AN INTERACTIVE, COMPUTER-MANAGED MODEL FOR THE EVALUATION OF AUDIO-TUTORIAL INSTRUCTION

By

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This study attempted to enhance the evaluation of individualized, audio-tutorial instruction by the use of computer management. The computer was used to provide (1) students with feedback on their achievement of behavioral objectives and (2) instructors with guidelines for the revision of teaching and evaluative materials.

The study developed a model system on a BASIC language time-sharing computer for use in an introductory physical science course. The system was designed to allow both students and instructors to gain access to the computer in an interactive mode, thereby minimizing the amount of special instruction required for its use. The computer programs generated and stored data on student work while the model was being tested, and these data were used to analyze the system's ability to evaluate instruction and the cost factors involved in its use.

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Chapter 1

INTRODUCTION TO THE STUDY

PURPOSE

The use of automated media to help administer individualized instruction has become increasingly popular within the past ten years. Programs have been implemented in so many disciplines that the applications of individualized, mediated instructional techniques seem limited only by imagination. In spite of their popularity, these techniques have been accompanied by several procedural problems. This study specifically examines one of these problems: that of monitoring and evaluating instruction which has been administered through individualized media.

Existing techniques for monitoring and evaluating individualized, audio-tutorial instruction are often unsatisfactory in the speed with which they provide feedback, the clarity of their criteria, and their ability to provide meaningful data for revision of the evaluative materials themselves. In an attempt to resolve some of these shortcomings, an evaluation model was designed to possess the following characteristics:

1. the capability of providing students with fast, meaningful feedback on their achievement of behavioral

objectives;

2. the capability of recording data on student performance for purposes of monitoring student progress, of analyzing the effectiveness of the instructional materials, and of providing information on the validity of the evaluative materials themselves; and

3. the capability of providing the instructor with an easy method for gaining access to the recorded data and for performing administrative manipulations to individual student records.

IMPLEMENTATION

The evaluation model was implemented through the use of interactive computer-managed instruction. Students worked through an audio-tutorial unit which directed them in performing laboratory activities and then took a short quiz at a computer terminal. The computer quizzes, or "check points", required students to answer questions based on the behavioral objectives of the unit studied and generated remedial messages which were contingent upon the students' responses. In addition, the computer stored data on the students' performances which were accessible to the instructor in an interactive mode. Both interactive environments led their users through all phases of their operation so that the amount of special instruction needed for their use was as little as possible.

This thesis begins by examining the development of mediated techniques for evaluating individualized instruction and presents several models which are being used at the college level. Special attention is paid to the feedback which each model offers and its ease of operation by users other than its designer. The computer is characterized not only as a medium for presenting instructional materials, but also as a tool for guiding the revision and improvement of these materials through detailed analysis of their use.

The on-line computer environments created for this study are described from both the user's and the programmer's points of view. Samples of student interaction at the computer terminal are printed in the appendices along with partial listings of the computer programs themselves. The descriptions emphasize those aspects of the evaluation model which are reproducible in other systems and which have significance beyond that of the current study.

The data collected by this study fall into two classes: course data and system data. The former category reflects upon how well the instructional materials aided students in achieving the stated behavioral objectives, while the latter yields an evaluation of the system's capability to measure student performance. From an examination of these two classes of data, recommendations are made for both the revision of the instructional and evaluative materials and the improvement of the evaluation model itself.

Chapter 2

REVIEW OF LITERATURE AND ONGOING PROJECTS

INTRODUCTION

This chapter is organized chronologically, tracing mediated techniques for the evaluation of instruction from the middle 1920's to the present. It is divided into two major sections, delimited by Skinner's introduction of programmed instruction in 1954 and the subsequent development of computer-assisted instruction (CAI). The first section emphasizes the inventive resourcefulness of earlier researchers and highlights the findings discovered during application of their techniques. The latter section examines both manual and mediated techniques for evaluating individualized instruction, stressing the special capabilities which the computer has contributed to this field.

THE DEVELOPMENT OF MECHANICAL DEVICES FOR EVALUATING INSTRUCTION

Pressey's Early Machines

Sidney L. Pressey is universally recognized as the first researcher to have truly evaluated instruction through media. This section therefore begins by examining the ingenuity of his inventions, the methods which he devised for their application, and the results which he published on their use.

The theoretical stage for Pressey's work was set by Edward L. Thorndike in 1912. In his classic book, Education, Thorndike stated:

> If, by a miracle of mechanical ingenuity, a book could be so arranged so that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be accomplished by print. (P. 165)

Pressey realized Thorndike's miracle in 1926. At that time, Pressey exhibited a machine which consisted of a horizontally mounted cylindrical drum on which were printed multiple choice questions to be viewed one at a time, and a set of four keys for the student to indicate his response.

The device could be used for either testing or drill. In test mode, all keys were active and the student was given no indication as to the correctness of his response. Questions were presented sequentially and the drum rotated to the next question as soon as any response had been made. A single switch converted the machine to its drill mode, in which all the response keys except the correct one would lock, thus immediately informing the student as to the correctness of his response. The drum would not advance to the next item until the correct response had been made.

One of the exciting features of this device was that it automatically recorded all responses for instructor evaluation. Pressey claimed that he used the information thus acquired to revise his lecture plans, spending more time on those concepts which were consistently missed and less on those easily grasped. In a much later paper (1964), Pressey pointed out that an attachable mechanism existed which would reward the user with a candy lozenge when a programmable number of correct responses had been made.

In 1927, Pressey refined the drill mode of his original machine so that it would omit successive presentations of questions which had been correctly answered twice in succession. Pressey's research showed that students who drilled with his machine did better on examinations than those who spent an equal amount of time simply studying the text. To account for this phenomenon, Pressey formulated three "laws of learning" which he claimed were responsible for its occurrence. The "law of recency" explained that the last response given by the learner was always the correct one and would therefore establish the strongest impression. The "law of exercise" suggested that the correct response was almost always the most frequent as it had to be given for the drum to advance. Finally, the "law of effect" was justified because the learner was penalized for wrong answers by the drum remaining on the same question and was rewarded for correct ones by the advancement of the drum.

Pressey discontinued much of his research in 1932 due to a lack of funds--he sponsored most of his work out of his own pocket. He remained confident, however, that an "industrial revolution" was coming in education and publicized yet another two inventions for scoring tests.

The first of Pressey's "contributions" was a generalized answer unit which he hoped would replace the procedure of students marking answers in their test booklets and thereby making the booklets non-reusable. (These booklets were costing five dollars per hundred during the depression.) The device consisted simply of a three by five inch card with numbered answer boxes which the student would mark with his responses. By placing a transparent window over the student's card, the teacher could easily distinguish correct responses from incorrect ones.

Pressey's second 1932 invention was an elaborate machine for grading tests. The student's answer sheet consisted of an 11 by 1-3/4 inch piece of cardboard with thirty rows of five circles each. The student marked his answer by punching through a circle. The card was then inserted into a machine consisting of 150 holes in the corresponding configuration with spring-loaded pins inserted into the correct answer positions. The pins were thus able to stick through the correct holes that the student had punched but were held down by the cardboard if the answer had not been punched. The device was able to sense the pins which protruded through the correctly punched holes, print the number of correct responses on the answer sheet, and keep a running tabulation of the number of correct responses to each item at a rate of one answer sheet per second! The tabulated results could be read directly from dials at the back of the machine to provide instant item analysis for class discussion.

Further Developments Before 1954

Pressey's 1932 article contained the following epilogue:

> The writer has found from bitter experience that one person alone can accomplish very little, and he is regretfully dropping further work on these problems. But he hopes that enough may have been done to stimulate other workers, that this fascinating field may be developed. (P. 672)

Prior to the advent of the computer, developments in the evaluation of instruction through media varied little from Pressey's original models. Several researchers did, however, attempt to demonstrate that learning could be significantly enhanced when students were given immediate feedback as to the correctness of their responses via mechanical devices. This section describes some of the major efforts in this area prior to the sweep of research on individualized instruction toward programmed learning.

During the early 1930's, John and Hans Peterson developed "chemosheets" which students marked with a damp swab. Correct answers turned blue, while incorrect answers turned red. John Peterson (1931) specifically investigated the use of the "Self-Instructor and Tester" (chemosheets) in an introductory psychology class. Experimental and control groups were drawn at random, and a multiple choice exam was employed as a pretest, study guide, and posttest. The experimental groups used chemosheets to accompany the study guides for reading assignments while the control groups used only untreated answer sheets. Peterson found that the increase in score from pretest to posttest was significantly greater for the experimental group than for the control group.

Using Pressey's 1926 drill device and 1932 test scorer, James Little (1934) again found a significant difference between the final exam grades of students who were immediately informed of their results on preliminary exams and students who did not have this feedback. Little also found that drill and the use of make-up prelims significantly improved final exam grades.

George Angell and Maurice Troyer publicized the development of a self-correcting "punchboard" in 1948. This device consisted of an 8-1/2 by 11 inch piece of paper inserted between the front cover and middle section of a solid holder, both with five perforations for each item. An answer key was inserted between the middle section and solid back cover. As the student marked his answer by punching through the paper, the key was visible through the hole and red spots appeared for correct answers.

Sidney Pressey reentered the field in 1950 and published a detailed report on the use of a three by five inch punchboard similar to that of Angell and Troyer. Pressey claimed that the punchboard "telescoped into one single simultaneous process the taking of a test, the informing of students as to their errors, and their guidance to finding the right answers". He further stated that "when the self-instructional tests were systematically used in college courses as an integral part of the teaching method, gains were substantial and sufficiently generalized to improve understanding of a topic as a whole--even help on related topics".

The Development of Programmed and Computer-Assisted Instruction

With the publishing of Skinner's historic paper in 1954, programmed instruction began to dominate research in individualized teaching methods and the role of the teacher was progressively ignored. When a student had completed a programmed lesson successfully, testing was deemed unnecessary. Unsuccessful completion of a program simply indicated that the steps between each frame were too large and that another program must be devised. These concepts were strongly attacked by Sidney Pressey (1960, 1963) and Herbert Thelan (1963). Pressey reiterated the philosophy which he had espoused even when his first teaching machine was introduced in 1927:

> Such devices should not operate to mechanize education in any unfortunate way (though educational sentimentalists may bring this charge). Rather they should free the teacher from much of the present-day drudgery of paper-grading, drill, and information-fixing --free her for real teaching of the inspirational. (P. 552)

Thelan specifically argued that the program-as-teacher concept must be discarded and the teacher's supervisory role clearly defined.

The first significant step beyond linear programming came in 1960 when Norman Crowder invented "intrinsic programming" which could adapt the presentation of subject material to individual students. Crowder's ideas were first realized in "Scramble Texts" which presented a multiple choice question after every few paragraphs of text. Each response was followed by a page number, and the student turned to the page corresponding to the answer he had chosen. Here he would find new material if he had chosen correctly or remedial material if he had chosen incorrectly. This technique required a great deal of textual material and several books were transferred to microfilm to be read from a viewer with random access to each frame by a numbered address. Crowder's intrinsic programming was extended to the computer by Gordon Pask (1960) and is still the most widely used lesson structure in on-line computer-assisted instruction.

By the end of the 1960's, experimental projects had demonstrated the computer's use in virtually every aspect of instruction from pre-school (Moore, 1964) through college (Levien, 1971) and from mathematics (Dennis, 1968) to art (Knowlton, 1972). These developments have been profiled elsewhere by the author (1973), and most are not relevant to the current topic as their experimental natures did not define the role of the teacher. Systems which provide feedback for the teacher as well as the student are generally classified as computer-managed instructional systems, and a profile of some existing projects is presented in the next section.

CURRENT TECHNIQUES FOR THE EVALUATION OF INDIVIDUALIZED INSTRUCTION

Manual Techniques

The problem of evaluating a large group of students moving through individualized material at different rates became immediately apparent with the introduction of audio-tutorial instruction by Postelthwait in 1962. Postelthwait (1972) chose to utilize "integrated" quiz sessions, involving both an oral and a written quiz. For the oral quiz, eight students would meet with an instructor at a seminar table for approximately half an hour. During this time, the instructor would ask each student to explain a different phenomenon which had been studied during the previous week. A score of nine was awarded if the instructor was "impressed" with a student's response, seven if he was "not impressed", and five if he was "disappointed". By making additional comments and contributions to another student's answer, a student could raise his own score by one point.

Following the oral test, all students were required to take a written exam of ten multiple choice questions which were worth a total of twenty points. Two bonus points could also be scored by answering a question which was based on an article in Scientific American. Thus, a total of 32 points (ten oral, twenty written, and two bonus) could be earned by a student each week. Records were kept by the instructional staff.

Postelthwait's model required that students be paced for weekly quiz sessions and that they meet at a specific time to take exams. John Butzow and Roland Pare (1972) modified this approach to allow students greater freedom of scheduling. Their model did not require students to work at any specific pace, but simply obliged them to fulfill a criterion-referenced grade contract by the end of one semester (Pare, 1973). The grade contracts stipulated that each student pass a history of science exam based on a required text and complete three audio-tutorial units for the grade of C, four units for the grade of B, and five units for an A. An additional reading assignment was also required for the grades of B and A.

This model utilized two techniques to evaluate student work. First, each student kept a detailed notebook of his experiences while he was working on a unit. This notebook was turned in at the completion of the unit by depositing it in a box for that purpose. The notebook was examined by an instructor and usually returned within 24 hours via another box accompanied by detailed diagnostics indicating satisfactory completion or the additional activities necessary to achieve this standard. After the notebook had been judged satisfactory, the student was required to take an activity-oriented examination based on the stated behavioral objectives of the unit. This examination was graded in precisely the same manner as the notebook, and all results were recorded by the staff in students' files.

Computerized Techniques

Computer-managed instruction (CMI) goes beyond the ordinary evaluation process by providing an analysis of student performances to guide the prescription of additional course work, the improvement of subject matter presentations, and the revision of the evaluative materials themselves. CMI therefore provides precise data to the teacher as well as the student and clearly defines the role of the teacher as a guide through the subject matter as well as an invaluable educational resource.

Techniques for CMI may be broken down into two distinct categories for purposes of this study, distinguished by the mode in which the computer is accessed when analyzing data. These two modes will be defined in the following sections and sample projects utilizing each technique will be discussed.

Off-line CMI. When applied to the instructional process, off-line computing refers to the use of the computer in a "batch" mode while neither the student nor the instructor is interacting directly with the computational process. The most common application of this technique involves the use of answer sheets which students mark with a pencil and which are subsequently processed by an optical mark reader. The optical reader performs a function identical to that of

Pressey's 1932 test grader, but it may also be coupled to a card punch which prepares standard computer cards for input into data analysis programs. When these cards are processed, extensive test statistics and item analyses may be generated for the instructor and individual student results may be recorded in a master file.

Paul Geisert (1973) has extended Butzow's testing technique by using the computer to store students' records. His model (in use at the University of Wyoming) also utilizes an open quiz room in which printed tests are distributed by an on-duty assistant, written by the student, and returned. These tests are graded on stated criteria by the specific teaching assistant assigned to that student. Each student receives a pack of computer cards at the beginning of the semester and submits them for processing as he completes the course objectives. These cards are fed directly to any of five packaged computer programs. Geisert's programs are described below because they are representative of simple off-line CMI systems.

1. Program "Report": generates an alphabetical list of all registered students and the cards submitted by each.

2. Program "Summary Report": generates a categorized table of students who have completed specific cards.

3. Program "Eight-Ball": generates mailing labels to be attached to "friendly reminders" for students who are more than one unit behind in their work.

4. Program "Recap": generates a summary of the

number of students who have completed each aspect of the course to allow the coordinator to plan available activities at specific times.

5. Program "Grade Card": generates end-of-term grades by summarizing each student's cards and comparing them to the criteria for each grade.

Geisert's course has an enrollment of 500 students, yet he has stressed that

> . . . these programs were not sophisticated computer programs and that the computer programming was not essential to the handling of the course data. Experience with this course demonstrated that all cards could have been processed using only a card sorter. (P. 22)

Franke et al. (1972) have demonstrated similar computer usage with the Biology Phase Achievement System at Iowa State University. Here the computer is used for generating examinations as well as keeping records. The enrollment in the experimental course is over 3500 students annually, and thus the role of the computer is considerably more important than in Geisert's model.

The Phase Achievement System (PAS) divides the course into eight "phases", and students may "test out" of any or all phases by means of a written examination. Examinations are generated from a bank of over 3000 questions grouped by phases, topic categories within each phase, and difficulty estimates based on the number of students answering the question correctly. A 120 question examination consisting of 15 questions from each phase is administered at the first class meeting and at two week intervals thereafter. By the end of the ten week quarter, a student must accumulate passing grades on seven out of the eight phases in order to receive a passing grade in the course. Grades of A, B, C and D are determined by the average of the highest scores achieved on each phase test passed by the student. The computer is used to generate reports documenting each student's achieved scores to date and summaries similar to those described for Geisert's model from master files stored on magnetic tape.

A highly sophisticated evaluation system making use of off-line CMI has been developed by Allan Kelley (1968, 1972) at the University of Wisconsin and Duke University and is called the Teaching Information Processing System (TIPS). This system differs from those discussed above because it produces extremely detailed outputs for students, teaching assistants, and the professor and generates individual weekly assignments for each student. Student progress is monitored by "surveys" consisting of ten multiple choice questions each, administered approximately every week. These surveys are not examinations, and Kelley's implementation does not use them for grading purposes (although they may be so used). Rather, results of the surveys are fed to a computer program which prints out individualized assignments contingent upon the decision rules specified by the professor. These assignments take into account each student's performance on the weekly survey, his previous course background, and his specific aptitudes (1973).

Summary item analysis reports are generated for the teaching assistants and professor to guide class discussions and the revision of course materials. The beauty of Kelley's design lies in its flexibility in applying the decision rules specified by the professor and the clarity of its reports.

Off-line CMI has thus been used in several types of situations. This technique has the advantage of being able to handle a virtually unlimited number of students and makes use of the computer in its most efficient mode. On the other hand, use of the system generally requires precise specification of program parameters (Kelley, 1973) and at least several hours wait (Kelley, 1972). An error in parameter specification can easily abort a run and double or triple the time required to receive results.

On-line CMI. Interactive programming has been used to overcome some of the utilization problems mentioned above. This technique may be referred to as on-line CMI and requires that the user interact directly with the program through a computer terminal while the computational process is taking place. In this mode, program parameters are specified at the request of the computer and mistakes may be immediately detected and corrected. Response to the user's requests are also immediate, so he may be led interactively through all steps necessary to generate the reports of his choosing. The only unguided acts which the user is required to perform are the connection of his terminal to the computer system and the loading and execution of the desired program. From there on in, the user is always prompted as to what data is required by the program.

This method of computing is usually coupled to interactive CAI programs which monitor as well as administer instruction to students through computer terminals operating under a time-sharing environment. The most widely used such environment is IBM's Coursewriter which has the ability to record student responses on magnetic tape for later "batch" processing and the generation of reports similar to those discussed under off-line CMI. A limited amount of data on the status of individual students is available to the instructor on-line while "monitoring" students working with the environment. Thus, feedback to the student is on-line and immediate while feedback to the instructor is generally off-line.

A true on-line system for both teachers and students has been developed by James Ghesquire (1973) on the PLATO system at the University of Illinois. This system creates both tabular and graphic displays of data collected during student CAI on a video display screen 8-1/2 inches square. Unfortunately, the unique characteristics of the PLATO system make most of Ghesquire's work non-exportable to other systems without major revisions. Similar research is being carried out on the TICCIT system at Brigham Young University (Schneider and McMurchie, 1973), but no complete reports have yet been released on those developments due to the proprietary nature of the system (Schneider, 1973).

SUMMARY

The development of mediated techniques for the evaluation of instruction has been traced from its origin in 1926 to the present. While techniques vary considerably with each implementation, the general features of representative systems have been described with an emphasis on the special characteristics of computer-managed instruction. The distinction between "off-line" and "on-line" CMI has been defined in terms of the mode of access to the computer. Unfortunately, published reports dealing with on-line CMI are extremely scarce as much of the research is proprietary information, but it is hoped that the literature presented will provide sufficient background for interpretation of the current study.

The evaluation model developed for this study was a full on-line system which incorporated many of the features discussed above. Students received immediate feedback on their performances by working at a computer terminal in an interactive mode. In the same fashion, the instructor was able to gain access to data on the entire class, individual students, or specific test items. Thus the CMI capabilities described in this chapter were provided in interactive packages for both students and teachers.

Chapter 3

DESIGN AND IMPLEMENTATION OF THE STUDY

INTRODUCTION

The experimental course used in this study was Ed C 140, "Studies in the Physical Sciences", taught by Dr. John W. Butzow at the University of Maine at Orono. This course was designed to provide non-science majors with the opportunity to fulfill their university science requirements in an environment which did not assume any previous training in science. With the extensive assistance of Roland Pare, the course was mediated in 1971 and now offers fifteen units of instruction in audio-tutorial format on 35 mm slides and standard cassette tape. Pare (1973) described Ed C 140 in great detail, including a manual approach to the evaluation scheme currently used in that course. This chapter describes (1) the audio-tutorial materials made to allow the implementation of computer-managed instruction (Unit One), (2) the interactive computer programs created to evaluate student learning, and (3) the interactive administrative programs developed to fulfill the goals of this study.

THE NEW UNIT ONE

The first topic studied in Ed C 140 has traditionally dealt with the concept of measurement, and this orientation was preserved in the new unit. Unit One was entitled "Extending the Senses through Measurement" and attempted to present a comprehensive picture of the metric system, emphasizing the relationships between various metric measures.

The unit was made up of four sections. Section One introduced the meter and its subdivisions and demonstrated techniques of graphing linear relationships. The main activity in this section required students to solve a problem by plotting data and finding the resultant slope. Section Two dealt with the concept of area as the square of a linear measurement and introduced the Celsius (Centigrade) temperature scale. Here students were also taught a quantitative method for expressing the tolerance in a measurement. Section Three presented volume as the cube of a linear measure and extended the discussion to liters and milliliters and the use of graduated cylinders. Time was discussed briefly and students were asked to perform a simple activity involving the use of a stop watch and the graphing of their resultant data. The tape script for this section is printed in Appendix A as an example of the course material. Copies of the slides which accompanied this tape script may be found in Appendix B. To conclude the unit, Section Four first dealt with mass and the metric measures of grams and kilograms and then directed students in performing a summary activity which incorporated almost all of the concepts and techniques used throughout the unit.

COMPUTER CHECK POINTS

Hardware and Software

At the end of each section in the new Unit One, students were directed to go to a computer terminal located in an adjacent room to check their progress. This terminal was an IBM 2741 Selectric teletypewriter and was linked through the university telephone lines to an IBM System/370 computer located elsewhere on campus. The check point programs ran under a virtual memory operating and time-sharing system with the capability of utilizing disk storage as core memory. Two unique features of this system were extremely meaningful to the currect study as they greatly simplified program control and essentially eliminated the user's need for any knowledge of the computer system to run the programs. These features are discussed in the following paragraphs.

Executive routines. Access to the computer was gained by dialing the system on a Dataphone and entering "logon edc140 student". This procedure was outlined both on a sheet posted on the wall and in more detail on a cassette tape next to the terminal. The code "edc140 student" was chosen for relevancy, as most of the students had never worked at a computer terminal before and the author wished to make as much of the computer experience as possible meaningful to the student.

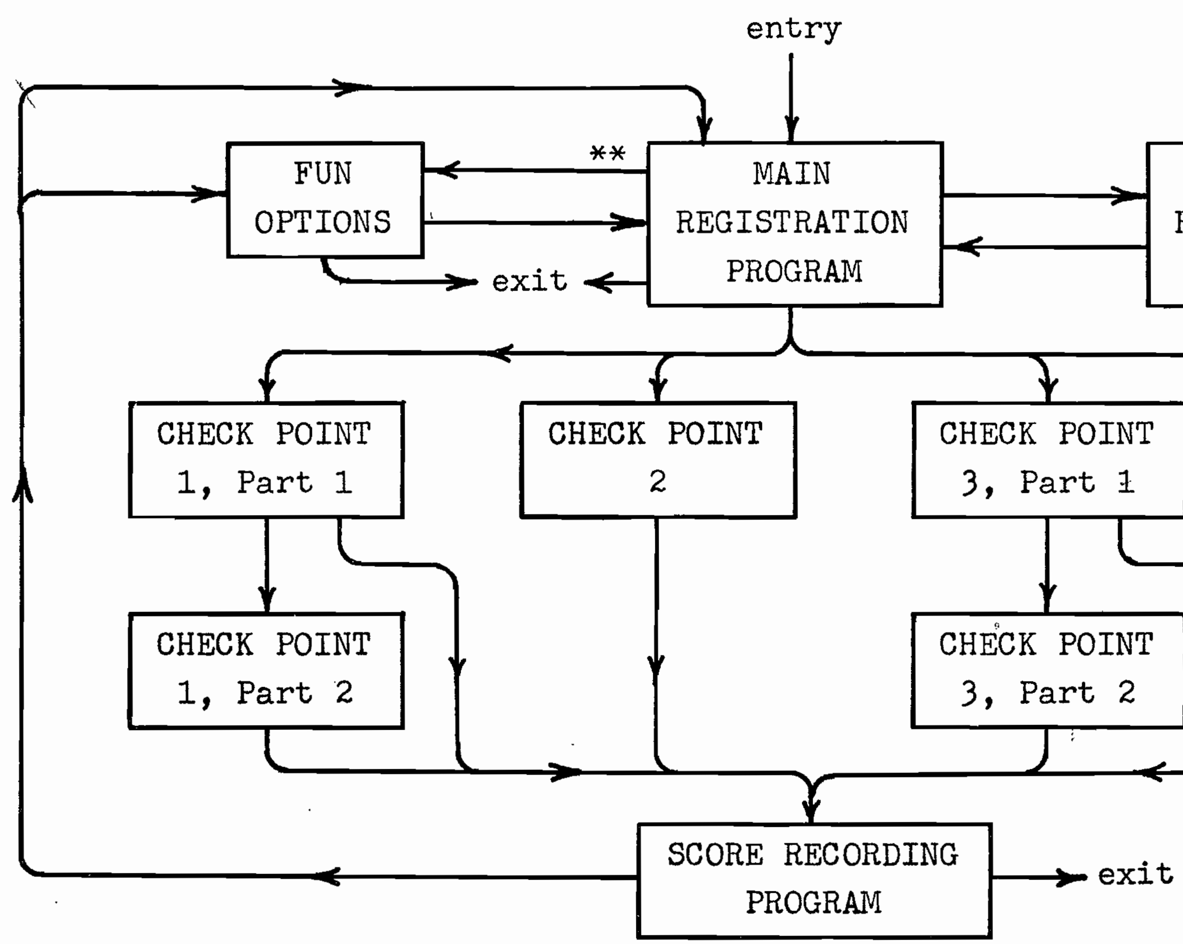
A system message stating the time and date was then typed to the student (see Appendix C, page 102). At this point, it was necessary to load and execute the check point registration program. This procedure was handled by an executive routine which was executed automatically by the mere pressing of the carriage return key. Executive routines differ from most normal computer programs in that they allow regular system commands to be interspersed within the program structure. The executive program first identified Ed C 140 and printed an introductory message (see page 102). It then set up a temporary work space, copied the relevant program and data files into this work space (while maintaining backup files in a separate storage area), and began execution of the check point registration program without any further input required by the student. After the student had completed his work, this same routine copied his data files back into the permanent storage area.

Thus the user needed only to log on to the computer system with the course code and program execution was begun automatically. Other executive routines allowed recovery of program execution after abnormal termination (which sometimes occurred while the programs were still being debugged) without loss of the data files. These routines could be evoked by the entry of a single word. (The functions of these routines are documented in the sample run of the administration program. See Appendix F, page 152.)

Program chaining. The second software feature which simplified program control was the BASIC "chain" command. This command could be inserted into a normal BASIC language program with an argument naming another BASIC program (see Appendix E, page 129, line 15150). When executed, this statement cleared the workspace of the current program, loaded the program named by the argument, and began execution of the new program. Thus, by chaining one program to another, an unlimited number of BASIC programs could be executed without requiring the user to issue any system commands. This feature was extremely useful to the current study as the BASIC compiler imposed a limit of 800 statement lines per program and the entire check point system required over 5000 statement lines.

Courseware

The registration program served as the main entry point into the complete network of CMI programs in the student environment. The basic structure of this network is shown in Figure 1. Each box in this figure represents a separate computer program and the connecting arrows represent paths available by program chaining. The printouts from two runs of Check Point 3 are reproduced in Appendix C and these are discussed in the next section to



** Path accessible only after a check point program has been run.

Figure 1

Student Program Network

demonstrate the system's characteristics. Copies of the slides which accompanied this check point may be found in Appendix D. The system will be discussed first from the student's view and then from a programmer's view. The latter discussion will present some of the programming techniques developed to attain the goals of this study.

The student's view. Students gained access to the system by entering "logon edc140 student" as was explained on page 30 and is shown on page 102 of Appendix C. The executive routine was then evoked by pressing the carriage return key. The student was warned that internal structuring was going to take place and that he or she would have to wait a few minutes to begin.

The first message typed by the registration program itself asked the student if he or she had ever registered at the terminal before (page 102). By indicating "no", the sample student (a girl) caused the system to chain to the routine for registration of a new student (see Figure 1). The message "One moment please..." was typed whenever program chaining was to take place because terminal operation paused for several seconds during compilation of the new program.

The new student registration program led the student through choosing a code name and registering his or her full name on the class roster (pages 102 and 103). When this was completed, control was returned to the main registration program and the student was asked to select a program option (page 103). The sample student indicated that she wished to run a check point program and then exercised the option to print a list of the available sections with computer check points. From this list, she chose to run the check point program for Section Three in Unit One.

At this point, the program scanned its log file to see if the student had ever run this check point before. Since she had not, the introductory message for Check Point 3 was printed (page 104). The sample student then exercised the option to print an explanation of the system codes for controlling question presentations. (This explanation was printed automatically on each student's first run of Check Point 1.) After this explanation, the student was instructed to turn on the slide projector and the system chained to part one of Check Point 3 and presented the first question.

Since the sample student had never run this check point before, each question was presented in turn (pages 104 to 107) with the program automatically chaining to part two after question five (page 106). Question variations were selected at random, and two attempts were usually allowed at solving each problem. Diagnostic messages were printed to the student contingent upon his responses, and response codes were recorded for both his first and last entries. When an unidentifiable response was entered (see Question 8, page 107), the student's complete entry was stored for later instructor evaluation. After completion of the check point, the system chained to the score recording program (page 108).

Student scores were evaluated for satisfactory completion on the basis of the number of questions answered correctly. If less than two questions had been answered incorrectly, the student was directed to proceed to the next section. As the sample student answered only six of the nine questions correctly, she was asked to review her work and given another opportunity to run the check point. She elected to redo only those questions which she had missed and caused the check point program to be reevoked (pages 108 to 109). Those questions which had been answered correctly were flagged, and only those answered incorrectly or omitted were presented. Question variations were determined by a subroutine which guaranteed that a specific variation was never presented to the same student twice in succession (see lines 16000 through 16180 on page 130 of Appendix E).

Subsequent execution of the score recording program caused the current and cumulative scores to be displayed (page 110). The cumulative score was a simple conglomerate of the best scores achieved on each question. The sample student chose not to rerun the check point program a third time even though her status was still not satisfactory. The program then directed her in logging off the computer.

A second session at the computer terminal is reproduced on pages 111 to 115 of Appendix C showing other aspects of the check point system. When the sample student logged on after she had already registered, she only needed to enter her code name to begin the terminal session (page 111). As she requested to run a check point which she had run previously, her present cumulative score was computed and displayed (page 112). Upon completion of the check point, the student elected to view the status of her work, and the table shown on page 115 was printed. The terminal was then disconnected from the computer by typing "logoff" after program termination had occurred.

The programmer's view. The computer programs which made up the student environment were all written in the BASIC language (IBM, 1973). Most of the programming capabilities in the version of BASIC used were no more powerful than those available in the version implemented on most minicomputers. This language was chosen because it is available on almost all time-sharing computers (especially those used in educational institutions) and thus affords maximum exportability of the techniques developed.

