

**DEVELOPING A MATHEMATICAL TUTORIAL
USING HYPERCARD**

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**MATHEMATICS 10
TUTORIAL
PACKAGE**

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MATHEMATICS 10 TUTORIAL PACKAGE

Purpose

The purpose of the Mathematics 10 Tutorial is to: (1) provide high school students with information regarding specific content outlined in the Alberta Education Mathematics 10 Curriculum Guide and (2) give them the opportunity to apply their mathematical knowledge. Being that the program is on HyperCard, students should be able to easily obtain material and questions for each concept by clicking on specific buttons throughout the program.

Contents of the Disks

- Disk 1: Information and questions on the Mathematics 10 units: Coordinate Geometry, Solving Linear Systems, and Trigonometry. (It must be noted that the Menu Bar has not yet been deleted from the program).
- Disk 2: Not completed as yet. When completed, this disk will contain information and questions on the Mathematics 10 units: Operations on Polynomials, Factoring Polynomials, Equations and Inequalities, and Statistics.

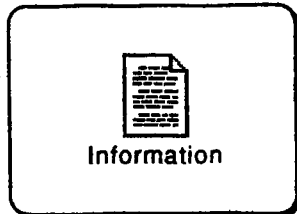
System Requirements

- Mathematics 10 Tutorial requires these system components:
- (1) MacIntosh Plus, MacIntosh SE, or MacIntosh II computers with at least 1 megabyte RAM and HyperCard Version 1.2.
 - (2) Hard disk drive
 - (3) Mouse

LEGEND

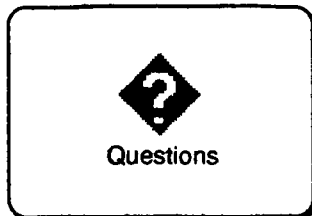
Information and/or questions will appear on the screen, when the mouse is pointed and pressed on specific buttons. Each of the following buttons has a function that the user should be aware of:

(1)



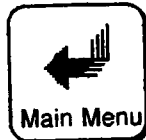
When selected, this Information button will allow the user to go through the stack of cards that will have information pertaining to a mathematical concept.

(2)



When selected, this Question button will allow the user to go through the stack of cards containing multiple-choice questions regarding a mathematical concept.

(3)



When selected, the program will return the user to the Main Menu or Home on which are the Mathematics 10 unit titles.

(4)



Regardless of which Information/Question Stack the user is viewing, he or she may get out of that stack and return to the concept or subconcept stack by pressing this button.

(5)



This button will allow the user to view the next card in the Information or Question stack.

(6)



This button will allow the user to view the previous card in either the Information or Question stack.

These buttons should make any part of this program accessible to the user.

INSTRUCTIONS

Getting Started

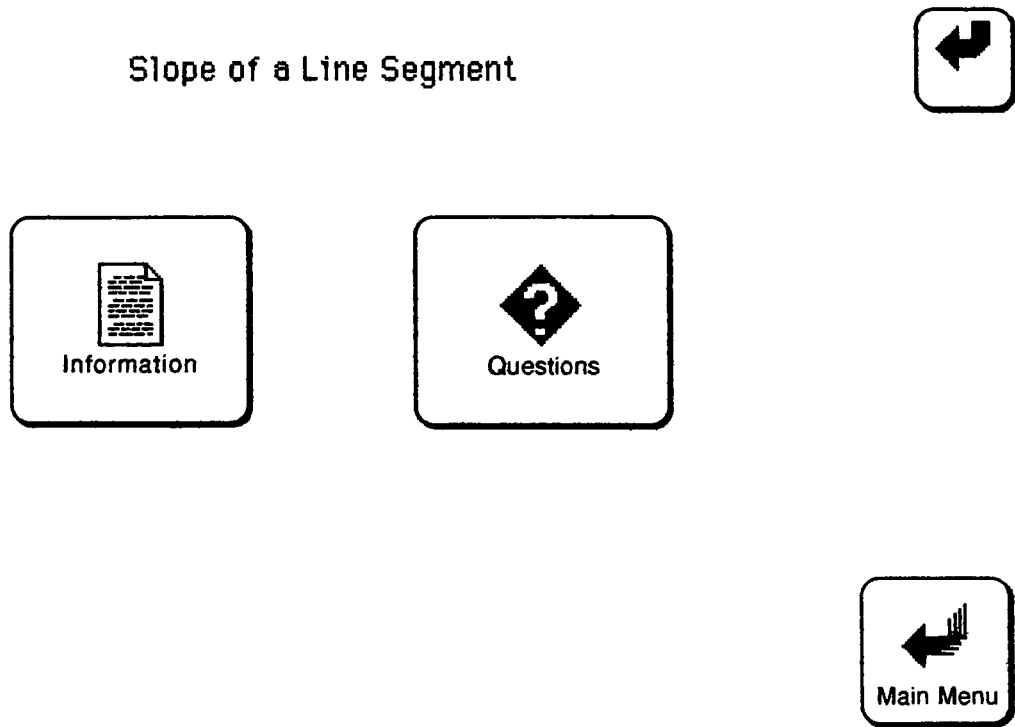
When Disk 1 is inserted into the disk drive, an image of a disk labelled as "Tutorial" will appear on the screen. Pointing and pressing the mouse on this disk will then illustrate "Sue's Disk". The user must again point and press the mouse on this illustration in order to obtain "Math 10" on the screen. By pressing the mouse on "Math 10", the user will get into the program. What will next appear on the screen are a series of stacks; the user must select the first stack entitled "Home", by clicking the mouse on it, in order to start at the beginning of the program.

