# SELF-LEARNING MATERIALS IN MATHEMATICS

(PAC PROGRAMME FOR UPPER PRIMARY LEVEL OF KERALA STATE)

## STANDARD VII


ACADEMIC COORDINATOR

MR. B. C. BASTI

CO-COORDINATOR

DR. B.S. UPADHYAYA



REGIONAL INSTITUTE OF EDUCATION
(NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING, NEW DELHI)
MYSORE-570 006

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# FOREWORD

*Regional Institute of Education, Mysore, conducted PAC Programme titled, "Development of Self-Learning Materials for the Upper Primary Schools of Kerala State" during 15th to 19th January 2001 and 26th February to 1st March 2001. As many as 17 primary teachers of Kerala state participated in the development of self-learning materials in Mathematics for VI and VII standard classes of Kerala State under the supervision of RIE Maths faculty and five resource persons from outside RIE. Mr. B.C. Basti was the Programme Coordinator. It is an innovative activity with its beginning in RIE, Mysore.*

*The material includes number of illustrations and examples covering fundamental concepts. I place on record my appreciation for the team and Mr. B.C. Basti, the Programme Coordinator, for having brought out useful addition to the existing material in Mathematics. It is sincerely hoped that the material will find maximum utilisation.*

**30th March 2001**

**PROF. G. RAVINDRA**
Principal, RIE, Mysore

# PREFACE

*The PAC Programme titled, "The Development of Self-Learning Materials for the Upper Primary Schools of Kerala State" was organised at RIE, Mysore, in two phases.*

*In the first phase from 15th to 19th January 2001, the topics for developing self-learning materials were identified and then the self-learning materials were also developed. In this programme the materials were developed by 17 primary teachers of Kerala state under the guidance and supervision of 5 resource persons and RIE Maths Faculty.*

*In the second phase from 26th February to 1st March 2001, all the 5 resource persons who participated in the first phase finalised the already developed self-learning materials.*

*I thank Principal, RIE, Mysore and Department of Extension Education, RIE, Mysore, for their cooperation in the work.*

**30th March 2001**

**B.C. BASTI**
Programme Coordinator
Sr. Lecturer in Maths
DESM, RIE, Mysore

# LIST OF RESOURCE PERSONS

1. K.S. Viswanathan
   Selection Grade Lecturer
   N.S.S. Training College
   Otteppelem
   Kerala State

2. Dr. T.S. Kumara Swamy
   1063/50 'A' Nandi
   II Main, 7th Cross
   Vidyaranyapuram
   Mysore-570 008

3. M.V. Gopala Krishna
   Retired Lecturer
   1047/21, 2nd Main, 6th Cross
   Vidyaranyapuram
   Mysore-570 008

4. Dr. S. Nirmala Devi
   Selection Grade Lecturer
   Farook Training College
   Farook College PO
   Kozhikode
   Kerala State

5. N.B. Badrinarayan
   28, 17th Cross, 2nd Main
   Jayanagar
   Mysore-570 014

Prof. G. Ravindra

Prof. N.M. Rao

Prof. D. Basavayya

Dr. B.S.P. Raju

Dr. B.S. Upadhyaya

Mr. B.C. Basti

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# CHAPTER I

# EXPONENTS

## 1. Introduction

In daily life and in particular while studying science, we come across very big and very small (almost equal to zero) numbers. Distance of the sun from us (on earth) is 148000000 kms and sun is the nearest star. In the case of several stars, light takes several years to reach the earth eventhough light travels with extremely great speed. The weight of an atom of lead is believed to be 0.000,000,000,000,000,000,000,336 of a gram. Writing such numbers this way (showing all the digits) is very difficult since it takes lot of time and space (of the paper). Therefore we want an easy way of writing such numbers. This is possible by writing numbers in what is called an Exponential form.

### History of exponents

It is said the actual form appeared first in ReneDescartes LaGeometrie (1637) eventhough exponent was used in the early $14^{th}$ century. The first mathematician, it is believed, to explain fully the significance of negative and fractional exponent was John Wallis (1655), his work being supplemented by Sir Issac Newton later (after 1669).

## 2. Concepts/Notation/Terminology and Rules

a. When a number a is multiplied by itself many times the product so got can be expressed in a short form called the exponential form.

b. The number so got is called a power of a.

c. The number of times a appears (as a factor) in the power of a is called the exponent or index of a.

d. a is called the base.

e. Notation (symbolic form)

$a^n$ = axaxax... n times

Accordingly, n is the exponent, a is the base and $a^n$ is the nth power of a.

f. $a^m \times a^n = a^{m+n}$ (m, n being positive integers)

g. $\frac{a^m}{a^n} = a^{m-n}$ (m, n being positive integers, m > n)

## 3. Examples/Verification of Results/Problem Solving

### (i) Examples

(a)

| Ex.No. | Multiplicative form | Value | Exponential form | Base | Exponent |
|---|---|---|---|---|---|
| (i) | 2x2 | 4 | $2^2$ | 2 | 2 |
| (ii) | 2x2x2 | 8 | $2^3$ | 2 | 3 |
| (iii) | 3x3x3x3 | 81 | $3^4$ | 3 | 4 |
| (iv) | 5x5x5 | 125 | $5^3$ | 5 | 3 |
| (v) | 10x10 | 100 | $10^2$ | 10 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| (vi) | 8x8x8x8x8 | 32768 | $8^5$ | 8 | 5 |
| (vii) | 10x10x10x10 | 10000 | $10^4$ | 10 | 4 |

**(b) Powers of 10**

| Sl. No. | Number | | Exponential form | Observation |
|---|---|---|---|---|
| | In words | Numeral | | |
| 1 | Ten | 10 | $10^1$ | Number of zeros to the right of 1 in the numeral = the exponent in the exponential form of the number |
| 2 | Hundred | 100 | $10^2$ | |
| 3 | Thousand | 1,000 | $10^3$ | |
| 4 | Ten thousand | 10,000 | $10^4$ | |
| 5 | One lakh | 1,00,000 | $10^5$ | |
| 6 | One million (or ten lakh) | 10,00,000 | $10^6$ | |
| 7 | One crore | 1,00,00,000 | $10^7$ | |

**(c) Powers of 1**

$1 = 1^1 = 1$

$1x1 = 1^2 = 1$

$1x1x1 = 1^3 = 1$

$1x1x1x1 = 1^4 = 1$

$1x1x1x1x1 = 1^5 = 1$ etc.

From these facts we infer that every power of 1 is 1 itself

i.e. $1^n = 1$ for all n

**(d) Squares and cubes of numbers from 1 to 10**

| a | $a^2$ | $a^3$ |
|---|---|---|
| 1 | 1 | 1 |
| 2 | 4 | 8 |
| 3 | 9 | 27 |
| 4 | 16 | 64 |
| 5 | 25 | 125 |

| | | |
|---|---|---|
| 6 | 36 | 216 |
| 7 | 49 | 343 |
| 8 | 64 | 512 |
| 9 | 81 | 729 |
| 10 | 100 | 1000 |

(ii) Verification of (a) $a^m \times a^n = a^{m+n}$

(b) $\frac{a^m}{a^n} = a^{m-n}$

(a) $2x2x2x2 = 2^4$

$2x2x2 = 2^3$

$2^4 \times 2^3 = (2x2x2x2) \times (2x2x2)$

$= 2x2x2x2x2x2x2$

$= 2^7 = 2^{4+3}$

$2^4 \times 2^3 = 2^{4+3}$

More generally,

$a^4 = axaxaxa$

$a^6 = axaxaxaxaxa$

$a^4 \times a^6 = axaxaxaxaxaxaxaxa$

$= a^{10}$

Hence $a^4 \times a^6 = a^{4+6}$

In these, we have verified

$a^m \times a^n = a^{m+n}$, when m, n are positive integers.

Hence for positive integer exponents m, n

$a^m \times a^n = a^{m+n}$

(b) $3x3x3x3x3 = 3^5$

$$3x3x3 = 3^3$$

$$\therefore \frac{3x3x3x3x3}{3x3x3} = \frac{3^5}{3^3}$$

$$3x3 = \frac{3^5}{3^3} \text{ or } 3^2 = \frac{3^5}{3^3}$$

$$\text{or } \frac{3^5}{3^3} = 3^{5-3}$$

More generally,

$a^6 = axaxaxaxaxa$

$a^4 = axaxaxa$

$$\frac{a^6}{a^4} = \frac{axaxaxaxaxa}{axaxaxa} = a^2$$

$$\text{or } \frac{a^6}{a^4} = a^{6-4}$$

This verifies $\frac{a^m}{a^n} = a^{m-n}$, for positive integer exponents m, n where m > n.

## 4. Suggested Learning Activities - Problem Solving

(i) A square plate is divided into smaller squares of length a. Find the total area of the plate in terms of a as a part of square in each case below.

(a) The sides of the plate are bisected by parallels through mid points of opposite sides.

(b) The sides of the plate are bisected by parallels through points of bisection of opposite sides.

(c) The sides of the plate are divided into four equal parts by parallels to the sides through the points of division of opposite sides.

(ii) Each small square on a chess board is 1 sq.mt. Express the area of the chess board (a) as a perfect square, (b) as a perfect cube.

(iii) A cube is divided into smaller ones of equal size by parallel/ planes to the faces. If each side of the smaller cube is a, what is the volume of the smaller cube, the given cube, in terms of a ?

**Problem Solving**

1. A product in which each factor is 2, has 10 factors. Express it as a power of 2. Which number does it represent ?

Answer: 2x2x... 10 times = $2^{10}$ = 1024

2. Express 648 as product of powers of prime factors.

Solution: We divide 648 repeatedly by its factors 2 and 3.

Accordingly,

| | |
|---|---|
| 2 | 648 |
| 2 | 324 |
| 2 | 162 |
| 3 | 81 |
| 3 | 27 |
| 3 | 9 |
| | 3 |

$\therefore$ 648 = 2x2x2x3x3x3

$\therefore$ 648 = $2^3 \times 3^4$

3. Simplify: (a) $3^2 \times 3^4$ (b) $\frac{7^8}{7^6}$ (c) $\frac{a^3xb^2xb^3}{b^6xa^2}$

**Solution**: (a) $3^2 \times 3^4 = 3^{2+4} = 3^6$

(b) $7^8/7^6 = 7^{8-6} = 7^2$

(c) $\frac{a^3xb^2xb^3}{b^6xa^2} = \frac{a^3}{a^2} \times \frac{b^{2+3}}{b^6} = a^{3-2} \times \frac{1}{b^{6-5}} = \frac{a}{b}$

4. Simplify: (a) $\frac{x^4 \times x^{14}}{x^9} \times \frac{y^6 \times y}{y^4 \times y^5}$

(b) $\left(\frac{x^2y^3z^4}{x^4y^2z^3}\right)^2$

**Answer:**

(a) $\frac{x^4 \times x^{14}}{x^9} \times \frac{y^6 \times y}{y^4 \times y^5} = \frac{x^{4+14}}{x^9} \times \frac{y^{9+1}}{y^{4+5}} = x^{18-9} \times y^{10-9}$

$= x^9 y^1 = x^9 y$

(b) $\left(\frac{x^2y^3z^4}{x^4y^2z^3}\right)^2 = \left(\frac{x^2}{x^4} \times \frac{y^3}{y^2} \times \frac{z^4}{z^3}\right)^2 = \left(\frac{y^{3-2} \times z^{4-3}}{x^{4-2}}\right)^2$

$= \left(\frac{y^1 \times z^1}{x^2}\right)^2 = \frac{y^2z^2}{x^4}$

5. In the table below write down the products in the empty spaces provided, as illustrated.

| X | 2 | $2^3$ | $2^5$ | $2^4$ |
|---|---|---|---|---|
| $2^5$ | | $2^8$ | | |
| $2^6$ | | | | |
| $2^7$ | | | | |

eg: $2^5 \times 2^3 = 2^8$ and $2^8$ is written at the intersection of the second row and second column

6. Find n so that $2^n \times 2^5 = 2/2^n$

$$2^n \times 2^5 = \frac{2}{2^n} = \frac{2^1}{2^n}$$

$2^{n+5} = 2^{1-n}$ $\therefore n+5 = 1-n$

$\therefore 2n = -4$

$\therefore n = -2$

**Exercises for Self Learning**

1. Express as a power (in the exponential form)

(a) 2x2x...14 times (b) 10x10x... 10 times

(c) 7x7x... 100 times (d) 5x5x... 20 times

2. Express as the product of powers of prime factors.

(a) 576 (b) 392 (c) 4608 (d) 98,000

3. Match the equal numbers from A and B

| A | 4608 | 144 | 625 | 3969 | 30375 | 4000 |
|---|---|---|---|---|---|---|
| B | $5^4$ | $2^5x5^3$ | $3^4x7^2$ | $5^3x3^5$ | $2^4x3^2$ | $3^2x2^9$ |

4. The dimensions of a rectangular tank are 5m, 5m and 16m. Express (a) its volume in the exponential form. (b) the total surface area in terms of powers of prime factors.

5. Express the following in its simplified form:

(a) $\frac{2^4 \times 2^7}{2^8} \times \frac{4^2 \times 4^3}{4^4}$ (b) $\frac{2^5 \times 3^4}{9^2 \times 16}$

(c) $\frac{10^5 \times 10^{18}}{10^6 x 10^5 x 10^9}$ (d) $10x10^2x10^3x10^4$

(e) $(x^2)^3 \times x^{2^3}$

## Answers to Exercises

1. (a) $2^{14}$ (b) $10^{10}$ (c) $7^{100}$ (d) $5^{20}$

2. (a) $2^6 \times 3^2$ (b) $2^3 \times 7^2$ (c) $2^9 \times 3^2$ (d) $2^4 x 5^3 x 7^2$

3.

| A | 4608 | 144 | 625 | 3969 | 30,375 | 4000 |
|---|---|---|---|---|---|---|
| B | $2^9 x 3^2$ | $2^4 x 3^2$ | $5^4$ | $3^4 x 7^2$ | $5^3 x 3^5$ | $2^5 x 5^3$ |

4. (a) $(5^2 \times 2^4)$ cm (b) $(2 \times 5^2 + 2^6 \times 5)$ sqm

5. (a) 8 (b) 4 (c) 2 (d) $10^{10}$ (e) $x^{14}$

# CHAPTER II

# GEOMETRICAL CONSTRUCTIONS: TRIANGLES AND RECTANGLES

## Introduction

of the various geometrical shapes we see triangles and rectangles are important. The shapes of the lateral faces of pyramids (of Egypt) are triangular and the windows and doors of our houses or even the shapes of the floor in our rooms or schools are rectangle. In this chapter we study the methods of drawing triangles and rectangles of given measurements.

## Concepts

1. **A triangle** is a plane figure with three sides joining three points which are not in a straight line.
2. **The three sides** and the **three angles** (between adjacent sides) are the elements of the triangle. The angular points are the vertices of the triangle.
3. A four sided figure in which each angle is a right angle is a rectangle. In a rectangle we can identify (i) the four vertices, (ii) the four sides, (iii) the four angles and (iv) the two diagonals (got by joining opposite vertices).

**Pre-knowledge**: Use of instruments in geometrical constructions.

## Learning Activities

### 1. Copying a triangular shape

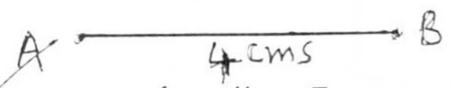
A cut-out in the shape of a triangle is given. Can it be copied on a sheet of paper ? Place the cut-out on a sheet of paper. Trace its edges using a pencil once around. The shape of the cut is got on the sheet.

### 2. Drawing a triangle of given measurements

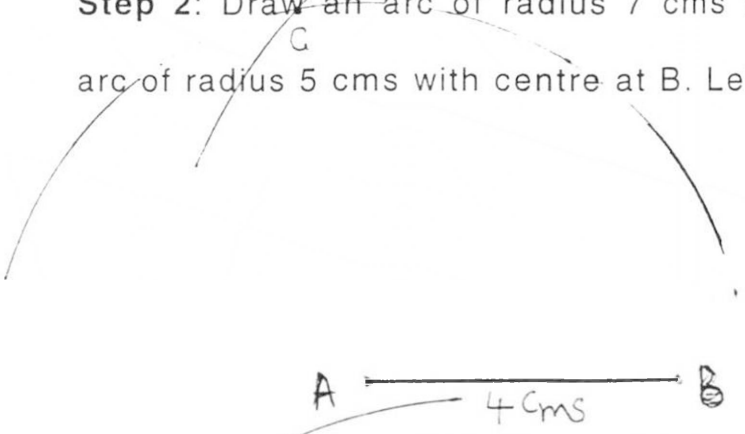
### (a) Given the measures of the sides

Construct the triangle ABC, given AB = 4 cms, BC = 5 cms and AC = 7 cms.

**Step 1**: Draw AB of length 4 cms



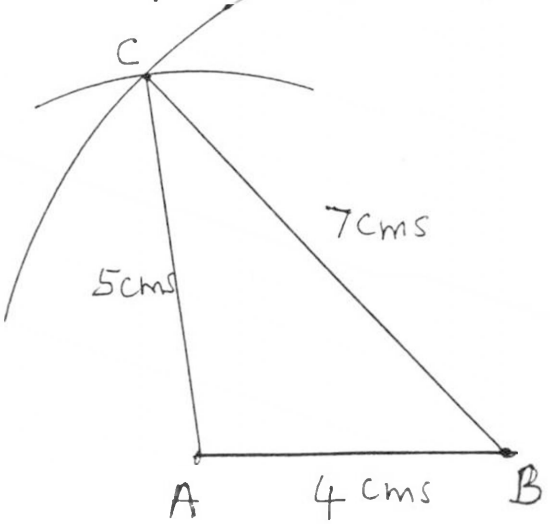

**Step 2**: Draw an arc of radius 7 cms with centre at A and another arc of radius 5 cms with centre at B. Let these arcs intersect at C.







**Step 3**: Join AC and BC. The $\Delta ABC$ is got.



**Caution**: The triangle cannot be constructed if the sum of lengths of any two sides is not greater than the length of the third side.

**For example**: The ΔABC cannot be constructed if

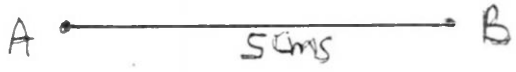
(i) AB = 4 cms, BC = 3 cms and AC = 7 cms

or if (ii) AB = 4 cms, BC = 3 cms and AC = 9 cms

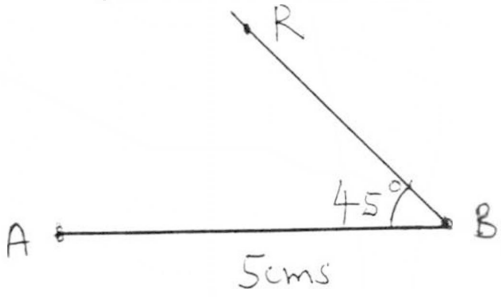
**(b) Given two sides and the angle between them**

Construct the ΔABC, given AB = 5 cms, BC = 6 cms and ∠ABC = 45°.

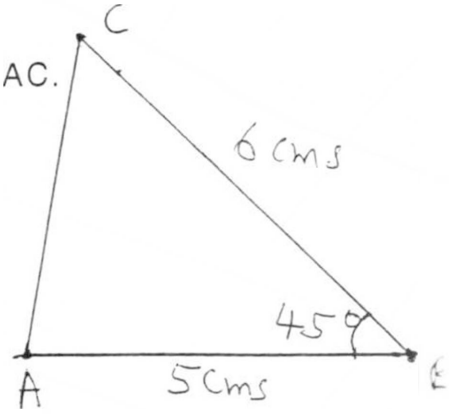
**Step 1**: Draw AB = 5 cms




**Step 2**: Construct an angle ∠ABR = 45° at B.



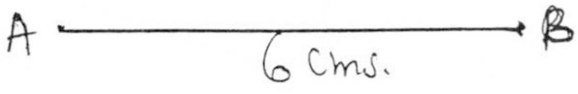

**Step 3**: Mark C on BR such that BC = 6 cms. Join AC.



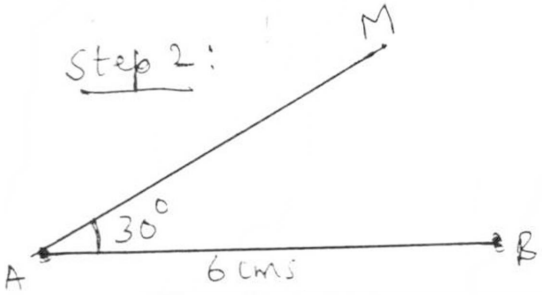

**(c) Given two angles and a side**

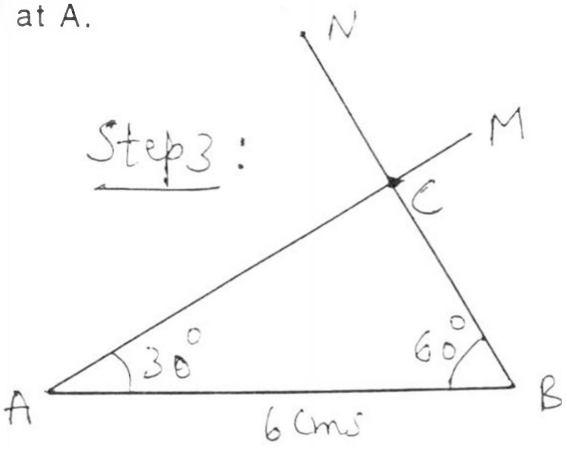
(i) Construct the ΔABC, given AB=6 cms, ∠BAC=30° and ∠ABC=60°.

**Step 1**: Draw AB = 6 cms.



**Step 2**: Construct an angle ∠BAM = 30° at A.




**Step 3**: Construct an angle ∠ABN = 60° at B.

Let AN and BM intersect at C. The ΔABC is got

(ii) Construct the ΔABC,given AB=6 cms, ∠BAC=40° and ∠ACB=60°.

In this construction, the angle at B must be found by using the fact A + B + C = 180°.

∴ 40° + B + 60° = 180° ∴ B = 80°

Therefore we are given

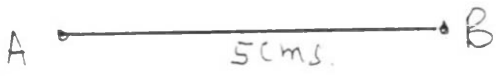
AB = 8 cms, A = 40° and B= 80°.

Now Δ can be constructed on the same lines as the previous one.

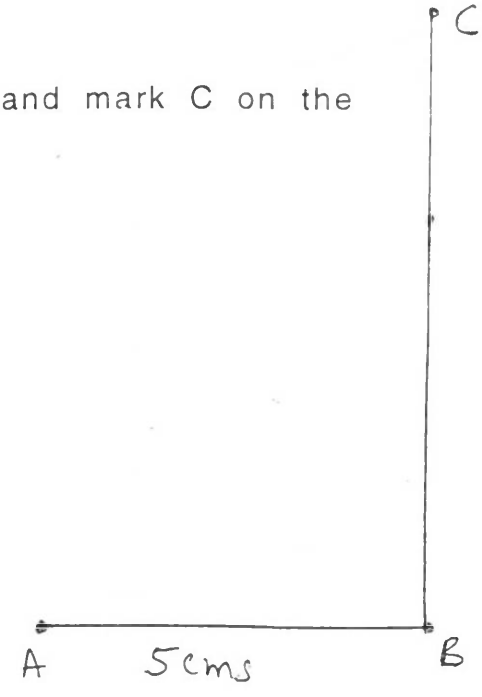
**3. Constructing a rectangle**

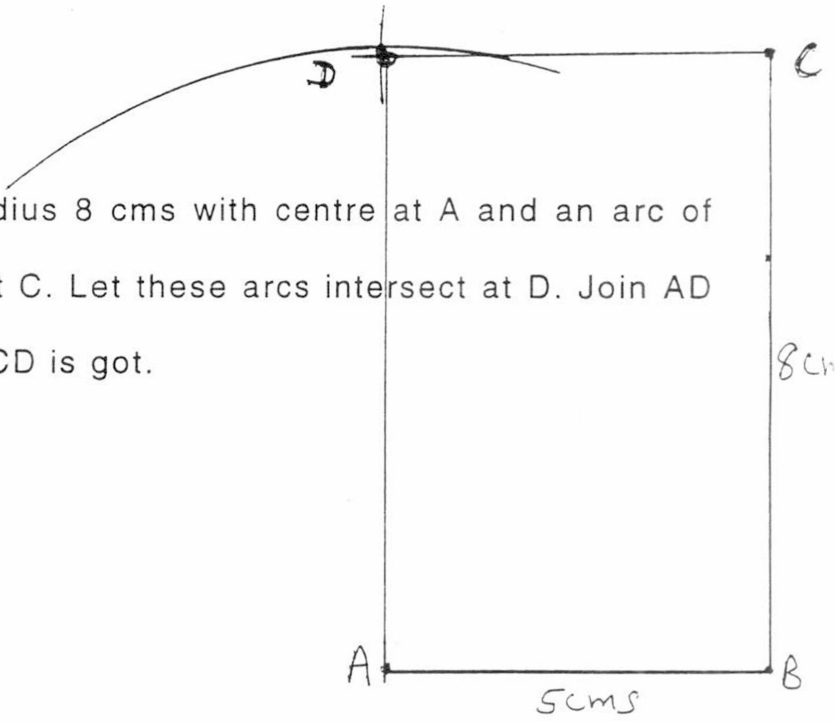
(i) Construct a rectangle ABCD given AB = 5 cms, BC = 8 cms.

