

```

0091 C REPORT NUMBER THREE
0092 C
0093 WRITE(6,310)IDATE
0094 WRITE(6,5015)
0095 5015 FORMAT(" BREAKDOWN BY FUNCTION WITHIN DIVISIONS"
0096 DO 5000 IDIV=1,1
0097 WRITE(6,5020)(IDIV VS 1,1DIV 1=1,10)
0098 5020 FORMAT(/" ",10A2/)
0099 WRITE(6,5025)
0100 5025 FORMAT(1X,"CURRENT PERIOD",15X,"YEAR TO DATE"/
0101 1 16X,2(" ", "HOURS ZDVTOT ZTOT=L")/)
0102 DO 5030 I=1,22
0103 5030 CALC(I)=0.
0104 DO 5040 IFUNC=1,8
0105 DO 5040 ISA=1,20
0106 JPTR=(IDIV-1)*10+IFUNC
0107 CALC(IFUNC,1)=CALC(IFUNC,1)+FLOAT(ICURN(JPT,ISA
0108 CALC(IFUNC,2)=CALC(IFUNC,2)+FLOAT(ILONG(JPT,ISA
0109 5040 CONTINUE
0110 XCTOT = 0.
0111 XLTOT = 0.
0112 DO 5050 I=1,8
0113 XCTOT = XCTOT + CALC(I,1)
0114 XLTOT = XLTOT + CALC(I,2)
0115 5050 CONTINUE
0116 DO 5060 IFUNC=1,8
0117 XTEMP = 1015058,5057,5058
0118 5052 IF(IFUNC-1)5054,5058,5054
0119 5054 IF(IFUNC-4)5200,5200,5200
0120 5056 IF(IFUNC-7)5058,5200,5058
0121 5058 XTEMP=0.
0122 YTEMP=0.
0123 ZTEMP=0.
0124 ZTEMP=0.
0125 IF(CALC(IFUNC))5057,5070,5060
0126 5060 XTEMP = CALC(IFUNC)/XCTOT*100.
0127 WTEMP=CALC(IFUNC)/SCTOT*100.
0128 5070 TEMP=CALC(IFUNC)+CALC(IFUNC,2)
0129 IF (TEMP) 5090,5090,5080

```

Computer Programming Course



**HEWLETT-PACKARD
COMPUTER PROGRAMMING COURSE
STUDENT ASSIGNMENT MANUAL
(STOCK NO. 5951-3033)**

—NOTICE—

The information contained in this manual is for training purposes only. Consult the Hewlett-Packard documentation supplied with the computer for current information concerning the specific computer system furnished.

The information contained in this publication may not be reproduced in any form without the expressed consent of the Hewlett-Packard Company.

COPYRIGHT HEWLETT-PACKARD COMPANY 1971

11000 Wolfe Road, Cupertino, California 95014 Area Code 408 257-7000 TWX 910-338-0221

HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

TABLE OF CONTENTS

	Page
FOREWORD	iii
LESSON I. COMPUTER FUNDAMENTALS	
Classroom Exercise 1-1	1-1
Classroom Exercise 1-2	1-4
Laboratory Exercise 1-1	1-6
Homework Assignment 1-1	1-9
LESSON II. INTRODUCTION TO BASIC	
Classroom Exercise 2-1	2-1
Laboratory Exercise 2-1	2-2
Laboratory Exercise 2-2	2-4
LESSON III. INTRODUCTION TO FORTRAN	
Classroom Exercise 3-1	3-1
Classroom Exercise 3-2	3-3
Laboratory Exercise 3-1	3-5
Homework Assignment 3-1	3-8
LESSON IV. HP SYMBOLIC EDITOR	
Classroom Exercise	4-1
LESSON V. FORTRAN CONTROL STATEMENTS	
Classroom Exercise 5-1	5-1
Laboratory Exercise 5-1	5-3
LESSON VI. FORTRAN PROGRAMMING TECHNIQUES	
Laboratory Exercise 6-1	6-1
APPENDIX A ANSWER SECTION	

FOREWORD

This manual contains the classroom exercises, laboratory exercises and homework assignments used in the Hewlett-Packard computer programming course. Each exercise and assignment in this manual is designed to give the student practice in a particular technique or to re-enforce a concept or procedure covered in the lecture phase. The student who rigorously pursues a solution to these exercises both in class and in the computer laboratory will gain the most benefit from the programming course.

The answers to all the exercises presented in the programming course are provided in Appendix A. The answers should be used primarily to check your results, they may also be used in the learning process when you feel that a look at the answer will provide a path of progress when all else has failed.

We sincerely hope that you enjoy attending our computer programming course.

Training Staff
Cupertino Division

Classroom Exercise Guide

Lesson: **INTRODUCTION TO COMPUTERS**

Exercise: 1-1

A. OBJECTIVE

1. To give the student practice in Octal to Decimal and Decimal to Octal conversion.

B. PROBLEMS

1. Convert the following decimal numbers to their octal equivalent values.

556_{10}

1024_{10}

$32,767_{10}$

2. Convert the following octal numbers to their decimal equivalent values.

457_8

1000_8

3777_8

3. Change the following octal values to their binary form.

17700₈

12345₈

7777₈

C. PROCEDURES

1. Use the procedure shown on Page 1-15 in your Students Manual.
2. Use the procedure shown on Page 1-14 in your Students Manual.
3. Use the procedure shown on Page 1-12 in your Students Manual.

D. RESULTS

1.

2.

3.

Classroom Exercise Guide

Lesson: **INTRODUCTION TO COMPUTERS**

Exercise: 1-2

A. OBJECTIVE

1. To give the student practice in converting negative decimal numbers to their octal machine form and converting two's complement values to their equivalent negative decimal values.

B. PROBLEMS

1. Convert the following negative decimal numbers to their octal equivalent values.

-12_{10}

-100_{10}

-20_{10}

2. Convert the following negative octal numbers to their decimal equivalent values.

177776_8

100001_8

177777_8

C. PROCEDURES

1. Use the procedures shown on Pages 1-19, 1-18, 1-15 in your Students Manual.
2. Use the procedures shown on Pages 1-19, 1-18, 1-14 in your Students Manual.

D. RESULTS

1.

2.

Laboratory Exercise Guide

Lesson: **INTRODUCTION TO COMPUTERS**

Exercise: 1-1



A. OBJECTIVE

1. To provide a simple exercise for those students who are unfamiliar with the ASR-33 teleprinter equipment. The exercise will provide "hands on" experience in creating a punched tape for input to the computer. Learning how to use the Teleprinter is a necessary function in the programming course as students must do the bulk of their own program tape preparation.

B. PROBLEM

1. The problem consists of nothing more than a typing exercise. A simple FORTRAN program has been prepared on a coding form. The student will interpret the coding form and punch a program tape using the Teleprinter. Upon completion of the program tape the student will submit the tape to the laboratory instructor for a FORTRAN compilation. If the computer detects no errors and the instructor is satisfied that the tape is correct, the solution will be judged correct and the exercise complete.

C. PROCEDURES

1. The ASR-33 Teleprinter has a 3 position switch on the right front panel, close to the operator's right knee.
 - a. LINE – Send and receive data to an external source.
 - b. LOCAL – Keyboard data is printed on the page printer but data is not transmitted or received.
 - c. OFF – Line power off.
2. Punch Controls
 - a. On the left side of the machine near the paper roller handle are 4 clear plastic buttons. The two on the left are not normally used. The two buttons on the right control the TAPE PUNCH. The TAPE PUNCH is turned on by depressing the button marked "ON".
3. Generating "Leader" and "Trailer"

In order for the computer to accept a tape punched on the Teleprinter a portion of the tape with no information on it must be generated. This portion of the tape is called "tape leader". In order to generate tape leader the upper rightmost key on the keyboard is used. This key is called "HERE IS". The "HERE IS" key will generate approximately 3 inches of leader which is sufficient for the computer. It should be noted however that 3 inches or more of "trailer" is required at the end of the program data tape as well. The "HERE IS" key is also used to generate "trailer".

