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Integrating Mathematical Concepts With Technology Education

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INTEGRATING MATHEMATICAL CONCEPTS WITH TECHNOLOGY EDUCATION

by

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This Independent Study submitted by Chen, Chei-chun in partial fulfillment of the requirements for the degree of Master of Education in the University of North Dakota, is hereby approved by the committee under whom the work has been done.

Myron Bender

(Chairperson)

Myron Bender

(Advisor)

PERMISSION

Title: Integrating Mathematical Concepts with Technology Education

Department: Industrial Technology

Degree: Master of Education

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Signature Chei-chun Chen

Date July, 22, 1991

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CHAPTER I

INTRODUCTION

Technology Education is a very important educational program which leads students to understand, use, and control technology in order to solve problems in their lives and to live better or more enjoyable in the technological society. Hence, all student must learn to use technology efficiently to help them solve their problems.

Mathematics is a language which has its own unique alphabet (symbols) grammar and syntax (rules and conventions), and stories to tell (logic and relationships). Most technologically advanced societies have recognized the need for better mathematics education, because mathematical concepts help people to solve many problems around them, such as number sense, estimation skills, ability to analyze data intelligently, knowledge of two- and three-dimensional geometry, knowledge of probability, etc.

It is apparently revealed that the "concepts to math" approach could be an important and easily applied response to one of Technology Education's most demanding challenges.

This study will involve the integration of Mathematics and Technology Education. Many students have difficulty in mathematics and to apply mathematical concepts skillfully.

This project is designed to motivate students to apply effectively mathematical concepts in Technology Education. Not only reinforce fulfillment in mathematics but also apply mathematical knowledge in Technology Education.

Statement of The Problem

Mathematics is the basic course in a scientific curriculum. It is also important in Technology Education. This study is conducted to determine how the mathematical concepts are applied to communication and manufacturing courses in Technology Education, and to integrate the mathematical concepts with Technology Education. Six exemplary learning modules for Technology Education were be developed to assist teachers with the integration of mathematics into the Technology Education curriculum.

Objectives

The study is conducted in order to :

1. Discuss the importance of integrating the Mathematical concepts with Technology Education.
2. Identify the concepts of Mathematics and Technology Education taught in the eight grade curriculum at the Junior High School level.
3. Develop learning modules that will integrate the mathematical concepts into Technology Education.

Purpose of the Study

The purpose of this study was to develop six learning activities that include:

1. The important concepts of Technology Education.
2. Mathematical skills which are used in life.
3. Suggestions for instructors to approach interdisciplinary education.

Interdisciplinary education is specially important for Junior High School students. They need to understand the interrelationships among disciplines. The study of technology can reinforce the accomplishment of other courses. Concepts and skills of Mathematics, the natural science, social sciences are used in many ways.

This study was designed to assist teachers by providing material, sources, and guidance necessary to successfully approach interdisciplinary education focusing on Mathematics and Technology Education.

Limitation of the Study

This study is limited to :

1. The available references and materials provided by the Eric Center and Industrial Technology Department at the University of North Dakota.
2. The activities were designed to assist instructors in Junior High School Technology Education programs. Therefore, all available materials on this topic focus on

Junior High School level.

It was assumed that the instructors possess the basic knowledge of Technology Education, such as binary digital number concepts, multiview drafting concept, Ohm's law, etc.

Definition of terms

Applied Mathematics: a foundation course to provide math strategy to solve practical problems in the workplace and in daily lives.

CAI: Computer-aided (assisted) instruction. Use of computer as an integral part of an instructional system, with the learner generally engaging in real-time interaction with the computer. Technology: a process undertaken in all cultures (a universal), which involves the systematic application of organized knowledge (synthesis) and tangibles (tools and material) for the extension of human faculties that are restricted as a result of the evolutionary process.

Cooperation: an instructional system that allows students of all achievement levels and background to work in teams to achieve a common goal.

CORD: the Center for Occupational Research and Development.

Industrial Art (I.A.): a general and fundamental school subject in a free society concerned with providing experiences that will help persons of all ages in both sexes to profit by the technology because all are involved as consumers, many as producers, and there are countless recreational opportunities for all.

ITEA: International Technology Education Association.

Science: a stream of man-made events involving a mathematical or systematic study of nature which results in a body of knowledge that is practical as well as theoretical.

Technology: a process undertaken in all cultures (a universal), which involves the systematic application of organized knowledge (synthesis) and tangibles (tools and material) for the extension of human faculties that are restricted as a result of the evolutionary process.

Technology Education (T.E.): a curriculum area concerned with the significance of industry, its organization, personnel, systems, techniques, resources and social/cultural impact, action-based instruction directed toward technological literacy for all students. The curricular area interfaces with the champion curricular area of secondary education developing the whole student in the best interest of educational goals.

Technology Literacy: the reasoning skills that allow people to understand the technological world around them.

CHAPTER II

REVIEW OF LITERATURE

Presently we are living in a fast changing technological era. The new environment promises grand extensions of the individual's normal powers of sense and reveals to him previously unavailable sights, liberties, and possibilities. (Pytlik, Lauda, & Johnson, 1978, p.39) Human needs some specific skills in order to survive in this period of time. These skills generally include the solving-problem ability, flexible adaptability, wide knowledge, and ability to use knowledge efficiently. The purpose of these skills is to improve the environment and increase quality of our life. In problem solving, math (mathematics) hold an important role, for example, the construction surveyor must use measurement, geometry, number skills; the chemist uses number, measurement, logic, and algebra skills; the weather predictor uses statistic and probability; even the commercial artist often does statistical research to determine the most effective type of design for a particular project.

In a technological society the adolescents need to understand how the subjects they study in school function outside the school. Hence, instruction in the basic educational skills of the 21st century must include not only reading, writing, and arithmetic, but also modern mathematics, science, and technology literacy.

A key to cultivate students' technology literacy is to introduce the principles behind automatic machines. Technology comes in many forms and changes from year to year but principles behind that technology have been true for a hundred years and are still true today. If we understand the principles today we will be better prepared to deal with change which tomorrow's technology will bring.

Mathematics in Junior High School

Math is the basic course of scientific curriculum. Chemistry, Physics, Engineering, Mechanics to mention a few, none of them need not be adept in math. Additionally, the applications of math in our life more than can be listed. That is why math is a required subject in school.

"What are the important ideas of mathematics that people should know and understand by the age of 18?" Blackwell, D. and Henkin, L. (1989) stated:

> This broader experience of mathematics that we have acquired through our profession is not something very remote and complex that can be understood only after years of abstruse study. On the contrary, it informs the simplest mathematical subjects to the same extent as the more sophisticated ones. The

> rules that high school students followed to computate are to memorize about computating in school with whole numbers, then deals with fractions and negative numbers, and later involves algebraic and possibly trigonometric formulas. (p.1)

In seventh- and eighth-grade mathematics, the practical aim is dominant. The content that students learn to compute with fractions, decimals, and percentages and to apply this skill to the solution of problems of the consumer, homemaker, and wage-earner was obviously practical.

Some of these attempts to make high school mathematics practical were severely criticized. It was pointed out that most of the applications touched the lives of some adults but not those of junior high school students, and that by the time these students became adults they would have to relearn what they had been taught in school. Another criticism was that the process of solving practical problems was merely a matter of following a model solution. Very little thinking or understanding was required. In real-life problems, flexibility in thinking is required, and the application of standard solutions is not likely to develop this flexibility. (Kinsella, 1965, p.11) Recently, modification in math curriculum has been made by mathematicians, scholars and administrators to use mathematical concepts efficiently in our real-life time.

Applied Mathematics

Many high school students have difficulty in math class because they are taught theory without practical application. In 1988, The Center for Occupation Research and Development developed Applied Mathematics. Applied math means useful math. Hands-on math activity laboratories are provided to make the mathematical concepts "come to life" and be more useful. It teaches the important mathematical concepts in workplace, such as arithmetic operations, problem-solving techniques, estimation of answers, measurement skills, geometry, data handling, simple statistics, and the use of algebraic formulas, in most cases many different type of occupations use the same concepts. Five occupations will be covered: Agriculture and Agricultural business, Health Occupation, Business and Marketing, Home Economic, and Industrial Technology.

Applied math is not to attempt to solve the complex equations. This is a foundation course to provide math strategy to solve practical problems in the workplace and in our daily lives. It will train people to have up-grade math ability to keep up with every changing the technology. It will also help students capable for predicting the result and saving time and material. In short, it makes works more efficient. Apparently, the feature of Applied math is fit to Technology Education (T.E.). (CORD, 10-88)

Mathematical Concepts Taught in Junior High School

The mathematical contents generally taught in Junior High School are : (1) Whole Number Operations (2) Addition and Subtraction of Decimals (3) Multiplication and Division of Decimals (4) Addition and Subtraction of Fractions (5) Multiplication and Division of Fractions (6) Equations (7) Measurement: Metric Units (8) Integers and Rational Numbers (9) Geometry (10) Ratio and Proportion (11) Percent (12) Perimeter, Area and Volume (13) Probability (14) Statistics and Graphs (15) Square Roots and Right Triangles (16) Measurement: Customary Units. All of them are useful around students' lives. But having difficulty to use these concepts sufficiently is the problems of many students. Even though there are many practice examples inside every math book, students still separate the experiences into in-class and off-class. Hence, it is very important to keep the class experience in touch with lifetime.

Trends in Technology Education

Today we live in a technological society. Our school programs should meet the need of that society. "Technology Education (T.E.) is the school discipline for the study of the application of knowledge, creativity, and resources to solve problems and extend human potential." (TEAC, 1988, p.16) In 1987, the report of the Commission on Technology Education for the State of New Jersey, technology education is defined as "both a new curriculum and a strategy for teaching." and "the application of knowledge to satisfy human needs and wants, and to extend human capabilities." (Kelty, N. 1987)

The teaching of technology is in its infancy in our school curricula. However, the majority of this work is being implemented in our schools under the name of technology education. Technology Education capitalizes on this rich potential with content an experiences to contribute to the growth and development of human beings. Thus, Technology Education has become a basic and fundamental study for all persons, regardless of educational or career goal. (TEAC, 1988, p.16)

One characteristic of T.E. which is in conformity with technological society is no right or wrong answers in a T.E. class. The teacher, or facilitator, acts as the liaison between the problem and the solution, guiding the student through the learning process. Emphasis is placed on "learning how to think", "learning how to learn",and "learning how to create" rather than rote learning. (Kelty, N. 1987)

T.E. programs will provide the educational base for skill-specific training in trade and industrial education programs for some students, and provide leading directions to technological careers for other educational avenues. Hence, T.E. is more important than before (Industrial Arts - I.A.) to let students live in technological society comfortably.

<u>The Challenge of Technology Education</u>

T.E. faces both internal and external challenges. A shortage of qualified technology teachers, a shift in emphasis to the "basics", limited financial resources, and increased school dropouts (at-risk youth), those of them we view as internal challenges. The field of external challenge is that T.E. is viewed as "shop learning" for low-ability students. We must work hard to change our image. The public needs to know that technology education leads to technological literacy for youth and adults, and that technological literacy will be a key component in maintaining our way of life. (Erekson, 1988)

Haynie,W.J. III (1989) asserted that "the T.E. laboratory is not intended to be a playground which ignores the important "basics" of general education. It has a duty to use the high levels of student motivation it generates to promote learning of those basics and then to use them in solving real world technological problems." (p.14) and Bensen, M.J. (1988) clarified that we will need new approaches to meet the challenges of preservice teacher preparation, teacher inservice, continuous curriculum change, facilities upgrading, program promotion and marketing, and articulation with programs at all levels.

In short, all we should do to meet the challenges are to recognize and act lifelong learning mode. It is a up-to-date learning way fitting in with technological society.

The Implementation of Technology Education

We have known that we need flexible and potential abilities to fit in today's technological society. T.E. best provides a broad educational base for entrance into a trade and industrial education program, and Selby, C. (1988) referred to T.E.:

> Technologies can be studied that are gender-friendly, culture-friendly. We know, both intuitively and from the best of cognitive science, that children learn from doing, from seeing, and from making. There can be immediate learning reinforced through experiential learning. (P.5)

T.E. should be implemented in public education to gain big value of the best curriculum plans. Moreover, teachers need to make a concerted effort to implement technology education programs in order to change curriculum successfully. Realistically, technology education teachers face the most difficult task in the change process. Implementing technology education programs means more to teachers than a change in philosophy, content, and activities. The basic job of generating a vision of what T.E. should be then turn it into reality. Visions have two parts. The first part is the practice of using the creative group dynamic process (brain-storming, nominal group process, images of potential futures, etc.) to discover the correct steps. The second part is to build a creative plan so the vision can be reached effectively and efficiently. (Wenig, 1987)

The Importance of Mathematical Concepts in T. E.

Recent advances in technology and a world that is becoming continually more complex and quantitative have shown that mathematical thinking is becoming ever more important. The future people will need more, better, and different mathematical skills. They must be able to relate their mathematical skills to the world around them and use their skills to help solve problems that are of important to themselves and to the world.

Most technologically advanced societies have recognized the need for better mathematics education and are devoting enormous national, local, and individual resources to the task of improving the teaching of mathematics.

Not only particular mathematical problems but also whole areas of mathematics have developed historically from one or another of the empirical sciences. In school curricula, the presentation of material on science and technology has been largely descriptive with very little mathematical formulation or analysis. (Blackwell & Henkin, 1989, p.31) Hence, it is time to really combine mathematical concepts and T.E. which is to cultivate students more adequate capability to solve problems. The program of T.E. have had well apply scientific and mathematical relationship such as aerodynamics, mechanical advantage, cost effectiveness, chemistry, ohm's law, or hydraulics to mention a few. But they are still not enough. We have to keep making endeavor in this direction in order to meet students needs.

<u>Mathematics and Technology Education improve accomplishment each other</u>

A technology-based program helps students understand the applications of science and mathematics and attracts a variety of students because of its relevance to the real world. (T.E. News. Dec., 1984) Technology is the application of mathematics and science for specific purposes and use knowledge, tools and skills to increase our potential, to solve practical problems, to modify our world.

Students must learn to use their native intellect to solve real problems that involve mathematical thinking. Technology education is taught in a laboratory environment which encourages students to apply much of what they have already learned in a general education program. (T.E. News. Dec., 1984) By T.E. class, mathematical skills would be adept by students' vivified use. Technology Education courses could possible succeed in teaching Mathematics to students who are not learning it at a functional level in their Mathematics classes. (Haynie,W.J. III, 1989)

There is an intimate relationship between T.E. and Mathematics. Students would have higher accomplishment when they use these two knowledge simultaneously in real-world problems.

Enhance mathematical concepts in Technology Education

It is curious and important to notice that few people express fear or anxiety about counting - a very important and complex skill. Blackwell, D and Henkin, L. (1989) pointed out:

> Because the language of counting is learned at the same time and in the same way as other basic parts of natural language, because counting emerges in the context of other aspects of experience that are important and interesting to children, and because counting enters into the social activities of children, a favorable emotional context generally surrounds the learning experience.
>
> The natural experiential context of mathematical activity being thus ruptured, a positive emotional environment for mathematics learning comes to depend on the enthusiasm of an exceptional teacher, parent, or friend, or indeed on special talent that is excited by even a limited contact with mathematics. (p.38)

In order to motivate students in mathematics, many teachers are encouraged to seek materials developed around the "concepts to math" model or to carefully plan assignments and topic sequences to maximize its potential. The "concepts to math" approach could be an important and easily applied response to one of Technology Education's most demanding challenges. (Haynie,W.J.III, 1989)

Besides, many educators endeavored in utilizing mathematics education. They expected mathematics could be used in real life. From previous review, the better way to achieve these educators expectations is to add more mathematical concepts into T.E. curriculum. There are many facts existing about applications of mathematical concepts in T.E., such as Ohm's law, horsepower, aerodynamics, work efficiency, energy, cost, or pressure....etc. Now we need more T.E. activities involving mathematical concepts. Take manufacturing technology as an example, we can put measurement, counting, and ratio concept into activities. Many other examples more than can be listed.

Interdisciplinary Education in Junior High School

"In industrial society, at the school level various courses are taught as separate subjects by separate teachers who themselves were only good at knowledge of disciplines inside their specializations. Now we are faced with the information society: technology, instantaneous communication, world-wide connectedness, massive and rapid change, new roles and responsibilities for individuals. We can't prepare people for information age life with industrial age schooling." (House, 1985, p.105) For example, in an era of heightened mathematical awareness and use, the math teachers who know only mathematics will find that knowledge insufficient for effective teaching. Mathematics teachers of the future will need adequate grounding in the physical, biological, behavioral and social science as training in mathematics itself. (Vogeli, 1985)

No single discipline currently exists which specialize in such synthesis of information across the various fields. The world can no longer be "understood" from a simple perspective. The prior academic disciplines were, by virtue of their specialization, "narrow-minded" in the sense. (Jinks, 1985, p.32) Now, We need a balance between all educational purposes and an understanding of how these curricular areas can support each other. (Bensen, 1988)

Erekson, T.L. (1988) indicated his opinion about T.E. in interdisciplines:

> As we look specifically at technology education, we must realize that the study of technology is truly an interdisciplinary endeavor. Technology education professionals must establish a network with other educators and develop the interdisciplinary curriculum needed to properly study technology. Technology education has been called the strategic link between academic education and vocational education. As such, it has unique relationships with each. (p.27)

The general curriculum of technology education offers the youth the opportunity to explore the world around them and at the same time develop their skills in reading, writing, mathematics and science and problem solving in a way that is relevant to a tangible end. It is the responsibility of the profession to share this alternative methods of learning with the rest of the world. (Meeks, 1986) Such as through learning how a refrigerator works a student can gain an understanding of the first and second laws of thermodynamics, Boyle's Law, the operation of a compressor, etc. This example can be expended with reference to an understanding of the basic operating principles of an automobile, a television set, the list is endless. In each case there is a direct educational tie to mathematical concepts, physical laws, economic principles, social and environmental issues, design theory, marketing strategies and propaganda analysis. Indeed, there is no other area in the educational arena which provides such a potent means of bringing all other educational disciplines into a common arena. (Stone, 1990)

An effort has been made by many technology instructors to interface other disciplines with our classes. Class units that involve activities and lessons relating to history, current events, geography, math, science, or literature are commonplace. These units are included to illustrate the true relationship between people and technology, and the world in which we live. (Gerstenecker, Dailber, Moore and Conley, 1987)

International Technology Education Association (ITEA) has accomplished the excellent work about linking technology education and with other education associations and professional groups, such as National Science Foundation, National Council of Teachers of Mathematics, Council for Exceptional Children, National Council for Accreditation of Teacher Education,..., etc. (Maley, 1987)

At current school level we need teachers who have a solid mathematics, science, and technology background. They will need a balance between breadth across the technology field and a measure of depth in a specialty area. Once they enter the teaching field, they will learn every day throughout their lifetimes. It is necessary to prepare teachers who are flexible, open to change, able to learn and adapt to the learning environment, and who are unusually well grounded in precision thinking. (Bensen, 1988, p.28)

As was expected science and mathematics educators wanted cooperative efforts when they saw how a contemporary program could provide first-hand experiences to apply the theoretical concepts of their fields. Social studies programs also need applications; these can be dealt with in enterprise courses. The study of the impact of technology can be another avenue to work with these teachers. Of course, the language arts provide a rich area for cooperation, to emphasize the importance of communication. (Bensen, 1988) All of them are a form of interdisciplinary education.

The Effective Teaching Method

It is common for teachers who think of themselves as aiming at the improvement of the problem-solving skills of their students. Teaching methods are obviously important for teachers. To motivate students is the first step of teaching procedures. The classroom climate is so important in developing successful class activity. The teacher's motivation should be to establish a feeling in the classroom of psychological safety and freedom where students are aware of that freedom and are willing to explore any and all ideas that lead to solving a problem. (Charles and Lester, 1984, p.29)

There have been many teaching skills developed long time ago, such as lecture, explanation, discussion, demonstration, and project are more traditional; Some of the most recent methods include: question, role play, video, cooperation, creation, simulation, programmed instruction, and CAI. And there is another tradition method from individuals working on puzzles and problems that may require protracted effort to forms of group play that may involve cooperative or competitive games. When such games are undertaken in the classroom, the positive emotions that are characteristic of children's play may lead to mathematical learning that remains alive, as compared with learning that is forced on students by a teacher's pressure. (Blackwell & Henkin, 1989, p.38) Lecture, discussion, creation, games, simulation, and CAD will be needed in following activities.

Summary

Youth who live in technological society should comprehend the need for a different set of basic human tools and knowledge as they face the future. The primary skills are no longer reading, writing, and arithmetic, nor specific abilities in welding, electronics, printing, or automobile mechanics. Learning how to think, how to learn, and how to create are a major priority for students. (Glines, 1986, p.9)

In the process of education, it is necessary to connect the relationship between discipline. Especially, math have been an essential skills in the past time (Industrial Era), it will be more important in this technological society (Information Era). That is not only students' but also educators' responsibilities to know how to use tools, then make educations come to life to solve the real live problems.

CHAPTER III

METHODOLOGY

The procedure of this study consisted of the following steps:

1) Review literature;
2) Select and structure research materials;
3) Design six learning modules for Junior High School students.

Review Literature

This study reviewed literature involving the relationship of technology and math, math in Junior High School, the trend of T.E., the importance of mathematical concepts in T.E. and finally reviewing some efficient teaching methods. The design of appropriate and useful learning models were by means of reviewing these literature.

Structure of Research Materials

The following materials were used to prepare the activities:

A. Textbook:

1). Addison-Wesley Mathematics

2). Technology Education - North Dakota Curriculum Guide

3). Technology in Your World - The Middle School/Junior High Standard Text

4). Math/Science/Technology Projects

5). Communication Technology

6). Other related books

B. Related periodicals and Journals:

1). The Technology Teacher

2). TIES

3). T.H.E. Journal

4). Other related periodicals

C. ERIC researches on math and T.E. activities.

Design of Learning Activities

The elements identified for the learning activities included: (1). Title of module; (2). Objective(s) of module; (3). Technology Education Unit; (4). Mathematical concept(s); (5). The Source of Information; (6). The activity; (7). Evaluation; and (8). Notes.

CHAPTER IV

PRESENTATION

General Introduction

This chapter was a presentation of each learning activity. The six learning activities were selected not in any order and were not related to one another. The components for each activity are as follow:

(1) Title of module which state what the lesson covers, (2) Objective(s) of module which identify the purpose of this activity, (3) Technology Education Unit which reveal what Technology Education unit is belonged to by this activity, (4) Mathematical Concept(s) which explain which mathematical concepts are involved, (5) The Source of Information for which where the material was prepared, (6) Activity which explains what is to be done, (7) Evaluation which determines if the objectives were met, (8). Note for further information.

List of Learning Activities

This chapter consists of six learning activities listed:

1. Binary digital number
2. Conversion of multiview and 3-dimension drawing
3. Electricity - Ohm's law
4. General Recognition of Technological Product
5. Measure and design
6. Pantograph manufacturing

Learning Module No.1

Title: Conversion of multiview and 3-dimension drawing

The skill of converting multiview and 3-dimension drawing is used widely in industrial and architecture drawing. Students have to learn how to do it in class. But they may feel bored if they learn multiview and 3 dimensional drawing only by hand-doing. This activity is to enhance students' interest and skill in converting multiview and 3-dimension chart. During this process, students need to use measurement and dimension, ratio and proportion, multiplication and division skill. Of course, they must recognize accurately the relationship of plane figure and solid drawing.

Objectives:

Upon completion of this activity, students will be able to :

1. identify multiview and 3-dimension drawing of one solid.
2. easily convert multiview and 3-dimension drawing each other.
3. measure the dimension with rulers.
4. read the dimension by measuring.
5. calculate enlargement and reduction with proportion.

Technology Education Unit:

Industrial Communication - Drafting Language of Industry.

Mathematical Concepts:

Measurement and dimension, ratio and proportion, multiplication and division.

Material:

1. Multiview drawing cards (mark 1,2,3,... on upper left hand corner);
2. Solid model or 3-dimension drawing cards (mark a, b, c,...on upper left hand corner);
3. Answer sheet for each group;
4. Rulers;
5. Drawing equipment.

Source:

1. J.W. Giachino and H.J. Beukema. (1961). Engineering TechnicalDrafting & Graphics. Illinois: Chicago, American Technical Society.
2. Kirkpatrick,J.M. (1982). Basic Industrial DraftingSkills. Massachusetts: A Diviwion of Wadsworth, Inc.

Activity:

1. The instructor will introduce concepts and drawing methods of multiview drawing and 3-dimension drawing, and let students practice several examples by hand.
2. Divide the students into small groups of 3-5.
3. Give each group some of multiview drawing cards and one piece of answer sheet (listed on P.30-60.).
4. Students will record the marks indicated on the upper-left hand corner of the cards on the answer sheet provided.
5. Put all solid models on the middle table (if no models, 3-dimension drawing cards may be used.)