**Step 1**: Draw AB = 5 cms




**Step 2**: Draw the perpendicular to AB at B and mark C on the perpendicular such that BC = 8 cms.






**Step 3**: Draw an arc of radius 8 cms with centre at A and an arc of radius 5 cms with centre at C. Let these arcs intersect at D. Join AD and CD. The rectangle ABCD is got.

**Note**: If the rectangle to be constructed is a square, then all the sides are equal.

(ii) Construct a square ABCD given the length of its side = 6 cms. Construct the rectangle ABCD taking AB = BC = 6 cms as in the previous case.

**Exercise**

**I. Construct the $\Delta ABC$ in each case below**

1. AB = 8 cms, BC = 6 cms, AC = 10 cms
2. ABC is an equilateral triangle of side 5 cms.
3. ABC is an isosceles triangle with AB = AC = 8 cms, BC = 4 cms.
4. AB = 6 cms, B = 120°, BC = 10 cms
5. AB = 10 cms, B = 80°, C = 50°
6. BC = 12 cms, B = 100°, A = 30°

**II. Construct the rectangle ABCD in each case below**

7. AB = BC = 9 cms
8. AB = 10 cms, AD = 8 cms
9. BC = 15 cms, AB = 9 cms
10. 2AB = 3BC and the perimeter of ABCD = 40 cms.

# CHAPTER III

# COMPOUND INTEREST

## 1. Introduction

A coconut vendor deposited Rs. 2000/- in a bank for two years and being an illiterate, he was pleasantly surprised to find that the money deposited had grown much more than his expectation. The extra money he got from the bank was the interest on the amount deposited together with the interest on the interest got at the end of the first year.

While the interest calculated for the entire period of deposit on the deposit amount only is simple interest, the interest calculated on the principal amount as well as on the interest accumulated from time to time is compound interest.

Banks pay interest (both simple and compound) on amounts deposited and charge interest (i.e. collect interest) on the amount loaned to others by them. A person who does business takes loan from banks and other financial institutions, private money lenders at a certain known rate of simple/compound interest and also gets interest on the amount he deposits in banks. Therefore it is necessary for him to know how to calculate the interest on the amount over a period of time.

Chartered accountants and consultants lend their services to individuals and business houses in advising them on wise moves they have to take to safeguard the business interests as well as calculations relating to interest accrued on deposits and loans.

**2. Concepts**

1. Money deposited grows to a bigger amount over a period of time. The money accrued over the deposited amount is interest.
2. Interest is calculated in two ways -
   (a) **Simple Interest**: Interest calculated on the deposited sum (only) over the period of deposit at the given rate of interest is called **simple interest** (SI).
   (b) **Compound Interest**: Interest calculated on the deposited sum as well as on the interest accrued from time to time is called **Compound Interest (CI)**.

**Pre-knowledge**: (a) Amount = Principal + Interest

$$\text{i.e. } A = P + I$$

$$\text{(b) Interest} = \frac{\text{Principal x Rate of interest x Time}}{100}$$

$$I = \frac{p \wedge n}{100}$$

(c) Terms/Symbols: (i) Principal (p)

(ii) Rate of interest per annum (=$\wedge$)

(iii) Period (n)

### 3. Examples

1. Mahavir kept Rs. 5000/- in a bank which pays interest @ 10% (SI) for 5 years. What is the amount he gets at the end of the period.
2. Karupaiah took loan of Rs. 2000 from a money lender who charges @ 20% (CI) for 2 years. How much interest has he to pay to the money lender at the end of the period along with the loan amount?

### 4. Learning Activities/Problem Solving

1. Let us find the interest accrued on the amount deposited by Mahavir in example 1.

   The rate of interest = 10% ($\wedge$)

   Period of deposit = 5 years (n)

   Principal = 5000 rupees (p)

Hence the (simple) interest accrued $= \frac{pn\wedge}{100}$

$$= \frac{5000 \times 5 \times 10}{100} = \text{Rs. } 250/-$$

$$\therefore I = \text{Rs. } 250$$

Therefore the amount he gets = A = P + I

$$= 5000 + 250$$

$$= \text{Rs. } 5250$$

$$A = 5250$$

2. Let us calculate the interest which Karupaiah has to pay to the money lender @ 20% (CI) in the example (2).

The loan amount = Rs. 2000 (p)

$\therefore I_1$ = The interest on the loan at the end of the first year

$$= \frac{2000 \times 20 \times 1}{100} = \text{Rs. } 400 \qquad (1)$$

$I_2$ = The interest at the end of second year

= The interest on the principal for the second year + The interest on the interest got at the end of the first year

$$= \frac{2000 \times 20 \times 1}{100} + \frac{400 \times 20 \times 1}{100} = 400 + 80 = 480 \qquad (2)$$

Hence the total interest to be paid = $I_1 + I_2$

$= 400 + 480$

$= \text{Rs. } 880$

**A short cut**: Instead of calculating interest this way, we can proceed the following way.

**Step 1**: Calculate the amount at the end of the first year $= P + I_1$

$= P_1$ (say)

**Step 2**: Calculate the interest for the second year on $P_1$ (as the principal) = $I_2$

The total interest = $(P_1 + I_2) - P$

**Step 3**: [The amount so got - The principal amount = The interest accrued = $(P + I_1 + I_2) - P = (I_1 + I_2)$]

**Accordingly**, $P_1 = P + I_1$

$= 2000 + 400 = 2400$

$$I2 = \frac{2400 \times 20}{100} = 480$$

$\therefore$ A= 2400 + 480= 2880

$\therefore$ I = The interest to be paid = 2880 - 2000 = Rs. 880

**3. Another problem**

Sukumaran deposited Rs. 20,000 in a bank which paid @ 12% compound interest, for three years. How much is earned by interest on the deposit over the period.

P = Principal = Rs. 20,000

$\wedge$ = Rate of interest = 12

n = Number of years = 3

**Step 1**: Interest at the end of the first year

$$I_1 = \frac{20000 \times 12}{100} = \text{Rs. } 2400$$

$\therefore$ $P_1$ = The amount at the end of one year = $P + I_1 = 20000 + 2400$

or $P_1 = 22400$

**Step 2**: Interest at the end of the second year

$$I_2 = \frac{22400 \times 12}{100} = \text{Rs. } 2,688$$

$\therefore$ $P_2$ = The amount at the end of second year = $P_1 + I_2$

$= 22400 + 2688 = \text{Rs. } 25,088$

**Step 3**: Interest at the end of the third year

$$I_3 = \frac{25088 \times 12}{100} = \text{Rs. } 3010.56$$

$\therefore$ $P_3$ = The amount at the end of third year = $P_2 + I_3$

= 25088 + 3010.56 = Rs. 28,098.56

$\therefore$ The total interest earned

= Amount at the end of three years - Principal

$\therefore$ I = 28,098.56 - 20,000

= Rs. 8,098.56

Also $I_1 + I_2 + I_3$

= 2400 + 2688 + 3010.56

= Rs. 8098.56 = I

i.e. $I = I_1 + I_2 + I_3$

**Exercises (for self learning)**

1. Calculate whatever is missing entry in the boxes if the interest is simple.

| | P | ^ | n | I | A |
|---|---|---|---|---|---|
| (1) | 2000 | 12 | 3 | - | - |
| (2) | 5000 | 10 | - | 1000 | - |
| (3) | - | 15 | 4 | 600 | - |

2. Find the interest accrued on a deposit of 10,000 kept for 2 years at the rate 8% compound interest.

3. Gopalan got loan of Rs. 12,000 from a bank, which charges 12% compound interest and repaid the amount along with the interest at the end of 2 years. How much money did he pay to the bank ?

4. Calculate the missing entry in the boxes, the interest being compounded.

| Name of the person who has taken loan from a bank | Loan amount | Rate of interest | Period loan |
|---|---|---|---|
| 1. John Verghese | 7,500 | 12% | 2 years |
| 2. Rahman Kutti | 12,000 | 10% | 3 years |
| 3. Padmavathi Ammal | 6,000 | 15% | 2 years |
| 4. Ranjan Nair | 15,000 | 8% | 3 years |

**Tips to problem solving**

If p = Principal, $\wedge$ = the rate of compound interest, A = the amount and I = the interest accumulated, then

(a) At the end of 2 years

$$A = P\left(1 + \frac{\wedge}{100}\right)^2 \quad \text{and } I = A - P$$

(b) At the end of 3 years

$$A = P\left(1 + \frac{\wedge}{100}\right)^3 \quad \text{and } I = A - P$$

**Exercises**

1. Ajit deposited 5000 rupees in a bank which pays interest at the rate of 12% (simple) for 5 years. How much does he get back at the end of the term ?

2. In the previous problem, had he deposited in another bank which pays 10% (compound) for 2 years, how much he would have got at the end of the term ?
3. Sujayan Nair kept Rs. 6000 in term deposit for 3 years in a saving scheme of a bank paying 11% simple interest. Vijayan kept Rs. 6000 in term deposit for 3 years in another scheme of the bank paying 10% compound interest. Who gets more interest at the end of the term and how much ?
4. A scooter company sells its brand of scooter which costs Rs. 18,000 on loan basis with initial deposit Rs. 3,000/- and @ 18% simple interest for the balance amount to be paid in 3 years. How much more will a customer of the company pay under the scheme ?
5. In the previous problem, if the company allows the customer to pay the balance amount in three equal instalments and charges 10% interest for the balance amount how much more will the customer pay ?
6. The table shows the amount (in rupees) loaned to different business houses by a financial money lending institution. Calculate the amount to be repaid in each case.

| Name | Dhanu Industries | Star Fabrics | Xavier Pharma | Aiyappa Automobiles |
|---|---|---|---|---|
| Amount of loan | 20,000 | 50,000 | 50,000 | 40,000 |
| Compound rate of interest | 10% | 12% | 12% | 9% |
| Period | 2 years | 3 years | 2 years | 3 years |

**Answers to Exercises**

(1) Rs. 8000, (2) Rs. 6050, (3) Sujayan Nair gets Rs. 1980 while Vijayan gets Rs. 1986. Hence Vijayan gets Rs. 6 more than Vijayan Nair, (4) Rs. 8,100, (5) Rs. 3,000, (6) Rs. 24,200; Rs. 70,246.40; Rs. 62,720 and Rs. 51,801.16.

# CHAPTER IV

# RATIO

## 1. Introduction

In daily life, we come across situations where magnitudes of like quantities such as lengths of objects, areas of regions, cost of articles, life-spans of persons, marks, height, weight, etc. are compared.

If two boys A and B are of weight 50 kg and 40 kg respectively, then the weight of A and B are in the ratio 5:4 or $\frac{5}{4}$.

**2. Concept**: (a) When measures of two like quantities are compared the result is a ratio.

(b) A ratio is a number (with no units attached to it).

## 3. Examples

(a) The age of the father is 45 years and that of the mother is 36 years. Their ages are in the ratio as 45:36 or $\frac{45}{36} = \frac{5}{4}$.

(b) The ratio of the area of a parallelogram to that of a triangle formed by two of the sides and a diagonal is 2:1 or $\frac{2}{1}$.

3. The amount earned by a person in a month is 2000 Rs. and the amount spent by him is 1800 Rs. Therefore the ratio of the earning to expenditure is $\frac{2000}{1800} = \frac{10}{9}$.

4. A pole is 10 m long and casts a shadow 25 m long. The ratio of the lengths of the pole to its shadow = $\frac{10}{25} = \frac{2}{5}$.

5. The times taken by two students to complete jobs assigned to them are 3 hours and 4 hours 30 minutes. The ratio of the times taken by them = $\frac{3}{4.5} = \frac{2}{3}$.

**4. Learning activities/problem solving**

(i) Two labourers Velu and Sanku picked coconuts from 15 trees and 10 trees and they together earned Rs. 100. How much should each get ?

**Solution**

$$\frac{\text{The amount earned by Velu}}{\text{The amount earned by Sanku}} = \frac{\text{The number of trees from which coconuts were picked by Velu}}{\text{The number of trees from which coconuts were picked by Sanku}}$$

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

Hence the total earnings must be divided in the ratio 3:2, i.e. Rs. 100 is to be divided in the ratio 3:2.

If the total amount is 3+2 = 5 Rs, then Velu get 3 Rs. and Sanku 2 Rs.

$$\text{Accordingly Velu gets } \frac{3}{3+2} \times 100 = \text{Rs. } 60$$

$$\text{and Sanku get } \frac{2}{3+2} \times 100 = \text{Rs. } 40$$

2. Two business persons A and B invested Rs.20,000 and Rs.50,000 respectively. At the end of one year they earned a profit Rs. 21,000. How do they share the profit ?

**Solution**

The profits shared by A and B

$$= \text{The ratio of their investment} = \frac{20,000}{50,000} = \frac{2}{5}.$$

∴ If the profit (2+5) = 7 Rs, A gets 2 Rs and B gets Rs. 5.

$$\text{If 21,000 Rs, A gets } \frac{2}{7}(21000) = 6,000 \text{ Rs.}$$

$$\text{and B gets } \frac{5}{7}(21000) = 15,000 \text{ Rs.}$$

**Tips to Problem Solving**

(a) If a profit x Rs. is to be shared between two persons A and B in the ratio p:q, then

$$\text{A's share} = \left(\frac{p}{p+q}\right) \times \text{Rs.}$$

and B's share = $\left(\frac{q}{p+q}\right)$ x Rs.

(b) If a profit x Rs. is to be shared between three persons A, B, C as p:q:r.

Then A's share = $\left(\frac{p}{p+q+\wedge}\right)$ x Rs.

B's share = $\left(\frac{q}{p+q+\wedge}\right)$ x Rs.

and C's share = $\left(\frac{\wedge}{p+q+\wedge}\right)$ x Rs.

5. Three cement dealers Vijayan, Wahid and Xavier got a profit of Rs. 45,000 in the ratio 2:3:4. How much does each one get ?

Vijayan's share = $\left(\frac{2}{2+3+4}\right)(45,000) = \frac{2}{9}(45,000) = 10,000$ Rs.

Wahid's share = $\frac{2}{9}(45,000) = 15,000$ Rs.

and Xavier's share = $\frac{4}{9}(45,000) =$ Rs.20,000

3. A water tank has capacity of 1000 gallons. Two pumps working simultaneously filled them. By the time the first pump could fill 5 gallons, the second pump filled 3 gallons only. How much of the tank was filled by each pump.

In a unit time both pumps together filled (5+3) gallons of water

If 8 gallons of water was filled by both, the first pump filled 5 gallons and the second 3 gallons.

When 1000 gallons was filled by both,

$$\text{the first pump filled } \frac{5}{8} \times 1000 = 625 \text{ gallons}$$

$$\text{and the second pump filled } \frac{3}{8} \times 1000 = 375 \text{ gallons}$$

4. In painting the walls of a building the paint and turpentine were mixed in the ratio 3:2. In doing so 24 litres of paint was used. How much of turpentine was used to mix with paint ?

$$\frac{\text{Amount of paint}}{\text{Amount of turpentine}} = \frac{3}{2}$$

But amount of paint = 24 litres

$$\therefore \frac{24}{\text{Amount of turpentine}} = \frac{3}{2}$$

$$\therefore 3 \times \text{Amount of turpentine} = 24 \times 2$$

$$\therefore \text{Amount of turpentine} = \frac{2}{3} \times 24 = 16 \text{ litres}$$

**5. Suggested Learning Activities**

List some problems drawn from the vocations of (a) tailoring, (b) carpentry, (c) geometry, (d) science.

## 6. Exercises

a. 40 children are to be divided into groups such that the numbers in the groups are as 7:3. How many are in each group.

b. Express 120 as the sum of two numbers which are in the ratio 2:3.

c. Express 640 as the sum of three numbers which are as 2:3:5.

d. Two masons build 5 m long and 3 m long walls respectively and earn Rs. 720. If the walls are of the same heights and thickness. how much does each get.

e. Two partners who invested Rs. 12,000 and Rs. 8,000 incurred a loss of Rs. 1000 in a month. How much has each lost ?

f. On a sheet 18 cm x 10 cm, twenty four lines of matter can be printed. How many lines which are equally long as on the first sheet can be printed on a sheet 15 cm x 10 cm ?

g. 20 litres of cooking oil is filled into two vessels whose capacity are as 2:3. How much of oil is contained in each vessel ?

h. Two cars cover a distance of 120 kms with constant speeds. If their speeds are as 3:4. Find the ratio of the times taken by them. If the speed of the slower car is 30 km/h, find the speed of the other car and the times the cars take.

## Answers to Exercises

1. 28 and 12, 2. 48, 72, 3. 128, 192, 320, 4. Rs. 450 and Rs. 270, 5. Rs. 600 and Rs. 400, 6. 20 lines, 7. 8 litres and 12 litres, 8. 4:3; 40 km/h; 3 hrs and 4 hrs respectively.

# CHAPTER V

# ANGLES

## 1. Introduction

In geometrical figures we find angles formed at the corners of the figures. In road maps we see angles formed at the intersection of roads (in crossings) and angles are formed by railway crossings between roads and railway tracks. We also see angles formed by intersecting surfaces of objects like walls and floors or roofs. Study of angles reveal special and interesting properties of figures and three dimensional objects and we learn how two figures or two objects differ from each other and how they are comparable as well. Angle and Angle-measure are very basic concepts in geometry and a knowledge of this is a must for every one and in particular to an engineer, an architect and a designer. Tailoring, carpentry, metal sheet cutting are but few vocations where angles play an important role.

**Pre-knowledge**: Ray, line, triangles and quadrilaterals.

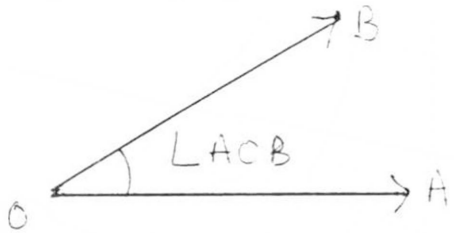
## 2. Concept

(i) An angle is formed by two rays with common initial point.

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

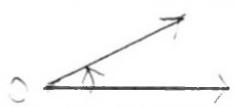
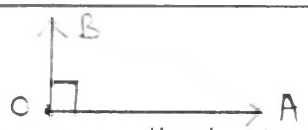
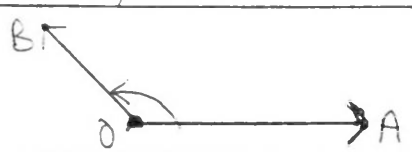
(iii) A pair of angles with one common arm and same vertex is called a linear pair, if the other arms are opposite rays.

(iv) **Measure of an angle**: Given an angle, a real number called the measure of the angle is assigned to the angle. A unit of angle measure is 1 degree denoted by $1^c$. In terms of this unit, each angle is associated with a number (to be read as so many degrees) lying between 0° and 180° (including the end values).




If the angle is ∠AOB (or $\overset{\frown}{AOB}$), its measure is denoted by m(∠AOB) and 0° ≤ m(∠AOB) ≤ 180°.

**(v) Classification of angles**

| | Name of the angle | Measure of the angle | The figure |
|---|---|---|---|
| 1 | Acute angle | < 90° |  |
| 2 | Right angle | = 90° |  Rays are perpendicular to each other (i.e. OA ⊥ OB) |
| 3 | Obtuse angle | > 90° |  |
| 4 | Straight angle | 180° | |

**(V) Angle-measuring instrument**: In the instrument (Geometric) box, the protractor is used to measure an angle in degrees.

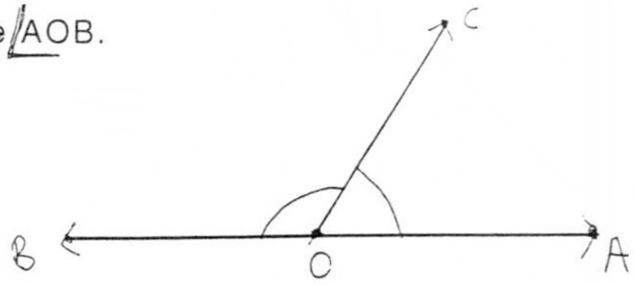
### 3. Examples

| Sl. No. | Angle | Angle measure | Type of the angle |
|---|---|---|---|
| 1 | Angle between two adjacent sides of a rectangular board | 90° | A right angle |
| 2 | An angle of an equilateral triangle | 60° | An acute angle |
| 3 | Angle between a side and the hypotenuse of a right triangle | <90° | An acute angle |
| 4 | Angle between the shorter sides of a right triangle | 90° | A right angle |
| 5 | Angle between any two wings of a 3-winged fan | 60° | An acute angle |
| 6 | Angle between the hour hand and minute hand at 4 pm in a clock | 120° | An obtuse angle |
| 7 | Angle between the two hands of a person, when the hands are stretched in opposite directions | 180° | A straight angle |
| 8 | Angle between the hands of a clock at 12 O'clock | 0° | An acute angle |

### 4. Learning Activities/Problem Solving/New Results

#### (a) Angles forming a linear pair

Look at the figure. You find a linear pair ∠AOC and ∠BOC. Further, the sum of the measures of the angles is the measure of the straight ~~line~~ ∠AOB.




i.e. m∠AOC + m∠BOC = m∠AOB = 180°

Thus m∠AOC + m∠BOC = 180° (1)

In words, the sum of the measures of angles forming a linear pair is 180° (the measure of a straight angle).

**(b) Definition**: Two angles are said to be supplementary to each other, if the sum of their measures is 180°.

Eg: The angle pairs are supplementary angles.

(a) 70°, 110°  (b) 140°, 40°

(b) 60°, 120°  (d) 30°, 150°

It follows from (1), that linear pairs are supplementary angles. (However supplementary angles need not form a linear pair). Therefore, if the measure of one angle of a linear pair is given, the measure of the other angle in the pair can be found using (1). Given a linear pair

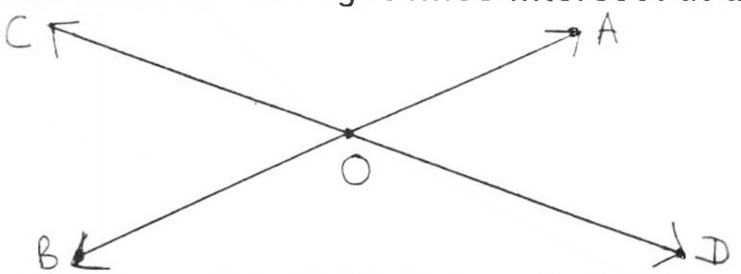
The measure of an angle of the pair

= 180° - The measure of the other angle of the pair

Eg: The measure of an angle of a linear pair is 40°. Find the measure of the other angle in the pair.

Ans: 180° - 40° = 140°

**(c) Angles formed when two straight lines intersect at a point**




In the figure, lines AB and CD intersect at 0. Consequently, the angles formed are ∠AOC, ∠COB, ∠BOD and ∠AOD.

**Let us find how these are related to each other**

In the figure, $\angle AOC$ and $\angle BOC$ form a linear pair.

$\therefore m\angle AOC + m\angle BOC = 180°$ (i)

$\angle BOC$ and $\angle BOD$ is a linear pair.

$\therefore m(\overset{\frown}{BOC}) + m(\overset{\frown}{BOD}) = 180°$ (ii)

$\therefore$ From (i) and (ii)

$m(\overset{\frown}{AOC}) + m(\overset{\frown}{BOC}) = m(\overset{\frown}{BOC}) + m(\overset{\frown}{BOD})$

$\therefore m(\overset{\frown}{AOC}) = m(\overset{\frown}{BOD})$

Likewise $m(\overset{\frown}{BOC}) = m(\overset{\frown}{AOD})$

**Definition**: When two straight lines intersect, four angles are formed. Among these the pairs of angles which are not linear pairs, are called pairs of vertically opposite angles.