Using the Program

The Home Menu, also known as the Main Menu, contains the units covered in Mathematics 10. On Disk 1, the Main Menu contains the units: Coordinate Geometry, Solving Linear Systems, and Trigonometry. The titles of these units are placed on buttons; the user may select any one of these three unit buttons by pointing and pressing the mouse on it. Upon selection of one of these unit buttons, the user will now see on the screen the concepts belonging to that particular unit. Choosing one of the concept buttons will result in either subconcepts of that chosen concept or an information/question card. By simply pointing and pressing the mouse on particular buttons, the user can move throughout the program to view whatever he or she desires regarding the Mathematics 10 units.

For instance, if the user chooses Coordinate Geometry, the next card that will appear on the screen contains concepts dealing with Coordinate Geometry, namely, Segments and Lines. If the Segments button is pressed, then what appears on the screen are the subconcepts: Length, Midpoint, and Slope. Selecting any one of

these subconcepts will bring onto the screen an Information/Question card, which will provide the user with the choice of obtaining information regarding that subconcept or of applying their knowledge by answering multiple-choice questions. Choosing Slope, for example, would bring to the screen the following card:



Like the other Information/Question cards, this card for the subconcept, Slope, gives the user four choices:

- (1) to click the mouse on the Main Menu button and return the program to Home;
- (2) to press the mouse on the single curved arrow button located on the top right corner of the screen and return to the previous subconcept card; in this case, the card returned to would be the one containing the Length, Midpoint, and Slope buttons;

- (3) to select the Information button, which will allow the user to view pages of information, one at a time, on the screen. (Information regarding Slope, including an explanation of the buttons on the information cards are below and on pages 6 to 8;
- (4) to choose the Question button, which will allow the user to apply his or her knowledge by answering multiple-choice questions, one at a time. (Questions and an explanation of the question card buttons are on pages 9 and 10).

Slope Information Cards:

For the following information card as well as the others illustrated on pages 6 and 7, the top right curved arrow button will return the user to the Information/Question card on Slope; the bottom right straight arrow button will bring the next page of information onto the screen.

Slope of a Line Segment



Slope is defined as the "steepness" of a segment or line. It is symbolized by "m"; and it is the ratio or the rise to the run.

$$m = \frac{\text{rise}}{\text{run}}$$

page 1



Thus, clicking the mouse on the bottom right straight arrow button on page 1 will make appear page 2; and pushing the same button on page 2 will produce page 3 on the screen, and so on. The bottom left straight arrow button will allow the user to return to the previous page, in case he or she needed to review that particular information again; thus, clicking the mouse on the bottom left button on page 5 will bring page 4 on the screen, and so on.

Slope of a Line Segment



In a coordinate system, the slope of any segment can be found if the coordinates of any two points $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ on the line segment are known.

The slope of the line segment joining $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ is given by the formula:

$$m \text{ of } P_1P_2 = \frac{y_2 - y_1}{x_2 - x_1}, (x_2 \neq x_1)$$



page 2



Slope Information Cards continued:

Slope of a Line Segment



Example 1: A section of roller-coaster track falls 25 m in a horizontal distance of 15 m. What is the slope of this section of track?

Solution: $m = \frac{\text{rise}}{\text{run}}$

$$m = \frac{25}{15}$$

$$m = \frac{5}{3}$$



page 3



Slope of a Line Segment



Example 2: Find the slope of the line segment whose endpoints are A(2,1) and B(5,3).

