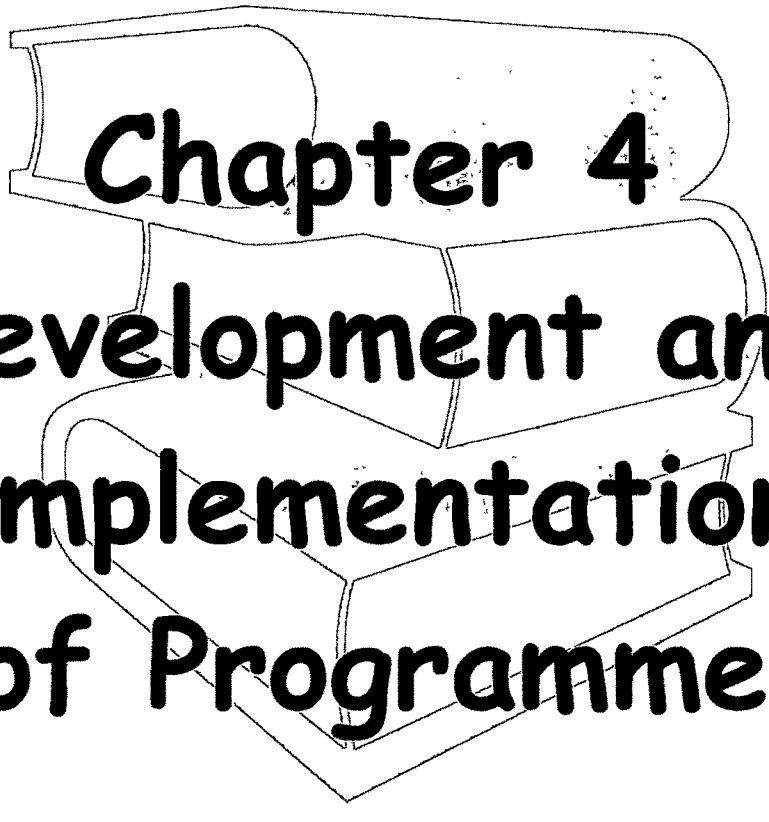


Chapter 4
Development and Implementation of Programme

CHAPTER IV

DEVELOPMENT AND IMPLEMENTATION OF PROGRAMME

Table – 14:

Marks of Mathematics of Class IX (Pre–Test)

Marks obtained	Frequency
1 – 10	0
11 – 20	0
21 – 30	11
31 – 40	24
41 – 50	35
Total	**70**

Mean marks obtained by the students in class IX is 38.92.

Table 15 represents the participation of co–curricular activities of the respondents.

Table – 15:

Participation of Co–Curricular Activities

Co–Curricular	Frequency	Percentage
Not Involved in Co–Curricular Activities	26	37
Involved in Co–Curricular Activities	44	63
Total	**70**	**100**

From the total seventy students sixty three percent (forty four) only were involved in the co–curricular activities while thirty seven percent (twenty six) were not involved in the co–curricular activities in school.

Table 16 represents the type of family of the respondents.

Table – 16:

Type of Family

Type of Family	Frequency	Percentage
Nuclear	35	50
Joint	35	50
Total	**70**	**100**

Both types of families i.e. nuclear and joint responded equally.

Table 17 represents the educational qualification of the parent's of the respondents.

Table – 17:

Parents' Education

Education	Frequency	Percentage
(A) Father		
Illiterate	0	0
Primary Education	1	1
Secondary & Higher Secondary	30	43
University Education	35	50
Father, No More	4	6
(B) Mother		
Illiterate	1	1
Primary Education	5	7
Secondary & Higher Secondary	45	64
University Education	18	26
Mother, No More	1	1

Qualification of most of the parents i.e. Fifty percent (thirty five) of fathers had gone upto university education and forty three percent (thirty) for secondary and higher secondary education. In the same way twenty six percent (eighteen) of mothers had gone upto university education and sixty four percent (forty five) for secondary and higher secondary education. This clearly indicates that parents of the respondents are educated. Table 18 represents the occupation of the parents.

Table – 18:

Parents' Occupation

Occupation	Frequency	Percentage
(A) Father		
Service	46	66
Business	20	29
Father, No More	4	6

(B) Mother		
Housewife	58	83
Service	10	14
Business	1	1
Mother, No More	1	1

Majority of fathers were in service while only about twenty nine percent were in business. Similarly majority of the mothers i.e. eighty three were housewives. Table 19 shows the total monthly income of the family of the respondents.

Table – 19:

Total Monthly Income of the Family

Income Group	Frequency	Percentage
Less than Rs. 2000	7	10
Rs. 2001 to Rs. 5000	12	17
Rs. 5001 to 10,000	22	31
Rs. 10,001 to Rs. 20,000	16	23
Rs. 20,001 and above	13	19

Above table emphasis that forty two percent students belonged to ten thousand and above income group.

4.3 SITUATION ANALYSIS (PHASE II)

The investigator collected the data from students, teachers and parents through a questionnaire for situation analysis. Programme for enhancing achievement in Mathematics for class X students was framed keeping in mind the data available from the same.

4.3.1 Analysis of Students' Questionnaire

Using frequency and percent and content analysis the analysis was carried out. The outcomes of the same were utilized in developing the programme. Ninety three percent students responded that they liked the

subject mathematics. The reasons for liking of Mathematics were – full marks can be obtained in Mathematics (seventy eight percent), mathematics is the subject of calculation so the system of cramming is less and sums can be solved easily, mathematics is a subject which is very useful to get success in future, if Mathematics is understood, it is a great pleasure to solve sums, sums in some chapters are easy to do so it creates interest in doing the sums, and mathematics is very useful in other subjects and in day to day life. The responses of the students for disliking the subject Mathematics were – inability to recall the subject matter in the examination, riders, theorems and sums in geometry are typical to understand, lack of previous knowledge, teaching method of the teacher is not satisfactory.

Sixty six percent students opined that they find it difficult to learn mathematics. Ninety one percent felt difficulty while learning mathematics in classroom. Difficulties were of following type – lack of concentration due to weak base, repeat transfer of teachers in the class, the method of explanation is different, speedy teaching, less practice in geometry, lack of proper guidance regarding preparation of the subject and less use of black board by the teachers.

Geometry was most difficult for students (fifty eight percent) while algebra and statistics were equally difficulty (about seventy three percent).

Majority of the students felt that chapters like factors, height and distance (fifty one percent), area (forty seven percent) and volume (sixty percent), rational expressions (thirty one percent), ratio and proportion (forty seven percent), Similarity and Pythagoras theorem (forty seven percent), Circle and Chord (fifty three percent), Arc of a Circle (fifty six percent) are difficult. The reasons given were – poor perquisite knowledge and sometimes students forgot the required formula. Majority of the students found following chapters little easier to learn like – cyclic expressions (ninety six percent), functions (ninety seven percent), computing (ninety three percent), similar triangle (eighty three percent), construction (eighty three percent).

About forty one percent students liked teachers of mathematics. Major reasons of liking of teachers were – teachers use maxim of easy to difficult while teaching, teacher never gets angry, teacher clarifies the previous knowledge needed for that chapter. About fifty nine percent students did not

like the teaching method of their teacher. Majority reasons for this were – teachers cannot make teaching interesting, teacher explains very quickly, teacher does not provide sufficient practice in the classroom, teacher does not explain the topic on the black–board.

Fifty three percent students told that their teacher did not gave attention towards their mistakes in calculation. Twenty nine percent students told that they are not taking help of teachers for the topic which are not understood. Fifty one percent students told that they are not participating in discussion in the classroom and, forty three percent responded that they are not asking questions to their teachers if they don't understand any topic. Thirty nine percent told that the teacher did not inspire them to ask questions during the period while eighty seven students responded that when they asked questions to the teachers they responded to them. Forty three percent students do not concentrate in the classroom and fifty one percent students feel boring in the period of mathematics. Fifty one percent students responded that higher strength of students in class created problem in the classroom in learning mathematics while ninety one percent students felt that additional coaching needed for weak students.

Eighty six percent students responded that the teacher gave homework and ninety seven percent students responded that they like the homework, but sixty seven percent students felt that teachers gave more homework than necessary. Fifty three percent students responded that their teacher did not check their homework while forty six percent students cannot spare sufficient time for homework. Twenty seven percent felt difficulty in doing mathematics homework and forty eight percent did not get any help or hints from the teacher. Forty one students responded that their teacher did not provide guidance about the homework given and forty eight percent students told that the teacher does not draw any attention to the mistakes committed.

Students' responses regarding the questions related to examination showed tension and fear for mathematics. For example, seventy four percent students felt fear when the date of the examination is declared, eighty three percent responded that they also felt fear on the day of examination of mathematics though they have prepared thoroughly, eighty three percent responded that the matter which they could not recollect in the examination

hall is clicked in their mind after coming out of the examination hall while seventy percent responded that their fear increases as examination time is near.

Forty six percent students failed in mathematics in class IX in either the first test or in the second test. When they failed in mathematics twenty percent students opined that they were disappointed and twenty five percent students opined that they were ashamed and felt self–pity. According to the students the reasons for failure were – disliking of the subject, lack of sufficient time for preparation, concepts were not understood and some of them not studied well, while some students faced the language problem. Sixty five percent students opined that more practice was required; thirty five students opined that slow teaching helped them to learn better while thirty percent students opined that more and more time for practice helped them. Ninety six percent students opined that practice of necessary prerequisite helped them. Fifty three percent students demanded first period for mathematics and fifty one percent students opined that seven or more periods per week should be conducted. Forty three percent students opined that frequent revision and more practice helped them.

Ninety percent students opined that they took help of their friends when they faced problem in mathematics, seventy nine percent students opined that their family members helped them in solving the problems of mathematics. Eighty four percent students opined that their friends inspired them and provided guidance regarding the subject.

Only forty four percent students study mathematics everyday while fifty six percent did not, sixty percent of students found sufficient time to study mathematics while forty percent did not. The reasons for not getting sufficient time were – too much homework in mathematics, in other subjects and mismatch between teaching in school and tuition class. Fifty one percent students opined that they spent one or two hours for studying mathematics, while only nineteen percent students spent more than two hours. Forty nine percent students opined that they did not prepare the topic of mathematics within forty hours learning the same unit, fifty three percent students prepare the subject by writing. Forty four percent students did not revise the topic that they have studied. Only twenty seven percent students approached the

teacher for personal difficulty and guidance. Only twenty nine percent students prepared chart to study major points. Only twenty one percent students use recess time for practising sums of mathematics and twenty three percent students opined that they did their homework of mathematics in free period in school that indicates students did not utilize their time in the best way.

Forty seven percent students opined that they lost their marks in definitions and in fill in the gaps while seventy percent students lost their marks in theorems, riders and constructions. Sixty one percent students opined that their handwriting also caused for not getting good marks. Forty one percent students opined that they did not cultivate good method of writing paper. Eighty seven percent students confessed that they could not recollect and remember the things prepared. Sixty nine percent students opined that less practice of writing question paper at home was the cause of less marks in mathematics. Seventy nine percent students opined that less time contributed for the subject, was the reason of less marks. Fifty one percent students opined that they did not get good marks because teacher of mathematics was not good. Forty four students confessed that the subject is tough therefore confidence is not developed, while fifty one percent students opined that they did not know how to prepare the subject.

Ninety three percent students were satisfied with the pattern of question paper of mathematics while seven percent were not satisfied with the pattern of subjects.

Majority of the students opined the following aspects were important to enhance the performance in mathematics – pattern of writing answers, requirement to improve handwriting, to enhance concentration, recalling method, revision planning, goal setting, mini nap for relaxation, positive thinking, removing examination fear, listening skill, speedy reading, writing and calculation, time management, how to study on the examination day, planning of three hours of examination, preparation of charts for important topics, examination tips, formation of good study habits.

4.3.2 Analysis of Parents' Questionnaire

Seventy six percent parents responded that their child study mathematics regularly. Seventy six percent parents responded that they knew their child felt difficulty in mathematics the reasons for that were as follow: (i) complaint regarding not understanding the subject, (ii) disliking of doing homework of mathematics, (iii) experienced laziness while doing homework, (iv) demanding help from the family members for solving mathematics, (v) using ready materials with solved problems, (vi) gets confused and becomes angry, stops working and goes to sleep, (vii) weak recalling of previous chapter (short term memory).

Seventy seven percent parents responded that they had seen their child's mathematics textbook and notebooks while twenty three percent had not seen at all.

Fifty three percent parents opined that they were able to help their child in mathematics while forty seven percent parents were unable to help. The reasons for not helping their child were as follow: there was a vast difference in the subject now and that we had studied, job of both the parents and joint family, the child was not ready to take help of parents.

Sixty seven percent parents opined that they sometimes discussed with Mathematics teacher about the study of their child. While twenty four percent parents never discussed anything with Mathematics teacher about their child's study.

Ninety percent parents said that they felt their child could score more marks than scored presently while ten percent parents felt that their child couldn't score more marks than scored presently. Following reasons were given by the parents for obtaining more marks – by understanding basic rules of Mathematics, by taking guidance of the teacher wherever found difficulty, by practising mathematics regularly for two–three hours, by repeating the things taught, by frequent revision of tough topics, by taking prerequisite test and unit test, by cultivating writing practice of the paper.

Following were the reasons for getting fifty or less than fifty marks in mathematics given by the parents.

The child found mathematics difficult, examination tension, lack of confidence and enthusiasm, examination fear, playful nature, wasting time on

watching television, interest in other activities, lack of writing practice, providing insufficient time to the subject, faced difficulty in understanding geometry, made mistakes in signs, figures, numbers, etc. lack of proper writing method.

The parents responded that their child did not sleep well on the day of examination, remain under tension till the paper gets over, gets irritated during the examination and sometimes gets depressed before and after examination. It clearly indicated that their child has examination fear. Seventy six percent parents responded that they checked the answer books of their child while twenty four percent did not.

Suggestions given by the parents after knowing the marks of their child indicates that frequent revision is needed, practice to write question paper in time is needed, more practice for particular type of error is needed.

4.3.3 Analysis of Teachers' Questionnaire

Majority of teachers opined that following were the reasons for securing less than fifty marks – disliking for the subject of mathematics from the beginning, inferiority complex, lack of enough practice, chapter on factors is not in the syllabus of class X and questions are asked, less attention to weak students in mathematics by teachers, theorems, definitions, riders are crammed without proper understanding, lethargy in basic matters like multiplication, division, square root, cube root, square root, cube, canceling numbers in numerator and denominator, papers are checked improperly due to less number of teachers, some teachers examine the papers typically, weak students do not understand when whole class is being taught, irregularity of the students, sums are not arranged gradually from easy to hard, also methods differ when we switch from one sum to the other.

According to average students, the subject is most difficult as a result one feels inferiority complex and have negative attitude towards mathematics.

While teaching mathematics to the average students the teachers found following difficulties. The students were weak in basic like LCM, factorization, expansion, square root, cube root, square.

According to majority of teachers, following type of help is being provided to weak students who experienced difficulty in mathematics –

providing additional help as and when needed, revision of each chapter, by conducting unit tests providing remedial measures.

In response to availability of time for teaching of mathematics following reasons were given by the teachers: though the time is sufficient for doing the syllabus, not sufficient time for revision and solving papers of 100 marks is not possible. Teachers felt that thirty to thirty five minutes were not sufficient to teach theorems in geometry.

In response to the teaching method followed, the following were the suggestions: to test pre–knowledge was essential, frequent and more revision makes the subject interesting, frequent unit tests for creating confidence, more practice in the classroom and group discussion and participation of the students makes the teaching interesting.

In response regarding the structure of paper, the teachers suggested that more options should be given in geometry section, more objective type of questions should be asked and multiple choice questions should be asked. In response to the supplementary literature, the teachers responded that the supplementary literature is necessary only for bright students, for average students text book is enough. Only frequent drilling of the text book examples helped the students to score good marks.

Seventy six percent of teachers test the prerequisite knowledge for particular chapter not in a very planned manner, simply few questions were put before the class, while other teachers felt that no time is available for testing previous knowledge. Forty eight percent teachers responded that they conduct test in the school after finishing the chapter while fifty two percent teachers said that they did not take test in the school after finishing the chapter. The reasons for not taking the test was lack of sufficient time, more administrative work was allotted to them and students are not ready to give the test.

All teachers responded that, if the test was held after teaching each chapter and mistakes were corrected, definitely it was beneficial to the students who were getting fifty or less than fifty.

Situation analysis clearly indicated that students are weak in basics and are not clear in prerequisite, teaching learning needs to be interesting.

4.4 TEACHING, TESTING AND COUNSELLING (PHASE III)

Here the investigator developed seven steps teaching programme. The seven steps were as under:

Step 1: Administration of Prerequisite Test

Step 2: Analysis of Prerequisite Test

Step 3: Remedial Measures based on Prerequisite Test

Step 4: Teaching of each Chapter

Step 5: Administration of Unit Test

Step 6: Analysis of Unit Test

Step 7: Remedial Measures based on Unit Test

The present study aims at the development of a programme for enhancing achievement of the students in Mathematics; therefore proper development of the programme is an important factor. The investigator analysed the data collected through the questionnaires and developed a teaching–learning process which shows seven steps programme for teaching 19 chapters of the textbook of class X, through which the investigator attempted to enhance the achievement and to reduce the factor which directly or indirectly restricts the achievement of the students. The investigator even kept in mind the correlates of the achievements, motivational factors and suggestions of the teachers and parents through which enhancement can be achieved. The investigator did not forget the most important things which created interest in teaching–learning process through testing and pointing out the errors committed by the students (error analysis) and remedial measures. The investigator also conducted individual and group counselling for better performance in Mathematics. In short, the investigator kept in mind all the factors derived from the situation analysis while developing and implementing the programme. The course outline and how the whole programme was carried out is discussed in detail on the following pages.

4.4.1 Chapter 1: Functions

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included some related items of class VIII and class IX such as set theory, real numbers, equalities and inequalities, angles, identities, logarithms and polynomials. In this test total twenty items were asked. All items were of objective type. Before teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given one mark and total marks were given to the each student. Marks obtained by the students in prerequisite test are shown in table 20 along with its frequency distribution in table 21.

Table – 20:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	6	19	7	37	6	55	6
2	6	20	7	38	6	56	6
3	12	21	6	39	7	57	7
4	13	22	12	40	7	58	6
5	11	23	7	41	8	59	3
6	3	24	6	42	8	60	3
7	13	25	8	43	6	61	9
8	6	26	10	44	2	62	7
9	6	27	3	45	1	63	7
10	8	28	5	46	5	64	7
11	3	29	6	47	4	65	4

12	4	30	5	48	4	66	6
13	4	31	3	49	4	67	10
14	3	32	5	50	7	68	12
15	1	33	6	51	5	69	5
16	2	34	4	52	4	70	8
17	5	35	1	53	5		
18	8	36	2	54	9		

Table – 21:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	29
6 – 10	35
11 – 15	6
16 – 20	0
Total	**70**

Mean marks obtained by students is 6.36 out of twenty marks. Students secured 31.8% marks which showed poor performance on prerequisite knowledge. This demands remedial actions to be taken to enhance their prerequisite knowledge and to prepare the students to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

(1) Define the term 'Set'.

True	False	N.A.
2 (2.85%)	30 (42.86%)	38 (54.29%)

(2) Give the name of set N, Z, Q and R.

True	False	N.A.
0 (0%)	67 (95.71%)	3 (4.29%)

(3) Write the prime numbers smaller than 20.

True	False	N.A.
13 (18.57%)	56 (80%)	1 (1.43%)

(4) The value of 5° is _____.

True	False	N.A.
21 (30%)	39 (55.71%)	10 (14.29%)

(5) Find the value of $\log_4{}^{64}$.

True	False	N.A.
7 (10%)	45 (64.29%)	18 (25.71%)

(6) $A = \{x / -1 \leq x < 4; x \in Z\}$. Write the set A in the list method.

True	False	N.A.
52 (74.29%)	17 (24.28%)	1 (1.43%)

(7) A = {x / x is a factor of 20} write the set A in the list method.

True	False	N.A.
28 (54.28%)	30 (42.86%)	2 (2.86%)

(8) If P(x) = 2x–1, find P(2) and P(0).

True	False	N.A.
31 (44.29%)	39 (55.71%)	0 (0%)

(9) If $P(x) = (-1)^x$, find P(3) and P(4).

True	False	N.A.
47 (67.14%)	22 (31.43%)	1 (1.43%)

(10) Find the value of |–5+3|.

True	False	N.A.
22 (31.43%)	47 (67.14%)	1 (1.43%)

(11) Write the value of sin 60° and tan 30°.

True	False	N.A.
22 (31.43%)	46 (65.71%)	2 (2.86%)

(12) Find the H.C.F. of 12 and 20.

True	False	N.A.
4 (5.71%)	58 (82.86%)	8 (11.43%)

(13) Find the L.C.M. of 60 and 45.

True	False	N.A.
25 (35.71%)	42 (60%)	3 (4.29%)

(14) Write the measures of complementary and supplementary angles of 40°.

True	False	N.A.
10 (14.28%)	30 (42.86%)	30 (42.86%)

(15) $\log_3 3 =$ _____ (Evaluate)

True	False	N.A.
28 (40%)	31 (44.29%)	11 (15.71%)

(16) $2^{-1} =$ _____ (Evaluate)

True	False	N.A.
5 (7.14%)	57 (81.43%)	8 (11.43%)

(17) $(-2)^{-1} =$ _____ (Evaluate)

True	False	N.A.
2 (2.86%)	64 (91.43%)	4 (5.71%)

(18) $(-1)^{-2} =$ _____ (Evaluate)

True	False	N.A.
33 (47.14%)	33 (47.14%)	4 (5.72%)

(19) $(x + 2)^2 =$ _____ write expansion.

True	False	N.A.
26 (37.14%)	44 (62.86%)	0 (0%)

(20) $4^0 \times 4^1 =$ _____ simplify and evaluate.

True	False	N.A.
15 (21.43%)	48 (68.57%)	7 (10%)

The findings of the analysis showed that the errors occurred due to lack of:

1. proper knowledge of set, kinds of sets and other information relating sets
2. knowledge of indices and laws of indices
3. knowledge of prime numbers and composite numbers
4. knowledge of operation of simple multiplication
5. knowledge of absolute value

6. knowledge of methods of factorization of numbers
7. basic knowledge of logarithm

This clearly indicated that students' were very poor in prerequisite concepts needed to study the chapter.

The errors on prerequisite test were found as follows:

On the basis of analysis of students' answer books, actual errors the students have made were worked out as follows:

1) In the concept set theory the basic knowledge of set – "Set is an undefined term" is not known by the students. The name of set and which elements are belonging to particular set e.g. N → is a set of natural numbers which contains the number starting from 1 to infinity, no rational numbers are the elements of N, also 0 is not a member of N. Most of the students take 0 as a member of N which creates an error. While checking the answer books the students made an error even in the sign of set, instead of writing "{ }" they write as "} {". On the basis of actual errors found from answer books was "1 is not a prime number" and "2 is the first prime number". Most of the students consider 1 as a prime number and 2 is not a prime number.
2) Lack of knowledge of indices, where any number raised to 0 is always 1 e.g. $3^0 = 1$, $(-5)^0 = 1$ where as they wrote as $3^0 = 0$, $(-5)^0 = 0$. $(-1)^5 = -1$, $(-1)^6 = 1$ when the base is negative and index is even then answer is positive, and index is odd then answer is negative. After teaching the base of indices the use of logarithms was taught, because students made errors in logarithms.
3) In case of equalities and inequalities, students made errors in understanding the basic meaning of the sign $<$, $>$, $\leq$ and $\geq$; students also were unable to understand the meaning of modulus ($|\ |$) and made errors. Students made errors and get confused in finding the numbers of H.C.F. and L.C.M., students mixed the concept of both. Students are unable to differentiate between H.C.F. and L.C.M.
4) Students committed error in finding out complementary and supplementary angle of a given angle. Complementary angle means

sum is 90, supplementary angle means sum is 180. Complementary angle of 30 is (90 – 30) = 60 while supplementary angle of 30 is (180 – 30) = 150. But the supplementary angle of the complementary angle of 30 is (90 – 30) = 60 and (180 – 60) = 120. So the supplementary angle of the complementary angle of 30 is 120. Students also committed errors in expansion of $(x+2)^2$ students wrote as x^2+2^2 means x^2+4.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis as well as discussion with subject teachers the guideline and suggestions were worked out for further remedy, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of set and the elements belonging to a given set were explained with necessary examples.
2. The difference between G.C.F. and L.C.M. was explained and the methods of finding them was taught by giving examples.
3. Full knowledge of prime and composite numbers was given.
4. Table of finding values of trigonometric functions for 0°, 30°, 45°, 60°, 90° was explained for better understanding the concept.
5. Basic knowledge of indices and laws of indices was provided.
6. Angles, their kinds and measures were clearly explained by giving examples.
7. Conversion of logarithm to index form and vice versa was clearly explained.

Above remedial teaching was carried out while solving prerequisite test paper in the classroom. Individual remedial teaching was also provided to the students who scored very less marks and made many errors.

STEP – 4: Teaching of the Chapter: "Functions"

1. After catering remedial teaching the chapter "Functions" was taught to the students. While teaching the chapter "Functions" teacher explained the theory aspect of the chapter then on the basis of that theory practical examples were explained on the black board, participation of

the students was also invited, students were asked some questions regarding the teaching made by the teacher and if the students could not answer the question the teacher explained the same repeatedly, then same type of examples were given in the class room to solve by themselves.

2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter a unit test was administered. Question paper was framed. This test was of twenty marks having two types of questions:

1) Fill in the Blanks:	6 items	x 1 mark	= 06
2) Solve the Sums:	7 items	x 2 marks	= 14
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was carried out by the investigator with the help of subject teachers.

(A) <u>Markwise Analysis</u>

Each correct item was given full mark, partly correct answer was given a mark proportionately as per the scheme given by the Board and total was given to each student. Marks obtained by students on unit test are shown in table 22 along with its frequency distribution in table 23.

Table – 22:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	6	19	7	37	11	55	3
2	2	20	15	38	5	56	7
3	13	21	11	39	5	57	3
4	5	22	7	40	6	58	13
5	11	23	13	41	13	59	5
6	4	24	6	42	5	60	3
7	12	25	9	43	3	61	7
8	5	26	8	44	4	62	18
9	9	27	10	45	8	63	13
10	9	28	5	46	5	64	5
11	15	29	1	47	5	65	7
12	8	30	4	48	4	66	6
13	2	31	6	49	9	67	13
14	7	32	5	50	17	68	12
15	4	33	7	51	9	69	5
16	3	34	4	52	7	70	7
17	8	35	9	53	14		
18	10	36	6	54	9		

Table – 23:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	26
6 – 10	28
11 – 15	14
16 – 20	2
Total	**70**

Mean marks obtained by students is 7.43 out of twenty marks. Students obtained 37.15% marks which showed poor performance in unit test. This clearly indicated need for remedial measures.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis of all the items on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. (A) Answer accordingly:

(1) $A = \{1, 3, 9, 27, 81\}$; $B = \{0, 1, 2, 3, 4\}$

Find the range of $f : A \to B$, $f(x) = \log_3 x$

True	False	P.T.	N.A.
25 (35.71%)	44 (62.86%)	1 (1.43%)	0 (0%)

(2) Find the range of $f : N \to N$, $f(n)$ = (H.C.F. of n and 6)

True	False	P.T.	N.A.
6 (8.57%)	62 (88.57%)	0 (0%)	2 (2.86%)

(3) Find the range of $f : N \to N \cup \{0\}$,

$f(x)$ = (The remainder obtained on dividing x by 4)

True	False	P.T.	N.A.
18 (25.71%)	48 (68.58%)	4 (5.71%)	0 (0%)

(4) P is the set of positive prime integers. Find range of $f : P \to N$

$f(x)$ = (number of factors of x)

True	False	P.T.	N.A.
14 (20%)	47 (67.15%)	4 (5.71%)	5 (7.14%)

(5) For $f : Z \to Z$, $f(x) = 2x^2 - 3x + 4$, find the value of $f(2) - f(-1)$.

True	False	P.T.	N.A.
27 (38.57%)	32 (45.71%)	9 (12.86%)	2 (2.86%)

(6) For $f : R - \{-1\} \to R$, $f(x) = \frac{x^2+1}{x+1}$, find the value of $\frac{f(2)}{f(-2)}$

True	False	P.T.	N.A.
15 (21.43%)	39 (55.71%)	11 (15.72%)	5 (7.14%)

(7) For f :N $\rightarrow$ Z, $f(x) = x^2 - 4x + 4$, find $f(x+2)$

True	False	P.T.	N.A.
20 (28.57%)	37 (52.86%)	0 (0%)	13 (18.57%)

Q.1. (B) Fill in the blanks by choosing correct options given in bracket:

(1) Set $\{x / -2 < x < 5, x \in R\}$ is written as _____ in interval notation.

([–2, 5], (–2,5), [–2, 5))

True	False	P.T.	N.A.
57 (81.43%)	12 (17.14%)	1 (1.43%)	0 (0%)

(2) f : Q $\rightarrow$ Z $f(x)$ = (The greatest integer not greater than x)

Then f (–4.3) = _____. (–5, –4, 3)

True	False	P.T.	N.A.
38 (54.29%)	32 (45.71%)	0 (0%)	0 (0%)

(3) The graph of f : [1,4] $\rightarrow$ [4, 7] $f(x) = x + 3$ is _____.

(line, ray, line–segment)

True	False	P.T.	N.A.
27 (38.57%)	43 (61.43%)	0 (0%)	0 (0%)

(4) $f : R \rightarrow R^+$, $f(x) = \frac{x^2+1}{x^2+4}$, $f(\sqrt{2})$ = _____. (2; ½, 3)

True	False	P.T.	N.A.
49 (70%)	21 (30%)	0 (0%)	0 (0%)

(5) For function f :N $\rightarrow$ Z, $f(x) = 2x - 3$, $f(a-2) - f(a)$ = _____.

(–4, –10, 10)

True	False	P.T.	N.A.
46 (65.71%)	24 (34.29%)	0 (0%)	0 (0%)

(6) For f : R$^+$ $\rightarrow$ R $f(X) = \log_{10} X$, $f(1)$ = _____. (1, 0, 0.1)

True	False	P.T.	N.A.
33 (47.14%)	37 (52.86%)	0 (0%)	0 (0%)

The errors were committed due to lack of:

1. knowledge of range of function.
2. complex knowledge of logarithm.
3. understanding the use of symbolic language of function.
4. ability to find G.C.F. and L.C.M.
5. understanding of symbolic use of closed and open intervals.
6. proper knowledge of finding values by replacing x in f(x), etc...

Paper analysis also disclosed that some errors were repeated even though sufficient previous knowledge was provided.

The errors on unit test were found as follows:

1) Some students could not find range of logarithmic function due to insufficient knowledge of rules of logarithm.

   e.g. $f(x)=\log_{10}{}^{x}, f(1) \therefore f(1)=\log_{10}{}^{1}=0$ but students were not able to write the correct answer as students were not aware that $\log_{10}{}^{1}$ is zero.

2) Some students could not express in interval notation due to lack of knowledge of different types of interval.

3) Some students found it difficult to find values involving surds due to insufficient knowledge of their operations.

   e.g. as surds was not explained to the students hence any operations or rationalization concept was not clear and made errors $f(x)=\frac{x^2+1}{x^2+4}; f\left(\sqrt{2}\right)=? \therefore f(\sqrt{2})=\frac{\left(\sqrt{2}\right)^2+1}{\left(\sqrt{2}\right)^2+4}=\frac{2+1}{2+4}=\frac{3}{6}=\frac{1}{2}$ but students wrote $\left(\sqrt{2}\right)^2=\sqrt{4}$ and committed error.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussion with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter "Functions".

Function, domain, co–domain and method of finding the range were explained by giving examples where students had committed more errors. More practice was given for finding the values of function by taking different

values of x like positive, negative, integer, fraction, rational and irrational numbers. Sufficient knowledge of mathematical symbols used in the Chapter was given. Intervals, their kinds and symbols were clearly explained.

Group discussions were held to solve difficulties. The teachers played guiding role during discussion. Group leaders even played active role during the same session. Students were given permission to use the blackboard. Each student was given an answer book for self analysis and suggested to analyse where errors were committed by them and were suggested to practice at least five sums of the same method in which they were unable to get full marks. The students were encouraged to solve textual examples, examples asked at S.S.C. Board examination and the unit test paper again after revision of the whole chapter.