Accordingly, in the figure

$\angle AOC$, $\angle BOD$ are vertically opposite angles

$\angle BOC$, $\angle AOD$ are vertically opposite angles

**Summary**

L.P. = Linear pair

V.O.A. = Vertically opposite angles

| Pair of angles | What are they called ? |
|---|---|
| 1, 2 | L.P. |
| 1, 3 | V.O.A. |
| 1, 4 | L.P. |
| 2, 3 | L.P. |
| 2, 4 | V.O.A. |
| 3, 4 | L.P. |

## Problems

1. In the table below, $\underline{A}$ and $\underline{B}$ are a linear pair. Find the missing entires in the table.

| | A | B |
|---|---|---|
| (1) | 100° | - |
| (2) | 70° | - |
| (3) | - | 90° |
| (4) | - | 45° |

**Ans:**

(1) $\angle B = 80°$

(2) $\angle B = 110°$

(3) $\angle A = 90°$

(4) $\angle A = 135°$

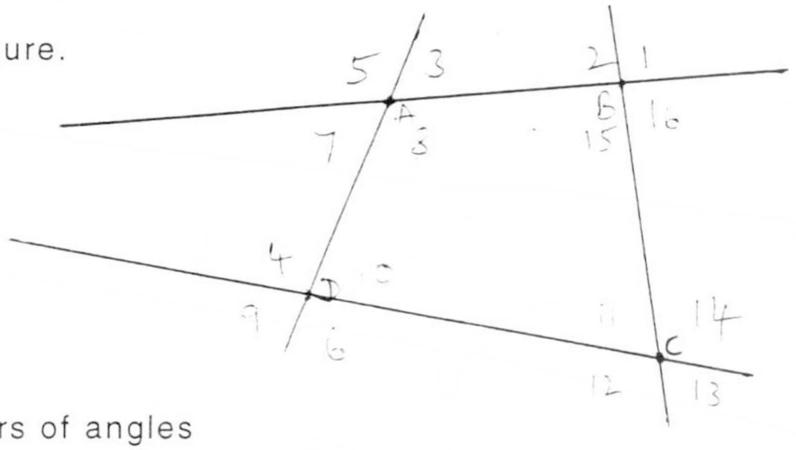
**2. Fill in the blank**

| | Figure (1) | Number of acute angles (2) | Number of right angles (3) | Number of obtuse angles (4) |
|---|---|---|---|---|
| 1 | A right triangle | - | - | - |
| 2 | An equilateral triangle | - | - | - |
| 3 | A rectangle | - | - | - |
| 4 | A parallelogram which is not a rectangle/square | - | - | - |
| 5 | A rhombus which is not a square | - | - | - |
| 6 | A trapezium which is not a parallelogram | - | - | - |

**Ans:**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | A right triangle | 2 | 1 | - |
| 2 | An equilateral triangle | 3 | - | - |
| 3 | A rectangle | - | 4 | - |
| 4 | A parallelogram | 2 | 2 | - |
| 5 | A rhombus | 2 | - | 2 |
| 6 | A trapezium | 2 | - | 2 |

(3) Identify the linear pairs of angles and vertically opposite pairs of angles in the figure.




Ans: (a) Linear pairs of angles

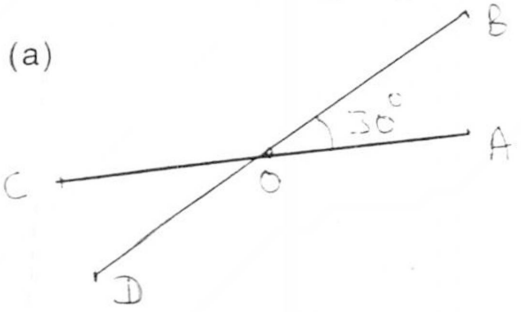
1,2; 2,15; 15,16; 1,16; 3,5; 5,7; 7,8; 3,8; 10,4; 4,9; 9,6; 10,6; 11.12; 12,13; 13,14; 11,14.

(b) Vertically opposite angle pairs

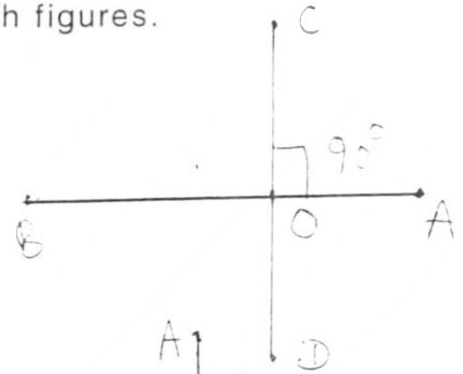
1,15; 2,16; 3,7; 5,8; 4,6; 9,10; 11,13 and 12,14.

(4) Find the missing angle measures in each figures.

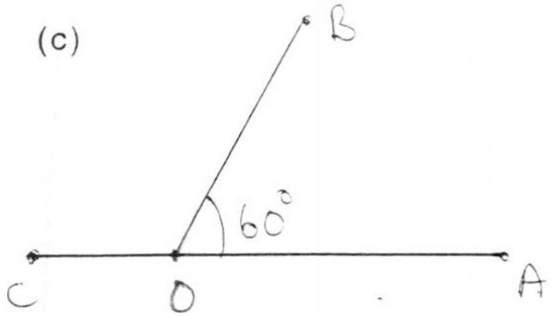
(a)



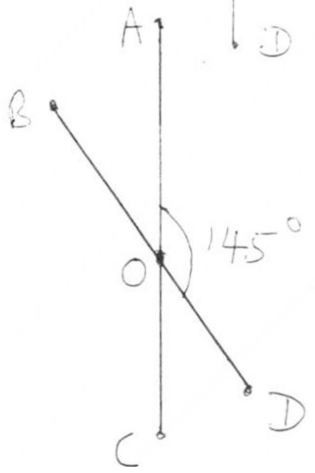

(b)



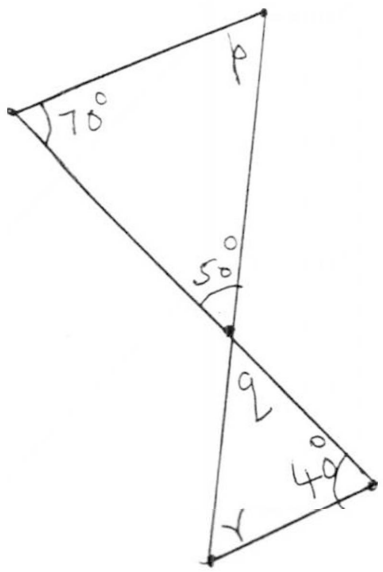

(c)




(d)




(e)



**Answers**

(a) $m(\angle BOC) = m(\angle AOD) = 150°$, $m(\angle COD) = 30°$

(b) Each angle = 90°

(c) $m(\angle BOC) = 120°$

(d) $m(\angle AOB) = m(\angle COD) = 35°$; $m(\angle BOC) = 145°$

(e) $\angle p = 180° - (70°+50°) = 60°$; $\angle q = 50°$; $\angle \wedge = 180° - (\angle q+40°)$

$= 180° - (50°+40°) = 90°$

5. Suggested learning activities

List the objects which you can see around, when angles are formed. Prepare the list of objects you saw and state whether the angle is acute/right/obtuse/straight.

6. Exercises

(i) Construct angles of following measures -

(a) 40°, (b) 70°, (c) 20°, (d) 90°, (e) 110°, (f) 160°, (g) 145°, (h) 85°

(ii) Pair the supplementary angles

$\angle A = 30°$, $\angle B = 50°$, $\angle C = 110°$, $\angle D = 130°$, $\angle E = 70°$, $\angle F = 150°$, $\angle G = 115°$, $\angle H = 65°$

(iii) State true or false

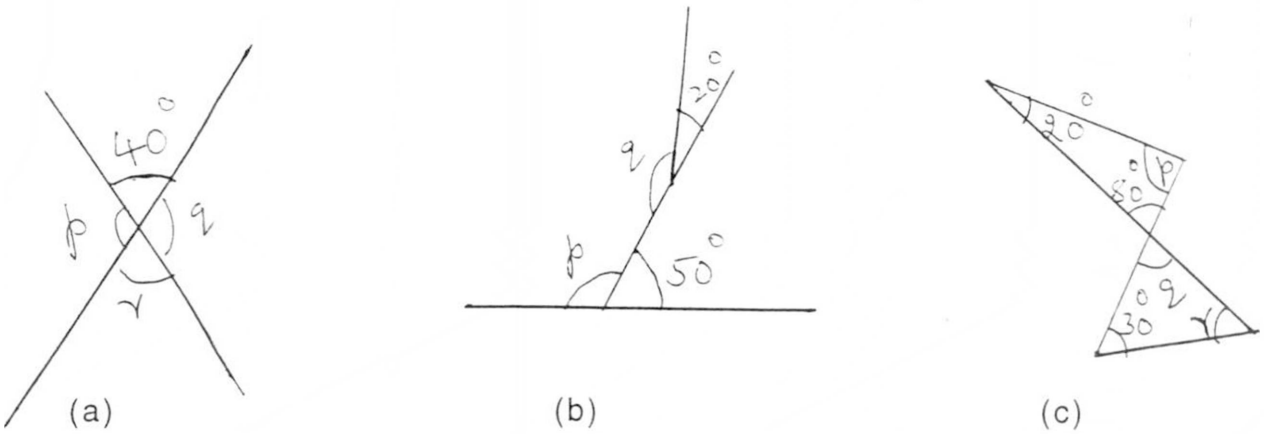
(a) Any two supplementary angles form a linear pair.

(b) Any linear pair of angles are supplementary.

(c) In a triangle there cannot be more than one right angle.

(d) When two lines intersect only one pair of equal angles are formed.

4. Find the missing angles in the pictures




(a) (b) (c)

5. State whether each of these angles is acute, obtuse right or a straight angle ?

   (i) 130°, (ii) 90°, (iii) 100°, (iv) 80°, (v) 89°, (vi) 91°

6. Construct linear pairs if one of the angles is -

   (a) 60°, (b) 90°, (c) 130°, (d) 35°, (e) 115°

7. Find the angles which are supplementary if their difference is

   (a) 30°, (b) 120°.

8. Match the statements in A and B below.

| A | B |
|---|---|
| 1. Supplementary angles | 1. 90° |
| 2. Vertically opposite angles | 2. Sum of the angles is 180° |
| 3. Linear pair | 3. Less than 90° |
| 4. Acute angle | 4. Sum of the angles is 90° |
| 5. Obtuse angle | 5. Common vertex, common arm and other arms on opposite rays |
| 6. Right angle | 6. Equal |
| | 7. Greater than 90° |

**Answers to Exercises**

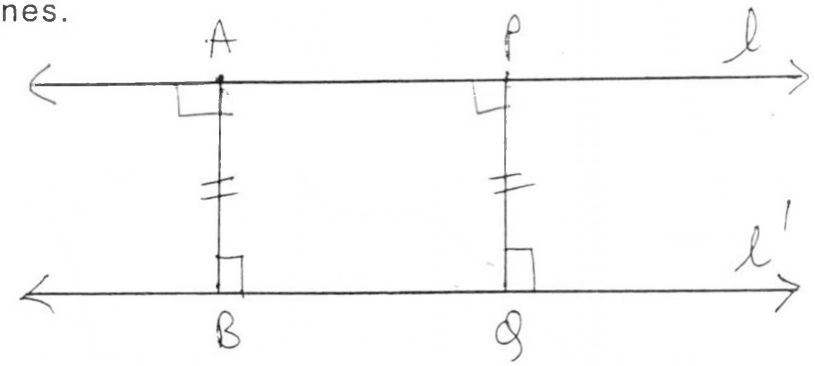
(2) A,F; B,D; C,E; G and H, (3) False, True, True, False, (4)(a) p=q=140°, ∧ = 40°; (b) p = 130°, q = 160°, (c) p = q = 80°, ∧ = 70°, (5) (i) obtuse, (ii) right, (iii) obtuse, (iv) acute, (v) acute, (vi) obtuse, (7) (a) 105° and 75°,(b) 150° and 30°,(8) 1-2; 2-6, 3-5, 4-3, 5-7, 6-1.

# CHAPTER VI

# PARALLEL LINES

## 1. Introduction

Two (or more) lines in a plane which would never intersect are called parallel lines. We see objects around us which resemble parallel lines. Straight stretches of railway lines, opposite edges of a rectangular door/window/board, the steel bars which are fitted evenly (i.el equidistant from each other) in a gate of a house, the intersections of three or more walls along vertical lines - all suggest the picture of parallel lines. When we consider two parallel lines, distance of any point on one of the lines, from the other line is the same (constant). This distance is called the distance between the parallel lines.




It is this basic, interesting property of parallel lines, which is very useful in all problems involving parallel lines.

The concept and properties of parallel lines are applied in solving daily life problems as in carpentry, printing, tailoring, house

building, drawing and architecture. In this chapter properties of parallel lines which are of extreme use are discussed.

**2. Concept**

(i) Two straight lines in plane are called parallel lines if they do not intersect.

(ii) The distance of any point on one of the parallel lines to the other line is constant and it is called the distance between the parallel lines.

(iii) When a transversal is drawn to cut two parallel lines

(a) the corresponding angles are equal

(b) the alternate angles are equal

(c) the interior angles on the same side of the transversal are supplementary

(iv) Drawing a parallel line to a given straight line through a given point not lying on the given line, using the set square.

**3. Examples**

(a) In a parallelogram, opposite sides are parallel.

(b) In a trapezium, one pair of opposite sides are parallel.

(c) In a ladder, the steps are parallel.

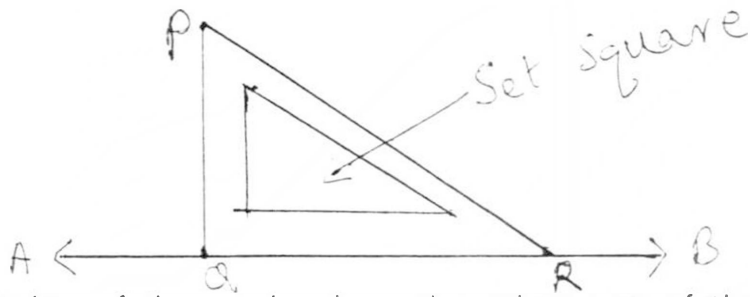
(d) Opposite vertical edges of a wall are parallel.

(e) Opposite edges of a rectangular floor are parallel.

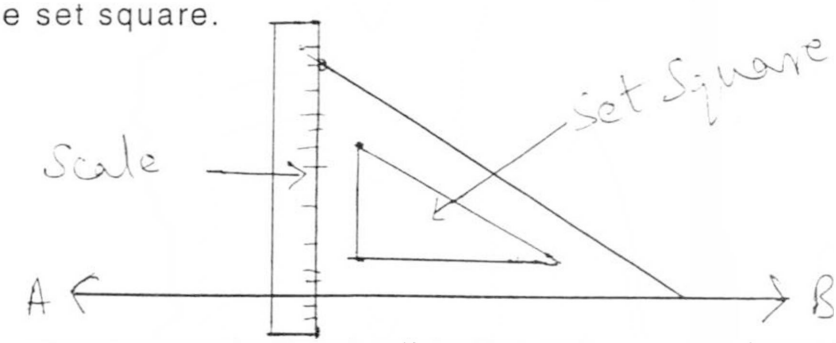
## 4. Learning Activities/Problem Solving

(a) Drawing a parallel line to a given line, using a scale and a set square.

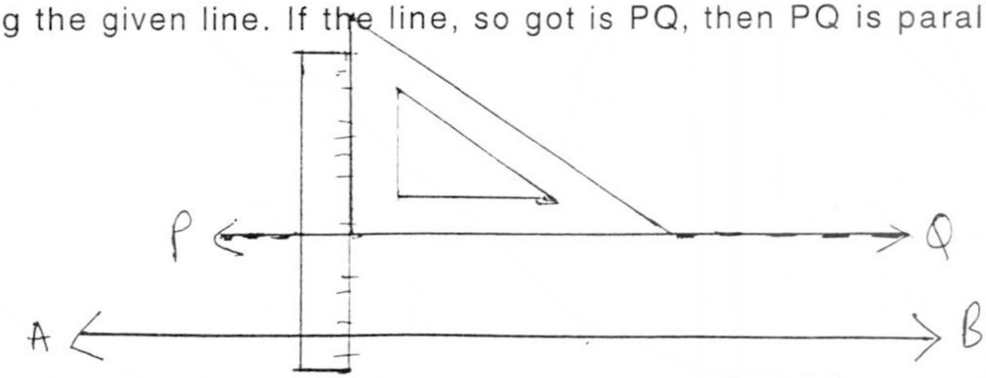
**Step 1**: Given the line AB, place the set square so that one of the arms of the right angle of the set square falls along the line AB.




**Step 2**: Place the edge of the scale along the other arm of the right angle of the set square.



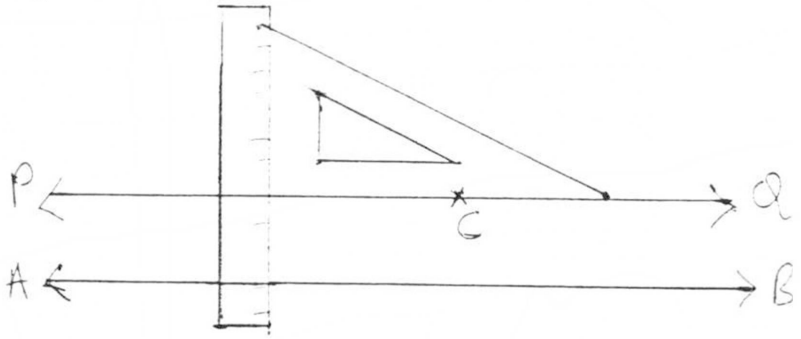

**Step 3**: Keeping the scale fixed, slide the set square along the scale to any position of your choice and draw the line along the arm which was along the given line. If the line, so got is PQ, then PQ is parallel to AB.




**Notation**: To state the line PQ is parallel to the line AB, we write PQ||AB.

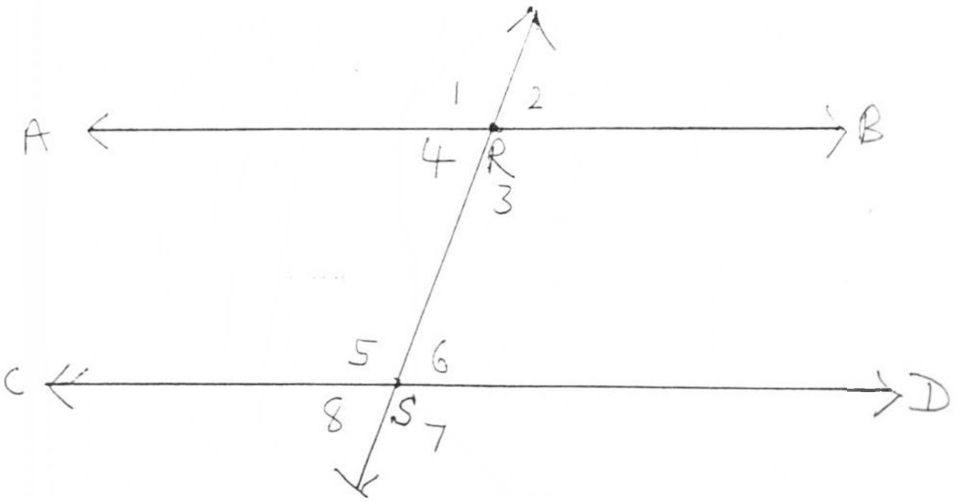
Note: This method can be used to draw a parallel line through a given point, to a given line when the point is outside the given line.

Given the line AB and a point C outside the line AB in step 3, bring the set square to the position so that the arm which was along AB, passes through C. Then draw the line along the arm. This line passes through C and is parallel to AB.




**(b) Parallel lines and a transversal properties**

Given the parallel lines AB and CD, any line PQ cutting both the parallel lines is called a transversal. When PQ is drawn, eight angles are formed as shown in the figure. The angles are named as 1 to 8.




**Activity**: Measure all the angles 1 to 8 and tabulate the values. When these angles are measured, we find -

(i) the following angles are equal

(a) 1,5; 2,6; 3,7; 4,8

(b) 3,5; 4,6

(c) 1,7; 2,8

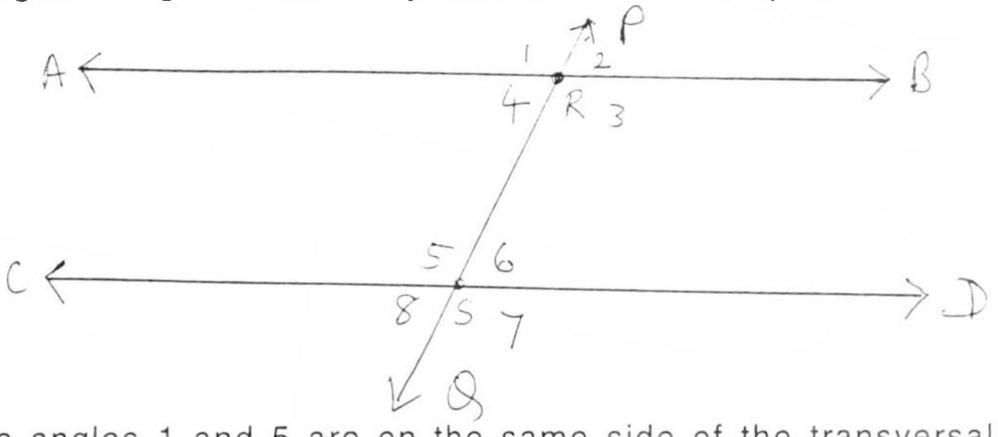
(ii) The following pairs of angles are supplementary

(a) 1,2; 1,4; 2,3; 3,4; 5,6; 6,7; 7,8; 5,8

(b) 4,5; 3,6

(c) 1,8; 2,7

**Naming the angles formed by a transversal with parallel lines**




(i) The angles 1 and 5 are on the same side of the transversal are above the lines in the figure. These angles are called the corresponding angles. We can find other pairs of corresponding angles in the figure. They are 2 and 6, 3 and 7, 4 and 8. Thus four pairs of corresponding angles are formed by the transversal with the parallel lines. By what we have verified in the activity, these pairs of corresponding angles are equal, i.e. 1 = 5; 2 = 6; 3 = 7 and 4= 8.

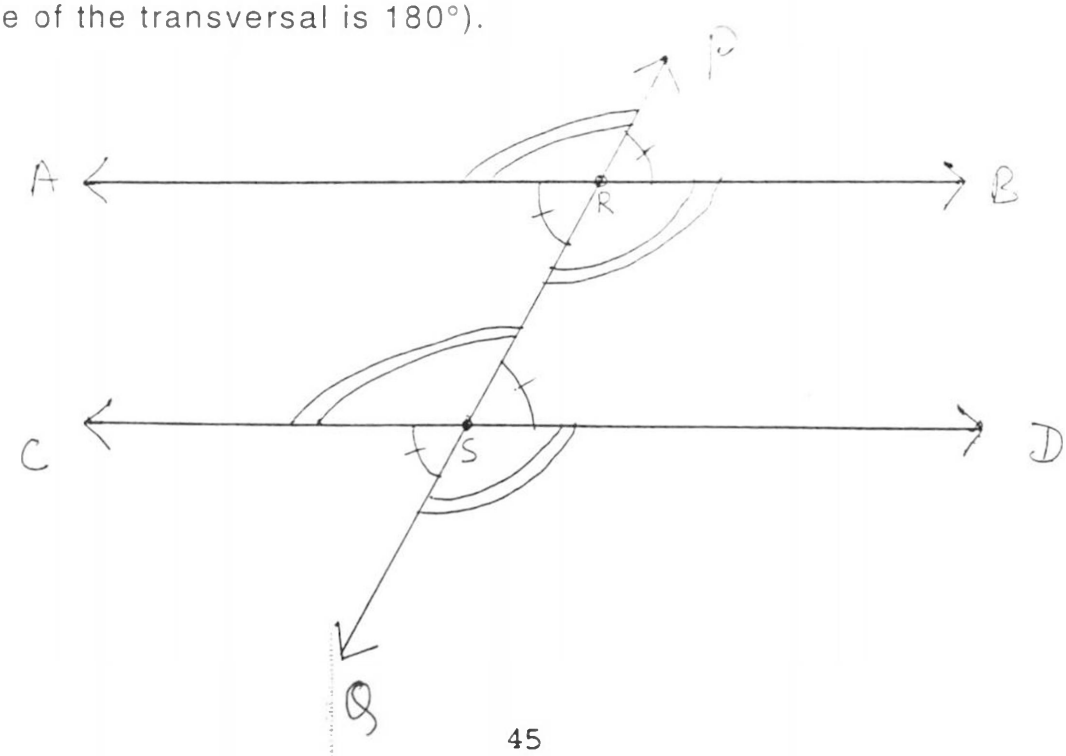
**Property 1**: When a transversal cuts a pair of parallel lines, the corresponding angles are equal.

(ii) The angles 4 and 6 are on opposite sides of the transversal but between the parallel lines. Likewise even the angles 3 and 5 are so. Such pairs of angles are called the alternate angles. Therefore, when a transversal cuts two parallel lines, two pairs of alternate angles are formed. We have verified in the activity, these pairs of alternate angles are equal, i.e. 3 = 5 and 4 = 6.

**Property 2**: When a transversal cuts a pair of parallel lines, the alternate angles are equal.

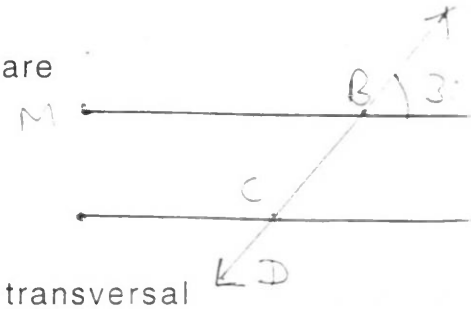
(iii) The angles 4 and 5 are interior (i.e. between the parallel lines) angles on the same side of the transversal. Likewise 3 and 6 are also such angles. We have verified that these are supplementary (i.e. their sum is 180°), i.e. 3 + 6 = 180° = 4 + 5.