4. Ending a Line

- a. A Teleprinter line is terminated by the depression of the "CARRIAGE RETURN" key (CR), followed by the "LINE FEED" key (LF).

5. Error Correction

- a. If an error is observed before the current line is ended (4a), the entire line may be negated by depressing the "RUB OUT" key and then ending the line normally with the (CR)(LF) keys. The "RUB OUT" character causes the computer to ignore the entire line that was in error. The line containing the error should then be repunched from the beginning. Errors that occurred before the current line must be corrected by other means.

D. RESULTS

1. The results of this exercise will be a punched paper tape that accurately reflects the original coding form and successfully passes the scrutiny of the computer and the laboratory instructor.

PROGRAMMER		DATE		PROGR				
C	Label	STATEMENT						
1	5	10	15	20	25	30	35	40
	FTN, L							
C								
C		YOUR	NAME					
C		THE	DATE;	DAY/MO/YR				
C		YOUR	FIRM	OR	COMPANY	NAME		
		PROGRAM	DEMO					
		READ(1,*)	A, B, C, D, K, I, X, Y, Z					
		Z = A + B * C						
		H = A + B / (C + D) ** 2 + X ** 2						
		E = 1. + X + X ** 2 / 2. + X ** 3 / 6.						
		F = (A + B + C * D ** 2) / (((A + 2.8) ** (I - 1) + B / (C + D						
		1) ** (A + 6.))						
		P = E + F + H						
		SQ = 2. * P * R * SIN(3.1416 / P)						
		Z = 0.5 * (X * S - A ** 2 * ALOG(ABS(X + Y)))						
C		END						
		ENDS						

Homework Assignment Guide

Lesson: **INTRODUCTION TO COMPUTERS**

Assignment: 1-1

1. Draw line that will connect the first item in column 1 to the most appropriate matching term in column 2. Using the next item in column 1 repeat the above procedure until all items have been paired.

1	2	2
DATA	17777	
OCTAL	ELECTRONIC DIGITAL COMPUTER	
BINARY	989	
COMPUTER	PROGRAMS	
DECIMAL	TWO'S COMPLEMENT	
ENIAC	1010110110	
NEGATIVE	ADDRESS	
MEMORY	FORMAT	

2. The HP 16-bit computer word format defines:
 - a. Integer data, real data, and instructions.
 - b. Instructions, word addresses, and full addresses.
 - c. Integer data, instructions, and full addresses.
 - d. Register reference, memory reference, input, output.
3. Which of the following statements is false?
 - a. All data going to or from memory passes through the Memory data register.
 - b. The contents of the Memory address register replaces the contents of the addressed memory location.
 - c. A driver is a program for an I/O device.
 - d. Only the A register can be used for logical operations.
4. The five main sections of a computer are:
 - a. Control, memory, interrupt, input, output.
 - b. Input, interrupt, output, memory, control.
 - c. Control, memory, output, arithmetic, input.
 - d. Input, contents, output, arithmetic, memory.

5. How many levels of translation exist between Assembly language and machine language?
 - a. One
 - b. Two
 - c. Four
 - d. None of the above

6. Which of the following statements correctly describe the Assembly process? The Assembler program is loaded into computer memory and:
 - a. the source tape is processed in two passes producing an Assembly listing and the object tape.
 - b. the object tape is processed in two passes producing an Assembly listing and a new object tape.
 - c. the source tape is processed, producing an ASCII object tape and the Assembly listing.
 - d. the source program tape is loaded into the computer, this produces an Assembly listing and the object tape.

7. How many levels of translation exist between FORTRAN language and machine language?
 - a. One
 - b. Two
 - c. Four
 - d. None of the above

8. Which of the following correctly describes the FORTRAN compilation procedure? The FORTRAN PASS 1 tape is loaded into the computer and:
 - a. the source tape is processed, producing the Compile listing and the object program tape.
 - b. the source tape is processed, producing the Compile listing and the intermediate tape. PASS 2 is loaded, the intermediate tape is processed, producing the Assembly listing and the object tape.
 - c. the source tape is processed, producing the Compile listing and the intermediate tape. PASS 2 is loaded and the source tape is processed, producing the Assembly listing and the object tape.
 - d. the source tape is processed, producing the Compile listing and the intermediate tape. PASS 2 is loaded and the object tape is processed, producing the Assembly listing and the object tape.

9. Which of the following statements best describes the loading of an object program using the Basic Control System? The B.C.S. tape is loaded into the computer and:
- a. the loader listing is produced, then the object program is loaded, then the relocatable library routines are loaded.
 - b. the object tape is loaded, then the relocatable library routines are loaded.
 - c. the relocatable library routines are loaded, then the object tape is loaded.
 - d. the source tape is loaded, then the relocatable library routines are loaded.
10. Draw a line that will connect the first item in column 1 to the most appropriate matching term in column 2. Using the next item in column 1 repeat the above procedure until all items have been paired.

1	2
FORTRAN LANGUAGE	SYSTEM
MACHINE LANGUAGE	DRIVER
HARDWARE	BINARY
ASSEMBLY LANGUAGE	$D = A + B + C$
S.I.O.	SOFTWARE
INTERRUPT	OUTPUT
SOURCE TAPE	LDA B
INPUT	EDITOR
HP SYMBOLIC	OBJECT TAPE

Classroom Exercise Guide

Lesson: INTRODUCTION TO HP BASIC

Exercise: 2-1

A

A. OBJECTIVE

1. The objective of this exercise is to provide a very simple programming task using the BASIC language.

B. PROBLEM

1. Calculate the Sum, Average, and Product of 4 values entered from the teleprinter keyboard.

C. PROCEDURES

1. Create a BASIC language program to solve the problem outlined in B.
2. The actual output data is shown in D. The format should be:

```
SUM = xxxx  
AVG = xxxx  
PROD = xxxx
```

D. RESULTS

1. The results of this exercise will be discussed in class. Two solutions are shown on page A-2-1.
2. The actual program results are shown below.

```
PROGRAM 1      RUN  
                ?1,2,3,4  
                SUM = 10  
                AVG = 2.5  
                PROD = 60  
  
                READY
```

```
PROGRAM 2      RUN  
                ENTER FOUR VALUES  
                ?1  
                ?2  
                ?3  
                ?4  
                SUM = 10  AVG = 2.5          PROD = 24
```

Laboratory Exercise Guide

Lesson: **INTRODUCTION TO HP BASIC**

Exercise: 2-1

A. OBJECTIVE

1. The objective of this exercise is to provide a straightforward BASIC programming task.

B. PROBLEM

1. Write a program to compute the hypotenuse of any right triangle.

C. PROCEDURES

1. Have the operator enter the values for the two sides at run time.
2. Check to assure that both input values are positive.
3. The program is outlined in the flowchart on page 2-3.

