Chapter I

INTRODUCTION

Background of the Study

The word "Mathematics" is derived from Greek word "mathema" which means knowledge, study, and learning. Mathematics is the study of topics such as quantity, numbers, structure, space and change. According to Eves (1990) "Mathematics is a gate and key of science. Neglect of mathematics word is injury to all knowledge. Since he who is ignorant of it can not know the other sciences or a thing of the world and worse man who are thus ignorance and so do not seek a remedy." Mathematics originated along with the origin of human civilization. Mathematics plays important role in the development of human civilization. Nothing can be done without taking consideration of mathematical figure. The modern science and technology stand on the foundation of applied mathematics. Mathematical activities directly or indirectly are related to daily life problem. Some main branches ofschool mathematics include arithmetic, algebra, geometry, and trigonometry. Other than arithmetic, geometry seems to be common area of school mathematics. It is also important area of mathematics whichlend spatial representation of mathematics.

Regarding geometry, Kelly and Ladd (1986, p.5-15) write “Geometry is one of the most useful and important branches of mathematics. It includes enormous range of ideas and can be viewed in many different ways. It has been interlocked with other subjects and different views of human activity. The basic ideas of mathematical system originated in geometry some twenty two or twenty three hundred years ago". About the development of Geometry N. Bulter and F.L. Weren(1941) mentioned “primitive people obtained their first knowledge of geometry from natural objects and later on from arts as well as needs that arose to understand and came of further the legacy of art, architecture, surveying, measurement etc. provided the stimulator the development of Sciences and similarly come into existence and provide a firm foundation for the science of geometry". According to NCTM, geometry is one of the content standards of school mathematics which is one of aims at developing spatial reasoning problem solving skills and communicating (Sellke, 1999). Furthermore, mathematics learning and teaching initiatives (MALATI) projects believes that geometry offers an excellent; context for learners to experience mathematical activity and that can be done at the primary and secondary levels (MALATI, 2005). "School mathematics curricula of Nepal have given emphasis on Geometry learning from the beginning of school curricula and Students understanding of intended geometric concepts at primary, lower secondary and secondary level"(Luitel, 2005).

School mathematics curriculum faces, serious dilemma when we come to geometry. Poor achievement and outdated curriculum have been major problems in geometry (Usiskin, 1982). Although geometry is a visual and interlinked subject in mathematics, it has not been made so an appealing subject as indicated by many studies. Among many reasons, lack of meaningful understanding of the geometry may have been one important factor contributing poor performance of students in geometry. Though we do not have much research based information of school students achievement in geometry, prevailing situation suggests that the condition is not satisfactory. To improve the existing situation of geometry teaching, it is necessary to know the existing condition of students thinking in geometry, more especially at lower levels of school geometry. The poor performance of students in geometry seems to begin from elementary grades as shown by many studies at lower secondary level of our curriculum; there are many basic concepts and skills to be thought to lay foundation of geometric thinking. Poor performance of students in geometry at higher grades might have need due to their poor performances at lower grades. Van Hiele model thinking in geometry has been found effective in dealing with students problems in geometry. According to the Van Hiele model of thinking (1951, 58) Students have not had sufficient experience at lower level to copy geometric experience at higher level. Many studies conducted on Van Hiele model have come to the similar conclusions regarding students thinking in geometry. The situation seems to be more frustration in case of our school students as reflected some studies and the experiences of mathematics teachers. Due to the lack of authentic information based on studies we have weakness ground to go for remedy. In such circumstance the researcher is interested to undertake this study which deals with Van Hiele level of geometric thinking among lower secondary students in geometry.

Statement of the Problem

Geometry is one of the important areas to be taught at lower secondary level. Teaching geometry is not an easy task. Due to traditional approach, did not know about level of thinking and curriculum. So the students' achievement low, not meaningfull understanding students in geometry teaching learning. VanHiele's Level ofGeometricThinking among Lower Secondary School Students in Geometry was attempt to assess the level of thinking in geometry of lower secondary school students.

Objectives of the Study

The study is done to attain the following objectives:

- To explore the Van Hiele's level of thinking of lower secondary school students in geometry.
- To find the relationship between achievement in geometry and Van Hiele's level of thinking.

Hypothesis

The following null hypotheses were tested in relation to objective no. 2:

- There is no difference between achievement of level 0 and level 1student in geometry.
- There is no difference between achievement of level 1 and level 2 students in geometry.

Significance of Study

The Van Hiele's level of thinking is new for classroom implication. This model is most important which has been found useful in assessing students thinking in geometry. The significance of the study lies on assessing Van Hiele level among lower secondary school students in geometry. The assignment of Van Hiele would indicate students' level of thinkingin geometry, which in turn would be used to find lapses and to recover them in teaching and learning geometry. This study helps to use different types of materials according to Van Hiele's level of thinking, improve the teaching strategies and improve the mathematics achievement of lower secondary level students.

Definitions of the Key Terms

Level of thinking: In this study, level of thinking refers to the thinking ability of the students according to the five levels based on the classification of Van Hiele.

Achievement: Achievement is defined as the scores obtained by the students in geometry test constructed and conducted by the researcher.

Delimitations of Study

The study was delimitated in the following aspects:

(a) This study was based on grade eight students of Community School of Bara district.

(b) This study was conducted in the area of geometry at lower secondary level.

(c) The study was limited to first three Van Hiele levels

Chapter II

REVIEW OF LITERATURE

The review of the literature may be a comprehensive inclusion of everything known as a given research topic and its related topics and a short summary of the literature most pertinent to the specific topic under study (Best and Kahn 2014:40). Similarly according to Kumar (2009), "A literature review provides researcher insights and basic ideas to carry out research successfully. While review the related literature researcher went through various written documents. Review of literature is an essential part of all studies. It is a way to discover what other researchers, in the similar area, have uncovered. A critical review of the literature helps the researcher to develop the understanding and insight into the present study. The review of related literature is an important source of further study of research task. The review of the related literature is presented under the two headings:

- Review of empirical literature
- Review of theoretical literature

Empirical Literature

Usiskin (1982) studied of "Van Hiele's level and achievement in secondary school geometry". He developed a multiple choice test to measure a student's Van Hiele's level of reasoning.It was intended to find out if these tests could at all predict student's achievement in geometry. Thepopulation for this study consists of all students in the United States enrolled in one-year geometry course. The sample studied consists of 2699 students enrolled in one-year geometry course in 13 schools. Schools were selected on the basis of meeting certain socio economic criteria. This study recommended that boys score was significantly higher than girls, level 5 does not testable. It was concluded that Van Hiele's level is very good predictor for multiple choice test of geometry content. Distribution of student among different level was; in level 0 a child recognizes a rectangle by its form, shape. In level 1, students analyze the component parts of figure. In level 2, students can establish interrelationships of properties within figure.

Genj (2006) conducted a study entitled "Determining High School Geometry students' Geometric Understanding Using Van Hiele Levels”the objective of this study was to find difference between standard-based curriculum and non-standard-based curriculum. For this study the researcher used participants, interview and task method. This study conducted in Provo. Using Van Hiele levels, this study examines 20 ninth-grade students of levels of geometric understanding at the beginning of their high school geometry course. Ten of the students had been taught mathematics using a Standards-based curriculum, the Connected Mathematics Project (CMP), during grades 6, 7, and 8, and the remaining 10students had been taught from a traditional curriculum in grades 6, 7, and 8. Students with a Connected Mathematics project background tended to show higher levels of geometric understanding than the students with a more traditional curriculum (NON cmp) background.

Atebe (2008) conducted a study entitled "Students Van Hiele's Level of Geometric Thought Conception in Plane Geometry". This study had three goals, out of which the main objective was to explore and determine the Van Hiele levels of geometric thinking of selected grade 10, 11, 12 learners in Nigeria and South Africa. Using both purposive and stratified sampling, 144 learners from 10, 11, and 12 in Nigeria and South Africa school and 6 mathematics teachers from Nigeria and South Africa were selected. The whole process of analyzing the classroom videos involved a consultative panel of 4 observers and 3 critical readers, using the checklist of Van Hiele phase descriptors to guide the analysis process. Concerning learners’ levels of geometric conceptualization, the results from this study revealed that the most of the learners were not yet ready for the formal deductive study of school geometry, as only 2% and 3% of them were respectively at Van Hiele levels 3 and4, while 47%, 22% and 24% were at levels 0, 1 and 2, respectively.

Connolly (2010) conducted a research work on" the impact of Van Hiele geometry instruction on student understanding." Its objective was to find out the impact of Van Hiele best geometry instruction on student understanding. Using inducting and deducting method he completed the study moreover. Forty-three students enrolled in the high school Regents Geometry course received instruction using the newly developed materials. The results of these students showed improvement over the results of the previous year's students under more traditional geometry instruction.

Watson (2012) Conducted a study entitled "A comparison of Van Hiele levels and final exam grade of students at the University of Southern Mississippi". In this study, the researcher used previously gathered information and spearman correlation to compare the correlation coefficient of 0.742. This research analyzed students final exam scores in a college mathematics class with geometric components and their Van Hiele levels upon entering the class. After the class was completed, each student's final exam grade was calculated. The researcher then reported that the results of the Van Hiele test are a major component in predicting a student's success in such a class.

Acharya (2016) conducted a research study on "Effectiveness of inductive method in teaching geometry at secondary level" using experimental method. The main objective of this study was to compare the achievement of the students in teaching geometry taught by inductive method with achievement of the student taught by deductive method. He selected school purposively there were 36 students in grade ix of Samundra Higher Secondary School Nuwakot. Achievement test, observation and interview were the major data collection tools. From this research he found that the mean achievement score of the students taught by inductive method was higher than the students taught by using deductive method. This study revealed that the inductive method could be more effective than the deductive method in teaching geometry at the secondary school level.