6. Students discuss the shape and dimension of each multiview drawing about 5-10 mins.
7. After discussing, every student in each group alternately brings a ruler and goes forward to the middle table to find the exact shape and dimension of solid which matches up the multiview drawing card. Only one student is allowed to the middle table at one time.
8. When the student find out the solid, he/she just goes back to his/her group and writes down the mark of solid on answer sheet. This will continue until all students have completed the exercise.
9. The teacher limits the time to complete this activity.

Evaluation:

The Teacher collects all answer sheets, and corrects them to determine which group obtains the highest score.

Note:

1. Before class, teachers can make some solid models depending on multiview drawing or 3-dimension cards provided in this research if they want. Materials are optional, such as boardcard, wood or styrofoam. There should be a mark on each model in order to match multiview drawing cards later.
2. Educators may revise this activity by giving 3-dimension cards or solids to students who in turn can match the cards with the solid models.

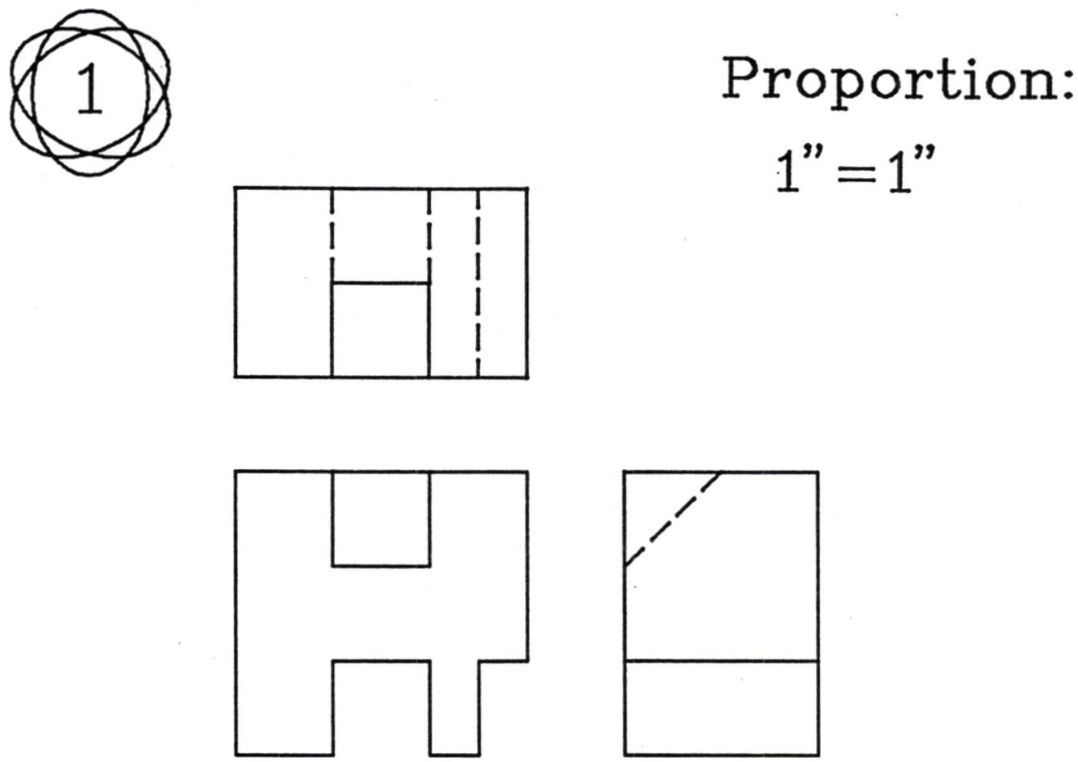


Figure 1-1. Multiview Drawing Smple 1

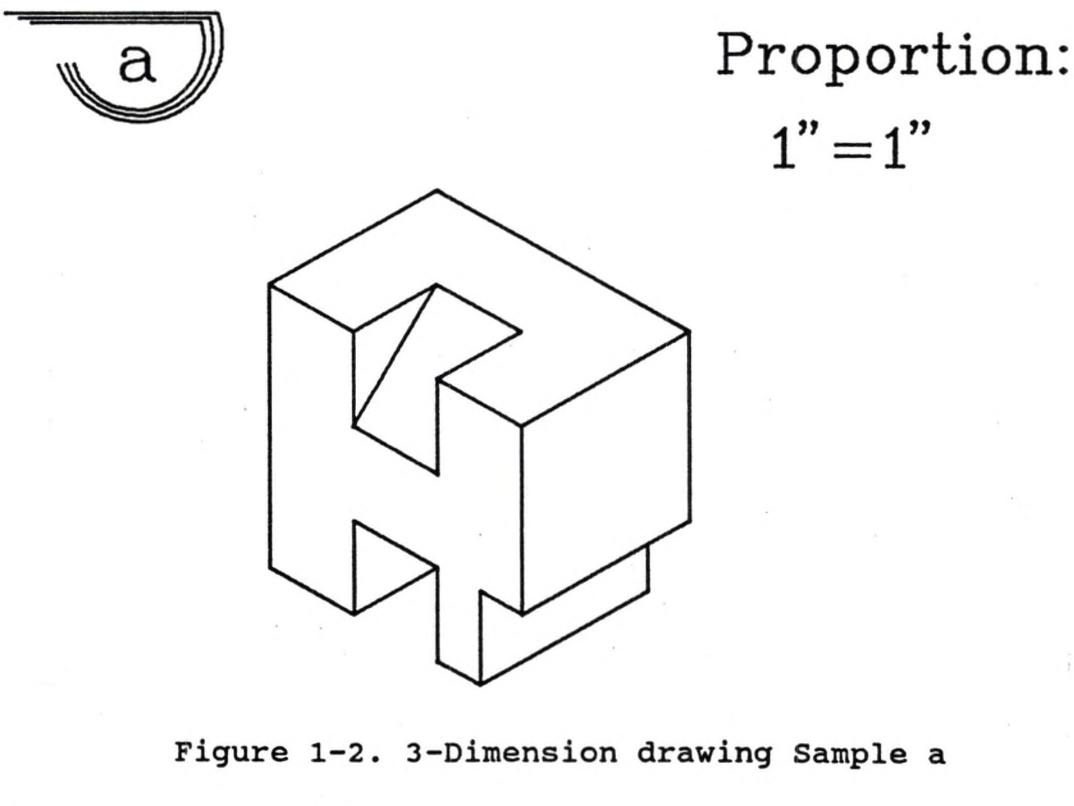


Figure 1-2. 3-Dimension drawing Sample a

2

Proportion:

1"=1"

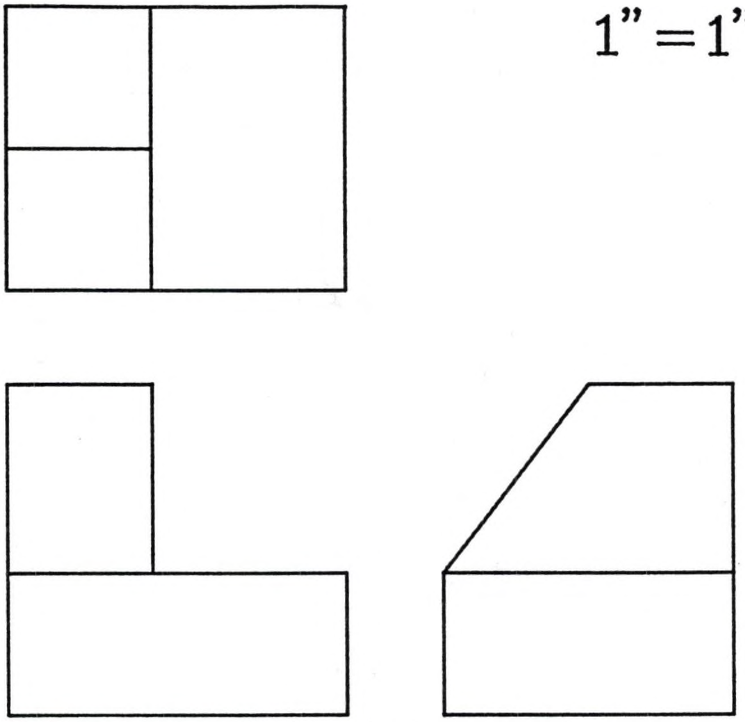


Figure 1-3. Multiview Drawing Smple 2

b

Proportion:

1"=1"

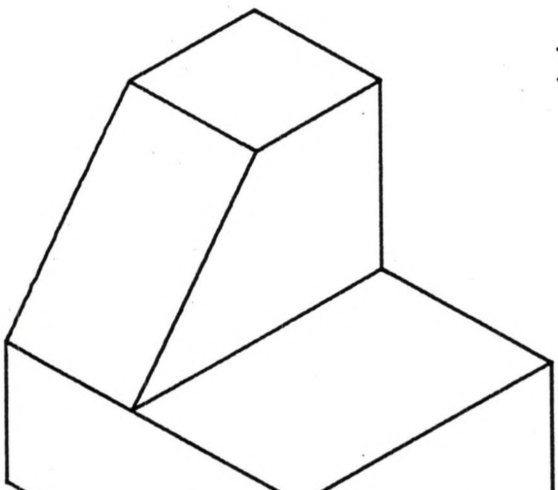


Figure 1-4. 3-Dimension drawing Sample b

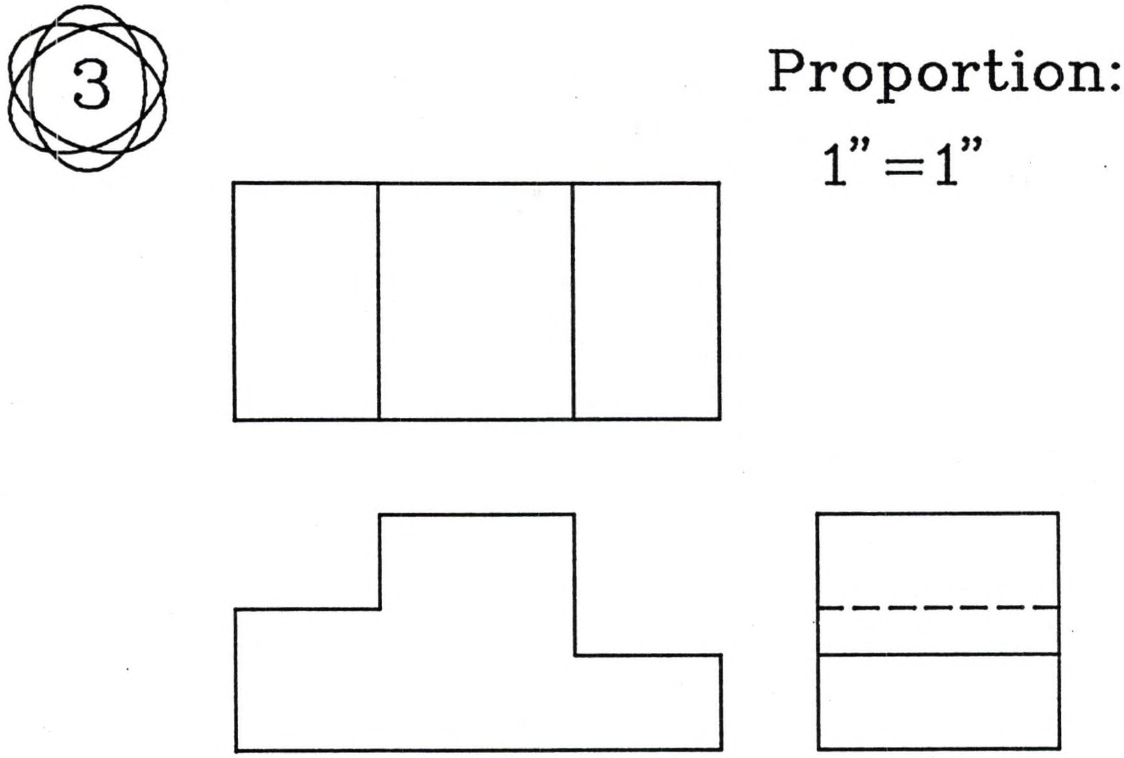


Figure 1-5. Multiview Drawing Smple 3

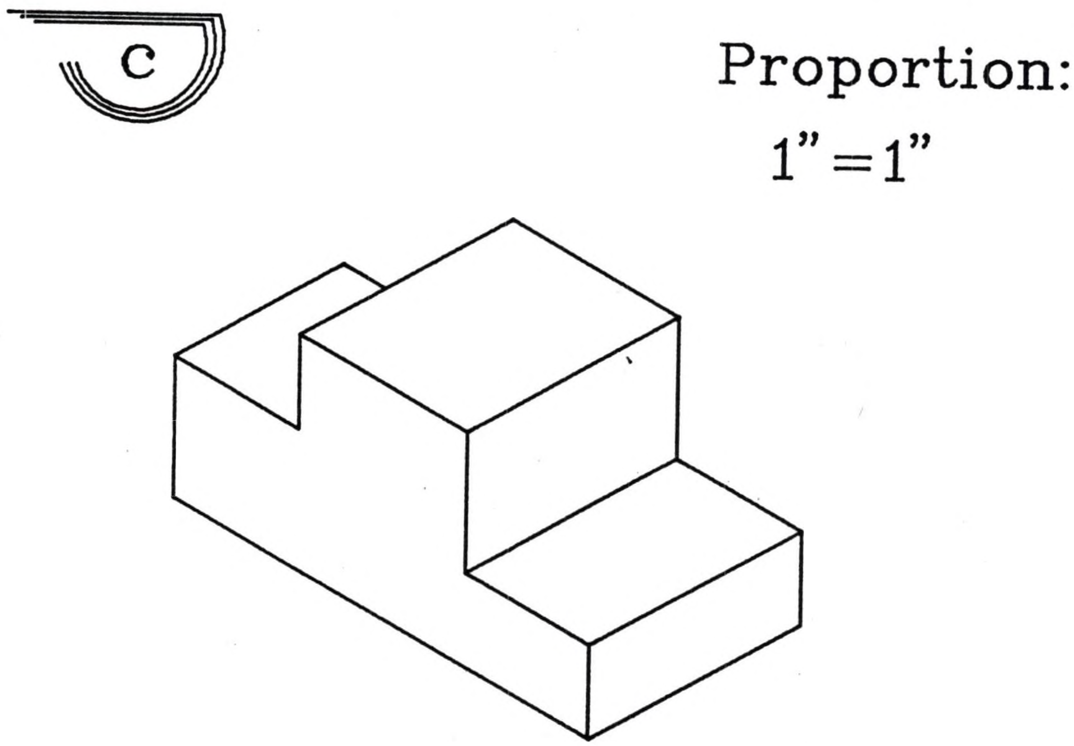


Figure 1-6. 3-Dimension drawing Sample c

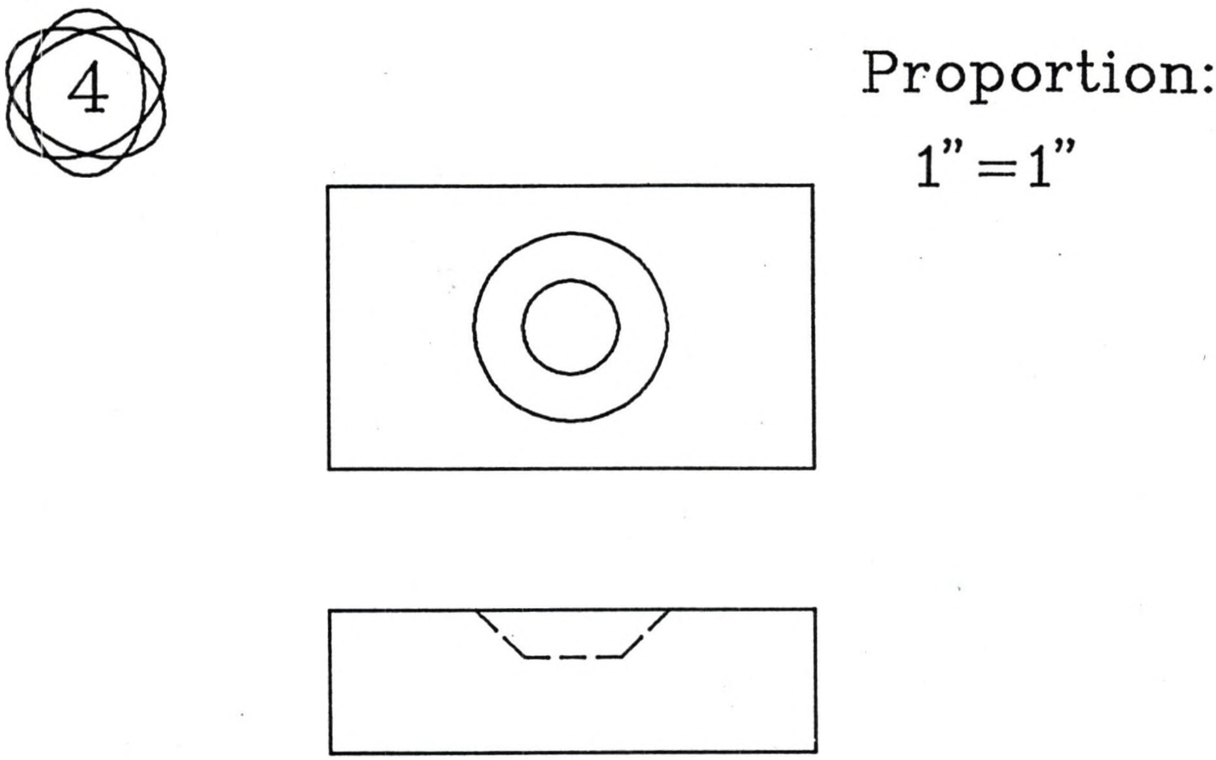


Figure 1-7. Multiview Drawing Smple 4

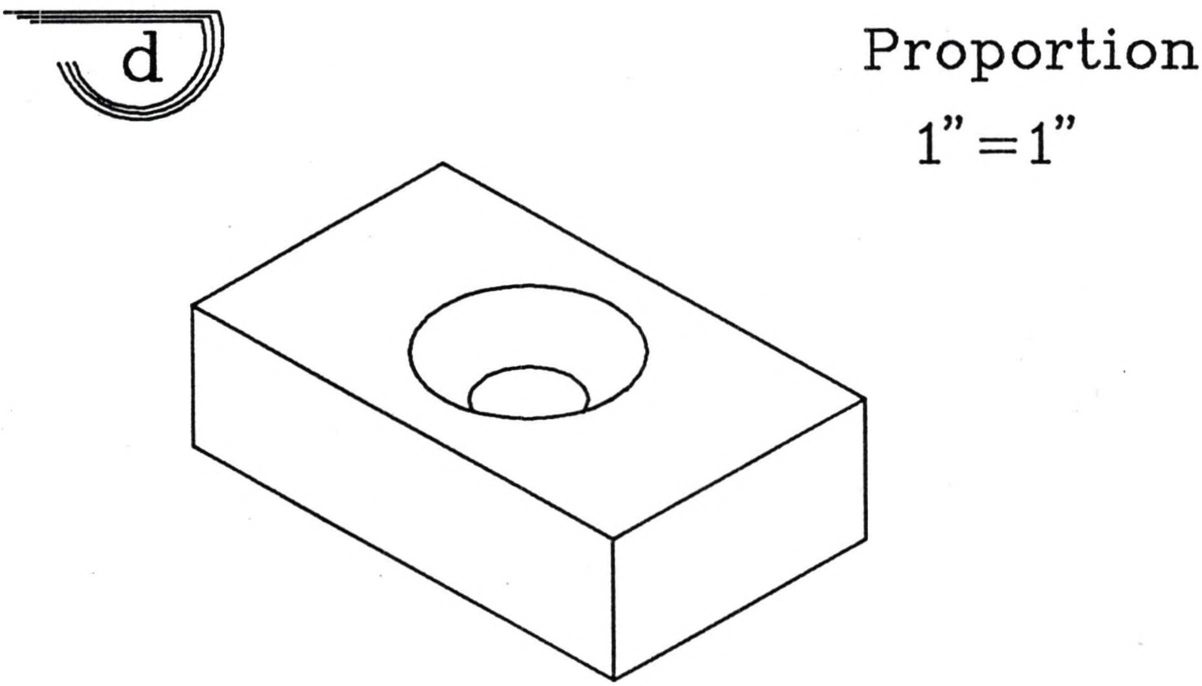


Figure 1-8. 3-Dimension drawing Sample d

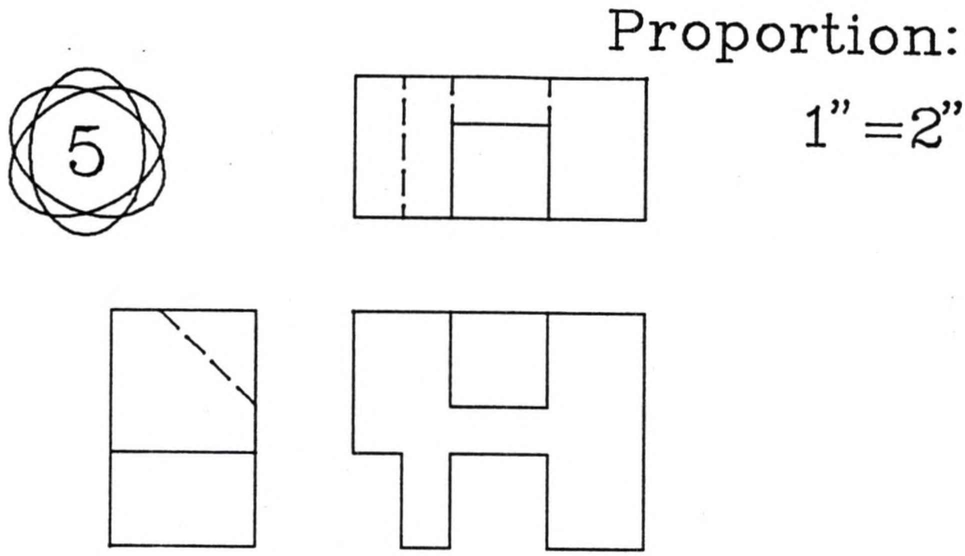


Figure 1-9. Multiview Drawing Smple 5

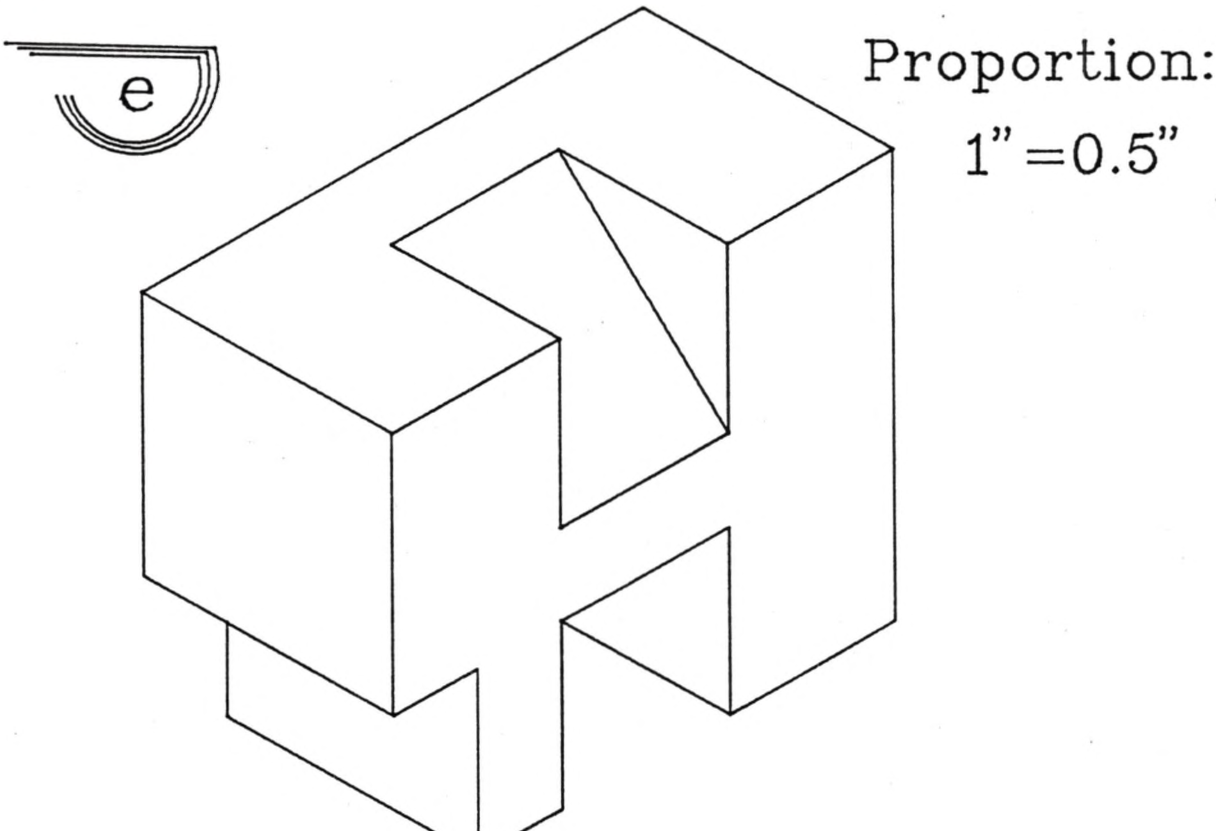


Figure 1-10. 3-Dimension drawing Sample e

Proportion:
1" = 1"