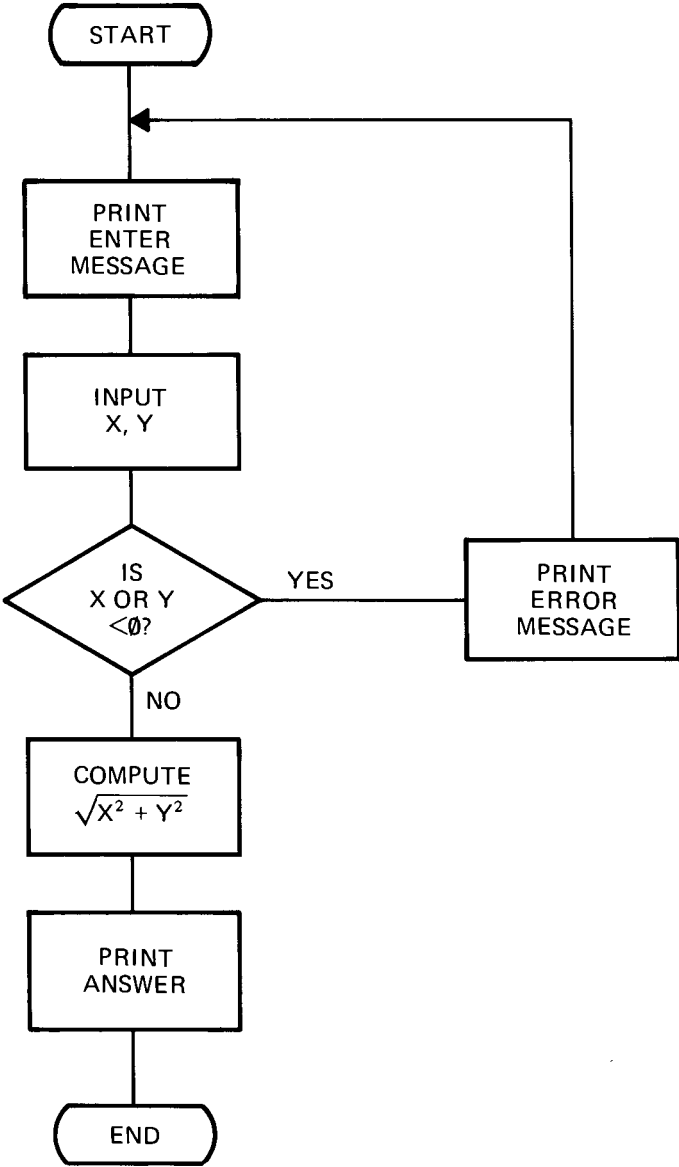
D. RESULTS

1. The results for the input values given below are:

```
RUN
ENTER VALUES FOR THE SIDES
?3,4
THE HYPOTENUSE IS = 5
```

```
READY
RUN
ENTER VALUES FOR THE SIDES
?3,0
ERROR - VALUES MUST BE >0
ENTER VALUES FOR THE SIDES
?
```

2. A solution is given in Appendix A-2-2.



Laboratory Exercise Guide

Lesson: **INTRODUCTION TO HP BASIC**

Exercise: **2-2**

A. OBJECTIVE

1. The objective of this exercise is to provide a programming task using the INT(X) function.

B. PROBLEM

1. Write a program to determine if a given number is a factor of another number.

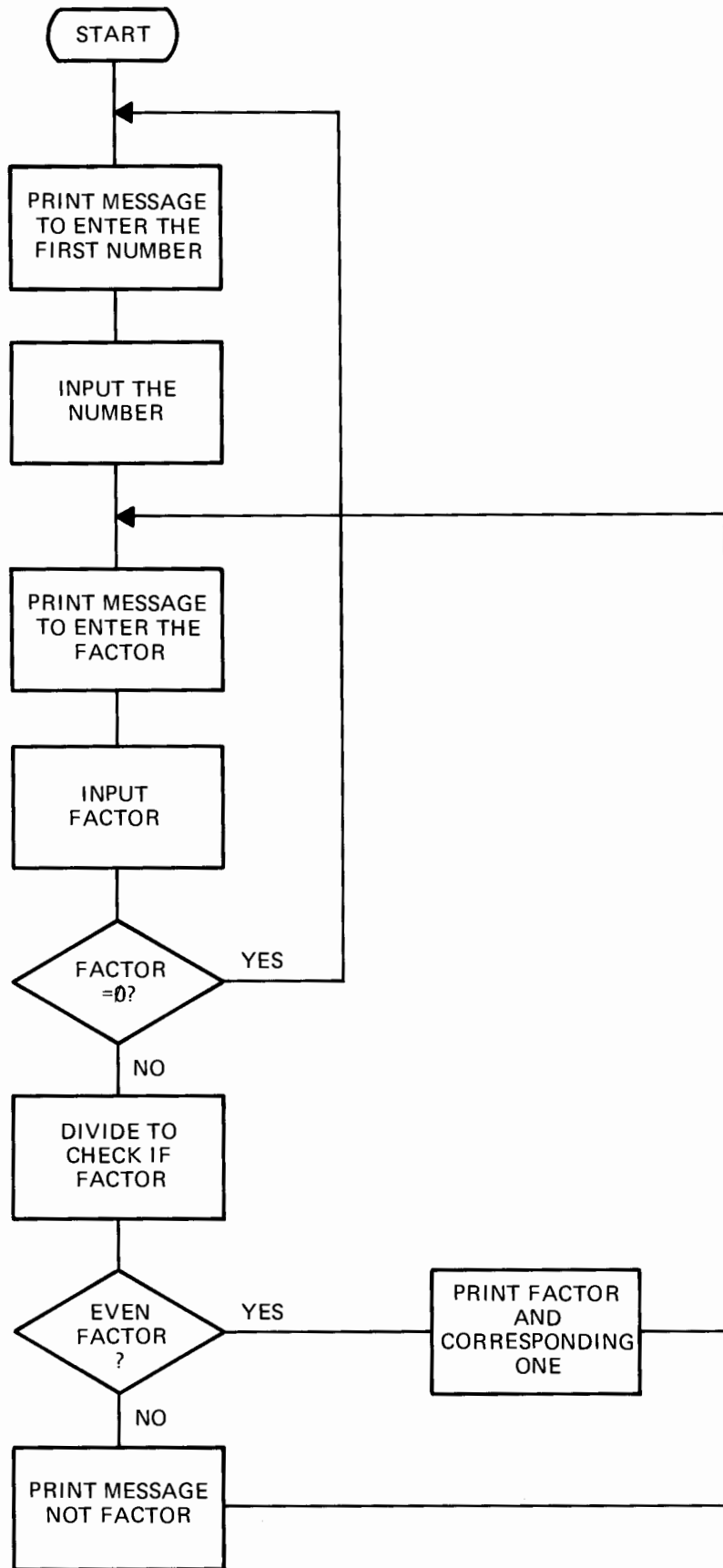
C. PROCEDURES

1. Have the operator enter a number.
2. Have the operator enter a possible factor.
3. If the possible factor is a zero have the operator enter a new first number.
4. The program is outlined in the flowchart on page 2-5.

D. RESULTS

1.

```
RUN
INPUT A NUMBER ?27
FACTOR ?3
3    IS A FACTOR
9    IS THE OTHER FACTOR
FACTOR ?5
5    IS NOT A FACTOR
TRY AGAIN
FACTOR ?0
INPUT A NUMBER ?
```
2. A solution is shown in Appendix A-2-3.



Classroom Exercise Guide

Lesson: INTRODUCTION TO FORTRAN

Exercise: 3-1

A. OBJECTIVE

1. To give the student practice in writing FORTRAN arithmetic statements.

B. PROBLEMS

1. Write the following expressions in FORTRAN.

a. $x = (a)(b)(c)$

b. $y = -xe^{AX} \cdot (\cos b \cdot x) / 2b$

c. $y = \frac{\text{Log}_e}{a} \left(\frac{a + \sqrt{a^2 - x^2}}{x} \right)$

2. What will be the value of "IANS" after the following statements are executed?

LABEL		C	STATEMENT
1	5	6	7
			I = 2
			J = 3
			K = 4
			L = 5
			IANS = I / J * I * * J + K + L / I * (K - J / L)

C. PROCEDURES

1. Use the procedures outlined in your students manual, pages 3-10 through 3-20 for Problem #1.
2. In FORTRAN the results of integer division are truncated: For example:

$$3/2 = 1$$

D. RESULTS

1. Write the results of the problems in the space provided. After completing the exercise check the results by comparing with the answers given on page A-3-1.