Kekana (2016) Conducted a study entitled "Using Geogebra in transformation geometry; investigation based on the Van Hielemodel” The aim of this study was to investigate on a small scale the potential of the use of Geogebra in teaching and learning of transformation geometry to grade 9 learners. Using mixed method for this research and 4 publics' schools selected by purposive sampling methods. Grades 9 learners were population for this study. Data collection tools were interviews, questionnaire, observation, and survey paper and pencil test. The results were indicated as the effect of the use of Geogebra is concerned; improved performance in transformation geometry was demonstrated.

Rizo (2016) Conducted a study entitled "The effect of using Van Hiele's instructional model in the teaching of congruent triangles in grade 10 in Gauteng high schools "the aim of the research work was to inquire the possible effect of teaching geometrical congruency using Van Hiele's instructional model. Grade 10 learners are population for this study and three randomly selected high schools in Gauteng formed the research field while intact groups of grade 10 learners in these schools formed the study participants (136 learners) for the study. Using mixed method for this research. Data collection tool were classroom test, (pre and post test) and video record and note pads. It was recommended that Van Hiele learning and instructional model be adopted and applied in the teaching of other areas of mathematics.

Theoretical Literature

Since Van Hiele model of thinking is taken as the theoretical basis of the study, the model has been reviewed in the respect of the study. The Van Hiele theory was developed in 1959 by two Dutch mathematics teachers: PiereVan Hiele and his wife Dina Van Hiele, Geldo based on their experience in classroom teaching of geometry in the Netherlands. TheVan Hiele theory is that children's understanding of geometric concepts can be characterized as being at a certain level within a range of hierarchical levels (Mayberry 1983).The Van Hiele concerned about the difficulties their students were having with geometry so they conducted research aimed at understanding children's levels of geometric thinking to determine the kinds of instruction that can best help children.

The Van Hiele model of geometric thinking consists of the following levels (Van Hiele, 1959).

Level 0: Recognition or Visualization

Level 1: Analysis or Descriptive level

Level 2: Informal Deduction or Order level

Level 3: Formal Deduction or logical Skills

Level 4: Rigor or Applied Skills

The Van Hiele model can be described as follows.

Level 0: Recognition or Visualization

It is initial level. Learners at this level recognize a geometric shape by its appearance alone (J.kalex 2012). Learners can identify name, compare geometric shapes such as triangles, square and rectangles in their visible form (Fusy, et. al.1988).

Level 1: Analysis or Descriptive level

Students at this level recognize/analyze figures by their properties or components, which are seen as independent of one another. Learners analyze the attributes and discover properties and rules through observation (Malloy, 2002). Learners can recognize and name properties of geometrics figures but they do not yet understand the difference between these properties and between difference figures (Van Hiele 1986).

Level 2: Informal Deduction or Order level

Learners at this level discover and formulate generalization about previously learned properties and rules and develop informal arguments to justify those generalizations (Molloy, 2002). Children not only think about properties but also able to notice relationships within and between figure. At this level children are able to formulate meaningful definitions and also children able to make and follows informal deductive arguments. (e.g. all squares are rectangle but not all rectangles are squares P.H. Van Hiele, 1959).

Level 3: Formal Deduction or Logical Skills

Learners at this level prove theorems deductive and understand the structure of the geometric system (Malloy, 2002). At this level children think about relationships between properties of shapes and also understand relationships between axioms definition theorems corollaries and postulates. They understand why it is needed (P.H.VanHiele, 1959)

Level 4: Rigor

Learners at this level can establish theorems in different systems and to analyze deductive system (Fusy,et. al. 1988, Malloy, 2002).They can also think in terms of abstracts mathematical systems. College mathematics majors and mathematics students are at this level (P.H.VanHiele, 1959).

Phases

According to Mary L.Crowley, (1987) the Van Hielephase of learning geometry given below:

Phase 1: Inquiry/ Information

At this initial stage, the teacher and students engage in conversation and activity about the objects of study for this level. Observations are made, questions are raised and level vocabulary is introduced (Hoffer 1983: 208). For example, the teachers ask students, "What is rhombus? A square?A parallelogram? How are they like? Different?The purpose of these activities is twofold: (1) the teacher learns what prior knowledge the students have about the topic, and (2) the students learn what direction further study will take.

Phase 2: Directed Orientation

The students explore the topic of study through materials that the teacher has carefully sequenced. These activities should gradually revel to the student the structures characteristics of this level. For example the teacher might ask students to use a Geoboard to construct a rhombus with equal diagonals, to construct another that is larger, to construct another that is smaller.

Phase 3: Explication

In this phase, building on their previous experiences, students expresses and exchange their emerging views about the structure that have been observed. Other than to assist students in using accurate and appropriate language, the teachers' role is minimal. It is during this phase that the level's system of relations begins to become apparent.

Phase 4: Free Orientation

In the phase ,the students encounters more complex tasks – tasks with many steps ,tasks that can be completed in several ways , and open-end tasks "they gain experience in finding their own way or resolving the tasks.

Phase 5: Integration

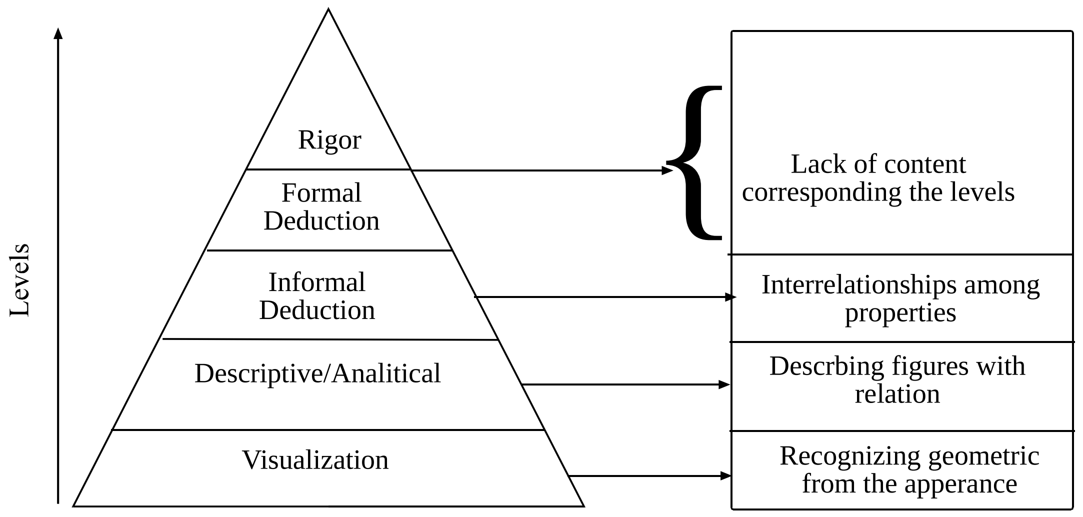
It is last phase. In this phase, students review and summarize what they have learned with goal of forming an overview of the new network of objects and relations. And students have attained a new level of thought .The new domain of thinking replaces the old and students are ready to repeat the phases of learning at the next level.

Implication of the Review for the Study

Determining and reviewing the related literature is the central and most important task for researcher in any research activity. It helps the researcher to bring the clarity on research problem and to improve in some intend methodology. From the above review the researcher found that boys score is higher than girls (i.e.sex), all level are not testable and also Van Hiele level is very good predictor for multiple choice test of geometry content (Usiskin, 1982). Teaching geometry is more effective if we use newly teaching materials by going through the research (Connolly, 2010).From Rizo (2016) Van Hiele learning and instructional model be adopted and applied in the teaching of other areas of mathematics. The above mentioned evidences show that teaching strategies are significant to make teaching and learning effective. The research projects carried out in the similar area commensurable to this study. Thus the above reviews became very helpful for this study because those reviews made clear about the methodology and theoretical framework.

Conceptual Framework

Conceptual framework is the plan or specific frame on which the whole study is based upon the basis of the review of related literature and in the reference of the aims and objective of the study; the first three Van Hiele levels seem to address the conceptual frame work of the study. The first three levels which match more to the lower secondary geometry course in school mathematics seem to address the problem as considered by the researcher for the study. This is why exploring Van Hiele levels among lower secondary students in geometry come to become the basis of conceptual framework. The following diagram is constructed to show relationship between Van Hiele levels and their characterizing feature of lower secondary geometric thinking.



Van Hiele Levels: Student's Performance at van Hiele Levels

Chapter III

METHODS AND PROCEDURES

This chapter represents the methods and procedures of the study so as to achieve the objectives of the study. This chapter explains about the design of the study, process of sampling, construction and validation of tools, implementation of the tools and collection and interpretation of data.

Design of the Study

According to Selltiz (1962) a research design is arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy. So, a research design is a plan of a researcher which helps him to carry out a research successfully. The researcher has adopted survey research deign for this study. The survey design is used when the population is both large and information is needed from wider sample. This survey design is applied to assessVan Hiele's level of geometric thinking among lower secondary school students in geometry.

Population of Study

Population is any group of individuals that has one or more characteristics common and that are of interest to the researcher (Best and Kahn, 2014) and the common characteristics common to all the students. All the grade eight students of Bara district were population of the study.

Sample of the Study

A sample is small proportion of the population that is selected for observation and analysis (Best and Kahn, 2014). That is portion of the population and representative of the population from which it was selected. According to District Education Office Bara, Fiscal Year -2074, there was 65 lower secondary schools and

2066 students. From every election region, 2 lower secondary schools were selected by random sampling method. Selecting in such a way sample schools (See Appendix- A) and 268 students (See Appendix- B) were selected for this study. A small sample was taken proportionally for the purpose of conducting interviews.

❖ Construction of the Tools

The types of tools to be used in any research largely depend on the already specified objectives of the study. The following instruments were developed to collect data for this study:

Construction of Van Hiele Geometry Test (VHGT).

Van Hiele Geometry Test of 35 minutes consisting of multiple choice items were constructed from the lower secondary geometry contents based on first three Van Hiele levels (i.e. visualization, analysis and informal deduction). The test was constructed on the basis of Van Hiele descriptors and level based indicators of the Van Hiele levels. The test consisted of 24 multiple choice items (See Appendix- C) on first three Van Hiele level.