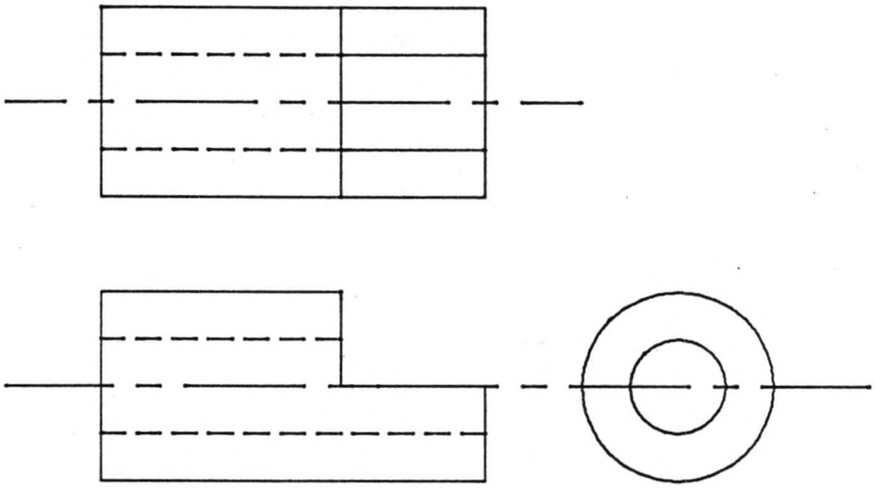


Figure 1-11 Multiview Drawing Smple 6

Proportion:
1" = 1"

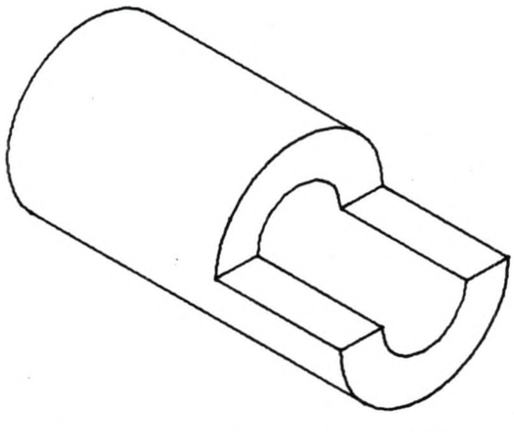


Figure 1-12. 3-Dimension drawing Sample f

Proportion:
1" = 2"

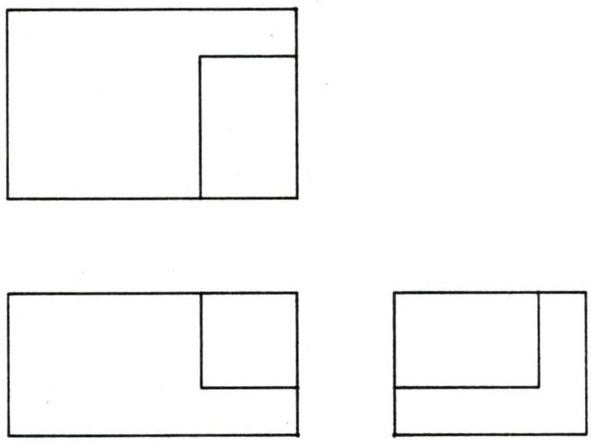


Figure 1-13 Multiview Drawing Smple 7

Proportion:
1" = 0.5"

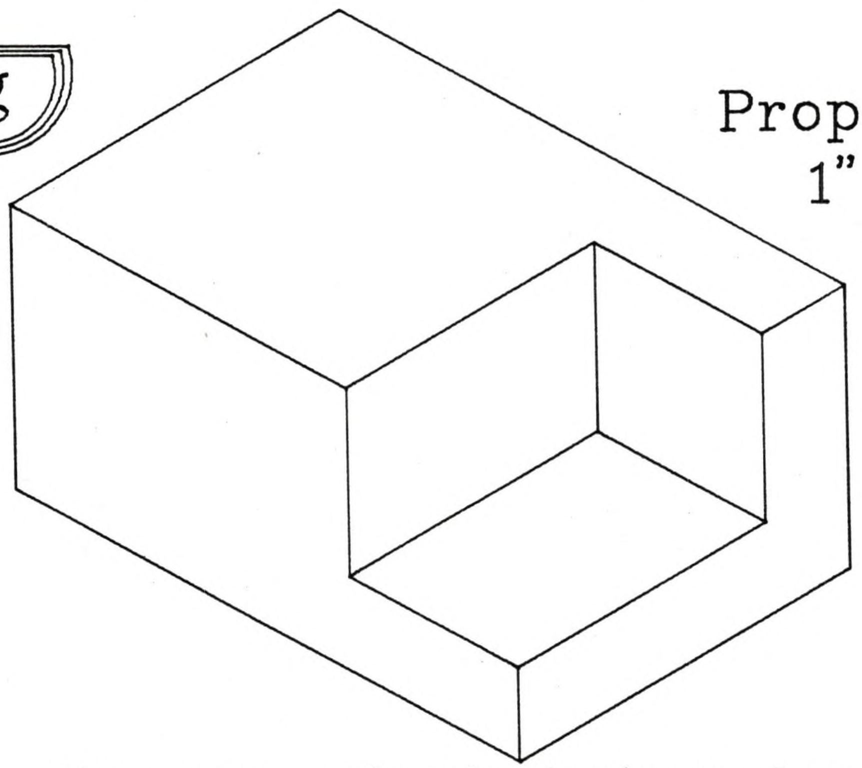


Figure 1-14. 3-Dimension drawing Sample g

8

Proportion:
1" = 1"

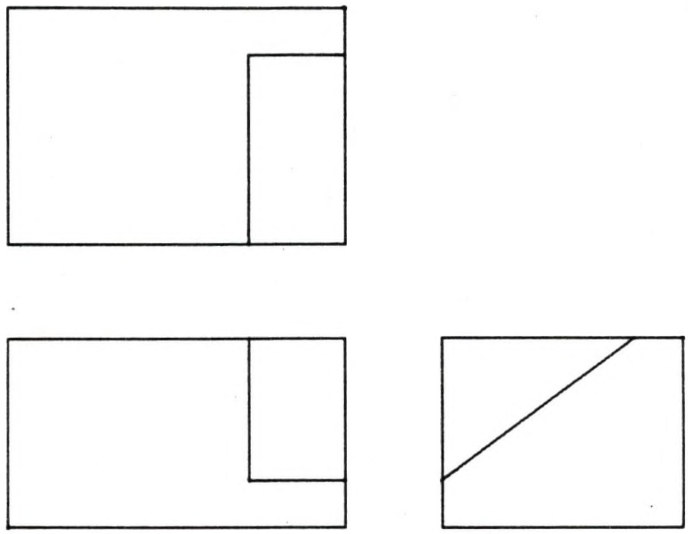


Figure 1-15 Multiview Drawing Smple 8

h

Proportion:
1" = 1"

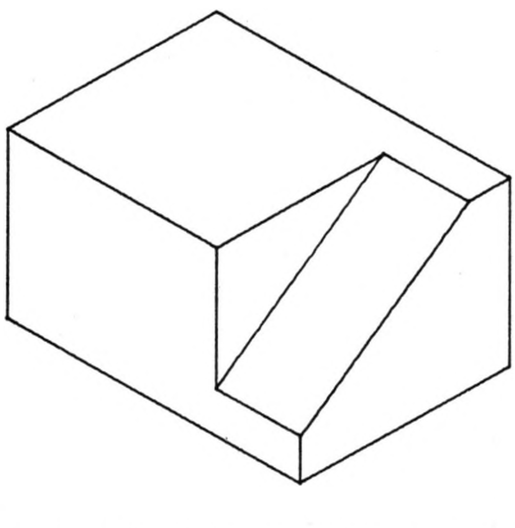


Figure 1-16. 3-Dimension drawing Sample h

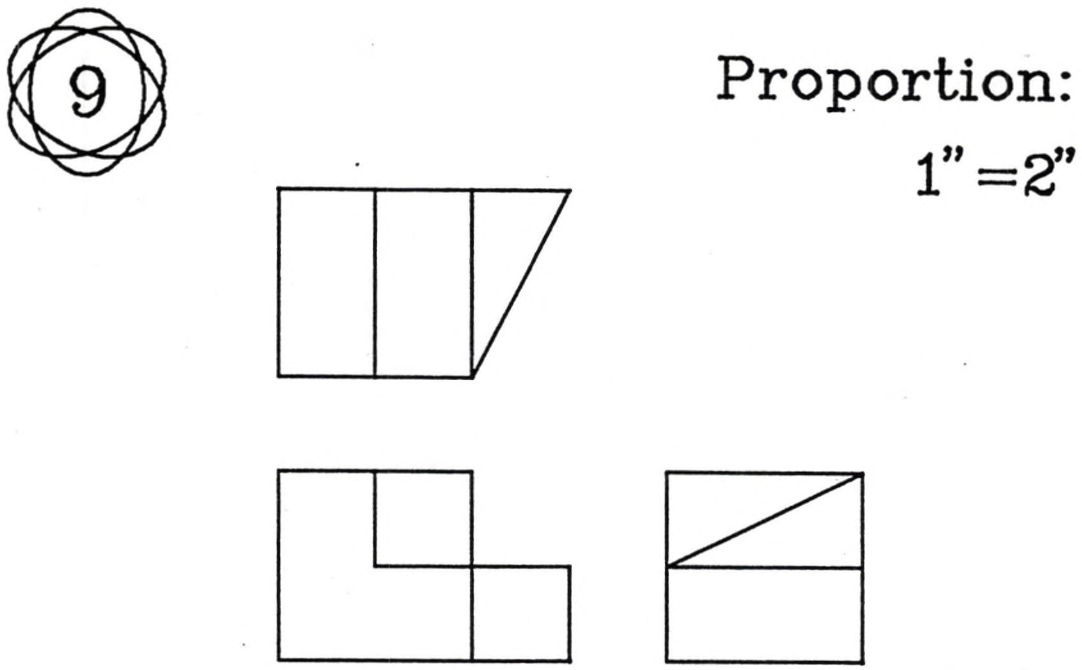


Figure 1-17 Multiview Drawing Smple 9

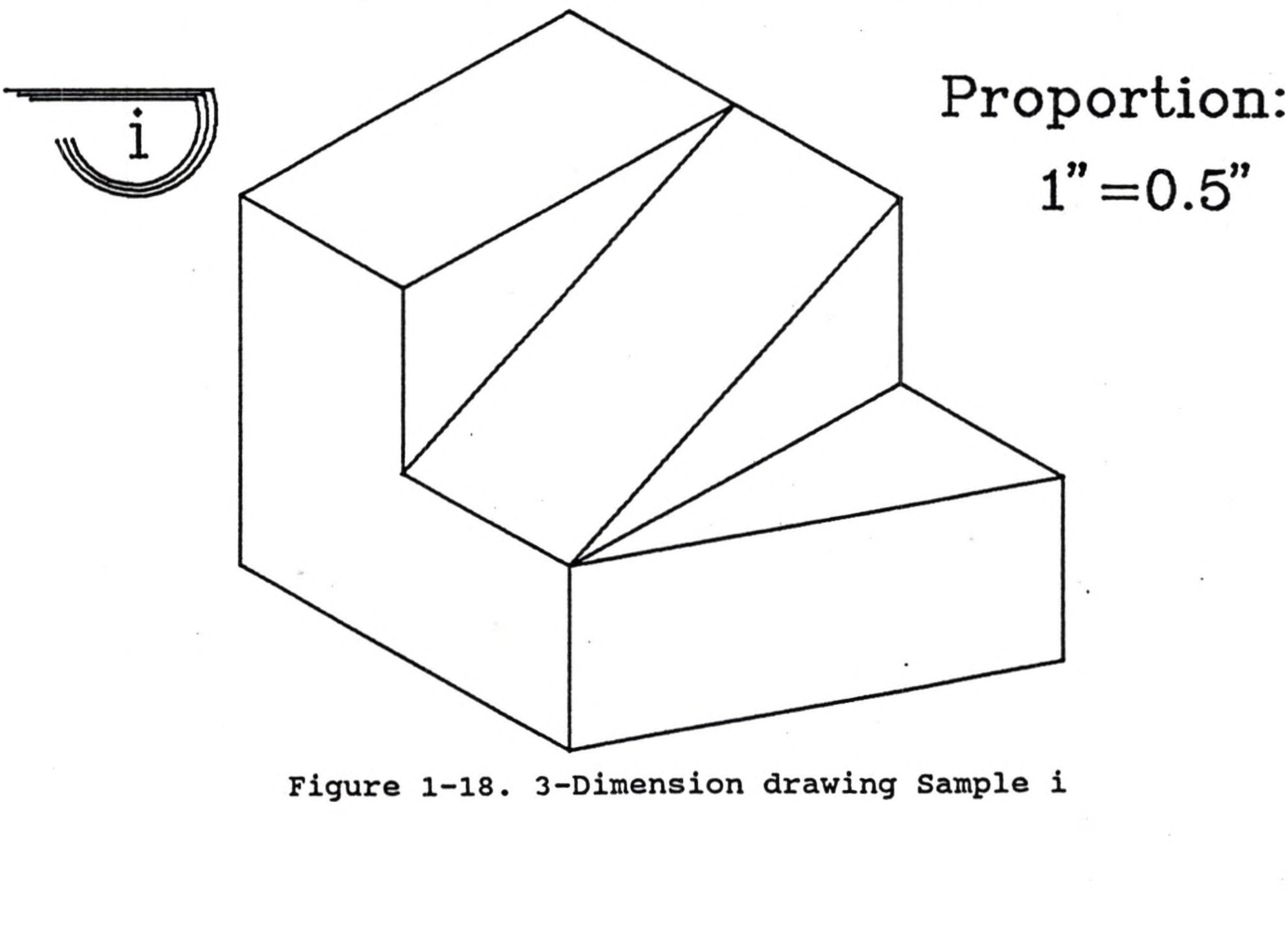


Figure 1-18. 3-Dimension drawing Sample i

10

Proportion:

1" =0.5"

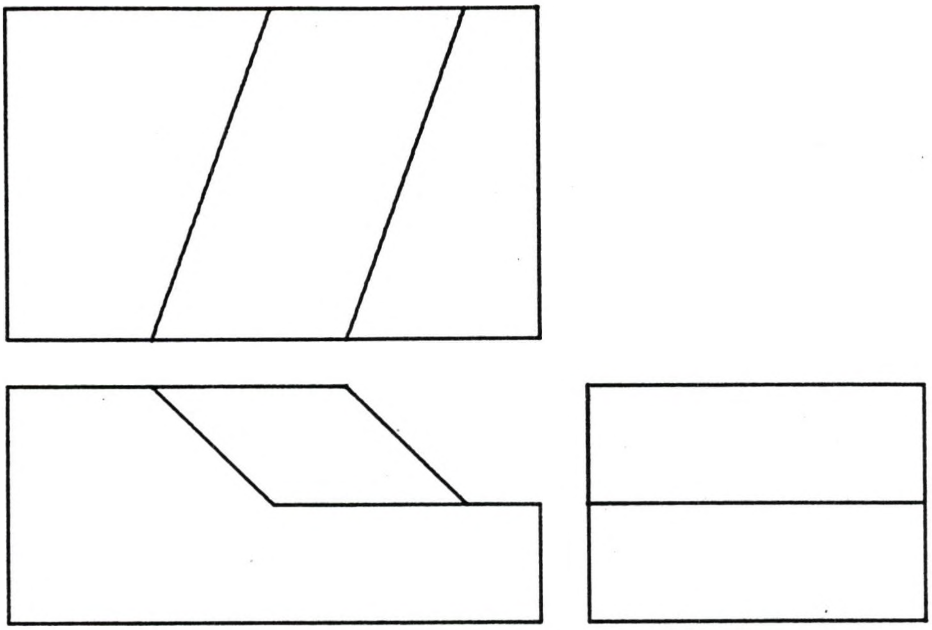


Figure 1-19 Multiview Drawing Smple 10

j

Proportion:

1" =2"

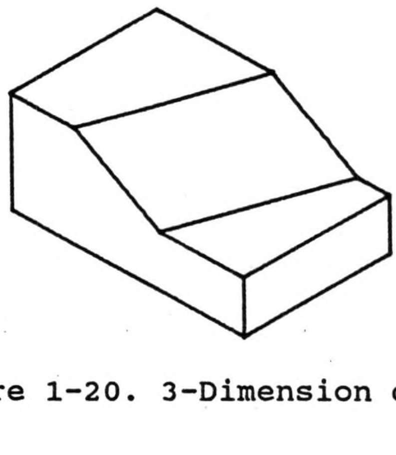


Figure 1-20. 3-Dimension drawing Sample j

11

Proportion:

1" = 1"

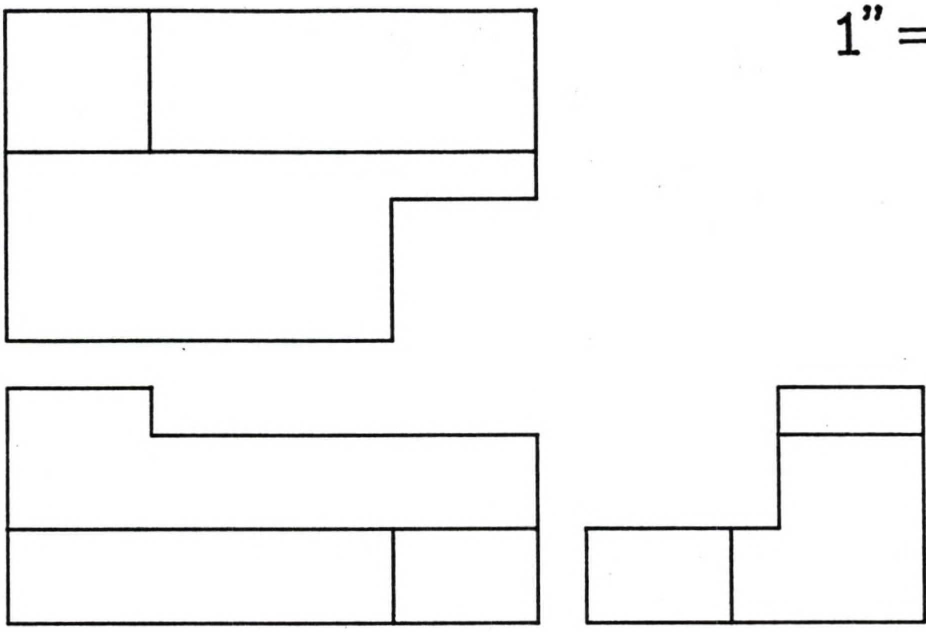


Figure 1-21 Multiview Drawing Smple 11

k

Proportion:

1" = 1"

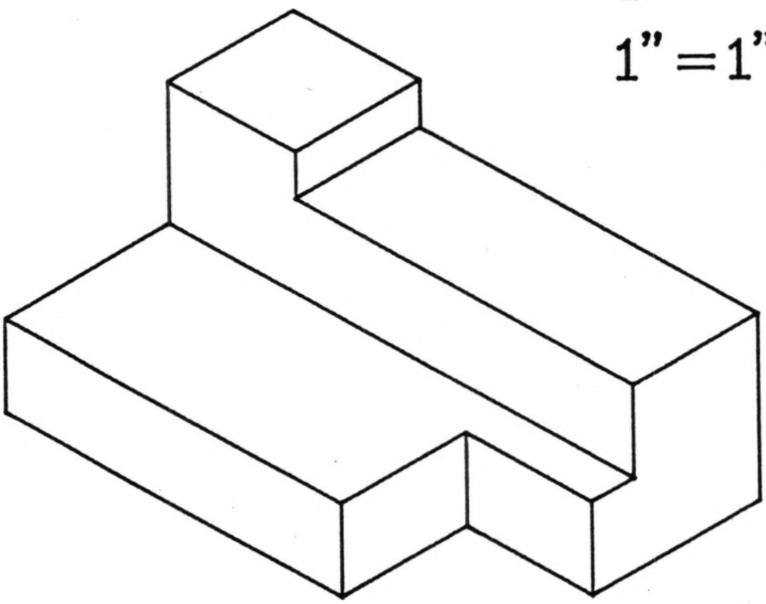


Figure 1-22. 3-Dimension drawing Sample k

12

Proportion:

1" =2"

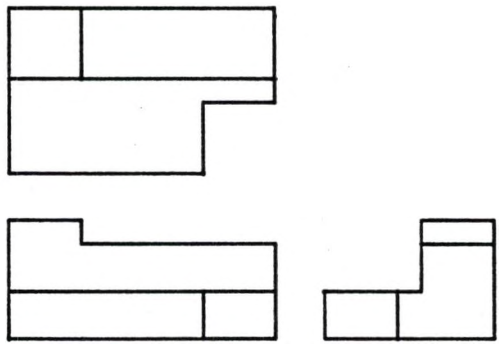


Figure 1-23 Multiview Drawing Smple 12

1

Proportion:

1" =0.5"

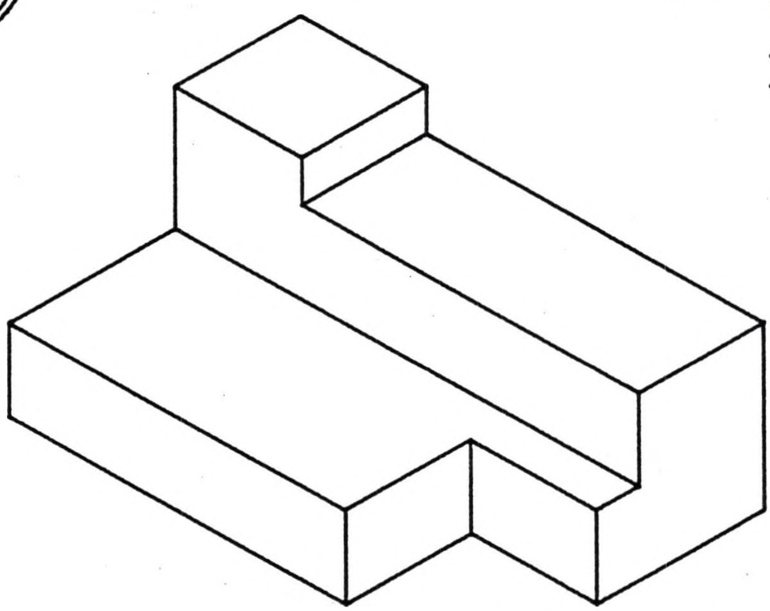


Figure 1-24. 3-Dimension drawing Sample 1

13

Proportion:

1" = 1"

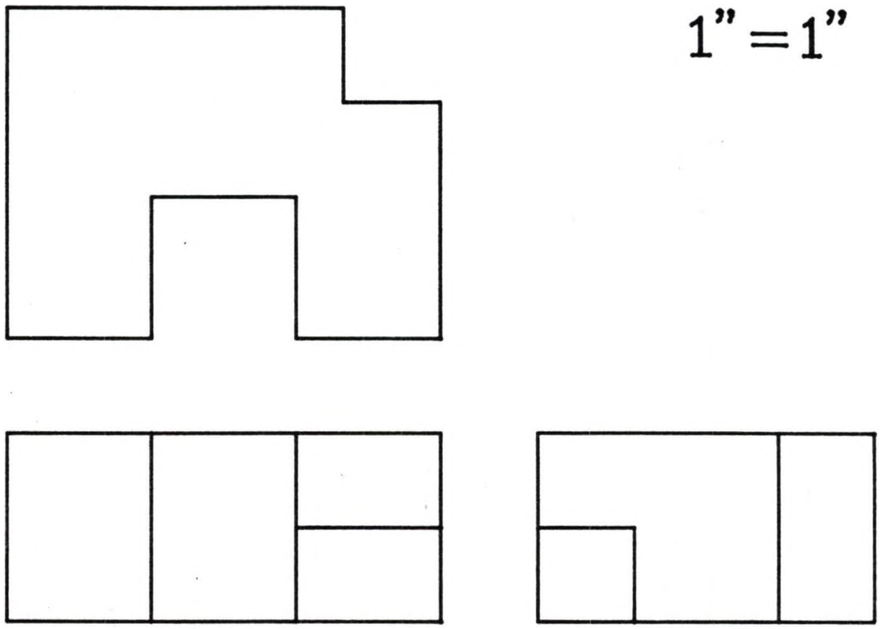


Figure 1-25 Multiview Drawing Smple 13

m

Proportion:

1" = 1"