**Property 3**: When a transversal cuts a pair of parallel lines, the interior angles on the same side of the transversal are supplementary (meaning, the sum of the interior angles on the same side of the transversal is 180°).



**Problems**

1. In the figure, name the angle pairs, which are




   (a) corresponding angles

   (b) alternate angles

   (c) interior angles on the same side of the transversal

Also find all the angles.

**Answer**

(a) Corresponding angles: ∠ABM, ∠BCD; ∠ABN, ∠BCQ; ∠DCP, ∠CBM; ∠DCQ, ∠CBN

(b) Alternate angles: ∠MBC, ∠BCQ; ∠NBC, ∠BCP

(c) Interior angles on the same side of the transversal: ∠MBC, ∠BCP; ∠NBC, ∠BCQ.

Using the properties of these angles (i.e. (1), (2), (3)).

Since ∠ABM and ∠ABN form a linear pair

$\angle ABM + \angle ABN = 180°$

$\therefore \angle ABM + 30° = 180°$ $\quad \therefore \angle ABM = 150°$

and likewise $\angle ABN + \angle NBC = 180°$ $\quad \therefore \angle NBC = 150°$

Hence $\angle BCP = \angle ABM = 150°$

From property (1), $\angle MBC = \angle PCB = 30°$

( $\angle MBC = \angle ABN = 30°$ being vertically opposite angles)

From property (1), $\angle ABN = \angle BCQ = 30°$

From property (1) $\angle DCQ = \angle NBC = 150°$

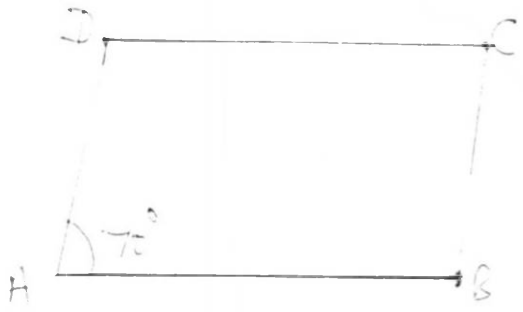
**Summarising**

(i) ∠ABN, ∠BCQ, ∠MBC, ∠PCD are each 30°

(ii) ∠ABM, ∠BCP, ∠NBC, ∠DCQ are each 150°

2. An angle of a parallelogram is 70°. Find the oth angles.

**Solution**




ABCD being a parallelogram

ABIICD

∴ ∠A + ∠D = 180° (1)

(because there are interior angles on the same side of the transversal AD)

∴ ∠D = 180° - ∠A = 110° (2)

ADIIBC

∴ ∠A + ∠B = 180° (3)

(because there are interior angles on the same side of the transversal AB)

∴ ∠B = 180° - ∠A = 110° (4)

∴ Again, since ABIICD, ∠B + ∠C = 180°

(because there are interior angles on the same side of the transversal AB)

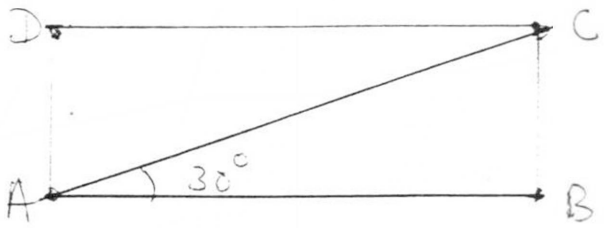
$\therefore \angle C = 180° - \angle B = 180° - 110° = 70°$

or $\angle C = 70°$ (5)

Hence $\angle A = \angle C = 70°$ and $\angle B = \angle D = 110°$

Note: In a parallelogram (a) opposite angles are equal and (b) adjacent angles are supplementary.

(3) Find the angles in the figure (if ABCD is a rectangle).




**Solution**

$\angle A = \angle B = \angle C = \angle D = 90°$ (because ABCD is a rectangle) (1)

$\angle DCA = \angle CAB = 30°$ (since there are alternate angles) (2)

$\angle DAC = 90° - \angle CAB = 60°$ (3)

$\angle BCA = \angle DAC = 60°$ (4)

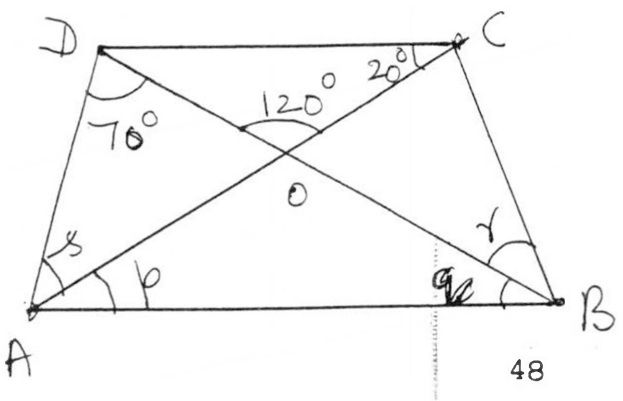
(since these are alternate angles)

4. ABCD is a trapezium in which ABIICD. Find the angles which are marked.

**Solution**: $\angle p = \angle OCD = 20°$ ( ABIICD) (1)

$\angle ODC = 180° - (120°+20°) = 40$

$\therefore \angle q = ODC = 40°$ (2)



$\angle C + \angle B = 180^\circ$ ( AB||CD)

$\therefore (20^\circ+80^\circ) + (\angle q+\angle \wedge) = 180^\circ$ or $100^\circ + 40^\circ + \angle \wedge = 180^\circ$

$\therefore \angle \wedge = 40^\circ$ (3)

$\angle A + \angle D = 180^\circ$ ( AB||CD)

$\therefore \angle p + \angle s + 70^\circ + \angle ODC = 180^\circ$

i.e. $20^\circ + \angle s + 70^\circ + 40^\circ = 180^\circ$

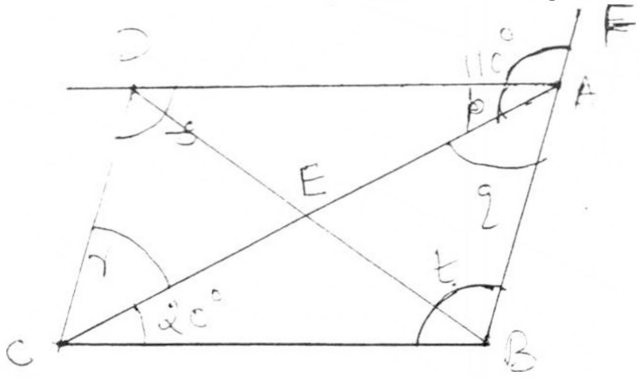
$\therefore \angle s = 180^\circ - 150^\circ = 30^\circ$ (4)

Hence $\angle p = 20^\circ$, $\angle q = 40^\circ$, $\angle \wedge = 40^\circ$, $\angle s = 30^\circ$

5. Find the marked angles in the figure.

$\angle DAB = 180^\circ - 110^\circ = 70^\circ$ (1)

$\angle DAC = \angle ACB = 20^\circ$ ( AB||CD) (2)
(alternate angles)




$\therefore \angle BAC = \angle DAB - \angle DAC$

$= 70^\circ - 20^\circ = 50^\circ$ (3)

$\therefore \angle BAC = 50^\circ$ (4)

$\angle ACD = \angle BAC = 50^\circ$ (alternate angles since AB||CD) (5)

$\therefore \angle BCD = \angle BCA + \angle ACD = 20^\circ + 50^\circ = 70^\circ$ (6)

$\therefore \angle ADC = 180^\circ - \angle BCD$ (internal angles on the side of transversal are supplementary)

$= 180° - 70°$

$\therefore \angle ADC = 110°$ (7)

$\therefore \angle ABC = \angle EAD = 110°$ (corresponding angles since AD||BC) (8)

Hence $\angle p = 20°$, $\angle q = 50°$, $\angle \wedge = 50°$, $\angle s = 110°$ and $\angle t = 110°$

**5. Suggested Learning Activities**

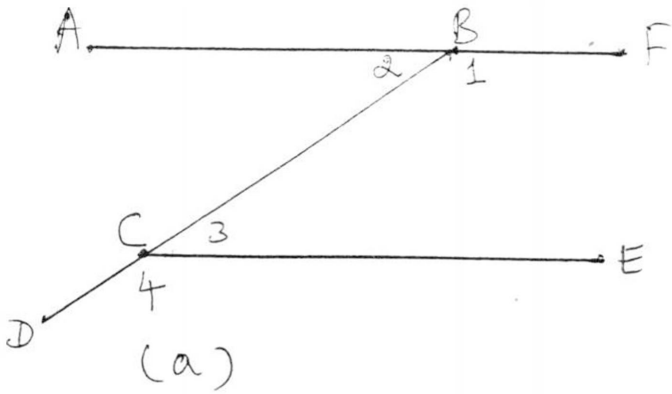
List the objects around you which look like

(a) parallel lines, (b) parallelogram, (c) rectangle, (d) square and (e) trapezium. Identify alternate angles, corresponding angles and interior angles on the same side of a transversal of parallel lines.

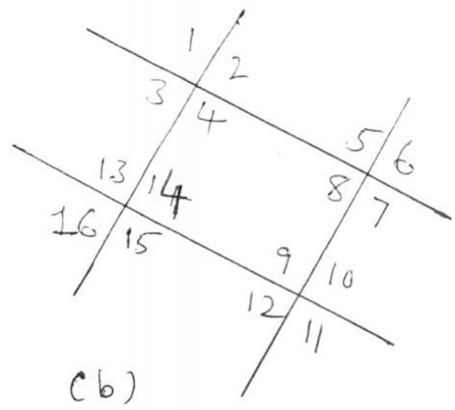
**6. Exercises**: Identify the alternate/corresponding/interior angles on the same side of the transversal in each figure and complete the table.

(i)

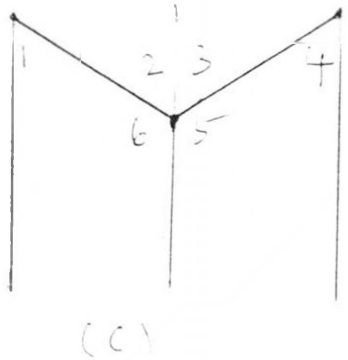
| Figure (1) | Alternate angles (2) | Corresponding angles (3) | Interior angles on the same side of the transversal (4) |
|---|---|---|---|
| (a) | | | |
| (b) | | | |
| (c) | | | |
| (d) | | | |



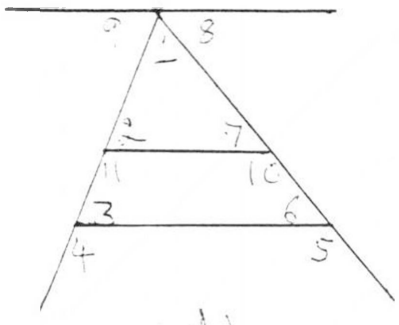
(a)



(b)



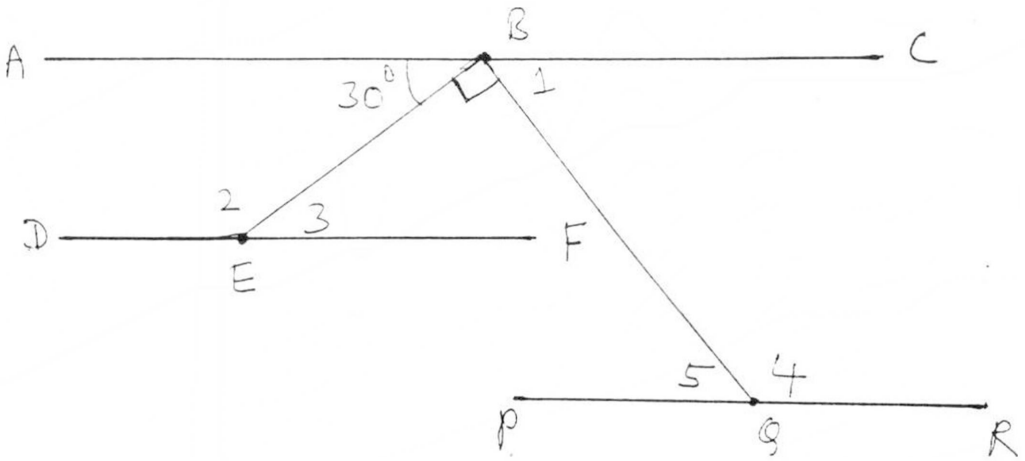

(c)




(d)

(ii) In a parallelogram one angle is 50° find the remaining angles.

(iii) In the figure, AC, DE and PR are horizontal lines and ∠EBQ=90°. Find the angles 1 to 5.

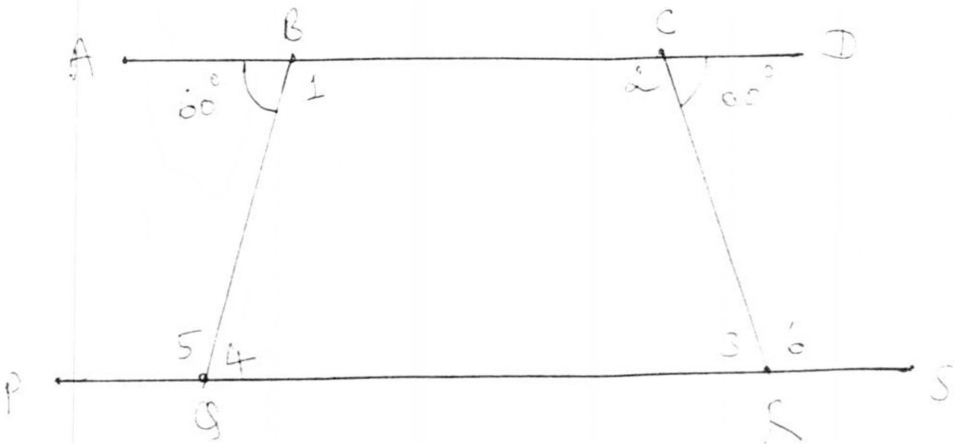



(iv) State the reasons for the following facts.

In a parallelogram, (a) opposite angles are equal

(b) adjacent angles are supplementary

(v) In the figure, find the angles 1 to 6.




**Answers to Exercises**

(i)

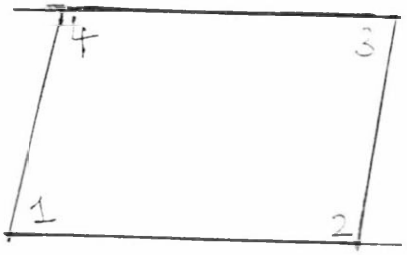
| Figure | Alternate angles | Corresponding angles | Interior angles on the same side of the transversal |
|---|---|---|---|
| (a) | (2,3) | (1,4) | (1,3) |
| (b) | (3,14),(4,13),(13,12), (16,9),(9,7),(10,8), (2,8),(4,5) | (1,13),(2,14)(3,16), (4,15),(13,9),(14,10), (16,12),(15,11), (12,8),(9,5),(11,7), (10,6),(7,4),(8,3), (6,2),(5,1) | (2,5),(4,8), (3,13),(4,14), (14,9),(15,12), (4,8),(2,5) |
| (c) | (1,2),(3,4) | - | (1,6),(5,4) |
| (d) | (9,2),(9,3),(8,7),(8,6) | (2,3),(11,4),(7,6), (10,5) | (11,3),(10,6) |

(ii) 50°, 130°, 130°

(iii) $\angle 1 = 60°$, $\angle 2 = 150°$, $\angle 3 = 30°$, $\angle 4 = 120°$, $\angle 5 = 60°$

(iv) (a) $\angle 1 + \angle 2 = 180° = \angle 1 + \angle 4$

( Interior angles on the same side of transversal are supplementary)




$\therefore \angle 2 = \angle 4$

Similarly, $\angle 1 = \angle 3$

(b) $\angle 1 + \angle 4 = 180°$ (same reason)

(v) $\angle 1 = 120°$, $\angle 2 = 120°$, $\angle 3 = 60°$, $\angle 4 = 60°$, $\angle 5 = 120°$ and $\angle 6 = 120°$

# CHAPTER VII

# NEGATIVE NUMBERS

## 1. Introduction

In many daily life situations we come across ideas which convey opposite meanings. Profit and Loss in business, hot and cold as for climatic variations, above sea level, below sea level as for altitudes of places, movements in opposite directions are some examples. In expressing these we use numbers and attach signs +, - with them. Such numbers with signs attached to them are called directed numbers. These are shown as points on a fixed line and the line is called a number line. Operations on numbers(as addition/ subtraction/multiplication/division) can be performed with the help of the number line.

Negative numbers are very useful in both mathematical problems as well as problems we come across elsewhere.

**Pre-knowledge**: Addition/multiplication/subtraction/division of nos.

## 2. Concepts

(i) Number line shows numbers as points.

(ii) A fixed point 0 on the number line is called as the origin and represents the number 0.

(iii) Choosing a convenient scale, points which are separated by unit distance are marked on both sides of the origin 0, on number line.

(iv) The numbers corresponding to the points on the right of 0 on the number line represent positive numbers while those on the left of 0 on the line represent negative numbers.

(v) Given two points A and B on the number line, if A is to the left of B (or B to the right of A) the number corresponding to A is less than the number corresponding to B. Accordingly, if a and bare numbers represented by A and B respectively, then we write $a < b$ or $b > a$.

(vi) As we move from left to right, we come across bigger numbers and movement in the opposite direction (i.e. from right to left) takes us to smaller numbers.

**Meaning of symbols**: < = less than; > = greater than

**3. Examples**

Profit and loss incurred in business by a petty shop keeper over the twelve months of an year is given below. We show this on the number line.

| Month | Profit (in Rs.) | Loss (in Rs.) |
|---|---|---|
| January | 200 | - |
| February | 100 | - |
| March | - | 500 |
| April | 300 | - |
| May | - | - |
| June | 600 | - |
| July | - | 400 |
| August | 500 | - |
| September | - | 200 |
| October | 400 | - |
| November | - | 300 |
| December | 800 | - |

We take that a length 1 cm means 100 Rs. This way of taking a unit length to correspond to an amount is known as selecting a scale. This is done in the most convenient way, to get a convenient scale.

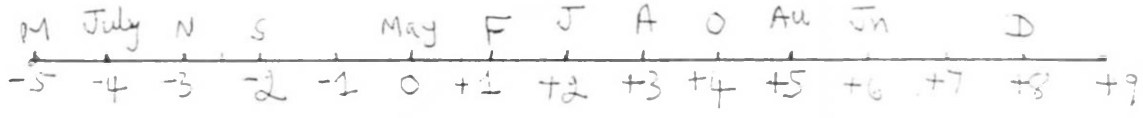
With the chosen scale the data becomes →

To distinguish profit from loss, we attach + sign to the profit and - sign to the loss.

Then we can further make the data brief

| Month | Profit (in Rs.) | Loss (in Rs.) |
|---|---|---|
| January | 2 | - |
| February | 1 | - |
| March | - | 5 |
| April | 3 | - |
| May | - | - |
| June | 6 | - |
| July | - | 4 |
| August | 5 | - |
| September | - | 2 |
| October | 4 | - |
| November | - | 3 |
| December | 8 | - |

| Month | J | F | M | A | My | Jn | Jy | Au | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Profit loss | +2 | +1 | -5 | +3 | 0 | +6 | -4 | +5 | -2 | +4 | -3 | +8 |




**Tail end question**

Look at this picture. On which months there was profit/loss/no profit or loss ?

**4. Learning Activities/Problems/New ideas**

**(a) The picture of a number line - Construction**

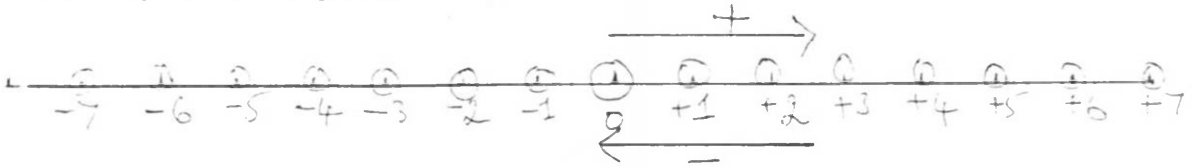
A straight line is drawn and a fixed point 0 is marked on the line steps of unit length are marked in succession to the right of 0. The points of the line got this way represent positive numbers +1,

+2, +3, +4, and so on. The distance between any two consecutive points marked stepwise this way is unit length. In the same way unit lengths are stepped off to the left of 0. The points of the number line so got represent whatare called negative numbers, -1, -2, -3, -4 and so on.

0 itself represents the number 0 (zero) (which is neither positive nor negative). The distance between any two consecutive points marked stepwise is again unit length.

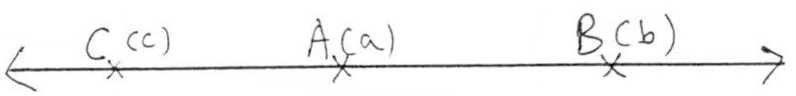
**Activity**: Construct a number line and mark numbers 0, ±1, ±2, ±3, ±4, ±5.

**(b) Moving to the right/moving to the left**




**Convention**: Movement to the right is assumed to be movement in the positive direction (as it takes us from a number to a bigger number) while movement to the left is assumed to be movement in the negative direction (as it takes us from a number to a smaller number) on the number line.

Accordingly, if the point A represents a number a, the point B represents a number b and the point C represents a number c as shown here under on the number line.



Then (i) a<b (or b>a) or a is less than b (or b is greater than a)

(ii) a>c (or c<a) or a is greater than c (or c is less than a)

(iii) c<b (or b>c) or c is less than b (or b is greater than c)

In particular,

(i) any positive number is greater than 0.

(ii) any negative number is less than 0.

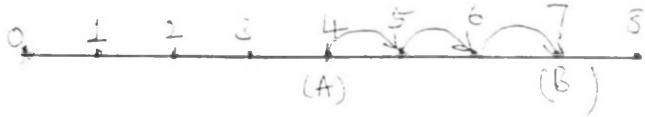
(iii) any negative number is less than any positive number.

**(c) Operations with numbers using the number line**

**1. Addition**

**Some examples**

**(i) To find (+4) + (+3)**




We start with A denoting +4 on the number line. Then we take three steps to the right (movement to the right means moving in the positive direction).

We come to the point B representing +7.

Thus (+4) + (+3) (or 4+3 simply)

= +7 (i.e. 4+3 = 7)

**(ii) To find (-5) + (+3)**

We start with A denoting -5 (5 steps from 0 to the left) and take 3 steps to the right (because we are adding +3) we come to B representing -2.

Thus (-5) + (+3) = -2

or -5 + 3 = -2

**(iii) To find (+3) + (-4)**

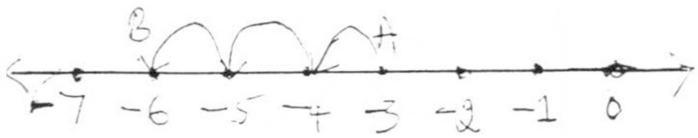
We start from A(+3) and take four steps to the left (movement to the right means moving in the negative direction) we come to B representing -1.

Thus (+3) + (-4) = -1

or 3 + (-4) = -1

**(iv) To find (-3) + (-3)**

We start from A(-3) and take 3 steps to the left (why ?) and come to B(-6).




Thus -3 + (-3) = -6

An easy way to add two numbers on the number line.

To add two numbers a and b (i.e. find a+b).

**Step 1**: Start with A(a) on the number line.

**Step 2**: Go b steps on the line to the right if b is positive or to the left if b is negative to come to a point B on the line.

Then the number represented by B is a+b.

## 2. Subtraction

### (i) The negative of a number

Let A and B be points on the number line, at the same distance from 0 (the origin) but on opposite side of 0. The number represented by B is called the negative of the number represented by A and vice versa.

Accordingly

(OA = OB)

-(+a) = -a and -(-a) = +a for any number a.

Note: A number and its negative have opposite signs and so on. In particular -0 = +0.

| Number | Negative of the number |
|---|---|
| +1 | -1 (i.e. -(+1) = -1) |
| -1 | +1 (i.e. -(-1) = +1) |
| +2 | -2 (i.e. -(+2) = -2) |
| -2 | +2 (i.e. -(-2) = +2) |
| +3 | -3 (i.e. -(+3) = -3) |
| -3 | +3 (i.e. -(-3) = +3) |
| +4 | -4 (i.e. -(+4) = -4) |
| -4 | +4 (i.e. -(-4) = +4) |

### (ii) Subtraction (as the addition of two numbers)

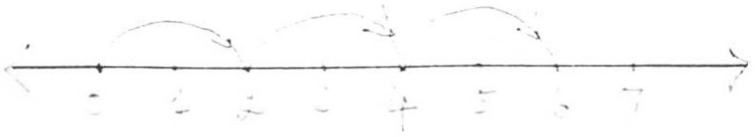
Given two numbers say 3 and 4 when -4 (i.e. the negative of 4) is added to 3 we get 3+(-4). The sum so got is called subtraction (difference) of 4 in 3 and we write 3 + (-4) = 3 - 4.