Validation of Van Hiele Geometry Test (VHGT)

Validity is that quality of a data gathering instrument or procedure that enables it to measure what it is supposed to measure (Best and Kahn, 2014). For establishing validity, the items were constructed from lower secondary geometry course focusing more on the grades 7 and 8 on the basis of level descriptors and the validation was established by consulting with the experts.

Reliability

Reliability is the degree of consistency that the instrument or procedure demonstrates whatever it is measuring, it does so consistently (Best and Kahn, 2014). The VHGT was administered to 35 eight grade students. To establish reliability of the test, the researcher used split half method. The work involved in the calculation of split-half reliability is shown in appendix-E and the reliability was found 0.62. This is supposed to be satisfactory reliability.

Construction of Geometry Test

Geometry test was constructed to assess students' achievement in geometry. It was a traditional achievement test based on lower secondary geometry course focusing more on the content of 7^{th} and 8^{th} grades. The test was constructed according to content specification of the scope and sequence chart of curriculum development centre. It consists of 24 multiple choice items(See Appendix- F).

Validation of Geometry Test

For establishing validity the tests was constructed on the basis of the scope and sequence chart of the curriculum and on the basis of text representation of the content details.

Reliability

To establish reliability the researcher used split half method. The work involved in the calculation of split-half reliability is shown in appendix-H and the reliability was found to be 0.63. This is supposed to be satisfactory reliability.

Item Analysis

The researcher VHGT and geometry Test administered for pilot test among 35 students of Shree AnupDipani Higher Secondary School, kolhabi Bara. The upper 27% of higher score i.e. higher score of ten students and the lower 27% of the scores i.e. the ten lower students were selected to item analysis.

Difficulty level (P) = $\frac{R}{T} \times 100$

Where R = Number of examine who gave correct answer

T = Total number of examinee

$$\text{Discrimination index (D)} = \frac{U_R - L_R}{U_N \text{ or } L_N}$$

Where

U_R = Number of correct response from 27% of upper scoring students

L_R = Number of correct response from 27% of lower scoring students

U_N = Total number of 27% of upper scoring students

L_N = Total number of 27% of lower scoring students

Administration of the Tools and Data Collection

The administered of the tools and data collection procedure has been made under the following headings:

Administration and data collection procedure for VHGT

First of all, the researcher selected 8 community lower secondary schools by random sampling method. Then the researcher visited the head and the subject teacher of the school, so as to get support for the administration of the tools. After that the researcher was administered VHGT at all the selected students of the sample schools as shown in the schedule (Appendix-A). Then the researcher was collected that tests from the students and analyze.

Administration and data collection procedure for geometry test

Similarly, the researcher visited the head and the subject teacher of the school, so as to get support for the administration of the tools. After that the researcher was administered VHGT to at all the selected students of the sample schools. Then the researcher was collected that tests from the students and analyze.

Data Analysis and Interpretation

Data Analysis and Interpretation has been made under the following headings:

Data analysis and interpretation of VHGT

The data on the test (level based test) was scored and analyzed by using the scheme adopted by Usiskin and Senk (1982,1989). Since there are 8 items on each level, 5 of 8 correct were taken as success criterion for each individual. The calculated data was analyzed and interpreted using simple statistical techniques. The mean, percentage, standard deviations were used for analysis of data. The collected data was also analyzed and interpreted with the help of statistical devices i.e. bar-diagram and table.

Data analysis and interpretation of geometry test

Geometry test was constructed to assess students' achievement in geometry. It was a traditional achievement test based on lower secondary geometry course focusing more on the content of 7^{th} and 8^{th} grades. Geometry test analyzed by geometry mean score based on fit student in each level. Students mean geometric scores among adjacent Van Hiele levels by using t- test at 0.05 level of significance.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF THE DATA

This chapter deals with the analysis and interpretation of the data. This is a survey research related to explore the Van Hiele's level of geometric thinking and its relationship to geometry achievement among lower secondary school students geometry. The data were collected from the eight lower secondary schools (See Appendix- A) of Bara district. The calculated data were tabulated and analyzed according to the objectives of the study. The collected data were analyzed under the following headings:

- Distribution of students on different Van Hiele Levels
- Distribution of boys and girls on Van Hiele Levels
- Students Geometry Test Achievement on different Van Hiele Levels
- Comparison of students geometry achievement between adjacent Van Hiele Levels

Distribution of students on different Van Hiele levels

Van Hiele geometry test designed by the researcher was administered to 268 eight grade students of the eight selected lower secondary schools to obtain their achievement scores. The scores were sub- divided into the three Van Hiele levels. The answer sheets were scored and students were assigned Van Hiele Levels according to success criterion (5 of 8 success criterion). To be at some level, a student should meet success criterion of that level and success criterion of all preceding level/levels. Students not fitting in such a scheme are said to be unfit. Assigning Van Hiele levels in such a way, the following results were obtained. Out of 268 students on which the test was administered, 232were found to be fitted and 36 were unfit in level scheme. The distribution of students into Van Hiele levels has been given in table 4.1.

Table 4.1: Distribution of students at each Van Hiele Level

Level	No. of students	Percentage (out of fit)
0	166	71.5%
1	47	20.3%
2	19	8.2%
Total fit	232	100%
Unfit	36	
Total number of students taken Van Hiele test	268	

Out of the 268 students taking Van Hiele geometry test a total of 232 (86.6%) learners were assignable at various Van Hiele level, while 36(13.4%) of them did not fit this classification scheme. The table shows that out of the fitted students about three quarters were at visual level (level 0) about one fifth among them attained descriptive/analytic level (level 1), and only less than one- tenth of total fitted attained to level of informal deduction (level 2). Such distributions of students show that majority of elementary school students were found at visual level. Such results seem to follow the result of other Van Hiele geometry tests in placing students at different levels. So as to facilitate comparison in the distribution of students at different levels, the following diagrammatic presentation (diagram 4.1.1) has been made.

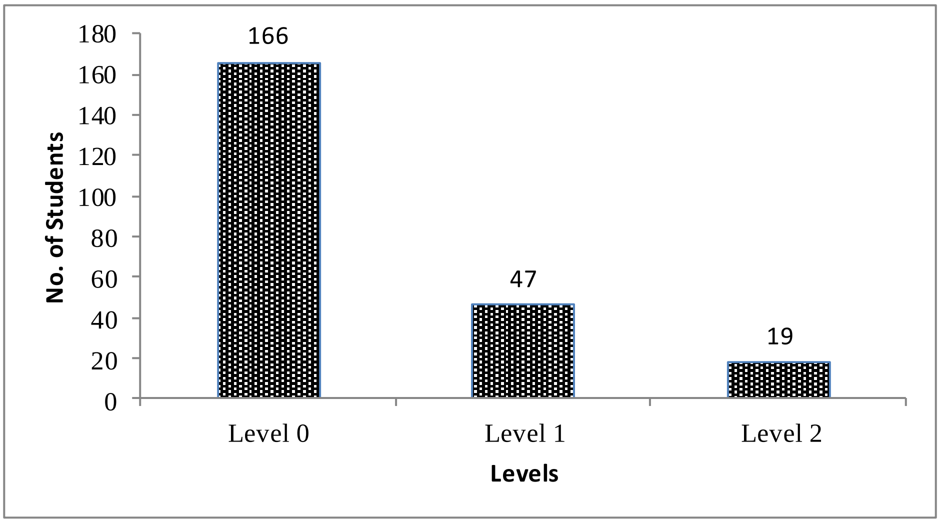


Figure 4.1.1: diagrammatic presentation of distribution of students of different Van Hiele levels. The table shows that out of 268 students who took the test 232 students fitted at different Van Hiele Levels and 36 students were found to be unfit to the success criterion. The table shows distribution of students on three Van Hiele levels. As shown in the table, the number of students decreases when the students move to upper levels. There were 166 students(71.5%) at level 0, 47 students (20.3%) at level 1 and 19 students (8.2%) at level 2.

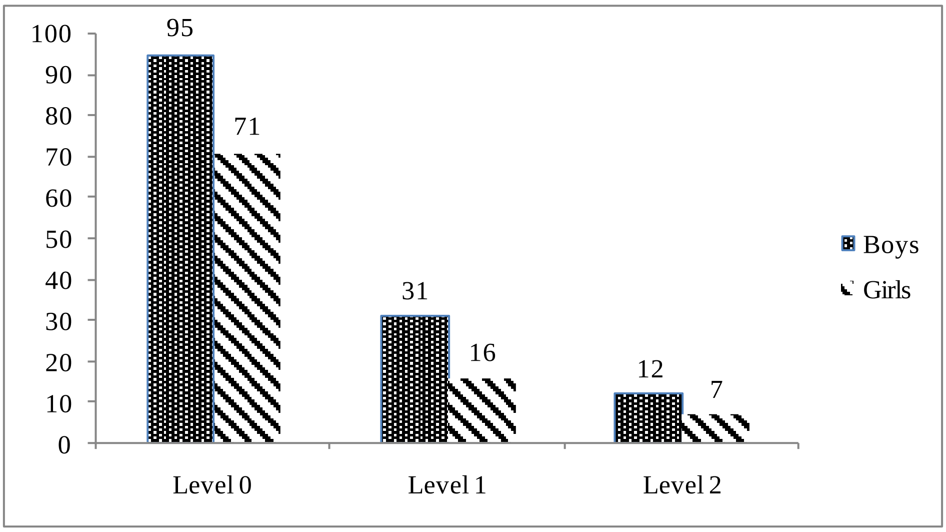
Distribution of boys and girls on Van Hiele Levels

Out of 268 students who took the Van Hiele test, 148 were boys and 120 were girl students. Out of 148 boy students on which the test was administered, 138 were found to be fitted and 10 were unfit in level scheme. Out of 120 girl students on which the test was administered, 94 were found to be fitted and 26 were unfit in level scheme. The distribution of boys and girls student into Van Hiele levels has been given in table 4.2.