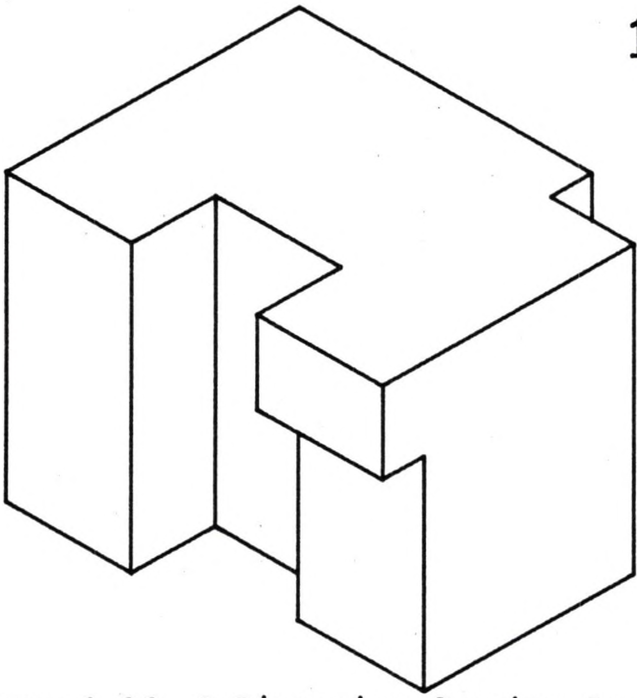


Figure 1-26. 3-Dimension drawing Sample m

14

Proportion:
1" =2"

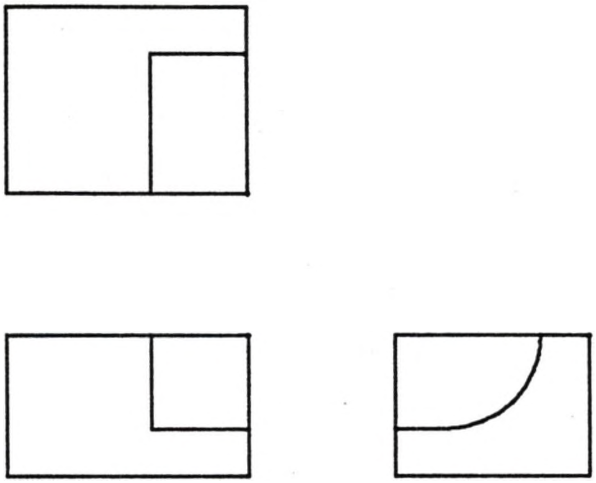


Figure 1-27 Multiview Drawing Smple 14

n

Proportion:
1" =0.5"

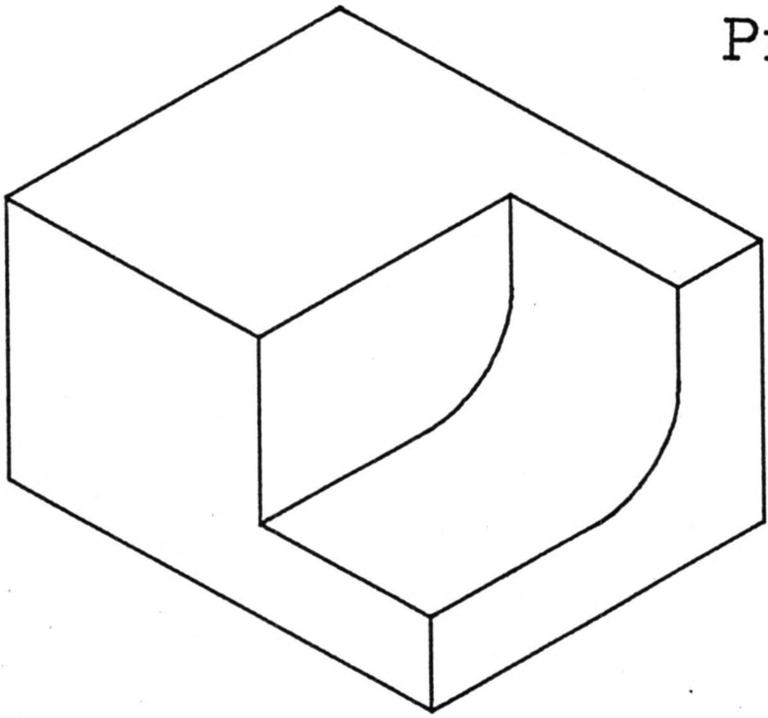


Figure 1-28. 3-Dimension drawing Sample n

15

Proportion:

1" =0.5"

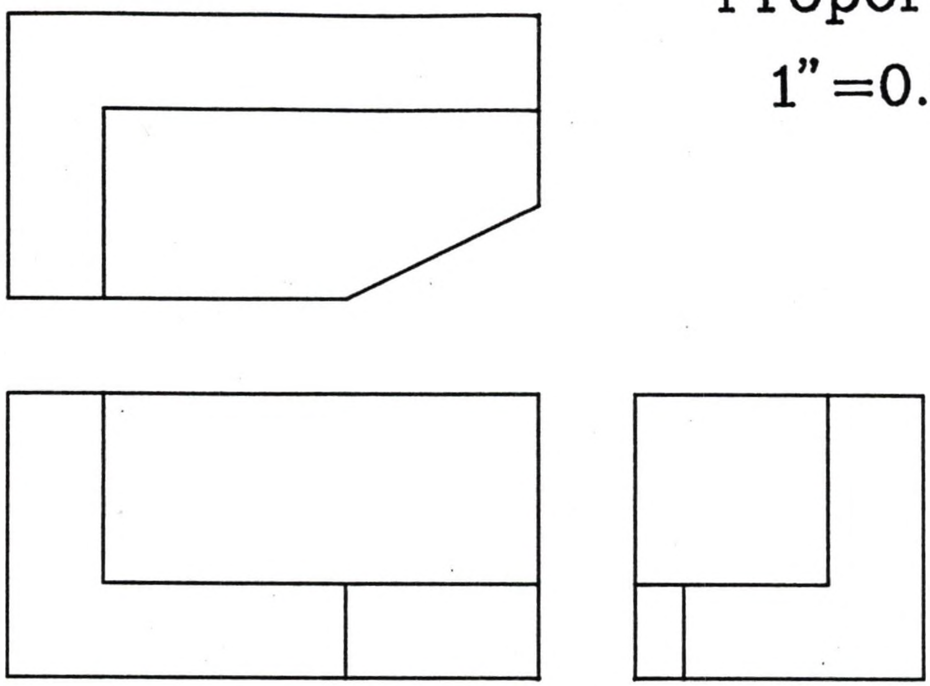


Figure 1-29 Multiview Drawing Smple 15

Proportion:

1" =2"

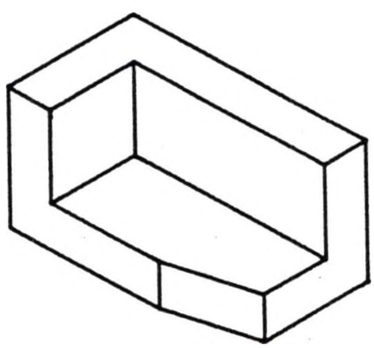


Figure 1-30. 3-Dimension drawing Sample o

16

Proportion:

1"=1"

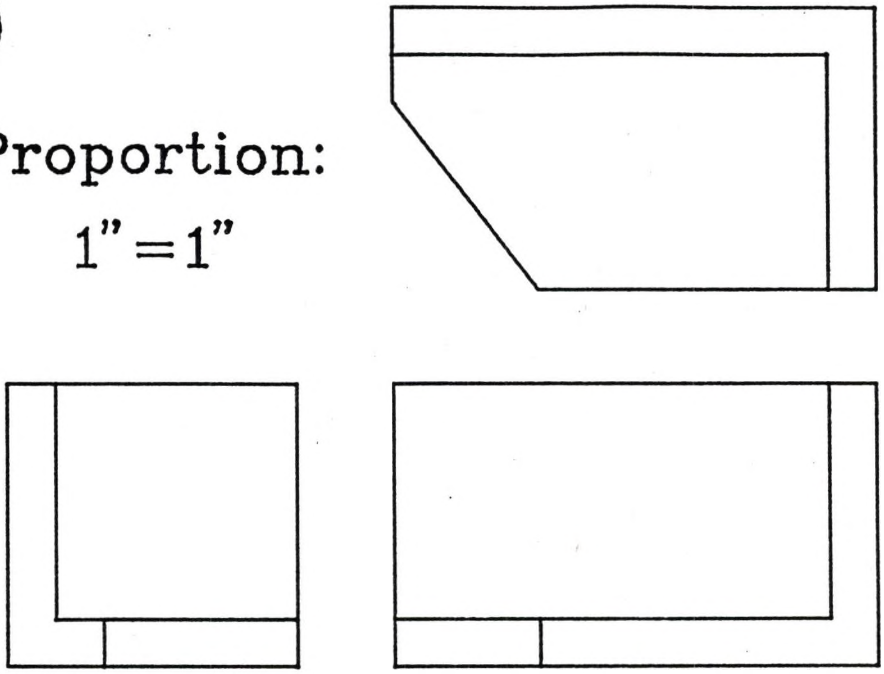


Figure 1-31 Multiview Drawing Smple 16

p

Proportion:

1"=1"

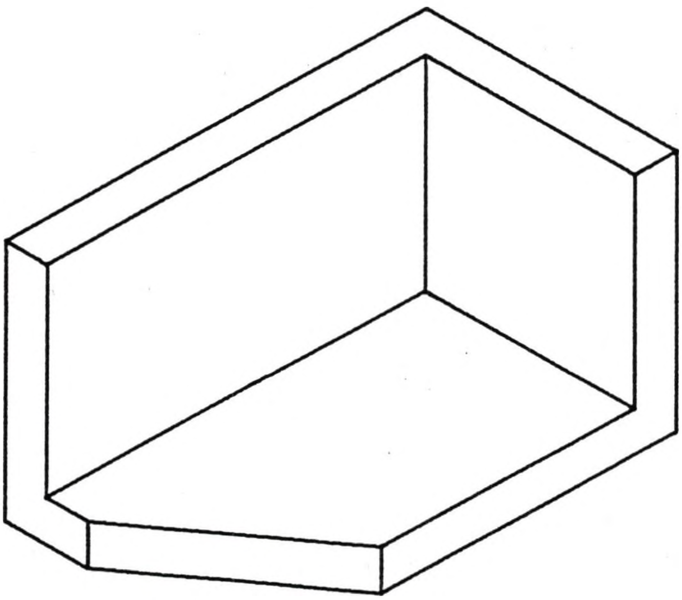


Figure 1-32. 3-Dimension drawing Sample p

17

Proportion:

1"=1"

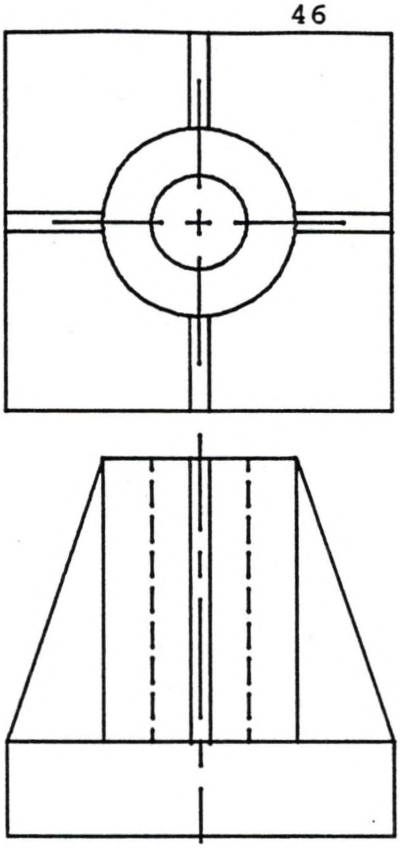


Figure 1-33 Multiview Drawing Smple 17

q

Proportion:

1"=1"

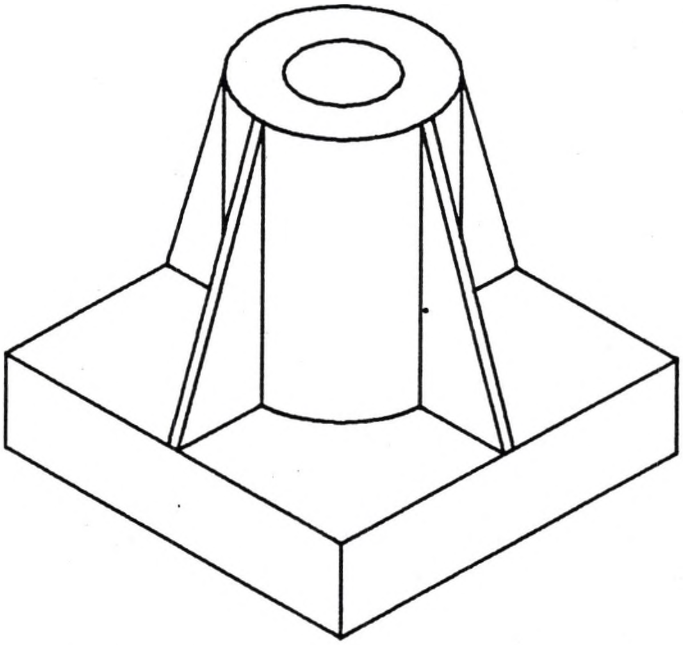


Figure 1-34. 3-Dimension drawing Sample q

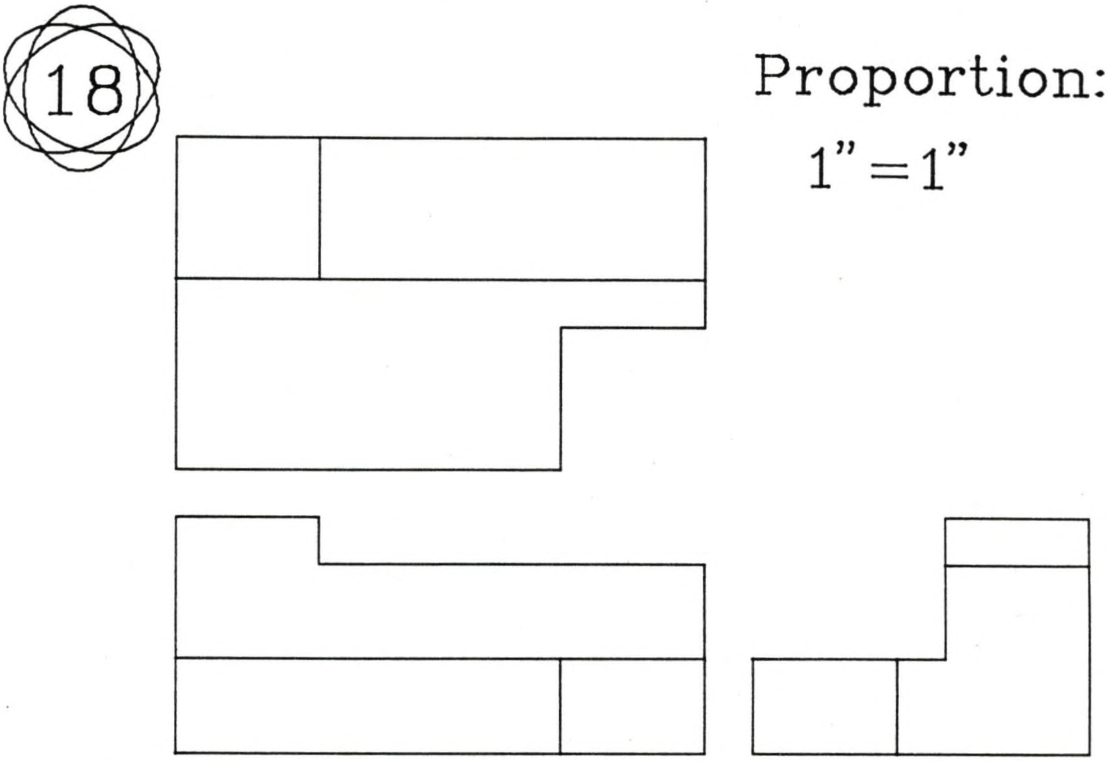


Figure 1-35 Multiview Drawing Smple 18

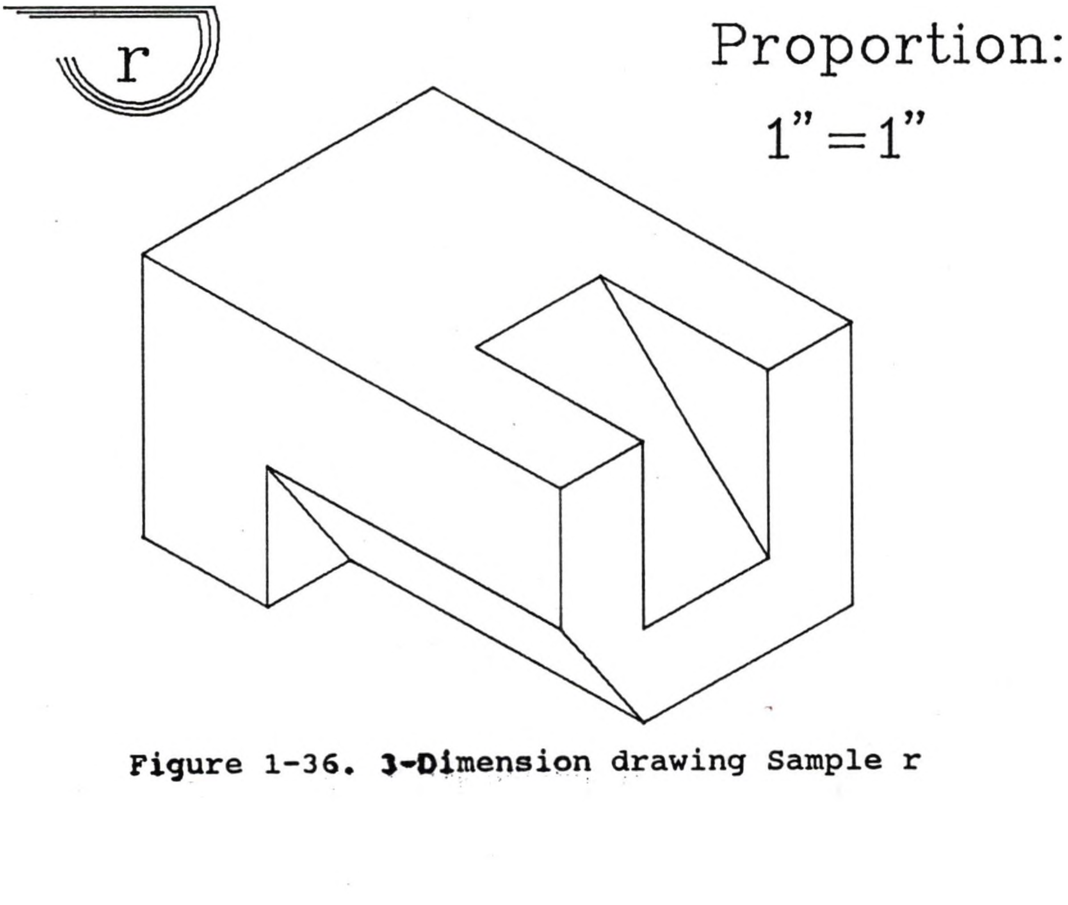


Figure 1-36. 3-Dimension drawing Sample r

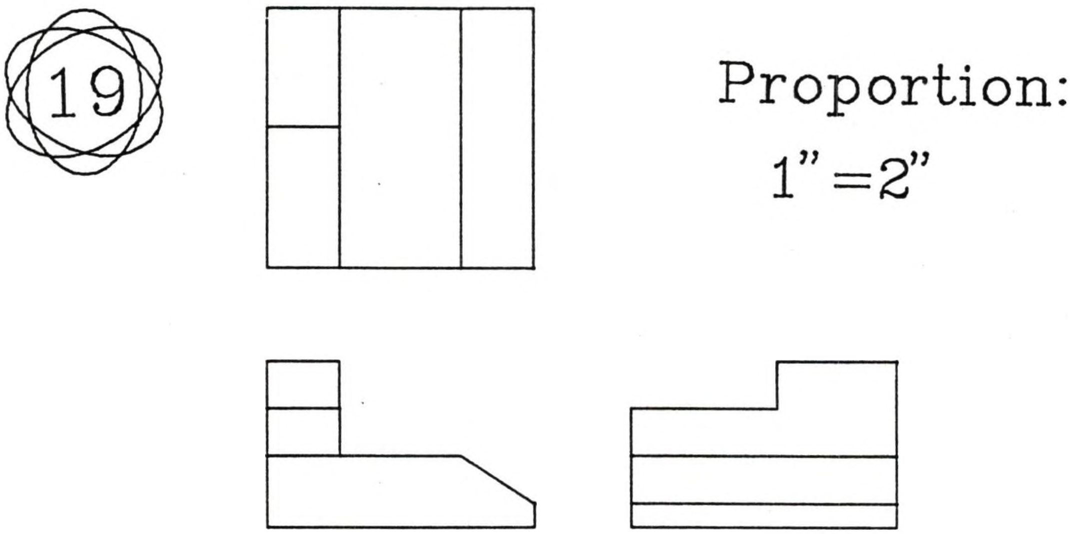


Figure 1-37 Multiview Drawing Smple 19

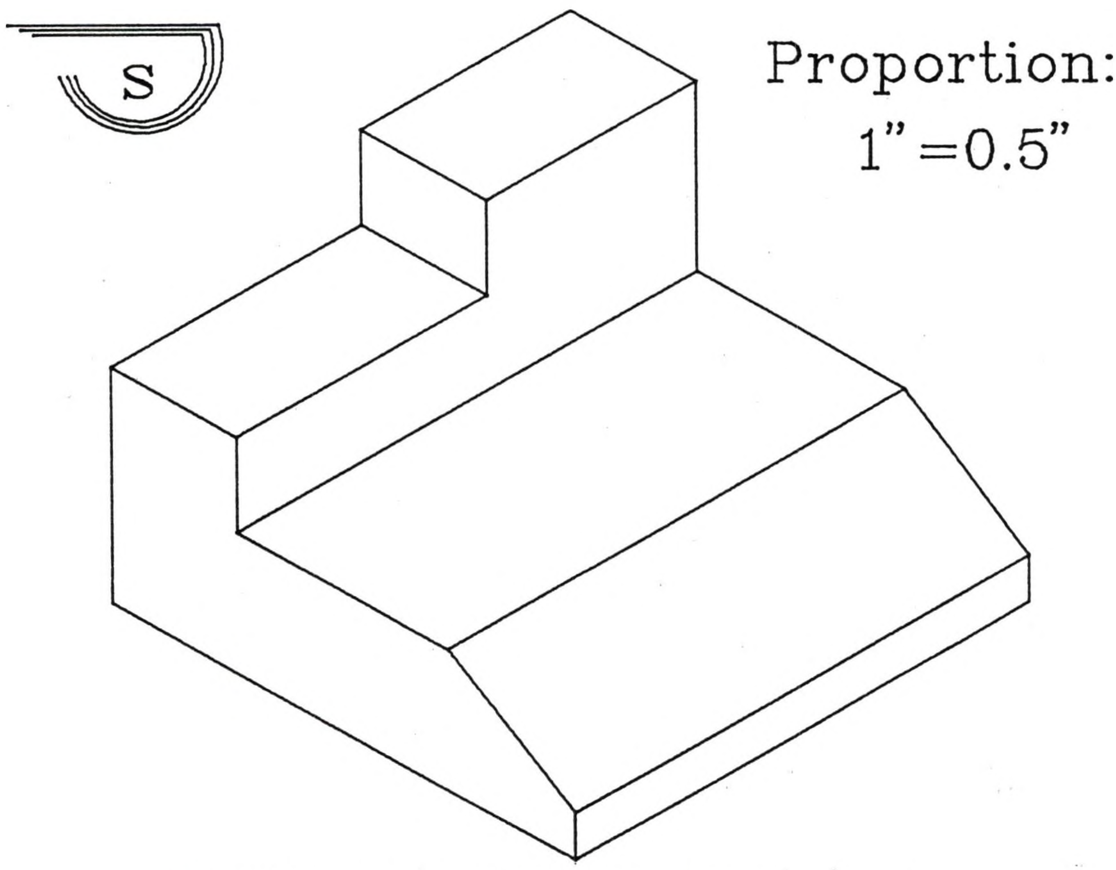


Figure 1-38. 3-Dimension drawing Sample s

20

Proportion:

1" = 1"

