^\circ$

* Construction of 90º angle :

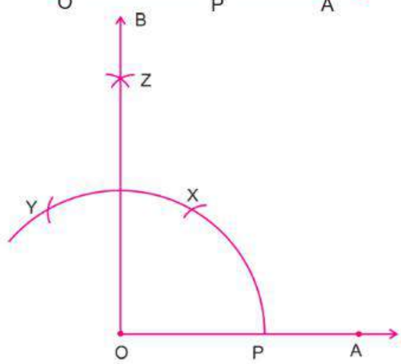
Since 90º is exactly in the mid of 60º and 120º. So for construction of 90º, we bisect the angle between 60º and 120º.

Step of Construction :

1. Draw arcs X and Y of angles 60º and 120º respectively as discussed above.



2. With X as centre and radius more than half of arc 'XY'. draw another arc.
3. With Y as centre and same radius, draw an arc cutting the previous arc at Z.
4. Join OZ and produce it to B.



5. Thus $\angle AOB = 90^\circ$

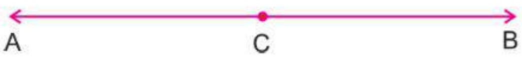
Aliter :-

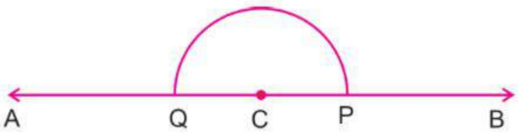
There is one more method to construct 90º by a ruler and compasses.

Since 90º is half of 180º i.e $90^\circ = \frac{1}{2} \times 180^\circ$ So we bisect angle between 0º and 180º.

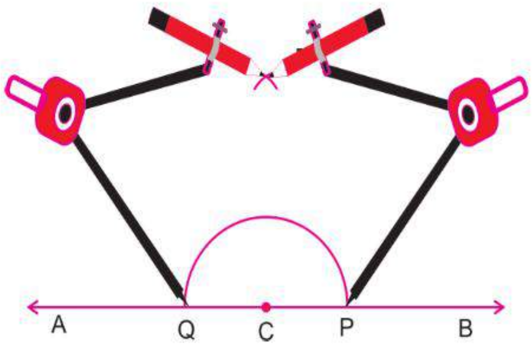
Step of Construction :

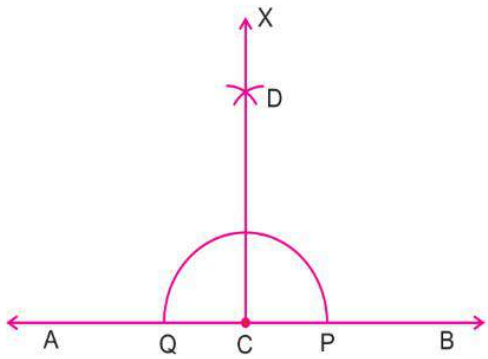
1. Draw a line AB and mark a point C on it.
2. Taking C as centre and with any suitable radius, draw an are PQ cutting AB at P and Q.





3. Here $\angle ACB = 180^\circ$ (It is a straight line)
4. Taking P and Q as the centres and with any convenient radius, draw arcs intersecting each other at D.





5. Join CD and produce it to X.
6. Thus $\angle ACX = \angle BCX = 90^\circ$

Exercise 10.5

1. Draw the following angles in both directions (Left and right) by protractor.

(i)	75º	(ii)	110º	(iii)	62º	(iv)	165º	(v)	170º
(vi)	32º	(vii)	128º	(viii)	25º	(ix)	80º	(x)	135º

2. Bisect the following angles by compasses :

(i)	48º	(ii)	140º	(iii)	75º	(iv)	64º	(v)	124º

3. Draw an angle of 80º and bisect it in to four equal parts by compasses.

4. Draw a right angle and bisect it.

5. Draw the following angles by ruler and compasses :

(i) 30º (ii) 45º (iii) 135º (iv) 180º (v) 120º (vi) 75º

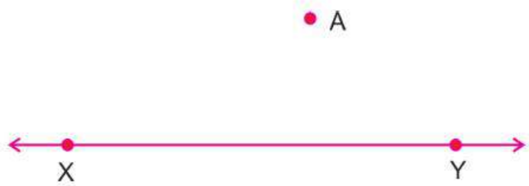
6. Draw an angle of 30º by protractor and bisect it by a ruler and compasses.

10.10. Construction of a Parallel Line through the point lying outside a line

We have studied about parallel lines in previous chapter that parallel lines are those lines which never intersect each other. Here we will construct a parallel line through a given point lying either side to a given line.

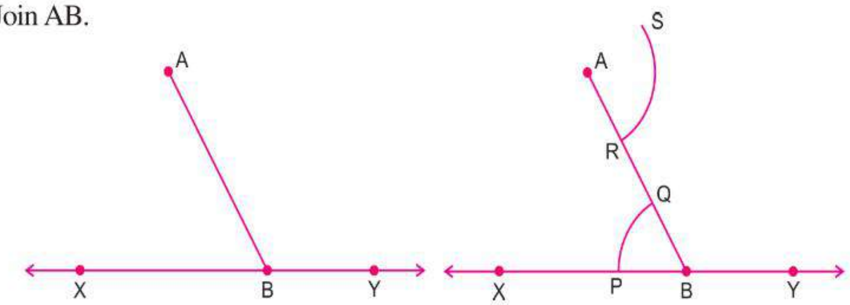
(a) By a Ruler and Compasses

Let us consider a line XY and a point A not lying on it.

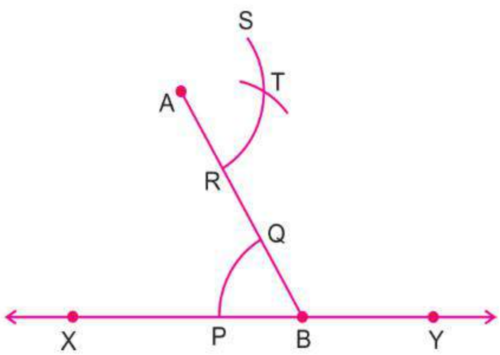


Steps of Construction

1. Take any point, say B, anywhere on line XY.
2. Join AB.

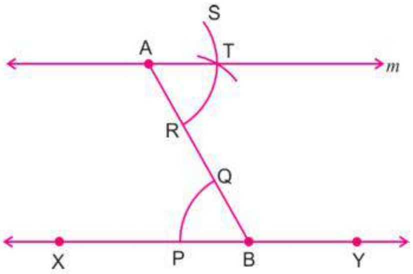


3. Now take B as centre, draw an arc PQ of any radius on XY. similarly draw an arc RS of same radius on line segment AB from point A.



4. Measure arc PQ with compasses.
5. Draw an arc equal to radius PQ from point R which intersect RS on T.

6. Join AT and produce it.



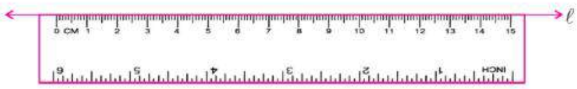
So the line m is the required line parallel to XY.

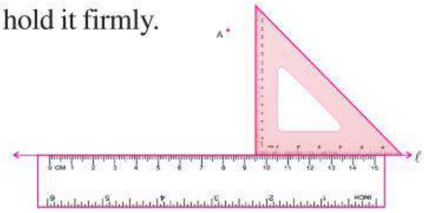
(b) By Set Squares

We can draw parallel line with the help of set squares also. This is the accurate method to construct a parallel line.

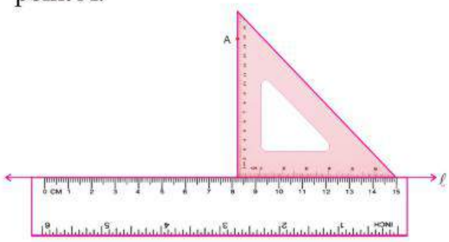
Step of Constructions :

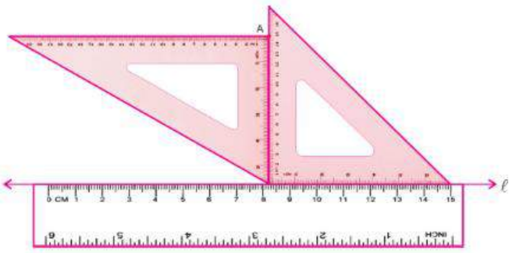
1. Given a line ℓ with point A not lying on it.
2. Place one of the edge of a ruler along the line ℓ and hold it firmly.



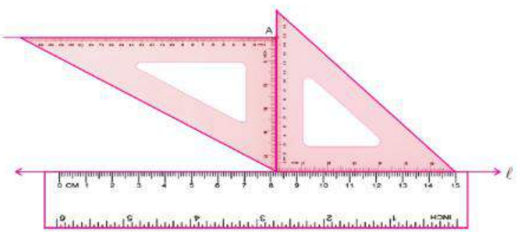


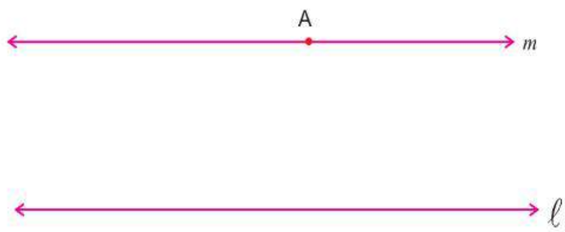
3. Place the set square in such a way that one of its edges containing the right angle coincides with the ruler.
4. Hold the ruler firmly, slide the set square along the line ℓ till its vertical side reaches the point A.





5. Firmly hold the set square in this position, take another set square and place it in such a way that one of its edges containing right angle concides with previous set square as shown.
6. Now draw a line m along side of second set square passing through A.





7. Thus $m \parallel \ell$ passing through A.

Exercise 10.6

1. Draw a line XY and point P not lying on XY. Draw a line parallel to XY passing through P with the help of ruler and compasses.

2. Draw a line *p* parallel to line *m* passing through a point A which is not lying on line *m* with the help of set squares.

3. Given a line AB and the point X is not lying on it Draw a line parallel to AB passing through X.

(i) By a ruler and compasses (ii) By set squares

Learning Outcomes

After completion of this chapter the students are now able to

- Know about geometrical tools.
- Draw different types of angles.
- Classify the angles according to their measurment.
- Construct the bisector of an angle.
- Draw the perpendicular bisector of a line segment.

T3X5V6

11

RATIO AND PROPORTION

Objectives

In this chapter you will learn

- To compare quantities using ratios.
- To use ratio in different situations.
- To capable of using proportion in practical life.
- To use unitary method in daily life problems.

11.1 Introduction

$\frac{\text{Paras's marks}}{\text{Charan's marks}}$

In our daily life, we come across many situations where we have to compare two quantities of same type in terms of their magnitudes/measurements.

For Example, In an examination Paras got 84 marks and Charan got 70 marks. Generally their performance can be compared in two ways:

(i) Comparison by difference

Difference of marks = 84 – 70 = 14

i.e. Paras got 14 marks more than Charan.

Such a comparison is known as comparison by difference.

(ii) Comparison by Division

$$\frac{\text{Paras's marks}}{\text{Charan's marks}} = \frac{84}{70} = \frac{6}{5}$$

i.e. Paras's marks are $\frac{6}{5}$ times the marks of Charan.

Or $$\frac{\text{Charan's marks}}{\text{Paras's marks}} = \frac{70}{84} = \frac{5}{6}$$

i.e. Charan's marks are $\frac{5}{6}$ times the marks of Paras.

Such a comparison is known as comparison by division.

Thus, If we want to observe that how much more (or less) one quantity is than the other' then we compare by difference. On the other hand, if we want to observe how many times more (or less) one quantity is than the other, we compare by division.

Infact, when we compare two quantities of the same kind by division, we say that we form a ratio of two quantities.

i.e. The **comparison by division** is also known as **ratio**.

11.2 Ratio

Ratio is the relation used to describe the number of times a quantity is, of the other. Thus, the ratio of two numbers a and b ($b \neq 0$) is $\frac{a}{b}$ or $a \div b$ and is represented as a:b (read as "a ratio b" or 'a is to b"), where a and b are called the terms of the ratio.

- The first term 'a' is called **antecedent** and the second term 'b' is called **consequent**.

11.2.1 Properties of Ratio

- The two quantities to be compared should be of same kind or in the same units (of length, volume or quantity etc.)

  i.e. we do not compare 18 boys and 12 horses but we can compare the number of boys and the number of horses,.
- The order of the terms in a ratio is important. i.e. the ratio 3 is to 4 or 3:4 is quite different from the ratio 4 is to 3 or 4:3.
- Ratio of two quantities is just a number and has no unit at all.
- **Equivalent Ratios :** The terms of ratio can be multiplied or divided by same non-zero number then there is no change in its value.

  i.e. 2 : 3

  $2 \times 2 : 3 \times 2 = 4:6$ (Multiply both terms by 2)

  or $2 \times 4 : 3 \times 4 = 8:12$ (Multiply both terms by 4)

  and 18:24

  or $18 \div 2 : 24 \div 2 = 9:12$ (Divide both terms by 2)
- **Ratio in the simplest form :** A ratio a:b is said to be in the simplest form if its antecedent a and consequent b have no common factor other than **1**.

  A ratio in the simplest form is also called the ratio in the lowest terms. For this, Divide both terms by their HCF.

  e.g. 32 : 24

  or HCF of 32 and 24 is 8.

  or $32 \div 8 : 24 \div 8$

  or 4 : 3

Note : *Difference between a fraction and a ratio*

- A fraction is a number that represents part of a whole or part of a group. The denominator represents the total number of equal parts the whole is divided into.
- A ratio is a comparison of two quantities

  for example In a group of 8 students, there are 5 boys and 3 girls, the fraction of the number of boys is $\frac{5}{8}$ and of girls is $\frac{3}{8}$. The denominator will always be 8, because the whole group consists of 8 students.

  While, the ratio of number of boys to number of girls is 5:3, The ratio of number of boys to total students is 5:8 and the ratio of number of girls to total students is 3:8.

  Ratio depends on the numbers that are being compared not the whole group.

Let's discuss some examples.

Example 1: **Express the following ratio in the simplest form:**

(i) 18:24 (ii) 15:45 (iii) 36:28

Solution : (i) 18:24

To express this ratio in the simplest form, we shall have to divide both terms by their HCF.

So HCF of 18 and 24 is 6.

$\therefore$ 18 : 24

$= (18 \div 6) : (24 \div 6) = 3:4$

Hence, the simplest form of 18:24 is 3:4.

Aliter : (Prime Factorisation)

We have 18:24

Prime factors of both terms

$2\times3\times3 : 2\times2\times2\times3$

Divide both terms with common factors 2×3, We have

$3:2\times2$ or $3:4$

Aliter : 18 : 24

In this, we divide both terms one by one by common factors.

- Both terms are divisible by 2, so divide both terms by 2, We have

  9:12
- Now both terms are divisible by 3, so divide both terms by 3, we have

  $3 : 4 \rightarrow$ Which is simplest form

(ii) 15:45

To express this ratio in the simplest form, we shall divide both terms by their HCF.

So, HCF of 15 and 45 is 15.

$\therefore$ 15 : 45

$\therefore$ $\frac{15}{45} = \frac{15 \div 15}{45 \div 15} = \frac{1}{3}$ or (15 ÷ 15) : (45 ÷ 15) = 1:3

Hence, the simplest form of 15:45 is 1:3.

Aliter : (Prime Factorisation)

15 : 45

First Prime factorise of both terms

= 3 × 5 : 3 × 3 × 5

Divide both terms with common factors 3 × 5 = 15, we have

= 1 : 3

Aliter : 15 : 45

Firstly divide both terms by 3.

= 5 : 15

Now divide both terms by 5.

= 1 : 3 (Which is simplest form)

(iii) 36 : 28

Divide both terms by their HCF = 4

$\therefore$ 36 : 28

= (36 ÷ 4) : (28 ÷ 4) = 9 : 7

Hence, the simplest form is 9 : 7

Aliter : 36: 28

= 2 × 2 × 3 × 3 : 2 × 2 × 7

= 9 : 7

Aliter : 36 : 28

Divide both terms by 2, We have

= 18 : 14

Again divide both terms by 2, we have

= 9 : 7

Example 2 : Find the ratio in the simplest form:

(i) 15 minutes to 40 minutes **(ii) 3kg to 800g**

(iii) 150cm to 6m **(iv) 2 dozen to 16pieces**

(v) 1 minute to 30 seconds

Solution : (i) 15 minutes : 40 minutes

= 15 : 40 (Divide both terms by their HCF= 5)

= 3 : 8

(ii) 3kg to 800g = 3000g to 800g ($\because$ 1kg = 1000g)

= 3000 : 800

= 15 : 4 (Divide both terms by their HCF=200)

(iii) 150cm to 6m = 150cm to 600cm ($\because$ 1m = 100cm)

= 150 : 600 (Divide both terms by their HCF=150)

= 1 : 4

(iv) 2 dozen to 16 pieces = 24 pieces to 16 pieces ($\because$ 1dozen = 12 units)

= 24 : 16 (Divide both terms by their HCF=8)

= 3 : 2

(v) 1 minute to 30 seconds

= 60 seconds to 30 seconds ($\because$ 1 minute = 60 seconds)

= 60 : 30 (Divide both terms by their HCF = 30)

= 2 :1

Example 3: **There are 35 boys and 25 girls in a class. Find the ratio of**

(i) The number of boys to the number of girls?

(ii) The number of girls to the total number of students in the class?

(iii) Total number of students to the number of boys?

Solution : We have number of boys = 35, number of girls = 25

$\therefore$ Total number of students in the class = 35 + 25 = 60

(i) Ratio of number of boys to the number of girls

= 35 : 25 (Divide both terms by their HCF = 5)

= 7 : 5

(ii) Ratio of the number of girls to the total number of students in the class.

= 25 : 60 (Divide both terms by their HCF = 5)

= 5 :12

(iii) Ratio of total number of students to the number of boys.

= 60 : 35 (Divide both terms by their HCF = 5)

= 12 : 7

Example 4: **In a year, Neha earns ₹80,000 and saves ₹30,000. Find the ratio of money.**

(i) She saves to the money she earns.

(ii) She earns to the money she spends.

(iii) She saves to the money she spends.

Solution : Neha's income = ₹80,000

Neha's savings = ₹30,000

Neha's spendings = ₹80,000 – ₹30000 = ₹50,000

(i) Ratio of Neha's savings to Neha's earnings.