Table 4.2: Distribution of boys and girls on Van Hiele Levels

Level	No. of boys and their percentages	No. of girls and their percentages
0	95 (68.8%)	71 (75.5%)
1	31 (22.6%)	16 (17%)
2	12 (8.6%)	7 (7.5%)
Total fit	138(100%)	94 (100%)
Unfit	10	26
Total number taking VHGT	148	120

The table shows that for both boys and girls majority of students were limited at visual level (68.8% of boys and 75.5% of girls) and the rest were at the levels 1 and 2. Slightly higher percentage of boys attained level 1(descriptive/analytic level) and level 2 (informal deduction) than that of girl students. On the whole majority of students (whether boys or girls) were found to be at basic Van Hiele level (level 0) and only less than one- third were found at level 1 and level 2 with less than one-tenth at level 2 where students can make inferences and informal deduction reasoning. The above information is represented diagrammatically by the following bar diagram:



Students Geometry Test Achievement on different Van Hiele Levels

To examine to what extent Van Hiele levels can be used to make basis for describing students' achievement in geometry. Students' scores on geometry test were categorized into the three categories:

I. Geometry test scores for level 0 students

II. Geometry test scores for level 1 students

III. Geometry test scores for level 2 students

To make comparison of students' geometric achievement among different Van Hiele levels mean scores were computed at each Van Hiele levels the summary of which is presented in the following table (table 4.3).

Table 4.3: Van Hiele Levels and geometry achievement

Level	No. of students	Mean score in Geometry Test
Level 0	166	17.1
Level 1	47	19.5
Level 2	19	20.2
Total (fit)	232	

The Table shows that students mean score in geometry test increases for higher Van Hiele levels. The mean score for level 0 was 17.1 and it was 19.5 for level 1and 20.2 for level 2.

Comparison of students' geometry achievement between adjacent Van Hiele Levels

To examine whether students achievement in geometry at higher Van Hiele level increases significantly or not, comparisons have been made in students mean geometric scores among adjacent Van Hiele levels by using t- test for independent samples. The summary of the work involved is given in the following table.

Table 4.4: Comparison Geometry Achievement of students between levels 0 and1

Level	No. of students	Mean score	Standard deviation	t- value
Level 0	166	17.1	2.69	10.9
Level 1	47	19.5	0.67	

The table shows that the difference in mean scores between level 1 and level 0 (19.5 – 17.1 = 2.4) is found to be statically significant at 0.05 (It is significant even at 0.01 level). This shows that the null hypothesis is significance difference between achievement of level 0 and level 1. Hence its alternative hypothesis is accepted.

Table 4.5: Comparison Geometry Achievement of students between levels 1 and 2

Level	No. of students	Mean score	Standard deviation	t- value
Level 1	47	19.5	0.67	5.3
Level 2	19	20.2	0.46	

The table shows that the difference in mean scores between level 1 and level 2 (20.2 – 19.5 = 0.7) is found to be statically significant at 0.05 (It is significant even at 0.01 level). This shows that the null hypothesis is significance difference between achievement of level 1 and level 2. Hence its alternative hypothesis is accepted.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter deals with the summary, major findings, conclusion and recommendations.

Summary

The design of the study was survey. The main purpose of the study was to explore measure Van Hiele's level of geometric thinking among lower secondary school students in geometry. In order to achieve the objectives, the researcher constructed VHGT and geometry test mainly based on eight grade mathematics text .The tests were piloted in Shree Anup Dipani Higher Secondary School, kolhabi, Bara and the interview which was piloted on five selected grade eight students. Finally VHGT and Geometry test contains 24 multiple choice items which were administered to the 268 sample students on basis of the data obtained from the tests analysis and interpretation were made in chapter iv. On the basis of those analysis and interpretations the following findings and conclusion have been drawn.

Findings of the study

On the basis of analysis and interpretation of the collected data, the major findings of the study are presented according to the following headings:

Finding based on VHGT

On the basis of analysis of the data obtained from the VHGT and Geometry Test the following finding were listed:

- Out of 268 students 232 students were found to be fitted and 36 were unfit in level scheme.
- The distribution of students on the first three Van Hiele levels were found to be 166(71.5%) at level 0, 47 (20.3%) at level 1 and only 19

(8.2%) at level 2. The distribution shows that the majority of the students were found to be at visual level of thinking.

- In terms of gender the boys were found to be 95(68.8%), 31(22.6%), and12(8.6%)respectively at the levels 0, 1 and 2.
- Similarly girls' were found to be 71(75.5%), 16(17%), and 7(7.5%)respectively at the levels 0, 1 and 2.

Finding based on Geometry Test

- Achievement mean score of geometry test were 17.1, 19.5 and 20.2 in level 0, level 1 and level 2 respectively.

Finding on the Relationship between VHGT and Geometry Test Achievement

- The geometry mean scores for level 1 was greater than that of level 0 and the mean score level 2 was greater than that of the level 1 which shows that the average scores increase for higher Van Hiele levels. Such situation supports Van Hiele hierarchy in the levels of thinking.
- Further, the difference in mean scores of adjacent levels (levels 1 and 0; and 2 and 1 were found to be statistically significant at 0.05 level). Such situation indicated that the Van Hiele level descriptors were found to be descriptors for geometric achievement of elementary schools students.

Conclusions

Based on the above findings, the following conclusion was drawn:

On the basis of the Van Hiele Geometric Test (VHGT), eight grade students were found to be limited to first three Van Hiele levels in which majority (about three – fourth) were limited to visual level of thinking. Both boys and girls followed similar pattern in hierarchical thinking. The higher scores of students in geometry (on the average) for students at higher Van Hiele levels indicated that the Van Hiele levels were found to be descriptors for students' achievement in geometry.

Recommendations

On the basis of above findings and conclusions, the following recommendations are presented:

- The findings of the study indicate that 71.5%, 20.3% and 8.2% students of grade eight were success in level 0, level 1 and level 2. Since this study was limited in many respects a larger sample covering verities of schools and students including many grades might be useful to explore Van Hiele levels for schools students.
- The mathematics teacher should be encouraged to use Van Hiele's approach in teaching geometry.
- The teacher guides writers should be written to emphasized on Van Hiele's approach in developing sample activities in particular area in teaching.
- VanHiele levels and phased should be incorporated in developing curricular materials, including texts and tests.

Recommendation for further Study

The researcher has been found the following Recommendation for further study:

- Similar study can be replicated in primary level and secondary level.
- Similar studies can be replicated among students of different social and cultural backgrounds.

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Appendix – A

List of sample schools

S.N	Name of schools	No. of students			Election region No.
		P	A	T	
1	Shree Nepal Rastriya Lower Secondary School, Bagewa, Bara	34	3	37	1
2	Shree Nepal Rastriya Lower Secondary School, Sinhasni, Bara	43	2	45	
1	Shree Nepal Rastriya Lower Secondary School, Madhuri Jabadi, Bara	33	5	38	2
2	Shree Nepal Rastriya Lower Secondary School, Bagdampur, Bara	57	4	61	
1	Shree Nepal Rastriya Namuna Lower Secondary School, Kalaiya, Bara	21	3	24	3
2	Shree Nepal Rastriya Lower Secondary School, Baghawan, Bara	38	3	41	
1	Shree Thani Lower Secondary School, Khairwa, Bara	30	5	35	4
2	Shree Nepal Rastriya Lower Secondary School, Amlekhganj, Bara	12	9	21	
Total	8	268	34	302	4

Source: DEO Bara 2074

Note: T = Total, A = Absent, P = Present

Appendix – B

Distribution of Boys and Girls

Election region	Boys	Girls	Total
1	47	30	77
2	58	32	90
3	28	31	59
4	15	27	42
Total	148	120	268

Source: DEO Bara 2074

Appendix – C

Van Hiele Geometry Test (VHGT)

lgb{]zgx?

1. of] k/LIf0f kq vf]Ng geg] ;Dd vf]Ng' x'Fb}g .

2. s[kof vfnL 7fpFdf pko'Qm ;"rgf eg{'xf];\ .

ljBfnosf] gfd M

gfd M

pd]/ -jif{df_ M lnË M s]6f ▢ s]6L ▢

sIff M

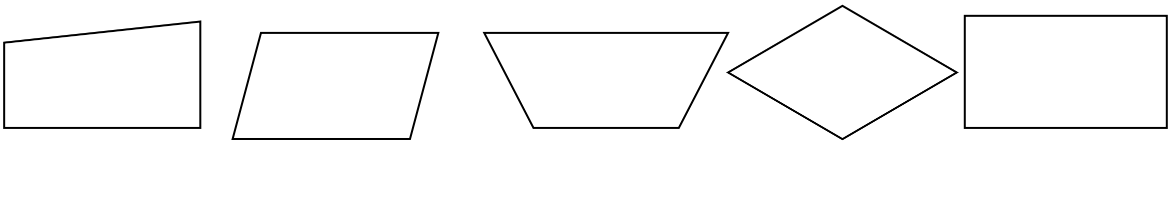
qmdfª\s

of] j:t'ut k|Zgkq xf] h;df @$ cf]6f ax'j}slNks k|Zgx? 5g\ . k|To]s k|Zgsf] kfFr cf]6f ljsNkx? lbOPsf] 5 . h; dWo] Pp6f dfq ;xL ljsNk 5 . k|To]s k|Zgx? Wofg k"j{s k9]/ o; pQ/ k'l:tsfdf /x]sf ;DalGwt k|Zgsf] ;xL ljsNkdf -✓_ lrgf] nufpg'xf];\ .