Classroom Exercise Guide

Lesson: **INTRODUCTION TO FORTRAN**

Exercise: **3-2**



A. OBJECTIVE

1. To give the student practice in writing FORTRAN input-output statements.

B. PROBLEMS

1. Provide the required FORTRAN statements to read values for variables A, B, C, IK, J. Use unit reference number 1 and the Free field input mode.
2. Provide the required FORTRAN statements to read values for variables Z, I, J, Y, BIG. Use unit reference number 5. Values for the variables have the following form:

```
Z = XXX.XX  
I = XXXXX  
J = XX  
Y = X.XXXXX  
BIG = XXXXXXXX.XX
```

3. Write the required FORTRAN statements to output the values for the variables in questions 1 and 2. Use unit reference number 6 for output. For question number 1 provide the following output form. For question number 2 use the same form as specified above.

```
A = XX.XXX  
B = X.XXXX  
C = XXX.XXX  
IK = XXXX  
J = X
```

C. PROCEDURES

1. Use the procedures outlined in your students manual, pages 3-23 through 3-30 for problems 1, 2, and 3.

D. RESULTS

1. Write the results of the problems in the space provided. After completion check the results by comparing with answers given on page A-3-2.

Laboratory Exercise Guide

Lesson: INTRODUCTION TO FORTRAN

Exercise: 3-1

A. OBJECTIVE

1. The objective of this exercise is to provide the student with a simple FORTRAN programming task.

B. PROBLEM

1. The problem presented for a FORTRAN program solution is to find the amount in a savings account. The formula for compound interest is:

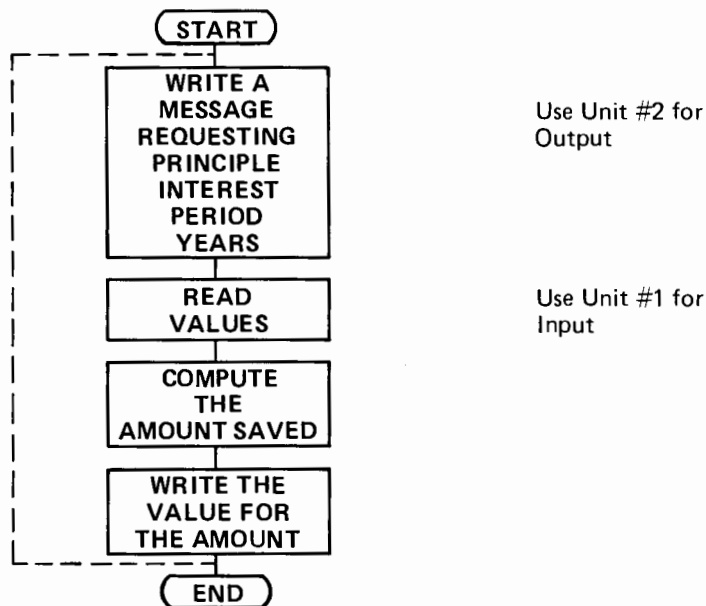
$$A = Z \left(1 + \frac{R}{Q}\right)^{NQ}$$

where

- A = amount saved
- Z = initial principle
- R = interest rate
- Q = period *no. of periods per year.*
- N = number of years

C. PROCEDURE

1. The specific program requirements are outlined in the flowchart:



Note: Optional loop may be created for continuous solutions. Reference Lesson V slide 5-2.

2. While any values may be used in the program, the following test data will yield the answers shown in D.

Input Test Data

Principle = 100 dollars
Interest = 6 percent
Period = 1 & 365 times a year
Years = 1

D. RESULTS

1. The following results were obtained:

```
*RUN
ENTER PRINCIPLE, INTEREST, PERIOD & NUMBER OF YEARS
100,6,1,1
THE AMOUNT AFTER 1 YEARS IS $ 106.00
ENTER PRINCIPLE, INTEREST, PERIOD & NUMBER OF YEARS
100,6,365,1
THE AMOUNT AFTER 1 YEARS IS $ 106.18
```

Homework Assignment Guide

Lesson: INTRODUCTION TO FORTRAN

Assignment: 3-1

1. Underline the permissible fixed point constants.

23.4	17	1000	-5
NAN	-10501	0.0	12345678
J47	5K00	1/2	274.1

2. Underline the permissible floating point constants.

-.017	40193.	1.001	B47
.K14	.0	5/7	1.0
27	2734.4712	SOX	-12

3. Underline the permissible fixed point variables.

5K	BAKER	ITR35	N
NOW	LOOKOUT	JEORJE	Y
KING7	M-1	M5M5M	N Y

4. Underline the permissible floating point variables.

V8	.5K	DOG	2.4
SUM	B 17	DROGUE5	7S
LTOT	M.5	A5523	X

5. Change the fixed point variables below to floating point variables by adding or changing one letter.

BETA	NUMB	MONEY	J5000
X	AJ3	KING6	SLOAD

6. Write symbols used in FORTRAN to denote the following:

Addition	Subtraction	Exponentiation	Grouping
Multiplication	Division		

7. Write FORTRAN statements for the following:

a. $X = A + B + C - 3$

b. $3Z = W^3 - Y^3$ (Solve for Z)

c. $S = \frac{ar - ar^n}{1 - r}$

d. $L = ar^{n-1}$

e. $C/5 = a^2 - b^2$ (Solve for C)

f. $3(X + Y) = W$ (Solve for W)

g. $2A \div 3B = K$ (Solve for K)

h. $\frac{A + B + C^3}{A} = T$

i. $L = \frac{1}{100} (Z^3 + Y)^3$

8. Write the mathematical equivalents of these FORTRAN expressions.

a. $3 * A ** 4$

b. $A - B - (C - D)$

c. $((A - B) * (B - C)) ** 3$

d. $T = A / (B * C)$

e. $P = 12 * N / K - K / 2$

9. Which of the following FORTRAN statements will store the largest value at KIND?

a. $KIND = 3 + 8 / 2 * 2 + 8$

b. $KIND = 3 + 8 / (2 * 2) + 8$

10. Because of the limited computer memory capacity the use of "Comment" statements within a FORTRAN program should be held to a minimum.

True False

11. What statement must terminate all FORTRAN programs?

12. What statement is used to enter data into the computer?

13. What does the FORMAT statement do?

14. Must all FORTRAN statements have a statement number?

15. Must statement numbers be in sequence?

Classroom Exercise Guide

Lesson: HP SYMBOLIC EDITOR PROGRAM

Exercise: 4-1

A. OBJECTIVE

1. To give the student practice in creating a symbolic edit file.

B. PROBLEM

1. Assuming a student has prepared the following FORTRAN program for Laboratory exercise 3-1. Four errors exist in this program. The HP Symbolic Editor will be used to correct this program. Provide the required edit file to correct the errors in the program.

```
FTN,L,B
C
C PROGRAM TO COMPUTE THE AMOUNT IN A SAVINGS ACCOUNT
C
C LABORATORY EXERCISE 3-1
C
PROGRAM SAVIT
1 WRITE (2,*)
100 FORMAT("ENTER PRINCIPLE, INTEREST, PERIOD & NUMBER OF YEARS")
READ (1,100) PRNCP,RATE,IPERD,IYEAR
TOTAL = PRNCP*((1+RATE*.01/FLOAT(IPERD))**(IPERD*IYEAR))
WRITE (2,200) TOTAL
200 FORMAT("THE AMOUNT AFTER"14" YEARS IS $"F10.2)
GO TO 1
END
END$
```

C. PROCEDURE

1. Use the procedures outlined in your Students Manual, pages 4-4 through 4-7.

D. RESULTS

1. Write the required edit information in the space below. Check your answers by comparing with the results shown on page A-4-1.

Classroom Exercise Guide

Lesson: **FORTRAN CONTROL STATEMENTS**

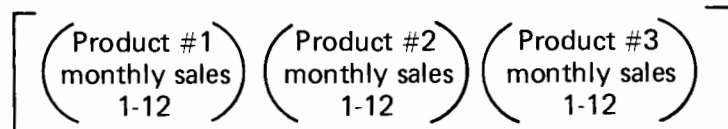
Exercise: 5-1

A. OBJECTIVE

1. To provide the student with a "DO Loop" exercise in the classroom. The instructor will work with the students on this exercise.