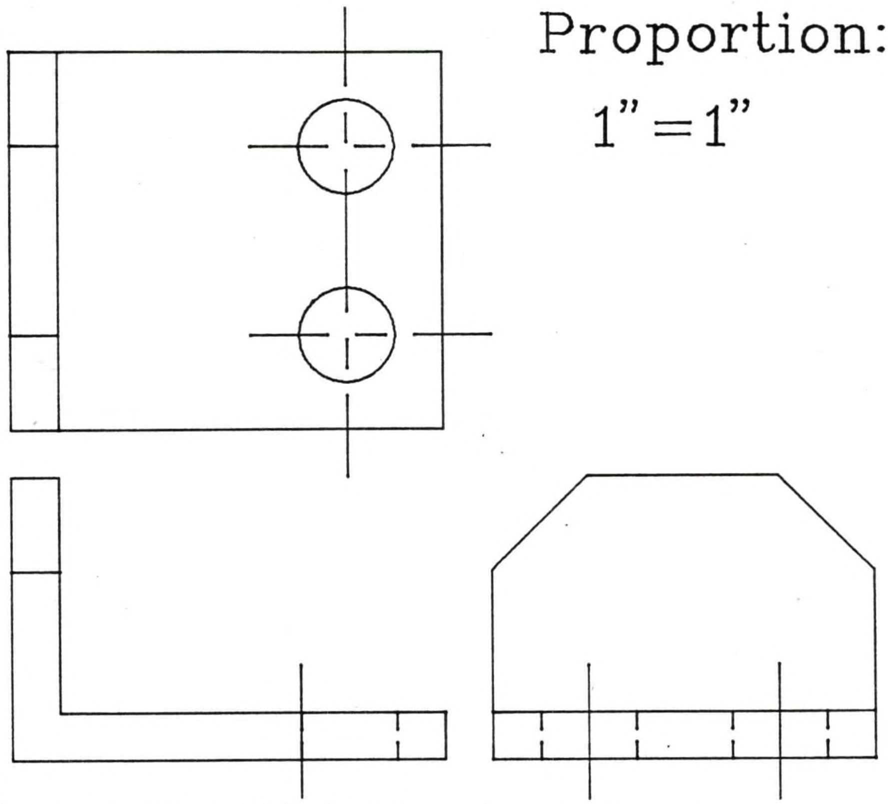


Figure 1-39 Multiview Drawing Smple 20

t

Proportion:

1" = 1"

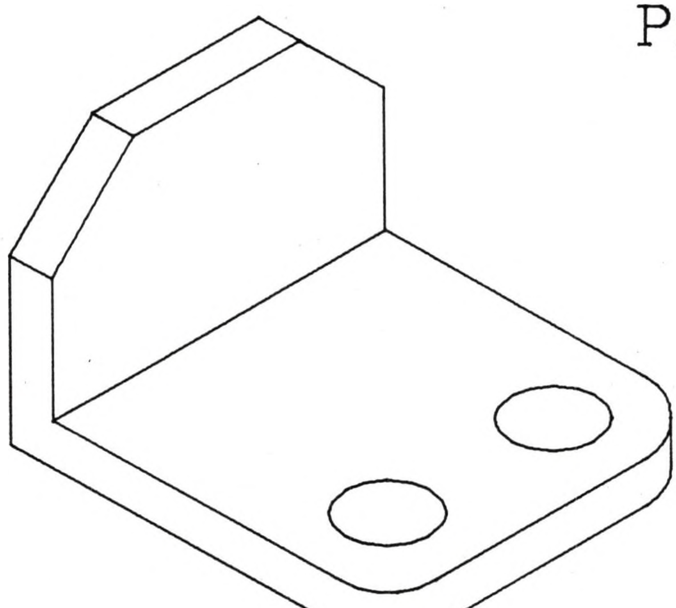


Figure 1-40. 3-Dimension drawing Sample t

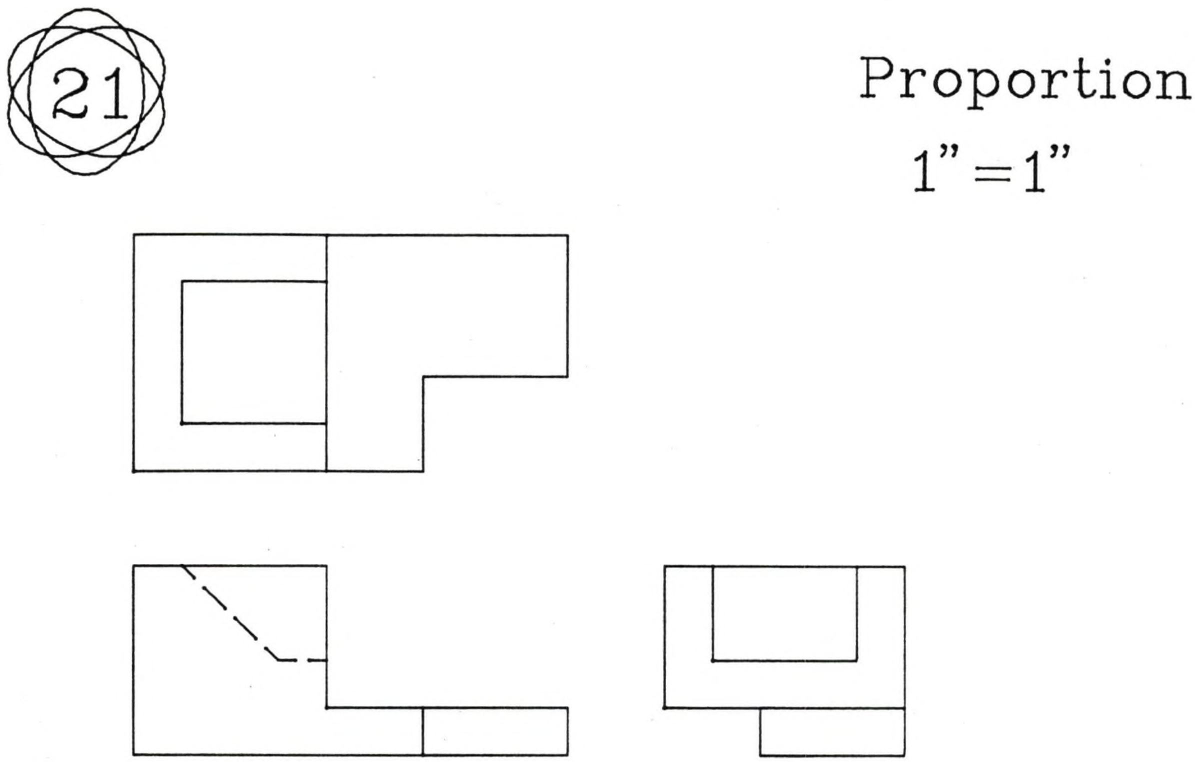


Figure 1-41 Multiview Drawing Smple 21

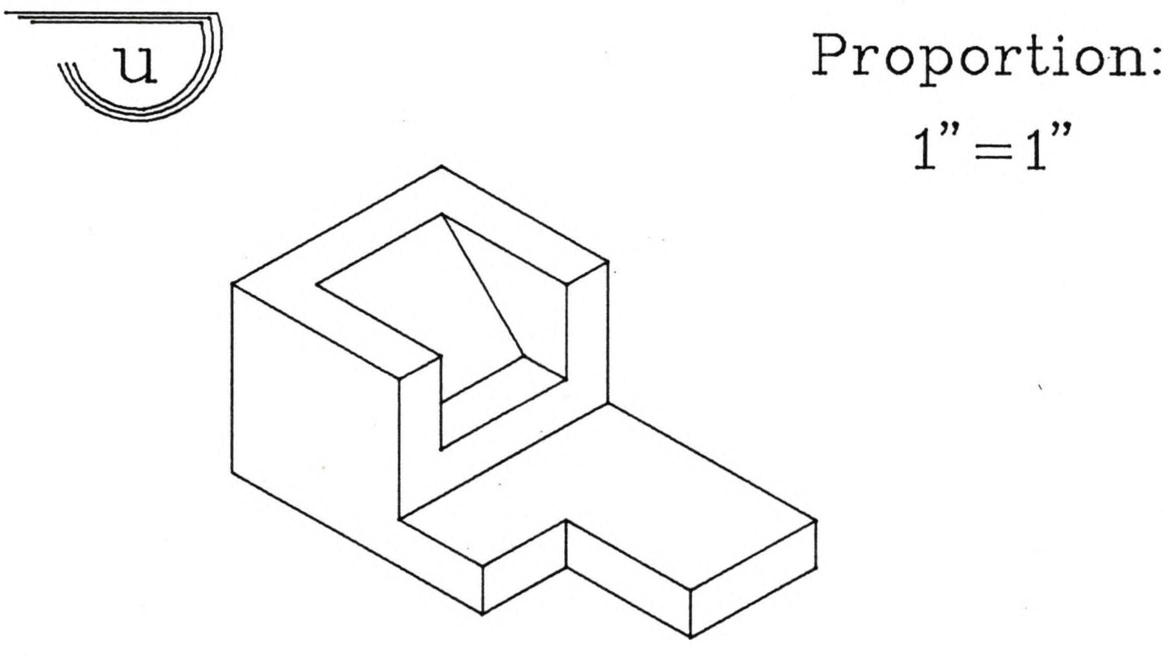


Figure 1-42. 3-Dimension drawing Sample u

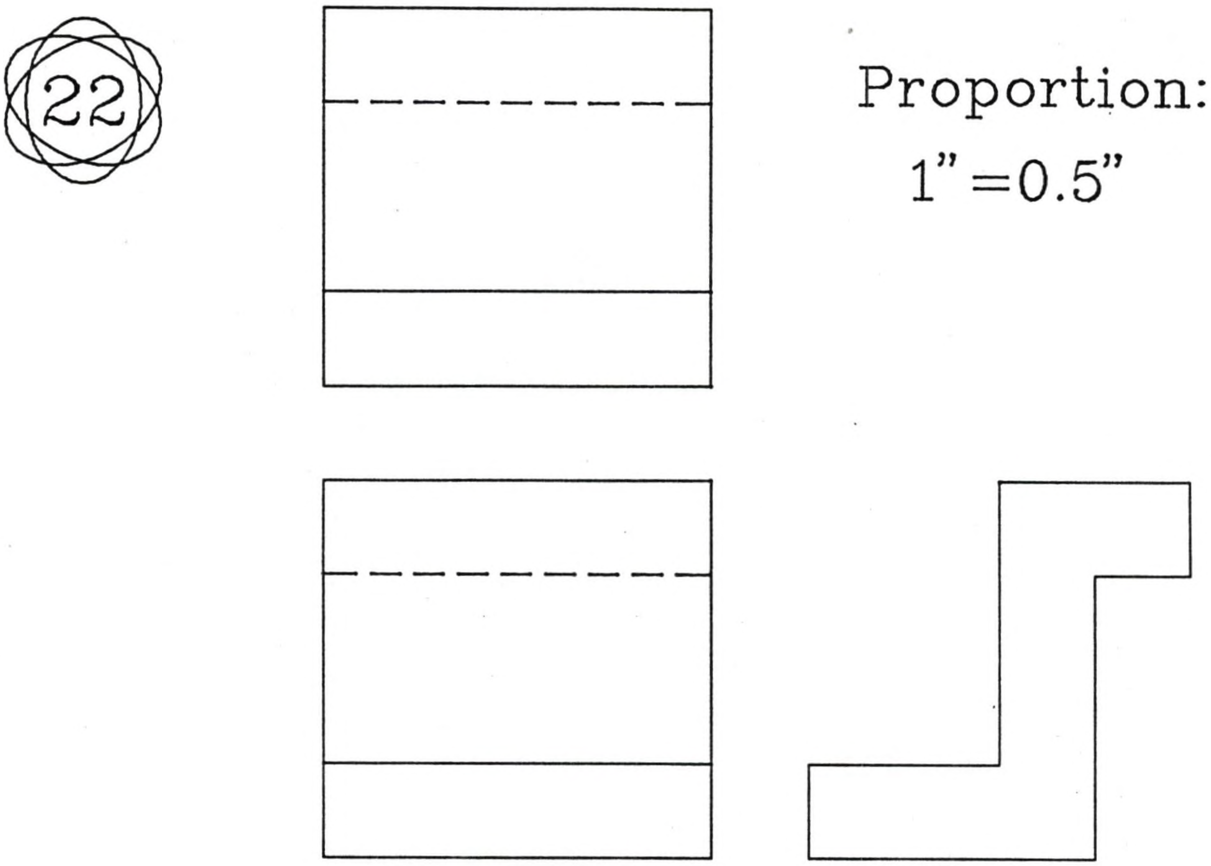


Figure 1-43 Multiview Drawing Smple 22

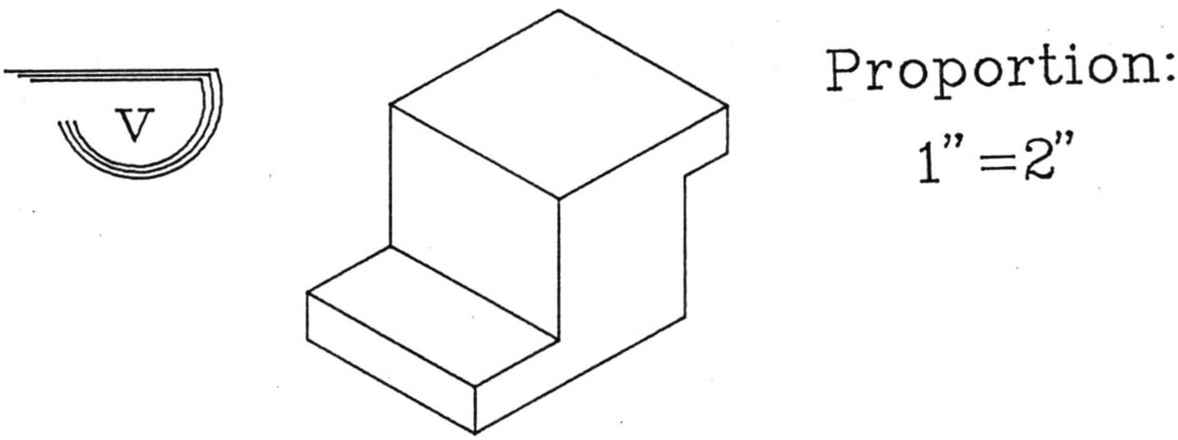


Figure 1-44. 3-Dimension drawing Sample v

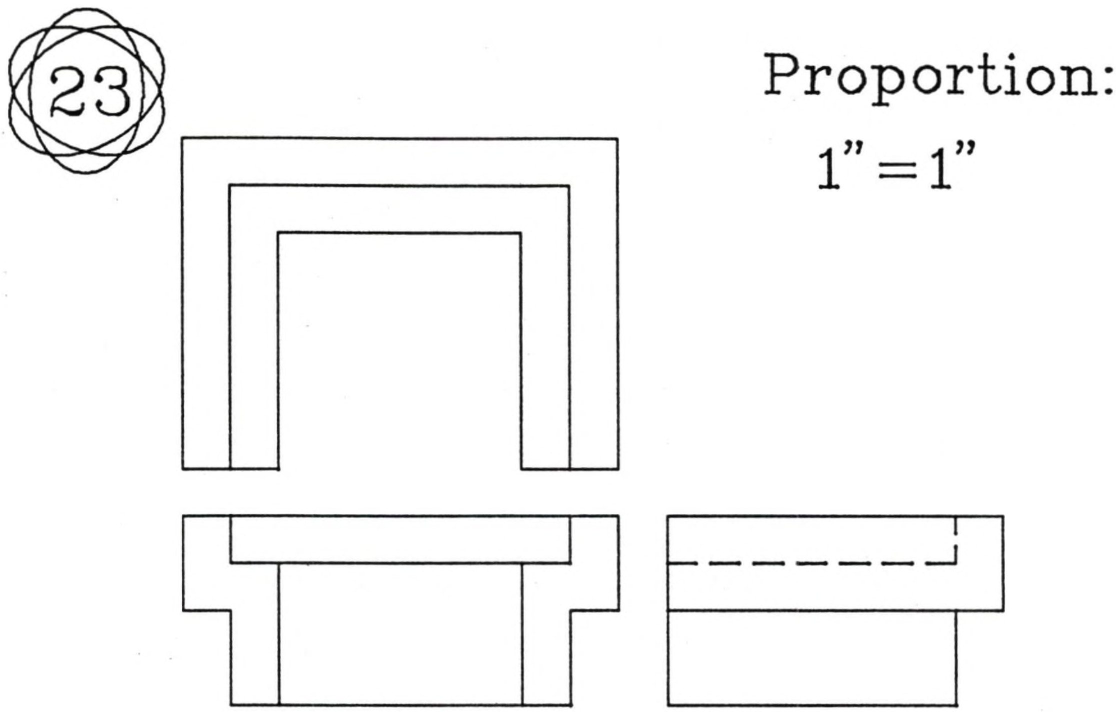


Figure 1-45 Multiview Drawing Smple 23

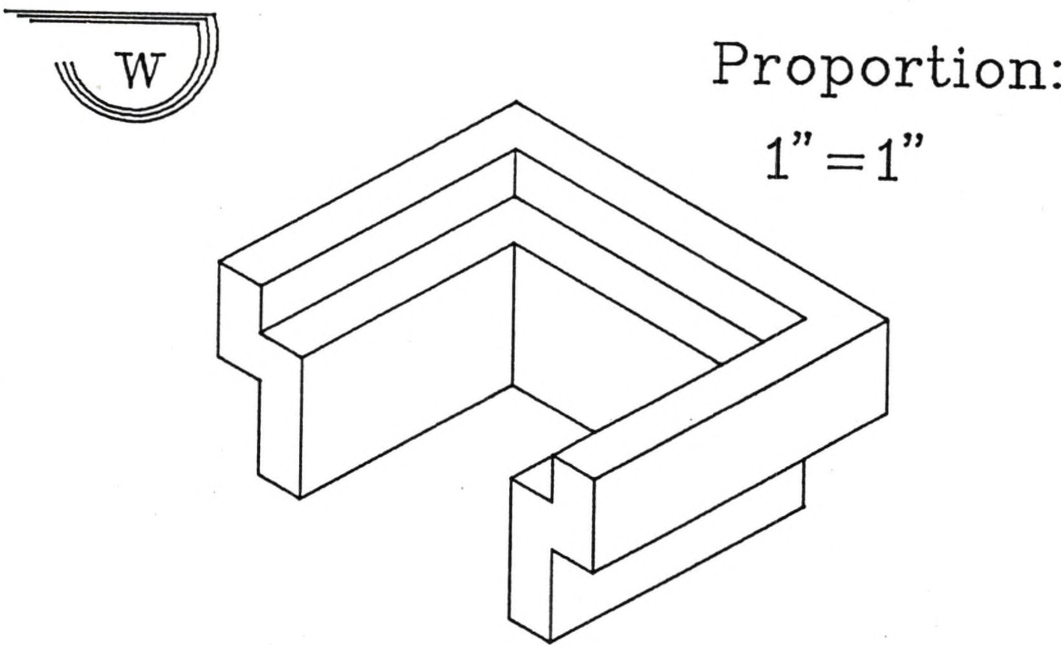


Figure 1-46. 3-Dimension drawing Sample w

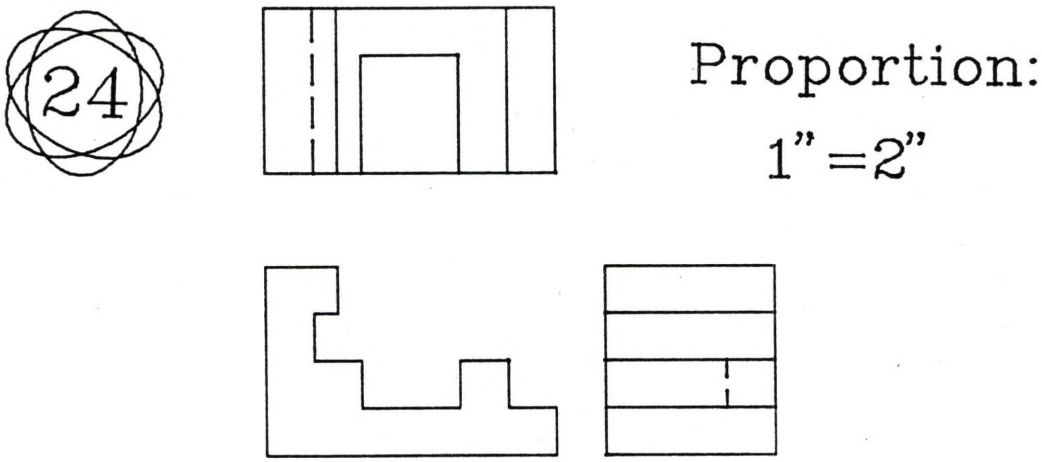


Figure 1-47 Multiview Drawing Smple 24

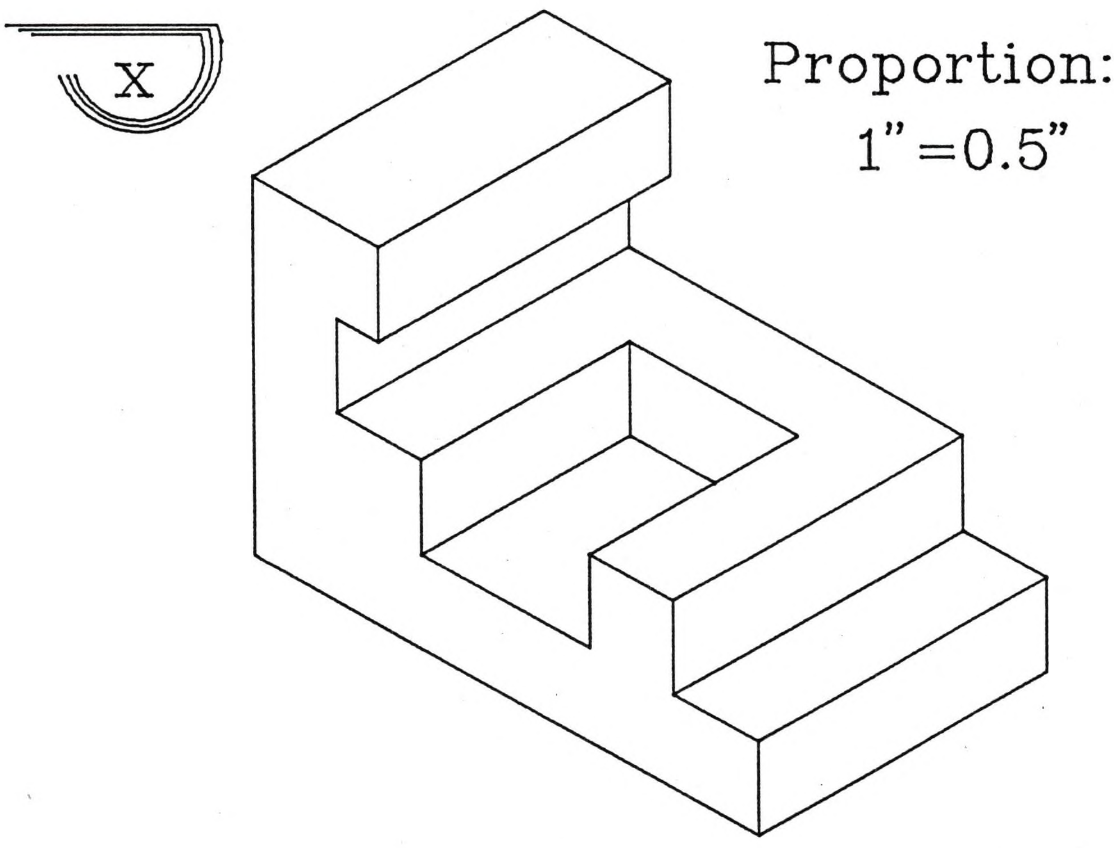


Figure 1-48. 3-Dimension drawing Sample x

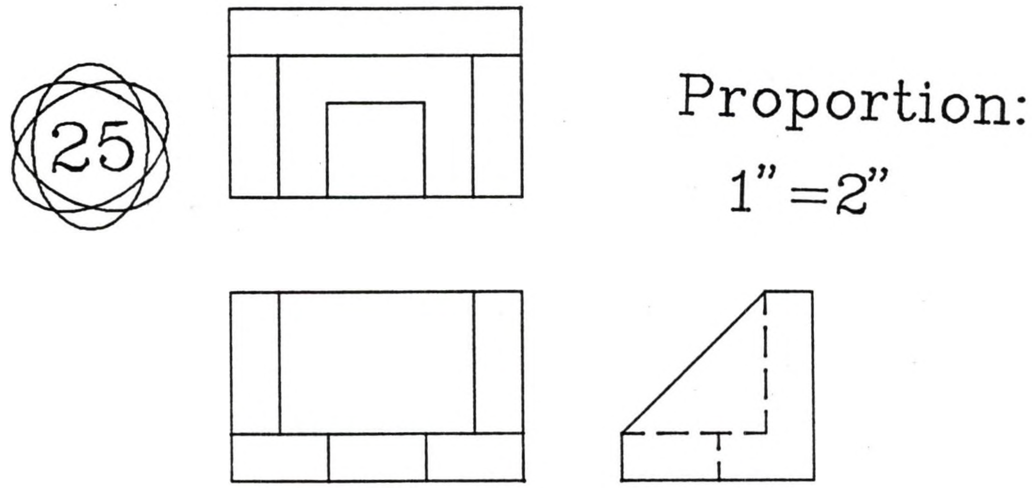


Figure 1-49 Multiview Drawing Smple 25

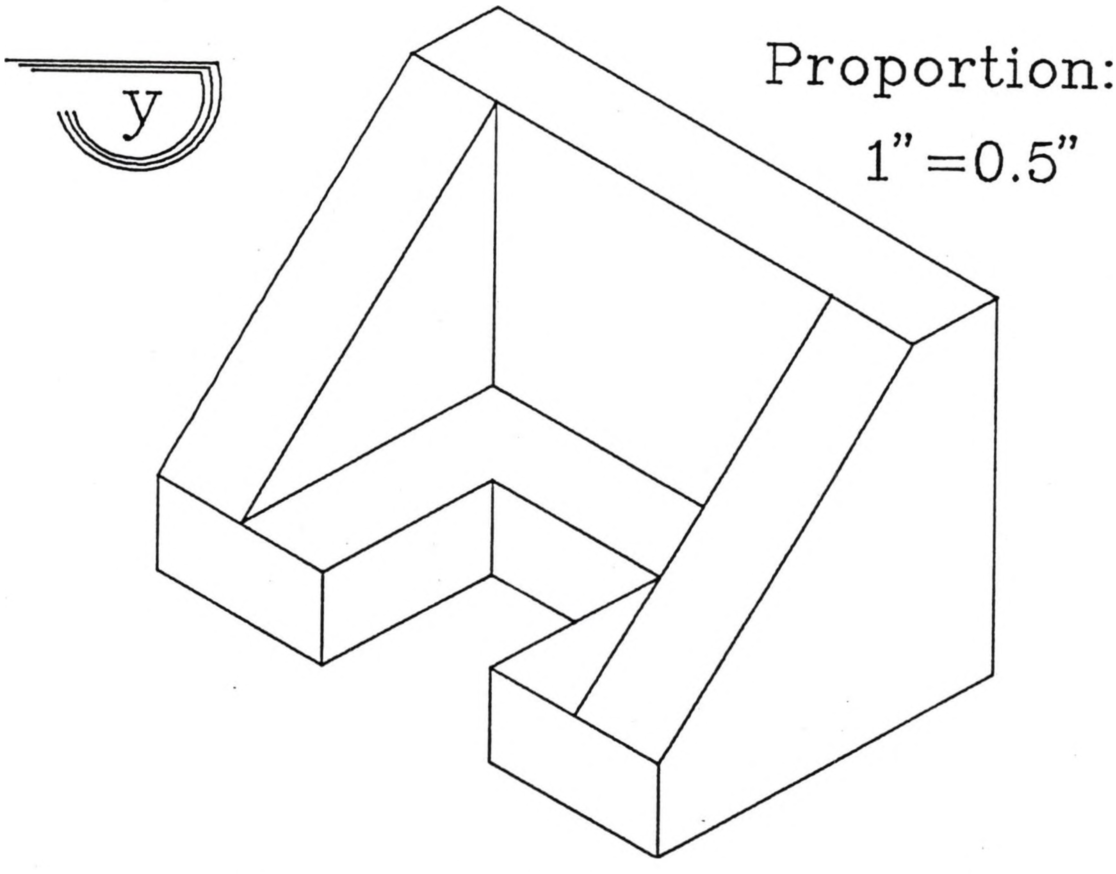


Figure 1-50. 3-Dimension drawing Sample y

26

Proportion:

1" = 1"

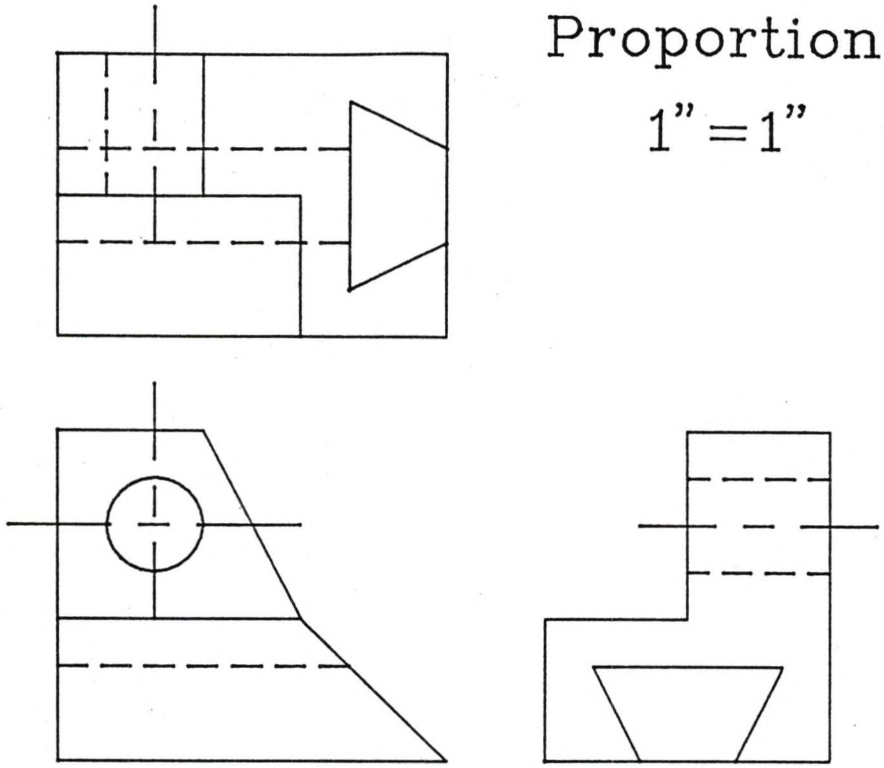


Figure 1-51 Multiview Drawing Smple 26

Z

Proportion

1" = 1"

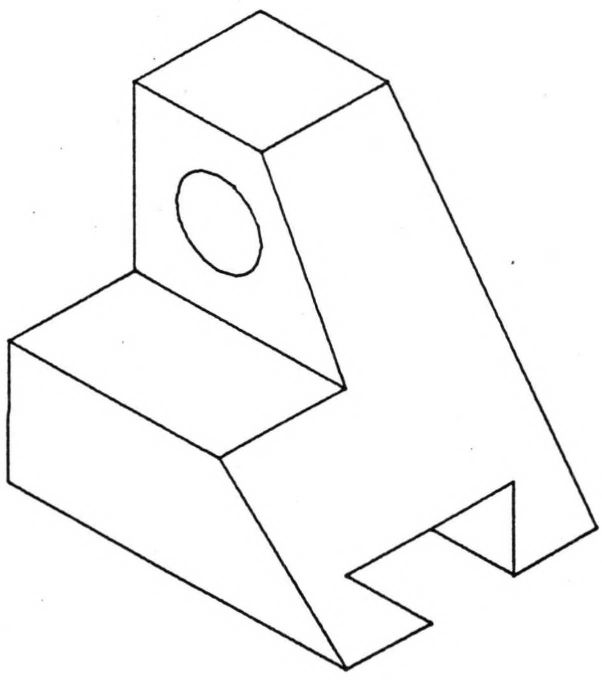


Figure 1-52. 3-Dimension drawing Sample z

Proportion:
1" =0.5"

27

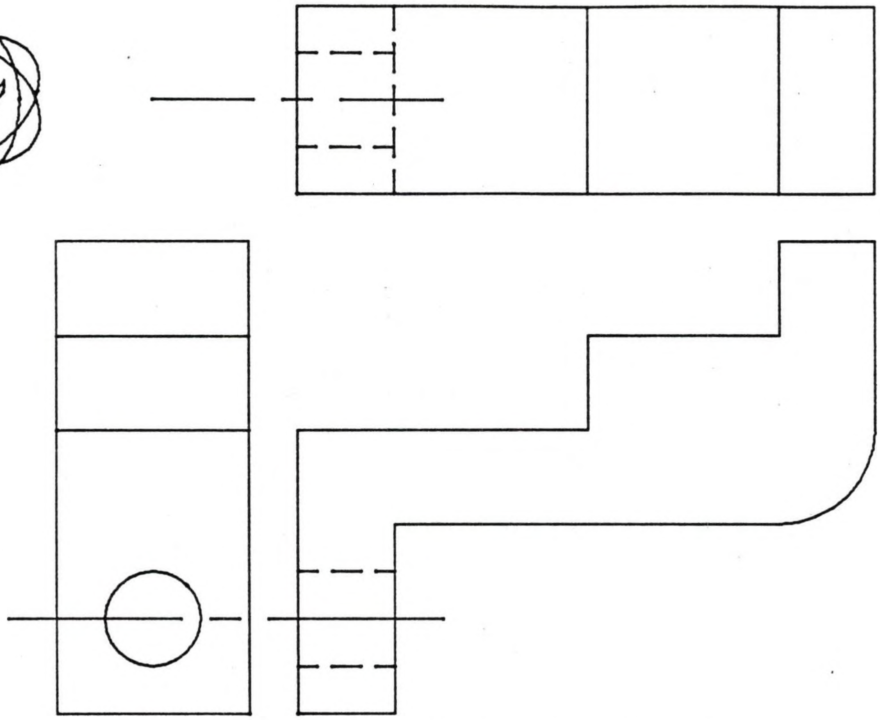


Figure 1-53 Multiview Drawing Smple 27

A

Proportion:

1" =2"

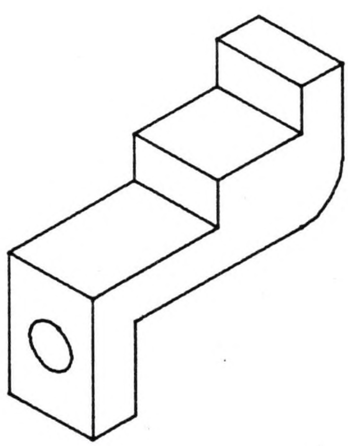


Figure 1-54. 3-Dimension drawing Sample A

28

Proportion:
1"=1"

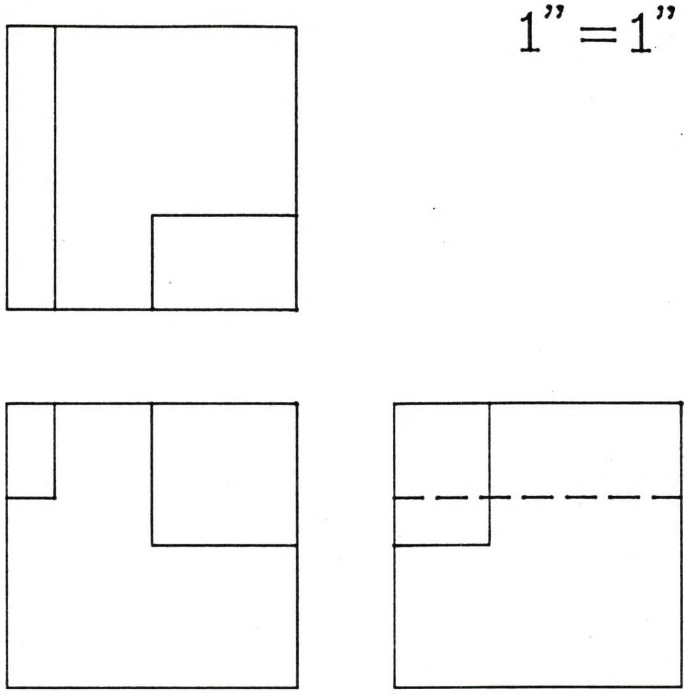


Figure 1-55 Multiview Drawing Smple 28

B

Proportion:
1"=1"

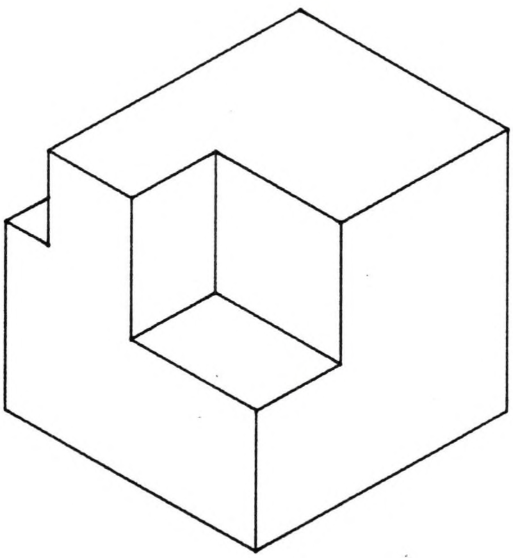


Figure 1-56. 3-Dimension drawing Sample B

29

Proportion:

1" = 1"

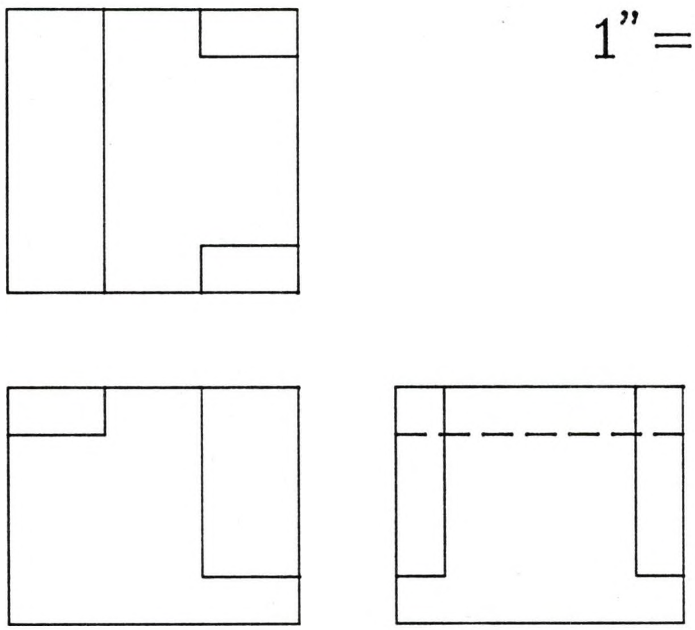


Figure 1-57 Multiview Drawing Smple 29

C

Proportion:

1" = 1"

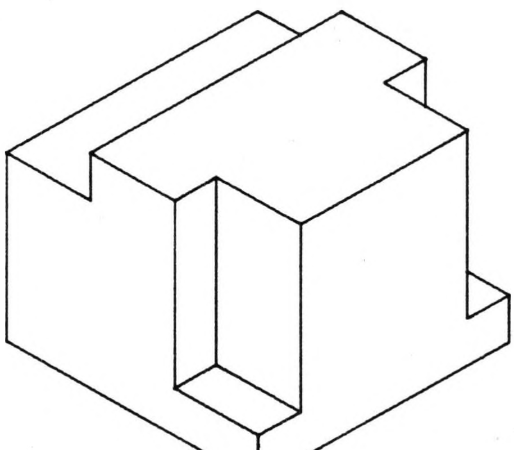


Figure 1-58. 3-Dimension drawing Sample C

30

Proportion:

1" = 1"

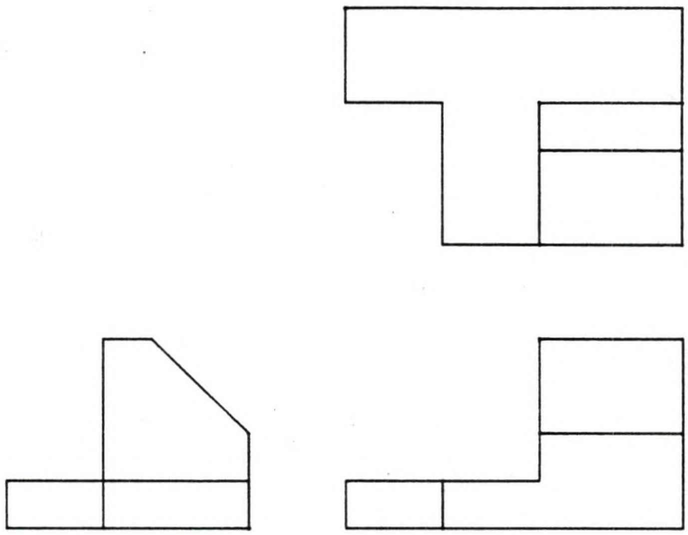


Figure 1-59 Multiview Drawing Smple 30

D

Proportion

1" = 1"

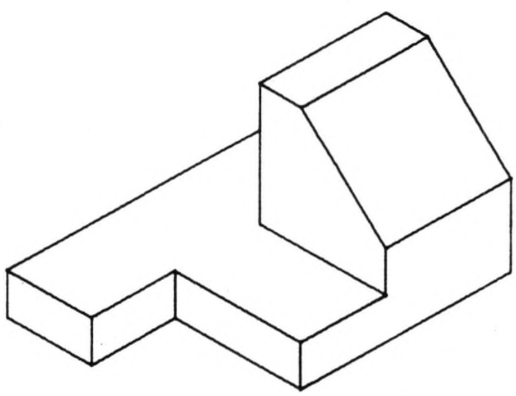


Figure 1-59. 3-Dimension drawing Sample D

Conversion of Multiview and 3-Dimension Drawing Answer Sheet

Original	Conversion	Original	Conversion
Score:			
Excellent ( )	Good ( )	Not Bad ( )	Work Harder ( )

Table 1-1. Answer Sheet for converting multiview and 3-dimension Drawing

Multiview and 3-dimension drawing answer

1	a	16	p
2	b	17	q
3	c	18	r
4	d	19	s
5	e	20	t
6	f	21	u
7	g	22	v
8	h	23	w
9	i	24	x
10	j	25	y
11	k	26	z
12	l	27	A
13	m	28	B
14	n	29	C
15	o	30	D

Learning Module No.2

Title: Electricity - Ohm's Law

Ohm's law is the basic concepts in electricity. It is necessary to have this knowledge either in the academic world of scientific field or in life. Through understanding Ohm's law, students use electrical products more efficiently. This activity will introduce Ohm's law and its practical application by demonstration and employing the question teaching method.

Objectives:

Upon completion of this activity, students will be able to :

1. understand the Ohm's law.
2. accurately calculate current, voltage, resistance and power by Ohm's law.
3. explain the difference between series circuits and parallel circuits.
4. predict the result of the problems by calculating.
5. design the circuit to solve the problem which is provided by teachers.

Technology Education Unit:

Electronic communication Technology

Mathematical Concepts:

Addition and subtraction, multiplication and division, and measurement.

Material:

Variable power supply (or batteries);

bulbs (can be replaced by resistances or LEDs);

Sockets;

board;

wires;   multimeter.

Source:

1. Bernard GRPB. (1977). Basic Electronics. (4 eds.). McGraw Hill, Inc.

2. Mark Sanders. (1991). Communication Technology - Today and Tomorrow. CA: GLENCOE/McFRAW-HILL Education Division.

Activity:

1. The teacher show the circuits which are provided in this activity by copying schematic diagram or constructing a circuit on the board to explain the relationship of current(I), voltage(V) and resistance(R).
2. By moving any component from the circuit will create new problems for the learners.
3. Students calculate Ohm's law. Teacher can select the students or students may volunteer to provide the answer for the problems.
4. The teacher demonstrates to give answers to students immediately.

5. After demonstration and questions, divide the students into groups, and provide work sheets for each group. They will follow the procedure step by step to build circuit on the board and complete the work sheet.

Evaluation:

Educator collects all work sheets after class, and evaluate students' accomplishment.

Note:

1. Before class, teachers can build some simple circuits on experiment boards (such as figure 2-1) or make copies from this research in order to have a lecture or demonstration during the class.
2. Teachers can change questions by using the same circuit.
3. Demonstration can give immediately feedback to student to enhance teaching effectiveness.

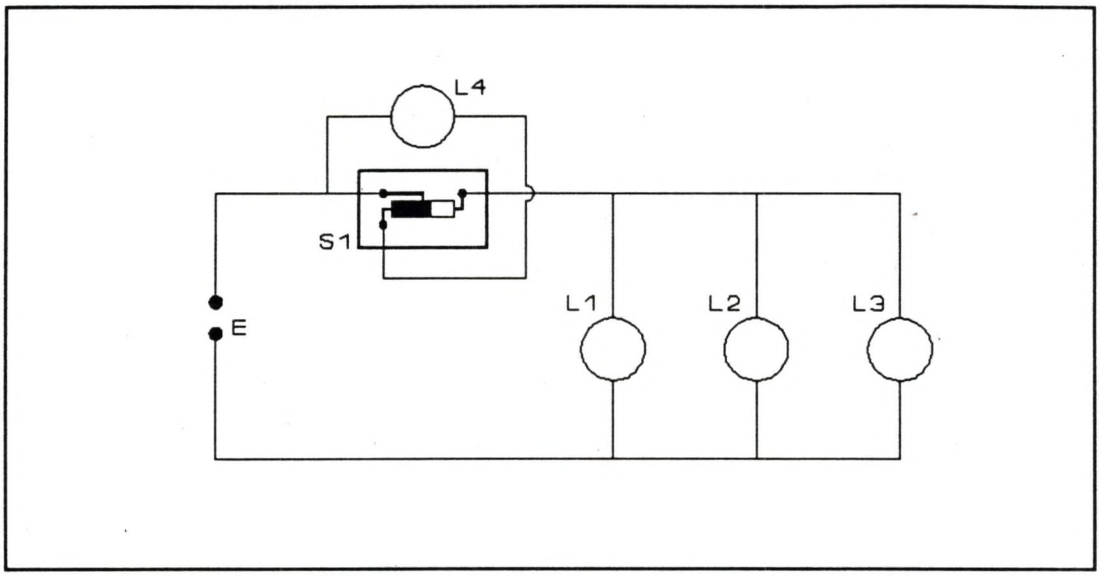


Figure 2-1. Pictorial Diagram for Ohm's Law Demonstration

E : Variable Power Supply or Batteries

L1, L2, L3, L4 : Lights.

S1 : 2-way Switch.

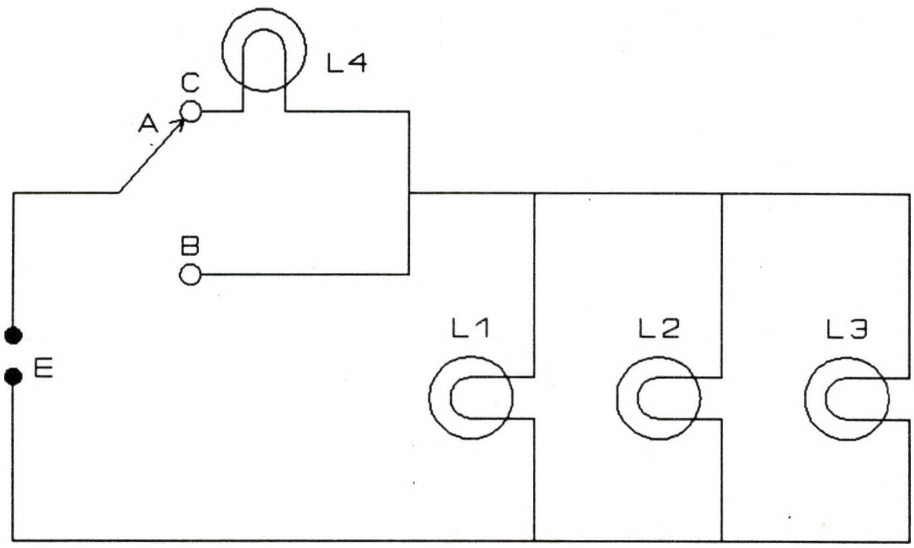


Figure 2-2. Schematic Circuit for Ohm's Law Demonstration

E : Variable Power Supply or Batteries

L1, L2, L3, L4 : Sockets. Screw bulbs when necessary.

L4 : (1) A is connected to C, when show series circuit. (such as L4 and L1 in the series circuit)

(2) A is connected to B, when show parallel circuit. (such as L1 and L2 in the parallel circuit)

(3) A is connected to C, when show sreies and parallel circuit at the same. (such as L1, L2, and L4 in the circuit)

Question Sample:

1. Provide students with data about how many ohms does a bulb have. (depending on which kind bulb does the laboratory have)
2. Adjust power supply.
3. Connect A to B, and let students to see the illumination of L1.
4. Students calculate I in this situation.
5. Disconnect power supply and connect A to C, students predict the results by calculating:

   (1) how much voltages do I have to adjust?

   (2) how much current in this circuit?
6. Give the same voltage with step 3, students distinguish the illumination in step 6 and step 3, and explain the reason.
7. Teachers change the problems using different bulbs and changing the situation of 2-way switch.

Ohm's Law Work Sheet

Group:__________________ **Name:________________**

1.

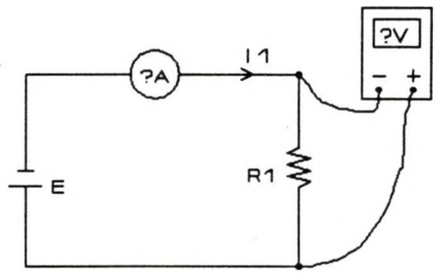


Figure 2-3. Ohm's Law Problem 1

(1). With 9V across 5Ω R1, the current I1 is_____A.

(2). The power W=I*V=_____A*9V=_____W.

(3). If R1= 10Ω, the current I is _____A.

(4). 3W bulb instead of R1, I1= _____A. (Hint:calculate how many ohms the 3W bulb has first)

2.