Listings of the BASIC language computer programs for parts one and two of Check Point 3 and the score recording program are printed in Appendix E. Three important features of these programs will be discussed from a programmer's point of view: response coding, digit packing, and file management. These aspects are highlighted because the techniques developed may be easily translated to other BASIC installations.

1. Student responses to each question were categorized and translated into single digit codes. For all questions, code "0" denoted that the question had been passed or omitted, codes "1" to "5" that it had been answered incorrectly, and codes "6" to "9" that it had been answered correctly. This technique allowed the program to record which of five different kinds of mistakes had been made or which question variation had caused the correct or incorrect response. The codes did not have the same significance for each question except for the general correct and incorrect format stated above. The significance of each score was documented within the program (see pages 124, 126, 129, 134, 137, and 138). Two response codes were recorded for each question, corresponding to the first and last responses entered. This double record assured that the student's first response would be saved for item analysis even if the question was subsequently answered correctly. When the student's score was evaluated, the first code was used only if the second score was zero, thus indicating that only one response had been entered. Both codes were set to zero when a question was omitted completely (see lines 2220 to 3210 of the score recording program on page 143).

2. The single digit response codes were packed into log records by a routine which performed "pseudo" string manipulation. (The routine differed from regular string manipulation in that individual storage locations could not be addressed directly. See lines 1140 to 1270 on page 142.)

This techniques allowed a three-digit student identification number, a two-digit unit number, a one-digit check point number, a one-digit satisfactory completion flag, and up to 28 one-digit response codes to be packed into five seven-digit numbers for addition to a disk file. (Data handling in the version of BASIC used did not allow a number longer than seven digits to be stored as an integer without the use of extended precision.) The format specifications for a packed log record are shown in Figure 2. Log records were unpacked by a second "pseudo" string routine which truncated the seven-digit numbers to the left and right of the desired digit (see lines 28200 to 28540 of the administration program on page 172). This routine utilized two functions, INT(X) and FNA(X), which returned the integral and fractional parts of "X" respectively. (INT(X) is an intrinsic BASIC function, while FNA(X) was defined by the statement FNA(X) = X - INT(X). See line 120, page 121.) Thus, the second digit (which indicated the check point number and is represented below by "C") in the first number of a packed log record (represented by "R1") could be extracted by the following calculation:

C = 10 * FNA(INT(R1/10)/10)

It may be seen that this expression is algebraically equivalent to a slightly simpler form,

C = INT(10*FNA(R1/100))

but this latter calculation often caused digits one <u>less</u> than the correct value to be returned. This mistake occurred due

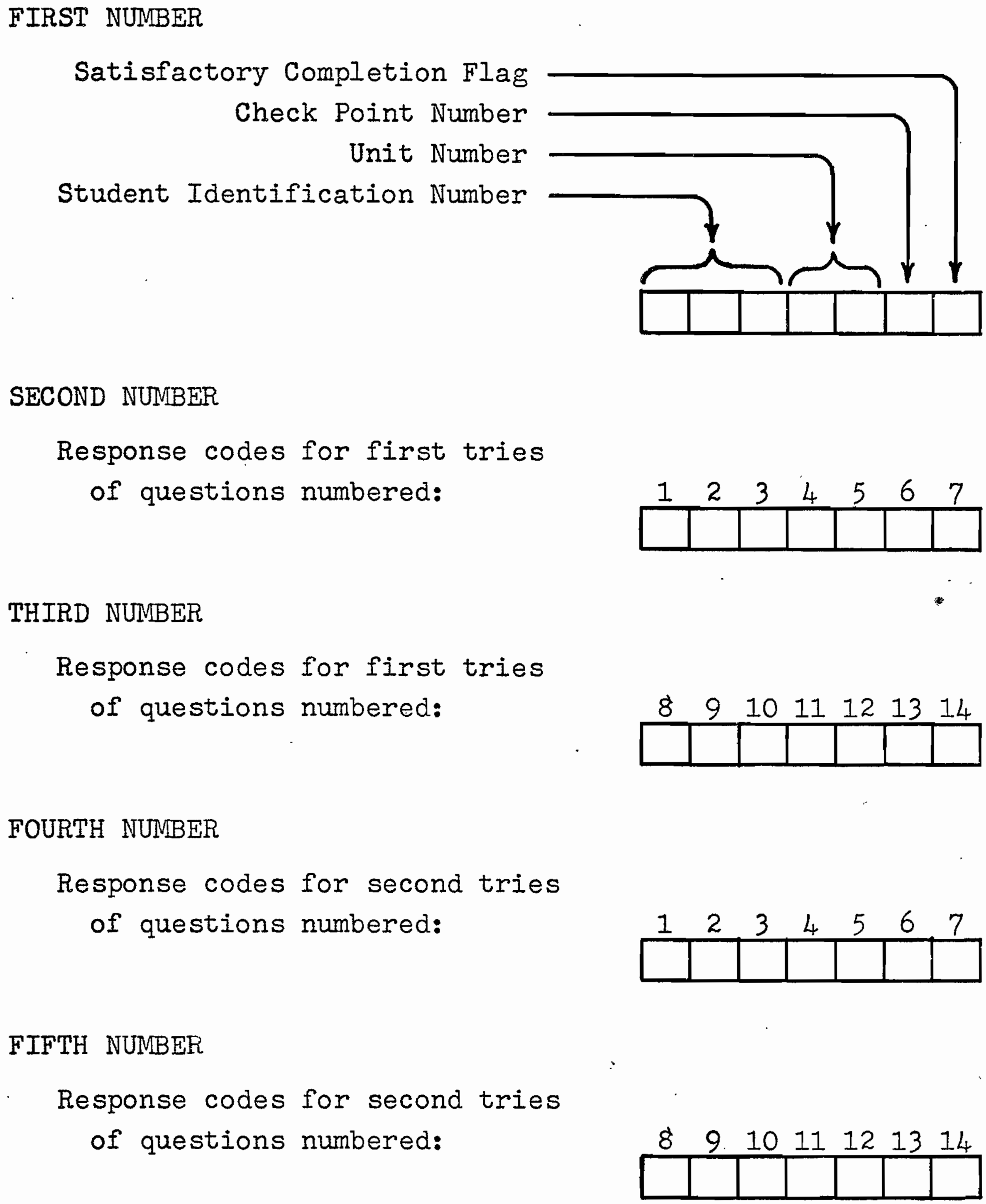


Figure 2

Format Specifications for a Packed Log Record to the nature of BASIC data handling when converting numbers from integer to real mode and back again. When changing from integer to real--as required by the FNA function--the computer sometimes translated "6" to "5.999999". If the integral part of this number was subsequently requested--as in the second equation--the calculation would return "5" instead of "6". Thus, the first equation was used because it computed the integral part first, but it alone would still not reproduce completely accurate data in integer mode. The values from this computation were therefore passed to a rounding subroutine which converted real numbers which were not integers to the next higher integer while leaving those that were integers unchanged (see lines 22000 to 22075, page 130).

3. Packed log records were added to the existing log file by appending them at the end, thus preserving the chronological characteristic of the file. Since the version of BASIC used allowed neither random access to files nor access in read and write modes simultaneously, it was necessary to copy the entire log into a temporary file and then rewrite it back into the original file, adding the new log records to the end while in write mode (lines 1000 to 1340, page 142). The first entry in the log file indicated the number of five-word records present. It would also have been possible to read the log file into core memory and rewrite it from there--thus saving the time required for writing to and reading from a temporary file--but this

approach would have limited the size of the log file to the size of the available array area, a critical factor in smaller computers. The technique employed limits file size only by available disk space.

Six other files were used by the program, although only four were allowed to be open at any one time. The eight files are listed below by the name and number with which they are referred to in the program listings.

1. CODENAME: the list of code names for all users;

2. REALNAME: the last and first names of all users with corresponding registration flags indicating whether or not they were students registered in Ed C 140;

3. LOGFILE: (described above);

4. PASSFILE: used to pass data such as the student identification number, previous scores, and question presentation flags from one program to another during chaining;

5. NSTRDANS: the number of stored answers in files six and seven;

6. NUMERANS: three-word records storing unexpected or special numeric responses entered by students including packed codes indicating the unit, check point, and question numbers at which the response had been entered as well as the student's identification number and the response code recorded;

7. ALPHAANS: three-word records storing unexpected or special alphameric responses entered by students with packed codes as described above; and

8. HOLDFILE: the temporary file described above.

ADMINISTRATIVE PROCEDURES

A separate on-line program environment which linked to the student data files was provided for the course instructors. This environment assumed that the instructors had no more knowledge of the computer hardware and software than the students, and thus also employed executive routines and the "chain" command to handle program loading and execution. All that was required of the instructor was a knowledge of the courseware for interpreting the displays generated. The program network for this environment is diagrammed in Figure 3 and a sample run of the administration programs is reproduced in Appendix F. This system will again be discussed from both the user's and the programmer's viewpoints.

The Instructor's View

Thirty-two administrative options were available to the instructor, and each was evoked simply by entering its number (see page 150). If the option chosen was not in the current program, the required program was chained and current parameters were passed to it via the pass file just as in the student environment. The first option printed detailed instructions for the operation of the system (page 151), while the second documented the "special CMS (Conversational Monitoring System) commands" which evoked

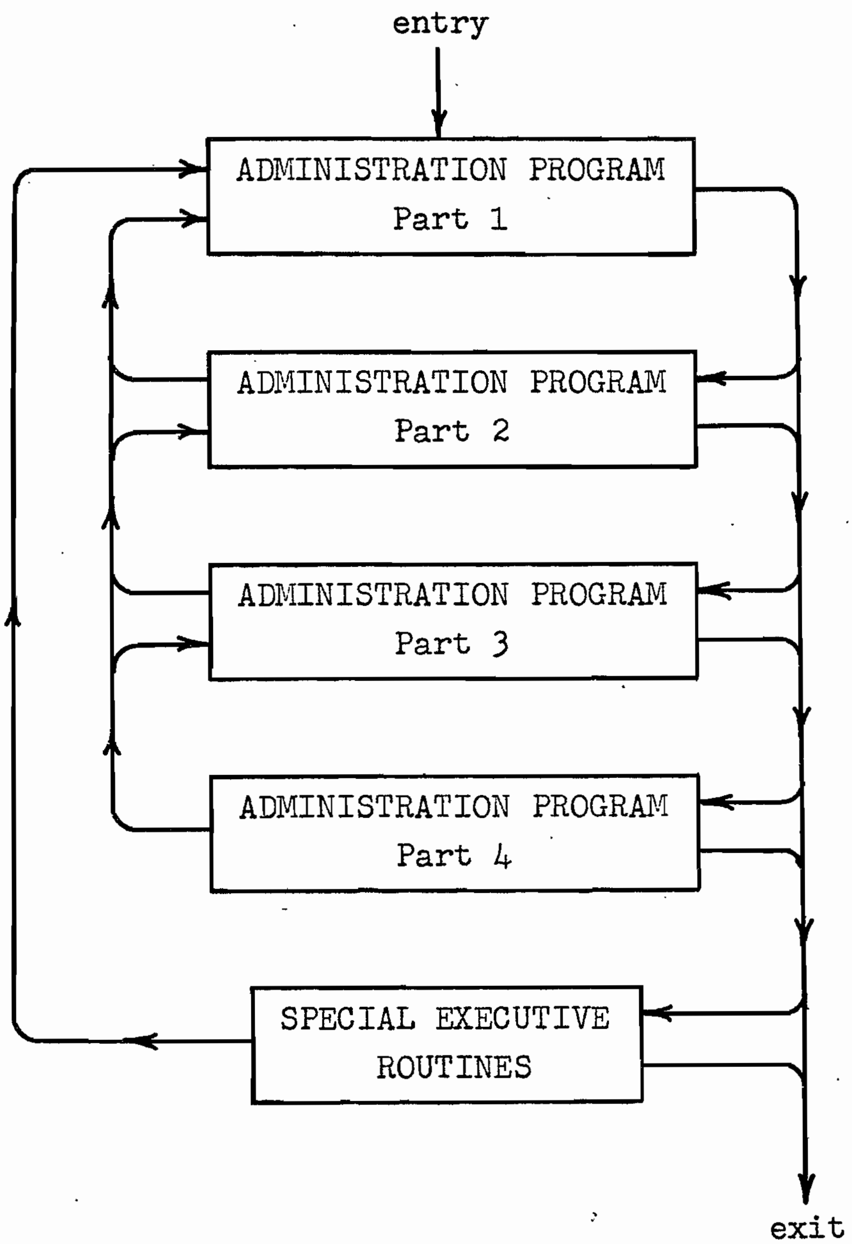


Figure 3

Administrative Program Network

executive routines and performed the functions specified on page 152.

The value of interactive CMI is clearly demonstrated in many of the sample options which follow. Option 24 allowed the instructor to create a log record for a student whose data did not get recorded (as sometimes happened while the programs were still being debugged) or for extraordinary circumstances (see pages 153 to 155). The instructor was led through this operation step by step and the results of his actions were immediately displayed (page 154). He was even informed of how to correct his actions if he was not satisfied with the results. In the case demonstrated, the instructor created two log records for Denise Michaud. To display these records as the student would see them, he then exercised Options 11 and 12 and caused chaining to other administration programs (see pages 155 to 156). Since data had been passed to the new programs, the user was still able to specify "same" when asked for the student's name and the program used the identification number for Denise Michaud rather than Pierre Michaud.

The functions of most options are straight-forward and may be inferred by examination of the examples printed in Appendix F. The option on page 162 demonstrates the type of error messages that were generated when incorrect or unrecognizable parameters were entered by the user. Response was immediate and mistakes were easily and quickly corrected.

Analyses of student performance are demonstrated by Options 16, 17, and 18 (pages 162 to 164). Option 17 provided a detailed item analysis for one or all questions in a specified check point. The execution of this option required extensive unpacking of the log file and demonstrates that even this complex computation may be carried out on-line with the results printed to the user within several seconds. Further analysis of this question was attained by exercising Option 18 and viewing the actual responses given by students who made unrecognizable entries. These two options displayed detailed information on the construct validity of each question and thus provided excellent guidelines for the revision of the evaluative materials.

The Programmer's View

The reader may trace the program flow for some of the options demonstrated in Appendix F by referring to the listing of Administration Program Part 4 which appears in Appendix G. Each administrative option operated as an independent subroutine from a small routine which directed the user in option selection (lines 20000 to 20530, pages 170 to 171), and generous use was made of secondary subroutines for functions which were performed repeatedly in many options. These secondary subroutines included digit conversion from real to integer mode (lines 14100 to 14200, page 167), data initialization (lines 15300 to 15490, page

168), specification of an individual student (lines 16500 to 16985, pages 168 to 169), alphabetization (lines 17000 to 17220, pages 169 to 170), and input code interpreting (lines 18000 to 18150, page 170).

The same programming techniques for digit packing and file management that were discussed for the check point programs were used in several instances. For example, the routine at lines 27160 through 27290 on page 171 unpacks the log file for item analysis as described previously. The routine at lines 28200 through 28540 (page 172) performs a similar function and generates a cumulative score. In general, each routine was designed to provide maximum ease of operation while still protecting the data files from accidental changes by the naive user.

SUMMARY

The on-line CMI system created for this study has been described from both the user's and the programmer's points of view. The special character of interactive computing has been highlighted as a means of providing instructors with fast access to evaluative data on individualized instruction regardless of their knowledge of computers. The use of two unique virtual memory software features was related to the current study, but emphasis was placed on those characteristics which are more general in nature and translatable to other installations. Several programming techniques have been specifically documented to facilitate replication of the check point system on other computers. The system's capabilities were demonstrated by annotating sample runs of the programs which appear in the appendices.

Attention shall now be turned to the data which was collected during the system's operation and subsequent evaluation of the check point system itself.

Chapter 4

USE OF THE MODEL

INTRODUCTION

Two types of information were collected while the check point model was being used: course data and system data. The former pertains to the model's courseware and was generated from student files by the administration programs. This information provided guidelines for revision of the audio-tutorial materials and the BASIC language check points. The latter data were recorded by the operating system monitor and suggested several changes in the overall programming design of the check point system itself. These two categories of data will be presented and discussed in turn.

COURSE DATA

The Sample

Approximately 36 students worked through Unit One and the accompanying check points. These students were all non-science majors in the Colleges of Education and Arts and Sciences at the University of Maine, and most had no previous science courses at the college level. The performance of these students on Check Point 3 will be examined in detail. A full examination of their performance on all check points is not possible within the scope of this thesis due to the volume of data involved. By discussing Check Point 3 once again, the reader may refer to the instructional and evaluative materials reproduced in the appendices for clarification of specific aspects mentioned below. All tables were made from actual printouts of the administration programs and portions of the check point program listing.

Overall Performance

The questions in Check Point 3 were based on the behavioral objectives for Section Three (see Appendix B, slide 53). These questions therefore involved identifying and relating metric units of volume, computing volumes of various objects, using graduated cylinders, and reading a stopwatch. Table 1 summarizes the overall student performance on this check point, where satisfactory completion signifies less than two incorrect responses. It can be seen that only one student out of 36 was not able to complete the check point satisfactorily after two runs, and thus one of the following two conclusions may be drawn concerning students' mastery of the behavioral objectives as measured by this check point: either the instructional materials did a fairly good job of assisting each student in achieving the objectives or most students were competent in the objectives from previous experience. Since over 60% of the students completed the check point satisfactorily on their first run, it would <u>not</u> be reasonable to infer that

TABLE 1

Overall Student Performance on Check Point 3

Total number of students attempting check point	36	
Number completing satisfactorily on first run	23	63.9%
Number completing satisfactorily on second run	10	27.8%
Number trying only once and still incomplete	2	5.6%
Number trying twice but still incomplete	1	2.8%

the contingency messages generated for wrong responses did more teaching than the audio-tutorial materials themselves. However, of the 11 students who did not complete the check point satisfactorily on their first run and who did attempt it a second time, the table shows that 10 did meet the criterion on the second run. Therefore, it may be asserted that the contingency messages did play a significant part in clarifying the questions and guiding students toward finding the correct answers. (It should be recalled that a student was never presented with the same question variation on the the second run which he or she had received on the first run.)

Further analysis of student performance was achieved by examining the actual response codes scored. This analysis provided data on weaknesses in the check point programs as well as the audio-tutorial presentations.

Item Analysis

Tables 2 through 10 present item analyses for each of the nine questions in Check Point 3. It should be noted that the "first" and "second" tries of a question refer to each run. That is, if a student answered a question incorrectly twice on his or her first run and then answered it correctly on his first try in the second run, his correct response would be recorded as a first try. This convention explains why the total number of attempts for each question

[Text continued on page 62.]

TABLE 2

Item Analysis: Question 1, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	0	1	1
2	Incorrect response to var. 2	1	1	2
3	Incorrect response to var. 3	3	1	4
4	(Not designated)	0	0	0
5	Unidentifiable response	20	0	20
6	Correct response to var. 1	10	4	14
7	Correct response to var. 2	3	9	12
8	Correct response to var. 3	2	5	7
9	(Not designated)	0	0	0

Total no. of attempts	39	
Correct on first try	15	38.5% of total
Incorrect on first try	24	61.5% of total
Correct on second try	18	75.0% of no. wrong on 1st try
Incorrect on second try	3	12.5% of no. wrong on 1st try
Passing on second try	3	12.5% of no. wrong on 1st try
Correct on either try	33	84.6% of total
Incorrect on both tries	3	7.7% of total
Incorrect, then passing	3	7.7% of total

TABLE 3

Item Analysis: Question 2, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	1	0	1
2	Incorrect response to var. 2	0	0	0
3	Incorrect response to var. 3	1	1	2
4	Incorrect response to var. 4	3	2	5
5	(Not designated)	0	0	0
6	Correct response to var. 1	13	1	14
7	Correct response to var. 2	4	0	4
8	Correct response to var. 3	8	0	8
9	Correct response to var. 4	8	1	9

Total no. of attempts	38	
Correct on first try	33	86.8% of total
Incorrect on first try	5	13.2% of total
Correct on second try	2	40.0% of no. wrong on 1st try
Incorrect on second try	3	60.0% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	35	92.1% of total
Incorrect on both tries	3	7.9% of total
Incorrect, then passing	0	0.0% of total

TABLE 4

Item Analysis: Question 3, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	4	3	7
2	Incorrect response to var. 2	1	0	1
3	Incorrect response to var. 3	5	2	7
4	Incorrect response to var. 4	5	0	5
5	(Not designated)	0	0	0
6	Correct response to var. 1	6	1	7
7	Correct response to var. 2	4	1	5
8	Correct response to var. 3	6	3	9
9	Correct response to var. 4	7	5	12

Total no. of attempts	38	
Correct on first try	23	60.5% of total
Incorrect on first try	15	39.5% of total
Correct on second try	10	66.7% of no. wrong on 1st try
Incorrect on second try	5	33.3% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	33	86.8% of total
Incorrect on both tries	5	13.2% of total
Incorrect, then passing	0	0.0% of total

TABLE 5

Item Analysis: Question 4, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	2	1	3
2	Incorrect response to var. 2	2	0	2
3	Incorrect response to var. 3	3	1	4
4	Incorrect response to var. 4	4	2	6
5	(Not designated)	0	0	0
6	Correct response to var. 1	9	1	10
7	Correct response to var. 2	7	1	8
8	Correct response to var. 3	9	2	11
9	Correct response to var. 4	3	2	5

Total no. of attempts	39	
Correct on first try	28	71.8% of total
Incorrect on first try	11	28.2% of total
Correct on second try	6	54.5% of no. wrong on 1st try
Incorrect on second try	4	36.4% of no. wrong on 1st try
Passing on second try	1	9.1% of no. wrong on 1st try
Correct on either try	34	87.2% of total
Incorrect on both tries	4	10.3% of total
Incorrect, then passing	1	2.6% of total

TABLE 6

Item Analysis: Question 5, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	8	5	13
2	Incorrect response to var. 2	7	4	11
3	Incorrect response to var. 3	4	1	5
4	Incorrect response to var. 4	9	8	17
5	(Not designated)	0	0	0
6	Correct response to var. 1	6	3	9
7	Correct response to var. 2	4	3	7
8	Correct response to var. 3	4	3	7
9	Correct response to var. 4	1	1	2

Total no. of attempts	43	
Correct on first try	15	34.9% of total
Incorrect on first try	28	65.1% of total
Correct on second try	10	35.7% of no. wrong on 1st try
Incorrect on second try	18	64.3% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	25	58.1% of total
Incorrect on both tries	18	41.9% of total
Incorrect, then passing	0	0.0% of total

TABLE 7

Item Analysis: Question 6, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on First try	Second try	Either try
1	Incorrect response to var. 1	4	4	8
2	Incorrect response to var. 2	1	0	1
3	Incorrect response to var. 3	0	0	0
4	Incorrect response to var. 4	0	0	0
5	Volume read at top of miniscus	14	0	14
6	Correct response to var. 1	17	14	31
7	Correct response to var. 2	3	1	4
8	Correct response to var. 3	0	0	0
9	Correct response to var. 4	0	0	0

Total no. of attempts	39	
Correct on first try	20	51.3% of total
Incorrect on first try	19	48.7% of total
Correct on second try	15	78.9% of no. wrong on 1st try
Incorrect on second try	4	21.1% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	35	89.7% of total
Incorrect on both tries	4	10.3% of total
Incorrect, then passing	0	0.0% of total

TABLE 8

Item Analysis: Question 7, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	0	0	0
2	Incorrect response to var. 2	0	0	0
3	Incorrect response to var. 3	5	4	9
4	Incorrect response to var. 4	1	0	1
5	Volume read at top of miniscus	15	0	15
6	Correct response to var. 1	0	0	0
7	Correct response to var. 2	0	0	0
8	Correct response to var. 3	15	16	31
9	Correct response to var. 4	3	1	4

Total no. of attempts	39	
Correct on first try	18	46.2% of total
Incorrect on first try	21	53.8% of total
Correct on second try	17	81.0% of no. wrong on 1st try
Incorrect on second try	4	19.0% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	35	89.7% of total
Incorrect on both tries	4	10.3% of total
Incorrect, then passing	0	0.0% of total

TABLE 9

Item Analysis: Question 8, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Unrecognizable third entry	0	0	0
2	"Milliliter" = third entry	0	1	1
3	(Not designated)	0	0	0
4	"Milliliter" = 1st or 2nd entry	1	0	1
5	Unrecognizable 1st or 2nd entry	5	0	5
6	(Not designated)	0	0	0
7	Correct response on third try	0	0	0
8	Correct response on second try	0	5	5
9	Correct response on first try	30	0	30

Total no. of attempts	36	
Correct on first try	30	83.3% of total
Incorrect on first try	6	16.7% of total
Correct on second try	5	83.3% of no. wrong on 1st try
Incorrect on second try	1	16.7% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	35	97.2% of total
Incorrect on both tries	1	2.8% of total
Incorrect, then passing	0	0.0% of total

TABLE 10

Item Analysis: Question 9, Check Point 3

Code	Designated Significance for this question	No. of students scoring code on		
		First try	Second try	Either try
1	Incorrect response to var. 1	0	0	0
2	Incorrect response to var. 2	8	1	9
3	Incorrect response to var. 3	1	0	1
4	Incorrect response to var. 4	0	0	0
5	(Not designated)	0	0	0
6	Correct response to var. 1	0	0	0
7	Correct response to var. 2	27	7	34
8	Correct response to var. 3	0	1	1
9	Correct response to var. 4	0	0	0

Total no. of attempts	36	
Correct on first try	27	75.0% of total
Incorrect on first try	9	25.0% of total
Correct on second try	8	88.9% of no. wrong on 1st try
Incorrect on second try	1	11.1% of no. wrong on 1st try
Passing on second try	0	0.0% of no. wrong on 1st try
Correct on either try	35	97.2% of total
Incorrect on both tries	1	2.8% of total
Incorrect, then passing	0	0.0% of total

was usually greater than 36, the number of <u>different</u> students who attempted the check point (see Table 1).

For all questions except number five, between 84.6% and 97.2% of the students were able to respond correctly with two tries. For each of these questions, it may also be seen that no more than 39 attempts were made, thus showing that the data was not severely distorted by the convention described above. That is, for a question with 39 attempts, only 3 students must have attempted it twice since 36 different students ran the check point. Therefore, the percentages would not have changed by more than a few points had the tabulation algorithm been more sophisticated.

For most questions, the data indicate approximately equivalent validities for the different variations when computed as percentages of correct responses on either try. For Questions 2 and 4, however, it was found that the fourth variation caused about 30% more incorrect responses than the other three. Both these questions required the student to calculate the volume of a solid given its dimensions, and the fourth variation of each presented larger numbers for the dimensions than the other three. Thus, the difference in these validities may have been caused simply by students' arithmetic errors when working with larger numbers.

A more striking validity difference is shown by the data for Question 5 (Table 6), and this difference might be attributed to something more than computational errors. In this question, students were asked to convert cubic centimeters to milliliters, cubic millimeters, liters, or cubic meters in variations one through four respectively. The percentages of students getting each variation correct on either try were 41%, 39%, 54% and 11% respectively. Thus, students found it much more difficult to convert from cubic centimeters to cubic meters than to milliliters, liters, or cubic millimeters.

Another interesting problem may be identified from the data on Questions 6 and 7 (Tables 7 and 8). These tables indicate that a great many students read the graduated cylinders at the top of the miniscus. This mistake could have been caused either by student error or illegibility of the slides. Other slides might be tested in a subsequent use of the model to ascertain whether or not the current photographs had caused this problem. If they had not, the audio-tutorial presentation of this concept would have to be strengthened, perhaps in the following manner.

The miniscus is first introduced with slide number 59 (page 99, Appendix B) and the discussion of pages 89 to 90 of the tape script in Appendix A. The student is then asked to read the volume of water in the 500 ml graduated cylinder pictured in slide 60 (page 99). The miniscus is not at all apparent in this photograph, and thus the concept is not reinforced by this exercise. Slide 60 might be replaced by a close-up photograph which shows the miniscus in several different cylinders more clearly, and the tape might then ask the student to read the volume in each before the correct answers are revealed. Alternatively, several cylinders might be filled to specific levels, covered and sealed to prevent evaporation, labelled with their correct volumes, and make available for students' examination while this concept is discussed. A third possibility for strengthening the miniscus concept is to ask the student to perform an activity in which he measures several different kinds of liquids and observes the different characteristics of each miniscus due to variations in surface tension.

It may be noted that an extraordinary preponderance of a single question variation is evident in each of Questions 6, 7, and 9. The reason for this is that these questions were all in Part 2 of Check Point 3, and the random number generator which selected question variations was not seeded after this program was compiled. Thus it evidently returned the same sequence of random numbers each time the program was run. This problem could have been avoided by using a seed algorithm based on the student identification number and the number of times he or she had run the check point previously, thus generating a unique seed for each run.

Program Analysis

Tables 11, 12, and 13 present the complete responses which were stored on Questions 1, 5, and 8 respectively. This data can be used to provide additional guidelines for the revision of the BASIC language programs as well as further insight into the types of errors made by students.

Questions 1 and 8 required alphameric responses from the student and stored answers whenever they could not be matched by the program or were incorrect on the third try. Question 1 recognized 60 responses (see lines 1160 to 1238 on pages 122 to 123), but Table 11 shows that even more varied entries were made. About half way through the experiment (after record number 15), this question was changed slightly to emphasize that it was asking for the <u>name</u> of a unit rather than a computed value. This seemed to improve matters some, as 15 unrecognizable responses were recorded in the first 20 attempts, and 9 in the subsequent 19. However, the ability of the program to provide the student with meaningful feedback on his or her response to this question must be judged relatively low. This ability could have been improved by programming each response into the check point as it was detected.

This approach was tried on Question 8. Table 13 shows that the response "liters" was often entered for this question, and this answer was programmed into the check point as a correct response. In this manner, the data stored by alphameric questions were used to increase their construct validities.

Incorrect responses to numeric questions were usually stored as deviations from the correct answer

[Text continued on page 69.]

TABLE 11

Stored Responses: Question 1, Check Point 3

Record Number	Code	Response
1	5	cubic mm
2	5	420
3	5	cm
4	5	cmm
5	5	420cc.
6	5	ml.
7	5	420cm
8	5	cm
9	5	square cm
10	5	cm
11	5	420
12	5	cm
13	5	mm
14	5	cm
15	5	3.6cc
16	5	mm
17	5	cubic meeters
18	5	meters
19	5	cm
20	5	meters
21	5	cm
22	5	m3
23	5	cubed meter
24	5	cubic cm.

TABLE 12

Stored Responses: Question 5, Check Point 3

Record Number	Code	Response
1	4	0.192555
2	1	-1766.232
3	1	12606.
4	4	0.014094
5	4	0.014733
6	4	1.260737
7	4	1.899098
8	4	1.533464
9	2	-1923807.
10	2	-1510848.
11	1	106623.
12	3	10.6920
13	2	-1526472.
14	1	175725.
15	2	-1530000.
16	4	-0.001404
17	4	1.194803
18	1	-1790.821

Note: Responses are stored as deviations from the correct answer.

TABLE 13

Stored Responses: Question 8, Check Point 3

Record Number	Code	Response
1	5	cc
2	5	cubic centimeters
3	2	milliliter
4	5	liters
5	5	liters
6	5	liters
7	5	liters

(response minus correct answer) to avoid having to record both the response and the correct answer. For example, refer to the answers stored for Question 5 in Table 12. The number of cubic centimeters presented to the student in this question was always between 1000 and 2000. In converting to another metric unit, the student needed to move the decimal point the correct number of places left or right. It has been shown previously that the most difficult variation to this question asked students to convert cubic centimeters to cubic meters. This conversion is performed by dividing by 1,000,000, thus giving an answer between 0.001 and 0.002. Since all but one of the answers stored for this variation (number 4) were positive, these data indicate that students generally failed to move the decimal point far enough to the left. More precisely, a stored answer (1) between 1.0 and 2.0 denotes that the student divided by 1000 rather than 1,000,000, (2) between 0.1 and 0.2 that he or she divided by 10,000, and (3) between 0.01 and 0.02 by 100,000. Conversely, the negative answers for variation two (converting cubic centimeters to cubic millimeters) indicate that students generally did not move the decimal point far enough to the right. In fact, since these answers were on the order of -1,000,000 one may conclude that students moved the decimal point to the <u>left</u> rather than the right.