B. PROBLEM

1. The XYZ Company manufactured 3 products in 1969. The total sales for each product by month are punched on paper tape according to the following format:



Only the actual sales figures (36 of them) are on the data tape. The data tape uses "free field" mode and each entry is a record.

Calculate and Store in memory:

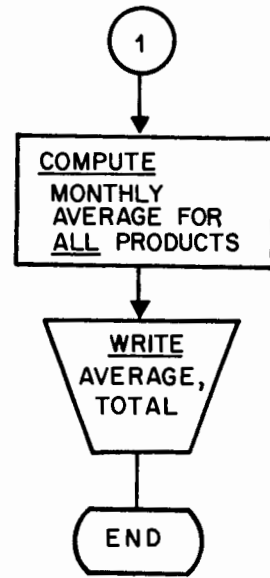
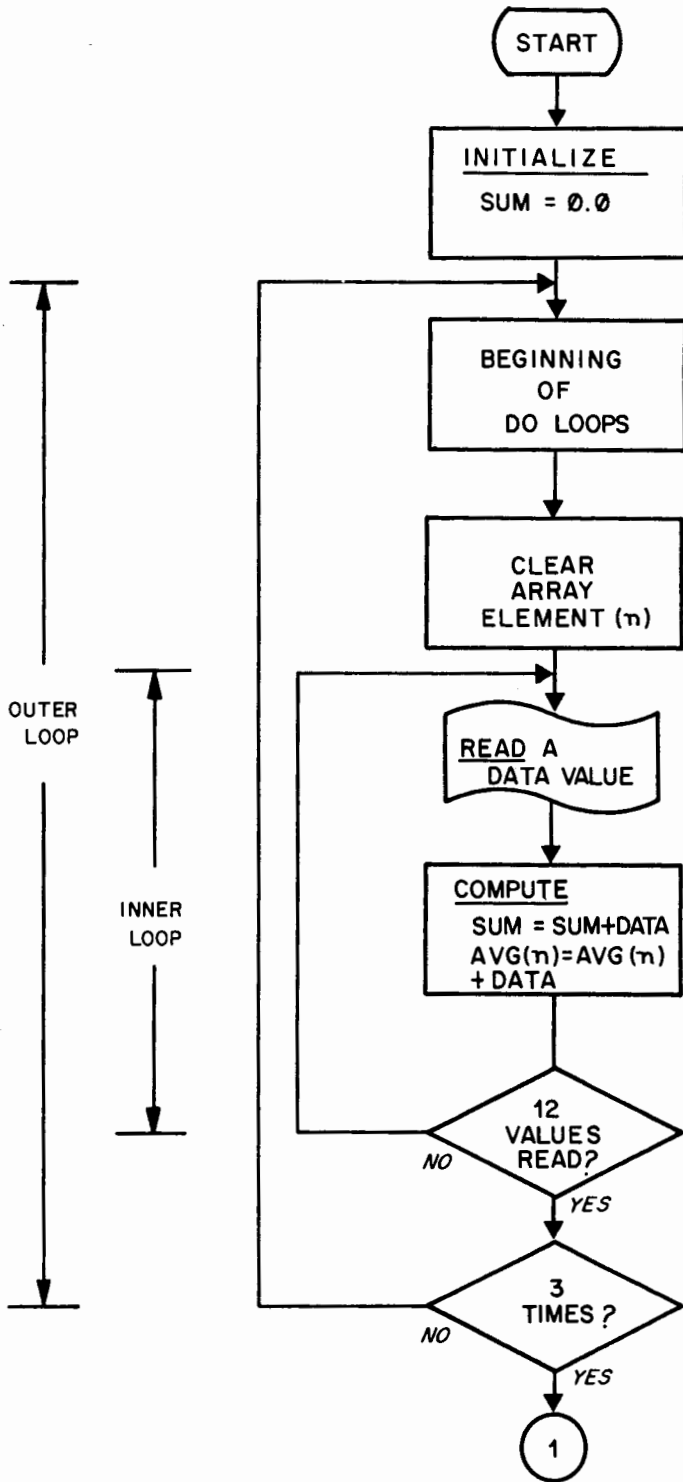
- 1) total sales for the year
- 2) average monthly sales volume (for all products put together)
- 3) average monthly sales volume for each of the three products

C. PROCEDURE

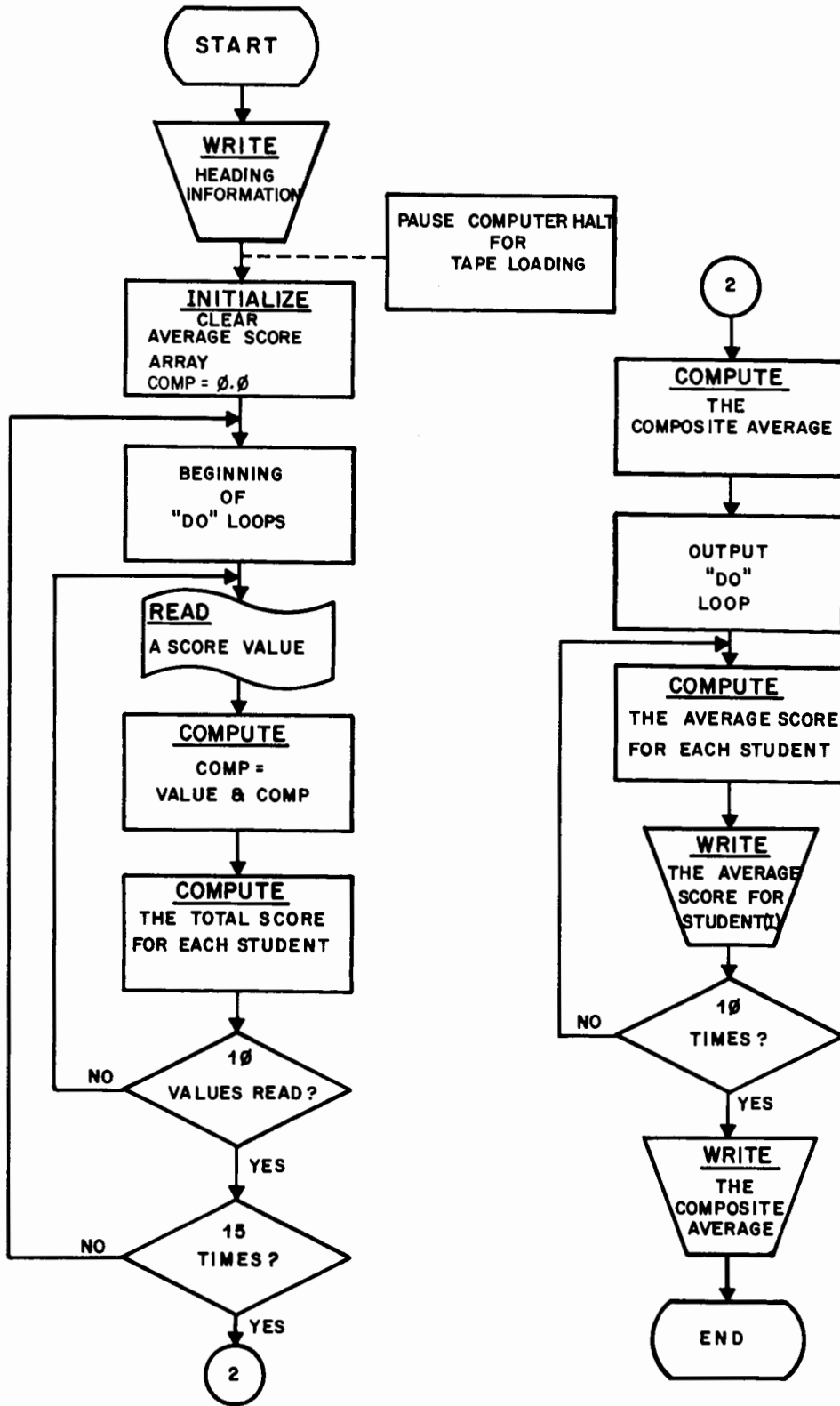
1. Write a FORTRAN program to solve the problem outlined in B. The instructor will work closely with you on this problem. Be prepared to make suggestions and offer solutions for this problem. Write the solution in the space provided on the next page.