Solution: $m \text{ of } AB = \frac{y_2 - y_1}{x_2 - x_1}$
 $= \frac{3 - 1}{5 - 2}$
 $= \frac{2}{3}$



page 4



Slope Information Cards continued:

Slope of a Line Segment



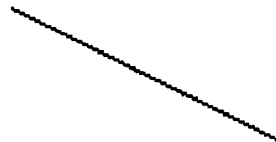
Line segments that have positive slopes rise to the right.

Eg.



Line segments that have negative slopes fall to the right.

Eg.



page 5



Slope of a Line Segment



The slope of any horizontal segment is zero. This is because the y -coordinates of the two endpoints are the same value; and since the difference of the the y -coordinates represents the rise, the overall result is 0.

The slope of any vertical segment is not defined as a real number. This is because the x -coordinates on the endpoints of the vertical segment are the same, and therefore, the difference between them is 0. Because the difference of the x -coordinates represents the run, the denominator of the slope ratio, the resulting slope is undefined.



page 6

The question cards have the same arrow buttons as the information cards; these buttons serve the same functions. Also, the letters beside the answer items in each multiple-choice question throughout the program are actual buttons that the user pushes in order to determine whether or not he or she has located the correct answer. If the user clicks the mouse onto the letter button belonging to the right answer, a positive response will appear on the screen; if the user selects the wrong button, then a "beep" will sound, indicating to the user that the answer that he or she has chosen is not correct. Below and on the following page are samples of question cards that appear in the program under Slope:

Questions Regarding Slopes of Segments



1. A line segment that has a zero slope:

(A) is horizontal

(B) has no length

(C) is vertical

(D) always passes through the origin

(E) does not exist



Slope Question Cards continued:

Questions Regarding Slopes of Segments



2. The slope of the segment whose endpoints are located at $R(-2,4)$ and $S(5,4)$ is:

- (A) undefined (B) 0
 (C) 3 (D) -3
 (E) 0.33



Questions Regarding Slopes of Segments



3. A line segment that has a slope that is not defined as a real number:

- (A) is horizontal (B) has no length
 (C) is vertical (D) always passes through the origin
 (E) do not exist



Quitting the Program

To quit the program, the user may select "Quit HyperCard" under the FILE command. After this has been done, the user can select "Shut Down" under SPECIAL; and the disk will be ejected.

APPENDIX A

**MATHEMATICS 10 TUTORIAL PACKAGE
DISC 1**

APPENDIX B

EVALUATION OF THE TUTORIAL PACKAGE

During the Taber School Division Professional Development Day on November 12, all of us high school mathematics teachers met in order to share our ideas and teaching strategies. Using the MacIntosh computer that was available in one of the classrooms, I demonstrated to these teachers how the Mathematics 10 Tutorial worked. They verbalized how impressed they were with the amount of time and material I had put into the program; and they wanted to obtain copies of the disks to use in their mathematics classrooms. Once they have a chance to use the program on their own, they may be able to provide me with additional feedback as to how they and their students liked it.

I also had some of my former grade 10 students from Myers High School go through the tutorial on Disk 1. The reason why I had asked these students to view the program was because they were familiar with the unit material that is on this disk, whereas my present grade 10 math students have not been exposed to the Coordinate Geometry, Solving Linear Systems, and Trigonometry units yet. The students indicated that they liked the way the program has been set up. They felt that the examples on the information cards reinforced what was explained and that the questions asked on the question cards are related to the material such that any student can go back to the examples in the explanations to help him or her calculate the answers. They also indicated that the information presented is easy to read and to understand and that the buttons throughout the program made whatever mathematical concepts they wanted accessible. Finally, they thought that this program would be especially helpful in helping students like themselves review for unit tests and final exams.

APPENDIX C

DEVELOPING A MATHEMATICS TUTORIAL USING HYPERCARD

HyperCard is an object-based database in which information such as words, charts, and pictures can be stored. A specific piece of information can be connected to other pieces of information through a linking process; this involves the creating of buttons on cards and stacks and, through the link command under Button Information, the linking of these buttons to other specific cards and stacks. Thus, a user can go from card to card by pointing the mouse at a particular button and clicking on it.