= 30,000 : 80,000 (Divide both terms by their HCF = 10,000)

= 3 : 8

(ii) Ratio of Neha's earnings to Neha's spendings

= 80,000 : 50,000 (Divide both terms by their HCF = 10,000)

= 8 : 5

(iii) Ratio of Neha's savings to Neha's spendings

= 30,000 : 50,000 (Divide both terms by their HCF = 10,000)

= 3 : 5

Example 5: **In a class test 42 out of 56 students passed. Find the ratio between the**

(i) Number of passed students to the number of failed students.

(ii) The number of failed students to the total number of students.

Solution : Total students in the class = 56

Number of passed students = 42

So, Number of failed students = 56 – 42 = 14

(i) Ratio of the number of passed to the number of failed students

= 42 : 14 (Divide both terms by their HCF = 14)

= 3 : 1

(ii) Ratio of the number of failed students to the total number of students in the class.

= 14 : 56 (Divide both terms by their HCF=14)

= 1 :4

Example 6: **The present age of mother is 48 years and that of son is 20 years. Find the ratio of.**

(i) Present age of son to the present age of mother.

(ii) Age of mother to the age of son 10 years ago.

(iii) Age of son to the age of mother after 8 years.

Solution : (i) Ratio of present age of son to the present age of mother

= 20 : 48 (Divide both terms by their HCF = 4)

= 5 : 12

(ii) 10 years ago, son's age = 20 – 10 = 10 years

Mother age = 48 – 10 = 38 years.

Ratio of age of mother to the age of son, 10 years ago.

= 38 : 10 (Divide both terms by their HCF=2)

= 19 : 5

(iii) After 8 years, Son's Age = 20 + 8 = 28 years

Mother's Age = 48 + 8 = 56 years

Ratio of son's age to mother's age after 8 years

= 28 : 56 (Divide both terms by their HCF=28)

= 1 : 2

Example 7: **Find an equivalent ratio of**

(i) 5:7 **(ii) 10:3**

Solution : (i) To find an equivalent ratio of 5 : 7,

Multiply both terms by same natural number except 1(suppose 2)

$\therefore$ $5:7 = (5\times2):(7\times2) = 10:14$

(ii) To find an equivalent ratio of 10 : 3,

Multiply both terms by same natural number except 1 (Suppose 3)

$\therefore$ $10:3 = (10\times3):(3\times3) = 30:9$

Example 8: **Divide ₹100 in ratio 2:3 between Aslam and Harpreet.**

Solution : Since. Aslam and Harpreet's share given in the ratio 2:3, which is in simplest form. To find their exact share, we have to multiply it with a variable (say x).

Let Aslam's share = 2x and Harpreet's share = 3x

A.T.Q (Aslam's share) + (Harpreet Share) = 100

$\Rightarrow$ $2x + 3x = 100$

$\Rightarrow$ $5x = 100$

$\Rightarrow$ $x = \frac{100}{5} = 20$

$\therefore$ Aslam's share = $2x = 2\times20 =$ ₹40

and Harpreet's share = $3x = 3\times20 =$ ₹60

Aliter : ₹100 is divided in total 2 + 3 = 5 parts

Aslam's share = $\frac{2}{5}$ of ₹100 = $\frac{2}{5} \times 100 =$ ₹40

Harpreet's share = $\frac{3}{5}$ of ₹100 = $\frac{3}{5} \times 100 =$ ₹60

Example 9: **The ratio of number of boys and girls in the class is 5:7. Find the number of boys and girls in the class if the total number of the students in the class is 72.**

Solution : Let the number of boys = 5x

and the number of girls = 7x

Given, Total number of students = 72

i.e. (Number of boys) + (Number of girls) = 72

$\Rightarrow$ $5x + 7x = 72$

$\Rightarrow$ $12x = 72$

$\Rightarrow$ $x = \frac{72}{12} = 6$

∴ Number of boys = $5x = 5 \times 6 = 30$

and number of girls = $7x = 7 \times 6 = 42$

Aliter :

Ratio of number of boys and girls = 5:7

Sum of terms of the ratio = $5 + 7 = 12$

∴ Number of boys = $\frac{5}{12} \times 72 = 30$

and number of girls = $\frac{7}{12} \times 72 = 42$

Exercise 11.1

1. Express the following ratios in the simplest form:

(i) 12:32 (ii) 45:25 (iii) 91:104 (iv) 60:72 (v) 375:125

2. Write the ratio in the simplest form:

(i) ₹20 to ₹55 (ii) 18m to 63m (iii) 40 paise to ₹2

(iv) One hour to 36 minutes (v) 5kg to 1200g

3. Simplify the following ratios:

(i) 2 years : 14 months (ii) 28 min: 2 hours

(iii) 125mℓ : 2ℓ (iv) 4m 20cm : 80cm

(v) 3 dozen : 12 pieces

4. Find two equivalent ratios for each given ratio:

(i) 4:1 (ii) 3:5 (iii) 5:12

5. The number of boys and girls in a class are 60 and 52 respectively. Find the ratio of number of boys to the number of girls.

6. Pankaj has 23 pens and 42 pencils. Find the ratio of pens to pencils.

7. In a year, Harjot earns ₹2,80,000 and saves ₹60,000. Find the ratio of money:

(i) He saves to the money he spends.

(ii) He earns to the money he saves.

(iii) He spends to the money he earns.

8. In a school, there are 175 boys, 205 girl students and 20 teachers. Find the ratio of the number of

(i) boys to the number of teachers.

(ii) girls to the number of boys.

(iii) Teachers to the number of total persons in the school.

9. Out of 144 students in a school, 48 play cricket, 28 play kabaddi, 40 play volley ball and the remaining play kho-kho. Find the ratio of
   (i) Number of students play kabaddi to the number of students play kho-kho.
   (ii) Number of students play cricket to the number of students play valleyball.
   (iii) Number of students who play kho-kho to the total students of school.
10. The present age of Kush and Shelly are 22 years and 16 years respectively. Find the ratio of
   (i) Their present ages.
   (ii) Kush's age to Shelly's age after 4 years.
   (iii) Shelly's age to Kush's age before 5 years.
   (iv) Kush's present age to Shelly's age after 6 years.
11. In a pencil box there are 150 pencils. Out of which 40 are red, 60 are black and the rest are blue pencils. Find the ratio of:
   (i) Red pencils to the black pencils.
   (ii) Blue pencils to the total number of pencils.
   (iii) Total pencils to the red pencils.
12. Divide ₹175 in ratio 4:3 between Preet and Sukhi.
13. Two numbers are in the ratio 3:7 and their sum is 140. Find the numbers.
14. The angles of a triangle are in the ratio 1:2:3. Find the measure of each angle.
15. A pipe of length 4m 16cm is cut into two pieces in ratio 3:5. Find the length of each piece of the pipe.

11.3 Proportion

When two ratios are equal then such type of equality of ratios are called proportional and their terms are said to be in proportion.

"An equality of two ratios is called a proportion."

Consider two ratios 4 : 10 and 8 : 20

We find that 4 : 10 = 2 : 5 and 8 : 20 = 2 : 5

Thus, 4 : 10 = 8 : 20 are in a proportion.

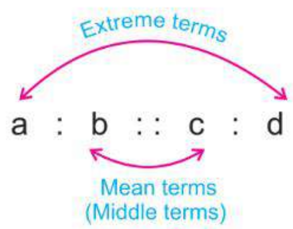
So, above proportion can also be written as 4:10::8:20. It is used as '4 to 10 as 8 to 20'.

• The symbol ': :'(double colon) or '=' is used to denote the equality of two ratios or proportion.

In general, four numbers a, b, c, d are in proportion, if a : b = c : d.

It can be represented as a:b::c:d means $\frac{a}{b}=\frac{c}{d}$ or ad = bc

Conversely, if ad = bc then $\frac{a}{b}=\frac{c}{d}$ or a: b::c:d.



Here a, b, c, d are called the first, second, third and fourth terms. The first and fourth terms of a proportion are called **extreme terms** and second, third terms are called the **middle terms** or **mean terms**.

We observe that,

Product of Extremes = Product of Means

- If product of extremes ≠ Product of Means, then terms are not in proportion.

11.3.1 CONTINUED PROPORTION

In a proportion, if second and third terms are equal then the proportion is called a continued proportion.

i.e. if a : b : : b : c then we say that a, b, c are in continued proportion.

For example : If 3:6: : 6:12 then 3, 6, 12 are in continued proportion.

Generally, If a, b,c are in continued proportion then

- 'a' is called first proportion.
- 'b' is called mean proportion.
- 'c' is called third proportion.

Let's consider some examples for making the concept of proportion more clear.

Example 11: Do the following ratios forms a proportion or not:

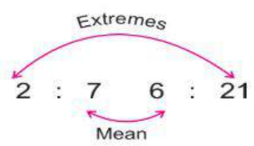
(i) 2:7 and 6:21 (ii) 12:10 and 48:40 (iii) 12:16 and 24:28

Solution : (i) Product of Extremes = 2×21 = 42

Product of Means = 7 × 6 = 42

∴ Product of extremes = Product of Means

Hence, 2:7 and 6:21 are in proportion.



Aliter :

First ratio = 2:7

Second ratio = 6:21

= 2 : 7 (Dividing both terms by 3)

∴ Both ratios are equal

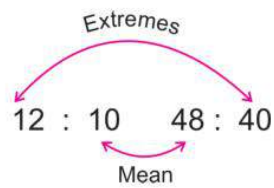
Hence 2:7 and 6:21 are in proportion.

(ii) Product of Extremes = 12 × 40 = 480

Product of Means = 10 × 48 = 480

∴ Product of extremes = Product of Means

Hence, 12 : 10 and 48 : 40 are in proportion.



Aliter :

First ratio = 12 : 10

= 6 : 5 (Dividing both terms by 2)

Second ratio = 48 : 40

= 6 :5 (Dividing both terms by 8)

∴ Both ratios are equal

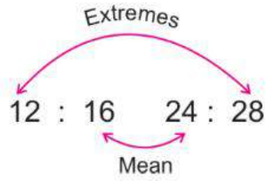
Hence 12:10 and 48:40 are in proportion.

(iii) Product of extremes = 12 × 28 = 336

Product of means = 16 × 24 = 384

∴ Product of extremes ≠ Product of means

Hence 12:16 and 24:28 are not in proportion.



Aliter :

First Ratio = 12:16

= 3 : 4 (Dividing both terms by 4)

Second ratio = 24 : 28

= 6 : 7 (Dividing both terms by 4)

∴ Both ratios are not equal.

Hence 12: 16 and 24: 28 are not in proportion.

Example 12: Do the following ratios form a proportion?

(i) 15kg : 25kg and 45kg : 75kg

(ii) 40 minutes: 2 hours and 20 min : 1 hour

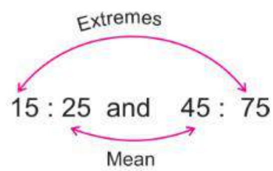
(iii) 600mℓ : 1ℓ and 1ℓ 200mℓ = 2ℓ

Solution : (i) Here units are same in both ratios.

Product of Extremes = 15 × 75 = 1125

Product of Means = 25 × 45 = 1125

∴ Product of Extremes = Product of Means



Hence, 15kg: 25kg and 45kg : 75kg are in proportion.

(ii) Here units are different so making units same

First convert all units in minutes, we have

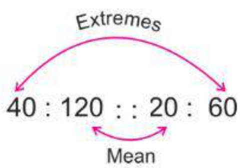
40 minutes : 2 hours and 20 minutes : 1 hour [∵ 1 hour = 60 min]

i.e. 40 minutes : 120 minutes and 20 minutes : 60 minutes

Product of Extremes = 40 ×60 = 2400

Product of Means = 120 × 20 = 2400

∴ Product of Extremes = Product of Means



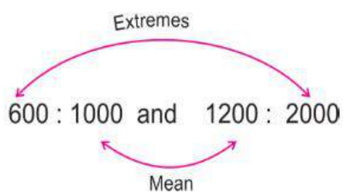
Hence 40 minutes : 2 hours and 20 minutes : 1 hour are in proportion.

(iii) Here units are different, so first make units same by converting into mℓ.

∴ 600mℓ : 1ℓ and 1ℓ 200mℓ : 2ℓ

= 600mℓ : 1000mℓ and 1200mℓ : 2000mℓ (∵ 1ℓ = 1000mℓ)

Now



Product of Extremes = 600×2000

= 1200000

Prouct of Means = $1000 \times 1200 = 1200000$

$\therefore$ Product of Extremes = Product of Means

Hence, 600mℓ : 1ℓ and 1ℓ 200 mℓ : 2ℓ are in proportion.

Example 13: Find the value of 'a' in each case:

(i) 9: a : : 45 : 40 (ii) 21 : 28 : : a : 32

Solution : (i) 9: a : : 45 : 40

Since, Given terms are in proportion.

$\therefore$ Product of Extremes = Product of Means

$\Rightarrow \quad 9 \times 40 = a \times 45$

$\Rightarrow \quad \frac{9 \times 40}{45} = a \quad \Rightarrow a = 8$

(ii) Given 21:28 : : a : 32

Since, Given terms are in proportion.

$\therefore$ Product of Extremes = Product of Means

$\Rightarrow \quad 21 \times 32 = 28 \times a$

$\Rightarrow \quad \frac{21 \times 32}{28} = a \quad \Rightarrow \quad a = 24$

Exampl 14: Show that 4, 8, 16 are in continued proportion.

Solution : For continued proportion, 4, 8, 16 can be written as 4, 8, 8, 16

$\therefore$ Product of Extremes = $4 \times 16 = 64$

Product of Means = $8 \times 8 = 64$

$\therefore$ Product of Extremes = Product of Means

Hence, 4, 8, 16 are in continued proportion.

Exercise 11.2

1. Determine if the following are in proportion.

(i) 20, 40, 25, 50 (ii) 35, 49, 55, 78 (iii) 24, 30, 36, 45

(iv) 10, 22, 45, 99 (v) 32, 48, 70, 210

2. Do the following ratios forms a proportion:

(i) 5 : 9 and 20:36 (ii) 24:36 and 32:48 (iii) 32:40 and 36:42

(iv) 27 : 18 and 3:2 (v) 35:28 and 77:44

3. State true or false of the following:

(i) 4 : 3 : : 36 : 37 (ii) 16:4 : : 20 : 5 (iii) 19 : 43 : : 8 : 21

4. Determine if the following ratios form a proportion.

(i) 40cm : 1m and ₹12 : ₹30.

(ii) 25min : 1 hour and 40km : 96km.

(iii) ₹4 : 35 paise and 8kg : 9kg.

5. Find the value of 'x' in each case:

(i) 25 : x : : 15 : 6 (ii) 28 : 49 : : x : 56 (iii) 8 : 20 : : 10 : x

6. Check if the following terms are in continued proportion:

(i) 1, 4, 16 (ii) 3, 9, 27 (iii) 5, 10, 20

11.4 Unitary Method

In our daily life, we come across many situations like cost of 12 pencils is ₹60, what is cost of 5 pencils. or cost of a dozen bananas is ₹72, What is cost of 4 bananas etc. How we find their costs?

The method of finding the value of unit quantity of an item on the basis of the given information and then finding the value of the desired quantity of the same item is called a unitary method.

From the above discussion:

$$\text{Cost of one Article} = \frac{\text{Cost of given number of articles}}{\text{Number of articles}}$$

Thus, if cost of any number of articles is given, the cost of 1 article can be obtained by dividing the cost of given number of articles with the number of articles.

Then, Cost of required number of articles = (Cost of one article) × (Required number of articles)

Thus, to find cost of required number of articles can be obtained by multiplying cost of one article with required number of articles.

Let's illustrate some examples:

Example 15: **The cost of 1 pen is ₹8. Find the cost of 12 such pens.**

Solution : Cost of 1 pen = ₹8

∴ Cost of 12 pens = ₹8 × 12 = ₹96

Example 16: **The cost of 9m cloth is ₹225. Find the cost of 1m cloth.**

Solution : Cost of 9m cloth = ₹225

∴ Cost of 1m cloth = ₹ $\frac{225}{9}$ = ₹25

Example 17: **The cost of 15 notebooks is ₹180. Find the cost of 8 such notebooks.**

Solution : Cost of 15 notebooks = ₹180

\ Cost of 1 notebook = ₹ $\frac{180}{15}$ = ₹12

Hence, cost of 8 notebooks = ₹12 × 8 = ₹96

Aliter :

We can solve this example by an alternate method called a **Proportion Method**.

If two quantities are related to each other in such a way that when one increases or decreases there is corresponding increase or decrease in other quantity such that ratio of two remains same, then those quantities are said to be in direct proportion.

According to Question:

Notebooks	Cost
15	180
8	x

By Cross product, we have

$$15 \times x = 180 \times 8$$

$$\therefore \quad x = \frac{180 \times 8}{15} = 96$$

$\therefore$ Cost of 8 notebooks in ₹96.

Example 18: If a car uses 18 litres petrol to cover 360km, what is the distance that the car can cover in 24 litres?

Solution : In 18ℓ, car covers distance = 360km

$\therefore$ In 1ℓ, car covers distance = $\frac{360}{18}$ = 20km

Hence, In 24ℓ, car covers distance = 20×24 = 480 km

Aliter :

Petrol (litres)	Distance
18	360
24	x

By cross product, we have

$$18 \times x = 24 \times 360$$

$$x = \frac{24 \times 360}{18} = 480$$

$\therefore$ Car cover 480 km distance in 24 litres.

Example 19: Raman purchased 15 chocolates for 375. How many chocolates can be purchased for ₹525?

Solution : For ₹375, Raman purchased chocolates = 15

$\therefore$ For ₹1, Raman purchased chocolates = $\frac{15}{375}$

Hence For ₹525, Raman purchased chocolates = $\frac{15}{375} \times 525 = 21$

Aliter :

Chocolates	Amount
15	375
x	525

By cross Product, we have

$$15 \times 525 = x \times 375$$

$$\Rightarrow \quad \frac{15 \times 525}{375} = x \qquad \Rightarrow \qquad x = 21$$

Hence, Raman purchased 21 chocolates for ₹525

Example 20: **Paras earns ₹1960 in a week.**

(i) How much will he earn in 18 days?

(ii) In how many days, he will earn ₹7000

Solution : (i) In a week (7 days), Paras earns = ₹1960

$$\therefore \quad \text{In a day, Paras earn} = ₹\frac{1960}{7} = ₹280$$

Hence, In 18 days, Paras will earn = ₹280 × 18 = ₹5040

Aliter :

Days	Earning
7	1960
18	x

By cross product, we have

$$7 \times x = 1960 \times 18$$

$$\therefore \quad x = \frac{1960 \times 18}{7} = ₹5040$$

Hence, Paras will earn ₹5040 in 18 days.