Time: 35 min

Group 'A'

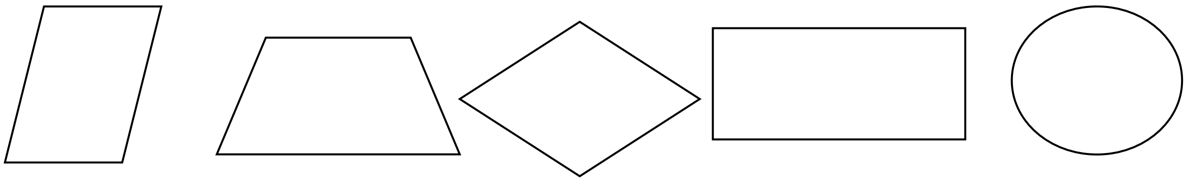
!= tn lbOPsf lrqx? dWo] s'g cfot x'g\ <



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

a)lrq (i) b) lrq (ii) c) lrq (iii) d) lrq (iv) e) lrq (v)

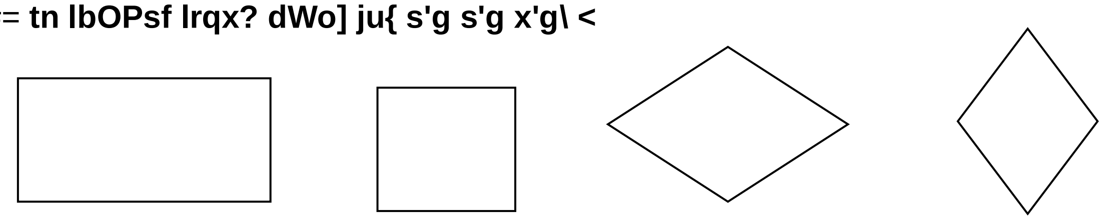
@= tn lbOPsf lrqx? dWo] s'g ;dafx' rte{'h x'g\ <



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

a)lrq (i) b) lrq (ii) c) lrq (iii) d) lrq (iv) e)lrq(v)

#= tn lbOPsf lrqx? dWo] ju{ s'g s'g x'g\ <

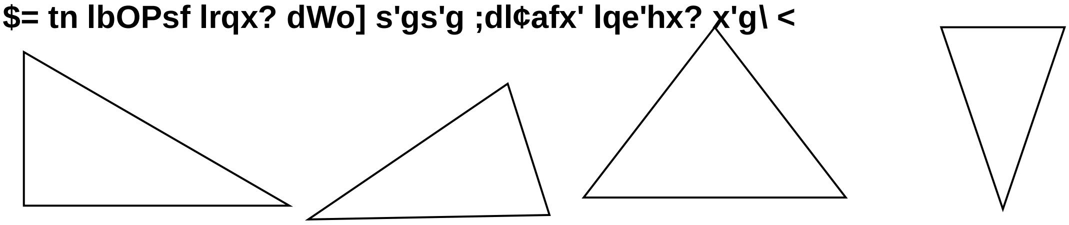


(i) (ii) (iii) (iv)

a)lrq (i) dfq b) lrq (ii) dfq c) lrq (i) / (ii) dfq

d)lrq(ii) / (iv) dfq e) lrq (iii) / (iv) dfq

$= tn lbOPsf lrqx? dWo] s'gs'g ;dl¢afx' lqe'hx? x'g\ <

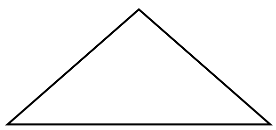


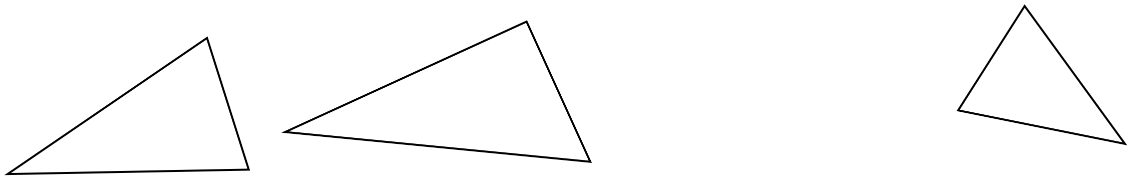
(i) (ii) (iii) (iv)

a)lrq (i) dfq b) lrq (i) / (ii) dfq c) lrq (ii) / (iv) dfq

d) lrq (ii) -u_ / (iv) e) lrq (iv) afx]s ;a}

%= tnlbOPsf lrqx? dWo] s'g s'g ;dsf]0f lqe'hx? x'g\ <+



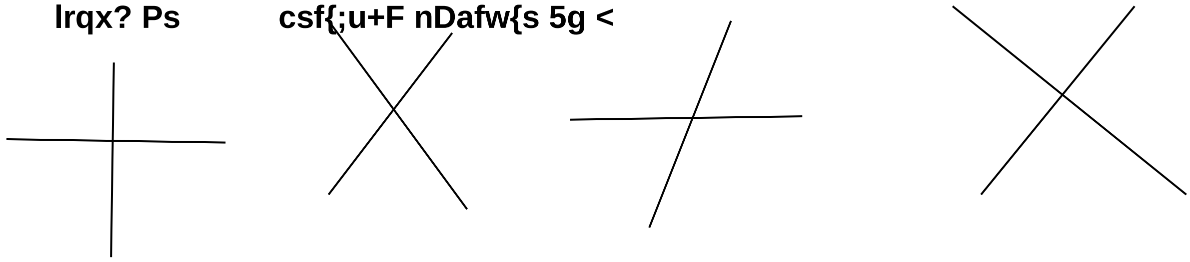


(i) (ii) (iii) (iv)

a)lrq (i) dfq b) lrq (ii) dfq c) lrq (iii)

d) lrq (i), (iii) / (iv) e) lrq (iv) afx]s ;a}

^= tn lbPsf lrqx?df b'O{cf]6f /]vfx? Ps cfk;df sfl6Psf 5g h;dWo] s'g s'g lrqx? Ps csf{;u+F nDafw{s 5g <

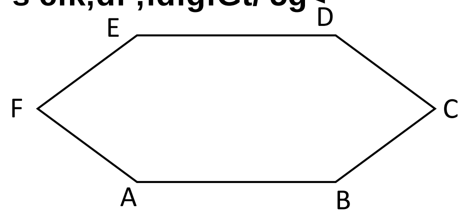


(i) (ii) (iii) (iv)

a)lrq (i) dfq b) lrq (ii) dfq c) lrq (iii)

d)lrq (i) / (iv) e)dflysf ;a}

&= ABCDEF**Pp6f ax'e'h xf] ,o;sf s'g /]vfv08x? Ps cfk;df ;fdfgfGt/ 5g<**



a) AB / CD b) BC / DE c) AB / DE

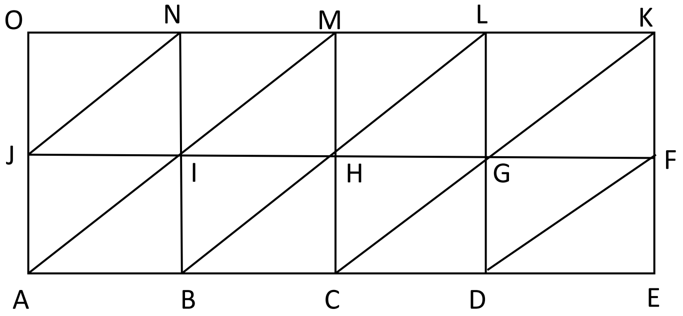
d) BC / FA e) dflysf s'g} klg xf]Og\

***= lbOPsf] ;+/rgfdf s'g Pp6f ;fdfgfGt/ rt'e{'h xf] <**

a) ABHM b) ACHI

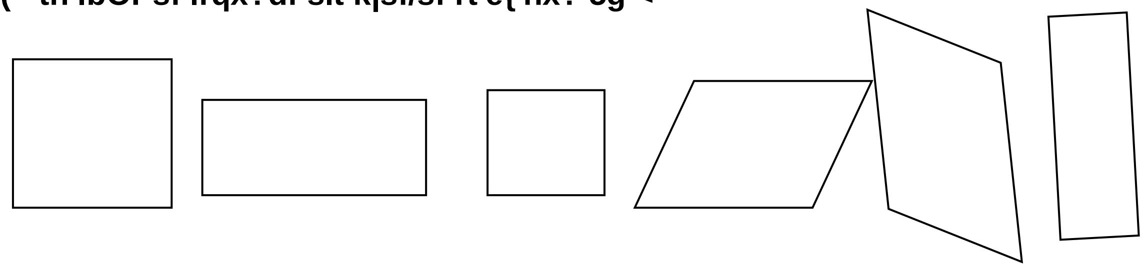
c) ACGI d) BCGI

e) BCGL



Group 'B'

(= tn lbOPsf lrqx?df slt k|sf/sf rt'e{'hx? 5g <



a) @ b) # c) $ d) % e) ^

!)= tn lbPsf dWo] s'g rt'e{'hsf u'0fx? xf]O{g <

a) ljkl/t e'hfx/ a/fa/ x"G5g . b) ljkl/t sf]0f]x? a/fa/ x'G5g . c)ljs{0fx? a/fa/ x"G5g .

d) cf;Gg e'hfx? a/fa/ x'G5g . e) ;a} sf]0fx? a/fa/ x'G5g .