D. RESULTS

1. The results of this exercise will be discussed in class, however, a solution to this exercise is provided on page A-5-1.



*AVERAGE = MONTHLY SALES BY PRODUCT
 TOTAL = MONTHLY SALES, ALL PRODUCTS*



D. RESULTS

1. The results of the program should have the following form.

TEST SCORING PROGRAM

LOAD DATA TAPE AND PRESS RUN

PAUSE

THE AVERAGE SCORE FOR STUDENT #	1	IS	80.60
THE AVERAGE SCORE FOR STUDENT #	2	IS	88.93
THE AVERAGE SCORE FOR STUDENT #	3	IS	79.40
THE AVERAGE SCORE FOR STUDENT #	4	IS	77.40
THE AVERAGE SCORE FOR STUDENT #	5	IS	84.20
THE AVERAGE SCORE FOR STUDENT #	6	IS	85.27
THE AVERAGE SCORE FOR STUDENT #	7	IS	81.53
THE AVERAGE SCORE FOR STUDENT #	8	IS	74.33
THE AVERAGE SCORE FOR STUDENT #	9	IS	76.47
THE AVERAGE SCORE FOR STUDENT #	10	IS	81.60

THE AVERAGE SCORE FOR ALL STUDENTS IS 80.97

PAUSE

Laboratory Exercise Guide

Lesson: **FORTRAN PROGRAMMING TECHNIQUES**

Exercise: 6-1

A. OBJECTIVE

1. The objective of this exercise is to give the student practice in creating and using Function subprograms.

B. PROBLEM

1. Read a test value and high and low limits from the teleprinter. Check the test against the upper and lower limits and output one of the following messages:

<= LOWER LIMIT
WITHIN LIMITS
=> UPPER LIMIT

C. PROCEDURES

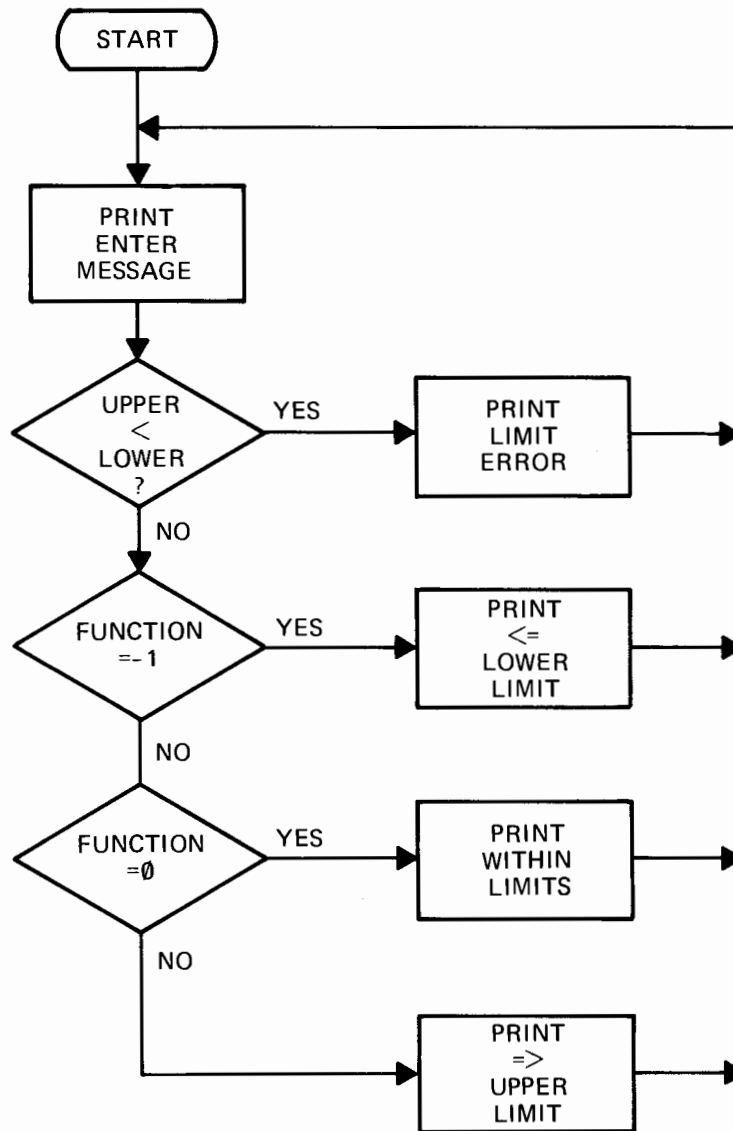
1. Write a FORTRAN program to solve the problem outlined in B. The program will be written in two parts.
 - a. The Main Program
 - b. The Function
2. The specific program requirements are outlined in the flowchart.

D. RESULTS

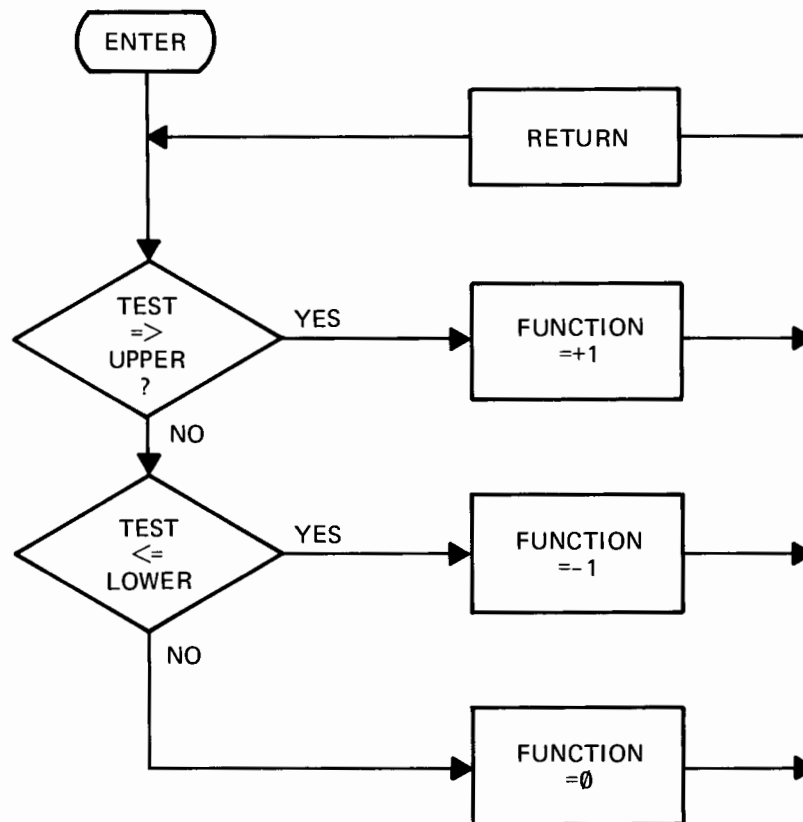
```
*RUN
ENTER VALUES FOR UPPER, LOWER AND TEST
-23,-34,7
=> UPPER LIMIT

ENTER VALUES FOR UPPER, LOWER AND TEST
100,150,75
LIMIT ERROR
ENTER VALUES FOR UPPER, LOWER AND TEST
34.56,33.12,34.23
WITHIN LIMITS
```