(ii) ₹1960 is earned in days = 7

$$\therefore \quad ₹1 \text{ is earned in days} = \frac{7}{1960}$$

$$\text{Hence, ₹7000 is earned in days} = \frac{7}{1960} \times 7000$$

$$= 25$$

Aliter :

Days	Earning
7	1960
x	7000

By cross product, we have

$$7 \times 7000 = 1960 \times x$$

$$\Rightarrow \quad \frac{7 \times 7000}{1960} = x \qquad \Rightarrow \quad x = 25$$

Hence, Paras will earn ₹7000 in 25 days.

Exercise 11.3

1. The cost of 1kg apples is ₹45. What is the cost of 7kg apples?
2. A car travels 224km in 7 litres of petrol. How much distance will it cover in 1 litre?
3. A pipe can fill 10 water tanks in 12 hours. How much time will it take to fill 15 such water tanks ?
4. The cost of 18m cloth is ₹810. What is the cost of 25m cloth?
5. The weight of 24 books is 6kg. What is the weight of 36 such books?
6. 'A' runs 28 km in 5 hours. How many kilometres does it run in 9 hours?
7. A 12m high pole casts a shadow of 30m. Find the height of the pole that casts a shadow of 45m.
8. A man earns ₹ 11200 in 7 months.
   (i) How much will he earn in 18 months?
   (ii) In how many months will he earn ₹40,000?
9. If the cost of a dozen soaps is ₹153.60 . What will be the cost of 16 such soaps?
10. Cost of 105 envelops is ₹35. How many envelops can be purchased for ₹10?
11. A bus travels 90km in $2\frac{1}{2}$ hours.
    (i) How much time is required to cover 54km with the same speed?
    (ii) Find the distance covered in 4 hours with the same speed?
12. Anshul made 57 runs in 6 overs. In how many overs he made 95 runs with same strike rate?
13. Cost of 5kg rice is ₹32.50.
    (i) What will be the cost of 14kg such rice?
    (ii) What quantity of rice can be purchased in ₹162.50 ?
14. If a cow grazes 21sq.m of a field in 6 days. How much area will it graze in 27 days?

Multiple Choice Questions

1. The ratio of 24 seconds to 1 minute is

   (a) 2:5 (b) 24:1 (c) 5:2 (d) 1:24

2. The ratio of 2m to 75cm is

   (a) 2:75 (b) 75:2 (c) 8:3 (d) 3:8

3. The ratio of 1 year to 8 months is

   (a) 2:3 (b) 3:2 (c) 1:8 (d) 8:1

4. Divide ₹40 in 2:3.

   (a) ₹20, ₹30 (b) ₹24, ₹16 (c) ₹30, ₹20 (d) ₹16, ₹24

5. Which of the following is equivalent ratio of 4:7.

   (a) 28:42 (b) 28:49 (c) 20:49 (d) 20:42

6. Find a , if 8, a, 40, 65 are in proportion.

   (a) 26 (b) 12 (c) 13 (d) 9

7. Find x if 12, 25, x, 75 are in proportion.

   (a) 36 (b) 40 (c) 30 (d) 38

8. The cost of 12 pens is ₹108. Find the cost of 18 such pens.

   (a) ₹152 (b) ₹216 (c) ₹ 162 (d) ₹144

9. Aslam earns ₹1680 in a week. In how many days, he will earn ₹2400?

   (a) 10 (b) 8 (c) 12 (d) 9

10. A bus travels 90km in $2\frac{1}{2}$ hours. How much distance it cover in 5 hours?

    (a) 100km (b) 180km (c) 150km (d) 120km

Learning Outcomes

After completion of this chapter the students are now able to

- Compare different quantities using ratio.
- Use ratio in different daily situations.
- Know about proportion.
- Use proportion in different situations.
- Apply unitary method to solve real life situations.

ANSWER KEY

Exercise 11.1

1. (i) 3:8 (ii) 9:5 (iii) 7:8 (iv) 5:6 (v) 3:1
2. (i) 4:11 (ii) 2:7 (iii) 1:5 (iv) 5:3 (v) 25:6
3. (i) 12:7 (ii) 7:30 (iii) 16 (iv) 21:4 (v) 3:1
4. (i) 8:2, 12:3 (ii) 6:10, 9:15 (iii) 10:24, 15:36
5. 15:13
6. 23:42
7. (i) 3:11 (ii) 14:3 (iii) 11:14
8. (i) 35:4 (ii) 41:35 (iii) 1:20
9. (i) 1:1 (ii) 6:5 (iii) 7:36
10. (i) 11:8 (ii) 13:10 (iii) 11:17 (iv) 1:1
11. (i) 2:3 (ii) 1:3 (iii) 15:4
12. 100,75
13. 42, 98
14. 30º, 60º, 90º'
15. 1m 56cm, 2m 60cm

Exercise 11.2

1. (i) Yes (ii) No (iii) Yes (iv) Yes (v) No
2. (i) Yes (ii) Yes (iii) No (iv) Yes (v) No
3. (i) False (ii) True (iii) False
4. (i) Yes (ii) Yes (iii) No
5. (i) 10 (ii) 32 (iii) 25
6. (i) Yes (ii) Yes (iii) Yes

Exercise 11.3

1. ₹315
2. 32km
3. 18 hours
4. ₹1125
5. 9kg
6. 50.4 km
7. 18m
8. (i) ₹28800 (ii) 25months
9. ₹204.80
10. 30
11. (i) $1\frac{1}{2}$ hours (ii) 144km
12. 10 overs
13. (i) ₹91 (ii) 25kg (iii) 94.5 sq.m

Multiple Choice Questions

(1) a (2) c (3) b (4) d (5) b

(6) c (7) a (8) c (9) a (10) b

12

PERIMETER & AREA

Objectives

In this chapter you will learn

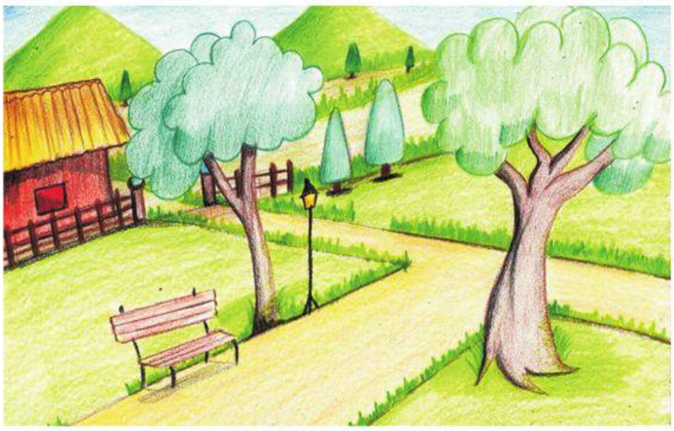
- About concept of perimeter.
- To find out the perimeter of the surroundings like fencing, photo-frame etc.
- About concept of area.
- To find out the area of the surroundings like floor, carpet etc.

12.1 Introduction

We have learnt about a point, a line and line segment. A point has only position, line has infinite length but not breadth, where as length of line segment can be measured. The line segments whether straight or curved form plane figures. When we talk about plane figures, we think about their regions and their boundaries. So we need some measures to compare them. In this chapter, we shall learn about the concept of perimeter and area of plane figures. These two concepts are of great practical utility in our day-to-day life. We shall also develop formulae for finding the perimeters and areas of a rectangle and a square.

12.2 Perimeter

We all know about fields/gardens. Suppose we want to fence it with barbed wire to make it safe from animals. To measure the length of the wire needed, we started from a point on the boundary of the field/garden and keeps moving the measuring tape along the boundary line, we reach the initial point again. i.e. starting point that means we have made a complete round of the field/garden and the length of the mea-



suring tape is equal to the distance covered in one full round. This length of the tape is called the perimeter of the garden.

Perimeter of a figure is the total length of its boundary.

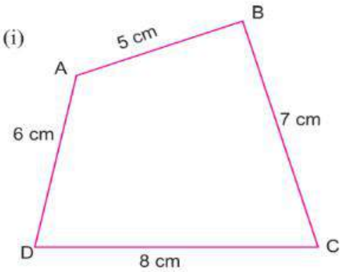
We know that all polygons (triangls, rectangle, square, hexagon etc.) are rectilinear figures.

∴ Perimeter = Sum of the lengths of its all sides.

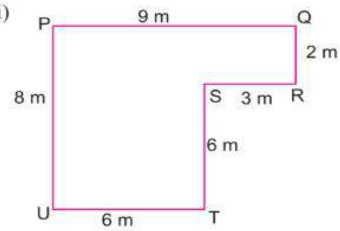
Let's consider some examples :

Example 1: Find the perimeter of each figure:

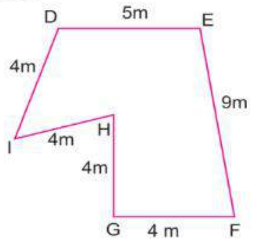
(i)



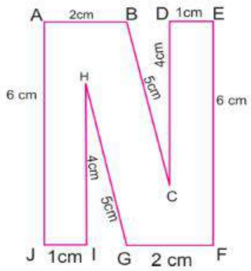
(ii)



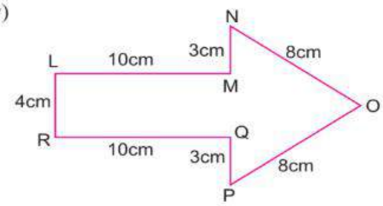
(iii)



(iv)



(v)



Solution : (i) Perimeter = Sum of all sides = AB + BC + CD + DA

= (5 + 7 + 8+ 6) cm = 26cm

(ii) Perimeter = Sum of all sides

= PQ + QR + RS + ST + TU + UP

= (9 + 2 + 3 + 6 + 6 + 8)m = 34m

(iii) Perimeter = Sum of all sides

= DE + EF + FG + GH + HI + ID

= (5 + 9 + 4 + 4 + 4 + 4)m = 30m

(iv) Perimeter = Sum of all sides

= AB + BC + CD + DE + EF + FG + GH + HI + IJ + JA

= (2 + 5 + 4 + 1 + 6 + 2 + 5 + 4 + 1 + 6) cm = 36cm

(v) Perimeter = Sum of all sides

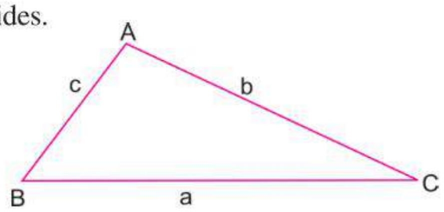
= LM + MN + NO + OP + PQ + QR + RL

= (10 + 3 + 8 + 8 + 3 + 10 + 4)cm

= 46cm.

12.2.1. Perimeter of a Triangle

Perimeter of ΔABC is the sum of the lengths of its sides.



i.e. Perimeter of ΔABC = AB + BC + CA

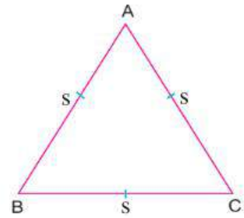
= c + a + b

or a + b + c

*** Perimeter of an Equilateral triangle :**

We know that a triangle having all sides are equal is called an equilateral triangle.

Let 's' be the length of each sides.



Perimeter of ΔABC = AB + BC + CA

= s + s + s

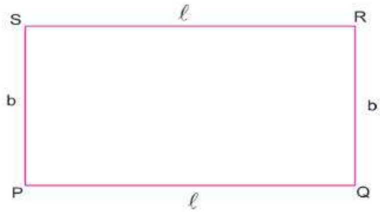
= 3s

= 3 × (Length of a side of ΔABC)

Perimeter of an equilateral triangle = 3 × Lenght of a side of the triangle

12.2.2.Perimeter of A Rectangle

Perimeter of a rectangle PQRS is the sum of all its sides.



Let 'ℓ' and 'b' denote its length and breadth respectively.

∴ Perimeter of rectangle PQRS = PQ + QR + RS + SP

$= \ell + b + \ell + b$

$= 2\ell + 2b = 2(\ell + b)$

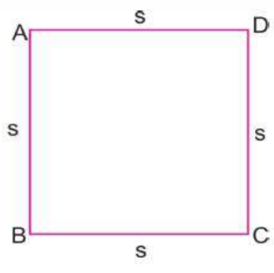
Perimeter of a rectangle = 2 × (length + Breadth)

From this formula, we can obtain the length or breadth of the rectangle.

∴ $\text{Length} = \frac{\text{Perimeter}}{2} - \text{Breadth}$ and $\text{Breadth} = \frac{\text{Perimeter}}{2} - \text{Length}$

Note:- Before finding perimeter, It must be noticed that **units of length and breadth are same.**

12.2.3. Perimeter of a Square



We know that in a square, all sides are equal.

Let 's' be each side of square.

∴ Perimeter of square ABCD = AB + BC + CD + DA

= s + s + s + s = 4s

= 4 × (side of square)

Perimeter of a square = 4 × (side of a square)

From this formula, we can obtain the side of the square.

$$\therefore \text{ side} = \frac{\text{Perimeter}}{4} \text{ or Perimeter} \div 4$$

12.2.4. Perimeter of a Regular Pentagon

A regular pentagon is a polygon with 5 equal sides.

$\therefore$ Perimeter of a Pentagon = 5 × Length of a side of regular pentagon

$$\Rightarrow \text{Length of a side of a regular pentagon} = \frac{\text{Perimeter of a regular pentagon}}{5}$$

12.2.5. Perimeter of a Regular Hexagon :

A regular hexagon is a polygon with 6 equal sides.

$\therefore$ Perimeter of a hexagon = 6 × Length of a side of regular hexagon

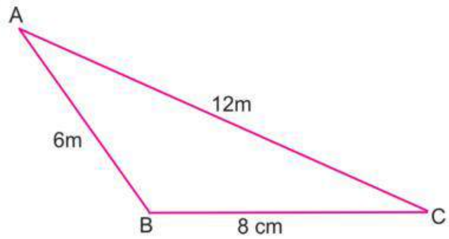
$$\Rightarrow \text{Length of a side of a regular Hexagon} = \frac{\text{Perimeter of a regular hexagon}}{6}$$

Let's consider some examples.

Example 2: **Find the perimeter of triangle ABC with sides AB = 6 m, BC = 8 m and AC = 12 m**

Solution : Perimeter of triangles ABC = Sum of lengths of its sides

= AB + BC + CA = (6 + 8 + 12)m = 26m

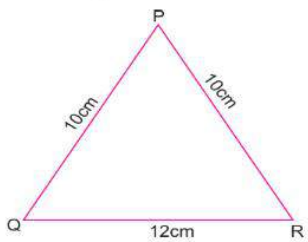


Example 3: **Find the perimeter of an isosceles triangle PQR with PQ = PR = 10cm as length of equal side and QR = 12cm as base.**

Solution : Sides of isosceles triangle = 10cm, 10cm, 12cm

$\therefore$ Perimeter = Sum of lengths of its sides

= (10 + 10 + 12)cm = 32cm



Example 4: **Find the perimeter of the following rectangles having**

(i) Length 15m and breadth 12m

(ii) Length 10.3cm and breadth 14.8cm

(iii) Length 128cm and 115cm

Solution : (i) Length of rectangle = 15m, Breadth of rectangle = 12m

$\therefore$ Perimeter of a rectangle = $2 \times$ (length + breadth)

$= 2 \times (15 + 12) = 2 \times 27 = 54$m

(ii) Length of rectangle = 10.3cm, Breadth of rectangle = 14.8cm

$\therefore$ Perimeter of rectangle = $2 \times$ (length + breadth)

$= 2 \times (10.3 + 14.8) = 2 \times 25.1$

$= 50.2$cm

(iii) Length of rectangle = 128cm, Breadth of rectangle = 115cm

$\therefore$ Perimeter of rectangle = $2 \times$ (length + breadth)

$= 2 \times (128 + 115) = 2 \times 243$

$= 486$cm

Example 5: **Find the perimeter of a square with**

(i) Side = 12m (ii) Side = 6.3cm (iii) Side = 85cm

Solution : (i) Side of square = 12m

$\therefore$ Perimeter of square = $4 \times$ side

$= 4 \times 12 = 48$m

(ii) Side of square = 6.3cm

$\therefore$ Perimeter of square = $4 \times$ side

$= 4 \times 6.3 = 25.2$cm

(iii) Side of square = 85cm

$\therefore$ Perimeter of a square = $4 \times$ side

$= 4 \times 85 = 340$cm

Example 6: **Find the Perimeter of a regular hexagon with side 15cm**

Solution : Side of hexagon = 15cm

Perimeter of a regular hexagon = $6 \times$ side

$= 6 \times 15 = 90$cm

Example 7: **Two sides of a triangle are 12cm and 15cm the perimeter of the triangle is 40cm. What is the length of the third side?**

Solution : Sum of length of two sides = (12 + 15) cm

= 27cm

Perimeter = 40cm

$\therefore$ third side = 40cm – 27cm = 13cm

Aliter :- Let sides are a = 12cm, b = 15cm, c = ?

Perimeter of a triangle = Sum of length of all sides

then

$40 = a + b + c$

$40 = 12 + 15 + c$

$$40 = 27 + c$$
$$c = 40 - 27$$
$$= 13cm$$

Example 8 : **If the Perimeter of an equilateral triangle is 45cm. Find the length of each side of the triangle.**

Solution : Given, Perimeter of an equilateral triangle = 45cm

Perimeter of an equilateral triangle = 3 × (Side of the triangle)

$\Rightarrow$ $45 = 3 \times \text{side} \Rightarrow \frac{45}{3} = \text{side}$

$\Rightarrow$ Side = 15cm

Example 9 : **If the perimeter of a square lawn is 72m. Find the side of the square lawn.**

Solution : Given Perimeter of square lawn = 72m

$\therefore$ Perimeter of square = 4 × (side)

$\Rightarrow$ 72m = 4 × (side)

$\Rightarrow$ $\text{side} = \frac{72}{4}\text{m} = 18\text{m}$

Example 10 : **The perimeter of a rectangle is 80cm. If length of the rectangle is 25cm. Find the breadth of the rectangle.**

Solution : Given, Perimeter of Rectangle = 80cm and

length of the rectangle = 25cm

$\therefore$ Perimeter of a Rectangle = 2 × (length + breadth)

$\Rightarrow$ 80 = 2 × (25 + breadth)

$\Rightarrow$ $\frac{80}{2} = 25 + \text{breadth}$

$\Rightarrow$ breadth + 25 = 40 $\Rightarrow$ breadth = 40 − 25 = 15cm

Applications of Perimeter in Daily life

Example 11: **Kanwar takes 5 rounds of square park of side 135m. Find the distance covered by Kanwar?**

Solution : Distance covered in 1 round of square park = Perimeter of square park

$\therefore$ Perimeter of the square = 4 × side

= 4 × 135 = 540m

Distance covered in 5 rounds of square park

= 5 × Perimeter of the square

= 5 × 540

= 2700m

or $\frac{2700}{1000}$ km = 2.7km ($\because$ 1km = 1000m)

Example 12: **A gardener wants to fence his rectangular garden of length 180m and breadth 150m. If he wants to use three layers of wire to fence the garden, find the length of the wire required by him.**

Solution : The gardener wants to fence his rectangular garden so we have to find perimeter of the garden

Given, length of the rectangular garden = 180m

breadth of the rectangular garden = 150m

$\therefore$ Perimeter of the rectangular garden = $2 \times$ (length + breadth)

$= 2 \times (180 + 150)$

$= 2 \times 330 = 660$m

$\therefore$ One layer of fencing = Perimeter of the garden

Three layers of fencing = $3 \times$ Perimeter of the garden

$= 3 \times 660 = 1980$m

So he needs 1980m of wire to fence his garden.