4.4.2 Chapter 2: Rational Expressions

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as identities, factorization, equations and polynomials. In this test total thirty items were asked. All items were of objective type. Before teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given one mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in Table 24 along with its frequency distribution in table 25.

Table – 24:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30
1	9	19	14	37	10	55	15
2	5	20	12	38	6	56	8
3	11	21	17	39	5	57	7
4	5	22	5	40	10	58	11
5	20	23	16	41	4	59	7
6	5	24	9	42	11	60	13
7	9	25	8	43	7	61	7
8	2	26	3	44	5	62	18
9	9	27	2	45	1	63	16
10	20	28	13	46	5	64	16
11	23	29	4	47	7	65	17
12	7	30	11	48	2	66	15
13	6	31	7	49	10	67	14
14	6	32	4	50	11	68	19
15	4	33	7	51	8	69	11
16	12	34	8	52	15	70	12
17	10	35	1	53	4		
18	14	36	2	54	9		

Table – 25:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	19
6 – 10	24
11 – 15	17
16 – 20	9
21 – 25	1
26 – 30	0
Total	**70**

Mean marks obtained by students is 9.36 out of thirty marks. Students secured 31.2% of marks which showed poor performance on prerequisite knowledge. This demands remedial actions to be taken to enhance their prerequisite knowledge and to prepare the students to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:

(1) The L.C.M. of 4, 3 and 2 is _____

True	False	N.A.
50 (71.43%)	20 (28.57%)	0 (0%)

(2) The L.C.M. of 5, 5 and 5 is _____

True	False	N.A.
54 (77.14%)	16 (22.86%)	0 (0%)

(3) The L.C.M. of a, a^2 and a^3 is _____

True	False	N.A.
29 (41.43%)	41 (58.57%)	0 (0%)

(4) The L.C.M. of $16x^5y^3$ and $24x^4y^2$ is _____

True	False	N.A.
9 (12.86%)	61 (87.14%)	0 (0%)

(5) The L.C.M. of ab, bc and ca is _____

True	False	N.A.
38 (54.29%)	32 (45.71%)	0 (0%)

(6) The L.C.M. of $(x+1)^2$, $(x-1)^2$ and $(x^2-1)^2$ is _____

True	False	N.A.
4 (5.71%)	66 (94.29%)	0 (0%)

Q.1. (B) Simplify:

(7) $\frac{5x}{4}-\frac{3x}{3}+\frac{x}{2}$

True	False	N.A.
10 (14.28%)	57 (81.43%)	3 (4.29%)

(8) $\frac{3x}{4} - \frac{x}{6} - \frac{7x}{2}$

True	False	N.A.
12 (17.14%)	52 (74.29%)	6 (8.57%)

(9) $\frac{2x}{5} - \frac{3x}{5} + \frac{7x}{5}$

True	False	N.A.
26 (37.14%)	38 (54.29%)	6 (8.57%)

(10) $\frac{5}{a} - \frac{3}{a^2} - \frac{1}{a^3}$

True	False	N.A.
7 (10%)	57 (81.43%)	6 (8.57%)

Q.1. (C) Factorize:

(11) $x^2 + 8xy + 16y^2$

True	False	N.A.
40 (57.14%)	27 (38.57%)	3 (4.29%)

(12) $x^2 - 16y^2$

True	False	N.A.
37 (52.85%)	30 (42.86%)	3 (4.29%)

(13) $x^4 + 64y^4$

True	False	N.A.
13 (18.57%)	50 (71.43%)	7 (10%)

(14) $x^2 + 10x + 16$

True	False	N.A.
30 (42.86%)	30 (42.86%)	10 (14.28%)

(15) $a^2 - 21ab - 72b^2$

True	False	N.A.
16 (22.86%)	38 (54.28%)	16 (22.86%)

(16) $8x^2 - 26x + 15$

True	False	N.A.
19 (27.14%)	34 (48.57%)	17 (24.29%)

(17) x^3+27

True	False	N.A.
30 (42.86%)	30 (42.86%)	10 (14.28%)

(18) $16x^4-81$

True	False	N.A.
32 (45.71%)	28 (40%)	10 (14.29%)

(19) $x^4-(x-1)^2$

True	False	N.A.
16 (22.86%)	44 (62.86%)	10 (14.28%)

(20) $x^2(x-1)^2-1$

True	False	N.A.
12 (17.14%)	46 (65.72%)	12 (17.14%)

Q.1. (D) Fill in the blanks so as to make each statement true:

(21) $10x^2y-8x^2y-6x^2y$ = _____

True	False	N.A.
15 (21.43%)	47 (67.14%)	8 (11.43%)

(22) $2x^2y-5xy^2-4x^2y+xy^2$ = _____

True	False	N.A.
4 (5.71%)	57 (81.43%)	9 (12.86%)

(23) $\left(2a^2b^3c^4\right)^2$ = _____

True	False	N.A.
18 (25.71%)	44 (62.86%)	8 (11.43%)

(24) $\sqrt{16x^{16}}$ = _____

True	False	N.A.
13 (18.57%)	46 (65.72%)	11 (15.71%)

(25) $\left(-6x^3y\right)\left(-xy\right)$ = _____

True	False	N.A.
15 (21.43%)	42 (60%)	13 (18.57%)

(26) $(2x+1)(4x^2-2x+1) =$ _____

True	False	N.A.
10 (14.29%)	49 (70%)	11 (15.71%)

(27) $(x+7)(x+9) =$ _____

True	False	N.A.
19 (27.14%)	41 (58.57%)	10 (14.29%)

(28) $\frac{x}{y} \div \frac{x}{y} =$ _____

True	False	N.A.
22 (31.43%)	37 (52.86%)	11 (15.71%)

(29) $(2a+3b)^2 - 6ab =$ _____

True	False	N.A.
2 (2.86%)	57 (81.43%)	11 (15.71%)

(30) The full name of H.C.F. is _____. The full name of L.C.M. is _____.

True	False	N.A.
56 (80%)	6 (8.57%)	8 (11.43%)

The findings of the analysis showed that the errors occurred due to lack of:

1. knowledge (ignorance) of finding L.C.M. of numbers
2. knowledge of multiplication with numerator after taking L.C.M.
3. knowledge of different methods of factorization of polynomials
4. knowledge of addition and subtraction
5. knowledge of changes to be made while converting division into multiplication
6. understanding of expansion of polynomials

The errors on prerequisite test were found as follows:

1) The students could not find L.C.M. of algebraic expression due to inclarity between HCF and LCM.
2) The students could not factorize due to insufficient knowledge of recognition of method to be applied particularly e.g. difference of

squares was applied in $16x^4-81$ committed sign errors in applied in writing factors of x^3+27, etc.

e.g. x^4+64y^4 middle term is to be found and convert expression as difference of squares i.e. $x^4+16x^2y^2+64y^2-16x^2y^2$ $\therefore (x^2+8y^2)^2-(4xy)^2$ and then to be factorized but students instead of this wrote $(x^2-8y^2)(x^2+8y^2)$ which is wrong when in factorizing x^3+27 students wrote factors as $(x+3)(x^2+6x+9)$ which is wrong.

3) The students could not simplify simple rational expressions due to inability to express them with some denominators.

e.g. $\frac{5}{a}-\frac{3}{a^2}-\frac{1}{a^3}$ students were not able to take LCM properly and did sum wrong.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis as well as discussions with subject teachers the guideline and suggestions were worked out for further remedy, to improve their previous knowledge which is necessarily required to learn the chapter. While solving prerequisite test paper in classroom following remedial teaching was carried out.

1. L.C.M. of numbers were explained with necessary examples.
2. Extra practice of expansion and factorization of polynomials was given.
3. Methods of addition and subtraction of rational numbers, addition and subtraction of polynomials were explained with examples.
4. Conversion of division into multiplication was explained in details.

STEP – 4: Teaching of the Chapter: "Rational Expressions"

1. After catering remedial teaching the chapter "Rational Expressions" was taught to the students. While teaching the chapter "Rational Expressions" teacher explained the theory aspect of the chapter and then on the basis of that theory practical example were explained on the black board, participation of the students was also invited, students were asked some questions regarding the teaching made by the teacher and if the students could not to answer the question the teacher explained the same type of examples again.

2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter. Demonstration was given to the students regarding preparation of notes.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Question paper was framed. This test was of twenty eight marks three types of questions:

1) Solve the Sums:	5 items	x 3 marks	= 15
2) Solve the Short Sums:	4 items	x 2 marks	= 08
3) Objective:	5 items	x 1 mark	= 05
			28

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full mark; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in Table 26 along with its frequency distribution in table 27.

Table – 26:

Marks of Unit Test

Roll No.	Marks Obtained Out of 28	Roll No.	Marks Obtained Out of 28	Roll No.	Marks Obtained Out of 28	Roll No.	Marks Obtained Out of 28
1	5	19	6	37	11	55	4
2	3	20	19	38	12	56	3
3	14	21	6	39	12	57	5
4	6	22	13	40	10	58	8
5	13	23	14	41	9	59	4
6	3	24	10	42	12	60	9
7	16	25	10	43	3	61	12
8	8	26	1	44	9	62	21
9	7	27	2	45	12	63	13
10	14	28	7	46	8	64	4
11	13	29	2	47	1	65	6
12	3	30	8	48	5	66	13
13	3	31	1	49	10	67	25
14	2	32	3	50	9	68	18
15	2	33	14	51	14	69	10
16	16	34	8	52	6	70	9
17	12	35	3	53	9		
18	18	36	6	54	14		

Table – 27:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	21
6 – 10	24
11 – 15	18
16 – 20	05
21 – 25	2
26 – 30	0
Total	**70**

Mean marks obtained by students is 8.93 out of twenty eight marks. Students obtained 31.89% marks which showed poor performance in unit test knowledge. This clearly indicated need for remedial measures.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Simplify

(1) $\frac{x+2}{x-2}+\frac{x-2}{x+2}-\frac{16}{x^2-4}$

True	False	P.T.	N.A.
31 (44.29%)	27 (38.57%)	11 (15.71%)	1 (1.43%)

(2) $\frac{1}{a+3}+\frac{a+1}{a^2-3a+9}-\frac{2a^2+a+12}{a^3+27}$

True	False	P.T.	N.A.
12 (17.14%)	49 (70%)	2 (2.86%)	7 (10%)

(3) $\frac{a^3-8}{a^2+2a+4}\div\frac{a^2-4}{a^2+4a+4}\times\frac{a}{a+2}$

True	False	P.T.	N.A.
19 (27.14%)	44 (62.86%)	0 (0%)	7 (10%)

(4) $\frac{2x^2+x-1}{x^2-4x+3}\div\frac{6x^2+x-2}{2x^2-5x+3}\div\frac{2x^2-7x+6}{3x^2-7x-6}$

True	False	P.T.	N.A.
6 (8.57%)	50 (71.43%)	2 (2.86%)	12 (17.14%)

(5) $\left(\frac{x^2}{2}+\frac{4}{x}\right)\left(\frac{1}{x^2-2x+4}\right)-\frac{x}{2x-4}$

True	False	P.T.	N.A.
2 (2.86%)	44 (62.86%)	11 (15.71%)	13 (18.57%)

Q.2. Do as directed:

(1) Simplify: $\left[\frac{1}{x-1}+\frac{1}{x+1}\right]\times\frac{x^2-1}{2x}$

True	False	P.T.	N.A.
43 (61.43%)	27 (38.57%)	0 (0%)	0 (0%)

(2) If $\frac{1}{x}+\frac{1}{x^2}+\frac{1}{x^3}=\frac{p(x)}{x^3}$; then find $p(x)$.

True	False	P.T.	N.A.
9 (12.86%)	49 (70%)	0 (0%)	12 (17.14%)

(3) Simplify: $\frac{5x}{x-3}+\frac{15}{3-x}$

True	False	P.T.	N.A.
31 (44.29%)	29 (41.42%)	2 (2.86%)	8 (11.43%)

(4) If $\left(\frac{1}{x}-1\right)\left(\frac{1}{x-1}-1\right)\left(\frac{1}{x-2}-1\right)=\frac{p(x)}{x}$; then find $p(x)$

True	False	P.T.	N.A.
1 (1.43%)	47 (67.14%)	7 (10%)	15 (21.43%)

Q.3. Fill in the blanks by choosing correct options.

(1) $\frac{1}{x-4}-\frac{1}{x+4}=$ _____ $\left(0,\frac{8}{x^2-16},-1\right)$

True	False	N.A.
37 (52.86%)	33 (47.14%)	0 (0%)

(2) $\frac{x-2}{x+2}\times\frac{2+x}{2-x}=$ _____ $(0,1,-1)$

True	False	N.A.
32 (45.71%)	38 (54.29%)	0 (0%)

(3) $\frac{x^2-3x+2}{x^2+x-2}\div\frac{x-2}{x+2}=$ _____ $(1,0,-1)$

True	False	N.A.
52 (74.28%)	17 (24.29%)	1 (1.43%)

(4) $\frac{(-a+b+c)^3}{(a-b-c)^3}=$ _____ $(0,1,-1)$

True	False	N.A.
25 (35.71%)	41 (58.57%)	4 (5.72%)

(5) $\frac{x^3-y^3}{x^2-y^2}=\frac{x^2+xy+y^2}{m}\therefore m=$ _____ $(x-y,x+y,1)$

True	False	N.A.
44 (62.86%)	23 (32.86%)	3 (4.28%)

The errors were committed due to lack of:

1. knowledge of addition / subtraction of rational expressions with same / different denominators.
2. knowledge of factorization in the sums of simplification.
3. knowledge of conversion of division into multiplication in mixed sums on rational expressions.
4. knowledge of cancellation of numerator and denominator.
5. knowledge of identity element 1 of multiplication.
6. knowledge of simplification of rational expressions involving brackets.
7. knowledge of taking L.C.M. in sums on multiplication and division.

The errors on unit test were found as follows:

1) The students could not simplify due to their inability in writing proper factors.
2) The students could not simplify due to their inability to cancel factors in same numerator and denominator in addition or subtraction of rational expressions.

   e.g. $\frac{x+2}{x-2}+\frac{x-2}{x+2}-\frac{16}{x^2-4} = -\frac{16}{x^2-4}$ students cancelled x+2 and x–2 ignoring plus sign in between two expression which is wrong.
3) The students could not simplify in multiplication and division of rational expressions due to inability to convert expression just following ÷ sign.

   e.g. students forgot to make reciprocal where ÷ sign was there.

   $$\frac{a^3-8}{a^2+2a+4}\div\frac{a^2-4}{a^2+4a+4}\times\frac{a}{a+2}$$

   students wrote $\frac{a^3-8}{a^2+2a+4}\times\frac{(a-2)(a+2)}{(a+2)(a+2)}\times\frac{a}{(a+2)}$ this is wrong

   but the right way will be $\frac{a^3-8}{a^2+2a+4}\times\frac{(a+2)(a+2)}{(a-2)(a+2)}\times\frac{a}{(a+2)}$
4) The students could not simplify due to their inability to make same denominators by taking – sign common in opposite expressions.

   e.g. $\frac{5x}{x-3}+\frac{15}{3-x}$ students took LCM as

4.4.3 Chapter 3: Cyclic Expressions

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII (Identities and Factorization) and class IX (Polynomials). In this test total twenty items were asked. All items were of objective type. Before teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 28 along with its frequency distribution in table 29.

Table – 28:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	6	19	4	37	6	55	3
2	2	20	6	38	7	56	6
3	3	21	12	39	5	57	6
4	6	22	7	40	11	58	8
5	8	23	9	41	3	59	5
6	0	24	6	42	6	60	7
7	7	25	5	43	5	61	7
8	16	26	0	44	3	62	8
9	13	27	4	45	4	63	5
10	3	28	9	46	7	64	0
11	0	29	6	47	1	65	6
12	6	30	3	48	8	66	6

13	2	31	3	49	1	67	7
14	4	32	1	50	6	68	8
15	2	33	4	51	5	69	8
16	4	34	6	52	5	70	7
17	5	35	2	53	11		
18	7	36	1	54	7		

Table – 29:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
0 – 2	12
3 – 5	21
6 – 8	30
9 – 11	4
12 – 14	2
15 – 17	1
18 – 20	0
Total	**70**

Mean marks obtained by students is 5.54 out of twenty marks. Students secured 27.7% of marks which showed poor performance in prerequisite knowledge. This demands remedial actions to be taken to enhance their prerequisite knowledge and to prepare the students to learn the chapter.

(B) Error wise Analysis

Answer–sheet were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:

(1) $ab(a+b)$ = _____ (open the bracket).

True	False	N.A.
52 (74.29%)	18 (25.71%)	0 (0%)

(2) a^2b+ab^2 = _____ (Take common)

True	False	N.A.
50 (71.43%)	19 (27.14%)	1 (1.43%)

(3) a^2-ab = _____ (Take common)

True	False	N.A.
38 (54.28%)	30 (42.86%)	2 (2.86%)

(4) $(b+c)^2$ = _____ (Expand)

True	False	N.A.
47 (67.14%)	23 (32.86%)	0 (0%)

(5) $(x-5)^2$ = _____ (Expand)

True	False	N.A.
38 (54.28%)	31 (44.29%)	1 (1.43%)

(6) c^2-a^2 = _____ (Factorise)

True	False	N.A.
44 (62.86%)	25 (35.71%)	1 (1.43%)

(7) $4x^2-25$ = _____ (Factorise)

True	False	N.A.
13 (18.57%)	50 (71.43%)	7 (10%)

(8) $4x^2-12x+9$ = _____ (Factorise)

True	False	N.A.
8 (11.43%)	48 (68.57%)	14 (20%)

(9) $(x+3)(x-3)$ = _____ (Expand)

True	False	N.A.
11 (15.71%)	50 (71.43%)	9 (12.86%)

(10) $2ab-3ab+ab$ = _____ (Simplify)

True	False	N.A.
7 (10%)	49 (70%)	14 (20%)

(11) $a-b=-($_____$)$

True	False	N.A.
18 (25.72%)	41 (58.57%)	11 (15.71%)

(12) $(a+b-c)^2$ = _____ (Expand)

True	False	N.A.
9 (12.86%)	49 (70%)	12 (17.14%)

(13) $(a-b-c)^2$ = _____ (Expand)

True	False	N.A.
6 (8.57%)	49 (70%)	15 (21.43%)

(14) $(b+c)^3$ = _____ (Expand)

True	False	N.A.
2 (2.86%)	59 (84.28%)	9 (12.86%)

(15) $(a-b)^3$ = _____ (Expand)

True	False	N.A.
3 (4.29%)	59 (84.28%)	8 (11.43%)

(16) m^3-a^3 = _____ (Factorise)

True	False	N.A.
4 (5.71%)	58 (82.86%)	8 (11.43%)

(17) If $a+b+c=0$ then $a^3+b^3+c^3$ = _____

True	False	N.A.
5 (7.14%)	58 (82.86%)	7 (10%)

(18) Factorize: $4b^2+9bc+2c^2$

True	False	N.A.
5 (7.14%)	55 (78.57%)	10 (14.29%)

(19) Factorize: $9b^2-26bc-3c^2$

True	False	N.A.
7 (10%)	50 (71.43%)	13 (18.57%)

(20) Decide whether $x-2$ is one of the factor of x^2-3x+2 or not.

True	False	N.A.
16 (22.86%)	48 (68.57%)	6 (8.57%)

The findings of the analysis showed that the errors occurred due to lack of:

1. knowledge of different methods of factorization of polynomials.
2. knowledge of methods of expansion of polynomials.
3. knowledge of simplification by taking common from given terms.
4. knowledge of determining factors using remainder theorem.
5. knowledge of arrangement / grouping of terms.

The errors on prerequisite test were found as follows:

1) The students could not expand properly due to insufficient knowledge – inability to recognize proper method.
   e.g. while expanding $(b+c)^2$ they write simply b^2+c^2 and while expanding $(x-5)^2$ they write x^2-25 which is not correct. Students do not have the knowledge of basic formula $(a+b)^2=a^2+2ab+b^2$ and $(b-c)^2=b^2-2bc+c^2$.
2) Same way students made error while expanding $(a+b-c)^2$ and $(a-b-c)^2$ students were not able to apply the concept properly as 'c' was negative and made mistake actual expression is
   $(a+b-c)^2=a^2+b^2+c^2+2ab-2bc-2ca$ and
   $(a-b-c)^2=a^2+b^2+c^2-2ab+2bc-2ca$ → in this formula the sign of 2bc becomes positive as 'b' and 'c' both are negative. Students made sign mistake in this term while writing expansion.
3) $(b+c)^3=b^3+c^3+3bc(b+c)$ students were not able to expand as their concept about $(a+b)^3$ was not clear.
4) The students could not factorize properly due to confusion between expansion and factorization e.g. $m^3-a^3=(m-a)(m^2+ma+a^2)$ but students made mistake in $m^3-a^3=(m-a)^3$.
5) Majority of the students do not have the knowledge of the formula that if $a+b+c=0$ then $a^3+b^3+c^3=3abc$ students wrote $a^3+b^3+c^3=$ also zero. It is because of the lacking of basic formula of 8^{th} std.
6) While deciding whether $x-2$ is one of the factor or not they put $x=-2$ in the polynomial and tried. But actually $x=2$ is to be taken and to be tried

for the existence of the factor. So, lacking of the knowledge of remainder theorem.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis as well as discussion with subject teachers the guideline and suggestions were worked out for further remedy, to improve their previous knowledge which is necessarily required to learn the chapter.

1. Sufficient knowledge of different methods of factorization was provided.
2. Different methods of expansions (identities) were deeply explained.
3. By using remainder theorem of standard IX methods of finding common factor and deciding other factors were taught.
4. The exhaustive practice of sums was provided.

STEP – 4: Teaching of the Chapter: "Cyclic Expressions"

1. The chapter "Cyclic Expressions" was taught in detail.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Question paper was framed. This test was of thirty eight marks two types of questions:

1) Solve the Sums:	6 items	x 3 marks	= 18
2) Solve the short sums: (Any ten from twelve)	10 items	x 2 marks	= 20
			38

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was carried out by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full mark; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 30 along with its frequency distribution in table 31.

Table – 30:

Marks of Unit Test

Roll No.	Marks Obtained Out of 38	Roll No.	Marks Obtained Out of 38	Roll No.	Marks Obtained Out of 38	Roll No.	Marks Obtained Out of 38
1	11	19	21	37	15	55	12
2	4	20	35	38	26	56	8
3	13	21	21	39	7	57	8
4	6	22	32	40	10	58	10
5	13	23	23	41	10	59	9
6	4	24	5	42	14	60	6
7	13	25	8	43	12	61	22
8	15	26	7	44	15	62	23
9	23	27	0	45	6	63	28
10	19	28	20	46	16	64	5
11	9	29	3	47	15	65	12
12	3	30	11	48	3	66	11
13	0	31	7	49	17	67	28
14	11	32	12	50	24	68	28
15	9	33	10	51	9	69	23
16	33	34	2	52	10	70	15
17	16	35	5	53	12		
18	24	36	4	54	11		

Table – 31:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 12	40
13 – 25	23
26 – 38	7
Total	**70**

Mean marks obtained by students is 12.87 out of thirty eight marks. Students obtained 33.87% marks which showed poor performance in unit test knowledge. This clearly indicated need for remedial measures.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

(1) $a(b^2+c^2)+b(c^2+a^2)+c(a^2+b^2)+2abc$

True	False	P.A.	N.A.
53 (75.72%)	6 (8.57%)	11 (15.71%)	0 (0%)

(2) $(a+b)(b+c)(c+a)+abc$

True	False	P.A.	N.A.
25 (35.71%)	28 (40%)	8 (11.43%)	9 (12.86%)

(3) $(a+b)(a^2-b^2)+(b+c)(b^2-c^2)+(c+a)(c^2-a^2)$

True	False	P.A.	N.A.
31 (44.28%)	21 (30%)	15 (21.43%)	3 (4.29%)

(4) $a^3+b^3+c^3-3abc$

True	False	P.A.	N.A.
8 (11.43%)	32 (45.71%)	15 (21.43%)	15 (21.43%)

(5) $2a^2(2b+c)+2b^2(2c+a)+2c^2(2a+b)+9abc$

True	False	P.A.	N.A.
19 (27.14%)	36 (51.43%)	6 (8.57%)	9 (12.86%)

(6) $ac(c+a)-ab(a-b)-bc(c-b)-2abc$

True	False	P.A.	N.A.
6 (8.57%)	37 (52.86%)	23 (32.86%)	4 (5.71%)

Factors

Factorize (Any Ten):

(1) x^3+3x^2-2

True	False	P.A.	N.A.
29 (41.43%)	34 (48.57%)	3 (4.29%)	4 (5.71%)

(2) $(1-x^2)(1-y^2)+4xy$

True	False	P.A.	N.A.
10 (14.29%)	50 (71.42%)	0 (0%)	10 (14.29%)

(3) $(x+4)^3-x-4$

True	False	P.A.	N.A.
13 (18.57%)	11 (15.71%)	1 (1.43%)	45 (64.29%)

(4) $a^4-4ab+4b^4-1$

True	False	P.A.	N.A.
9 (12.86%)	10 (14.29%)	3 (4.29%)	48 (68.57%)

(5) $(x^3+y^3)-(1+x^3y^3)$

True	False	P.A.	N.A.
6 (8.57%)	21 (30%)	2 (2.85%)	41 (58.57%)

(6) $(x^2-6x)^2-8(x^2-6x+8)-64$

True	False	P.A.	N.A.
16 (22.85%)	10 (14.29%)	9 (12.86%)	35 (50%)

(7) $15(x+y)(x-y)-16xy$

True	False	P.A.	N.A.
21 (30%)	15 (21.43%)	4 (5.71%)	30 (42.86%)

(8) $(x^2+7x)^2-8(x^2+7x)-180$

True	False	P.A.	N.A.
16 (22.85%)	10 (14.29%)	8 (11.43%)	36 (51.43%)

(9) $(x^2-x)(x^2-x-1)-30$

True	False	P.A.	N.A.
13 (18.57%)	13 (18.57%)	8 (11.43%)	36 (51.43%)

(10) $x^2-9-y(y-6)$

True	False	P.A.	N.A.
1 (1.43%)	21 (30%)	1 (1.43%)	47 (67.14%)

(11) $2(2x+3)^2+(2x+3)(x-1)-3(x-1)^2$

True	False	P.A.	N.A.
10 (14.29%)	14 (20%)	3 (4.29%)	43 (61.42%)

(12) $(x-y)^2-(1-xy)^2$

True	False	P.A.	N.A.
8 (11.43%)	30 (42.86%)	0 (0%)	32 (45.71%)

The errors were committed due to lack of:

1. knowledge of standard form of cyclic expression.
2. knowledge of factorization of cyclic expressions.
3. knowledge of converting the answer in cyclic form by taking minus sign common.
4. knowledge of considering changes in signs while removing bracket.
5. knowledge of addition / subtraction of like terms.
6. knowledge of difference between $(b+c)^2$ and b^2+c^2.
7. knowledge of factorization of different kinds.
8. knowledge of factor theorem to determine factor.

The errors on unit test were found as follows:

1) The students could not factorize cyclic expressions due to inability to make proper groupings.
2) The students could not factorize cyclic expressions due to – inability to expand – inability to use proper formula.
   e.g. students were not able to place '9abc' term properly hence they were not able to form proper group and then were not able to factorize.

3) The students could not factorize due to proper recognition of different types of factors.

e.g. $(x^3+y^3)-(1+x^3y^3)$ students factorize without noticing minus sign and wrote $(x+y)(x^2-xy+y^2)-(1+xy)(1-xy+x^2y^2)$ which is wrong but it can be done as below

$$x^3+y^3-1-x^3y^3$$

$$= x^3-x^3y^3-1+y^3 = x^3(1-y^3)-1(1-y^3) = (x^3-1)(1-y^3)$$

$$=(x-1)(x^2+x+1)(1-y)(1+y+y^2)$$ which is the right method.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

Enough knowledge of standard form of cyclic expression was given. Different methods of factorization of cyclic expressions were explained with illustrations. Sufficient explanation was given to convert original answer in cyclic form by taking minus sign common. Insufficient knowledge of change signs while removing brackets were important. Knowledge of addition of positive and negative terms was explained. Revision of sums of different kinds of factors was given. Use of remainder theorem was explained with illustrations.

Group discussions were held to solve difficulties. Teachers played guiding role during discussion. Each student was given an answer book for self analysis, to analyse where errors were committed by them and were suggested to practice at least five sums of the same method in which failed to get full marks. The students were encouraged to solve all the sums asked at the S.S.C. Board examination and the unit test paper again after revision of the whole chapter.

4.4.4 Chapter 4: Ratio and Proportion

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed for the chapter which included the related items of class VIII (Factorization) and class IX (Trigonometry). In this test total fifteen items were asked. All items were of objective type. Before teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of fifteen marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 32 along with its frequency distribution in table 33.

Table – 32:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	5	19	7	37	8	55	10
2	5	20	13	38	9	56	8
3	5	21	11	39	11	57	10
4	5	22	13	40	7	58	12
5	13	23	11	41	6	59	1
6	5	24	11	42	6	60	6
7	12	25	11	43	9	61	10
8	8	26	15	44	4	62	8
9	13	27	6	45	5	63	7
10	12	28	15	46	9	64	6
11	7	29	11	47	3	65	9
12	8	30	9	48	2	66	9
13	6	31	6	49	12	67	13

14	6	32	4	50	6	68	11
15	5	33	2	51	3	69	11
16	8	34	4	52	7	70	13
17	9	35	5	53	6		
18	10	36	1	54	12		

Table – 33:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	17
6 – 10	32
11 – 15	21
Total	**70**

Mean marks obtained by students is 8.29 out of fifteen marks. Students secured 55.27% marks which showed poor performance in prerequisite knowledge. This demands remedial actions to be taken to enhance their prerequisite knowledge and to prepare the students to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:–

(1) What is the ratio of 64 and 80? .....

True	False	N.A.
11 (15.72%)	41 (58.57%)	18 (25.71%)

(2) Are $\frac{12}{16}$ and $\frac{15}{20}$ equal ratios? Yes ( ), No ( )

True	False	N.A.
51 (72.86%)	19 (27.14%)	0 (0%)

(3) What is the inverse ratio of $\frac{5}{8}$ .....

True	False	N.A.
55 (78.57%)	15 (21.43%)	0 (0%)

(4) If $\frac{x^3}{y^3}=\frac{125}{64}$, then $\frac{x}{y}$ = ...

True	False	N.A.
57 (81.43%)	13 (18.57%)	0 (0%)

(5) $[k^3]^{1/3}$ = ...

True	False	N.A.
50 (71.43%)	15 (21.43%)	5 (7.14%)

(6) $\sqrt{5\times125}$ = ...

True	False	N.A.
40 (57.14%)	30 (42.86%)	0 (0%)

(7) If $x^2 = 9$ then x = ... or .....

True	False	N.A.
35 (50%)	29 (41.43%)	6 (8.57%)

(8) If $\frac{x}{5}=\frac{15}{25}$ then x = ...

True	False	N.A.
50 (71.43%)	14 (20%)	6 (8.57%)

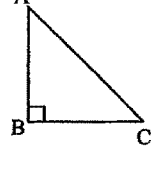
(9) $\sqrt{8a^3b^2\times32ab^3}$ = ...

True	False	N.A.
17 (24.29%)	33 (47.14%)	20 (28.57%)

(10) $\sqrt{\frac{a^2}{b^2}\times\frac{b^2}{a^2}}$ = ...

True	False	N.A.
27 (38.57%)	31 (44.29%)	12 (17.14%)

(11) In the given figure $\sin A=\frac{BC}{AC}$. Then $\cos C$ =.....



True	False	N.A.
20 (28.57%)	49 (70%)	1 (1.43%)

(12) $(b^2k+d^2k)^2 = \square\ (b^2+d^2)^2$ (Write in the box by taking common)

True	False	N.A.
43 (61.43%)	23 (32.86%)	4 (5.71%)

(13) If $a=3k, b=2k$ then $3a-2b$ = ...

True	False	N.A.
42 (60%)	19 (27.14%)	9 (12.86%)

(14) Write the factors of $a^3+b^3+c^3-3abc$ .....

True	False	N.A.
24 (34.29%)	34 (48.57%)	12 (17.14%)

(15) Write $4b^3k^3+5d^3k^3+6f^3k^3$ by taking common.