!!= olb rt'e'{sf]

(i) ;a} e'hfx? a/fa/ (ii) ;a} sf]0fx? a/fa/ / (iii) k|To]s sf]0f ;dsf]0f

5eg] To;tf] rt'e'{hnfO{ elgG5 <

a)cfot b);fdfgfGt/ rt'e'{h c);dafx' rt'e'{h d) ju{ e) ;dnDa rt'e'{h

!@= **lbO{Psf rt'e'{hx? To:tf 5g h;sf**

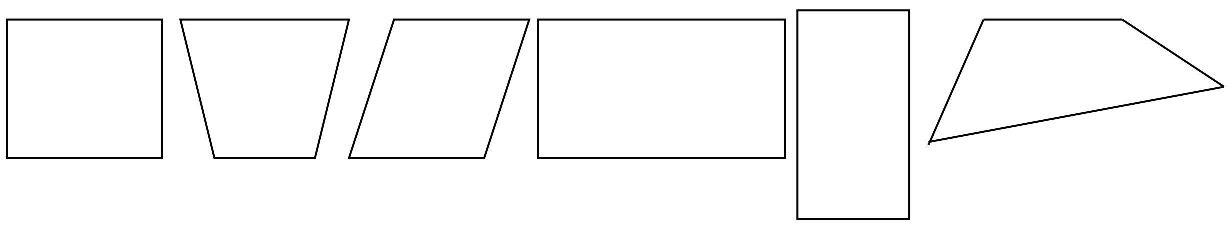
(i) ljkl/t e'hfx? ;fdfgfGt/ (ii) ljkl/t e'hfx? a/fa/ /

(iii) ljkl/t sf]0fx? a/fa/ t/ ;dsf]0f 5}g **eg] To:tf rt'e'{hnfO{ elgG5 <**

a)cfotb);fdfgfGt/ rt'e'{h c);dafx' rt'e'{h d) ju{ e) ;dnDa rt'e'{h

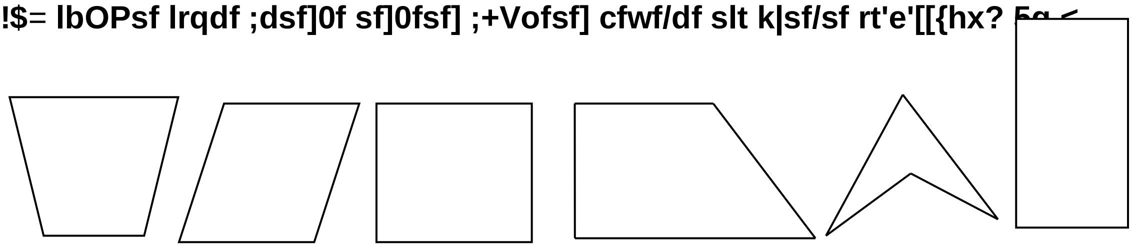
!#= **lbOPsf lrqdf ;fdfgfGt/ e'hfx?sf] ;+Vofsf] cfwf/df slt k|sf/sf rt'e'{hx/? 5g**

<



a) @ b) # c) $ d) % e) ^

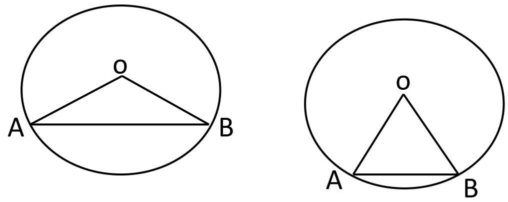
!$= lbOPsf lrqdf ;dsf]0f sf]0fsf] ;+Vofsf] cfwf/df slt k|sf/sf rt'e'[[{hx? 5g <



a) @ b) # c) $ d) % e) ^

!%= O j[tsf] s]Gb|ljGb' xf], A /B j[tsf] kl/lwdf b'O{j6f ljGb'x? 5g eg] lqe'h

AOB**nfO{ s]elgG5<**



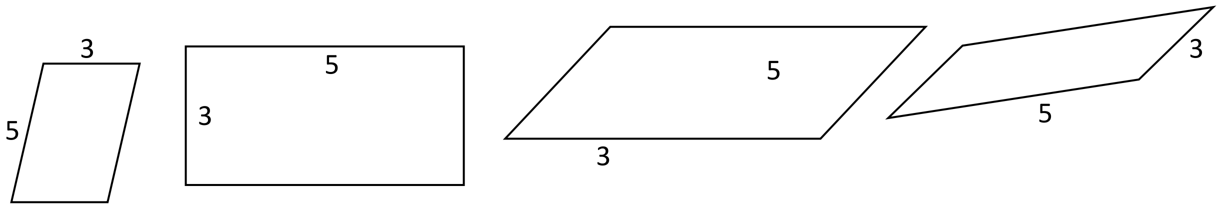
a)lj;dafx' lqe'h b) ;dafx' lqe'h

c) ;dl¢afx' lqe'h d) ;dl¢afx' lqe'h / ;dafx' lqe'h

e)dflysf s'g} klg xf]Og .

!^= lrqdf e'hfsf] nDafO{ lbOPsf 5g, lbOPsf dWo] cf;Gg e'hfsf] nDafO{ # /

% nfO{ u'0fg ubf{ -# x % =!%_ lf]qkmn lbg] lrq s'g xf] <



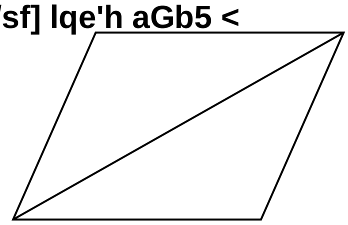
(i) (ii)(iii) (iv)

a)lrq(i)b) lrq (ii)c) lrq (iii) d) lrq (iv)

e)dflysf ;a} lrqdf # x % = !% x'G5

Group 'C'

!&= s'g} ;dafx' rt'e'[{hsf] ljs{0f hf]8bf s'g k|sf/sf] lqe'h aGb5 <



a)lj;dafx' lqe'h b) ;dafx' lqe'h dfq

c) ;dl¢afx' lqe'h dfq d) ;dl¢afx' jf ;dafx lqe'h

e) dflysf s'g} klg xf]Og\

!*= tn lOO{Psf dWo] s'g ;DaGw ;dfgfGt/ rt'e'{h / cfot aLr ;xL xf] <

a) ;a} cfotx? ;dfgfGt/ rt'e'{h x'G5g . b) ;a} ;dfgfGt/ rt'e'{hx? cfot x'G5g .

c)s]xL cfotx? dfq ;fdfgfGt/ rt'e'{h x'G5g . d) TofxfF cfot x'b}g hfxfF ;dfgfGt/

rt'e'{h x'G5g .

e)cfot / ;dfgfGt/ rt'e'{h aLr s'g} ;DaGw x'b}g .

!(=tn lbOPsf dWo] s'g ;xL xf] <

a) ;a} ;dl¢afx' lqe'hx? ;dafx' lqe'h klg x'G5g .

b) ;a} ;dafx' lqe'hx? ;dl¢afx' lqe'h klg x'G5g .

c)s]xL ;dafx' lqe'hx? ;dl¢afx' lqe'h klg x'G5g .

d) ;dafx' lqe'h ;dl¢afx' lqe'h x'g ;Sb}g .

e) ;dafx' lqe'h ;dl¢afx' lqe'h x'g ;Sb}g / ;dl¢afx' lqe'h ;dafx' lqe'h x'g ;Sb}g .

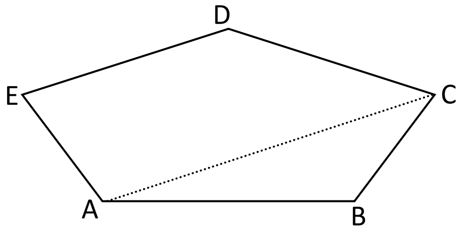
@)=s'g} lqe'hdf Go"gtd slt j6f Go"g sf]0fx? x'G5g<

a)! b) @ c) # d) !jf @ e) s'g} klg xf]Og

@!= s'g} rt'e'{hdf clwstd slt j6f Go"g sf]0fx? x'G5g<

a)! b) @ c) # d) $ e) @ jf #

@@=s'g} lqe'hsf] sf]0fx?sf] of]ukmn !*) l8u|L x'G5 eg] k~re'h ABCDE **sf] sf]0fx?sf] of]ukmn slt x'G5 <**



a) #^) l8u|L b)$%) l8u|L c) %)) l8u|L

d) %$) l8u|L e) %&) l8u|L

@#= tn lbOPsf tYo dWo] ;d?k lqe'h / cg'?k lqe'h aLrsf] ;DaGw s'g ;xL xf] <

a) ;a} ;d?k lqe'hx? cg'?k lqe'h x'G5g . b) ;a} cg'?k lqe'hx? ;d?k lqe'h xG5 .

c)s]xL cg'?k lqe'hx? dfq ;d?k lqe'h xG5 . d) s'g} klg cg'?k lqe'h ;d?k lqe'h x'b}g .

e)a, b / c df eg] cg';f/ cg'?ktf / ;d?ktf aLr ;DaGw x'b}g .

@$=Pp6f To:tf] rt'e'{h h:fsf] Pp6f ljs{0f csf{ ljs{0fnfO{ () l8u|Ldf cw{ljefhg u5{ / To:tf] rt'e'{h sf] gfd kitelbG5 eg] tn lbOPsf dWo] kite s'g xf] <

a) ;dfgfGt/ rt'e'{h b) cfot c) ;dafx' rt'e'{h

d) ;dl¢afx' ;dnDa rt'e'{h e) dflysf ;a}

;dfKt

Appendix – D

Item analysis table of VHGT

item No.	Upper 27% students making correct response										Lower 27% students making correct response										P value	D value	Remarks
	1	2	3	4	5	6	7	8	9	10	26	27	28	29	30	31	32	33	34	35			
1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	1	85%	0.3	cancelled
2	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1	0	70%	0.4	accepted
3	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	0	1	0	70%	0.4	accepted
4	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1	0	1	1	0	50%	0.4	accepted
5	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	85%	0.1	cancelled
6	1	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	0	65%	0.5	accepted
7	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	1	55%	0.5	accepted
8	1	1	1	1	1	1	0	1	0	1	0	1	0	0	1	1	0	0	0	0	55%	0.5	accepted
9	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0	1	0	1	0	1	70%	0.2	accepted
10	1	1	1	1	0	1	0	1	1	1	1	0	1	0	0	0	0	0	1	0	60%	0.6	accepted
11	1	1	1	1	1	0	1	0	1	0	1	0	1	0	0	0	1	1	1	0	65%	0.5	accepted
12	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	0	0	1	0	0	64%	0.3	accepted
13	1	1	1	1	0	1	1	0	1	1	0	1		0	1	0	1	0	0	0	58%	0.6	accepted
14	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.7	accepted
15	1	1	1	1	0	1	0	1	0	1	0	1	1	1	0	0	0	1	0	0	62.5%	0.5	accepted