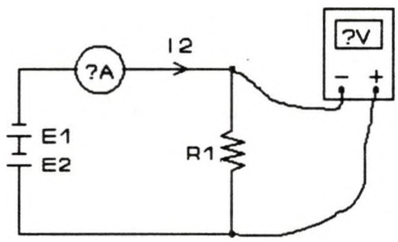


Figure 2-4. Ohm's Law Problem 2

(1). Connect one more battery (E1+E2=18V), R1= 5Ω,I2=_____ A, compared with I1 of 1-(1), is reduce_____ same____, enlarge_____

(2). The power W=18V*_____A=_____W

Ohm's Law Work Sheet

Group:___________________ **Name:_________________**

3.

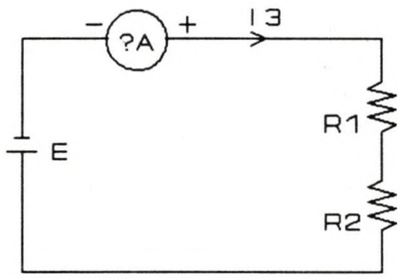


Figure 2-5. Ohm's Law Problem 3

(1). With 9V across two series 5Ω R1 and R2, the current I3 is ____A. (Hint: read data on meter)

(2). Resistance R(total) in this circuit becomes to be 9V/ ____A= _____R.

(3). Total R=R1+R2=____Ω+____Ω=____Ω.

(4). Two 3W bulbs instead of R1 and R2, compare with question 1-(4) the illumination is reduce______, same______, or enlarge_____.

Ohm's Law Work Sheet

Group:____________________ **Name:__________________**

4.

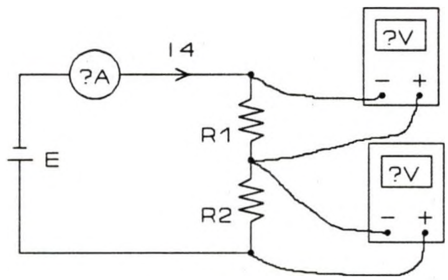


Figure 2-6. Ohm's Law Problem 4

(1). With 9V across series 5Ω and 10Ω resistances, V1=_____V, V2=_____V, I4=_____A. (Hint: read data on meter)

(2). Connect the third resistance 5Ω, I4=_____A, V1=I4*R1= _____V, V2=I4*R2=_____V, V3=I4*R3=_____V.

(3). From those data, we got a conclusion that the total resistance in series circuits R=R1+R2+R3+....+Rn, right _____, or wrong_____.

(4). The current in the series circuit is the same, right _____, or wrong_____.

Ohm's Law Work Sheet

Group:__________________ **Name:**__________________

5.

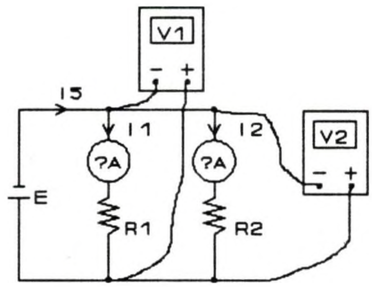


Figure 2-7. Ohm's Law Problem 5

(1). With 9V across two parallel 5Ω resistances, V1=_____V, I1=_____A, V2=_____V, I2=_____A, I5=_____A. (by reading on meter)

(2). Total resistance R is 9V/I5= 9V/_____A=_____Ω.

(3). The voltage across the parallel load is the same, right _____ or wrong_____.

(4). Compare total resistance of parallel circuit 5-(2) and total resistance of series circuit 3-(2), which one is larger? paralle circuit _____, or series circuit _____.

(5). Two 20W bulbs instead of R1 and R2, compare with 1-(4), the illumination is reduce_____, same_____, enlarge____; compare with 3-(4), the illumination is reduce____, same _____, enlarge_____.

(6). Check if 1/R (R=total resistance)= 1/R1+1/R2, right____, wrong_____.

Ohm's Law Work Sheet

Group:____________________ **Name:____________________**

6.

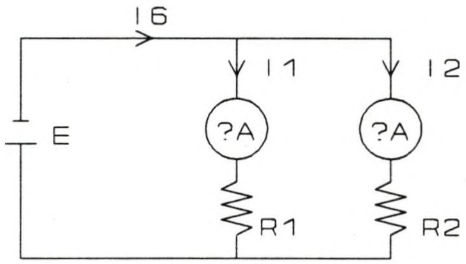


Figure 2-8. Ohm's Law Problem 6

(1). With 9V across two parallel resistances 10Ω and 5Ω, V1= _____V, I1=_____A, V2=_____V, I2=_____A, I6=_____A.

(2). I6=I1+I2=_____A+_____A=_____A.

(3). Total resistance R is 9V/I6= 9V/_____A=_____Ω.

(4). The power W1=9V*I1= 9V*_____A=_____W. W2=9V*I2=9V*_____A=____W.

(5). Explain why W1 and W2 are different?

____

____

Ohm's Law Work Sheet

Group:__________________ **Name:________________**

7.

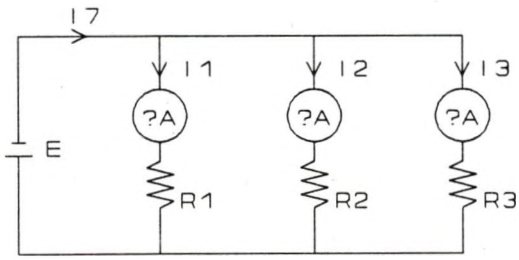


Figure 2-9. Ohm's Law Problem 7

(1). With 9V across three parallel resistances, R1=10Ω, R2=5Ω, R3=5Ω, total resistance R= 1/(1/R1+1/R2+1/R3)= 1/(1/___ +1/_____+1/_____) = ______Ω

(2). I1=9V/R1=9V/_____Ω=_____A, I2=9V/R2=9V/____Ω=____A, I3=9V/R3=9V/_____Ω= _____A,

I7=I1+I2+I3=_____A = 9V/R(total)

(3). From question 5,6,7, we got a conclusion that total resistance in parallel circuits 1/R= 1/R1 + 1/R2 + 1/R3 + ... + 1/Rn, right_____, or wrong_____.

Ohm's Law Work Sheet

Group:____________________ **Name:**__________________

8.

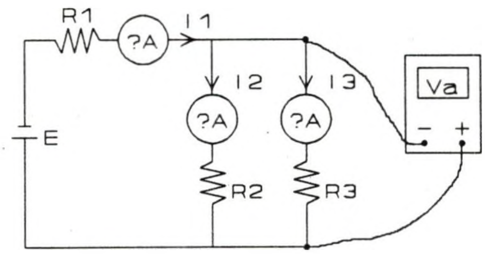


Figure 2-10. Ohm's Law Problem 8

(1). E=9V,R1=5Ω, R2=10Ω, R3=5Ω, Check if total resistance R=1/(1/R2+1/R3)+R1=8.33Ω, right_____,or wrong_____.

(2). I1=9V/8.33Ω=______A.

(3). V1=I1*R1=_____A*5Ω=______V.

(4). The voltage Va across R2 and R3 is 9V-V1=_____V.

(5). I2=Va/R2=______A, I3=Va/R3=______A.

Ohm's Law Work Sheet

Group:__________________ **Name:**________________

9. Design a circuit so that when you press the button, two bulbs and one bell work at the same time. The bell should have maximum power. (Hint: design several possible circuits and calculate how much power the bell has.)

Ohm's Law Work Sheet Answer

1. (1)1.8; (2)1.8; 16.2 (3)0.9
(4)0.5

2. (1)3.6; enlarge (2)2.6; 64.8

3. (1)0.9; (2)0.9; 10 (3)5;5;10
(4)reduce

4. (1)3; 6; 0.6 (2)0.45; 2.25; 4.5; 2.25
(3)right (4)right

5. (1)9; 1.8; 9; 1.8; 3.6
(2)3.6; 2.5 (3)right
(4)series circuit (5)enlarge; enlarge
(6)right

6. (1)9; 0.9; 9; 1.8; 2.7
(2)0.9; 1.8; 2.7 (3)2.7; 3.3
(4)0.9; 8.1; 1.8; 16.2

7. (1)10; 5; 5; 2 (2)10; 0.9; 5; 1.8; 5; 1.8; 4.5
(3)right

8. (1)right (2)1.08 (3)1.08; 5.4
(4)4.6 (5)0.46; 0.92

9. Possible design:

Suppose: Bulb= 5Ω; Bell= 2Ω; Power= 10V

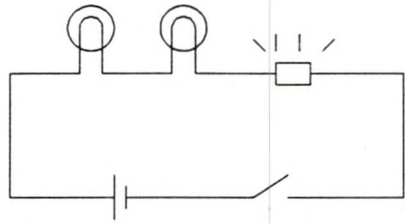


Figure 2-11.
Possible Design 1

$R=5+5+2=12\ \Omega$
$I=10/12=0.83\ A$
$W=I^2*R=0.83^2*2=1.38\ W$

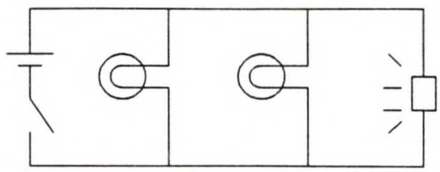


Figure 2-12.
Possible Design 2

$R=1/(1/5+1/5+1/2)= 10/9 =1.1\ \Omega$
$I=10/1.1=9\ A$

current of passing bell $=9*2/12=1.5\ A$

$W=1.5^2*2=4.5\ W$

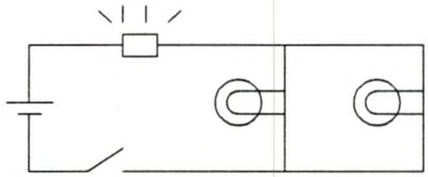


Figure 2-13.
Possible Design 3

$R=2+1/(1/5+1/5)=4.5\ \Omega$

$I=10/4.5=2.2\ A$

$W=2.2^2*2=9.68$

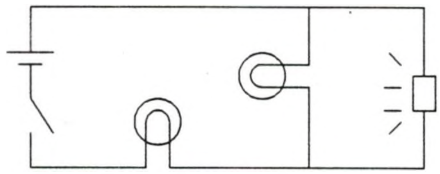


Figure 2-14.
Possible Design 4

$R=5+1/(1/2+1/5)=6.4\ \Omega$

$I=10/6.4=1.6\ A$

current of passing bell = $1.5*2/(5+2)=0.43\ A$

$W=(0.43)^2*2=0.37\ W$

Learning Module No.3

Title: Binary Digital Exhibition

Binary is a very important concept in basic awareness of computer. It leads students higher recognition in computer programming and application. This learning module will assist students to adept in converting decimal, binary, octal and hexadecimal numbers.

Objectives:

Upon completion of this activity, students will be able to:

1. accurately convert binary, octal, and hexadecimal number to decimal number.
2. and also convert decimal number to binary, octal, and hexadecimal numbers.
3. recognize the basic operating system of computer.
4. recognize the symbols of electronic components.
5. connect the circuit provided in figure 3-2.

Technology Education Unit:

Electronic communication Technology

Mathematical Concepts:

Numeric operating, addition and division.

Material:

1 wood board; 8 bulbs;

8 on-off switch;

8 resistances (if necessary);

1 DC Power Supply or battery.

Activity:

1. The teacher introduce binary concept by demonstrating with teaching aids. (Figure 3-1, p.80)
2. After demonstration, distribute components to students. They will construct the circuit by following the schematic diagram. (Figure 3-2, p.81)
3. Divide students into 3 groups.
4. Each group will complete the answer sheet that is on page 86. (Table 3-1)
5. Students in each group will design questions regarding converting binary, octal, hexadecimal, and decimal numbers.
6. One group provides questions, and shows on the board which they made previously (Figure 3-1), the other two groups will compete to write down questions and answers on answer sheet. (Table 3-1)
7. During a limited time period, other groups alternately will give questions and answers.

Evaluation:

1. The group which give questions collects and corrects the answer sheet.
2. The group which gets the most right answers wins.

Note:

1. The teacher can change the material depending on the equipment available in the laboratory. (LEDs may be substituted for bulbs)
2. Students do this activity by using the products.

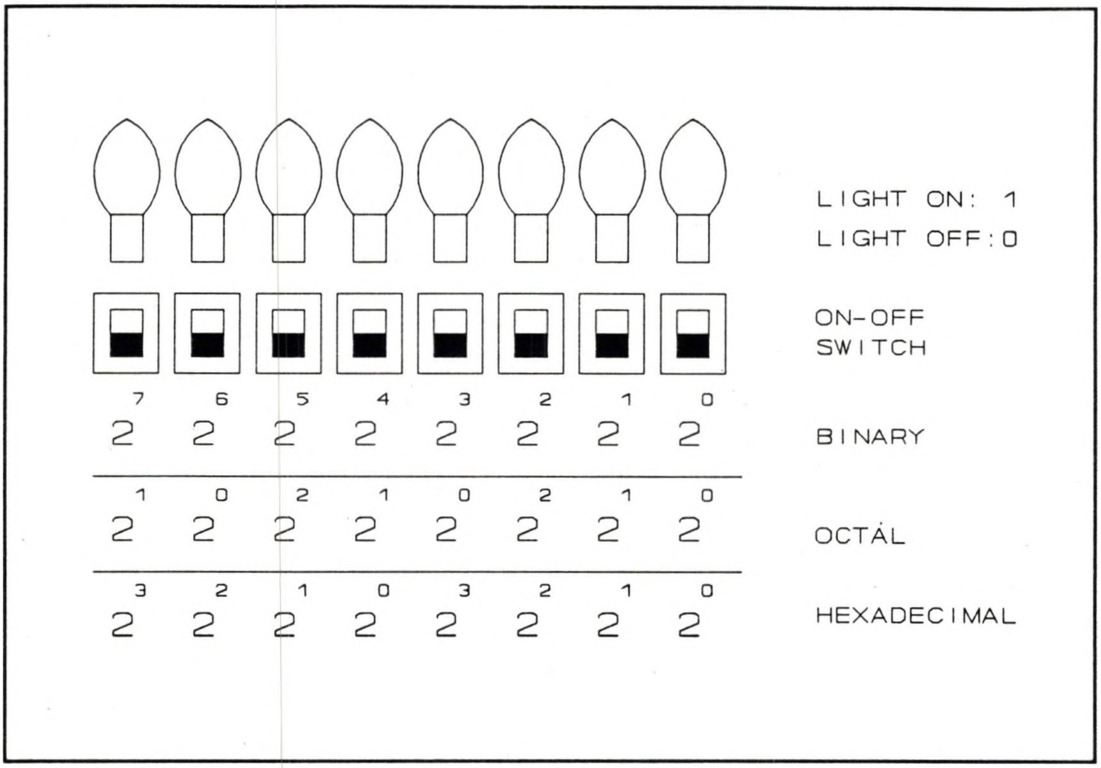


FIGURE 3-1.

Pictorial Diagram for Binary Digital Exhibition

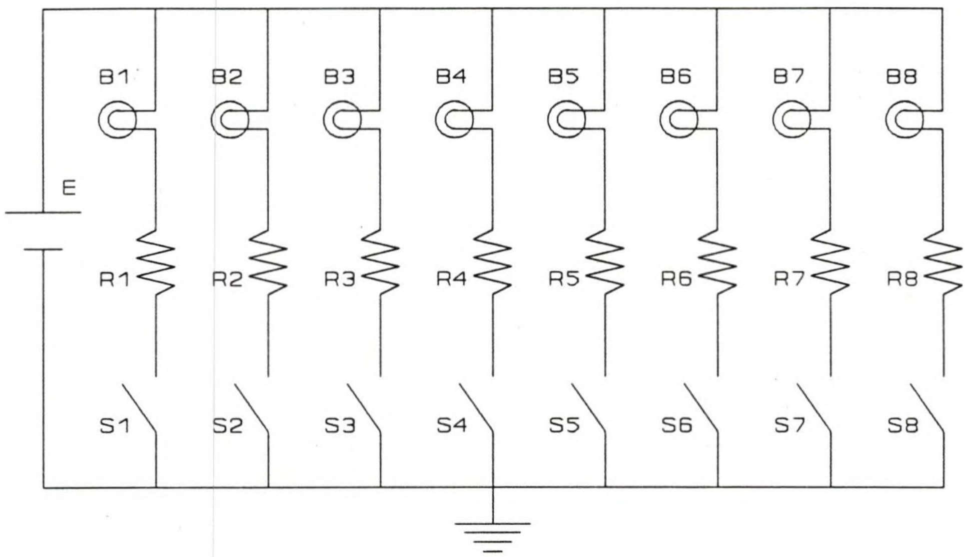


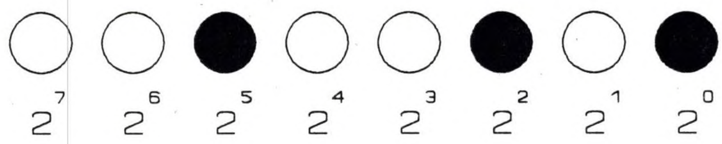
FIGURE 3-2.

Schematic Diagram for Binary Digital Exhibition

Question Sample:

Dark : 1
Blank : 0

1. Binary



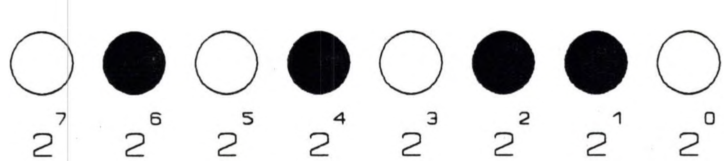
Decimal:

$2^7*0+2^6*0+2^5*1+2^4*0+2^3*0+2^2*1+2^1*0+2^0*1$

= 32 + 4 + 1

= 37

2. Binary



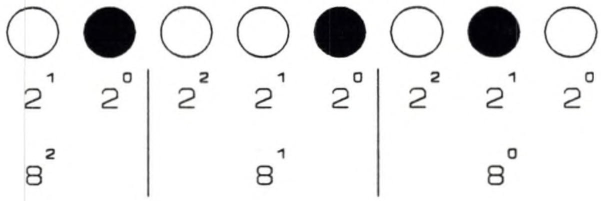
Decimal:

$2^7*0+2^6*1+2^5*0+2^4*1+2^3*0+2^2*1+2^1*1+2^0*0$

= 64 + 16 + 4 + 2

= 86

3. Octal



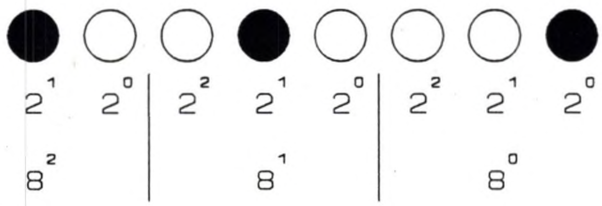
Octal:

$8^2*1+8^1*1+8^0*2 \quad = \quad (112)_8$

Decimal:

$8^2*1+8^1*1+8^0*2 \quad = \quad 64 + 8 + 2 = (74)_{10}$

4. Octal



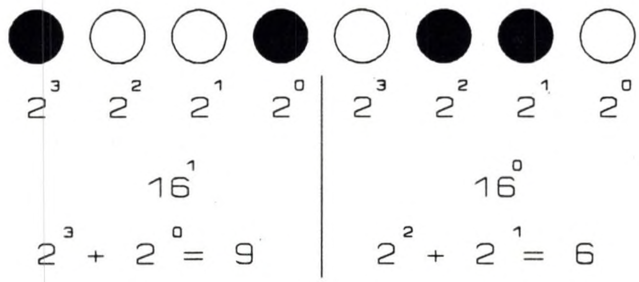
Octal:

$8^2*2+8^1*2+8^0*1 \quad = \quad (221)_8$

Decimal:

$8^2*2+8^1*2+8^0*1 = 128 + 16 + 1 = (145)_{10}$

5. Hexadecimal



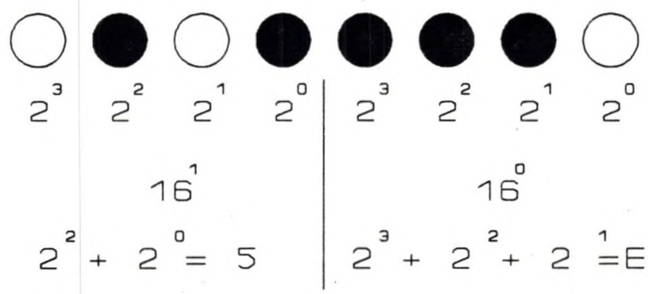
Hexadecimal:

$16^1*9+16^0*6 = (96)_{16}$

Decimal:

$16^1*9+16^0*6 = 144 + 6 = (150)_{10}$

6. Hexadecimal



Hexadecimal:

$16^1*5+16^0*E = (5E)_{16}$

Decimal:

$16^1*5+16^0*E = 80 + 14 = (94)_{10}$

Binary Digital Number Converting answer sheet

GROUP: NAME:

Binary	Decimal	Octal	Decimal
Decimal	Binary	Decimal	Octal
Binary	Hexadecimal	Hexadecimal	Decimal
Hexadecimal	Binary	Decimal	Hexadecimal

SCORE:

Table 3-1. Answer Sheet for Binary Digital Number Converting

Learning Module No.4

Title: General Recognition of Technical Product

Objectives:

Upon completion of this activity, students will be able to:

1. investigate the market circumstance.
2. describe the features of technical products.
3. interpret the meaning of data which is collected by themselves.
4. transform the raw data into correlated information.
5. draw pie chart which presents the information.
6. use drafting program if possible. (AutoCAD or related drafting software)

Technology Education Unit:

Transportation Technology

Mathematical Concepts:

Addition, Division, Multiplication, Percentage, Angle.

Material: drawing equipment, AutoCAD software.

Activity:

1. Divide students into groups. (The size of the group will be determined by the teacher)
2. Students investigate the car models of their friends, neighbors and relatives (including their parents') and fill the work sheets.
3. Collect the data from the same group, and discuss which car is the most popular.

4. The teacher give a lecture about transforming the raw data into correlated information.
5. Draw a pie chart to present the result. (It is better to draw a pie chart with AutoCAD)
6. Each group gives a presentation to the class to show their pie chart and explain the features of the most popular cars.

<u>**Evaluation**</u>:

1. The teacher collect all work sheets and check the data that students investigated and converted.
2. The teacher evaluates each group pie charts.

<u>**Note**</u>:

1. The teacher may select other technical products which students may be interested to investigating.
2. May be there are some bias about the data, but that's not very important. The purpose of this activity is to cultivate students' understanding of technical products.

Market Investigating Work Sheet

1.

Year	Model	Fuel Mileage	Body Dimension	Engine Size	Tire Size	Price	Quantity

2. Describe the advantages and features of the most popular cars.

Table 4-1. Market Investigating Work Sheet

Sample:

1. Market Investigating Work Sheet

Year	Model	Fuel Mileage	Body Dimension	Engine Size	Tire Size	Price	Quantity
	Chevrolet						5
	Corvette						3
	CAMARO						2
	GMC						3
	PONTIAC						4
	FORD						6
	BUICK						2
	TOTOTA						5

2. Describe the advantages and features of the most popular cars.

Table 4–2. Market Investigating Sample

Sample:

total cars: 30

Chevrolet:	5	5/30=0.167=16.7%	0.167*360=60
Corvette:	3	3/30=0.100=10.0%	0.100*360=36
Camaro:	2	2/30=0.067=6.7%	0.067*360=24
GMC:	3	3/30=0.100=10.0%	0.100*360=36
Pontiac:	4	4/30=0.133=13.3%	0.133*360=48
Ford:	6	6/30=0.200=20.0%	0.200*360=72
Buick:	2	2/30=0.067=6.7%	0.067*360=24
Toyota:	5	5/30=0.167=16.7%	0.167*360=60

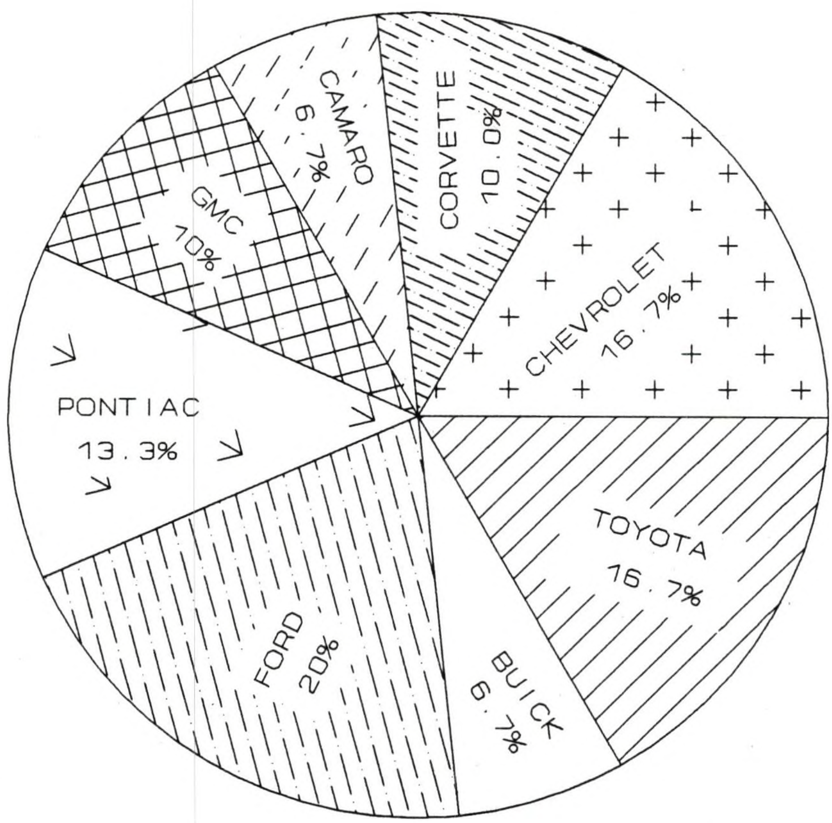


Figure 4-1. Market Investigating Pie Chart

Learning Module No.5

Title: Measure and Design

Objectives:

Upon completion of this activity, students will be able to:

1. measure with feet rulers (steel tape).
2. accurately convert feet to meter.
3. do an architecture drawing (landscape plan drawing) including structure and furniture.
4. recognize the concepts of interior design.