These data clearly show severe misunderstandings in the relationships of cubic units and indicate a need for detailed treatment of this topic in the audio-tutorial materials. The relationships of cubic units were mentioned only in regards to one of the three sample problems in the audio-tutorial presentation (see page 88, Appendix A). The concept might be strengthened by asking the student to calculate the volumes for this problem in both cubic centimeters and cubic millimeters and then drawing his or her attention to the factor of 1000 which relates these two measures. A fourth problem might be added which deals directly with this concept, asking the student to create a table showing the volumes of various objects in cubic millimeters, cubic centimeters, cubic meters, milliliters, and liters. Finally, students might be asked to construct cubic centimeters and a cubic meter and determine just how many of the smaller cubes would be required to fill the larger one.

SYSTEM DATA

The data collected by the operating system monitor are summarized in Table 14. This information classifies the amount that each system was used and provides several statistics which should be taken into account in a subsequent implementaion of the check point system.

Instructor Usage

The amount of instructor time shown in Table 14 was used mainly for entering and debugging the check point and administration programs. These times do not, of course,

TABLE 14

Statistics on System Usage

Month	Number of Logons	Connect Time (hours)	CPU Time (hours)
Use by Instructors			
November	39	44.590	0.120
December	44	57.582	0.547
January	35	74.710	0.911
February	52	51.814	0.669
Totals	170	228.696	2.247
Use by Students			
January	36	28.224	0.554
February	57	63.556	0.699
Totals	93	91.780	1.242

include the time spent developing and writing the programs off-line. It may be estimated that approximately equal amounts of time were spent off-line and on, thus indicating a total time on the order of 400 to 500 hours for creation of the check point system. The table shows an average of just under one hour per student logon, and thus it may be assumed that the four check points comprised approximately four hours of student interaction. This ratio of 100 hours of instructor preparation time to one hour of student time is compatible with the result found by other studies (Simonsen and Renshaw, 1974), but the author estimates that approximately half of this time was spent in creating and debugging the registration and score recording programs while another quarter was required for the administration programs. Thus, it may be inferred that about 25 hours of instructor time would be required to write, enter, and debug additional check points. These values are very rough estimates indeed, but they do suggest the magnitude of time which must be considered when planning to create a CMI system of this type.

Student Usage

The most prominent information conveyed by the student usage data is that students averaged nearly an hour to run each check point. This result was highly undesirable because students tended to become frustrated when they were required to sit at the terminal for so long. Perhaps the most significant factors contributing to this time were the printing speed of the teletypewriter and the number of questions in each check point. The terminal printed only 14.7 characters per second, significantly fewer than most students can read. The use of a cathode-ray tube (CRT) terminal might have greatly increased the display rate and thus significantly decreased student boredom. Even with the teletypewriter, time could have been saved by reducing the number of choices available to the student in the registration program. This program might have scanned the course log for the student's status as soon as he or she had registered, and then immediately channeled him into the check point program which he was to run. Choices for data display would then be offered only after the check point had been completed.

Table 14 also shows that students used an average of 0.0135 CPU (Central Processing Unit) hours per hour of connect time. As the Virtual Memory System is new at the University of Maine, the cost of Virtual CPU time has not yet been fully validated, but has been estimated between \$200 and \$250 per CPU hour. Thus, the operating cost of the check point system itself was between \$2.70 and \$3.37 per student contact hour, not including terminal and line costs. This figure is much higher than most cost estimates for undergraduate, college level education, a figure which is usually quoted as between \$1.00 and \$1.50 per student contact hour (Simonsen and Renshaw, 1974).

Several alterations might be made to reduce this cost. It was mentioned in Chapter 3 that an executive routine performed program control for the student by setting up a temporary work area and copying programs and data files into this area from a permanent storage disk. This procedure was required because the programs were stored in packed format (800 byte records) to conserve disk space and had to be unpacked (to 80 byte records) for execution. However, the executive routine which performed this function required over 16 CPU seconds to run. If more disk space had been allocated, the programs could have been stored in a ready-to-run format and this time could have been saved.

The amount of saving may be calculated as follows. Since the executive routine was called once per logon, the total time attributable to this overhead was 1488 CPU seconds or 0.413 CPU hours, found by multiplying 93 logons times 16 CPU seconds per logon. Subtracting this from the 1.242 CPU hours used, the time attributable to program execution itself may be computed as 0.829 CPU hours. The cost per student contact hour for program execution may then be estimated as between $1.81 and $2.26, a reduction of 30% over the actual cost computed previously. The cost for the extra disk space would be negligible, as only two additional cylinders would have been needed and disk packs of 400 cylinders apiece rent for $25 per month.

Further run-time cost savings might have been realized if the check points could have been stored as object programs rather than in their BASIC language form, thus eliminating the need for compilation. If the check point system had been written in FORTRAN rather than BASIC or if the operating system had allowed access to the BASIC object program, this could have been done. The time saving which this approach would have made possible may be estimated on the order of 16 CPU seconds per logon, as most programs required about 4 CPU seconds to compile and each run usually involved at least four compilations. This capability could have reduced the cost another 30%, bringing the cost of the system down to the level quoted previously for college education. It must also be noted that CPU time on smaller computers costs far less than $200 to $250 per hour, but it is doubtful that the check point programs could have been run in a partition much smaller than that employed without major revisions, as they averaged over 500 BASIC statements per program.

SUMMARY

Data from two sources have been presented on the use of the evaluation model, indicating revisions to the audio-tutorial lesson materials, the BASIC language check point programs, and the overall design of the check point system itself. Check Point 3 was used once again to demonstrate the use of the administration programs in providing feedback on the effectiveness of the teaching and evaluative materials. The cost of the system was studied and suggestions were made for reducing costs in subsequent implementations of the model.

The data presented in this chapter have gone beyond that generated by most audio-tutorial evaluation systems in that the computer was used to provide feedback on its own performance as well as all aspects of the instructional process. Revisions based on this feedback could be used to improve instruction, increase the effectiveness of evaluation, and reduce the cost of the system. The ease in collecting this data must once again be emphasized as a major facet of the check point system design.

Chapter 5

EVALUATION OF THE MODEL

The model check point system achieved varying degrees of success in realizing the three ideal characteristics described in Chapter 1. In short, its goals were to provide fast, meaningful feedback to the student, a record of student interaction, and easy access to all stored data. Performance of the system in relation to each of these goals is evaluated below.

The data presented in Chapter 4 showed that the system required almost an hour for students to run each check point. This amount of time was considerably greater than the author had intended the check points to require. Suggestions were made which could significantly reduce this time, hopefully to as low as fifteen minutes per check point. The contingency messages printed after incorrect responses allowed most students who had missed a question on their first attempt to answer it correctly on their second, and almost all students were able to complete the check points satisfactorily within two runs even though different question variations were presented. Thus, the model achieved its goal in providing meaningful feedback through an automated system, but fell short of its objective to do so in a short amount of time.

A substantial amount of information was made available by the recorded data. This information was used to suggest revisions to both the audio-tutorial instructional materials and the computer-managed evaluation model. Further analysis would be required for full evaluation of the data-packing techniques developed, involving an examination of run-time versus storage space costs on various computers used for interactive CMI. The only assessments which may be made at this time are that data-packing may be accomplished even with a very simple computer language and that these techniques may provide an effective method for managing large amounts of data in a relatively small storage area.

The administration programs were not difficult to use, but would have been even more convenient if mnemonic codes had been used to call options rather than numbers. It was difficult to remember the numbers of specific options when thirty-two were available, and the listing of the reference numbers took fifteen minutes to type. Thus the instructors found it easiest to print the list once and save it for future reference, as they found that they had to refer back to it constantly for option numbers. Although data were computed within seconds, the printing rate of the terminal limited the speed with which these data could be displayed. The use of a CRT terminal might have facilitated the instructor's work on-line, but would also have limited him off-line without a hard copy of the generated data to study. A possible solution to this dilemma might be the use of a command which the instructor at a CRT terminal could use to spool the output on his terminal to a high speed printer.

This study has laid the groundwork needed to create a completely interactive CMI system for the evaluation of audio-tutorial instruction on a BASIC language time-sharing computer. The techniques developed have proven effective even though considerable refinement is warranted. Many suggestions have been made, the implementations of which are unfortunately beyond the scope of this investigation. Perhaps these will be pursued in a subsequent study. Most importantly, this study has demonstrated that a computer system may be created to assist instructors in evaluating individualized instruction even though the users may have had no former experience in computing.

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APPENDIX A

TAPE SCRIPT FOR

Unit One

EXTENDING THE SENSES THROUGH MEASUREMENT

Section Three

VOLUME AND TIME

INTRODUCTION

[MUSICAL PRELUDE: Jesse Colin Young, "Together"]

You should now have completed all the requirements for section two including the check point on the computer terminal. If you have not, please do so before you go on. If you have, you are ready to begin section three.

[PAUSE 5 seconds]

The title of this section is shown in slide number 52. Please remember to use your slide projector only in the "low" lamp switch position if your model has more than one lamp position. Section three will examine the concepts of volume and time. From your work in this section, it is hoped that you will achieve the objectives outlined in slide number 53.

[PAUSE 30 seconds]

You will notice that the objectives for section three are parallel to those of section two. This section is structured almost identically to the previous one, and begins by examining volume from a mathematical viewpoint. I will present you with the equations that you will need to calculate volume and then ask you to solve three problems using these equations. The second topic will examine the use of the instruments that we have in the lab for finding volumes of liquids, gases, and irregularly-shaped solids.

Finally, I will discuss the operation of the stopwatches that we have in our laboratory and ask you to carry out an activity which will give you an idea of their accuracy.

Refer now to slide number 54. In this slide you see several objects whose volumes will play an important part in some of your later experiences. All of these objects are three dimensional and can be thought of as having volume because they occupy space. That is, when the objects were arranged for this photograph, they displaced the air which originally occupied the space they now occupy. The amount of space that each object occupies is called its volume.

CALCULATING VOLUME

Volumes can be found by one of two methods, calculation or measurement. Slide number 55 shows how to calculate the volumes of regular solids. A regular solid is defined as an object whose top and bottom are both identical and parallel. Note that object three also fits these criteria, but that its height is the length of an imaginary line perpendicular to and connecting the top and bottom planes. This situation corresponds to the computation of the area of the scalene triangle in slide 42. You might want to refer back to that slide for clarification.

[PAUSE 10 seconds]

Volume Formulae

In all regular solids, then, the volume is equal to the area of the base times the height. A capital "B" is used in the symbolic equation to represent the area of the base of a three dimensional object. You will recall that we used a small "b" to represent the length of the base of a two dimensional figure in our area computations.

Using this formula for the cube, we can find the area of the base by multiplying the width, "w", by the length, "l", and thus write "V equals w times l times h". The area of the circle which forms the base of the cylinder is found by multiplying π times the radius squared, and thus the volume of the cylinder may be expressed as πr squared times h.

The computational units of volume are cubic centimeters, represented as "cm cubed" or "cc". You have probably heard the term "cc's" applied to the size of injections on at least one television hospital show.

The method for calculating the volume of a sphere is shown in slide number 56. This formula, volume equals four-thirds πr cubed, is derived by making successive approximations as we did to find the area of a circle. Note again that the units are in cubic centimeters because four-thirds and π are pure numbers with no units while the radius is expressed in centimeters and is cubed in the formula. In both this formula and the ones shown in the previous slide, the volume could also be expressed in cubic millimeters or cubic meters if the linear measurements had been made in these other units. The important points are that the unit is cubic in nature and that all dimensions must be expressed in the same unit.

Problems on Volume

Slide number 57 presents three problems on volume. Solve these problems before you go on. As in the area problems, diagrams may help you visualize the objects described. Use the value of 3.14 for π.

[MUSIC: Jesse Colin Young selection]

To begin the first problem on slide 57 you must determine the dimensions of the cube. The problem states that a perfect cube has squares as all six of its sides, and thus the width, length, and height of the cube must all be identical. Furthermore, the volume of the cube is 1000 cc, so whatever the single length is that represents the width, length, and height of the object, it must yield 1000 cc when it is cubed. This single number turns out to be 10 cm, which you can check by substituting it into the volume formula. If the sphere is to just fit into the cube, the sphere must have a diameter of 10 cm and thus a radius of 5 cm. Finally, by plugging 5 cm into the formula four-thirds πr cubed, we can compute the volume of the sphere as approximately 523 cc.

Problem number two is a straight-forward one and simply emphasizes the point that the formula for computing the volume of a regular solid is applicable to any object whose base and top are congruent and parallel, regardless of shape. The area of the base is found by applying the triangle formula $A=\frac{1}{2}bh$ to get one-half times 5.0 cm times 3.2 cm, or 8.0 square centimeters. Multiplying by the height of the object, 25.4 cm, the volume can be computed as about 203 cubic centimeters.

The first step in problem number three is to convert all the dimensions to the same units. If we use millimeters, our computation will involve very large numbers. If we use centimeters, we will be working with smaller numbers and our answer will have the convenient units of cubic centimeters that we are already familiar with. So 15 mm becomes 1.5 cm, 20 mm becomes 2.0 cm, and 14 mm becomes 1.4 cm. The volume of the regular rectangular solid is then found by multiplying the three dimensions together to give approximately 4.32 cubic centimeters. If you used millimeters, the volume would be 4320 cubic millimeters.

The radius of the base of the cylinder will be one-half its diameter, or 0.7 centimeters. Applying the circle formula $A=\pi r^2$, we can find the area of the base to be approximately 1.54 square centimeters. Finally, multiplying by the cylinder's height, 2.0 cm, the volume turns out to be about 3.08 cubic centimeters. If you used millimeters, you should have found this volume to be approximately 3080 cubic millimeters. Thus, by comparing

4.32 cc to 3.08 cc, one can conclude that the rectangular solid has a larger volume than the cylinder.

MEASURING VOLUME

Using Graduated Cylinders

With the basic concept of quantitative volume firmly in hand, you are ready to look at some of the special equipment that we have in the laboratory for finding volumes. Refer to slide number 58. Here you see a graduated cylinder and a perfect cube. The cube measures one centimeter in length, width, and height, and therefore has a volume of exactly one cubic centimeter. In our discussion of standards in section one, I pointed out the importance of reproducibility of the standard measure of length for purposes of international trade and communication. Measures of volume are used so often that a secondary standard was set up for this measure based on the primary standard of length. This secondary standard defines the milliliter as exactly equal to one cubic centimeter. The graduated cylinder on the right is calibrated in milliliters, and contains liquid just up to the first marked division. This amount of liquid has precisely the same volume as the metal cube.

Slide number 59 shows a close-up of this graduated cylinder with some water in it. Note how the water adheres to the sides of the cylinder and appears to curl at its surface. This phenomenon is known as the miniscus and is caused by the surface tension of the water. When you read a graduated cylinder, make sure that the surface of the liquid is at your eye level and read to the bottom of the miniscus. The volume of water in this cylinder is 6.6 ml.

In slide number 60 you see a much larger graduated cylinder and a blender which is calibrated in metric units. The graduated cylinder holds a total of 500 ml. The slide is a bit difficult to read, but see if you can judge the approximate volume of water in the graduated cylinder.

[PAUSE 15 seconds]

The cylinder indicates a volume of approximately 388 ml.

As you can guess from the prefix "milli-", the milliliter is really a subunit of a larger unit of volume, the liter. Just as one meter was 1000 times longer than a millimeter, so one liter contains 1000 times as much volume as one milliliter. The blender in this slide is made to hold one liter of liquid, which is actually just 54 ml more than the volume you are familiar with as one quart. Please note that while the blender shows marks for fractional parts of a liter, we still recommend strongly that you use decimals. The liter is used in most industrial and everyday applications because the milliliter is too small to be practical. Perhaps you have bought milk in liter cartons while on a visit to Canada or even purchased gasoline by the liter.

To practice working with graduated cylinders and understanding the markings of laboratory containers, try the following experience. Obtain a large graduated cylinder like that pictured in the slide. Fill a beaker or flask with water to its very top and pour its contents into the flask. You may use a smaller cylinder for small containers. Record the labelled volume of the container and measure each three times to determine how accurately you can replicate your results. Write up this experience and tell why you think there is a discrepancy between the capacity of each container and the volume marked on its label.

[MUSIC: Jesse Colin Young selection]

Irregular Volumes

The graduated cylinder can be used to find the volumes of substances other than liquids. Refer to slide number 61. You can conveniently compute the volume of small irregularly-shaped objects by recording the volume in a partially filled graduated cylinder and then finding the difference in volume when an object such as a rock is dropped into the cylinder. In the case pictured, the two cylinders both contained the same initial water volume of 20 ml before the rock was dropped into the cylinder on the left. The volume of the rock is calculated by subtracting the initial water volume, 20 ml, shown in the cylinder at the right, from the final total volume, 22 ml, shown in the cylinder at the left. This gives a difference of 2 ml, the volume of the rock.

The volumes of objects which normally float in water may also be measured with this immersion method by forcing them to sink with some type of anchor or placing metal weights on top of them. Of course, the volume of the anchor or weights must then be considered in the calculation and subtracted out to find the true volume of the object you are interested in.

Some substances require the immersion method of measurement if they are to be measured at all accurately. The following experience will demonstrate this principle to you. Place about 20 ml of fine sand into a 50 ml graduated cylinder. With another cylinder, measure out 20 ml of water and pour this into the cylinder with the sand. Record the final total volume and calculate what volume of sand your cylinder really contains. Think carefully about where you should read the graduated cylinder when it contains both sand and water. Write this experience up in your notebook and tell why the calculated volume of sand is different from the amount that you thought you had originally. Do not try to get the sand out of the graduated cylinder when you are finished, but simply place it by the sink for one of the laboratory assistants to take care of.

[MUSIC: Jesse Colin Young selection]

MEASURING TIME

The final topic in this section of unit one is time. Slide number 62 shows the exact definition of the familiar unit of time that you know as the second.

[PAUSE 10 seconds]

Since you are already very familiar with this unit, the only points that I need to introduce pertain to the timing devices that we have for you to work with in the laboratory.

Using a Stop Watch

Slide number 63 shows a standard stop watch and the proper method for operating it. Notice that the switch is operated with the index finger, not the thumb. This technique is preferred because most people have quicker reaction times with their index fingers than their thumbs, and also because the stems of stop watches are ofter quite fragile and might be broken by an over-zealous jab with the thumb.

This stop watch is calibrated in seconds, and once around will equal sixty seconds. The small divisions in between the marked seconds represent two-tenths of a second each. The small dial counts complete revolutions of the larger dial and is marked off in minutes.

Try to read the time shown on the watch in the slide.

[PAUSE 15 seconds]

The watch shows an elapsed time of 12.2 seconds. If you are still unclear about the operation and reading of a stop watch, please see an instructor for further clarification.

Estimating Time Durations

To demonstrate the necessity of extending the senses through measurement in scientific work, we would like you to play a little game with your lab partner or some other member of the class. Meters and liters may have been new terms to you when you first began this unit, but you have been working with seconds throughout your entire life. Yet, I wonder how good you are at estimating elapsed times. This game will allow you to practice using a stop watch and analyze your ability to judge elapsed times.

First, agree with your partner on an initial time duration that you will try to estimate. Perhaps five seconds is a good place to start. Have your partner work the stop watch and say "go". When you think five seconds have elapsed, say "stop". You may count or feel your pulse or devise any other method you wish to improve your guess short of looking at another clock or similar timing device. Try estimating many time durations, both longer and shorter than five seconds.

As you work, make a table similar to that shown in slide number 64, but try estimating about ten different times. Compute the percent error of each guess by dividing the amount you were off by your goal and multiplying by 100%

as shown in the formula. Plot this data on a graph. If your points appear to be at all linear, draw a best fit line and find its slope. Write a complete equation for the line in the generalized form discussed in section one. Refer back to slide number 35 if you need to review the form of this equation. When you write up this experience in your notebook, try to make a concluding statement about your findings based on your graphed data and the mathematical relationship that results. After you have finished this experience, please go to the computer terminal and run the check point program for section three.

CONCLUSION

Before you go on to section four, you might like to do a little experimenting on your own with the concepts and techniques that have been introduced in section three. We have an electric stop watch which one of the instructors can show you how to operate. You might be interested in comparing the accuracy of the electric stop watch to the spring one that you used in this section. Time one against the other and see how closely they agree. A significant accuracy factor also exists in the tip of your finger. You might want to see how accurately you and your laboratory partner can reproduce each other's results when you both time the same thing. Let an object fall to the floor from a height of one meter and see how closely you can replicate your data.

These activities are supplemental to the required ones in this section, but might provide you with considerably more experience in scientific experimentation than the more structured activities in the unit itself. Experimentation is the essence of science, and the only way that you can really get a feel for the process of science is to carry out a few experiments which you design yourself. The laboratory instructors are available to help you in locating any equipment or resources that you might like to explore.

During section three I have been playing Jesse Colin Young's album "Together", and I think that you might enjoy hearing the cut he simply calls "Peace Song".

[MUSIC: Jesse Colin Young, "Peace Song"]

APPENDIX B

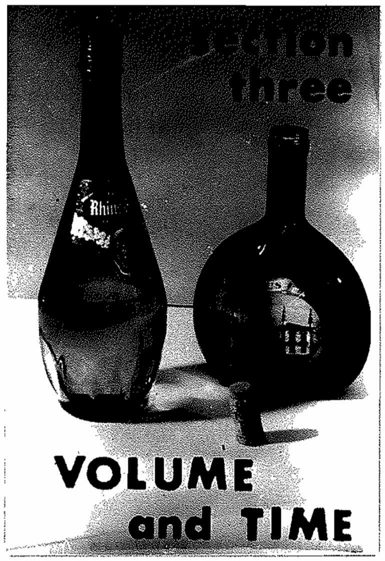
COPIES OF SLIDES FOR

Unit One

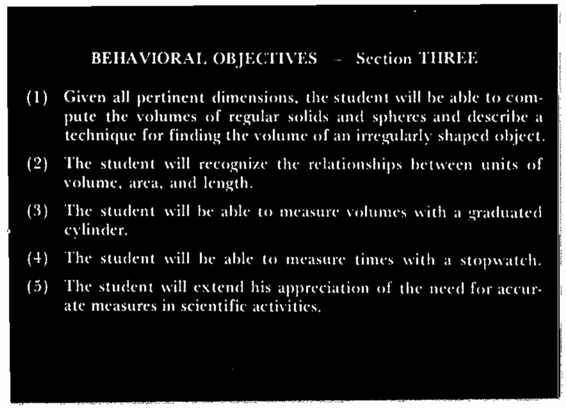
EXTENDING THE SENSES THROUGH MEASUREMENT

Section Three

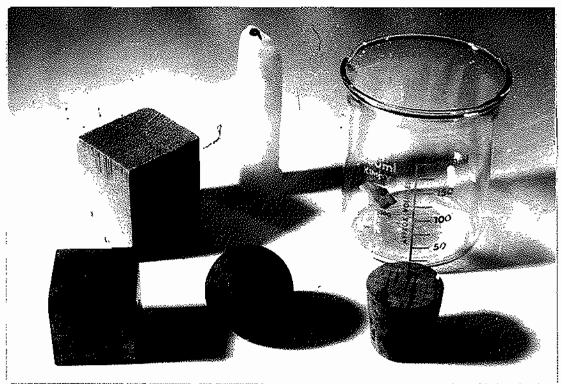
VOLUME AND TIME



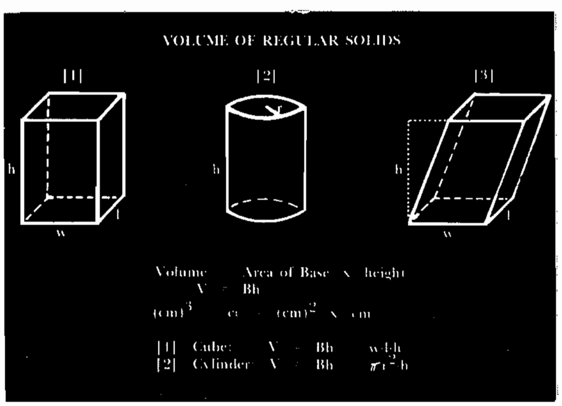
Slide 52



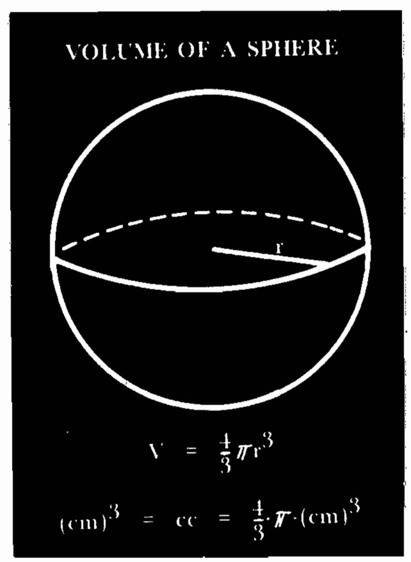
Slide 53



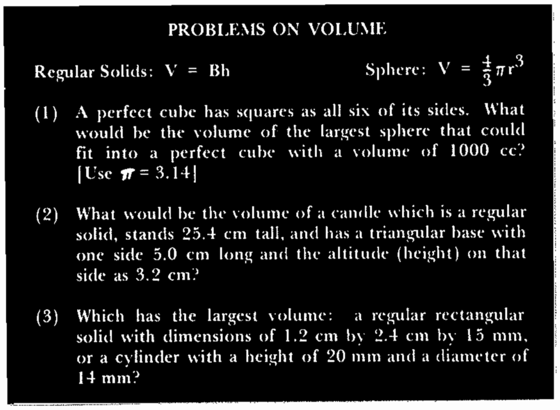
Slide 54



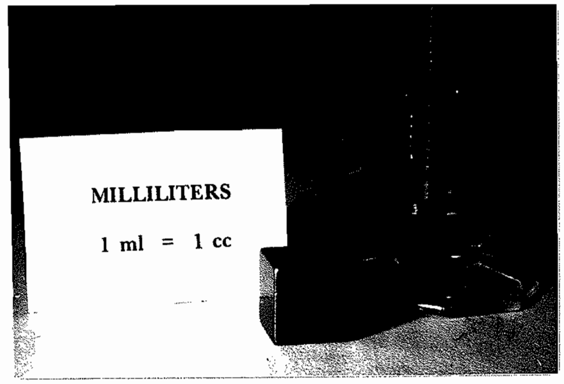
Slide 55



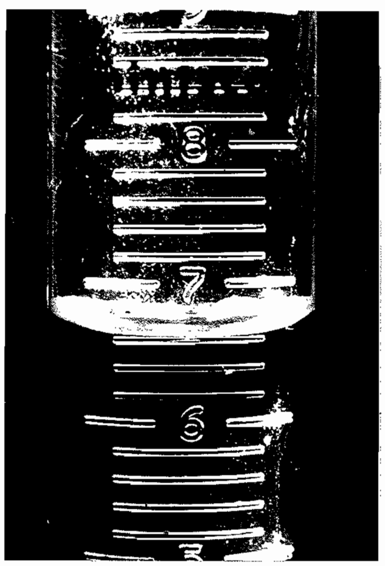
Slide 56



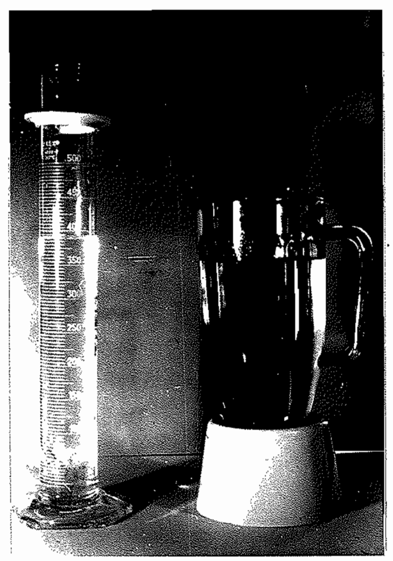
Slide 57



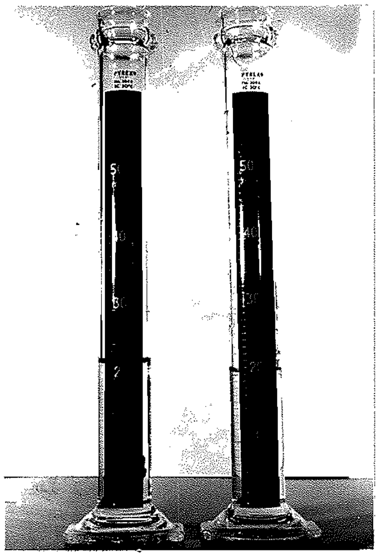
Slide 58



Slide 59



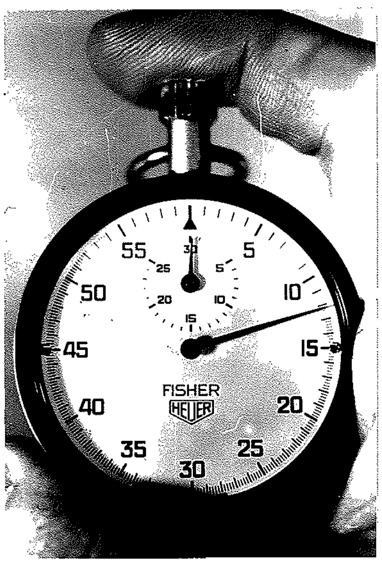
Slide 60



Slide 61

The SECOND is defined as the duration of 9,192,631,770 cycles of the radiation associated with a specified transition of the cesium atom.

Slide 62



Slide 63

ESTIMATING TIME DURATIONS
Sample Data Table

Goal	Recorded Time	Off By	Percent Error
1 sec	1.3 sec	.3 sec	30 %
5	4.5	.5	10
10	12.4	2.4	24
30	26.0	4.0	13
60	75.3	15.3	26

$$\text{Percent Error} = \frac{\text{Off By}}{\text{Goal}} \times 100\ \%$$

Slide 64

APPENDIX C

SAMPLE RUNS OF

CHECK POINT THREE

```
CAPS  online    1jh359 qsyosu

logon edc140 student
LOGON AT 10:11:37 EDT THURSDAY 02/28/74
U OF ME V1.12 12/22/73
```

* * * * *   E D   C   1 4 0 ,   S T U D I E S   I N   T H E   P H Y S I C A L   S C I E N C E S   * * * * *

Welcome! This is the Registration Program which introduces all the computer check points in our course.

The computer must first recall the check point programs and files from its storage. This takes a couple of minutes, so please be patient. You will see one message in "computerese" which indicates that everything is running properly, and then the check point program will begin. Please stand by!

DASD 193 DEFINED 005 CYL

Almost ready, don't go away...

All set! Have you ever registered at this terminal before (type "yes" or "no" and press the RETURN key)? no

One moment please...

In order to protect the confidentiality of the data which will be stored on your work, this program allows you to select a secret (!) code name for yourself and then use this code name every time you log on to the computer rather than your full name. The code name may be any word that is less than ten letters long, and it is always typed over a printing mask to prevent anyone else from learning it by looking over your shoulder or rummaging through discarded computer sheets!

Select a code name now and type it over the printing mask.

Code name? [redacted]

Enter your code name again to make sure that you did not make a typing error.

Code name? [redacted]

Okay, the code name you have selected is now EXCLUSIVELY yours! If you forget your secret code name, you will have to see one of the instructors about changing it before you can logon.

In order to activate your code name, please enter your full name, just as it appears on your registration forms. Please type your LAST NAME FIRST and separate it from your first name by a comma.

Your full name, please? Ann, Raggedy

I have recorded your full name as RAGGEDY ANN. Is this correct (please respond with "y" or "n")? y

One moment please...