True	False	N.A.
29 (41.43%)	28 (40%)	13 (18.57%)

The findings of the analysis showed that the errors occurred due to lack of:

1. finding ratio because of absence of knowledge of multiplication and division.
2. finding square root, cube root.
3. proper concept of trigonometric ratios like sin, cos, etc. of angles

The errors on prerequisite test were found as follows:

1) The students could not find simple ratio due to inability to cancel common numbers in numerator and denominator.

   e.g. $\frac{12}{16}$ and $\frac{15}{20}$ are equal ratios but students were not able to reduce it properly and wrote wrong answer.

2) The students could not find proper value of square root involving algebraic expression due to insufficient knowledge of powers and indices.

   e.g. $\frac{x^3}{y^3}=\frac{125}{64} \therefore \left(\frac{x}{y}\right)^3=\left(\frac{5}{4}\right)^3 \therefore \frac{x}{y}=\frac{5}{4}$ but students instead of finding cube root made cube of $\frac{125}{64}$ and went wrong.

3) The students could not take common from bracket with perfect square due to inability to square and take common.
e.g. $(b^2k+d^2k)^2 = k^2 (b^2+d^2)^2$ is right but students were not able to take common K or took 'K' only common and forgot to square as they were not clear in concept.

4) Students could not write $\cos C = \frac{BC}{AC}$ due to lack of knowledge of trigonometry that $\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis and discussion with subject teachers the guideline and suggestions were worked out for further remedy, to improve their previous knowledge which is necessarily required to learn the chapter.

(i) The students were taught about ratio and proportion.

(ii) They were taught to find squares, cubes, square roots and cube roots.

(iii) Their concept of sin, cos, etc. of angles were explained by making tables (of 0°, 30°, 45°, 60°, 90° angles).

STEP – 4: Teaching of the Chapter: "Ratio and Proportion"

1. The chapter "Ratio and Proportion" was taught in detail.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Question paper was framed. This test was of twenty marks, three types of questions:

1) Solve the Sums:	3 items	x 3 marks	= 09
2) Solve the Short sums	4 items	x 2 marks	= 08
3) Objectives (Fill in the gaps):	3 items	x 1 mark	= 03
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full mark; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 34 along with its frequency distribution in table 35.

Table – 34:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	10	19	2	37	5	55	11
2	5	20	15	38	14	56	8
3	4	21	13	39	8	57	11
4	9	22	12	40	14	58	17
5	9	23	2	41	15	59	1
6	6	24	9	42	4	60	7
7	18	25	5	43	8	61	17
8	17	26	1	44	3	62	14
9	9	27	7	45	6	63	13
10	10	28	7	46	14	64	5
11	12	29	7	47	2	65	6
12	5	30	16	48	6	66	7
13	4	31	7	49	17	67	18
14	7	32	2	50	9	68	12
15	5	33	5	51	4	69	7

16	15	34	12	52	10	70	4
17	14	35	5	53	6		
18	11	36	6	54	17		

Table – 35:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	20
6 – 10	25
11 – 15	17
16 – 20	8
Total	**70**

Mean marks obtained by students is 8.93 out of twenty marks students obtained 44.65% marks which showed poor performance in unit test knowledge. This clearly indicated need for remedial measures.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis of all the items on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Do as directed:

(1) If a, b and c, d are in proportion, prove that $\frac{a^3+b^3+c^3+d^3}{a^{-3}+b^{-3}+c^{-3}+d^{-3}} = (ad)^3$

True	False	P.T.	N.A.
22 (31.43%)	9 (12.86%)	25 (35.71%)	14 (20%)

(2) If $\frac{a}{u+v-w} = \frac{b}{v+w-u} = \frac{c}{w+u-v}$ then prove that

$au+bv+cw = av+bw+cu$.

True	False	P.T.	N.A.
28 (40%)	20 (28.57%)	12 (17.14%)	10 (14.29%)

(3) If $\frac{x}{y+z}=\frac{y}{z+x}=\frac{z}{x+y}$, show that the value of each ratio is $\frac{1}{2}$ or -1.

True	False	P.T.	N.A.
46 (65.71%)	4 (5.71%)	10 (14.29%)	10 (14.29%)

Q.2. Do as directed:

(1) If $\frac{x^2+1}{x^2-1}=\frac{5}{4}$ using only the properties of proportional find x.

True	False	P.T.	N.A.
23 (32.86%)	30 (42.86%)	1 (1.43%)	16 (22.85%)

(2) If 6 is the geometric mean of $a(a>0)$ and 4, find the value of a.

True	False	P.T.	N.A.
27 (38.57%)	20 (28.57%)	0 (0%)	23 (32.86%)

(3) If $\frac{a}{b}=\frac{c}{d}$ then prove that $(ab+cd)^2=(a^2+c^2)(b^2+d^2)$

True	False	P.T.	N.A.
26 (37.14%)	22 (31.43%)	3 (4.29%)	19 (27.14%)

(4) If $2a=5b$ and $3b=8c$, then find $a:b:c$.

True	False	P.T.	N.A.
1 (1.43%)	26 (37.14%)	2 (2.86%)	41 (58.57%)

Q.3. Fill in the blanks in each of the following by selecting the proper alternative from those given in the brackets: 03

(1) If $15:12=25:x$, then x=..... (12, 20, 18)

True	False	P.T.	N.A.
61 (87.14%)	8 (11.43%)	1 (1.43%)	0 (0%)

(2) The geometric mean of $(a^2+b^2)^2$ and $(a^2-b^2)^2$ for $a>b$ is .....

$\left[(a^2-b^2)^2, a^4-b^4, a^2-b^2\right]$

True	False	P.T.	N.A.
36 (51.43%)	32 (45.71%)	0 (0%)	2 (2.86%)

(3) If $a:b=1:2$, $c:d=2:5$ and $e:f=3:4$, then $ace:bdf$ = ...

(6:11, 11:6, 3:20).

True	False	P.T.	N.A.
14 (20%)	54 (77.14%)	0 (0%)	2 (2.86%)

The errors were committed due to lack of:

1. knowledge of factorization of quadratic and cubic expressions.
2. placing values in the equation.
3. knowledge of simplifying the expressions.
4. finding ratio because of improper knowledge of multiplication and division.
5. finding geometric mean.

The errors on unit test were found as follows:

1) The students could not find proper value due to inability to apply proper properties of proportion.

   e.g. $\frac{x^2+1}{x^2-1}=\frac{5}{4}$ and should be done by components and dividends but students did it by cross–multiplication which is wrong; as question asked was to do solve by properties of proportion.

2) The students could not prove that each ratio equal to ... or ... due to inability to use proper method.

   e.g. for proving we have to take $x+y+z\neq 0$ and $x+y+z=0$ and apply each ratio separately so two different values can be obtained, but students did only one of it and left the other due to not knowing proper method.

3) The students could not prove sum on proportion due to inability to simplify using powers and indices.

4) The students could not find a:b:c due to insufficient knowledge of they are proportional to the denominators i.e. $\frac{a}{p}=\frac{b}{q}=\frac{c}{r}\Rightarrow a:b:c=p:q:r$.

   e.g. a:b=1:2, c:d=2:5 and e:f=3:4 ∴ace:bdf, i.e. 1x2x3:2x5x4

   i.e. 6:40 ∴3:20 but students were unable to do as they were not clear in their mind about proportional.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussion with subject teachers the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The revision of factorization of quadratic and cubic expression was carried out. They were taught to place value properly in the sums and to simplify it. The unit test paper solved and they were taught how to find ratio and proportion and geometric mean. The concept of basic rules and different types of ratios were explained. The concept of ratio and proportion from standard seven was also cleared. Exhaustive practice on ratio and proportion was given. Each student was given an answer book for self analysis to analyse where errors were committed and were also suggested to practice at least two sums of the same method in which students could not achieve good marks. Complete revision of the whole chapter by solving textual examples, to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again after revision of the whole chapter.

4.4.5 Chapter 5: Variation

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII (Equations, Identities, Factorization and Real Numbers) and class IX (Linear equations of two variables). In this test total twenty items were included. All items were of objective type. Before teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

In the answer book each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 36 along with its frequency distribution in table 37.

Table – 36:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	5	19	9	37	7	55	9
2	5	20	10	38	6	56	8
3	10	21	14	39	10	57	3
4	6	22	16	40	8	58	14
5	15	23	12	41	2	59	7
6	5	24	10	42	9	60	8
7	16	25	9	43	7	61	12
8	10	26	14	44	2	62	11
9	14	27	5	45	2	63	10
10	12	28	13	46	6	64	2
11	5	29	5	47	1	65	8
12	8	30	8	48	1	66	13
13	11	31	15	49	14	67	13
14	9	32	3	50	7	68	13
15	9	33	1	51	3	69	8
16	3	34	4	52	11	70	10
17	9	35	3	53	8		
18	13	36	1	54	12		

Table – 37:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	20
6 – 10	29
11 – 15	19
16 – 20	2
Total	**70**

Mean marks obtained by students is 8.21 out of twenty marks. Students secured 41.05% marks which showed poor performance on prerequisite knowledge. This demands remedial actions to be taken to enhance their prerequisite knowledge and to prepare the students to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer Accordingly:

(1) If $y=3+2x$ and $x=10$, then find y.

True	False	N.A.
62 (88.57%)	7 (10%)	1 (1.43%)

(2) $y=\frac{2}{3}x$ is given. If $y=24$, then find x.

True	False	N.A.
31 (44.28%)	36 (51.43%)	3 (4.29%)

(3) If $y=\frac{10}{x}$ and $y=\frac{5}{2}$, then find the value of x.

True	False	N.A.
37 (52.86%)	23 (32.86%)	10 (14.28%)

(4) $\sqrt{y}=8$ is given. What is the value of y?

True	False	N.A.
21 (30%)	44 (62.86%)	5 (7.14%)

(5) $\sqrt[3]{x}=5$ is given. What is the value of x?

True	False	N.A.
23 (32.86%)	33 (47.14%)	14 (20%)

(6) If $y=x^2+1$, and $y=17$, then find the value of x $(x>0)$.

True	False	N.A.
50 (71.43%)	13 (18.57%)	7 (10%)

(7) $y^3 = \frac{27}{64}$ is given. What will be the value of y?

True	False	N.A.
51 (72.86%)	10 (14.28%)	9 (12.86%)

(8) If $x^2y^2 - 4xy + 4 = 0$, then find the value of xy.

True	False	N.A.
14 (20%)	22 (31.43%)	34 (48.57%)

(9) If $x^{2/3} = 16$, then find the value of x.

True	False	N.A.
6 (8.57%)	34 (48.57%)	30 (42.86%)

(10) $x + 200y = 1800$; $x + 100y = 1000$ From the pairs of equation, find the value of x and y. (By the method of elimination)

True	False	N.A.
31 (44.28%)	24 (34.29%)	15 (21.43%)

(11) Factorise: $k^2 + k - 6$

True	False	N.A.
23 (32.86%)	21 (30%)	26 (37.14%)

(12) Expand: $(x + y)(x^2 - xy + y^2)$

True	False	N.A.
28 (40%)	28 (40%)	14 (20%)

(13) Expand: $(x + y)(x - y)$

True	False	N.A.
39 (55.71%)	23 (32.86%)	8 (11.43%)

(14) If $xy = 1$, then what is the relation between x and y?
(Multiplicative inverse or additive inverse)

True	False	N.A.
31 (44.28%)	24 (34.29%)	15 (21.43%)

(15) $1 - \cos^2\theta =$ .....

True	False	N.A.
21 (30%)	24 (34.29%)	25 (35.71%)

(16) 1 hour and 30 minutes = ... hours.

True	False	N.A.
25 (35.71%)	36 (51.43%)	9 (12.86%)

(17) If $y = \frac{1}{z}$ then $\frac{1}{y}$ = ... (In terms of z)

True	False	N.A.
24 (34.29%)	18 (25.71%)	28 (40%)

(18) If $y = z^4$ then y^3 = ... (In terms of z)

True	False	N.A.
10 (14.28%)	30 (42.86%)	30 (42.86%)

(19) If the individual expense of lunch of 40 students is Rs. 175. What is the total expense of the lunch of all the 40 students?

True	False	N.A.
24 (34.29%)	21 (30%)	25 (35.71%)

(20) If x=4 then $\left(x^{1/2}+1\right)$=_____.

True	False	N.A.
30 (42.86%)	22 (31.43%)	18 (25.71%)

The findings of the analysis showed that the errors occurred due to lack of:

1. students were unable to factorize quadratic expressions.
2. the concept of different kinds of variation was not clear.
3. students were unable to find square, square root and cube root.
4. in the sums involving expansion, students committed error in expanding.
5. students either misunderstood the problems or could not understand the problems.
6. students did not know the relation between two variables.
7. students were unable to simplify.

The errors on prerequisite test were found as follows:

1) In factorization of $x^2y^2-4xy+4$, the students factorized it as $(xy+2)^2$ i.e. concept of factorization of perfect square trinomials is not clear.
2) In factorization of k^2+k-6, the students factorized it as (k–3) (k+2) or (k+3) (k+2) or (k–3) (k–2) – committing for trinomial expression of ax^2+bx+c form or (k+6) (k–1) – inability to find proper parts.
3) In calculating y from $\sqrt{y} = 8$, the students calculated $y = \sqrt{8}$ i.e. misunderstanding the concept of squaring.
4) In calculating x from $\sqrt[3]{x}=5$, the students calculated $x = \sqrt[3]{5}$ i.e. misunderstanding the concept of cubing.
5) In calculating x from $x^2 = 16$, the students calculated x = 256 i.e. misunderstanding the concept of finding square root.
6) The students expanded $(x+y)(x^2-xy+y^2) = x^3-y^3$ – students were not clear with expansion of x^3+y^3.
7) $(x+y)(x-y) = x^2+y^2$ or $x^2-2xy+y^2$ – committing sign error or wrong use of formula.
8) In calculating x from $y=\frac{10}{x}$, the students used x = 10y – due to misconcepting of changing sides of variable.
9) In calculating y = 3+2x10 = 5x10 = 50 – due to ignorance of rules of operation BODMAS.
10) In finding y^3 from $y=z^4$ the students wrote $y^3=z^{4+3}=z^7$ or $y^3=z^4=z^{64}$ – due to inability of using rules of indices like $(x^m)^n = x^{mn}$.
11) In calculating x from $x^{2/3}=16$, most of the students left this problem, they do not have the knowledge of taking reciprocal of $\frac{2}{3}$ that is $\frac{3}{2}$ as a index on both the sides, means: $x^{2/3}=16$, so $\left(x^{2/3}\right)^{3/2}=(16)^{3/2}=\left(4^2\right)^{3/2}=(4)^3=64$, $\therefore$x=64 students have lack of knowledge of power and indices.
12) Students wrote 1 hour and 30 minutes is equal to 1.30 hours which is incorrect. 30 minutes means one half hour means 0.5 hour and so, 1 hour 30 minutes is equal to 1.5 hour.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis as well as discussion with subject teachers the guideline and suggestions were worked out for further remedy, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The revision of factorization of quadratic expressions was carried out.
2. The concept of different kinds of variation was cleared.
3. The practice of square, square root and cube root was explained.
4. The practice of sums of expansion was given.
5. Different types of problems were explained with more illustrations and exhaustive practice was given.
6. The sums of relation between two variables were given for practice.
7. The practice sums on simplification was given.

STEP – 4: Teaching of the Chapter: "Variation"

1. After catering remedial teaching the chapter "Variation" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Question paper was framed. This test was of twenty marks three types of questions:

1) Solve the Sums:	4 items	x 3 marks	= 12
2) Solve the Short Sums:	3 items	x 2 marks	= 06
3) Objective (Fill in the gaps):	2 items	x 1 mark	= 02
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was carried out by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full mark, partly correct answer was given a mark proportionately as per the scheme given by the Board and total were given to each student. Marks obtained by the students in unit test are shown in table 38 along with its frequency distribution in table 39.

Table – 38:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	3	19	8	37	7	55	5
2	4	20	20	38	17	56	7
3	1	21	17	39	14	57	10
4	10	22	10	40	11	58	9
5	6	23	4	41	10	59	4
6	2	24	13	42	6	60	3
7	12	25	14	43	6	61	1
8	10	26	10	44	5	62	4
9	11	27	10	45	4	63	9
10	7	28	10	46	7	64	1
11	2	29	9	47	1	65	7
12	8	30	20	48	1	66	10
13	12	31	8	49	2	67	13
14	3	32	18	50	8	68	14
15	6	33	7	51	8	69	10
16	8	34	12	52	4	70	7
17	2	35	1	53	2		
18	8	36	5	54	5		

Table – 39:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	24
6 – 10	31
11 – 15	10
16 – 20	5
Total	**70**

Mean marks obtained by students is 7.71 out of twenty marks. Students obtained 38.55% marks which showed poor performance in unit test. This clearly indicated need for remedial measures.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Solve the following

(1) For a cuboidal (that is, having the shape for a cuboid) box whose height and volume are constant, the length and breadth vary inversely as each other. When the length is 10 units, the breadth is 4 units. If the length is 8 units, what is the breadth? Find the length when the breadth is 2 units.

True	False	P.T.	N.A.
36 (51.43%)	14 (20%)	7 (10%)	13 (18.57%)

(2) The weight of a sphere is in compound variation with the cube of its diameter and the density. The weight of a sphere of diameter 2 units and density 4.2 units is 16.8 units. If the diameter of the sphere is 4 units and the weight is 64 units, find its density.

True	False	P.T.	N.A.
26 (37.14%)	24 (34.28%)	3 (4.29%)	17 (24.29%)

(3) The expenses of a hostel are partially constant and partially vary directly as the number of hostelites. The expenses for 120 hostelites amount to Rs. 2000 and for 100 hostelites, they amount of Rs. 1700. If the expenses are Rs. 1880, find the number of hostelites.

True	False	P.T.	N.A.
20 (28.57%)	22 (31.43%)	11 (15.71%)	17 (24.29%)

(4) $x+y$ varies directly as $\frac{x}{y}$ and x^2-xy+y^2 varies inversely as $\frac{x}{y}$ ($x\neq0$, $y\neq0$). Prove that x^3+y^3 is constant.

True	False	P.T.	N.A.
7 (10%)	15 (21.43%)	15 (21.43%)	33 (47.14%)

Q.2. (A) Solve the following:

(1) The cube of x varies inversely as the square root of y and $x=2$ when $y=9$, Find x when $y=\frac{1}{81}$

True	False	P.T.	N.A.
31 (44.29%)	31 (44.29%)	0 (0%)	8 (11.42%)

(2) y partially varies directly as the square of x and is partially constant. When $x=2$, $y=5$ and when $x=3$, $y=10$. Find y for $x=1$. Also find x for $y=17$. ($x>0$)

True	False	P.T.	N.A.
10 (14.28%)	38 (54.29%)	2 (2.86%)	20 (28.57%)

(3) For acute angle θ, $x\alpha\frac{1+\cos\theta}{\sin\theta}$, $y\alpha\frac{1-\cos\theta}{\sin\theta}$. Prove that $x\alpha\frac{1}{y}$.

True	False	P.T.	N.A.
22 (31.43%)	12 (17.14%)	1 (1.43%)	35 (50.00%)

Q.2. (B) Fill in the blanks by selecting the proper alternative from those given in the brackets:

(1) $x\alpha y^2$ and $y\alpha z^3$ then $x\alpha$ ..... (z^2, z^5, z^6)

True	False	P.T.	N.A.
45 (64.29%)	24 (34.28%)	0 (0%)	1 (1.43%)

(2) y varies inversely as the square root of x. $y = 1$ when $x = \frac{1}{4}$. Then $y =$ ..... When $x = \frac{1}{9}$. $(\frac{1}{2}, \frac{3}{2}, 9)$

True	False	P.T.	N.A.
49 (70.00%)	19 (27.14%)	0 (0%)	2 (2.86%)

The errors were committed due to lack of:

1. clarity of the concept of direct variation, inverse variation and joint variation.
2. understanding the data of problems on variation.
3. finding the value of the given sum.
4. inability to find square root and cuberoot.
5. proper supposition in problems on variation.
6. placing values properly while finding the final answer.

The errors of unit test were found as follows:

1) Length (x) varies inversely as breadth (y). The students wrote xαy – due to misconception of inverse variation.
2) In compound variation problem, the students wrote x=z+ky in stead of x=kyz – due to misconception of compound variation.
3) Students made error while making equations in the problem of partial variation.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve the knowledge of the chapter.

The concept of direct variation, inverse variation and joint variation was once again cleared. How to understand the data was explained thoroughly. Finding the value from the sum was clearly explained. How to find square root and cube root was explained. In problem sums how to make supposition was explained. Students were explained to be careful while placing values. Exhaustive practice sums were given for practice from easy to hard keeping

all the above points in mind. On the basis of group discussions difficulties were solved by the teachers. Students were suggested to practice at least five sums of the same method at home and each student was given an answer book for self analysis to analyse where errors were committed.

4.4.6 Chapter 6: Quadratic Equations

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII (Real numbers, Identities, Factorization, Equations) and class IX (Area). In this test total thirty items were included. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of thirty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 40 along with its frequency distribution in table 41.

Table – 40:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30	Roll No.	Marks Obtained Out of 30
1	5	19	13	37	11	55	6
2	3	20	14	38	11	56	10
3	6	21	9	39	13	57	10
4	7	22	22	40	9	58	9
5	8	23	14	41	9	59	5
6	5	24	9	42	11	60	7

7	23	25	8	43	4	61	12
8	14	26	20	44	3	62	7
9	22	27	13	45	4	63	6
10	17	28	28	46	10	64	4
11	12	29	9	47	2	65	8
12	8	30	8	48	7	66	16
13	12	31	17	49	12	67	11
14	9	32	5	50	9	68	18
15	6	33	1	51	8	69	6
16	11	34	8	52	8	70	16
17	16	35	3	53	9		
18	12	36	7	54	12		

Table – 41:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	12
6 – 10	30
11 – 15	17
16 – 20	7
21 – 25	3
26 – 30	1
Total	**70**

Mean marks obtained by students is 10.29 out of thirty marks. Students secured 34.29% of marks which shows poor performance on prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:

(1) Factorise: $x^2 - 25$

True	False	N.A.
61 (87.14%)	6 (8.57%)	3 (4.29%)

(2) Factorise: $x^2 - 3x - 10$

True	False	N.A.
42 (60%)	18 (25.71%)	10 (14.29%)

(3) Factorise: $14x^2 - 45x - 14$

True	False	N.A.
13 (18.58%)	18 (25.71%)	39 (55.71%)

(4) Write the middle term of the expression $x^2 + \frac{1}{x^2}$.

True	False	N.A.
9 (12.86%)	41 (58.57%)	20 (28.57%)

(5) Write the expansion of $(x + 1)^2$ .....

True	False	N.A.
35 (50%)	30 (42.86%)	5 (7.14%)

(6) Write the expansion of $(x - \frac{1}{x})^2$ .....

True	False	N.A.
7 (10%)	48 (68.57%)	15 (21.43%)

(7) By comparing the equation $\sqrt{3}.x^2 - 2\sqrt{2}x - 2\sqrt{3} = 0$

With $a\,x^2 + b\,x + c = 0$, a = ..., b = ..., c = ...

True	False	N.A.
25 (35.71%)	21 (30%)	24 (34.29%)

(8) If $3m - 10 = 0$, then m = ...

True	False	N.A.
14 (20%)	40 (57.14%)	16 (22.86%)

(9) Is $\sqrt{57}$ is a rational or an irrational number?

True	False	N.A.
57 (81.42%)	10 (14.29%)	3 (4.29%)

(10) $x = 16$ is given. Is $\sqrt{x}$ a rational or an irrational number?

True	False	N.A.
59 (84.28%)	8 (11.43%)	3 (4.29%)

(11) What is the value of $[2\sqrt{5}]^2$?

True	False	N.A.
31 (44.29%)	27 (38.57%)	12 (17.14%)

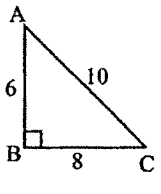
(12) If $\sqrt{75}$ is expressed as $\sqrt{75} = \sqrt{25 \times 3} = 5\sqrt{3}$, then how is $\sqrt{80}$ expressed?

True	False	N.A.
19 (27.14%)	36 (51.43%)	15 (21.43%)

(13) Write the formula of perimeter of rectangle .....

True	False	N.A.
18 (25.71%)	44 (62.86%)	8 (11.43%)

(14) What will be the area of right angle ΔABC for the given figure?



True	False	N.A.
32 (45.71%)	29 (41.43%)	9 (12.86%)

(15) Is –9 a natural number or not? Yes ( ), No ( )

True	False	N.A.
44 (62.85%)	24 (34.29%)	2 (2.86%)

(16) If $\frac{x}{x+1} = a$, then $\frac{x+1}{x}$=.....

True	False	N.A.
31 (44.29%)	33 (47.14%)	6 (8.57%)

(17) Which of $\frac{1}{3}$ and $\frac{1}{5}$ is greater and which one is smaller?

Greater no. ( ) Smaller no. ( )

True	False	N.A.
37 (52.86%)	32 (45.71%)	1 (1.43%)

(18) Out of $\frac{100}{37}$ and $\frac{100}{73}$, which one is greater and which one is smaller?

Greater no. ( ) Smaller no. ( )

True	False	N.A.
29 (41.43%)	38 (54.28%)	3 (4.29%)

(19) Out of $\frac{100}{x+5}$ and $\frac{100}{x-5}$, which one is greater and which one is smaller?

Greater no. ( ) Smaller no. ( )

True	False	N.A.
18 (25.71%)	46 (65.71%)	6 (8.58%)

(20) Write the intersection of $\left\{\frac{-5}{4}, \frac{-9}{7}\right\}$ and $\left\{\frac{-5}{4}, \frac{5}{8}\right\}$

True	False	N.A.
29 (41.43%)	16 (22.86%)	25 (35.71%)

(21) $\left(1-3\sqrt{2}\right) \times \left(1+3\sqrt{2}\right) =$ .....

True	False	N.A.
4 (5.71%)	42 (60%)	24 (34.29%)

(22) $\left(1-3\sqrt{2}\right)+\left(1+3\sqrt{2}\right) =$ .....

True	False	N.A.
22 (31.43%)	20 (28.57%)	28 (40%)

(23) $\left[-\frac{1}{2}\right]\left[-\frac{1}{3}\right] =$ .....

True	False	N.A.
25 (35.71%)	21 (30%)	24 (34.29%)

(24) $-\frac{1}{2}-\frac{1}{3}=$.....

True	False	N.A.
10 (14.28%)	37 (52.86%)	23 (32.86%)

(25) The cost of 1 kg sugar is Rs. x. If the price of 1 kg sugar increases by Rs. 5, then what will be the new cost of 1 kg sugar?

True	False	N.A.
7 (10%)	28 (40%)	35 (50%)

(26) The speed of a train is $(x+5)$ km/hour. How long will it take to cover 450 km?

True	False	N.A.
0 (0%)	34 (48.57%)	36 (51.43%)

(27) The present age of a cricketer is x year. What was his age 5 years ago? What will be his age after 10 years?

True	False	N.A.
19 (27.14%)	29 (41.43%)	22 (31.43%)

(28) The first part of 25 is x, then what will be the second part?

True	False	N.A.
7 (10%)	39 (55.71%)	24 (34.29%)

(29) Suppose first natural number is x, then what is the second consecutive natural number?

True	False	N.A.
10 (14.29%)	35 (50%)	25 (35.71%)

(30) Suppose first even natural number is x, then what is the second consecutive even natural number?

True	False	N.A.
8 (11.43%)	33 (47.14%)	29 (41.43%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Knowledge of factorization of quadratic expressions.
2. Ability to simplify.
3. ab = 0 then a = 0 or b = 0

The errors on prerequisite test were as follows:

1) The students could not factorize quadratic expression due to inability to recognize proper method.

   e.g. $x^2-25=(x-5)(x+5)$ but students are not clear about $a^2-b^2=(a+b)(a-b)$ and take $(x-5)^2$ which is wrong.

2) While expanding $\left(x-\frac{1}{x}\right)^2$ students could not write middle term as –2 due to lack of confidence of finding it by doing multiplication $2\times(x)\times\left(-\frac{1}{x}\right)=-2$.

3) The knowledge of surds is not clear hence students wrote $\sqrt{80}=40$ which is wrong.

4) Students could not write the formula of perimeter of a rectangle and also could not find the area of right angled triangle due to lack of knowledge that one of the two sides making right angle is base and another is altitude.

5) Students could not identify greater and smaller number from $\frac{1}{3}$ and $\frac{1}{5}$; $\frac{100}{37}$ and $\frac{100}{73}$; $\frac{100}{x+5}$ and $\frac{100}{x-5}$. This is because they do not have knowledge that, in two numbers when numerator is same, if denominator is greater; number becomes smaller and if denominator is smaller then number becomes greater.

6) The students found it difficult to write problem in mathematics form e.g. let x be present age. ∴5 years ago = x–5 and x+5 years after 5 years but students wrote $\frac{x}{5}$ and 5x which is wrong or 5–x which is also wrong.

7) Students do not know how to assume for consecutive natural number i.e. x, x+1, x+2, x+3 and also for consecutive even natural number i.e. x, x+2, x+4, x+6.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter. Extra practice sums for quadratic expressions were explained, simplification was taught and more sums were explained for extra practice and concept of ab = 0 then a = 0 or b = 0 was cleared.

STEP – 4: Teaching of the Chapter: "Quadratic Equations"

1. The chapter "Quadratic Equations" was taught in detail.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of 20 marks three types of items were asked:

1) Solve the Sums:	4 items	x 3 marks	= 12
2) Solve the short sums:	2 items	x 2 marks	= 04
3) Solve the short sums:	4 items	x 1 mark	= 04
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks, partly correct answer was given a mark proportionately as per the scheme given by the Board and total were given to each student. Marks obtained by the students in unit test are shown in table 42 along with its frequency distribution in table 43.

Table – 42:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	1	19	11	37	1	55	1
2	3	20	18	38	11	56	1
3	16	21	14	39	12	57	5
4	8	22	8	40	5	58	7
5	11	23	8	41	5	59	1
6	1	24	8	42	7	60	6
7	5	25	10	43	5	61	11
8	10	26	14	44	4	62	16
9	11	27	4	45	11	63	12
10	11	28	7	46	5	64	13
11	15	29	3	47	1	65	13
12	5	30	11	48	3	66	10
13	6	31	5	49	5	67	16
14	8	32	8	50	1	68	18
15	9	33	14	51	8	69	14
16	10	34	8	52	1	70	12
17	10	35	8	53	14		
18	8	36	1	54	11		

Table – 43:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	24
6 – 10	21
11 – 15	20
16 – 20	5
Total	**70**

Mean on the basis of marks obtained by students is 8.42 out of twenty marks. Students obtained 42.14% marks which showed poor performance in unit test, so necessary remedial actions were taken to enhance their knowledge regarding the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Solve the following problems:

(1) Solve the equation $\left(x^2+\frac{1}{x^2}\right)-10\left(x+\frac{1}{x}\right)+18=0$.

True	False	N.A.	P.T.
25 (35.71%)	25 (35.71%)	1 (1.43%)	19 (27.15%)

(2) Solve the equation $(x+1)(x+2)=110$ by the method of perfect square.

True	False	N.A.	P.T.
49 (70%)	15 (21.43%)	2 (2.86%)	4 (5.71%)

(3) By selling an item for Rs. 56, gain is as much percent as it costs in rupees. What is the cost price of the item?

True	False	N.A.	P.T.
21 (30%)	27 (38.57%)	21 (30%)	1 (1.43%)

(4) The product of a Cricketer's age (in years) five years ago and his age (in years) 12 years later, is 480. Find the present age of the cricketer.

True	False	N.A.	P.T.
16 (22.86%)	25 (35.71%)	27 (38.57%)	2 (2.86%)

Q.2. Solve any two of the following:

(1) For given real number k, solve the equation $x^2-\frac{3k^2}{4}=kx$.

True	False	N.A.	P.T.
24 (34.29%)	28 (40%)	11 (15.71%)	7 (10%)

(2) For what values of m are the roots of the equation $(m+1)x^2+2(m+3)x+(2m+3)=0$ equal?

True	False	N.A.	P.T.
7 (10%)	23 (32.85%)	37 (52.86%)	3 (4.29%)

(3) Find c if the equations $x^2-5x+6=0$ and $x^3+3x+c=0$ have a common root.