It is readily seen that 3 - 4 = -1

### 3. Multiplication - Product of numbers

When two numbers are multiplied, the various possibilities are: (i) both numbers are positive, (ii) one of them is positive and the other is negative, (iii) both are negative numbers.

(i) Multiply (+3) and (+2)



Consider (+3) x (+2) as repeated addition.

(+3) x (+2) = (+2) + (+2) + (+2) = +6

Thus (+3) x (+2) = +6

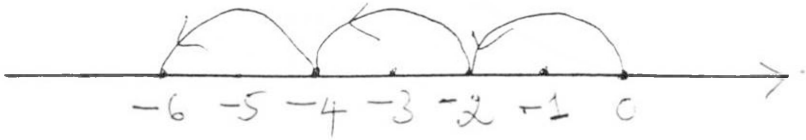
More generally,

(A positive number) x (A positive number) = (A positive number)

Symbolically, (+) x (+) = (+) (I)

(ii) Multiply (+3) and (-2)

(+3) x (-2) = (-2) + (-2) + (-2) = -6 or (+3) x (-2) = -6




More generally,

(A positive number) x (A negative number) = (A negative number)

Symbolically, (+) x (-) = (-), Likewise (-) x (+) = (-) (II)

(iii) Multiply -3 and -2

(-3) x (-2) = -(3 x -2) = -6

= The negative of (-6) = + 6

Hence (-3) x (-2) = +6

More generally,

(A negative number) x (A negative number) = (A positive number)

Symbolically, (-) x (-) = (+) (III)

The rules I, II and III of multiplication for directed numbers (numbers with sign + or -) are extremely important and useful in solving problems. We put these rules in the form of a multiplication table, which is easy to remember.

| x | + | - |
|---|---|---|
| + | + | - |
| - | - | + |

**An important fact**

Product of a number with zero is zero.

i.e. for any number a, a x 0 = 0 x a = 0

**4. Division**

The rules of division of a number by another number is the same as for multiplication of numbers as division is multiplication of a number by the reciprocal of another number (i.e. $\frac{a}{b} = a \times \frac{1}{b}$).

| x / ÷ | + | - |
|---|---|---|
| + | + | - |
| - | - | + |

Accordingly,

(i) $\frac{+3}{+2} = +\frac{3}{2}$

(ii) $\frac{+3}{-2} = \frac{-3}{+2} = -\frac{3}{2}$

(iii) $\frac{-3}{-2} = +\frac{3}{2}$

## 5. Suggested learning activities

Given examples from daily life where directed numbers are used.

## 6. Exercises

(i) Find the value of

(a) (+210+135)+(+255) (b) (+5) + (-7) + (+6)

(c) (-150) + 50 - 200 (d) 415 - 255 (e) 310 - 625

(ii) Find the value of

(a) 15 x (-35) (b) (-40) x 25 (c) (-20) x (-30)

(d) 10 x (-30) x 40 (e) $\frac{-40 \times 10}{10 - 30}$ (f) $\frac{30 - 60 + 100}{100 - 30 - 60}$

(g) $\frac{21x12 - 13x8}{-3x13 + 18x6}$ (h) $\frac{30 - 2x(-10) + 3x(-20)}{60 + 3(-15) + (-10)x(-30)}$

3. The profit and loss in a business over six months is given below. Use directed numbers to find the net profit or net loss in the business during the period of four months.

| Months | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|
| Profit (in Rs) | 6,000 | | 10,000 | | 12,000 | |
| Loss (in Rs) | | 4,200 | | 6,000 | | 8,800 |

4. A balloon was let to rise in the air and observed for in intervals of 5 minutes over 45 minutes. Using directed numbers, find the height of the balloon at the end of 45 minutes.

| At the end of | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| Up (rise) (min) | 20 | | 30 | 20 | | 60 | 40 | 10 | |
| Down (fall) (min) | | 10 | | | 25 | | | | 80 |

5. A squirrel is running to and fro in a straight line passing through the base of a tree. Observations made are given below. Find the position of the squirrel at the end of the observations with respect to the base of the tree, using directed numbers.

| Observation number | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Distance covered (a) to the right | 5 m | 15 m | | | 8 m |
| (b) to the left | | | 12 m | 16 m | |

**Answers to Exercises**

(1) (a) +600, (b) +4, (c) -300, (d) +160, (e) -315, (f) - 198

(2) (a) -525, (b) -1000, (c) +600, (d) -12000, (e) +20, (f) +7, (g) $\frac{148}{69}$,

(h) $-\frac{2}{63}$

(3) +9,000

(4) 65 m above the ground level.

(5) 0 (the squirrel is at the base of the tree itself at the end)

# CHAPTER VIII

# PRISMS

## Introduction

You have seen match box, an oil tin, a dice. Can you draw the figures of these objects ? Look at the pictures given below. Trace each of them on a drawing sheet and fold along the dotted lines. Do you know the names of these figures ?

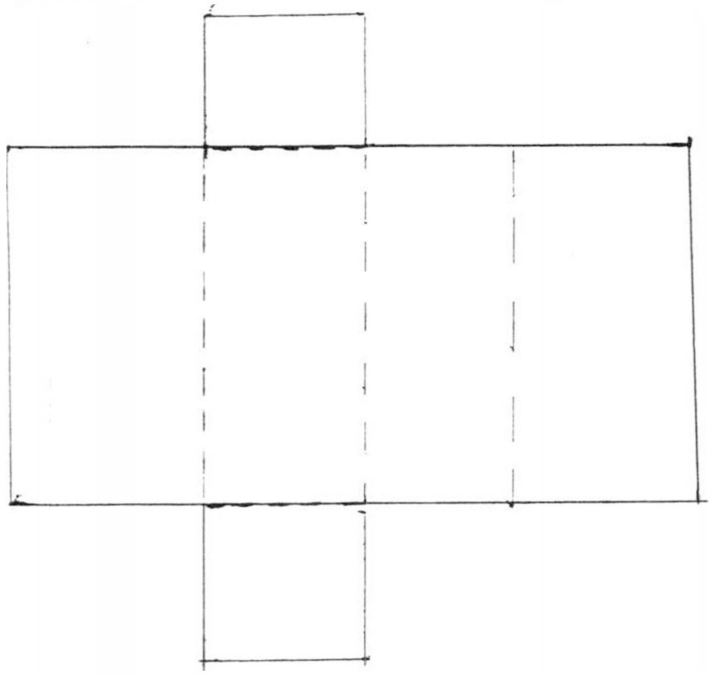
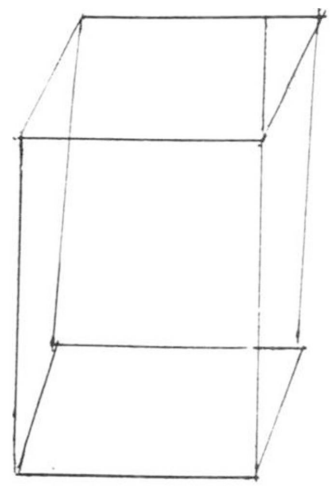


Fig 1



Rectangular prism

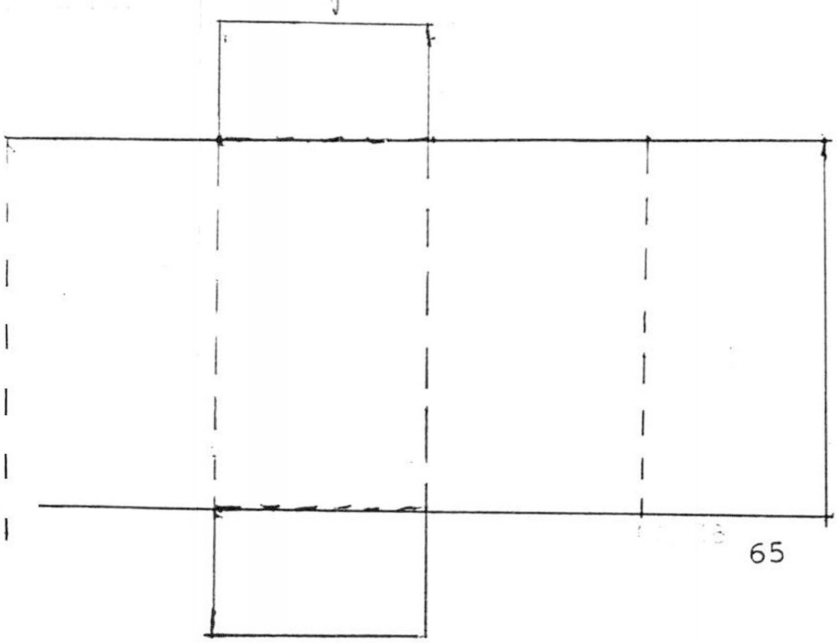
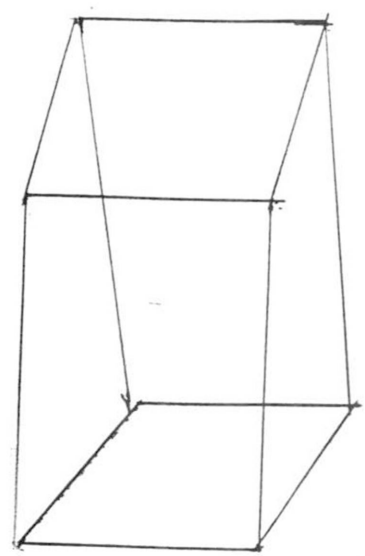


Fig 2



Square based prism.

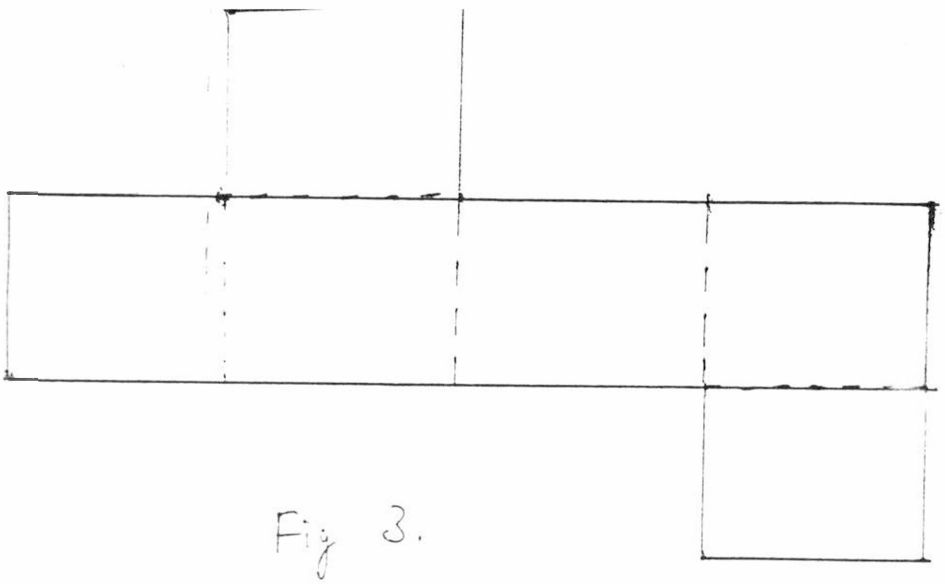
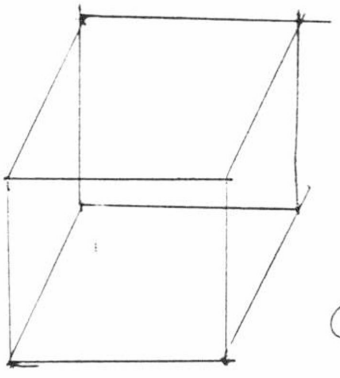
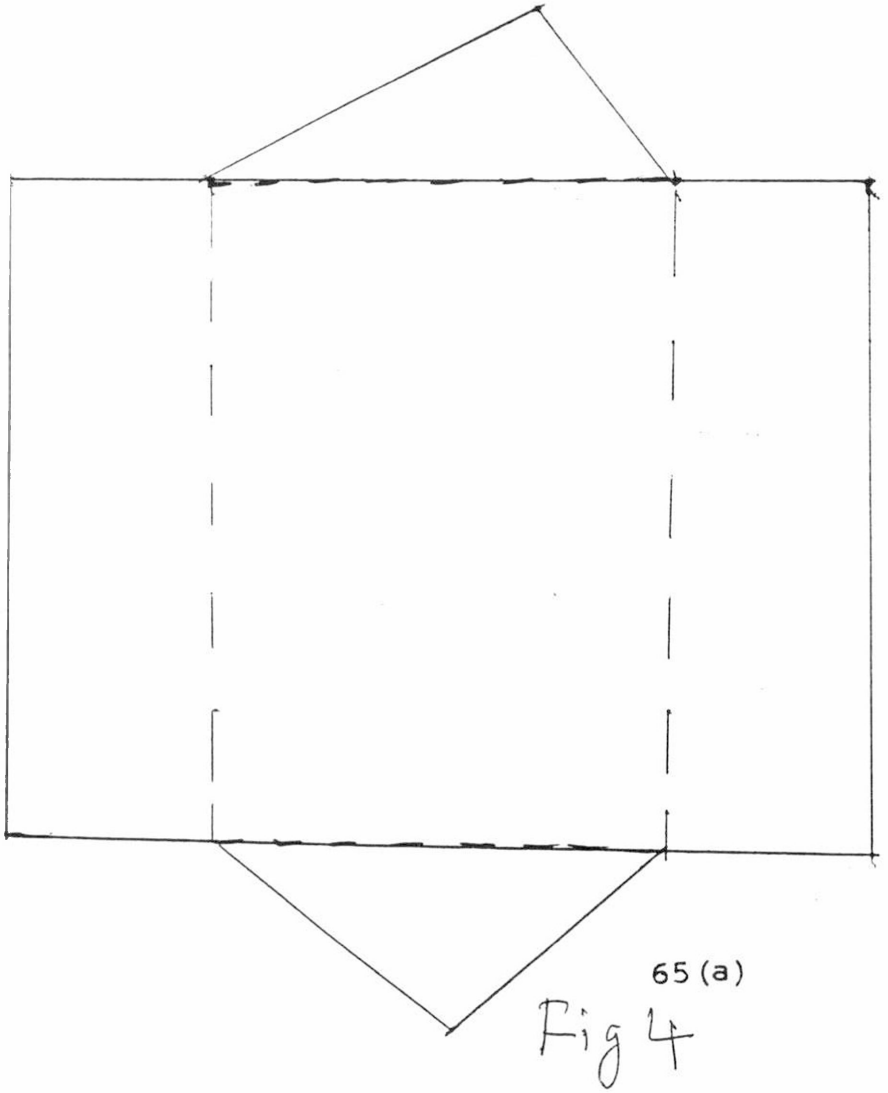


Fig 3.

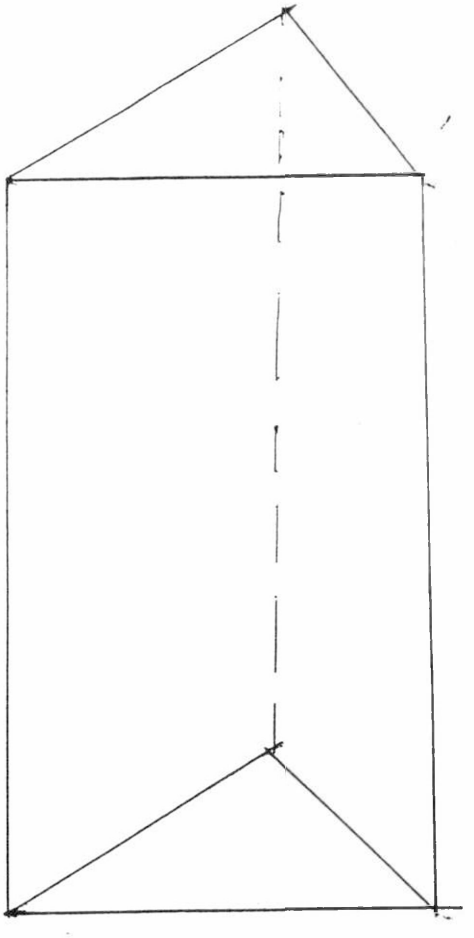


Cube.



65 (a)

Fig 4



Triangular based prism.

The solids you have made look like those shown by the side of them. These solids are called prisms.

Depending upon the shape, they are named as (1) rectangular prism, (2) square based prism, (3) cube. (4) triangular prism.

Now count the number of edges, vertices and faces of each prism. Enter them in the following table.

| Name of prism | No. of edges E | No. of vertices V | No. of faces F |
|---|---|---|---|
| 1. Rectangular prism | 12 | 8 | 6 |
| 2. Square prism | - | - | - |
| 3. Cube | - | - | - |
| 4. Triangular prism | - | - | - |

Try to verify the relation V+F = E+2 in each case. Fig. 1 is called a rectangular prism, since all the faces are rectangular in shape. In Fig. 2 the base is a square. Therefore it is called a square based prism.

What is the shape of each face of a cube ? Why the Fig. 4 is called a triangular prism ? You can answer these questions.

Thus have learnt about the types of prisms and the relation among the vertices, faces and edges of a prism in this chapter.

# CHAPTER IX

# SQUARE AND SQUARE ROOTS

## Introduction

You have learnt about natural numbers, fractions, and decimals in your previous class. Now you will learn about squares and square roots of numbers.

## 1. Rows and Columns

Kutti was playing with sand. She collected some marbles and tried to arrange them as shown below.

1 4 9

In how many rows she has arranged the marbles ? How many columns are there ? Can you arrange 16 marbles in equal number of rows and columns. In this case how many rows and columns that you find ? Similarly try to arrange 25 marbles in equal number of rows and columns.

You will observe that the marbles 4, 9, 16, 25 can be arranged in equal number of rows and columns. Can you say why ?

The numbers 1, 4, 9, 16, 25 are called square numbers. Hence it was possible to arrange the marbles in equal number of rows and columns.

There are 6 rows of chairs in a room. There are 6 chairs in each row. How many chairs are there in all ? It is very simple 6x6=36. This can also be written in the form of $6^2 = 36$.

**Activity**: Look at these examples and complete the table.

| | |
|---|---|
| $1 \times 1 = 1^2 = 1$ | $6 \times 6 =$ = |
| $2 \times 2 = 2^2 = 4$ | $7 \times 7 =$ = |
| $3 \times 3 = 3^2 = 9$ | $8 \times 8 =$ = |
| $4 \times 4 =$ = | $9 \times 9 =$ = |
| $5 \times 5 =$ = | $10 \times 10 =$ = |

You observe that when a number is multiplied by the same number, you get a square number.

[Thus the perfect square number is the product of two equal numbers. The square of a number is also denoted by the second exponent of the number.]

**Exercise 9.1**

1. Find the squares of all the counting numbers from 1 to 25.
2. Can you say the digits that do not occur in the unit place when a counting number is squared ?
3. Fill up the blanks with the same pattern. Can you explain the method of finding the correct answer ?

| | |
|---|---|
| $10 \times 10 = 10^2 = 100$ | $100 \times 100 = 100^2 = 10000$ |
| $20 \times 20 = 20^2 = 400$ | $200 \times 200 = 200^2 = 40000$ |
| $30 \times 30 =$ = | $500 \times 500 = 500^2 = 250000$ |
| $40 \times 40 =$ = | $600 \times 600 =$ = |
| $50 \times 50 =$ = | $800 \times 800 =$ = |
| | $3000 \times 3000 = 3000^2 =$ |

## 2a. Pythagorean Triplets

Find the squares of 3, 4 and 5. Can you find some relation among these square numbers ?

$3^2 = 9$; $4^2 = 16$; $5^2 = 25$

$9 + 16 = 25$

$3^2 + 4^2 = 5^2$

Similarly try with 6, 8 and 10

$6^2$ = _____; $8^2$ = _____; $10^2$ = _____

$10^2$ = _____ + _____

**Activity**: Try to find similar relations among the following sets of numbers.

1) 9, 12, 15 2) 5, 12, 13

3) 8, 15, 17 4) 7, 24, 25

These sets of numbers which satisfy the above condition are called pythagorian triplets.

Check whether the following sets of numbers

1) 5, 6, 7 2) 8, 9, 12

are pythagorian triplets. If not give reason.

## 2b) Squares of decimals and fraction

Look at these examples

If $(12)^2 = 144$ then $(1.2)^2 = 1.44$ $(0.12)^2 = 0.0144$

If $(15)^2 = 225$ then $(1.5)^2 = 2.25$ $(0.15)^2 = 0.0255$

If $(14)^2 = 196$ then $(1.4)^2$ = $(0.14)^2$ =

If $(16)^2 = 256$ then $(1.6)^2 =$ $(0.16)^2 =$

If $(25)^2 = 625$ then $(2.5)^2 =$ $(0.25)^2 =$

If the side of a square measures 4.5 cms, what is its area ?

Area of the square = 4.5 x 4.5

$= (4.5)^2$

$= 20.25$

Similarly if the side of a square measures $\frac{3}{4}$ metre then what is its area ?

Area of the square is $\frac{3}{4} \times \frac{3}{4} = \frac{3}{4}^2 = \frac{3^2}{4^2} = \frac{9}{16}$

Similarly $\frac{2}{5} \times \frac{2}{5} = \frac{2}{5}^2 = \frac{2^2}{5^2} = \frac{4}{25}$

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

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

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

From the above example it is clear that

$$\text{[Square of a fraction} = \frac{\text{Square of the numerator}}{\text{Square of the denominator}} \text{ ]}$$

**Exercise: 9.2**

1. Find the square of 0.3, 0.02, 0.05, 0.4, 0.007.

2. Match the following:

| A | B |
|---|---|
| $(0.6)^2$ | 0.000036 |
| $(0.06)^2$ | 36 |
| $(0.006)^2$ | 0.36 |
| $(6)^2$ | 0.0036 |

3. Find the squares and match the answers given in the brackets.

$\frac{2}{7}, \frac{3}{5}, \frac{9}{10}, \frac{2}{3}, \frac{5}{6}$ $\quad$ $\left[\frac{9}{25}, \frac{4}{9}, \frac{25}{36}, \frac{4}{49}, \frac{81}{100}\right]$

4. In each pair given below circle the larger number.

   $[1/2, (1/2)^2]$, $[3,4, (3/4)^2]$, $[5/3, (5/3)^2]$, $[7/6, (7/6)^2]$,

   $[0.5, (0.5)^2]$, $[0.11, (0.11)^2]$

5. a) If $(24)^2 = 576$ find the values of the following without actual multiplication (i) $(2.4)^2$ (ii) $(0.24)^2$ (iii) $(240)^2$

   b) If $(35)^2 = 1225$ find the values of the following without actual multiplication (i) $(3.5)^2$ (ii) $(0.35)^2$ (iii) $(0.035)^2$ (iv) $(350)^2$

**Square Root**

Suppose there are 36 students in your class if the teacher asks you to sit in equal number of rows and columns, how many rows will be there ? How many columns will be there ? Since the rows the columns are equal in number, is it not easy to find the

number whose square is 36, i.e. $36 = 6^2$. Here 6 is called the square root of 36.

Similarly, $81 = 9^2$ $\therefore$ 9 is called the square root of 81.

$49 = 7^2$ $\therefore$ 7 is called the square root of 49.

$121 = 11^2$ $\therefore$ 11 is called the square root of 121.

In symbols these are written as

$\sqrt{36} = \sqrt{6 \times 6} = \sqrt{6^2} = 6$

$\sqrt{49} = \sqrt{7 \times 7} = \sqrt{7^2} = 7$

$\sqrt{121} = \sqrt{11 \times 11} = \sqrt{11^2} = 11$

$\sqrt{81} = \sqrt{9 \times 9} = \sqrt{9^2} = 9$

$\sqrt{64} =$ $=$ $=$

$\sqrt{100} =$ $=$ $=$

How to find the square root of a number ? One of the method is by factorising the given number.

Example: Find the square root of 144

| | |
|---|---|
| 2 | 144 |
| 2 | 72 |
| 2 | 36 |
| 2 | 18 |
| 3 | 9 |
| | 3 |

$144 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$

$= 2^2 \times 2^2 \times 3^2$

$\sqrt{144} = \sqrt{2^2 \times 2^2 \times 3^2}$

$= 2 \times 2 \times 3$

$= 12$

$\therefore \sqrt{144} = 12$

Find the square root of 196.

| | | | |
|---|---|---|---|
| 2 \| 196 | 196 | = 2x2x7x7 |
| 2 \| 98 | | $= 2^2 \times 7^2$ |
| 7 \| 49 | $\sqrt{196}$ | $= \sqrt{2^2 \times 7^2}$ |
| 7 | | = 2 x 7 |
| | | = 14 |

Steps to workout the problem by factor method:

1. Write the prime factors of the given number.
2. Pair them with 2 as exponent for each factor.
3. Write them under radical sign.
4. Take the square root of each factor.
5. The product of these factors gives the square root.