Example 13: **Find the cost of constructing wall around a square park of side 30m at the rate of ₹ 500 per running metre**

Solution : Given side of square park = 30m

$\therefore$ Perimeter of a square = $4 \times$ side of the square

$= 4 \times 30 = 120$m

Also cost of constructing wall per metre = ₹ 5

$\therefore$ cost of constructing wall around a square park = $120 \times 500 =$ ₹ 60000

Example 14 : **If the length of a rectangle is x units and breadth is 3 units. Find the perimeter of the rectangle**

Solution : Given, length of the rectangle = x units

Breadth of the rectangle = 3 units

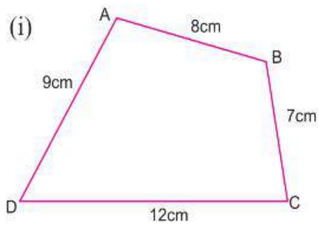
$\therefore$ Perimeter of the rectangle = 2 (length + breadth)

$= 2(x + 3)$ units

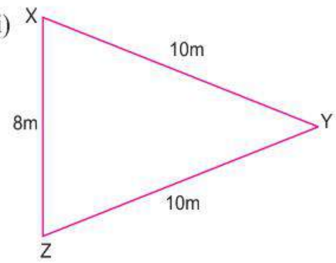
Exercise 12.1

1. Find the perimeter of the following shapes:-

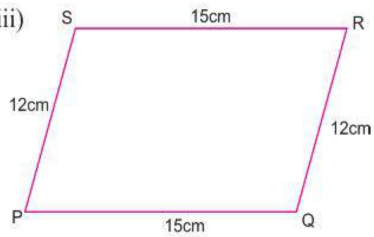
(i)



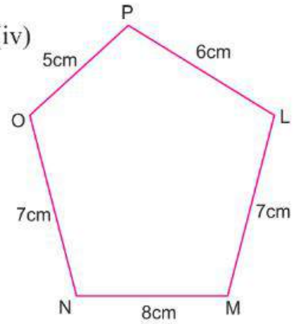
(ii)



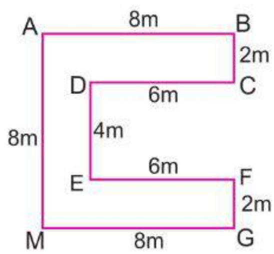
(iii)



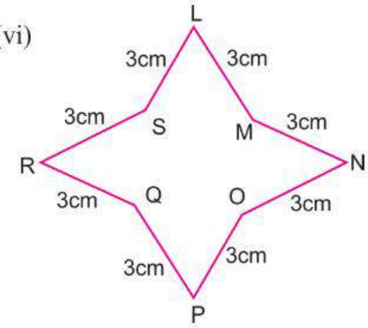
(iv)



(v)



(vi)



2. Find the perimeter of the triangle with sides :

(i) 5cm, 6cm and 7cm (ii) 10m, 12m, 18m (iii) 4.6cm, 3.2cm and 5.8cm

3. Find the perimeter of an isosceles triangle with 15cm as length of equal side and 18cm as base.

4. Find the perimeter of a square with side :

(i) 16cm (ii) 4.8mm (iii) 125cm (iv) 45m (v) 39cm

5. Find the perimeter of a rectangle with

(i) Length 20m and breadth 15m

(ii) Length 25m and breadth 35m

(iii) Length 40cm and breadth 28cm

(iv) Length 18.3cm and breadth 6.8cm

(v) Length 0.125 m and breadth 15cm.

6. Find the perimeter of a regualar hexagon with side :

(i) 5cm (ii) 12cm (iii) 7.2cm

7. Find the perimeter of an equilateral triangle with side

(i) 10cm (ii) 8m (iii) 24m (iv) 5.6m (v) 12.1cm

8. If the perimeter of a triangle is 48cm and two sides are 12cm and 17cm. Find the third side.

9. Find the side of an equilateral triangle, if the perimeter is :

(i) 45cm (ii) 69mm (iii) 117cm

10. Find the side of a square if the perimeter is:

(i) 52cm (ii) 60cm (iii)112cm

11. (i) The perimeter of rectangular field is 260m. If its length is 80m then find its breadth.

(ii) The perimeter of a rectangualr garden is 140m. If its breadth is 45m then find its length.

(iii) The perimeter of a rectangle is 114cm. If its length is 32cm then find its breadth in metres.

12. The side of a triangular field are 15m, 20m and 18m. Find the total distance travelled by a boy in taking 2 complete rounds of this field.

13. Find the cost of fencing a square field of side 26m at the rate of ₹ 3 per metre.

14. Mani runs around a square park of side 75m. Kush runs around a rectangular park of length 60m and breadth 45m. Who covers less distance?

15. Find the cost of framing a rectangular white board with length 240 cm and breadth 150 cm at the rate of ₹ 6 per cm.

16. If length of a rectangle is 'a' units and breadth is 5 units. Find the perimeter of the rectangle.

17. Fill in the blanks:-

(i) The sum of lengths of all sides of a polygon is called ....

(ii) Perimeter of Square = ... × side

(iii) Perimeter of Rectangle = 2 × (.................. + ...)

(iv) Side of a square = (..................) ÷ 4

(v) Perimeter of an equilateral triangle = ... × side

12.3. Area

We have learnt in previous classes that the area of the portion of the plane or a shape can be defined as the amount of stuff required to cover it. For finding the area of a polygon, we consider the enclosed region of the polygon.

Let us consider an example to clear the idea. Pritpal buys a piece of land which is 80 metres long and 65 metres wide and his friend Aslam buys a piece of land which is 60 metres long and 75 metres wide at the same rate.

Who will pay the more price?

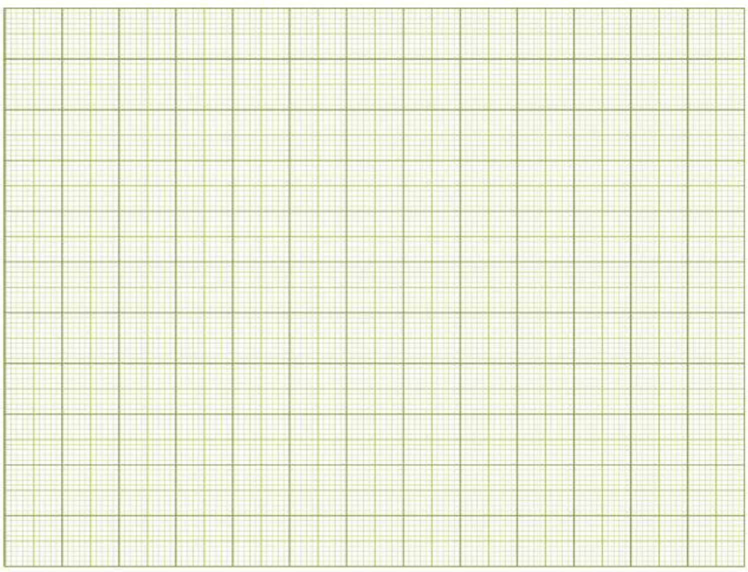
Obviously, the one who has more land will pay more. In this case, we shall find the areas of both the lands to know who has more land.

The measurement of the region enclosed by a close plane figure is called its area.

Unit of Area:- Let a square of side 1 unit. It covers the region 1 square units. So we always denote the area in square units.

12.3.1 Finding Area by the use of squared paper (Graph paper) :

The squared paper or a graph paper is a convenient method for finding the approximate area of a region enclosed by any simple closed curve.



- If the figure encloses an exact number of complete squares, then count the number of squares.
- If the figure consists more than half or half squares then use the following formula :

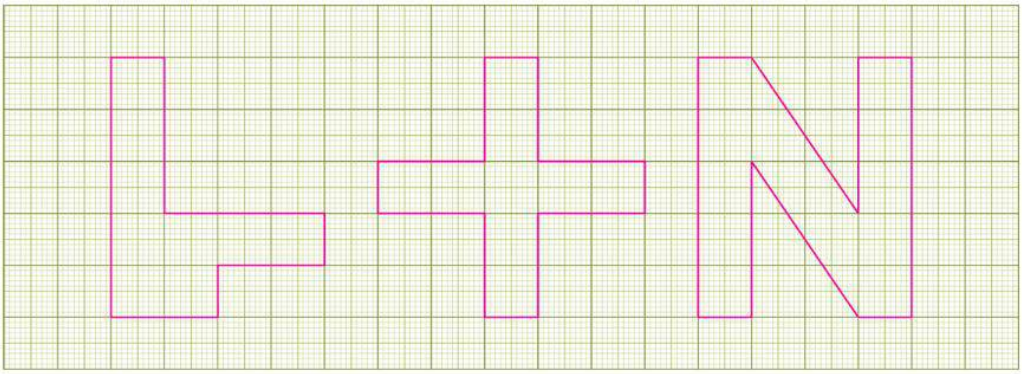
Area of the plane figure = $\left(m + n + \frac{1}{2}p\right)$

where m = Number of complete squares

n = Number of squares more than half part enclosed

p = Number of squares exactly half part enclosed.

Example 15:- Find the approximate area of each of the following figures by counting the number of squares - complete, more than half and exactly half. (Area of 1 square box = 1sq.cm)



Solution : (i) Number of complete squares m = 9

Here we do not have any half square or more than half

$\therefore$ n = 0, p = 0

$\therefore$ Area of plane figure = $m + n + \frac{1}{2}p$

= 9 + 0 + 0 = 9 sq.cm.

(ii) Number of complete squares, m = 9

Here n = 0, p = 0

$\therefore$ Area plane figure = 9 sq.cm.

(iii) Number of complete squares, m = 10

Number of squares exactly half, p = 0

Number of squares more than half (n) = 4

$\therefore$ Area of plane figures = $m + n + \frac{1}{2}p$

$= 10 + 4 + \frac{1}{2} \times (0)$

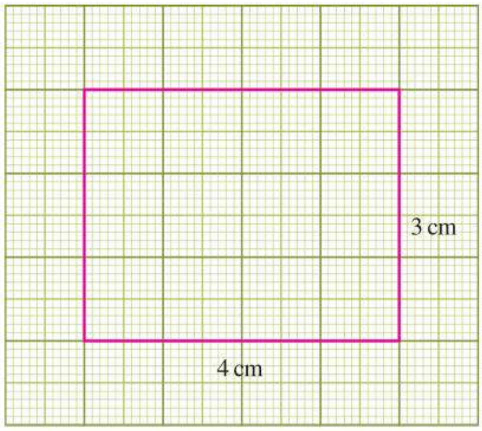
= 14 + 0

= 14 sq.cm.

12.3.2 Measurement of Area by Using Formula

We have learnt in previous class about the area of a rectangle and a square. In this class, we shall discuss it in detail.

- **Area of a Rectangle :**



Let us draw a rectangle of length 4cm and breadth 3cm on a graph paper with 1cm × 1cm squares.

We find that it covers 12 squares completely.

∴ Area of the rectangle = 12 sq. cm

We observe that, there are 4 squares in a row and there are 3 such rows.

∴ Total number of squares

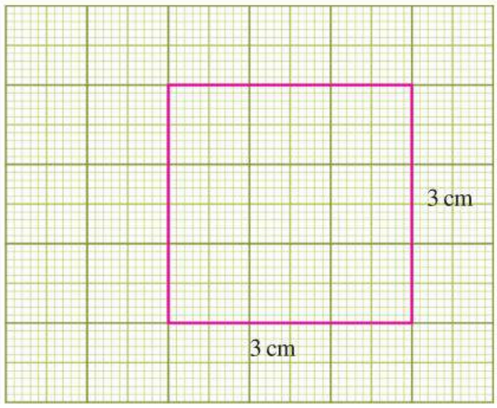
= 4 × 3 = length × breadth

Area of rectangle = length × breadth

from the above formula, we can derive :

$$\textbf{Length} = \frac{\textbf{Area}}{\textbf{Breadth}} \quad \text{or} \quad \textbf{Breadth} = \frac{\textbf{Area}}{\textbf{Length}}$$

- **Area of a Square**



Let us draw a square of side 3cm on a graph paper with 1cm × 1cm squares.

We find that it covers 9 squares completely.

∴ Area of the square = 9 sq. cm

We observe that, there are 3 squares in a row and there are 3 such rows.

∴ The Total number of squares

= 3 × 3 = side × side

Area of square = side × side

Note:- To find the area of a figure, all its dimension must be expressed in same units.

Example 16: **Find the area of the rectangle with**

(i) length = 15cm and breadth = 12cm

(ii) length = 18m and breadth = 24m

(iii) length = 5cm and breadth = 12mm

Solution : (i) Length of rectangle = 15cm and breadth of rectangle = 12cm

∴ Area of Rectangle = Length × Breadth

= 15cm × 12cm

= 180 sq.cm.

(ii) Length of rectangle = 18m and breadth of rectangle = 24m

$\therefore$ Area of Rectangle = Length × Breadth

= 18m × 24m

= 432 sq.m.

(iii) Here units of length and breadth are different. First convert them in same units

Length = 5cm = 5 × 10 mm = 50mm (∵ 1cm = 10mm)

Breadth = 12mm

$\therefore$ Area of Rectangle = Length × Breadth

= 50mm × 12mm

= 600 sq.mm.

Example 17: Find the area of square with side

(i) 5cm (ii) 4.1mm (iii) 18m

Solution : (i) Side of a square = 5cm

$\therefore$ Area of Rectangle = side × side

= 5cm × 5cm

= 25 sq.cm

(ii) Side of a square = 4.1mm

$\therefore$ Area of Rectangle = side × side

= 4.1mm × 4.1mm

= 16.81 sq.mm

(iii) Side of a square = 18m

$\therefore$ Area of Rectangle = side × side

= 18m × 18m

= 324 sq.m

Example 18: The length of a rectangular plot is 90m and its area is 1800 sq.m. Find the breadth of the plot.

Solution : Length of rectangle plot = 90m

Area of Rectangle plot = 1800 sq.m

$\therefore$ Area = Length × Breadth

$\Rightarrow$ 1800 = 90 × Breadth

$\Rightarrow \dfrac{1800}{90}$ = Breadth

$\Rightarrow$ Breadth = 20m.

Example 19: The side of a square plot of land is 35m. Find the cost of levelling the plot, if the rate is ₹ 4 per square metre

Solution : Side of Square plot = 35m

Area of Square plot = side × side

= 35m × 35m

= 1225 sq.m.

New levelling cost of 1 sq.m = ₹ 4

∴ Levelling cost of 1225 sq.m = ₹ 4 × 1225

= ₹ 4900

Example 20: The area of a rectangle is 380 sq. cm and its breadth is 20cm. Find the perimeter of the rectangle.

Solution : Given area of rectangle = 380 sq. cm

and breadth of rectangle = 20cm

Area of rectangle = length × breadth

380 = length × 20

⇒ length of rectangle $= \frac{380}{20} = 19$cm

Now, Perimeter of Rectangle = 2 × (length + breadth)

= 2 × (19 + 20)

= 2 × 39 = 78cm

Example 21: How many envelops can be made out of a sheet of paper measuring 108cm by 105cm, if each evelope requires a piece of paper of size 9cm by 15cm.

Solution : Given length of sheet of paper = 108cm

and breadth of sheet of paper = 105cm

Area of sheet of paper = length × breadth

= (108 × 105) sq.cm

Area of paper required for one envelope = (9 × 15) sq. cm

∴ Number of envelops that can be made $= \frac{\text{Area of Sheet of paper}}{\text{Area of one envelope}}$

$= \frac{108 \times 105}{9 \times 15} = 84$

Hence, 84 envelops can be made.

Example 22: The perimeter of the square is 68cm. Find its area.

Solution : Perimeter of square = 68cm

⇒ 4 × side of square = 68cm

⇒ Side of square $= \frac{68}{4} = 17$cm

∴ Area of square = side × side

= 17cm × 17cm

= 289 sq.cm

Example 23: A marble tile measures 25cm by 20cm. How many tiles will be required to cover a floor of size 4.5m by 3m?

1m	=	100cm
1 sq. m	=	100cm × 100cm
	=	10000 sq. cm

Solution : Area of the floor $= 4.5 \times 3$ sq. m

$= 13.5$ sq.m

$= 13.5 \times 10000$

$= 135000$ sq.cm

Area of one tile $= (25 \times 20)$ sq cm

$= 500$ sq.cm

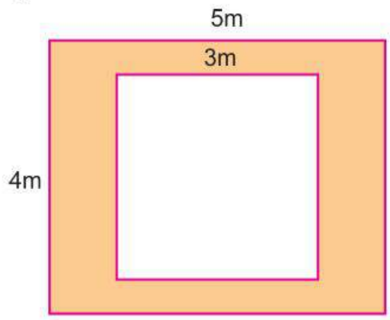
∴ Number of tiles required to cover the floor

$$= \frac{\text{Area of the floor}}{\text{Area of one tile}}$$

$$= \frac{135000}{500} = 270$$

Hence, 270 tiles will be required to cover the floor.

Example 24: The floor is 5m long and 4m wide. A square carpet of side 3m is laid on the floor. Find the area of the floor that is not carpeted.



Solution : Given length of floor = 5m,

Breadth = 4m

Area of the floor = length × breadth

= 5m × 4m

= 20 sq. m

Area of the square carpet = side × side

= 3m × 3m = 9 sq. m

∴ Area that is not carpeted = (Area of floor) – (Area of the carpet)

= (20 – 9) sq.m = 11 sq.m

Example 25: **(i) What will happen to the area of a square if its side is doubled?**

(ii) What will happen to the area of a rectangle if its length is doubled and breadth is trebled (Tripled)?