You are now registered for this terminal session and may select a program option from the following list:

(1) Run a check point program
(2) Display all the data stored on your work
(3) Display stored data in summary form
or...
(4) End this terminal session

Which option would you like to execute (type a number)? 1

What is the <u>SECTION</u> number of the check point you want to run (enter "99" for a list of available sections)? 99

SECTIONS WITH COMPUTER CHECK POINTS IN UNIT 1

<u>Number</u>	<u>Title</u>
1	Length and Graphing
2	Area and Temperature
3	Volume and Time
4	Mass and Summary Activities

What is the <u>SECTION</u> number of the check point you want to run? 3

* * * * *   U N I T   O N E ,   C H E C K   P O I N T   # 3   * * * * *

Check Point #3 has 9 questions and requires about 30 minutes to complete.

Would you like another explanation of the codes "pass", "stop", "88888", & "99999" (respond "y" or "n")? y

You may control question presentations even as a check point program is running. If you do not have enough time to complete the entire program in one sitting, you may terminate it and return at another time. You may run each check point as many times as you'like. To TERMINATE a program, enter a "code" instead of a normal answer when the computer is waiting for your response. If the program is expecting a numeric response, enter the code "99999". If it is expecting an alphameric response, enter "stop".

You may also elect to PASS a question without answering it and then return to that question later. To do this, enter the code "88888" if the program is expecting a numeric response, or "pass" if it is expecting an alphameric response. (Please don't worry about these codes, I'll prompt you whenever they're active!)

Turn on the slide projector now and view the title slide in slot #14 which reads "slides for UNIT ONE Check Point 3".

Certain questions in this check point will refer to slides by the numbers which will appear in the upper right-hand corner of each picture. With the slide tray in place, you are ready to begin.

One moment please...

QUESTIONS FOR CHECK POINT # 3

(1) Project the slide labelled "4-A" in the upper right-hand corner. Enter below the NAME of the UNIT of MEASURE in which the volume of this figure would be expressed if it was computed with the formula for the volume of a regular rectangular solid. (The usable codes are "pass" and "stop".)

NAME of volume unit? centimeters

Your entry does not match any of the answers that I anticipated. It will be recorded for later evaluation by one of the instructors. Please check your spelling or re-enter your answer in a slightly different form. (The usable codes are "pass" and "stop".)

NAME of volume unit? cubic centimeters

Yes, that is the correct unit.

(2) Please refer now to the slide labelled simply "5" which is in slot #18 of the slide tray. Here you see pictured a wooden regular rectangular solid. This solid has a length of 19.3 cm, a width of 17.5 cm, and a height of 36 cm. Calculate the VOLUME of this solid and enter your answer below to the nearest cubic centimeter. (Codes "88888" and "99999" may also be entered.)

Volume of solid? 12286 cc

That value is too large. Check over your work and the volume formula and make another entry. (Codes "88888" and "99999" may also be entered.)

Volume of solid? 12158 cc

Your answer is now correct.

(3) Slide "6" (in slot #19) shows a wooden rod. This rod is 10 cm long and has a radius of 2.8 cm. Find the VOLUME of this rod and enter this value below to the nearest TENTH of a cubic centimeter. Use 3.14 as the value for "pi". (Active codes: "88888" & "99999".)

Volume of the ROD? 246.2 cc

Your answer is correct.

(4) Advance your projector now to slide "7" (slot #20). This picture shows a wooden sphere with a radius of 1 cm. Compute the VOLUME of this sphere to the nearest TENTH of a cubic centimeter, using 3.14 for "pi". (Acceptable codes are "88888" and "99999".)

Volume of SPHERE? 45 cc

That value is too large. Check over your work and the volume formula and make another entry. (Acceptable codes are "88888" and "99999".)

Volume of SPHERE? 4.5 cc

Your entry is still not correct. The volume of a sphere is found by multiplying 4/3 times "pi" times the radius cubed. In this case, the volume turns out to be 4.1 cubic centimeters. Please check your work to find where you went wrong.

You'll get another chance on a similar problem at the end of this program, but I'll go on to the next one now.

The next question does not refer to a slide, so please put the projector switch into the "fan" position while you are working on it. Thank you.

(5) Imagine that the volume of an irregularly-shaped rock is found to be 1145 cubic centimeters by immersing it in a large graduated cylinder with a known volume of water. Enter below the equivalent volume of the rock expressed in LITERS. (You may also enter codes "88888" and "99999".)

Equivalent volume? 11.45 l

The digits in your entry are correct, but the decimal point is too far to the RIGHT (your value is too large). Think again and make a new entry. (You may also enter codes "88888" and "99999".)

Equivalent volume? .1145 l

That value is still incorrect. One LITER contains exactly 1000 cubic centimeters (or milliliters). That is, 1000 cc = 1 l. Therefore, the number of liters equivalent to 1145 cc is found by DIVIDING by 1000 to get 1.145 liters.

The next question will now be presented, but you'll be able to return to this one after the program is concluded.

One moment please...

(6) This question refers to the picture of the graduated cylinder shown in the slide labelled "8-A". Please be sure that you are viewing the correct slide before attempting to solve this problem. Read the VOLUME of the water shown in this graduated cylinder and enter its value below to the nearest TENTH of a milliliter. (Codes "88888" and "99999" will also be recognized.)

Volume? 8.8 ml

You have read to the TOP of the miniscus. Read to the BOTTOM of it and enter another value. (Codes "88888" and "99999" will also be recognized.)

Volume? 8.7 ml

Your new entry is now correct.

(7) Move the projector to view the slide labelled "9-C". This graduated cylinder contained 9 ml of water before the rock was dropped into it. Using the technique of water immersion, express the volume of the ROCK to the nearest HALF (.5) of a milliliter. (Codes "88888" and "99999" are active.)

Volume of rock? 88888 ml

Please put the slide projector switch on "fan" until you are asked to use it again.

(8) If Maine "goes metric" at some time in the future, we will no longer be buying milk by quarts and gallons. Enter below the name of the metric unit that would most likely be used to sell milk if we were to change our system of measures. (Codes "pass" and "stop" are now active.)

Unit? milliliters

Your answer does not match any that I anticipated. Please check your spelling and make a new entry. (Codes "pass" and "stop" are now active.)

Unit? milliliter

The MILLILITER is too small a unit to be practical for retail sales. Think again and try another unit. (Codes "pass" and "stop" are now active.)

Unit? liter

Yes, that is the correct unit.

(9) For the last question in this check point, please refer to the slide labelled "10-B". Read the time shown here to the nearest TENTH of a second and enter its value below. Be sure you are viewing slide "10-B". (Acceptable codes are "88888" and "99999".)

Time? 38.2 sec

Your answer is the correct one.

Please switch the slide projector to "fan" until you need it again. Thank you.

One moment please...

The following data has been recorded summarizing the run you have just completed. (Note: "C" = Answered Correctly, "X" = Answered Incorrectly, and "-" = Omitted.)

Name: RAGGEDY ANN

Unit 1	Check Point # 3	--	Question #	1	2	3	4	5	6	7	8	9
			Response :	C	C	C	X	X	C	-	C	C

You have answered six of the nine questions in this check point correctly. If you have the time now, I suggest that you look over your work and redo those questions that you missed. If you feel unable to answer these questions now, please log off and go over your work with one of the instructors. You may also log off and come back to this check point later if you don't have the time to run it again now.

Would you like to rerun the check point now (answer "y" or "n")? y

Please select one of the following presentation criteria:

(1) Present all questions, # 1 through # 9
(2) Present only those answered incorrectly or omitted
or...
(3) Enter this number to cancel your request to rerun this check point and return to the main program options.

Which questions would you like presented this time (enter "1", "2", or "3")? 22

Please enter a single numeral, "1" through "3". Your choice? 2

One moment please...

QUESTIONS FOR CHECK POINT # 3

(4) Advance your projector now to slide "7" (slot #20). This picture shows a wooden sphere with a radius of 2 cm. Compute the VOLUME of this sphere to the nearest TENTH of a cubic centimeter, using 3.14 for "pi". (Acceptable codes are "88888" and "99999".)

Volume of SPHERE? 33.4 cc

Your answer is correct.

The next question does not refer to a slide, so please put the projector switch into the "fan" position while you are working on it. Thank you.

(5) Imagine that the volume of an irregularly-shaped rock is found to be 1546 cubic centimeters by immersing it in a large graduated cylinder with a known volume of water. Enter below the equivalent volume of the rock expressed in CUBIC METERS. (You may also enter codes "88888" and "99999".)

Equivalent volume? 15.46 cubic m

The digits in your entry are correct, but the decimal point is too far to the RIGHT (your value is too large). Think again and make a new entry. (You may also enter codes "88888" and "99999".)

Equivalent volume? .1546 cubic m

That value is still incorrect. It takes 1,000,000 CUBIC centimeters to equal just one CUBIC meter, so to solve this problem you were required to DIVIDE by one million. The correct answer to this question is therefore 0.001546 cubic meter. See an instructor if you need more help.

The next question will now be presented, but you'll be able to return to this one after the program is concluded.

One moment please...

(7) Move the projector to view the slide labelled "9-A". This graduated cylinder contained 10 ml of water before the rock was dropped into it. Using the technique of water immersion, express the volume of the ROCK to the nearest HALF (.5) of a milliliter. (Codes "88888" and "99999" are active.)

Volume of rock? 15 ml

That value is too large. Note the size of each marked division and enter another value. (Codes "88888" and "99999" are active.)

Volume of rock? 13 ml

That entry is also incorrect. The volume of the rock is found by SUBTRACTING the initial volume of the water, 10 ml, from the TOTAL volume of the rock PLUS the water. The total volume is equal to 14 ml. Note that this value corresponds to the reading at the BOTTOM of the miniscus. Thus, the volume of the rock is 14 ml - 10 ml, or 4 ml.

I will go on to the next question now, but you'll get an opportunity to return to this one at the end of the check point.

Please switch the slide projector to "fan" until you need it again. Thank you.

One moment please...

The following data has been recorded summarizing the run you have just completed. (Note: "C" = Answered Correctly, "X" = Answered Incorrectly, and "-" = Omitted.)

Name: RAGGEDY ANN

Unit 1	Check Point # 3	--	Question #	1	2	3	4	5	6	7	8	9
			Response :	-	-	-	C	X	-	X	-	-

The cumulative data recorded for your work on this check point is as follows:

Number of runs = 2	Question #	1	2	3	4	5	6	7	8	9
	Response :	C	C	C	C	X	C	X	C	C

You have answered seven of the nine questions in this check point correctly. If you have the time now, I suggest that you look over your work and redo those questions that you missed. If you feel unable to answer these questions now, please log off and go over your work with one of the instructors. You may also log off and come back to this check point later if you don't have the time to run it again now.

Would you like to rerun the check point now (answer "y" or "n")? n

Okay, but please be sure to return to this check point to re-evaluate the concepts and skills that you have missed.

Is another student waiting to use the terminal ("y" or "n")? n

Please select a main program option from the following list:

(1) Run another check point program
(2) Display all the data stored on your work
(3) Display stored data in summary form
(4) Branch to the fun options
or...
(5) Pass control to another student
(6) End this terminal session

Which option would you like to execute (type a number)? 6

Using the "select" button, please return the slide tray to slot "0" before you turn it off.

When you see the "Ready" message ("R;"), please follow the instructions either on side 2 of the instruction tape or on the sample sheet posted for logging off or transferring control to another student. Thank you and have a nice day...

R;

```
CAPS  online    1jh359 qsyosu

logon edc140 student
LOGON AT 12:18:49 EDT FRIDAY 03/01/74
U OF ME V1.12 12/22/73


    * * * * *   E D - C   1 4 0 ,   S T U D I E S   I N   T H E   P H Y S I C A L   S C I E N C E S   * * * * *

    Welcome!  This is the Registration Program which introduces all the computer check points in our course.

    The computer must first recall the check point programs and files from its storage.  This takes a couple of minutes, so
please be patient.  You will see one message in "computerese" which indicates that everything is running properly, and then
the check point program will begin.  Please stand by!

DASD 193 DEFINED 005 CYL

    Almost ready, don't go away...

    All set!  Have you ever registered at this terminal before (type "yes" or "no" and press the RETURN key)? yes

    Please identify yourself now by typing your secret code name on the printing mask.  (Press RETURN after all your entries!)

        Code name? [redacted]

    Your secret code name identifies you as RAGGEDY ANN.

    You are now registered for this terminal session and may select a program option from the following list:

        (1)  Run a check point program
        (2)  Display all the data stored on your work
        (3)  Display stored data in summary form
      or...
        (4)  End this terminal session

    Which option would you like to execute (type a number)? 1
```

What is the SECTION number of the check point you want to run (enter "99" for a list of available sections)? 3

The course log shows that you have run this check point twice before. Would you like a print out of your cumulative score (answer with "y" or "n")? y

CUMULATIVE SCORE FOR RAGGEDY ANN

(Note: "C" = Answered Correctly, "X" = Answered Incorrectly, and "-" = Omitted.)

Unit 1	Check Point # 3	--	Question #	1	2	3	4	5	6	7	8	9
			Response :	C	C	C	C	X	C	X	C	C

Please select one of the following presentation criteria:

(1) Present all questions, # 1 through # 9
(2) Present only those answered incorrectly or omitted
or...
(3) Enter this number if you want to cancel your request to run this check point & return to the main program options.

Which questions would you like presented this time (type "1", "2", or "3")? 2

* * * * * UNIT ONE, CHECK POINT # 3 * * * * *

Check Point #3 has 9 questions and requires about 30 minutes to complete.

Would you like another explanation of the codes "pass", "stop", "88888", & "99999" (respond "y" or "n")? n

Turn on the slide projector now and view the title slide in slot #14 which reads "slides for UNIT ONE Check Point 3".

Certain questions in this check point will refer to slides by the numbers which will appear in the upper right-hand corner of each picture. With the slide tray in place, you are ready to begin.

One moment please...

QUESTIONS FOR CHECK POINT # 3

The next question does not refer to a slide, so please put the projector switch into the "fan" position while you are working on it. Thank you.

(5) Imagine that the volume of an irregularly-shaped rock is found to be 1405 cubic centimeters by immersing it in a large graduated cylinder with a known volume of water. Enter below the equivalent volume of the rock expressed in MILLILITERS. (You may also enter codes "88888" and "99999".)

Equivalent volume? 1405 ml

Yes, that answer is correct.

One moment please...

(7) Move the projector to view the slide labelled "9-B". This graduated cylinder contained 7 ml of water before the rock was dropped into it. Using the technique of water immersion, express the volume of the ROCK to the nearest HALF (.5) of a milliliter. (Codes "88888" and "99999" are active.)

Volume of rock? 8 ml

You have read to the TOP of the miniscus. Read to the BOTTOM of it and enter another value. (Codes "88888" and "99999" are active.)

Volume of rock? 7.5 ml

Your new entry is now correct.

Please switch the slide projector to "fan" until you need it again. Thank you.

One moment please...

The following data has been recorded summarizing the run you have just completed. (Note: "C" = Answered Correctly, "X" = Answered Incorrectly, and "-" = Omitted.)

Name: RAGGEDY ANN

Unit 1	Check Point # 3 --	Question #	1	2	3	4	5	6	7	8	9
		Response :	-	-	-	-	C	-	C	-	-

The cumulative data recorded for your work on this check point is as follows:

Number of runs = 3	Question #	1	2	3	4	5	6	7	8	9
	Response :	C	C	C	C	C	C	C	C	C

You have answered all the questions in this check point correctly, and you are now ready to go on to section four.

Is another student waiting to use the terminal ("y" or "n")? n

Please select a main program option from the following list:

(1) Run another check point program
(2) Display all the data stored on your work
(3) Display stored data in summary form
(4) Branch to the fun options

or...

(5) Pass control to another student
(6) End this terminal session

Which option would you like to execute (type a number)? 3

One moment please...

SUMMARY OF STORED DATA ON CHECK POINT WORK OF RAGGEDY ANN

Unit	Check Point	No. of Runs	Status
1	1	0	Not yet attempted
1	2	0	Not yet attempted
1	3	3	Completed Satisfactorily
1	4	0	Not yet attempted

Select another program option from the above list (or enter "99" to retype the option list). Your choice? 6

If you have used the slide projector, please hold the "select" button and return the tray to slot "0" before you turn it off completely.

When you see the "Ready" message ("R;"), please follow the instructions either on side 2 of the instruction tape or on the sample sheet posted for logging off or transferring control to another student. Thanks and have a nice day!

R;

logoff
CONNECT=00:21:43 VIRTCPU=000:18.42 TOTCPU=000:24.01
LOGOFF AT 12:40:32 EDT FRIDAY 03/01/74

APPENDIX D

COPIES OF SLIDES FOR

SAMPLE RUNS OF

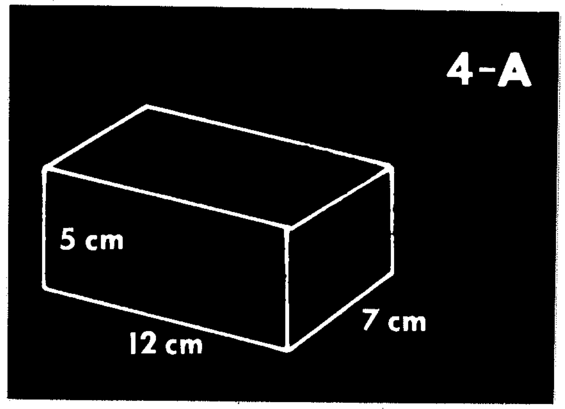
CHECK POINT THREE

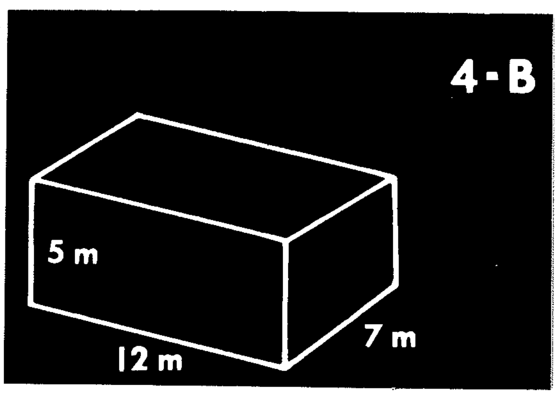
slides for

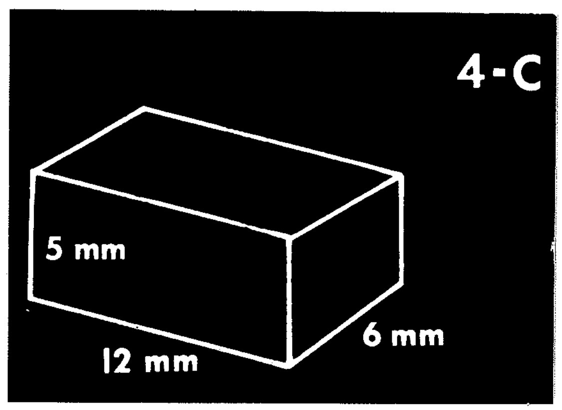
UNIT ONE

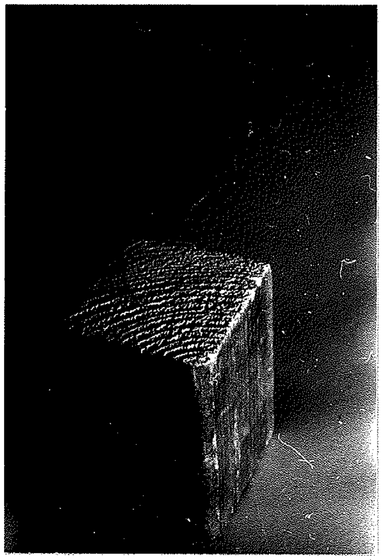
Check Point

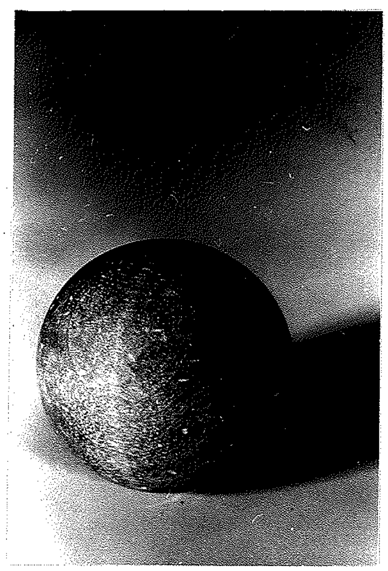
3

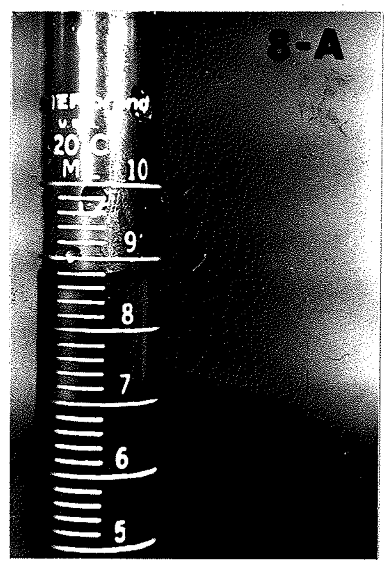











8-A
10
9
8
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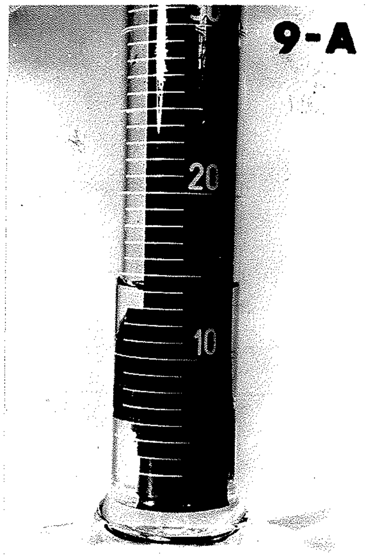
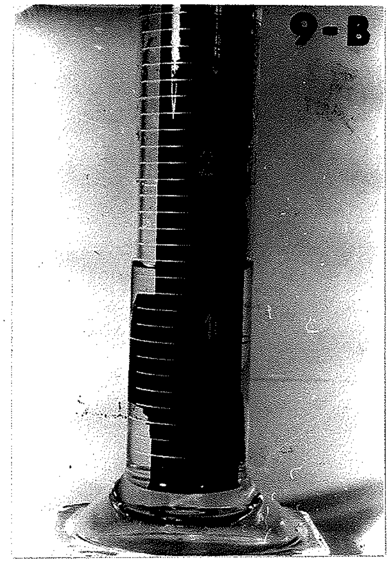
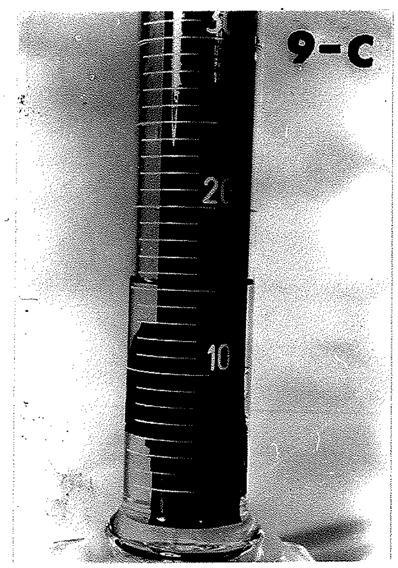
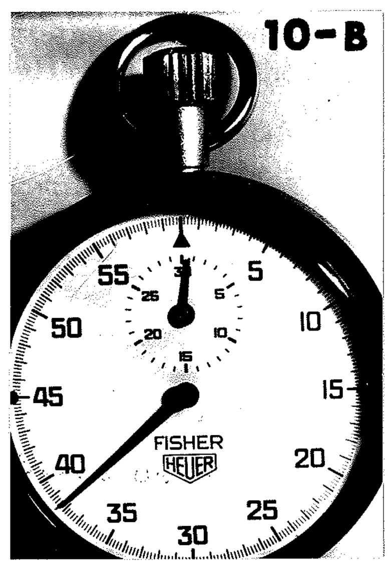
6
5