Using HyperCard's capabilities of linking information together, I have developed, to some extent, a Mathematics 10 tutorial on a disk. I decided to start with three major units that are covered in Mathematics 10 - Coordinate Geometry, Trigonometry, and Solving Linear Systems. I have developed, on this disk, stacks of information and questions for each of these units. My intention is to continue using HyperCard to link information and questions for the five remaining units on a second, and if necessary, a third disk.

The purpose of using HyperCard to create this tutorial is to, first of all, determine whether or not I can put together a math package that is based on the material that I teach and that the students can use sometime in the future; and secondly, to become more proficient in using HyperCard to the point where I can successfully connect information and, later, add the extra frills to make the tutorial interesting and fun to use.

The main objective of the tutorial itself, which is still in the

APPENDIX C - USING HYPERCARD

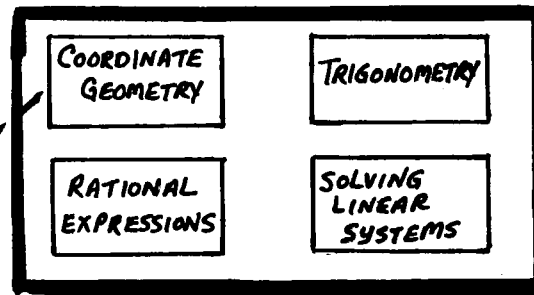
process of being completed, is to tutor students that are having some problems with certain areas taught in Mathematics 10 or to serve as a means of helping students review material for an upcoming assignment and/or quiz. Rather than searching for software packages that concentrate on the same content covered in Mathematics 10 and are, at the same time, relatively expensive, I decided that I would develop my own and have students experiment with them, once these disks are completed.

As was mentioned before, what is on Disk 1 concentrates on three out of the eight units covered in the Mathematics 10 curriculum. The three units, Coordinate Geometry, Trigonometry, and Solving Linear Systems, are on the Home stack (also referred to as the Main Menu). From the Main Menu, a student would be able to select one of these three areas that he/she is interested in looking at. Because the connections of information and questions of all three units are very similar, due to the linkages made through HyperCard, references will be made throughout this Appendix to only one of the units, Coordinate Geometry, in order to explain how the cards and stacks are linked together to form the units' basic structures.

Coordinate Geometry is divided into two main concepts, namely Segments and Lines. Therefore, the next card that appears on the screen upon selection of Coordinate Geometry from the Home card is one that has these two components. Each of these concepts, in turn, are divided into subconcepts that are put into separate stacks. Each subconcept contains information and accompanying questions for the student to practice on. A schematic diagram illustrating the hierarchical structure of the stacks and cards making up the Coordinate Geometry unit is on the following page:

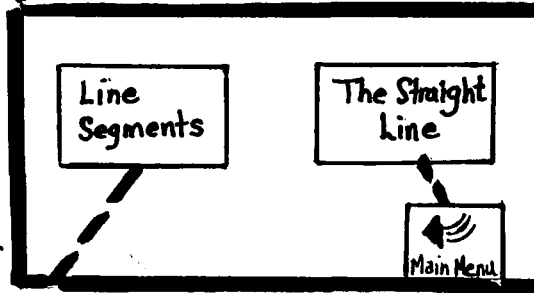
MATHEMATIC 10 TUTORIAL

HOME
(MAIN MENU)



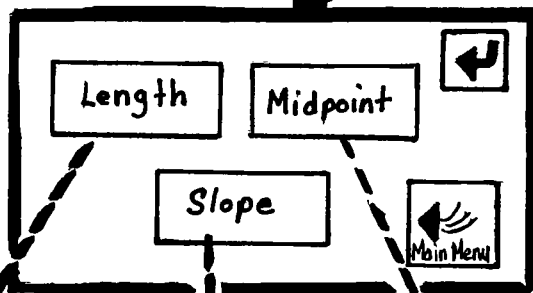
Linked to
Concept
Stack

CONCEPT
STACK



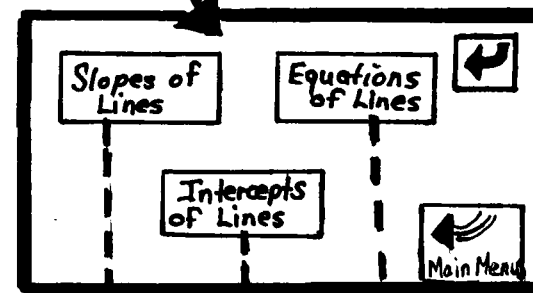
Linked to
Subconcept
Stack

SUBCONCEPT
STACK



Each subconcept is
linked to a stack
of information
and questions.