True	False	N.A.	P.T.
13 (18.57%)	37 (52.86%)	19 (27.14%)	1 (1.43%)

Q.3. Solve the following problems:

(1) The zeros of a quadratic polynomial are 2 and 3 and the co–efficient of x^2 is 3. Find factors of the polynomial.

True	False	N.A.	P.T.
9 (12.86%)	36 (51.43%)	25 (35.71%)	0 (0%)

(2) Form the quadratic equation in whose roots are $-\frac{1}{3}$ and $\frac{1}{7}$.

True	False	N.A.	P.T.
14 (20%)	31 (44.29%)	25 (35.71%)	0 (0%)

(3) Find the discriminant Δ of $4x^2-3x-1=0$.

True	False	N.A.	P.T.
35 (50%)	32 (45.71%)	3 (4.29%)	0 (0%)

(4) Find the sum and the product of the roots of the equation $2x^2-7x+6=0$.

True	False	N.A.	P.T.
23 (32.86%)	27 (38.57%)	18 (25.71%)	2 (2.86%)

The errors were committed due to lack of:

1. Clear idea of simplification.
2. Ability to make equation from data on quadratic problems.
3. Ability for supposition in equation.
4. Clear idea of finding roots from the value of Δ.

The errors on unit test were as follows:

1) The students found it difficult to solve quadratic equation in Que 1 (1) due to their inability to make proper supposition and convert it into x^2+1/x^2.

e.g. Let the present age be x years hence five years ago will be (x–5) and twelve years later will be (x+12). ∴(x–5)(x+12)=480 and solving this will give answer but students were not able to form the equation as the concept of linear equation with one variable was not clear.

2) The students could not solve problem due to inability of converting it into equation.

3) The students could not find value of m when roots are equal due to inability to find a, b, c of quadratic equation.

e.g. $(m+1)x^2+2(m+3)x+(2m+3)=0$ ∴ a=m+1, b=2(m+3) and c=2m+3 but students open the bracket and then tried to find a,b,c and went wrong.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve the knowledge of the chapter "Quadratic Equations".

Remedial teaching was provided as extra sums on simplification were taught and extra practice was given, students were taught to form equations from the given data of problems on quadratic equation and practice was explained, students were taught to solve quadratic equation by factorization and by using formula and the idea of the forms of roots from the value of Δ was given. Group discussions were held to solve their difficulties. Teachers played guiding role during discussions.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were told to solve all the sums asked at the S.S.C. Board Examination and to solve the unit test paper.

4.4.7 Chapter 7: Trigonometry

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed for the chapter which includes the related items of class VIII and class IX such as identities, angles, factorization and trigonometry. In this test total twenty–five items were included. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty five marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 44 along with its frequency distribution in table 45.

Table – 44:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25
1	9	19	17	37	22	55	13
2	12	20	20	38	22	56	15
3	23	21	19	39	20	57	17
4	20	22	16	40	22	58	22
5	25	23	14	41	20	59	21
6	13	24	17	42	17	60	18
7	23	25	11	43	13	61	24
8	23	26	5	44	10	62	23
9	18	27	7	45	3	63	11
10	24	28	15	46	7	64	14
11	13	29	12	47	9	65	18
12	12	30	16	48	16	66	22

13	13	31	10	49	21	67	21
14	16	32	18	50	19	68	23
15	18	33	16	51	10	69	15
16	18	34	15	52	13	70	24
17	22	35	14	53	16		
18	24	36	2	54	20		

Table – 45:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	3
6 – 10	7
11 – 15	18
16 – 20	23
21 – 25	19
Total	**70**

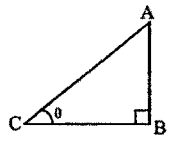
Mean marks obtained by students is 16.43 out of twenty five marks. Students secured 65.72% marks which shows satisfactory performance on prerequisite knowledge. But necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. See the figure given aside and fill in the blanks:

If $\sin\theta = \frac{AB}{AC}$ then



(1) $\cos\theta$ = _____ and $\tan\theta$ = _____

True	False	N.A.
58 (82.86%)	11 (15.71%)	1 (1.43%)

(2) $\sin\theta.\text{cosec}\,\theta =$ _____

True	False	N.A.
60 (85.71%)	8 (11.43%)	2 (2.86%)

(3) $\tan\theta.\cot\theta =$ _____

True	False	N.A.
55 (78.57%)	9 (12.86%)	6 (8.57%)

(4) $\sec\theta = \frac{1}{\ldots\ldots\ldots}$

True	False	N.A.
56 (80%)	12 (17.14%)	2 (2.86%)

(5) $\frac{\sin\theta}{\cos\theta} = \ldots\ldots\ldots$

True	False	N.A.
61 (87.14%)	7 (10%)	2 (2.86%)

(6) $\frac{\cos\theta}{\sin\theta} = \ldots\ldots\ldots$

True	False	N.A.
56 (80%)	11 (15.71%)	3 (4.29%)

(7) $\frac{1}{\sin\theta} = \ldots\ldots\ldots$

True	False	N.A.
50 (71.43%)	15 (21.43%)	5 (7.14%)

(8) $\sin^2\theta + \cos^2\theta = \ldots\ldots\ldots$

True	False	N.A.
54 (77.14%)	10 (14.29%)	6 (8.57%)

(9) Expand: $(x + y)^2 = \ldots\ldots\ldots$

True	False	N.A.
57 (81.43%)	12 (17.14%)	1 (1.43%)

(10) Expand: $(x - y)^2 = \ldots\ldots\ldots$

True	False	N.A.
50 (71.43%)	18 (25.71%)	2 (2.86%)

(11) Factorise: $a^3 + b^3$ = ...

True	False	N.A.
33 (47.14%)	35 (50%)	2 (2.86%)

(12) Factorise: $a^3 - b^3$ = ...

True	False	N.A.
38 (54.29%)	27 (38.57%)	5 (7.14%)

(13) Factorise: $a^2 - b^2$ = ...

True	False	N.A.
55 (78.57%)	12 (17.14%)	3 (4.29%)

(14) Factorise: $(a+b)^2 - c^2$ = ...

True	False	N.A.
28 (40%)	32 (45.71%)	10 (14.29%)

(15) The complementary angle of measure 30° = ...

True	False	N.A.
35 (50%)	17 (24.29%)	18 (25.71%)

(16) $\sin 30^\circ = \cos 60^\circ$ = ...

True	False	N.A.
26 (37.14%)	29 (41.43%)	15 (21.43%)

(17) $\tan 45^\circ = \cot\theta$ then θ = ...

True	False	N.A.
35 (50%)	22 (31.43%)	13 (18.57%)

(18) $\left(\sqrt{2}\right)^2$ = ...

True	False	N.A.
66 (94.28%)	3 (4.29%)	1 (1.43%)

(19) $\left(\sqrt{3}\right)^4$ = ...

True	False	N.A.
56 (80%)	13 (18.57%)	1 (1.43%)

(20) $\frac{3}{2} - \frac{1}{2}$ = ...

True	False	N.A.
55 (78.57%)	10 (14.29%)	5 (7.14%)

(21) $(\sqrt{2}+1)(\sqrt{2}-1) =$ .....

True	False	N.A.
30 (42.86%)	30 (42.86%)	10 (14.28%)

(22) $\frac{2}{\sqrt{3}} \times \frac{3}{2} =$ .....

True	False	N.A.
29 (41.43%)	29 (41.43%)	12 (17.14%)

(23) $\frac{3}{5}.\frac{12}{13}+\frac{4}{5}.\frac{5}{13} =$ .....

True	False	N.A.
32 (45.71%)	27 (38.57%)	11 (15.72%)

(24) $\left(\frac{2}{\sqrt{3}}\right)^2.(\sqrt{2})^2(\sqrt{3})^2 =$ ..... (Simplify)

True	False	N.A.
44 (62.86%)	17 (24.28%)	9 (12.86%)

(25) $1-\frac{1}{4}-\frac{1}{3} =$ .....

True	False	N.A.
27 (38.57%)	30 (42.86%)	13 (18.57%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Concept of trigonometric ratios obtained from right angled triangle is not clear.
2. Knowledge of trigonometric ratios of angles and trigonometric identities.
3. Concept of values of trigonometric ratios for specific angles is not clear.
4. Ability to factorize quadratic and cubic expressions.
5. Ability to multiply, divide, they find difficulty in simplification.

The errors on prerequisite test were as follows:

1) The students could not fill the blanks due to improper knowledge of different trigonometric ratios and relation between them.

e.g. $\tan\vartheta = \frac{\sin\vartheta}{\cos\vartheta}$ and also $\tan\vartheta = \frac{1}{\cot\vartheta}$ hence they make mistake in selecting the right ratio.

2) The students could not answer sums involving fractions due to their inability to simplify fractions.

e.g. $1-\frac{1}{4}-\frac{1}{3}=\frac{12-3-4}{12}=\frac{5}{12}$ but students make mistake in taking LCM and then in simplifying $1-\frac{1}{4}-\frac{1}{3}=\frac{1-3-4}{12}=\frac{-6}{12}$ which is wrong.

3) The students had problem in squaring quadratic surds.

e.g. concept of surds is not clear as they have not learnt till now. $\left(\sqrt{2}\right)^2=2$ but they write $\left(\sqrt{2}\right)^2=4$ which is wrong.

e.g. concept of using right factorizing formula is not clear $a^3+b^3=(a+b)(a^2-ab+b^2)$ but students make mistake as $a^3+b^3=(a+b)(a^2-2ab+b^2)$ which is wrong.

4) Students could not write $\sec\vartheta=\frac{1}{\cos\vartheta}$ as they do not have proper knowledge of inverse trigonometric functions.

5) Students found lack of knowledge about complementary angle and supplementary angle.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. Trigonometric ratios of standard 9 were thoroughly revised.
2. Idea of fundamental trigonometric identity was explained and how to derive other trigonometric identities was taught.
3. The idea of reciprocal of trigonometric ratio was explained.
4. Factors of quadratic and cubic expressions from standard 8 and 9 were thoroughly revised.

5. For remembering values of trigonometric ratios for some specific values technique of formation of table and diagram was taught.
6. By giving extra practice in sums on simplification, their weakness was eliminated.

Above remedial teaching was carried out while solving prerequisite test paper in classroom. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Trigonometry"

1. After catering remedial teaching the chapter "Trigonometry" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for important sums for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of twenty marks two types of items were asked:

1) Solve the short sums:	5 items	x 2 marks	= 10
2) Solve the short sums:	3 items	x 2 marks	= 06
2) Objective:	4 items	x 1 mark	= 04
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 46 along with its frequency distribution in table 47.

Table – 46:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	10	19	10	37	16	55	3
2	12	20	13	38	15	56	7
3	2	21	14	39	8	57	1
4	8	22	9	40	5	58	14
5	5	23	14	41	15	59	5
6	10	24	3	42	9	60	4
7	9	25	3	43	12	61	10
8	13	26	3	44	6	62	11
9	7	27	4	45	6	63	13
10	17	28	4	46	5	64	11
11	10	29	10	47	5	65	15
12	12	30	9	48	5	66	16
13	11	31	10	49	7	67	13
14	12	32	5	50	7	68	17
15	15	33	6	51	3	69	9
16	14	34	9	52	8	70	5
17	17	35	5	53	13		
18	11	36	18	54	12		

Table – 47:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	19
6 – 10	23
11 – 15	32
16 – 20	6
Total	**70**

Mean marks obtained by students is 10.93 out of twenty marks. Students obtained 54.65% marks which showed satisfactory performance in unit test knowledge. But even then necessary remedial actions were taken to enhance their knowledge regarding chapter "Trigonometry".

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis of all the items on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Do as directed:

(1) Prove that: $\frac{\sin^2\theta}{1-\cos\theta}+\frac{\sin^2\theta}{1+\cos\theta}=2$

True	False	N.A.	P.T.
48 (68.57%)	17 (24.29%)	5 (7.14%)	0 (0%)

(2) If $\cos\theta=b$, then obtain the other trigonometric ratios of θ..

True	False	N.A.	P.T.
40 (57.14%)	7 (10%)	20 (28.57%)	3 (4.29%)

(3) Prove that: $\frac{\sec\theta}{\tan\theta+\cot\theta}=\sin\theta$

True	False	N.A.	P.T.
41 (58.57%)	14 (20%)	11 (15.72%)	4 (5.71%)

(4) Prove that: $\cos ec\theta.\sec(90-\theta)-\cot\theta.\tan(90-\theta)=1$

True	False	N.A.	P.T.
35 (50%)	10 (14.28%)	24 (34.29%)	1 (1.43%)

(5) Evaluate: $2\sin^2 60^o + \sec^2 60^o - 2\cos^4 45^o - 3\cos ec^2 60^o$

True	False	N.A.	P.T.
15 (21.43%)	32 (45.71%)	22 (31.43%)	1 (1.43%)

Q.2. Do as directed:

(1) Prove that: $\frac{(\sec\theta - \tan\theta)^2 + 1}{\sec\theta - \tan\theta} = 2\sec\theta$

True	False	N.A.	P.T.
24 (34.29%)	30 (42.86%)	12 (17.14%)	4 (5.71%)

(2) If $3\sin\theta + 5\cos\theta = 5$ then prove that $(3\cos\theta - 5\sin\theta)^2 = 9$.

True	False	N.A.	P.T.
15 (21.43%)	15 (21.43%)	39 (55.71%)	1 (1.43%)

(3) Prove that: $\frac{\cot 30^o + 1}{\cot 30^o - 1} = 2(1 + \cos 30^o)$

True	False	N.A.	P.T.
13 (18.58%)	21 (30%)	32 (45.71%)	4 (5.71%)

Q.3. Fill in the blanks in each of the following by selecting the proper alternative from those given in the brackets:

(1) cosec 30° = sec θ then θ = _____. (30°, 60°, 90°).

True	False	N.A.	P.T.
57 (81.43%)	10 (14.28%)	3 (4.29%)	0 (0%)

(2) tan 80° x tan 10° = _____. (1, 2, 2tan80°).

True	False	N.A.	P.T.
11 (15.71%)	52 (74.29%)	7 (10%)	(0%)

(3) $\cos^2 40^o + \sin^2 \theta = 1$ then θ = _____. (40°, 20°, 50°).

True	False	N.A.	P.T.
49 (70%)	19 (27.14%)	2 (2.86%)	0 (0%)

(4) $\sin\theta$. cos (90-θ) + $\cos\theta$. sin (90-θ) = _____. (–1 , 0 , 1).

True	False	N.A.	P.T.
58 (82.86%)	10 (14.28%)	2 (2.86%)	0 (0%)

The errors were committed due to lack of:

1. Proper information on trigonometric ratios of right angled triangle.
2. Proper idea of trigonometric ratios and trigonometric identities.

3. Information of values of trigonometric ratios for specific measures of angles.
4. Ability to simplify after placing values of trigonometric ratios for specific measures of angles.
5. Ability to put values of identifies of trigonometry.

The errors on unit test were as follows:

1) The students could not solve prove that sums due to their inability to use proper formula.

   e.g. selection of formula is not clear in minds of the students due to lack of practice $\sin^2\vartheta = 1-\cos^2\vartheta \ \therefore \sin^2\vartheta = (1-\cos\vartheta)(1+\cos\vartheta)$ but they mistake it as $\sin^2\vartheta = \cos^2\vartheta - 1$ which is wrong.

2) The students could not find value of other trigonometric ratios when one ratio is given due to insufficient knowledge of relations between different ratios.

   e.g. $\cos\vartheta = b$ students are not clear about ratio like $\sin\vartheta$ or $\tan\vartheta$. $\sin\vartheta = {}^{opp}/_{hyp}$ but they take it as ${}^{hyp}/_{opp}$ which is wrong or they forget to use Pythagoras theorem for finding points.

3) The students could not solve sums due to inability to put proper identity in place of 1.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

Trigonometric ratios of class IX were thoroughly revised and exercise for practice was given. Trigonometric ratios and their reciprocals were clearly explained. Trigonometric identity was taught and derivation of other identities was taught. Students were taught how to remember values of trigonometric ratios for specific measures of angles by forming table and diagram.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.8 Chapter 8: Height and Distance

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class IX such as Height and distance, Trigonometry and Parallel lines in plane II. In this test total fifteen items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of fifteen marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 48 along with its frequency distribution in table 49.

Table – 48:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	7	19	8	37	12	55	8
2	10	20	11	38	10	56	7
3	9	21	12	39	11	57	12
4	9	22	5	40	8	58	15
5	13	23	9	41	11	59	8

6	10	24	14	42	5	60	6
7	14	25	4	43	6	61	7
8	11	26	5	44	6	62	11
9	8	27	7	45	4	63	9
10	12	28	7	46	6	64	9
11	9	29	6	47	3	65	5
12	3	30	11	48	4	66	9
13	4	31	4	49	12	67	11
14	6	32	4	50	10	68	13
15	4	33	2	51	5	69	6
16	7	34	8	52	4	70	10
17	9	35	7	53	8		
18	11	36	4	54	6		

Table – 49:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	17
6 – 10	35
11 – 15	18
Total	**70**

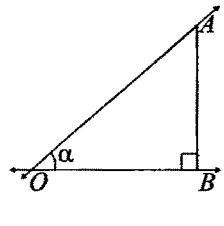
Mean marks obtained by students is 8.071 out of fifteen marks. Students secured 53.81% of marks which shows satisfactory performance on prerequisite knowledge. But necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

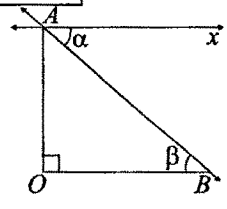
Q.1.

(1) As shown in figure O is the place of observer. A is the place of object then α is ..... (angle of elevation / angle of depression)



True	False	N.A.
51 (72.86%)	19 (27.14%)	0 (0%)

(2) As shown in figure A is the place of observer. B is the place of object then α = ... (angle of elevation / angle of depression).

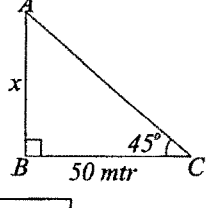


True	False	N.A.
51 (72.86%)	18 (25.71%)	1 (1.43%)

(3) With reference to above figure if $\alpha = 30^\circ$ then β = ...

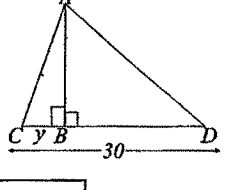
True	False	N.A.
51 (72.86%)	11 (15.71%)	8 (11.43%)

(4) With reference to given figure the value of x = ...



True	False	N.A.
43 (61.43%)	12 (17.14%)	15 (21.43%)

(5) With reference to given figure, if BC = y, CD = 30 then BD = ...

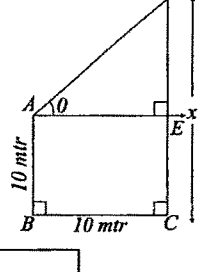


True	False	N.A.
29 (41.43%)	33 (47.14%)	8 (11.43%)

(6) With reference to given figure, if AB = 10m, BC = 10m, then

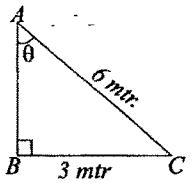
(i) DE = ...

(ii) $\tan\theta$ = ...



True	False	N.A.
11 (15.71%)	46 (65.72%)	13 (18.57%)

(7) With reference to given figure if $m\angle A = \theta$, BC = $3m$, AC = $6m$ then θ = ...



True	False	N.A.
13 (18.57%)	36 (51.43%)	21(30%)

(8) If 0.5 $x \doteq$ 150 then x = ...

True	False	N.A.
37 (52.86%)	22 (31.43%)	11 (15.71%)

(9) If $0.2700 = \frac{x}{400}$ then x = ...

True	False	N.A.
52 (74.29%)	6 (8.57%)	12 (17.14%)

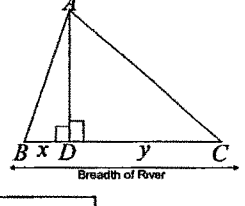
(10) If $x = \frac{120}{0.6000}$ then x = ...

True	False	N.A.
25 (35.71%)	31 (44.29%)	14 (20%)

(11) 0.7000 x 50 = ...

True	False	N.A.
30 (42.86%)	22 (31.43%)	18 (25.71%)

(12) As shown in figure if x = 19.59 m and y = 23.66 m then breadth of river = ...



True	False	N.A.
28 (40%)	28 (40%)	14 (20%)

(13) If we observe top of tower from top of building, we get angle of elevation. Then whose height is more the building or the tower?

True	False	N.A.
46 (65.72%)	12 (17.14%)	12 (17.14%)

(14) If we observe top of a building from a top of a hill, we get angle of depression. Whose height is less? The hill or the building?

True	False	N.A.
50 (71.43%)	11 (15.71%)	9 (12.86%)

(15) The angle of elevation of top of a hill from the bottom of a tower is 30°. The angle of elevation of the top of the tower from the bottom of the hill is 60°. Then among these two which is having more height, a hill or a tower?

True	False	N.A.
45 (64.29%)	15 (21.43%)	10 (14.28%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Understanding in angle of elevation and angle of depression.
2. Ability to find values of trigonometric functions for measures of specific angles.
3. Ability to find measures of the sides or breadth from the given data.
4. Ability to draw figure for the given data.

The errors on prerequisite test were found as follows:

1) The students had insufficient knowledge of angle of elevation / depression.

   e.g. meaning of elevation or depression is not clear in mind. Elevation means looking up above eye level with respect to horizon. $\angle\alpha$ is depression but they mistake it as elevation.

2) The students committed errors due to their inability in multiplication and division of numbers with decimal prints.

   e.g. $\frac{120}{0.6000}=\frac{120}{0.6}=\frac{1200}{6}=200$ but $\frac{120}{0.6000}=\frac{120}{0.6x1000}=\frac{1200}{6x1000}=\frac{1}{5}$

   which is wrong.

STEP – 3: Remedial Measures Based on Unit Test

On the basis of error analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of angle of elevation and angle of depression was cleared with necessary diagrams.

2. The exhaustive practice on the values of trigonometric functions for specific values was carried out.
3. Students were taught to find measures of the sides from figures.
4. The knowledge of 'Height and Distance' from standard 9 was revised.

Above remedial teaching was carried out while solving prerequisite test paper in class–room. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Height and Distance"

1. After catering remedial teaching the chapter "Height and Distance" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks two types of questions were asked:

1) Solve the Sums: 5 items x 3 marks = 15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) <u>Markwise Analysis</u>

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total

marks were given to each student. Marks obtained by the students in unit test are shown in table 50 along with its frequency distribution in table 51.

Table – 50:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	3	19	9	37	8	55	6
2	11	20	12	38	0	56	12
3	3	21	12	39	6	57	1
4	7	22	7	40	12	58	8
5	3	23	0	41	2	59	1
6	3	24	12	42	6	60	8
7	6	25	5	43	0	61	3
8	0	26	0	44	6	62	9
9	6	27	0	45	6	63	11
10	8	28	3	46	0	64	9
11	12	29	3	47	6	65	9
12	4	30	3	48	0	66	9
13	6	31	6	49	8	67	10
14	6	32	1	50	3	68	12
15	6	33	9	51	0	69	12
16	0	34	4	52	6	70	12
17	11	35	12	53	9		
18	9	36	6	54	3		

Table – 51:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	14
3 – 5	13
6 – 8	21
9 – 11	12
12 – 14	10
15 – 17	0
Total	**70**

Mean marks obtained by students' shows 6.614 out of fifteen marks. Students obtained 44.1% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

(1) When the angle of elevation of the sun is 41°11', the length of the shadow of a pole is 16 metres. Find the height of the pole. Also find the length of the shadow of the pole when the angle of elevation of the sun is 54°28'. (tan 41°11'=0.8750, tan 54°28'=1.4000).

True	False	N.A.	P.A.
37 (52.86%)	22 (31.43%)	5 (7.14%)	6 (8.57%)

(2) From a point A, h metres above the ground level, the angle of elevation of the top of a tower is α and the angle of depression of the bottom of the tower is β. Prove that the height of the tower is $\frac{h(\tan\alpha+\tan\beta)}{\tan\beta}$ metres.

True	False	N.A.	P.A.
7 (10%)	5 (7.14%)	54 (77.14%)	4 (5.72%)

(3) Watching from a top of a 180 metre high lighthouse, the angle of depression of two boats anchored in opposite directions from the lighthouse are found to be 45° and 30°58'. Find the distance between the boats (tan 30°58'=0.6000).

True	False	N.A.	P.A.
41 (58.57%)	15 (21.43%)	8 (11.43%)	6 (8.57%)

(4) The angles of depression of the top and the bottom of a tower as measured from the top of a 100 metre high hill are 30° and 45° respectively. Find the height of the tower and the distance of the tower from the hill.

True	False	N.A.	P.A.
27 (38.57%)	7 (10%)	25 (35.72%)	11 (15.71%)

(5) Watching from a top of a 40 metre high building, the angle of depression of a car moving towards the building is found to increase from 30° to 45° during some interval of time. find the distance covered by the car during that time interval.

(cot 30° = $\sqrt{3}$, tan 45°=1, $\sqrt{3}$=1.73).

True	False	N.A.	P.A.
11 (15.71%)	13 (18.57%)	37 (52.86%)	9 (12.86%)

The errors were committed due to lack of:

1. Understanding of practical language of problems on 'Height and Distance'.
2. Information in angle of elevation and angle of depression.
3. Ability to simplify by placing values of trigonometric function for specific measures of angles.
4. Ability to find values.

The errors on unit test were found as follows:

1) The students could not solve problems on height and distance due to inability to understand the problem.
   e.g. instead of top angle 30° they take it as 45° due to not understanding the sum properly.
2) The students could not solve problems of height and distance due to lack of drawing figures.
   e.g. as in above as the angles are taken incorrectly they have confusion and will not be able to draw correct figure.
3) The students could not solve problems on height and distance due to their inability to use sin, tan, etc.
   e.g. as trigonometric ratios are not clear they make mistake in taking sin, tan in problems.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

Exhaustive practice on the problems of 'Height and Distance' was given together how to draw figure and to solve the problem. From the data how to draw figure was explained. They were also taught how to find measures of angle of elevation and angle of depression. They were taught how to find values of trigonometric function for measures specific angles and exhaustive practice from S.S.C. Board examination was given. Exhaustive practice on sums of finding values of the trigonometric functions was carried out so that they become firm.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again..

4.4.9 Chapter 9: Statistics

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII (classification of data) and class IX (height and distance and linear equations of two variables). In this test total twenty five items (questions) were asked. All items (questions) were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty five marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 52 along with its frequency distribution in table 53.

Table – 52:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25	Roll No.	Marks Obtained Out of 25
1	14	19	16	37	20	55	2
2	13	20	13	38	14	56	4
3	13	21	17	39	12	57	7
4	10	22	18	40	17	58	23
5	15	23	21	41	10	59	5
6	10	24	18	42	15	60	2
7	16	25	9	43	14	61	18
8	15	26	2	44	10	62	18
9	11	27	9	45	7	63	6
10	15	28	12	46	5	64	8
11	10	29	7	47	2	65	12
12	9	30	11	48	5	66	15
13	9	31	6	49	21	67	13
14	6	32	11	50	17	68	20
15	12	33	11	51	12	69	7
16	11	34	9	52	13	70	11
17	14	35	10	53	13		
18	14	36	1	54	10		

Table – 53:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	9
6 – 10	20
11 – 15	27
16 – 20	11
21 – 25	3
Total	**70**

Mean marks obtained by students is 11.5 out of twenty five marks. Students secured 46% of marks which shows poor performance on prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1.

(1) $\frac{32}{12}$ = ... (convert into decimal form)

True	False	N.A.
23 (32.86%)	47 (67.14%)	0 (0%)

(2) The mid value of class 20 – 34 is .....

True	False	N.A.
48 (68.57%)	22 (31.43%)	0 (0%)

(3) 14.5 x 5 = ...

True	False	N.A.
54 (77.14%)	16 (22.86%)	0 (0%)

(4) The lower limit and upper limit of class 20 – 29 are ..... and ..... respectively.

True	False	N.A.
40 (57.14%)	30 (42.86%)	0 (0%)

(5) Add: 367.5 + 552.0 + 1691.0 + 817.5 + 580.5 + 512.5

True	False	N.A.
38 (54.29%)	32 (45.71%)	0 (0%)

(6) Add: (–30) + (–16) + 0 + 15 + 18 + 21

True	False	N.A.
32 (45.71%)	37 (52.86%)	1 (1.43%)

(7) Simplify: $4.5-\frac{44.5}{10}$

True	False	N.A.
24 (34.29%)	44 (62.85%)	2 (2.86%)

(8) Add: $\frac{2}{5}+\frac{5}{3}+\frac{1}{3}+\frac{5}{6}+\frac{1}{6}$

True	False	N.A.
19 (27.14%)	48 (68.57%)	3 (4.29%)

(9) Add: 5.00 + 4.80 + 5.35 + 4.75 + 3.90 + 4.20 + 4.90

True	False	N.A.
50 (71.43%)	18 (25.71%)	2 (2.86%)

(10) Arrange in ascending order: 107, 99, 96, 110, 99, 88, 99, 110, 105, 110

True	False	N.A.
65 (92.86%)	4 (5.71%)	1 (1.43%)

(11) If $\frac{x_1+6+2x_1}{3}=6$, then x_1 = ...

True	False	N.A.
20 (28.57%)	46 (65.72%)	4 (5.71%)

(12) Class length of class 30 – 39 is .....

True	False	N.A.
38 (54.28%)	29 (41.43%)	3 (4.29%)

(13) If $x_3+x_1=$ 70 and $x_3-x_1=$ 50 then find x_1 and x_3 by method of elimination.

True	False	N.A.
29 (41.43%)	37 (52.86%)	4 (5.71%)

(14) For the class 60 – 64, the lower limit point is ..... and the upper limit point is .....

True	False	N.A.
41 (58.57%)	26 (37.14%)	3 (4.29%)

(15) The difference between the upper limit point and the lower limit point is known as .....

True	False	N.A.
23 (32.86%)	43 (61.43%)	4 (5.71%)

(16) Arrange in to ascending order: $\frac{x}{5}, \frac{x}{6}, \frac{x}{4}, \frac{x}{2}, \frac{x}{3}$ $(x > 0)$.

True	False	N.A.
32 (45.71%)	33 (47.15%)	5 (7.14%)

(17) If $\frac{3+2+1+4+x}{5}$ =3.2, then x = ...

True	False	N.A.
23 (32.86%)	43 (61.43%)	4 (5.71%)

(18) 72 – 0.75 = ...

True	False	N.A.
23 (32.86%)	42 (60%)	5 (7.14%)

(19) Simplify: 3 (30.5) – 2 (28.2).

True	False	N.A.
24 (34.29%)	41 (58.57%)	5 (7.14%)

(20) $a + 6b = 32$ and $a + b = 12$. Solve this equation by the method of elimination.

True	False	N.A.
29 (41.43%)	34 (48.57%)	7 (10%)

(21) If 2.08 = $\frac{19+11y}{25}$, then find the value of y.

True	False	N.A.
28 (40%)	35 (50%)	7 (10%)

(22) Convert these ratio into ratio with equal denominator: $\frac{1}{2}, \frac{2}{5}, \frac{4}{3}$

True	False	N.A.
16 (22.86%)	46 (65.71%)	8 (11.43%)

(23) Add: 1 + 1.1 + 1.01 + 1.001

True	False	N.A.
39 (55.72%)	26 (37.14%)	5 (7.14%)

(24) Divide upto two decimal points $\frac{3700}{42}$

True	False	N.A.
22 (31.43%)	38 (54.29%)	10 (14.28%)

(25) Divide upto two decimal points $\frac{28}{9}$

True	False	N.A.
26 (37.14%)	35 (50%)	9 (12.86%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Knowledge of lower boundary and upper boundary and lower boundary point and upper boundary point.
2. Ability to add fractions.
3. Clarity of mid value and class length of a class.
4. Ability to simplify.

The errors on prerequisite test were found as follows:

1) The students .do not have clear idea. of lower boundary, lower boundary point, upper boundary and upper boundary point. E.g. 20–29 upper boundary was written as 20 or 29.5 while lower boundary was written as 29 or 19.5.
2) Some students could not give answer in converting fraction in decimal due to inability in canceling numerator and denominator and inability in dividing numbers.
3) Some students could not add number dealing in decimal and hence committed error.