Technology Education Unit:

Construction Technology

Mathematical Concepts:

Measurement, Proportion and Ratio.

Material:

paper,	pencil,	erase,
steel tape,	T-square,	triangle rulers,
bow compass,	scissors,	glue.

Source:

Betts, M.R., Hauenstein, A.D., and Fannin, J.W. (1976). Teacher's Guide for Exploring The Construction Industry. Illinois: Bloomington, Mcknight Publishing Company.

Activity:

1. The teacher will introduce measuring method with rulers, and the concepts of interior design, symbols of construction drawing.

2. Students will do two assignments in this activity.
3. In the first assignment, students measure the dimensions of their own homes using an American standard tape measure and draw them on papers and convert to millimeter.
4. Ratio should be mentioned on paper.
5. In the second assignment, students will draw the floor plan of their houses. (no furniture)
6. Copy furniture symbols from the first assignment - landscape plan drawing and cut them into individual.
7. Students rearrange furniture by themselves or by classmates. (students can exchange work one another)
8. After rearrangement, students attach all furniture with glue.
9. Each student has a 2-3 minutes presentation to explain their design.

Evaluation:

1. The teacher collect all work sheets and check the data they measure and convert.
2. Students hand in assignments to show how they design.

Note:

1. Teachers assign work time depending on practical need.
2. Teachers should provide reference about interior design before the second assignment.

Measure Record Form

Ratio: 1/100

Item	**Original Scale/** feet	**Original Scale/** meter	**Reduce Scale/** millimeter

Table 5-1. Recording Measurement

Sample:

Measure Record Form

Ratio: 1/100

Item	**Original Scale/** feet	**Original Scale/** meter	**Reduce Scale/** millimeter
total area	118'-4"*78'-8"	36*24	360*240
dining room	19'-8"*19'-8"	6*6	60*60
living room	39'-4"*78'-8"	12*24	120*240

Table 5-2. Sample for Recording Measurement

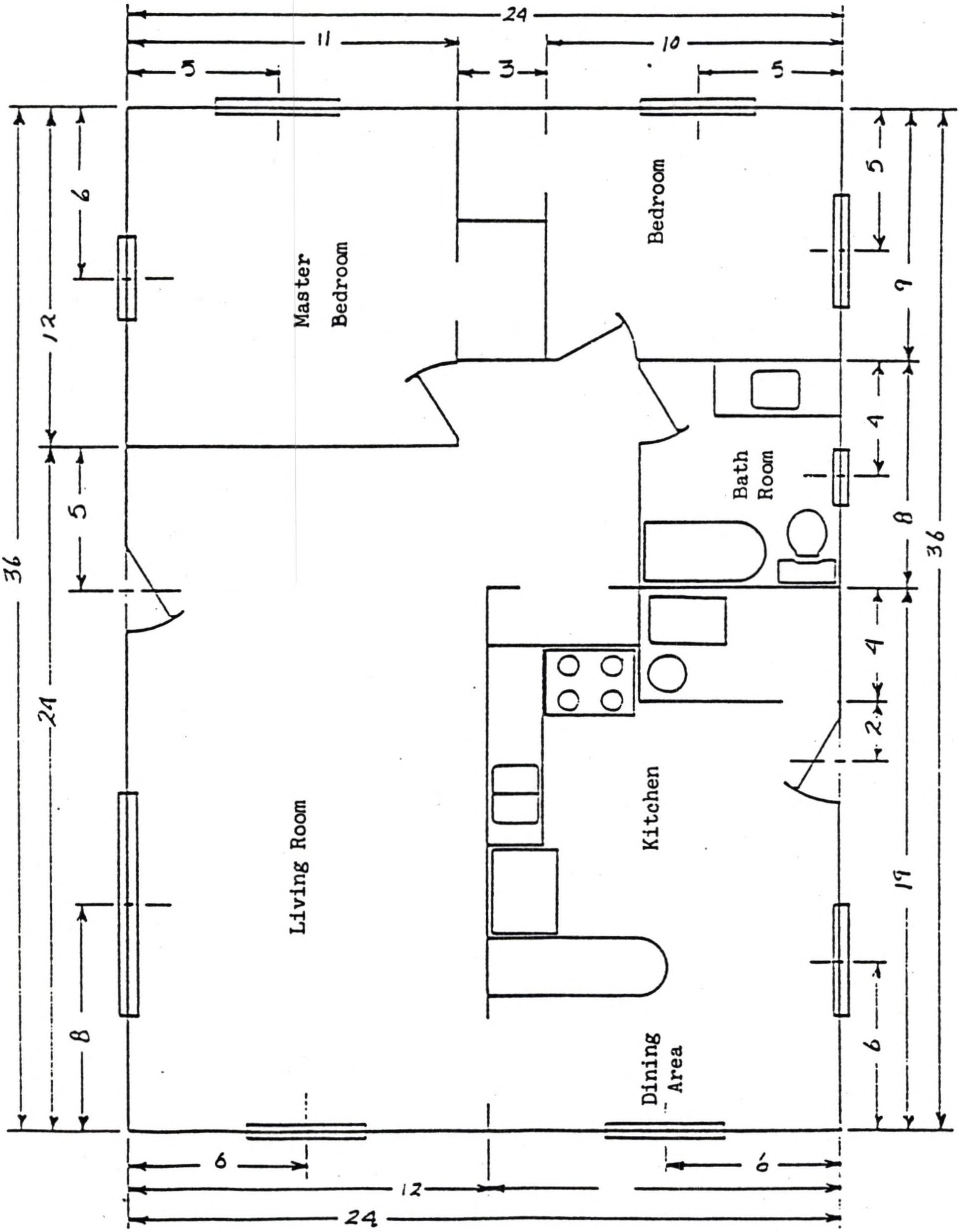


Figure 5-1. Floor Plan

Symbols

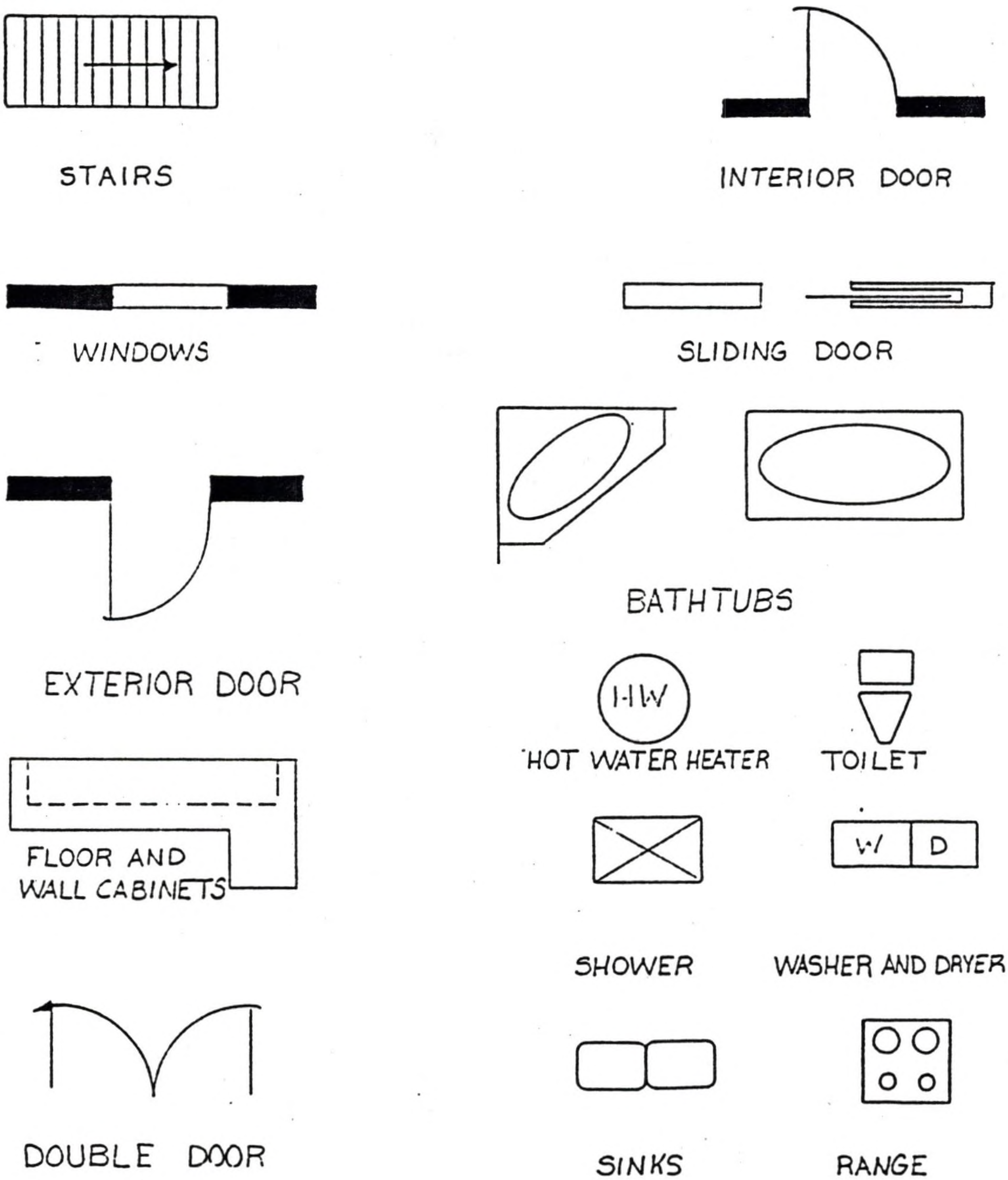


Figure 5-2. Architectural Symbols

Learning Module No.6

Title: Pantograph Manufacturing

Objectives:

Upon completion of this activity, students will be able to:

1. recognize several materials generally used to make a pantograph.
2. identify the assembly techniques.
3. select a appropriate assembly technique for the material selected.
4. design a model for the product in manufacturing process.
5. explain the advantages of automation.
6. design a manufacturing production line for the product they will produce.
7. determine the break-even point:
   a. mathematical formula
   b. charting

Technology Education Unit:

Manufacturing Technology

Mathematical Concepts:

measurement, proportion and ratio.

Material:

drawing equipment;

working material (wood, metal, plastic, etc.)

Source:

Eicholz, R.E., O'Daffer, P.G. & Fleenor, C.R. (1987). Addison-Wesley Mathematics. Addison-Wesley Publishing Company, Inc.

Wright, T. (1991). Technology Education Activities - Manufacturing Technology (Book 3 of 3, MF-E-002). CITE (Center for Implementing Technology Education)

Activity:

1. Teachers explain to students that a pantograph is a mechanical linkage that can be used to produce drawings that are similar to a given drawing.
2. Divide students into groups.
3. Students are asked to solve the following problems:
   (1) Which kind material is better to make a pantograph?
   (2) How many assembling techniques does the material have?
   (3) Which assembling technique is most appropriate to do this job?
   (4) Is it necessary to fix B on the middle of AC, E on the middle of CF? (see figure 6-1)
   explain why?
   (5) Does the length (AC length) affect the proportion?
   (6) How do you design F1,F2,... to fit different type of pens? (see figure 6-1)

4. Students assign jobs to each other for designing and producing a model for pantograph, purchasing the material, cutting the material, fabricating, assembling and testing the product.
5. Students sketch pantograph on grid paper. Dimensions and materials are also mentioned.
6. Students discuss and complete the Bill of Materials sheets.
7. Calculate break-even point by following equations and determine how many units they have to fabricate if they want to sell the products for a profit.
8. Students will fabricate a given number of pantgraphs.
9. Finally, each student evaluates the whole manufacturing process by completing a job analysis sheet.

Evaluation:

1. Educators take a look the working process of each group to see if every student participates in the activity.
2. Educators gather job assignment sheets from each group and job analysis sheets from each student to check students' performances.

Note:

Break-even is the point at which the total revenue derived from a product equals the total cost of producing it. Break-even may be determined using the following formula:

$$BE = F/(P-V)$$

When : BE = Break-even point in units

P = Selling price

F = Fixed costs

V = Variable cost per unit

Typical fixed costs are:

Supervision and managerial salaries

Rent

Equipment depreciation or lease costs

Insurance

Utility costs

Tooling

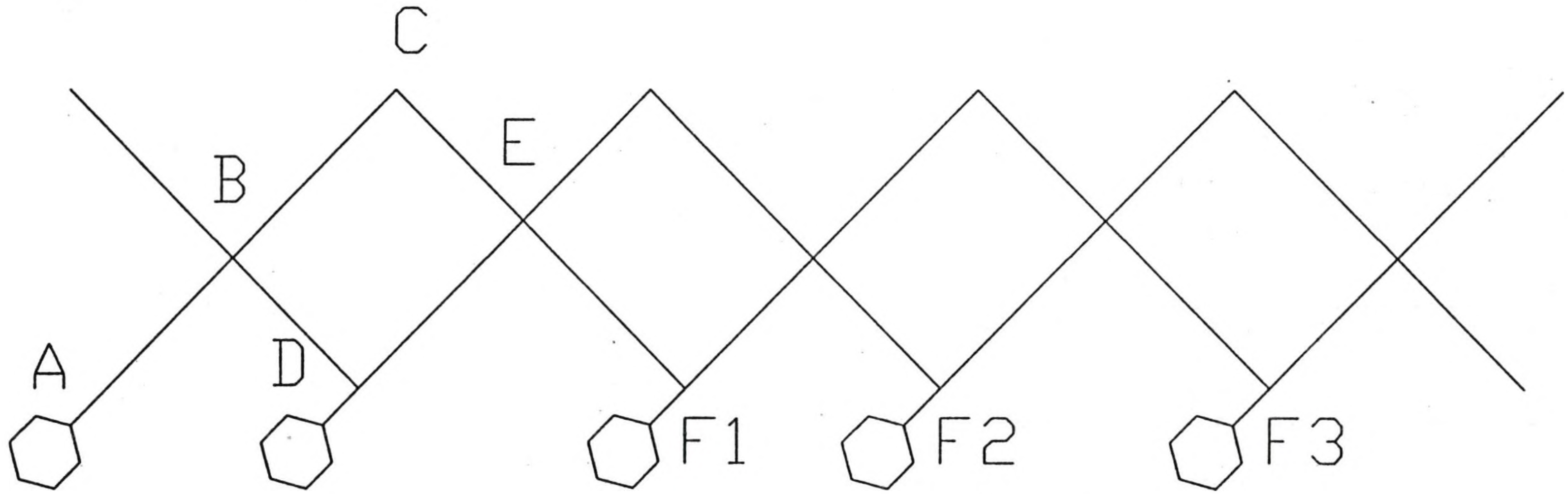
Engineering costs

Variable costs include:

Materials

Production labor

Packaging



A: pinned to table
D: pointer
F1,F2,... : pens

Figure 6-1. Pantograph Sample

Job Assignation Sheet

Group:_________________

Name	Job

Table 6-1. Students Assign Job Here

GRID PAPER

GROUP: ________ NAME: ______________________________

BILL OF MATERIALS

PRODUCT NAME: ______________________________

PREPARED BY: ____________________ DATE: __________

Part No.	Quantity	Part Name	Size T * W * L	Material

Table 6–2. Bill of Materials

Break-Even Work Sheet

Group:__________ **Name:**____________________

COST ITEM	FIXED	VARIABLE
Advertising		
Building rent		
Equipment rent		
Inspection gage construction		
Labor (25% fixed, 75% variable)*		
Management salaries		
Material costs		
Packaging materials		
Product engineering cost		
Sales commission		
Supervision salaries		
Tooling		
Utilities		
Totals:		

* 25% of labor cost is considered fixed since the workers will be new on the job and receive paid training.

Table 6-3. Break-Even Work Sheet

Break-Even Formula Sheet

Group:________ **Name:**____________________

Break-even is the point at which the total revenue derived from a product equals the total cost of producing it. Break-even may be determined using the following formula:

BE = F/(P-V)

When : BE = Break-even point in units
P = Selling price
F = Fixed costs
V = Variable cost per unit

For example:
Selling price = $ 4.00
Fixed costs = $ 96.43
Variable costs per product = $ 2.28
Break-even would be calculated as follows:

BE = F/(P-V)
=96.43/(4.00-2.28)
=56 products

Calculate the break-even point for your product in the space below.

Job Analysis Sheet

Group:__________ **Name:**______________________

1. Do you think the material selected by your group is good? if not, what's your opinion?

2. Are the processes efficient during producing? if not, explain which part should be modified?

3. What do you do in this manufacturing process?

4. Are you satisfied for your job? explain why you are or you are not.

5. How can you improve the manufacturing line if put this job to real factory?

Sample: **Break-Even Work Sheet**

Group:__________ **Name:**______________________

COST ITEM	FIXED	VARIABLE
Advertising	$ 7.78	
Building rent	$ 9.00	
Equipment rent	$ 15.00	
Inspection gage construction	$ 2.29	
Labor (25% fixed, 75% variable)*	$ 25.00	$ 0.75
Management salaries	$ 2.50	
Material costs		$ 1.16
Packaging materials		$ 0.12
Product engineering cost	$ 11.37	
Sales commission		$ 0.25
Supervision salaries	$ 12.50	
Tooling	$ 8.49	
Utilities	$ 2.50	
Totals:	$ 96.43	$ 2.28

* 25% of labor cost is considered fixed since the workers will be new on the job and receive paid training.

Table 6-4. Break-Even Work Sheet

SAMPLE BREAK-EVEN CHART

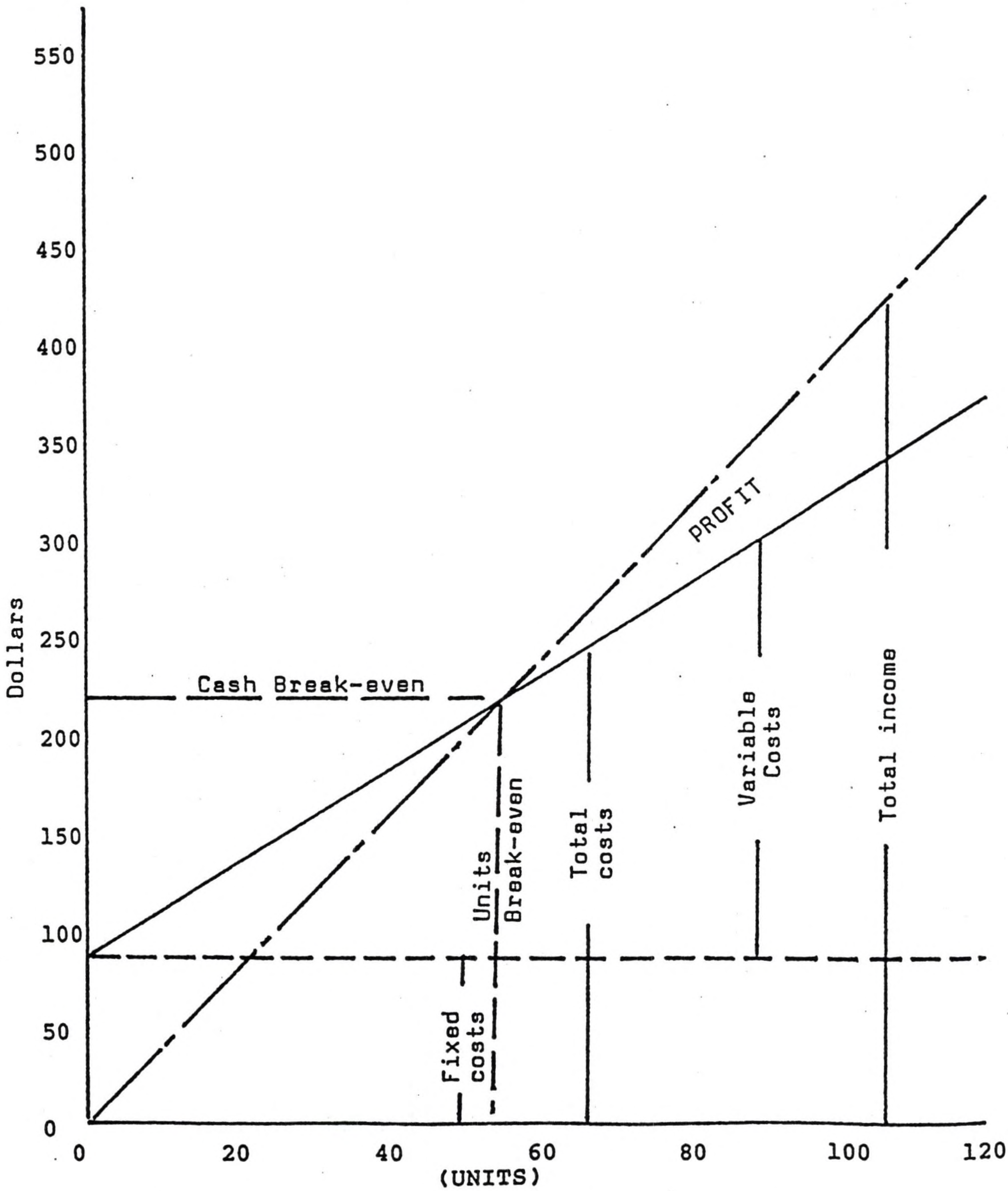


Figure 6-2. Sample for Break-Even Chart

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Restatement of the Objectives

The study was conducted to clarify the intimate relationship between Mathematics and Technology Education and provide learning activities for Junior High School Technology Education curriculum. In order to fulfill the purpose, it was necessary to meet the following objectives:

1. Discuss the importance of integrating the mathematical concepts with Technology Education.
2. Identify the concepts of Mathematics and Technology Education taught at Junior High School curriculum.
3. Develop learning activities modules that will integrate the mathematical concepts into Technology Education.

Summary

Technology is constantly changing. It is dynamic because a technology is never perfect. It will be modified and improved from day to day. But basic principles behind the technology have been true and never change.

Technology Education is a course which teaches students to understand, use, and control technology. It also causes students to think about the culture and environment problems around them. It is a course of preparing people how to live more efficient and more comfortable.

Technology Education is the application of Mathematics and Science. It will widely utilize these two tools in any invention and innovation. Many facts from reviewing of the literature revealed that mathematical concepts are becoming more and more important in the applications of our real lives. Technology Education instructors should concern this trend and put more mathematical concepts into Technology Education activities.

It is an interdisciplinary education era, especially in Junior High School. Students in Junior High School should understand the interrelationships among disciplines. They need to develop a wholistic view of their culture and they need to know which tools they could use. That is why this study focused on integration mathematics and Technology Education.

Instructional material must be available for assisting Junior High School Technology Education instructors to deal with the different needs of students. It was the purpose of this study to provide learning activities which would help instructors integrate the mathematical concepts into Technology Education study. These learning activities were to match the structure of Technology Education - communication, construction, manufacturing, and energy, power/transportation. The learning modules prepared through this study will provide instructors ideas to integrate mathematical concepts into Technology Education.

Conclusions

The following conclusions were based on the review of the literature and processes of creating learning activities in this research.

1. It is very important that students possess technology literacy in order to fit the technological society in future.
2. Technology Education is an interdisciplinary education. It involved the field of each course in school, such as Mathematics and Science are useful tools in Technology Education.
3. There are a lot of examples of mathematical concepts needed in occupations and real world lives.

4. Mathematical concepts are more and more important in current technology society.
5. Students will be adept in mathematical skills by studying Technology Education because there are lots applications relating real lives.

Recommendations

Based upon the results of the study, it was recommended that:

1. Advanced modification and/or improvement curriculum to the Technology Education classrooms could be designed and tested.
2. The learning activities included in this study are to be used as examples only and are to be used as a guide to create others for classroom use.
3. Mathematics has a potential needed in Technology Education. Instructors should develop further curriculum which integrated mathematical concepts with Technology Education.
4. It is further recommended that in-service teacher workshop educations are conducted to implement the learning modules at the Junior High School level.
5. Technology Education instructors should have the opportunity to develop curriculum with instructors of

other subjects, such as Mathematics, Science, or Social science instructors.

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