Solution : (i) Let the side of the square = x cm

∴ Area of the square = $(x \times x)$ sq. cm

Now, If the side is doubled, then

side of new square = 2x cm

∴ Area of the new square = $[(2x) \times (2x)]$ sq.cm

$= (2 \times 2 \times x \times x)$ sq.cm

$= (4 \times x \times x)$ sq.cm

$= 4\ (x \times x)$ sq.cm

$= 4 \times$ (Area of Original square)

$\therefore$ If side is doubled, then the area becomes 4 times of original area

(ii) Let ℓ cm and b cm be the length and breadth of the rectangle respectively.

$\therefore$ Area of the rectangle $= \ell \times b$

Now, If length is double and breadth is trebled.

$\therefore$ Now length $= 2\ell$

and new breadth $= 3b$

Thus, area of new rectangle $=$ length $\times$ breadth

$= 2\ell \times 3b$

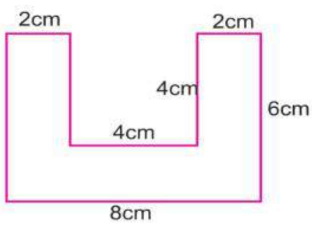
$= 6 \times (\ell \times b)$

$= 6 \times$ (Area of Original Rectangle)

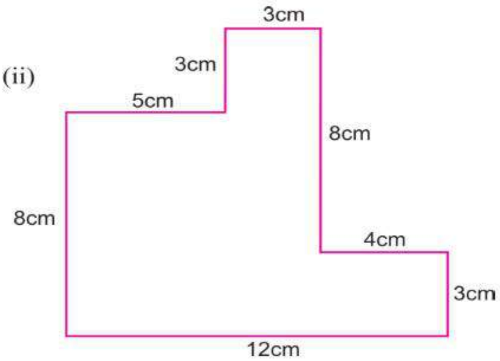
Hence, Area becomes 6 times of original area.

Example 26: Find the area of the following figures by splitting it into rectangles and squares :

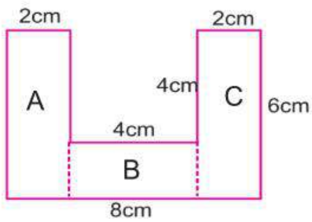
(i)



(ii)



Solution : (i) The given figures cna be divided into 3 parts



- Rectangle A of size 2cm × 6cm
- Rectangle B of size 4cm × 2cm
- Rectangle C of size 2cm × 6cm

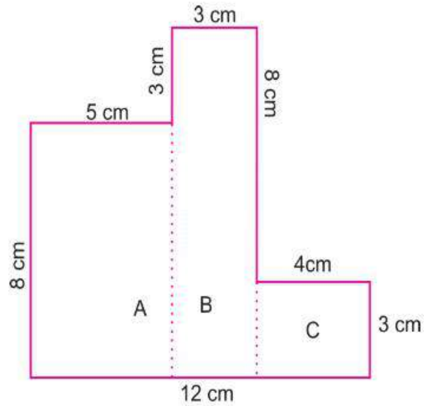
$\therefore$ Area of rectangle A = 2cm × 6cm = 12 sq. cm.

Area of rectangle B = 4cm × 2cm = 8 sq. cm

Area of rectangle C = 2cm × 6cm = 12 sq.cm

$\Rightarrow$ Total area of the figures = 12 + 8 + 12 = 32 sq. cm

(ii) The figure can be divided into 3 parts.



- Rectangle A of size 5cm × 8cm
- Rectangle B of size 3cm × 11cm
- Rectangle C of size 4cm × 3cm

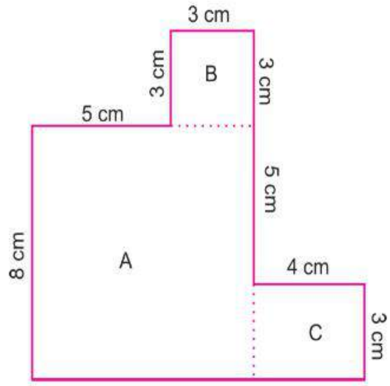
∴ Area of rectangle A = 5cm × 8cm = 40 sq. cm.

Area of rectangle B = 3cm × 11cm = 33 sq. cm

Area of rectangle C = 4cm × 3cm = 12 sq.cm

∴ Total area of the figures = 40 + 33 + 12 = 85 sq. cm

Alter :- The figure can be divided into 3 parts.



- Square A of size 8cm × 8cm
- Square B of size 3cm × 3cm
- Rectanlge C of size 4cm × 3cm

∴ Area of rectangle A = 8cm × 8cm = 64 sq. cm.

Area of rectangle B = 3cm × 3cm = 9 sq. cm

Area of rectangle C = 4cm × 3cm = 12 sq.cm

⇒ Total area of the figures = 64 + 9 + 12 = 85 sq. cm

Example 27: If the length of the rectangle x units and breadth of the rectangle is 5 units. Find the area of the rectangle

Solution : Length of the rectangle = x units

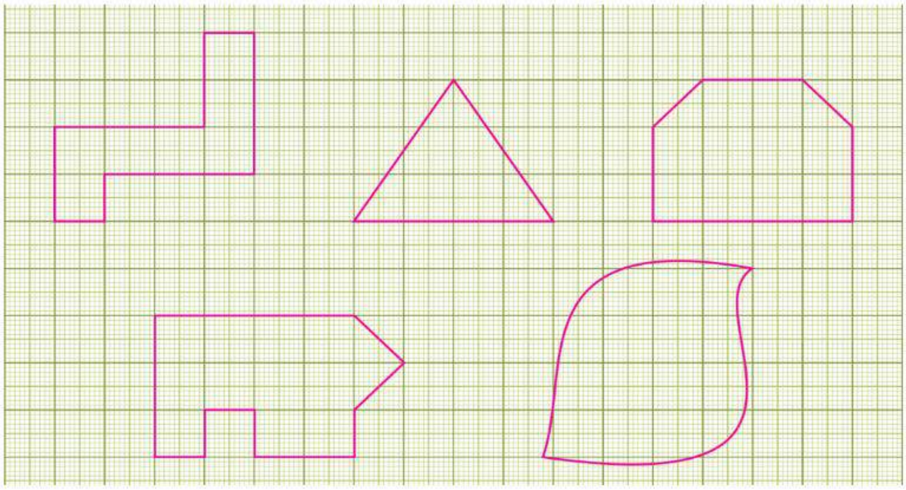
Breadth of the rectangle = 5 units

Area of the rectangle = Length × Breadth

= x × 5 = 5x sq. units.

Exercise 12.2

1. Find the approximate area of each of the following figures by counting the number of squares – complete, more than half and exactly half.



2. Find the area of a rectangle whose

(i) length = 12cm, breadth = 16cm (ii) length = 25m, breadth = 18m

(iii) length = 2.7m, breadth = 45cm (iv) length = 4.2cm, breadth = 1.5cm

(v) length = 3.8mm, breadth = 4mm

3. Find the area of the square with side :

(i) 19cm (ii) 24mm (iii) 3.5cm (iv) 2.6cm (v) 8.2cm

4. The area of a rectangle is 216 sq.cm and its length is 12cm. Find its breadth.

5. The area of a rectangle is 225 sq. m and its breadth is 9m. Find its length.

6. The length and breadth of a ground are 32m and 24m. Find the cost of levelling the ground at the rate of ₹ 3 per sq. m

7. Find the perimeter of a rectangle whose area is 324 sq.cm and its one side is 36cm.

8. The perimeter of a square field is 100m. Find its area.

9. Area of a rectangle of length 20cm is 340 sq. cm. Find its perimeter.

10. A marble tile measure 15cm × 20cm. How many tiles will be required to cover a wall of size 4m × 6m?

11. Find the cost of levelling the square field of side 75m at the rate of ₹ 5 per square metre.

12. How many stamps of size 2cm × 1.5cm can be pasted on a sheet of paper of size 6cm × 12cm?

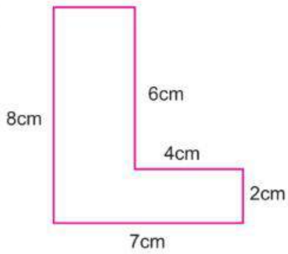
13. (i) What will happen to the area of a square if its side is trebled (tripled)?

(ii) What will happen to the area of a rectangle if its length is halved and breadth is doubled?

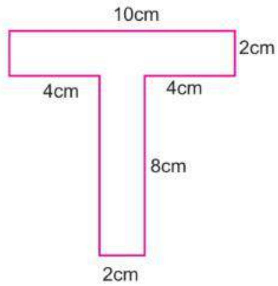
(iii) What will happen to the area of a square if its side is halved?

14. Find the area of the following figures by splitting it into rectangles and squares :

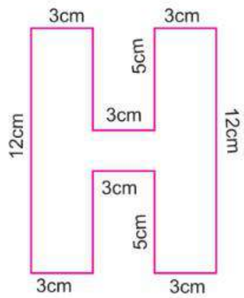
(i)



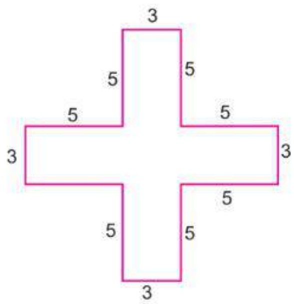
(ii)



(iii)



(iv)



15. Fill in the blanks:-

(i) 1 square metre = ... sq. cm.

(ii) 1 square cm = ... sq. mm.

(iii) Area of Rectangle = ... × ....

(iv) Length = ... ÷ breadth

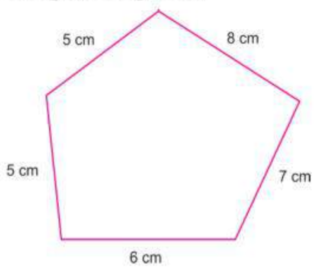
(v) Area of square = ... × ....

Multiple Choice Questions

1. The outer boundary of a closed figure is called ....

(a) Perimeter (b) Region (c) Area (d) Curve

2. Find the perimeter of the given figures :



(a) 30cm (b) 31cm (c) 32cm (d) 33cm

3. Perimeter of an equilateral triangle = ...

(a) 3 + Side (b) Side × Side (c) Side + Side (d) 3 × Side

4. Perimeter of Retangle = ...

(a) 2l + b (b) 2 (l + b) (c) l + 2b (d) l × b

5. If side of an equilateral triangle is 4cm then perimeter = ...

(a) 8cm (b) 7cm (c) 12cm (d) 16cm

6. If length and breadth of a rectangle are 2.4cm and 1.9cm then its perimeter is ....

(a) 4.3cm (b) 8.2cm (c) 4.2cm (d) 8.6cm

7. The perimeter of a square is 16cm then its side is ....

(a) 4cm (b) 64cm (c) 24cm (d) 32cm

8. The perimeter of a rectangle is 50cm and its length is 12cm then breadth is ....

(a) 38cm (b) 13cm (c) 62cm (d) 18cm

9. Two sides of a triangle are 4.8cm and 3.9cm. The perimeter of the triangle is 12cm. Find the third side.

(a) 3.3cm (b) 4.3cm (c) 20.7cm (d) 3.7cm

10. Samandeep takes 3 rounds of square park of side125m. Find the distance covered by her.

(a) 1.5km (b) 1500km (c) 500m (d) 375m

11. The measurement of the region enclosed by a closed plane figure is called its ....

(a) Circumference (b) Curve (c) Perimeter (d) Area

12. If the length of a rectangle is x units and breadth is 5 units then its perimeter is ....

(a) 5x (b) 2 (x + 5) (c) 10x (d) 10 + x

13. Find the area of the given rectangle whose length is 16m and breadth is 8m.

(a) 42 sq.m (b) 128 sq.m (c) 72 sq.m (d) 21 sq.m

14. The area of a rectangle is $144m^2$. If its breadth is 9m then find its length.

(a) 16sq.m (b) 12m (c) 16m (d) 18m

15. 1 sq.m = ... m.

(a) 100 (b) 10000 (c) 1000 (d) 1

16. Find the area of a square having side 3.6cm.

(a) 14.4 cm (b) 12.96 cm (c) 1.29 sq.cm (d) 12.96 sq.cm

17. The perimeter of a square is 68m. Find its area.

(a) 289 sq.m (b) 329 sq.m (c) 279 sq.m (d) 249 sq.m

18. A marble tile is of side 25cm by 25cm. How many tiles will be required to cover a floor of 4m by 3m?

(a) 216 (b) 192 (c) 188 (d) 196

19. What will happen to the area of a square, if side is doubled?

(a) Double (b) Half (c) Four times (d) Nochange

20. Find the perimeter of a rectangle whose area is 234sq.cm and its one side is 13cm.

(a) 31cm (b) 62cm (c) 18cm (d) 24cm

Learning Outcomes

After completion of this chapter the students are now able to

- Know about the concept of perimeter.
- Find the perimeter from their surrounding and use it in its practical life.
- Know about the concept of area.
- Use the concept of area in its daily use..

ANSWER KEY

Exercise 12.1

1. (i) 36cm (ii) 28m (iii) 54cm (iv) 33cm (v) 44m (vi) 24cm

2. (i) 18cm (ii) 40m (iii) 13.6cm **3.** 48cm

4. (i) 64cm (ii) 19.2mm (iii) 500cm (iv) 180m (v) 156cm

5. (i) 70m (ii) 120m (iii) 136cm (iv) 50.2cm (v) 55cm

6. (i) 30cm (ii) 72cm (iii) 43.2cm

7. (i) 30cm (ii) 24m (iii) 72m (iv) 16.8m (v) 36.3cm

8. 19cm **9.** (i) 15cm (ii) 23mm (iii) 39cm

10. (i) 13cm (ii) 15cm (iii) 28cm **11.** (i) 50m (ii) 25 m (iii) 25cm

12. 106m **13.** ₹ 312 **14.** Kush **15.** ₹ 4680 **16.** 2 (a + 5)

17. (i) Perimeter (ii) 4 (iii) Length, breadth (iv) Perimeter (v) 3

Exercise 12.2

1. (i) 7 units (ii) 6 units (iii) 11 units (iv) 12 units (v) 13 units

2. (i) 192 sq cm (ii) 450 sq m (iii) 12150 sq cm (iv) 6.3 sq cm (v) 15.2 sq mm

3. (i) 361 sq cm (ii) 576 sq mm (iii) 12.25 sq cm (iv) 6.76 sq cm (v) 67.24 sq.cm

4. 18cm **5.** 25m **6.** ₹ 2304 **7.** 90cm **8.** 625 sq m **9.** 74cm

10. 800 **11.** ₹ 28125 **12.** 24 **13.** (i) 9 times (ii) No effect (iii) One fourth times

14. (i) 32 sq cm (ii) 36 sq.cm (iii) 78 sqcm (iv) 69 sq units **15.** 4y sq units

16. (i) 10000 (ii) 100 (iii) length, breadth (iv) Area (v) Side, Side

Multiple Choice Questions

(1) a **(2)** b **(3)** d **(4)** b **(5)** c **(6)** d **(7)** a **(8)** b **(9)** a **(10)** a

(11) d **(12)** b **(13)** b **(14)** c **(15)** b **(16)** d **(17)** a **(18)** b **(19)** c **(20)** b

13

SYMMETRY

Objectives

In this chapter you will learn

- About symmetrical figures.
- About symmetrical lines.
- To identify the symmetrical figures in daily life.
- About the reflection of different objects.

13.1 Introduction

Symmetry is an important geometrical concept exhibited in nature and is widely used in engineering, architecture, textile designing, pottery and many other fields. We can observe symmetry in nature such as flowers, leaves and insects. Around us, we find symmetry on bed sheets, shawls and also in monuments like Taj Mahal and Eiffel Tower.

Symmetry around us

When a picture is folded from the middle and the two halves match exactly, then we say that the picture is symmetrical. This phenomenon is called **Symmetry.**

13.2 Making Symmetric Figures

13.2.1 Ink Blot Devils:-

Take a piece of paper. Fold it in half. Spill a few drops of ink on one half Side. Now press the both halves together and see the resulting figure. Is it symmetric? If yes then find its line of symmetry.

Is there any other line along which it can be folded in two identical parts?

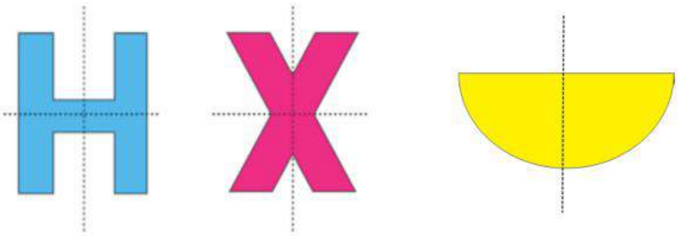
Try more such patterns

13.2.2 Inked String Patterns

Fold a paper in half. On one half portion, arrange short lengths of thread dropped in coloured inks or paints. Now press the two halves. observe the figure you obtain. Is it Symmetric?

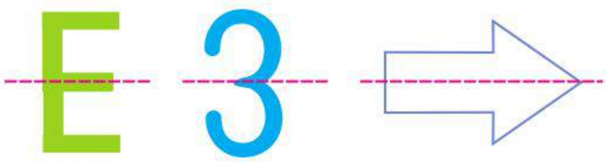
13.3. Lines of Symmetry

If you observe the symmetrical figure, there are some lines which divide the figure into two exactly identical halves. These **lines are called lines of symmetry or axis of Symmetry.**



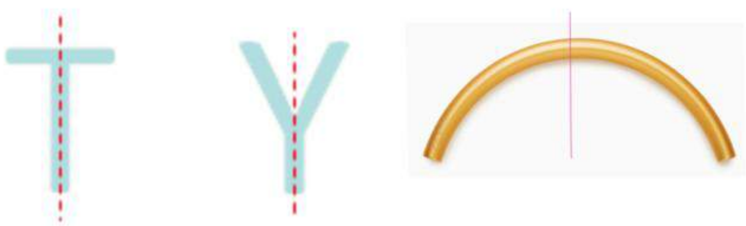
Lines of Symmetry.