4) Some students could not find mid value due to the concept of mid value of class is not clear.

5) Some students could not find class length due to the concept of class length upper boundary point – lower boundary point was not clear. Also the students were unable to find boundary points. Class length of 30–39, students wrote 9. Actually it is 10.

6) Students could not solve the equations $x_3 + x_1 = 70$ and $x_3 - x_1 = 50$ and also a+6b=32 and a+b=12 because they do not have proper knowledge of finding solution of equations by eliminating method.

7) They could not simplify 3(30.5)–2(28.2) while multiplying (30.5) with 3; majority students write 90.15. But actually it is 91.5 students multiply the numbers directly, so students should not make hurry while multiplying.

8) They could not make ascending order because they do not have knowledge that when numerator is same; and denominator becomes smaller than number becomes greater.

9) Students could not simplify 1+1.1+1.01+1.001, they don't know how to arrange them properly.

10) While converting ratios with equal denominator $\frac{1}{2};\frac{2}{5};\frac{4}{3}$ they multiply only denominator and write $\frac{1}{2}\times\frac{1}{15}=\frac{1}{30}$, $\frac{2}{5}\times\frac{1}{6}=\frac{2}{30}$, $\frac{4}{3}\times\frac{1}{10}=\frac{4}{30}$ and write final answer as $\frac{1}{30},\frac{2}{30},\frac{4}{30}$. But actually it should be $\frac{1}{2}\times\frac{15}{15}=\frac{15}{30}$, $\frac{2}{5}\times\frac{6}{6}=\frac{12}{30}$, $\frac{4}{3}\times\frac{10}{10}=\frac{40}{30}$ and the final answer is $\frac{15}{30},\frac{12}{30},\frac{40}{30}$, They don't know that same number is to be multiplied in denominator and numerator both.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of lower boundary, upper boundary, lower boundary point and upper boundary point was cleared.
2. Students were taught how to add fractions.
3. Students were taught how to find mid value and class length of a class.
4. More practice on simplification was given.

STEP – 4: Teaching of the Chapter: "Statistics"

1. After catering remedial teaching the chapter "Statistics" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of twenty marks two types of items were asked:

1) Solve the sums:	4 items	x 3 marks	= 12
2) Solve the short sums:	4 items	x 2 marks	= 08
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) <u>Markwise Analysis</u>

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total

marks were given to each student. Marks obtained by the students in unit test are shown in table 54 along with its frequency distribution in table 55.

Table – 54:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	12	19	13	37	17	55	14
2	13	20	13	38	16	56	10
3	3	21	8	39	15	57	15
4	10	22	3	40	15	58	15
5	13	23	16	41	12	59	15
6	12	24	8	42	14	60	12
7	16	25	11	43	14	61	15
8	12	26	5	44	12	62	16
9	12	27	8	45	9	63	11
10	14	28	12	46	9	64	13
11	11	29	9	47	8	65	14
12	10	30	13	48	13	66	14
13	10	31	8	49	16	67	12
14	12	32	13	50	16	68	18
15	12	33	2	51	11	69	11
16	13	34	11	52	13	70	15
17	16	35	1	53	14		
18	16	36	10	54	13		

Table – 55:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	5
6 – 10	13
11 – 15	42
16 – 20	10
Total	**70**

Mean marks obtained by students is 12.07 out of twenty marks. Students obtained 60.35% marks which showed satisfactory performance in unit test knowledge. But necessary remedial actions were taken to enhance their knowledge regarding chapter "Statistics".

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. Do as directed:

(1) A frequency distribution of score obtained by 90 students in an intelligence – quotient test is given below. Find the mean of the data.

Score:	85–89	90–94	95–99	100–104	105–109	110–114	115–119
Frequency:	6	6	8	16	24	20	10

True	False	N.A.	P.A.
43 (61.43%)	19 (27.14%)	8 (11.43%)	0 (0%)

(2) A frequency distribution of the life of 200 electric bulbs is given below. Find the median of the grouped data.

Life (in hours) of electrical bulb	Number of bulbs
400 – 499	32
500 – 599	31
600 – 699	42
700 – 799	36
800 – 899	33
900 – 999	26

True	False	N.A.	P.A.
41 (58.57%)	22 (31.43%)	6 (8.57%)	1 (1.43%)

(3) Frequency distribution of daily wages of 50 workers is given below:

Wages (in Rs.)	20–29	30–39	40–49	50–59
Number of Workers	5	27	15	3

Find the mean and median of the daily wages of the workers.

True	False	N.A.	P.A.
36 (51.43%)	23 (32.86%)	10 (14.28%)	1 (1.43%)

(4) Competitors participating in a body–building contest were given marks out of 30 and the data of marks are as follows:

17, 12, 15, 5, 11, 12, 20, 12, 22, 14, 12, 18, 11, 12, 8

Find the mean, median and the mode from the data.

True	False	N.A.	P.A.
35 (50%)	24 (34.29%)	11 (15.71%)	0 (0%)

Q.2. Do as directed:

(1) Observation of some data are $\frac{x}{5}$, x, $\frac{x}{4}$, $\frac{x}{2}$ and $\frac{x}{3}$. Where $x>0$. If the median of the data is 8, find the value of x. What will be the mean of the data?

True	False	N.A.	P.A.
42 (60%)	18 (25.71%)	4 (5.72%)	6 (8.57%)

(2) Observation of an ungrouped data are x_1, x_2 and x_3 and it is given that $x_1 < x_2 < x_3$. If the mean and median of the data are 30 and 20 respectively and if $x_3 - x_1 = 50$, find the observations x_1, x_2, x_3.

True	False	N.A.	P.A.
47 (67.14%)	11 (15.72%)	6 (8.57%)	6 (8.57%)

(3) The number of children of five families are 3, 2, 1, 4, x. If the mean of the data is 3.2, find the value of observation x. What will be the median of the data?

True	False	N.A.	P.A.
44 (62.86%)	18 (25.71%)	5 (7.14%)	3 (4.29%)

(4) Find the mean of the data with observations $\frac{2}{5}, \frac{5}{3}, \frac{1}{3}, \frac{5}{6}, \frac{1}{6}$.

True	False	N.A.	P.A.
42 (60%)	17 (24.29%)	5 (7.14%)	6 (8.57%)

The errors were committed due to lack of:

1. Ability to form a required table from the given grouped data.
2. Ability to find class length, boundary, boundary points, mid value and cumulative frequency correctly.
3. Ability to use proper formulae of mean, median and mode.
4. Clarity of mean, median and mode of ungrouped data.

The errors on unit test were found as follows:

1) In finding mean, the students were not clear about how to form tables? What is required in the table? What should be taken as assumed mean? e.g. In finding mean, table requires class, frequency, mid value. $u_i, f_i u_i$.
2) In finding median, the students could not find cumulative frequency due to insufficient knowledge of cumulative frequency due to inability to find median class.
3) Clarity to find mean, median, mode due to inability to distinguish between mean, median, mode.
4) The students committed error in finding mean of L.C.M. due to committing error in not multiplying both the sides by L.C.M. of denominator.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter "Statistics".

The concept of discrete variable and continuous variable was clearly explained so that they can easily form tables. The formulae of mean, median and mode were prepared and they remembered them. Students were taught how to form table from the formula. Students were taught where to use which formula in different sums.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were

suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.10 Chapter 10: Computing

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which includes the related items of class IX such as computing. In this test total six items were asked. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by students along with marks also. This test was of six marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 56 along with its frequency distribution in table 57.

Table – 56:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 6	Roll No.	Marks Obtained Out of 6	Roll No.	Marks Obtained Out of 6	Roll No.	Marks Obtained Out of 6
1	1	19	2	37	4	55	2
2	2	20	1	38	2	56	4
3	3	21	1	39	2	57	2
4	1	22	1	40	3	58	4
5	1	23	1	41	3	59	2
6	2	24	6	42	1	60	2
7	3	25	2	43	2	61	6
8	3	26	2	44	1	62	2
9	6	27	1	45	3	63	2
10	2	28	4	46	1	64	3

11	2	29	2	47	1	65	2
12	3	30	3	48	2	66	3
13	1	31	2	49	2	67	2
14	1	32	2	50	2	68	5
15	3	33	1	51	1	69	3
16	3	34	4	52	3	70	3
17	3	35	3	53	2		
18	1	36	1	54	2		

Table – 57:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	67
6 – 10	3
Total	**70**

Mean marks obtained by students is 3.21 out of six marks. Students secured 53.57% marks which shows poor performance in prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter "Computing".

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Fill in the Blanks:

(1) _____ is considered the father of modern computing machine.

True	False	N.A.
10 (14.29%)	49 (70%)	11 (15.71%)

(2) The pictorial representation of solution of a problem is called _____.

True	False	N.A.
32 (45.71%)	30 (42.86%)	8 (11.43%)

(3) The symbol ◯ represents _____.

True	False	N.A.
36 (51.43%)	29 (41.43%)	5 (7.14%)

(4) Modern computer can perform more than _____ addition–subtraction in a second.

True	False	N.A.
35 (50%)	29 (41.43%)	6 (8.57%)

(5) Computer is a _____ of mathematics.

True	False	N.A.
7 (10%)	50 (71.43%)	13 (18.57%)

(6) In a flow chart the symbol for decision is _____.

True	False	N.A.
47 (67.14%)	13 (18.57%)	10 (14.29%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Understanding the question properly, something else was given as answer.
2. Knowledge of using symbolic language of the computer.
3. Knowledge of different parts of the computer.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of symbols used in the language of computer was clearly explained.
2. The different parts of the computer were explained by direct demonstration.

STEP – 4: Teaching of the Chapter: "Computing"

1. After catering remedial teaching the chapter "Computing" of class X was taught to the sample students.

2. Sufficient practice was given as per need to solve the short sums i.e. fill in the gaps. Home assignment was given and same was checked and necessary guidance was provided.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of ten marks objective type of questions were asked:

1) Objectives:

(Fill in the Blanks) 10 items x 1 mark = 10/10

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 58 along with its frequency distribution in table 59.

Table – 58:

Marks of Unit Test

Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10
1	7	19	8	37	9	55	3
2	2	20	10	38	10	56	10
3	9	21	10	39	9	57	9
4	3	22	9	40	6	58	10
5	8	23	10	41	9	59	8
6	9	24	8	42	6	60	8

7	2	25	3	43	8	61	7
8	6	26	6	44	6	62	9
9	9	27	2	45	7	63	10
10	10	28	1	46	10	64	10
11	10	29	2	47	6	65	9
12	10	30	8	48	10	66	7
13	5	31	9	49	10	67	10
14	1	32	8	50	8	68	2
15	10	33	8	51	10	69	9
16	8	34	7	52	7	70	6
17	10	35	8	53	10		
18	10	36	5	54	8		

Table – 59:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	12
6 – 10	58
Total	**70**

Mean marks obtained by students is 7.14 out of ten marks. Students obtained 71.4% marks which shows satisfactory performance in unit test knowledge, so necessary remedial actions will be taken to enhance their knowledge regarding the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F) and not attempted (NA) is presented in following lines.

Q.1. Fill in the Blanks:

(1) _____ is the main and key part of a computer.

(OPD, IPD, CPU)

True	False	N.A.
60 (85.72%)	5 (7.14%)	5 (7.14%)

(2) Control unit is a part of _____.

True	False	N.A.
58 (82.86%)	8 (11.43%)	4 (5.71%)

(3) A computer receives the data through _____

(IPD, CPU, OPD)

True	False	N.A.
36 (51.43%)	29 (41.43%)	5 (7.14%)

(4) All the parts of the computer are controlled by _____.

(IPD, CPU, OPD)

True	False	N.A.
54 (77.14%)	11 (15.72%)	5 (7.14%)

(5) In a computer, the data is stored in the _____.

(memory unit, control unit, arithmetical and logical unit)

True	False	N.A.
61 (87.15%)	4 (5.71%)	5 (7.14%)

(6) A plan or design of logical steps and instructions to be executed in solving a problem is called _____

(a memory, a flow–chart, an algorithm)

True	False	N.A.
50 (71.43%)	14 (20%)	6 (8.57%)

(7) Loop is used in a flow–chart to indicate _____ steps in short.

(pictorial, repeated, repetition)

True	False	N.A.
46 (65.71%)	17 (24.29%)	7 (10%)

(8) Modern computers can perform _____ additions per second. (one thousand, ten thousand, one lakh)

True	False	N.A.
57 (81.43%)	8 (11.43%)	5 (7.14%)

(9) In a flow–chart, ◇ symbol is used to represent _____.

(start, decision, output)

True	False	N.A.
51 (72.86%)	12 (17.14%)	7 (10%)

(10) Diagrammatic representation of an algorithm is called _____.

(logical unit, execution, a flow–chart)

True	False	N.A.
54 (77.14%)	8 (11.43%)	8 (11.43%)

The errors were committed due to lack of:

1. Understanding of the question, they give answer other than the required answer.
2. Proper knowledge of different parts of the computer.
3. Proper knowledge of use of symbols in computer language.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The use of symbols in the language of computer was explained. The different parts of the computer were explained by direct demonstration. Extra practice was provided for solving the fill in the gaps and difficulties were solved in group.

4.4.11 Chapter 11: Similar Triangles

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as plane, angle, triangle and their congruence, parallel lines in a plane II, plane quadrilaterals, concurrent lines and point of conference. In this test total twenty items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twenty marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 60 along with its frequency distribution in table 61.

Table – 60:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	13	19	11	37	12	55	6
2	12	20	9	38	15	56	9
3	16	21	10	39	11	57	13
4	12	22	10	40	13	58	11
5	15	23	10	41	12	59	8
6	9	24	16	42	12	60	9
7	16	25	11	43	8	61	11
8	16	26	14	44	11	62	8
9	14	27	9	45	7	63	3
10	8	28	15	46	4	64	10
11	8	29	8	47	7	65	9
12	12	30	7	48	7	66	10
13	10	31	10	49	13	67	15
14	6	32	8	50	10	68	14
15	10	33	14	51	9	69	10
16	11	34	5	52	14	70	14
17	11	35	12	53	12		
18	11	36	5	54	16		

Table – 61:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	4
6 – 10	30
11 – 15	31
16 – 20	5
Total	**70**

Mean marks obtained by students is 10.64 out of twenty marks. Students secured 53.21% of marks which shows poor performance in prerequisite knowledge, so necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of True (T), False (F), and Not Attempted (NA) is presented in following lines.

(1) A Triangle has _____ elements.

True	False	N.A.
49 (70%)	21 (30%)	0 (0%)

(2) In ΔPQR the side opposite to ∠P is _____ and the angle opposite to $\overline{PQ}$ is _____.

True	False	N.A.
56 (80%)	14 (20%)	0 (0%)

(3) For the correspondence ABC ↔ XYZ between ΔABC and ΔXYZ, the angle corresponding to ∠B is _____ and the side corresponding to $\overline{AC}$ is _____.

True	False	N.A.
60 (85.71%)	9 (12.86%)	1 (1.43%)

(4) $\angle A \cong \angle D$ and $m\angle A = 70$, then $m\angle D =$ _____.

True	False	N.A.
58 (82.86%)	8 (11.43%)	4 (5.71%)

(5) In ΔABC AB = 5, BC = 7 and AC = 10, then find perimeter of ΔABC.

True	False	N.A.
54 (77.14%)	7 (10%)	9 (12.86%)

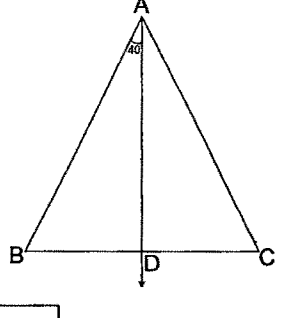
(6) If $m\angle A = 70$, $m\angle C = 50$, then find $m\angle B$.

True	False	N.A.
49 (70%)	13 (18.57%)	8 (11.43%)

(7) For P – M – Q, if PM = 5 and QM = 3, then find PQ.

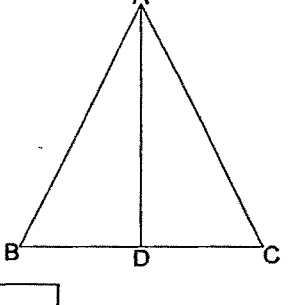
True	False	N.A.
42 (60%)	15 (21.43%)	13 (18.57%)

(8) In the given figure, $\overrightarrow{AD}$ is the bisector of $\angle A$. If m$\angle BAD$ = 40, then find m$\angle BAC$.



True	False	N.A.
10 (14.29%)	49 (70%)	11 (15.71%)

(9) In the given figure, D is the midpoint of $\overline{BC}$, then $\overline{AD}$ is _____ of ΔABC.

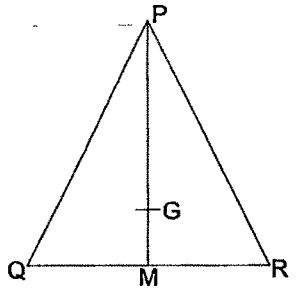


True	False	N.A.
40 (57.14%)	24 (34.29%)	6 (8.57%)

(10) The point of concurrence of all the three medians of a triangle is called _____.

True	False	N.A.
35 (50%)	28 (40%)	7 (10%)

(11) In the given figure, $\overline{PM}$ is the median of ΔPQR and G is centroid. If PM = 12 then PG = _____, GM = _____.

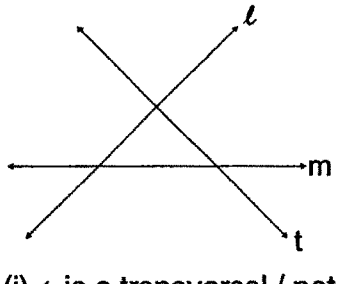


True	False	N.A.
1 (1.43%)	61 (87.14%)	8 (11.43%)

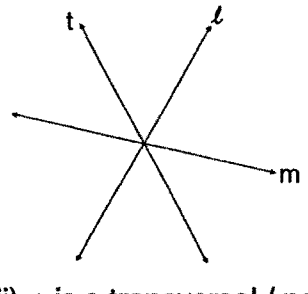
(12) Draw figure showing "l is parallel to m" i.e. ($l \parallel m$).

True	False	N.A.
58 (82.86%)	10 (14.28%)	2 (2.86%)

(13) In the given two figures, state whether t is a transversal of l and m or not.



(i) t is a transversal / not



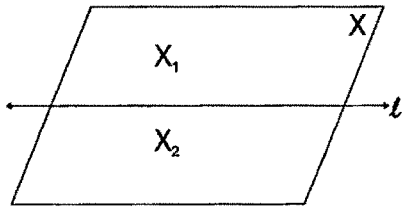
(ii) t is a transversal / not

True	False	N.A.
19 (27.14%)	50 (71.43%)	1 (1.43%)

(14) In the given figure line l divides the plane X in two half planes X_1 and X_2, then

(i) closed half plane $X_1 \cap l$ = _____.

(ii) half plane $X_1 \cap l$ = _____.



True	False	N.A.
0 (0%)	45 (64.29%)	25 (35.71%)

(15) e.g. □ABCD is read as Quadrilateral ABCD

In same way, □^{m}ABCD is read as _____ (Answer).

True	False	N.A.
48 (68.57%)	17 (24.29%)	5 (7.14%)

(16) A quadrilateral has _____ elements.

True	False	N.A.
9 (12.86%)	58 (82.86%)	3 (4.28%)

(17) State the diagonals of □PQRS.

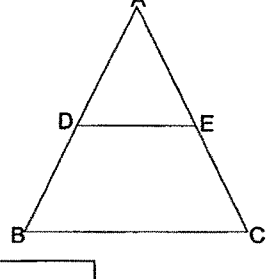
True	False	N.A.
34 (48.57%)	25 (35.71%)	11 (15.72%)

(18) In □ABCD the side opposite to $\overline{AB}$ is _____ and the angle opposite to ∠B is _____.

True	False	N.A.
56 (80%)	13 (18.57%	1 (1.43%)

(19) In ΔABC, D and E are the mid points of $\overline{AB}$ and $\overline{AC}$ respectively.

If BC = 10, then DE = _____.



True	False	N.A.
51 (72.86%)	15 (21.43%)	4 (5.71%)

(20) In ΔABC $\overline{AB} \cong \overline{AC}$ and B–C–D. If $m\angle B = 72$, then $m\angle ACD$ = _____.

True	False	N.A.
18 (25.71%)	34 (48.58%)	18 (25.71%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Information of elements of triangles
2. Information of transversal of a pair of lines
3. Information of elements of basic like angle bisectors, median, centroid, etc.

4. Information of division of a quadrilateral
5. Clarity of elements of a quadrilateral like sides, diagonals, angles.

The errors on prerequisite test were found as follows:

1) In the number of elements of triangle some students wrote 3, some wrote 10. The students were not clear about which parts are considered as elements of triangle.
2) Some students do not have clear concept of transversal of line. So the students wrote the given line is transversal in figure 2 of question 13.
3) The students had no clear idea about angle bisector (a ray), median (a line segment) and centroid (a point). Also the students were lacking in knowledge of ray, line segment, etc. so the students committed errors. E.g. (i) The students could not recognize median in the figure (ii) If $\overrightarrow{AD}$ bisects $\angle$BAC, then the students could find m$\angle$BAC when m$\angle$BAD was given.
4) In the number of elements of quadrilateral, the students gave answers 4, 8. The students were not clear whether diagonals and angles are elements or not.
5) The students could not find AG and GD when G is centroid on the median $\overline{AD}$ due to improper knowledge of ratio between AG and GD.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The students were equipped with triangles and its elements.
2. They were given practice for transversal of lines, angle bisectors, medians, centroid, etc.
3. They were well equipped with elements of quadrilateral like sides, diagonals, angles and information of division of quadrilateral was given.

STEP – 4: Teaching of the Chapter: "Similar Triangles"

1. After catering remedial teaching the chapter "Similar Triangles" of class X was taught to the sample students.
2. Practice was given as per need to solve the problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of twenty marks four types of questions were asked:

1) Theorem:	1 item	x 4 marks	= 04
2) Rider:	2 items	x 4 marks	= 08
3) Definitions:	2 items	x 1 mark	= 02
4) Solve the short sums:	3 items	x 2 marks	= 06
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 62 along with its frequency distribution in table 63.

Table – 62:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	8	19	3	37	14	55	2
2	1	20	6	38	6	56	11
3	7	21	14	39	11	57	2
4	6	22	6	40	7	58	7
5	12	23	10	41	10	59	3
6	4	24	13	42	4	60	6
7	7	25	10	43	11	61	4
8	3	26	10	44	12	62	8
9	14	27	5	45	10	63	4
10	7	28	6	46	6	64	5
11	11	29	12	47	3	65	5
12	6	30	6	48	1	66	6
13	3	31	12	49	4	67	15
14	3	32	6	50	8	68	8
15	11	33	5	51	9	69	5
16	5	34	3	52	20	70	10
17	13	35	10	53	10		
18	7	36	13	54	2		

Table – 63:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	23
6 – 10	30
11 – 15	16
16 – 20	1
Total	**70**

Mean marks obtained by students is 7.64 out of twenty marks students obtained 38.21% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1.(A) Prove that if a line intersects two sides of a triangle in two distinct points in such a way that the line – segments cut by it on the two sides of the triangle lying in its same closed half – plane are proportional to the corresponding sides, then the line is parallel to the third side of the triangle.

True	False	N.A.	P.A.
40 (57.14%)	4 (5.71%)	1 (1.43%)	25 (35.72%)

Q.1.(B) The medians $\overline{AD}$ and $\overline{BE}$ of ΔABC intersect each other in G. A line through G, parallel to $\overline{BD}$ intersects $\overline{AC}$ in K. Prove that AC = 6EK.

True	False	N.A.	P.A.
17 (24.29%)	17 (24.29%)	9 (12.85%)	27 (38.57%)

Q.1.(C) The diagnols $\overline{AC}$ and $\overline{BD}$ of □ABCD bisect each other in O at right angles. Prove that ΔABO ~ ΔCBO and ΔAOB ~ ΔCOD.

True	False	N.A.	P.A.
3 (4.29%)	13 (18.57%)	28 (40%)	26 (37.14%)

Q.1.(D) Define: (1) Similarity of Triangles

True	False	N.A.	P.A.
40 (57.14%)	22 (31.43%)	8 (11.43%)	0 (0%)

(2) Transversal of Lines

True	False	N.A.	P.A.
40 (57.14%)	16 (22.86%)	14 (20%)	0 (0%)

Do as directed:

Q.1.(E)

(1) The measures of the three sides of a triangle are 8, 10 and 12. The measure of the longest side of triangle similar to the given triangle is 15. Then, find the measure of the smallest side of the triangle.

True	False	N.A.	P.A.
18 (25.72%)	32 (45.71%)	20 (28.57%)	0 (0%)

(2) In ΔABC, A–M–B, A–N–C and $\overline{MN} \| \overline{BC}$. If AM = 2.1, MB = 2.8 and AC = 6.3, find AN.

True	False	N.A.	P.A.
17 (24.29%)	35 (50%)	17 (24.29%)	1 (1.42%)

(3) In ΔABC the bisector of ∠A, intersects $\overline{BC}$ in D such that B–D–C. If AB = 10, AC = 15 and BC = 20, find BD.

True	False	N.A.	P.A.
3 (4.29%)	40 (57.14%)	26 (37.14%)	1 (1.43%)

(4) ΔABC ~ ΔBPC and P∈ $\overline{AC}$. If AB = 12, BC = 6 and PC = 4, then find the perimeter of ΔABP.

True	False	N.A.	P.A.
3 (4.29%)	28 (40%)	39 (55.71%)	0 (0%)

The errors were committed due to lack of:

1. Ability in writing riders.
2. Clarity in adjacent sides.
3. Concept of Similarity.
4. Ability to write all the steps of riders and if they were they commit errors in the steps.

The errors of unit test were found as follows:

1) The students could not write all steps of theorem properly due to insufficient basic knowledge of geometry like theorems and postulates taught in previous standards 8 and 9.
2) The students could not attempt rider due to:
    a. lack of understanding of problem,
    b. no clarity of concept of medians and parallel lines, and
    c. lack of concept of basic proportion theorem.
3) The students have no clarity in congruent and similar triangles. The students committed error between congruent and similar triangles.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The concepts of similarity and adjacent side were cleared. The main points needed to prove riders were thoroughly explained and more practice was given. Students were explained how to write points with reasons while writing theorems.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence of the students, they were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.12 Chapter 12: Conditions of Similarity

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as line segments and rays, condition of congruence of triangle, angles, parallel lines in a plane, plane quadrilaterals, properties of parallelogram. In this test total seventeen items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of seventeen marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 64 along with its frequency distribution in table 65.

Table – 64:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 17	Roll No.	Marks Obtained Out of 17	Roll No.	Marks Obtained Out of 17	Roll No.	Marks Obtained Out of 17
1	5	19	6	37	11	55	3
2	6	20	7	38	8	56	7
3	10	21	7	39	10	57	12
4	10	22	6	40	2	58	6
5	10	23	7	41	8	59	5
6	4	24	8	42	1	60	5
7	11	25	6	43	9	61	6
8	9	26	7	44	6	62	7
9	6	27	5	45	3	63	1
10	4	28	8	46	2	64	3
11	6	29	9	47	2	65	2
12	2	30	3	48	2	66	2
13	6	31	2	49	9	67	8
14	5	32	5	50	7	68	10
15	5	33	2	51	2	69	5
16	1	34	1	52	2	70	7
17	6	35	1	53	3		
18	4	36	1	54	12		

Table – 65:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 3	22
4 – 6	22
7 – 9	17
10 – 12	9
13 – 15	0
16 – 18	0
Total	**70**

Mean marks obtained by students is 5.557 out of seventeen marks. Students secured 32.69% of marks which shows poor performance in prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

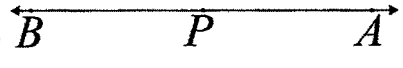
Answer–sheet were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:

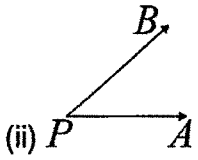
(1) In ΔABC, AB=BC=AC=5, state the kind of ΔABC.

True	False	N.A.
32 (45.72%)	12 (17.14%)	26 (37.14%)

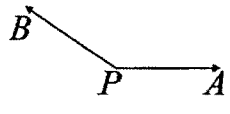
(2) In which of the following figures $\overrightarrow{PA}$ and $\overrightarrow{PB}$ are opposite rays

(i) 

is / not

(ii) 

is / not

(iii) 

is / not

True	False	N.A.
15 (21.43%)	53 (75.71%)	2 (2.86%)

(3) Write the conditions for congruence of triangles.

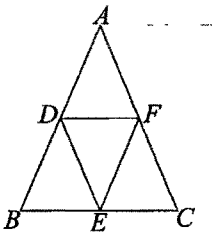
e.g. SAS, AAS, write remaining three conditions.

True	False	N.A.
13 (18.57%)	47 (67.14%)	10 (14.29%)

(4) In ΔABC and ΔDEF, $\overline{AB} \cong \overline{EF}$, $\overline{BC} \cong \overline{DE}$ and $\angle\ldots\ldots \cong \angle\ldots\ldots$ then by SAS postulate the correspondence .....↔..... is a congruence.

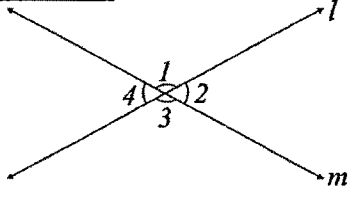
True	False	N.A.
2 (2.86%)	61 (87.14%)	7 (10%)

(5) With reference to given figure, in ΔABC, D, E and F are respectively the mid points of sides $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$, then area of ΔABC = ... x area of ΔDEF.



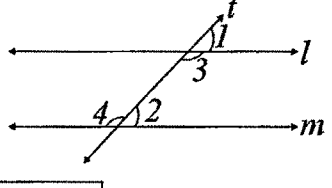
True	False	N.A.
3 (4.29%)	45 (64.28%)	22 (31.43%)

(6) With reference to given figure, $m\angle 1=100$, then $m\angle 3=$....., $m\angle 2=$..... and $m\angle 4=$.....



True	False	N.A.
18 (25.71%)	43 (61.43%)	9 (12.86%)

(7) With reference to given figure, $m\angle 1=80$, then $m\angle 2=$....., $m\angle 3=100$, then $m\angle 4=$.....

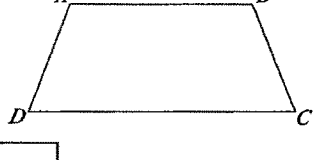


True	False	N.A.
31 (44.29%)	33 (47.14%)	6 (8.57%)

(8) The pair of alternate angles formed by a transversal of two parallel lines are .....

True	False	N.A.
15 (21.43%)	38 (54.29%)	17 (24.28%)

(9) Mention the kind of quadrilateral from the figure given below.



True	False	N.A.
26 (37.14%)	35 (50%)	9 (12.86%)

(10) A quadrilateral having both pairs of opposite sides parallel is .....

True	False	N.A.
47 (67.14%)	20 (28.57%)	3 (4.29%)

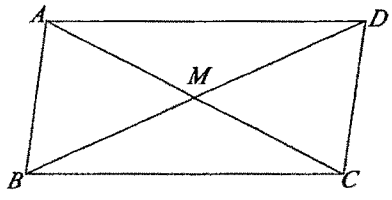
(11) A parallelogram with all its sides congruent is .....

True	False	N.A.
35 (50%)	26 (37.14%)	9 (12.86%)

(12) As shown in figure, □ABCD is a parallelogram.

AM = 5 then AC = ...

BD = 12 then BM = ...

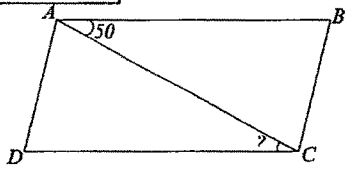


True	False	N.A.
46 (65.72%)	20 (28.57%)	4 (5.71%)

(13) In □^{m}ABCD, AB=8, BC=5 then find the perimeter of □ABCD.

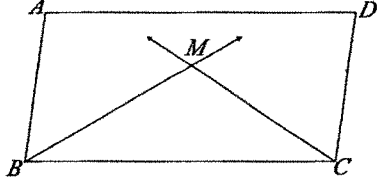
True	False	N.A.
27 (38.57%)	24 (34.29%)	19 (27.14%)

(14) As shown in figure, □ABCD is a parallelogram, on the basis of it find the measure of angle marked with '?'.