9-A
20
10


9-B


9-C
10


10-B
FISHER
HEUER

APPENDIX E

PROGRAM LISTINGS FOR

CHECK POINT THREE

Parts One and Two

and

SCORE RECORDING PROGRAM

```
10 REM     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
15 REM     *                                                                 *
20 REMARK  *     C H E C K    P O I N T    0 1 3 ,    P A R T    O N E      *
25 REM     *                                                                 *
30 REM     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
35 REM
40 REM
50 REMARK:                              COPYRIGHT
60 REM
70 REMARK:                           JESSE M. HEINES
80 REM
90 REMARK:                            JANUARY, 1974
100 REM
110 REM
115 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
118 REM
120 DEF FNA(X)=X-INT(X)
123 REMARK:  "FNA(X)" RETURNS THE FRACTIONAL PART OF THE DECIMAL NUMBER "X".
125 REMARK:  "INT(X)" RETURNS THE INTEGRAL PART OF THE DECIMAL NUMBER "X".
130 DIM S(10,2)
133 REMARK:  ARRAY "S" HOLDS THE SCORES ACHEIVED ON THIS RUN.
135 REM      ----------------------------------------
140 REMARK:  ROUTINE TO GATHER DATA FROM "PASSFILE"
143 REM      ----------------------------------------
150 OPEN 4,'PASSFILE',INPUT
160 GET 4: J,T,S1,S2,S3,S4,S5
210 REMARK:  "J" IS THE STUDENT'S REFERENCE NUMBER.
220 REMARK:  "T" IS THE NUMBER OF TIMES HE OR SHE HAS PREVIOUSLY RUN THIS
230 REM          CHECK POINT.
240 REMARK:  "S1" THROUGH "S5" ARE SEEDS FOR THE RANDOM NUMBER GENERATOR.
250 S1=S1+S2+S3+S4+S5
260 S1=RND(S1)
263 FOR K=1 TO 10
265 GET 4: F(K),P(K)
270 REMARK:  ARRAY "F" IS FOR THE PRESENTATION FLAGS FOR EACH QUESTION,
275 REM          WHERE "0" = PRESENT AND "1" = OMIT.
280 REMARK:  ARRAY "P" IS FOR THE CUMULATIVE PREVIOUS SCORES BY QUESTION NO.
290 NEXT K
295 CLOSE 4
300 REM      -------------------------------------------
310 REMARK:  ROUTINES FOR OPENING STORED ANSWER FILES
320 REM      -------------------------------------------
330 OPEN 5,'NSTRDANS',INPUT
340 REMARK:  FILE "NSTRDANS" CONTAINS TWO ELEMENTS, "N6" & "N7", WHICH
350 REM          INDICATE THE NUMBER OF ENTRIES IN FILE #6, "NUMERANS", AND
355 REM          FILE #7, "ALPHAANS", RESPECTIVELY.
360 GET 5: N6,N7
370 CLOSE 4,5
380 OPEN 6,'NUMERANS',INPUT
390 OPEN 7,'ALPHAANS',INPUT
400 OPEN 8,'HOLDFILE',OUTPUT
410 REMARK:  FILE #6 CONTAINS RECORDS OF STORED NUMERIC ANSWERS.
420 REMARK:  FILE #7 CONTAINS RECORDS OF STORED ALPHAMERIC ANSWERS.
430 REMARK:  FILE #8 IS USED TO HOLD TEMPORARY DATA.
440 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
460 REMARK:  THE FOLLOWING STATEMENTS READ IN THE EXISTING STORED ANSWER FILES
470 REM          AND STORE THEM TEMPORARILY IN "HOLDFILE".
490 FOR K=1 TO N6+1
500 GET 6: R1,R2,R3
510 PUT 8: R1,R2,R3
520 NEXT K
530 FOR K=1 TO N7+1
540 GET 7: R1,R2,R$
550 PUT 8: R1,R2,R$
640 NEXT K
645 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
650 REMARK:  THE FOLLOWING STATEMENTS REWRITE THE EXISTING STORED ANSWER FILES
653 REM          AND OPEN THEM TO RECEIVE OUTPUT FROM THIS PROGRAM.
660 OPEN 6,'NUMERANS',OUTPUT
670 OPEN 7,'ALPHAANS',OUTPUT
```

```
680 OPEN 8,'HOLDFILE',INPUT
690 FOR K=1 TO N6+1
700 GET 8: R1,R2,R3
710 PUT 6: R1,R2,R3
720 NEXT K
730 FOR K=1 TO N7+1
740 GET 8: R1,R2,R$
750 PUT 7: R1,R2,R$
760 NEXT K
770 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
780 U=1
785 REMARK:  "U" IS THE UNIT NUMBER OF THIS CHECK POINT.
790 C=3
795 REMARK:  "C" IS THE SECTION NUMBER OF THIS CHECK POINT.
800 A$(1)='A'
810 A$(2)='B'
820 A$(3)='C'
830 A$(4)='D'
840 REMARK:  ARRAY "A$" IS USED TO REFERENCE VARIOUS SLIDES.
843 DIM U$(20),V$(20),W$(20)
845 REMARK:  THE ABOVE ARRAYS ARE USED FOR QUESTION VARIATIONS.
847 USE X$
850 REMARK:  "X$" IS A DUMMY VARIABLE, USED TO RECEIVE AN ARGUMENT FROM
851 REM         A CHAINED PROGRAM.
853 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
860 PRINT
870 PRINT 'QUESTIONS FOR CHECK POINT # 3'
880 PRINT
890 PRINT
900 PRINT
945 REM
950 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
955 REM
1000 IF F(1)=1 GOTO 2000
1010 REM     ----------------
1020 REMARK:  QUESTION (1)
1030 REM     ----------------
1040 Q=1
1050 REMARK:  "Q" IS THE NUMBER OF THIS QUESTION FOR ARRAY SUBSCRIPT REFERENCE.
1080 GOSUB 16000
1085 REMARK:  "S1" IS THE VARIATION NUMBER FOR THE CURRENT PRESENTATION OF THIS
1087 REM         QUESTION AND IS SET BY THE CONTINGENCIES OF THE SUBROUTINE
1088 REM         WHICH BEGINS AT LINE 16000.
1090 IF S1<4 GOTO 1120
1100 S1=1
1110 REMARK:  ANY OF THE FOLLOWING 60 RESPONSES WILL BE RECOGNIZED FOR THIS
1113 REM         QUESTION.
1120 U$( 1)='CC'
1122 U$( 2)='C C'
1124 U$( 3)='CM3'
1126 U$( 4)='CM 3'
1128 U$( 5)='C M3'
1130 U$( 6)='C M 3'
1132 U$( 7)='CM**3'
1134 U$( 8)='MILLILITER'
1136 U$( 9)='MILLILITERS'
1138 U$(10)='MILLI LITER'
1140 U$(11)='MILLI LITERS'
1142 U$(12)='MILLILITRE'
1144 U$(13)='MILLILITRES'
1146 U$(14)='CUBIC CENTIMETER'
1148 U$(15)='CUBIC CENTIMETERS'
1150 U$(16)='CUBIC CENTIMETRE'
1152 U$(17)='CUBIC CENTIMETRES'
1154 U$(18)='CUBICCENTIMETERS'
1156 U$(19)='CUBICCENTIMETER'
1158 U$(20)='CENTIMETERS CUBED'
1160 V$( 1)='CUBIC METERS'
1162 V$( 2)='CUBIC METRES'
1164 V$( 3)='METERS CUBED'
```

```
1166 V$( 4)='METRES CUBED'
1168 V$( 5)='CUBIC M'
1170 V$( 6)='CUBICMETERS'
1172 V$( 7)='CUBICMETRES'
1174 V$( 8)='CUBIC METER'
1176 V$( 9)='CUBIC METRE'
1178 V$(10)='METERSCUBED'
1180 V$(11)='METRESCUBED'
1182 V$(12)='METERCUBED'
1184 V$(13)='METRECUBED'
1186 V$(14)='CUBICMETER'
1188 V$(15)='CUBICMETRE'
1190 V$(16)='METER CUBED'
1192 V$(17)='METRE CUBED'
1194 V$(18)='CUBICM'
1196 V$(19)='M CUBED'
1198 V$(20)='MCUBED'
1200 W$( 1)='CUBIC MILLIMETERS'
1202 W$( 2)='CUBIC MILLIMETRES'
1204 W$( 3)='CUBICMILLIMETERS'
1206 W$( 4)='CUBICMILLIMETRES'
1208 W$( 5)='CUBIC MILLIMETRE'
1210 W$( 6)='CUBIC MILLIMETER'
1212 W$( 7)='CUBICMILLIMETER'
1214 W$( 8)='CUBICMILLIMETRE'
1216 W$( 9)='MILLIMETERS CUBED'
1218 W$(10)='MILLIMETRES CUBED'
1220 W$(11)='MILLIMETER CUBED'
1222 W$(12)='MILLIMETRE CUBED'
1224 W$(13)='MILLIMETERSCUBED'
1226 W$(14)='MILLIMETRESCUBED'
1228 W$(15)='MILLIMETERCUBED'
1230 W$(16)='MILLIMETRECUBED'
1232 W$(17)='CUBIC ML'
1234 W$(18)='CUBICML'
1236 W$(19)='ML CUBED'
1238 W$(20)='MLCUBED'
1239 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1240 PRINT '(1)  Project the slide labelled "4-'; A$(S1); '" in the upper ';
1250 PRINT 'right-hand corner.  Enter below the NAME of the UNIT of MEASURE in'
1260 PRINT '      which the volume of this figure would be expressed if it ';
1270 PRINT 'was computed with the formula for the volume of a regular'
1290 PRINT '      rectangular solid.  ';
1300 PRINT '(The usable codes are "pass" and "stop".)'
1310 PRINT
1320 PRINT '             NAME of volume unit';
1330 INPUT E$(1)
1335 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1340 GOSUB 22725
1350 GOTO 1300,1790 ON G
1360 PRINT
1370 FOR K=0 TO 2
1380 FOR M=1 TO 20
1390 GOTO 1400,1420,1440,1400,1420 ON S1+K
1400 IF E$(1)=U$(M) GOTO 1830
1410 GOTO 1450
1420 IF E$(1)=V$(M) GOTO 1830
1430 GOTO 1450
1440 IF E$(1)=W$(M) GOTO 1830
1450 NEXT M
1460 NEXT K
1465 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1470 GOTO 1580,1630 ON C1
1475 REMARK:  "C1" COUNTS THE NUMBER OF STUDENT ENTRIES FOR THIS QUESTION.
1480 PRINT '      Your entry does not match any of the answers that I anticipa';
1490 PRINT 'ted.  It will be recorded for later evaluation by one of the'
1500 PRINT '      instructors.  Please check your spelling or re-enter your ';
1510 PRINT 'answer in a slightly different form.'
1515 PRINT '      ';
1520 C1=C1+1
```

```
1530 S(1,1)=5
1540 IF J=0 GOTO 1300
1550 PUT 7: 013015, J, E$(1)
1560 N7=N7+1
1570 GOTO 1300
1575 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1580 IF S(1,1)<>5 GOTO 1480
1590 PRINT '      I am sorry, but I can''t match that answer either.  Please ';
1600 PRINT 'try just one more time, expressing your response in a slightly'
1610 PRINT '      different form once again.  ';
1620 GOTO 1520
1623 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1630 IF J=0 GOTO 1660
1640 PUT 7: 013015, J, E$(1)
1650 N7=N7+1
1660 S(1,2)=S1
1670 GOTO 1680,1700,1720 ON S1
1680 PRINT '      The volume of this cube should be in units of CUBIC CENTI';
1690 GOTO 1730
1700 PRINT '      The volume of this cube should be in units of CUBIC ';
1710 GOTO 1730
1720 PRINT '      The volume of this cube should be in units of CUBIC MILLI';
1730 PRINT 'METERS.  If you feel that your response was equivalent to this'
1740 PRINT '      answer, please see one of the instructors after you have ';
1750 PRINT 'completed this check point.'
1760 PRINT
1770 PRINT '      You will get a chance to try this question again later, but ';
1780 PRINT 'right now the program will go on to the next problem.'
1790 PRINT
1800 PRINT
1810 PRINT
1820 GOTO 2000
1823 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1830 IF K<>0 GOTO 1890
1840 PRINT '      Yes, that is the correct unit.'
1850 IF C1<=1 GOTO 1870
1860 C1=1
1870 S(1,C1+1)=S1+5
1880 GOTO 1790
1883 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1890 IF C1=1 GOTO 1660
1900 PRINT '      That is not the correct unit.  Please be sure you are ';
1910 PRINT 'viewing slide "'; A$(S1); '" and enter another answer.'
1920 C1=C1+1
1930 S(1,1)=S1
1933 PRINT '      ';
1940 GOTO 1300
1950 REM    ----------------------------------------
1952 REMARK:  SCORE RECAPITULATION FOR QUESTION #1
1954 REM    ----------------------------------------
1955 REM
1956 REM         SCORE              DESIGNATED SIGNIFICANCE
1958 REM
1960 REM           0          NOT ATTEMPTED
1962 REM           1          INCORRECT RESPONSE TO VARIATION NUMBER 1
1964 REM           2          INCORRECT RESPONSE TO VARIATION NUMBER 2
1966 REM           3          INCORRECT RESPONSE TO VARIATION NUMBER 3
1968 REM           4          (NOT DESIGNATED)
1970 REM           5          UNIDENTIFIABLE RESPONSE
1972 REM           6          CORRECT RESPONSE TO VARIATION NUMBER 1
1974 REM           7          CORRECT RESPONSE TO VARIATION NUMBER 2
1976 REM           8          CORRECT RESPONSE TO VARIATION NUMBER 3
1978 REM           9          (NOT DESIGNATED)
1980 REM
1982 REMARK:    STORED ANSWERS ARE UNIDENTIFIABLE RESPONSES.
1984 REM
1986 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
1988 REM
```

```
2000 IF F(2)=1 GOTO 3000
2010 REM    ----------------
2020 REMARK:  QUESTION (2)
2030 REM    ----------------
2040 Q=2
2060 GOSUB 16000
2065 X=51*RND
2067 REMARK:  "X" IS A MULTIPURPOSE TEMPORARY STORAGE VARIABLE.
2070 L=(S1-1)* 5+0.1*INT(X)
2075 L=INT(10*L)/10
2076 REMARK:  "L" IS THE LENGTH OF THE DESCRIBED RECTANGULAR SOLID.
2078 X=51*RND
2080 W=(S1-1)* 5+0.1*INT(X)
2085 W=INT(10*W)/10
2087 REMARK:  "W" IS THE WIDTH OF THE DESCRIBED RECTANGULAR SOLID.
2088 X=101*RND
2090 H=(S1-1)*10+0.1*INT(X)
2095 H=INT(10*H)/10
2097 REMARK:  "H" IS THE HEIGHT OF THE DESCRIBED RECTANGULAR SOLID.
2100 IF S1<>1 GOTO 2150
2110 IF H<5 GOTO 2088
2150 A=L*W*H
2155 REMARK:  "A" IS THE CORRECT ANSWER TO THIS PROBLEM, THE VOLUME OF THE
2156 REM          DESCRIBED RECTANGULAR SOLID.
2157 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2160 PRINT '(2)  Please refer now to the slide labelled simply "5" which is ';
2170 PRINT 'in slot #18 of the slide tray.  Here you see pictured a wooden'
2180 PRINT '      regular rectangular solid.  This solid has a length of '; L;
2190 PRINT 'cm, a width of '; W; 'cm, and a height of '; H; 'cm.'
2200 PRINT '      Calculate the VOLUME of this solid and enter your answer ';
2210 PRINT 'below to the nearest cubic centimeter.'
2220 PRINT '    ';
2230 PRINT '(Codes "88888" and "99999" may also be entered.)'
2240 PRINT
2250 PRINT '           Volume of solid';_____ cc
2260 INPUT E(2)
2265 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2270 GOSUB 22500
2280 GOTO 2230,2590 ON G
2285 S2=2.1
2287 REMARK:  "S2" IS THE TOLERANCE ALLOWED BETWEEN THE STUDENT'S RESPONSE AND
2288 REM          THE CORRECT ANSWER.
2290 PRINT
2300 IF E(Q)>A+S2 GOTO 2380
2310 IF E(Q)<A-S2 GOTO 2440
2320 IF C1=1 GOTO 2360
2330 PRINT '      Your answer is correct.'
2340 S(Q,C1+1)=S1+5
2350 GOTO 2590
2360 PRINT '      Your answer is now correct.'
2370 GOTO 2340
2373 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2380 IF C1=1 GOTO 2480
2390 PRINT '      That value is too large.  Check over your work and the ';
2400 PRINT 'volume formula and make another entry.'
2410 C1=1
2420 S(Q,1)=S1
2430 GOTO 2220,3190,4140 ON Q-1
2440 IF C1=1 GOTO 2480
2450 PRINT '      Your entry is too small.  Please check the volume formula ';
2460 PRINT 'and your arithmetic and enter another value.'
2470 GOTO 2410
2473 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2480 A=INT(10*A)/10
2490 GOTO 3260,4210 ON Q-2
2500 PRINT '      Your answer is still incorrect.  The volume of this regular ';
2510 PRINT 'rectangular solid is '; A; 'cubic centimeters, found by'
2520 PRINT '      multiplying the length times the width times the height.'
2530 PRINT
2540 PRINT '      We will go on to the next problem now, but you''ll have ';
```

```
2550 PRINT 'another crack at this one at the end of the program.'
2560 S(Q,2)=S1
2565 IF J=0 GOTO 2590
2570 PUT 6: 013000+10*Q+S1, J, E(Q)-A
2580 N6=N6+1
2590 PRINT
2600 PRINT
2610 PRINT
2620 GOTO 4000,5000 ON Q-2
2630 REM    ---------------------------------------------------
2640 REMARK:  SCORE RECAPITULATION FOR QUESTIONS #2 THROUGH #4
2650 REM    ---------------------------------------------------
2660 REM
2670 REM         SCORE             DESIGNATED SIGNIFICANCE
2680 REM
2690 REM           0          NOT ATTEMPTED
2700 REM           1          INCORRECT RESPONSE TO VARIATION NUMBER 1
2710 REM           2          INCORRECT RESPONSE TO VARIATION NUMBER 2
2720 REM           3          INCORRECT RESPONSE TO VARIATION NUMBER 3
2730 REM           4          INCORRECT RESPONSE TO VARIATION NUMBER 4
2740 REM           5          (NOT DESIGNATED FOR THESE QUESTIONS)
2750 REM           6          CORRECT RESPONSE TO VARIATION NUMBER 1
2760 REM           7          CORRECT RESPONSE TO VARIATION NUMBER 2
2770 REM           8          CORRECT RESPONSE TO VARIATION NUMBER 3
2780 REM           9          CORRECT RESPONSE TO VARIATION NUMBER 4
2790 REM
2800 REMARK:    STORED ANSWERS FOR THESE QUESTIONS ARE EXPRESSED AS DEVIATIONS
2810 REM      FROM THE CORRECT ANSWER AND ARE STORED ONLY AFTER TWO INCORRECT
2820 REM      RESPONSES HAVE BEEN MADE.
2830 REM
2840 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
2850 REM
3000 IF F(3)=1 GOTO 4000
3010 REM    ----------------
3020 REMARK:  QUESTION (3)
3030 REM    ----------------
3040 Q=3
3050 GOSUB 16000
3060 X=(10*S1+1)*RND
3070 IF X=0 GOTO 3060
3080 L=(S1)*5+INT(X)
3090 L=INT(L)
3093 REMARK:  "L" IS THE LENGTH OF THE DESCRIBED ROD.
3100 X=10*(S1+RND)
3110 W=INT(X)/10
3113 REMARK:  "W" IS THE RADIUS OF THE DESCRIBED ROD.
3120 A=3.14*W*W*L
3123 REMARK:  "A" IS THE CORRECT ANSWER TO THIS PROBLEM, THE VOLUME OF THE
3125 REM        DESCRIBED ROD.
3130 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3150 PRINT '(3)  Slide "6" (in slot #19) shows a wooden rod.  This rod is '; L;
3160 PRINT 'cm long and has a radius of '; W; ' cm.  Find the VOLUME of '
3170 PRINT '     this rod and enter this value below to the nearest TENTH of ';
3180 PRINT 'a cubic centimeter.  Use 3.14 as the value for "pi".'
3190 PRINT '     ';
3200 PRINT '(Active codes:  "88888" & "99999".)'
3210 PRINT
3220 PRINT '          Volume of the ROD';______ cc
3230 INPUT E(3)
3235 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3240 GOSUB 22500
3245 S2=.21
3247 REMARK:  "S2" IS THE TOLERANCE ALLOWED BETWEEN THE STUDENT'S RESPONSE AND
3248 REM        THE CORRECT ANSWER.
3250 GOTO 2290,3200,2590 ON G+1
3255 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3260 PRINT '     That response is also incorrect.  This rod has a volume of ';
3270 PRINT A; 'cubic centimeters.  This value is derived from the'
3280 PRINT '     formula for the volume of a cylinder, V = B x h = 3.14 x r ';
3290 PRINT 'x r x h.  If you are still unsure of how this volume is found,'
```

```
3300 PRINT '     please refer back to the presentation or consult an ';
3310 PRINT 'instructor.  This computation is extremely important, and it will'
3320 PRINT '     be used in the final activity in section four.'
3330 PRINT
3340 PRINT '     I will go on to the next problem now, but you may return to ';
3350 PRINT 'this one at the end of the check point.'
3360 GOTO 2560
3370 REM
3380 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
3390 REM
4000 IF F(4)=1 GOTO 5000
4010 REM    ----------------
4020 REMARK:  QUESTION (4)
4030 REM    ----------------
4040 Q=4
4050 GOSUB 16000
4060 X=S1*10*RND
4070 W=S1+INT(X)/10
4080 REMARK:  "W" IS THE RADIUS OF THE DESCRIBED SPHERE.
4090 A=(4/3)*3.14*W**3
4093 REMARK:  "A" IS THE CORRECT ANSWER TO THIS PROBLEM, THE VOLUME OF THE
4095 REM          DESCRIBED SPHERE.
4098 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4100 PRINT '(4)  Advance your projector now to slide "7" (slot #20).  This ';
4110 PRINT 'picture shows a wooden sphere with a radius of '; W; 'cm.'
4120 PRINT '     Compute the VOLUME of this sphere to the nearest TENTH of a ';
4130 PRINT 'cubic centimeter, using 3.14 for "pi".'
4140 PRINT '     ';
4150 PRINT '(Acceptable codes are "88888" and "99999".)'
4160 PRINT
4170 PRINT '          Volume of SPHERE';_____ cc
4180 INPUT E(4)
4185 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4190 GOSUB 22500
4195 S2=.21
4197 REMARK:  "S2" IS THE TOLERANCE ALLOWED BETWEEN THE STUDENT'S RESPONSE AND
4198 REM          THE CORRECT ANSWER.
4200 GOTO 2290,4150,2590 ON G+1
4205 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4210 PRINT '     Your entry is still not correct.  The volume of a sphere is ';
4220 PRINT 'found by multiplying 4/3 times "pi" times the radius cubed.'
4230 PRINT '     In this case, the volume turns out to be '; A; 'cubic centi';
4240 PRINT 'meters.  Please check your work to find where you went wrong.'
4250 PRINT
4260 PRINT '     You''ll get another chance on a similar problem at the end ';
4270 PRINT 'of this program, but I''ll go on to the next one now.'
4280 GOTO 2560
4290 REM
4300 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
4310 REM
5000 IF F(5)=1 GOTO 5810
5010 REM    ----------------
5020 REMARK:  QUESTION (5)
5030 REM    ----------------
5031 PRINT 'The next question does not refer to a slide, so please put the ';
5032 PRINT 'projector switch into the "fan" position while you are'
5033 PRINT 'working on it.  Thank you.'
5034 PRINT
5035 PRINT
5036 PRINT
5040 Q=5
5050 GOSUB 16000
5060 U$(1)='MILLILITERS'
5070 U$(2)='CUBIC MILLIMETERS'
5080 U$(3)='LITERS'
5090 U$(4)='CUBIC METERS'
5100 V$(1)='ml
5110 V$(2)='cubic mm
5120 V$(3)='l
5130 V$(4)='cubic m
```

```
5140 X=1000+1000*RND
5145 W=INT(X)
5147 REMARK:  "W" IS THE NUMBER OF CUBIC CENTIMETERS PRESENTED AND IS ALWAYS AN
5148 REM         INTEGER GREATER THAN 1000 BUT LESS THAN 2000.
5150 GOTO 5160,5180,5200,5220 ON S1
5160 A=W
5170 GOTO 5230
5180 A=W*1000
5190 GOTO 5230
5200 A=W/1000
5210 GOTO 5230
5220 A=W/1000000
5223 REMARK:  "A" IS THE CORRECT ANSWER TO THIS PROBLEM, DERIVED FROM "W"
5225 REM         CONTINGENT UPON THE CURRENT QUESTION VARIATION.
5226 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
5230 PRINT '(5)  Imagine that the volume of an irregularly-shaped rock is ';
5240 PRINT 'found to be '; W; 'cubic centimeters by immersing it in a large'
5250 PRINT '      graduated cylinder with a known volume of water.  Enter ';
5260 PRINT 'below the equivalent volume of the rock expressed in'
5270 PRINT '      '; U$(S1); '.  ';
5280 PRINT '(You may also enter codes "88888" and "99999".)'
5290 PRINT
5300 PRINT '             Equivalent volume _______ '; V$(S1); '
5310 INPUT E(5)
5315 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
5320 GOSUB 22500
5330 GOTO 5280,5800 ON G
5340 PRINT
5350 IF E(5)>1.01*A GOTO 5400
5360 IF E(5)< .99*A GOTO 5550
5370 PRINT '      Yes, that answer is correct.'
5380 S(5,C1+1)=S1+5
5390 GOTO 5800
5395 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
5400 IF C1=1 GOTO 5660
5410 FOR K=1 TO 7
5420 IF E(5)>1.02*(10**K)*A GOTO 5480
5430 IF E(5)< .98*(10**K)*A GOTO 5480
5440 PRINT '      The digits in your entry are correct, but the decimal point ';
5450 PRINT 'is too far to the RIGHT (your value is too large).  Think again'
5460 PRINT '      and make a new entry.  ';
5470 GOTO 5520
5480 NEXT K
5490 PRINT '      Your entry is too large.  The digits in the correct answer ';
5500 PRINT 'will be the same as in the question, '; W; ', but the decimal'
5510 PRINT '      point will be moved.  Think again and make a new entry.  ';
5520 C1=1
5530 S(5,1)=S1
5540 GOTO 5280
5543 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
5550 IF C1=1 GOTO 5660
5560 FOR K=1 TO 7
5570 IF E(5)>1.02*A/(10**K) GOTO 5630
5580 IF E(5)< .98*A/(10**K) GOTO 5630
5590 PRINT '      The digits in your entry are correct, but the decimal point ';
5600 PRINT 'is too far to the LEFT (your value is too small).  Think again'
5610 PRINT '      and make a new entry.  ';
5620 GOTO 5520
5630 NEXT K
5640 PRINT '      Your entry is too small.  The digits in the correct answer ';
5650 GOTO 5500
5653 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
5660 GOTO 5830,5890,5940 ON S1-1
5670 PRINT '      That value is still incorrect.  The milliliter is defined ';
5680 PRINT 'exactly equal to one cubic centimeter; and therefore there are'
5690 PRINT '      exactly the SAME number of milliliters in the rock''s volume';
5700 PRINT ' as cubic centimeters.  In other words, 1 cc = 1 ml, and thus'
5710 PRINT '      '; W; 'cc  = '; A; 'ml.  Please see an instructor if this ';
5720 PRINT 'concept is still not clear to you.'
5730 PRINT
```

```
5740 PRINT '     The next question will now be presented, but you''ll be able';
5750 PRINT ' to return to this one after the program is concluded.'
5760 S(5,2)=S1
5770 IF J=0 GOTO 5800
5780 PUT 6: 013050+S1, J, E(5)-A
5790 N6=N6+1
5800 PRINT
5810 B$='013PT2'
5820 GOTO 22143,15000 ON F(5)+1
5830 PRINT '     That value is still incorrect.  There are 1000 CUBIC milli';
5840 PRINT 'meters in each CUBIC centimeter, so 1 cc = 1000 cu mm.  To find'
5850 PRINT '     the number of cubic millimeters in '; W; 'cubic centimeters ';
5860 PRINT 'you must MULTIPLY by 1000.  In this case, the correct answer'
5870 PRINT '     is '; A; 'cubic millimeters.'
5880 GOTO 5730
5890 PRINT '     That value is still incorrect.  One LITER contains exactly ';
5900 PRINT '1000 cubic centimeters (or milliliters).  That is, 1000 cc = 1 l.'
5910 PRINT '     Therefore, the number of liters equivalent to '; W; 'cc is ';
5920 PRINT 'found by DIVIDING by 1000 to get '; A; 'liters.'
5930 GOTO 5730
5940 PRINT '     That value is still incorrect.  It takes 1,000,000 CUBIC ';
5950 PRINT 'centimeters to equal just one CUBIC meter, so to solve this'
5960 PRINT '     problem you were required to DIVIDE by one million.  The ';
5970 PRINT 'correct answer to this question is therefore'
5973 PRINT USING 5975, A
5975 :      0.###### cubic meter.  See an instructor if you need more help.
5990 GOTO 5730
6000 REM    ----------------------------------------
6010 REMARK:  SCORE RECAPITULATION FOR QUESTION #5
6020 REM    ----------------------------------------
6030 REM
6040 REM          SCORE              DESIGNATED SIGNIFICANCE
6050 REM
6060 REM            0           NOT ATTEMPTED
6070 REM            1           INCORRECT RESPONSE TO VARIATION NUMBER 1
6080 REM            2           INCORRECT RESPONSE TO VARIATION NUMBER 2
6090 REM            3           INCORRECT RESPONSE TO VARIATION NUMBER 3
6100 REM            4           INCORRECT RESPONSE TO VARIATION NUMBER 4
6110 REM            5           (NOT DESIGNATED)
6120 REM            6           CORRECT RESPONSE TO VARIATION NUMBER 1
6130 REM            7           CORRECT RESPONSE TO VARIATION NUMBER 2
6140 REM            8           CORRECT RESPONSE TO VARIATION NUMBER 3
6150 REM            9           CORRECT RESPONSE TO VARIATION NUMBER 4
6160 REM
6170 REMARK:    STORED ANSWERS ARE EXPRESSED AS DEVIATIONS FROM THE CORRECT
6180 REM      ANSWER AND ARE STORED ONLY AFTER TWO INCORRECT RESPONSES HAVE
6190 REM      BEEN MADE.
6200 REM
6210 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
6220 REM
15000 REM   ------------------------------------------------------------
15010 REMARK:  ROUTINE FOR CHAINING TO PART TWO OR "RECORDER" PROGRAM
15020 REM   ------------------------------------------------------------
15023 PRINT 'One moment please...'
15025 PRINT
15027 PRINT
15030 OPEN 5,'NSTRDANS',OUTPUT
15040 PUT 5: N6,N7
15050 CLOSE 5,6,7,8
15060 OPEN 4,'PASSFILE',OUTPUT
15070 PUT 4: J,T,U,C,X,X,X
15080 REMARK:  DATA PASSED ARE STUDENT NUMBER ("J"), NUMBER OF PREVIOUS
15090 REM         EXECUTIONS OF THIS CHECK POINT ("T"), UNIT NUMBER ("1"), &
15100 REM         CHECK POINT NUMBER ("3").
15110 FOR K=1 TO 10
15120 PUT 4: F(K),P(K),S(K,1),S(K,2)
15130 NEXT K
15140 CLOSE 4
15150 CHAIN B$, D$
15160 REMARK:  "B$" IS THE NAME OF THE PROGRAM TO BE CHAINED ("013PT2" OR
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15170 REM         "RECORDER").  IF THE RECORDER PROGRAM IS CHAINED AND "D$" IS
15180 REM         SET TO "QUICKIE", DISPLAY OF SCORES ACHIEVED ON THE CURRENT
15190 REM         RUN WILL BE SUPPRESSED.
16000 REM     -------------------------------------------------------
16010 REMARK:  SUBROUTINE TO GENERATE SLIDE REFERENCE NUMBER ("S1")
16020 REM     -------------------------------------------------------
16030 C1=0
16040 REMARK:  "C1" COUNTS THE NO. OF STUDENT ENTRIES FOR THE CURRENT QUESTION.
16050 X=P(Q)
16060 GOSUB 22000
16070 GOTO 16110,16110,16110,16130,16080,16150,16150,16150,16130 ON X
16080 S1=INT(5*RND)
16090 IF S1=0 GOTO 16080
16100 RETURN
16105 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16110 X=P(Q)+1
16120 GOTO 16160
16130 S1=1
16140 RETURN
16145 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16150 X=P(Q)-4
16160 GOSUB 22000
16170 S1=X
16180 RETURN
22000 REM     ----------------------
22010 REMARK:  ROUNDING SUBROUTINE
22020 REM     ----------------------
22021 REMARK:  THIS SUBROUTINE CONVERTS FLOATING POINT NUMBERS TO INTEGER MODE
22022 REM         BY ROUNDING THEM TO THE NEXT HIGHEST INTEGER, E.G., 5.999 = 6.
22030 FOR Z=0 TO 1000
22040 IF X>Z GOTO 22070
22050 X=Z
22060 RETURN
22070 NEXT Z
22075 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22080 PRINT
22083 PRINT
22085 PRINT '*********************'
22087 PRINT
22090 PRINT 'I''m sorry, but an error has occurred in the program.  Please ';
22100 PRINT 'logoff and take this complete print out to your instructor.'
22110 PRINT
22120 PRINT 'NOTE TO INSTRUCTOR:  Argument of rounding subroutine greater ';
22130 PRINT 'than 1000.'
22133 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22135 D$='QUICKIE'
22140 B$='RECORDER'
22143 PRINT
22145 PRINT
22150 GOTO 15000
22500 REM     -------------------------------------------------------------
22510 REMARK:  SUBROUTINE FOR STUDENT TO TERMINATE PROGRAM OR PASS QUESTION
22520 REM     -------------------------------------------------------------
22521 REMARK:  THIS SUBROUTINE IS ENTERED AFTER EVERY STUDENT INPUT.  IT RETURNS
22522 REM         THE VALUE OF G=0 IF THE STUDENT HAS NOT ENTERED A CODE, G=1 IF
22523 REM         A PROGRAM TERMINATION CODE HAS BEEN ENTERED BUT THEN CANCELED,
22524 REM         AND G=2 IF A PASS CODE HAS BEEN ENTERED.
22525 G=0
22530 IF E(Q)=99999 GOTO 22560
22540 IF E(Q)=88888 GOTO 22710
22550 RETURN
22555 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22560 PRINT
22563 PRINT
22570 PRINT '     You have indicated that you wish to TERMINATE this program.';
22580 PRINT '  Type "yes" to confirm your request, or "no" to cancel it.'
22583 PRINT
22585 PRINT '            Confirmation';
22590 INPUT B$
22600 IF B$='YES' GOTO 23000
```

```
22610 G=1
22620 PRINT
22623 PRINT
22630 PRINT '     Enter another answer to the above problem.  ';
22640 RETURN
22650 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22710 G=2
22720 RETURN
22723 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22725 G=0
22730 IF E$(Q)='STOP' GOTO 22560
22735 IF E$(Q)='99999' GOTO 22560
22740 IF E$(Q)='PASS' GOTO 22710
22745 IF E$(Q)='88888' GOTO 22710
22750 RETURN
22760 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
23000 PRINT
23003 IF Q=5 GOTO 23010
23005 PRINT '     Please switch the slide projector to "fan" ';
23007 PRINT 'until you need it again or are ready to logoff.  Thanks.'
23008 PRINT
23010 PRINT '     Would you like a summary of your score or are you in a hurry';
23020 PRINT ' to leave (enter "summarize" or "quickie")';
23030 INPUT A$
23040 IF A$='SUMMARIZE' GOTO 22140
23050 GOTO 22135
23060 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
24000 END
```

```
10 REM     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
15 REM     *                                                                   *
20 REMARK  *      C H E C K   P O I N T   0 1 3 ,   P A R T   T W O            *
25 REM     *                                                                   *
30 REM     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
35 REM
40 REM
50 REMARK:                              COPYRIGHT
60 REM
70 REMARK:                          JESSE M. HEINES
80 REM
90 REMARK:                           JANUARY, 1974
100 REM
110 REM
113 REM    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
115 REM
120 DEF FNA(X)=X-INT(X)
123 REMARK:  "FNA(X)" RETURNS THE FRACTIONAL PART OF THE DECIMAL NUMBER "X".
125 REMARK:  "INT(X)" RETURNS THE INTEGRAL PART OF THE DECIMAL NUMBER "X".
130 DIM S(10,2)
133 REMARK:  ARRAY "S" HOLDS THE SCORES ACHIEVED ON THIS RUN.
135 REM    ------------------------------------------
140 REMARK:  ROUTINE TO GATHER DATA FROM "PASSFILE"
143 REM    ------------------------------------------
150 OPEN 4,'PASSFILE',INPUT
160 GET 4: J,T,U,C,X,X,X
210 REMARK:  "J" IS THE STUDENT'S REFERENCE NUMBER.
220 REMARK:  "T" IS THE NUMBER OF TIMES HE OR SHE HAS PREVIOUSLY RUN THIS
230 REM           CHECK POINT.
240 REMARK:  "U" IS THE UNIT NUMBER OF THIS CHECK POINT.
250 REMARK:  "C" IS THE SECTION NUMBER OF THIS CHECK POINT.
260 FOR K=1 TO 10
263 GET 4: F(K),P(K),S(K,1),S(K,2)
270 REMARK:  ARRAY "F" IS FOR THE PRESENTATION FLAGS FOR FOR EACH QUESTION,
275 REM           WHERE "0" = PRESENT AND "1" = OMIT.
280 REMARK:  ARRAY "P" IS FOR THE CUMULATIVE PREVIOUS SCORES BY QUESTION NO.
290 NEXT K
293 CLOSE 4
300 REM    --------------------------------------------
310 REMARK:  ROUTINES FOR OPENING STORED ANSWER FILES
320 REM    --------------------------------------------
330 OPEN 5,'NSTRDANS',INPUT
340 REMARK:  FILE "NSTRDANS" CONTAINS TWO ELEMENTS, "N6" & "N7", WHICH
350 REM           INDICATE THE NUMBER OF ENTRIES IN FILE #6, "NUMERANS", AND
355 REM           FILE #7, "ALPHAANS", RESPECTIVELY.
360 GET 5: N6,N7
370 CLOSE 4,5
380 OPEN 6,'NUMERANS',INPUT
390 OPEN 7,'ALPHAANS',INPUT
400 OPEN 8,'HOLDFILE',OUTPUT
410 REMARK:  FILE #6 CONTAINS RECORDS OF STORED NUMERIC ANSWERS.
420 REMARK:  FILE #7 CONTAINS RECORDS OF STORED ALPHAMERIC ANSWERS.
430 REMARK:  FILE #8 IS USED TO HOLD TEMPORARY DATA.
435 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
440 REMARK:  THE FOLLOWING STATEMENTS READ IN THE EXISTING STORED ANSWER FILES
450 REM           AND STORE THEM TEMPORARILY IN "HOLDFILE".
490 FOR K=1 TO N6+1
500 GET 6: R1,R2,R3
510 PUT 8: R1,R2,R3
520 NEXT K
530 FOR K=1 TO N7+1
540 GET 7: R1,R2,R$
550 PUT 8: R1,R2,R$
640 NEXT K
645 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
650 REMARK:  THE FOLLOWING STATEMENTS REWRITE THE EXISTING STORED ANSWER FILES
653 REM           AND OPEN THEM TO RECEIVE OUTPUT FROM THIS PROGRAM.
660 OPEN 6,'NUMERANS',OUTPUT
670 OPEN 7,'ALPHAANS',OUTPUT
680 OPEN 8,'HOLDFILE',INPUT
```

```
690 FOR K=1 TO N6+1
700 GET 8: R1,R2,R3
710 PUT 6: R1,R2,R3
720 NEXT K
730 FOR K=1 TO N7+1
740 GET 8: R1,R2,R$
750 PUT 7: R1,R2,R$
760 NEXT K
770 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
780 USE X$
790 REMARK:  "X$" IS A DUMMY VARIABLE, USED TO RECEIVE AN ARGUMENT FROM A
795 REM         CHAINED PROGRAM.
800 A$(1)='A'
810 A$(2)='B'
820 A$(3)='C'
830 A$(4)='D'
840 PRINT
910 DIM U$(20),V$(20),W$(20)
920 REMARK:  THE ABOVE ARRAYS ARE USED FOR QUESTION VARIATIONS.
930 REM
940 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
950 REM
6000 IF F(6)=1 GOTO 7000
6010 REM   ----------------
6020 REMARK:  QUESTION (6)
6030 REM   ----------------
6040 Q=6
6043 REMARK:  "Q" IS THE NUMBER OF THIS QUESTION FOR ARRAY SUBSCRIPT REFERENCE.
6050 GOSUB 16000
6053 REMARK:  THE SUBROUTINE AT LINE 16000 RETURNS A VARIATION NUMBER, "S1",
6055 REM         FOR THE CURRENT PRESENTATION OF THIS QUESTION CONTINGENT UPON
6057 REM         THE STUDENT'S PREVIOUS SCORE.
6060 A(1)=8.7
6070 A(2)=7.6
6080 A(3)=8.4
6090 A(4)=8.1
6092 REMARK:  THE CORRECT ANSWER TO THIS PROBLEM IS REPRESENTED AS "A(S1)".
6095 S2=.05
6097 REMARK:  "S2" IS THE TOLERANCE ALLOWED BETWEEN THE STUDENT'S RESPONSE
6098 REM         AND THE CORRECT ANSWER.
6099 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6100 PRINT '(6)  This question refers to the picture of the graduated cylin';
6110 PRINT 'der shown in the slide labelled "8-'; A$(S1); '".  Please be sure'
6120 PRINT '       that you are viewing the correct slide before attempting to ';
6130 PRINT 'solve this problem.  Read the VOLUME of the water shown in this'
6140 PRINT '       graduated cylinder and enter its value below to the nearest ';
6150 PRINT 'TENTH of a milliliter.'