Observe the pictures shown in Fig. The line of symmetry in these pictures is horizontal. This type of symmetry is called **horizontal symmetry.**



Horizontal Symmetry

Observe the pictures shown in Fig. The line of symmetry in these pictures is vertical. This type of symmetry is called **vertical symmetry.**



Vertical Symmetry

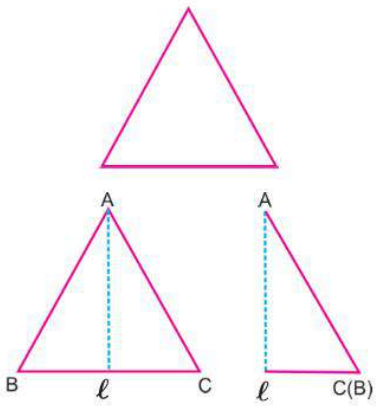
ACTIVITY

Determine the number of lines of symmetry of different shapes by paper folding.

Material Required : Chart Paper, Scale etc.

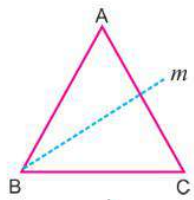
Procedure : 1. Equilateral Triangle:

Case I :



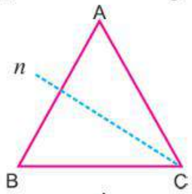
- Cut an equilateral ΔABC from the chart paper.
- Now fold the triangle in such a way so that B and C coincides.
- You will observe that after unfolding, the crease made by folding, passes through A.
- This crease divides the triangle in two identical parts.
- So there is one line of symmetry (ℓ) through A.

Case II



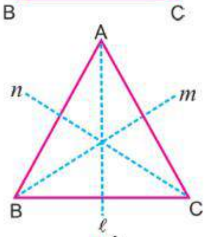
- Now fold the triangle in such a way that A and C coincides.
- You will observe that after unfolding crease made by folding passes through B.
- This crease divides the triangle in two identical parts.
- So there is one more line of symmetry (m) through B.

Case III



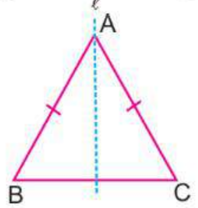
- Now fold the triangle in such a way that A and B coincides.
- You will observe that after unfolding, crease made by folding passing through C.
- This crease divides the triangle in two identical parts.
- So there is again one more line of symmetry (n) through C.

Thus, An equilateral triangle has 3 lines of symmetry



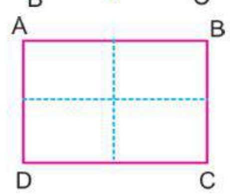
(2) Isosceles Triangle:

Follow the process as discussed above you will find, there is only one line of symmetry in an Isosceles Triangle. (Which is between the vertex of equal sides)



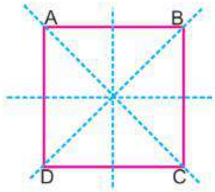
(3) Rectangle:

Follow the process as discussed above, you will find there are 2 lines of symmetry in a rectangle.



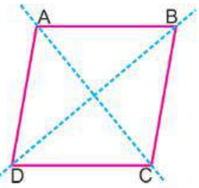
(4) Square:

Follow the process as discussed above, you will find, there are 4 lines of symmetry in a square.



(5) Rhombus:

Follow the process as discussed above, you will find there are 2 lines of symmetry in a rhombus.



*** Lines of Symmetry for Regular Polygons**

A polygon is a closed figure made of line segments. A triangle is a polygon with the least number of sides (three sides).

A regular polygon has all its sides equal and all its angles equal.

For example : (1) An equilateral triangle has three lines of symmetry.

(2) A square has four lines of symmetry.

(3) A regular pentagon has five lines of symmetry.

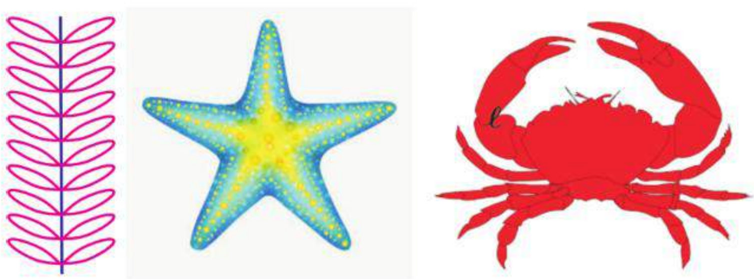
Therefore we can say that regular polygons are symmetrical figures having as many lines of symmetry as they have sides or vertices.

Symmetry, Symmetry Everywhere!

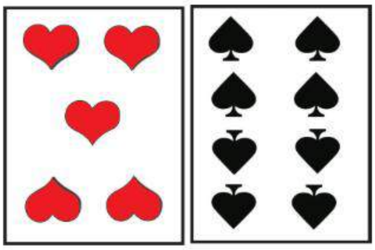
- Many road signs you see everyday have lines of symmetry. Here, are a few.

Identify a few more symmetric road signs and draw them. Do not forget to mark the lines of symmetry.

- The nature has plenty of things having symmetry in their shapes: look at these:



- The designs on some playing cards have line symmetry. Identify them for the following cards.

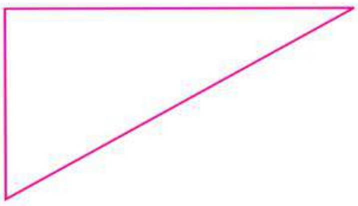


- Let us take scissor !

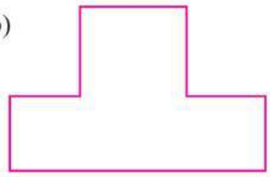
  How many lines of symmetry does it have?

Example 1:- Identify the figures which are symmterical :

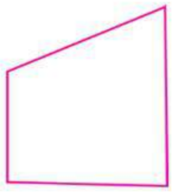
(a)



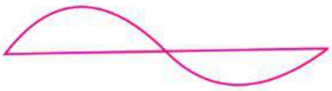
(b)



(c)



(d)



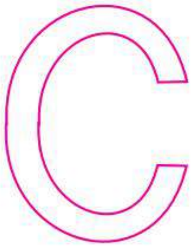
(e)

Sol. : Figure (b) and (e) are symmetrical

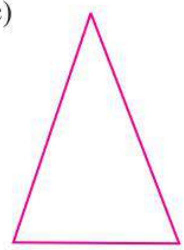
Example 2: Draw line/lines of symmetry in the following figure

(a)

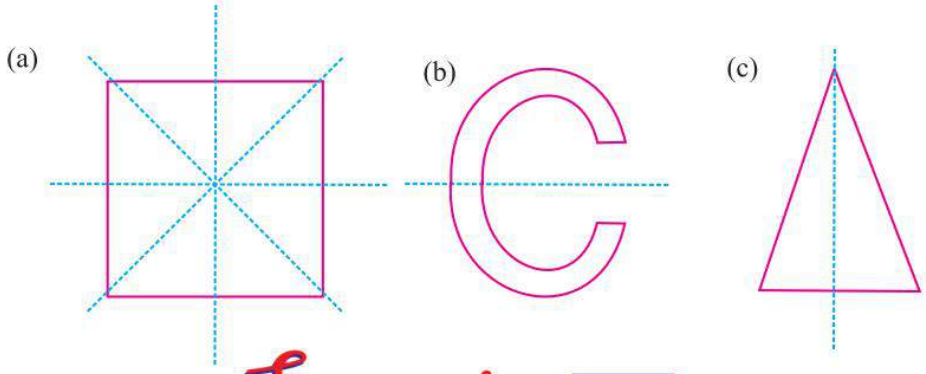
(b)



(c)

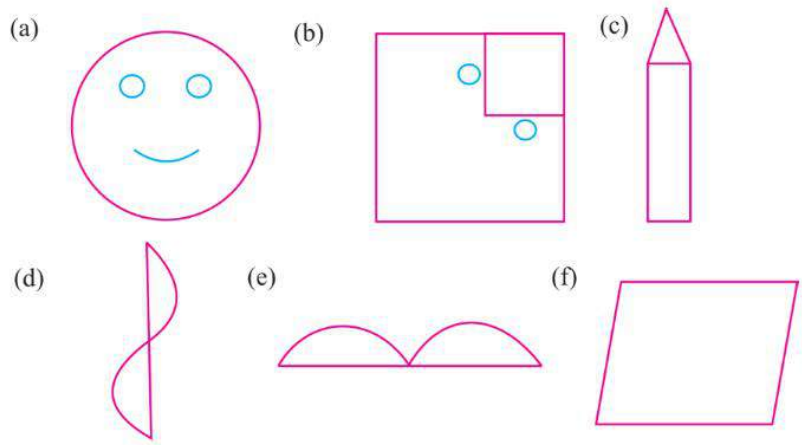


Sol.



Exercise 13.1

1. Classify the figure as symmetrical or non-symmetrical. Also draw the line/ lines of symmetry (if any).



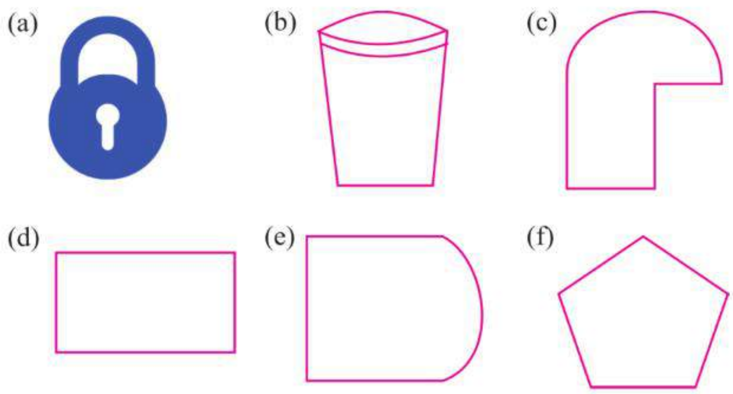
2. Which Capital letter of english alphabet have:

(i) No line of symmetry.

(ii) 1 line of symmetry.

(iii) 2 lines of symmetry.

3. Find the numbers of line/ lines of symmetry for the following :



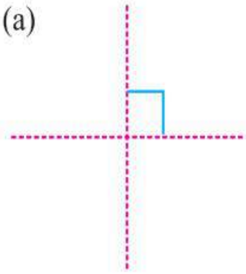
4. Draw the line (s) of symmetry in the following figures:

(a) Rhombus (b) Scalene Triangle (c) Parallelogram

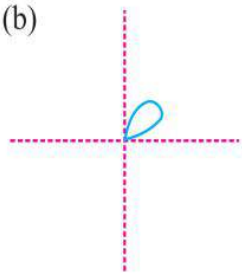
(d) Rectangle (e) Square (f) Regular Pentagon

5. Complete each of the figure using both lines of symmetry:

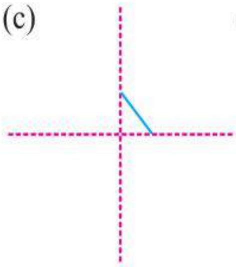
(a)



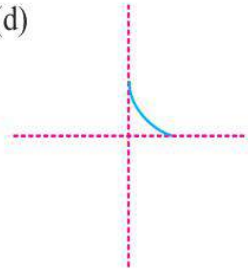
(b)



(c)



(d)



6. Draw a triangle which has:

(i) No line of symmetry

(ii) Exactly one line of symmetry

(iii) Exactly three lines of symmetry.

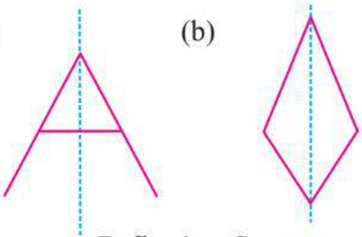
7. List any three symmetrical objects from your day-to-day life.

13.4 Reflection Symmetry

In figures with line of symmetry, the two identical parts are mirror images of each other. If a mirror is placed on the line of symmetry, then the image of one half of the figure/objects will fall exactly on the other half. Then, this line becomes the mirror line.

Look at the adjoining figures. We consider the dotted line to be a mirror, and each part is a **mirror image** of the other. Here, the mirror line act as a line of symmetry and the object along with its image form a symmetrical shape.

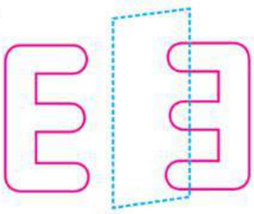
(a) (b)



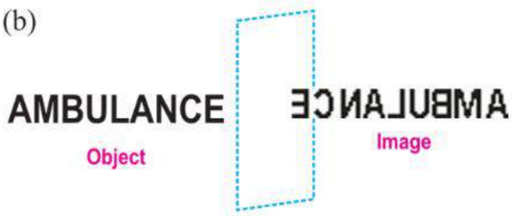
Reflection Symmetry

In reflection symmetry, one part is the object and the other part is the image and they are at an equal distance from the mirror line (line of symmetry).

(a)

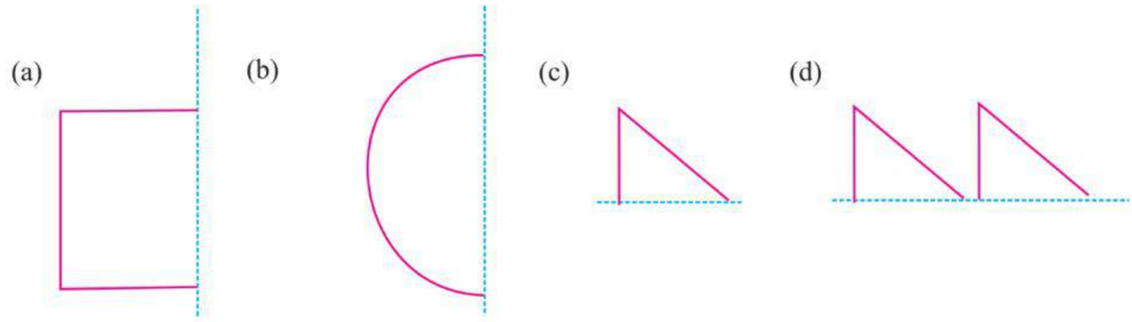


(b)

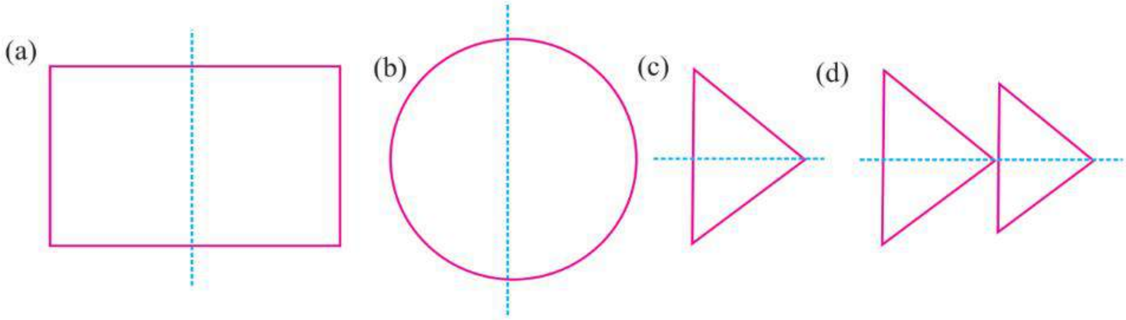


Mirror images of some Figures

Example 3: Reflect each of the given figures in the dotted line (mirror line) and draw the image:-



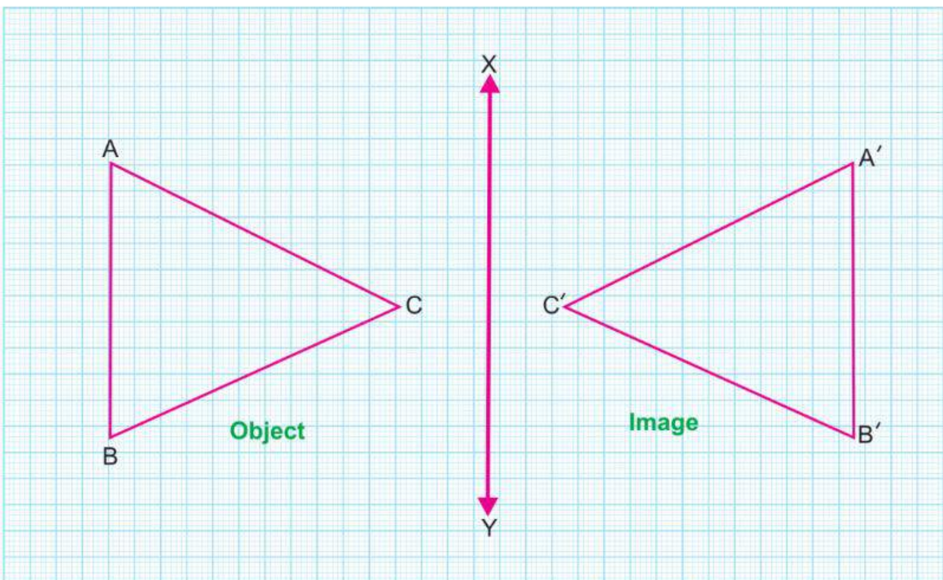
Sol. The reflections of the given figures are as follows:-



* To Draw the reflection of a figure using a graph paper

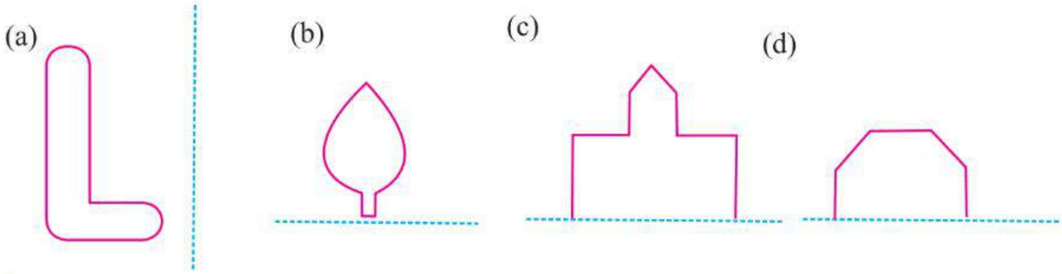
We can draw reflection of a figure using a graph paper.

Take a graph paper. Draw a triangle ΔABC. Then, draw its reflection ΔA´B´C´, where A and A´, B and B´, C and C´ are equidistant from the line of symmetry.