Square roots of decimals and fractions:

Look at these examples.

(i) $\sqrt{0.04} = \sqrt{\frac{4}{100}} = \frac{\sqrt{4}}{\sqrt{100}} = \frac{2}{10} = 0.2$

(ii) $\sqrt{0.25} = \sqrt{\frac{25}{100}} = \frac{\sqrt{25}}{\sqrt{100}} = \frac{5}{10} = 0.5$

(iii) $\sqrt{0.0009} = \sqrt{\frac{9}{10000}} = \frac{\sqrt{9}}{\sqrt{10000}} = \frac{3}{100} = 0.03$

(iv) $\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{\sqrt{3x3}}{\sqrt{4x4}} = \frac{\sqrt{3^2}}{\sqrt{4^2}} = \frac{3}{4}$

(iv) $\sqrt{\frac{36}{49}} = \frac{\sqrt{36}}{\sqrt{49}} = \frac{\sqrt{6x6}}{\sqrt{7x7}} = \frac{\sqrt{6^2}}{\sqrt{7^2}} = \frac{6}{7}$

$$\text{Thus square root of a fraction} = \frac{\text{Square root of numerator}}{\text{Square root of denominator}}$$

$$\text{i.e.} \quad \sqrt{\frac{x}{y}} = \frac{\sqrt{x}}{\sqrt{y}}$$

**Exercise: 9.3**

1. Find the square root of

   256, 324, 484, 576, 625.

2. Find the square root of

   $\frac{9}{25}, \frac{16}{36}, \frac{25}{9}, \frac{625}{324}, \frac{196}{225}, \frac{256}{81}$

3. Write the rest 5 terms of the pattern below.

   $1 = 1$

   $1 + 3 = 4$

   $1 + 3 + 5 = 9$

   $1 + 3 + 5 + 7 = 16$

   .
   .
   .

What is special about the series ? Can you suggest an easy method to find the sum.

4. A side of a square napkin is 15 cms. Find its area.
5. Mani's grandfather has a square napkin of size 25 cms. Find its area.
6. Find the length of the side of the square field whose area is 3600 square meters.

7. A square hall has its area 6.25 sq mts. Find its perimeter.
8. In a pendol 2025 chairs are arranged in equal number of rows and columns. How many chairs are there in each row ?
9. The length and breadth of a rectangular field are 80 mts and 20 mts. Find the length of the side of a square field whose area is equal to that of the rectangular field.

Thus in this chapter you have learnt about the square and square roots of numbers.

## ANSWERS

Ex: 9.1

2) (3, 7,8)

Ex: 9.3

1) 16, 18, 22, 24, 25

2) $\frac{3}{5}, \frac{4}{6}, \frac{5}{3}, \frac{25}{18}, \frac{14}{15}, \frac{16}{9}$

4) 225 sq cms

5) 625 sq cms

6) 60 mts

7) 10 mts

8) 45 mts

9) 40 mts

# CHAPTER X

# ALGEBRAIC EXPRESSIONS

## 1. Introduction

You have learnt about the fundamental operations with natural numbers. You know how to write mathematical statements. Look at these statements.

1. "The sum of five and three" 5 + 3
2. "Six times four" 6 x 4
3. "Sum of four and eight" 4 + 8
4. "Three times five" 3 x 5
5. "Sum of x and five" x + 5
6. "3 times y" 3 x y
7. "Sum of x, y and z" x + y + z
8. "Three times p + 2 times q" 3xp + 2xq

In the first four statements natural numbers are used and their values can be found out as 8, 24, 12, 15. In the last four examples the values of x, y, z, p, q are not known. They can take any you like,

In (5) if x = 8 then x+5 = 8+5 = 13

In (6) if y = 4 then 3xy = 3x4 = 12

Thus the varying numbers x, y, z, etc. are called variables. The terms x+5, 3xy, x+y+z, 3xp + 2xq are called "algebraic expressions".

Arun purchases three note books at Rs. x per book and five pencils at Rs. y per pencil, what is the total amount of money has to pay ?

Cost of one book = Rs. x

Cost of three books = 3 x x = Rs. 3x

Cost of one pencil = Rs. y

Cost of five pencils = 5 x y = Rs. 5y

Total amount that Arun has to pay is Rs. 3x+5y. This is an algebraic expression.

How many variables are there ?

Which are the variables ?

2. Monomials, Binomials, Trinomials and Coefficients

Look at these algebraic expressions, 4x, 5y, 2x+3y, 4x-3y+2z, 5p-2q, 2p+3q-r.

Some of these expressions contain only one term like 4x, 5y. They are called monomials.

Some of them contains two terms like 2x+3y, 5p-2q. They are called binomials.

The algebraic expression contain three terms like 4x-3y+2z, 2p+3q-r are called Trinomials.

Mohan and his friends are making algebraic expressions choosing 2 or 3 times from the table. Let us take a look at some of the expressions they have made.

| | | | |
|---|---|---|---|
| 5x | 4p | -2q | 4m |
| 3y | 4n | 4z | 2l |
| 7a | -5b | 6c | 7 |
| 3r | 5d | 8x | 5y |

Mohan : 5x + 4p - Binomial

Reena : 4p - 2q - Binomial

Santhosh : 7a + 6c - 5b - Trinomial

Can't you also make some expressions like this by choosing 2 or 3 from the table. Give some examples.

Consider an algebraic expression 3x-4y+9z. Here there are three terms. The first term has a variable x and a number 3. It is three times x. The number 3 is called the coefficient of the variable x.

The coefficient of y in the second term is -4.

The coefficient of z in the third term is 9.

Here are some expressions. Write the variable and the coefficients in each term.

1. 4x - 5y
2. 3x + 5y - 4z
3. 4p - 5q
4. 5m + 7n
5. 4a + 5b - 8c

### 3. Exponents

Think of an unknown number say x multiply it by itself. What do you get ? It is $x \times x$. This can be written as $x^2$.

Multiply it again by itself. Then what do you get ? It is $x \times x \times x$. This can be written as $x^3$. Here 2 and 3 are called the powers of x. They are also known as exponents or index.

Similarly,

$y \times y = y^2$; $y \times y \times y = y^3$; $y \times y \times y \times y = y^4$; $x^2 \times x^3 = x^5$; $y \times y^2 \times y^3 = y^6$

In $4x^2$ variable is x; coefficient of $x^2$ is 4; power of x is 2

In $-5m^4$ variable is m; coefficient of m is -5; power of m is 4

In $9p^5$ variable is p; coefficient of p is 9; power of p is 5

In $6a^3$ - - -

In $-3y^4$ - - -

In $8x^6$ - - -

### 4. Like and Unlike Terms

Look at these algebraic terms

1. 3ab, 5ab, -7ab
2. $2y^2$, $-3y^2$, $6y^2$
3. 10a, 7b, 5c
4. $8x^2$, $3y^2$, $6z^2$

In the first two examples each term contains the same variables ab in (1) and $y^2$ in (2). They are called like terms.

In examples (3) and (4) the variables are different in each term. They are called unlike terms.

Let us classify the following into sets of like and unlike terms.

1. 5a, 5b, -6a, -3c, 2b, 4c, 3x

The sets of like terms are

(5a, -6a); (5b, 2b); (-3c, 4c); 3x

2. $3x^2$, 5yz, $-2z^2$, 4yz, $8z^2$, $4x^2$

The sets of like terms are

($3x^2$, $4x^2$); (5yz, 4yz); ($-2z^2$, $8z^2$)

3. Can you collect the like terms and write them from the table.

| | | | |
|---|---|---|---|
| 3x | 4y | 5p | 4a2 |
| 5a2 | 6x | -8y | -3p |
| 2p | -4y | -3x | 4a2 |

**5. Addition and Subtraction of algebraic terms:**

Santhosh knows how to add 5 and 3, i.e. 5+3 = 8. He wanted to know how to add the like terms 5x and 3x. He asked his brother. His brother helped him to add. He said, you know the sum of 5x and 3x is 5x + 3x = (5+3)x = 8x. Santhosh was happy. He tried to subtract. 5x - 3x = (5-3)x = 2x and showed that to his brother. He told it is okay. Thus Santhosh came to know that it is very simple to add or subtract like terms.

Can you try to add or subtract the like terms ?

10p + 7p = _____ 5x + 9x = _____ 8x - 5x= _____

5y - 3y = _____ $8y^2 + 4y^2$ = _____ 4xy + 2xy = _____

$15x^2 - 8x^2$ = _____ $5z^2 - 4z^2$ = _____ 8a - 3a = _____

Santhosh wanted to add 5x and 3y. He asked his brother. His brother asked him what types of terms they are ? Santhosh told that they are unlike terms. It is okay. Then you can write the sum as 5x+3y only. Because they are unlike terms. Then his brother asked him what is the sum of 3a and 2b. Santhosh said 3a+2b quickly. He was happy because he was able to give correct answer. He tried to find the sum of the algebraic expressions on the same lines.

E.g.: Find the sum of

1. $4x + 10y, 9x + 7y$

$$\begin{array}{r} 4x + 10y \\ 9x + 7y \\ \hline (4+9)x + (10+7)y \\ 13x + 17\ y \end{array}$$

2. $3p - 4q, 4p - 5q$

$$\begin{array}{r} 3p - 4q \\ 4p - 5q \\ \hline (3+4)p + (-4-5)q \\ 7p + (-9)q \\ 7p - 9q \end{array}$$

**Exercise: 10.1**

Now you can find the sum of the algebraic expressions given below.

1. $4a + 2b + 3, 2a + 5b + 6$
2. $3x - 4y + 2z, 4x - 5y + 6z$
3. $2x^2 + 3x - 4, 3x^2 - 6x + 5c$
4. $4a - 5b + 2c, 7a - 6b - 5c$
5. $5xy - 7x - 4y; 2xy + 10x - 6y$

Look at these examples.

| | | | |
|---|---|---|---|
| +5x | +5x | -5x | -5x |
| +2x | +2x | +2x | +2x |
| (-) | (+) | (-) | (+) |
| ----- | ------ | ------ | ------ |
| (5-2)x | (5+2)x | (-5-2)x | (-5+2)x |
| 3x | 7x | -7x | -3x |

You will find that you have to change the sign of the number to be subtracted and then add them. Try some more problem of the same type.

**Exercise: 10.2**

| | | | |
|---|---|---|---|
| 1. 7y | 2. 7y | 3. -7y | 4. -7y |
| +3y | -3y | +3y | -3y |
| ---- | ---- | ---- | ---- |
| ---- | ---- | ---- | ---- |

| | | | |
|---|---|---|---|
| 5. 4x + 3y | 6. 4x + 3y | 7. -4x - 3y | 8. -4x - 3y |
| 2x + y | -2x - y | 2x - y | -2x - y |
| ------ | ------- | ------- | -------- |
| ------ | ------- | ------- | -------- |

9. (9x + 7y) - (4x + 5y)

9x + 7y
4x + 5y
(-) (-)
---
(9-4)x + (7-5)y
5x + 2y

10. (10p + 4q) - (3p + 8q)

10p - 4q
3p - 8q
(-) (+)
---
(10-3)p + (-4+8)q
7p + 4q

11. Subtract $2x + 3y - 5z$ from $4x - 7y + 6z$

12. What expression subtracted from $4x + 3y + 10z$ gives $5x-6y+4z$.

13. Subtract $3a - 2b + 5c$ from $4a + 5b - 4c$.

14. From $4p^2 + 2p + 1$ subtract $2p^2 + 4p - 5$.

15. $(4a^2 + 5ab - b^2) - (2a^2 - 4ab + 3b^2)$

16. $(2x - 6y + z) - (4x + 7y - 2z)$

**6. Multiplication and Division of Algebraic Expressions**

Shashi knew how to multiply 4 and 3 or divide 8 by 2, i.e. $4x3= 12$, $\underline{8} \div 2 = 4$. If they are $4x$ and $-3y$ she was not able to multiply or divide them. She asks her father to tell her how to multiply or divide the algebraic expressions. Her father told her to know the laws of applicable during multiplication or division of algebraic terms.

(i) $(+a) \times (+b) = +ab$ $\quad +a \div +b = + a/b$

(ii) $(+a) \times (-b) = -ab$ $\quad +a \div -b = -a/b$

(iii) $(-a) \times (+b) = -ab$ $\quad -a \div +b = -a/b$

(iv) $(-a) \times (-b) = +ab$ $\quad -a \div -b = +a/b$

The product of two terms having like signs is positive. The product of two terms with unlike signs is negative. The same rule holds good even for division.

Now Shashi was able to find the product of $4x$ and $-3y$, i.e. $+4x \times -3y = -12xy$. Shashi tried some more problems of the same type.

1. $2x \times 5y = 10xy$

2. $-3a \times 8b = -24ab$

3. $-4m \times -3n = +12\ mn$

4. $5p \times -3q = -15\ pq$

5. $\frac{6x^2}{2x} = 3x$

6. $\frac{-6x^2}{2x} = -3x$

7. $\frac{6x^2}{-2x} = -3x$

8. $\frac{-6x^2}{-2x} = 3x$

**Exercise: 10.3**

Now you can find the product of 2 algebraic terms.

1. $4a \times 3b =$

2. $-5a \times 2a =$

3. $4x \times -3y =$

4. $-3m \times -6n =$

5. $2x \times 4x =$

6. $3y \times -4y =$

7. $-6m \times 3m =$

8. $-5a \times -4a =$

9. $4y \times -2y =$

10. $3p \times -5q =$

11. What is the area of a rectangle of length 5x cms and breadth 3y cms ?

12. What is the area of a square of side 5 a cms ?

13. Connect the equals.

| | | | | |
|---|---|---|---|---|
| 2bx3c | 2ax-3b | -3ax2c | -2ax-3b | 3cx2a |
| 6ca | -6ac | 6ab | 6bc | -6ab |

14. Simplify

a) $\frac{2a^2 \times 3a}{6a}$

b) $\frac{4m^2 \times 6m^3}{12m^4}$

c) $\frac{5x^4 \times 10x^3}{25x^5}$

d) $\frac{6m^2 \times -2m^3}{4m^4}$

e) $\frac{3a^2 \times 4b^2}{6ab}$

15. Simplify

a) $\frac{-4x^3 \times -5y^2}{20x^2y}$ b) $\frac{-4p^2 \times 6q^3}{12qp^2}$ c) $\frac{x^3 \times 4x^2}{2x^4}$

d) $\frac{-4y^3 \times -6x^2}{10y^2x}$ e) $\frac{m^4 \times 5n^2}{m^3n}$

**7. To find the value of algebraic expressions**

Anjali learnt about algebraic expressions. An algebraic expression contains variables like x, y, a, b, etc. She wanted to know what happens to an expression 3x + 5y when x= 2, y = 4 ? She tried as follows.

$3x + 5y = 3 \times x + 5 \times y$

$= 3 \times 2 + 5 \times 4$

$= 6 + 20$

$= 26$

She asked her teacher whether she is correct. Her teacher was very happy because Anjali had done the problem using the correct principle. Teacher said it is okay. Try to find the value of 3x + 5y when x = 4, y = 2.

$3x + 5y = 3 \times x + 5 \times y$

$= 3 \times 4 + 5 \times 2$

$= 12 + 10$

$= 22$

She learnt that as the value of the variables changes the value of algebraic expression also changes.

**Exercise: 10.4**

You can find the value of algebraic expressions given below.

1. $2x + 3y + z$ when $x = 3, y = 2, z = 5$
2. $3a - b + 2c$ when $a = 4, b = 3, c = 1$
3. $x^2 + 4x + 2$ when $x = 2$
4. $p^2 + 2pq + q^2$ when $p = 5, q = 6$
5. $xy + yz - zx$ when $x = 1, y = 2, z = 3$
6. If $a = 1, b = -2, c = 3$, find the value of
   (i) $a^2 + b^2 + c^2$
   (ii) $ab + bc + ca$
   (iii) $a^3 + b^3 + c^3 - 3abc$

In this chapter you have learnt about algebraic expressions, meaning of monomials, binomials, trinomials, exponent and coefficient. You have also studied about the fundamental operations with algebraic expressions and finding the value of expressions.

## ANSWERS

**Ex: 10.1**

1) $6a + 7b + 9$, 2) $7x - 9y + 8z$, 3) $5x^2 - 3x + 1$, 4) $11a - 11b - 3c$,

5) $7xy + 3x - 10y$

**Ex: 10.2**

11) $2x - 10y + 11z$ 12) $-x + 9y + 6z$

13) $a + 7b - 9c$ 14) $2p^2 - 2p + 6$

15) $a^2 + 9ab - 2b^2$ 16) $-2x - 13y + 3z$

**Ex: 10.3**

11) 15xy sq cms 12) $25a^2$ sq cms 14) (a) $a^2$, (b) 2m,

(c) $2x^2$, (d) -3m, (e) 2ab

15) (a) xy, (b) -2pq, (c) 2x, (d) 12xy/5, (e) 5mn

**Ex: 10.4**

1) 17, 2) 11, 3) 14, 4) 121, 5) 5, 6) (i) 14, (ii) -5, (iii) 38

# CHAPTER XI

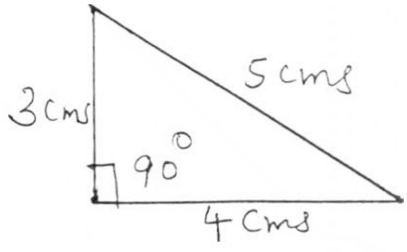
# PYTHAGORAS THEOREM

## 1. Introduction

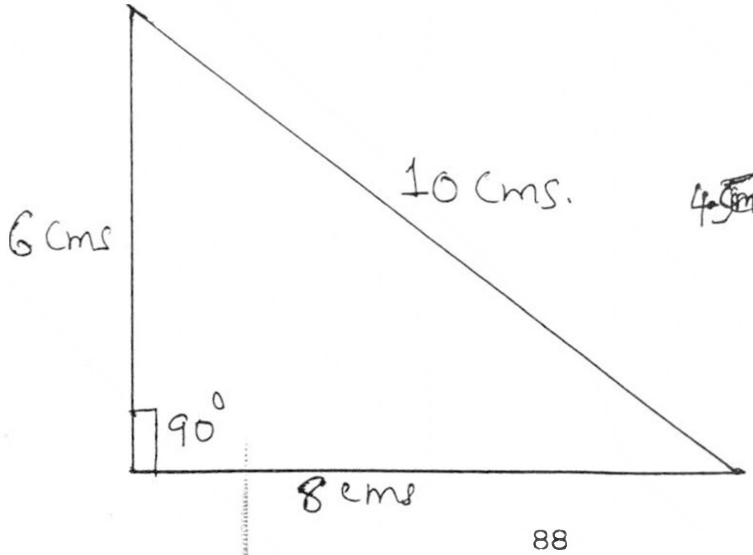
You have studied about the triangles in your previous classes. One important theorem concerning a right angled triangle has come to be known as Pythagora's theorem. Pythagoras, an outstanding Greek Philosopher and Mathematician, who lived in 570-490 B.C. You will know more about right angled triangle.

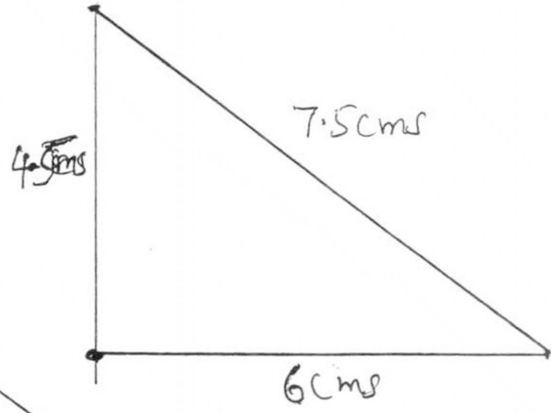
Construct the triangles with the following measurements.

1. 6 cm, 8 cm, 10 cm
2. 3 cm, 4 cm, 5 cm
3. 4.5 cm, 6 cm, 7.5 cm

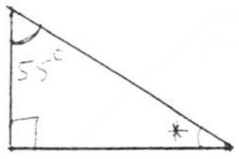



In each triangle find the measure of the greatest angle. The measure of the greatest angle will be 90°. The triangle having an angle as 90° is called right angled triangle.



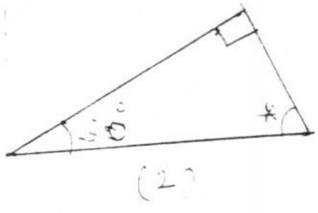



Find the value of marked angle in the figure.



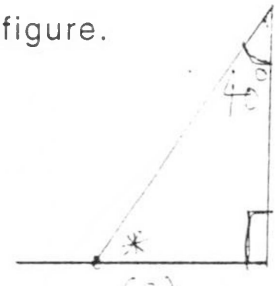

(1)

* = ——



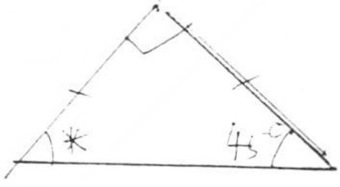

(2)

* = ——




(3)

* = ——




* = ——

2. Names of the sides of a right angled triangle.

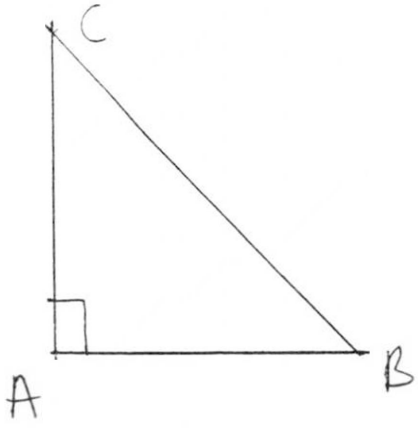
Consider a right angled triangle ΔABC in which ∠A = 90°.

Which is the side opposite to the right angle ?

The side opposite to the right angle is called the Hypotenuse.

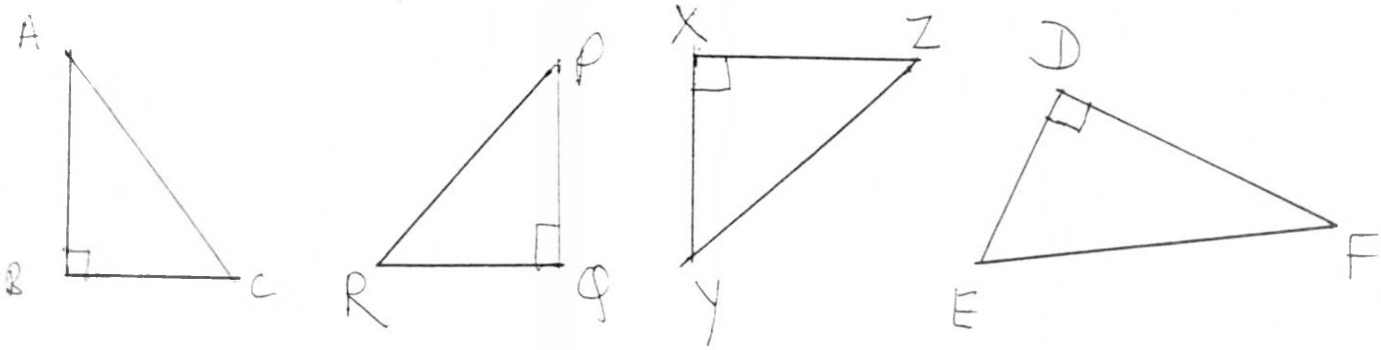
The other two sides are called Base and altitude of the triangle.

In ΔABC if AB is considered as base then AC is the altitude and if AC is the base, then AB is the altitude.



**Exercise**

1. Here are some right angled triangles. Find the hypotenuse in each of them.



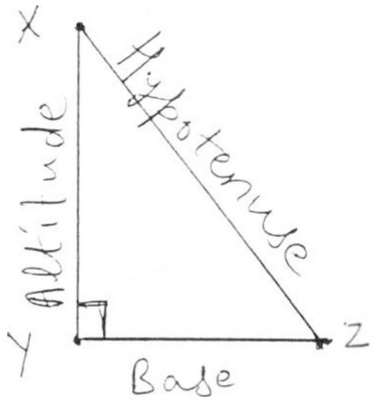

2. The largest side of a right angled triangle is _____.
3. The measure of greatest angle of a right angled triangle is _____.
4. The angle of a right angled triangle other than the right angle are _____ angles.
5. If the two acute angles of a right angled triangle are equal, then each one of them measure _____.
6. The maximum number of right angles in a right angled triangle is _____.

**3. Towards a relation**

You have drawn few right angled triangles. Measure their sides and complete the table below.

| Sl. No. | Base | Altitude | Hypote nuse | Base$^2$ | Altitude$^2$ | Hypot enuse$^2$ | Relation |
|---|---|---|---|---|---|---|---|
| 1 | 3 | 4 | 5 | $3^2=9$ | $4^2=16$ | $5^2=25$ | $3^2+4^2=5^2$ |
| 2 | 6 | 8 | 10 | - | - | - | - |
| 3 | 6 | 4.5 | 7.5 | - | - | - | - |
| 4 | 9 | 12 | 15 | - | - | - | - |

You will notice some relation among the squares of base, altitude and hypotenuse of a right angled triangle.