16	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	0	1	0	44.2%	0.2	accepted
17	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	25%	0.5	cancelled
18	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	56.2%	0.8	accepted
19	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	25%	0.2	cancelled
20	1	1	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1	55%	0.3	ac[illegible]
21	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.7	accepted
22	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	25%	0.5	cancelled
23	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	0	1	0	44.2%	0.3	accepted
24	1	1	1	1	0	1	1	0	1	1	0	1		0	1	0	1	0	0	0	58%	0.6	accepted
25	1	0	1	0	1	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	37.5%	0.5	accepted
26	1	1	0	0	0	1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	43.75	0.3	accepted
27	1	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	44.2%	0.3	accepted
28	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	25%	0.2	cancelled
29	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.7	accepted
30	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	56.2%	0.8	accepted

Appendix – E

Split half reliability of the VHGT

Students	X (Odd)	Y (Even)	X^2	Y^2	XY
1	9	11	81	121	99
2	10	9	100	81	90
3	9	10	81	100	90
4	10	11	100	121	110
5	11	10	121	100	110
6	10	10	100	100	100
7	12	8	144	64	96
8	8	8	64	64	64
9	11	9	121	81	99
10	9	11	81	121	99
11	12	9	144	81	108
12	9	8	81	64	72
13	11	7	121	49	77
14	8	9	64	81	72
15	7	10	49	100	70
16	9	10	81	100	90

17	7	11	49	121	77
18	6	10	36	100	60
19	9	9	81	81	81
20	8	10	64	100	80
21	8	10	64	100	80
22	10	8	100	64	80
23	8	9	64	81	72
24	9	8	81	64	72
25	8	7	64	49	56
26	9	8	81	64	72
27	8	8	64	64	64
28	8	6	64	36	48
29	6	5	36	25	30
30	5	4	25	16	20
31	5	3	25	9	15
32	4	4	16	16	16
33	3	5	9	25	15
34	3	3	9	9	9
35	3	2	9	4	6
Total	281	284	2466	2475	2365

Where, X = number of correct response for odd question

Y = number of correct response for even question

Now, karl person's coefficient of correlation

$$r_{xy} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \times \sqrt{N\sum Y^2 - (\sum Y)^2}} = 0.45$$

So, reliability of whole test = $\frac{2r_{xy}}{1+r_{xy}} = 0.62$

Appendix – F

Geometry Test -Hofldlt k/LIf0f_

ljwfnosf] gfd M===

F.M.: 24

ljBfyL{sf] gfd M==

P.M.: 10

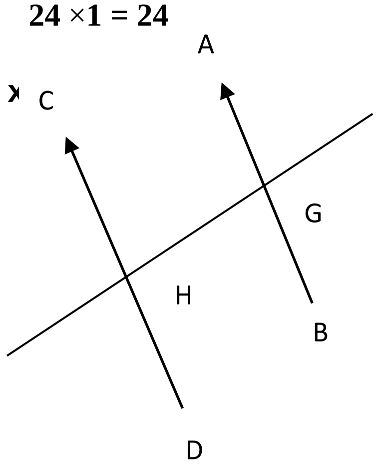
laifo M ul0ft Time: 30 min

ldlt M

;xL pQ/df -✓_ lrgf] nufpg'xf];

Group 'A' **24 ×1 = 24**

!= lbOPsf] lrqdf $\angle$AGH sf] PsfGt/ sf]0f s'g x



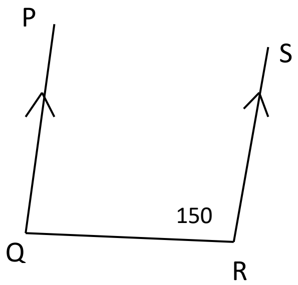
a) $\angle$ AGB

b) $\angle$ GHD

c) $\angle$ CHG

d) $\angle$ BGH

@= lbOPsf] lrqdf $\angle$PQR sf] dfg slt x'G5 <



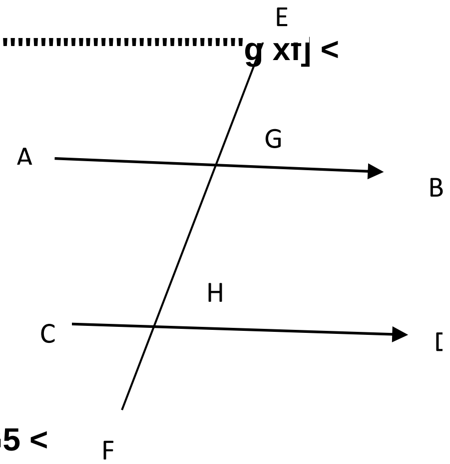
a) 30

b) 65

c) 55

d) 60

#= lbOPsf] lrqdf ∠GHC sf] ;+ut sf]0f s''''''''''''''''''''''''''''g xf] <



a) ∠AGH

b) ∠AGE

c) ∠BGH

d) ∠FHD

$=cw{Jof; 7cm ePsf] j[tsf] kl/lw slt x'G5 <

a) 22 cm   b) 154 cm   c) 48 cm   d) 44 cm

%=olb b'O{j6f ;dfgfGt/ /]vfx?nfO{ Pp6f 5]bsn] sf65 eg]

a) PsfGt/ sf]0fx? a/fa/ x'G5g . b) ;+utsf]0fx? a/fa/ x'G5g .

c) qmdfut lelq sf]0fx?sf] of]ukmn !*) l8u|L xG5 . d) dflysf ;a} 7Ls .

^= tn lbOPsf dWo] s'g a]7Ls 5g <

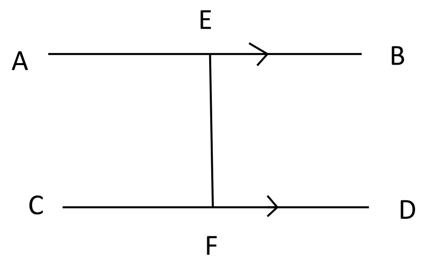
a) ;dl¢afx' lqe'hsf] cfwf/ sf]0fx? a/fa/ x'G5g .

b) lqe'hsf] lelq sf]0fx?sf] of]ukmn () l8u|L x'G5 .

c) ;dafx' lqe'hsf] k|To]s sf]0f ^) l8u|L x'G5 .

d) lqe'hsf] aflx/L sf]0f lelq b'O{ cgf;Gg sf]0fx?sf] of]ukmnsf] a/a/ x'G5 .

&=lbPsf] lrqdf ∠AEF sf] qmdfut leqL sf]0f s'g xf] <



a) ∠BEF

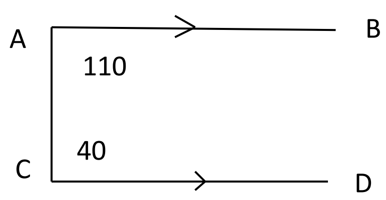
b) ∠EFD

c) ∠EFC

d) dflysf ;a}

***=lrq x]/L AB / CD /]vfx? ;dfgfGt/ 5g jf 5}gg sf/0f ;lxt n]v .**

a) (Yes parallel) ;dfgfGt/ xf] .



b) (Not parallel) ;dfgfGt/ xf]Og .

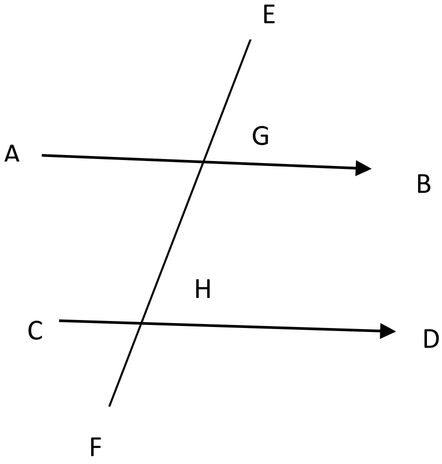
c) All of the above) dflysf ;a} .

d) (None of the above) dflysf s'g} klg xf]Og .

(=Jof; 14cmePsf] cw{j[tsf] kl/lw slt x'G5 <

a) 26 cm b) 36 cm c) 16 cm d) 30 cm

!)=lbOPsf] lrqdf s'g PsfGt/ sf]0f xf] <



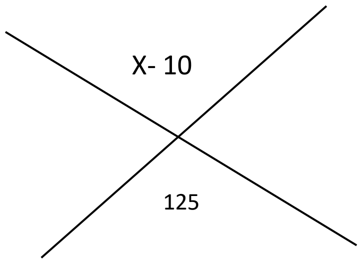
a) $\angle AGE$ and $\angle CHG$

b) $\angle CHF$ and $\angle GHD$

c) $\angle CHG$ and $\angle HGB$

d) $\angle AGE$ and $\angle EGB$

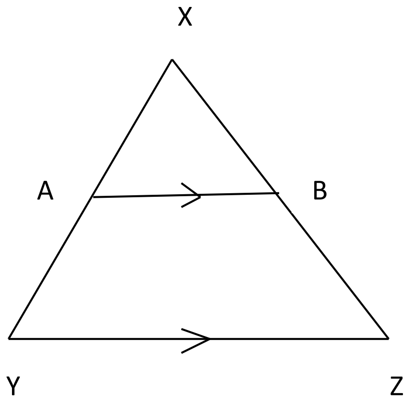
!!= lbOPsf] lrqdf x sf] dfg slt x'G5 <



a) 125 b) 135

c) 115 d) 145

!@=olb ΔXAB /ΔXYZ ;d?k 5g / XZ = 40cm, AB = 15cm,YZ=20cm lbOPsf] 5 eg] XB sf] nDafO{ slt x'G5 <