6160 PRINT '     ';
6165 IF Q=7 GOTO 7180
6170 PRINT '(Codes "88888" and "99999" will also be recognized.)'
6180 PRINT
6190 PRINT '            Volume';_____ ml
6200 INPUT E(6)
6205 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6210 GOSUB 22500
6220 GOTO 6170,6590 ON G
6230 PRINT
6240 IF E(Q)>=A(S1)+S2 GOTO 6320
6250 IF E(Q)<A(S1)-S2 GOTO 6450
6260 IF C1=1 GOTO 6300
6270 PRINT '      Your entry is the correct value.'
6280 S(Q,C1+1)=S1+5
6290 GOTO 6590
6300 PRINT '      Your new entry is now correct.'
6310 GOTO 6280
6320 IF C1=1 GOTO 6475
6325 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6330 IF E(Q)>A(S1)+3*S2 GOTO 6395
6340 IF E(Q)<A(S1)+S2 GOTO 6400
6350 PRINT '      You have read to the TOP of the miniscus.  Read to the ';
```

```
6360 PRINT 'BOTTOM of it and enter another value.'
6370 S(Q,1)=5
6380 C1=C1+1
6390 GOTO 6160
6393 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6395 IF Q=7 GOTO 7240
6400 PRINT '     That value is too large.  Note the size of each marked ';
6410 PRINT 'division and enter another value.'
6420 S(Q,1)=S1
6430 C1=C1+1
6440 GOTO 6160
6445 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6450 IF C1=1 GOTO 6475
6460 PRINT '     That value is too small.  Note the size of each marked ';
6470 GOTO 6410
6473 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
6475 IF Q=7 GOTO 7290
6480 PRINT '     Your answer is still not correct.  It should be '; A(S1);
6490 PRINT 'ml.  Note that this value corresponds to the reading at the BOTTOM'
6500 PRINT '     of the miniscus.'
6510 PRINT
6520 PRINT '     You will get a chance to try this problem again after all ';
6530 PRINT 'the others have been presented, but right now the program will go'
6540 PRINT '     on to the next question.'
6550 S(Q,2)=S1
6560 IF J=0 GOTO 6590
6570 PUT 6: 013000+10*Q+S1, J, E(Q)-A(S1)
6580 N6=N6+1
6590 PRINT
6600 PRINT
6610 PRINT
6620 IF Q=7 GOTO 8000
6630 REM    -----------------------------------------------
6640 REMARK:  SCORE RECAPITULATION FOR QUESTIONS #6 AND #7
6650 REM    -----------------------------------------------
6660 REM
6670 REM         SCORE            DESIGNATED SIGNIFICANCE
6680 REM
6690 REM           0           NOT ATTEMPTED
6700 REM           1           INCORRECT RESPONSE TO VARIATION NUMBER 1
6710 REM           2           INCORRECT RESPONSE TO VARIATION NUMBER 2
6720 REM           3           INCORRECT RESPONSE TO VARIATION NUMBER 3
6730 REM           4           INCORRECT RESPONSE TO VARIATION NUMBER 4
6740 REM           5           GRADUATED CYLINDER READ AT TOP OF MINISCUS
6750 REM           6           CORRECT RESPONSE TO VARIATION NUMBER 1
6760 REM           7           CORRECT RESPONSE TO VARIATION NUMBER 2
6770 REM           8           CORRECT RESPONSE TO VARIATION NUMBER 3
6780 REM           9           CORRECT RESPONSE TO VARIATION NUMBER 4
6790 REM
6800 REMARK:   STORED ANSWERS ARE EXPRESSED AS DEVIATIONS FROM THE CORRECT
6810 REM    ANSWER AND ARE STORED AFTER THE SECOND INCORRECT RESPONSE.
6820 REM
6830 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
6840 REM
7000 IF F(7)=1 GOTO 8000
7010 REM    ----------------
7020 REMARK:  QUESTION (7)
7030 REM    ----------------
7040 Q=7
7050 GOSUB 16000
7060 A(1)=14.0
7070 A(2)=14.5
7080 A(3)=15.0
7090 A(4)=16.0
7095 X=4*RND
7100 W=7.0+INT(X)
7110 A(S1)=A(S1)-W
7120 S2=.25
7125 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
7130 PRINT '(7)  Move the projector to view the slide labelled "9-'; A$(S1);
```

```
7140 PRINT '". This graduated cylinder contained '; W; 'ml of water before'
7150 PRINT '     the rock was dropped into it.  Using the technique of water ';
7160 PRINT 'immersion, express the volume of the ROCK to the nearest'
7170 PRINT '      HALF (.5) of a milliliter.  ';
7180 PRINT '(Codes "88888" and "99999" are active.)'
7190 PRINT
7200 PRINT '            Volume of rock';_____ ml
7210 INPUT E(7)
7215 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
7220 GOSUB 22500
7230 GOTO 6230,7180,6590 ON G+1
7240 IF E(7)>A(S1)+W+.25 GOTO 6400
7250 IF E(7)<A(S1)+W-.25 GOTO 6400
7260 PRINT '      You''ve entered the TOTAL volume of the rock PLUS the water';
7270 PRINT '.  The problem asks for the volume of the ROCK alone.  Try again.'
7280 GOTO 6420
7285 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
7290 PRINT '      That entry is also incorrect.  The volume of the rock is ';
7300 PRINT 'found by SUBTRACTING the initial volume of the water, '; W; 'ml,'
7310 PRINT '      from the TOTAL volume of the rock PLUS the water.  The total';
7320 PRINT ' volume is equal to '; A(S1)+W; 'ml.  Note that this value'
7330 PRINT '     corresponds to the reading at the BOTTOM of the miniscus.  ';
7340 PRINT 'Thus, the volume of the rock is '; A(S1)+W; 'ml  - '; W; 'ml, or'
7350 PRINT '     '; A(S1); 'ml.'
7360 PRINT
7370 PRINT '      I will go on to the next question now, but you''ll get an ';
7380 PRINT 'opportunity to return to this one at the end of the check point.'
7390 GOTO 6550
7400 REM
7410 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
7420 REM
8000 IF F(8)=1 GOTO 9000
8010 REM    ----------------
8020 REMARK:  QUESTION (8)
8023 REM    ----------------
8025 REMARK:  THE FOLLOWING STATEMENTS DETERMINE IF THE SLIDE PROJECTOR IS ON,
8030 REM      AND, IF IT IS, INSTRUCT THE STUDENT TO TURN IT OFF.
8031 IF F(7)=0 GOTO 8038
8032 IF F(6)=0 GOTO 8038
8033 IF F(5)=0 GOTO 8043
8034 FOR K=1 TO 4
8035 IF F(K)=0 GOTO 8038
8036 NEXT K
8037 GOTO 8043
8038 PRINT 'Please put the slide projector switch on "fan" until you are ';
8039 PRINT 'asked to use it again.'
8040 PRINT
8041 PRINT
8042 PRINT
8043 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8044 Q=8
8045 C1=0
8050 U$(1)='LITER'
8060 U$(2)='LITRE'
8063 U$(3)='L'
8065 U$(4)='L.'
8067 U$(5)='LITERS'
8068 REMARK:  ALL ELEMENTS OF ARRAY "U$" ARE CORRECT ANSWERS TO THIS PROBLEM.
8070 V$(1)='LETER'
8080 V$(2)='LETRE'
8083 REMARK:  ELEMENTS OF ARRAY "V$" ARE ALTERNATIVE CORRECT ANSWERS.
8090 W$(1)='MILLILITER'
8100 W$(2)='MILLI LITER'
8110 W$(3)='MILLILITRE'
8120 W$(4)='MILLI LITRE'
8123 REMARK:  ELEMENTS OF ARRAY "W$" ARE SPECIFIC INCORRECT RESPONSES.
8125 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8130 PRINT '(8)  If Maine "goes metric" at some time in the future, we will ';
8140 PRINT 'no longer be buying milk by quarts and gallons.  Enter below'
8150 PRINT '      the name of the metric unit that would most likely be used ';
```

```
8160 PRINT 'to sell milk if we were to change our system of measures.'
8170 PRINT '     ';
8180 PRINT '(Codes "pass" and "stop" are now active.)'
8190 PRINT
8200 PRINT '          Unit';
8210 INPUT E$(8)
8215 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8220 GOSUB 22725
8230 GOTO 8180,8730 ON G
8240 PRINT
8250 FOR K=1 TO 5
8260 IF E$(8)=U$(K) GOTO 8460
8270 NEXT K
8280 FOR K=1 TO 2
8290 IF E$(8)=V$(K) GOTO 8510
8300 NEXT K
8310 FOR K=1 TO 4
8320 IF E$(8)=W$(K) GOTO 8550
8330 NEXT K
8335 IF C1=2 GOTO 8620
8340 IF S(8,1)=5 GOTO 8430
8350 S(8,1)=5
8360 PRINT '     Your answer does not match any that I anticipated.  Please ';
8370 PRINT 'check your spelling and make a new entry.'
8380 C1=C1+1
8385 S2=1
8388 REMARK:  "S2" COUNTS THE NUMBER OF UNRECOGNIZABLE RESPONSES ENTERED.
8390 IF J=0 GOTO 8420
8400 PUT 7: 013080+S(8,S2), J, E$(8)
8410 N7=N7+1
8420 GOTO 8170,8670 ON S2
8430 PRINT '     That answer can not be matched either.  Please try once ';
8440 PRINT 'again.  I am looking for a metric unit of VOLUME.'
8450 GOTO 8380
8455 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8460 PRINT '     Yes, that is the correct unit.'
8465 S2=9
8470 IF C1<=1 GOTO 8490
8480 C1=1
8490 S(8,C1+1)=S2-C1
8500 GOTO 8730
8505 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8510 PRINT '     Your entry will be judged correct, but the unit name should ';
8520 PRINT 'be spelled either "liter" of "litre" (the European way).'
8530 S2=7
8540 GOTO 8470
8545 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8550 GOTO 8570,8560,8640 ON C1+1
8560 IF S(8,1)<>5 GOTO 8640
8570 PRINT '     The MILLILITER is too small a unit to be practical for ';
8580 PRINT 'retail sales.  Think again and try another unit.'
8590 C1=C1+1
8600 S(8,1)=4
8610 GOTO 8170
8615 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8620 S(8,2)=1
8625 S2=2
8630 GOTO 8390
8635 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
8640 S(8,2)=2
8650 S2=2
8660 GOTO 8390
8670 PRINT '     The metric unit of volume that would be used to sell milk ';
8680 PRINT '(and most other liquids) is the LITER, which is just a little'
8690 PRINT '     larger than our quart.'
8700 PRINT
8710 PRINT '     You will get another chance to answer this question at the ';
8720 PRINT 'end of the program, but right now we will proceed onward.'
8730 PRINT
8740 PRINT
```

```
8750 PRINT
8760 REM     ---------------------------------------
8770 REMARK:  SCORE RECAPITULATION FOR QUESTION #8
8780 REM     ---------------------------------------
8790 REM
8800 REM          SCORE           DESIGNATED SIGNIFICANCE
8810 REM
8820 REM            0        NOT ATTEMPTED
8830 REM            1        UNRECOGNIZABLE RESPONSE ENTERED ON THIRD TRY
8840 REM            2        RESPONSE "MILLILITER" ENTERED ON THIRD TRY
8850 REM            3        NOT DESIGNATED FOR THIS QUESTION
8860 REM            4        "MILLILITER" ENTERED ON FIRST OF SECOND TRY
8870 REM            5        UNRECOGNIZABLE RESPONSE ENTERED ON 1ST OR 2ND TRY
8880 REM            6        NOT DESIGNATED FOR THIS QUESTION
8890 REM            7        CORRECT RESPONSE ENTERED ON THIRD TRY
8900 REM            8        CORRECT RESPONSE ENTERED ON SECOND TRY
8910 REM            9        CORRECT RESPONSE ENTERED ON FIRST TRY
8920 REM
8930 REM   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
8940 REM
9000 IF F(9)=1 GOTO 9510
9010 REM     ---------------
9020 REMARK:  QUESTION (9)
9030 REM     ---------------
9040 Q=9
9050 GOSUB 16000
9060 A(1)=22.5
9070 A(2)=38.2
9080 A(3)= 3.0
9090 A(4)=40.6
9093 REMARK:  THE CORRECT ANSWER TO THIS PROBLEM IS REPRESENTED AS "A(S1)".
9095 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9100 PRINT '(9)  For the last question in this check point, please refer to ';
9110 PRINT 'the slide labelled "10-'; A$(S1); '".  Read the time shown here'
9120 PRINT '      to the nearest TENTH of a second and enter its value below. ';
9130 PRINT 'Be sure you are viewing slide "10-'; A$(S1); '".'
9140 PRINT '     ';
9150 PRINT '(Acceptable codes are "88888" and "99999".)'
9160 PRINT
9170 PRINT '          Time';_____ sec
9180 INPUT E(9)
9185 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9190 GOSUB 22500
9195 PRINT
9200 GOTO 9150,9520 ON G
9210 IF E(9)>A(S1)+.15 GOTO 9310
9220 IF E(9)>A(S1)+.05 GOTO 9340
9230 IF E(9)>A(S1)-.05 GOTO 9400
9240 IF E(9)>A(S1)-.15 GOTO 9340
9250 IF C1=1 GOTO 9420
9260 PRINT '      Your entry is too small.  Note the size of each division ';
9270 PRINT 'and enter another answer.'
9280 C1=C1+1
9290 S(9,1)=S1
9300 GOTO 9140
9305 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9310 IF C1=1 GOTO 9420
9320 PRINT '      Your entry is too large.  Note the size of each division ';
9330 GOTO 9270
9335 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9340 PRINT '      That value is off by one-tenth of a second.  You will be ';
9350 PRINT 'credited with a correct answer, but the exact time shown on the'
9355 PRINT USING 9360, A(S1)
9360 :      watch is ##.# seconds.
9370 S(9,C1+1)=5+S1
9380 PRINT
9390 GOTO 9520
9395 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9400 PRINT '      Your answer is the correct one.'
9410 GOTO 9370
```

```
9413 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
9415 PRINT USING 9420, A(S1)
9420 :      That entry is still off.  It should be ##.# seconds.
9430 PRINT
9440 PRINT '     You''ll get another crack at this problem in just a minute, ';
9450 PRINT 'but first your current score will be displayed.'
9460 S(9,2)=S1
9470 IF J=0 GOTO 9500
9480 PUT 6: 013090+S1, J, E(9)-A(S1)
9490 N6=N6+1
9500 PRINT
9510 GOTO 9540,9540,9540,9540,22140,9540,9540,22140,9520 ON Q
9520 PRINT
9530 PRINT
9540 PRINT 'Please switch the slide projector to "fan" until you need ';
9550 PRINT 'it again.  Thank you.'
9560 PRINT
9570 GOTO 22140
9580 REM     ----------------------------------------
9590 REMARK:  SCORE RECAPITULATION FOR QUESTION #9
9600 REM     ----------------------------------------
9610 REM
9620 REM          SCORE            DESIGNATED SIGNIFICANCE
9630 REM
9640 REM            0          NOT ATTEMPTED
9650 REM            1          INCORRECT RESPONSE TO VARIATION NUMBER 1
9660 REM            2          INCORRECT RESPONSE TO VARIATION NUMBER 2
9670 REM            3          INCORRECT RESPONSE TO VARIATION NUMBER 3
9680 REM            4          INCORRECT REPSONSE TO VARIATION NUMBER 4
9690 REM            5          NOT DESIGNATED FOR THIS QUESTION
9700 REM            6          CORRECT RESPONSE TO VARIATION NUMBER 1
9710 REM            7          CORRECT RESPONSE TO VARIATION NUMBER 2
9720 REM            8          CORRECT RESPONSE TO VARIATION NUMBER 3
9730 REM            9          CORRECT RESPONSE TO VARIATION NUMBER 4
9740 REM
9750 REMARK:    STORED ANSWERS ARE EXPRESSED AS DEVIATIONS FROM THE CORRECT
9760 REM     ANSWER AND ARE STORED AFTER THE SECOND INCORRECT RESPONSE.
9770 REM
9780 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
9790 REM
15000 REM     ----------------------------------------------
15010 REMARK:  ROUTINE FOR CHAINING TO "RECORDER" PROGRAM
15020 REM     ----------------------------------------------
15023 PRINT 'One moment please...'
15025 PRINT
15027 PRINT
15030 OPEN 5,'NSTRDANS',OUTPUT
15040 PUT 5: N6,N7
15050 CLOSE 5,6,7,8
15060 OPEN 4,'PASSFILE',OUTPUT
15070 PUT 4: J,T,U,C,X,X,X
15080 REMARK:  DATA PASSED ARE STUDENT NUMBER ("J"), NUMBER OF PREVIOUS
15090 REM          EXECUTIONS OF THIS CHECK POINT ("T"), UNIT NUMBER ("1"), &
15100 REM          CHECK POINT NUMBER ("3").
15110 FOR K=1 TO 10
15120 PUT 4: F(K),P(K),S(K,1),S(K,2)
15130 NEXT K
15140 CLOSE 4
15150 CHAIN 'RECORDER', D$
15160 REMARK:  IF "D$" = "QUICKIE", DISPLAY OF SCORES ACHIEVED ON THE CURRENT
15170 REM          RUN WILL BE SUPPRESSED.
16000 REM     -----------------------------------------------------
16010 REMARK:  SUBROUTINE TO GENERATE SLIDE REFERENCE NUMBER ("S1")
16020 REM     -----------------------------------------------------
16030 C1=0
16040 REMARK:  "C1" COUNTS THE NO. OF STUDENT ENTRIES FOR THE CURRENT QUESTION.
16050 X=P(Q)
16060 GOSUB 22000
16070 GOTO 16110,16110,16110,16130,16080,16150,16150,16150,16130 ON X
16080 S1=INT(5*RND)
```

```
16090 IF S1=0 GOTO 16080
16100 RETURN
16105 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16110 X=P(Q)+1
16120 GOTO 16160
16130 S1=1
16140 RETURN
16145 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16150 X=P(Q)-4
16160 GOSUB 22000
16170 S1=X
16180 RETURN
22000 REM     ----------------------
22010 REMARK:  ROUNDING SUBROUTINE
22020 REM     ----------------------
22030 FOR Z=0 TO 1000
22040 IF X>Z GOTO 22070
22050 X=Z
22060 RETURN
22070 NEXT Z
22075 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22080 PRINT
22083 PRINT
22085 PRINT '*********************'
22087 PRINT
22090 PRINT 'I''m sorry, but an error has occurred in the program.  Please ';
22100 PRINT 'logoff and take this complete print out to your instructor.'
22110 PRINT
22120 PRINT 'NOTE TO INSTRUCTOR:  Argument of rounding subroutine greater ';
22130 PRINT 'than 1000.'
22133 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22135 D$='QUICKIE'
22140 PRINT
22145 PRINT
22150 GOTO 15000
22500 REM    ------------------------------------------------------------------
22510 REMARK:  SUBROUTINE FOR STUDENT TO TERMINATE PROGRAM OR PASS QUESTION
22520 REM    ------------------------------------------------------------------
22521 REMARK:  THIS SUBROUTINE IS ENTERED AFTER EVERY STUDENT INPUT.  IT RETURNS
22522 REM         THE VALUE OF G=0 IF THE STUDENT HAS NOT ENTERED A CODE, G=1 IF
22523 REM         A PROGRAM TERMINATION CODE HAS BEEN ENTERED BUT THEN CANCELED,
22524 REM         AND G=2 IF A PASS CODE HAS BEEN ENTERED.
22525 G=0
22530 IF E(Q)=99999 GOTO 22560
22540 IF E(Q)=88888 GOTO 22710
22550 RETURN
22555 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22560 PRINT
22563 PRINT
22570 PRINT '      You have indicated that you wish to TERMINATE this program.';
22580 PRINT '  Type "yes" to confirm your request, or "no" to cancel it.'
22583 PRINT
22585 PRINT '           Confirmation';
22590 INPUT B$
22600 IF B$='YES' GOTO 23000
22610 G=1
22620 PRINT
22623 PRINT
22630 PRINT '      Enter another answer to the above problem.  ';
22640 RETURN
22650 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22710 G=2
22720 RETURN
22723 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
22725 G=0
22730 IF E$(Q)='STOP' GOTO 22560
22735 IF E$(Q)='99999' GOTO 22560
22740 IF E$(Q)='PASS' GOTO 22710
22745 IF E$(Q)='88888' GOTO 22710
22750 RETURN
```

```
22760 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
23000 PRINT
23001 IF Q=8 GOTO 23010
23002 PRINT '      Please put the slide projector on "fan" until you need ';
23003 PRINT 'it again.  Thanks.'
23004 PRINT
23010 PRINT '      Would you like a summary of your score or are you in a hurry';
23020 PRINT ' to leave (enter "summarize" or "go-like-a-bunny")';
23030 INPUT A$
23040 IF A$='SUMMARIZE' GOTO 22140
23050 GOTO 22135
23060 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
24000 END
```

```
 10 REM    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 15 REM    *                                                                  *
 20 REMARK *        S C O R E   R E C O R D I N G   P R O G R A M             *
 25 REM    *                                                                  *
 30 REM    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 35 REM
 40 REM
 50 REMARK:                              COPYRIGHT
 60 REM
 70 REMARK:                            JESSE M. HEINES
 80 REM
 90 REMARK:                             DECEMBER 1973
100 REM
110 REM
113 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
115 REM
120 DEF FNA(X)=X-INT(X)
123 REMARK:  "FNA(X)" RETURNS THE FRACTIONAL PART OF THE DECIMAL NUMBER "X".
125 REMARK:  "INT(X)" RETURND THE INTEGRAL PART OF THE DECIMAL NUMBER "X".
130 DIM S(10,2)
133 REMARK:  ARRAY "S" HOLDS THE SCORES JUST SCHIEVED.
135 REM      ----------------------------------------
140 REMARK:  ROUTINE TO GATHER DATA FROM "PASSFILE"
143 REM      ----------------------------------------
150 OPEN 4,'PASSFILE',INPUT
160 GET 4: J,T,U,C,X,X,X
210 REMARK:  "J" IS THE STUDENT'S REFERENCE NUMBER.
220 REMARK:  "T" IS THE NUMBER OF TIMES HE OR SHE HAS PREVIOUSLY RUN THE
230 REM          CHECK POINT WHICH HAS JUST BEEN LEFT.
240 REMARK:  "U" IS THE UNIT NUMBER OF THE CHECK POINT JUST EXECUTED.
250 REMARK:  "C" IS THE SECTION NUMBER OF THE CHECK POINT JUST EXECUTED.
253 REMARK:  "X" IS A DUMMY VARIABLE.
255 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
260 FOR K=1 TO 10
263 GET 4: F(K),P(K),S(K,1),S(K,2)
270 REMARK:  ARRAY "F" IS FOR THE PRESENTATION FLAGS (NOT NEEDED HERE).
280 REMARK:  ARRAY "P" IS FOR THE CUMULATIVE PREVIOUS SCORES BY QUESTION NO.
290 REMARK:  ARRAY "S" CONTAINS THE SCORES JUST ACHIEVED.
295 NEXT K
297 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
300 USE D$
310 REMARK:  "D$" IS AN ARGUMENT PASSED FROM THE CHAINING PROGRAM.  IF IT IS
320 REM        SET TO "QUICKIE", DISPLAY OF THE STUDENT'S SCORED WILL BE
330 REM        SUPPRESSED.  ANY OTHER STRING WILL GENERATE THE DISPLAY.
335 DIM Q(1,4)
340 REMARK:  ARRAY "Q" CONTAINS THE NUMBER OF QUESTIONS IN EACH CHECK POINT.
350 Q(1,1)=10
360 Q(1,2)= 7
370 Q(1,3)= 9
380 Q(1,4)= 9
500 REM      ------------------------------------------
510 REMARK:  ROUTINE FOR CALCULATING CUMULATIVE SCORE
520 REM      ------------------------------------------
590 FOR K=1 TO Q(U,C)
600 IF S(K,2)=0 GOTO 630
610 N=2
620 GOTO 640
630 N=1
640 IF S(K,N)>P(K) GOTO 660
650 IF S(K,N)=6 GOTO 660
653 IF P(K)<>4 GOTO 670
655 IF S(K,N)<>1 GOTO 670
660 P(K)=S(K,N)
670 NEXT K
675 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
680 E1=0
690 REMARK:  "E1" IS THE TOTAL CUMULATIVE NO. OF QUESTIONS ANSWERED CORRECTLY.
710 FOR K=1 TO Q(U,C)
720 IF P(K)<=5 GOTO 740
730 E1=E1+1
```

```
740 NEXT K
750 IF Q(U,C)-E1<=1 GOTO 780
760 E2=0
770 GOTO 840
780 E2=1
790 REMARK:  "E2" IS THE SATISFACTORY COMPLETION FLAG, WHERE A VALUE OF
800 REM          "1" = COMPLETED SATISFACTORILY, AND "2" = NOT COMPLETED
810 REM          SATISFACTORILY.  SATISFACTORY COMPLETION CRITERION IS ONE OR
820 REM          LESS QUESTIONS MISSED.
830 REM     -----------------------------------------------------
840 REMARK:  ROUTINE TO CONVERT PREVIOUS SCORES TO INTEGER MODE
850 REM     -----------------------------------------------------
860 FOR K=1 TO Q(U,C)
865 R(K)=0
870 FOR Z=0 TO 100
880 IF P(K)>Z GOTO 910
890 P(K)=Z
900 GOTO 920
910 NEXT Z
920 NEXT K
1000 REM     ------------------------------
1010 REMARK:  ROUTINE FOR RECORDING SCORE
1020 REM     ------------------------------
1060 REMARK:  ROUTINE TO READ IN EXISTING COURSE LOG.
1070 OPEN 3,'LOGFILE',INPUT
1075 OPEN 8,'HOLDFILE',OUTPUT
1080 REMARK:  FILE #3 CONTAINS THE COURSE LOG.
1085 REMARK:  FILE #8 HOLDS DATA TEMPORARILY.
1090 GET 3: N3
1100 REMARK:  "N3" IS THE NUMBER OF ENTRIES IN THE COURSE LOG.
1110 FOR K=1 TO N3
1120 GET 3: R1,R2,R3,R4,R5
1123 PUT 8: R1,R2,R3,R4,R5
1125 REMARK:  "R1" THROUGH "R5" ARE EXISTING LOG RECORDS.
1130 NEXT K
1135 PUT 8: 0
1138 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1140 REMARK:  ROUTINE FOR GENERATING NEW LOG RECORD FROM CURRENT SCORES.
1190 R(1)=J*10000+100*U+10*C+E2
1200 FOR K=1 TO 2
1210 M=1000000
1220 FOR L=1 TO 7
1230 R(2*K)=R(2*K)+M*S(L,K)
1235 IF L>3 GOTO 1250
1240 R(1+2*K)=R(1+2*K)+M*S(L+7,K)
1250 M=INT(M/10)
1260 NEXT L
1270 NEXT K
1275 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1280 REMARK:  ROUTINE FOR REWRITING NEW COURSE LOG.
1290 OPEN 3,'LOGFILE',OUTPUT
1295 OPEN 8,'HOLDFILE',INPUT
1300 PUT 3: N3+1
1310 FOR K=1 TO N3
1315 GET 8: R1,R2,R3,R4,R5
1320 PUT 3: R1,R2,R3,R4,R5
1330 NEXT K
1333 FOR K=1 TO 5
1335 PUT 3: R(K)
1337 NEXT K
1340 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1345 IF D$='QUICKIE' GOTO 7010
1350 REMARK:  "D$" EQUALS "QUICKIE" ONLY IF THE ROUNDING SUBROUTINE BOMBED OR
1353 REM          IF THE STUDENT HAS TERMINATED THE PROGRAM AND IS IN A HURRY.
1355 IF J=0 GOTO 1420
1360 OPEN 2,'REALNAME',INPUT
1370 FOR K=1 TO J
1380 GET 2: L$,F$,X
1390 NEXT K
1400 REMARK:  "L$" AND "F$" ARE THE STUDENT'S LAST AND FIRST NAMES.
```

```
1410 GOTO 1440
1420 L$='STUDENT'
1430 F$='SAMPLE'
1440 OPEN 8,'HOLDFILE',OUTPUT
1450 PUT 8: 0
1460 CLOSE 2,3,8
2000 REM    ---------------------------------------------
2010 REMARK:  ROUTINE FOR DISPLAYING SCORE FOR THIS RUN
2020 REM    ---------------------------------------------
2090 T=T+1
2095 PRINT
2100 PRINT '     The following data has been recorded summarizing the run ';
2110 PRINT 'you have just completed.  (Note:  "C" = Answered Correctly,'
2120 PRINT '"X" = Answered Incorrectly, and "-" = Omitted.)'
2130 PRINT
2140 PRINT
2150 PRINT 'Name:  '; F$; ' '; L$
2160 PRINT
2170 PRINT 'Unit'; U; 'Check Point #'; C; '--    Question #    ';
2180 FOR K=1 TO Q(U,C)
2190 PRINT K;
2200 NEXT K
2210 PRINT ' '
2215 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2220 PRINT '                                        Response :    ';
2230 FOR K=1 TO Q(U,C)
2240 GOTO 2280,2280,2280,2280,2280,2300,2300,2300,2300 ON S(K,2)
2250 GOTO 2280,2280,2280,2280,2280,2300,2300,2300,2300 ON S(K,1)
2260 PRINT ' -    ';
2270 GOTO 2310
2280 PRINT ' X    ';
2290 GOTO 2310
2300 PRINT ' C    ';
2310 NEXT K
2320 PRINT ' '
2330 PRINT
2340 PRINT
2350 REM     ---------------------------------------
2360 REMARK:  ROUTINE TO DISPLAY CUMULATIVE SCORE
2370 REM     ---------------------------------------
2450 IF T=1 GOTO 3000
2460 PRINT '     The cumulative data recorded for your work on this check ';
2470 PRINT 'point is as follows:'
2480 PRINT
2490 PRINT
2500 PRINT 'Number of runs ='; T; '                Question #    ';
2530 FOR K=1 TO Q(U,C)
2540 PRINT K;
2550 NEXT K
2560 PRINT ' '
2565 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2570 PRINT '                                        Response :    ';
2580 FOR K=1 TO Q(U,C)
2590 GOTO 2620,2620,2620,2620,2620,2640,2640,2640,2640 ON P(K)
2600 PRINT ' -    ';
2610 GOTO 2650
2620 PRINT ' X    ';
2630 GOTO 2650
2640 PRINT ' C    ';
2650 NEXT K
2660 PRINT ' '
2670 PRINT
2680 PRINT
3000 REM     -----------------------------------
3010 REMARK:  ROUTINE TO EVALUATE TOTAL SCORE
3020 REM     -----------------------------------
3090 H$(1)='one'
3100 H$(2)='two'
3110 H$(3)='three'
3120 H$(4)='four'
```

```
3130 H$(5)='five'
3140 H$(6)='six'
3150 H$(7)='seven'
3160 H$(8)='eight'
3170 H$(9)='nine'
3180 H$(10)='ten'
3200 GOTO 3430,3490,3490,3490,3490,3490,3490,3490,3490,3490 ON Q(U,C)-E1
3210 GOTO 3220 ON U
3220 IF C=4 GOTO 3320
3230 PRINT '     You have answered all the questions in this check point cor';
3240 PRINT 'rectly, and you are now ready to go on to section '; H$(C+1); '.'
3250 GOTO 7010
3300 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3320 PRINT '     You have answered all the questions in this check point cor';
3330 PRINT 'rectly, and you should have satisfactorily completed all the'
3340 PRINT 'check points in Unit One.  If not, redo those check points in ';
3350 PRINT 'which your cumulative score shows two or more questions answered'
3360 PRINT 'incorrectly or omitted.  (Display the summarized data on your ';
3365 PRINT 'work if you are not sure about the status of your other scores.)'
3370 PRINT
3380 PRINT '     When all check points in this unit are completed satisfactor';
3390 PRINT 'ily, check over your notebook and deposit it in the "Material'
3400 PRINT 'to be Corrected" box for evaluation by one of the instructors.  ';
3410 PRINT 'You may then begin work on any other unit of your own choosing.'
3413 IF Q(U,C)-E1=1 GOTO 5000
3420 GOTO 7010
3425 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3430 X=Q(U,C)
3440 PRINT '     You have completed this check point satisfactorily by ';
3450 PRINT 'answering '; H$(E1); ' of its '; H$(X); ' questions correctly.'
3451 GOTO 7010
3452 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3453 PRINT
3460 PRINT '     Although it is not at all required, you may now go back and ';
3470 PRINT 'redo the one question that you missed if you have time.'
3480 GOTO 4000
3485 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
3490 X=Q(U,C)
3493 IF E1>0 GOTO 3500
3495 PRINT '     You haven''t answered any of the '; H$(X); ' questions ';
3497 GOTO 3510
3500 PRINT '     You have answered '; H$(E1); ' of the '; H$(X); ' questions ';
3510 PRINT 'in this check point correctly.  If you have the time now, I ';
3515 PRINT 'suggest that you'
3520 PRINT 'look over your work and redo those questions that you missed.  ';
3530 PRINT 'If you feel unable to answer these questions now, please log off'
3540 PRINT 'and go over your work with one of the instructors.  You may also ';
3550 PRINT 'log off and come back to this check point later if you don''t'
3560 PRINT 'have the time to run it again now.'
4000 REM    ------------------------------
4010 REMARK:  ROUTINE TO RERUN CHECK POINT
4020 REM    ------------------------------
4030 PRINT
4040 PRINT '     Would you like to rerun the check point now (answer "y" or ';
4050 PRINT '"n")';
4060 INPUT A$
4070 IF A$='Y' GOTO 4280
4080 IF A$='YES' GOTO 4280
4090 IF A$='N' GOTO 4150
4100 IF A$='NO' GOTO 4150
4110 PRINT
4120 PRINT '     The computer can only recognize the responses "y" or "n" to ';
4130 PRINT 'this question.  Please answer again.'
4140 GOTO 4030
4145 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4150 PRINT
4170 IF E2<>1 GOTO 4220
4175 IF C=4 GOTO 4250
4180 PRINT '     All right, but please make sure that you have achieved all ';
4190 PRINT 'the objectives in section '; H$(C); ' before you proceed to'
```

```
4200 PRINT 'section '; H$(C+1); '.'
4210 GOTO 5010
4215 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4220 PRINT '     Okay, but please be sure to return to this check point ';
4230 PRINT 'to re-evaluate the concepts and skills that you have missed.'
4240 GOTO 7010
4245 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4250 PRINT '     All right, you have still completed this check point satis';
4260 PRINT 'factorily, and by now you should have done the same with all the'
4270 GOTO 3340
4275 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4280 PRINT
4290 PRINT
4300 PRINT '     Please select one of the following presentation criteria:'
4310 PRINT
4320 PRINT '          (1)  Present all questions, # 1 through #'; Q(U,C)
4340 PRINT '          (2)  Present only those answered incorrectly or omitted'
4350 PRINT '        or...'
4360 PRINT '          (3)  Enter this number to cancel your request to rerun ';
4370 PRINT 'this check point and return to the main program options.'
4380 PRINT
4390 PRINT '     Which questions would you like presented this time (enter ';
4400 PRINT '"1", "2", or "3")';
4410 INPUT A
4420 GOTO 4460,4500,5000 ON A
4430 PRINT
4440 PRINT '     Please enter a single numeral, "1" through "3".  Your choice';
4450 GOTO 4410
4453 REM     ----------------------------------------
4455 REMARK:  ROUTINE FOR CHAINING TO A CHECK POINT
4457 REM     ----------------------------------------
4460 FOR K=1 TO Q(U,C)
4470 F(K)=0
4480 NEXT K
4490 GOTO 4553
4500 FOR K=1 TO Q(U,C)
4510 IF P(K)>=6 GOTO 4540
4520 F(K)=0
4530 GOTO 4550
4540 F(K)=1
4550 NEXT K
4551 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
4553 PRINT
4554 PRINT
4555 PRINT 'One moment please...'
4557 PRINT
4558 PRINT
4560 OPEN 4,'PASSFILE',OUTPUT
4570 PUT 4: J,T,R(1),R(2),R(3),R(4),R(5)
4580 FOR K=1 TO 10
4590 PUT 4: F(K),P(K)
4600 NEXT K
4610 GOTO 4620 ON U
4620 GOTO 4630,4640,4650,4660 ON C
4630 CHAIN 'CHKPT011'
4640 CHAIN 'CHKPT012'
4650 CHAIN 'CHKPT013'
4660 CHAIN 'CHKPT014'
5000 REM     ------------------------------------------
5010 REMARK:  ROUTINE TO PRESENT MAIN PROGRAM OPTIONS
5020 REM     ----------------------------------------
5030 PRINT
5040 PRINT
5050 PRINT '     Please select a main program option from the following list:'
5060 PRINT
5070 PRINT '          (1)  Run another check point program'
5080 PRINT '          (2)  Display all the data stored on your work'
5085 PRINT '          (3)  Display stored data in summary form'
5090 PRINT '          (4)  Branch to the fun options'
5093 PRINT '        or...'
```

```
5095 PRINT '            (5)  Pass control to another student'
5100 PRINT '            (6)  End this terminal session'
5110 PRINT
5120 PRINT '      Which option would you like to execute (type a number)';
5130 INPUT P
5140 GOTO 5172,5172,5172,6010,7010,5240 ON P
5150 PRINT
5160 PRINT '      Please type a single digit number, 1 through 5.  Your choice';
5167 GOTO 5130
5168 REM    --------------------
5169 REMARK:  CHAINING ROUTINE
5170 REM    --------------------
5172 B$='REGISTER'
5173 PRINT
5175 PRINT
5177 PRINT 'One moment please...'
5178 PRINT
5179 PRINT
5180 OPEN 4,'PASSFILE',OUTPUT
5190 PUT 4: J,P
5200 FOR K=1 TO 45
5210 PUT 4: 0
5220 NEXT K
5230 CHAIN B$, 'CHAINED'
5233 REM    -----------------------
5235 REMARK:  TERMINATION ROUTINE
5237 REM    -----------------------
5240 PRINT
5250 PRINT
5260 IF C=1 GOTO 5360
5270 PRINT '      Using the "select" button, please return the slide tray to ';
5280 PRINT 'slot "0" before you turn it off.'
5320 PRINT
5360 PRINT '      When you see the "Ready" message ("R;"), please follow the ';
5370 PRINT 'instructions either on side 2 of the instruction tape or on the'
5380 PRINT 'sample sheet posted for logging off or transferring control to ';
5383 PRINT 'another student.  Thank you and have a nice day...'
5390 PRINT
5400 PRINT
5410 STOP
6000 REM    ----------------------------------------
6010 REMARK:  ROUTINE TO BRANCH TO THE FUN OPTIONS
6020 REM    ----------------------------------------
6030 B$='FUNOPTS'
6040 GOTO 5173
7000 REM    ----------------------------------------------------
7010 REMARK:  ROUTINE FOR PASSING CONTROL TO ANOTHER STUDENT
7020 REM    ----------------------------------------------------
7030 PRINT
7035 PRINT
7040 IF P=5 GOTO 7170
7050 PRINT '      Is another student waiting to use the terminal ("y" or "n")';
7060 INPUT A$
7070 PRINT
7080 IF A$='Y' GOTO 7170
7090 IF A$='YES' GOTO 7170
7100 IF A$='N' GOTO 7140
7110 IF A$='NO' GOTO 7140
7120 PRINT '      Please respond with "y" or "n".  Is another student waiting';
7130 GOTO 7060
7135 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
7140 IF D$='QUICKIE' GOTO 5260
7150 IF Q(U,C)-E1=1 GOTO 3453
7160 GOTO 5040
7165 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
7170 IF C=1 GOTO 7210
7175 PRINT
7180 PRINT '      Using the "select" button, please return the slide tray to ';
7190 PRINT 'slot "0" and turn it off.'
7200 PRINT
```

```
7210 PRINT '     When you see the message "PAUSE AT LINE  07260", remove ';
7220 PRINT 'your print out, align the paper on a fresh sheet for the next'
7230 PRINT 'student, and press the RETURN key.  The registration program ';
7240 PRINT 'will then rebegin within a few seconds.'
7250 PRINT
7260 PAUSE
7270 PRINT
7280 PRINT
7290 PRINT 'One moment please...'
7300 PRINT
7310 PRINT
7320 CHAIN 'REGISTER', 'REBEGIN'
7330 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
8000 END
```