This relation is formed by a Greek Mathematician Pythagoras. So we call it Pythogorian theorem. The relation is

$(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Altitude})^2$

$= 3^2 + 4^2$

$= 9 + 16$

$= 25$

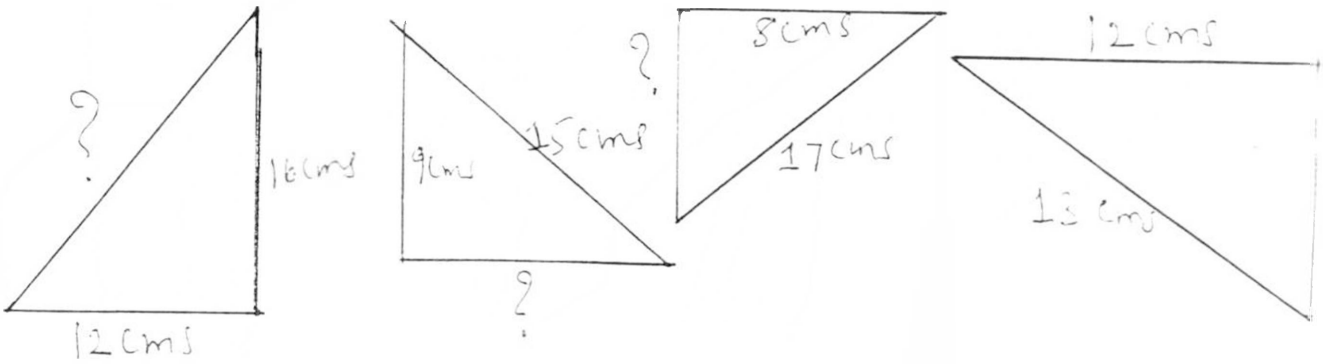
$\text{Hypotenuse} = \sqrt{25} = 5$

Complete the table below.

| Sl.No. | Base | Altitude | Hypotenuse |
|---|---|---|---|
| 1 | 10 cm | 24 cm | - |
| 2 | 24 cm | 7 cm | - |
| 3 | - | 40 cm | 41 cm |
| 4 | - | 60 cm | 61 cm |
| 5 | 21 cm | - | 29 cm |

**Exercise**

1. Find the length of the third side in the following figures.




The largest side of right angled triangle is its hypotenuse. So by the Pythagoras theorem, the square of the longest side of a right angled triangle is the sum of the squares of the other sides. Infact the converse of Pythagoras theorem is also true.

Find out which of the triangles with sides as given below are right angled by using the converse of Pythagoras theorem.

| | | | |
|---|---|---|---|
| 1. | 8 cm | 15 cm | 17 cm |
| 2. | 5 cm | 6 cm | 7 cm |
| 3. | 20 cm | 21 cm | 29 cm |
| 4. | 12 cm | 15 cm | 27 cm |
| 5. | 4.5 cm | 20 cm | 10.5 cm |

**4. Pythagorean Triplets**

Three counting numbers which occurs as the lengths of the side of a right angled triangle are called a Pythagorean Triplets.

E.g.: 1) 3, 4, 5

2) 6, 8, 10

3) 9, 12, 15

**Exercise**

1. Identify which of the sets from Pythagorean Triplets in the following.

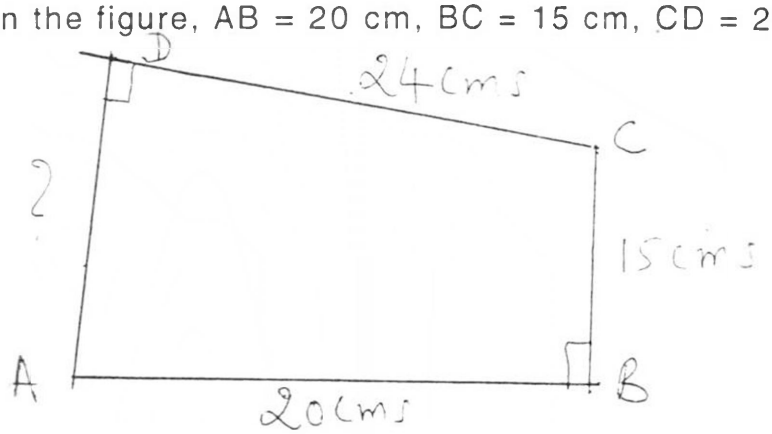
   (a) 9, 15, 22
   (b) 17, 15, 8
   (c) 5, 13, 12
   (d) 4, 7, 8

2. A ladder 13 m long leans against a wall. The foot of the ladder is 5 m away from the wall. How high is the top of the ladder be from the ground ?

3. An arecanut tree is 32 m high. It is broken at a height of 15 m from the ground and the top of the tree touches the ground. How far away is the top from the bottom now ?

4. Two posts standing erect are 8 m and 15 m high. If they stand 24 m apart, find the distance between their tops.

5. In the figure, AB = 20 cm, BC = 15 cm, CD = 24 cm, find AD.




In this chapter you have learnt about the right angled triangle and the relation among the sides.

**Answers**: (1) (c), (b); (2) 12 m; (3) 8 m; (4) 25 m; (5) 7 cm

# CHAPTER XII

# TIME AND DISTANCE

Rani and Reena are sisters. They are studying in the same school. One day they left the home together to go to school. But Rani wanted to post a letter. She went to post office, posted the letter and then went to school. But both of them reached the school at the same time. Who walked faster ?

Gopal and Manohar are friends. They thought of a trip on a holiday. Gopal travelled in a car and took 3 hours to reach Thekkady, which was 150 kms away from his pace. Manohar travelled in jeep and took 2 hours to reach Athirapally which was 90 kms away from his place, which travelled faster car or jeep ?

In the first example, the distance travelled is different, but the time taken is same. In the second example both time and distance are different. To Compare the speed of different vehicles, the distance travelled in unit time is considered.

A train started from Cannanore at 6 am reached Trivandrum at 5 pm which is 440 kms away from Cannanore. What distance the train has travelled in each hour.

To find the answer you have to divide the total distance travelled by the train by the time taken for the journey.

Total distance = 440 kms (D)

Time taken for the journey = 11 hours (T)

The distance travelled in one hour = 440/11 = 44 kms

The distance travelled in a unit time is called the speed. Therefore the speed of the train is 44 kms per hour.

$$\therefore \text{Average speed} = \frac{\text{Total distance travelled}}{\text{Time taken}}$$

In symbols it can be written as

$$S = \frac{D}{T}$$

1) A car travelled 500 kms in 10 hours. Find the speed of the car ?

$$S = \frac{D}{T}$$

D = 500 kms

T = 10 hours

$$\therefore S = \frac{500}{10}$$

$$= 50 \text{ kms/hour}$$

2) A train travelled in an average speed of 60 km/hr took 8 hours to reach Chennai. Calculate the distance travelled by the train to reach Chennai.

$$S = \frac{D}{T}$$

Hence D = S x T

S = 60 km/hour

T = 8 hours

$\therefore$ D = 60 x 8

= 480 kms

3) A car is travelling in an average speed of 50 km/hour travelled 300 km. Find out the time taken by the car for the journey ?

$$S = \frac{D}{T}$$

Hence

$$T = \frac{D}{S}$$

D = 300 km

S= 50 km/hour

$$\therefore T = \frac{300}{50}$$

= 6 hours

**Exercise 12.1**

1. Fill up the table

| Distance travelled | Time taken | Average speed |
|---|---|---|
| 300 km | 10 hours | - |
| - | 8 hours | 40 km/hour |
| 825 km | - | 75 km/h |
| 600 km | - | 100 km/h |
| - | 6 hours | 55 km/h |
| 750 km | 5 hours | - |
| 100 km | 4 hours | - |

2) A bus started at 7 am from Ernakulam reached Calicut at 12 noon. The distance between Ernakulam and Calicut is 225 km. Calculate the speed of the bus ?

3) A train travelling with an average speed of 60 km/hour took 7 hours to reach a place. Calculate the distance covered by the train during that journey.

4) Geetha is travelling by a car with an average speed of 70 km/hr. She travelled 350 km. Find out the time taken by her for that journey.

Look at this example,

Ravi travalled 2½ hour in a bus and 1½ hour in a train. The average speed of the bus was 40 km/h and the average speed of the train was 80 km/hr. What was the average speed of the journey ?

$$S \times T = D$$

Distance travelled by the bus = 40 x 2½ = 100 kms

Distance travelled by the train = 80 x 1½ = 120 kms

Total distance = 100 + 120 = 220 km

Total time taken = 2½ + 1½ = 4 hours

Hence,

$$\text{The average speed} = \frac{220}{4}$$

$$= 55 \text{ km/hour}$$

**Exercise: 12.2**

1. Rani want to see her friend at Trivandrum which is 120 km away from her house. She travelled in fast passenger pus of an average speed of 40 km/hr. Her return journey was in an ordinary bus of an average speed of 30 km/h. Calculate the average speed of the journey.
2. Thomas travelled 3 hours in a car and 2 hours in a train. The average speed of the car was 60 km/hr and the average speed of the train was 70 km/hr. What was the average speed of the journey.

You have learnt that the average speed is expressed in kms/hr. It can also be expressed as mts/sec which are the smaller units.

1 km/hour = 1000 meter/3600 seconds

$$1 \text{ km/hour} = \frac{5}{18} \text{ m/sec}$$

1. 54 km/hour convert it into m/sec.

$$1 \text{ km/hour} = \frac{5}{18} \text{ m/sec}$$

$$54 \text{ km/hour} = \frac{54 \times 5}{18}$$

$$= 15 \text{ m/sec}$$

2. 90 km/hr

$$1 \text{ km/hour} = \frac{5}{18} \text{ m/sec}$$

$$90 \text{ km/hour} = \frac{90 \times 5}{18} = 25 \text{ m/sec}$$

$$= 15 \text{ m/sec}$$

3. 30 m/sec convert it into km/hour.

$$\frac{5}{18} \text{ m/sec} = 1 \text{ km/h}$$

$$1 \text{ m/sec} = \frac{18}{5} \text{ km/h}$$

$$30 \text{ m/sec} = \frac{30 \times 18}{5} \text{ km/h}$$

$$= 108 \text{ km/hour}$$

**Exercise: 12.3**

1. Complete the table

| Time | 1 hour | 3 min | 15 min | 10 min | 5 min | 1 min |
|---|---|---|---|---|---|---|
| Distance | 120 kms | - | - | - | - | - |

2. Convert the following into m/sec.

   a) 36 km/h

   b) 72 km/h

   c) 126 km/h

3. Convert the following into km/h.

   a) 15 m/sec

   b) 25 m/sec

   c) 35 m/sec

4. A train is travelling with an average speed of 90 km/h. If the length of the train is 100 m, what time will it take to pass a telephone post.

In this chapter you have learnt about the meaning of sped, and conversion of km/hour into m/sec.

## ANSWERS

Ex: 12.1

2) 45 km/hr 3) 420 kms 4) 5 hours

Ex: 12.2

1) 34 2/7 km/hr 2) 64 km/hr

Ex: 12.3

2) (a) 10 m/sec (b) 20 m/sec (c) 35 m/sec

3) (a) 54 kms/hr (b) 90 kms/hr (c) 126 kms/hr

4) 4 secs

# CHAPTER XIII

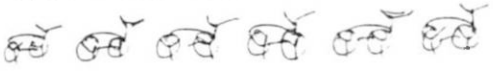
## COMPARISON THROUGH PICTURES

Arun was fond of looking at the pictures in Newspapers. One day he saw the pictures of number of bicycles given infront of various states in the paper. He was not able to understand because he saw only 5 bicycles infront of Kerala. Did they sell only 5 bicycles in Kerala ? He wondered.

Kerala

Tamil Nadu

Andhra Pradesh

Karnataka 

He showed the paper and asked his father about the picture. His father observed carefully and showed that one bicycle stands for 1000 bicycles to Arun. Can you say how many cycles are sold in Kerala ? Arun answered 5000 bicycles. Can you find out how many are sold in other states ? Arun was able to answer these questions.

Thus a picture reveals the facts clearly and their numbers. The comparison becomes easy through pictures. Pictures have a strong appeal even to a lay man. A figure which shows numerical details through pictures is called a Pictogram.

E.g. 1: The production of tyres in various countries are given below as Pictogram. Examine the figures and complete the table below and answer the questions given.

Germany

Ireland

Australia

India

China

| Country | Number of tyres |
|---|---|
| Germany | |
| Ireland | |
| Australia | |
| India | |
| China | |

Which countries production is maximum ?

Which countries production is minimum ?

Name the two countries which have the same production.

E.g. 2: Jain aparels company makes ready-made dresses. The pictogram shows its production of vests over a continuous period of six years. Use it to fill the table below.

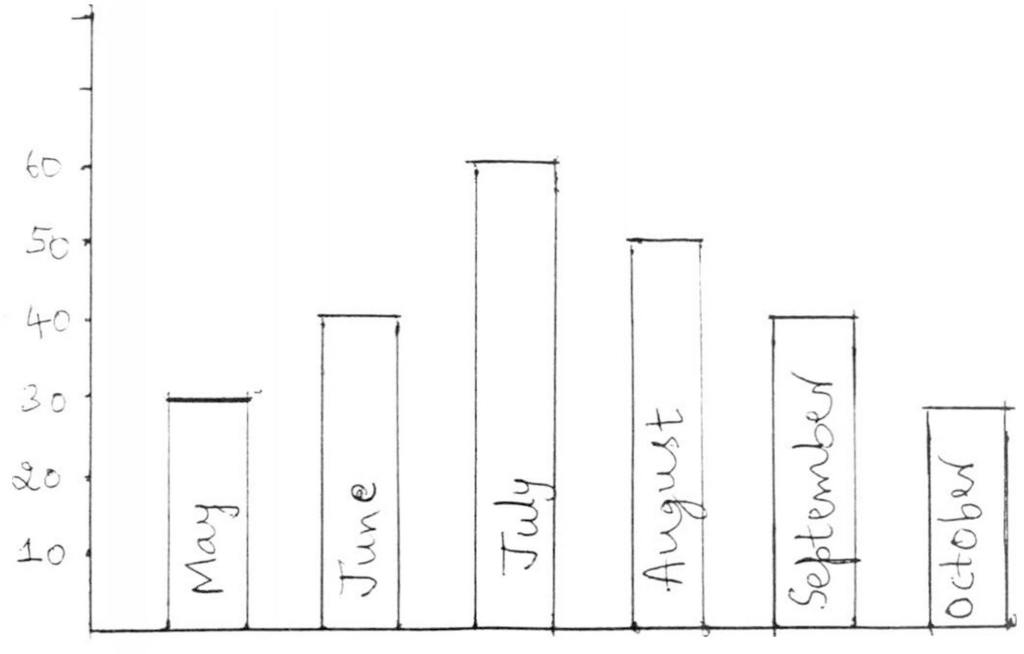
| Year | Production |
|---|---|
| 1993 | |
| 1994 | |
| 1995 | |
| 1996 | |
| 1997 | |
| 1998 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1993 | T | T | T | | | | | |
| 1994 | T | T | T | T | | | | |
| 1995 | T | T | T | | | | | |
| 1996 | T | T | T | T | T | | | |
| 1997 | T | T | T | T | T | T | | |
| 1998 | T | T | T | T | T | T | T | T |

T = 10,000 vests

Which year recorded the maximum production ? During which years was the production the same ? During which years did the production exceed 50000 ? By how much did the production in 1998 exceed in 1996.

E.g. 3: The Monsoon

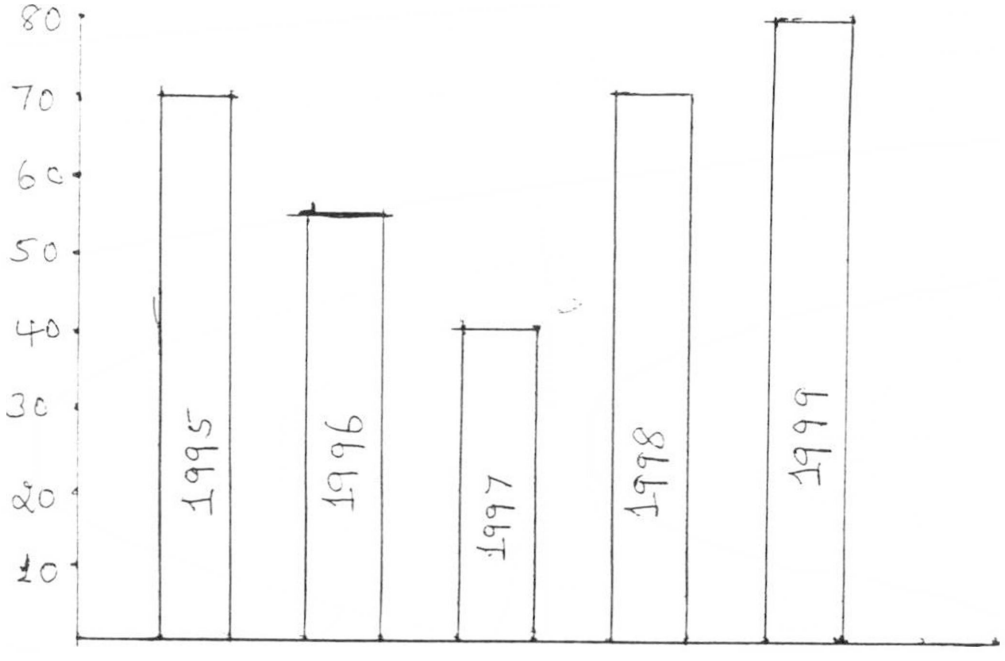


The bar graph shows the amount of rainfall in a place over six continuous months.

Which month recorded the maximum rainfall ?

Which month recorded the minimum rainfall ?

E.g. 4: To School




The bar diagram shows the number of students admitted to the fifth standard during five consecutive years in Jyothi school. Examine the diagram and complete the table below.

| Year | Number of students |
|---|---|
| 1995 | |
| 1996 | |
| 1997 | |
| 1998 | |
| 1999 | |

How many students joined in 1998 ? _____

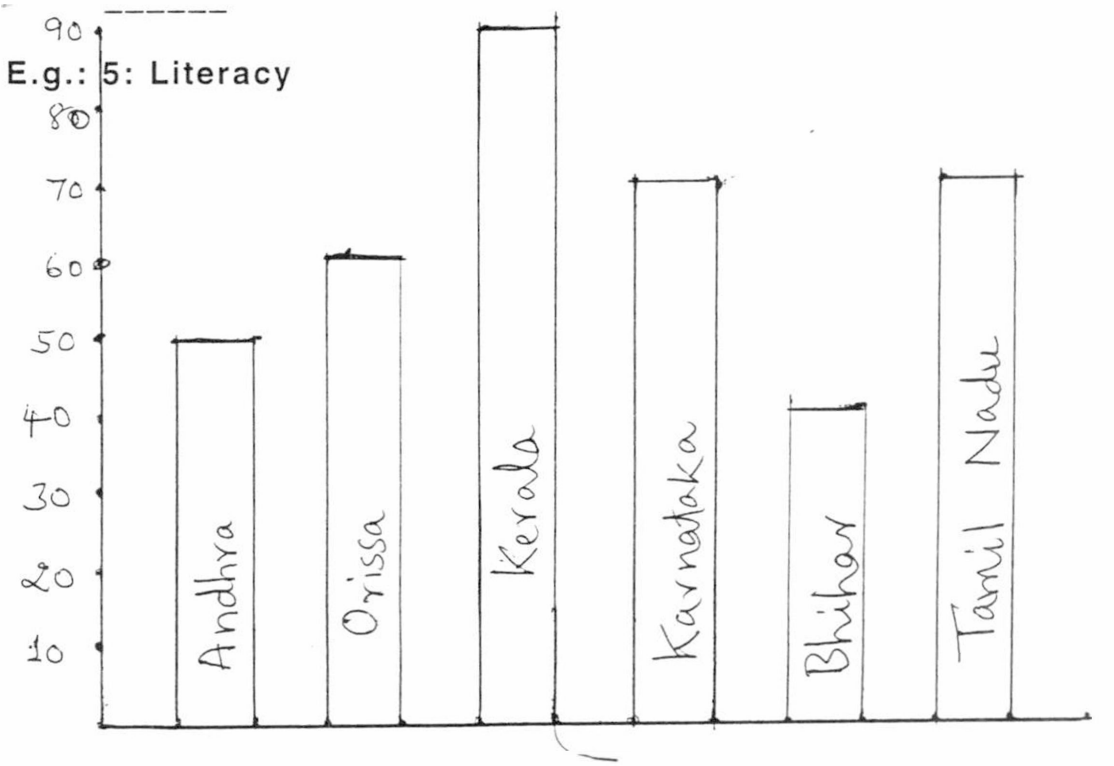
How many students more were admitted in 1999 than in 1996 ?

_____

How many students less were admitted in 1995 than in 1999 ?

_____

**E.g.: 5: Literacy**




Look at this bar diagram. It shows the percentage of literacy in various Indian states.

Which state has the maximum literacy ?

Which state has the minimum literacy ?

Which states have more than 60% literacy ?

How much more is the literacy per cent in Kerala than the literacy per cent in Tamil Nadu ?

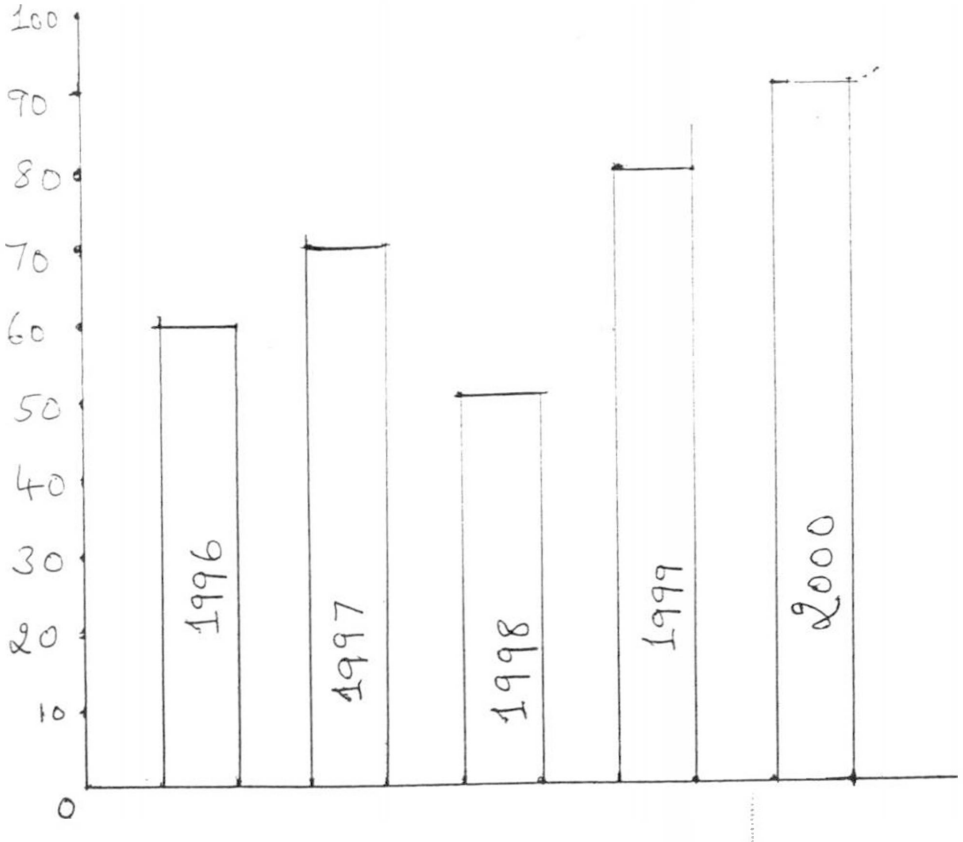
What is the difference in the percentage of literacy between Andhra Pradesh and Karnataka ?

This is another way of representing numerical data. It is called a bar diagram since bars are used to represent data.

**Exercise**

The data shows the percentage of 7th standard result of a school, during the past five years, represented on a bar diagram.

| Year | Result |
|---|---|
| 1996 | |
| 1997 | |
| 1998 | |
| 1999 | |
| 2000 | |

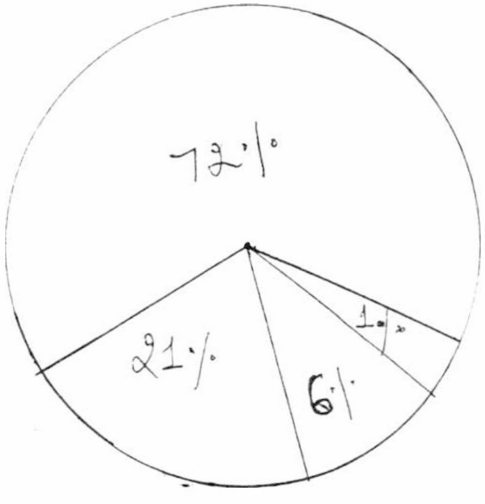


Write down the answer for the following questions from the given data and table.