SUBCONCEPT
STACK

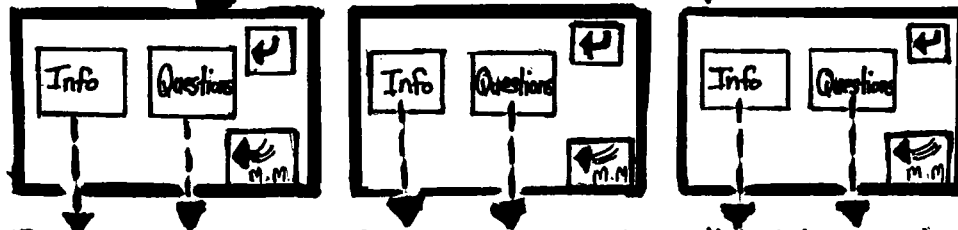


Info +
Questions

I & Q

I & Q

Like the Line
Segment Subconcept
Stack, each
subconcept dealing
with the straight
line is linked
to a stack of
information and
questions.



The Information button for each subconcept is linked to a series of information cards; the question button is linked to a series of cards containing multiple-choice questions.

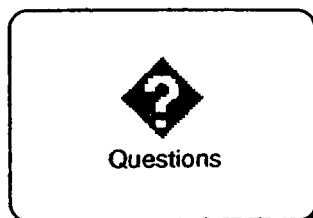
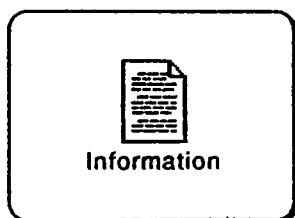
APPENDIX C - USING HYPERCARD

The layout of cards and stacks on the previous page shows the pattern that a student could follow upon selecting certain buttons. With the return and Main Menu buttons located in the Concept, Subconcept, and Information/Question stacks, students should be able to get in and out of cards and stacks quite easily. For instance, if a student has read through all of the information about Lengths of Segments, he/she can return to the Information/Question card and select Questions; the student can then attempt as many questions as he/she wants or return to the Information/Question card and, from there, go to the Main Menu to select another unit or the Segment Subconcept Card to look at the information under Midpoint or Slope. A printed copy of the Information/Question Card for Lengths of Line Segments, which is similar to the Information/Question Card for Slope of a Line Segment shown on page 4, is illustrated below:

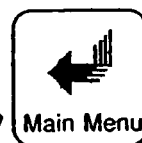
*RETURN BUTTON
Allows student to
return to Line Segment
Subconcept Menu*



Lengths of Line Segments



*Allows student
to return to
menu containing
selection of units*



APPENDIX C - USING HYPERCARD

The rest of the Information/Question cards linked to the other subconcepts (Midpoint, Slope, Equations of Lines, and so on) have the same features of allowing students to either obtain information about these subconcepts, determine the answers to the questions regarding them, or to move on to another subconcept of the same unit or to the concepts and subconcepts of the Trigonometry and Solving Linear Systems Units. With such options, students should not ever feel that they are trapped within a certain stack or card.

When a student selects the Information button for any one of the subconcepts, he/she is provided with mathematical explanations and equations. The content discussed covers the Mathematics 10 curriculum and supplements the textbook material; basically, I have expanded upon the material covered in Mathematics 10, explaining the content in my words and using my own examples. The cards containing the explanations regarding the information for Length of a Line Segment are linked together through the straight arrow buttons located on the bottom right and left corners of each card; examples of these cards are illustrated on the following two pages (pages 19 and 20):

Length of a Line Segment



For a segment that is parallel to the x-axis, that is, the endpoints of the segment have the same y-coordinates, the length of the segment is defined to be the absolute value of the difference between the two x-coordinates.

Eg. If A(3,5) and B(6,5) form a line segment, which would be parallel to the x-axis when plotted, the length of segment AB is $= |6 - 3|$. The length, therefore, is 3 units.

page 1



Length of a Line Segment



For a line segment that is parallel to the y-axis, that is, the x-coordinates of the endpoints are the same, the length of the line segment is determined by the absolute value of the difference between the two y-coordinates.