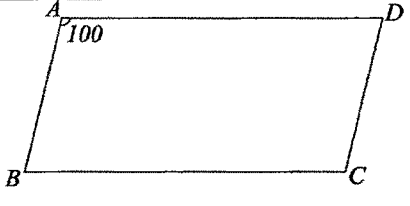
True	False	N.A.
32 (45.71%)	28 (40%)	10 (14.29%)

(15) In □^{m}ABCD, bisectors of ∠B and ∠C intersects at M. What is the measure of ∠BMC?



True	False	N.A.
6 (8.58%)	32 (45.71%)	32 (45.71%)

(16) □ABCD is a parallelogram. $m\angle A=100$ then what are the measures of other three angles? $m\angle B$=....., $m\angle C$=....., $m\angle D$=.....

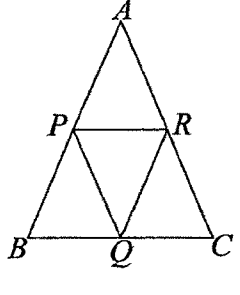


True	False	N.A.
28 (40%)	30 (42.86%)	12 (17.14%)

(17) P, Q and R are respectively the midpoints of sides $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$ of ΔABC.

(i) PBQR is a .....

(ii) PBCR is a .....



True	False	N.A.
13 (18.57%)	49 (70%)	8 (11.43%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Idea of similarity.
2. Knowledge of kinds of congruency of triangles.
3. Finding ratio of areas of two similar triangles.
4. Knowledge of measurements of angles of a quadrilateral and the quadrilateral formed by the bisectors of angles of a quadrilateral.
5. Ignorance of angles formed by the transversal of two lines and measures of such angles.

The errors on prerequisite test were found as follows:

1) Some students could not distinguish between different kinds of triangles – equilateral triangles, isosceles triangle.
2) The students had no correct distinguish between definition, postulate and other conditions of congruence.
3) Concept of mid point and betweenness was not clear.
4) The students had no clear concept of different kinds of angles – alternate angles, corresponding angles, interior angles, vertically opposite angles.

   Due to lack of knowledge of different angles they were not able to get correct answers $\angle 1=80$ $\therefore$ $\angle 2=80$ is correct as they are corresponding angles but students took it as linear pair and wrote wrongly.
5) The students had not clear idea about different kinds of quadrilateral and were unable to draw correct figures for particular kinds of quadrilateral.

   e.g. students were not able to identify the types that it is Rhombus but students wrote square as all sides were congruent but angles were not.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, fo improve their previous knowledge which is necessarily required to learn the chapter.

1. The idea of similarity and congruence was given by different examples.
2. The idea of ratio of measures of corresponding sides was explained.
3. The definitions of median, centroid, incentre, etc.
4. The idea of right angle, perpendicular segment, foot of perpendicular altitude, kinds of angles formed by transversal of two lines, their measures, kinds of quadrilateral, the measures of their angles, etc. was given with necessary diagrams.

Above remedial teaching was carried out while solving prerequisite test paper in class–room. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Conditions of Similarity"

1. After catering remedial teaching the chapter "Conditions of Similarity" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The teaching session was arranged in such a way that the students can understand all definitions, theorems, riders and equations.
4. The investigator encouraged the students to make method wise notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of twenty marks three types of questions were asked:

1) Theorems:	1 item	x 4 marks	= 04
2) Solve the Sums:	2 items	x 4 marks	= 08
3) Solve the short sums:	4 items	x 2 marks	= 08
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 66 along with its frequency distribution in table 67.

Table – 66:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	2	19	8	37	14	55	6
2	3	20	10	38	12	56	6
3	2	21	13	39	9	57	4
4	8	22	11	40	9	58	11
5	8	23	9	41	8	59	8
6	4	24	2	42	10	60	8
7	13	25	6	43	4	61	8
8	6	26	4	44	5	62	12
9	6	27	5	45	5	63	9
10	6	28	4	46	16	64	5
11	11	29	11	47	14	65	9
12	6	30	14	48	15	66	10
13	5	31	11	49	8	67	14
14	5	32	7	50	11	68	2
15	13	33	6	51	11	69	6

16	8	34	6	52	6	70	9
17	10	35	9	53	9		
18	8	36	6	54	5		

Table – 67:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 5	17
6 – 10	35
11 – 15	17
16 – 20	1
Total	**70**

Mean marks obtained by students is 8.143 out of twenty marks. Students obtained 40.71% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1(A) Prove that if for a correspondence between two triangles, two pairs of corresponding sides are proportional and their included angles are congruent then the correspondence is a similarity.

True	False	N.A.	P.T.
46 (65.71%)	5 (7.14%)	2 (2.86%)	17 (24.29%)

Q.1(B) (1) $\overline{AD}$ is the median ΔABC. G is the centroid of ΔABC. ΔXAD and ΔYGD are equilateral triangles. Prove that XAD = 9YGD.

True	False	N.A.	P.T.
17 (24.29%)	13 (18.57%)	17 (24.29%)	23 (32.85%)

(2) $\overline{CM}$ and $\overline{RN}$ are respectively the medians of ΔABC and ΔPQR. If $\frac{AB}{PQ}=\frac{AC}{PR}=\frac{CM}{RN}$, prove that ΔAMC ~ ΔPNR.

True	False	N.A.	P.T.
5 (7.14%)	10 (14.29%)	25 (35.71%)	30 (42.86%)

Q.1(C) Do as directed:

(1) ΔABC ~ ΔPQR. If area of ΔABC is 18, area of ΔPQR is 32 and AB=6, then find PQ.

True	False	N.A.	P.T.
34 (48.57%)	30 (42.86%)	6 (8.57%)	0 (0%)

(2) In ΔABC, A–M–B, A–N–C and $\overline{MN} \parallel \overline{BC}$. If AM=6, MN=7.5 and BC=10 then find AB.

True	False	N.A.	P.T.
20 (28.57%)	38 (54.29%)	12 (17.14%)	0 (0%)

(3) In ΔABC and ΔPQR, $\frac{AB}{RQ}=\frac{BC}{PR}=\frac{CA}{PQ}$. Which correspondence of ΔABC and ΔPQR is a similarity, and by which theorem?

True	False	N.A.	P.T.
21 (30%)	25 (35.71%)	7 (10%)	17 (24.29%)

(4) In ΔABC, P, Q and R are respectively the midpoints of $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$. If area of ΔABC=30 then find the area of □PBCR.

True	False	N.A.	P.T.
11 (15.71%)	28 (40%)	31 (44.29%)	0 (0%)

The errors were committed due to lack of:

1. Ability in writing data to prove and proof of theorems.
2. Clarity in concept of conditions of similarity.
3. Ability in writing riders.
4. Ability to calculate sums on geometry.
5. Recognising corresponding sides.
6. Ability to write definitions.

The errors on unit tests were found as follows:

1) The concept of congruence and similarity was not clear, so they committed errors even in using symbols of $\cong$ and ~.

   e.g. the two triangles are similar but students write $\Delta ABC \cong \Delta PQR$ which is wrong. They don't mean congruent but similar hence symbols are not clear in mind.

2) Some students could not attempt problems on theorems due to lack of knowledge of different points of concurrence, area i.e. centroid.

3) If triangles are similar then the corresponding areas are proportional to squares of lengths of sides was not clear to the students.

   e.g. Students make mistake between perimeter and area and use wrong formula $\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta PQR} = \frac{AB}{PQ}$ which is wrong it should be $\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta PQR} = \frac{AB^2}{PQ^2}$.

4) The students were unable to apply basic proportional to theorem.

   e.g. as basic proportionality theorem is not clear they apply wrong proportion students mistake by taking $\frac{AM}{MB} = \frac{MN}{BC}$ which is wrong as we have to take proportionality between ΔAMN and ΔABC $\therefore \frac{AM}{AB} = \frac{MN}{BC}$ will give the correct result.

5) Students could not attempt theorem perfectly and made errors like

   a) $\Delta ABC \leftrightarrow \Delta DEF$ instead of writing $ABC \leftrightarrow DEF$

   b) Some of them write $ABC \sim DEF$ and $ABC \cong DEF$ instead of writing $\Delta ABC \sim \Delta DEF$ and $\Delta ABC \cong \Delta DEF$. It showed that students do not have knowledge of using symbols of congruence; similarity and correspondence.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The idea of similarity and congruence of triangles were explained different examples. The idea of how to find corresponding sides was given. For definition first related concept was cleared then oral of same was taken and they wrote them also. They were also given definitions twice in homework. They were taught how to write data, to prove and how to draw figure, how to write and remember proof was point wise explained. The required definitions from standard 9 were explained again with necessary diagrams. The list of statements of all the theorems, corollaries was formed together with the list of formulae and told to remember it so as to facilitate in solving calculations. The riders based on theorem were taken with the respective theorems so that the concept and use of theorem is cleared in their mind.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.13 Chapter 13: Similarity and Pythagoras Theorem

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which includes the related items of class VIII and class IX such as the real numbers, inequalities, perpendicularity and special point sets, parallel lines in plane II, properties of parallelogram, concurrent lines and point of concurrence. In this test total fifteen items (questions) were asked. All items (questions) were ofobjective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of fifteen marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 68 along with its frequency distribution in table 69.

Table – 68:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	7	19	8	37	7	55	1
2	2	20	6	38	7	56	6
3	7	21	3	39	7	57	8
4	5	22	9	40	3	58	5
5	6	23	7	41	4	59	5
6	6	24	8	42	2	60	4
7	10	25	6	43	4	61	2
8	8	26	5	44	2	62	3
9	7	27	4	45	1	63	4
10	1	28	8	46	2	64	2
11	3	29	6	47	3	65	2
12	2	30	3	48	7	66	5
13	4	31	4	49	8	67	4
14	1	32	1	50	8	68	7
15	5	33	1	51	3	69	2
16	4	34	1	52	1	70	7
17	10	35	1	53	5		
18	2	36	2	54	8		

Table – 69:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 3	27
4 – 6	22
7 – 9	19
10 – 12	2
13 – 15	0
Total	**70**

Mean marks obtained by students is 4.829 out of fifteen marks. Students secured 23.19% marks which showed poor performance in prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

(1) In ΔABC $m\angle B=90^\circ$ then $\overline{AC}$ is called .....

True	False	N.A.
34 (48.57%)	23 (32.86%)	13 (18.57%)

(2) In ΔABC, $\angle B$ is a right angle. $\therefore$Other two angles $\angle A$ and $\angle C$ are .....

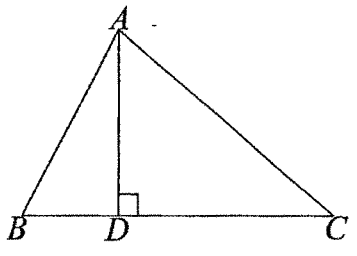
True	False	N.A.
24 (34.29%)	33 (47.14%)	13 (18.57%)

(3) The principle of Pythagoras is for _____ triangle

(an acute angled, an obtuse angled, a right angled)

True	False	N.A.
51 (72.86%)	17 (24.28%)	2 (2.86%)

(4) As shown in figure, In ΔABC, $\overline{AD} \perp \overline{BC}$ and D$\in \overline{BC}$. $\therefore \overline{AD}$ is called ..... of ΔABC [Write Answer]

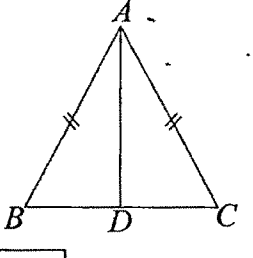


True	False	N.A.
5 (7.14%)	50 (71.43%)	15 (21.43%)

(5) As shown in figure, in ΔABC

AB = AC. $\overline{AD}$ is a median.

$\therefore$ $m\angle$ADC=.....



True	False	N.A.
12 (17.14%)	45 (64.29%)	13 (18.57%)

(6) If $P \notin l$, $\overline{PM} \perp l$ and $M \in l$ then point M is called ..... of $\overline{PM}$.

True	False	N.A.
3 (4.29%)	46 (65.71%)	21 (30%)

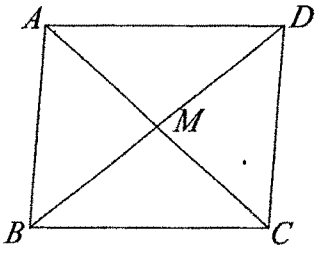
(7) ABCD is a rhombus. Diagonals $\overline{AC}$ and $\overline{BD}$ intersect each other in M.

(i) AM = 5, then AC = ...

(ii) BD = 12, then BM = ...

(iii) $m\angle$AMB = ...

(iv) AB = 5, then perimeter of ABCD = ...



True	False	N.A.
0 (0%)	68 (97.14%)	2 (2.86%)

(8) The diagonals of ..... and ..... bisect each other at right angles.

True	False	N.A.
3 (4.29%)	45 (64.28%)	22 (31.43%)

(9) The diagonals of ..... and ..... are congruent.

True	False	N.A.
9 (12.86%)	29 (41.43%)	32 (45.71%)

(10) The diagonals of ..... are congruent and bisect each other at right angles.

True	False	N.A.
8 (11.43%)	34 (48.57%)	28 (40%)

(11) ABCD is a rectangle. If AC=13, then BD=.....

True	False	N.A.
52 (74.29%)	5 (7.14%)	13 (18.57%)

(12) ABCD is a rectangle. If AB=5 and BC=12, then what will be the perimeter of ABCD?

True	False	N.A.
22 (31.43%)	26 (37.14%)	22 (31.43%)

(13) ABCD is a square. If AC=12, then BD=.....

True	False	N.A.
9 (12.86%)	44 (62.86%)	17 (24.28%)

(14) ABCD is a square. If AB=5, then what will be its perimeter?

True	False	N.A.
33 (47.14%)	16 (22.86%)	21 (30%)

(15) ABCD is a square, $m\angle A$=.....

True	False	N.A.
21 (30%)	32 (45.72%)	17 (24.28%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Information on altitude, median and perpendicular bisector.
2. Proper data in the kinds of a quadrilateral, their diagonals and angels.
3. Ability in finding measures of sides and perimeter of a quadrilateral.
4. Little deficiency in the knowledge of Pythagoras Principle.

The errors on prerequisite were found as follows:

1) The students could not make differences between altitude and median so the concept of altitude was not clear.

e.g. $\overline{AD}$ is altitude, but having no idea of median or altitude students wrote answer as median.

2) Some students could not recognize even hypotenuse of a right angled triangle.

e.g. concept of right angled Δ is not clear hence students were not able to identify hypotenuse in side opposite to right angle is hypotenuse but students were not clear in their idea.

3) The students were not well equipped with properties of isosceles triangle – like median on base of an isosceles triangle is also an altitude.

e.g. AB=AC hence $\overline{AD}$ is median and $\overline{AD}$ is altitude, but students are not clear that in isosceles a median and altitude is one and the same.

4) The students were not well equipped with properties of square, rectangle like diagonals are congruent.

e.g. diagnosis of square and rectangle are congruent but this property is not clear hence they write rhombus or parallelogram which is wrong.

5) The students were not well equipped with properties of rhombus, rectangle like diagonals are congruent but they bisect each other at right angle.

e.g. as properties are not clear in minds of students they were not able to distinguish about different quadrilaterals i.e. rhombus, rectangle, etc.

6) The students had no clarity about perimeter e.g. even though length and breadth of rectangle are given, they could not find perimeter.

e.g. instead of finding perimeter students just multiply length and breath i.e. they find area which is wrong. AB=5, BC=12 students write 12x5=60 but actually it should be 2(5+12) = 34.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The students were equipped with the information of altitude, median and perpendicular bisector and their effect on the sides and angles of the triangle.

2. Students were informed with full details of different kinds of quadrilaterals, their diagonals, measures of angles and sides with charts. Also sums for practice on perimeter of quadrilateral were given.
3. What is Pythagoras theorem? What is Pythagoras theorem for? was explained in detail.

Above remedial teaching was carried out while solving prerequisite test paper in class–room. Individual remedial teaching was also prepared to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Similarity & Pythagoras Theorem"

1. After catering remedial teaching the chapter "Similarity and Pythagoras Theorem" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The teaching session was arranged in such a way that the students can understand all the theorems, definitions, riders.
4. The investigator encouraged the students to make method wise notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was conducted. Paper was framed as per the blue print given by the Board. This test was of twenty marks four types of questions were asked:

1) Theorem:	1 item	x 4 marks	= 04
2) Rider:	1 item	x 4 marks	= 04
3) Rider:	1 item	x 4 marks	= 04
4) Objective (Definitions):	2 items	x 1 mark	= 02
5) Solve the short sums:	3 items	x 2 marks	= 06
			20

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 70 along with its frequency distribution in table 71.

Table – 70:

Marks of Unit Test

Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20	Roll No.	Marks Obtained Out of 20
1	2	19	5	37	8	55	2
2	2	20	9	38	11	56	6
3	3	21	7	39	9	57	2
4	7	22	6	40	9	58	11
5	6	23	14	41	11	59	0
6	2	24	3	42	14	60	1
7	16	25	12	43	5	61	6
8	11	26	2	44	1	62	11
9	7	27	1	45	5	63	16
10	9	28	1	46	4	64	8
11	7	29	9	47	4	65	3
12	3	30	9	48	0	66	10
13	4	31	13	49	17	67	19
14	4	32	5	50	10	68	13
15	4	33	10	51	8	69	11
16	14	34	14	52	14	70	5
17	12	35	7	53	3		
18	4	36	17	54	5		

Table – 71:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	12
3 – 5	17
6 – 8	12
9 – 11	15
12 – 14	9
15 – 17	4
18 – 20	1
Total	**70**

Mean marks obtained by students is 7.34 out of twenty marks. Students obtained 36.71% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1(A) Prove that in a right angled triangle the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the remaining sides.

True	False	P.T.	N.A.
33 (47.15%)	4 (5.71%)	29 (41.43%)	4 (5.71%)

Q.1(B) In ΔABC, $\overline{BD}$ is the altitude on hypotenuse $\overline{AC}$. If BD = 2CD, prove that AC = 5CD.

True	False	P.T.	N.A.
4 (5.71%)	13 (18.58%)	42 (60%)	42 (15.71%)

Q.1(C) In ΔPQR, $\angle Q$ is a right angle, $N \in \overline{PQ}$ and $M \in \overline{QR}$. Prove that $PM^2 + RN^2 = PR^2 + MN^2$.

True	False	P.T.	N.A.
11 (15.71%)	11 (15.71%)	32 (45.72%)	16 (22.86%)

Q.1(D)Define: (1) Adjacent line – segment

True	False	P.T.	N.A.
30 (42.86%)	19 (27.14%)	0 (0%)	21 (30%)

(2) Altitude of a triangle

True	False	P.T.	N.A.
9 (12.86%)	46 (65.71%)	0 (0%)	15 (21.43%)

Q.1(E)Do as directed:

(1) In ΔABC, $\angle B$ is a right angle. $\overline{BM} \perp \overline{AC}$ and $M \in \overline{AC}$.

If AM = 4 and MC = 12, then find AB and BC.

True	False	P.T.	N.A.
21 (30%)	21 (30%)	19 (27.14%)	9 (12.86%)

(2) In ΔABC, $\angle B$ is a right angle. If AB = 20 and AC = 29, then find BC.

True	False	P.T.	N.A.
28 (40%)	25 (35.71%)	0 (0%)	17 (24.29%)

(3) In ΔABC, $\overline{AD}$ is a median and G is the centroid.

If AB = 29, BC = 40 and AC = 29, then find AG.

True	False	P.T.	N.A.
4 (5.71%)	32 (45.71%)	3 (4.29%)	31 (44.29%)

The errors were committed due to lack of:

1. Ability to write Pythagoras Theorem properly.
2. Ability to write riders properly and particularly they could not write proof.
3. Conceptual clarity in definition.
4. Ability to calculate geometric problems.

Paper analysis also discloses that some errors were repeated even though sufficient previous knowledge was provided.

The errors on unit test were found as follows:

1) The students were unable to write formulas for Pythagoras theorem or in ΔABC, $m\angle B=90$ and $\overline{BM}$ is altitude, then $BM^2=AM.CM$, etc.
   e.g. students have to apply geometric mean instead of that students apply Pythagoras theorem. $AB^2=AM^2+AC^2$ this is wrong, actually $AB^2=AM \times AC$ is right $\therefore AB^2=4 \times 16$ $\therefore AB=2 \times 4=8$.
2) The students were unable to solve problems on theorems due to their inability of writing formula.
   e.g. students were not able to write Apollonius theorem formula correct. Hence they were not able to get correct answer. $AB^2+AC^2=2(AD^2+BD^2)$ is correct formula but students make mistake. $AB^2+AC^2=2AD^2+BD^2$ and also $AG=\frac{2}{3}AD$ concept of median is not clear that centroid divides median in ratio 2:1.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The students were taught to write data, to prove. They were also explained how to draw figure and write proof point wise by explaining Pythagoras theorem twice. With theorems related riders were explained and writing practice of point wise proof was also given. Concept of definition was clearly explained. They were allowed to recite them twice and writing practice of the same was given in the class, as well as at home. They were told to prepare list of all the statement of theorems, corollaries and list of formula and were told to remember the same to facilitate calculations.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to

solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.14 Chapter 14: Circle and Chord

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as line segments and rays, point, line and idea of distance, conditions of congruence of triangles, and perpendicular bisector concept. In this test total twelve items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twelve marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 72 along with its frequency distribution in table 73.

Table – 72:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12
1	8	19	5	37	10	55	7
2	7	20	5	38	8	56	7
3	7	21	5	39	9	57	8
4	8	22	8	40	5	58	7
5	9	23	6	41	9	59	8
6	3	24	9	42	8	60	6
7	8	25	8	43	8	61	5

8	7	26	7	44	4	62	5
9	6	27	9	45	7	63	6
10	9	28	7	46	8	64	7
11	9	29	4	47	1	65	4
12	7	30	8	48	4	66	5
13	5	31	5	49	10	67	9
14	9	32	6	50	9	68	10
15	6	33	7	51	6	69	4
16	5	34	6	52	6	70	9
17	9	35	6	53	11		
18	5	36	4	54	8		

Table – 73:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 3	2
4 – 6	27
7 – 9	37
10 – 12	4
Total	**70**

Mean marks obtained by students is 6.843 out of twelve marks. Students secured 57.023% of marks which showed poor performance in prerequisite knowledge, so necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheet were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

(1) How many end points a line segment has? (one / two / no)

True	False	N.A.
58 (82.86%)	12 (17.14%)	0 (0.0%)

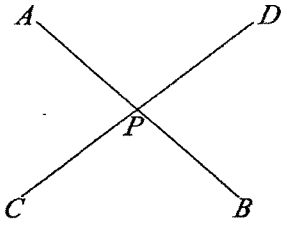
(2) If A – P – B then $\overline{AB}$ is the union of which two line – segments?

True	False	N.A.
51 (72.86%)	14 (20%)	5 (7.14%)

(3) In the figure given beside, $\overline{AB}$ and $\overline{CD}$ bisect at P.

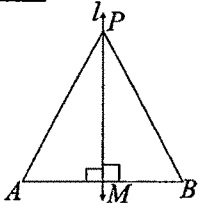
If AB = CD = 10 then PA = ...

PC = ...



True	False	N.A.
62 (88.57%)	6 (8.57%)	2 (2.86%)

(4) In the figure given beside l is perpendicular bisector of $\overline{AB}$. $P \in l$. If PA=7 then PB = ...



True	False	N.A.
64 (91.43%)	4 (5.71%)	2 (2.86%)

(5) Which are the two necessary conditions for perpendicular bisector of line – segment?

True	False	N.A.
14 (20%)	28 (40%)	28 (40%)

(6) Value of $(15.6)^2$ is .....

True	False	N.A.
37 (52.86%)	29 (41.43%)	4 (5.71%)

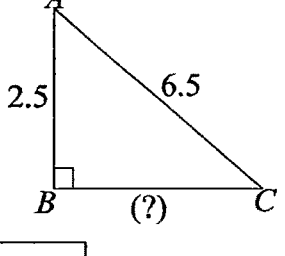
(7) 207.36 is the square of .....

True	False	N.A.
24 (34.28%)	29 (41.43%)	17 (24.29%)

(8) If the diameter of circle is 15.2, then radius is .....

True	False	N.A.
60 (85.71%)	7 (10%)	3 (4.29%)

(9) Find BC = ... with reference to given figure.

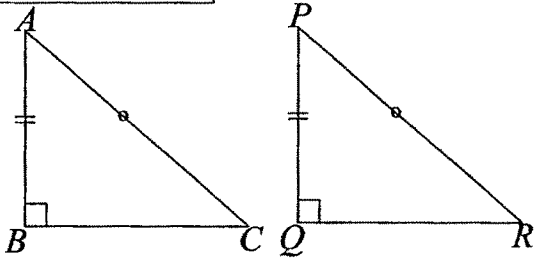


True	False	N.A.
44 (62.86%)	20 (28.57%)	6 (8.57%)

(10) If P – M – N, PN = 6, PM = 4.5 then MN = ...

True	False	N.A.
30 (42.86%)	31 (44.28%)	9 (12.86%)

(11) In ΔABC and ΔPQR, $m\angle B = m\angle Q = 90$ $\overline{AC} \cong \overline{PR}$, $\overline{AB} \cong \overline{PQ}$ then according to which condition these two triangles are congruent?



True	False	N.A.
10 (14.29%)	53 (75.71%)	7 (10%)

(12) If all the angles of parallelogram are right angle then this parallelogram is .....

True	False	N.A.
26 (37.14%)	36 (51.43%)	8 (11.43%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Clarity in concepts of conditions of similarity and congruency of triangles.
2. Knowledge in different kinds of quadrilaterals.
3. Ability in finding square and square root of numbers involving decimal point.
4. Information of end points and perpendicular bisector of line segment.
5. Ability in finding diameter and radius of a circle.

The errors on prerequisite test were found as follows:

1) The concept of betweenness and midpoint of a line segment was not clear, so the students were unable to write $\overline{AB}$ as union of two line segments when A–P–B is given.

   e.g. A–P–B then $\overline{AB} = \overline{AP} \cup \overline{PB}$ but students wrote $\overline{AB} = \overline{AB} \cup \overline{AP}$ or $\overline{AB} = \overline{AB} \cup \overline{PB}$ which is wrong.

2) The students had no clarity between bisector, perpendicular bisector, etc.

e.g. PA=7 then PB=7 but students were not clear about perpendicular bisector hence they wrote some different answer.

3) The students find difficult to deal with numbers with decimal points – e.g. the students could not find $(15.6)^2$ or $\sqrt{207.36}$ because of lack of knowledge of the process of finding square–root.
4) The students do not know that radius of a circle is the half of its diameter.
5) The students do not have knowledge of different conditions of congruence.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of similarity and congruence of triangles were cleared by giving various examples.
2. The information on different kinds of quadrilateral was given with necessary diagrams.
3. The revision of definitions of line segment, ray, etc. of standard VIII was carried out.
4. The relation between diameter and radius of a circle was given with necessary examples and extra practice was also given.
5. The square and square root of decimal numbers were explained and exhaustive practice was given.

Above remedial teaching was carried out while solving prerequisite test paper in class-room. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Circle and Chord"

1. After catering remedial teaching the chapter "Circle and Chord" of class X was taught to the sample students.

2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The teaching session was arranged in such a way that the students can understand all definitions, theorems, riders and equations.
4. The investigator encouraged the students to make method wise notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks. Four types of questions were asked:

1) Theorems:	1 item	x 4 marks	= 04
2) Objectives (Definitions):	3 items	x 1 mark	= 03
3) Solve the Short Sums			
(Any two from three)	2 items	x 2 marks	= 04
3) Objective:	4 items	x 1 mark	= 04
			15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 74 along with its frequency distribution in table 75.

Table – 74:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	10	19	1	37	12	55	2
2	1	20	4	38	8	56	4
3	3	21	7	39	9	57	2
4	6	22	6	40	6	58	1
5	10	23	10	41	13	59	4
6	1	24	6	42	7	60	4
7	13	25	7	43	4	61	10
8	13	26	1	44	7	62	6
9	10	27	4	45	1	63	2
10	10	28	5	46	5	64	2
11	5	29	5	47	3	65	5
12	8	30	7	48	4	66	7
13	6	31	7	49	10	67	11
14	3	32	4	50	5	68	12
15	5	33	4	51	5	69	8
16	9	34	13	52	5	70	7
17	8	35	9	53	7		
18	6	36	13	54	7		

Table – 75:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 3	13
4 – 6	25
7 – 9	17
10 – 12	10
13 – 15	5
Total	**70**

Mean marks obtained by the students is 6.67 out of fifteen marks. Students obtained 44.47% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1(A) Prove that perpendicular drawn through the centre of a circle on a chord bisects the chord.

True	False	N.A.	P.A.
36 (51.43%)	6 (8.57%)	12 (17.14%)	16 (22.86%)

Q.1(B)Give Definitions

(1) Circle

True	False	N.A.	P.A.
36 (51.43%)	18 (25.71%)	16 (22.86%)	0 (0%)

(2) Concentric Circles

True	False	N.A.	P.A.
34 (48.57%)	10 (14.29%)	26 (37.14%)	0 (0%)

(3) Radius

True	False	N.A.	P.A.
27 (38.57%)	21 (30%)	22 (31.43%)	0 (0%)

Q.2(A)Solve any two of the following:

(1) The lengths of two parallel chords of ⊙ (P, 13) are respectively 24 and 10. If these chords are on the same side of the line containing the diameter parallel to them, then find the distance between the chords.

True	False	N.A.	P.A.
25 (35.71%)	18 (25.71%)	24 (34.29%)	3 (4.29%)

(2) $\overline{AB}$ and $\overline{CD}$ are distinct chords of a circle with centre P. The feet of the perpendiculars drawn from P on $\overline{AB}$ and $\overline{CD}$ are respectively M and N. If AB = 5.2, CD = 5.2 and PM = 4.5, then what will be the measure of $\overline{PN}$?

True	False	N.A.	P.A.
21 (30%)	21 (30%)	27 (38.57%)	1 (1.43%)

(3) $\overline{AB}$ is a diameter of ⊙ (P, r). Measures of chords, other than diameters, lying in different half–planes of $\overleftrightarrow{AB}$ and parallel to $\overline{AB}$ are 24 and 18. If the distance between them is 21, find diameter of the circle.

True	False	N.A.	P.A.
1 (1.43%)	12 (17.14%)	56 (80%)	1 (1.43%)

Q.2(B)Do as directed:

(1) The length of a chord of a circle is 48 and its distance from the centre is 7. Find the diameter of the circle.

True	False	N.A.	P.A.
28 (40%)	27 (38.57%)	15 (21.43%)	0 (0%)

(2) In a circle with radius r, what is the distance of a chord of length r from its centre?

True	False	N.A.	P.A.
3 (4.29%)	25 (35.71%)	42 (60%)	0 (0%)

(3) "All the points of the chord of a circle lie in the interior of the circle." Is this statement true or false?

True	False	N.A.	P.A.
30 (42.86%)	25 (35.71%)	15 (21.43%)	0 (0%)

(4) Express ⊙ (P, 5) in set notation.

True	False	N.A.	P.A.
8 (11.43%)	24 (34.29%)	38 (54.28%)	0 (0%)

The errors were committed due to lack of:

1. Proper way of writing theorems.
2. Clarity in concepts of definitions.
3. Information in the distance between two parallel chords, the distance of chord from the centre i.e. ability to formulae of Pythagoras.
4. Clarity in the concept of expressing circle in set language, to find diameter, radius etc.

The errors on unit test were found as follows:

1) The concept of chord, diameter, their relation, radius, was not clear to the students.
2) The different properties of chord and circle application of Pythagoras were not clear, so the students could not calculate length of chord or diameter or distance between chords.

   e.g. the concept that when line segment from centre of circle bisects the chord at perpendicularly hence Pythagoras theorem can be applied is not clear.