MAIN PROGRAM



FUNCTION



APPENDIX A
ANSWERS TO EXERCISES

Classroom Exercise Answer Sheet

Exercise: 1-1

$$\begin{array}{r} 1. \quad 8 \overline{)556} \quad 4 \\ \quad \quad \underline{69} \quad 5 \\ \quad \quad \quad \underline{8} \quad 0 \\ \quad \quad \quad \quad \underline{1} \quad 1 \end{array} \quad 1054_8 \text{ ANSWER}$$

$$\begin{array}{r} 8 \overline{)1024} \quad 0 \\ \quad \quad \underline{128} \quad 0 \\ \quad \quad \quad \underline{16} \quad 0 \\ \quad \quad \quad \quad \underline{2} \quad 2 \end{array} \quad 2000_8 \text{ ANSWER}$$

$$\begin{array}{r} 8 \overline{)32767} \quad 7 \\ \quad \quad \underline{4095} \quad 7 \\ \quad \quad \quad \underline{511} \quad 7 \\ \quad \quad \quad \quad \underline{63} \quad 7 \\ \quad \quad \quad \quad \quad \underline{7} \quad 7 \end{array} \quad 7777_8 \text{ ANSWER}$$

$$\begin{array}{r}
 2. \quad 457_8 \\
 \times 8 \\
 \hline
 32 \\
 +5 \\
 \hline
 37 \\
 \times 8 \\
 \hline
 296 \\
 +7 \\
 \hline
 303_{10}
 \end{array}$$

ANSWER

$$\begin{array}{r}
 1000_8 \\
 \times 8 \\
 \hline
 8 \\
 +0 \\
 \hline
 8 \\
 \times 8 \\
 \hline
 64 \\
 +0 \\
 \hline
 64 \\
 \times 8 \\
 \hline
 512 \\
 +0 \\
 \hline
 512_{10}
 \end{array}$$

ANSWER

$$\begin{array}{r}
 3777_8 \\
 \times 8 \\
 \hline
 24 \\
 +7 \\
 \hline
 31 \\
 \times 8 \\
 \hline
 248 \\
 +7 \\
 \hline
 255 \\
 \times 8 \\
 \hline
 2040 \\
 +7 \\
 \hline
 2047_{10}
 \end{array}$$

ANSWER

3. 0 001 111 111 000 000 ANSWER
 0 001 010 011 100 101 ANSWER
 0 111 111 111 111 111 ANSWER

$$\begin{array}{r} 100001 \\ 077776 \\ \hline 1 \\ 077777 \\ \hline \text{x8} \\ \hline 56 \\ \hline +7 \\ \hline 63 \\ \hline \text{x8} \\ \hline 504 \\ \hline +7 \\ \hline 511 \\ \hline \text{x8} \\ \hline 4088 \\ \hline +7 \\ \hline 4095 \\ \hline \text{x8} \\ \hline 32760 \\ \hline +7 \\ \hline -32767_{10} \end{array}$$

ONE'S COMPLEMENT
ADD ONE

ANSWER

$$\begin{array}{r} 177777 \\ 000000 \\ \hline 1 \\ \hline -1_{10} \end{array}$$

ONE'S COMPLEMENT
ADD ONE
ANSWER

Laboratory Exercise Answer Sheet

Exercise: 1-1

```
FTN,L
C
C YOUR NAME
C THE DATE; DAY/MO/YR
C YOUR FIRM OR COMPANY NAME
PROGRAM DEMO
READ(1,*)A,B,C,D,K,I,X,Y,Z
Z=A+B*C
H=A+B/(C+D)**2+X**2
E=1.+X+X**2/2.+X**3/6.
F=(A+B+C*D**2)/(((A+2.8)**(I-1)+B/(C+D))*(A+6.))
P=E+F+H
SQ=2.*P*R*SIN(3.1416/P)
Z=0.5*(X*S-A**2*ALOG(ABS(X+Y)))
C
END
END$
```

Homework Assignment Answer Sheet

Assignment: 1-1

- | | | | |
|----|----------|---|-----------------------------|
| 1. | DATA | — | FORMAT |
| | OCTAL | — | 177777 |
| | BINARY | — | 1010110110 |
| | COMPUTER | — | PROGRAMS |
| | DECIMAL | — | 989 |
| | ENIAC | — | ELECTRONIC DIGITAL COMPUTER |
| | NEGATIVE | — | TWO'S COMPLEMENT |
| | MEMORY | — | ADDRESS |

2. c
3. b
4. c
5. a
6. a
7. b
8. b
9. b

- | | | | |
|-----|-------------------|---|-------------|
| 10. | FORTRAN LANGUAGE | — | D=A+BC |
| | MACHINE LANGUAGE | — | BINARY |
| | HARDWARE | — | SOFTWARE |
| | ASSEMBLY LANGUAGE | — | LDA B |
| | S.I.O. | — | DRIVER |
| | INTERRUPT | — | SYSTEM |
| | SOURCE TAPE | — | OBJECT TAPE |
| | INPUT | — | OUTPUT |
| | HP SYMBOLIC | — | EDITOR |



Classroom Exercise Answer Sheet

Exercise: 2-1

1.

```
10 INPUT A,B,C,D
20 LET S=A+B+C+D
30 LET A=S/4
40 LET P=A*B*C*D
50 PRINT "SUM ="S
60 PRINT "AVG ="A
70 PRINT "PROD ="P
80 END
```

2.

```
10 PRINT "ENTER FOUR VALUES"
20 LET C=0
30 LET S=0
40 LET P=1
50 INPUT V
60 LET S=S+V
70 LET P=P*V
80 LET C=C+1
90 IF (C-4)=0 THEN 110
100 GOTO 50
110 LET A=S/4
120 PRINT "SUM ="S"AVG ="A"PROD ="P
130 GOTO 10
140 END
```

Laboratory Exercise Answer Sheet

Exercise: 2-1

```
10 PRINT "ENTER VALUES FOR THE SIDES"  
20 INPUT X,Y  
30 IF X>0 THEN 50  
40 GOTO 60  
50 IF Y>0 THEN 80  
60 PRINT "ERROR - VALUES MUST BE >0"  
70 GOTO 10  
80 LET H=SQR(X↑2+Y↑2)  
90 PRINT "THE HYPOTENUSE IS ="H  
100 END
```


Laboratory Exercise Answer Sheet

Exercise: 2-2

```
10 PRINT "INPUT A NUMBER ";
20 INPUT X
30 PRINT "FACTOR ";
40 INPUT Y
50 IF Y<= 0 THEN 10
60 LET Z=X/Y
70 IF INT(Z)=Z THEN 110
80 PRINT Y"IS NOT A FACTOR"
90 PRINT "TRY AGAIN"
100 GOTO 30
110 PRINT Y"IS A FACTOR"
120 PRINT Z"IS THE OTHER FACTOR"
130 GO TO 30
140 END
```


Classroom Exercise Answer Sheet

Exercise: 3-1

1. $X = A * B * C$
 $Y = -X * \text{EXP}(A * X) * \text{COS}(B * X) / (2.0 * B)$
 $Y = \text{ALOG}((A + \text{SQRT}(A * A - X * X)) / X) / A$
2. IANS = 12

Classroom Exercise Answer Sheet

Exercise: 3-2

1. READ(1,*)A,B,C,IK,J
2. READ(5,100)Z,I,J,Y,BIG
100 FORMAT(F6.2,I5,I2,F7.5,F10.2)
3. WRITE(6,101)A,B,C,IK,J
101 FORMAT(F6.3,F6.4,F7.3,I4,I1)
WRITE(6,100)Z,I,J,Y,BIG

Laboratory Exercise Answer Sheet

Exercise: 3-1



```
FTN,L,B
C
C PROGRAM TO COMPUTE THE AMOUNT IN A SAVINGS ACCOUNT
C
C LABORATORY EXERCISE 3-1
C
  PROGRAM SAVIT
  1 WRITE (2,100)
100 FORMAT("ENTER PRINCIPLE, INTEREST, PERIOD & NUMBER OF YEARS")
  READ (1,*) PRNCP,RATE,IPERD,IYEAR
  TOTAL = PRNCP*((1.+RATE*.01/FLOAT(IPERD))**(IPERD*IYEAR))
  WRITE (2,200) IYEAR, TOTAL
200 FORMAT("THE AMOUNT AFTER"14" YEARS IS $"F10.2)
  GO TO 1
  END
  ENDS
```