APPENDIX F

SAMPLE RUN OF ADMINISTRATION PROGRAM

```
CAPS online    1jh359 qsyosu

logon butzow mask
ENTER PASSWORD:
[redacted]
LOGON AT 15:45:26 EDT THURSDAY 04/18/74
U OF ME V1.12 12/22/73

VM/370's gettin' it on...

DASD 193 DEFINED 005 CYL

Loading data files and compiling...

Enter a main program option number ("0" = list available options).  Your choice? 0
```

MAIN PROGRAM OPTION NUMBERS

Explanations of System Operation

1. Print general instructions
2. Print summary of special CMS commands

Displays of Summary and System Data

3. Print the Ed C 140 class roster
4. Print the names of all users not registered in Ed C 140
5. Display the status of all students on a unit
6. Display the number of entries in each file
7. Print the course log in coded form
8. Create an array of code names

Displays of Data on Individual Students

9. Verify the registration of a student
10. Display the satisfactory completion data on a student's work
11. Display response summaries for each check point run by a student
12. Display a student's cumulative score on a check point
13. Print all answers stored by a specific student
14. Display the log records on a student's work in coded form
15. Identify the student assigned to a specific ID number

Displays of Data on Check Points

16. Summarize the satisfactory completion data on a check point
17. Display a statistical summary of a question
18. Print all answers stored for a question
19. Calculate statistical measures on the answers stored for a numeric question

Maintenance to Data on Individual Students

20. Correct the name by which a student is registered
21. Change a student's code name
22. Change the registration flag on a student's name
23. Change a student's score
24. Create a new log record on a student
25. Delete all data stored on a student
26. Delete all log records stored on a student
27. Delete specific log records stored on a student
28. Delete all numeric answers stored on a student
29. Delete all alphameric answers stored on a student

Maintenance to Entire Data Files

30. Delete a specific stored numeric answer
31. Delete all log records which contain only zeroes for data
32. Clear all current files for a new term

Please enter another main program option number. Your choice? 1

The instructions take about 15 minutes to print. Please confirm your request. Print instructions ("y" or "n")? y

A "pause" message will now be generated. Move the paper to a new sheet and press RETURN.

PAUSE AT LINE 29030

INSTRUCTIONS

This program allows the instructor to manipulate the student files and generate statistics from the stored data. All functions operate as subroutines by the selection of a main program option number. Option "0" will print a list of the available options. All routines are interactive and lead the user through the specification of any necessary parameters.

Whenever the program demands a user entry (by printing a question mark), one of several code words may be entered as well as the expected responses. "Cancel", "pass", and "88888" will cancel the execution of a routine and allow the user to input a new main program option number. "Stop" and "99999" will terminate this administration program and cause the CMS ready message ("R;") to be displayed. When the program expects a numeric response, only "88888" and "99999" will be recognized.

If a major error is made during file manipulation which can not be altered by one of the cancelation commands, the user should terminate this program and enter "retrieve" after the ready message. This command will reset the data files to the state in which they were when the last logon or other CMS command was executed.

To re-invoke this administration program after termination, enter "restart". To execute the Ed C 140 check point programs, exit from this program and enter "ldchkpts" after the ready message. A second ready message will appear within a few minutes, and then enter "rebegin". When the check point programs are run under this logon, the message "INPUT FILE '* BASDATA B1' NOT FOUND." is always displayed and the scores generated are NOT recorded on the permanent disks. To record these scores, enter the command "update" under CMS.

If any editing changes are made to the programs on disk "c", the command "savedits" MUST be issued under CMS to copy the edited files to their permanent storage disks. Print outs of all programs may be attained by entering "printall" under CMS. This will cause listings to be generated on the line printer in Wingate Hall, and they should then be picked up from the "B" shelf (for "Butzow") within a few hours.

Please enter another main program option number. Your choice? 2

SUMMARY OF SPECIAL CMS COMMANDS

Command	Logon	Function
rebegin	edc140	Re-invokes registration program
	butzow	Same, but check points must first have been loaded by "ldchkpts"
restart	butzow	Re-invokes administration program
backup	edc140	Allows re-entry into a check point which has been terminated by a system error
update	(both)	Updates the emergency backup files by replacing them with the current data files (Note: This command is automatically executed by the "rebegin" and "restart" commands.)
restore	(both)	Restores any deleted current data files with their emergency backup files (Note: This command should be used only if a user has terminated a program by "hx" and, in so doing, inadvertantly deleted one of the "basdata" data files.)
retrieve	butzow	Retrieves the states of all data files at the time of the last logon or special CMS command and resets the current files to their former states
ldchkpts	butzow	Loads check point programs for trial execution
savedits	butzow	Copies edited files to their permanent storage disks

```
Please enter another main program option number.  Your choice? 24

     ROUTINE TO CREATE A NEW LOG RECORD ON A STUDENT

     Student's last name? michaud

     The roster has the following two students with the last name of MICHAUD:

          1    DENISE MICHAUD  (Ed C 140)
          2    PIERRE MICHAUD  (other)

     What is the index number to the left of the student in question (enter "99" if he or she does not appear on this list)? 1

     Unit number? 1

     Section number? 1

     Has the student completed this check point satisfactorily ("y" or "n")? n

     The first element has now been defined.  Would you like instructions for creating the other four ("y" or "n")? y

         The second through fifth elements of a log record code for specific classsifications of responses.  The first
     two of these elements contain codes for the FIRST try at a question, and the latter two record the LAST try.  Digits "1"
     through "5" represent INCORRECT responses, while "6" to "9" denote CORRECT responses and digit "0" indicates that a
     question has been OMITTED (or does not exist).  Enter the codes for each question as the are requested below.  (Cancelation
     and termination codes "88888 and "99999" are still active.)

     Code for FIRST try of question number...

       1    ? 9
       2    ? 9
       3    ? 1
       4    ? 2
       5    ? 9
       6    ? 9
       7    ? 9
       8    ? 2
       9    ? 1
      10    ? 2
```

```
Code for LAST try of question number...

   1     ? 0
   2     ? 0
   3     ? 8
   4     ? 7
   5     ? 0
   6     ? 0
   7     ? 0
   8     ? 7
   9     ? 1
   10    ? 1


One moment please...

    The following log record has been recorded on DENISE MICHAUD:

          Id.       1st entry:     11111    2nd entry:     11111
        JJJUUCF      1234567     8901234     1234567     8901234

         410110      9912999     2120000       87000     7110000

    If you wish to change this record, exercise option 21.

Please enter another main program option number.  Your choice? 24

    ROUTINE TO CREATE A NEW LOG RECORD ON A STUDENT

    Student's last name? same

    Unit number? 1

    Section number? 1

    Has the student completed this check point satisfactorily ("y" or "n")? y

    The first element has now been defined.  Would you like instructions for creating the other four ("y" or "n")? n

    Code for FIRST try of question number...

       1     ? 0
```

```
2     ? 0
3     ? 0
4     ? 0
5     ? 0
6     ? 0
7     ? 0
8     ? 0
9     ? 9
10    ? 8

Code for LAST try of question number...

1     ? 0
2     ? 0
3     ? 0
4     ? 0
5     ? 0
6     ? 0
7     ? 0
8     ? 0
9     ? 0
10    ? 0

One moment please...

The following log record has been recorded on DENISE MICHAUD:

     Id.      1st entry:    11111    2nd entry:    11111
   JJJUUCF     1234567    8901234     1234567    8901234

    410111          0     980000           0          0

If you wish to change this record, exercise option 21.

Please enter another main program option number.  Your choice? 11

One moment please...
```

```
ROUTINE TO DISPLAY RESPONSE SUMMARIES OF EACH CHECK POINT RUN BY A STUDENT

Student's last name? same

DATA STORED ON CHECK POINT WORK OF DENISE MICHAUD

Unit 1    Check Point # 1    --    Question #    1   2   3   4   5   6   7   8   9   10
                                   Response :    C   C   C   C   C   C   C   C   X   X

Unit 1    Check Point # 1    --    Question #    1   2   3   4   5   6   7   8   9   10
                                   Response :    -   -   -   -   -   -   -   -   C   C

     Note:  With the above run, this check point was completed satisfactorily.

Please enter another main program option number.  Your choice? 12

One moment please...

ROUTINE TO DISPLAY A STUDENT'S CUMULATIVE SCORE ON A CHECK POINT

Student's last name? same

Enter the unit and section numbers as "U,S".  (To cancel, enter "88888,0".)  Entry? 1,1

CUMULATIVE SCORE FOR DENISE MICHAUD

Unit 1    Check Point # 1    --    Question #    1   2   3   4   5   6   7   8   9   10
                                   Response :    C   C   C   C   C   C   C   C   C   C

       Number of runs = 2    --    This check point has been completed satisfactorily.
```

```
Please enter another main program option number.  Your choice? 22

    ROUTINE TO CHANGE A REGISTRATION FLAG

    Student's last name? ann

    RAGGEDY ANN currently IS registered in Ed C 140.

    Do you wish to change this flag ("y" or "n")? y

    RAGGEDY ANN is now flagged as NOT registered in Ed C 140.

Please enter another main program option number.  Your choice? 6

    Registration:                40 students,   9 other,   49 total
    Course log:                 197 entries
    Stored numeric answers:     223 entries
    Stored alphameric answers:   40 entries

    The course registration is limited to a total of 300 entries, but the sizes of all other files are unlimited.

Please enter another main program option number.  Your choice? 3

    There are  40   students on the roster.  If you wish to reset the margin and carriage controls and move the paper
    to a new page, do so BEFORE you press the RETURN key for your confirming entry.  Print roster ("y" or "n")? y
```

E D C 1 4 0 R O S T E R

BARTON, JAMES
BARTON, WINSTON LEVERETT
BRADY, PEARL
BROWN, BETTE
CLARK, REBEKAH JEAN
COLBURN, APRIL JEAN
CONNOR, KAREN LEE
DAVIS, DIANE F.
DREW, CANDACE LEE
DULAC, DEBRA RAE
ELLIS, JUDY
FOOTE, CHARLENE MARIAN
GREENLEAF, DEBRA
HOYT, DARCY
JAMES, ERNEST ARTHUR
JOHNSON, BARBARA ETHEL
KIMBALL, MARCIA
LACROSSE, TERESA
LITTLEFIELD$ KELLY
LUNT, CYNTHIA
MAC KENZIE, PAMELA
MCKEEN, JAMES S
MCKENNEY, LYNNE
MICHAUD, DENISE
MOORE, SHARON
OTTERSON, MARK
PINARD, LINDA M.C.
REYNOLDS, MARION
RINTZ, MARY
ROLLINS, NANCY
ROLSKY, VICKI ANNE
SABINE, STEVEN PAUL
SHAW, RICHARD
SMITH, LINDA ANNE
WEATHERBEE, RONALD JAMES
WILKINSON, LEIGH
WOLCOTT, BONNIE LAURIE
WOODMAN, FREDERICK
YARDLEY, PATRICIA LYNN
ZACK, MARLA

```
Please enter another main program option number.  Your choice? 20

One moment please...

     ROUTINE TO CORRECT THE NAME BY WHICH A STUDENT IS REGISTERED

     Student's current last name? littlefield6

     This student is registered as KELLY LITTLEFIELD6  Enter the correct full name below, LAST NAME FIRST, and separate the
     first and last names by a comma.  (To cancel, set LAST NAME to a code.)

          Full name? littlefield, kelly

     KELLY LITTLEFIELD6has been changed to KELLY LITTLEFIELD.

Please enter another main program option number.  Your choice? 14

One moment please...

     ROUTINE TO DISPLAY LOG RECORDS ON A STUDENT IN CODED FORM

     Student's last name? ann

     The log records on RAGGEDY ANN are as follows (plus leading zeroes):

     Rec       Id.      1st entry:    11111     2nd entry:    11111
      #      JJJUUCF     1234567     8901234     1234567     8901234

       1      490130     5471350     4700000     6901360     8000000
       2      490130        7401           0         401           0
       3      490131         605           0           7           0
```

```
Please enter another main program option number.  Your choice? 11

One moment please...

     ROUTINE TO DISPLAY RESPONSE SUMMARIES OF EACH CHECK POINT RUN BY A STUDENT

     Student's last name? same

     DATA STORED ON CHECK POINT WORK OF RAGGEDY ANN

     Unit 1    Check Point # 3    --    Question #   1   2   3   4   5   6   7   8   9
                                        Response :   C   C   C   X   X   C   -   C   C

     Unit 1    Check Point # 3    --    Question #   1   2   3   4   5   6   7   8   9
                                        Response :   -   -   -   C   X   -   X   -   -

     Unit 1    Check Point # 3    --    Question #   1   2   3   4   5   6   7   8   9
                                        Response :   -   -   -   -   C   -   C   -   -
          Note:  With the above run, this check point was completed satisfactorily.
```

```
Please enter another main program option number.  Your choice? 5

ROUTINE TO PRINT THE STATUS OF ALL STUDENTS ON A UNIT

On which unit number would you like the status displayed? 1

STATUS OF ALL STUDENTS ON UNIT 1

("C" = Completed Satisfactorily, "I" = Incomplete, and "-" = Not Yet Attempted.  Number of runs is in parentheses.)
```

Last Name	First Name	1	2	3	4
BARTON	JAMES	C (1)	C (1)	I (1)	- (0)
BARTON	WINSTON LEVERETT	C (1)	C (2)	C (1)	C (2)
BRADY	PEARL	C (2)	C (1)	C (1)	- (0)
BROWN	BETTE	C (1)	C (2)	C (1)	C (2)
CLARK	REBEKAH JEAN	C (1)	C (2)	C (1)	C (1)
COLBURN	APRIL JEAN	C (1)	C (2)	C (1)	C (2)
CONNOR	KAREN LEE	C (1)	C (1)	C (2)	C (2)
DAVIS	DIANE F.	C (2)	C (1)	C (2)	I (1)
DREW	CANDACE LEE	I (1)	C (1)	I (2)	- (0)
DULAC	DEBRA RAE	C (1)	C (1)	C (1)	C (2)
ELLIS	JUDY	- (0)	- (0)	I (1)	- (0)
FOOTE	CHARLENE MARIAN	C (1)	- (0)	- (0)	- (0)
GREENLEAF	DEBRA	C (1)	C (1)	C (1)	C (1)
HOYT	DARCY	C (1)	C (1)	I (1)	C (1)
JAMES	ERNEST ARTHUR	C (1)	C (2)	C (2)	C (2)
JOHNSON	BARBARA ETHEL	C (1)	C (1)	C (2)	C (1)
LACROSSE	TERESA	C (1)	C (1)	C (1)	C (1)
LITTLEFIELD	KELLY	C (1)	- (0)	- (0)	- (0)
LUNT	CYNTHIA	C (1)	C (2)	C (2)	- (0)
MAC KENZIE	PAMELA	C (1)	C (1)	C (2)	C (1)
MCKEEN	JAMES S	C (1)	C (2)	C (1)	- (0)
MCKENNEY	LYNNE	C (2)	C (1)	C (1)	C (1)
MICHAUD	DENISE	C (2)	C (2)	C (2)	C (1)
MOORE	SHARON	C (1)	C (1)	C (1)	C (1)
OTTERSON	MARK	C (1)	C (1)	C (1)	C (1)
PINARD	LINDA M.C.	C (3)	- (0)	- (0)	- (0)
REYNOLDS	MARION	C (1)	C (1)	C (2)	C (1)
RINTZ	MARY	C (1)	C (2)	C (1)	C (1)
ROLLINS	NANCY	C (2)	C (1)	C (2)	C (1)
ROLSKY	VICKI ANNE	C (2)	- (0)	- (0)	- (0)
SABINE	STEVEN PAUL	C (2)	C (2)	C (2)	C (2)
SHAW	RICHARD	C (2)	C (1)	C (2)	C (2)
SMITH	LINDA ANNE	C (1)	C (1)	C (1)	- (0)
WEATHERBEE	RONALD JAMES	C (1)	C (2)	C (1)	C (2)

```
Please enter another main program option number.  Your choice? 299

No option exists by that number.  Please enter another.  ("99999" = terminate program.)  Your choice? 29

One moment please...

     ROUTINE TO ERASE A STUDENT'S STORED ALPHAMERIC ANSWERS

     Student's last name? mckenny

     The roster contains no student by the last name of MCKENNY.  Do you wish to try another last name ("y" or "n")? yy

     Please enter only "y" or "n" or a code.  Your choice? y

     Student's last name? mckenney

     Confirmation will erase  1    stored alphameric answers.  Erase ("y" or "n")? y

     All alphameric answers stored on LYNNE MCKENNEY have been deleted.  They may still be retrieved by issuing
     the "retrieve" command under CMS.

Please enter another main program option number.  Your choice? 16

One moment please...

     SUMMARY OF SATISFACTORY COMPLETION DATA ON A CHECK POINT

     Enter the unit and section numbers as "U,S".  (To cancel, enter "88888,0".)  Entry? 1,3

     SUMMARY OF CHECK POINT # 3    IN UNIT 1

     Total number of students attempting check point:       35
     Number completing satisfactorily on first run:         22   ( 62.9%)
     Number completing satisfactorily on second run:         9   ( 25.7%)
     Number completing satisfactorily after second run:      0   (  0.0%)
     No. trying only once and still incomplete:              3   (  8.6%)
     No. trying twice but still incomplete:                  1   (  2.9%)
     No. trying more than twice but still incomplete:        0   (  0.0%)
```

Please enter another main program option number. Your choice? 17

STATISTICAL SUMMARY OF A QUESTION

Enter the unit and section numbers as "U,S". (To cancel, enter "88888,0".) Entry? 1,3

What is the number of the question you are interested in (for all questions in this check point, enter "100")? 1

SUMMARY OF QUESTION # 1   IN UNIT 1   SECTION 3

Number of students achieving FIRST try score of									Number achieving SECOND try score of								
1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
0	1	3	0	19	10	3	2	0	1	1	1	0	0	3	9	5	0

Total number of attempts:	38	
No. correct on first try:	15	(39.5% of total)
No. incorrect on first try:	23	(60.5% of total)
No. correct on second try:	17	(73.9% of no. wrong on 1st try)
No. incorrect on second try:	3	(13.0% of no. wrong on 1st try)
No. passing on second try:	3	(13.0% of no. wrong on 1st try)
No. correct on either try:	32	(84.2% of total)
No. incorrect on both tries:	3	(7.9% of total)
No. incorrect, then passing:	3	(7.9% of total)

Please enter another main program option number. Your choice? 18

ROUTINE TO DISPLAY ALL STORED ANSWERS ON A QUESTION

Enter the unit, section, and question numbers as "U,S,Q". (To cancel, enter "88888,0,0".) Entry? 1,3,1

STORED ANSWERS FOR QUESTION # 1   IN UNIT 1   SECTION 3

Code	Answer	Name
5	CUBIC MM	ROLLINS
5	420	BARTON
5	CM	CONNOR
5	CMM	CONNOR
5	420CC.	DULAC
5	ML.	DULAC
5	420CM	HOYT
5	CM	HOYT
5	SQUARE CM	HOYT
5	CM	JAMES
5	420.	JAMES
5	CM	GREENLEAF
5	MM	GREENLEAF
5	CM	REYNOLDS
5	3.6CC	OTTERSON
5	MM	JAMES
5	CUBIC MEETERS	JOHNSON
5	METERS	SMITH
5	CM	LUNT
5	METERS	MICHAUD
5	CM	DREW
5	M3	WEATHERBEE
5	CUBED METER	BROWN

```
Please enter another main program option number.  Your choice? 8

One moment please...

     CODE NAME ARRAY

          PHYDEAU            JJ                  CANADA              SMILE               POPCORN             D.W.ELLIS
                    SERPENT             PIERRE              WIN                 DINGBAT             KACI
          SUNSHINE           KASM                PEACE               DIANE               MORNING             WINKER M.
                    FROG                CENT                BOJOE               PUNKIE              MELITA
          REEFER             CANDY               EAJ                 BUTCH               MUNCHKIN            BREEZE
                    GIMPY               OTTERSON            IMAGE               BIGSHOT             FLAMINGO
          WOODMC             GOLDIE              ZEAK                CHIPLYNNE           RUDIE               JACK
                    STREAK              ART                 CRACK               JUDY                LMCP
          LEIGHWILK          YES                 DAVID               PCHS                LOLLIE

Please enter another main program option number.  Your choice? 99999

R;

logoff
CONNECT=02:23:32 VIRTCPU=003:35.44 TOTCPU=005:33.84
LOGOFF AT 18:08:58 EDT THURSDAY 04/18/74
```