   $AB = 48 \therefore AM = \frac{1}{2} AB = \frac{1}{2} \times 48 = 24$

   $\therefore$ by pathogras in ΔAPM

   $AP^2 = AM^2 + PM^2 = (24)^2 + (7)^2 = 576 + 49 = 625 \therefore AP = 25$ but students take AB instead of AM.
3) Expression of circle in set language was not clear due to not clear understanding of what is circle?

   e.g. $\odot$ (P,5) mean circle with centre p & radius 5 but students could not find radius and hence cannot solve the sum.
4) While writing the theorem and solving the problems students made errors in putting a centre of the circle and also draw wrong perpendicular bisector.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The students were taught how to write data, to prove and how to draw figure. How to write and remember proof was point–wise explained. For definition, first related concept was cleared then oral of the same was taken and they wrote them also. They were, also given to write definitions twice in homework. The list of statements of all the theorems, corollaries was formed together with the list of formulae and told to remember it so as to facilitate in solving calculations. The practice of relation between diameter, radius of a circle, use of set language, etc. was given.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.15 Chapter 15: Arc of A Circle

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as Angles, Triangles and Their Congruence and Plane Quadrilaterals. In this test total ten items (questions) were asked. All items (questions) were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of ten marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 76 along with its frequency distribution in table 77.

Table – 76:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10
1	5	19	5	37	5	55	4
2	6	20	4	38	7	56	2
3	4	21	2	39	8	57	6
4	5	22	5	40	1	58	5
5	9	23	5	41	7	59	7
6	5	24	5	42	4	60	3
7	7	25	5	43	4	61	1
8	7	26	6	44	3	62	3
9	7	27	7	45	2	63	3
10	5	28	8	46	2	64	6
11	5	29	3	47	1	65	2
12	2	30	5	48	1	66	3
13	3	31	5	49	8	67	7
14	3	32	2	50	6	68	7
15	3	33	4	51	2	69	6
16	6	34	6	52	3	70	8
17	6	35	5	53	6		
18	3	36	2	54	9		

Table – 77:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	45
6 – 10	25
Total	**70**

Mean marks obtained by students is 4.786 out of ten marks. Students secured 47.86% of marks which shows poor performance in prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

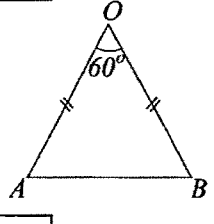
(B) Error wise Analysis

Answer–sheet were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

(1) In how many parts the angle divides the plane? Which are they?

True	False	N.A.
9 (12.86%)	33 (47.14%)	28 (40%)

(2) In ΔOAB OA = OB. If $m\angle AOB = 60^{\circ}$ then $m\angle OAB$ = ... and $m\angle ABO$ = ...



True	False	N.A.
51 (72.86%)	15 (21.43%)	4 (5.71%)

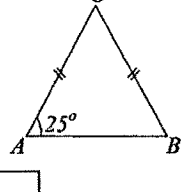
(3) In equilateral triangle, what is the measure of each angle?

True	False	N.A.
53 (75.71%)	14 (20%)	3 (4.29%)

(4) If all the angles of rhombus are right angle then state the type of the rhombus?

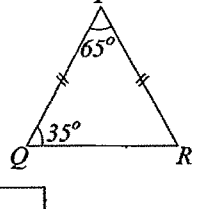
True	False	N.A.
28 (40%)	27 (38.57%)	15 (21.43%)

(5) In ΔAOB, OA = OB. If $m\angle OAB = 25$ then $m\angle AOB$ = ...



True	False	N.A.
18 (25.71%)	38 (54.29%)	14 (20%)

(6) In ΔPQR $m\angle P = 65$, $m\angle Q = 35$ then find $m\angle R$

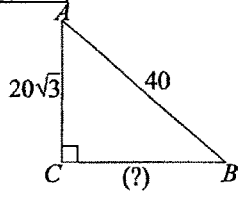


True	False	N.A.
45 (64.29%)	19 (27.14%)	6 (8.57%)

(7) If $(1.8)^2 = 0.9x$ then find the value of x

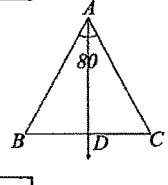
True	False	N.A.
9 (12.86%)	41 (58.57%)	20 (28.57%)

(8) According to Pythagoras law, find the measure of BC in the given figure



True	False	N.A.
37 (52.86%)	27 (38.57%)	6 (8.57%)

(9) In ΔABC, $\overrightarrow{AD}$ is a bisector of ∠A. If $m\angle A = 80$ then find $m\angle BAD$



True	False	N.A.
33 (47.14%)	16 (22.86%)	21 (30%)

(10) What are sum of measure of all angles in convex quadrilateral?

True	False	N.A.
43 (61.43%)	15 (21.43%)	12 (17.14%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Information of division of a plane by an angle.
2. Knowledge of kinds of triangles and quadrilaterals and measures of angles related to the kind of the triangles and quadrilaterals.
3. Ability to use Pythagoras theorem properly.
4. Ability to find measures of angles and the measures when angle bisectors are given.

The errors on prerequisite tests were found as follows:

1) The concept of isosceles triangle and equilateral triangle in terms of sides or angles was not known e.g. if in ΔOAB, OA=OB and m∠AOB=60 then ΔOAB is an equilateral triangle.
2) The students find it difficult to apply Pythagoras theorem to evaluate one side when the other two sides of a right angled triangle are given.

3) The concept of angle bisector was not clear e.g. $\overrightarrow{AB}$ bisects ∠BAC, then m∠BAD = m∠CAD.
4) Students could not find the value of x from $(1.8)^2=0.9x$, students do not know division in decimal system.
5) Students do not have knowledge that two sides of a triangle are congruent; their opposite angles are also congruent and vice versa.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. They were explained the division of the plane by angles by different figures.
2. They were reminded different kinds of triangles and their angles from standard VIII and different kinds of quadrilaterals and their angles from standard IX.
3. Pythagoras theorem and its application were once again explained.
4. Exhaustive practice was given for finding measures of angles by giving different examples. More practice sums were given as homework.

Above remedial teaching was carried out while solving prerequisite test paper in class–room. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Arc of A Circle"

1. After catering remedial teaching the chapter "Arc of A Circle" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.

3. The teaching session was arranged in such a way that the students can understand all definitions, theorems, riders and equations.
4. The investigator encouraged the students to make notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks four types of questions were asked:

1) Theorem:	1 items	x 4 marks	= 04
2) Objectives (Definitions):	3 items	x 1 mark	= 03
3) Solve the short sums: (Any two from three)	2 items	x 2 marks	= 04
3) Objectives:	4 items	x 1 mark	= 04
			15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 78 along with its frequency distribution in table 79.

Table – 78:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	2	19	1	37	11	55	1
2	2	20	8	38	5	56	5
3	4	21	2	39	6	57	3
4	4	22	3	40	5	58	2
5	10	23	2	41	15	59	1
6	5	24	5	42	3	60	7
7	9	25	0	43	6	61	5
8	11	26	2	44	4	62	1
9	6	27	0	45	0	63	3
10	2	28	3	46	4	64	0
11	2	29	4	47	1	65	6
12	3	30	5	48	5	66	6
13	4	31	5	49	4	67	11
14	5	32	4	50	3	68	12
15	0	33	4	51	5	69	7
16	5	34	9	52	5	70	4
17	5	35	8	53	10		
18	3	36	14	54	7		

Table – 79:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	18
3 – 5	32
6 – 8	10
9 – 11	7
12 – 14	2
15 – 17	1
Total	**70**

Mean marks obtained by students is 4.686 out of fifteen marks. Students got only 31.24% marks which showed poor performance in unit test

knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1(A) Prove that an angle inscribed in a semi–circle is a right angle.

True	False	N.A.	P.T.
31 (44.29%)	7 (10%)	14 (20%)	18 (25.71%)

Q.1(B)Give definitions:

(1) Arc of a circle

True	False	N.A.	P.T.
18 (25.71%)	16 (22.86%)	36 (51.43%)	0 (0%)

(2) Congruent arcs

True	False	N.A.	P.T.
19 (27.14%)	17 (24.29%)	34 (48.57%)	0 (0%)

(3) Segment of a circle

True	False	N.A.	P.T.
17 (24.29%)	11 (15.71%)	42 (60%)	0 (0%)

Q.2(A)Solve any two of the following:

(1) O is the centre of the circum circle of ΔABC. If $m\angle BOC = 100$ and $m\angle AOB = 110$, then find the measure of all the three angles of ΔABC.

True	False	N.A.	P.T.
12 (17.14%)	28 (40%)	28 (40%)	2 (2.86%)

(2) In ΔABC, the bisector of $\angle A$ intersects the circum circle of ΔABC at D. If $m\angle BCD = 37$, then find the measure of $\angle BAC$.

True	False	8	P.T.
9 (12.86%)	14 (20%)	45 (64.29%)	2 (2.86%)

(3) $\angle ABC$ is an angle inscribed in a semi–circle of ⊙ (P, r). If ΔABC is an isosceles triangle and AB = 8, find r.

True	False	N.A.	P.T.
3 (4.29%)	13 (18.57%)	54 (77.14%)	0 (0%)

Q.2(B)Do as directed:

(1) $\overline{AB}$ is an arc of ⊙ (P, 4), AB = 4, then find the measure of the angle subtended by minor $\overset{\frown}{AB}$ at the centre P.

True	False	N.A.	P.T.
17 (24.29%)	29 (41.43%)	24 (34.28%)	0 (0%)

(2) $\angle PQR$ is an angle inscribed in a semi–circle. If PQ = 9 and the radius of the corresponding circle is 7.5, find QR.

True	False	N.A.	P.T.
15 (21.43%)	25 (35.71%)	30 (42.86%)	0 (0%)

(3) $\overset{\frown}{AB}$ is an arc of a circle with centre O. P is a point of the major $\overset{\frown}{AB}$ and P ≠ A, P ≠ B, then $\angle APB$ is .....

True	False	N.A.	P.T.
7 (10%)	32 (45.71%)	31 (44.29%)	0 (0%)

(4) Write the type of arc having length 8π in ⊙ (P, 6).

True	False	N.A.	P.T.
20 (28.57%)	19 (27.14%)	31 (44.29%)	0 (0%)

The errors were committed due to lack of:

1. Ability to write theorem properly.
2. Conceptual clarity in definitions.
3. Ability to solve sums on calculations on circle and its arc.
4. Information on kinds of arcs and angles subtended by arc at the centre as well as on the other part of the circle.

The errors on unit test were found as follows:

1) The concept of major arc, minor arc, semicircular arc was not clear so the students could not decide about kind of arc having length 8π in Θ(P,6).

2) The properties of arc and relation with angles were nto clear, so they could not give proper measure of an angle inscribed in a semicircle.
   e.g. m∠ABC=90 as BC is diameter and AB=8, AC=8. then by Pythagoras theorem BC i.e. radius can be obtained but students were not clear about right angled triangle.
3) The students were unable to write theorem on semicircle because the fundamentals were not clear like line segment joining the midpoints of two sides of a triangle is parallel to the third and transversal of parallel lines form congruent corresponding angles.
4) Students could not write definitions with perfect words.

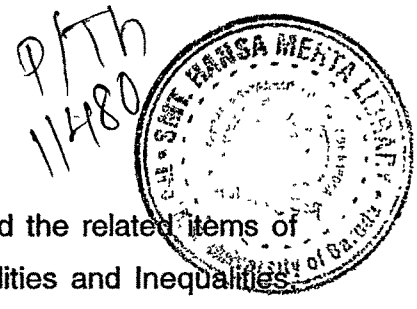
STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

They were given full information on how to write data and to prove of the theorem. They were also informed how to draw figure and to develop proof from data. The concepts of definitions were cleared. They recited the same in class twice and made writing practice in the class as well as at home. They were told to prepare list of all the statements of theorems, corollaries and list of formulae and were told to remember the same to facilitate calculations. The information of kinds of arcs, angles formed by are once again given. Extra practice of the sums was carried out from S.S.C. Board examinations.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.



4.4.16 Chapter 16: Circle and its Tangent

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as Real Numbers, Equalities and Inequalities, Angles, concurrent Lines and Point of Concurrence. In this test total ten items were asked. All items were objective type. Before starting teaching the chapter of class X a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by students along with marks also. This test was of ten marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 80 along with its frequency distribution in table 81.

Table – 80:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10
1	3	19	3	37	6	55	3
2	4	20	3	38	5	56	6
3	4	21	3	39	4	57	4
4	5	22	4	40	3	58	6
5	3	23	3	41	4	59	6
6	1	24	3	42	3	60	7
7	6	25	4	43	5	61	3
8	5	26	3	44	4	62	4
9	5	27	4	45	2	63	4
10	7	28	6	46	6	64	1
11	3	29	2	47	2	65	3
12	5	30	3	48	1	66	3

13	2	31	2	49	6	67	8
14	4	32	6	50	5	68	7
15	3	33	5	51	3	69	3
16	4	34	5	52	5	70	6
17	3	35	3	53	4		
18	2	36	3	54	7		

Table – 81:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	55
6 – 10	15
Total	**70**

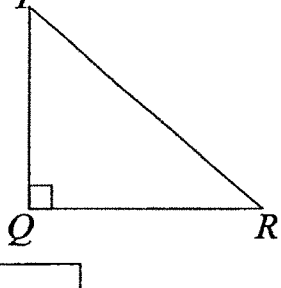
Mean marks obtained by students is 4.071 out of ten marks. Students obtained 40.71% of marks which showed poor performance in prerequisite knowledge. So necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

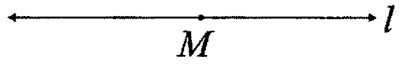
Q.1. Answer accordingly:

(1) In the figure given beside which is the longest side of the ΔPQR?



True	False	N.A.
59 (84.29%)	11 (15.71%)	0 (0%)

(2) Point M in on the l. How many points we get on l at a distance 10 from M on l?



True	False	N.A.
13 (18.57%)	49 (70%)	8 (11.43%)

(3) If $a < b$ then $b^2 - a^2$ ..... 0 (>, <, =)

True	False	N.A.
35 (50%)	29 (41.43%)	6 (8.57%)

(4) If $|x-3|=5$ then find all possible value of x

True	False	N.A.
37 (52.86%)	27 (38.57%)	6 (8.57%)

(5) a + b = 11, b + c = 13, c + a = 12 then find the value of a + b + c

True	False	N.A.
10 (14.29%)	46 (65.71%)	14 (20%)

(6) Find the measure of supplementary angle of measure 65°?

True	False	N.A.
15 (21.43%)	37 (52.86%)	18 (25.71%)

(7) In ΔACB, ∠C is right angle. $m\angle B = 50$, then find $m\angle A$.

True	False	N.A.
42 (60%)	20 (28.57%)	8 (11.43%)

(8) ∠A and ∠C are supplementary angles. $m\angle A : m\angle C = 4:6$ then find $m\angle A$ and $m\angle C$.

True	False	N.A.
3 (4.29%)	33 (47.14%)	34 (48.57%)

(9) In right angle triangle, mid–point of hypotenuse is ..... of triangle (In centre, circum centre, ortho–centre)

True	False	N.A.
21 (30%)	43 (61.43%)	6 (8.57%)

(10) What is the value of $(5\sqrt{2})^2$?

True	False	N.A.
48(68.57%)	13 (18.57%)	9 (12.86%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Information on supplementary angles, complementary angles, corresponding angles, etc.
2. Inability to find absolute values of given numbers.
3. Information of the points at a definite distance from the line.
4. Information of Orthocentre, circumcentre, incentre and centroid of a right angled triangle.
5. Inability to obtain solution of equations and to find ratios of measures of angles.

The errors on prerequisite test were found as follows:

1) The students were unable to find two solutions of equation containing absolute value i.e. $|x-3|=5$ due to incomplete knowledge of absolute value.
2) The students were unable to find supplementary angle due to confusion between supplementary and complementary angles.
   e.g. 65–x=180 ∴x=180–65=115° but instead of 180 students took 90° therefore they got wrong.
3) The students find it difficult to square irrational numbers like $\left(5\sqrt{2}\right)^2$ due to improper knowledge about reverse operations of square and square root.
   e.g. $(5\sqrt{2})^2 = 25\times 2 = 50$ but students wrote $25\times\sqrt{2} = 25\sqrt{2}$ is wrong.
4) Students could not find the value of a+b+c from given equations. They do not know direct method of adding all three equations.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. Information of different kinds of angles formed by transversal of two lines was given together with relation between their measures.
2. Five sums on absolute values were taught and extra practice was given.
3. Revision of point, line, ray and points on line at a certain distance from a given point was carried out from 8^{th} standard.
4. Concept of Orthocentre, circumcentre, incentre and centroid of right angled triangle was cleared.
5. Extra practice of obtaining solution of equations and finding measures of angles from given ratio was taken and sums for practice was given.

Above remedial teaching was carried out while solving prerequisite test paper in class–room. Individual remedial teaching was also provided to the students who scored very less marks.

STEP – 4: Teaching of the Chapter: "Circle and Its Tangent"

1. After catering remedial teaching the chapter "Circle and Its Tangent" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The teaching session was arranged in such a way that the students can understand all definitions, theorems, riders and equations.
4. The investigator encouraged the students to make notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks. Four types of questions were asked:

1) Theorem:	1 items	x 4 marks	= 04
2) Objectives (Definitions):	2 items	x 1 mark	= 02
2) Solve the Short Sums:			
(Any two from three)	2 items	x 2 marks	= 04
3) Objectives:	5 items	x 1 mark	= 05
			15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 82 along with its frequency distribution in table 83.

Table – 82:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	1	19	1	37	11	55	3
2	3	20	7	38	12	56	5
3	2	21	11	39	11	57	4
4	9	22	5	40	4	58	1
5	5	23	1	41	12	59	4
6	1	24	2	42	6	60	4
7	2	25	2	43	1	61	2
8	9	26	4	44	3	62	3
9	3	27	1	45	3	63	5
10	4	28	2	46	1	64	2
11	8	29	5	47	1	65	7
12	1	30	5	48	2	66	12
13	2	31	5	49	5	67	11

14	1	32	4	50	9	68	8
15	4	33	4	51	6	69	7
16	7	34	6	52	5	70	1
17	3	35	6	53	13		
18	6	36	13	54	7		

Table – 83:

Frequency Distribution of Marks of Unit Test

Class	*f*
1 – 3	28
4 – 6	23
7 – 9	10
10 – 12	7
13 – 15	2
Total	**70**

Mean marks obtained by students is 5.086 out of fifteen marks. Students obtained 33.9% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1(A) Prove that a tangent of a circle is perpendicular to the radius drawn through the point of contact.

True	False	N.A.	P.T.
31 (44.29%)	6 (8.57%)	28 (40%)	5 (7.14%)

Q.1(B) Give Definitions:

(1) Tangent of a circle

True	False	N.A.	P.T.
33 (47.14%)	14 (20%)	23 (32.86%)	0 (0%)

(2) Cyclic quadrilateral

True	False	N.A.	P.T.
30 (42.86%)	12 (17.14%)	28 (40%)	0 (0%)

Q.2(A) Solve any two of the following:

(1) The radii of two concentric circles are 3.4 and 1.6. A chord of the circle of larger radius touches the circle of smaller radius. Find the length of the chord.

True	False	N.A.	P.T.
11 (15.71%)	28 (40%)	31 (44.29%)	0 (0%)

(2) Three circles with centres P, Q and R lie in the same plane and each of them touch the other two externally. If PQ = 4, QR = 6 and PR = 8, then find the radius of each circle.

True	False	N.A.	P.T.
2 (2.86%)	12 (17.14%)	56 (80%)	0 (0%)

(3) □ABCD is a cyclic quadrilateral and $\overline{AB}$ is a diameter of the circum circle of □ABCD. If $m\angle ADC = 130$, find $m\angle BAC$.

True	False	N.A.	P.T.
6 (8.57%)	14 (20%)	49 (70%)	1 (1.43%)

Q.2(B) Do as directed: 5

(1) In a cyclic quadrilateral □ABCD, $m\angle A - m\angle C = 20$, find $m\angle A$ and $m\angle C$.

True	False	N.A.	P.T.
17 (24.29%)	21 (30%)	32 (45.71%)	0 (0%)

(2) A line passing through a point P lying in the exterior of ⊙ (O, 4.5) touches the circle at a point A. AP = 6. If $\overline{OP}$ intersects the circle in the point B, find PB.

True	False	N.A.	P.T.
5 (7.14%)	11 (15.72%)	54 (77.14%)	0 (0%)

(3) "If a line intersects a circle at one and only one point, then that line is a tangent of the circle." State whether the statement is true or false.

True	False	N.A.	P.T.
39 (55.71%)	20 (28.57%)	11 (15.72%)	0 (0%)

(4) "All the points of a tangent of a circle lie in the exterior of the circle." State whether the statement is true or false.

True	False	N.A.	P.T.
38 (54.29%)	19 (27.14%)	13 (18.57%)	0 (0%)

(5) If ⊙ (P, 8) and ⊙ (Q, 4.5) are touching each other internally, find PQ.

True	False	N.A.	P.T.
9 (12.86%)	22 (31.43%)	39 (55.71%)	0 (0%)

The errors were committed due to lack of:

1. Ability to write definitions.
2. Ability to write theorems properly.
3. Understanding of difference when tangents intersect externally or internally.
4. Students find difficulty in solving calculations on circle.
5. Information of relation between different kinds of two circles and are unable to find length of chord, etc. from them.

The errors on unit test were found as follows:

1) The students had no clear concept of tangent and properties of chord so they were unable to find length of chord touching inner concentric circle.

   e.g. AC is radius of inner circle and also distance of chord BD from centre A. Hence ΔABC is right triangle. Therefore by Pythagoras theorem it can be found easily but students were not able to find AC or AB and hence went wrong.

2) The concept of cyclic quadrilateral and the property – opposite angles of a cyclic quadrilateral and supplementary was not clear.

   e.g. m∠A– m∠C=20 and m∠A+ m∠C=180 (opposite angles are supplementary). Therefore ∠C can be found by elimination method but students were not knowing that opposite angles are supplementary.

3) The students were unable to use application of tangent and secant due to lack of enough practice.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.17 Chapter 17: Construction

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which includes the related items of class VIII and class IX such as constructions. In this test total eight items were asked. All items were of objective type. Before starting teaching the chapter of class X a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of eight marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 84 along with its frequency distribution in table 85.

Table – 84:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 8	Roll No.	Marks Obtained Out of 8	Roll No.	Marks Obtained Out of 8	Roll No.	Marks Obtained Out of 8
1	7	19	4	37	7	55	2
2	1	20	7	38	5	56	4
3	5	21	7	39	4	57	5
4	4	22	1	40	3	58	5
5	3	23	5	41	6	59	1
6	4	24	3	42	3	60	4
7	5	25	2	43	3	61	3
8	6	26	1	44	3	62	4
9	6	27	3	45	5	63	0
10	4	28	5	46	0	64	1
11	5	29	2	47	0	65	4
12	6	30	1	48	3	66	5
13	0	31	3	49	5	67	5
14	1	32	3	50	3	68	4
15	4	33	4	51	2	69	0
16	5	34	3	52	3	70	3
17	5	35	6	53	6		
18	5	36	5	54	4		

Table – 85:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
0 – 2	16
3 – 5	44
6 – 8	10
Total	**70**

Mean marks obtained by students is 3.74 out of eight marks students secured 46.75% marks which showed poor performance in prerequisite knowledge, so necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer Accordingly

(1) Line l and point P on line l are given. Construct line m which is passes through P and perpendicular to l.

True	False	N.A.
26 (37.14%)	29 (41.43%)	15 (21.43%)

(2) Construct the bi–sector of $\angle AOB$.

True	False	N.A.
21 (30%)	32 (45.71%)	17 (24.29%)

(3) Construct the angle of measure 60°.

True	False	N.A.
50 (71.43%)	17 (24.29%)	03 (4.28%)

(4) Construct the angle of measure 90°.

True	False	N.A.
50 (71.43%)	13 (18.57%)	07 (10%)

(5) Construct the angle of measure 75°.

True	False	N.A.
40 (57.14%)	17 (24.29%)	13 (18.57%)

(6) $\overline{AB}$ of measure 5 cm is given. Construct perpendicular bisector of $\overline{AB}$.

True	False	N.A.
31 (44.29%)	15 (21.43%)	24 (34.28%)

(7) $\overline{AB}$ of measure 7 cm is given. Divide $\overline{AB}$ in to three congruent line–segment.

True	False	N.A.
25 (35.71%)	14 (20%)	31 (44.29%)

(8) Construct ∠AOB of measure 22.5°. Construct ∠PQR on given $\overrightarrow{QR}$ in such a way that ∠AOB ≅ ∠PQR. (Draw figure only).

True	False	N.A.
14 (20%)	06 (8.57%)	50 (71.43%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Not understanding the question asked.
2. Ability in proper measurement of angles.
3. Ability in drawing using compass.
4. Students draw some other thing which is not related to the question.
5. Ability to decide centre from where to draw the arc.
6. Ability to join exact points for drawing angle bisector.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The students were taught how to measure angles.
2. Students were told to read the given question carefully.
3. Students were taught where to place compass and how to draw the arc.
4. Students were taught to join exact points using sharp pencils.
5. All constructions of standard IX were taught for enhancing basic knowledge and given enough practice for drawing it.

STEP – 4: Teaching of the Chapter: "Construction"

1. After catering remedial teaching the chapter "Construction" of class X was taught to the sample students.
2. Practice of solving constructions was given to the students for the above chapter.

3. Home work was given and checked by the teachers regularly and necessary guidance was provided.
4. Difficulties of the students were solved before, after and during teaching sessions.
5. Students were encouraged to participate in classroom teaching and group discussions.
6. Students were given construction to solve by themselves in the class room and sufficient time was provided to them to draw the construction.
7. For self study to strength the acquired knowledge practice material for construction was provided to the students.

STEP – 5: Administration of Unit Test

After completing the teaching of the chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of ten marks two types of questions were asked:

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

1) Construction with Step of Construction:	2 items	x 4 mark	= 08
2) Objectives:	2 items	x 1 mark	= 02
			10

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 86 along with its frequency distribution in table 87.

Table – 86:

Marks of Unit Test

Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10
1	2	19	2	37	4	55	0
2	0	20	5	38	4	56	1
3	2	21	7	39	6	57	6
4	5	22	4	40	7	58	3
5	5	23	3	41	9	59	0
6	8	24	3	42	4	60	4
7	6	25	0	43	3	61	5
8	4	26	6	44	2	62	5
9	8	27	1	45	0	63	0
10	2	28	0	46	0	64	2
11	2	29	0	47	0	65	2
12	3	30	2	48	0	66	8
13	1	31	2	49	0	67	2
14	0	32	4	50	5	68	9
15	7	33	3	51	4	69	6
16	2	34	4	52	4	70	4
17	5	35	3	53	0		
18	0	36	4	54	0		

Table – 87:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	31
3 – 5	26
6 – 8	11
9 – 11	02
Total	**70**

Mean marks obtained by students is 3.314 out of ten marks. Students obtained 33.14% marks which showed poor performance in unit test knowledge, so necessary remedial actions will be taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1. (A) Construct a regular octagon inscribed in a circle. Mention the steps required.

True	False	P.T.	N.A.
18 (25.72%)	25 (35.71%)	19 (27.14%)	8 (11.43%)

Q.1. (B) $\overline{PQ}$ is given. Construct ΔABC such that BC = 4PQ, $m\angle A = 45$ and the length of median $\overline{AD}$ is 3PQ. Mention the steps required.

True	False	P.T.	N.A.
2 (2.86%)	4 (5.71%)	30 (42.86%)	34 (48.57%)

Q.1. (C) (1) State the postulate of the straight rule.

True	False	P.T.	N.A.
14 (20%)	9 (12.86%)	0 (0%)	47 (67.14%)

(2) State the postulate of the compass.

True	False	P.T.	N.A.
10 (14.29%)	9 (12.86%)	0 (0%)	51 (72.85%)

The errors were committed due to lack of:

1. Drawing proper construction.
2. Ability to write proper steps even though the construction is drawn.
3. Understanding concept of radius of a circle.
4. Ability to use definition or definition is forgotten (basic knowledge of definitions of VIII and IX standard).
5. Ability to draw circle of exact (required) radius.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of error analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter "Construction".

They were taught to draw circle of required radius. The concept of perpendicular bisector of a line segment and angle bisector was cleared. They were taught to draw construction and simultaneously write the steps. Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

Complete revision was made by solving all constructions asked at the S.S.C. Board examination. Finally, some of the students were called to draw construction on the blackboard.

4.4.18 Chapter 18: Area

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class VIII and class IX such as area. In this test total ten items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of ten marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 88 along with its frequency distribution in table 89.

Table – 88:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10	Roll No.	Marks Obtained Out of 10
1	Absent	19	1	37	5	55	3
2	1	20	6	38	2	56	5
3	3	21	8	39	3	57	5
4	4	22	1	40	1	58	4
5	5	23	3	41	9	59	5
6	Absent	24	5	42	4	60	1
7	1	25	2	43	2	61	3
8	2	26	Absent	44	1	62	3
9	4	27	2	45	3	63	1
10	4	28	1	46	5	64	3
11	7	29	1	47	2	65	3
12	8	30	5	48	3	66	5
13	2	31	1	49	3	67	7
14	1	32	Absent	50	3	68	5
15	1	33	3	51	1	69	2
16	4	34	7	52	1	70	5
17	4	35	1	53	7		
18	7	36	Absent	54	4		

Table – 89:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 5	56
6 – 10	9
Total	**65**

Mean marks obtained by students is 3.69 out of ten marks. Students secured 36.9% of marks which showed poor performance in prerequisite knowledge, so necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheet were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1. Answer accordingly:

(1) Circumference of the circle is ..... (Write formula)

True	False	N.A.
21 (32.31%)	31 (47.69%)	13 (20%)

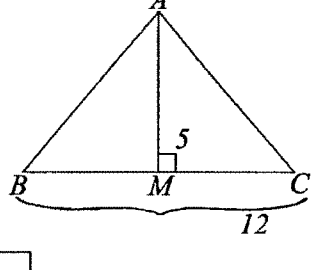
(2) Formula for the area of circle .....

True	False	N.A.
19 (29.23%)	27 (41.54%)	19 (29.23%)

(3) Simplify: $\frac{22\times21\times21\times100}{7\times360}$

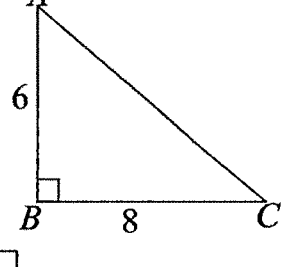
True	False	N.A.
35 (53.85%)	30 (46.15%)	0 (0%)

(4) In given figure, $\overline{AM}$ is a altitude on base $\overline{BC}$ BC = 12, AM = 5 then find the area of ΔABC.



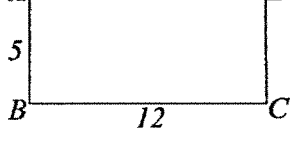
True	False	N.A.
8 (12.30%)	35 (53.85%)	22 (33.85%)

(5) In given figure, find the area of ΔABC



True	False	N.A.
18 (27.69%)	29 (44.62%)	18 (27.69%)

(6) In given figure, find the area of rectangle ABCD



True	False	N.A.
11 (16.92%)	31 (47.69%)	23 (35.39%)

(7) Find the value of $(3.5)^2$

True	False	N.A.
51 (78.46%)	11 (16.92%)	3 (4.62%)

(8) Find the value of $\sqrt{82.81}$

True	False	N.A.
17 (26.16%)	11 (16.92%)	37 (56.92%)

(9) If $4070 = \frac{22}{7} \times 35 \times x$ then find x

True	False	N.A.
25 (38.46%)	25 (38.46%)	15 (23.08%)

(10) $2464 = 4 \times \frac{22}{7} \times r^2$ then find the value of r

True	False	N.A.
20 (30.77%)	24 (36.92%)	21 (32.31%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Clarity of concept of area.
2. Clarity of difference in the area of different geometric figures.
3. Ability to remember formulae of area of different geometric figures.
4. Ability to simplify.
5. Writing correct figures in the formula.
6. Ability to write units properly.
7. Ability to cancel
8. Ability to transfer fractions from R.H.S. to L.H.S. and vice versa.

The errors on prerequisite test were found as follows:

1) The students could not simplify due to inability of cancellation of numbers in numerator and denominator.

e.g. $\frac{22\times21\times21\times100}{7\times360}=385$ but students made mistake like $\frac{22\times21\times21\times100}{7\times360}=\frac{4410\times22}{7\times36}=\frac{97020}{252}$ or in some cases were not able to write in reduced form.

2) The students committed error while transferring fraction from one side to the other.

e.g. $4070=\frac{22}{7}\times35\times x \ \therefore\frac{4070\times7}{22\times35}$ but students wrote in some cases like $x=\frac{4070\times22\times35}{7}$ which is wrong.