Homework Assignment Answer Sheet

Assignment: 3-1

1. 17, ~~1000~~, -10501
2. -~~0~~17, ~~40~~193., 1.~~00~~1, .~~0~~, 1.~~0~~, 2734.4712
3. ITR35, N, NOW, KING7, M5M5M, NY
4. V8, DOG, SUM, B17, A5523, X
5. Several of the many possible answers are:
NUMB = SUMB, DUMB, RUMB, TUMB, etc.
MONEY = HONEY, BONEY, FONEY, PONEY, etc.
J5~~000~~ = A5~~000~~ thru H5~~000~~ and O5~~000~~ thru Z5~~000~~.
KING6 = BING6, SING6, RING6, etc.
6. Add is + Exponentiation is **
Multiply is *
Subtract is - Grouping uses ()
Divide is /
7.
 - a) $X = Z + B + C - 3.$
 - b) $Z = (W^{**3} - Y^{**3})/3.$
 - c) $S = (A * (R - R^{**N})) / (1. - R)$
 - d) $L = A * R^{**} (N - 1)$
 - e) $C = 5. * (A * A - B * B)$
 - f) $W = 3. *(X + Y)$
 - g) $K = 2. * A / (3. * B)$
 - h) $T = (A + B + C^{**3})/A$
 - i) $L = 1./ 100. *(Z^{**3} + Y)^{**3}$
8.
 - a) $3A^4$
 - b) $A - B - (C - D)$
 - c) $(A - B)^3 (B - C)^3$

8. (continued)
- d) $T = \frac{A}{BC}$
- e) $P = \frac{12N}{K} - \frac{K}{2}$
9. a) 19 will be stored at KIND
b) 13 will be stored at KIND
10. False. Comment statements have no effect on computer memory capacity.
11. The END statement.
12. The READ statement enters data into the computer. It also identifies the FORMAT statement for the data to be read and the areas into which the data is to be read.
13. Defines fields so that data may be input or output in the format intended by the user.
14. NO
15. NO
16. NO
17. WRITE (2, 100) I
100 FORMAT ("INTEGER = " I6)
18. READ (5, 30) X
30 FORMAT (F10.2)

19. & 20.

```
FTN,L
C
C THIS IS A SAMPLE PROGRAM FOR STUDENT DIAGNOSTIC EVALUATION
C ALL PROGRAM ERRORS HAVE BEEN CORRECTED
C
      PROGRAM ERROR
10    READ(1,*)A,B,C,V,X
20    V=A+B
30    Z=A**2+B**2
      V=X**1.97+3.7
      K=5
60    Y=(B+13.)**2
70    WRITE(6,100)V,Y,X
80    DELTA=((A+6.)*(A**3+Y*X))*X/3.
      J=A
      K6=K**J
100   FORMAT(F10.2,F10.2,F10.2)
      END
      ENDS
```


Classroom Exercise Answer Sheet

Exercise: 4-1

```

/R,8
  1 WRITE (2,100)
/R,10,12
  READ (1,*) PRNCP,RATE,IPERD,IYEAR
  TOTAL = PRNCP*((1.+RATE*.01/FLOAT(IPERD))**(IPERD*IYEAR))
  WRITE (2,200) IYEAR, TOTAL
/E

```

LISTING OF THE CORRECTED TAPE

```

FTN,L,B
C
C PROGRAM TO COMPUTE THE AMOUNT IN A SAVINGS ACCOUNT
C
C LABORATORY EXERCISE 3-1
C
  PROGRAM SAVIT
  1 WRITE (2,100)
100 FORMAT("ENTER PRINCIPLE, INTEREST, PERIOD & NUMBER OF YEARS")
  READ (1,*) PRNCP,RATE,IPERD,IYEAR
  TOTAL = PRNCP*((1.+RATE*.01/FLOAT(IPERD))**(IPERD*IYEAR))
  WRITE (2,200) IYEAR, TOTAL
200 FORMAT("THE AMOUNT AFTER"14" YEARS IS $"F10.2)
  GO TO 1
  END
  ENDS$

```


Classroom Exercise Answer Sheet

Exercise: 5-1

```
FTN,B,L
C
C CLASS EXERCISE 5-1
C
    PROGRAM DLOOP
    DIMENSION AVG(3)
    SUM=0.0
    DO 20 I=1,3
        AVG(I)=0.0
        DO 10 J=1,12
            READ(5,*)DATA
            SUM=SUM+DATA
10     AVG(I)=AVG(I)+DATA
20     AVG(I)=AVG(I)/12.
        TAVE=SUM/12.
C
C OUTPUT DATA
C
    WRITE(2,100)AVG,TAVE
100  FORMAT("AVERAGE SALES BY PRODUCT"/3(F10.2/)"TOTAL AVERAGE"/F10.2)
C
    END
    ENDS
```

Laboratory Exercise Answer Sheet

Exercise: 5-1

```
FTN,A,B,L
C A PROGRAM TO COMPUTE AVERAGE SCORES
C
C LABORATORY EXERCISE 5-1
C
    PROGRAM AVERG
    DIMENSION AVGSC(10)
    1 WRITE(2,100)
    PAUSE
    DO 10 I=1,10
    10 AVGSC(I)=0.0
    COMP=0.0
    DO 20 J=1,15
    DO 30 K=1,10
    READ(5,*)VALUE
    COMP=COMP+VALUE
    30 AVGSC(K)=AVGSC(K)+VALUE
    20 CONTINUE
    COMP=COMP/150.
    DO 40 L=1,10
    AVGSC(L)=AVGSC(L)/15.
    40 WRITE(2,101)L,AVGSC(L)
    WRITE(2,102)COMP
    PAUSE
    GO TO 1
    100 FORMAT("TEST SCORING PROGRAM"// "LOAD DATA TAPE AND PRESS RUN"//)
    101 FORMAT("THE AVERAGE SCORE FOR STUDENT # "I2" IS "F6.2)
    102 FORMAT(// "THE AVERAGE SCORE FOR ALL STUDENTS IS "F6.2//)
    END
    END$
```

Laboratory Exercise Answer Sheet

Exercise: 6-1

```
FTN,L,A
C
C   MAIN PROGRAM
C
  PROGRAM LMTST
  5  WRITE (2,100)
 100 FORMAT ("ENTER VALUES FOR UPPER, LOWER AND TEST"//)
  READ (1,*) X,Y,Z
  IF(X-Y) 6,7,7
  6  WRITE (2,150)
 150 FORMAT ("LIMIT ERROR")
  GO TO 5
  7  IF (ILIMIT(X,Y,Z)) 10,20,30
 10  WRITE (2,200)
 200 FORMAT (// " <= LOWER LIMIT"//)
  GO TO 5
 20  WRITE (2,300)
 300 FORMAT (// " WITHIN LIMITS"//)
  GO TO 5
 30  WRITE (2,400)
 400 FORMAT (// " => UPPER LIMIT"//)
  GO TO 5
  END

C
C   FUNCTION SUBPROGRAM
C
  FUNCTION ILIMIT (UPPER,XLOWR,TEST)
  ILIMIT = 1
  IF (UPPER-TEST) 30,30,10
 10  ILIMIT = -1
  IF (XLOWR-TEST) 20,30,30
 20  ILIMIT = 0
 30  RETURN
  END
  ENDS
```




11000 WOLFE ROAD, CUPERTINO, CALIFORNIA 95014, TELEPHONE 408 257-7000, TWX 910-338-0221
EUROPE: 1217 MEYRIN-GENEVA, SWITZERLAND CABLE "HEWPACKSA" GENEVA TEL. (022) 41.54.00