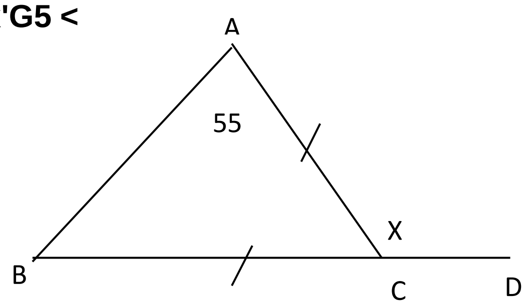
a) 25 cm

b) 30 cm

c) 35 cm

d) 40cm

!#=lbOPsf] lrqdf x sf] dfg slt x'G5 <



a) 55 b) 100

b) 110 d) 120

!$=cfotsf lelq sf]0fx?sf] of]ukmn slt x'G5 <

a) 90 b) 200 c) 180 d) 360

!%= tn lbOPsf dWo] s'g ;dfgfGt/ rt'e'{hsf u'0fx? 5g <

a) (The opposite sides are equal) ljkl/t e'hfx? a/fa/ x'G5g .

b) (The diagonals bisect each other) ljs{0fn] cw{ ljefhg ub{5 .

c) (The opposite angles are equal) ljkl/t sf]0fx? a/fa/ x'G5 .

d) (All of the above) dflysf ;a}

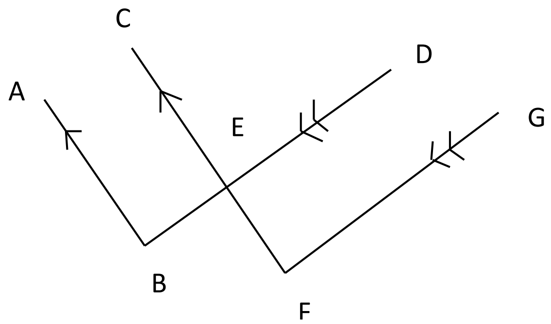
!^= lbOPsf] lrqdf ∠ABD sf] ;+ut sf]0fsf] csf]{ ;+ut sf]0f s'g xf] <

a) ∠BEC

b) ∠ CED

c) ∠ EFG

d) ∠ DEF



!&= ;Kte'hdf slt cf]6f sf]0f aG5 <

a) 3   b) 5   c) 7   d) 8

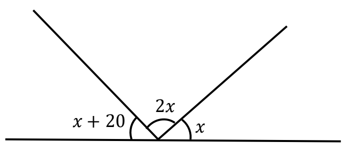
!*= lbOPsf] lrqaf6 x sf] dfg slt x'G5 <

a) 25

b) 35

c) 40

d) 45



!(= k'/ssf]0f (complementary angle) sf] dfg slt x'G5 <

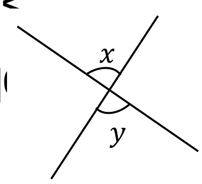
a) 60   b) 90   c) 180   d) 120

@)= a[tsf] s]Gb| laGb' eP/ hfg] / a[tsf] kl/lwsf] b'O{j6f laGb'df cgTo x'g] l;wf/]vfnfO{ s] elgG5 <

a)cWf{jof;   b) Jof;   c) kl/lw   d) rfk

@!= lbOPsf] lrqaf6 x / y nfO{ s'g sf]0f elgG5 <

a) cf;Gg sf]0f   b) ;dk'/s sf]



c) lziff{led'v sf]0f   d) PsfGt/ sf]0f

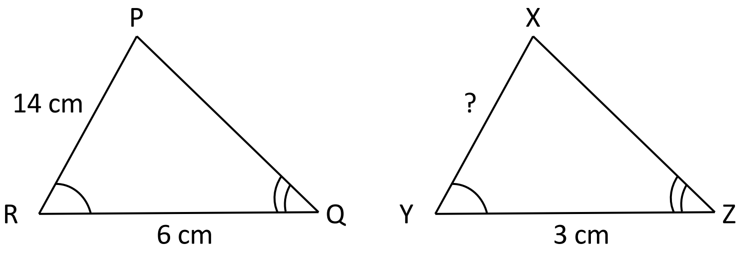
@@= olb ΔPQRl ΔXYZ ;d?k 5g\ eg] XYsf] nDafO slt xf]nf <

a) 7cm

b) 8cm

c) 9cm

d) 10 cm



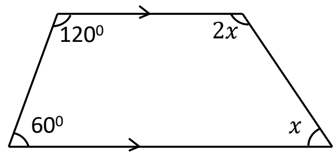
@#= lbPsf] lrqaf6 x sf] dfg slt x'G5 <

a) 55^0

b) 65^0

c) 60^0

d) 75^0



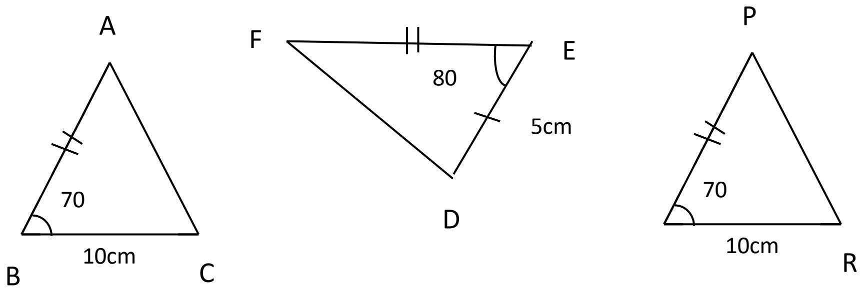
@$=lbOPsf] lrqdf s'g s'g lqe'hx? cg'?k 5g <

a) ABC and EFD

b) ABC and PQR

c) EFD and PQR

d) All of the above



;dfKt

Appendix – G

Item analysis table of Geometry Test

item No.	Upper 27% students making correct response										Lower 27% students making correct response										P value	D value	Remarks
	1	2	3	4	5	6	7	8	9	10	26	27	28	29	30	31	32	33	34	35			
1	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.75	accepted
2	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1	0	70%	0.4	accepted
3	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	0	1	0	70%	0.4	accepted
4	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1	0	1	1	0	50%	0.4	accepted
5	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	0	65%	0.42	accepted
6	1	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	0	65%	0.5	accepted
7	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	1	55%	0.5	accepted
8	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	25%	0.25	cancelled
9	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0	1	0	1	0	1	70%	0.2	accepted
10	1	1	1	1	0	1	0	1	1	1	1	0	1	0	0	0	0	0	1	0	60%	0.6	accepted
11	1	1	1	1	1	0	1	0	1	0	1	0	1	0	0	0	1	1	1	0	65%	0.5	accepted
12	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	0	0	1	0	0	64%	0.38	accepted
13	1	1	1	1	0	1	1	0	1	1	0	1		0	1	0	1	0	0	0	58%	0.62	accepted
14	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.75	accepted
15	1	1	1	1	0	1	0	1	0	1	0	1	1	1	0	0	0	1	0	0	62.5%	0.5	accepted
16	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	0	1	0	44.25%	0.25	accepted
17	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	25%	0.5	cancelled

18	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	25%	0.5	cancelled
19	1	1	1	1	1	1	0	1	0	1	0	1	0	0	1	1	0	0	0	0	55%	0.5	
20	1	1	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1	55%	0.3	accepted
21	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	50%	0.75	accepted
22	1	0	1	0	1	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	37.5%	0.5	accepted
23	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	0	1	0	44.25%	0.25	accepted
24	1	1	1	1	0	1	1	0	1	1	0	1		0	1	0	1	0	0	0	58%	0.62	accepted
25	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	25%	0.25	cancelled
26	1	1	0	0	0	1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	43.75	0.36	accepted
27	1	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	44.2%	0.38	accepted
28	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	56.25%	0.87	accepted

Appendix – H

Split half reliability of the Geometry Test

Students	X (Odd)	Y (Even)	X^2	Y^2	XY
1	12	11	144	121	132
2	11	12	121	144	132
3	9	9	81	91	81
4	10	8	100	64	80
5	9	10	81	100	90
6	8	12	64	144	96
7	12	11	144	121	132
8	11	10	121	100	110
9	10	10	100	100	100
10	11	12	121	144	132
11	10	9	100	81	90
12	9	8	81	64	72
13	11	9	121	81	99
14	10	9	100	81	90
15	10	10	100	100	100
16	9	10	81	100	90
17	10	10	100	100	100
18	11	11	121	121	121
19	9	12	81	144	108
20	8	9	64	81	72
21	8	8	64	64	64
22	8	10	64	100	80

23	7	10	49	100	70
24	9	9	81	81	81
25	8	7	64	49	56
26	7	6	49	36	42
27	6	8	36	64	48
28	5	6	25	36	30
29	5	5	25	25	25
30	5	5	25	25	25
31	4	5	16	25	20
32	4	4	16	16	16
33	4	3	16	9	12
34	3	3	9	9	9
35	3	3	9	9	9
Total	286	295	2586	2597	2487

Where, X = number of correct response for odd question

Y = number of correct response for even question

Now, karl person's coefficient of correlation

$$r_{xy} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \times \sqrt{N\sum Y^2 - (\sum Y)^2}} = 0.46$$

So, reliability of whole test = $\frac{2r_{xy}}{1+r_{xy}} = 0.63$

Appendix – I

Statistical formulae used for data analysis

1. Mean $\left(\bar{X}\right) = \frac{\sum fX}{N}$

2. Standard Deviation (σ) = $\sqrt{\frac{\sum f\left(X-\bar{X}\right)^2}{N}} = \sqrt{\frac{\sum fx^2}{N}}$

3. $t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$

Where,

M_1= Mean source of boys

M_2= Mean source of girls

σ_1 = standard deviation of boys score

σ_2= standard deviation of girls score

N_1= Number of the boys

N_2 = Number of the girls

4. Difficulty level (P) = $\frac{R}{T} \times 100$

Where R = Number of examine who gave correct answer

T = Total number of examinee

5. Discrimination index (D) = $\frac{U_R - L_R}{U_N \text{ or } L_N}$

Where

U_R = Number of correct response from 27% of upper scoring students

L_R = Number of correct response from 27% of lower scoring students

U_N = Total number of 27% of upper scoring students

L_N= Total number of 27% of lower scoring students

6. $r_{xy} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - \left(\sum X\right)^2} \times \sqrt{N\sum Y^2 - \left(\sum Y\right)^2}}$

Appendix – J

Photo Gallery