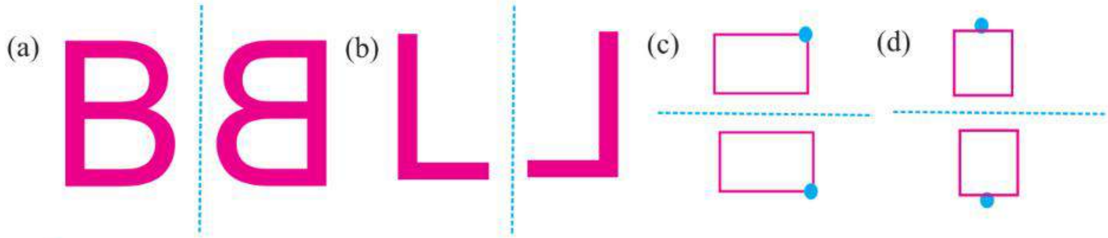


Exercise 13.2

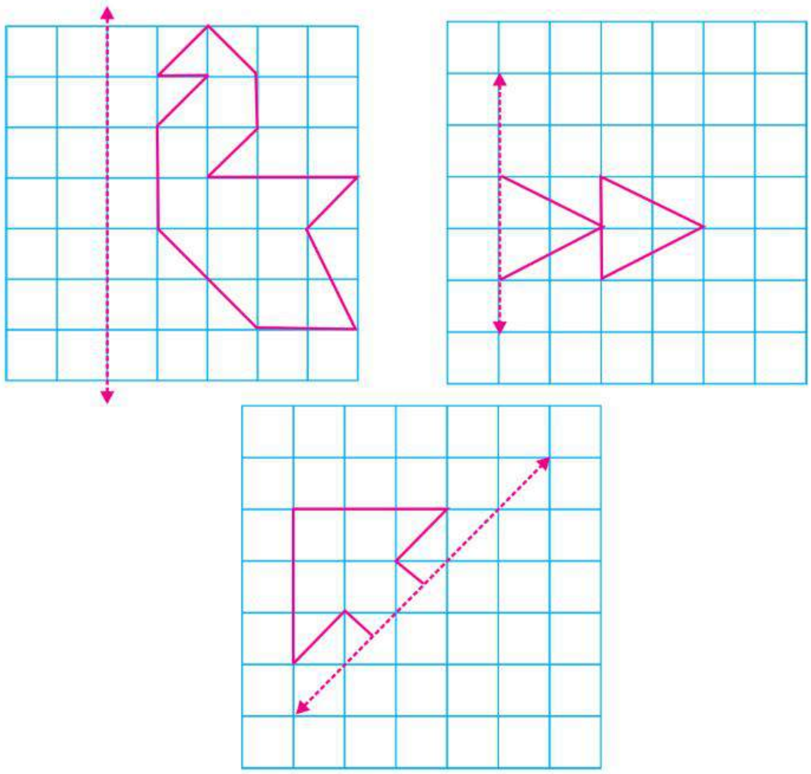
1. Draw the reflection of following figures along the dotted line :-



2. Write 'yes' for right reflection and 'no' for wrong reflection:-



3. Trace the figures on the graph paper and draw the reflections. The dotted line is the line of symmetry:-



* Key Points

- A line of symmetry divides a figure into two equal parts.
- If two parts of an object or a figure are identical then it is said to be symmetrical.
- A symmetrical figure can have more than one line of symmetry.
- A regular polygon has as many lines of symmetry as the number of sides and vertices.
- A line of symmetry is very closely related to reflection symmetry.

Multiple Choice Questions

1. An equilateral triangle has .... lines of symmetry.

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

2. A rectangle has .... lines of symmetry

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

3. A square has .... lines of symmetry.

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

4. An isosceles triangle has .... line (s) of symmetry.

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

5. A circle has .... lines of symmetry.

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

6. A rhombus has .... lines of symmetry.

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

7. A regular hexagon has .... lines of symmetry.

(a) 3 (b) 2 (c) 6 (d) 5

8. The mirror reflection of name ARUN is

(a) NUSA (b) ИUЯA (c) NURA (d) ARUN

Learning Outcomes

After completion of this chapter the students are now able to

- Recognise the symmetrical figures.
- Draw symmetrical lines of different shapes.
- Recognise the symmetrical designs in daily life.
- To know about reflection of mirror images.

ANSWER KEY

Exercise 13.1

1. (a) Symmetric (b) Symmetric (c) Symmetric

(d) Non-Symmetric (e) Symmetric (f) Non-Symmetric

2. (i) F, G, J, L, N, P, Q, R, S, Z

(ii) A, B, C, D, E, K, M, T, U, V, W, Y

(iii) O, X, H, I

3. (a) 1 (b) 1 (c) 0 (d) 2 (e) 1

(f) 1

Exercise 13.2

2. (a) Yes (b) Yes (c) Yes (d) Yes

Multiple Choice Questions

(1) b **(2)** a **(3)** d **(4)** a **(5)** d **(6)** b **(7)** c **(8)** b

P5J3U7

14

DATA HANDLING

Objectives

In this chapter you will learn

- To collect and arrange the data.
- To represent the data in pictograph.
- To interpret the pictograph and bar graph.
- To Use the graphs in daily life situation.

14.1 Introduction

In our daily life, we come across many situations when decisions have to be made based on the data. Our decisions are based on the collection, organisation, analysis and interpretation of the facts gathered.

You must have observed that your teacher records the attendance of students in your class everyday or records marks obtained by you after every test or examination.

14.2 Collection of Data

The initial step of any investigation is the collection of data. It may be collection of numbers, figures, facts or symbols. So the collection of facts gathered in the form of numerical values is called **data** which gives meaningful information. There are two types of data.

Primary Data : The data collected directly from the source is called the primary data. For Example attendance recorded by your teacher is primary data.

Secondary Data : When the data is collected from an external source is called secondary data . For Example the data collected from newspapers, magazines, internet etc. is secondary data.

Let us consider an example.

A teacher collects the data of the choice of the sweets of 25 students of class 6th which is as follows:

Ladoo, Barfi, Ladoo, Jalebi, Rasgulla, Ladoo, Jalebi, Jalebi, Ladoo, Barfi, Rasgulla, Rasgulla, Barfi, Jalebi, Ladoo, Ladoo, Barfi, Barfi, Jalebi, Rasgulla, Rasgulla, Barfi, Ladoo, Jalebi, Jalebi

The teacher wants to know the number of students who like different sweets. He starts counting one by one. This process is very time consuming and he has to repeat the same for every sweet. If there are 100 students then it becomes difficult. To make this process easy we organise the data in different ways.

14.3 Organisation of Data

Organisation of data helps in bringing out meaningful conclusion from the data. To make the above data meaningful, we have to arrange the data in a tabular form.

When the number of observations is larger, then to minimise the number of errors and to make tabulation easier, we can use **tally marks.**

Tally marks are always recorded in the bunches of five. Fifth tally mark is drawn diagonally across the first four to make a group of five i.e. 1 = |, 2 = || 3 = |||, 4 = ||||, 5 = ~~||||~~, 6 = ~~||||~~| so on.

Sweet name	Tally marks	Number of Students
Ladoo	~~||||~~ ||	7
Barfi	~~||||~~		6
Jalebi	~~||||~~ ||	7
Rasgulla	~~||||~~	5

This is the better way to understand and analyse the data.

Let's consider some examples.

Example 1: **In a Mathematics Test, the following marks were obtained by 40 students. Arrange these marks in a table using tally marks.**

8	1	3	7	6	5	5	4	4	2
4	9	5	3	7	1	6	5	2	7
7	3	8	4	2	8	9	5	8	6
7	4	5	6	9	6	4	4	6	6

(i) Find how many students obtained marks equal to or more than 7?

(ii) How many students obtained marks below 4?

Solution :

Marks	Tally Marks	Number of Students
1				2
2					3
3					3
4	~~||||~~ ||	7
5	~~				~~		6
6	~~||||~~ ||	7
7	~~||||~~	5
8						4
9					3

(i) Number of students obtained marks equal to or more than $7 = 5 + 4 + 3 = 12$

(ii) Number of students obtained marks below $4 = 2 + 3 + 3 = 8$

Exercise 14.1

1. The heights (in cm) of students of a class 6th were recorded as below:

116, 117, 125, 116, 118, 120, 125, 121, 124, 117, 116, 115, 119, 121, 124, 117, 116, 119, 123, 120, 116, 121, 119, 116, 118, 125, 116, 119, 123, 122, 121, 120

Arrange the data in a tabular form using tally marks.

2. The weight of 25 students (in kg) are given below:

25, 34, 32, 28, 25, 28, 34, 32, 32, 34, 32, 25, 28, 34, 34, 28, 28, 25, 32, 33, 32, 34, 33, 32, 25

Arrange the data in a tabular form using tally marks.

3. Ekta is asked to collect data for size of shoes of students in her class 6th. Her finding are recorded in the manner shown below:

5	4	7	5	6	7	6	5	6	6	5
4	5	6	8	7	4	6	5	6	4	6
5	7	6	7	5	7	6	4	8	7	

Arrange the data in a tabular form using tally marks.

4. Shweta threw a dice 40 times and noted the number appearing each time as shown below:

1	3	5	6	6	3	5	4	1	6
2	5	3	4	6	1	5	5	6	1
1	2	2	3	5	2	4	5	5	6
5	1	6	2	3	5	2	4	1	5

Make a table and enter the data using tally marks. Find the number that appeared :

(i) The minimum number of times.

(ii) The maximum number of times.

5. The students of class 6th had a Maths test and scored marks out of 10, which are listed below:

3	7	6	2	5	9	10	8	7	1
8	4	3	5	6	7	8	7	6	5
3	6	9	8	7	5	9	6	7	8

(i) Organise the data using tally marks.

(ii) How many students scored less than or equal to 6?

(iii) How many students scored more than 7?

14.4 Representation of Data

There are many ways to represent numerical data. Such as pictographs, bar graphs etc. These graphs help us in the suitable representation of the data.

14.4.1 Pictograph

A pictograph is a way of representing data using pictures or symbols to match the frequencies of different information or events. The picture visually helps to understand and analyse the data.

Example 1: **The following pictograph shows the number of absentees in a class of 21 students during the first week of April 2018.**

 = 1 absentee

Days **Number of Absentees**

Monday

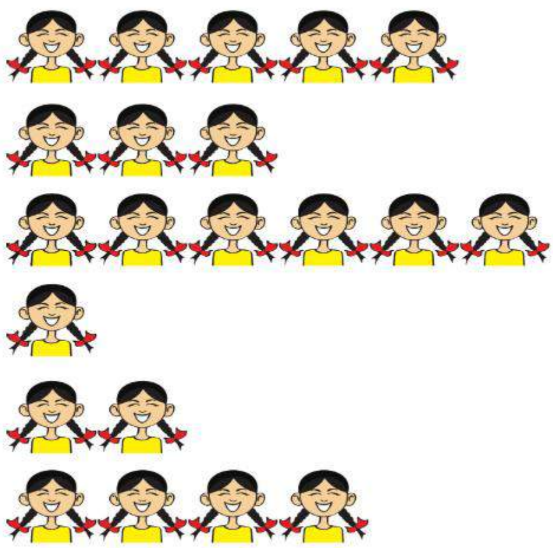
Tuesday

Wednesday

Thursday

Friday

Saturday



(i) **On which day were the maximum number of students absent?**

(ii) **What was the total number of absentees in that week?**

(iii) **On which day were the minimum number of students absent?**

Solution : (i) There are 6 pictures against Wednesday. Thus, maximum number of students were absent on Wednesday.

(ii) There are 21 pictures in all, so the total number of absentees in that week was 21.

(iii) There is 1 picture against Thursday. Thus, minimum number of students were absent on Thursday.

Example 2. **Total number of dogs in five villages are as follows:**

Village A : 30 **Village D = 40**

Village B : 20 **Village E = 60**

Village C : 50

Prepare a pictograph of these animals using one symbol ( = 10 dogs) and answer the following.

Questions:

(i) How many symbols are used to represent dogs of village E?

(ii) Which village has maximum number of dogs?

Solution : Taking the scale (as given), we may draw the pictograph as shown below:

Village | **Number of Dogs**  = 10 dogs

A 

B 

C 

D 

E 

(i) There are 6 symbols for village E.

(ii) Village E has maximum number of dogs.

Example 3. **The following number of electric bulbs were purchased for a school in the first five months of a year.**

January - 30, **February - 25** **March - 40**

April - 15 **May - 35**

Represent the above information by pictograph.

Solution : Taking the scale  := 10 bulbs, we may draw the pictograph as shown below:

Months | **Number of Bulbs**  = 10 bulbs

January 

February 

March 

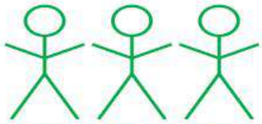
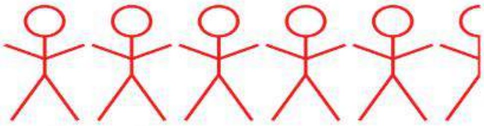
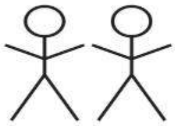
April 

May 

Exercise 14.2

1. The colour of refrigerators preferred by number of people living in a locality are shown by the following pictograph:

 = 10 people

Colours	**Number of People**
Blue	
Green	
Red	
Black	

(i) Find the number of people preferring blue colour?

(ii) How many people liked red colour?'

2. A survey was carried out on 30 students of class VI in a school. Data about different modes of transport used by them to travel to school was displayed through pictograph.

 = 1 student

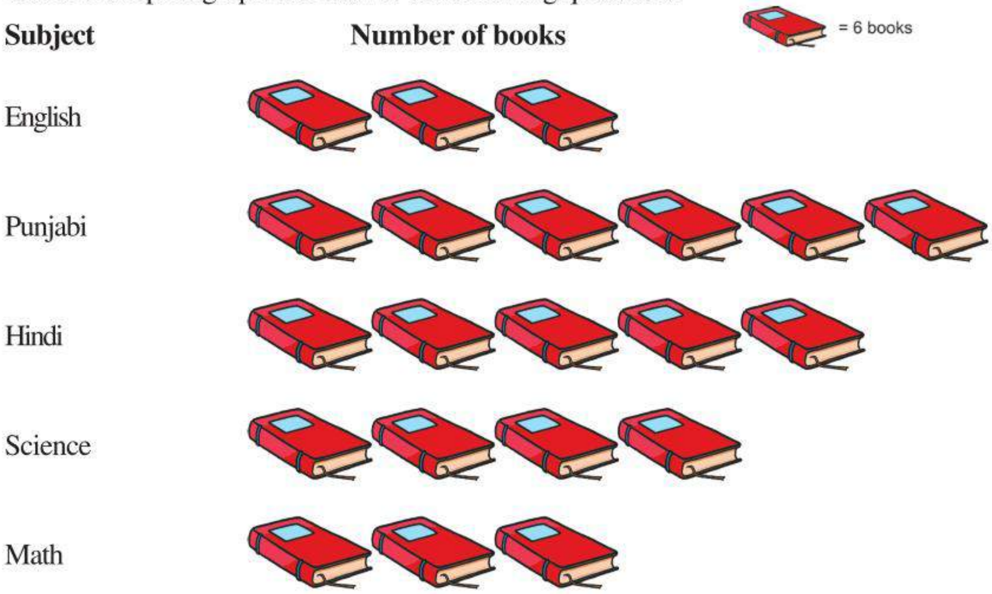
Mode of Travelling	**Number of Students**
Private car	
Public Bus	
School Bus	
Cycle	
Walking	

Observe this pictograph and answer these questions?

(i) How many students come on foot?

(ii) By which mode of transport, less students come?

3. Following is the pictograph showing books on different subjects kept in school library. Observe the pictograph and answer the following questions:



(i) How many math books are there in the library?

(ii) Which books are minimum in number?

(iii) Which books are maximum in number?

4. The number of desks in rooms of classes VI to X are given below:

Class	VI	VII	VIII	IX	X
No. of desks	30	50	40	35	45

Draw the pictograph by using any suitable scale.

5. In the half yearly examination, the marks scored by a student in each subject out of 100 are given below:

Subject	English	Hindi	Maths	Science	Social Science
Marks scored	70	85	80	65	75

Draw a pictograph taking the scale in which one picture = 10 marks and answer the following questions:

(i) In which subject the maximum marks are obtained?

(ii) In which subject the student has to do more hard work?

(iii) What is the difference between the maximum and minimum marks?

Read the following information and choose the correct answer for given questions:

6. The marks received by Harjeet in different subjects are as follows:

Subjects	Punjabi	English	Hindi	Math	Science
Marks	43	40	45	48	37

(i) In which subject, Harjeet scored maximum?

(a) Science (b) Hindi (c) Math (d) Punjabi

(ii) In which subject, Harjeet scored minimum?

(a) Science (b) Hindi (c) Math (d) Punjabi

(iii) How many marks he scored in Math?

(a) 40 (b) 45 (c) 48 (d) 48

(iv) How many marks he scored in English?

(a) 40 (b) 45 (c) 48 (d) 43

(v) In how many subjects, he scored more than 45?

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

7. The number of books sold by a shopkeeper on the different days are shown below:

Days	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of books sold	250	280	190	175	220	300

(i) On which day, the sale is maximum?

(a) Saturday (b) Friday (c) Thursday (d) Wednesday

(ii) On which day, the sale is minimum?

(a) Saturday (b) Friday (c) Thursday (d) Wednesday

(iii) On Friday, how many books are sold?

(a) 280 (b) 220 (c) 175 (d) 300

(iv) On Tuesday, how many books are sold?

(a) 220 (b) 175 (c) 280 (d) 300

(v) How many books are sold on Saturday?

(a) 220 (b) 175 (c) 280 (d) 300

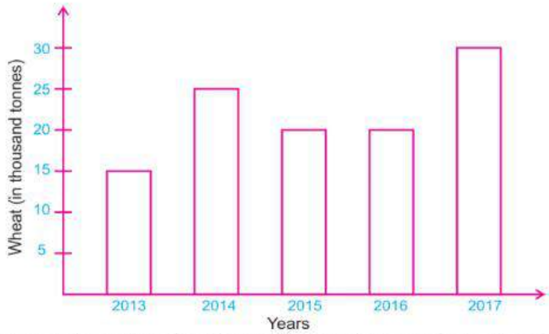
14.4.2 Bar Graph

We have observed that drawing pictograph is very time consuming. Interpretations of pictograph may differ from person to person while using half or quarter pictures as data may be any number like 4, 51, 87 etc. Pictograph of this type of data is quite difficult.

So, we use another method to represent the data visually in a simple manner called **Bar Graph.** Graphs communicate information quite effectively. You can see bar graphs in newspapers and magazines.

A bar graph is a chart with rectangular bars of equal width and lengths of bars are, proportional to the values that they represent. The bars can be horizontal or vertical with equal spacing between them.

Example 1: **The bar graph given below shows the amount of wheat purchased by government during the year 2013-17.**



Read the bar graph and write down your observation. In which year was

(i) The wheat production maximum?