Eg. The length of the segment whose endpoints are located at C(3, -1) and D(3, -7), the length of segment CD $= |-7 - (-1)|$. The length is 6 units.



page 2



Length of a Line Segment



For segments which are not parallel to the x-axis nor the y-axis, the lengths of these segments are determined by the distance formula. The length of the segment whose endpoints are located at $A(x_1, y_1)$ and $B(x_2, y_2)$ can be determined as follows:

$$\text{Length of } AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Eg. Determine the length of segment AB, given $A(1,5)$ and $B(6,-4)$.

$$AB = \sqrt{(6-1)^2 + (-4-5)^2}$$

$$AB = \sqrt{(5)^2 + (-9)^2}$$

$$AB = 10.3$$



page 3



The return buttons, as was previously explained in the Instructions, enables the students to return to the Information/Question Menu, in case they would rather work on the questions or get back to the Subconcept Menu. The arrows located on the bottom left and bottom right corners allow the students to observe one card at a time on the screen. The same buttons with the same options appear on all the information cards for the other subconcepts of this unit as well as the for the concepts and subconcepts of the other two units on Disk 1.

If a student selects the Question button on any one of the Information/Question Cards, multiple-choice questions will appear, one at a time, on the screen. The questions that are linked to the Question button located on the Segment Length Information/Question Card are also linked to each other by the bottom left and right straight arrow buttons. The bottom right button on page 1, for instance, will produce segment questions on page 2; and the bottom left button on page 2 will bring back page 1 onto the screen. Examples of these question cards are illustrated on the following page:

Segment Questions



1. Given segment AB where A is located at (3,-4) and B is located at (3,-9), what is the length of that segment?

- A. 6
- B. 13
- C. 5
- D. -5
- E. 7.8



page 1



Segment Questions



2. What are the lengths of the sides of triangle ABC with vertices A(4,0), B(4,-3) and C(1,-5)?

- A. 9, 13, 34
- B. 73, 89, 50
- C. 3, 3.6, 3.6
- D. 3, 3.6, 5.8
- E. 8.5, 9.4, 7.1



page 2



APPENDIX C - USING HYPERCARD

As was explained on page 2 of the Instruction section, the return buttons on these question cards allow the student to go back to the Information/Question card; and the lower left and lower right arrow buttons enable the student to view the questions in specific order. All of the question cards for the other subconcepts of this unit as well as the concepts and/or subconcepts of Trigonometry and Solving Linear Systems have the same button features.

With regards to the multiple-choice questions, buttons are located in front of each answer for every question card contained in each of the three units on Disk 1. As was mentioned on page 9, students will either hear a "beep", if they select the button(s) of the wrong answers; or they see a positive response, which is the word "WOW!" repeated several times, appear on the screen, when they push the button in front of the correct answer.

The positive and negative responses were entered into the scripts of the answer buttons on the question cards. The script for the buttons of the incorrect answer items, for instance, is "on Mouse Up, beep, end Mouse Up". The script for the buttons producing the positive WOW! repetitive sequence on the screen is much more detailed, involving a connection between these buttons and a separate stack containing the positive response. The scripts for the answer buttons are the same for Coordinate Geometry, Trigonometry, and Solving Linear Systems.

The linkages of information and questions that form the hierarchical structure of cards and stacks contained in the Coordinate Geometry Unit are similar to those made in the Trigonometry and Solving Linear Systems Units. The

APPENDIX C - USING HYPERCARD

Information/Question cards are connected to the Trigonometry Unit concepts, which are Similar Triangles, Trigonometric Ratios, and Solving Right Triangles. The Solving Linear Systems Unit, which is divided into Methods of Solving, Number of Solutions, and Solving Linear Problems, is structured in the same manner as the other two units in this program.

Although some changes will be made, with regards to, for instance, the positive and negative question responses and the amount and type of material that is presented in the program, the material of the remaining five Mathematics 10 units that will be contained in Disks 2 and 3 will be linked together, by means of HyperCard, in much the same way as that of Disk 1.

REFERENCES

- Brendan, Kelly, Bob Alexander, and Paul Atkinson.
Mathematics 10. Don Mills, Ontario: Addison-Wesley,
1987.
- Brendan, Kelly, Bob Alexander, and Paul Atkinson.
Mathematics 10 - Teacher's Resource Book. Don Mills,
Ontario: Addison-Wesley, 1987.
- Ebos, Frank and Bob Tuck. Math Is 4. Toronto, Ontario:
Nelson, 1980.
- Jones, Mimi and Dave Myers. Hands-On HyperCard. New York:
John Wiley & Sons, Inc., 1988.
- Hyper-Talk Tutor. Class Software, 1991.

APPENDIX A

MATHEMATICS 10 TUTORIAL PACKAGE
DISK 1

*Susan
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