1. Which year has the maximum percentage of pass ?
2. Which year has the minimum percentage of pass ?
3. Which of the years have the same percentage of pass ?
4. What is the difference in percentage of pass in the year 1998 from 2000 ?

E.g.: (1) The data shows the percentage of gas in atmosphere represented by pie-diagram.

| Gas in atmosphere | Percentage |
|---|---|
| Nitrogen (N2) | 72% |
| Oxygen (O2) | - |
| Carbondioxide (CO2) | - |
| Inert gas | 1% |

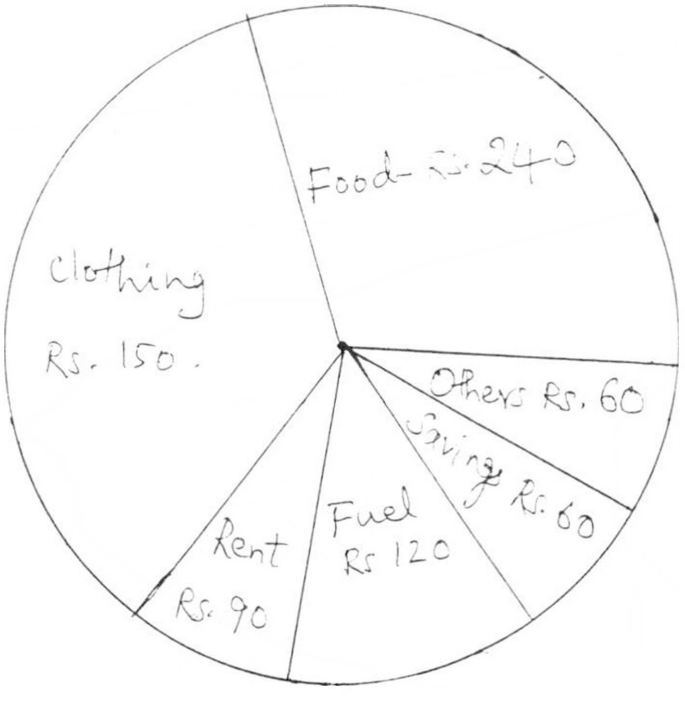



Please write down the answer from the given table.

1. Which gas present in maximum ?
2. Which gas present in minimum ?

E.g. 2: The monthly expenditure of a small family is shown below in pie-diagram.

1. Food
2. Clothing
3. Rent
4. Fuel
5. Savings
6. Others

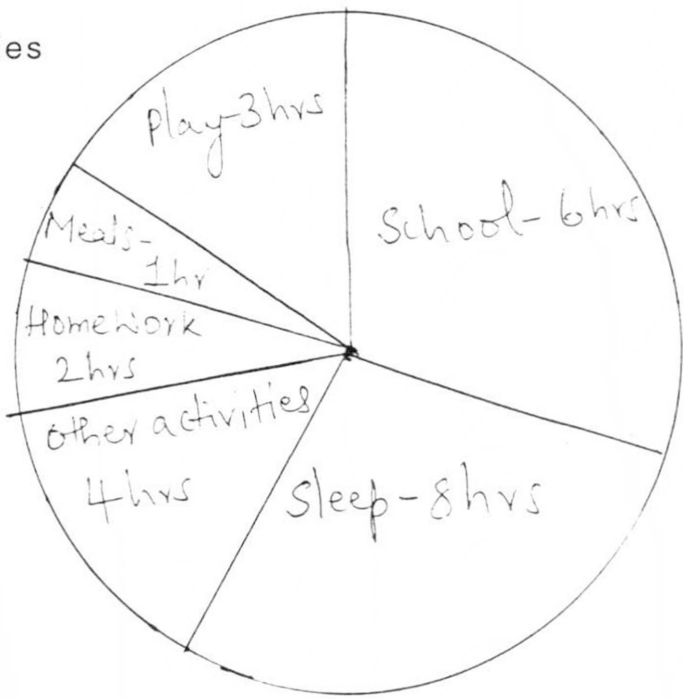



Please write down the answer from the given pie-diagram.

1. For which item the family spent more money ?
2. For which item the family spent least money ?
3. Name the two items for which he spent equal amount ?
4. How much did they spend more for food than clothing ?

E.g. 3: Mohan spends his day as follows

1. School
2. Play
3. Meals
4. Homework
5. Other activities
6. Sleep



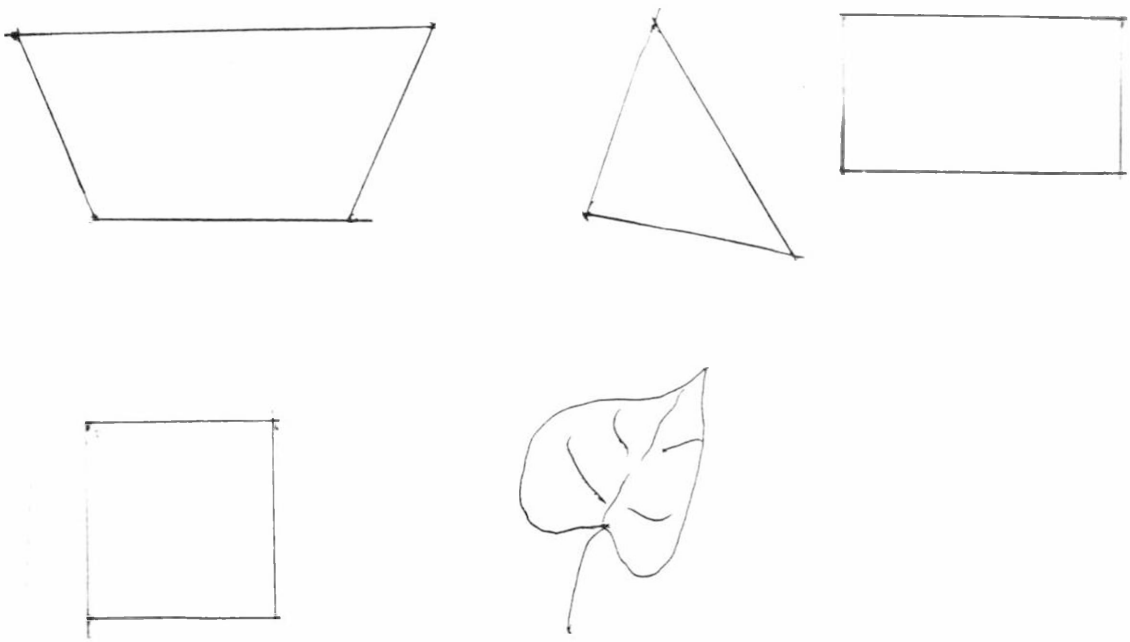

Answer the following

1. How much time he spent in school ?
2. For which activity he spent minimum time ?
3. How much time he spent for sleeping ?
4. For how long he used to play ?

Thus a pictogram, a bar graph and a pie-chart are the different ways of graphical representation of data. You will learn more about the other types of graphs in higher classes. These graphs help for comparison of different aspects of data.

# CHAPTER XIV

## AREA



1. Look at the above pictures.

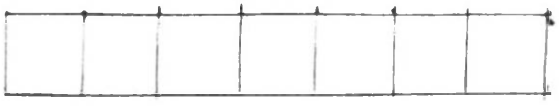
They are different in shape. They are occupying different amount of space. The extent to which they are spread is different. How to measure the spread of these pictures ? This measure of space occupied by plane figure is called area of the figure.

Area of square = Side x Side

= 1 x 1

= 1

Consider a square of side 1 cm. You can call it as a unit square. Its area is called one square centimetre or 1 sq cm. If you take a square of 1 mt. Its area is 1 sq mt. Look at this picture

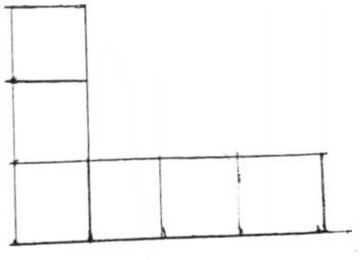


It is divided into squares of side 1 cm.

Such squares are 7 in number.

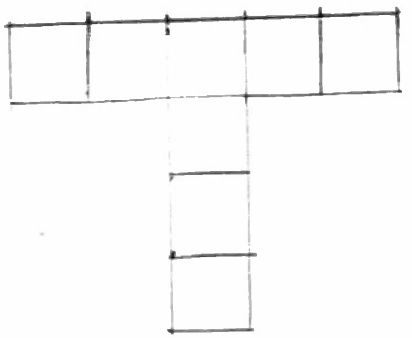
So its area 7 sq cm.

Here are some more pictures. Each is divided into squares of side 1 cm. Can you count them and find the area.



Number of squares = 6

Area = 6 sq cm

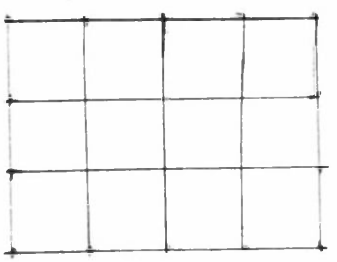


Number of squares = 8

Area = 8 sq cm

2. Area of a rectangle

Can you find the area of the figure ?

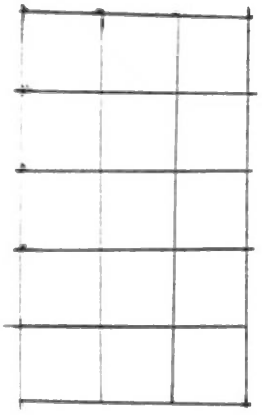


1. Count the number of squares in the figure.

2. How many squares are there in a column ?

3. How many squares are there in a row ?

Area = 3 X 4 = 12 Sq. Cms.



1. Column is 3
2. Row is 5

Area = 3 x 5 = 15 sq cm

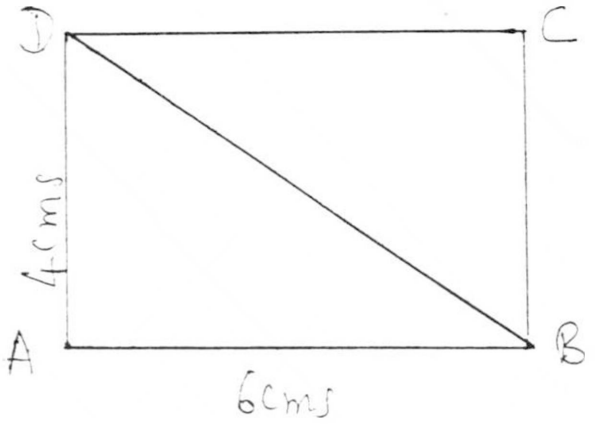
Easy way to calculate area of rectangle is to find the product of length and breadth of the rectangle.

$$A = l \times b$$

**Exercise: 14.1**

1. Ramu's maths book has length 25 cm and breadth 12 cm. What is its area ?
2. Sita wants to fix a mica sheet on her table. The table top is 60 cm long and 40 cm broad. What is the area of the mica sheet needed.

3. Area of right angled triangle.




Consider rectangle ABCD

Length AB = 6 cm  Area = l x b

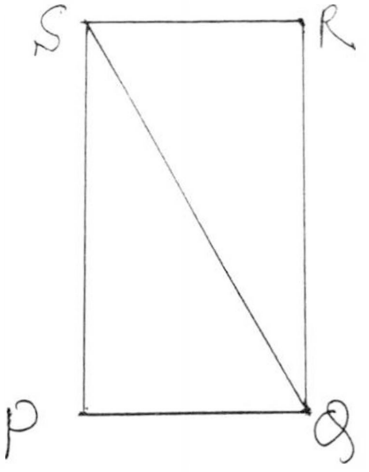
Breadth AD = 4 cm  = 6 x 4

= 24 sq cm

Join BD. Now there are two equal right angled triangles. Can you give the area of one right angled triangle here ?

$$\text{Area of right angled triangle} = \frac{24}{2} = 12 \text{ sq cm}$$

$$\therefore \text{Area of right angled triangle} = \frac{1}{2} \text{ area of rectangle}$$



Area of rectangle PQRS = 5 x 3 = 15 sq cm

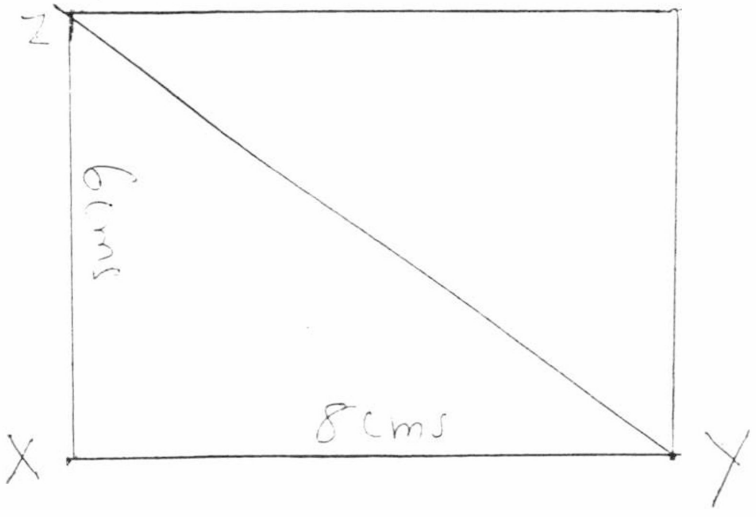
Area of right angled triangle $\Delta PQS$ = ½ x 5 x 3

= 7.5 sq cm

From the above example, it is clear that area of right angled triangle = ½ x base x altitude.

$\therefore$ A = ½ x b x h

**Example**




Area of right angled triangle $\Delta XYZ$

= ½ x base x altitude

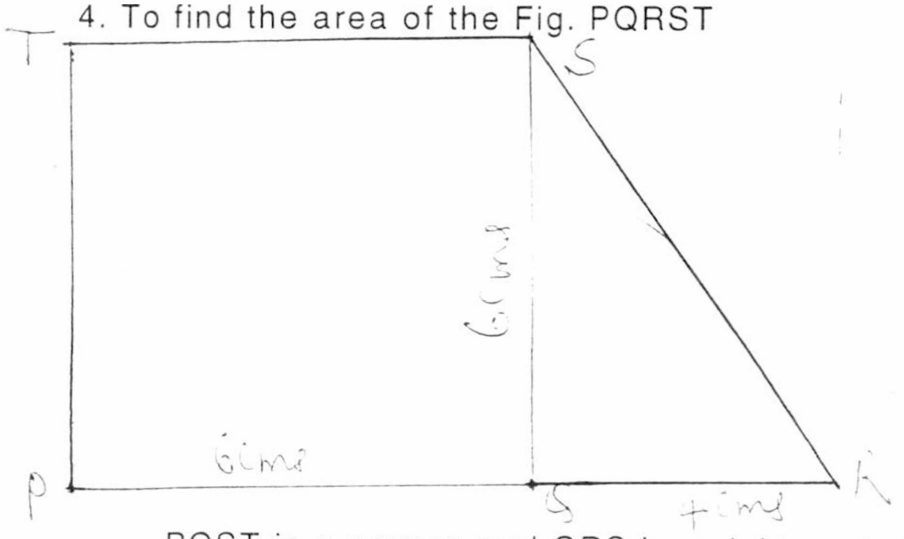
= ½ x 8 x 6

= 24 sq cm

Complete the table.

| Sl.No. | Base (b) | Altitude (h) | Area (A) |
|---|---|---|---|
| 1 | 18 cm | 25 cm | - |
| 2 | 27 cm | 20 cm | - |
| 3 | - | 18 cm | 135 sq cm |
| 4 | - | 13 cm | 71.55 sq cm |
| 5 | 21 cm | - | 168 sq cm |
| 6 | 25 cm | - | 275 sq cm |
| 7 | 10 cm | 50 cm | - |

4. To find the area of the Fig. PQRST




PQST is a square and QRS is a right angled triangle.

The side of square is 6 cm

i.e. PT = PQ = QS = TS = 6 cm

Area of square PQST = side x side

= 6 x 6

= 36 sq cm

Area of right angled triangle = ½ x b x h

= ½ x 6 x 4

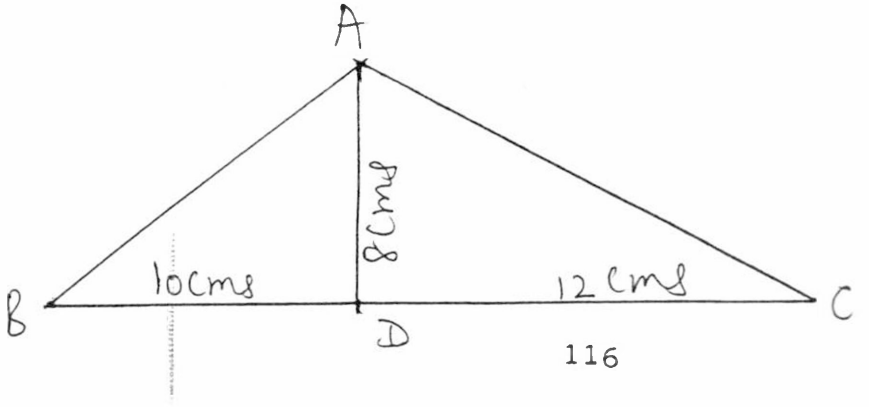
= 12 sq cm

Area of whole figure = 36 + 12

= 48 sq cm

**Exercise: 14.2**

1. Find the area of the each figure given below.

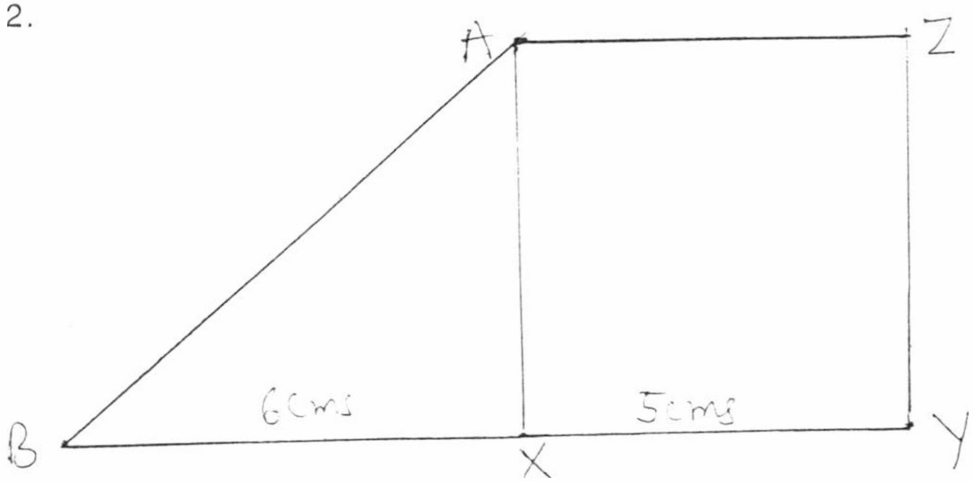


(a) Area of right angled ΔABD = _____

(b) Area of right angled ΔADC = _____

(c) Area of whole figure = _____

2.



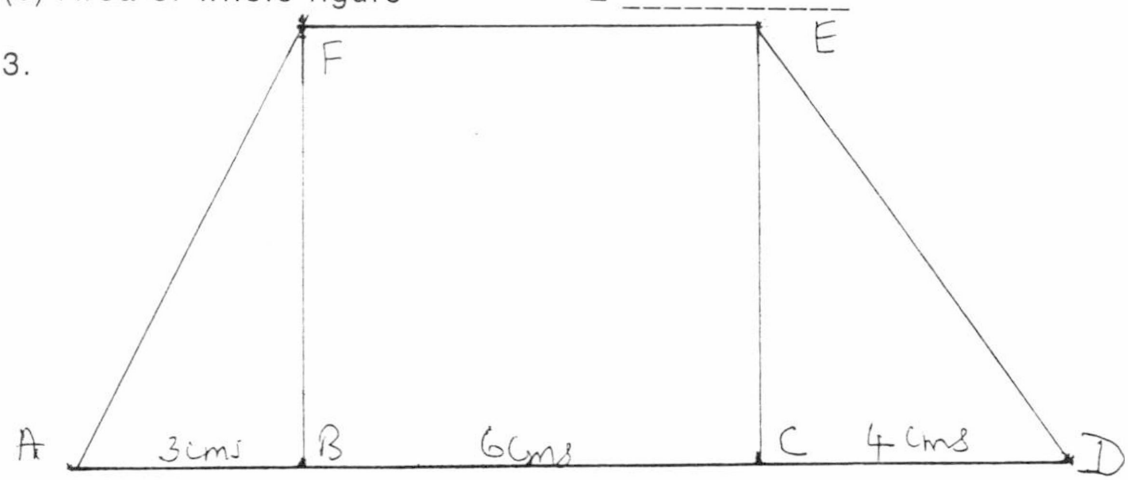

Square

(a) Area of ~~rectangle~~ XYZA = _____

(b) Area of right angled ΔXAB = _____

(c) Area of whole figure = _____

3.



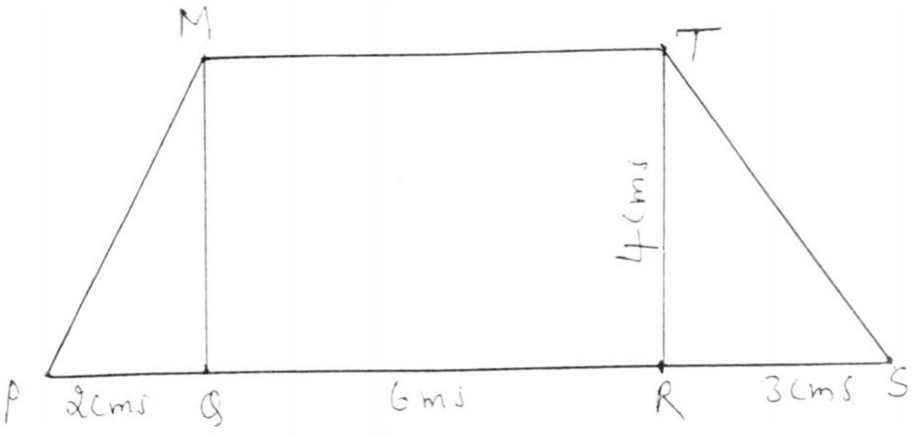

(a) Area of square BCEF = _____

(b) Area of right angled ΔBAF = _____

(c) Area of right angled ΔCDE = _____

(d) Area of whole figure = _____

4.




(a) Area of ΔPQM = _____

(b) Area of rectangle QRTM = _____

(c) Area of ΔRST = _____

(d) Area of the whole figure = _____

Thus in this chapter you have learnt the meaning of area, to find the area of a square, rectangle and a right angled triangle.

# LIST OF PARTICIPANTS

1. K.P. Narayanan
   Assistant Teacher
   A.U.P. School, Malappuram

2. K. Premraj
   Assistant Teacher
   Girls High School
   Velanchery

3. Krishnan Namboodiri, V.E.
   Assistant Teacher
   A.U.P. School, Choolur, Calicut

4. Denni Morais, D.
   U.P.S.A.
   St. Thomas H.S.S., Poonthure
   Thiruvananthapuram

5. Ramakrishnan, K.P.
   Assistant Teacher
   Poilkav U.P. School, PO Edakkulam
   Quailandy-673 306

6. Vinodan, P.
   P.D. Teacher
   DIET Lab School
   Palayad PO, Thalassery
   Kannur District

7. V. Somarajan
   P.D. Teacher
   Government HSS
   Kilimannoor, Trivandrum

8. M.K. Mehaboob
   UPS Assistant
   Govt. Higher Secondary School
   Venjaramoode, Trivandrum

9. C. Kamalasana Kurup
   UPS Assistant, Govt. HSS
   Bharathannoor, Bharathannoor PO
   Triandrum District

10. A. Lazar
U.P.S. Assistant
Govt. Model BHSS
Thycand, Thiruvananthapuram

11. Sivathanu Pillai, C.
U.P.S. Assistant
Govt. Model Boy's Higher Secondary School
Thycand PO
Thiruvananthapuram

12. R. Anandakrishnan Chettiar
P.D. Teacher
Govt. H.S., Azhoor
Azhoor PO
Thiruvananthapuram District

13. Mary Celine
U.P.S. Assistant
Govt. Girls Higher Secondary School
Cotton Hill
Thiruvananthapuram

14. Saramma P. Daniel
P.D. Teacher
Govt. Girls' Higher Secondary School
Cotton Hill
Trivandrum

15. Susan Mathew
P.D. Teacher
Govt. V.H.S.S.
Vathiyoorkavu
Thiruvananthapuram

16. C. Geetha
P.D. Teacher
G.V.H.S.S., Vathiyoorkavu
Vathiyoorkavu PO
Thiruvananthapuram

17. Suseelakumari, B.
P.D. Teacher
J.M.H.S., Sasthamcutta
Kollam District