3) The students were unable to find square root and square of numbers with decimal point.

e.g. $\sqrt{82.81}=41.405$ which is wrong students simply divided by 2. Actually it will be $\sqrt{82.81}=9.1$.

4) Students could not write the formula of circumference and area of a circle. They could not differentiate these two terms of a circle.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of error analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of area was cleared
2. The models of cylinder, cone and sphere were made and shown them and they were explained how the formula of their area can be developed.
3. The chart of formulas of area was made and they were told to remember.
4. The compulsion of writing units was made in the class till they were accustomed to write units.
5. They were given more practice so that they do not commit errors in simplification in future.

6. They were clearly explained how to cancel and what care should be taken while transferring a fraction from LHS to RHS and vice versa.

Individual remedial teaching was provided to the students who faced difficulty in area.

STEP – 4: Teaching of the Chapter: "Area"

1. After catering remedial teaching the chapter "Area" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make method–wise notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks three types of questions were asked:

1) Solve the Sums:	2 items	x 3 marks	= 06
2) Solve the Short Sums:	3 items	x 2 marks	= 06
3) Objectives:	3 items	x 1 mark	= 03
			15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 90 along with its frequency distribution in table 91.

Table – 90:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	Absent	19	8	37	13	55	1
2	10	20	5	38	1	56	6
3	1	21	1	39	0	57	3
4	12	22	9	40	5	58	13
5	7	23	13	41	14	59	3
6	Absent	24	0	42	2	60	1
7	9	25	10	43	1	61	9
8	9	26	Absent	44	3	62	8
9	4	27	7	45	6	63	2
10	6	28	3	46	6	64	6
11	11	29	3	47	7	65	6
12	7	30	3	48	6	66	14
13	0	31	2	49	1	67	11
14	2	32	Absent	50	1	68	10
15	12	33	9	51	1	69	1
16	8	34	7	52	1	70	5
17	5	35	9	53	1		
18	13	36	Absent	54	9		

Table – 91:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	19
3 – 5	11
6 – 8	15
9 – 11	12
12 – 14	8
15 – 17	0
Total	**65**

Mean marks obtained by students is 6.03 out of fifteen marks. Students obtained 40.2% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1 (A) Solve of the following sums:

(1) There are two cones. The curved surface area of one is twice that of the other. The slant height of the latter is twice that of the former. Find the ratio of their radii.

True	False	N.A.	P.T.
32 (49.23%)	10 (15.38%)	20 (30.77%)	3 (4.62%)

(2) The base radius and the height of a cone are 35 cm and 84 cm respectively. Find the area of the curved surface of the cone.

True	False	N.A.	P.T.
5 (7.69%)	25 (38.46%)	30 (46.16%)	5 (7.69%)

(B) Answer the following: 6

(1) The radius of a hemi–sphere is 14 cm. Find its total surface area.

True	False	N.A.	P.T.
26 (40%)	28 (43.08%)	11 (16.92%)	0 (0%)

(2) The surface area of a spherical ball is 2464 sq cm. Find the diameter of the ball in cm.

True	False	N.A.	P.T.
29 (44.62%)	14 (21.54%)	18 (27.69%)	4 (6.15%)

(3) A sector is cut from a circle of radius 21 cm. The angle of the sector is 150. Find the area of the sector.

True	False	N.A.	P.T.
17 (26.15%)	18 (27.69%)	29 (44.62%)	1 (1.54%)

(C) Fill in the blanks so as to make each of the following statements true.

(1) Total surface area of a cone = ...

True	False	N.A.	P.T.
27 (41.54%)	30 (46.15%)	8 (12.31%)	0 (0%)

(2) A chord congruent to the radius of a circle subtends an angle of measure ..... at the centre.

True	False	N.A.	P.T.
20 (30.77%)	34 (52.31%)	11 (16.92%)	0 (0%)

(3) If the radius of a sphere is doubled, its surface area will become ..... times the original surface area.

True	False	N.A.	P.T.
26 (40%)	28 (43.08%)	11 (16.92%)	0 (0%)

The errors were committed due to lack of:

1. Clear difference in area and volume.
2. Remembering formula.
3. Placing proper values in the formula.
4. Ability to simplify.
5. Ability to write proper units.

The errors on unit test were found as follows:

1) The students committed error between segment and sector of a circle due to inclarity in concept of sector and segment.
2) The students could not find area of segment due to insufficient knowledge of finding area of a triangle.
   e.g. for finding area of segment area of triangle is required but students are not able to find height i.e. altitude when angle at centre is 120°, 60°, etc. e.g. when angle at centre is 60° then it is equilateral triangle ∴ altitude = $\frac{\sqrt{3}}{2} \cdot x$ where x is side of triangle.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter.

The concept of area and volume was given in different ways. We encountered them to make models of cylinder, cone and sphere and data of formula of area was given. The list of formulae was made and students were told to remember them. Different practical sums on area were taken. The compulsion of writing units was made in the class till students were accustomed to write units. Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.19 Chapter 19: Volume

STEP – 1: Administration of Prerequisite Test

The prerequisite test was framed which included the related items of class IX such as area and process of simplification. In this test total twelve items were asked. All items were of objective type. Before starting teaching the chapter a prerequisite test was administered and assessment was carried out itemwise with major focus on errors committed by the students along with marks also. This test was of twelve marks.

STEP – 2: Analysis of Prerequisite Test

Analysis of answer books was made by the subject teachers. The markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given a mark and total marks were given to each student. Marks obtained by the students in prerequisite test are shown in table 92 along with its frequency distribution in table 93.

Table – 92:

Marks of Prerequisite Test

Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12	Roll No.	Marks Obtained Out of 12
1	Absent	19	1	37	2	55	2
2	6	20	7	38	1	56	Absent
3	4	21	1	39	1	57	3
4	6	22	3	40	2	58	7
5	5	23	2	41	11	59	Absent
6	Absent	24	5	42	2	60	Absent
7	1	25	3	43	3	61	5
8	1	26	Absent	44	2	62	4
9	3	27	1	45	2	63	4
10	1	28	2	46	2	64	7
11	10	29	2	47	Absent	65	4
12	4	30	6	48	1	66	4
13	5	31	3	49	2	67	6
14	1	32	Absent	50	2	68	6
15	2	33	2	51	1	69	2
16	7	34	5	52	Absent	70	6
17	3	35	1	53	7		
18	1	36	Absent	54	2		

Table – 93:

Frequency Distribution of Marks of Prerequisite Test

Class	*f*
1 – 3	36
4 – 6	17
7 – 9	5
10 – 12	2
Total	**60**

Mean marks obtained by students is 3.65 out of twelve marks. Students secured 30.42% of marks which showed poor performance in prerequisite knowledge, so necessary remedial actions were taken to enhance their prerequisite knowledge and prepared them to learn the chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), and not attempted (NA) is presented in following lines.

Q.1.

(1) $V = \frac{1}{3} \times \frac{22}{7} \times \frac{35 \times 35}{1} \times \frac{72}{1}$, then find V

True	False	N.A.
21 (35%)	27 (45%)	12 (20%)

(2) $V = \frac{1}{3} \times \frac{22}{7} \times \frac{9}{2} \times \frac{9}{2} \times \frac{35}{10}$, then find V

True	False	N.A.
23 (38.33%)	20 (33.33%)	17 (28.34%)

(3) $V = \frac{539}{3}$ (Divide upto two decimal points)

True	False	N.A.
35 (58.34%)	14 (23.33%)	11 (18.33%)

(4) $\frac{3168}{7} = 4 \times \frac{22}{7} \times r^2$, then find r

True	False	N.A.
16 (26.67%)	26 (43.33%)	18 (30%)

(5) $4851 = \frac{4}{3} \times \frac{22}{7} \times r^3$, then find r

True	False	N.A.
2 (3.34%)	26 (43.33%)	32 (53.33%)

(6) $4\pi r^2 = \frac{4}{3}\pi r^3$ then find r

True	False	N.A.
12 (20%)	14 (23.33%)	34 (56.67%)

(7) Evaluate = $\sqrt{(12)^2+(3.5)^2}$

True	False	N.A.
10 (16.67%)	20 (33.33%)	30 (50%)

(8) 1 cm = ... m. m (10, 100, 1000)

True	False	N.A.
20 (33.33%)	35 (58.34%)	5 (8.33%)

(9) $228\pi = 12\pi h$, then find h

True	False	N.A.
15 (25%)	38 (63.33%)	7 (11.67%)

(10) 1 rupee coin is ..... (cylinder, sphere, cone)

True	False	N.A.
3 (5%)	21 (35%)	36 (60%)

(11) 1 cubic metre = ... litre (100, 1000, 10000)

True	False	N.A.
34 (56.67%)	20 (33.33%)	6 (10%)

(12) $r^3 = \frac{38808}{1000} \times \frac{7}{22} \times \frac{3}{4}$ then find r

True	False	N.A.
3 (5%)	21 (35%)	36 (60%)

The findings of the analysis showed that the errors were committed due to lack of:

1. Clarity of concept of volume
2. Ability to remember formulae of volume
3. Writing correct figures in the formula
4. Ability to simplify
5. Ability to write proper units
6. Ability to cancel
7. Ability to transfer fractions from R.H.S. to L.H.S. and vice versa.

The errors on prerequisite test were found as follows:

1) The students had insufficient knowledge of conversion of one unit into other and write proper units.

e.g. $1m^3 = 100$ litre is wrong as $1m^3 = 1000$ litre.

2) Students could not find the value of 'r' in no. 6 as they could not eliminate π and r^2 from both the sides.

3) While evaluating $\sqrt{(12)^2 + (3.5)^2}$ students could not find out the square root of 156.25 as it comes by summation.

STEP – 3: Remedial Measures Based on Prerequisite Test

On the basis of errors analysis of Mathematics as well as discussions with subject teachers the guideline and suggestions were worked out, to improve their previous knowledge which is necessarily required to learn the chapter.

1. The concept of volume was cleared.
2. The models of cylinder, cone and sphere were made and they were explained how the formula of their volume can be developed.
3. The chart of formulate of volume was made and they were told to remember.
4. The compulsion of writing units was made in the class till they were accustomed to write units.

Individual remedial teaching was provided to the students who faced difficulty in volume.

STEP – 4: Teaching of the Chapter: "Volume"

1. After catering remedial teaching the chapter "Volume" of class X was taught to the sample students.
2. Practice was given as per need to solve problems. Home assignment was given and same was checked and necessary guidance was provided. Difficulties of the students were solved before, after and during teaching sessions. Students were encouraged to participate in classroom teaching and group discussion.
3. The investigator encouraged the students to make notes for the whole chapter for fast and frequent revision and recalling of the chapter.

STEP – 5: Administration of Unit Test

After completing the teaching of chapter unit test was administered. Paper was framed as per the blue print given by the Board. This test was of fifteen marks three types of questions were asked:

1) Solve the Sums:

(Any two from three)	2 items	x 3 marks	= 06
2) Solve the short sums:	3 items	x 2 marks	= 06
3) Objectives:	3 items	x 1 mark	= 03
			15

Answer books were assessed by the subject teachers as per the guideline given by the investigator.

STEP – 6: Analysis of Unit Test

Analysis of answer books was made by the subject teachers. Markwise analysis as well as errorwise analysis was made by the investigator with the help of subject teachers.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board and total marks were given to each student. Marks obtained by the students in unit test are shown in table 94 along with its frequency distribution in table 95.

Table – 94:

Marks of Unit Test

Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15	Roll No.	Marks Obtained Out of 15
1	Absent	19	5	37	11	55	7
2	2	20	12	38	1	56	Absent
3	3	21	3	39	2	57	2
4	7	22	3	40	0	58	13
5	6	23	10	41	11	59	Absent
6	Absent	24	2	42	3	60	Absent
7	9	25	12	43	0	61	1
8	14	26	Absent	44	0	62	9
9	2	27	14	45	4	63	11

10	6	28	1	46	7	64	9
11	12	29	0	47	Absent	65	10
12	5	30	1	48	8	66	13
13	10	31	7	49	0	67	6
14	0	32	Absent	50	1	68	12
15	6	33	5	51	2	69	1
16	4	34	1	52	Absent	70	5
17	0	35	0	53	0		
18	2	36	Absent	54	3		

Table – 95:

Frequency Distribution of Marks of Unit Test

Class	*f*
0 – 2	23
3 – 5	11
6 – 8	9
9 – 11	9
12 – 14	8
15 – 17	0
Total	**60**

Mean marks obtained by students is 5.4 out of fifteen marks. Students obtained 36% marks which showed poor performance in unit test knowledge, so necessary remedial actions were taken to enhance their knowledge regarding chapter.

(B) Error wise Analysis

Answer–sheets were assessed and analysed by the subject teachers as per the suggestions of the investigator. Detailed analysis on the basis of true (T), false (F), partly–true (PT) and not attempted (NA) is presented in following lines.

Q.1 (A) Solve the following sums:

(1) The radius and thickness of a circular gold medal are 4 cm and 0.5 cm respectively. The medal is melted and small spherical balls (i.e. beads) of radius 2 millimeters are made out of it. Find the number of balls thus obtained.

True	False	P.T.	N.A.
20 (33.33%)	11 (18.33%)	27 (45%)	2 (3.34%)

(2) The surface area of a sphere is $\frac{3168}{7}$ sq. cm. Find its volume.

True	False	P.T.	N.A.
16 (26.67%)	12 (20%)	26 (43.33%)	6 (10%)

(3) The curved surface area of a cone is 550 sq.cm. and its slant height is 25 cm. Find the volume of the cone.

True	False	P.T.	N.A.
4 (6.67%)	9 (15%)	43 (71.66%)	4 (6.67%)

Q.1 (B) Solve the following:

(1) The volume of a sphere is 4851 cu cm. Find its radius.

True	False	P.T.	N.A.
29 (48.33%)	18 (30%)	13 (21.67%)	0 (0%)

(2) The numbers representing surface area and the volume of a sphere are equal. Find its radius.

True	False	P.T.	N.A.
19 (31.67%)	9 (15%)	32 (53.33%)	0 (0%)

(3) The volumes of a sphere and a cone are equal. The radius of the sphere is 6 cm and the base radius of the cone is also 6 cm. Find the height of the cone.

True	False	P.T.	N.A.
7 (11.67%)	13 (21.67%)	40 (66.66%)	0 (0%)

Q.1 (C) Fill in the blanks so as to make each of the following statements true:

(1) The formula of the volume of one rupee coin is .....

True	False	P.T.	N.A.
23 (38.34%)	26 (43.33%)	11 (18.33%)	0 (0%)

(2) The volume of a hemisphere V = ...

True	False	P.T.	N.A.
36 (60%)	15 (25%)	9 (15%)	0 (0%)

(3) The volume of a sphere with radius π cm is ..... cu cm.

True	False	P.T.	N.A.
11 (18.33%)	24 (40%)	25 (41.67%)	0 (0%)

The errors were committed due to lack of:

1. Clear difference in the formulate of area and volume
2. Remembering formula
3. Placing proper values in the formula
4. Ability to simplify
5. Ability to write proper units

The errors on unit test were found as follows:

1) The students committed error in writing formula of a coin due to inability to recognize sphere and cylinder at small level.
   e.g. students think 1 re can is sphere as it is very thin but actually it is cylinder.

STEP – 7: Remedial Measures Based on Unit Test

On the basis of errors analysis as well as discussions with subject teachers, the guideline and suggestions were worked out, to improve and enhance the knowledge of the chapter "Volume".

The Concept of area and volume was clearly explained in different ways. We encouraged them to make models of cylinder, sphere and how to develop formulate from them was explained. The list of formulate was made and students were told to remember them. Different practical sums on volume were taken. The compulsion of writing units was made in the class till students were accustomed to write units themselves.

Group discussion was held to solve their difficulties. Teachers played guiding role during discussion.

Each student was given an answer book for self analysis and suggested to analyse where errors were committed. Students were suggested to practice at least five sums of the same method in which they failed to get full marks. To increase confidence the students were advised to solve all the sums asked at the S.S.C. Board examination and to solve the unit test paper again.

4.4.20 Counselling Sessions

The investigator held four counselling sessions to enhance the achievement and to provide necessary and important information regarding correlates to achievement which highly enables the students to enhance their achievements. In counselling session all the concepts derived from situation analysis were kept in mind while framing the counselling session, such as in the students' questionnaire. Majority of the students opined following aspects were important to enhance the performance in mathematics – pattern of writing answer book, requirement to improve handwriting, to enhance concentration, recalling method, revision planning, goal setting, mini nap for relaxation, positive thinking, removing examination fear, listening skill, speedy reading, writing and calculation, time management, how to study on the examination day, planning of three hours of examination, preparation of charts for important topics, examination tips, formation of good study habits.

Purpose of this counselling sessions was to improve and develop different skills, to reduce the stress and change the attitude towards mathematics and increase confidence in mathematics. Four counselling sessions were held, detailed contents of the counselling sessions like particulars, day, date and time duration are mentioned as under. Apart from this schedule group and individual counselling was provided as and when needed.

Table – 96:

Content and Schedule of Counselling Sessions

Sr. No.	Particulars and Components	Day, Date and Time Duration
1)	Positive Goal Setting – (a) Setting goal for marks in mathematics. (b) How to achieve the goal? (c) Positive thinking (negative to positive attitude for mathematics).	Wednesday 30th June, 2004 7:00 pm to 9:30 pm
2)	Relevant Skill Development – (a) Enhance Concentration. (b) Recalling Skill. (c) Revision Planning. (d) Listening Skill. (e) Speedy Reading, Writing and Calculation.	Wednesday 28th July, 2004 7:00 pm to 9:30 pm

	(f) How to improve handwriting. (g) Good habit formation regarding study (study habits).	
3)	Examination Skill Development – (a) How to study on the examination day. (b) Planning of three hours of examination and information related to it. (c) Importance of chart marking and notes of model sums. (d) Pattern of writing answer.	Wednesday 1st November, 2004 7:00 pm to 9:30 pm
4)	Stress Management – (a) Mini–nap (Short sleep). (b) Simple Relaxation technique. (c) Removing fear for mathematics. (d) Time management. (e) Deep Breathing. (f) Auto suggestions during breathing phases.	Saturday 4th December, 2004 7:00 pm to 9:30 pm

Description of the Counselling Sessions:

(1) Positive Goal Setting

In the first counselling session which was held for the students, the title of the counselling session was goal setting. In which the investigator discussed regarding positive thinking, with illustrations of how negative thinking affects the confidence and result. The investigator also asked the students to tell and guess their marks for the final achievement test. Investigator also explained to the students how higher expectation change the student's behaviour and working system for the subject. Further investigator asked the students few questions regarding their expectation and advised the students to ask the question regarding goal setting. After discussion the investigator explained the methodology to achieve the expected goal. By the end of the session the investigator made the students think positively for mathematics and told them to work hard to achieve the expected goal. Such practice was followed while teaching chapters.

(2) Relevant Skill Development

The title of the second counselling session was relevant skill development in which the investigator discussed regarding development of different skills which are necessary to enhance the achievement and

confidence. The investigator focused on study habits in which the investigator explained to the students how to prepare the subject mathematics. Investigator explained the concentration technique to the students and demonstrated in the classroom twice and asked to practice the same. The investigator explained recalling method in detail. Practice makes man perfect – on this line the investigator explained the importance of revision so that the students can practice the same matter frequently. The investigator explained about listening skill, speedy reading and calculation. The investigator gave information regarding handwriting improvement and explained by showing the answer books of the students with bad handwriting and good handwriting and advised the students to try to improve handwriting and art of writing to enhance the achievement. The investigator advised the students to ask questions regarding the topic of the session. Entire session was followed by fruitful discussion. Queries of the students were resolved. During teaching of chapters, these points were integrated.

(3) Development of Skill Related to Examination

The title of the third counselling session was skill related to examination in which the investigator started the session by saying fire the fear because if the students become fearless, they can score well. The investigator explained how to make a chart for different mathematical concepts to remember. The investigator also explained writing pattern by showing the student's model answer books written by students of class X. The investigator also explained how to work on the day of examination of mathematics, how much sleep one should take and what to revise on the day of examination. The investigator explained the need and importance of six hour's sleep during the examination days; students were provided a five hour revision plan for the day and advised to use the chart that they had made for all the chapters of mathematics for quick revision of examination. The students were explained in detail regarding answering essay type questions and typical sums. The investigator also explained to the students the planning of three hour's paper. Then the investigator asked the students for their questions regarding the topics of the session and the students asked some questions and the investigator explained the matter regarding the

questions. Development of skill was also stressed during teaching of chapters.

(4) Stress Management

The title of the fourth counselling session was stress management in which the investigator explained how stress affects the concentration and how lack of concentration affects the result of mathematics. So to minimise stress the investigator demonstrated some techniques like mini–nap (short sleep), relaxation technique and deep breathing. The investigator advised the students to practice the same technique. The investigator also explained by giving illustration how positive auto suggestions affect the behaviour and noted down some positive auto suggestions to give to their mind daily in the morning. For example, mathematics is an easy subject, now I am able to understand mathematics, my mathematics teacher is very co–operative, hard–work makes everything possible, everyday my interest is increasing in mathematics, etc. Time is a crucial matter, so the investigator explained to the students the importance of time because time is money. The investigator explained the benefits of using time in the best manner. In this way time management concept was given to the students and the students were advised to use their time in the best way for example. The session was followed by discussion. Doubts of students were resolved.

The investigator finally received a positive and appreciable feedback from the students and he also realized the positive effect of the above counselling sessions on the students' behaviour and study habits, the investigator observed that the students had increased their confidence in examination and examination fear was reduced. The students had tried better handwriting. The students made chart for the subject matter, the students also made recalling and concentration and relaxation technique twice in a week. In short, counselling session helped the students to enhance their confidence, reduce stress and fear.

4.4.21 Pilot Test

Investigator had kept in mind all the aspects which were necessary to make the programme more effective and interesting based on situation analysis. As well as the investigator also provided counselling regarding correlates of achievement and the pilot test was administered.

After completing the teaching of the nineteen chapters of Mathematics of class X and twenty days revision, the pilot test was conducted. The purpose of the Pilot Test was to locate the errors made by the students question wise, to locate the chapters in which the students were facing problems, to search out the kind of questions they were not able to attempt properly, to check their writing patterns, to check whether they were able to finish the question paper in time or not, to create confidence in writing and to frame the remedial revision plan and procedure for enhancing their achievement.

STEP 1: Administration of the Pilot Test

The pilot test was administered for the students who have attended the whole programme. There were sixty students who attended the whole programme. They appeared in the pilot test administered as on February 20, 2005. The pilot test paper was framed as per the blue print (Appendix) given by the Board. This test was of 100 marks. There were five questions of twenty marks each. Under personal supervision of the investigator the pilot test was administered in a peaceful atmosphere in two classrooms with well arranged sitting arrangement. The answer books of pilot test were assessed by the expert subject teacher as per the marking scheme given by the Board.

STEP 2: Analysis of the Pilot Test

Analysis of answer books was made by the subject teacher and mark–wise analysis as well as list of the content in which the students had made errors, were identified.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board. Question–wise marks and total marks out of 100 marks were noted on the

answer books. Details of the same are presented in Table 97 along with its frequency distribution in the Table 98.

Table – 97:

Marks of the Pilot Test

Roll No.	Q.1.	Q.2.	Q.3.	Q.4.	Q.5.	Total Marks
1	0	0	0	0	0	Absent
2	2	12	8	7	13	42
3	8	7	1	3	5	24
4	7	13	15	6	7	48
5	13	10	12	8	18	61
6	0	0	0	0	0	Absent
7	17	18	13	8	15	71
8	14	20	16	16	14	80
9	19	16	11	9	8	63
10	16	17	17	14	11	75
11	12	19	9	13	5	58
12	6	13	11	3	1	34
13	2	8	1	2	6	19
14	12	9	8	13	5	47
15	17	12	13	8	4	54
16	17	13	15	20	12	77
17	16	20	13	13	9	71
18	12	13	11	9	8	53
19	16	13	15	11	4	59
20	14 ½	15	16	11	11	68
21	16	18	17	17	17	85
22	14	16	12	11	7	60
23	15	18	9 ½	8	5 ½	56
24	11	13	6	5	12	47
25	10	13	0	5	8	36
26	0	0	0	0	0	Absent
27	9	13	10	4	4	40
28	12	8	9	6	5	40
29	17	15	15	17	2	66
30	16	19	12	4	2	53
31	18	15	16	8	10	67
32	0	0	0	0	0	Absent
33	12	10	3	4	6	35

34	13	11	9	12	0	45
35	3	15	8	2	4	32
36	0	0	0	0	0	Absent
37	6	11	13	10	4	44
38	12	17	10	16	5	60
39	13	18	8	13	11	63
40	12	14	5	9	12	52
41	9	13	11	9	9	51
42	14	14	11	7	15	61
43	12	14	9	2	3	40
44	8	3	5	4	1	21
45	13	4	1	0	4	22
46	8	10	4	2	2	26
47	0	0	0	0	0	Absent
48	10	8	4	0	2	24
49	11	12	7	5	2	37
50	8	12	7	9	0	36
51	12	11	8	15	2	48
52	0	0	0	0	0	Absent
53	11	11	8	5	2	37
54	12	11	8	10	8	49
55	15	12	15	12	9	63
56	0	0	0	0	0	Absent
57	11	9	5	5	7	37
58	14	16	14	4	8	56
59	0	0	0	0	0	Absent
60	0	0	0	0	0	Absent
61	11	12	7	8	3	41
62	7	11	14	5	8	45
63	16	14	6	2	8	46
64	10	15	11	9	9	54
65	11	10	12	12	6	51
66	15	14	12	10	12	63
67	19 ½	19	11 ½	18	13	81
68	16	13	12	14	13	68
69	13	10	5	5	6	39
70	11	15	10	13	8	57

Roll No. 1, 6, 26, 32, 36, 47, 52, 56, 59 and 60 were absent in the Pilot Test.

Table – 98:

Frequency Distribution of Marks of the Pilot Test

Class	Frequency
1 – 10	0
11 – 20	1
21 – 30	5
31 – 40	12
41 – 50	11
51 – 60	14
61 – 70	10
71 – 80	5
81 – 90	2
91 – 100	0
Total	**60**

Mean marks scored in mathematics of class IX was 39.17 and mean marks obtained by the students in the pilot test was 50.82 which showed improvement in performance in the pilot test. To further enhance their performance necessary remedial actions were taken by the investigator.

STEP 3: Remedial Measures Based on the Pilot Test

For enhancing achievement sixty students were divided into three groups on the basis of marks obtained in the pilot test.

Group 1: The students who obtained less than or equal to fifty marks in the pilot testing i.e. twenty nine students.

Group 2: The students who obtained fifty one marks to seventy marks in the pilot testing i.e. twenty four students.

Group 3: The students who obtained more than seventy marks in the pilot testing i.e. seven students.

After grouping, the students were given their answer–book for self–evaluation, students were given enough time for noting the chapter number and name as well as specific topic or type of sums which were not understood or had made mistakes. On the basis of above information as well as suggestions of paper assessor remedial teaching was provided for one week to each group, necessary counselling such as presentation method, handwriting improvement, relaxation technique, sequence of answering the question, etc. were provided. All the efforts were made group–wise.

Three question papers of S.S.C. Board Examination were solved in the class–room i.e. March 2000, March 2001 and March 2002 and two question papers of Board Examination i.e. March 2003 and March 2004 were given as homework. All difficulties were solved in the class–room to increase their confidence, to increase their speed and to increase their marks in the final achievement test.

4.5 EFFECTIVENESS OF THE PROGRAMME (PHASE IV)

4.5.1 Final Achievement Test

After developing and implementing the programme that is teaching nineteen chapters and conducting the pilot test, as well as providing counselling the final achievement test was administered by the investigator to study the effectiveness of the programme.

STEP 1: Administration of Final Achievement Test

The final achievement test was administered for the students who had attended the whole programme. There were sixty students who had attended the whole programme. The students appeared in the final achievement test administered on February 28, 2005. The final achievement test paper was framed as per the blue print given by the Board. This test was of 100 marks. There were five questions of twenty marks each in the final achievement test. Time duration was of three hours. Under personal supervision of the investigator the final achievement test was administered in a peaceful atmosphere in two classrooms with well arranged sitting arrangement. Answer books of the final achievement test were assessed by the expert subject teacher as per the scheme of the marks given by the Board.

STEP 2: Analysis of the Final Achievement Test

Mark–wise analysis of answer books was made by the subject teacher.

(A) Markwise Analysis

Each correct item was given full marks; partly correct answer was given a mark proportionately as per the scheme given by the Board. Question–wise marks and total marks out of 100 marks were written on the answer books. Question–wise and total marks obtained by sixty students in the final achievement test have been presented in the Table 99 along with its frequency distribution in the Table 100.

Table – 99:

Marks of the Final Achievement Test (Post–Test)

Roll No.	Q.1.	Q.2.	Q.2.	Q.4.	Q.5.	Total Marks
1	0	0	0	0	0	Absent
2	8	8	4	11	11	42
3	17	12 ½	6	10	12 ½	58
4	15	13 ½	12	11	8	60
5	16	16	11	10	10	63
6	0	0	0	0	0	Absent
7	11	13 ½	11 ½	11	17	64
8	13 ½	13 ½	13 ½	16	10	67
9	19	16 ½	16	17	8	77
10	19	20	10	15	18	82
11	18	13 ½	9 ½	11	5	57
12	6 ½	12	6 ½	8	9	42
13	12	7 ½	8	5	2	35
14	11	10 ½	1	7	9	39
15	13	14	12	10	6	55
16	18	16	15	12	8	69
17	17	16 ½	14 ½	14	17	79
18	19	15 ½	7	10 ½	14	66
19	19	8	14	14	11	66
20	17	15	12	13	15	72
21	17	15	15	17	15 ½	80
22	19 ½	13	15 ½	18	19	85
23	17	16	11 ½	11	9	65
24	6	11	11	12 ½	6	47
25	18	16	13	8	8	63
26	0	0	0	0	0	Absent
27	15	12	12	15	7	61
28	13	13 ½	14	11	10	62
29	18	14	19	13	9	73
30	17	18	14	12	15 ½	77
31	17	17 ½	11	9 ½	6	61
32	0	0	0	0	0	Absent
33	16	15	10 ½	3	7	52
34	12	17 ½	12	15	5	62
35	16	16	13 ½	8	8	62

36	0	0	0	0	0	Absent
37	10	7 ½	7 ½	9	9	43
38	17	15	9	13	14	68
39	11 ½	13	5	12	12	54
40	12	17 ½	12	11	12 ½	65
41	16	14	12	13	15	70
42	16	18	8	13	9 ½	65
43	17	11	4	8	6 ½	47
44	11	11	11	9	10	52
45	12	8	8	6	6	40
46	11	16	7	10	3	47
47	0	0	0	0	0	Absent
48	15 ½	11	4	2 ½	6	39
49	11	16	6	12 ½	8	54
50	17	16	7 ½	10	13 ½	64
51	17	13 ½	13	10	7 ½	61
52	0	0	0	0	0	Absent
53	18	17 ½	9	14	8	67
54	17	18	6	15	11	67
55	15	17 ½	8	4	9 ½	54
56	0	0	0	0	0	Absent
57	14	12	9	13	8	56
58	18 ½	18 ½	15	13	14 ½	80
59	0	0	0	0	0	Absent
60	0	0	0	0	0	Absent
61	18	17 ½	8 ½	9	16	69
62	19	16 ½	10	11	8 ½	65
63	13	12	7	12	11 ½	56
64	18	12	4	8 ½	11	54
65	18	13	10	12	10	63
66	14	13	11	9	11	58
67	18	18 ½	17	16 ½	19 ½	90
68	19	19	11	12	18	79
69	18	12	4	8 ½	11	54
70	14	15	9	10	12	60

Roll No. 1, 6, 26, 32, 36, 47, 52, 56, 59 and 60 were absent in the Final Achievement Test.

Table – 100:

Frequency Distribution of Marks of the Final Achievement Test (Post–Test)

Class	Frequency
1 – 10	0
11 – 20	0
21 – 30	0
31 – 40	4
41 – 50	6
51 – 60	15
61 – 70	24
71 – 80	8
81 – 90	3
91 – 100	0
Total	**60**

Mean marks obtained by the students is 61.33% which showed the improvement in performance in the final achievement test as compared to mean score of 50.82 in the pilot test.