APPENDIX G

PROGRAM LISTING FOR

ADMINISTRATION PROGRAM

Part Four

```
10000 REM    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
10005 REM    *                                                                           *
10010 REMARK *      A D M I N I S T R A T I O N   P R O G R A M   0 4                    *
10015 REM    *                                                                           *
10020 REM    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
10030 REM
10035 REM
10040 REMARK:                              COPYRIGHT
10050 REM
10060 REMARK:                           JESSE M. HEINES
10070 REM
10080 REMARK:                            FEBRUARY 1974
10090 REM
10100 REM
10110 REM  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
10120 REM
11010 REM    --------------------
11020 REMARK:  ARRAY DIMENSIONS
11030 REM    --------------------
11040 DIM C$(300),N$(600),Q(1,4),S(300),C(2,9),T(300,4),N(300)
11050 REMARK:  ARRAY "C$" IS FOR CODE NAMES.
11060 REMARK:  ARRAY "N$" IS FOR REAL NAMES.
11070 REMARK:  ARRAY "Q" CONTAINS THE NUMBER OF QUESTIONS IN EACH CHECK POINT.
11080 REMARK:  ARRAY "S" IS FOR SEQUENCING PRINT OUTS OF OTHER ARRAYS.
11090 REMARK:  ARRAY "C" IS FOR CUMULATIVE STATISTICS ON A CHECK POINT.
11095 REMARK:  ARRAY "T" STORES THE NO. OF TIMES A STUDENT HAS RUN A PROGRAM.
11098 REMARK:  ARRAY "N" IS FOR STUDENT REGISTRATION FLAGS.
11100 R$(1)='one'
11110 R$(2)='two'
11120 R$(3)='three'
11130 R$(4)='four'
11140 R$(5)='five'
11150 R$(6)='six'
11160 R$(7)='seven'
11170 R$(8)='eight'
11180 R$(9)='nine'
11190 R$(10)='ten'
11250 DEF FNA(X)=X-INT(X)
11260 REMARK:  THE ABOVE FUNCTION RETURNS THE FRACTIONAL PART OF "X".
11270 Q(1,1)=10
11280 Q(1,2)= 7
11290 Q(1,3)= 9
11300 Q(1,4)= 9
12000 REM    -----------------
12010 REMARK:  ENTRY ROUTINE
12020 REM    -----------------
12030 USE X$
12035 REMARK:  "X$" IS A DUMMY VARIABLE, USED TO RECEIVE AN ARGUMENT FROM A
12038 REM            CHAINED PROGRAM.
12040 GET 'PASSFILE', P,J,L$,F$
12050 GOTO 20110
13000 REM    ---------------------------------------------------------
13010 REMARK:  SUBROUTINE TO PRESENT "ONE MOMENT PLEASE..." MESSAGE
13020 REM    ---------------------------------------------------------
13030 PRINT 'One moment please...'
13040 PRINT
13050 PRINT
13060 RETURN
14100 REM    -----------------------
14110 REMARK:  ROUNDING SUBROUTINE
14120 REM    -----------------------
14130 FOR Z=0 TO 1000
14140 IF X>Z GOTO 14170
14150 X=Z
14160 RETURN
14170 NEXT Z
14180 PRINT
14190 PRINT 'ERROR:  ARGUMENT OF ROUNDING SUBROUTINE GREATER THAN 1000.'
14200 STOP
```

```
15300 REM   ----------------------------------------------------------------
15310 REMARK:  SUBROUTINE FOR LOADING CODE NAME AND REAL NAME ARRAYS
15320 REM   ----------------------------------------------------------------
15330 IF F1=1 GOTO 15490
15340 REMARK:  FLAG "F1" IS SET TO "1" WHEN THE NAME ARRAYS HAVE BEEN LOADED.
15360 OPEN 1,'CODENAME',INPUT
15370 OPEN 2,'REALNAME',INPUT
15380 GET 1: N1
15390 FOR K=1 TO N1
15400 GET 1: C$(K)
15410 GET 2: N$(2*K-1),N$(2*K),N(K)
15420 NEXT K
15425 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
15430 F1=1
15440 N2=N1
15443 REMARK:  "N1" IS THE TOTAL NUMBER OF PEOPLE REGISTERED.
15445 REMARK:  "N2" IS THE NUMBER OF REGISTRANTS IN ED C 140.
15450 FOR K=1 TO N1
15460 IF N(K)=0 GOTO 15480
15470 N2=N2-1
15480 NEXT K
15490 RETURN
16500 REM   ----------------------------------------------------------------
16510 REMARK:  SUBROUTINE TO LOCATE ID NUMBER ("J") FOR AN ENTERED LAST NAME
16520 REM   ----------------------------------------------------------------
16530 H$=L$
16533 G$=F$
16535 H=J
16536 REMARK:  "H$", "G$", AND "H" HOLD THE CURRENTS STUDENT'S LAST NAME,
16537 REM         FIRST NAME, AND REFERENCE NUMBER, RESPECTIVELY, IN THE EVENT
16538 REM         THAT A CODE IS ENTERED BY THE USER.
16539 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16540 PRINT '     Student''s last name';
16560 INPUT L$
16561 IF L$='DEMO' GOTO 16955
16564 A$=L$
16566 GOSUB 18010
16567 IF G=1 GOTO 16980
16569 IF L$='SAME' GOTO 16975
16570 PRINT
16575 GOSUB 15310
16580 K=0
16585 A=1
16590 FOR J=1 TO N1
16600 IF N$(2*J-1)=L$ GOTO 16730
16610 NEXT J
16620 IF K>0 GOTO 16760
16630 PRINT '     The roster contains no student by the last name of '; L$;
16633 PRINT '.  ';
16635 GOTO 16640
16637 PRINT '     ';
16640 PRINT 'Do you wish to try another last name ("y" or "n")';
16650 INPUT A$
16660 GOSUB 18010
16670 IF G=1 GOTO 16980
16680 PRINT
16690 IF A$='Y' GOTO 16540
16700 IF A$='YES' GOTO 16540
16710 PRINT 'Please enter only "y" or "n" or a code.  Your choice';
16720 GOTO 16650
16725 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16730 K=K+1
16740 S(K)=J
16745 F2=0
16750 GOTO 16610
16755 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16760 IF K>1 GOTO 16780
16773 J=S(K)
16775 GOTO 16935
16780 PRINT '     The roster has the following '; R$(K); ' students with the ';
```

```
16790 PRINT 'last name of '; L$; ':'
16793 PRINT
16795 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16797 REMARK:  THE FOLLOWING STATEMENTS ALPHABETIZE THE LIST OF STUDENTS WITH
16800 REM          THE ENTERED LAST NAME ("L$").
16801 FOR M=1 TO K-1
16802 FOR N=M+1 TO K
16803 S1=S(M)
16804 S2=S(N)
16805 IF N$(2*S1)<N$(2*S2) GOTO 16809
16806 A=S(M)
16807 S(M)=S(N)
16808 S(N)=A
16809 NEXT N
16810 NEXT M
16811 F2=0
16812 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16813 REMARK:  THE FOLLOWING STATEMENTS PRINT THE LIST OF ALL STUDENTS WITH THE
16814 REM          ENTERED LAST NAME.
16815 FOR M=1 TO K
16820 X=S(M)
16830 PRINT '        ';
16838 PRINT M; N$(2*X); ' '; L$;
16839 IF N(X)=1 GOTO 16842
16840 PRINT '  (Ed C 140)'
16841 GOTO 16844
16842 PRINT '  (other)'
16844 NEXT M
16845 IF P=2 GOTO 16950
16850 PRINT
16860 PRINT '     What is the index number to the left of the student in ';
16870 PRINT 'question (enter "99" if he or she does not appear on this list)';
16890 INPUT A
16891 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16892 GOSUB 18110
16894 IF G=1 GOTO 16980
16900 PRINT
16910 IF A=99 GOTO 16637
16913 IF A=0 GOTO 16917
16915 IF A<K GOTO 16925
16917 PRINT '     Please enter a single number or code as described above.  ';
16918 PRINT 'Your choice';
16919 GOTO 16890
16920 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16925 J=S(A)
16930 REMARK:  "J" IS THE STUDENT'S ID NUMBER.
16935 F$=N$(2*J)
16940 PRINT
16950 RETURN
16953 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16955 J=0
16960 F$='SAMPLE'
16965 L$='STUDENT'
16970 IF P=2 GOTO 16972
16971 PRINT
16972 PRINT
16973 RETURN
16974 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
16975 IF J=0 GOTO 16960
16980 L$=H$
16982 F$=G$
16983 J=H
16985 GOTO 16970
17000 REM    -----------------------------------------
17010 REMARK:  SUBROUTINE TO ALPHABETIZE CLASS ROSTER
17020 REM    -----------------------------------------
17030 IF F2=1 GOTO 17220
17033 REMARK:  FLAG "F2" IS SET TO "1" AFTER THE CLASS ROSTER IS ALPHABETIZED.
17040 GOSUB 15310
17050 FOR K=1 TO N1
```

```
17060 S(K)=K
17070 NEXT K
17075 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
17080 FOR K=1 TO N1-1
17090 FOR M=K+1 TO N1
17100 S1=S(K)
17110 S2=S(M)
17120 IF N$(2*S1-1)<N$(2*S2-1) GOTO 17190
17130 IF N$(2*S1-1)=N$(2*S2-1) GOTO 17180
17140 A=S(K)
17150 S(K)=S(M)
17160 S(M)=A
17170 GOTO 17190
17180 IF N$(2*S1)>N$(2*S2) GOTO 17140
17190 NEXT M
17200 NEXT K
17205 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
17210 F2=1
17220 RETURN
18000 REM      ---------------------------------------
18010 REMARK:  INPUT CODE INTERPRETING SUBROUTINE
18020 REM      ---------------------------------------
18030 IF A$='N' GOTO 18140
18040 IF A$='NO' GOTO 18140
18050 IF A$='STOP' GOTO 50000
18060 IF A$='99999' GOTO 50000
18070 IF A$='CANCEL' GOTO 18140
18080 IF A$='PASS' GOTO 18140
18090 IF A$='88888' GOTO 18140
18095 G=0
18100 RETURN
18105 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
18110 IF A=99999 GOTO 50000
18120 IF A=88888 GOTO 18140
18125 G=0
18130 RETURN
18140 G=1
18150 RETURN
19000 REM      ---------------------------------------------------
19010 REMARK:  ROUTINE FOR CHAINING TO OTHER "ADMIN" PROGRAMS
19020 REM      ---------------------------------------------------
19030 B$='ADMIN01'
19040 GOTO 19060
19050 B$='ADMIN02'
19053 GOTO 19060
19055 B$='ADMIN03'
19060 GOSUB 13010
19070 OPEN 4,'PASSFILE',OUTPUT
19080 PUT 4: P,J,L$,F$
19090 CHAIN B$,'CHAINED'
20000 REM      -------------------------------------------------------
20010 REMARK:  ROUTINE FOR SELECTION OF MAIN PROGRAM OPTION ("P")
20020 REM      -------------------------------------------------------
20070 CLOSE 1,2,3,4,5,6,7,8
20073 CLOSE 'CODENAME', 'REALNAME', 'LOGFILE', 'PASSFILE'
20075 CLOSE 'NSTRDANS', 'NUMERANS', 'ALPHAANS', 'HOLDFILE'
20080 INPUT P
20090 PRINT
20100 PRINT
20110 IF P=0 GOTO 19030
20120 GOTO 19030,19030,19030,33010,30010,19030,19050,35010,19030,19030 ON P
20123 GOTO 19030,28010,29010,19050,34010,27010,19055,19055,31010,19055 ON P-10
20125 GOTO 19030,19030,19050,19050,19050,19055,19050,19055,19055,19055 ON P-20
20127 GOTO 32010,19030 ON P-30
20130 IF P=99999 GOTO 50000
20135 IF P=88888 GOTO 20520
20140 PRINT 'No option exists by that number.  Please enter another.  ';
20150 PRINT '("99999" = terminate program.)  Your choice';
20160 GOTO 20080
20170 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
20500 PRINT
20510 PRINT
20520 PRINT 'Please enter another main program option number.  Your choice';
20530 GOTO 20010
27000 REM  ----------------------------------------------------------------
27010 REMARK:  SUMMARY OF SATISFACTORY COMPLETION DATA ON A CHECK POINT  (#16)
27020 REM  ----------------------------------------------------------------
27030 PRINT '     SUMMARY OF SATISFACTORY COMPLETION DATA ON A CHECK POINT'
27040 PRINT
27050 PRINT '     Enter the unit and section numbers as "U,S".  (To cancel, ';
27060 PRINT 'enter "88888,0".)  Entry';
27070 INPUT A,C
27080 GOSUB 18110
27090 IF G=1 GOTO 20500
27100 PRINT
27103 PRINT
27105 FOR K=1 TO 7
27107 R(K)=0
27108 NEXT K
27110 U=A
27120 MAT T = CON
27130 REMARK:  THE ABOVE STATEMENT SETS ALL ELEMENTS OF ARRAY "T" TO 1.
27133 GOSUB 15310
27140 OPEN 3,'LOGFILE', INPUT
27150 GET 3: N3
27155 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
27160 FOR K=1 TO N3
27170 GET 3: R1,R2,R3,R4,R5
27173 J3=INT(R1/10000)
27175 IF N(J3)=1 GOTO 27290
27180 X=10*FNA(INT(R1/10)/10)
27190 GOSUB 14110
27200 IF X<>C GOTO 27290
27210 X=100*FNA(INT(R1/100)/100)
27213 GOSUB 14110
27215 IF X<>U GOTO 27290
27216 IF R2+R3+R4+R5=0 GOTO 27290
27217 J3=INT(R1/10000)
27220 IF T(J3,2)=3 GOTO 27290
27230 T(J3,1)=T(J3,1)+1
27240 REMARK:  "T(J3,1)" COUNTS THE NUMBER OF RUNS MADE FOR A CHECK POINT BY
27250 REM          EACH STUDENT ("J3").
27260 X=10*FNA(R1/10)
27263 GOSUB 14110
27265 T(J3,2)=2+X
27270 REMARK:  "T(J3,2)" CONTAINS THE SATISFACTORY COMPLETION FLAG ON THIS
27280 REM          CHECK POINT FOR EACH STUDENT.
27290 NEXT K
27295 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
27300 FOR K=1 TO 300
27310 IF T(K,1)=1 GOTO 27390
27320 R(1)=R(1)+1
27330 REMARK:  "R(1)" COUNTS THE NO. OF STUDENTS WHO HAVE RUN THIS CHECK POINT.
27340 IF T(K,1)>=5 GOTO 27370
27350 C1=T(K,1)+3*(3-T(K,2))
27360 GOTO 27380
27370 C1=4+3*(3-T(K,2))
27380 R(C1)=R(C1)+1
27390 NEXT K
27400 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
27410 PRINT '     SUMMARY OF CHECK POINT #'; C; 'IN UNIT'; U
27420 PRINT
27430 PRINT USING 27500, R(1)
27440 PRINT USING 27510, R(2),100*R(2)/R(1)
27450 PRINT USING 27520, R(3),100*R(3)/R(1)
27460 PRINT USING 27530, R(4),100*R(4)/R(1)
27470 PRINT USING 27540, R(5),100*R(5)/R(1)
27480 PRINT USING 27550, R(6),100*R(6)/R(1)
27490 PRINT USING 27560, R(7),100*R(7)/R(1)
27500 :     Total number of students attempting check point:      ###
```

```
27510 :     Number completing satisfactorily on first run:          ###   (###.#%)
27520 :     Number completing satisfactorily on second run:         ###   (###.#%)
27530 .     Number completing satisfactorily after second run:      ###   (###.#%)
27540 :     No. trying only once and still incomplete:              ###   (###.#%)
27550 :     No. trying twice but still incomplete:                  ###   (###.#%)
27560 :     No. trying more than twice but still incomplete:        ###   (###.#%)
27570 GOTO 20500
28000 REM   ------------------------------------------------------------
28010 REMARK:  ROUTINE TO DISPLAY A STUDENT'S CUMULATIVE SCORE  (#12)
28020 REM   ------------------------------------------------------------
28030 PRINT '      ROUTINE TO DISPLAY A STUDENT''S CUMULATIVE SCORE ON A CHECK ';
28040 PRINT 'POINT'
28050 PRINT
28060 GOSUB 16510
28070 IF G=1 GOTO 20500
28080 PRINT '      Enter the unit and section numbers as "U,S".  (To cancel, ';
28090 PRINT 'enter "88888,0".)  Entry';
28100 INPUT A,C
28110 GOSUB 18110
28120 IF G=1 GOTO 20500
28130 U=A
28140 T=0
28150 FOR K=1 TO 10
28160 R(K)=0
28170 NEXT K
28180 OPEN 3,'LOGFILE',INPUT
28190 GET 3: N3
28195 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28200 FOR K=1 TO N3
28210 GET 3: R1,R2,R3,R4,R5
28220 IF INT(R1/10000)<>J GOTO 28540
28240 X=10*FNA(INT(R1/10)/10)
28250 GOSUB 14110
28260 IF X<>C GOTO 28540
28270 X=100*FNA(INT(R1/100)/100)
28280 GOSUB 14110
28300 IF X<>U GOTO 28540
28310 T=T+1
28315 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28320 FOR M=1 TO 7
28330 X=10*FNA(INT(R4/(10**(7-M)))/10)
28340 GOSUB 14110
28350 IF X<>0 GOTO 28380
28360 X=10*FNA(INT(R2/(10**(7-M)))/10)
28370 GOSUB 14110
28380 IF X<=R(M) GOTO 28400
28390 R(M)=X
28400 NEXT M
28405 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28410 IF Q(U,C)<=7 GOTO 28510
28420 FOR M=8 TO Q(U,C)
28430 X=10*FNA(INT(R5/(10**(14-M)))/10)
28440 GOSUB 14110
28450 IF X<>0 GOTO 28480
28460 X=10*FNA(INT(R3/(10**(14-M)))/10)
28470 GOSUB 14110
28480 IF X<=R(M) GOTO 28500
28490 R(M)=X
28500 NEXT M
28505 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28510 X=10*FNA(R1/10)
28520 GOSUB 14110
28530 F=X
28540 NEXT K
28545 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28550 PRINT
28560 PRINT
28570 PRINT '      CUMULATIVE SCORE FOR '; F$; ' '; L$
28580 PRINT
28590 PRINT '      Unit'; U; 'Check Point #'; C; '--    Question #     ';
```

```
28600 FOR K=1 TO Q(U,C)
28610 PRINT K;
28620 NEXT K
28630 PRINT ' '
28635 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28640 PRINT '                                                      Response :     ';
28650 FOR K=1 TO Q(U,C)
28660 IF R(K)=0 GOTO 28720
28670 IF R(K)<=5 GOTO 28700
28680 PRINT ' C    ';
28690 GOTO 28730
28700 PRINT ' X    ';
28710 GOTO 28730
28720 PRINT ' -    ';
28730 NEXT K
28735 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
28740 PRINT ' '
28750 PRINT
28753 PRINT '             Number of runs ='; T; '--     ';
28760 IF F=1 GOTO 28790
28770 PRINT 'This check point is not yet completed satisfactorily.'
28780 GOTO 20500
28790 PRINT 'This check point has been completed satisfactorily.'
28800 GOTO 20500
29000 REM   ----------------------------------------------------------
29010 REMARK:  ROUTINE TO PRINT ALL ANSWERS STORED BY A STUDENT  (#13)
29020 REM   ----------------------------------------------------------
29030 PRINT '      ROUTINE TO PRINT ALL ANSWERS STORED BY A STUDENT'
29040 PRINT
29050 GOSUB 16510
29060 IF G=1 GOTO 20520
29070 CLOSE 1,2,3,4,5,6,7,8
29080 GET 'NSTRDANS', N6,N7
29090 C6=0
29100 OPEN 6,'NUMERANS',INPUT
29110 OPEN 7,'ALPHAANS',INPUT
29113 GET 6: X,X,X
29115 GET 7: X,X,X$
29117 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
29120 F=6
29130 FOR K=1 TO N6
29140 GET 6: R1,R2,R3
29150 IF R2=J GOTO 29250
29160 NEXT K
29163 IF C6=0 GOTO 29175
29165 PRINT
29167 PRINT '          (Note:  SOME numeric answers are stored as deviations ';
29168 PRINT 'from the correct answer.)'
29169 PRINT
29170 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
29175 F=6
29180 FOR K=1 TO N7
29190 GET 7: R1,R2,R$
29200 IF R2=J GOTO 29250
29210 NEXT K
29220 IF C6=1 GOTO 20500
29230 PRINT '      No answers are stored on '; F$; ' ' L$; '.'
29240 GOTO 20500
29245 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
29250 IF C6=1 GOTO 29290
29260 PRINT '      The following answers are stored on '; F$; ' '; L$; ':'
29270 PRINT
29280 PRINT '      Unit     Section  Question    Code             Answer'
29290 U=INT(R1/10000)
29300 X=10*FNA(INT(R1/1000)/10)
29310 GOSUB 14110
29320 C=X
29330 X=100*FNA(INT(R1/10)/100)
29340 GOSUB 14110
29350 Q=X
```

```
29360 X=10*FNA(R1/10)
29370 GOSUB 14110
29380 S=X
29390 C6=1
29400 IF F=7 GOTO 29440
29410 PRINT USING 29420, U,C,Q,S,R3
29420 :      ##         #          #          #         ##########.#######
29430 GOTO 29160
29440 PRINT USING 29450, U,C,Q,S,R$
29450 :      ##         #          #          #            ###################
29460 GOTO 29210
30090 REM  ------------------------------------------------------------------
30010 REMARK:  ROUTINE TO PRINT THE STATUS OF ALL STUDENTS ON A UNIT  (#5)
30020 REM  ------------------------------------------------------------------
30023 PRINT '     ROUTINE TO PRINT THE STATUS OF ALL STUDENTS ON A UNIT'
30025 PRINT
30027 PRINT '     On which unit number would you like the status displayed';
30028 INPUT A
30029 GOSUB 18110
30030 IF G=1 GOTO 20500
30033 U=A
30035 GOSUB 17010
30040 CLOSE 1,2,3,4,5,6,7,8
30050 MAT T = CON
30060 OPEN 3,'LOGFILE',INPUT
30070 GET 3: N3
30075 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
30080 FOR K=1 TO N3
30090 GET 3: R1,R2,R3,R4,R5
30100 X=100*FNA(INT(R1/100)/100)
30110 GOSUB 14110
30120 IF X<>U GOTO 30220
30130 J3=INT(R1/10000)
30140 X=10*FNA(INT(R1/10)/10)
30150 COSUB 14110
30160 C=X
30170 X=10*FNA(R1/10)
30180 GOSUB 14110
30190 T(J3,C)=T(J3,C)+1
30200 IF T(J3,C)>200 GOTO 30220
30203 IF T(J3,C)<100 GOTO 30215
30210 T(J3,C)=T(J3,C)+100*X
30213 GOTO 30220
30215 T(J3,C)=T(J3,C)+100*(X+1)
30220 NEXT K
30222 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
30223 PRINT
30225 PRINT
30230 PRINT '     STATUS OF ALL STUDENTS ON UNIT'; U
30240 PRINT
30250 PRINT '          ("C" = Completed Satisfactorily, "I" = Incomplete, ';
30260 PRINT 'and "-" = Not Yet Attempted.  Number of runs is in parentheses.)'
30270 PRINT
30273 PRINT
30280 PRINT '     Last Name        First Name        1        2        3';
30290 PRINT '      4'
30300 PRINT
30393 C$(1)='-'
30395 C$(2)='I'
30397 C$(3)='C'
30398 REM - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
30400 FOR K=1 TO N1
30420 S1=S(K)
30430 IF N(S1)=1 GOTO 30550
30440 S2=INT(T(S1,1)/100)+1
30450 S3=T(S1,1)-1-100*(S2-1)
30460 S4=INT(T(S1,2)/100)+1
30470 S5=T(S1,2)-1-100*(S4-1)
30480 S6=INT(T(S1,3)/100)+1
30490 S7=T(S1,3)-1-100*(S6-1)
```

```
30500 S8=INT(T(S1,4)/100)+1
30510 S9=T(S1,4)-1-100*(S8-1)
30520 S1=2*S1
30530 PRINT USING 30540, N$(S1-1),N$(S1),C$(S2),S3,C$(S4),S5,C$(S6),S7,C$(S8),S9
30540 :      ################# ################### # (#)    # (#)    # (#)    # (#)
30550 NEXT K
30560 GOTO 20500
31000 REM     -------------------------------------------------------------------
31010 REMARK:  CALCULATION OF STATISTICAL MEASURES ON STORED ANSWERS  (#19)
31020 REM     -------------------------------------------------------------------
31030 PRINT '      STATISTICAL MEASURES ON STORED NUMERIC ANSWERS'
31040 PRINT
31050 PRINT '      Enter the unit, section, and question numbers as "U,S,Q".  ';
31060 PRINT '(To cancel, enter "88888,0,0".)  Entry';
31070 INPUT A,C,Q
31080 GOSUB 18110
31090 IF G=1 GOTO 20500
31100 C6=0
31110 U=A
31120 F2=0
31125 GOSUB 15310
31127 CLOSE 1,2,3,4,5,6,7,8
31130 GET 'NSTRDANS', N6
31140 OPEN 6,'NUMERANS',INPUT
31145 T=0
31180 GET 6: X,X,X
31185 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
31190 FOR K=1 TO N6
31200 GET 6: R1,R2,R3
31210 IF N(R2)=1 GOTO 31345
31220 X=100*FNA(INT(R1/10)/100)
31230 GOSUB 14110
31240 IF X<>Q GOTO 31345
31250 X=10*FNA(INT(R1/1000)/10)
31260 GOSUB 14110
31270 IF X<>C GOTO 31345
31280 IF INT(R1/10000)<>U GOTO 31345
31290 C6=C6+1
31293 S(C6)=R3
31300 T=T+R3
31303 IF C6>1 GOTO 31310
31305 S1=R3
31307 S2=R3
31308 GOTO 31345
31310 IF R3>S1 GOTO 31330
31320 S1=R3
31330 IF R3<S2 GOTO 31345
31340 S2=R3
31345 NEXT K
31350 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
31351 PRINT
31352 PRINT
31353 IF C6>0 GOTO 31360
31354 PRINT '      There are no numeric answers stored for Question #'; Q;
31355 PRINT 'in Unit'; U; 'Section'; C
31356 GOTO 20500
31358 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
31360 A=T/C6
31370 S3=0
31380 FOR K=1 TO C6
31390 S3=S3+(A-S(K))**2
31400 NEXT K
31410 S3=SQR(S3/C6)
31420 PRINT '      STATISTICS ON ANSWERS TO QUESTION #'; Q; 'IN UNIT'; U;
31430 PRINT 'SECTION'; C
31440 PRINT
31450 PRINT '      Number of stored answers:    '; C6
31460 PRINT '      Mean:                        '; A
31470 PRINT '      Standard deviation:          '; S3
31480 PRINT '      Maximum:                     '; S2
```

```
31490 PRINT '     Minimum:                          '; S1
31500 GOTO 20500
32000 REM    ---------------------------------------------------------------
32010 REMARK:  ROUTINE TO DELETE ALL RECORDS WHICH CONTAIN ONLY ZEROES  (#31)
32020 REM    ---------------------------------------------------------------
32030 GOSUB 15310
32040 OPEN 3,'LOGFILE',INPUT
32050 GET 3: N3
32060 OPEN 8,'HOLDFILE',OUTPUT
32070 C3=0
32080 C$(1)='(Ed C 140)'
32090 C$(2)='(Other)'
32100 FOR K=1 TO N3
32110 GET 3: R1,R2,R3,R4,R5
32120 PUT 8: R1,R2,R3,R4,R5
32130 IF R2+R3+R4+R5=0 GOTO 32160
32140 NEXT K
32150 GOTO 32250
32155 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
32160 C3=C3+1
32170 IF C3>1 GOTO 32210
32180 PRINT '     Confirmation will erase "zero" log records on the following ';
32190 PRINT 'student(s):'
32200 PRINT
32210 X=INT(R1/10000)
32220 Y=N(X)
32230 PRINT '            '; N$(2*X-1); ', '; N$(2*X); '  '; C$(Y+1)
32240 GOTO 32140
32245 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
32250 IF C3>0 GOTO 32280
32260 PRINT '     The log contains no records with only zeroes for data.'
32270 GOTO 20500
32280 PRINT
32290 PRINT '     Confirmation ("y" or "n")';
32300 INPUT A$
32310 GOSUB 18050
32320 PRINT
32330 IF A$='YES' GOTO 32410
32340 IF A$='Y' GOTO 32140
32350 IF A$='NO' GOTO 32385
32360 IF A$='N' GOTO 32385
32370 PRINT '     Please respond with "y" or "n" or a code.  Your choice';
32380 GOTO 32300
32382 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
32385 PRINT
32390 PRINT '     The log will remain unchanged.'
32400 GOTO 20500
32405 REM  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
32410 OPEN 3,'LOGFILE',OUTPUT
32420 PUT 3:N3-C3
32430 OPEN 8,'HOLDFILE',INPUT
32440 FOR K=1 TO N3
32450 GET 8: R1,R2,R3,R4,R5
32460 IF R1+R2+R3+R4=0 GOTO 32480
32470 PUT 3: R1,R2,R3,R4,R5
32480 NEXT K
32485 PRINT
32490 PRINT '     The records have been deleted, but may still be retrieved by';
32500 PRINT ' issuing the "retrieve" command under CMS.'
32510 GOTO 20500
33000 REM    ---------------------------------------------------------------
33010 REMARK:  ROUTINE TO PRINT THE NAMES OF ALL NON - ED C 140 USERS  (#4)
33020 REM    ---------------------------------------------------------------
33030 GOSUB 17010
33040 C2=0
33050 FOR K=1 TO N1
33053 X=S(K)
33060 IF N(X)=0 GOTO 33120
33070 IF C2>0 GOTO 33100
33080 PRINT '     USERS NOT REGISTERED IN ED C 140'
```

```
33090 PRINT
33100 PRINT '            '; N$(2*X-1); ', '; N$(2*X)
33110 C2=C2+1
33120 NEXT K
33130 IF C2>0 GOTO 20500
33140 PRINT '     All students on the roster ARE registered in Ed C 140.'
33150 GOTO 20500
34000 REM    -------------------------------------------------------
34010 REMARK:  IDENTIFICATION OF A STUDENT FROM AN ID NUMBER  (#15)
34020 REM    -------------------------------------------------------
34030 PRINT '      IDENTIFICATION OF A STUDENT FROM AN ID NUMBER'
34040 PRINT
34050 GOSUB 15310
34060 PRINT '     Enter the ID number of the student you wish to identify.  ';
34070 PRINT 'Entry';
34080 INPUT A
34090 GOSUB 18110
34100 IF G=1 GOTO 20500
34110 PRINT
34115 PRINT
34117 IF A=0 GOTO 34140
34118 IF A>N1 GOTO 34140
34120 PRINT '      ID number '; A; 'is assigned to '; N$(2*A); ' '; N$(2*A-1);'.'
34123 J=A
34125 L$=N$(2*A-1)
34127 F$=N$(2*A)
34130 GOTO 20500
34140 PRINT '      ID number '; A; 'is not unassigned.'
34150 GOTO 20500
35000 REM    ------------------------------------------------
35010 REMARK:  ROUTINE TO PRINT AN ARRAY OF CODE NAMES  (#8)
35020 REM    ------------------------------------------------
35030 PRINT '      CODE NAME ARRAY'
35040 PRINT
35060 GOSUB 15310
35070 X=0
35075 PRINT
35080 PRINT '            '; C$(X+1),C$(X+2),C$(X+3),C$(X+4),C$(X+5),C$(X+6)
35090 IF X+6>=N1 GOTO 20500
35095 PRINT
35100 PRINT '                     '; C$(X+7),C$(X+8),C$(X+9),C$(X+10),C$(X+11)
35110 IF X+11>=N1 GOTO 20500
35120 X=X+11
35130 GOTO 35075
35140 REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
50000 END
```

BIOGRAPHY OF AUTHOR

Jesse M. Heines was born April 18th, 1948 in New Brunswick, New Jersey. He graduated from East Brunswick High School, East Brunswick, New Jersey in June, 1966 and was elected to the National Honor Society. In June, 1970, he received a Bachelor of Science degree from the Massachusetts Institute of Technology in Cambridge, Mass.

During the academic years of 1970 to 1972, Mr. Heines was employed at the Anglo-American School in Moscow, U.S.S.R., and taught sixth, seventh, and eighth grade science and math. On August 16th, 1971, he was married to Evelyn Scott McKay in Edinburgh, Scotland.

Mr. Heines enrolled for graduate study at the University of Maine at Orono in September, 1972. He has served as a graduate assistant in Science Education and is now a candidate for the degree of Master of Science in Education.