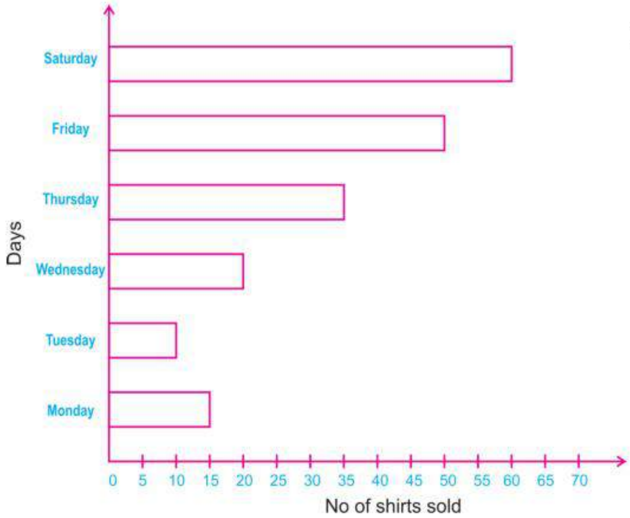
(ii) The wheat production minimum?

Solution : (i) It is observed that wheat production in year 2017 is maximum.

(ii) It is observed that wheat production in year 2013 is minimum.

Example 2: **Observe this bar graph which is showing the sale of shirts in a ready made shop from Monday to Saturday.**

1 unit length = 5 shirts



Now answer the following questions:

(i) What information does the above bar graph provide?

(ii) What is the scale chosen on the horizontal line representing number of shirts?

(iii) On which day were the maximum number of shirts sold? How many shirts were sold on that day?

(iv) On which day were the minimum number of shirts sold?

(v) How many shirts were sold on thursday?

Solution : (i) The above bar graph represent the sale of shirts on different days.

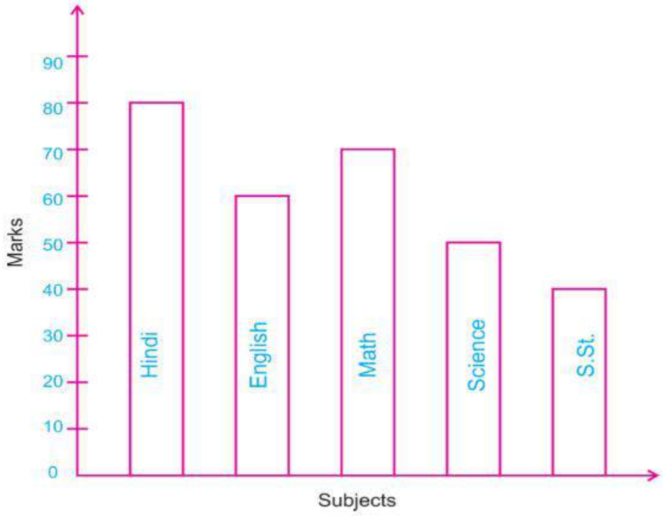
(ii) 1 unit length = 5 shirts

(iii) The maximum number of shirts sold on Saturday. There are $60 \times 5 = 300$ shirts sold on Saturday.

(iv) The minimum number of shirts sold on Tuesday.

(v) $30 \times 5 = 150$ shirts sold on Thursday.

Example 3: **Observe this Bar Graph which shows the marks obtained by Aniza in half yearly exam in different subjects.**



Answer the following questions:

(i) What information does the Bar graph give?

(ii) State the name of subjects and marks obtained in each of them?

(iii) Name the subject in which Aniza scored maximum marks?

(iv) Name the subject in which she scored minimum marks?

Solution : (i) The bar graph gives information of marks obtained by Aniza in different subjects.

(ii) Hindi = 80, English = 60, Maths = 70, Science = 50, S.St = 40

(iii) She has scored maximum marks in Hindi.

(iv) She has scored minimum marks in S.St.

Construction of a Bar Graph

To draw a bar graph, we draw two mutually perpendicular lines on a plane paper. The horizontal line is called **x-axis** and the vertical line is called **y-axis**. If the rectangular bars are drawn on a horizontal line (x–axis), the scale of heights of bars is shown along the y-axis or vice-versa.

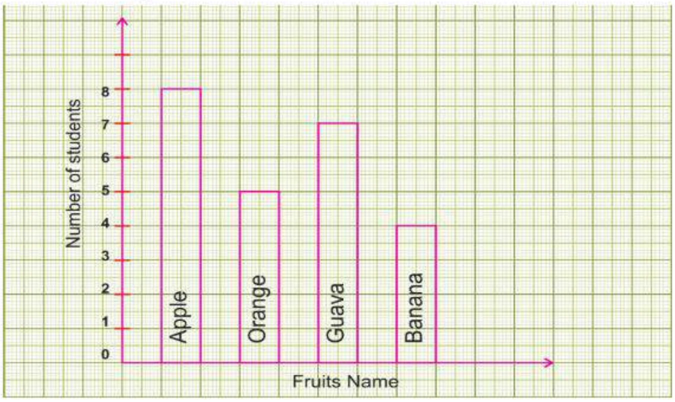
For drawing bar graphs, the following points should be kept in mind:

- The width of the bar should be uniform throughout.
- The gap/space between the bars should be uniform throughout.
- Bars may be horizontal or vertical.
- Choose a suitable scale for determining the height of bars.

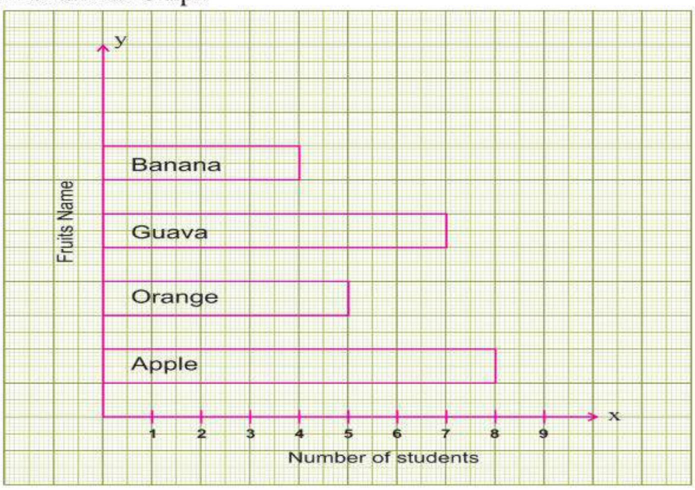
Example 4 : **The following table gives the information of choice of fruits of class 6th students. Draw a bar graph for this data.**

Fruit	Apple	Orange	Guava	Banana
No. of students	8	5	7	4

Solution : Vertical Bar Graph



Horizental Bar Graph



Note :- Students can draw any type of Bar Graph as their Choice

It is observed that above information represented through a vertical bar graph (Graph 1)

It can also be represented through a horizontal bar graph (Graph 2)

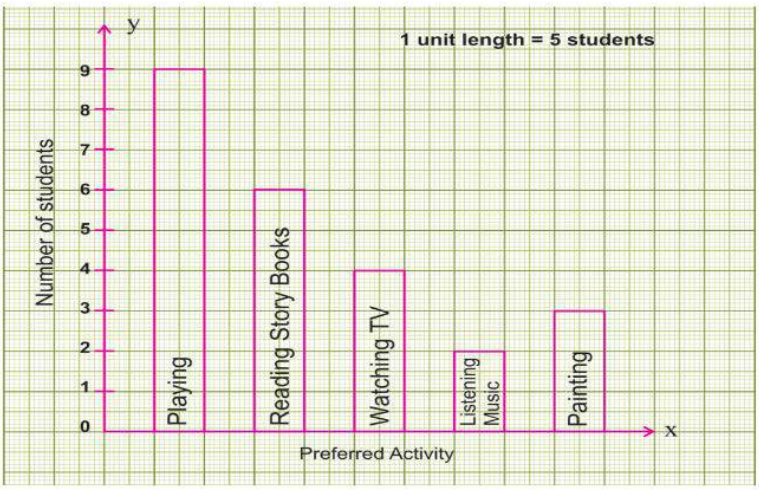
Usually we draw vertical Bar graph.

Example 5 : **A survey of 120 school students was done to find the activity they prefer to do in their free time.**

Preferred activity	Number of Students
Playing	45
Reading story books	30
Watching TV	20
Listening Music	10
Painting	15

Draw a bar graph to illustrate the above data taking scale of 1 unit length = 5 students. Which activity is preferred by most of the students other than playing?

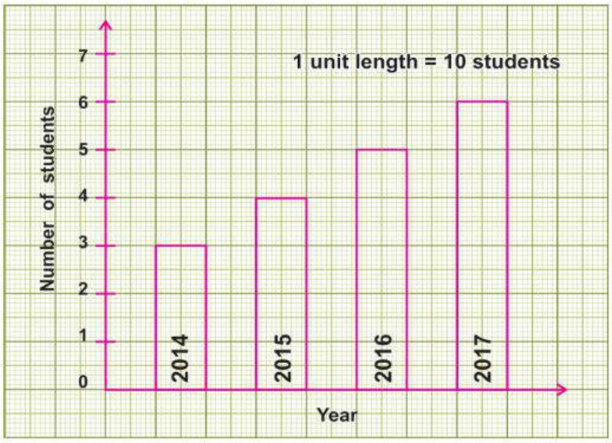
Solution :



- Reading story book is preffered most by the students other than playing.

Exercise 14.3

1. Read the adjoining bar graph showing the number of students in a particular class of a school:



Answer the following questions:

1. What is the scale of this graph?
2. How many students are there in 2016?
3. Is the number of students in the year 2017 twice the year 2014?

2. Read the bar graph and answer the following questions:

(i) What is the information given by the bar graph?

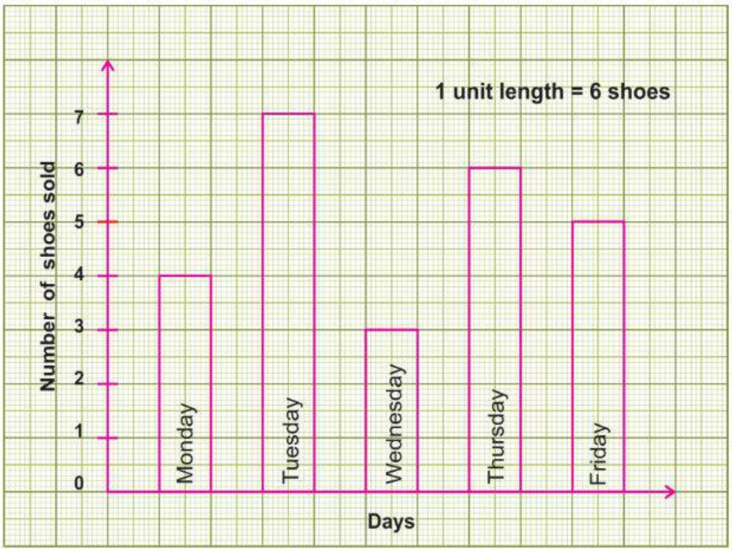
(ii) Which scale is used in this bar graph?

(iii) What is the maximum age? How many students have maximum age?

(iv) How many students have minimum age?

(v) How many students are 13 years old?

3. Read the given bar graph and answer the following questions:



(i) What information does the bar graph represent?

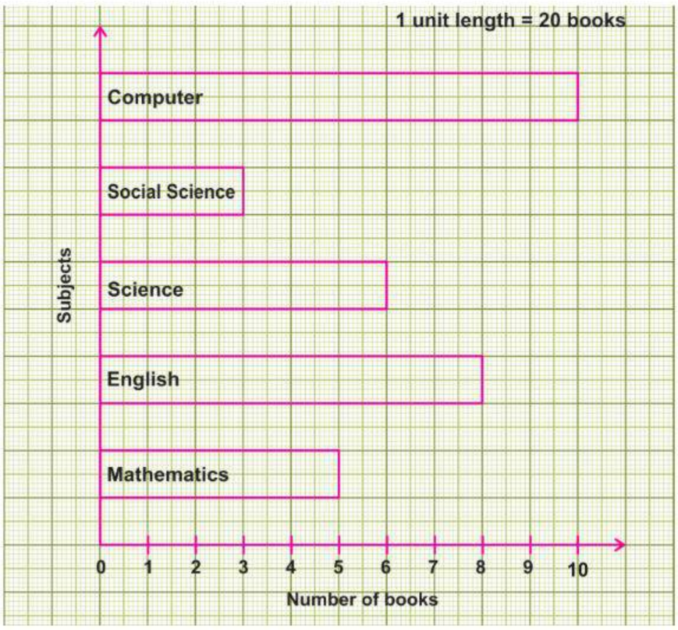
(ii) What is the scale chosen for this graph?

(iii) On which day were the maximum number of shoes sold and how many?

(iv) On which day were the minimum number of shoes sold and how many?

(v) How many shoes were sold on Thursday?

4. Read the bar grpah which shows the number of books of different subjects in a library:



Answer the following questions:

(i) What information does the bar graph gives?

(ii) What is the scale chosen for this graph?

(iii) Which subject has maximum number of books and how many?

(iv) Which subject has minimum number of books and how many?

5 : The number of Mathematics books sold by a shopkeeper on the different days are shown below:

Days	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Number of books sold	65	40	30	50	20	70

Draw a bar graph to represent the above information choosing the scale of your choice.

Multiple Choice Questions

1. If ☆ represents 10 flowers then how many flowers does ☆☆☆☆☆ represent?

(a) 30 (b) 40 (c) 50 (d) 5

2. If ☺ = 7 children then what does ☺ ☺ ☺ represent?

(a) 1 (b) 14 (c) 21 (d) 28

3. What is value of 卌 II

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

4. If □□□□ represents 400, then what does □□ stand for?

(a) 200 (b) 2000 (c) 20 (d) 2

5. .... represents data through picture of objects.

(a) Bar Graph (b) Histogram

(c) Pictograph (d) None of these

6. Which tally marks represents 14?

(a) 卌 IIII (b) 卌 卌 IIII

(c) N N IIII (d) IIII IIII IIII II

7. If ☆ represents 4 balls, No. of ☆ to be drawn to represents 40 balls.

(a) 5 (b) 10 (c) 12 (d) 160

8. .... is method of representing the data in uniform width size horizontal or vertical box with equal spacing.

(a) Histogram (b) Bar Graph

(c) Pictograph (d) Tally Marks

9. A .... is a collection of numbers gathered to give some information.

(a) Frequency (b) Data

(c) Tally mark (d) None of these

10. If on a scale 1 unit = 200 then how much quantity does 5 units will represent?

(a) 100 (b) 1000 (c) 300 (d) 600

Learning Outcomes

After completion of this chapter the students are now able to

(i) Collect and arrange the different type of data.

(ii) Represent the data in pictograph and bar graph.

(iii) Interpret the pictograph & bar graph.

(iv) Use the graphs in daily life situation.

ANSWER KEY

Exercise 14.1

1.

Height (in cm)	Tally marks	Frequency
115	I	1
116	卌 II	7
117	III	3
118	II	2
119	IIII	4
120	III	3
121	IIII	4
122	I	1
123	II	2
124	II	2
125	III	3

2.

Weight (in kg)	Tally marks	Frequency
25	卌	5
28	卌	5
32	卌 II	7
33	II	2
34	卌 II	6

3.

Size of shoes	Tally Marks	Frequency
4	𝍸	5
5	𝍸 𝍷𝍷𝍷	8
6	𝍸 𝍸	10
7	𝍸 𝍷𝍷	7
8	𝍷𝍷	2

4.

Number of dice	Tally marks	Frequency
1	𝍸 𝍷𝍷	7
2	𝍸 𝍷	6
3	𝍸	5
4	𝍷𝍷𝍷𝍷	4
5	𝍸 𝍸 𝍷	11
6	𝍸 𝍷𝍷	7

(i) 4 (ii) 5

5. (i)

Marks	Tally Marks	Frequency
1	𝍷	1
2	𝍷	1
3	𝍷𝍷𝍷	3
4	𝍷	1
5	𝍷𝍷𝍷𝍷	4
6	𝍸	5
7	𝍸 𝍷	6
8	𝍸	5
9	𝍷𝍷𝍷	3
10	𝍷	1

(ii) 15 (iii) 9

Exercise 14.2

1. (i) 50 (ii) 55
2. (i) 9 (ii) Private car
3. (i) 18 (ii) Math and English (iii) Punjabi
5. (i) Hindi (ii) Science (iii) 20
6. (i) c (ii) a (iii) c (iv) a (v) d
7. (i) a (ii) c (iii) b (iv) c (v) d

Exercise 14.3

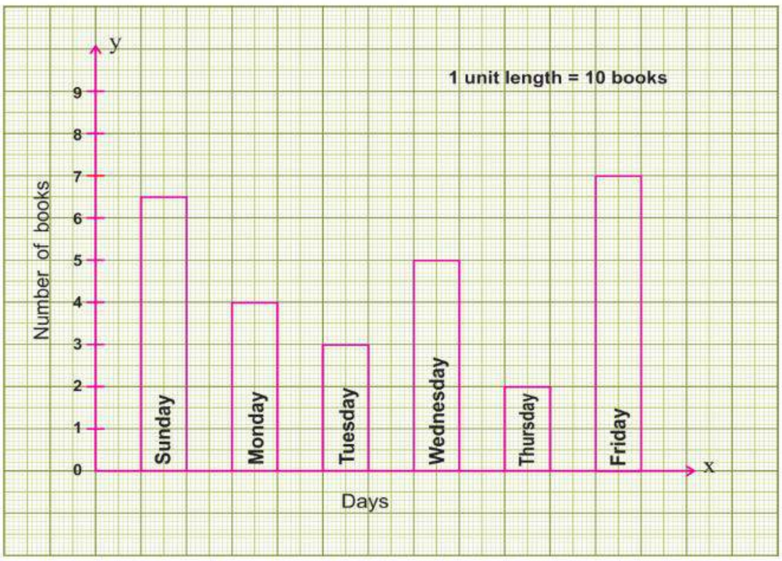
1. (i) 1 unit = 10 students (ii) 50 (iii) Yes

2. (i) Age of different students (ii) 1 unit = 4 students
   (iii) 15, 24 students (iv) 16 (v) 28

3. (i) Number of shoes sold in different days.
   (ii) 1 unit = 6 shoes sold (iii) Tuesday, 42 shoes
   (iv) Wednesday, 18 shoes (v) 36 shoes

4. (i) Number of books of different subjects in the library.
   (ii) 1 unit = 20 books (iii) Computer, 200 books
   (iv) Social Science, 60 books

5.



Multiple Choice Questions

1. (c)	2. (c)	3. (b)	4. (a)	5. (c)
6. (b)	7. (b)	8. (b)	9. (b)	10. (b)